November 19, 2014

OECD International Symposium
in commemoration of the 50th Anniversary of Japan's Accession

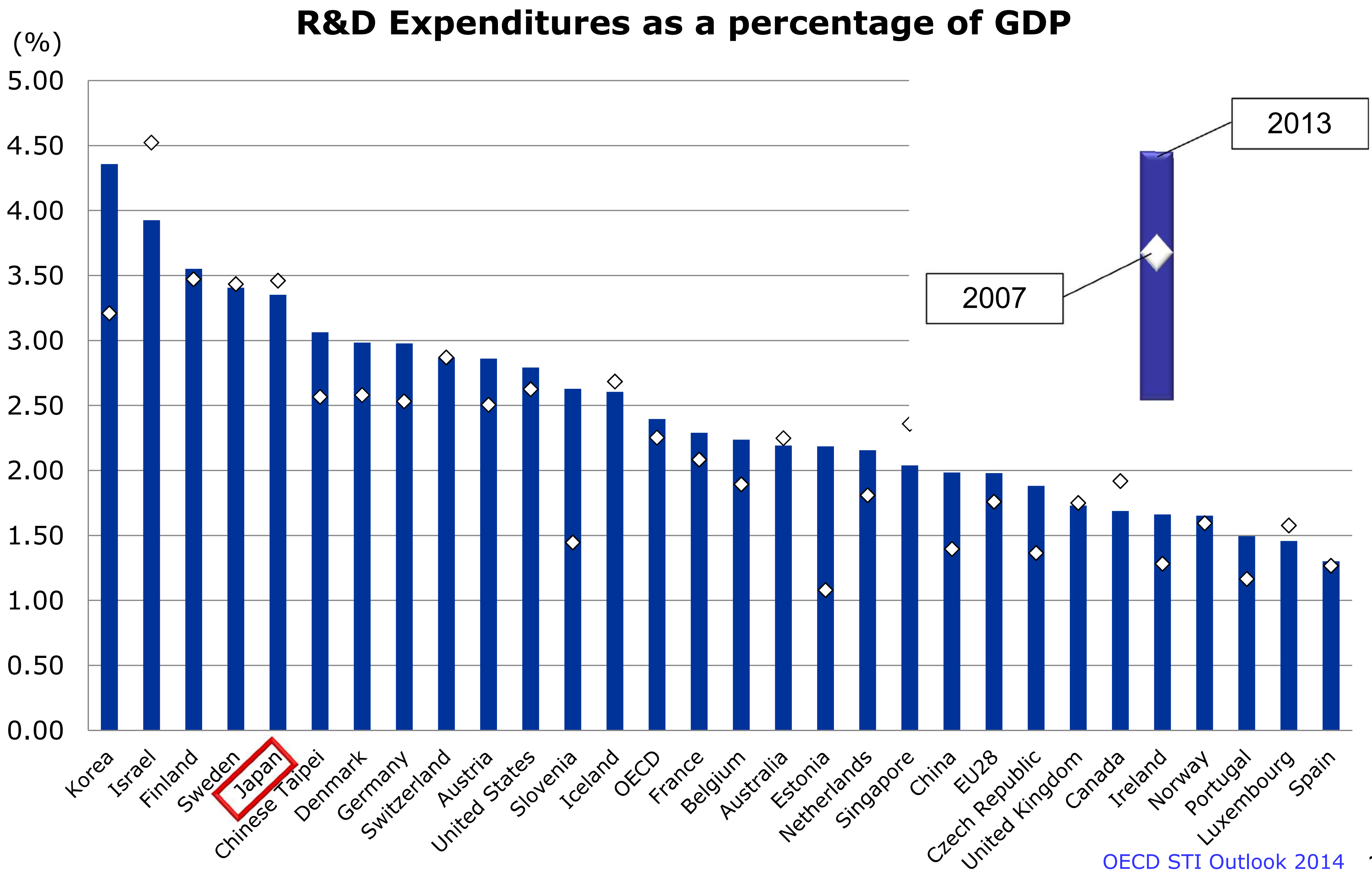
Enhancing Japan’s STI

Yuko Harayama

Executive Member
Council for Science, Technology and Innovation
Cabinet Office

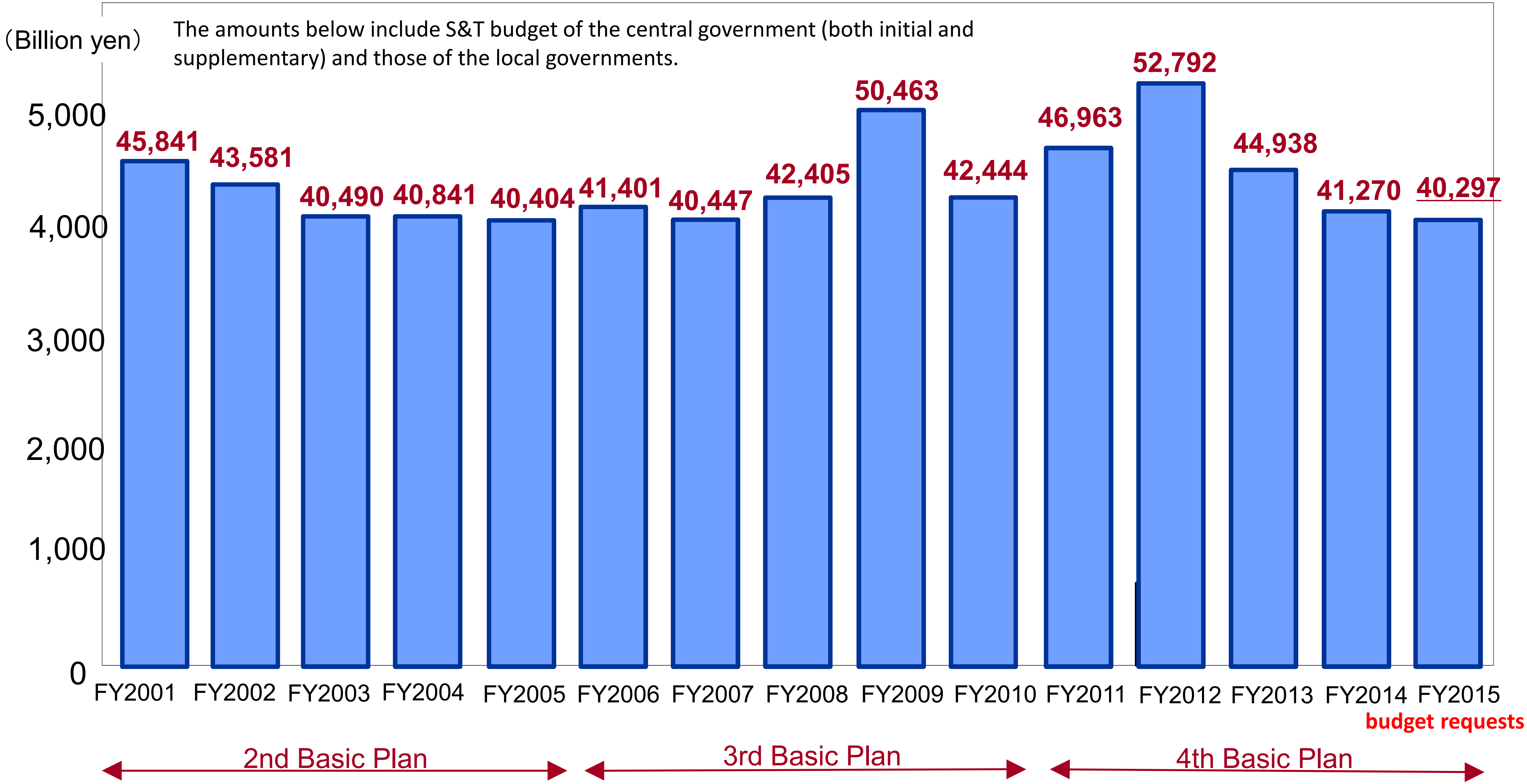
A SNAPSHOT OF JAPAN’S STI

R&D Expenditures



OECD STI Outlook 2014

Transition of overall S&T Budget



1st Plan (FY1996-2000) Investment under the basic plan Approx.17 trillion yen Actual budget: 17.6 trillion yen	**2nd Plan (FY2001-2005)** Investment under the basic plan Approx.24 trillion yen Actual budget: 21.1 trillion yen	**3rd Plan (FY2006-2010)** Investment under the basic plan Approx.25 trillion yen Actual budget: 21.7 trillion yen	**4th Plan (FY2011-2015)** Investment under the basic plan Approx.25 trillion yen

Strength in Basic Research

of Nobel laureates in natural sciences since 1901 (since 2000)

