

Implementing Roadmaps

- Experiences and Challenges -



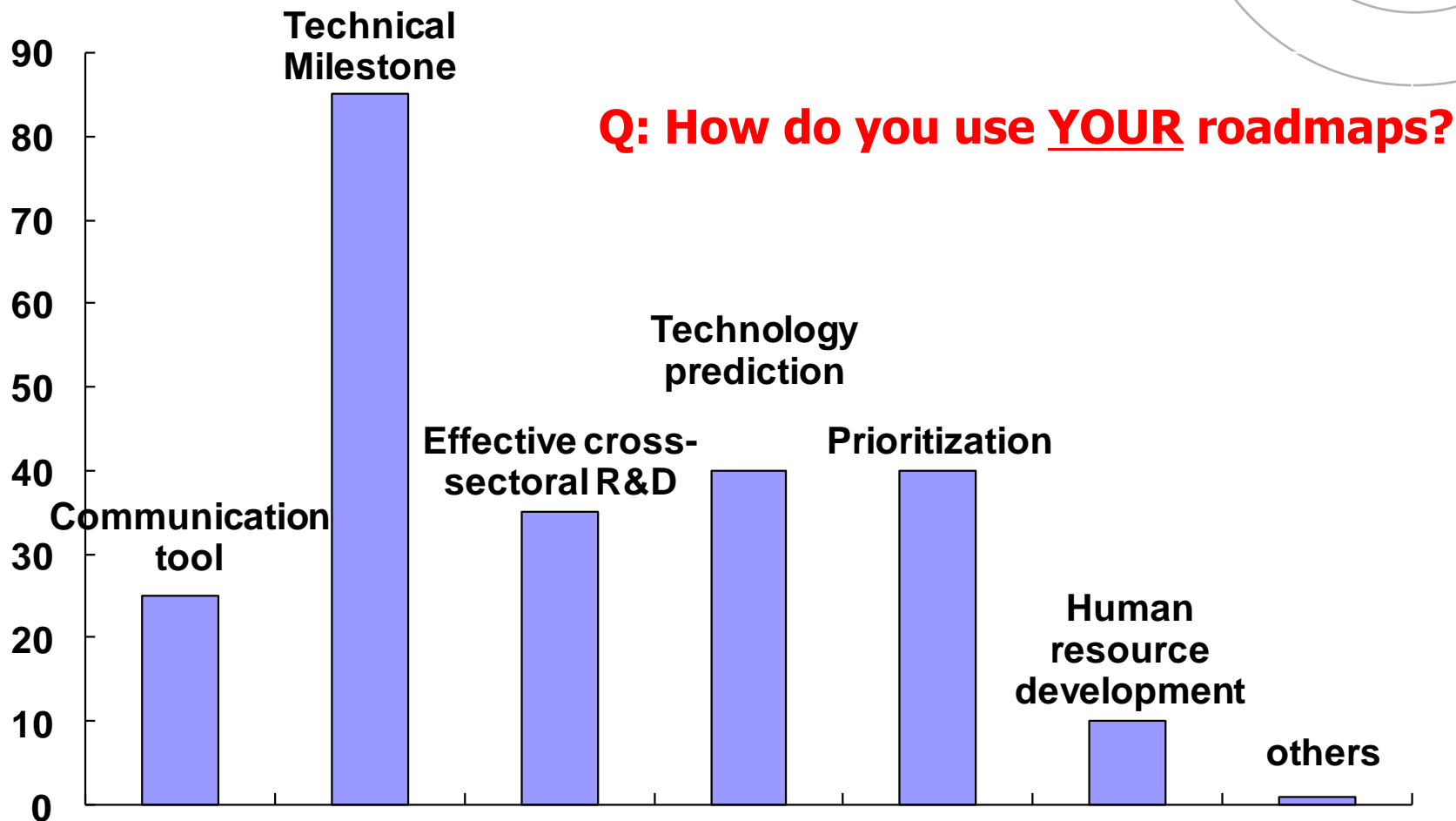
IEA Workshop on Energy Technology Roadmaps

15 - 16 May 2008, Paris

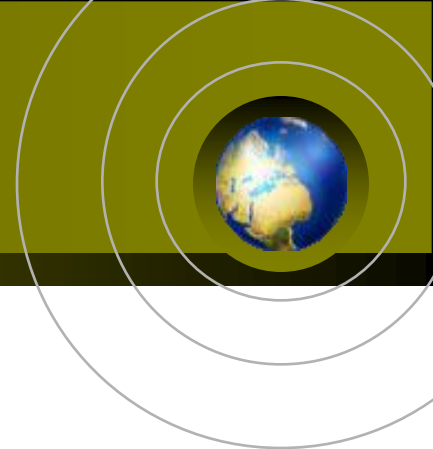
Makoto Akai

National Institute of Advanced Industrial Science and Technology

Role of technology roadmaps: *Inquiry to the Private Sector*



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



Tech. RM 2005
(20 areas)

Tech. RM 2006
(24 areas)

Tech. RM 2007
(25 areas)

Energy Technology Vision 2100
Oct. 2005

Energy Tech. RM 2006
Nov. 2006 [provisional]

Sectoral Tech. RMs
➤ Energy Efficiency, Fuels, PV,
➤ Electricity and Gas, etc.

