

Challenges and Successes in Technology Roadmap Implementation

Lessons Learned from Public and Private Sector Roadmaps

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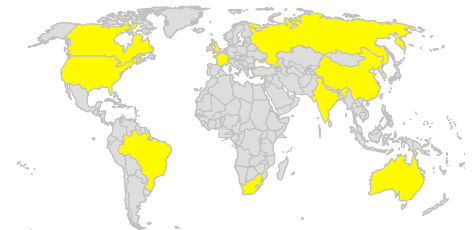
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Energy Technology Roadmaps Workshop
International Energy Agency
Paris, France

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

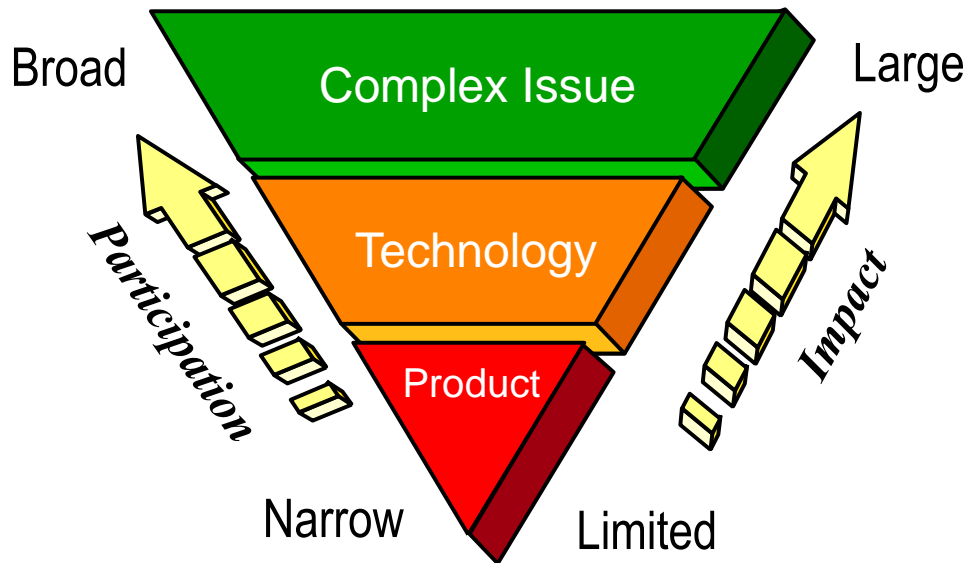
Energy Technologies

- 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



Implementing complex roadmaps is very challenging and requires special strategies

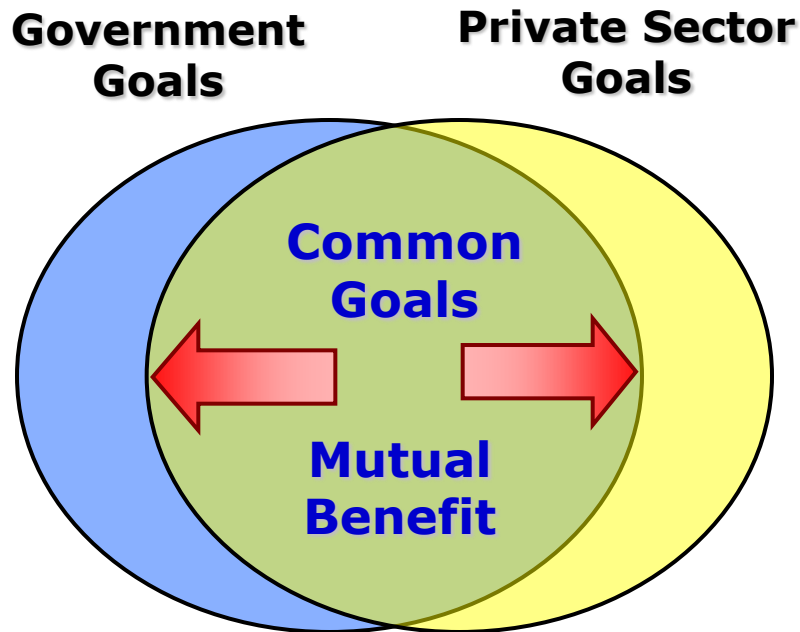
Product – Single organization, highly focused, detailed steps and timelines, structured implementation

