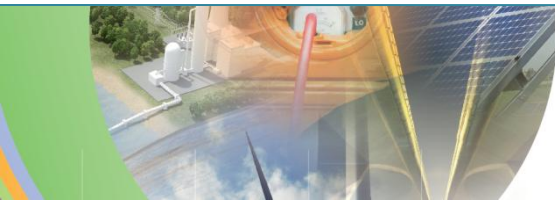


Introduction to Energy Technology Roadmaps

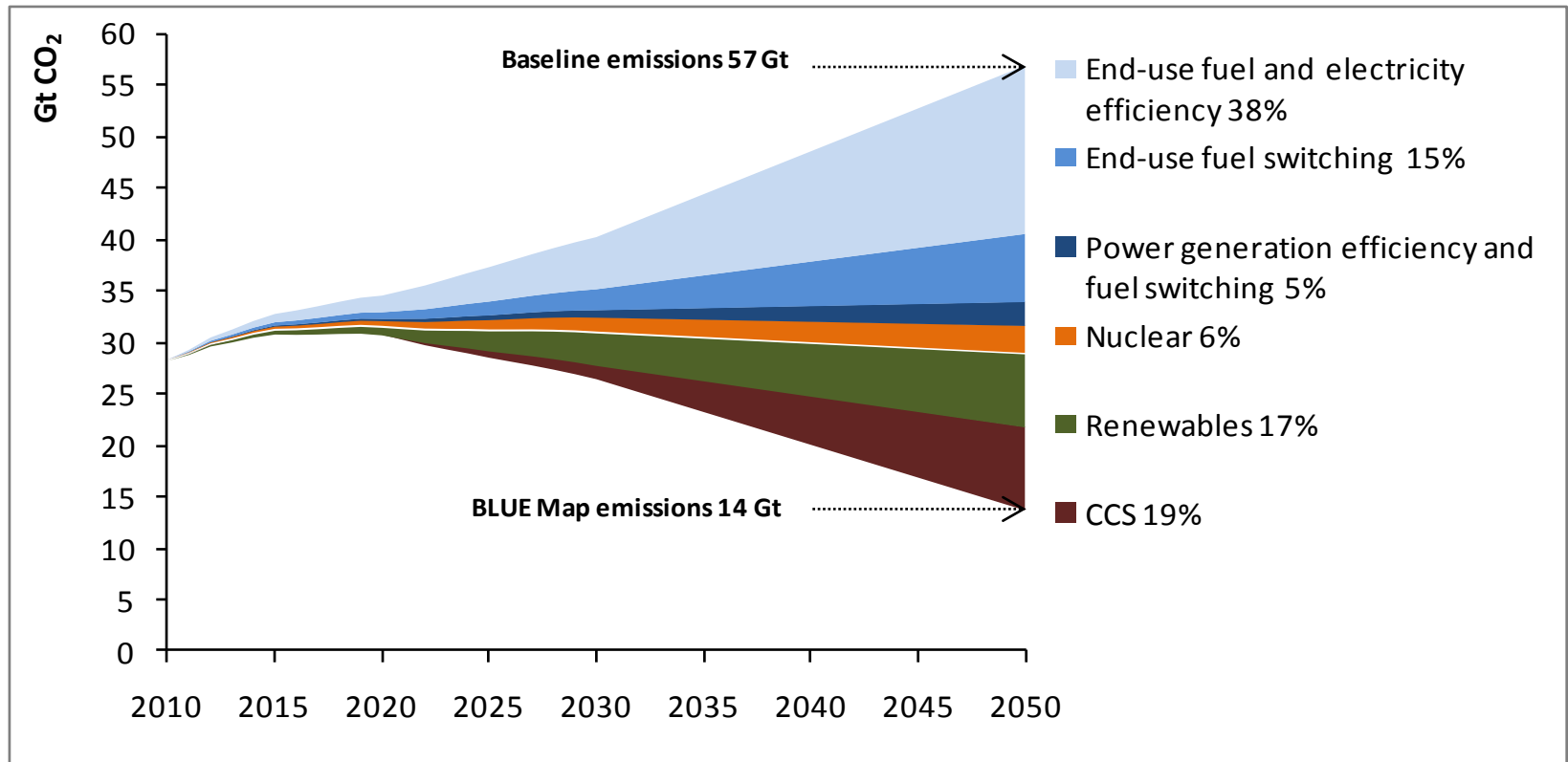
Energy technology roadmaps

Overview

- **Global context for energy technology roadmaps**
- **About technology roadmaps**
- **Roadmap How-to guide**
- **Examples of IEA roadmaps**



Key technologies for reducing global CO₂ emissions



source: IEA Energy Technology Perspectives 2010

A wide range of technologies will be necessary to reduce energy-related CO₂ emissions substantially.

