Challenges and Successes in Technology Roadmap Implementation

Lessons Learned from Public and Private Sector Roadmaps

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16 May 2008
Energy Technology Roadmaps Workshop
International Energy Agency
Paris, France
Agenda

• Roadmap Experience
• Successful Energy Technology Roadmaps
• Strategies for Implementation
• Results and Impacts
• Lessons Learned
Energetics Experience with Technology Roadmaps

- Created 100+ technology roadmaps since 1997 in energy, manufacturing, security, health, and basic science

- Led international roadmap efforts on six continents

- Consulted with national governments on roadmapping techniques

- Energetics’ techniques and methods cited in two global studies of roadmapping best practices
Energetics Energy Technology Roadmaps
(Partial Inventory)

**Energy Efficiency and Productivity**
- Aluminum (5)
- Chemicals (5)
- Combustion
- Petroleum Refining
- Forest Products
- Forging
- Metal Casting
- Process Heating
- Steel
- Vehicle Lightweighting

**Energy Technologies**
- Crop-Based Renewable Resources
- Fuel Cells
- Hydrogen Energy (3)
- Natural Gas (4)
- Propane (3)
- Oil Heat
- Nuclear Energy
- Photovoltaics

**Energy Strategies**
- Combined Heat and Power (CHP)
- Carbon Sequestration
- Grid 2030: A Vision for Electricity’s Next 100 Years
- Efficient Lighting for Buildings
- Electric Cooperatives
Types of Technology Roadmaps

**Product** – Single organization, highly focused, detailed steps and timelines, structured implementation

**Technology** – Multiple organizations, options linked through technology pathways, priorities and timeframes defined, implementation varies

**Complex Issue** – Many stakeholders, multifaceted issues, focus on common goals and outcomes, technology portfolios, implementation challenging

Implementing complex roadmaps is very challenging and requires special strategies
Partnering for Success
Aligning Public and Private Goals

Government Goals

Private Sector Goals

Common Goals

Mutual Benefit

Sources of Industry R&D Funding in OECD Countries

Private Sector and Other

Government

SOURCE: OECD, Main Science and Technology Indicators (2006).
Anatomy of an Excellent Roadmap

Logical structure; priorities aligned with goals

Priorities and time frames

Senior-level vision and commitment

Layered, digestible information

Clear technology pathways

Implementation and action plans

Key Technical Tasks

1. Protocol for rock mass characterization
2. Protocol for explosive characterization & selection
3. Model to link 1 & 2
4. Model validation
   a. Define project
   b. Funding and support

Expected Benefits/Metrics

Next Steps

Project Leader & Partners

Partners

- ORICA
- HSBM
- GEMM (P843)
- UQ/JK/SMI
- TRICOMIN/IM2/ASPB
- LOP
- AMIRA CHILE

Short proposal expression of interest

Proposal development (w/i 1-year)

Timeline

Breakout Group:

- Mining
- Preparers:
  - RS, FG, JC, GC

Schedule

Milestone

Implementation and action plans
Roadmap Challenges and Success Factors

- Include the right people at each stage
- Get senior-level buy-in early
- Define a clear scope
- Balance consensus with technical detail
- Encourage non-linear thinking
- Identify ways to accelerate technology development
- Outline a realistic implementation strategy
- Identify champions, commit to action
Considerations for Energy Technology Roadmaps

- Energy: complex and multi-dimensional – a good roadmap application
- Large stakeholder community
  End users, manufacturers, technology developers, government agencies, researchers, interest groups
- Balanced portfolio vs. focus technologies
- Complex, capital-intensive infrastructures
- Mature vs. immature technology platforms
- Long time horizons for results to appear

Typical Roadmap Development Process

1. **Form Senior-Level Steering Group**
2. **Prepare Technology Roadmap**
3. **Identify Technology Development Pathways**
4. **Establish Priorities and Time Lines**
5. **Establish Shared Vision and Goals**
6. **Implement Roadmap via Partnerships**
7. **Communicate and Socialize the Roadmap**
8. **Monitor Progress, Update As Needed**

The process is iterative, with feedback loops between each step.
Roadmap Implementation: A Show Stopper?