Rank	Country	Total
1(1)	US	250(58)
2(3)	UK	78(10)
3(4)	Germany	69(7)
4(5)	France	31(6)
5(2)	**Japan**	**17(12)**
6(8)	Sweden	16(1)
7(8)	Swiss	15(1)
8(6)	Russia	14(4)
8(8)	Netherlands	14(1)
10(8)	Canada	9(1)
10(8)	Austria	9(1)
10(13)	Denmark	9(0)
13(13)	Italy	7(0)
14(7)	Australia	6(2)

Japanese Nobel laureates in natural sciences

	year	Name	prize
1	2014	Isamu Akasaki	Physics
2	2014	Hiroshi Amano	Physics
3	2012	Shinya Yamanaka	Physiology / Medicine
4	2010	Akira Suzuki	Chemistry
5	2010	Ei-ichi Negishi	Chemistry
6	2008	Osamu Shimomura	Chemistry
7	2008	Makoto Kobayashi	Physics
8	2008	Toshihide Maskawa	Physics
9	2002	Masatoshi Koshiba	Physics
10	2002	Koichi Tanaka	Chemistry
11	2001	Ryōji Noyori	Chemistry
12	2000	Hideki Shirakawa	Chemistry
13	1987	Susumu Tonegawa	Physiology / Medicine
14	1981	Kenichi Fukui	Chemistry
15	1973	Leo Esaki	Physics
16	1965	Sin-Itiro Tomonaga	Physics
17	1949	Hideki Yukawa	Physics

Strength in Basic Research

Nobel Laureates in Physics 2014

The award honors Dr.Akasaki, Dr.Amano and Dr.Nakamura for their contribution to developing the world’s first blue light emitting diodes(LEDs).

Dr. Isamu Akasaki
Professor Meijo University

Dr. Hiroshi Amano
Professor Nagoya University

Dr. Shuji Nakamura
University of California,
Santa Barbara

Innovation Power

Rank	GII	GCI	TRGI
1	Switzerland	Switzerland	United States(45)
2	United Kingdom	Singapore	**Japan(28)**
3	Sweden	United States	France(12)
4	Finland	Finland	Switzerland(4)
5	Netherlands	Germany	Germany(3)
6	United States	**Japan**	Korea(3)
7	Singapore	Hong Kong	Sweden(2)
8	Denmark	Netherlands	Canada(1)
9	Luxembourg	United Kingdom	Netherlands(1)
10	Hong Kong	Sweden	Taiwan(1)
Rank of Japan	**21**	**6**	**2**

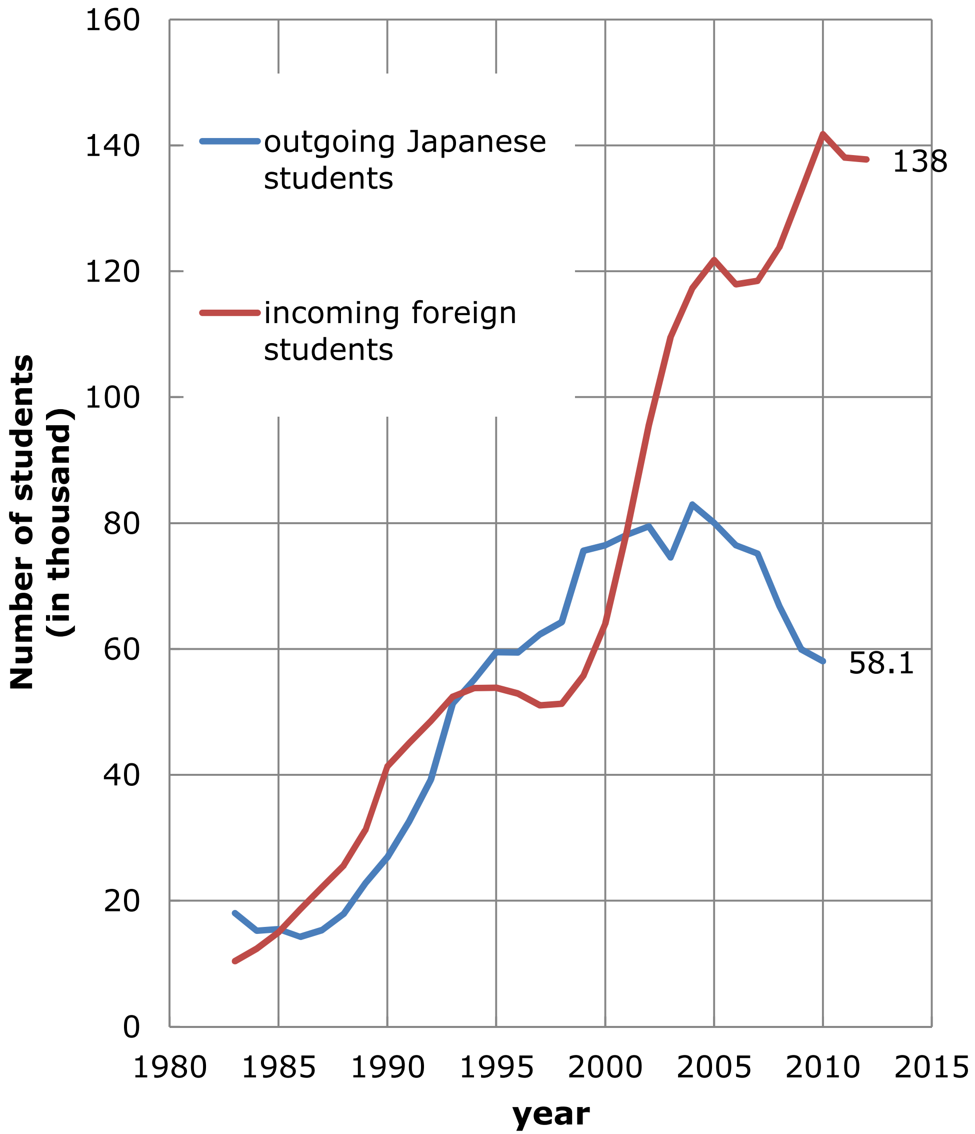
GII: Global Innovation Index 2014 by Cornell University, INSEAD, and WIPO (2014)
GCI: Global Competitiveness Index 2014-2015 , World Economic Forum (2014)
TRGI: Thomson Reuters 2013 Top 100 Global Innovators, Thomson Reuters (2013)

# of companies shown in parenthesis

Innovation potential can be measured in various ways with different indices combined but Japan's innovation potential is not highly evaluated in general.

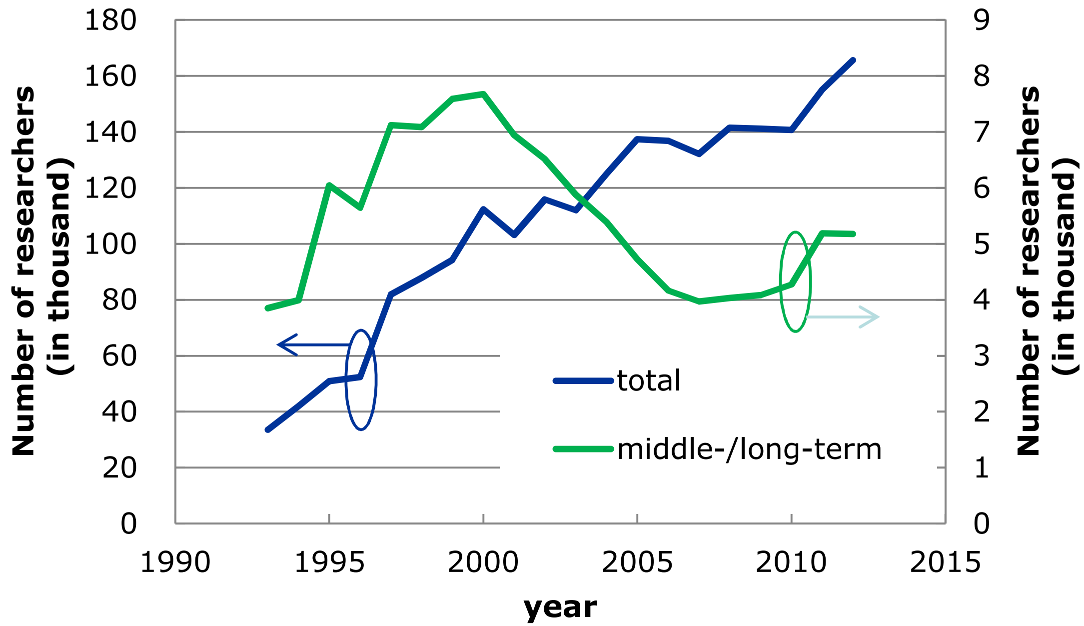
Human Resources in S&T (1) (Mobility)

Trends in Student Exchange (higher education stages)

