

***Cool Earth—Innovative Energy
Technology Program***

May 15, 2008

Toshi SHIRAI

**Agency for Natural Resources and Energy
Ministry of Economy, Trade and Industry**

What is a technology roadmap?

- “A consensus articulation of a scientifically informed vision of attractive technology futures”
 - Branscomb (Former science advisor to US president)
- “Roadmaps communicate visions, attract resources from business and government, stimulate investigations, and monitor progress. They become the inventory of possibilities for a particular field, thus stimulating earlier, more targeted investigations. They **facilitate more interdisciplinary networking and teamed pursuit**”
 - Robert Galvin (Chairman of the Executive Committee of Motorola)

Technology roadmaps in METI

Objectives of roadmaps:

- **As communication tools** for sharing information, exchanging views among technology experts and the government, integrating knowledge and strengthening partnerships among industry, academia, and the government to **build up common understanding on R&D needs and development directions**, which are essential to promote coherent long-term investment
- **As project management tools** to optimize R&D investment by clarifying milestones and objectives, **monitoring progress, identifying gaps and challenges to overcome**
- **As a knowledge base to promote cooperation across sectors, technology areas, and industry-academia partnerships**
- **As tools to fulfill accountability to taxpayers by clarifying pathways from R&D to commercialization and the public benefit**

