46th JAIF Annual Conference
Tokyo, April 24, 2013

# Scientific Advice for Policy and Social Consensus Formation

## - Lessons Learned from the Fukushima Nuclear Accident -

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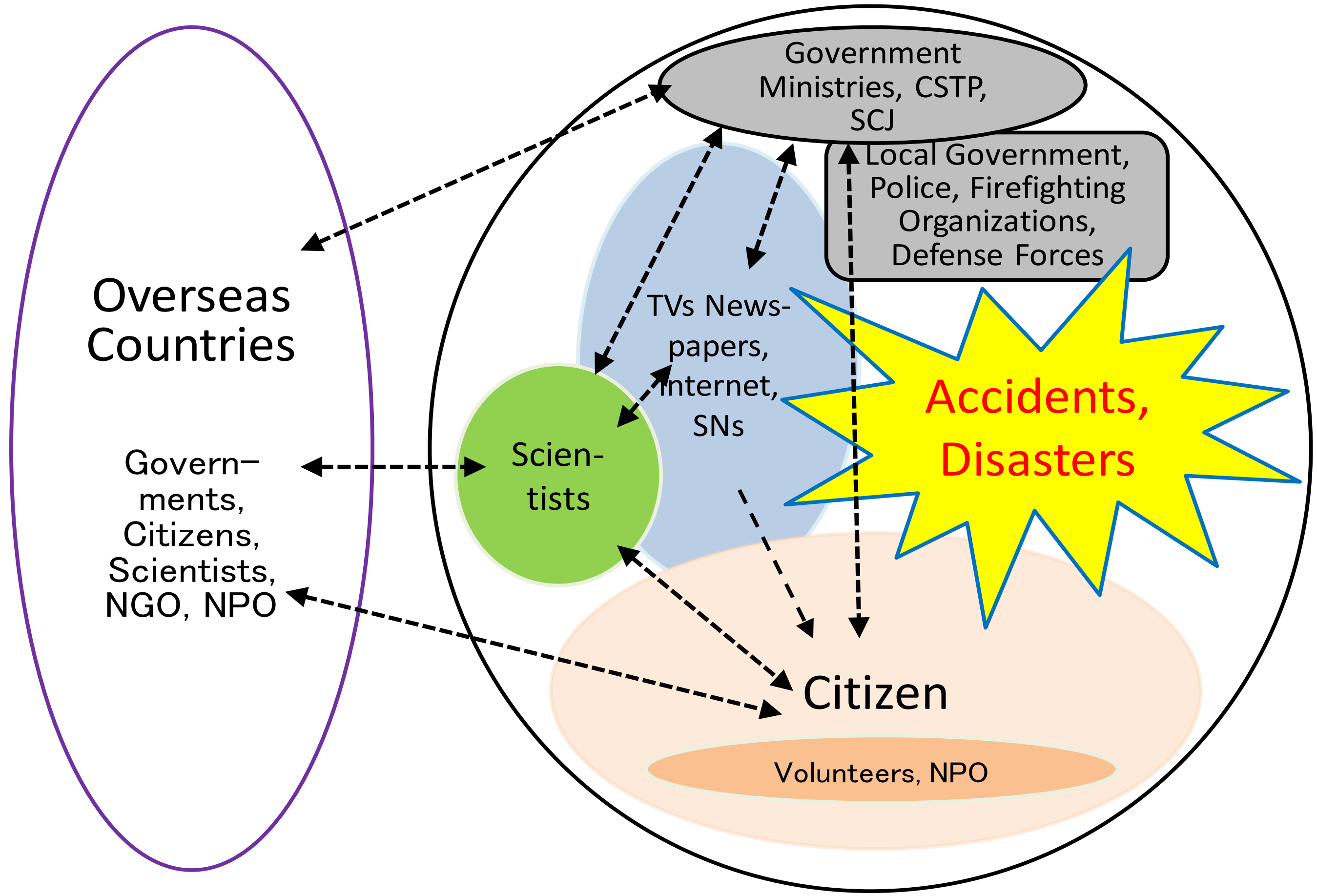
- **Consequences in the relationship of scientists with government, media and society after the nuclear accident**
- Scientist as adviser
- Scientific advice for energy policy
- Summary

# Disordered Relationship of Scientists to Government, Media and Society




- Disruption in the chain of command without legal basis and clear understandings on the responsibility and roles of each sector at the time of emergency?

(Kasagi, Trends in the Sciences, Nov. 2011)

# Disordered Relationship of Scientists to Government, Media, Society (Cntd.)

- Legally and morally ambiguous relationship between those in charge of accidents and scientists
  - Did the government employ advice of scientists or not?
  - How should scientists take proper action when summoned by the House of Prime Minister or Congress Members?
  - How should scientists react to mass media when interviews or asked to prepare scientific explanations?
- Lack of coherent voice of scientists
  - Lack of information on accident progression, basic specifications of plants
  - Did the SCJ and scientific/technical societies dispatch the information desired by society and their professional judgments timely?
  - Principles and codes for disclosing professional jug dement? Multiple opinions? Conflicting views?
- Lack of reporting to overseas countries, academia and scientists
  - Insufficient reports on the accident, possible collaboration, feedback, thereby inviting distrust and a feeling of doubt on Japan

# Overseas Voices


Company, … released only a heavily … released in an undoc- … manual revealed just how lacking … of contingency measures. This conceal- … idea of why even senior political figures struggled … in the wake of the disaster, and why they have now chosen … pose their questions in this very public way.

This all points to a problem in Japan that predates Fukushima and seems to afflict every Japanese regime: the absence of a strong and independent scientific voice to advise the government. In this case, such a voice — be it from a chief scientist appointed by the government or from a truly independent nuclear regulator — could have helped to direct evacuations, medical relief, screening for radiation and decontamination efforts. It also would have helped to lead the studies needed to find answers to the questions mentioned above.