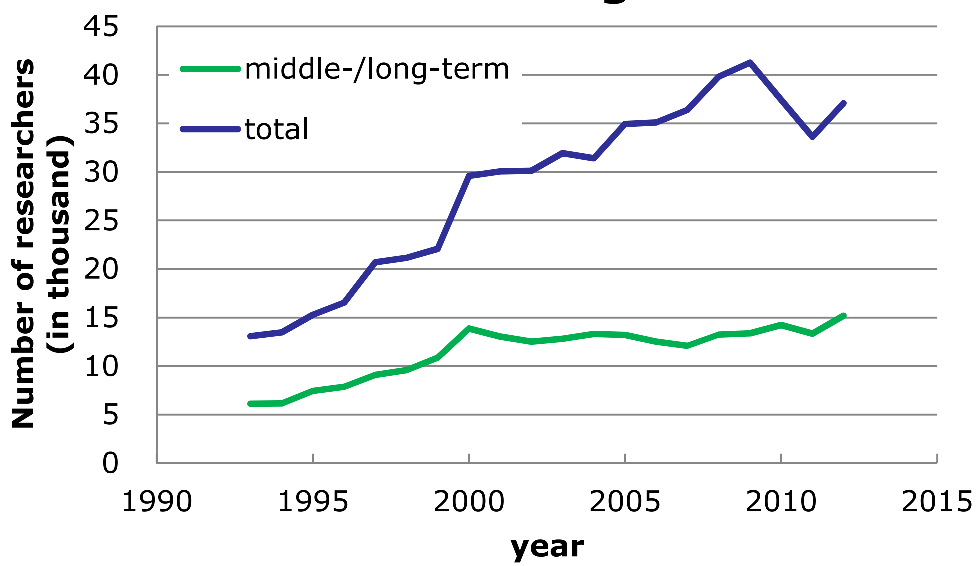


White Paper on Education, Culture, Sports, Science and Technology, 2013

Number of outgoing researchers

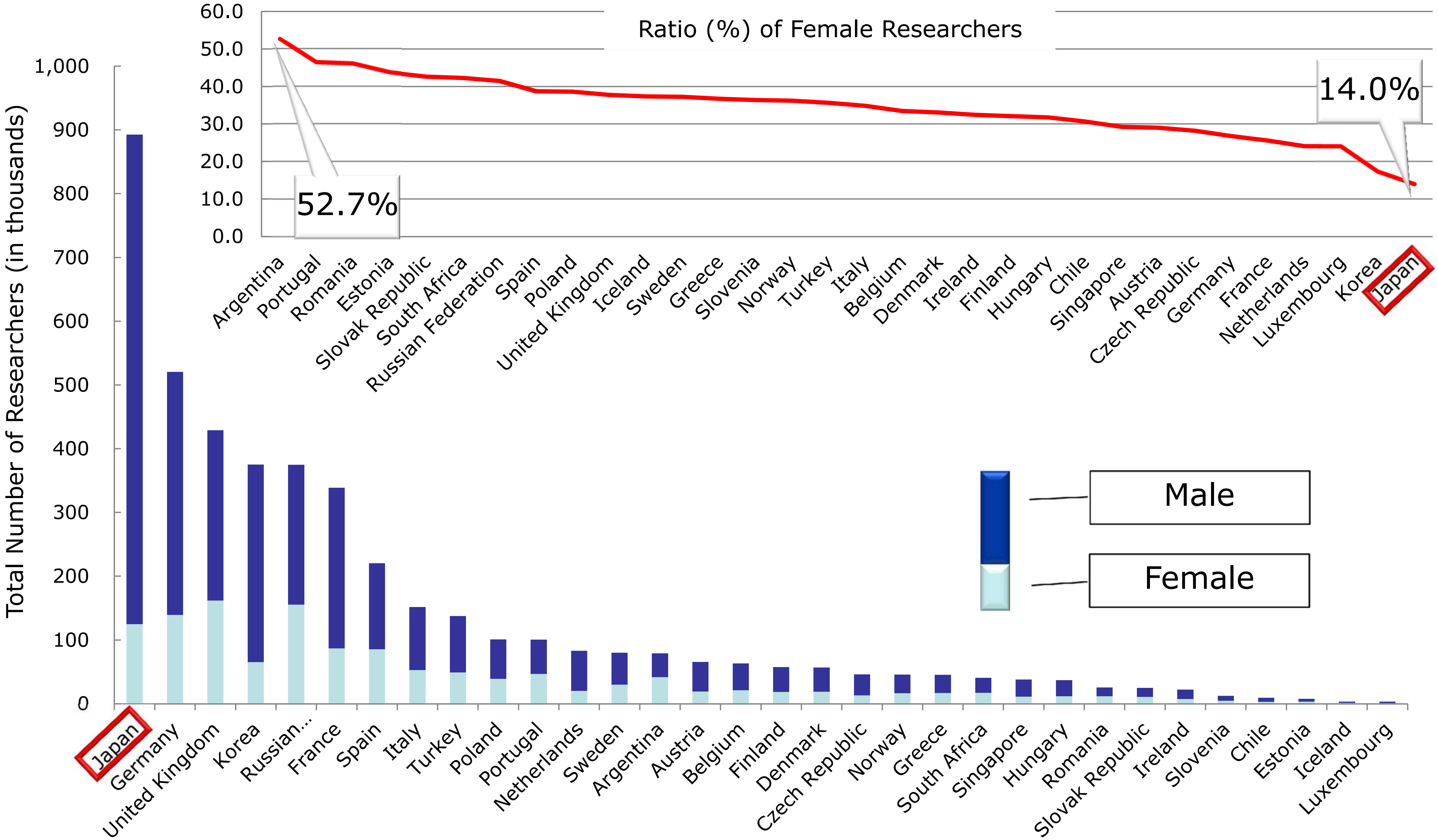


Number of incoming researchers



Middle-/long-term means that period of stay for research is over 30 days

Human Resources in S&T (2) (Gender)



Note1: Statistical data for 2011
Note2: Data missing for some countries including the US

Main Science and Technology Indicators, OECD ST and R&D Statistics 2013, et al.

ORGANIZATIONAL AND POLICY FRAMEWORK

Administrative Organization for Promoting STI

Cabinet Office

Roles:

- Support the Cabinet in formulating important policies and in overall coordination of Ministries
- Make total planning and coordination from a higher standpoint of view than other Ministries

Councils on key policy fields

1. Council on Fiscal and Economic Policy
2. **Council for Science, Technology and Innovation**
3. Advisory Council for National Strategic Special Zones
4. Central Disaster Management Council
5. Council for Gender Equality

Council for Science, Technology and Innovation (CSTI)

Chair: Prime Minister
Member: 7 cabinet members (including PM & Minister for S&T Policy) and 8 executive members
Secretariat: STI Bureau, CAO

<Main Functions>

1. Investigate and discuss basic S&T Innovation policies
2. Investigate and discuss S&T budgets and the allocation of human resources
3. Assess Japan's key R&D
4. Investigate and discuss Framework conditions for the promotion of innovation

・Basic policies on S&T
(Budget Allocation, Basic Strategy etc)
・Response

・Consultation

Ministries(14 ministries)
→ In conformity with the basic policy indicated by CSTI, each ministry promotes S&T according to the division of duties

MEXT (Ministry of Education, S&T)
- University policy
- Basic research
- General promotion of S&T

METI (Ministry of Economy, Trade and Industry)
- Industrial policy
- Energy, Nuclear power

MHLW (Ministry of Health, Labor and Welfare)
- Clinical study

MAFF (Ministry of Agriculture, Forestry and Fisheries)
- GMO
- Agriculture and Fisheries

Other ministries

・・・

Council for Science, Technology and Innovation (CSTI)

From CSTP to CSTI

Act on the Establishment of the Cabinet Office was amended during the last Diet session. The amendment, which brings about the following changes, came into force as of May 19, 2014.

- Former Council for Science and Technology Policy (CSTP) is now Council for Science, Technology and Innovation (CSTI).
- New mandate is added which is to deal with the issues related to the development of environment to promote innovation in addition to "the promotion of science and technology".
- Term of office of executive members of the Council is extended from 2 years to 3 years.

Council for Science, Technology and Innovation (CSTI)

Chairperson

Shinzo ABE
Prime Minister

Cabinet Members

Yoshihide SUGA
Chief Cabinet Secretary

Taro ASO
Minister of Finance

Shunichi YAMAGUCHI
Minister of State for Science and Technology Policy

Hakubun SHIMOMURA
Minister of Education, Culture, Sports, Science and Technology

Sanae TAKAICHI
Minister for Internal Affairs and Communications

Yoichi MIYAZAWA
Minister of Economy, Trade and Industry

※ *Relevant ministers are appointed ad-hoc members when needed to attend plenary session meetings of CSTI*

Executive Members

Dr. Kazuo KYUMA
Former Executive Adviser,
Mitsubishi Electric Corp.
(Permanent Position)

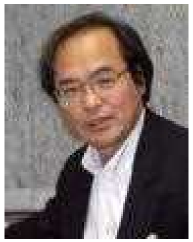
Dr. Yuko HARAYAMA
Professor Emeritus,
Tohoku University
(Permanent Position)

Mr. Takeshi UCHIYAMADA
Chairman of the board,
Toyota Motor Corp.

