Nanotechnology Research in Japan

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http://www.nanonet.go.jp/

Japanese Governmental System for Science & Technology Promotion

Prime Minister

To realize the strategy

Cabinet Office

Minister Responsible for Science & Technology Policy

Council for Science and Technology Policy
- ○Planning the comprehensive strategy
- ○Planning of Funding
- ○Evaluation of Important Projects, etc.

Atomic Energy Commission, etc.
- ○Planning, Proposing the Policy

To Present Basic Policy

Ministries

Ministry of Health, Labor and Welfare

Ministry of Economy, Trade and Industry

cooperation

Ministry of Education, Culture, Sports, Science and Technology

To Plan, promote, and execute concrete issues based on the basic policy

Council
○Consideration of Important Issues

- ○To Plan, Promote, and Coordinate concerning Science & Technology
- ○To Promote and Evaluate Important Research Fields;
  Life Sciences, Information Technology, Nanotechnology, Material Sciences, etc.
- ○To manage the revolution of the Science & Technology System

Research Institutes

Research Institutes

Universities
- ○Basic Researches
- ○Personnel Training

Univ. of Tokyo, Kyoto Univ., Tokyo Inst. of Tech., etc.

cooperation

Independent Administrative Institutes
- ○Change of Management
- ○Open to Other Organizations
- ○Flexible & Competitive Research

National Institute of Materials Science (NIMS)
RIKEN, JST, etc.

Outline of the 3rd Basic Plan

1. Fundamental Concept

- Recent situation revolving around S&T
- Basic stance toward the 3rd plan
- Fundamental ideas and policy goals
- Total gov'tal R&D investment: 25 trillion yen (208 bill. dollar)

2. Strategic Priority Setting in S&T

- Promotion of basic researches
- Prioritization of R&D for policy-oriented subjects

Primary prioritized areas; Life science, IT, Environmental sciences, Nano-tech. & materials
Secondary prioritized areas; Energy, MONODZUKURI tech., Infrastructure, Frontier (outer space & oceans)

- Promotion strategy for the prioritized areas

3. S&T system reforms

- Fostering S&T personnel and providing opportunities
- Progress in science and leading to innovation
- Upgrading infrastructures for S&T promotion
- Strategic commitment on international S&T activities

4. Public Confidence and Engagement

- Responsible actions regarding ethical, legal and social issues
- Reinforcement of accountability and public relations of S&T activities
- Promotion of public understanding of S&T
- Facilitation of public engagement with S&T-related issues

5. Missions of the CSTP

- More efficient and effective management of governmental R&D
- Break of institutional or operational bottle necks
- Follow-up of the Plan and promotion of progress in S&T

http://www8.cao.go.jp/cstp/english/basic/3rd-BasicPlan_outline.pdf

Strategic priority setting in S&T

Basic Research

~ Steady promotion ~

Policy mission-oriented R&D

Further Prioritization

4 priority promotion areas

(Life science, IT, Environmental science、**Nanotech & materials**)

4 promotion areas

(Energy, MONODZUKURI-tech、Social infrastructure、Frontier)

Promotion Strategies for R&D Areas

- **Background of the present situation**
- **Setting goals**
- ***Important R&D themes***
- ***Strategic S&T priorities***
- **Various measures for promoting S&T**

Promotion Strategy for Nanotech. & Materials (Important R&D Themes)
by Council for Science and Technology Policy (CSTP)

NANO-ELECTRONICS

- ○Next-Generation Silicon-based Nano-electronics superior to conventional silicon semiconductors
- ○Electron/Photon-controlled Nano-electronics
- ○Nano-scale Manufacturing Technology for Electronics
- ○Cost Reduction Technology for Nano-electronics Components
- ○Energy-saving/Environmentally-friendly Nano-electronics
- ○Nano-electronics for Security

MATERIALS

[To Deal with Energy Issues]

- ○Advanced Materials to Promote the Use of Unpopular Energy
- ○Advanced Materials for Highly Efficient Use of Energy

[To Build an Environmentally-friendly Sustainable Society]

- ○Materials to Deal with Toxic Substances
- ○Substitution and Saving Technology for Rare or Deficit Materials
- ○Materials for Environmental Improvement and Conservation

[To Build a Secure and Safe Society]

- ○Materials for a Secure and Safe Society

[To Maintain and Reinforce Industrial Competitiveness]

- ○Materials for the Most Advanced Electro-Apparatus
- ○Materials for Competitive Transport Equipment
- ○Manufacturing Technology for Innovative Materials and Components for the Next-Generation

