Taiwan's Experience in the Development of Life Science Industry

Taiwan - Your partner of choice in the biotechnology, pharmaceutical and medical device industries

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- Taiwan's Quick Fact & Advantages
- Taiwan's Life Sciences: Definitions, Facts and Figures
- Strengths in Life Sciences
- Bioclusters
- Research Institutes
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- Discussion & Summary

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Taiwan's Quick Facts

Area: **35,980 km²**
Population: **22,770,383**
GDP per capita: **US$16,792 (2007)**
Unemployment rate: **3.9% (2007)**
Imports (global ranking): **15th**
Exports (global ranking): **15th**
Foreign exchange reserves:
US$253.3 billion
Languages: **Mandarin/Taiwanese/English**
Climate: **Subtropical**
Highest mountain: **Mt. Jade (3,952 meters)**

Taiwan's advantages

- Deep industrial base and strong vertical integration in the IT and electronics sectors
- Strong industrial research and development capabilities
- Entrepreneurial and innovative corporate sector
- A leading source of venture capital in Asia
- Advanced harbor infrastructure and central hub for Asian transportation routes
- Mature B2B infrastructure
- Chinese and international market experience and success

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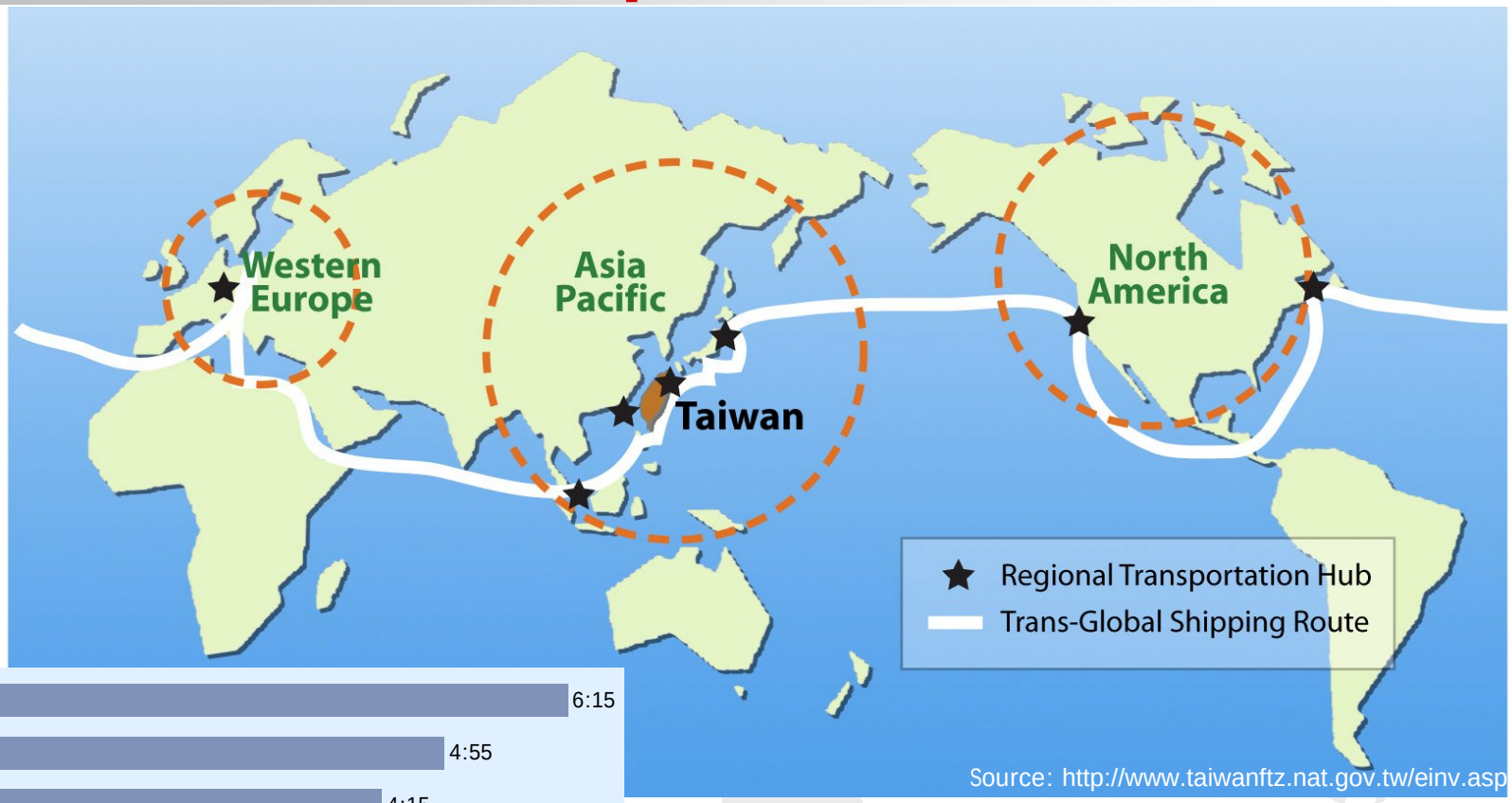
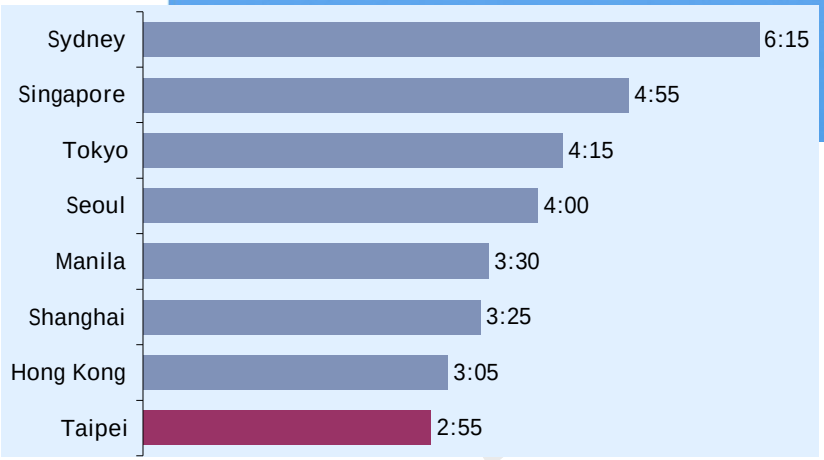
Taiwan: the central hub for Asian transportation routes