Dr. Toshio HIRANO
President,
Osaka University

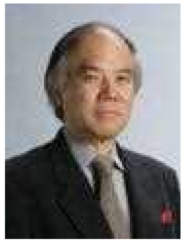
Dr. Motoko KOTANI
Professor,
Tohoku University

Mr. Hiroaki NAKANISHI
President,
Hitachi, Ltd.



Dr. Kazuhito HASHIMOTO
Professor,
University of Tokyo

Head of an Affiliated Organization



Dr. Takashi ONISHI
President,
Science Council of Japan

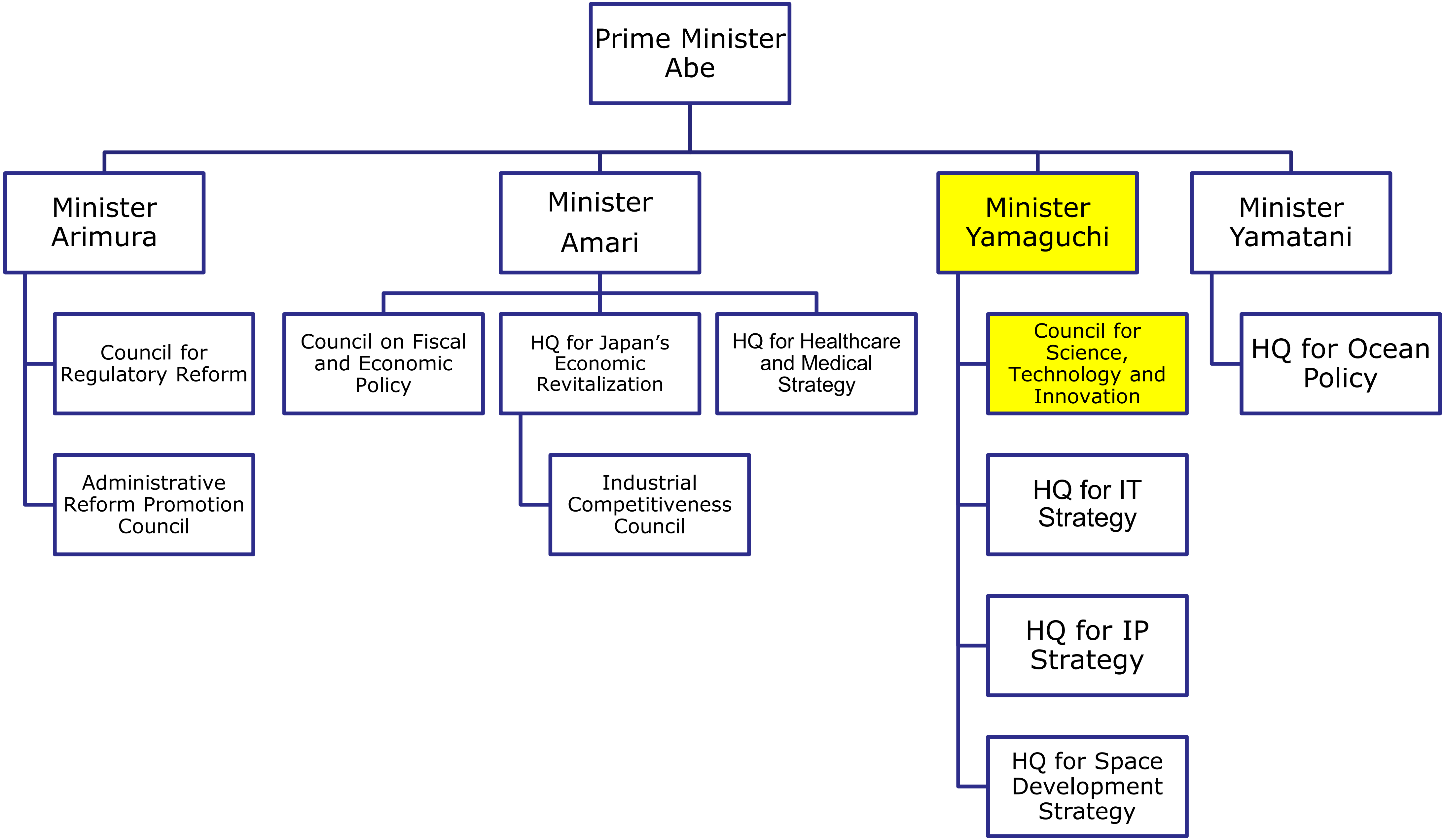
Our tasks

- **Actions**
  - "Comprehensive STI Strategy" (2014)
    - Implementation (budget 2015)
  - Preparation of the 5th S&T Basic Plan (2016-2020)

Challenge: Japan as a "Most Innovation-friendly country"

- **Putting into practice the "OECD spirit"**
  - Benchmarking
  - Evidence-based policy making
  - Horizontality (cross-ministerial)
  - Measurement
  - "Better policies for better lives"

Our counterparts



STI POLICY
UNDER ABE ADMINISTRATION

Comprehensive STI Strategy

- **Basis**
  - Innovation as a driver of economic growth and social change
- **3 perspectives to promote STI**
  - Acting "smart",
  - Implementing "system" thinking
  - Think "global"
- **Comprehensive package of challenge-driven STI policies**
  - Including "Tokyo 2020 Olympic and Paralympic Games"
- **Actions for improving framework conditions for STI**
- **Creating new policy instruments**
  - Cross-ministerial Strategic Innovation Promotion Program (SIP)
  - Impulsing Paradigm Change through disruptive Technologies Program (ImPACT)

Improving STI Framework conditions

- **Reviewing institutional framework**
  - Status of national R&D corporations
    - Among incorporated administrative agencies (IAAs), a category for those conducting R&D has been created
    - A new system is being drafted to maximize the potential of IAAs in this category
  - Infrastructures (with particular eyes on intangibles, including data infrastructure)
  - Funding systems

- **Enhancing international collaborations**
  - Brain circulation
  - Experience sharing in policy making
  - Forming forum to address common grand challenges

- **To start with**
  - Strengthening the bridging functions of AIST and NEDO
  - Reforming Ph.D. programs

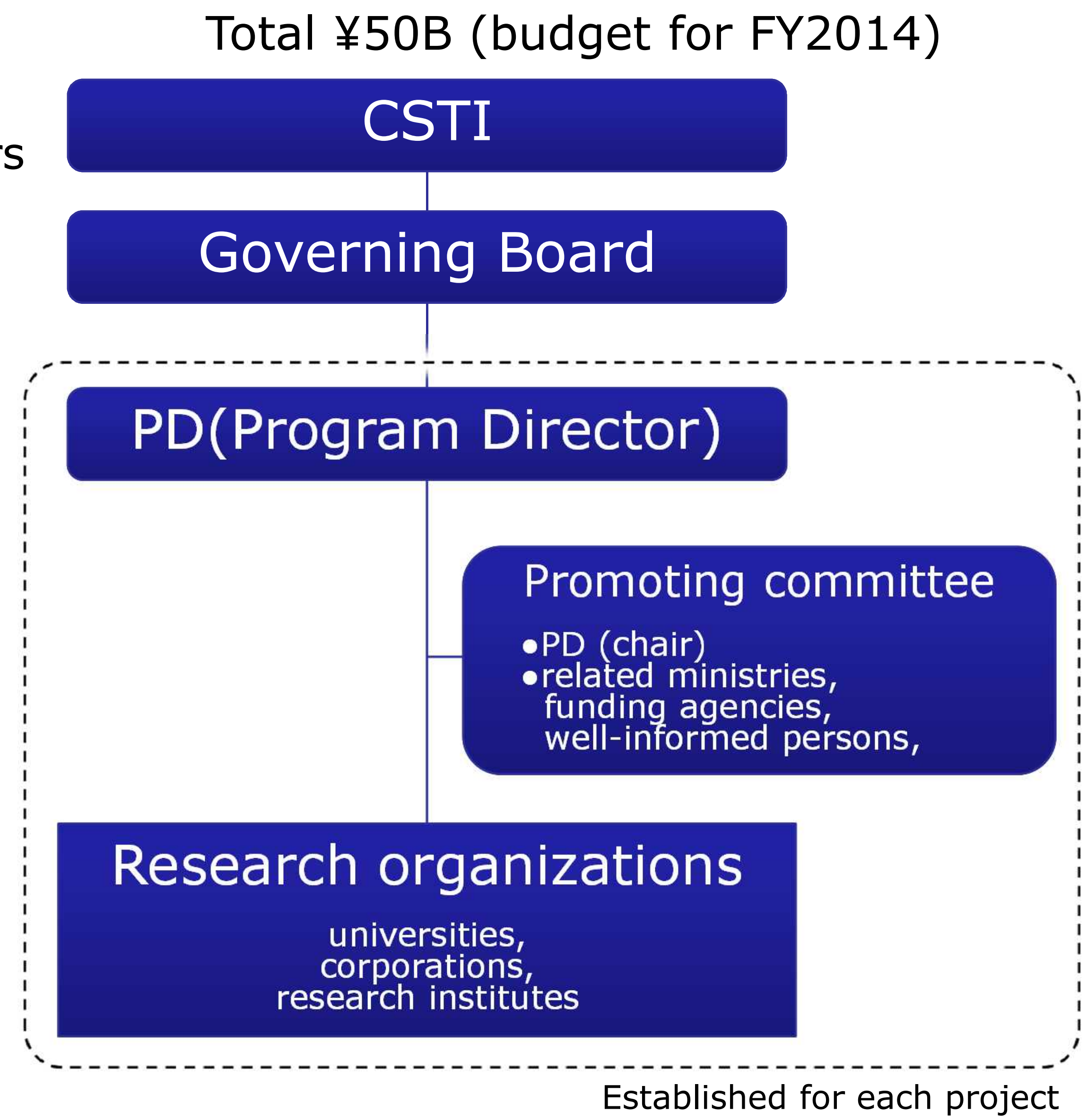
SIP (Cross-Ministerial Strategic Innovation Promotion Program)