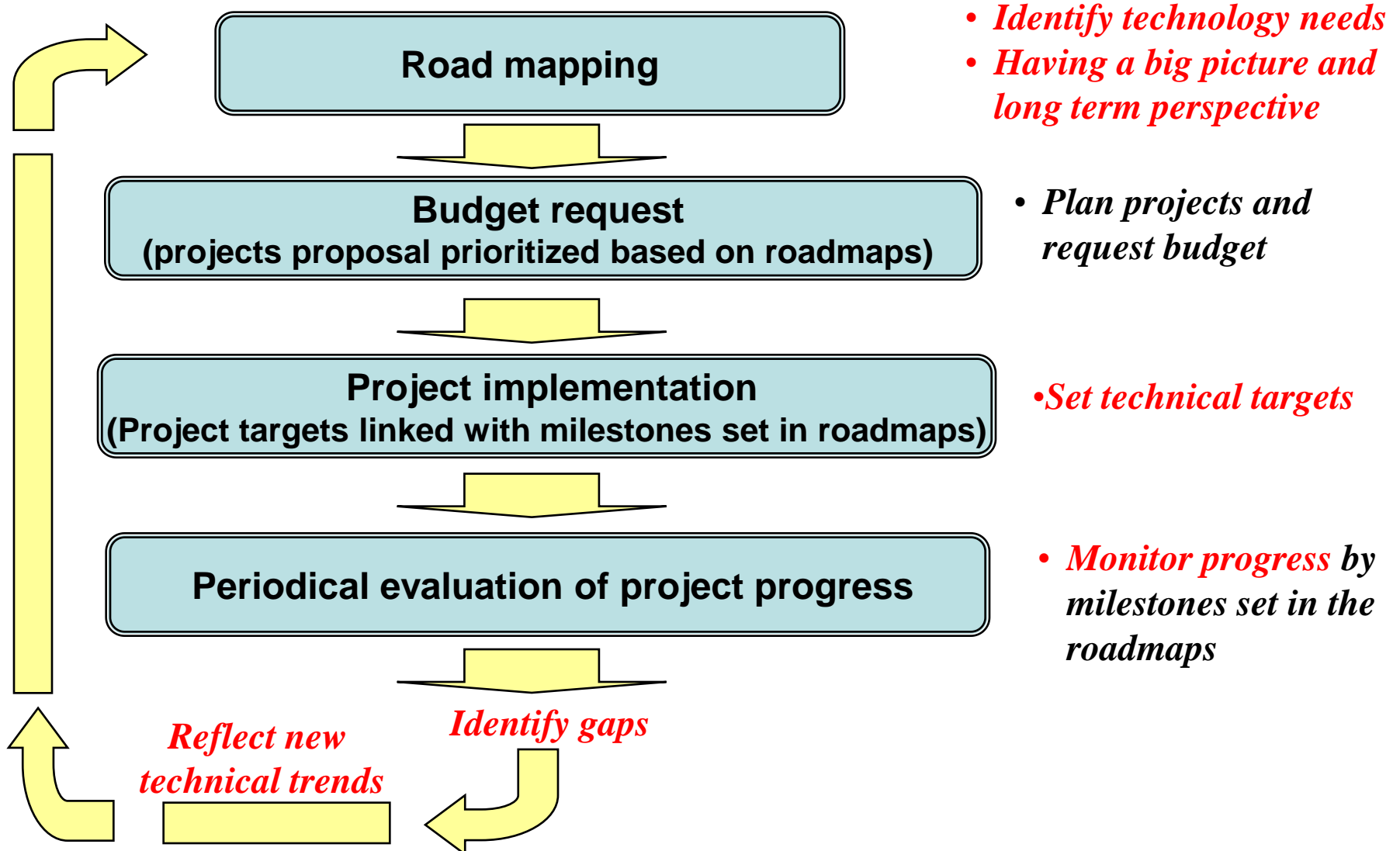
Road mapping process

- **Set up task forces in corporation with NEDO, AIST and other institutions, which are composed of experts from academia, industry, and public research institutions (about 700 experts totally) to incorporate the best available information**
- **Develop roadmaps for 29 areas including energy**
- **Conduct intensive discussion on roadmaps**
- **Undertake an annual reviewing process to reflect the latest technological trends & progress in R&D projects**