- Complex, multi-party roadmaps are hardest to implement
- New collaborative ideas often at odds with organizational inertia
- Innovative technologies require long-term commitment
- Roles and responsibilities often poorly defined
Key Implementation Issues

• Clarify roadmap ownership, find champions
• Clearly communicate the value proposition to investors
• Provide sufficient technical detail for action
• Coordinate with government and business funding cycles
• Engage the right people during implementation
• Determine how the roadmap will be implemented (collaboration, coordination, central)
Strategies for Success: Three Paths

**Coordinated**
- Led and facilitated by a single organization
- Roadmap defines common vision & technology options
- Roles of public and private partners clearly defined
- Roadmap issued and publicized
- Partners fund own roadmap activities using a common framework

**Collaborative**
- Conceived and organized by interested partners
- Roadmap defines technology pathways and priorities
- Roadmap socialized with key partners
- Existing or new organizations formed to oversee roadmap
- R&D efforts monitored, reviewed, and guided by partners

**Centralized**
- Conceived and led by a single organization
- Roadmap targets a few priority technology needs
- Action plans developed for top priorities
- Projects developed; funds gathered/allocated for projects
- Projects initiated, managed, and monitored by a single organization
Case Study 1: Energy Control System Security

• Identifies energy sector’s most critical cyber security challenges and needs
• Industry-driven synthesis of public and private sector input
• Provides strategic framework necessary
  – to align multitude of public and private programs
  – To align investments to address security needs in a timely and efficient manner
• Implementation guided by expert public-private steering group
Case Study 1: Energy Control System Security

1) Key Alliances Formed

- Owners & operators
- Equipment vendors
- Industry organizations
- Government agencies
- Researchers

2) Roadmap Outlined

- Priorities and Timing

3) Existing R&D Identified

- Web-based ieRoadmap developed
- >80 projects identified
- All projects linked to the roadmap

4) Expert Group Formed

- Identify gaps and opportunities
- Guide public and private investment
Case Study 2: Hydrogen Energy Roadmap

- A National Vision for America’s Transition to a Hydrogen Economy: To 2030 and Beyond, 2001
- National Hydrogen Energy Roadmap, 2002
  - Contributions from 300+ individuals representing 120+ organizations in public and private sectors
- International Partnership for a Hydrogen Economy (IPHE) formed, 2003
  - 16 member countries plus EC
- China, India, Brazil conduct H₂ roadmapping
Results and Impacts

National Hydrogen Energy Roadmap (US)

- Directed investment of $1.2 billion in US
- Stimulated global H$_2$ research and coordination through IPHE

Aluminum Industry Inert Anode Roadmap

- Inert anode top priority in 1997 Aluminum Roadmap
- Detailed *Inert Anode Roadmap* presented clear development path to address this priority
- Aluminum Roadmap updated in 2003; inert anode removed from priority list due to successful R&D
Results and Impact

U.S. Propane Education & Research Council (PERC)

- Roadmaps built industry support for increased PERC funding
  - PERC funded through industry-paid assessment ("self-taxed")
- Robust pipeline of new technologies now entering marketplace, including:
  - Propane F-150 pick-up truck
  - Desiccant dehumidifier
Lessons Learned

• It’s all about the end game: getting it “perfect” not as important as getting it “going”
• A compelling value proposition is essential
• Clarify expectations for implementation
• Combine short-term returns (quick hits) with long-term commitment
• Champions and leaders make the difference
• Better to improve the effectiveness of private R&D by 10% rather than design the ideal government R&D program
Checklist for Successful Implementation

- Have a strategy for the end game – who will commit to actions and resources?
- Select an implementation approach that fits your situation and desired outcomes
- Engage partners and develop action plans through the roadmap development process
- Socialize the roadmap through a proactive outreach process
- Link key public and private initiatives
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