Characteristics

- Strengthening Japan's competitive edge
- Cross-border: ministries, disciplines, sectors
- Regulatory reform as a component
  ➡ **Innovation accelerator**

Policy innovation

- CSTI's direct engagement
  - Themes
  - Budget
  - Governance
- **Program directors** (PD) with large competencies
  - Designing and managing project
  - Coordinating related ministries and institutional actors
  - Bridging to business



Themes of SIP

Priority policy issues	Subjects	Description
Energy	Innovative combustion technology	Improving fuel efficiency of automobile engines
	Next-generation power electronics	Integrating new semiconductor materials into highly efficient power electronics system
	Structural Materials for Innovation (SM⁴I)	Developing ultra-strong and –light materials such as magnesium-, titanium-alloys and carbon fibers
	Energy carrier	Promoting R&D to contribute to the efficient and cost-effective technologies for utilizing hydrogen
	Next-generation technology for ocean resources exploration	Establishing technologies for efficiently exploring submarine hydrothermal polymetallic ore
Next-generation infrastructures	Automated Driving System	Developing new transportation system including technologies for avoidance accidents and alleviating congestion
	Infrastructure maintenance, renovation and management	Developing low-cost operation & maintenance system and long life materials for infrastructures
	Enhancement of societal resiliency against natural disasters	Developing technologies for observation, forecast and prediction of natural disasters
Local resources	Technologies for creating next-generation agriculture, forestry and fisheries	Realizing evolutionary high-yield and high-profit models by utilization of advanced IT etc
	Innovative design/manufacturing technologies	Establishing new styles of innovations arising from regions using new technologies such as Additive Manufacturing

Program Directors for SIP

Innovative combustion technology

Masanori Sugiyama
Toyota Motor Corp.

Structural Materials for Innovation（SM^{4}I）

Teruo Kishi
Univ. of Tokyo, NIMS

Next-generation technology for ocean resources exploration

Tetsuro Urabe
Univ. of Tokyo, JMEC

Infrastructure maintenance, renovation and management

Yozo Fujino
Yokohama National Univ.

Tech. for creating next-generation agriculture, forestry and fisheries

Takeshi Nishio
Hosei Univ.

Next-generation power electronics

Tatsuo Ohmori
Mitsubishi Electric Corp.

Energy carrier

Shigeru Muraki
Tokyo Gas Co.,Ltd.

Automated Driving System

Hiroyuki Watanabe
Toyota Motor Corp.

Enhancement of societal resiliency against natural disasters

Masayoshi Nakashima
Kyoto Univ.

Innovative design/manufacturing technologies

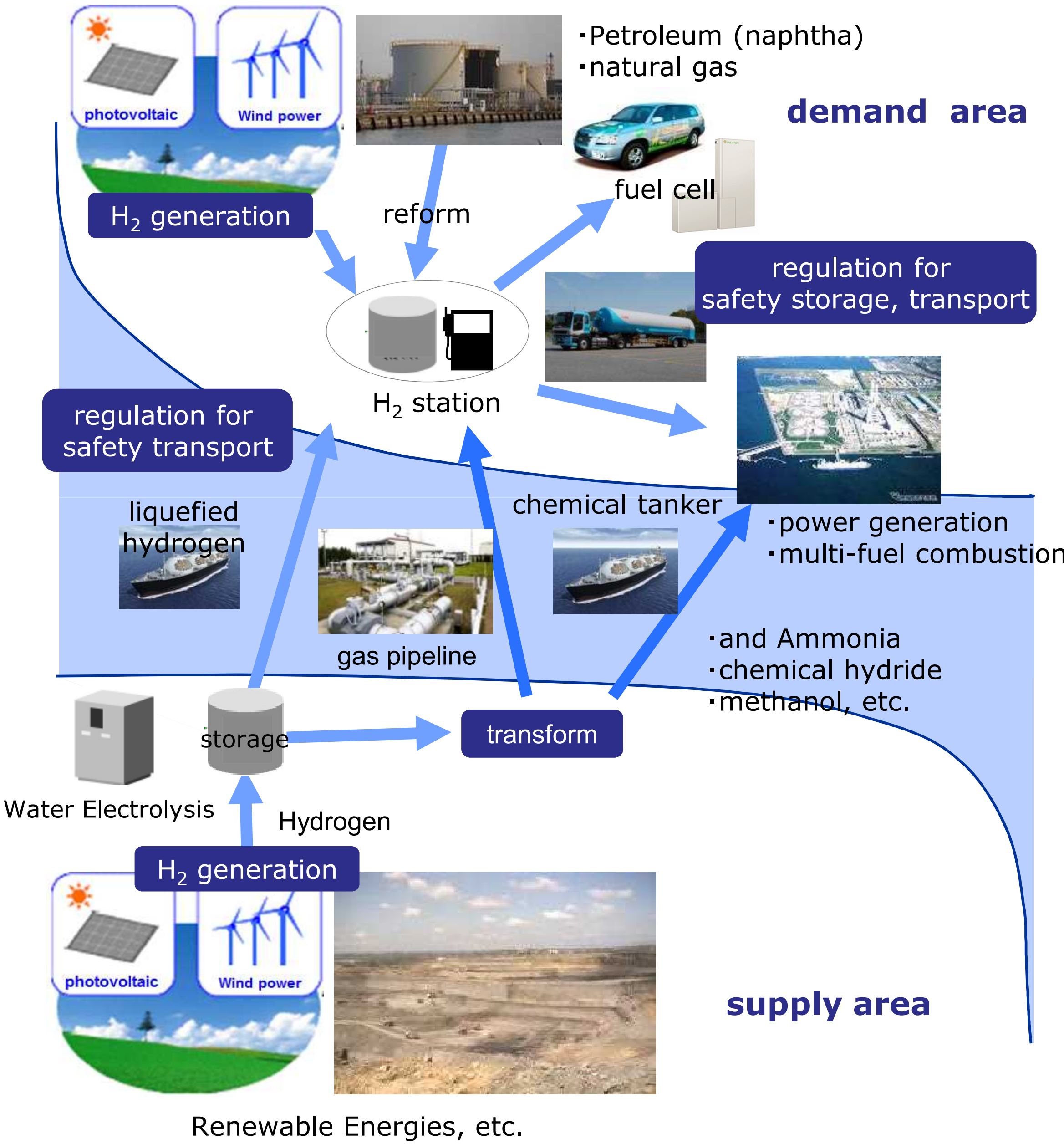
Naoya Sasaki
Hitachi, Ltd.

