Implementing Roadmaps

- Experiences and Challenges -

IEA Workshop on Energy Technology Roadmaps

15 - 16 May 2008, Paris

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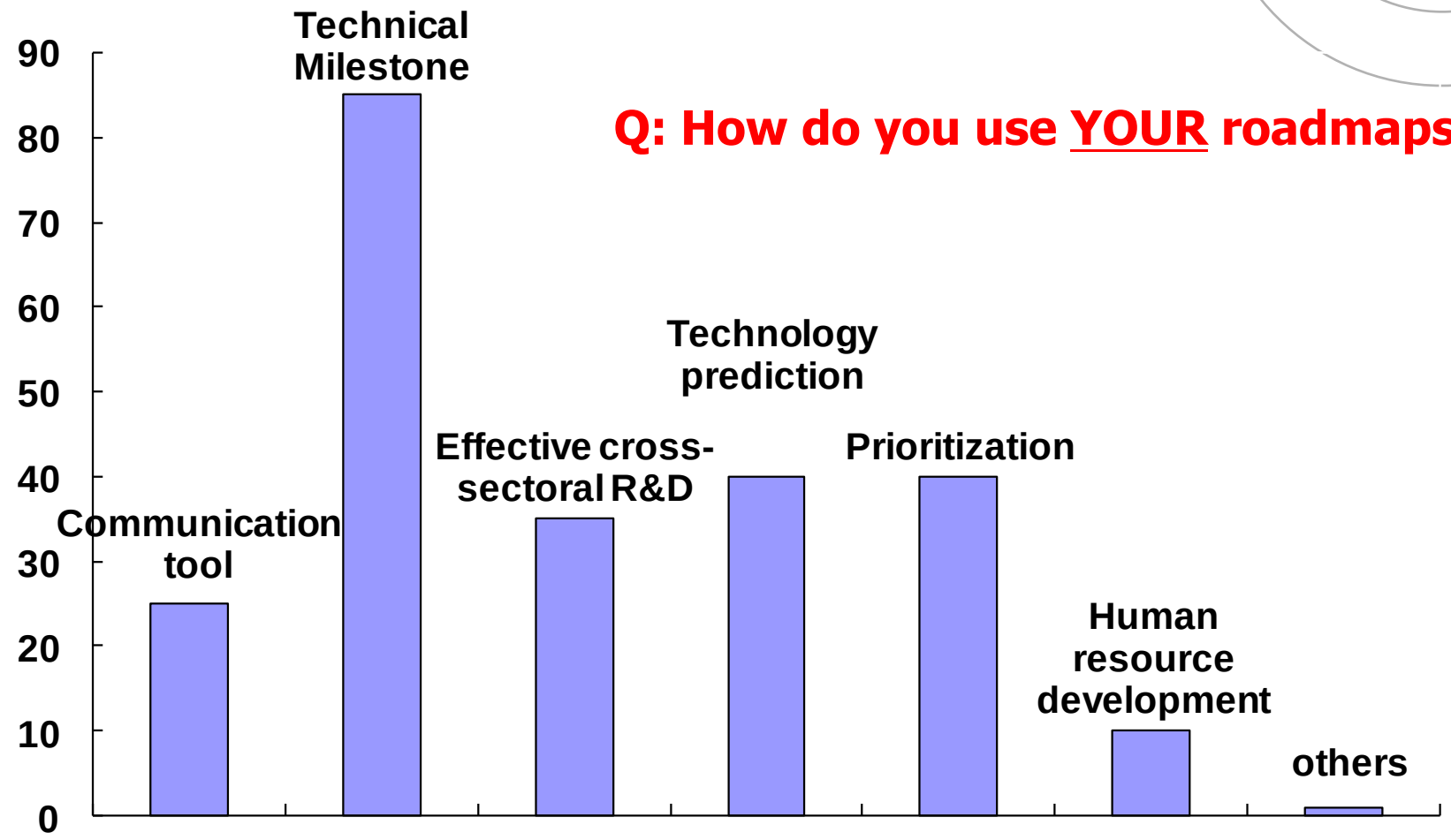
National Institute of Advanced Industrial Science and Technology

Role of technology roadmaps:

Inquiry to the Private Sector



Q: How do you use YOUR roadmaps?

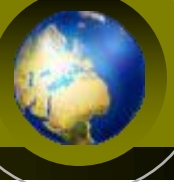
Significance of Technology Roadmaps of METI

- **Communication tools**
  - **To build up common understanding on R&D needs and development direction through**
    - **sharing information,**
    - **exchanging views among technology experts and a government,**
    - **integrating knowledge and strengthen partnerships among industries, academia, and a government**
  - **Essential to promote coherent long-term investment**

Significance of Technology Roadmaps in METI (cont'd)

- **Project management** tools to optimize R&D investment by clarifying milestones and objectives, monitoring progress, identifying gaps and challenges to overcome
- **Knowledge base** to promote cooperation across sectors, technology areas, and industry-academia partnerships
- Tools to fulfill **accountability** to taxpayers by clarifying pathways from R&D to commercialization and the public benefit