Energy technology roadmaps

ABOUT TECHNOLOGY ROADMAPS



Energy technology roadmaps



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IEA Roadmap Definition

“A technology roadmap is a dynamic set of technical, policy, legal, financial, market & organizational requirements identified by all stakeholders involved in its development. The effort shall lead to improved and enhanced sharing and collaboration of all related technology-specific RDD&D information among participants.

The goal is to accelerate the overall RDD&D process in order to deliver an earlier uptake of the specific energy technology into the marketplace”.



Technology roadmaps provide answers

- **Where is technology today?**
 - GW installed capacity/kWh of savings
 - Leading countries/regions
 - Cost, efficiency
- **What is the deployment pathway needed to achieve 2050 goals?**
 - Use IEA Energy Technology Perspectives BLUE Map scenarios
- **What are the priority near-term actions?**
 - R&D gaps and how to fill them
 - Identify barriers and obstacles and how to overcome
 - Market requirements and policy needs
 - Technology diffusion/transfer and international collaboration needs



Technology roadmaps status

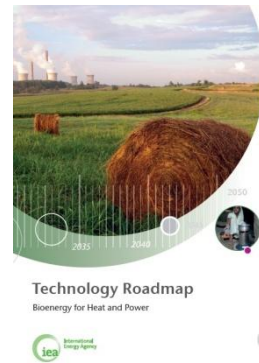
2009

2010

2011

2012 / 2013

- Bioenergy for heat and power
- Vehicle Fuel Economy
- Solar heating & cooling
- High efficiency, low emissions coal
- Chemical catalysis
- Hydropower
- Energy efficient building envelopes



Energy technology roadmaps



HOW-TO GUIDE

Energy technology roadmaps

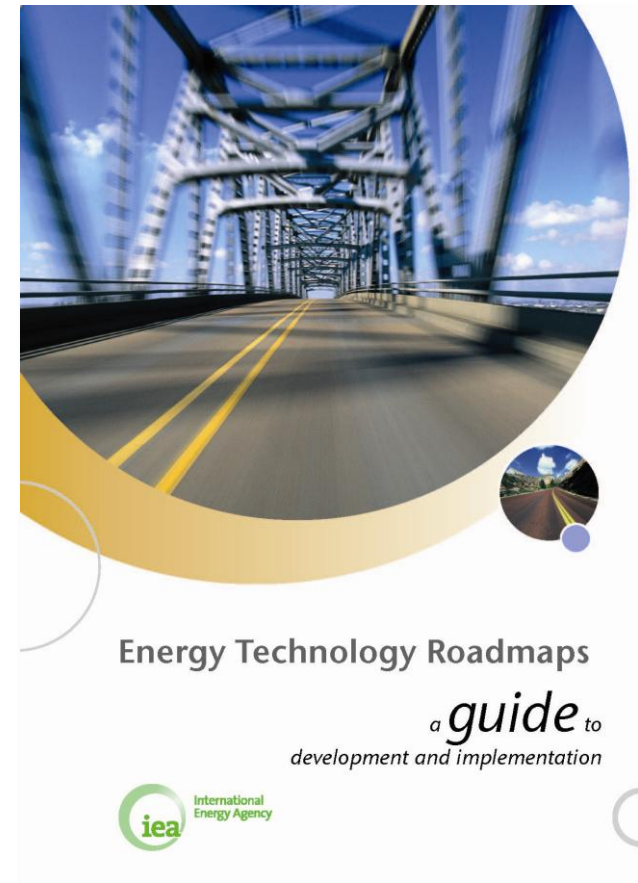


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Energy technology roadmaps guide