Example of SIP (1) Energy Carrier

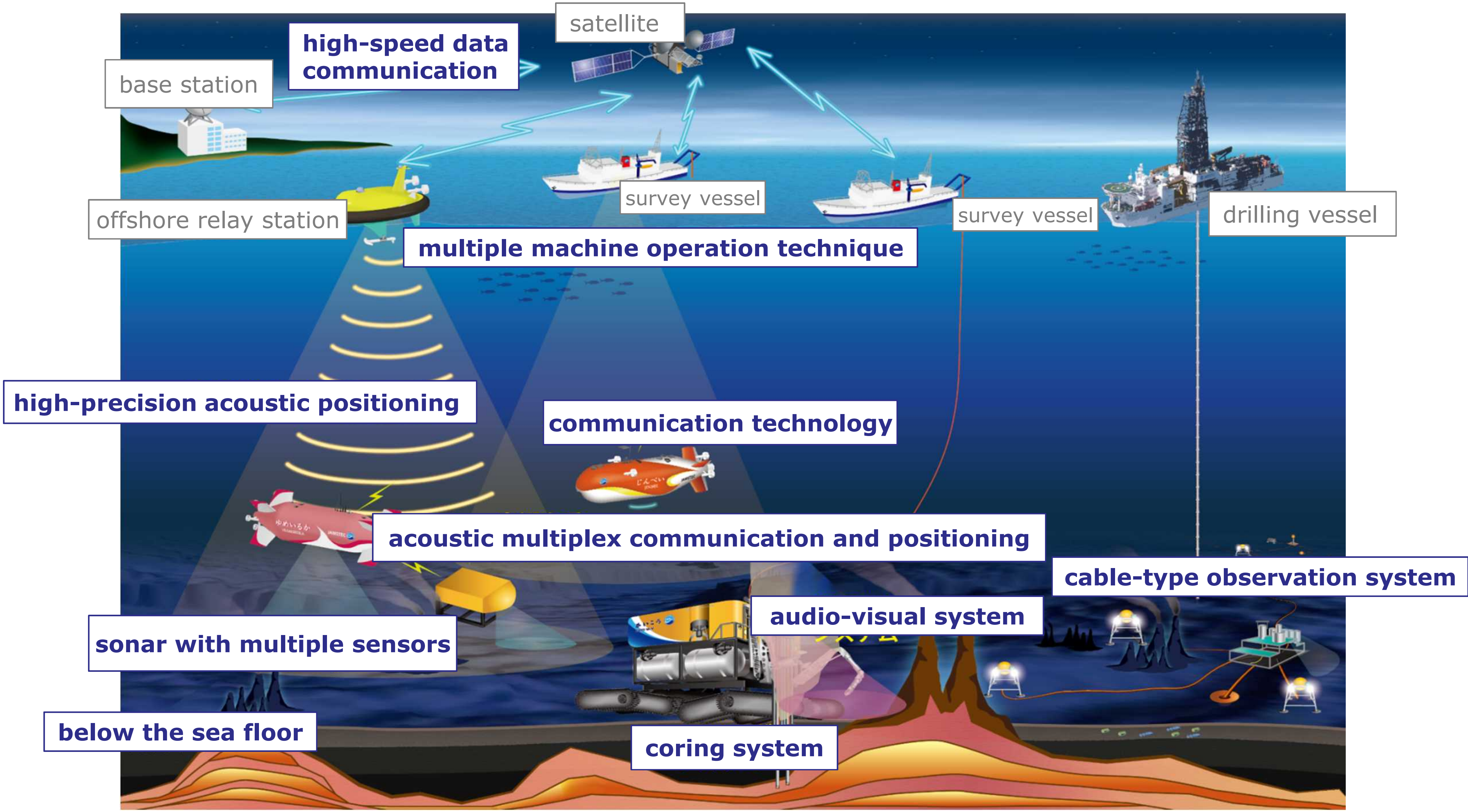
- R&D on efficient and cost-effective technologies to generate, transport, store and utilize hydrogen.

- Describe scenarios to create "Hydrogen Society" with related ministries(CAO, MEXT, METI, MLIT, FDMA), research institutes and private enterprises collaborating with each other.

＋ **CAO**(Cabinet Office), **MEXT**(Ministry of Education, Culture, Sports, Science and Technology), **METI**(Ministry of Economy, Trade and Industry), **MLIT**(Ministry of Land, Infrastructure, Transport and Tourism), **FDMA**(Fire and Disaster Management Agency, Ministry of Internal Affairs and Communications)



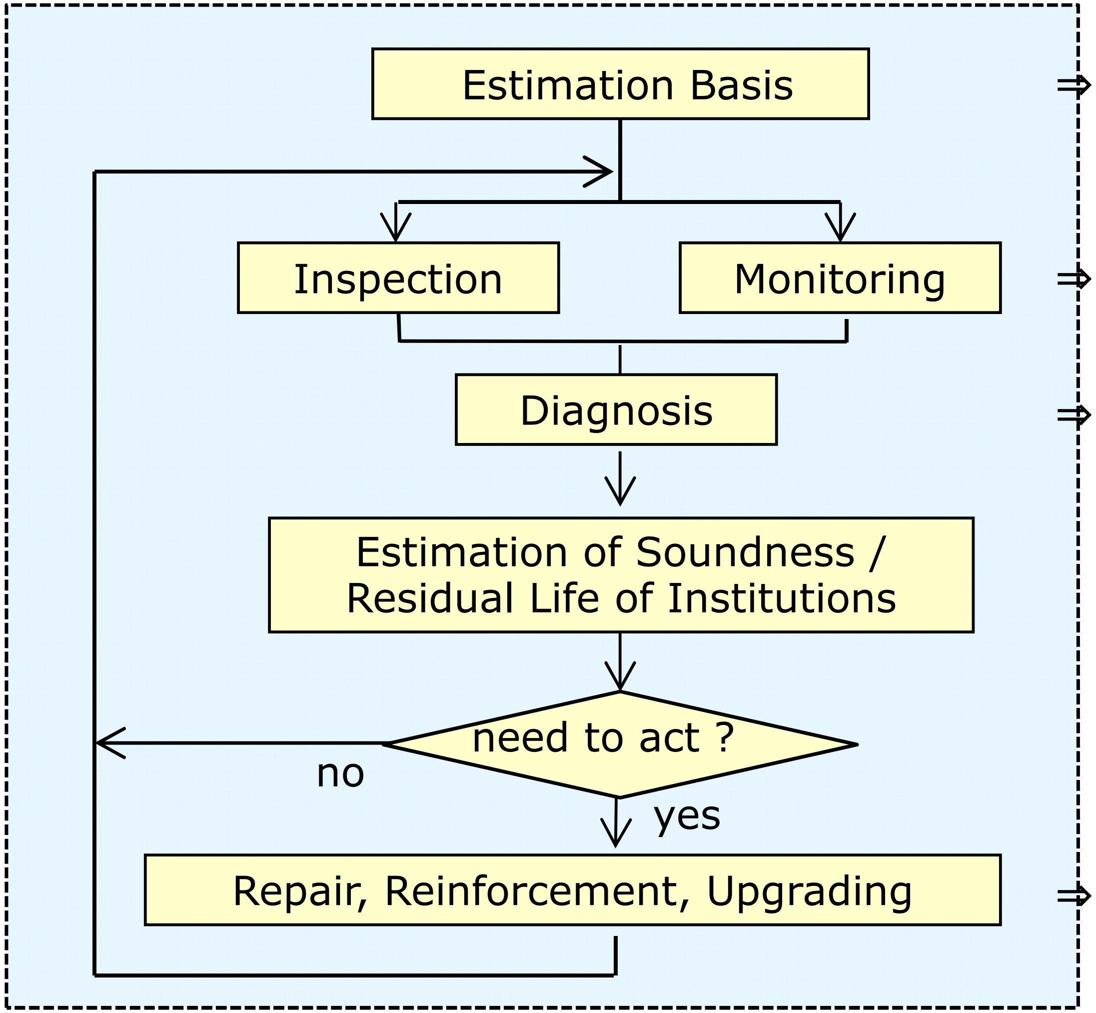
Example of SIP (2) Next-generation technology for ocean resources exploration



Example of SIP (3)　Infrastructure maintenance, renovation and management

Flow of Infrastructure Management and R&D on component technologies

Research on Asset Management



⇒ R&D on technologies to estimate the soundness and the residual life of institutions