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

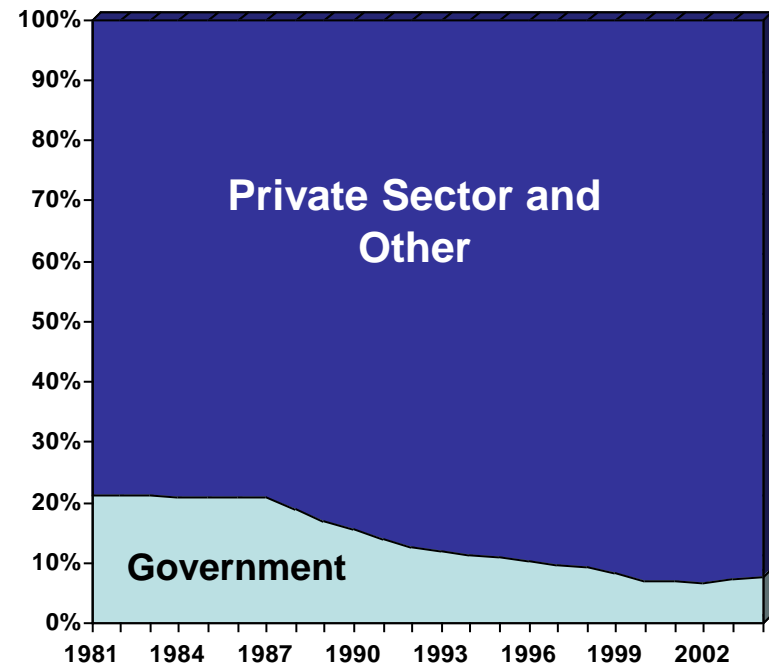
Complex Issue – Many stakeholders, multifaceted issues, focus on common goals and outcomes, technology portfolios, implementation challenging

Partnering for Success

Aligning Public and Private Goals



Sources of Industry R&D Funding in OECD Countries



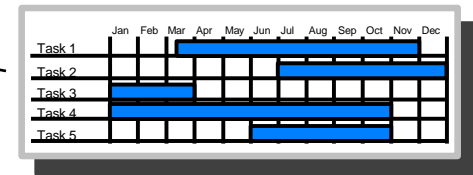
SOURCE: OECD, Main Science and Technology Indicators (2006).

Anatomy of an Excellent Roadmap



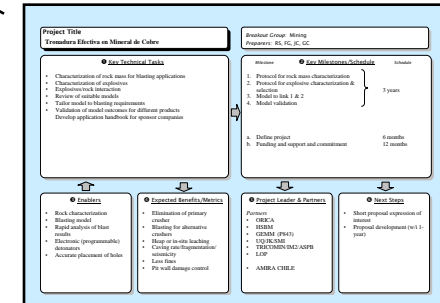
Logical structure; priorities aligned with goals