Many times in Japan's recent history, the government has handed responsibility for dealing with issues involving tricky scientific concepts to bureaucrats or politicians. All too often, these officials, not understanding the issues, do what governments shouldn't do — hide the problem and hope it will go away. In the meantime, politicians fumble for answers, while ill-informed government spokespeople tell confused stories that can make them look foolish, irresponsible or deceitful.

This is how the government handled Minamata disease caused by industrial mercury poisoning in the 1950s and 60s, the HIV-tainted blood products problem in the 1980s, and the BSE scare of a decade ago. And now it is how it has handled Fukushima. Fear of spreading panic, for example, prevented warnings being issued on the dangers of radiation predicted by simulations. As a result, more residents than necessary were exposed.

The government's main sources for scientific information for Fukushima were the industry ministry's Nuclear and Industrial Safety Agency and the Nuclear Safety Commission. Although these bodies might have expertise in nuclear-reactor physics, they also have ties to the nuclear industry that create a conflict of interest. And they were not an effective and prompt source for quick decisions on decontamination or health risks. The government recognized this by shifting nuclear monitoring and safety regulation functions to a new, as yet … ministry. … report on the … transparent.

… broader and more permanent … Fukushima should be the incident that finally forces the government to put in place a structure that could bring fast and decisive action on critical situations in the future.

*"… fumble for answers, while spokespeople tell confused stories."*

Japan could start by following the example of countries such as the United States and the United Kingdom, and take on a science adviser. Five years ago, Japan did claim to establish such a system, installing a scientist as a special adviser to the cabinet (see *Nature* 443, 734–735; 2006). But that was based more on hopes of encouraging innovation than dealing with the broad range of scientific issues that a proper science adviser takes on — and the experiment lasted only two years. Now there is no science adviser. Efforts to give the Science Council of Japan a more influential role, akin to the US National Academy of Sciences, have also come up short (see *Nature* 428, 357; 2004).

Scientists can help to understand what is known and, critically, what cannot be known about a situation. In the absence of certainty, they can help to understand the risks involved. They can help to explain this cogently and clearly to people at large. They can do this from an unbiased and apolitical perspective, so that even if circumstances change they can change their assessment with less risk of being criticized for political motives. And they give the politicians both cover for unpopular decisions and, in the case of a political appointee such as an adviser, a trusted personal relationship.

Japan can do better. The Japanese people deserve better. ■

## Error of judgment

*The European Court of Justice was wrong to weigh in on the definition of a human embryo.*

The question of when a formless clump of developing cells can truly be said to become a human will never have a clear answer. It depends on whom you ask: biologists, theologians, and pro-life and pro-choice campaigners have all wrestled with the concept for years. Regulations that cover the relevant scientific fields and issues should take all these conflicting views into account. Not everybody will be happy with the outcome, but, by definition, not everybody can be.

In October, the European Court of Justice (ECJ) took on the





Nature, Vol. 480, 15 Dec. 2011, 291

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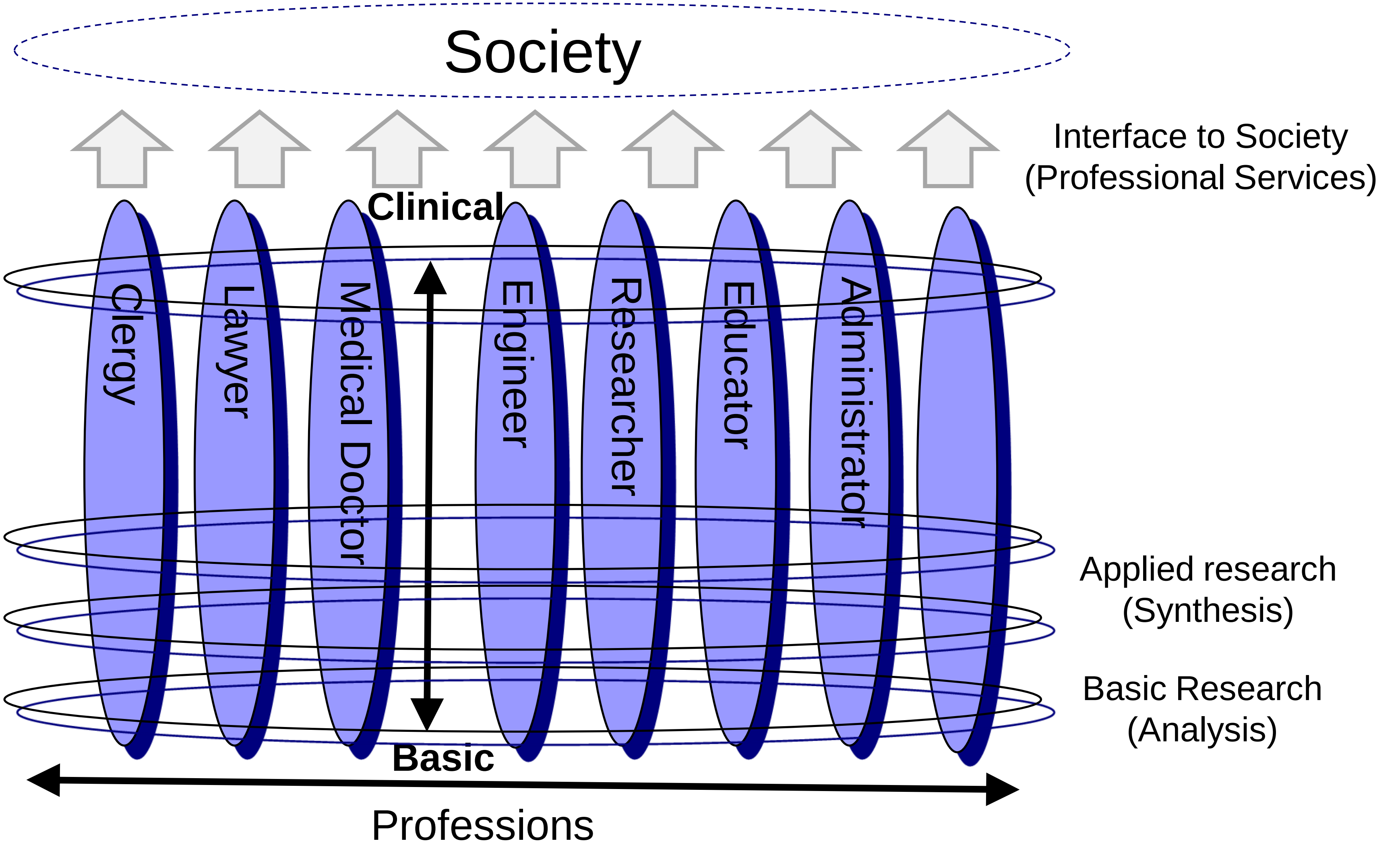
# “Scientist”