**Cool Earth -
Innovative
Energy
Technology
Program**
Mar. 2008

Five Policy Goals

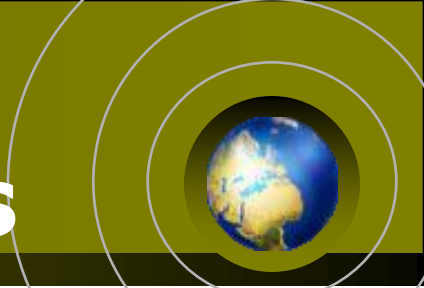
New National Energy Strategy
May 2006

Energy Technology RM 2007
Apr. 2007

Energy Basic Plan
Mar. 2007

**Energy Demand and
Supply Outlook**
May. 2008

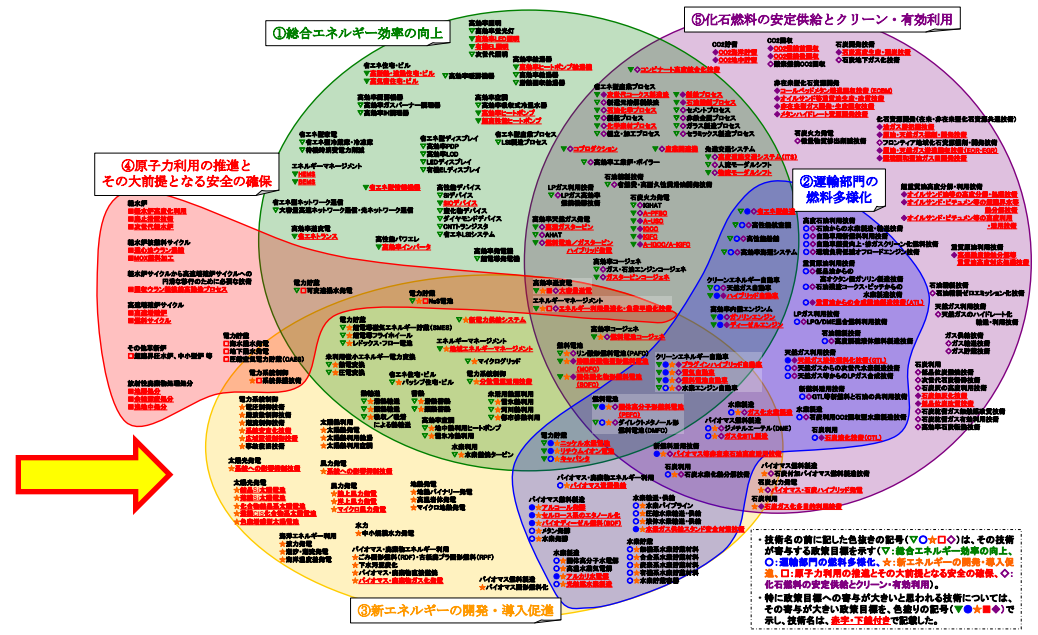
Development of Energy Technology Roadmaps



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!