- **Guide published in 2010 by IEA**
 - Understanding roadmaps
 - Roadmap development process
 - Tailoring the roadmap process

http://www.iea.org/publications/free_new_Desc.asp?PUBS_ID=2291



Energy technology roadmaps

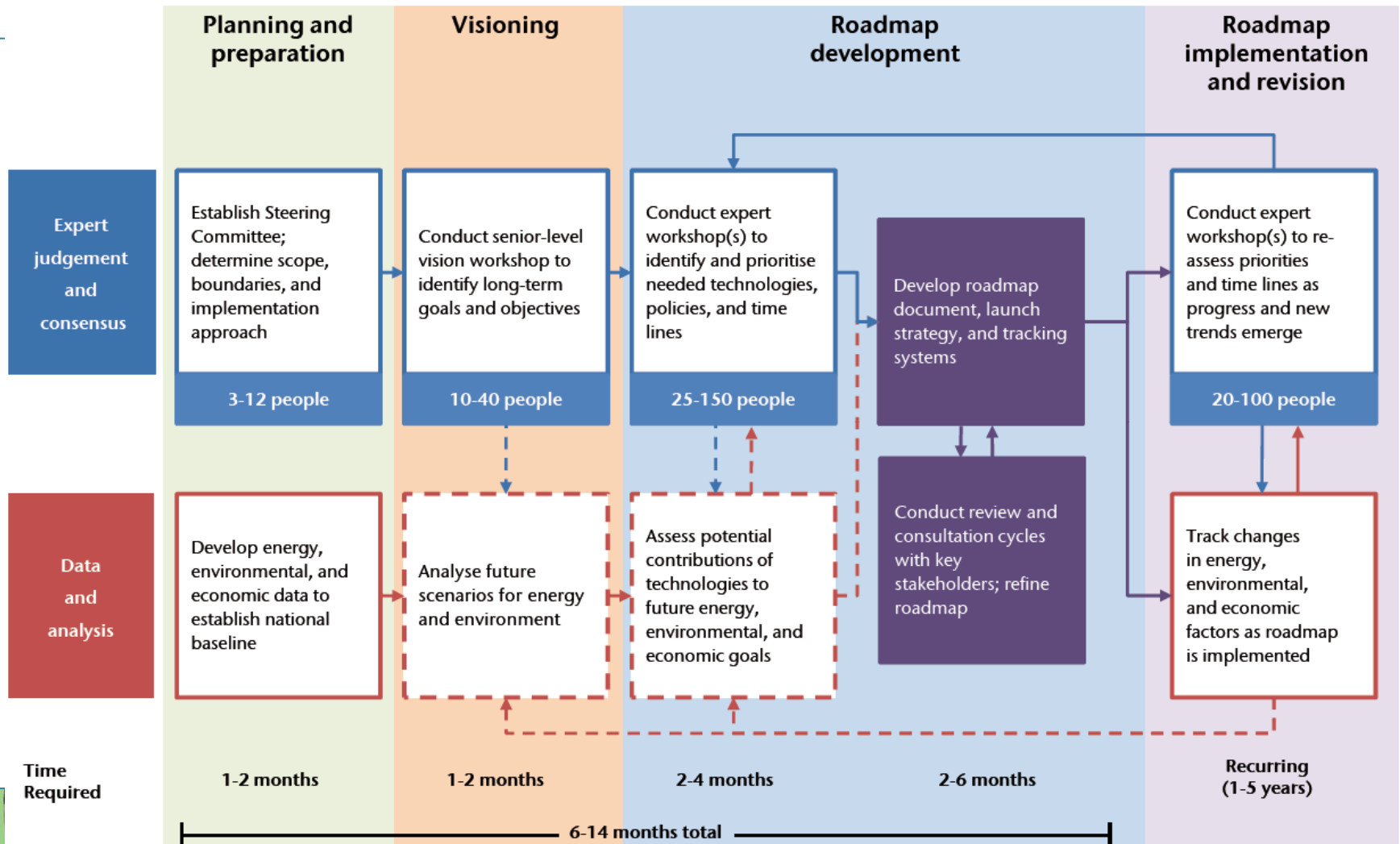


Roadmap logic

- **Goal to achieve**
- **Milestones to be met**
- **Gaps to be filled**
- **Actions to overcome gaps and barriers**
- **What and when things need to be achieved**