- The word “scientist” here refers to researchers and specialists engaged in activities that create new knowledge, or in the use and application of scientific knowledge, in all academic fields ranging from humanities and social sciences to natural sciences, regardless of which institution they belong to.

(Science Council of Japan, Code of Conduct for Scientists, 2006)

# Modern Society Supported by Profession

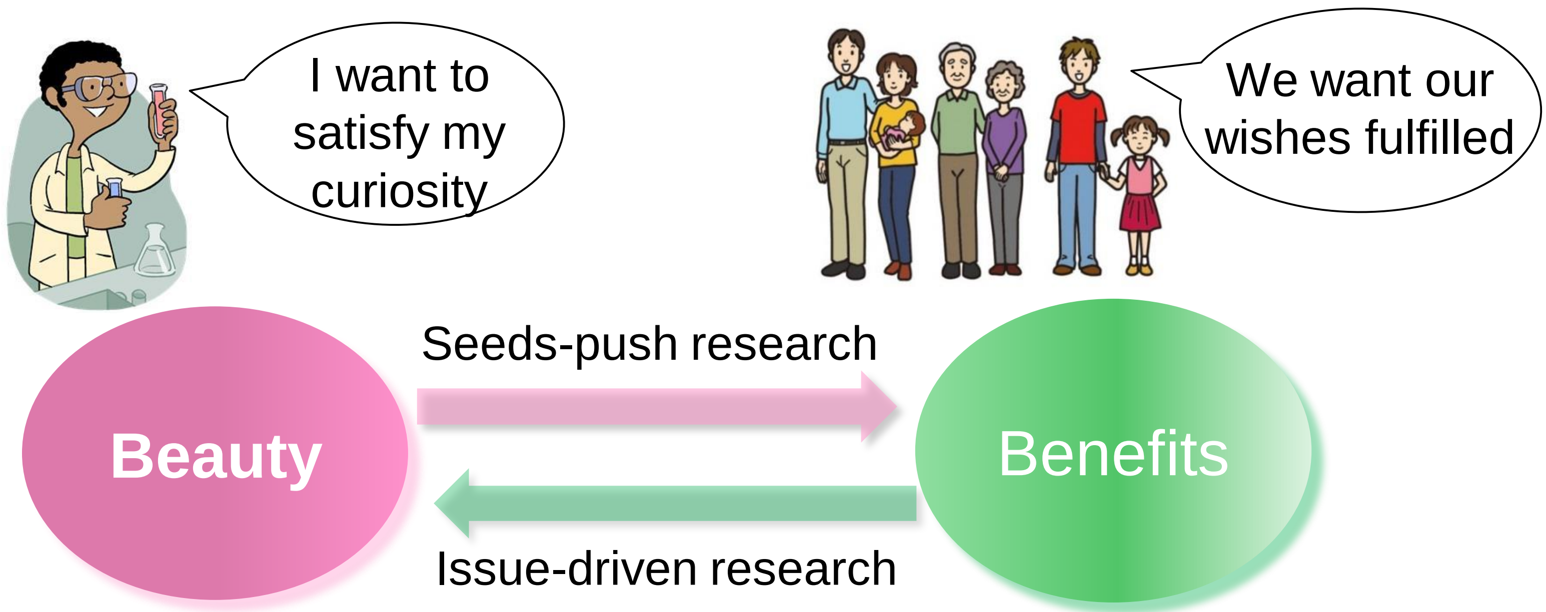
(Kasagi, Trends in the Sciences, Dec. 2006)




“Profession” = A disciplined group of individuals who adhere to high ethical standards and uphold themselves to, and are accepted by the public as possessing special knowledge and skills in a widely recognized, organized body of learning derived from education and training at a high level, and who are prepared to exercise this knowledge and these skills in the interest of others. (Australian Council of Professions)

# Two Roles of Scientists for Society

I. Creation of scientific knowledge for social benefit and its transfer to the next generation（"Social Contract," J. Lubchenco, 1997)




II. Responsibility of scientists as advisor to the public and the policy (Science for Policy)

(Kasagi, N. et al., AAAS Meeting, Boston, Feb. 2013)

# Scientific Advice for Government and Society
## (Science for Policy)

- “Science for Society” as a undercurrent of modern science and technology as well as a central engine for social and economic activities (ICSU, 1999)
- Necessity for utilizing scientific advice in policy making and R&D strategy planning
  - Ex. Foods, water, energy, manufacturing, medicine, education, transportation, information, environment
- Necessity for scientific advice in case of emergency
  - Ex. Minamata disease, HIV-contaminated blood products, GHG, nuclear accident
- Indispensable mutual understanding with society, government and mass media with regards to the role of scientists and a framework for scientific integrity

# What is Scientific Advice ?

- Science: A system of knowledge based on rationale and demonstration
- Is science objective ?
  - Approved by peer and external reviews with secondary opinions as appropriate
- Professional's knowledge? Co-benefit or dis-benefit of authority?
  - Confidence (uncertainty) of scientific knowledge, demarcation from subjective judgment

Ref. Torahiko Terada (Physicist), "The negative effect of authority is not a fault of a person of authority, but of those who blind believe in such a person."