エネルギー技術 一俯瞰図一



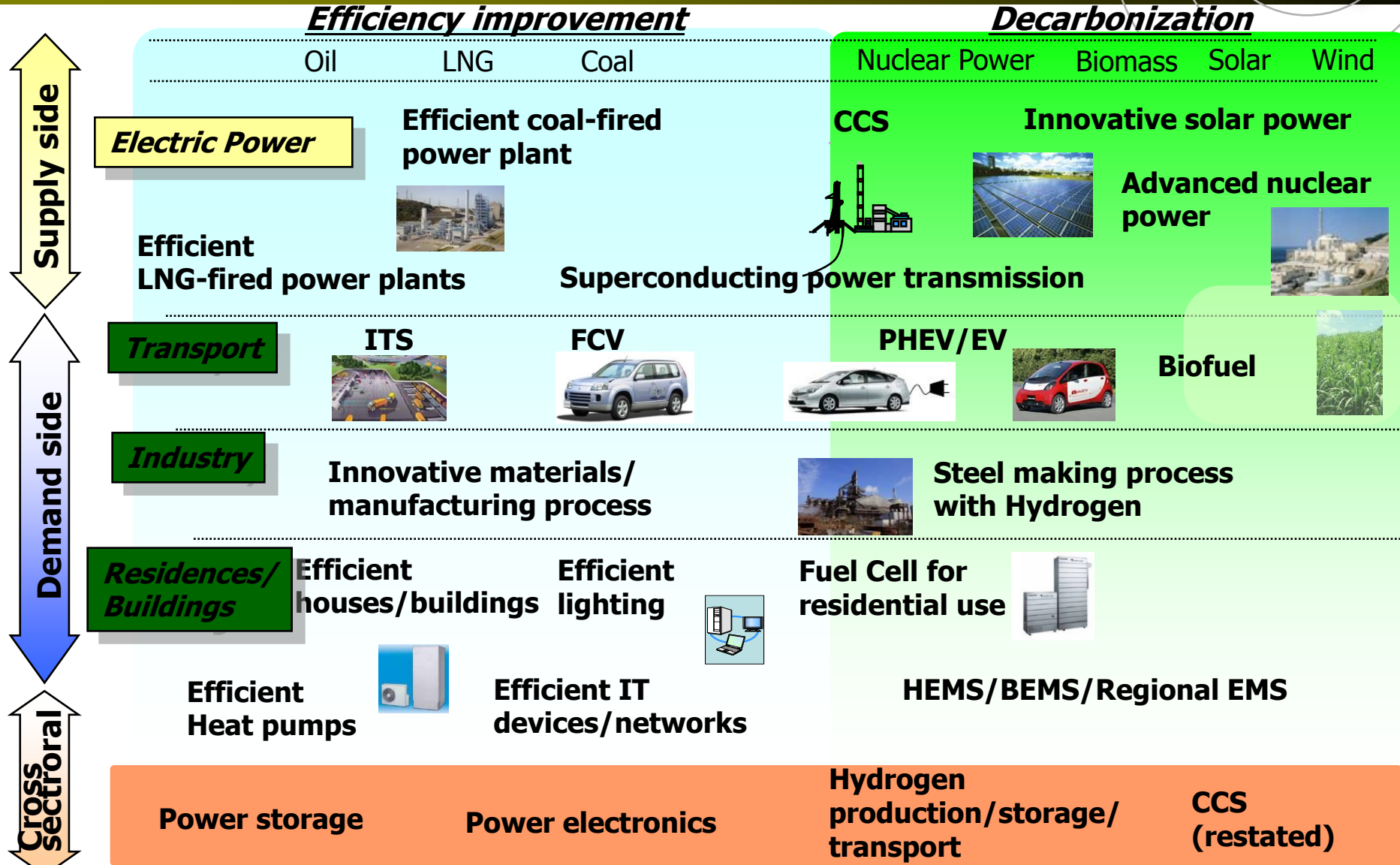
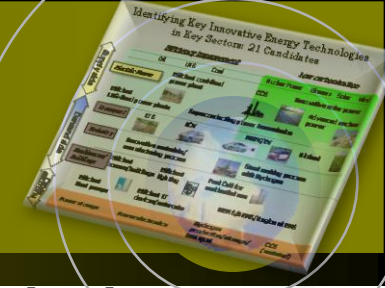
Technology Map

⇒ *Technology Inventory*

図解名の前に記した色付きの記号(▼○●○)は、その技術が寄与する政策目標を表す(▼:総合エネルギー効率の向上、○:運輸部門の燃料多様化、●:新エネルギーの開発・導入促進、○:化石燃料の安定供給とクリーン・有効利用)。
 ・特に政策目標への寄与が大きいと思われる技術については、その寄与が大きい政策目標を、色塗りの記号(▼●★●)で示し、技術名は、黒字で表示して強調した。

Technology Portfolio

Cool Earth - Innovative Energy Technology Program



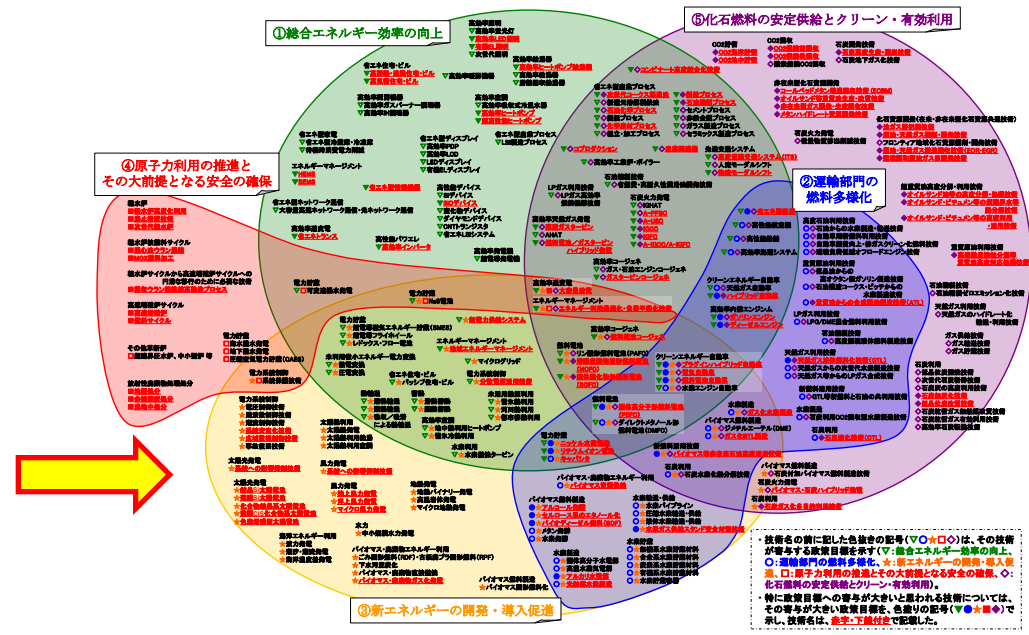
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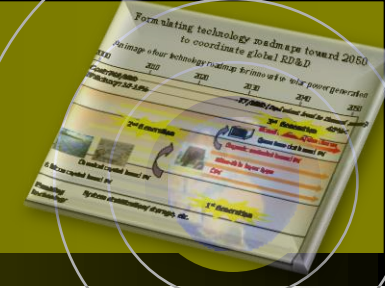
エネルギー技術 一俯瞰図一