Key Elements of METI Technology Roadmaps



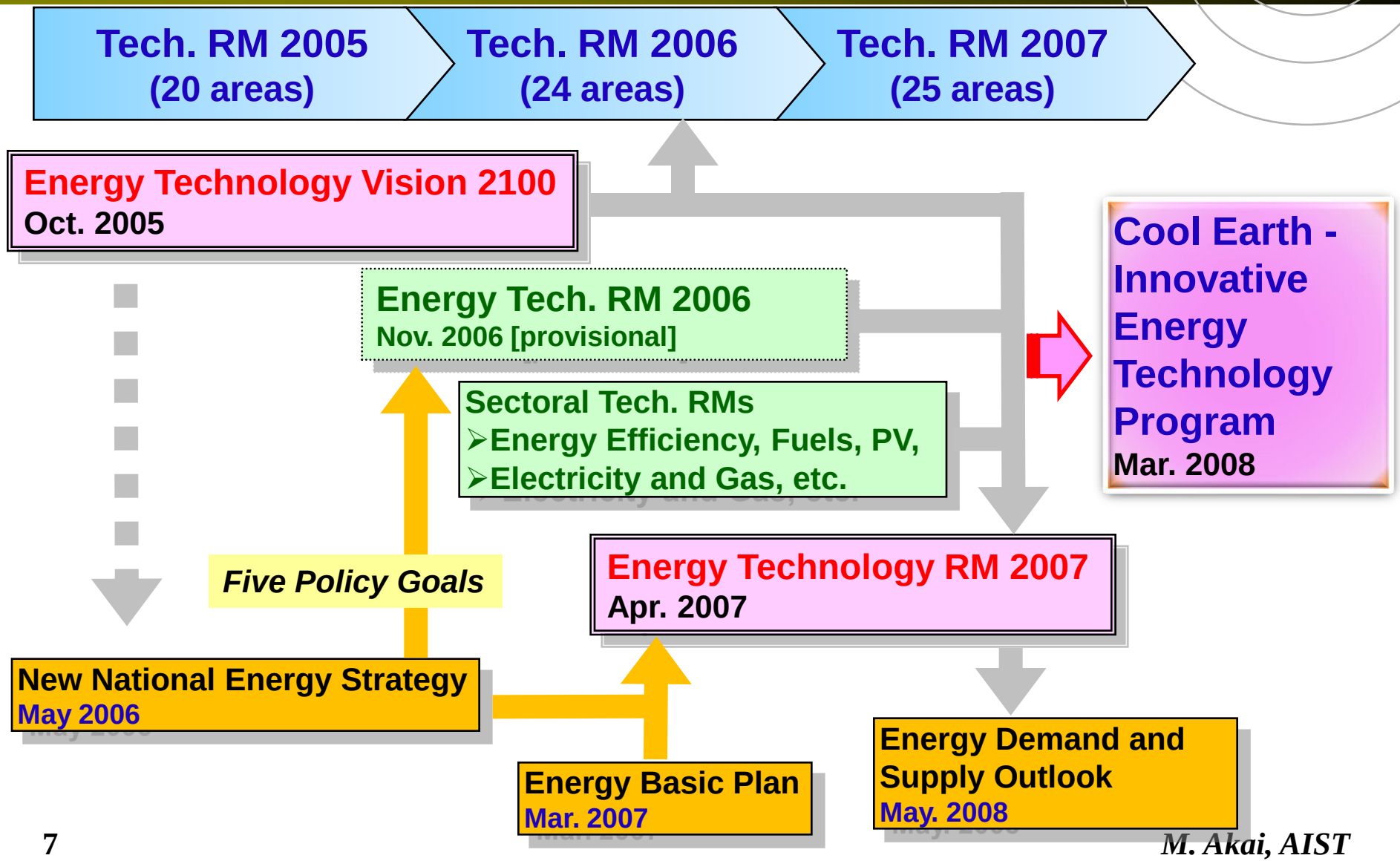
- **Pathway to commercialization (Basic research, applied research, demonstration, and commercialization)**
- **Technical milestones (e.g. cost reduction), required technical performance set along the timeline**
- **Technical challenges, required elemental technology**
- **Required policy and measures to promote deployment and commercialization, other than technology R&D investment (e.g. deployment policy, standardization of technology)**

Roadmapping Process

- By task forces in cooperation with NEDO, AIST and other institutions,
  - about 300 experts totally from academia, industry, and public research institutions
  - incorporating the best available information
- Developed roadmaps for 25 technology areas including energy
- Undertake an annual reviewing process to reflect the latest technological trends & progress in R&D projects