# Enabling Independent, Non-biased and Fair Scientific Advice

- Scientists' independence and fairness as a social contract, but not an assumption

（1）Scientists themselves should establish their code of conduct and also concrete guidelines as a basic rule at the interface with society, politics and media

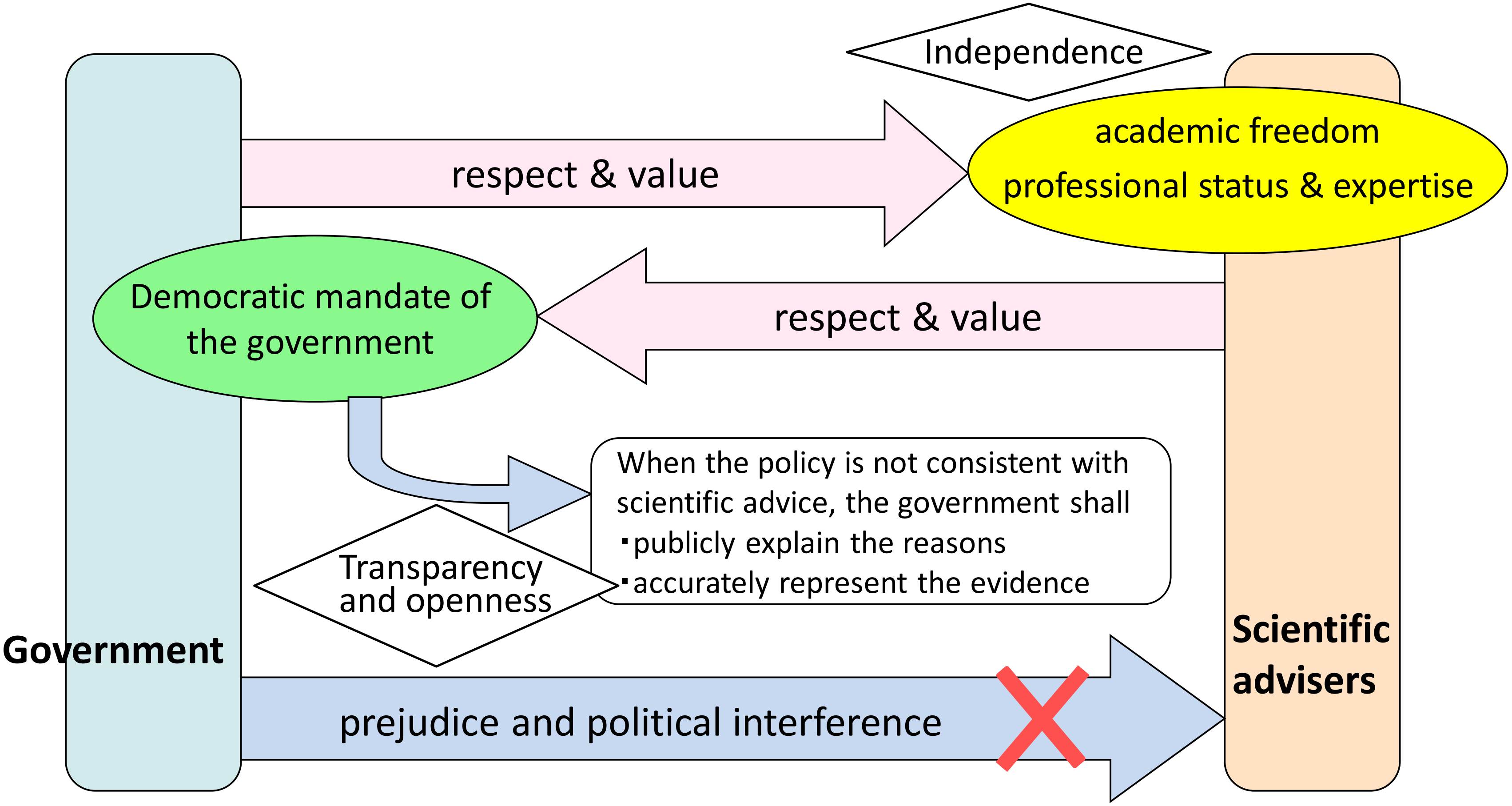
  - Rules of publicizing advice, peer review, and additional opinion

（2）The government should introduce a system in which scientific advice is fully and fairly utilized in policy making process

（3）Scientists keep dialog and cooperation with the media in order to develop a better framework of dispatching scientific information

- Internationally equivalent code of conduct and guidelines through international network of science community

# Relationship between Government and Scientific Advise in the UK




“ Scientific advisers should respect the democratic mandate of the Government to take decisions based on a wide range of factors and recognize that science is only part of the evidence that Government must consider in developing policy.”