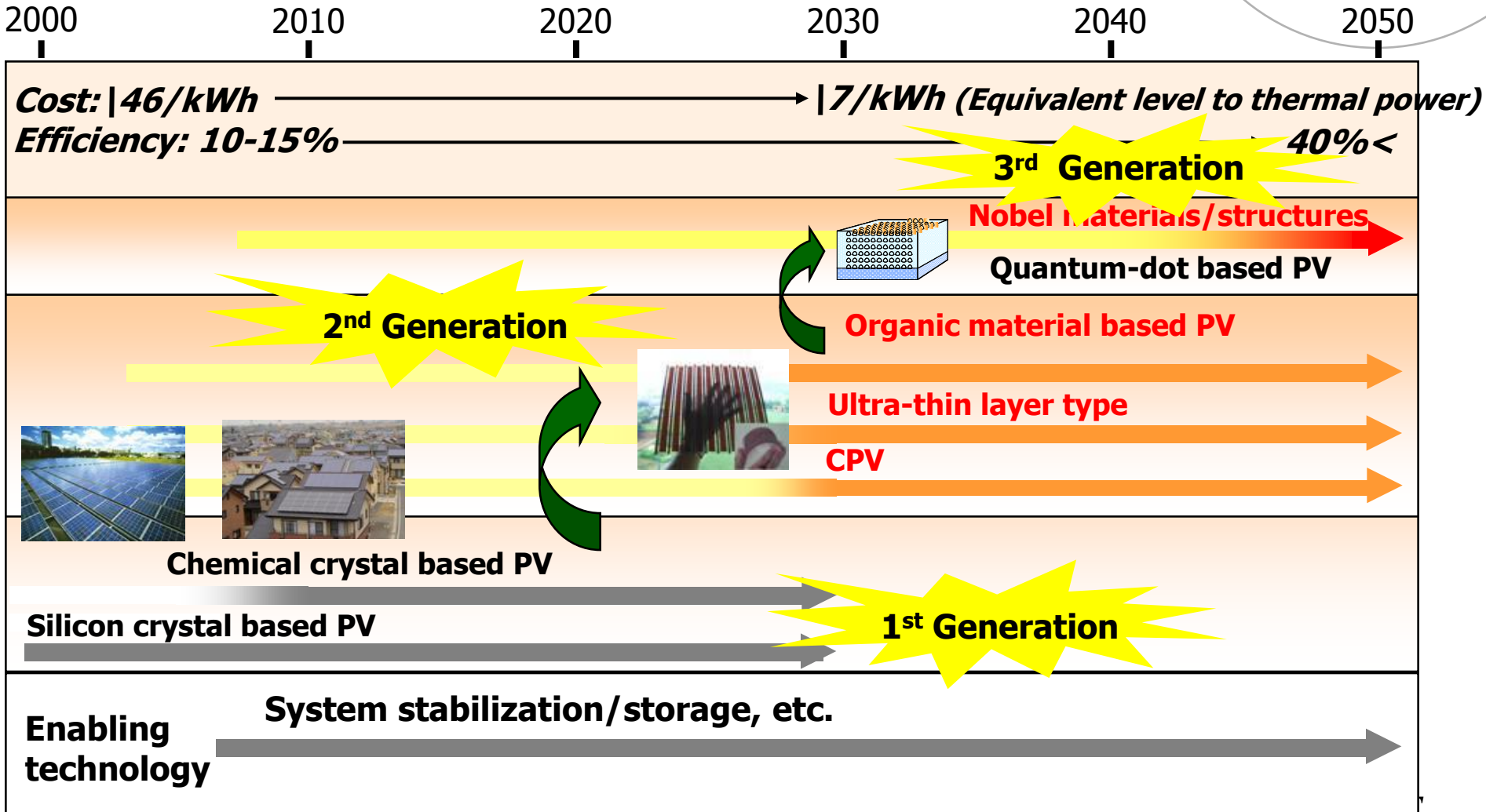
Technology Map

⇒ *Technology Inventory*

Development of Technology Roadmaps

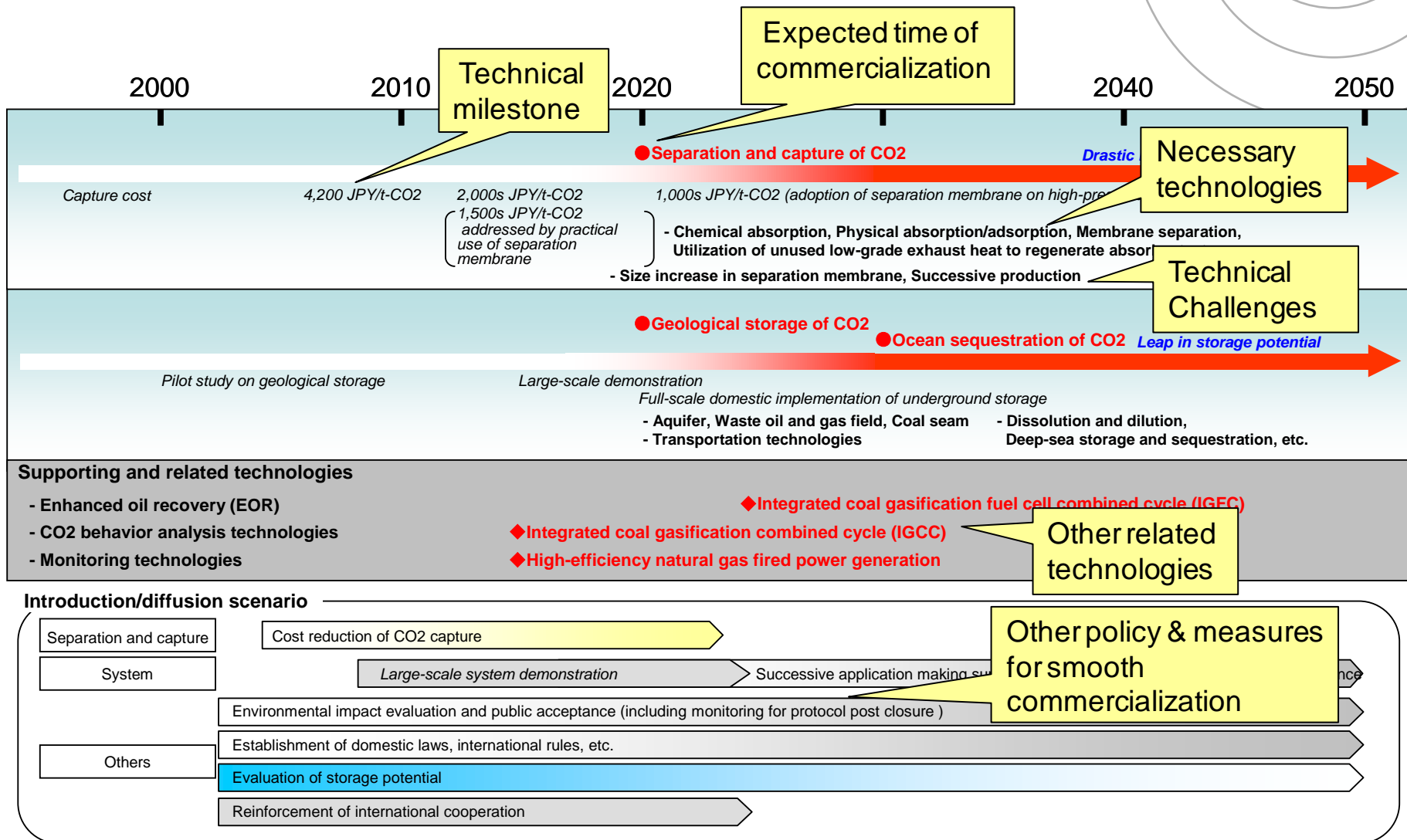
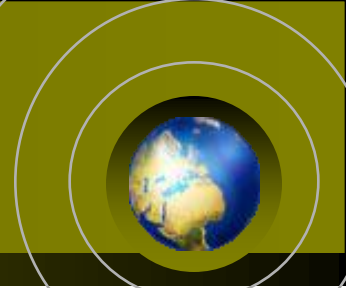


An image of our technology roadmap for innovative solar power generation

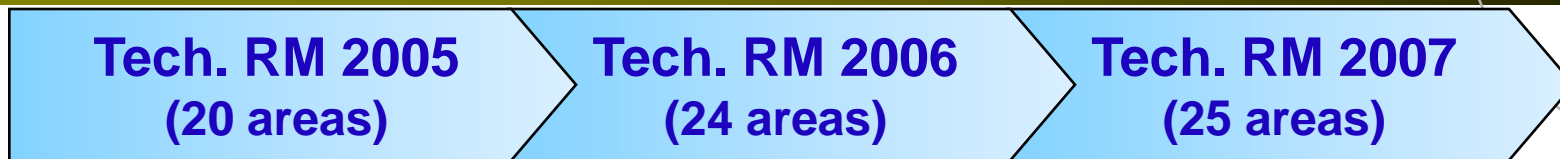
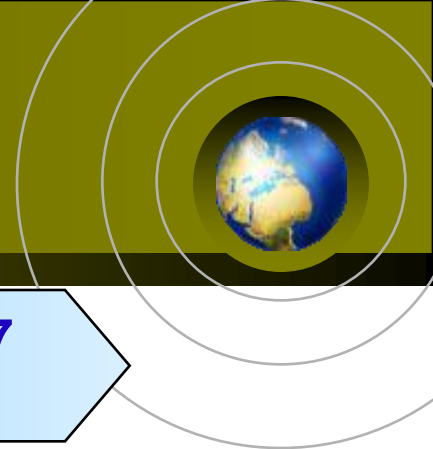


Example of Technology Roadmap (CCS)

Cool Earth - Innovative Energy Technology Program



Utilization of Technology Inventory



Energy Technology Vision 2100
Oct. 2005

Technology Inventory

Technology Inventory

Energy Tech. RM 2006
Nov. 2006 [provisional]

Technology Inventory

Cool Earth - Innovative Energy Technology Program
Mar. 2008

Sectoral Tech. RMs
➤ Energy Efficiency, Fuels, PV,
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Policy Goals