Priorities and time frames

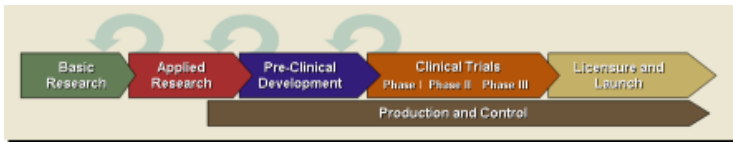


Senior-level vision and commitment

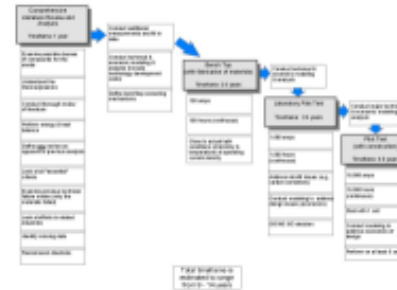
Implementation and action plans



Clear technology pathways



Layered, digestible information

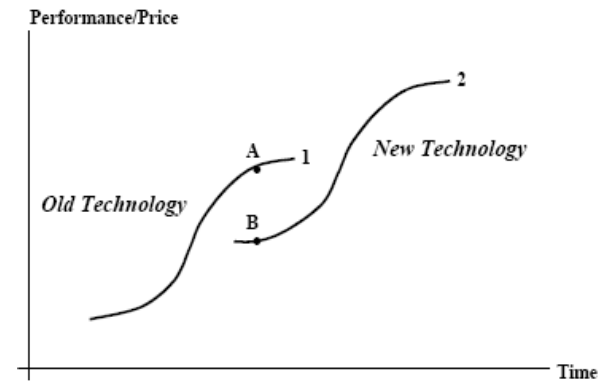


Roadmap Challenges and Success Factors

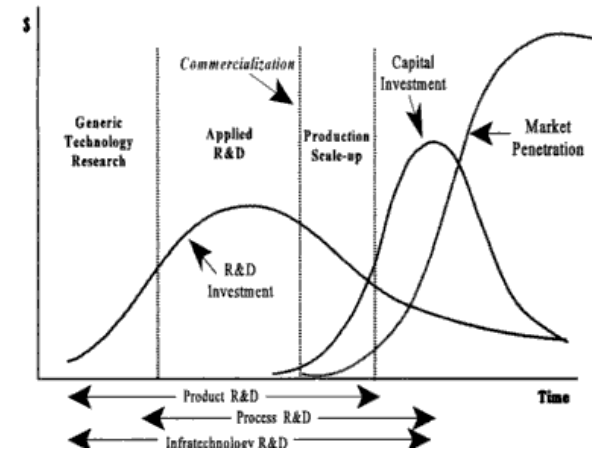
- Include the right people at each stage
- Get senior-level buy-in early
- Define a clear scope
- Balance consensus with technical detail
- Encourage non-linear thinking
- Identify ways to accelerate technology development
- Outline a realistic implementation strategy
- Identify champions, commit to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