**UK Department of Business, Innovation, and Skills, "Principles of Scientific Advice to Government"（ March 24, 2010）**

# Framework of Building Scientific Advice

- Required scientists' code of conduct and guidelines for scientific advice in policy making process
- Science Council of Japan composed of merit-based co-opted members
  - Academic societies composed of disciplinary members
- Council of Sci. and Tech. Policy, committees and commissions in the government
  - Transparency, legitimacy and justification of appointments
- Advisory scientists for prime minister and ministers
- Public think-tank
  - NISTEP, CRDS(JST), GRIPS, RIETI, ……

# Code of Conduct for Scientists by Science Council of Japan

**I. Responsibility of Scientists**

**II. Fair Scientific Research**

**III. Science in Society**

【**Dialog with Society**】 Scientists should participate actively in the dialog and communication with the citizen in order to cultivate better mutual understanding. ……

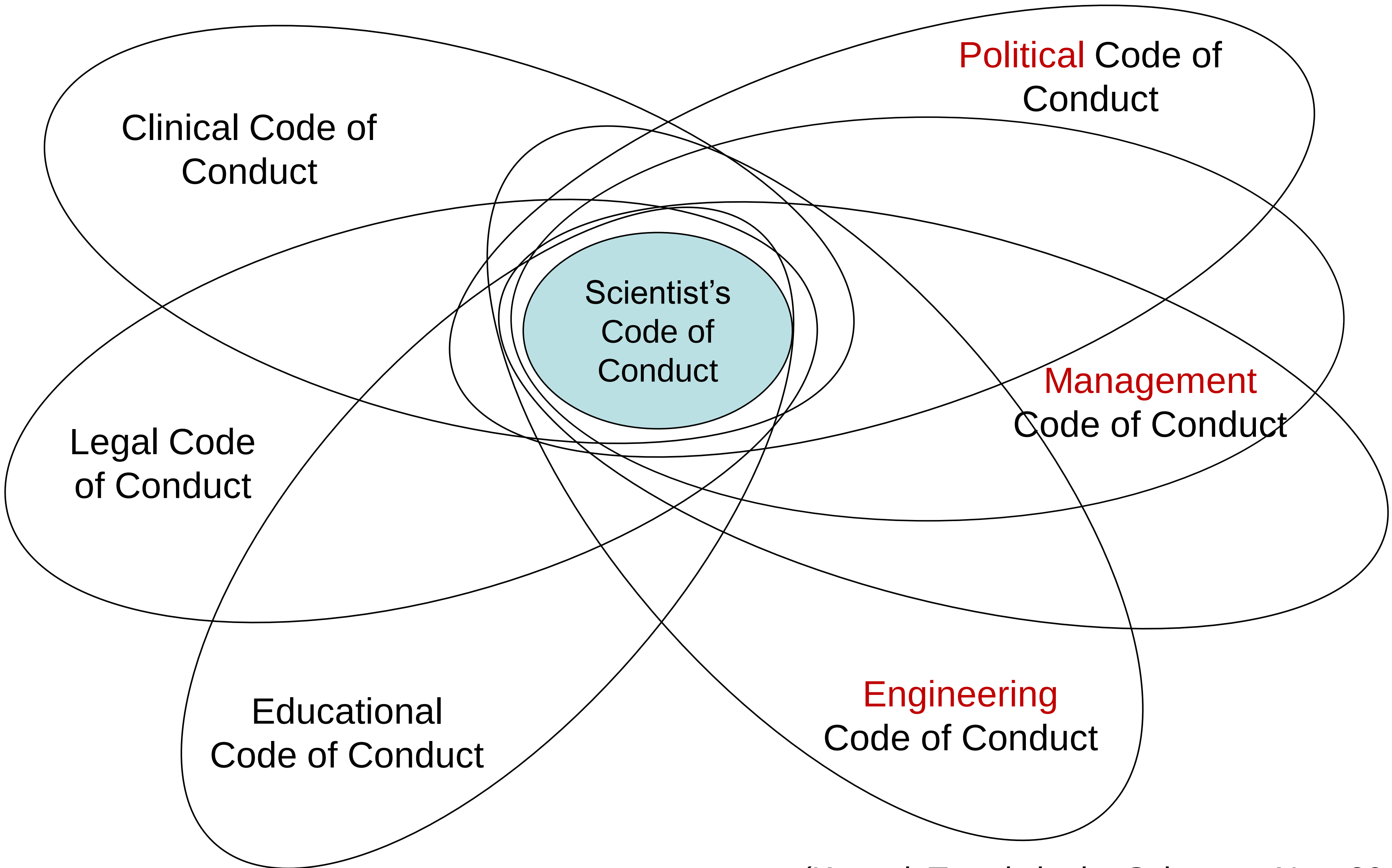
【**Scientific Advice**】 Scientists should make research work for the purpose of public benefit and provide fair advice based on scientific evidence. ……..

【**Scientific Advice for Policy Makers**】 Scientists regard scientific advice would be sufficiently respected when they offer it to policy makers, but at the same time accept it should not be a single unique basis for political decision. …….

**IV. Legal Compliance**

(extracted from the revised version as of Feb. 2013 and translated by NK)

# Connection of Scientist's Code of Conduct to Professional Code of Conduct




(Kasagi, Trends in the Sciences, Nov. 2011)