Shortest average traveling time (by air and by sea) within Asian Pacific region

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Competitive Rankings

World ranking	Lowest Risk Environment for Investment	Business Environment (in Asia)	E-Government ranking
1	**Switzerland**	**Singapore**	**South Korea**
2	**Singapore**	**Japan**	**Singapore**
3	**Netherlands**	**Taiwan**	**Taiwan**
4	**Japan**	**China**	**USA**
5	**Norway**	**Malaysia**	**Great Britain**
6	**Taiwan**	**South Korea**	**Canada**
Source	Business Environment Risk Intelligence (BERI), 2007	Business Environment Risk Intelligence (BERI), 2007	Seventh Annual Global e-Government Study, Brown University, 2007

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Competitive Rankings - 2

World ranking	IT Competitiveness	Workforce	US Patents Issued
1	**United States**	**Singapore**	**United States**
2	**Japan**	**Switzerland**	**Japan**
3	**South Korea**	**Taiwan**	**Germany**
4	**United Kingdom**	**Belgium**	**Taiwan**
5	**Australia**	**United States**	**France**
6	**Taiwan**	**Japan**	**United Kingdom**
Source	Economist Intelligence Unit (EIU), 2007	Labor Force Evaluation Manifest (LFEM), BERI, 2004	National Science Council, 2006

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Taiwan's future development

2015 forecast

- **Vision & role in the global setting**
  - Hub of international network
  - Value initiator and champion
  - Innovator of soft economy
  - Pioneer of new life style

- **Key technology sectors**
  - Biotechnology (Life science)
    - Preventive & personalized medicine, infectious, aging related diseases, etc.
  - Smart/innovative material
    - Nano-material & application, smart material & application, etc,
  - Green energy
    - Clean conversion, solar power, biofuel, etc.
  - Semiconductor
    - Next generation semiconductor & memory, flexible substrate, etc.
  - Innovative communication
    - Virtual reality/simulation system, utility/grid computing, micro& nanosatellites, etc.
  - Mutili-dimentional integrated technology
    - Wireless (eg. WiMAX/WeBro), distributed health care, advance display, green building, robot, etc.

Source: Study conducted by IEK, ITRI

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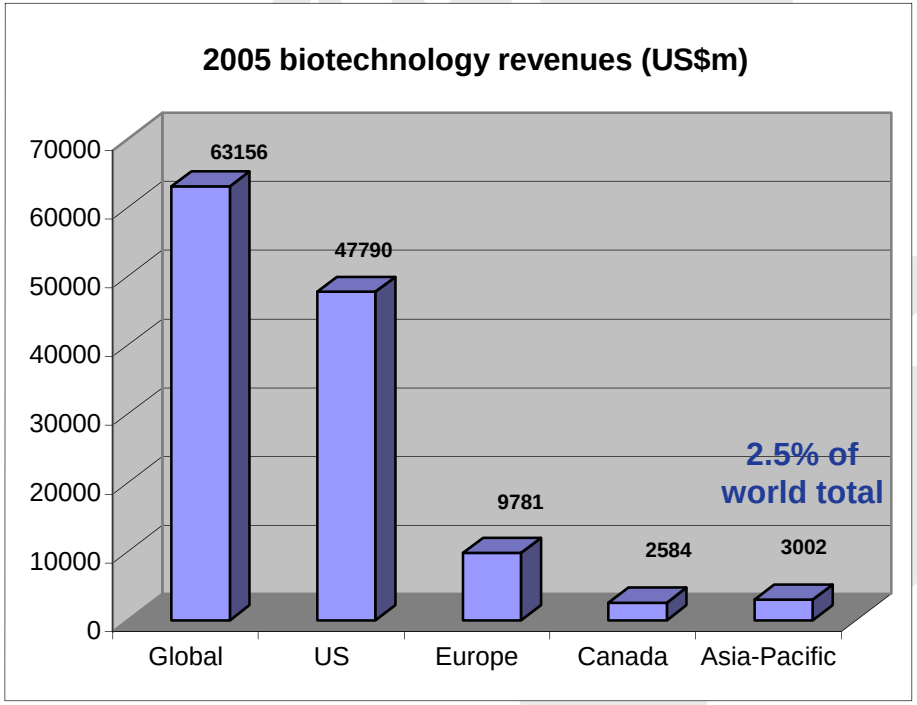
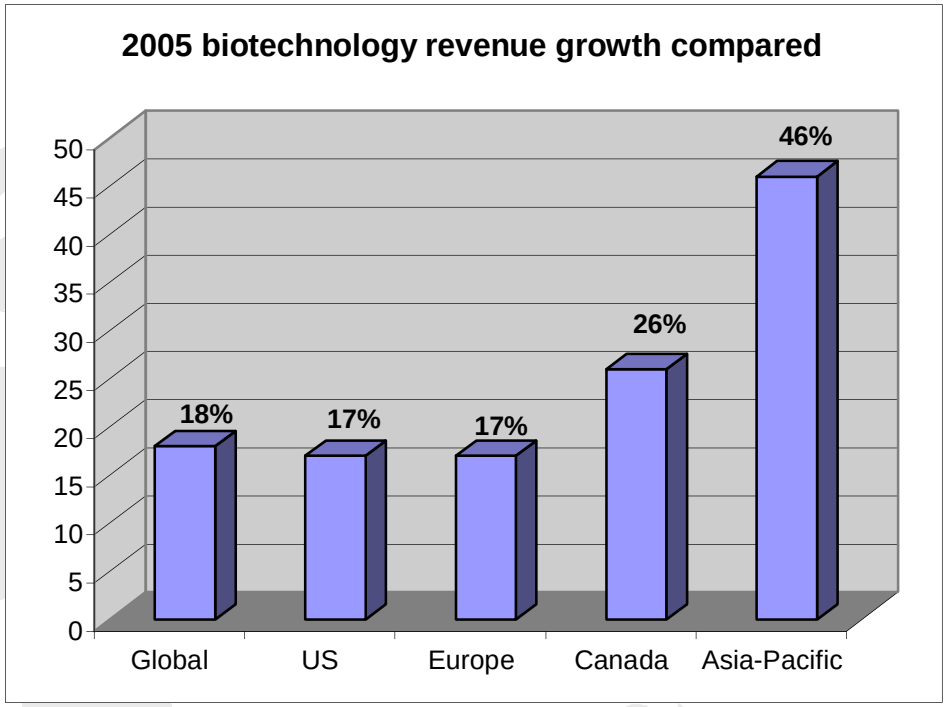
Asian share of global bioindustry