Energy Technology RM 2007
Apr. 2007

New National Energy Strategy
May 2006

Technology Inventory

Energy Basic Plan
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Energy Demand and Supply Outlook
May. 2008

Process – Energy Technology RM

ETV 2100 to Cool Earth Program

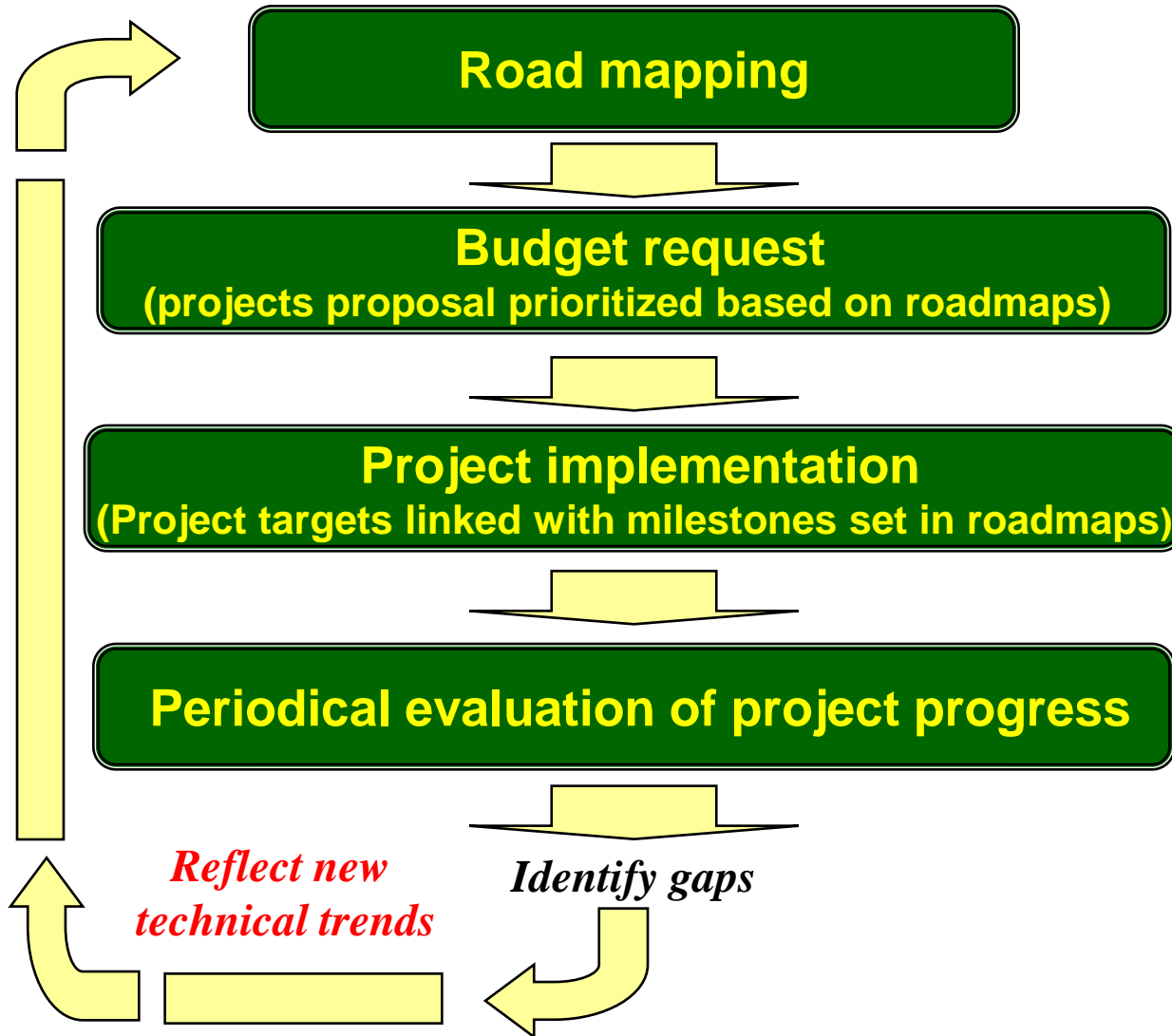
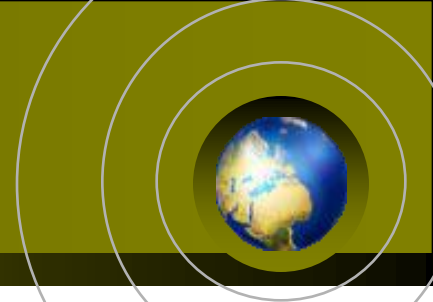


Utilization of well prepared technology inventory

- **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



経済産業省
技術戦略マップ
検索システム

検索質問文
MEMS技術の応用例

AIST

次のような検索質問を入力することができます。

- 人と機械の連携を円滑にする役割
- MEMS技術の応用例
 - MEMS製造技術の応用例
- 家電に関するサービス
 - コンテンツを情報家電に配信するサービス

※ 数は全角のアラビア数字で入力して下さい(3、四…× ⇒ 3、4…○)