NANO-BIOTECHNOLOGY & BIO-MATERIALS

- ○Molecular Imaging Technology for Investigating Internal Structures and Mechanisms
- ○Manipulation Technology for Internal Molecules
- ○Diagnosis and Treatment Methods using DDS and Imaging Technology
- ○Apparatus with Super-microscopic Processing Technology
- ○Detection Technology for Ultra Traces of Substances
- ○Patient-friendly Bio-devices with High Safety and Advanced Functions
- ○Regeneration Initiation Materials
- ○Nano-biotechnology Applied Food

FUNDAMENTALS for NANOTECHNOLOGY & MATERIALS

[Technological Fundamentals]

- ○Advanced Nano-measurement and Nano-processing Technology
- ○Novel Utilization of Quantum Beams for Measurement, Fabrication and Manufacturing Technology
- ○Simulation and Design Technology to Exploit Material Properties and Functions

[Promotional Fundamentals]

- ○Responsible R&D of Nanotechnology
- ○Human Resource Development and Environmental Improvement for R&D Activities

NANO- and MATERIALS SCIENCE

- ○Quantum Computational Technology, Clarification and Control of Interface Functions, Mechanism Clarification of Nano-scaled Bio-systems, Strongly Correlated Electronics

Strategically Focused Science and Technology:

R&D subjects to which governmental funds will be allocated, preferably in the period of the 3rd Basic Plan

STRATEGY CONCEPTS

Concept 1: To Find Solutions, with "*True Nano*" and Advanced Materials, to Serious Social and Industrial Issues,

Concept 2: To Keep Up Competitiveness by Quantum Jumps and Massive Industrial Applications of Nanotechnology, and

Concept 3: To Prepare R&D Fundamentals which Accelerate Innovation with "*True Nano*" and Advanced Materials

"True Nano": Nanotechnology which is expected to cause discontinuous progress, or to provide great industrial applications by using phenomena and characteristics peculiar to nanotechnology

Strategy Concept 1:
To Find Solutions, with "*True Nano*" and Advanced Materials, to Serious Social and Industrial Issues

① Advanced Materials which can drastically reduce costs of clean energy
- Aiming at overcoming Japan's serious energy problem
- Commercializing clean energy technologies and penetrating them into markets
- Mainly focusing on fuel cells and photovoltaic cells for the immediate future

② Advanced Materials which can fully substitute rare or deficit materials
- Aiming at building a sustainable society which is free from resource problems
- Strengthening Japan's industrial competitiveness independent of specific countries with dominant natural resources
- Revolutionizing substitutional material technologies

③ Advanced Nanotechnology & Materials which Support Our Secure and Safe Daily Lives
- Aiming at preventing and reducing natural and man-made disasters, and providing secure and safe food
- Developing high-strength steel for construction, materials for securing human lives against terrorism, disasters and accidents.
- Developing nano-particle processing technologies and nano-scale evaluation technologies for domestic farm products in order to develop safer and higher quality food

④ Advanced Materials which can Play a Crucial Role in Innovation
- Aiming at scaling up outputs of nanotechnology R&D to practical materials
- Developing scaling-up technologies such as surface/interface control technologies

Strategy Concept 2:

To Keep Up Competitiveness by Quantum Jumps and Massive Industrial Applications of Nanotechnology

⑤ Advanced Electronics which Break Through the Function Limits of Devices

- Aiming at breaking through performance limitations of current device technologies, including achieving greater energy saving, higher packing density and faster processing
- Only "*True Nano*" and/or material revolution can achieve this breakthrough
- Indispensable R&D investment for industrial competitiveness

⑥ Advanced Nano-biotechnology and Nano-medical Technology aiming at the Realization and Unification of Very Early-stage Diagnosis and Minimally-invasive Medicine

- Aiming at realizing very early-stage diagnosis and minimally-invasive medicine for serious diseases such as cancer, cardiovascular disorders, and dementia
- Clarifying and regulating nano-scaled structures and the functions of living bodies

Strategy Concept 3:

To Prepare R&D Fundamentals which Accelerate Innovation with "*True Nano*" and Advanced Materials

⑦ R&D for the Social Acceptance of Nanotechnology
- Aiming at building the circumstances where society and the public accept nanotechnology
- Evaluating the impacts or effects of nanotechnology or nano-materials on human health and the environment
- Standardizing nanotechnology

⑧ Advanced R&D at Innovation COEs which Leads to the Commercialization of Nanotechnology
- Aiming at smoothing the commercialization of outputs of nanotechnology R&Ds
- Building nanotechnology R&D strongholds or foundries