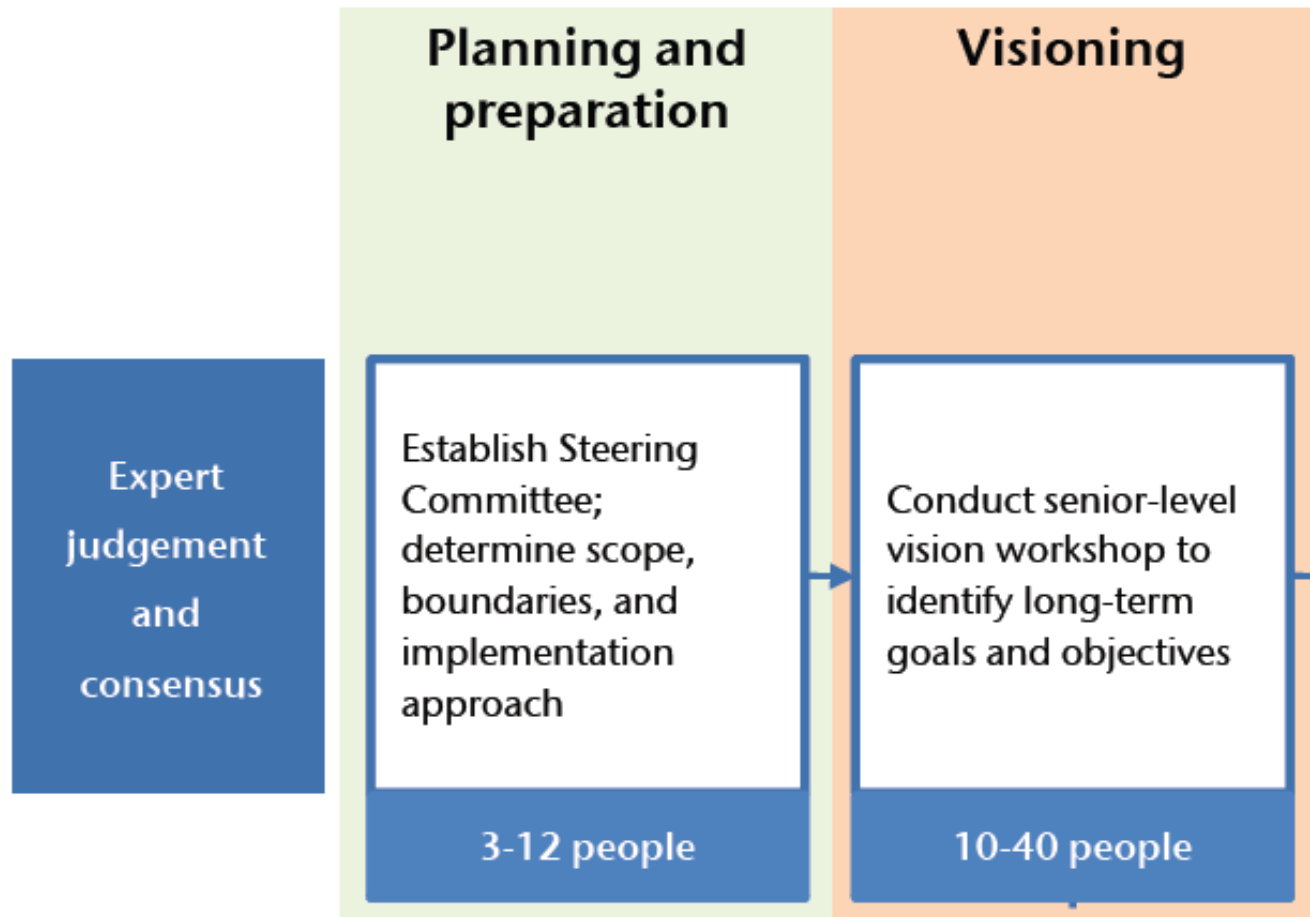


Roadmap process outline



Note: Dotted lines indicate optional steps, based on analysis capabilities and resources.