Revenue from Asia is relatively small, only 2.5% of world total…

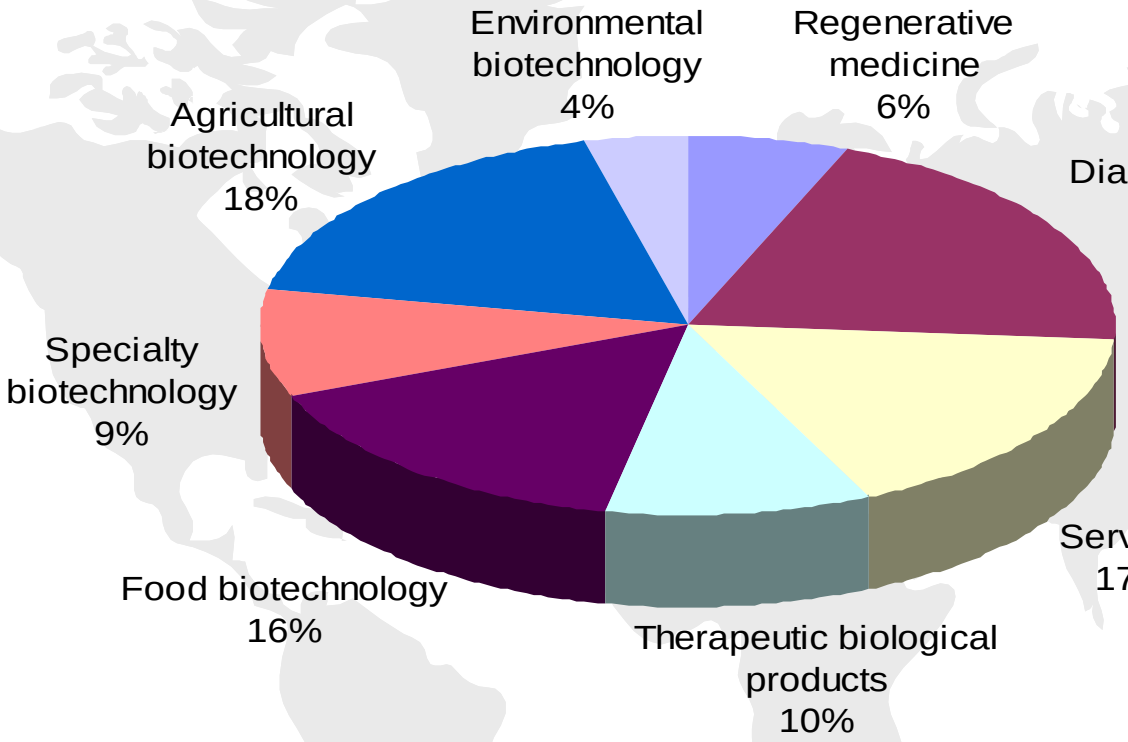
…But revenue growth rate is high, more than double global average.