⑨ Cutting-edge Nano-measurement and Nano-processing Technology
- Aiming at contributing to varied technological progress, such as information tech, medical engineering, and environmental measurement, and at strengthening industrial competitiveness
- Developing analysis and measurement technologies with nano-meter resolution
- Unifying nano-measurement and nano-processing

⑩ Development and Shared-Use of X-Ray Free Electron Lasers
- Aiming at providing brand-new analytical methods which could not be realized with conventional technologies
- Expecting broad scientific and industrial applications, such as the development of nano-structured materials which can adsorb specific molecules, and structural and functional clarification of proteins crucial to medicine

Institutes for Nanotechnology Research, Development and Assessment

CSTP
NTPT

METI
- **Flagship type R&D**
  NEDO (FA)
  AIST (RI)

Industries
NBCI

MEXT
- **Basic research**
  JSPS (FA)
  Universities
- **Long term challenge**
  JST (FA)
- **Generic technology**
  NIMS (RI)
  RIKEN (RI)

MHLW
- **Safety of foods & drugs**
  NIHS (RI)
- **Occupational health**
  NIIH (RI)

MOE
- **Environmental Protection**
  NIES (RI)

FA: Funding Agency
RI: National Research Institute

CSTP: Council for Science and Technology Policy,
MEXT: Ministry of Education, Culture, Sports, Science and Technology,
METI: Ministry of Economy, Trade and Industries,
MHLW: Ministry of Health, Labor and Welfare, MOE: Ministry of the Environment, NTPT: Nanotechnology & Materials Project Team,
JSPS: Japan Society for the Promotion of Science, JST: Japan Science and Technology Agency,
NIMS: National Institute for Materials Science, NEDO: New Energy and Industrial Technology Development Organization,
AIST: National Institute of Advanced Industrial Science and Technology, NIHS: National Institute of Health Sciences,
NIIH: National Institute of Industrial Health, NIES: National Institute for Environmental Studies. NBCI: Nanotechnology Business Creation Initiative

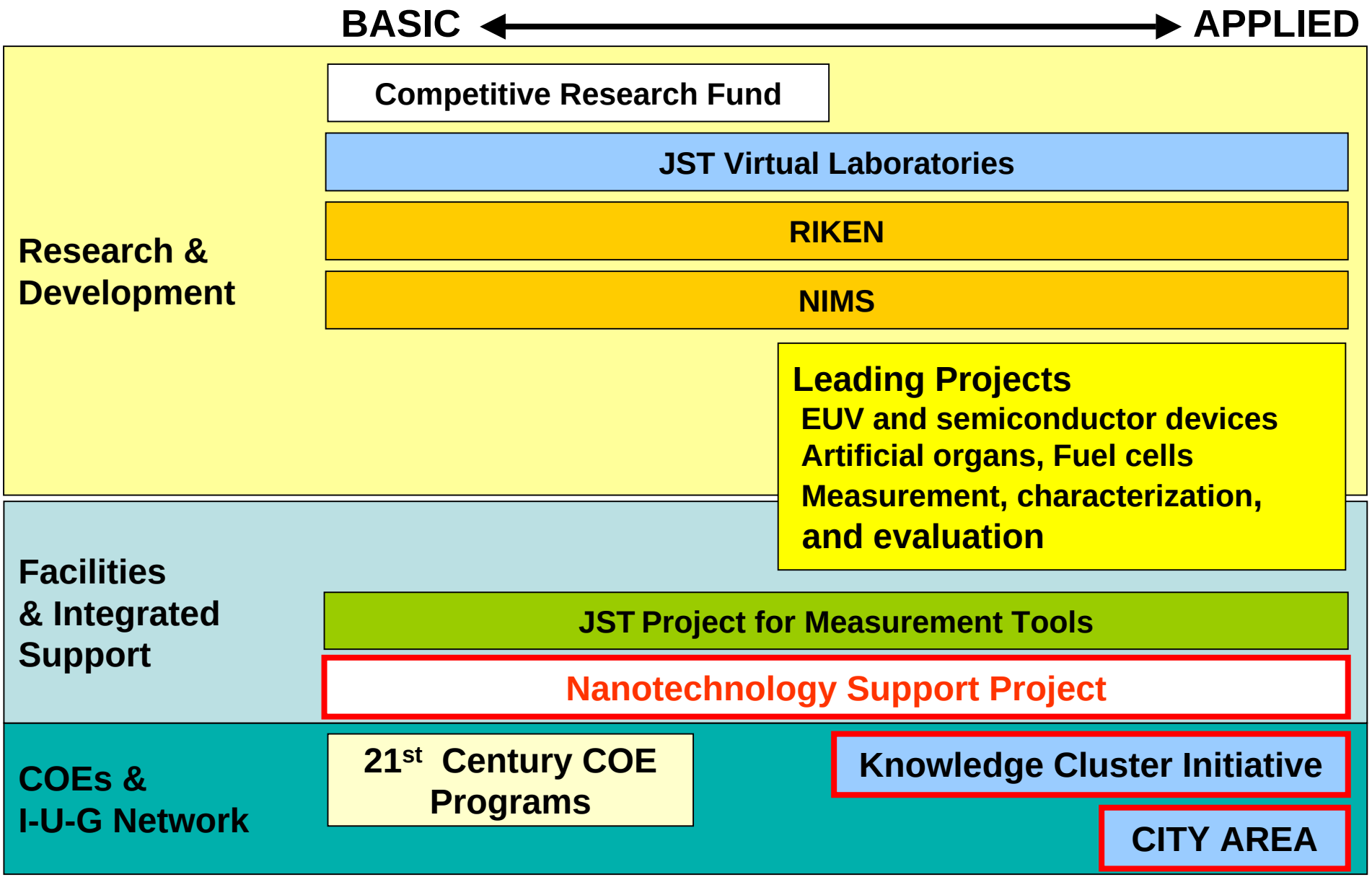
Government Funding Categorized as Nanotechnology & Materials