Roadmap process outline



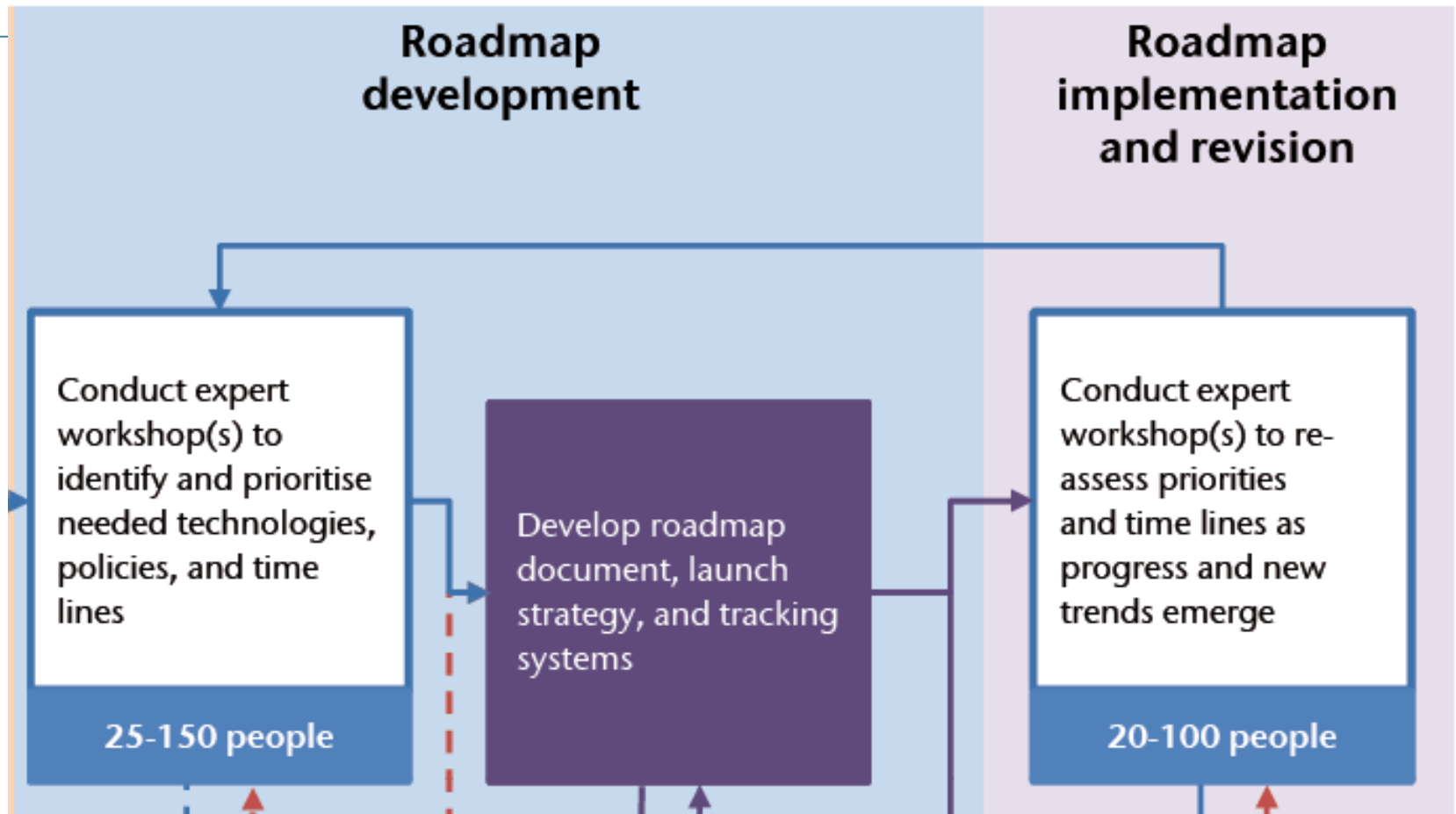
Energy technology roadmaps

Planning and preparation phase

- Ensure leadership commitment
- Appoint a steering committee
- Develop a statement of purpose and scope
- Conduct baseline research
 - Technologies, markets, policies
- Select stakeholders and experts