Recent Development in Energy Sector

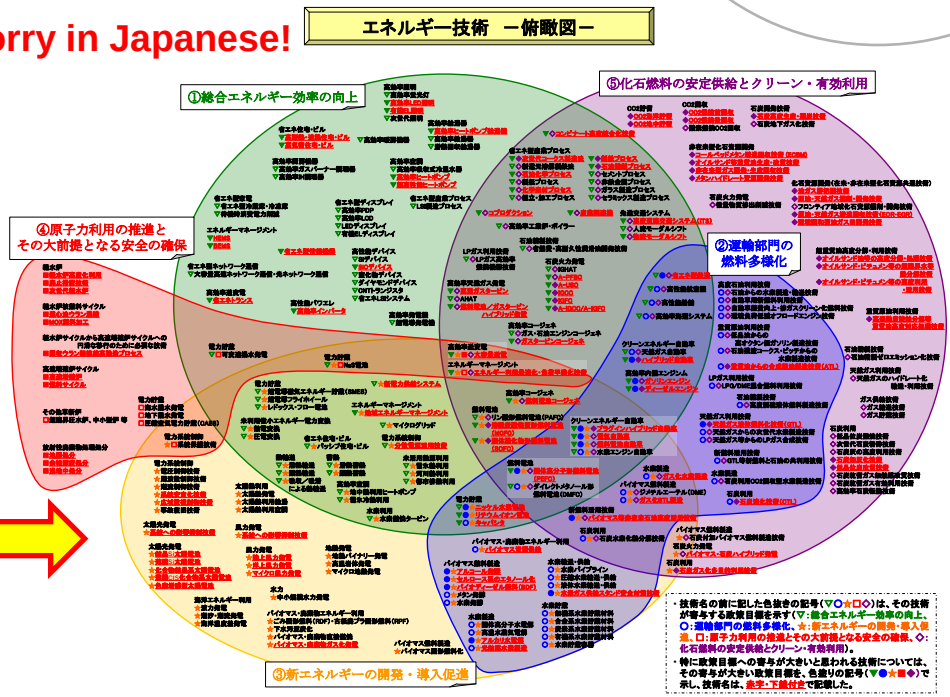
Energy Technology Roadmapping



Development of Energy Technology Roadmaps

1. Definition of target(s)
2. Identification of energy technologies and enabling technologies or sciences
3. Prioritization based on technology assessment in accordance with policy goals
4. Mapping of technologies
5. Development of technology portfolio
6. Developing technology roadmaps
7. Supplementary scenario analysis

Sorry in Japanese!



Technology Map

⇒ *Technology Inventory*

Technology Portfolio

Cool Earth - Innovative Energy Technology Program

Efficiency improvement ***Decarbonization***

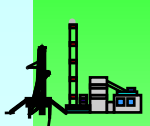
Oil LNG Coal Nuclear Power Biomass Solar Wind

Supply side

Electric Power

Efficient coal-fired power plant

CCS



Innovative solar power

Advanced nuclear power

Efficient LNG-fired power plants

Superconducting power transmission

Demand side

Transport

ITS

FCV

PHEV/EV

Biofuel

Industry

Innovative materials/ manufacturing process

Steel making process with Hydrogen

Residences/ Buildings

Efficient houses/buildings

Efficient lighting

Fuel Cell for residential use

Efficient Heat pumps

Efficient IT devices/networks

HEMS/BEMS/Regional EMS

Cross sectroral

Power storage **Power electronics** **Hydrogen production/storage/ transport** **CCS (restated)**

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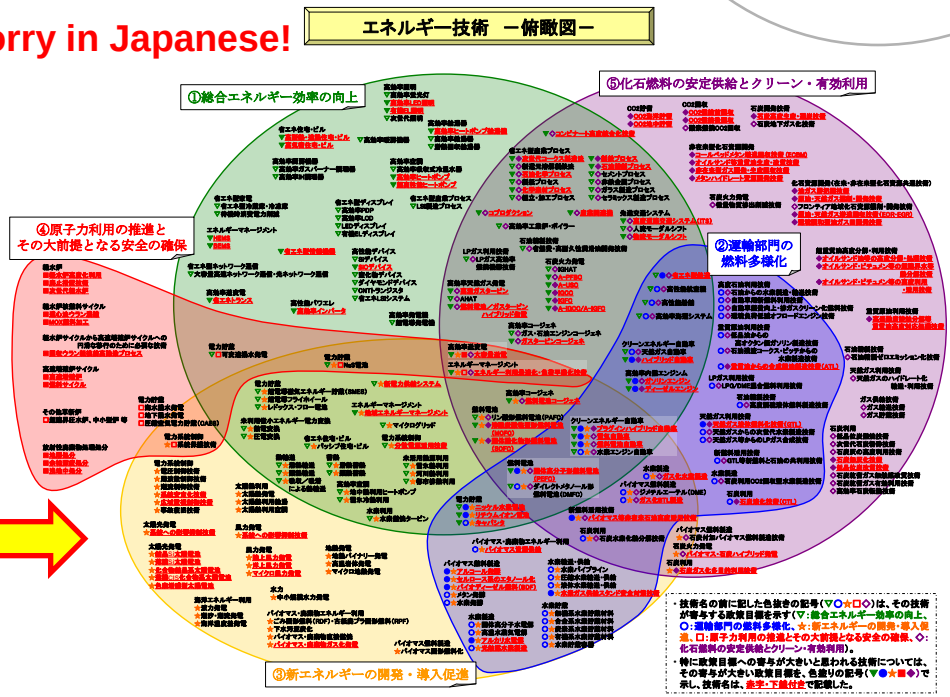

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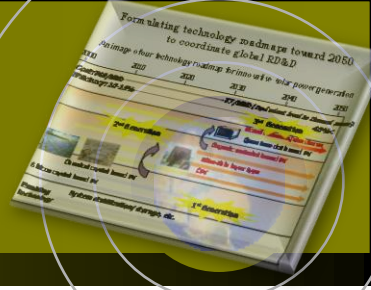