Key elements in roadmaps

- Pathway to commercialization (basic research, applied research, demonstration, 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)

Implementing roadmaps: Project Management Cycle



Cool Earth- Innovative Energy Technology Program - Outline -

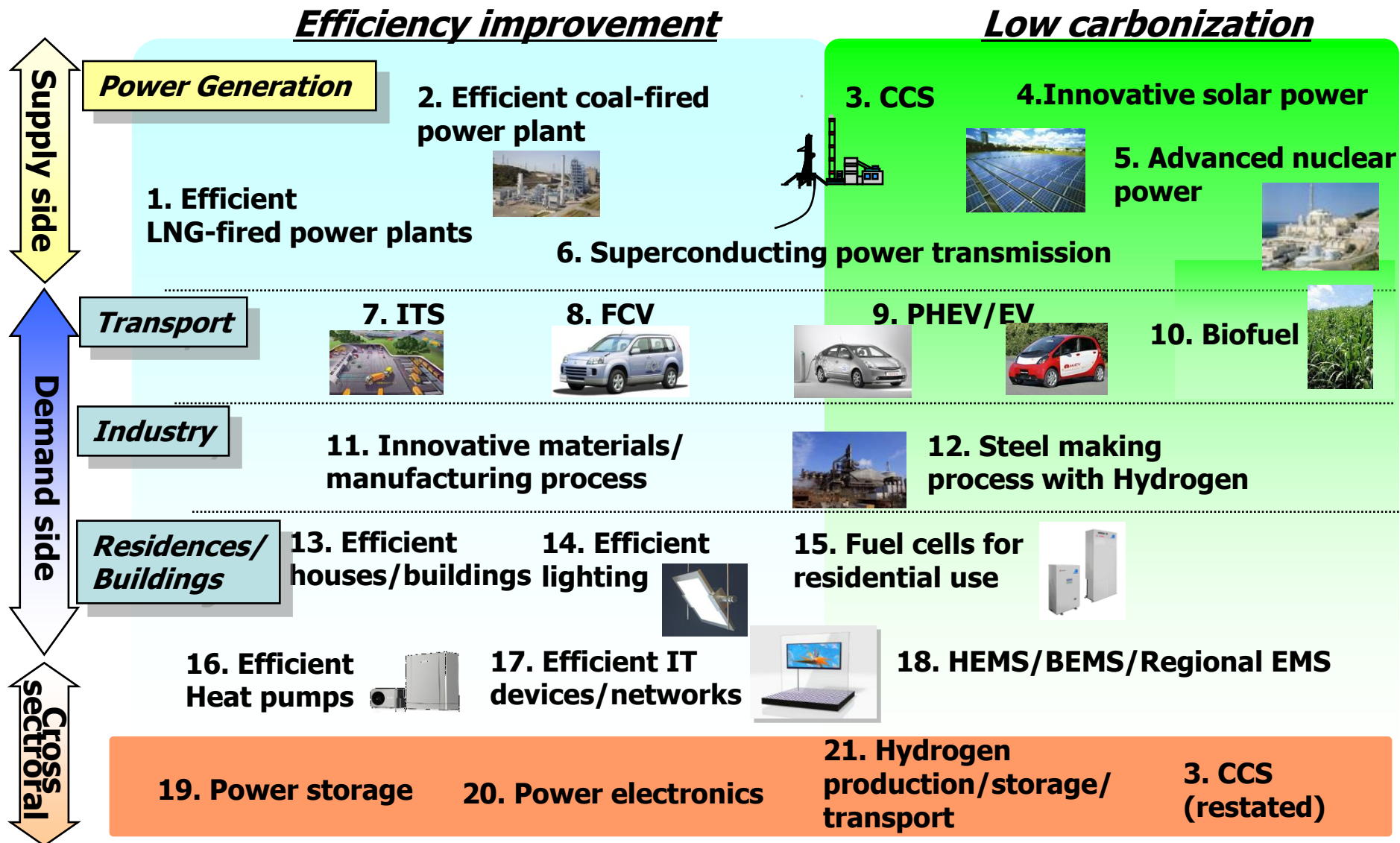
• Japan has formulated “Cool Earth - Innovative Energy Technology Program” to address substantial reduction in the long-term through innovative energy technology RD&D.