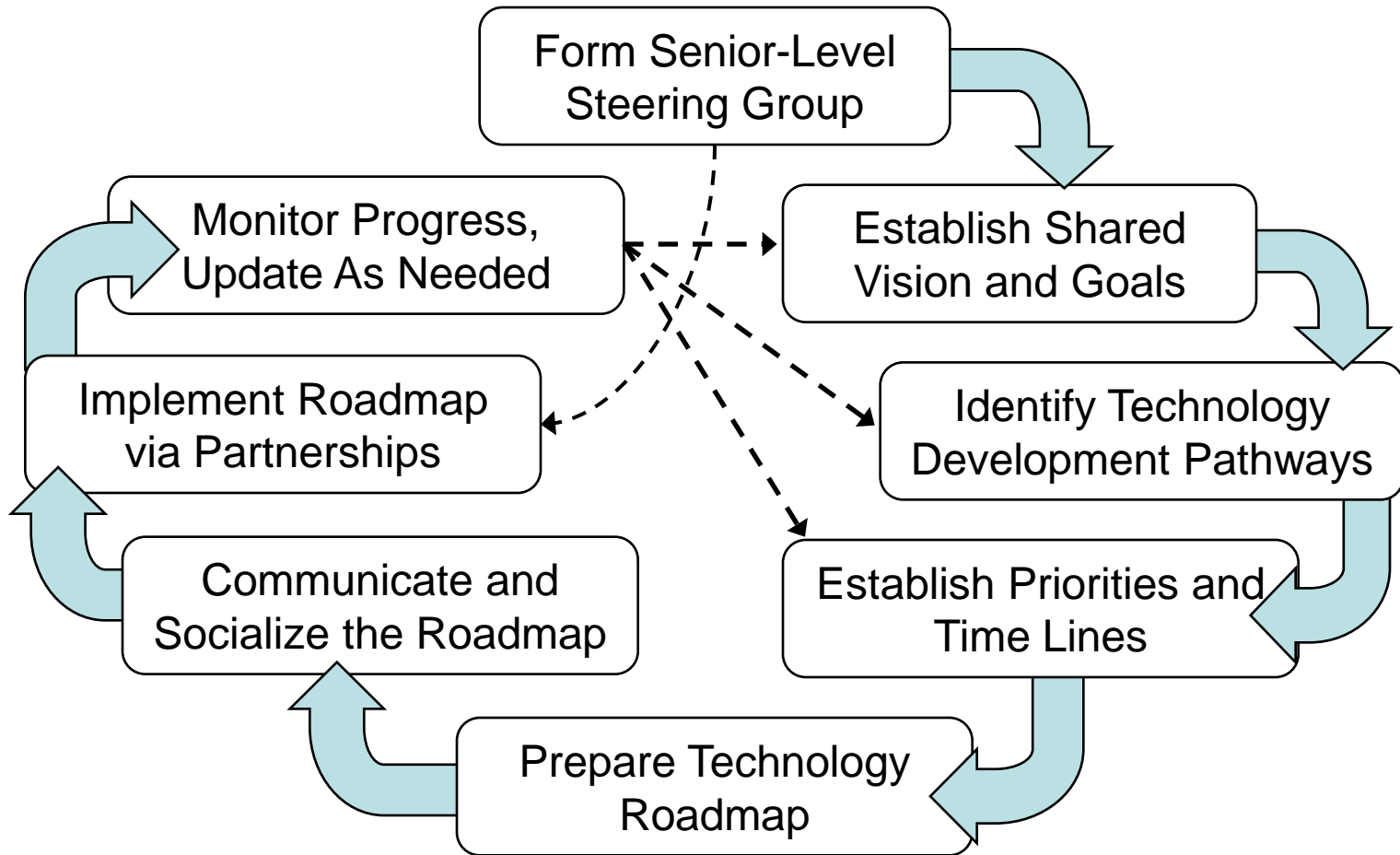


Source: G. Tasse, *The Economics of R&D Policy*, Quorum Books, 1997, Chap. 7



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Typical Roadmap Development Process



Roadmap Implementation: A Show Stopper?

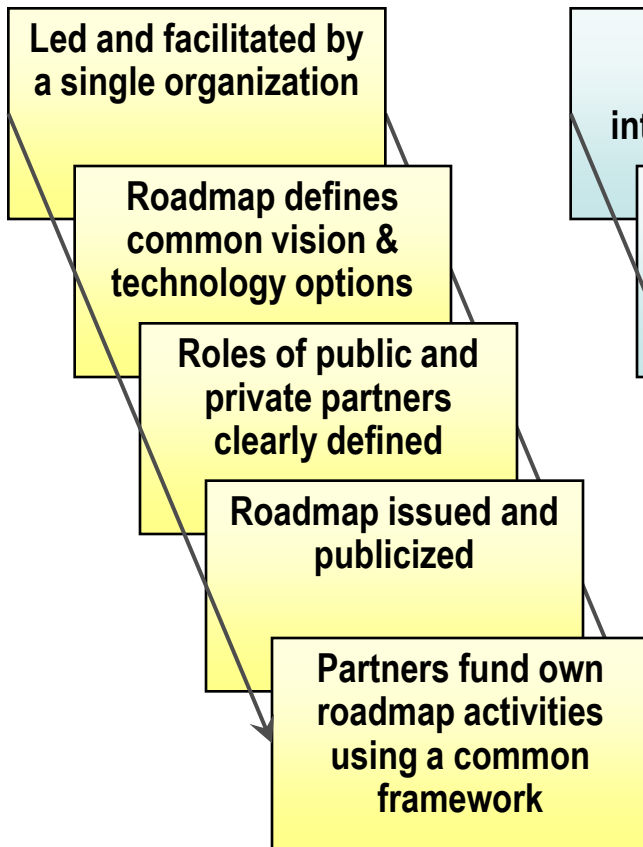
- Complex, multi-party roadmaps are hardest to implement
- New collaborative ideas often at odds with organizational inertia
- Innovative technologies require long-term commitment
- Roles and responsibilities often poorly defined