開発履歴		
2006	0401	ver.01 限定テスト公開(基本機能、一部データのみ)
	0731	ver.02 限定テスト公開(全データ)
	0901	ver.03 テスト公開(公開)
	0921	ver.04 テスト公開(JSTセンサー導入)
	1030	ver.05 テスト公開(UI改良)
2007	0109	ver.09 公開(センサーの学習機能実装)
	0202	ver.1.0 公開(URL変更)
	0209	ver.1.1 公開(意味構造化完了)

MEMS	技術	応用	例
* MEMS 重要 技術 技術 修飾 プリンティング 加工 マスク 評価 力 先進	* 技術 バイオテクノロジー メカトロニクス 科学技術 技 カーエレクトロニクス テクニク テクノ メカ メカニク	* 応用 アプリケーション 製造 想定 — イメージ 省エネ 資源 日本 代替	* 例 ケース 場合 資源 技術 年度 適用 空力 低減 回収

再検索

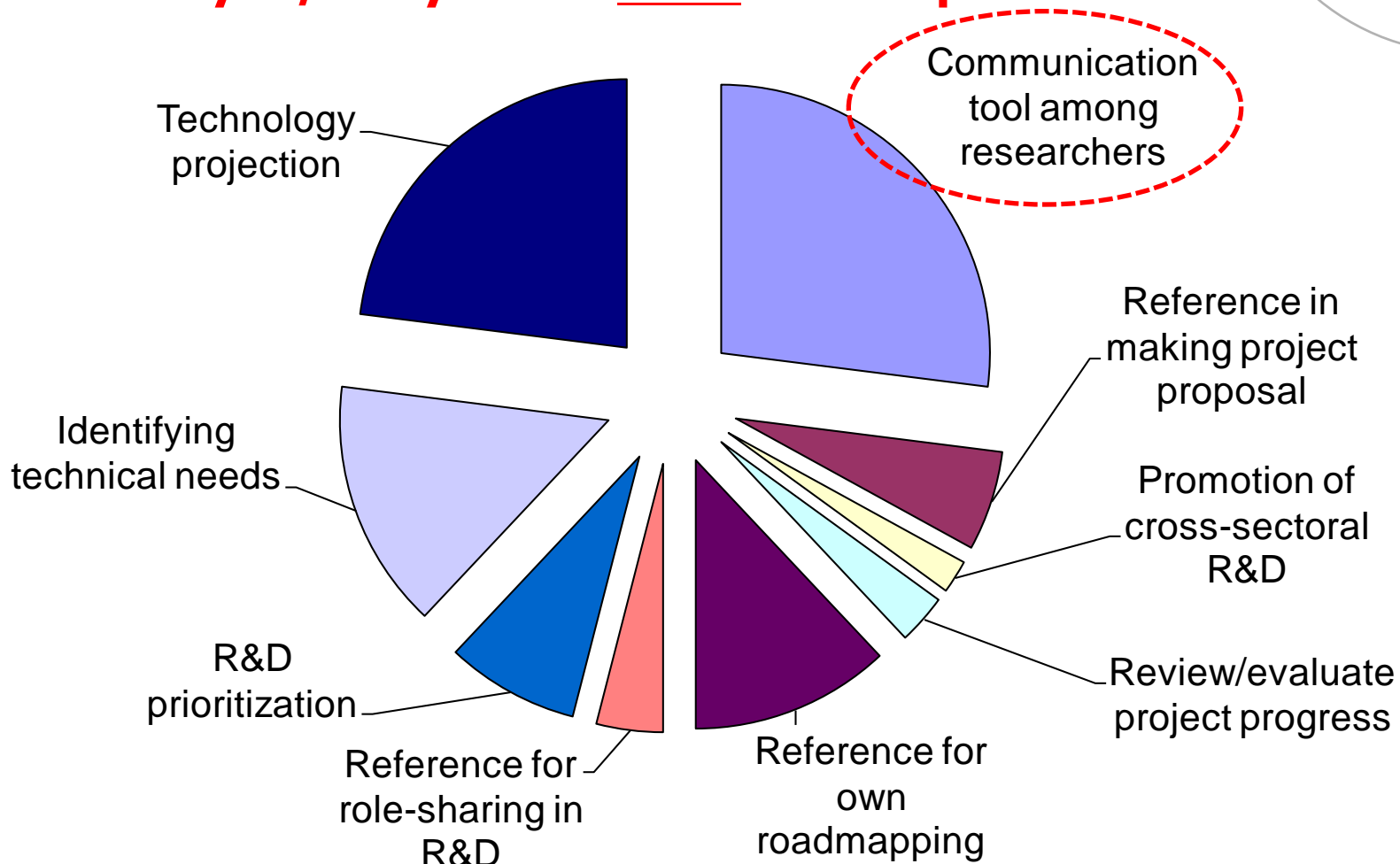
■ Development of “Search Tool” designed specifically to METI’s Technology Roadmap by AIST