- ✓ Committee has been set under Minister Amari (discussed by experts from industry, academia, public research institutions).
- ✓ Identified 21 key energy technologies to be focused on with high priority.
- ✓ Formulated technology roadmaps for them, which give RD&D direction and milestones on performance with timelines.
- ✓ Strengthen international cooperation to accelerate innovative technology RD&D.

Criteria for narrowing down the focus of innovative energy technology sector by sector

1. Deliver substantial reductions in CO₂ emissions in the world by 2050:
 - Commercialized by 2030 considering the period required for the diffusion of the technology, and
 - Commercialized after 2030 if the period required for diffusion is short.
2. Deliver substantial performance through:
 - Material innovation (e.g. PV with new structures or materials, etc.)
 - Innovation in production processes (e.g. hydrogen used steel making process, etc.)
 - Demonstration of systems based on established elemental technologies (e.g. CCS)
3. Technologies that Japan can lead the world in developing

21 Key Innovative Energy Technologies



Formulation of technology roadmaps

- Analyze Japan's position in technology
 - Focus our resources where we have technological advantages
 - Severe competition in the world does NOT allow us to take our advantage for granted: substantial action taken by the U.S., EC, South Korea & China, etc.
- Indicate pathway to commercialization to develop common understanding on technical challenges and RD&D direction
 - Timeline for R&D, Demonstration, and Diffusion
- Reveal technical milestones
 - Relied on expert judge
- Identify challenges for deployment