An image of our technology roadmap for innovative solar power generation

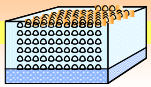
2000 2010 2020 2030 2040 2050

Cost: ¥46/kWh → *¥7/kWh (Equivalent level to thermal power)*

Efficiency: 10-15% → *40%<*

3rd Generation

Nobel materials/structures



Quantum-dot based PV

2nd Generation

Organic material based PV

Ultra-thin layer type

CPV

Chemical crystal based PV

Silicon crystal based PV

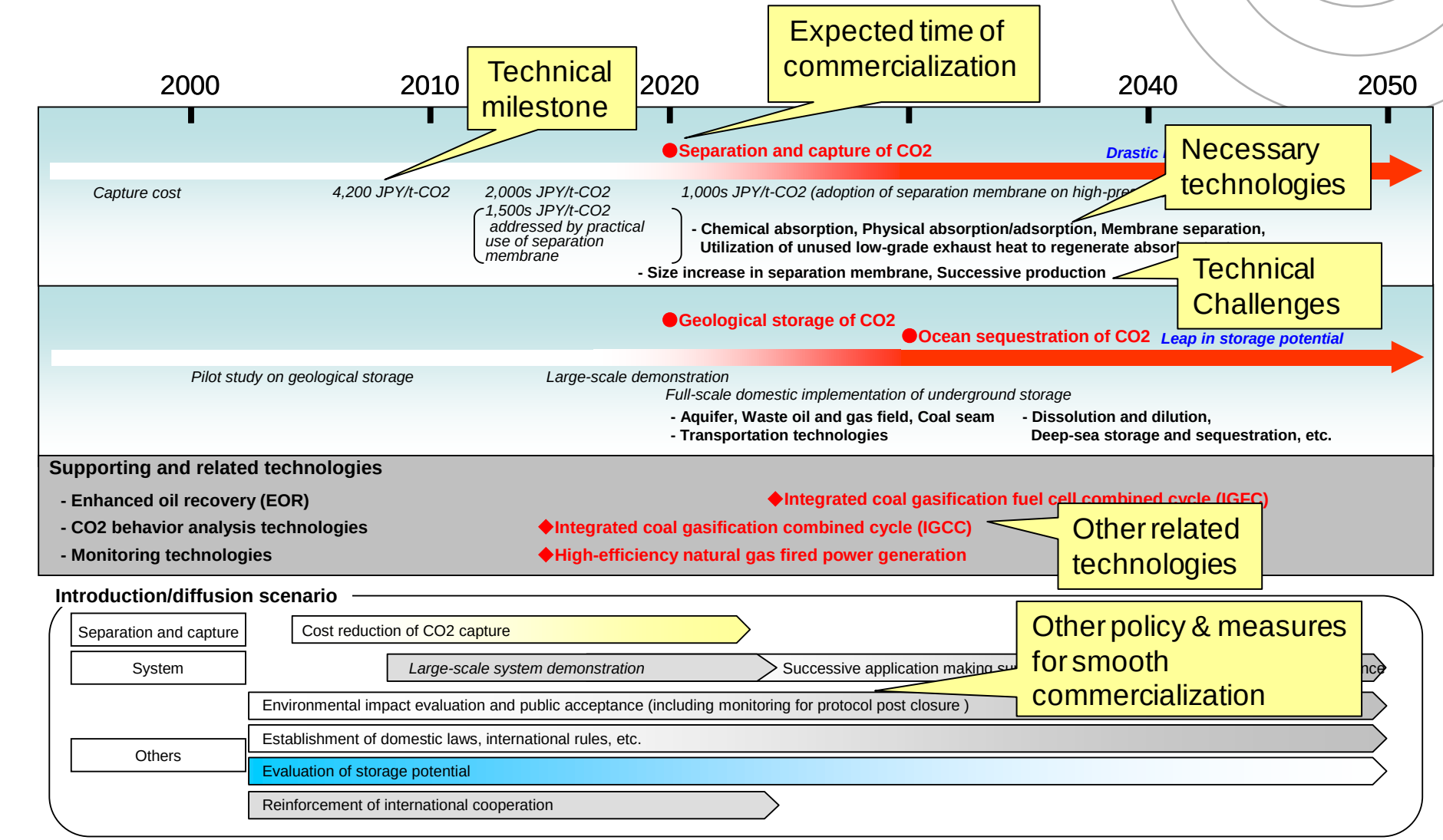
1st Generation

Enabling technology

System stabilization/storage, etc.