Key Implementation Issues

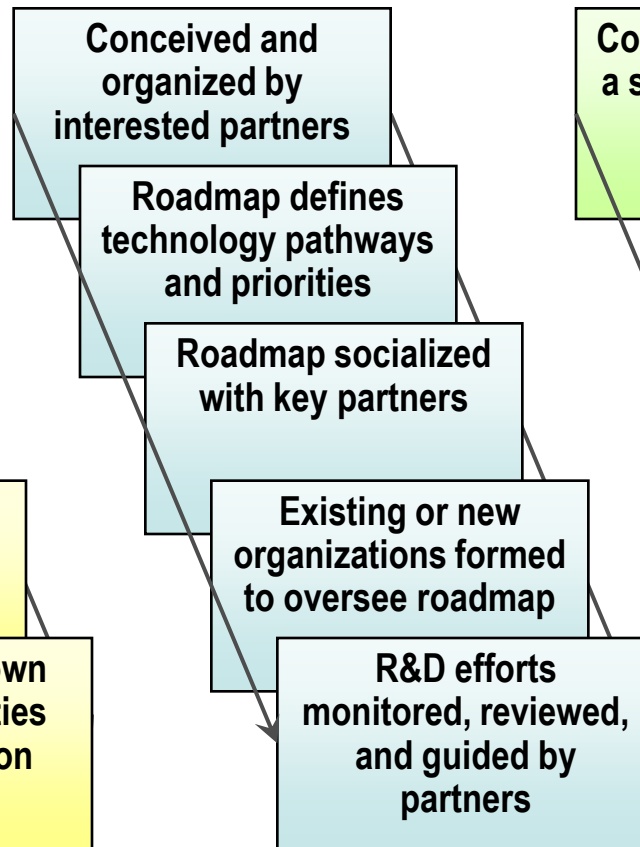
- Clarify roadmap ownership, find champions
- Clearly communicate the value proposition to investors
- Provide sufficient technical detail for action
- Coordinate with government and business funding cycles
- Engage the right people during implementation
- Determine how the roadmap will be implemented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