R&D

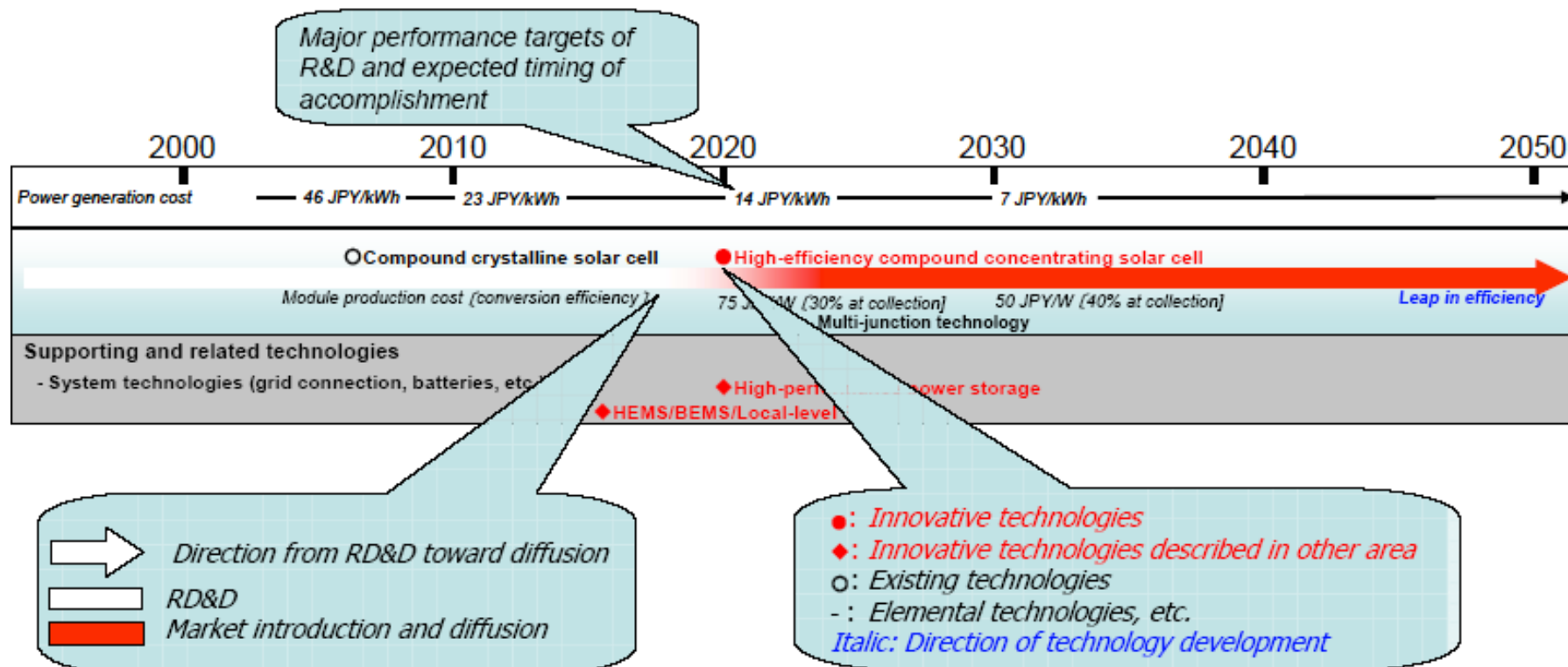
Demonstration

Deployment, diffusion

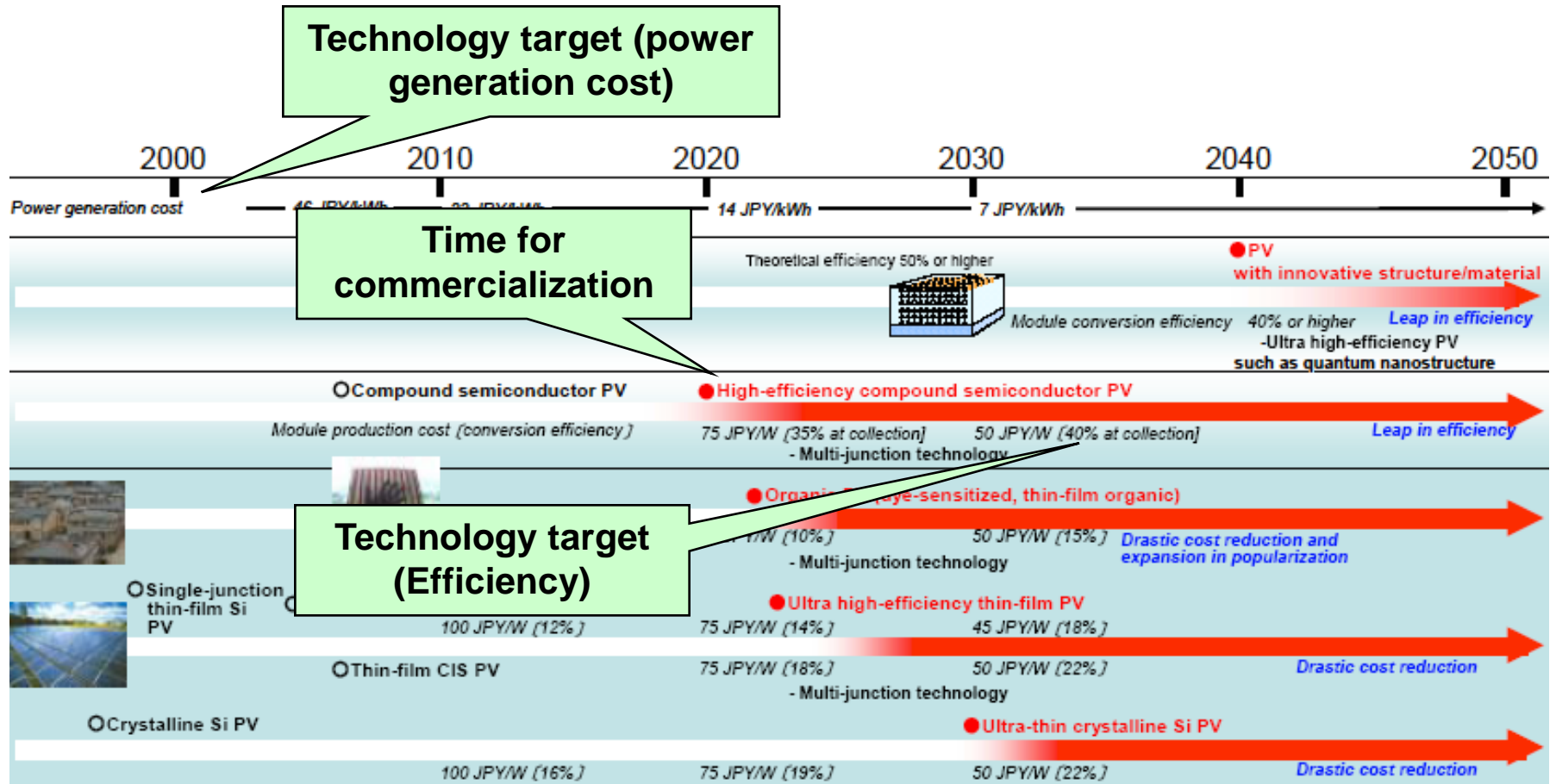


ORD&D Roadmap

Milestones including elemental technologies to promote RD&D and the direction of RD&D for 21 Innovative Technologies are developed on temporal axis. Relevant supporting technologies are also referred to.



Example of PV technology roadmap toward 2050



\$630 M requested for FY 2008 as an initial action to implement the roadmap

Power generation

- Zero-emission coal fired power plants : \$40M
- Fast reactor cycle: \$50M
- Innovative PV: \$20M



Industry

- Innovative Steelmaking: \$6M
- Innovative Glass melting process: \$4M



Transport

- Power storage for EV, etc: \$83M
- PEFC type fuel cell technology development: \$67M