⇒ R&D on sensors, ICT, robots

⇒ R&D on technologies to diagnose and to estimate deterioration

data management,
R&D on database technologies

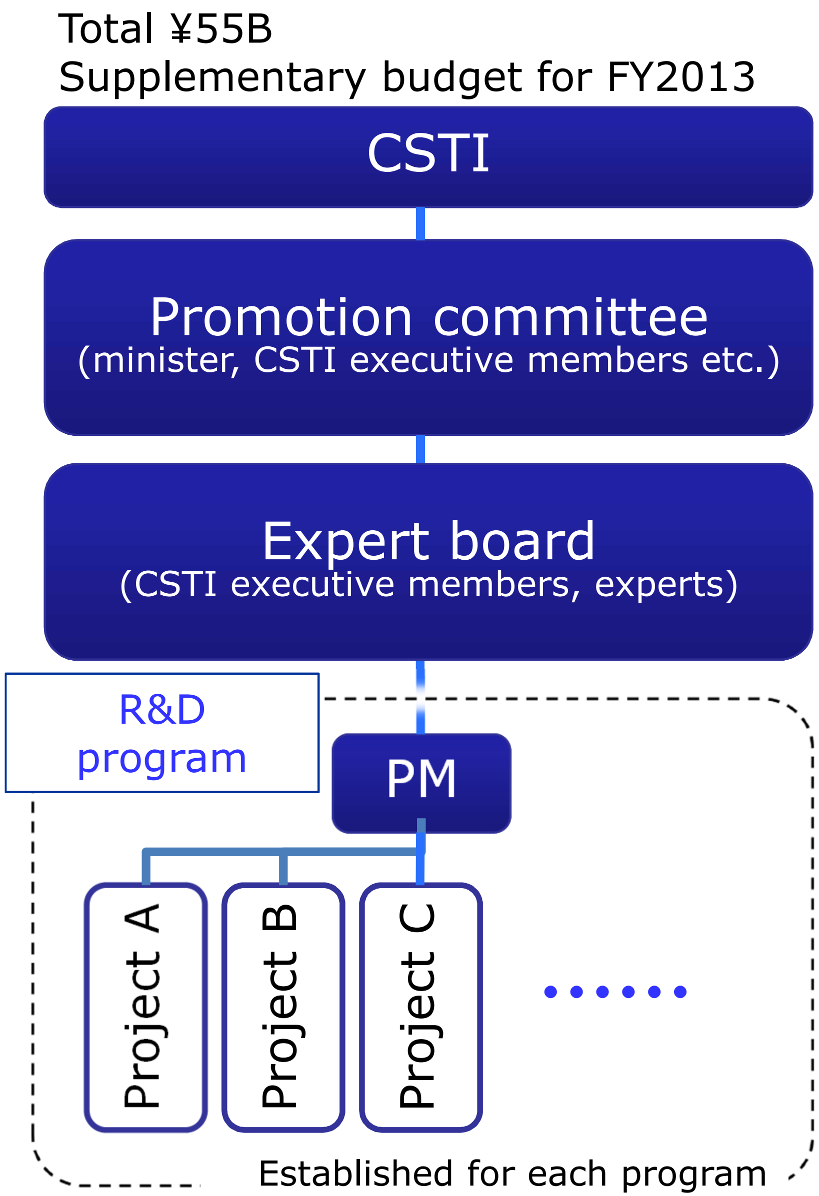
⇒ R&D on new materials and methods

ImPACT (Impulsing PAradigm Change through disruptive Technologies) Program

- **Characteristics**
  - Seeking the next generation of innovation
  - Investing in high risk but high impact R&D

  ➡ **Game changer in innovation**

- **Policy innovation**
  - CSTI's direct engagement
    - Themes
    - Budget
    - Governance
  - **Program managers** (PM) with large competencies
    - Bringing disruptive ideas
    - Designing and managing projects



Themes of ImPACT Program

1. **Overcoming resource constraints and innovating Monozukuri power**
   - Next century Japan’s style value creation

2. **Innovative energy-saving and eco-friendly society transforming our life style**
   - Co-evolution with the earth

3. **Highly functional society beyond information network society**
   - Smart community connecting people and society

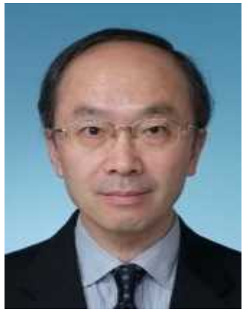
4. **The most comfortable living environment in the advent of the aging society**
   - Healthy and comfortable life for everyone

5. **Controlling the effect of natural disasters and hazards and minimizing damage**
   - Ensuring resilience for every Japanese citizen

Program Managers for ImPACT Program

ITO (U Tokyo)
Resource constraints

GODA (U Tokyo)
Resource constraints



SANO (Toshiba)
Comfortable living environment

SAHASI (Tohoku)
Energy-saving & eco

SANKAI (Tsukuba)
Comfortable living environment

SUZUKI (Kojima P.)
Resource constraints

TADOKORO (Tohoku)
Natural disasters

FUJITA (Toshiba)
Energy-saving & eco

MIYATA (Nagoya)
Comfortable living environment

YAGI (Canon)
Comfortable living environment

YAMAKAWA (NTT D)
Comfortable living environment

YAMAMOTO (NII)
Highly functional society

Example of ImPACT (1) Realization of ultimate eco-IT devices for long-time use without charging

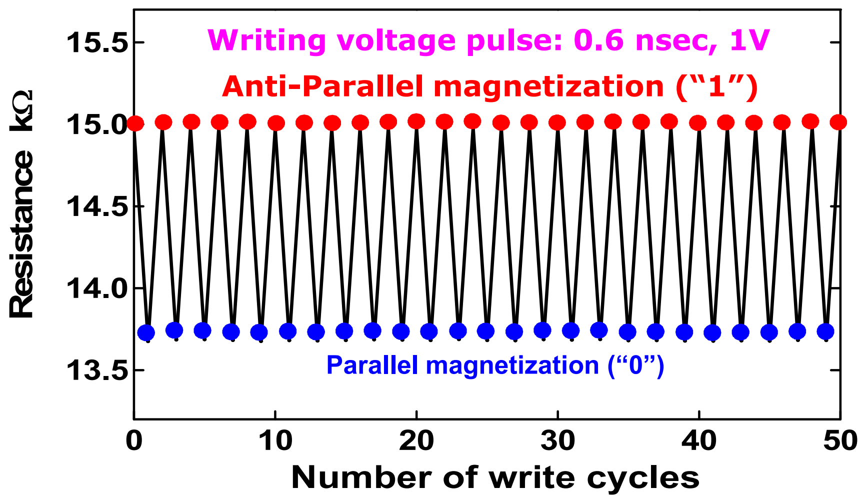
<Overview of R&D Program>

The goal of this program is to develop technology for magnetic memory recording using voltage only, without current flow for reducing the power consumption of IT devices, and realization of an eco-society with no charging- stress.

<Key Points of Disruptive Innovation>

The base is the development of the ultimate high-speed large-capacity memory, where information is written by voltage, to significantly reduce power consumption during standby and operation.

Magnetic memory ultra-fast recoding by voltage pulse
(Innovative technology from Japan)



<Expected Impact on Industry and Society>

Realization of mobile devices that stay without charging for a month, a safe and secure society with no-charging disaster-prevention sensors and emergency information access systems, and revival of national electronics industry.

- Mobile device without charging for a month
- Cleaning the outlets from continuously connected chargers

- Remove the need for battery replacement for IT devices and sensors
- Revival of Japan's industrial competitiveness through technological innovation in lost areas of DRAM, logic circuits, cloud systems, etc.

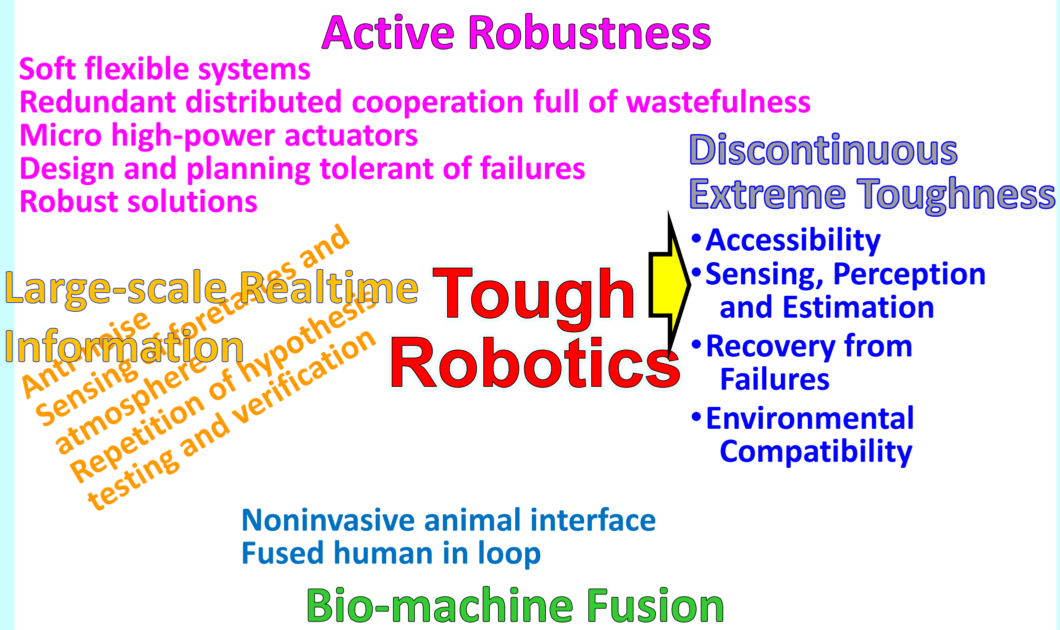
Example of ImPACT (2) Tough Robotics Challenge

＜Overview of R&D Program＞

The goal of this program is to develop key fundamental technologies for remote autonomous robots that can toughly complete missions under unknown changing disaster conditions.