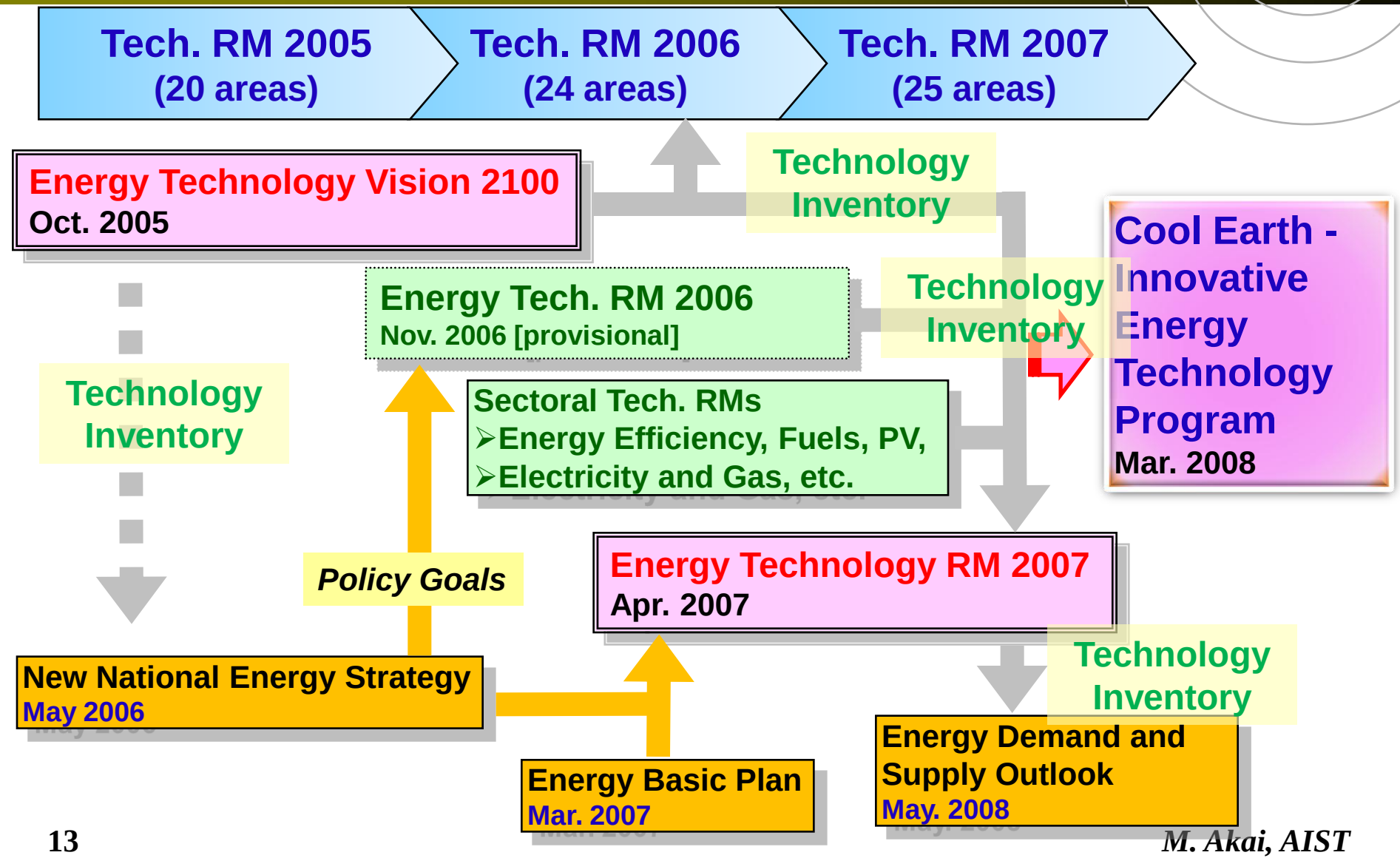
Example of Technology Roadmap (CCS)