- Natural language
- Interactive

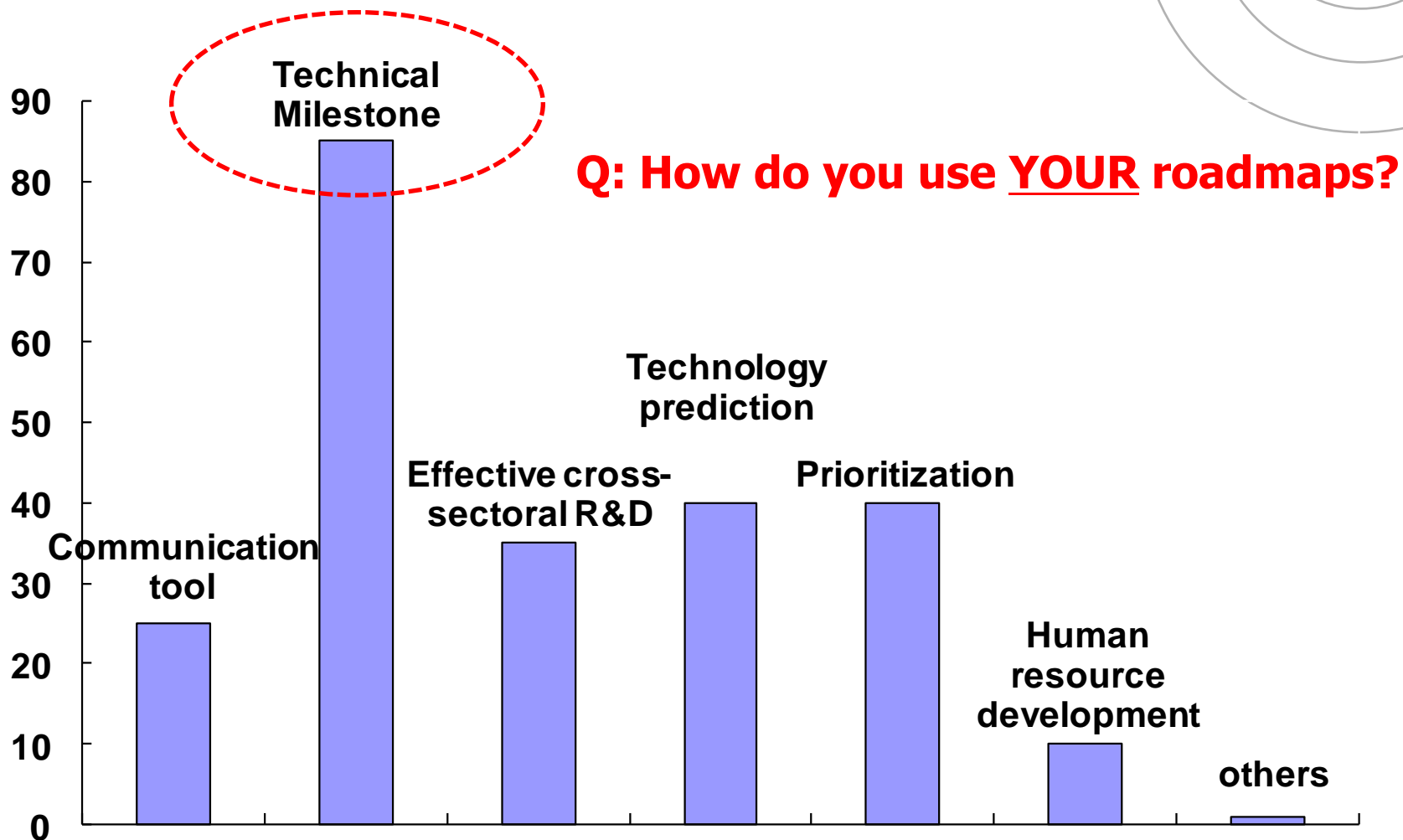
Feedbacks on METI's Roadmaps



How do you/will you use METI roadmaps?



Role of technology roadmaps: *Inquiry to the Private Sector*



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

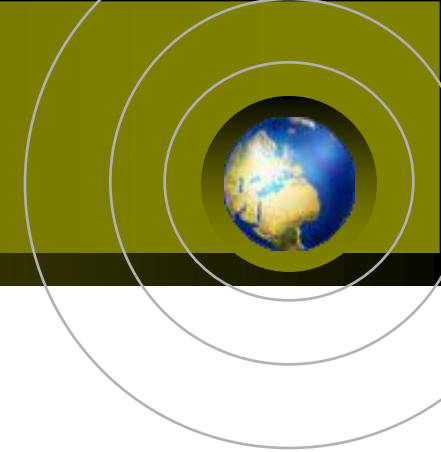
Normative (goal-oriented):

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

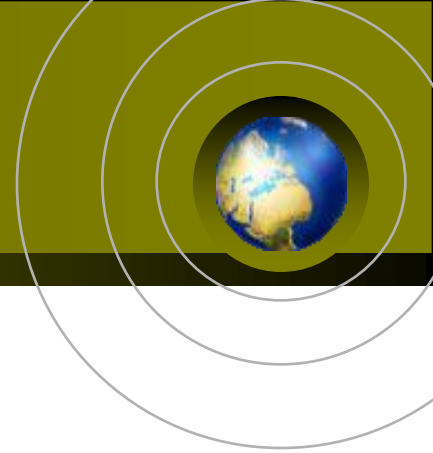
Clement K. Wang & Paul D. Guild

- **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**