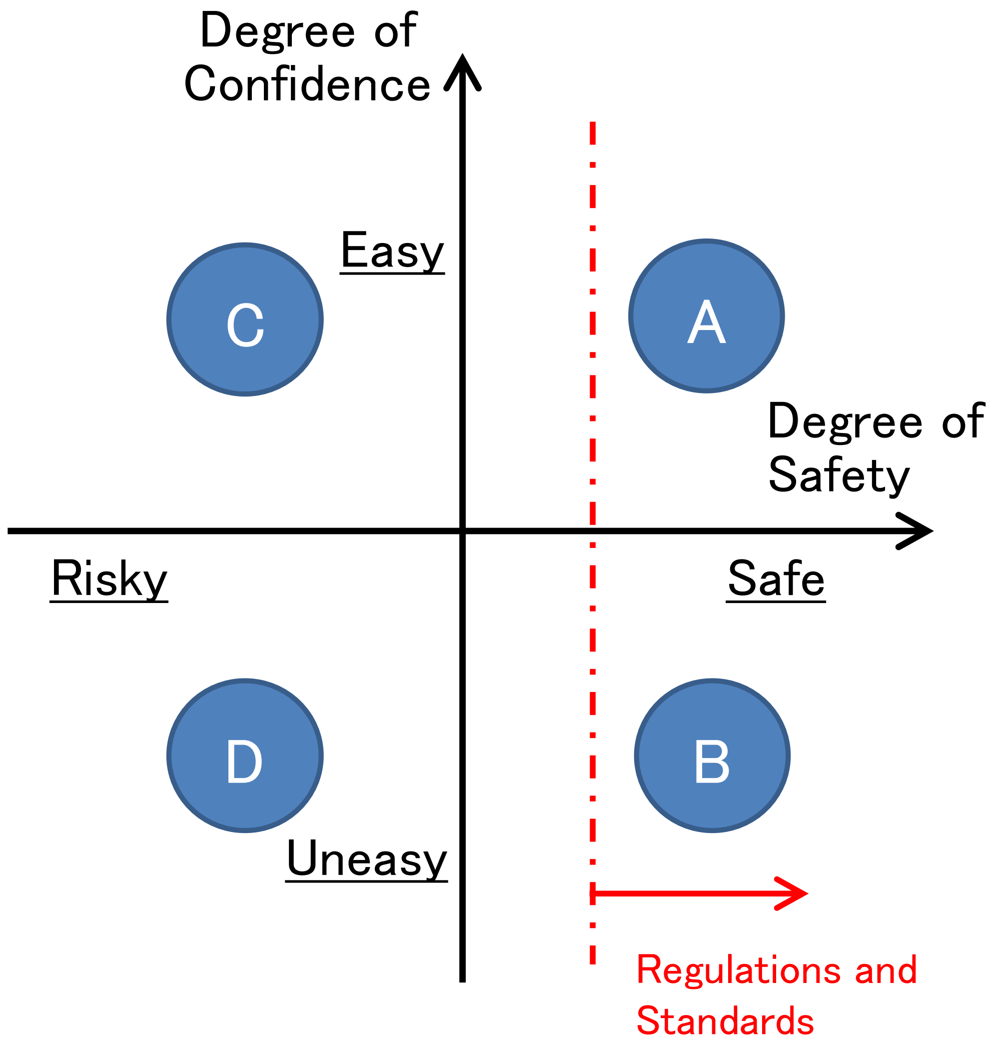
# Risk Communication System

- Scientific explanation to the public; importance of reasoning for judgment
  - Reliability, transparency, timeliness, lay-language
- Risk communication in conformity with the scientist's code of conduct; best and worst scenarios; safety affirmative action with minimum damage
  - Adequate modes of expression of the information and judgment with contingency and uncertainty
- Utilization of scientific knowledge to contain accidents at the time of emergency
  - Information service for disaster development (diffusion of radioactive materials), utilization of information with uncertainty, panic avoidance
- Justifiable assessment and judgment of risk with extraordinary damage of extremely small possibility

# Network for Scientists' Urgent Advice

- Tree-structured network of scientific experts making case-adequate scientific advice through Science Advisor and Science Academy at the time of emergency
- Network formed with elementary and systematic knowledge depending on classifications of possibly great disasters with a risk of many lives and social damage; classified not by academic disciplines, but by disaster types
  - Earthquake, tsunami
  - Volcanic eruption
  - Abnormal weather, typhoon, torrential rain
  - Abnormal event in ocean and space
  - Nuclear power plant accident, radioactive exposure
  - Infectious disease, disease-causing germs
  - Foods contamination, live stock infection
  - Environmental contamination, aerial pollution
  - Information and communication system failure, leak and loss of data
  - Economic crisis
  - Terrorism, invasion

# Public Trust vs. Safety and Security




Public sense of safety on artifacts depends on the trust on scientists！

(Kasagi, Trends in the Sciences, Nov. 2011)

# Role of Scientist as Advisor and its Paradox

- Pure Scientist
  - No-interest in decision making and simply share some fundamental information about factors involved
  - May compel a particular decision outcome (stealth issue advocacy)
- Science Arbiter
  - Service ready to answer factual questions that the decision-maker thinks are relevant, but does not tell what he/she ought to prefer
  - May compel a particular decision outcome (stealth issue advocacy)
- Issue Advocate
  - Ventures into telling the decision-maker what he/she ought to prefer by making the case for one alternative over others
- Honest Broker of Policy Alternatives
  - Expands (or at least clarifies) the scope of choice for decision-making in a way so that the decision-maker can reduce choice based on his/her own preferences and values
  - A collection of experts working together with a range of views, experiences, and knowledge: Ex. IPCC

(R. A. Pielke, Jr., The Honest Broker, 2007)

# Role of Journalism and Mass Media

- Report the message and voices of the government and scientists with plain language, and make constructive criticism as appropriate

- Sometimes, their own incentive and motivation of utilizing scientists as well as scientific information with biased filtering

- Lack of rational principles for treating professionals and their explanations
  - Comparison of information from different sources?