‘Life Sciences’ defined

In Taiwan, ‘Life Sciences’ includes the following:

- Biotechnology
- Pharmaceutical manufacturing
- Medical devices
- Herbal medicine / Nutraceuticals
- Agricultural bioscience; E.g., flower biotech
- Industrial bioscience; E.g., biofuels
- Related service industries; E.g., clinical trials

Distribution of ‘Biotechnology’ companies

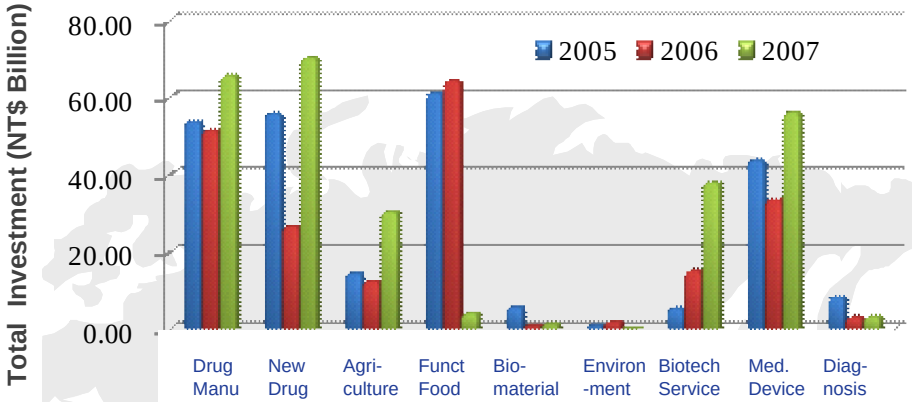


- **In Taiwan, Biotechnology is defined as:**
  - “A set of powerful tools that employ living organisms or parts of organisms to make or modify products, improve plants or animals, or develop microorganisms for specific uses.
  - Examples of this new ‘biotechnology’ include industrial use of recombinant DNA, cell fusion, and novel bio-processing.”

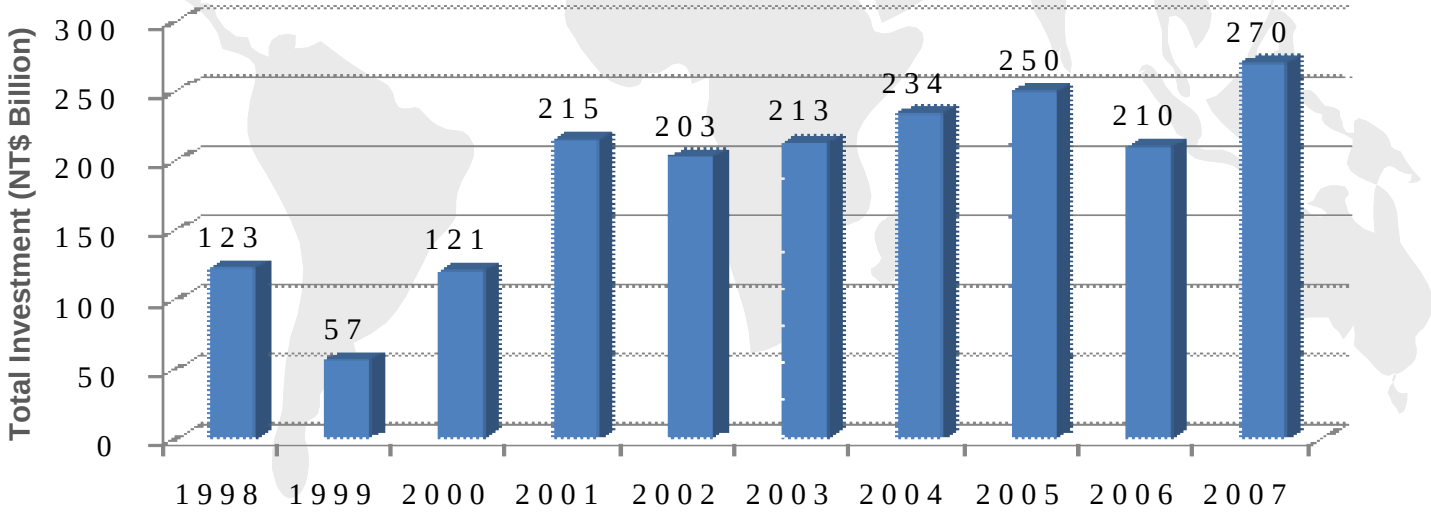
Source: Biotechnology and Pharmaceutical Industries Program Office, MOEA

Life Science Industry: Facts and Figures

- Since Year 2001, the annual investment has maintained in a total of over NT$200 billion.
- The investment has been centered mainly on drug manufacture, new drug development, functional food, & medical device。



2005	53.80	55.90	14.48	61.21	5.76	1.00	5.50	43.83	8.49
2006	51.54	26.69	12.56	64.46	0.80	1.95	15.24	33.69	3.20
2007	65.80	70.41	30.48	4.20	1.36	0.00	38.10	56.23	3.32



Source: STAG

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Life Science Industry: Facts and Figures

- Continued

Company and Revenue in Some Sectors

Type	Biotechnology			Pharmaceuticals			Medical devices			Total		
Year	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007
Revenue	386	434	483	624	660	680	590	697	749	1,600	1,791	1,912
Number of manufacture	253	268	294	419	368	321	484	500	501	1,156	1,136	1,116
Size of work force	8,090	8,570	9,320	14,995	12,224	11,274	15,000	16,350	20,200	38,085	37,144	40,794
Export value	153	176	193	115	137	155	270	293	317	538	606	665
Import value	161	187	205	577	698	707	395	447	462	1,133	1,332	1,374
Domestic sales vs. export	60:40	60：40	60:40	82:18	79:21	77：23	54:46	58:42	58：42	66:34	66:34	65：35
Domestic market demand	394	445	495	1,086	1,221	1,232	715	851	894	2,195	2,517	2,621

Units: NT$ billion, at US$1 = NT$31.6
Source: Biotechnology and Pharmaceutical Industries Program Office (BPIPO), MOEA, 2007

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Taiwan's strengths in life sciences

A. Government involvement, planning and industry support
B. Strategic location as regional hub and gateway to China
C. Existing expertise in related high technology industries & highly-educated workforce
D. Returning experienced overseas-based Taiwanese bioscientists
E. Strong IP protection
F. World-class research facilities and research infrastructure
G. Abundant capital and well-developed VC industry
H. Strong clinical trials infrastructure and large patient pool
I. Historical strengths in botanical medicine
J. Subtropical location encouraging development in Asian-prevalent disease therapies, flower biotech, etc.

