Japan’s New Science and Innovation Policy
-Beyond the Boundaries for Innovation -

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at ISPlasma 2011, in Nagoya
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Japan Science & Technology Agency (JST)
Contents

I. Innovation under the Changing World
II. Japan’s New Science & Innovation Policy
III. New Innovation Ecosystem
IV. Green Innovation in Japan
V. Conclusion
Since 1989

End of the Cold-War
ICT revolution

Globalization ⇒ The World is Changing Rapidly ...

- Sustainable development
- Climate change, disasters
- Energy, water & resources shortage
- Aging society, Smarter cities
- Infectious diseases, Disparity
- Knowledge-based society

Now

Climate change

Economic crisis & New Emerging market
Since 1989

The Rules of games are Changing!!
Innovation & Entrepreneurship
Globalization and Localization

Shaping the Post-Crisis World

Shaping the Values and Leadership
Principles for a Post-Crisis World
Catalising the Next Wave of Growth through Science & Innovation
Rethink, Redesign and Rebuild

Green New Deal & Smart Ageing Society
Global Management & Governance of Enterprises and S&I

Economic crisis & New Emerging market
Innovation for what in the 21st century?

- Innovation for profit
- Innovation for competitiveness
- Innovation for growth
- Innovation for employment
- Innovation for wellbeing & quality of life
- Innovation for safety, security & social cohesion
- Innovation for sustainable development

Innovation horizon is expanding, Science and technology policy is changing.
The broad concept of innovation embraced by the OECD Innovation Strategy emphasises the need for a better match between supply-side inputs and the demand side, including the role of markets. Moreover, policy actions need to reflect the changing nature of innovation.

* Broadening policies to foster innovation beyond science and technology in recognition of the fact that innovation involves a wide range of investments in intangible assets and of actors.

* Education and training policies adapted to the needs of society today to empower people throughout society to be creative, engage in innovation and benefit from its outcomes.
* Greater policy attention to the creation and growth of new firms and their role in creating breakthrough innovations and new jobs.

* Sufficient attention for the fundamental role of scientific research in enabling radical innovation and providing the foundation for future innovation.

* Improved mechanisms to foster the diffusion and application of knowledge through well-functioning networks and markets.

* Attention for the role of government in creating new platforms for innovation.

* New approaches and governance mechanisms for international cooperation in science and technology to help address global challenges and share costs and risks.

* Frameworks for measuring the broader, more networked concept of innovation and its impacts to guide policy making.
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Legal framework: S&T Basic Law and Basic Plan

1st Basic Plan (FY 1996-2000)
- Increase in government R&D expenditure
  - The total budget for governmental R&D expenditure exceeded 170 B$. <176 B$>
- Construction of new R&D system
  - Increase in competitive research funds
  - Support plan for 10,000 post-doctoral fellows
  - Promotion of industry-academia-government collaboration
  - Implementation of evaluation systems

2nd Basic Plan (FY 2001-2005)
- Three basic ideas
  - Creation of wisdom
  - Vitality from wisdom
  - Sophisticated society by wisdom
- Key policies
  - Strategic priority setting in S&T
  - Promotion of basic researches
  - Prioritization of R&D
  - S&T system reforms
  - Doubling of competitive research funds
  - Enhancement of industry-academia-government collaboration
  - Total budget: 240 B$ <211 B$>

3rd Basic Plan (FY 2006-2010)
- Three basic ideas
- Key Policies
- Prioritization of R&D
- Promoted 4 Areas
- Promoted 4 Areas
- S&T System Reform
- Total budget: 250 B$ <215 B$>

4th Basic Plan (FY 2011-2015)
- Three basic ideas
- Key Policies
- Prioritization of R&D
- Promoted 4 Areas
- Promoted 4 Areas
- S&T System Reform
- Total budget: 250 B$ <215 B$>

Science and Technology Basic Law (enacted unanimously in 1995)
New Growth Strategy, June 2010
- Strong Economy, Robust Public Finances & Strong Social Security System -

- Achieve nominal & real growth in excess of 3% and 2% by 2020
- Return consumer prices to positive increase in FY2011
- Lower unemployment rate to 3%-4% at an early time