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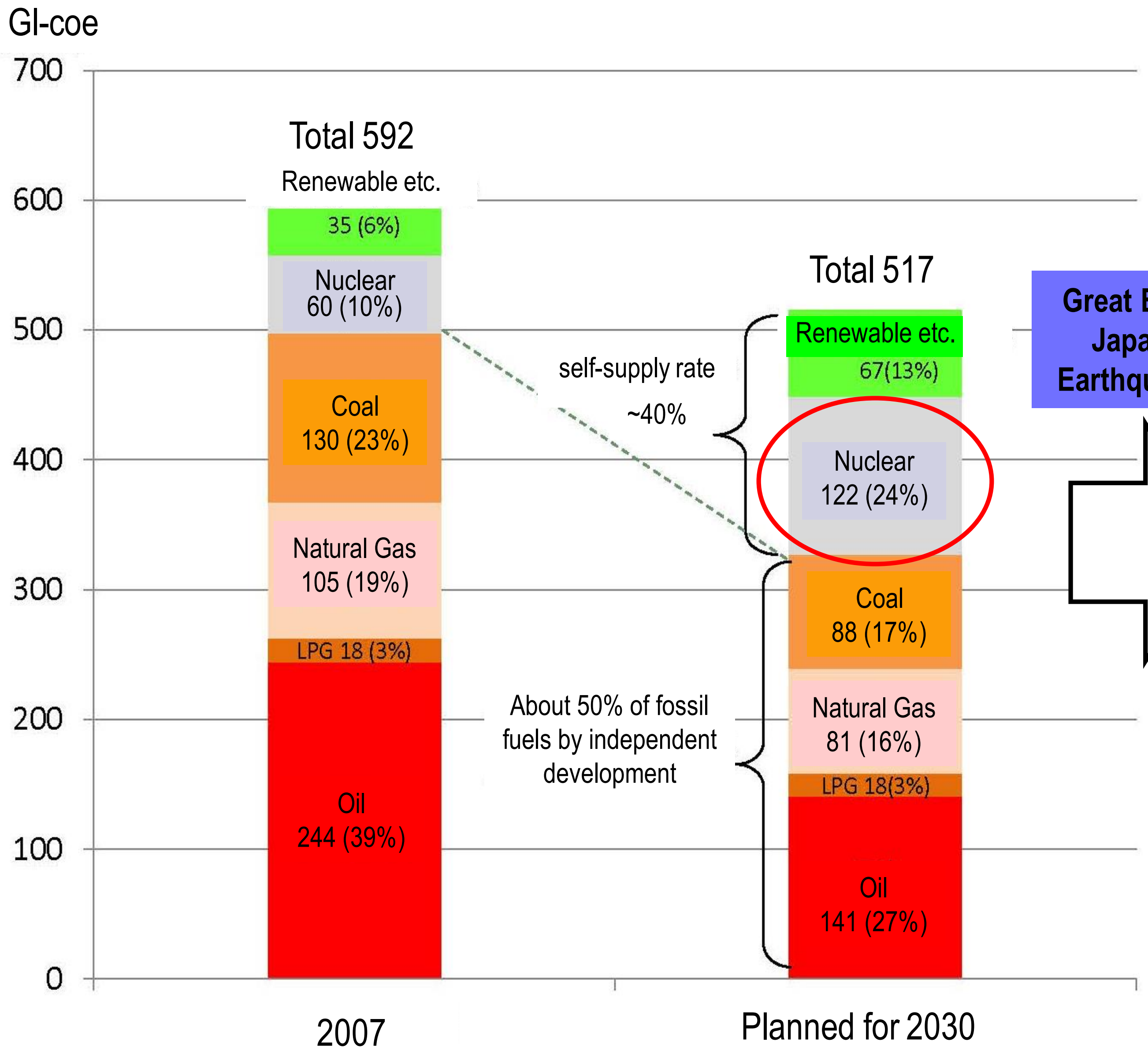
# Redesigning "Basic Energy Plan"

## Primary Energy Breakdown in 2030




**Great East Japan Earthquake**

New energy plan options for 2030 with nuclear power fractions of:

a. 0 %
b. 5 %
c. 20~25 %

and renewables of 25~35%

# Assessment Indices for Technology Options

| Energy Security | Environment (Safety) | Economy (Cost) |
|---|---|---|
| • Resource reserve (geophysical/geopolitical distribution), Reserve-production ratio (fossil and nuclear fuels)<br>• Security and stability of resource feedstock (import dependence, independent development)<br>• Stability of international market fuel price<br>• Time-dependent fluctuation, rates of availability and operation (natural energy resources)<br>• Rate of plant operation (periods of inspection and repair)<br>• Response to load fluctuations<br>• Disaster countermeasures and energy supply to isolated areas | • Climate change (GHG)<br>• Radioactive wastes, radioactive contamination (nuclear power)<br>• Atmospheric contamination (NOx, SOx, soot, particulates), Ozone layer destruction (CFC), thermal discharge<br>• Compatibility to food production, Condensation of specific molecules (N, P) (biomass, biofuels)<br>• Impacts on ecology and biodiversity | • LCA, energy profit ratio, energy payback time<br>• Fuel costs (mining, transformation, transportation, storage), material cost, energy price, electric power price<br>• Business continuity stability against fuel price fluctuation<br>• Costs for R&D, equipment, plant construction, land, installation, environmental countermeasures<br>• Length of periods for environmental assessment and construction<br>• Costs for maintenance, waste processing, decommissioning<br>• Costs for countermeasures to terrorism and disaster, recovery cost and time, compensation<br>• Economical impact as energy industry (energy equipment, electric power market, fuel businesses), employment |

(Kasagi, Energy and Resources, Mar. 2012)

# Evaluation Indices for R&D Theme Assessment

5（favorable）～ 1（not favorable）

| Category | Index | Description |
|---|---|---|
| A. Stability of Supply | A-1 Quantitative impact | Quantitative influence to national energy flow |
| | A-2 Easiness of procurement | Difficulty in securing energy resources and avoiding various risks*1 |
| | A-3 Supply stability | Time-dependent (hourly, daily, monthly) fluctuations and irregularity |
| | A-4 Adaptability to stringency and accident | Adaptability to natural and accidental disasters |
| B. Environmental Impact | B-1 GHG emission | Amount of annual emissions of GHG ($CO_2$, $CH_4$, $N_2O$, HCFC) [t-$CO_2$] |
| | B-2 Environmental risk | Contamination of air, water, soil except for B-1 |
| | B-3 Radiation risk | Possibility and seriousness of accident |
| | B-4 Impact on food production and ecosystem | Compatibility with food production and conservation of biodiversity, and other environmental conformity |