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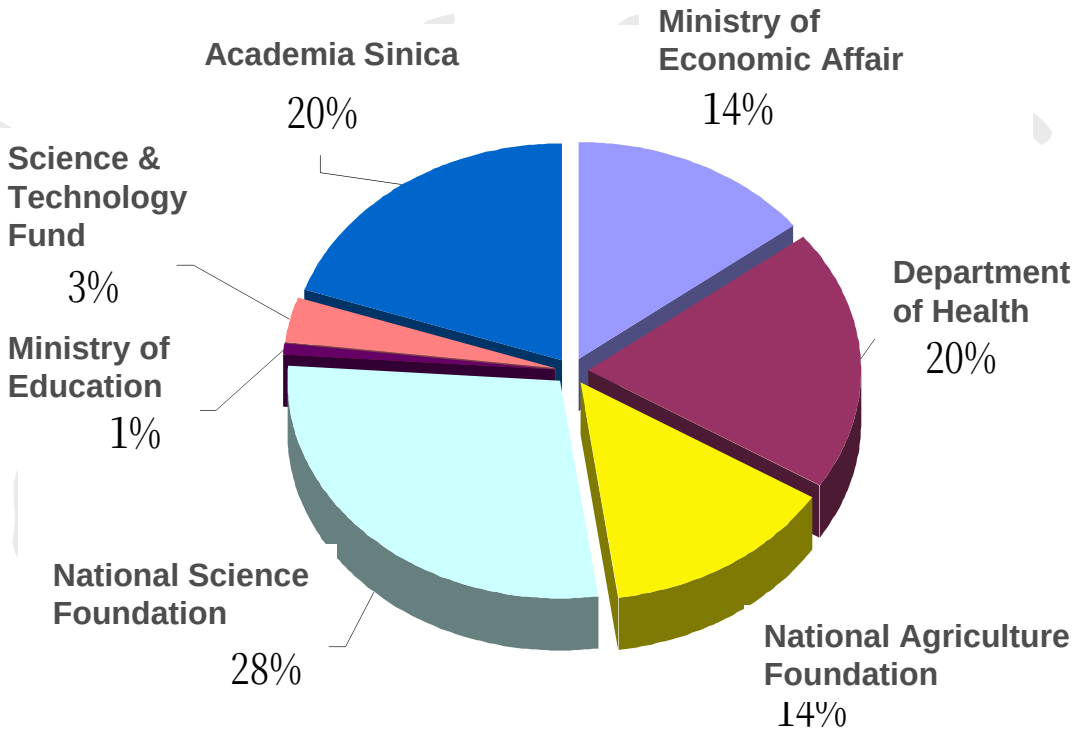
A: Government involvement, planning and support

- **Since early ’80s, life sciences have been targeted as developmentally important for the nation.**
- **1995** Promotion Plan for the Biotechnology Industries **set out:**
  - National development objectives
  - Action tasks
  - Guidelines for government, academia, and private sector
  - Suggestions for upgrading life science laws and regulations, R&D programs, technology transfer and commercialization, investment promotion, and marketing strategies
- **Program of investment incentives, research grants and loans established**

Government's support: investment budget expenditure

	2006	2007
R&D	**124.8**	**135.6**
Promotion and guidance	**7.1**	**7.7**
Training and recruitment	**5.2**	**6.5**
Infrastructure development	**22.5**	**24.0**
Bioclusters	**(16.5)**	**(34.5)**
Investment	**(39.0)**	**(19.0)**
Total budget	**159.6**	**175.1**



B. Regional hub and gateway to China

- Ideal location for Asian regional operations or research center.
- For any Greater China-focused biotech project, Taiwan is the perfect location for operations headquarters; high standard and quality of facilities, talent, clinical trials infrastructure, etc.
- Taiwan and China have ethnically-similar populations; scientific and marketing test results from Taiwan usually apply to China as well.

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C: Existing expertise in high technology & highly educated workforce

- Taiwan's development into a world-leading information technology (IT) products manufacturing hub has fostered strengths in precision manufacturing, miniaturization, electronic control systems, and device design engineering.

  These strengths can be transferred into the life sciences, particularly the medical devices and medical equipment sectors.

- Students' science and mathematics' levels high compared to worldwide average.
- Over 8,000 students in life science-related disciplines graduate every year from over 150 universities with life science departments.
- High proportion of bioscientists have overseas training and professional experience.

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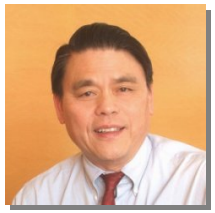
D. Returning overseas-based Taiwanese bioscientists

- **Over recent years, many have returned to Taiwan to start companies and facilitate local industry development:**
  - Dr. KC Lin (from Biogen) - PharmaEssentia
  - Dr. Ellson Chen (from Celera Genomics) - Vita Genomics
  - Dr. Hsu Min-chu (from Roche) - TaiGen Biotechnology
  - Dr. Lee Yuan-tze, (from US academia)
    - Previously President of Academia Sinica
  - Dr. Jo Shen, Dr. Hardy Chan (from Syntex) - ScinoPharm
  - And many more!