【Growth areas】

<table>
<thead>
<tr>
<th>Green Innovation</th>
<th>Life Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Targets by 2020</strong></td>
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</tr>
<tr>
<td>- Create over ¥50 trillion in new markets and 1.4 million new jobs</td>
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<tr>
<td>- Reduce worldwide greenhouse gas emissions by 1.3 billion tons using Japanese technology</td>
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<tr>
<td>- Foster industries that meet demand and create jobs: -Roughly ¥45 trillion in new markets and 2.8 million new jobs</td>
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</tbody>
</table>

Opening new frontiers
Platforms to support growth

S&T as an engine for New Growth Strategy

The 4th S&T Basic Plan (FY 2011-2015)

Comprehensive promotion of science, technology and innovation policy
**Positioning of the Basic Plan in National Strategy**

- A five-year-plan with the foresight of 10 years ahead, based on “New Growth Strategy”.
  - Comprehensive promotion of science, technology and innovation policy

- Perspective for 2020
  - Nation which realizes sustainable growth
  - “...takes the lead in solving global issues
  - “...create the world's highest knowledge
  - Nation where the youths hold a dream

**Two major innovation as the national strategic pillar**

**Green Innovation**
To realize low carbon society with sustainability
- Renewable energy, Low carbon of energy supply and demand, Saving energy, Green infrastructure
- Accelerate innovation by affirmative legal framework
- Establish “National Lab” with proper regulation easing
- Develop strategies for the international standardization

**Life Innovation**
To realize high quality of life in an aging society
- Promotion of preventive medicine, Development of innovative diagnostic and treatment method,
  Development of life-supporting technology for elderly and disability people
- Promote translational research
- Promote regulatory science
  Accelerate innovation by affirmative legal framework

**The new system which stimulates innovation**
To construct the system which promote issue-driven innovation
- Establish Innovation Strategy Platform
- Establish Open Innovation Centers
- Create a new market by the new affirmative legal framework
Promotion of R&D which sustains the nation and produces new advantage

Drastic Reinforcement of S&T Potential

Drastic reinforcement of basic research
- Reinforce basic research based on originality/variety
- Reinforce the world top-level basic research
- Form the group of “Research Universities”
- R&D Hub for International research network

Bases for the high quality of life
- Maintain necessities: food/resources/energy
- Maintain safe society

Bases for the industries
- Extend advantage of Japan
- Create new advantage for the future

Bases for the nation
- Maintain a technology bases for security
- Develop a new frontier

Common Base for R&D
- Maintain cross-sectional key technologies
- Establish hubs of advanced R&D

Implementing the new policy

Reforming S&T System
: Construction of PDCA (Plan-Do-Check-Action) cycle

Bridging Science and Society
: New development of S&T communication

Increasing R&D investment
: Increase public and private R&D investment to 4% (3.6), and government investment at 1% (0.7) of GDP <250 B$>

International openness
Integrated with world vitality
“East-Asia Science and Innovation Area” Initiative

Human capital for S&T
Drastic reinforcement of the graduate school education

Formation of research environment of international standard
- Domestic/international maintenance and utilization of large research facilities

Install implementation of East Asia Science and Innovation Area Initiative
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Funding system for science–based national innovation system in Japan

Diversity

curiosity-driven research ('bottom-up’ research)

Scientific frontier
Technological seeds

Sprouting Phase

Creating new fields

Science

Technology

mission oriented basic research
Exploratory & high risk research

"Exit" oriented R&D,
prototype, demonstration & Social experiments

Public sectors
NGO etc.

Market & Society

Intellectual &
Cultural values

Social &
Public values

Economic Values

Valley of Death

backcasting

Interaction Fields

Universities

Public research institutes

Private Companies

Input

Proof of Concept

Finance, Tax, Regulations, IPR, Standards, Social capital, culture etc.

Prototypes

Output

Venture, Start-ups, VC/risk money
Grand challenges we should meet

- The world is confronted with the global challenges of climate change, food and energy security, and infectious deceases which threaten sustainability.

- The New Growth Strategy should be empowered by S&T and innovation to transform the grand challenges to opportunities for thriving in the fiercer global competition.

- Due to complexity of the challenges, it is getting more difficult to find a solution by single discipline of S&T.