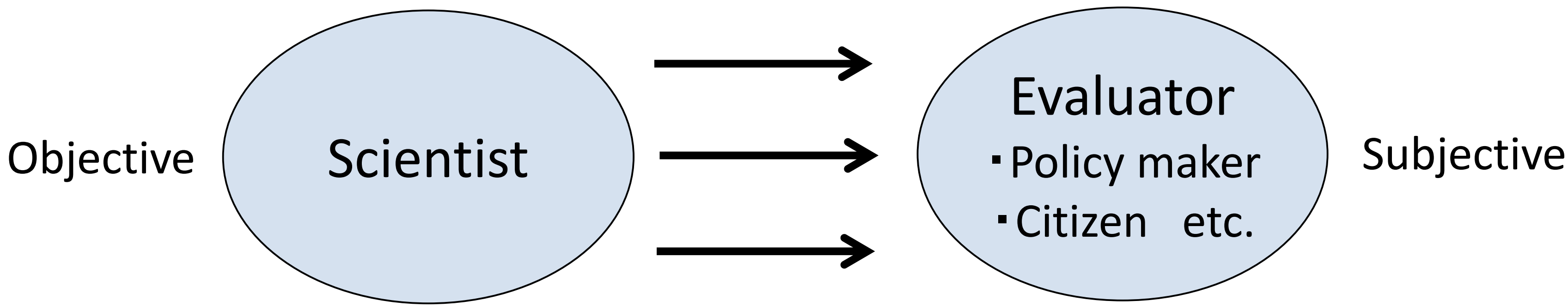
*1 Ex. geopolitical risk, market risk (price stability), amount of availability

# Evaluation Indices for R&D Theme Assessment

| | | |
|---|---|---|
| C. Economy | C-1 Economic impact | Expected industry size (market, employment), finance-equivalent impact on energy flow |
| | C-2 Cost performance | Cost-benefit performance, business incentive (ex. EPR, EPT, lead time etc.) |
| | C-3 Int'l competitiveness and overseas expansion | Possibility of product export and business overseas deployment |
| | C-4 Spillover effect | Induction of related and peripheral industrials, demerit avoidance |
| D. Policy relevance and R&D investment risk | D-1 Policy relevance | Compatibility with national energy-related policies |
| | D-2 Int'l R&D competitiveness | Current competitiveness of R&D on target technology*3 |
| | D-3 Int'l technology competitiveness | Current competitiveness of technology and industry |
| | D-4 Scientific merit and impact | Scientific originality, novelty, degree of challenge*4 |
| | D-5 R&D Fundamentals, human resource development | Size of research community and technical societies, level of activities, and R&D environment |
| | D-6 Barrier to market introduction | Social barriers against technology introduction to market (regulations, opportunity*5, roadblocks*6) |

※2 R&D cost, initial cost, operational cost, grid stabilizing cost etc.
※3 Basic, applied and development research
※4 Includes R&D themes which are not completely new, but very important in science
※5 Intangible policy measures (subsidiaries, deregulation, FIT), change in social acceptance
※6 Regulatory degree, openness of market, conservativeness of industry, fragmented administration, etc.

# Separation and Quantification of Scientific Basis and Political Judgment

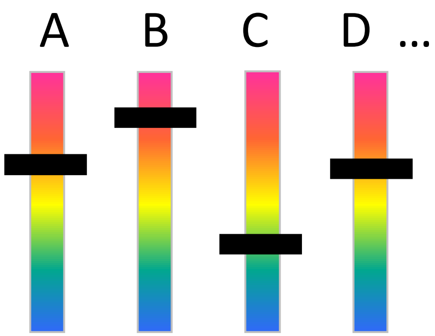



Assessment of target technology → $p_i$

Weight for assessment index → $w_i$

- Clear distinction between scientific assessment and subjective judgment; clarification of the basis for selection and the rationale for discussion
- Help for decision makers in making rational thinking and finding essential difference in different opinions

Relative assessment of target technologies




Weighted assessment index (prioritization) :

$$P = \sum_{i}^{N} w_i \, p_i, \quad \sum_{i}^{N} w_i = 1.0$$

# Social Wish in Different Regional Contexts

| | Japan | East Asia | World |
|---|---|---|---|
| Stable and sustainable supply | National security | Harmonization | Sustainability |
| Environment[1] (Generalized safety) | Eagerness to safety and security | Technology transfer and environmental conservation | Consensus formation (Climate change prevention) |
| Growth and prosperity[2] (Competitive economy, better life) | Sustainable prosperity | Economic cooperation | Equity |

1. Difference between time scales of climate change and disaster
2. Economic growth (quantitative expansion) vs. social prosperity (qualitative development)

# Need for Rational Methodology for Science and Technology Policy

- Need for policy-making process aiming at achieving and solving societal issues (The 4th S&T Basic Plan)
- Inherent difficulties in logical, objective, evidence-based policy-making only being overcome by demarcation of objective assessment and subjective judgment
- A fair and transparent process indispensable to build public trust in the national science and technology policy

- Consequences in the relationship of scientists with government, media and society after the nuclear accident
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# For Scientists to Better Serve Society and Policy

- Urgent need to establish a fair and transparent system to exploit scientific advice effectively in society
  - Code of conduct in scientific advice with common understandings of industry, academia and government
  - Internationally equivalent operation by learning good practices in other countries
  - Science advisor, public think-tank
- Scientists' continuous effort required to build public trust and have scientific advice utilized for rational consensus building under democracy
- As for the national energy policy, reexamination necessary from various viewpoints including domestic and international situations with political judgment rigorously separated from independent scientific advice
- Good relationship of science with politics, media and society only possible with long-term experience and training based on the mutual understanding