(billion JPY)

FY	2001	2002	2003	2004	2005
MEXT	65	72	75	78	81
Others	20	19	19	16	16
Total	85	91	95	94	97

http://www.nanonet.go.jp/japanese/info/budget/budget2005a.pdf

Nanotechnology Programs by MEXT



JST Virtual Labo in Nanotechnology
[2002-2006]

Strategy Target	Research Area	
Creation of Nanodevice / Material / System for Overcoming Integration / Function Limits in Data Processing and Communications	**Creation of Ultra fast, Ultralow Power, Super-performance Nanodevices and Systems: Hiroyuki Sakaki**, The University of Tokyo	**Creation of Innovative Technology by Integration of Nanotechnology with Information, Biological, and Environmental Technologies: Sukekatsu Ushioda,** Japan Advanced Institute of Science and Technology
	Creation of Nanodevices/system Based on New Physical Phenomena and Functional Principles: Koji Kajimura, Japan Society for The Promotion of Machine Industry	
	Nano Factory and Process Monitoring for Advanced Information Processing and Communication Research Supervisor: Kenji Gamo, Osaka University	
	Creation and Application of Nano-Structural Materials for Advanced Data Processing and Communication: Hidetoshi Fukuyama, Tohoku University	
Creation of Functional Materials/ System that Utilize Nano Biotechnology for Realizing a Noninvasive Medical Treatment System	**Creation of Bio-devices and Bio-systems with Chemical and Biological Molecules for Medical Use: Masuo Aizawa,** Tokyo Institute of Technology	
	Creation and Application of "Soft Nano-machine", the Hyper functional Molecular Machine: Hirokazu Hotani, Nagoya University	
	Creation of Novel Nano-material/system Synthesized by Self organization for Medical Use: Koji Kaya, WAKO Institute/Discovery Research Institute, RIKEN	
Creation of Nano Materials/ System for Realizing Environmental Conservation and Advanced Energy Recycling to Minimize Stress on the Environment	**Creation of Nano-Structured Catalysts and Materials for Environmental Conservation: Makoto Misono,** National Institute of Technology and Evaluation	
	development of Advanced Nanostructured Materials for Energy Conversion and Storage: Akira Fujishima, The University of Tokyo	

Nanotechnology and Materials R&D Budget by MEXT in FY2005

FY2005 81 bill. yen (FY2004 78 bill. yen)

R&D for Practical / Industrial Use

Leading Projects 2.8 bill. yen

Toward the goal in 5 years

Nanotechnology Virtual Laboratory

JST Competitive Funding

Challenging Research Projects

toward the goal in 10-20 years

Generic Technology

National Institute for Materials Science (NIMS) 16.1bil.yen

Institute of Physical & Chemical Research (RIKEN) 2.4bil.yen

Basic Research

Universities, etc.

Grant-in-Aid for Scientific Research, and so on.

Interdisciplinary / Inter-organizational Support for Researchers

Nanotechnology Support Project 2.4 bill. yen

- Supporting Effective Utilization of Facilities
- Nanotechnology Researcher's Network Center of Japan