- A diversity of knowledge derived in different disciplines of S&T along with social science and humanities should be integrated to address the challenges, which is characterized by Issue-driven Innovation beyond Discipline-oriented Innovation.
Grand challenge we should meet; New Policy: Issue-driven innovation beyond discipline-oriented Innovation

Knowledge

“Innovation Platform”
Integrated knowledge and approach in a diversity of disciplines

Society and Market

Issue-driven

Addressing the challenges of climate change, ageing society etc., through issue-driven innovation

We need combination of technological innovation and social innovation

A

B

C
Integrating Disciplines for Green innovation & Life innovation

- Theory
- Experiment
- Computer modeling & simulation: “third pillar”
  - Modeling
  - Prediction
  - Visualization
  ⇒ Cloud computing

Breaking new knowledge frontier
Problem solving
and value creating for society & economy

Physical, Chemistry, Material Science

Mathematics, Computer Science

Cognitive science, Robotics

BT

IT

NT
Basic Loop for Sustainable Evolution
by H.Yoshikawa, CRDS/JST

Useful knowledge for sustainability (Utilization Knowledge, Factual knowledge)

Designing Scientists

Actors

Actions for sustainability

Observing Scientists

Knowledge and data (Judgment of goodness for sustainability)

Society
Values, Environment

Facts caused or not caused by actions

*Actors in Society are:
statesmen, policymakers, business humans, administrators, engineers, educators, writers, artists, journalists, etc...
who move society.

Sustainable and Environmentally Friendly Society (LCS, BD, QOL)

Policy / Social system  Social science / Civic science

"Element" industry (Parts & Materials)  Green industry  "Umbrella" industry (Solution business)

**Fusion & Evolution of Technologies**

**Nanoelectronics**
- Green electronics
- Quantum Computer

**Nanobiotechnology**
- Regenerative medicine
- DDS

**Green nanotech**
- Renewable energy
- Artificial photosynthesis
- Smart grid

**General engineering / Inverse design of functions**

**Nanotechnology**
- MEMS-NEMS
- Processing/Synthesis

**Biotechnology**
- Omics
- IPS

**Chemical engineering**
- ICT

**Systems engineering**
- Geophysics/Ecology

**Computational science**
- Systems science

**Interdisciplinary fusion**

**Engineering gap**

**Innovation gap**

**Simple system**
- Atom
- Molecule

**Complex system**
- Artificial system
- Ecosystem

**Progress**  **Fusion**  **System** (Evolution of Nanotechnology)
Major Issues in Nanotechnology / Materials

Sustainable and Environmentally friendly Society

- International Collaboration
- Standardization
- Risk Assessment / Management
- Fusion of technological areas
- Fusion of scientific disciplines

Nanotechnology/Materials

Energy

- Energy Saving
  - Ultra Low Power Devices
  - Carbon-based Nanoelectronics
  - Non-volatile Memory • CPU
Multi-functional System
- Fusion of nano-CMOS and Spin • Photonics • Bio • MEMS
  - Smart-interface (Smart-sensor • Robot, High-resolution Display, Wearable PDA)
  - Ultra-high-speed Computation
  - Quantum Computer
  - Nano-photonics

Green Nanotechnology

Energy Generation
- Solar Cell with High Efficiency and Low Cost
- Thermoelectric device, Fuel Cell
- Biorefinery
- Artificial Photosynthesis (Hydrogen • Fuel Production)

Energy Transmission & Storage
- New battery Cell Material, Superconductor Material

Energy Saving
- Thermal Insulating Structural Material, Lightweight Material for Transportation
- Complex Total Energy System

Environment Protection
- Membrane Separation (Water, Gas)
- Environmental Monitoring System with High Sensitivity & Selectivity
- Green Process, Replacement for Rare Natural Resource

Nano electronics

- Innovative nano-medical technology
- Drug delivery • Intracellular injection
- Implant devices for the diagnosis and treatment
- Materials for Regenerative medicine
- Application of biological systems to sustainable system
- Environmental cleanup by imitating photosynthesis
- Environmental Monitoring by biomaterial
- Application of biological systems to other fields
  - Devices using self-organization
  - Biomimetic ultra low power IT