Strategies for Success: Three Paths

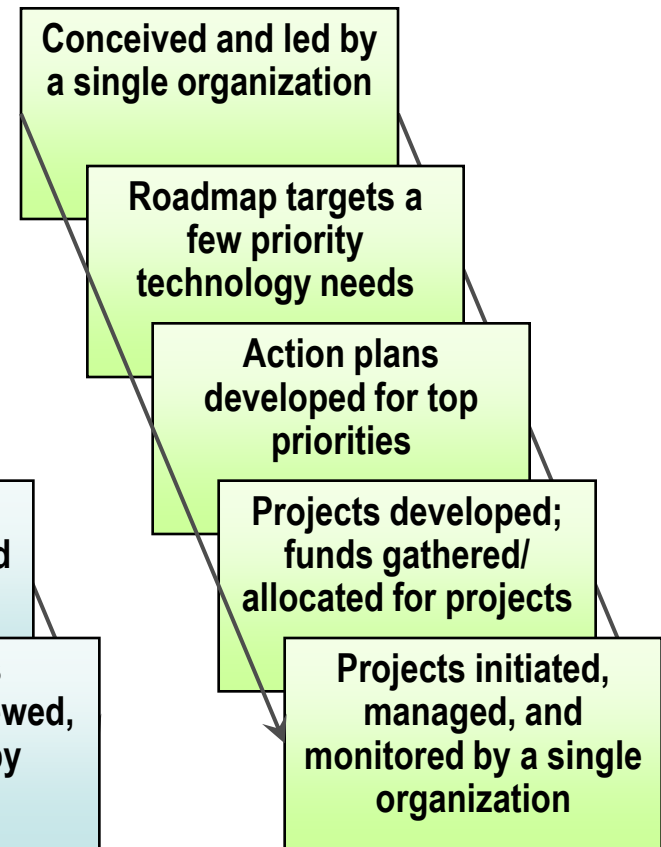
Coordinated



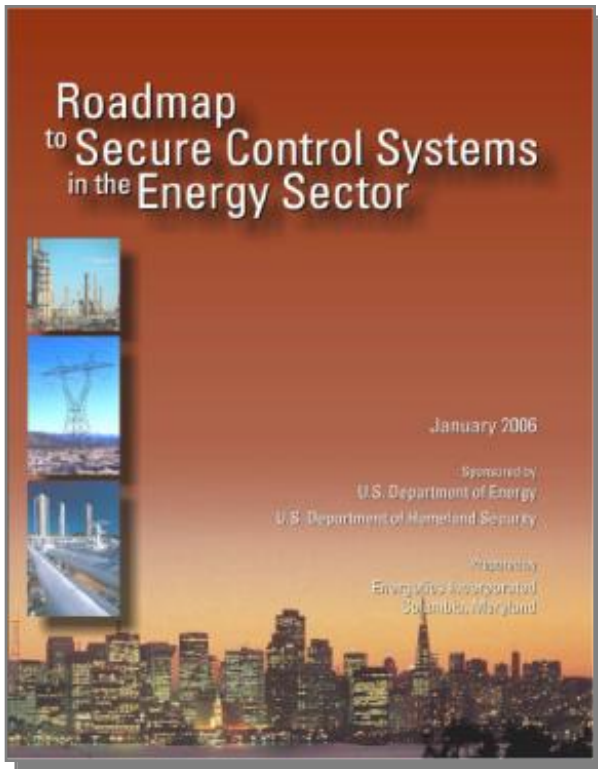
Collaborative



Centralized



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

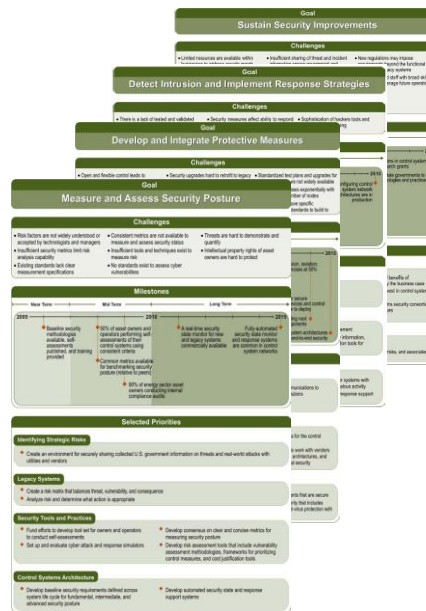
Case Study 1: Energy Control System Security

1) Key Alliances Formed



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

2) Roadmap Outlined Priorities and Timing



3) Existing R&D Identified

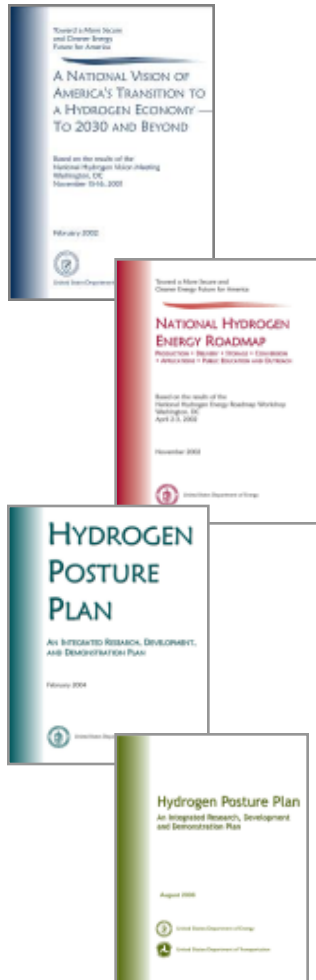


- Web-based *ieRoadmap* developed
- >80 projects identified
- All projects linked to the roadmap