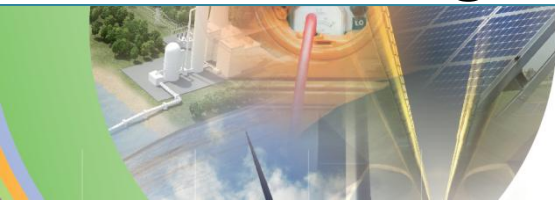


Roadmap process outline

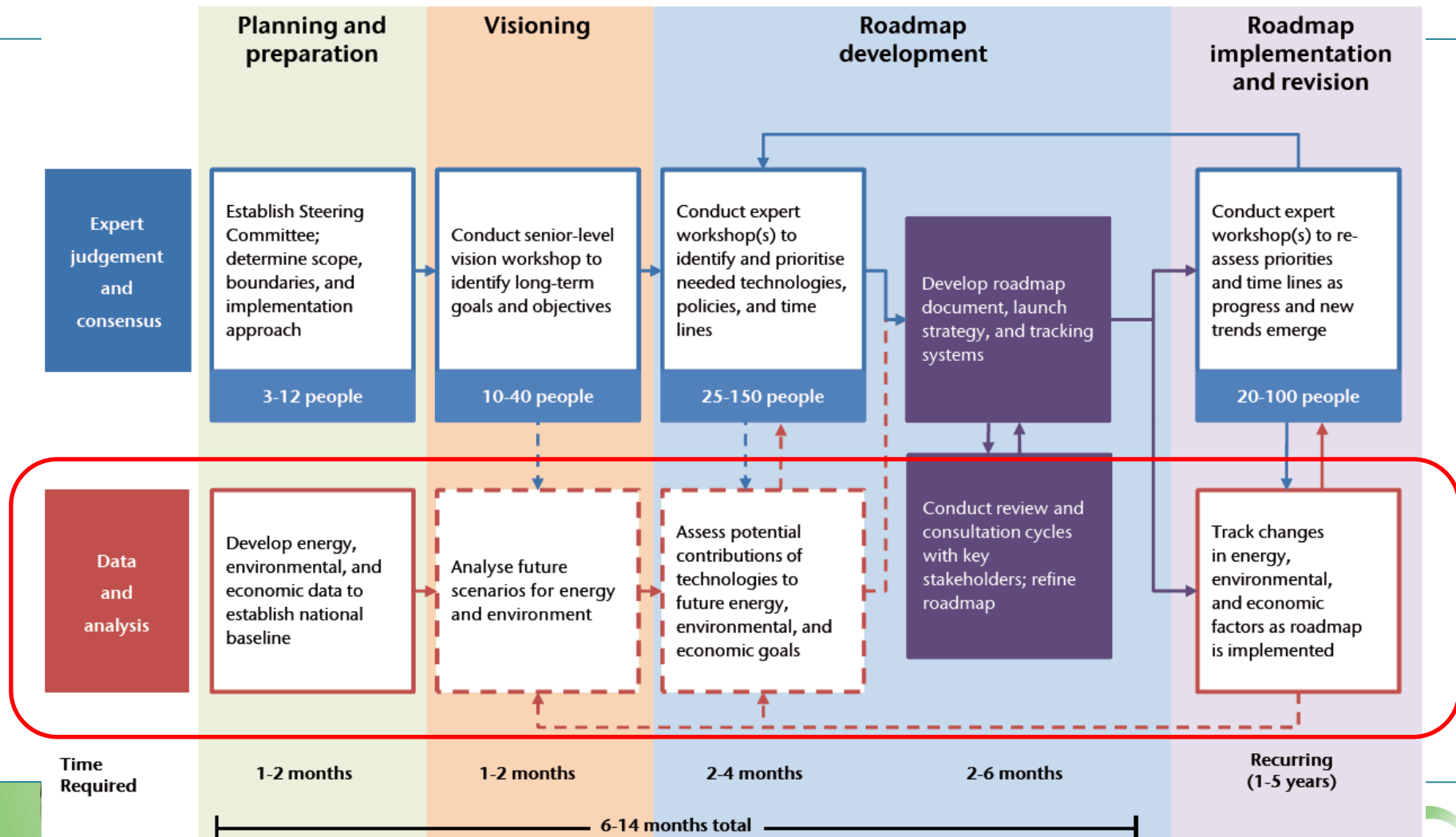


Expert judgment and consensus: roadmap workshops

- **Structured vision and technology roadmap workshops can:**
 - Build consensus on goals and targets
 - Evaluate and verify assumptions
 - Identify technical and institutional barriers
 - Define alternative technology pathways
 - Develop implementation strategies and priorities