New Substances / Materials

- New Magnetic Material
- Corrosion Resistant & High-refractory Metal
- Wide-gap Semiconductor
- Oxide Semiconductor
- Composite • Hybrid Material
- New Structured • Space & Gap Material
- Molecular & Organic • Bio-Material

Common & Basic Technology in Nanotech / Control Technology in Substances & Materials / Nanoscience

- Material Preparation and processing
  - Self-organization / Hierarchical Control of structure
  - Integration of Bottom-up & Top-down processes
  - Nano & Micro Printing, 3D nano-fabrication
- Theory & Design
  - Exploration and design of new material, Element Strategy
  - Design for nano-system, Theory for surface & Interface
  - Calculation for Dynamics, Simulation
- Nano-scale Measurement & Analysis
  - Three dimensional Imaging, Visualization, Dynamic Measurement
  - Measurement for surface, bulk and Interface
  - In-situ Measurement

User Facilities network and R&D centers
- Funding systems
- Human Resources / Education
Area ・Thin-film high-efficiency solar cell (20%)
・Fuel cell: SOFC/PEFC
・New material for rechargeable battery
・Thermal Insulating Structural Material (building, transportation)
・Material for light transport
・Low-pressure High-strength environmental purification separation membrane (water, gas)
・Materials for Regenerative Medicine
・DNA chip
・Nano-DDS
・Flexible Electronics
・Carbon-based Nanoelectronics
・Novel Non-volatile Memory
・Fusion of Nano-CMOS and MEMS
・Organic thin-film solar cell (20%)
・High-efficiency thermo electric element (ZT > 3 @ room temperature)
・Superconducting power transmission
・Superconducting power transmission
・For auto mobile low-cost, long-life rechargeable battery
・Super-lubricant material (nano-tribology)
・Replacement for Rare Natural Resource
・Room-temperature production process (energy-saving, material-saving)
・Highly advanced Regenerative Medicine
・Cell chip
・DNA chip
・Molecular Imaging
・Environmental Monitoring by Biomaterial
・Integrated System of Drug Delivery, Diagnosis and Treatment
・Devices using Self-organization
・Environmental Cleanup by mimicking Photosynthesis
・High-sensitivity high-selectivity environmental monitoring
・Implant Devices for Diagnosis and Treatment
・Nano-Cell Surgery
・3D-Imaging in Cell
・Ultra low power IT by Biomimetic
・Super Smart Grid
・Fusion of Nano-CMOS and Bio
・Wearable PDA
- Fusion of Nano-CMOS and Photonics
- Spin-wave Electronics
- Fusion of Nano-CMOS and Spin
- Ultra-high-speed Quantum Computer
## Platforms: past and future

<table>
<thead>
<tr>
<th>Field</th>
<th>Big National Projects</th>
<th>Industrial Achievem.</th>
<th>Examples of Research Centres for Innovation (planned, not yet financed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>Sunshine Project (74-00): solar, fuel cell, geothermal, bio-e.</td>
<td>Solar cell E conserving commoditites</td>
<td>Innovative Energy R.Centre</td>
</tr>
<tr>
<td></td>
<td>Moonlight Project (73-93): heat pump, insulation</td>
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</tr>
<tr>
<td>Manufacturing</td>
<td>Fully automated flexible manufacturing (77-88, 13.7by): Automation of batch production,</td>
<td>Productivity Automation</td>
<td>High-tech Manufacturing Research Centre</td>
</tr>
<tr>
<td>Robotics</td>
<td>Robotics for extreme condition (83-90, 20by): Tele-operation, Intelligent robot, Multiple degree of motion</td>
<td>(basic Knowledge)</td>
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<tr>
<td>Nano tech</td>
<td>Atom technology (92-02, 26.2by): Nano science, New material, New observation</td>
<td>(basic Knowledge)</td>
<td>R.Centre of Nano-technology</td>
</tr>
<tr>
<td>Optics</td>
<td>Femto-second technology (95-04, 10.8by): High speed communication, Energy-conserving network</td>
<td>(basic Knowledge)</td>
<td>R.Centre of Optical Network</td>
</tr>
</tbody>
</table>