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E. Strong IP protection

- Respect for intellectual property (IP), and strong laws for their protection.
- Decades of international OEM manufacturing partnerships in the IT sector speaks for itself; Taiwan is trusted by the overseas community and by its business partners to protect valuable intellectual property.

F. World-class research facilities and infrastructure

- Industrial Technology Reseach Institute (ITRI)
- Development Center for Biotechnology (DCB)
- National Health Research Institutes (NHRI)
- Industrial Technology Research Institute (ITRI)
- Genomics Research Institute, at Academia Sinica
- Food Industry Research & Development Institute
- Animal Technology Institute, Taiwan (ATIT)
- *Plus* increasing numbers of universities with life science departments and research centers

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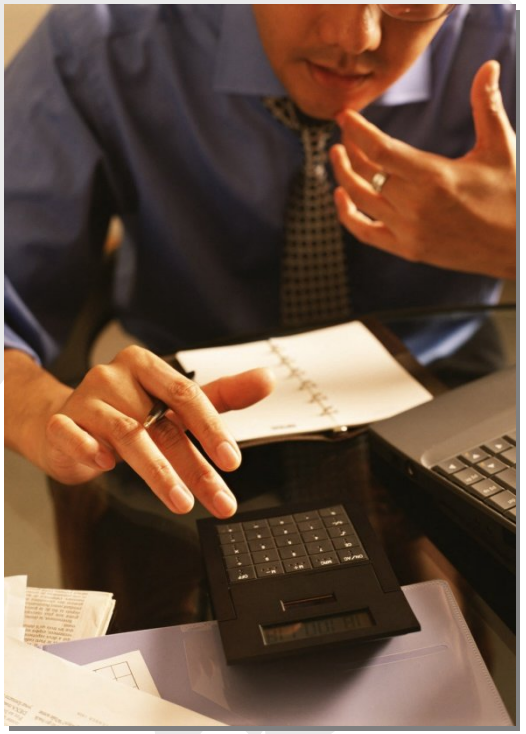
G. Abundant capital and well-developed VC industry

- Taiwan's large foreign exchange reserves and highly-developed venture capital industry means abundant funding is available to emerging high-tech industries in many sectors, including the life sciences.
- Local VC firms have success investing in biotech overseas, and now encouraged to help fund and jumpstart the island's emerging life science industry.
- The Development Fund, Executive Yuan, invests in a number of promising local life science companies every year.



H. Well-developed clinical trials infrastructure, large patient pool

Taiwan has become the center of clinical trials in the Asia-Pacific region:

- 18 clinical trials-capable medical centers, all ICH-GCP compliant
- From 2003-2006 the number of clinical trial sites by international pharmaceutical companies exceeded those in Singapore, China, Korea, Japan (over 1,400)
- The development of clinical trial capability is an important goal of the government's **Bio-Tech Island** project, a five-year plan to develop infrastructure and a foundation for future industry growth

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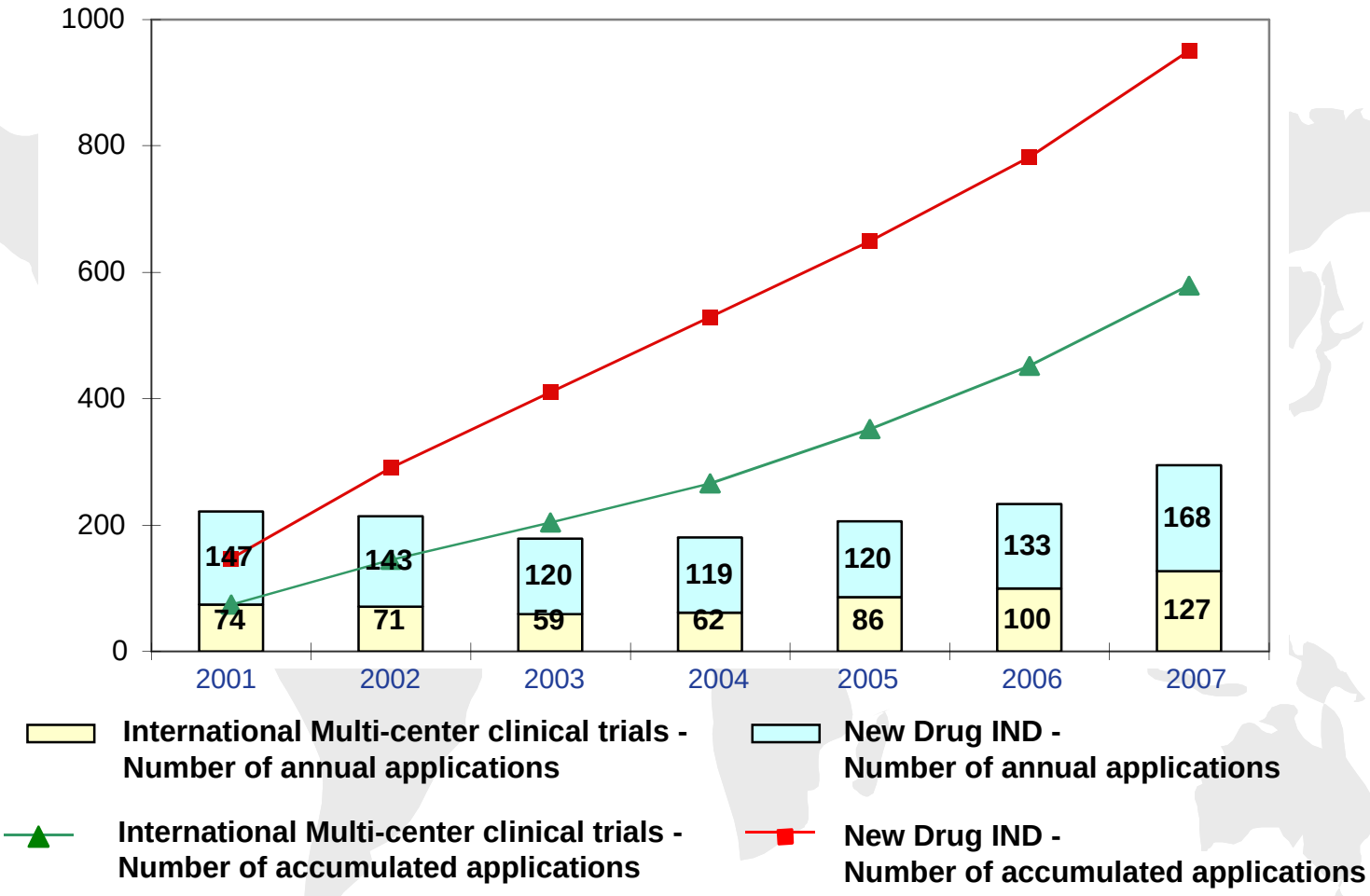
Growth in IND and international multi-center clinical trial applications in Taiwan 2001-2007