Cool Earth - Innovative Energy Technology Program



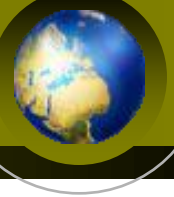
M. Akai, AIST

Utilization of Technology Inventory



Process – Energy Technology RM

ETV 2100 to Cool Earth Program

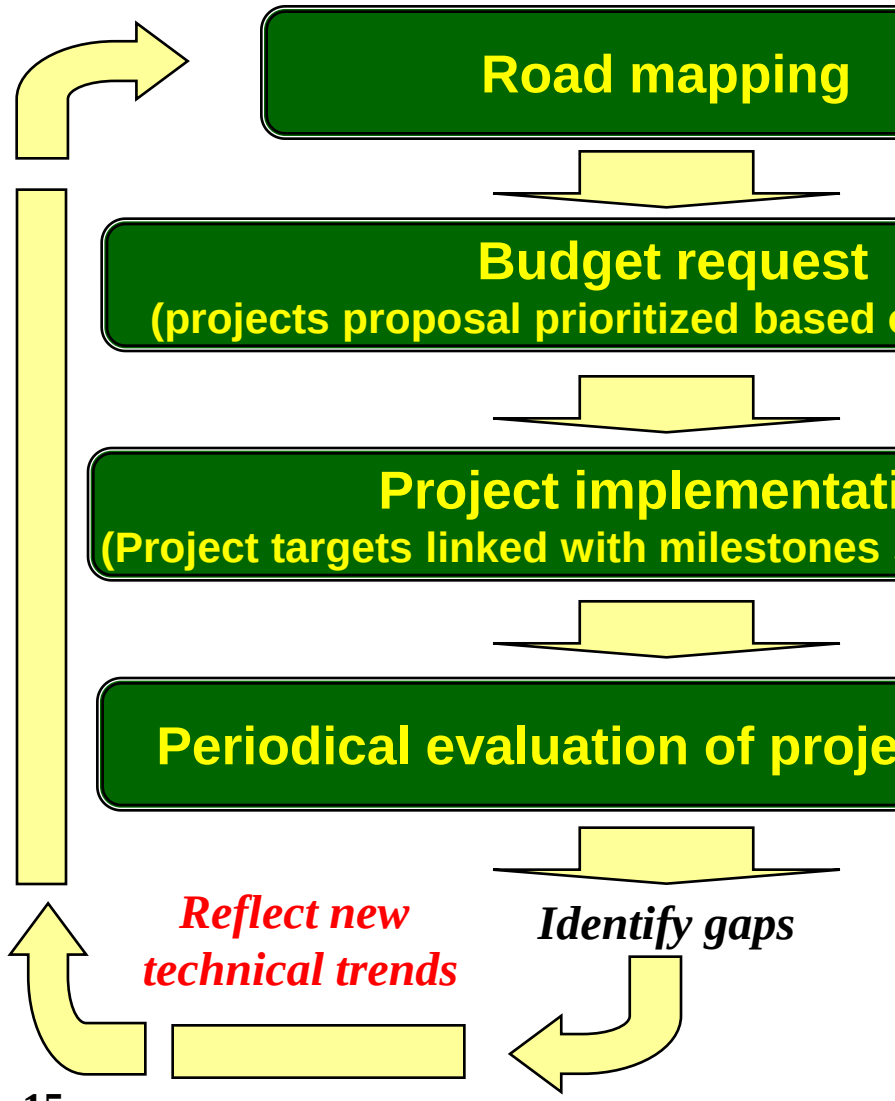


Utilization of well prepared technology inventory

- **Energy Technology Vision 2100**
  - **18 months' discussion through:**
    - **Workshops (5),**
    - **Steering committee meetings (8) and WG meetings (48),**
    - **Core group meetings (>50),**
    - **E-mails (>3000)**
  - **> 100 experts involved**
- **Energy Technology Roadmap 2007**
  - **6 months' discussion in SC and WG meetings**
- **Cool Earth - Innovative Energy Tech. Program**
  - **7 months' discussion in Advisory Panel and WG meetings**

Implementing Roadmaps

Project Management Cycle



- *Identify technology needs*
- *Having a big picture and long-term perspective*

- *Plan projects and request budget*

- *Set technical targets*

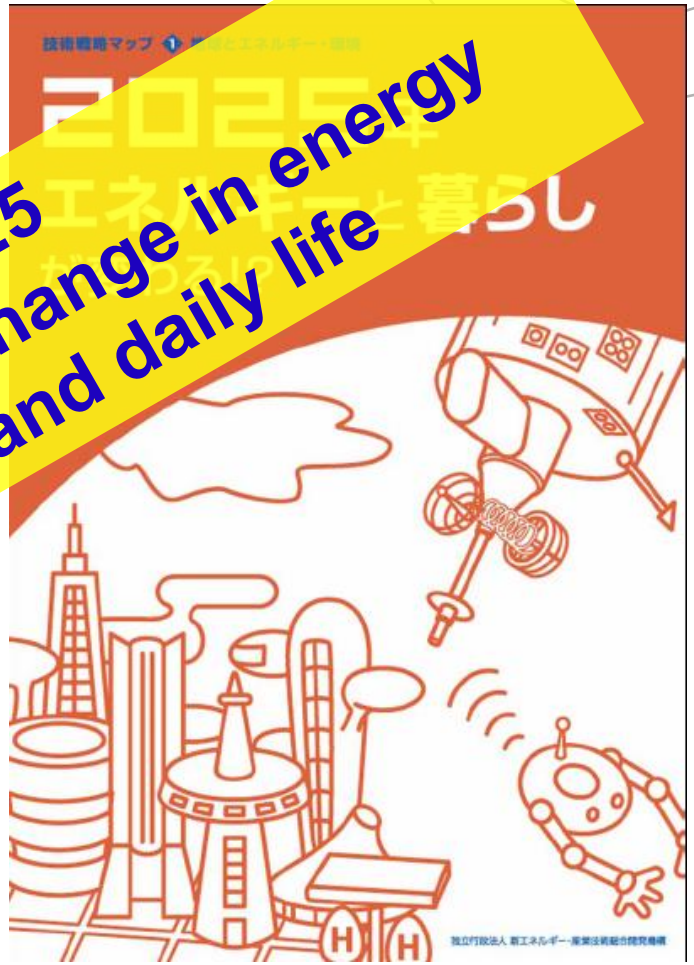
- *Monitor progress by milestones set in the roadmaps*

Utilization of Technology Roadmap
Scenario Development

- **Important "Gedunken Experiment" based on accurate and correct insights into:**
  - **Technologies, Enabling technologies, and Science**
    - **Energy efficiency, renewables, nuclear, CCS …**
  - **Technology assessment**
  - **Socio-economic development**
- **Supplemented by technology road-mapping**