### National Projects, Public Consortium, Private Consortium,

**Examples in the future (dreams?)**

- **Energy**
  - Hydrogen society
  - Computational science
  - Four dimensional lens
- **Manufacturing**
  - Integrated Design/Manufacturing
  - Service
  - Medicine, public s., new industry
- **Robotics**
  - Cheap-labour Robotics
  - Education
  - Work-is-learning project
- **Bio**
  - Health industry
  - Security
  - Mitigation, adaptation
- **Ocean**
  - Ocean industry
- **Geology**
  - New resource, waste
Science-based Engineering
Engineering-based Science

○ Nobel Prize
○ bio-science, nano-material, climate change research, complex system
e-science, e-education
○ analysis– synthesis, prediction, forecast/foresight
  system thinking, design thinking
○ US/DOE, NIH-road-map, US/NIST, EU 7th program
# ノーベル賞と関連の分析機器(1950年以降)

<table>
<thead>
<tr>
<th>年</th>
<th>受賞者名</th>
<th>受賞の理由</th>
<th>関連する現在の製品</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>F. Bloch（米）</td>
<td>磁気共鳴吸収による原子核の磁気モーメントの測定</td>
<td>磁気共鳴装置</td>
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<tr>
<td></td>
<td>E.M. Purcell（米）</td>
<td>磁気共鳴吸収による原子核の磁気モーメントの測定</td>
<td>磁気共鳴装置</td>
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<td></td>
<td>A.J.P. Martin（英）</td>
<td>分配クロマトグラフィーの開発と物質の分離・分析への応用</td>
<td>ガスクロマトグラフ</td>
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<tr>
<td></td>
<td>R.L.M. Synge（英）</td>
<td>分配クロマトグラフィーの開発と物質の分離・分析への応用</td>
<td>ガスクロマトグラフ</td>
</tr>
<tr>
<td>1953</td>
<td>F. Zernike（荷）</td>
<td>位相差顕微鏡の研究</td>
<td>位相差顕微鏡</td>
</tr>
<tr>
<td>1959</td>
<td>J. Heyrovsky（チェコ）</td>
<td>ポーラログラフの理論及びポーラログラフの説明</td>
<td>ポーラログラフ</td>
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<tr>
<td>1962</td>
<td>F.H.C. Crick（英）</td>
<td>メーゼの分子構造及び生体における情報伝達に対するその意義の発見</td>
<td>レーザー顕微鏡</td>
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<tr>
<td></td>
<td>J.D. Watson（米）</td>
<td>メーゼの分子構造及び生体における情報伝達に対するその意義の発見</td>
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<td></td>
<td>M.H.F. Wilkins（英）</td>
<td>メーゼの分子構造及び生体における情報伝達に対するその意義の発見</td>
<td>レーザー顕微鏡</td>
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<td>1964</td>
<td>C.H. Townes（米）</td>
<td>メーゼ、レーザーの発見及び量子電気テロニクスの基礎的研究</td>
<td>レーザー顕微鏡</td>
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<td></td>
<td>N.G. Basov（旧ソ）</td>
<td>メーゼ、レーザーの発見及び量子電気テロニクスの基礎的研究</td>
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<td></td>
<td>D.C. Hodgkin（英）</td>
<td>X線回折法による生体物質の分子構造の研究</td>
<td>X線回折装置</td>
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<td>1979</td>
<td>G.N. Hounsfield（英）</td>
<td>コンビューターを用いたX線断層撮影技術の開発</td>
<td>X線CT診断装置</td>
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<td>X線CT診断装置</td>
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<td>1980</td>
<td>P. Berg（米）</td>
<td>遺伝子工学の基礎となる核酸の生化学的研究</td>
<td>DNAシーケンサー</td>
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<td></td>
<td>F. Sanger（英）</td>
<td>研究の塩基配列の解明</td>
<td>DNAシーケンサー</td>
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<td></td>
<td>W. Gilbert（米）</td>
<td>研究の塩基配列の解明</td>
<td>DNAシーケンサー</td>
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<td>1981</td>
<td>K. Sjogbahn（スウェーデン）</td>
<td>高分解能光電子分光法の開発</td>
<td>X線光電子分光装置</td>
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<td>1984</td>
<td>R.B. Merrifield（米）</td>
<td>固相反応によるペプチド合成法の開発</td>
<td>ペプチド合成装置</td>
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<tr>
<td>1988</td>
<td>E. Ruska（旧西独）</td>
<td>電子顕微鏡に関する基礎研究と開発</td>
<td>透過型電子顕微鏡</td>
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<td>G. Birnberg（旧西独）</td>
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<td>H. Rohrer（スイス）</td>
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<td>1989</td>
<td>N.F. Ramsey（米）</td>
<td>走査型トンネル顕微鏡の開発</td>
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<td>H.G. Dehmolt（米）</td>
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<td>W. Paul（旧西独）</td>
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<tr>
<td>1991</td>
<td>P. Ernst（スイス）</td>
<td>高感度・高分解能磁気共鳴法の開発と実用化</td>
<td>フーリエ変換型磁気共鳴装置</td>
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<tr>
<td>1993</td>
<td>K.B. Mullis（米）</td>
<td>Polymerase Chain Reaction（PCR）法の発明</td>
<td>DNA増幅・検出装置</td>
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<tr>
<td>2002</td>
<td>田中耕一（日本）</td>
<td>生体高分子の同定及び構造解析のための手法の開発</td>
<td>質量分析装置</td>
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<td>J.B. Fenn（米）</td>
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World Conference on Science (ICSU/UNESCO)
Declaration on Science and the Use of Scientific Knowledge
- Science for the 21st Century
A New Commitment -