4) Expert Group Formed

- Identify gaps and opportunities
- Guide public and private investment

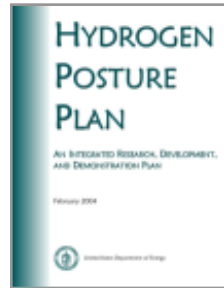
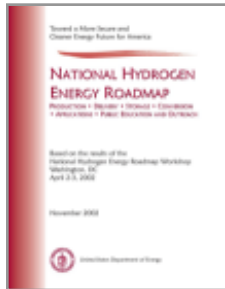
Case Study 2: Hydrogen Energy Roadmap



- 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
- Hydrogen Posture Plan provides detailed technology pathways, 2004, 2006 update
- China, India, Brazil conduct H₂ roadmapping

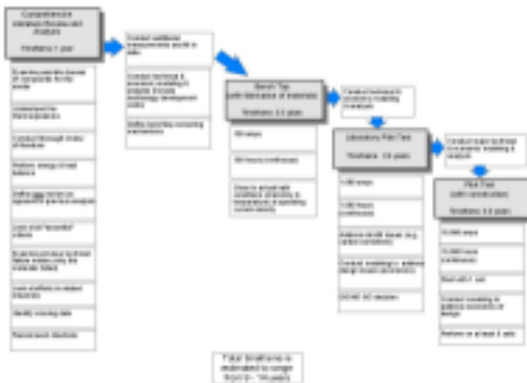
Results and Impacts

National Hydrogen Energy Roadmap (US)



- Directed investment of \$1.2 billion in US
- Stimulated global H₂ research and coordination through IPHE

Aluminum Industry Inert Anode Roadmap

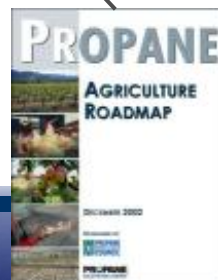
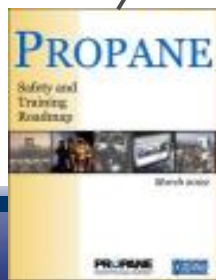
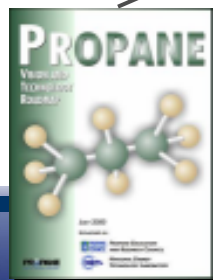
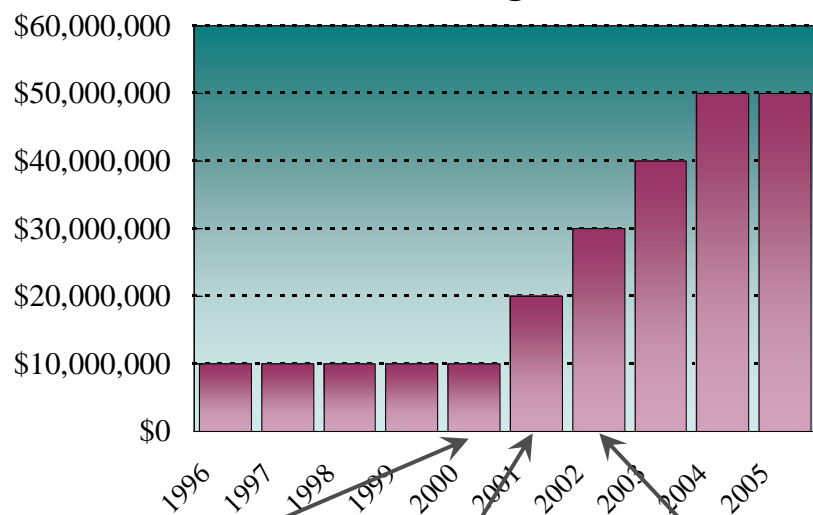


- Inert anode top priority in 1997 Aluminum Roadmap
- Detailed *Inert Anode Roadmap* presented clear development path to address this priority
- Aluminum Roadmap updated in 2003; inert anode removed from priority list due to successful R&D

Results and Impact

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

Propane Education & Research Council Annual Budget



- 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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