Utilization of Technology Roadmap
Public communication

- **Development of educational package by NEDO**
  - **Target audiences:**
    - **Junior high school or high school students**
- **Interpretation of roadmaps to depict an image of future life**



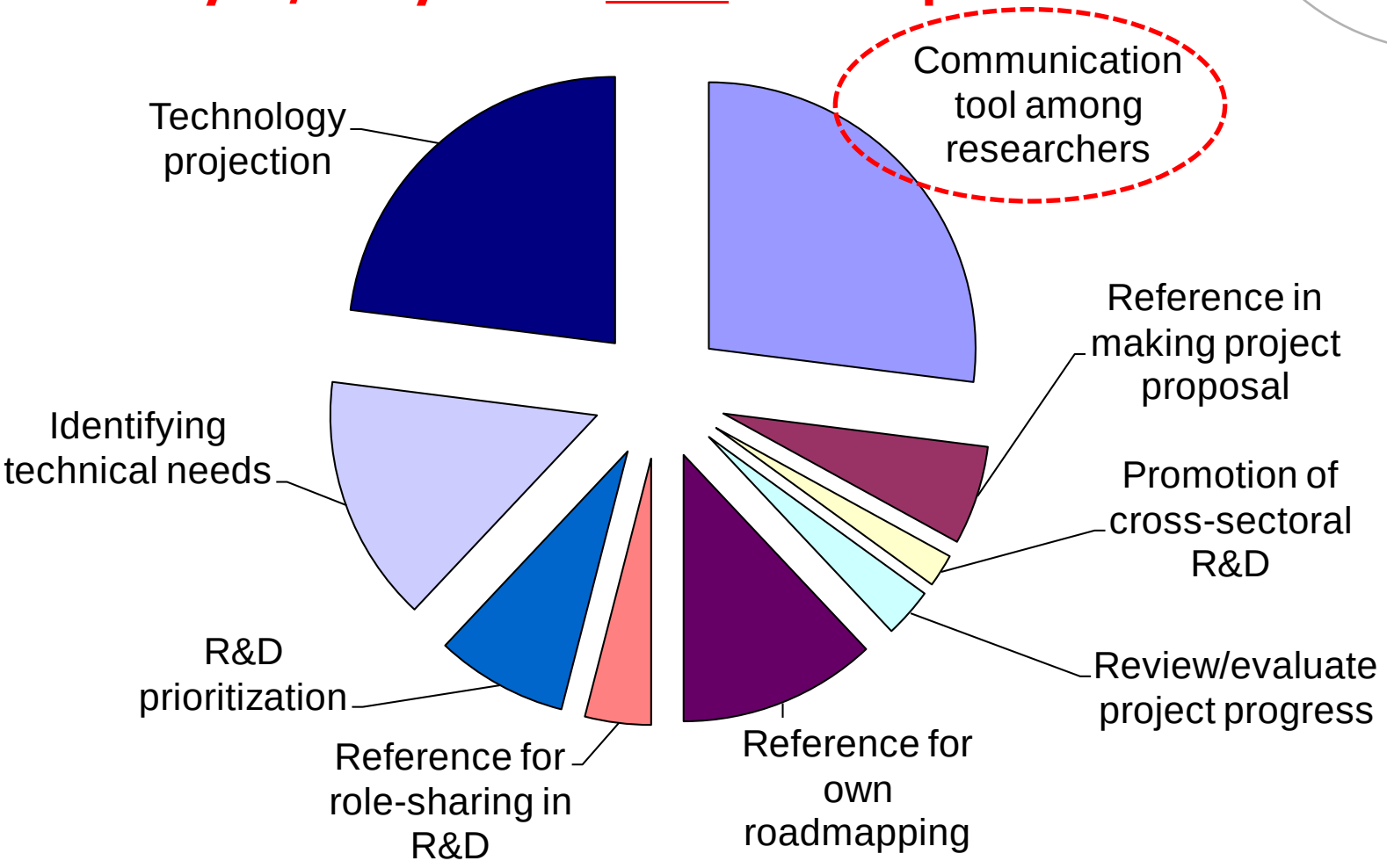
Utilization of Technology Roadmap

Development of Search Tool

- **Development of "Search Tool" designed specifically to METI's Technology Roadmap by AIST**
  - **Natural language**
  - **Interactive**

Feedbacks on METI's Roadmaps

How do you/will you use METI roadmaps?