1999

20th Century

★ Science for knowledge;
Knowledge for progress

21st Century

★ Science for knowledge;
knowledge for progress
★ Science for peace
★ Science for development
★ Science in society and
Science for society

WSF 2009 in Budapest
University in the 21\textsuperscript{st} century
Transforming and reinventing universities
for the new world order and value systems

Universities in the 21\textsuperscript{st} century
- Global university, global career, global brand, brains business.
- Instruments of national competition as well as of peace.
  A powerful force for global integration, mutual understanding, geopolitical stability and foreign policy.
- Brain circulation & network, university network, open innovation, collective intelligence
- COE (Center of Excellence) ⇔ NOE (Network of Excellences)

Exploring the future of modern university system
Solving Global Problems


Challenge of Sustainability and Development

Corporate Values: Competitiveness, Growth, Profit, CSR, Economic Crisis

Developed Countries

BRICS etc.

Developing Countries

Knowledge, S&T,

Innovation Ecosystem

Global

Regional

National

Local

Developed Countries

BRICS etc.

Developing Countries

Market & Society

Global Innovation Ecosystem Since 2006～

Human Resources

Regulations & Standards

International Collaboration and Global governance

Finance & Taxes

Heterogeneous Diverse Locally relevant

Local

International
How to secure and nurture human capital in the globalization

Brain drain/gain →
Global brain circulation and brain network

6.8B, World & US
500M, Europe
130M, Japan

American Chemical Society
“Educating chemists with skills needed to compete in the new global economy”
Presidential session of ACS meeting 2010 in SF

→ Quality: science, engineering, management, arts, sports...
Green Innovation Symposium:

“Joint Statement” says:
- Various support activities for international cooperation are crucial
- The experts of each funding agency would have a network meeting to specify problems to be solved by international cooperation between/among the funding agencies and to consider concrete measures to be taken

**Green Innovation Working Group:**

“The first Working Group Meeting”
April, 2011 in Germany
Organized by German Research Foundation (DFG)

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**Participant Agencies (From 9 Countries):**
- National Natural Science Foundation of China (NSFC)
- German Research Foundation (DFG)
- French National Research Agency (ANR)
- National Research Foundation of Korea (NRF)
- National Council on Science and Technology of Mexico (CONACYT)
- Swedish Governmental Agency for Innovation Systems (VINNOVA)
- Engineering and Physical Sciences Research Council of UK (EPSRC)
- National Science Foundation of USA (NSF)
- Japan Science and Technology Agency (JST)
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“Japan will aim to reduce its greenhouse gas emissions by 25% by 2020 for its mid-term goal.”