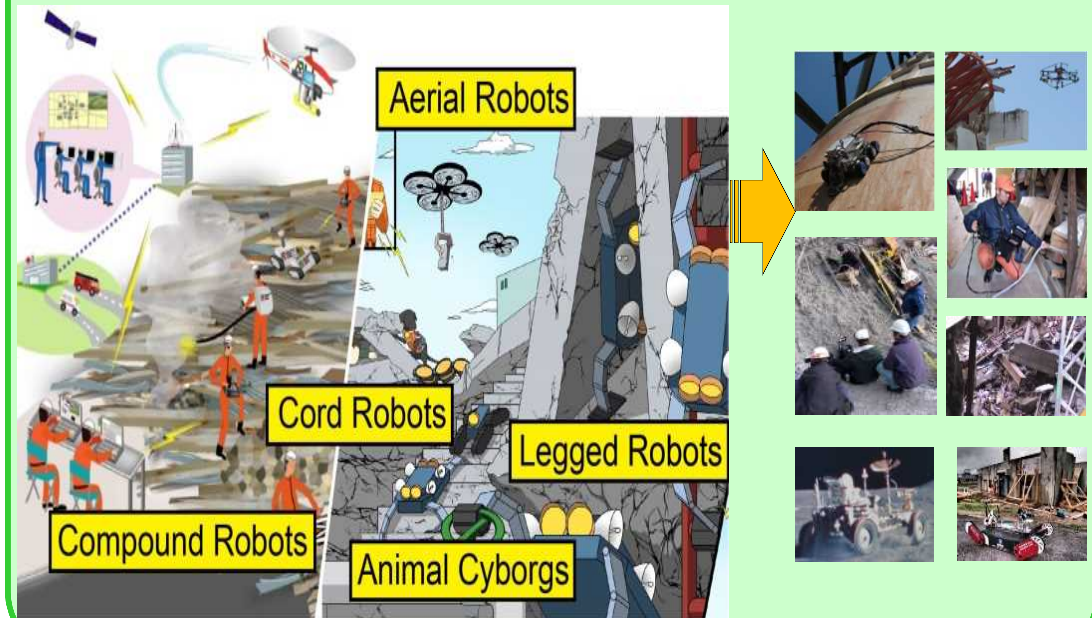
＜Key Points of Disruptive Innovation＞

Technologies of active robustness, large-scale real-time information and bio-machine fusion will establish the remote autonomous robotics toughly operable under extreme disaster environments.



＜Expected Impact on Industry and Society＞

Robot application to disaster response, recovery and mitigation leads the world safety and security as well as commercialization and expansion of future advanced robot services outdoor.



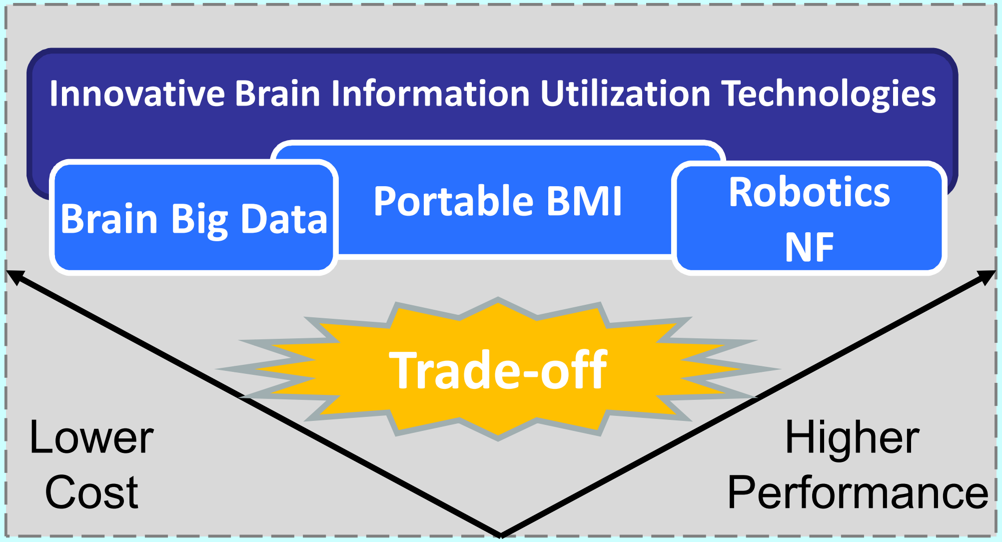
Example of ImPACT (3) Actualize Energetic Life by visualizing and controlling brain information

＜Overview of R&D Program＞

Visualizing and controlling brain information will become a platform for manufacturing and service innovation, which include equipments controlled by thoughts, or support multilingual communication. Anyone can understand and train their own brains to actualize rich and energetic life which meet their own needs.

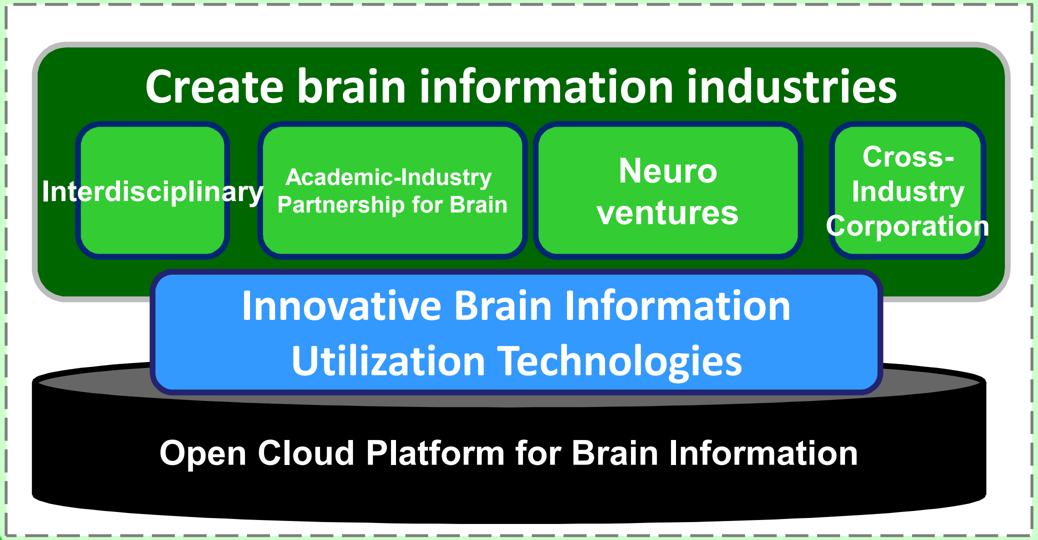
＜Key Points of Disruptive Innovation＞

We aim to develop lower cost and higher performance Brain information utilization technologies using brain big data and robotics neurofeedback (NF) having portable brain-machine interface (BMI) as a central technology.



＜Expected Impact on Industry and Society＞

The technology to be developed will help establish an innovation ecosystem including academia-industry partnerships and neuro ventures, supported by a brain information platform, to create the world's first brain information industry, and bring richness to the life.



Preparation of the 5th S&T Basic Plan(1)

[Projected schedule]

2015	Oct.	➢ **Follow-up of "The 4th S&T Basic Plan"** approved by CSTI ➢ **Consultation** by the Prime Minister on the formulation of "The 5th S&T Basic Plan" to CSTI
	Nov.	➢ **Discussions start at "The Basic Plan Expert Panel"** (meetings to be held on a monthly basis)
2016	Jun.	➢ **Interim Report** by "The Basic Plan Expert Panel"
	Dec.	➢ **Recommendation** of "The Draft 5th S&T Basic Plan" by CSTI
2017	Mar.	➢ **Cabinet decision** on "The 5th S&T Basic Plan"

* Public consultation to take place at an appropriate time.
* Details to be further examined.

Preparation of the 5th S&T Basic Plan(2)

[Basic Thoughts]

- Context (2016-2020)
  - Time of drastic changes surrounding STI
    - Connectivity, Openness
    - Beyond existing borders, Co-(production)
    - Data-driven innovation

    → Unpredictable, Unforeseeable, Transformational
  - Increased global competition & cooperation
- The key is preparedness
  - Flexible, adaptable and evolving innovation system!

[Directions]

- Consolidate "fundamentals"
- Encourage and prepare the ground for cross-border co-production of knowledge
- Nurture creative and collaborative mindsets
  - Providing spaces for experience, challenge and learning
- Increase social tolerance vis-à-vis those who attempt to achieve a breakthrough

Looking forward to your insights!