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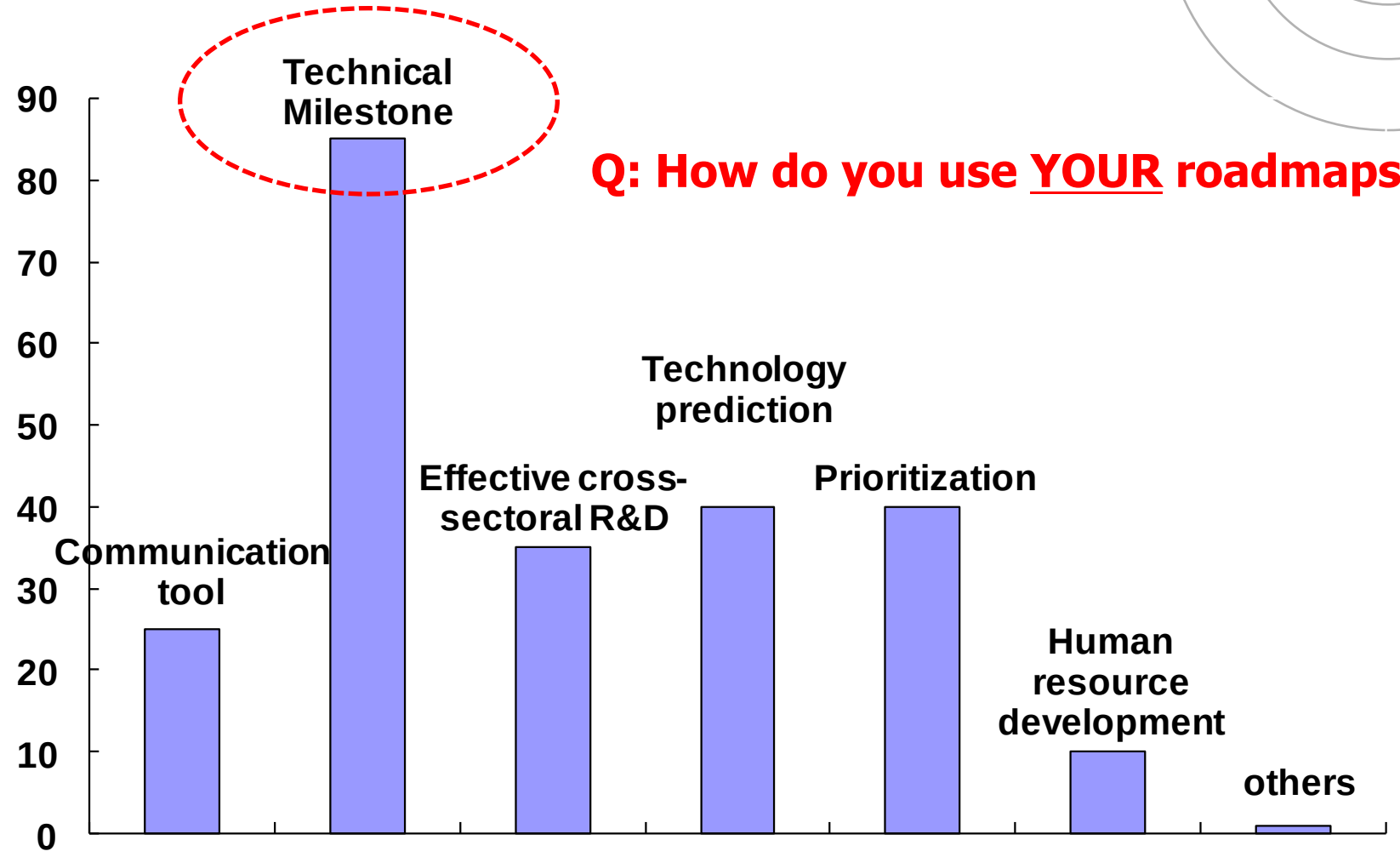

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Challenges in Developing/Implementing Roadmaps

- Difficulty to predict technology progress & address "off-road" technologies, especially technologies in boundary areas
- Technology push vs. demand pull
- Optimal technical targets/milestones setting
- Flexible/continuous revision of roadmaps
- Commitment from industry and research institutions to implement roadmaps/engagement of industry
- Linkage with financial resources
- Continuous monitoring

Importance of "roadmapping" rather than roadmaps themselves

Scenario Development/Roadmapping by Backcasting

Exploratory (opportunity-oriented):

- ***what futures are likely to happen? ⇒ Forecasting***
  - **starts from today's assured basis of knowledge and is oriented towards the future**

Normative (goal-oriented):

- ***how desirable futures might be attained? ⇒ Backcasting***
  - **first assesses future goals, needs, desires, missions, etc. and works backward to the present**

Clement K. Wang &Paul D. Guild

- **Need for "POLITICAL WILL"**
  - **Especially in the case of government lead exercise**

Political Will and S&T

- **Political Will as a key driver**
  - **To set desirable target for the future**
  - **To develop roadmaps**
  - **To promote R&D activities**

    ≈ Implementation of Roadmaps
  - **To design and promote socio-economic system to challenge policy goals such as energy security, climate change, etc.**

- **Available science and technologies, coupled with proper assessments, to drive Policies**

Thank you!

References

- Groenveld, P. (1997), Roadmapping integrates business and technology, Research Technology Management, Sept-Oct., pp. 48-55.
- Phaal, R., Farrukh, C.J.P., Mitchell, R. and Probert, D.R. (2002), Starting up technology roadmapping fast, Research Technology Management, 46 (2), pp. 52-58. Republished in IEEE Engineering Management Review (2003), 31 (3).
- Galvin, R. (1998), Science roadmaps, Science, 280, p. 803.
- Albright, R.E. and Kappel, T.A. (2003), Roadmapping in the corporation, Research Technology Management, 42 (2), pp. 31-40
- Da Costa O., Boden M., Punie Y., Zappacosta M., (2003) Science and Technology Roadmapping: from Industry to Public Policy, IPTS Report 73