LCS: Social Scenario Research for Low Carbon Society

Founded in Dec 2009
in JST (Japan Science and Technology Agency)

Director-General:
Hiroshi Komiyama,
Former President of the University of Tokyo

We are running out of time
We need a concurrent approach to accelerate the process.
Structuring of knowledge and actions is the key.

- Improve energy efficiency by three times
- Double the use of renewable energy
- Establish recycling system of materials
CO2 Emission per GDP (As of 2005)

[ KeCO2/US$ (Central Currency Exchange Rate of 2000)]

No growth for Developing Countries without introducing Energy-Saving Technology
→ Then New Energy Development

Japan should contribute to the world with its Energy-Saving Technologies

Data by Dr. Tetsunari Iida, Institute for Sustainable Energy Policies (ISEP)
# CO2 Reduction for each sector (1990 basis) 1/2

**by JST LCS Center**

## Reduction rate

<table>
<thead>
<tr>
<th>Daily Life</th>
<th>Residence/Office</th>
<th>Transportation</th>
<th>Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6%</td>
<td>6%</td>
<td>2%</td>
</tr>
</tbody>
</table>

- **Residence/Office**: Solar power (80% of new houses), High efficiency electrical appliances (100%), Insulation, Smart Energy Management System (100%), Removal of old house by compact city (4%)
- **Transportation**: Hybrid car (20%), Energy saving car (30%), Modal shift
- **Agriculture**: Treatment of plant disease, Reduction of fertilization, CO2 fixation

## Energy consumption by final use (Japan)

### Pie Chart:
- Home
- Office
- Industries
- Transportation
### CO2 Reduction for each sector (1990 basis) 2/2

<table>
<thead>
<tr>
<th>Sector</th>
<th>Reduction Method</th>
</tr>
</thead>
</table>
| **Electricity** | **5%**  
  - Nuclear power (6%, operating rate → 90%)  
  - High eff. power plant  
  - Coal -biomass mixed fuel (50%)  
  - Solar power, Wind, Geothermal  
  - Higher voltage (1w → 2W/400V) |
| **Industry**    | **3%**  
  - Annual reduction rate of 1%/y |
| **Forest**      | **3%**  
  - Regeneration |
| **New CDM α**   | **25% + α** |

**Total**: 25% + α

Reduction: 410 Mt-CO2/y
Development and Diffusion of Environment & Energy Technology - Short/Medium/Long term - (CSTP, 2008)

Baseline Scenario* (IEA Outlook)

Improvement and Diffusion of Existing Efficient Technology

Innovative Technology

GHG emissions

Short and Medium-term

Medium and Long-term

(Note): This is a figure indicating images of GHG emissions reduction in the whole world.

* Baseline includes the effects of technology developments and improvements in energy efficiencies that can be expected on the basis of government actions already enacted.
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New Perspectives for Science and Innovation: No. 1

- Gravity of scientific activities moving to developing countries
  - “Silent Sputnik” (Rita Colwell);
    - (AAAS2010 Annual Conf. “Bridging Science and Society”)
    - (AAAS2011 “Science without Borders”)
  - “Royal Society Global Science Report”; “New entrants are reshaping the landscape for science and innovation in the world. But what do these changes mean? How should policymakers, scientists and business leaders respond? And how do we strike the right balance between competition and collaboration?”

- Reshaping science and innovation system, Design & system thinking and foresight under the complex and uncertain world

- Scientific integrity, Quality control of science
  - Global governance of science
  - Science diplomacy
New Perspectives for Science and Innovation: No. 2

- Bridging science and society
- Beyond the boundaries (disciplines, organizations, generations, nations)
- Network, Platform & Connectivity for Innovation
  - COE (Center of Excellence) ⇔ NOE (Network of Excellences)
- Transformative research, Converging Tech.

New innovation model
- Disruptive Innovation (by Christensen)
- Reverse Innovation (by Immelt)
- Frugal Innovation (by the Economist)
New Perspectives for Science and Innovation: No.3

- National, Regional and Global science and innovation ecosystem
  - Open innovation
  - Global governance of science
  - Globally integrated enterprise
  - System of systems (ex. ERA, ARA etc)

- Brain circulation & network, collective intelligence
  - S&E workforce: non-traditional skills and sense
  - Global leaders under the uncertain and complex world
Thank you very much for your attention!!

Questions:
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