I. Historical strengths in botanical medicine

- **Herbal-based treatments form essential part of** Traditional Chinese Medicine (TCM)**; Taiwan retains much expertise handed down over 1000s of years of TCM practice in China.**
- **Many of Taiwan's biotechnology companies are working on botanically-derived new drug candidates for today's unmet medical needs.**
- **Herbal medicine treatment covered under Taiwan's National Health Insurance:**
  - Licensed physicians only
  - GMP-factory manufactured medicines only
  - ***Encourages modernized, standardized herbal medicine industry***

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Example botanically-derived drug discovery and development companies

Company name	Current research focus, therapeutic area
Medigreen Biotechnology	**Cancer therapy, Asthma, stomach ulcers**
PhytoHealth	**Osteoporosis and diabetic vascular complications, Influenza treatment**
NatureWise Biotech and Medicals	**Cancer therapy, Alzheimer's disease**
Microbio	**Diabetic foot ulcers, Cancer therapy**
BrainGenesis Biotechnology	**Ischemic stroke**
SunTen Phytotech	**Cholesterol/triglyceride lowering, GI disorders, Skin disorders**
Golden Biotechnology	**Cancer therapy**

J. Subtropical location encouraging development in Asian-prevalent disease therapies, flower biotech, etc.

- **World leader in R&D for hepatitis, liver disease treatment**
- **Leading anti-viral and vaccine research hub for modern viral diseases such as SARS, Enterovirus, Avian Flu, etc.**
- **Biotech-driven world-leading orchid breed development, growing and export center**
  - **Taiwan Orchid Biotech Park** located in Tainan County, Southern Taiwan

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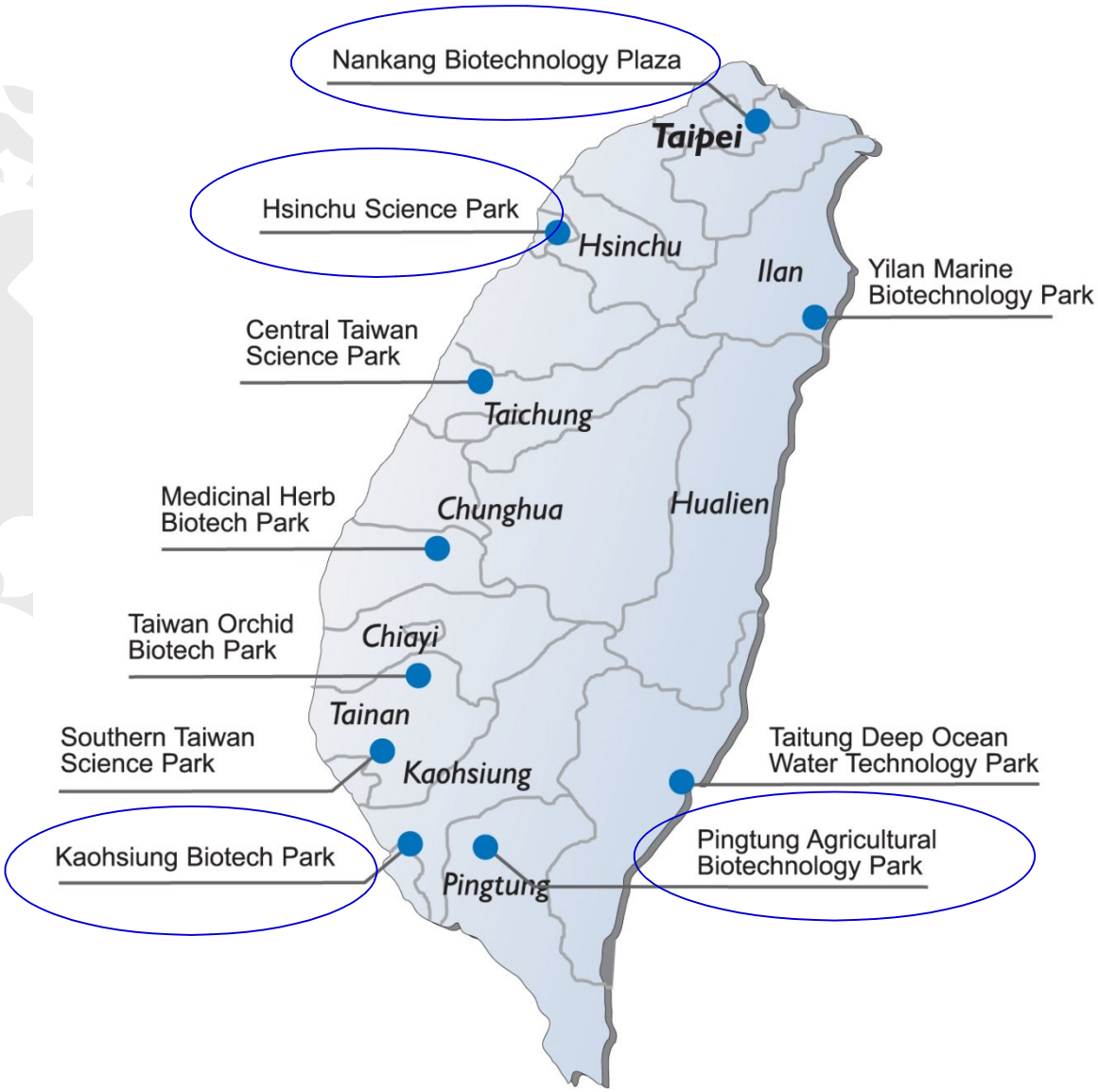
Biotechnology industry clusters