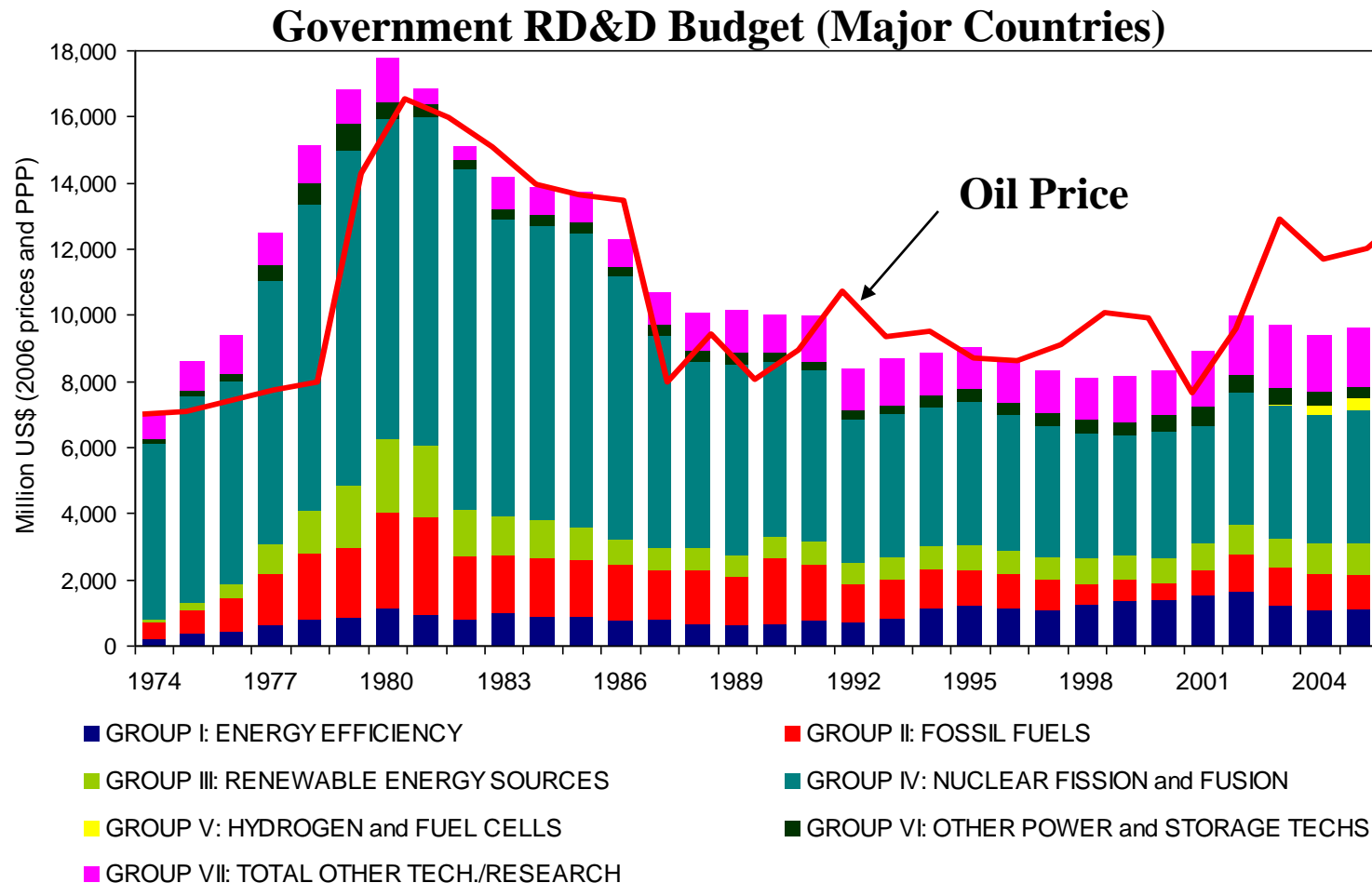
Commercial/Residential

- Green IT (Efficient IT device & Network): \$30M



Need for international action

Public RD&D spending in the energy field has been stagnating recently, so it is essential to secure substantial investment for innovative technologies.



Source: IEA



Global efforts are needed to secure the investment!!

International Cooperation

- Effective use of Technology Roadmaps to Accelerate RD&D-

- **Building up common understanding** on technologies in need and challenges to be overcome in continuous road-mapping process
- **Help formulate technology strategy and promote action to achieve long-term goals, common understanding on technology R&D needs** by clarifying technology milestones/challenges to **be overcome**
- **Promote long-term, coherent investment** in energy technology to address climate change by clarifying technology direction
- **Ensure global efforts and promote steady progress** through reviewing technology progress based on the roadmaps
- **Identify areas of focus** where further global efforts or cooperation is needed, by clarifying the gap between what has been done and what is needed
- **Promote coherent, systematic approach** to international technology cooperation

Enhancing International Cooperation

- Building upon existing partnerships-

- CCS: FutureGen, CSLF, APP
- Nuclear: GNEP, GIF
- Fuel cells: IPHE
- Others: Implementing agreements in IEA

- Promoting further collaboration (Examples)-

- CCS
 - ✓ Promote CCS demonstration under international cooperation, enhance cross-linking among international partnerships (launched China-Japan CCS-EOR project & Callide A project between Australia and Japan)
- Innovative steel making: Participate in IISI program, joint programs in the EU
- Innovative PV: International COE program for 3rd Generation PV
- Green IT: Holding an international symposium, sharing information on R&D

Suggestion for future work on international energy technology roadmaps

- Need to launch continuous process for roadmapping
- Engage various stakeholders
- Extract as much information as possible from existing roadmaps for key technologies (milestones, time for commercialization, best practices on P&M)
- Develop “top-runner” roadmaps as reference/benchmark for national actions
- Stock take current RD&D actions & progress
- Identify gap and recommend future action (areas for int’l cooperation, etc)

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
- “Cool Earth Innovative Energy Technology Program”
http://www.meti.go.jp/english/newtopics/data/nBackIssue20080305_04.html