Nankang Biotechnology Plaza

- **Located at the Nankang Software Park, East Taipei**
  - Part of the **Taipei Technology Corridor**:
    - Beitou-Shilin Technology Park
    - Neihu Technology Park
    - Nankang Software Park
- **Opened: 2003**
- **20 floors of office and lab space**
- **30+ companies**
- **Bio-incubation center; 20+ startups**
- **Major institutes:**
  - Biotechnology and Pharmaceutical Industries Program Office (BPIPO), Ministry of Economic Affairs
  - Development Center for Biotechnology (DCB)
  - National Health Research Institutes (NHRI), Department of Health

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Hsinchu Biomedical Science Park

- **Part of the Hsinchu Science Park, (est. 1980), home of world-leading IT companies. Known as** Asia's Silicon Valley**.**
- **0.383 sq.km. in area, located near the THSR Liuchia station, 8 km from Hsinchu City.**
- **Affiliated with regional branches of National Taiwan University (NTU), National Chiao Tung University (NCTU), National Tsing Hua University (NTHU), and the Industrial Technology Research Institute (ITRI).**
- **Future Facilities:**
  - 600-bed hospital
  - Cancer research and proton therapy center
  - Incubation center
  - Joint research centers
  - Information network center
  - Biotechnology center
  - Living and community spaces

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Kaohsiung Biomedical Devices Science Park

- **A part of the** Southern Taiwan Science Park, **Tainan County, but located in Kaohsiung (still under construction)**
- **Special focus on devices and materials used for:**
  - Orthopedic medicine
  - General surgery
  - Dental implants
  - Ophthalmology
  - Microsurgery
- **Initial focus of the park:**
  - Vehicles for mobility challenged; wheelchairs, etc.
  - Controlling mechanics for medical equipment and devices
  - Hearing aids

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Pingtung Agriculture Biotechnology Park

- **Opened 2007, an model for developing a sustainable, eco-friendly science park and people-centered living environment**
- **Park tenants focused on:**
  - Green technologies
  - New breeds of grain and special-use crops
  - New breeds of fruits and vegetables
  - Flower breed development
  - Bio-organic fertilizers
  - Biological agents for veterinary use
  - Functional foods
  - Medical cosmetics
  - Testing and diagnosis technologies

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Research institutes

Major life science-focused research institutes include:

- Industrial Technology Research Institute (ITRI)
- Development Center for Biotechnology (DCB)
- National Health Research Institutes (NHRI)
- Academia Sinica
- Animal Technology Institute, Taiwan (ATIT)

Industrial Technology Research Institute (ITRI)

- Taiwan's leading applied research center
- Est. in 1973 in Hsinchu
- 5,700 employees, 1,000 PhDs
- 8,900 patents and over 140 spin-off companies
- 6 Core Research Labs, 5 Focus Centers, and 5 Linkage Centers
- In life sciences:
  - Biomedical Engineering Research Laboratories (BEL)
  - Medical Electronics and Device Technology Center (MED)
  - Others also involved include:
    - Nanotechnology Research Center
    - Material and Chemical Research Laboratories
    - Mechanical and Systems Research Laboratories
    - Electronics and Optoelectronics Research Laboratories

ITRI: Where Taiwan's High-Tech begin

Taiwan Semiconductor Manufacturing Co. (TSM) and United Microelectronics Co. (UCM) have their origin in ITRI

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Industrial Technology Research Institute (ITRI)

Continued!

Biomedical Engineering Laboratory (BEL)

- Focused on biotech and pharmaceutical fields:
  - Therapeutics
    - Small molecule, Herbal medicine, Protein drug
  - Molecular diagnostics
    - BioChip, miRNA, Proteomics
  - Regenerative Medicine
    - Stem cell, Cell therapy, Biomaterial
- Disease focuses:
  - cancer and liver disease

Medical Electronics and Device Technology Center (MED)

- Medical device research and development
- “Point-of-care” healthcare products
- “e-Health” system development

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