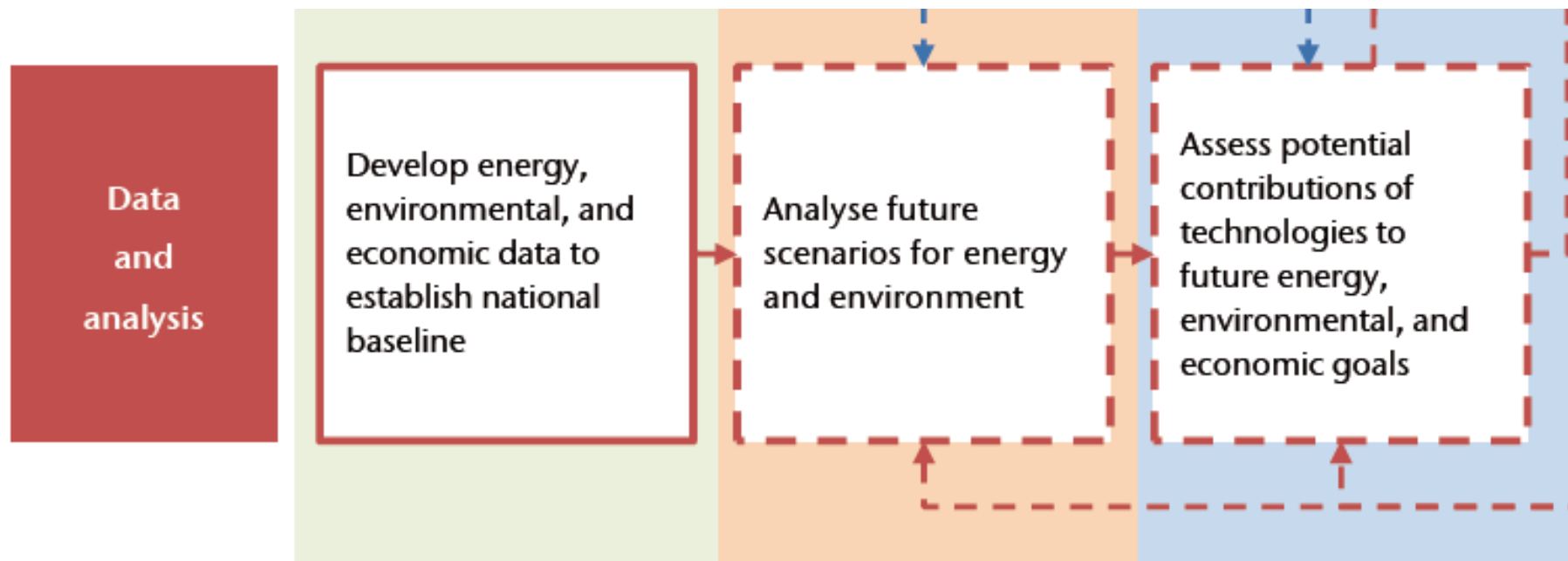


Roadmap process outline



Note: Dotted lines indicate optional steps, based on analysis capabilities and resources.

Roadmap process outline



Baseline data

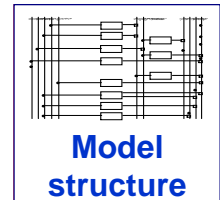
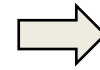
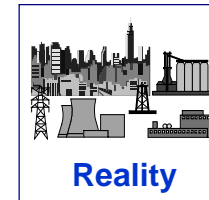
Situation analysis of key factors:

- **Technologies:**
 - Current status of costs and performance
 - Technology readiness
 - Market penetration and limitations
- **Markets:**
 - Suppliers, distributors and customers
 - Energy characteristics (production, delivery, storage and consumption)
 - Environmental impacts (air, water and land impacts)
- **Public policies:**
 - Current status and requirements of relevant, existing laws and regulations



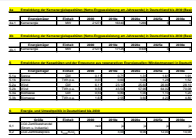
Model-based scenario analysis

- Representation of relevant aspects in real-world system:
 - Model scope depending on technology area
 - Several models may be required
- Typically quantitative formulation with balance between accuracy and manageability:
 - Complexity may vary: from simulation-based spreadsheet models to more elaborate cost optimization models
- Exploring possible future technology deployment pathways through scenarios

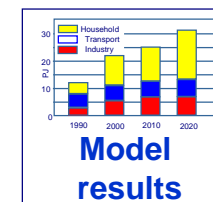


$$\begin{aligned}P_{BHKW,S} &= \eta_{BHKW} \cdot P_{Coal,BHKW} \\O_{BHKW,CO_2} &= \varepsilon \cdot P_{Coal,BHKW} \\Q_{BHKW,H} &= \eta_{2,BHKW} \cdot P_{Coal,BHKW}\end{aligned}$$

Mathematical description

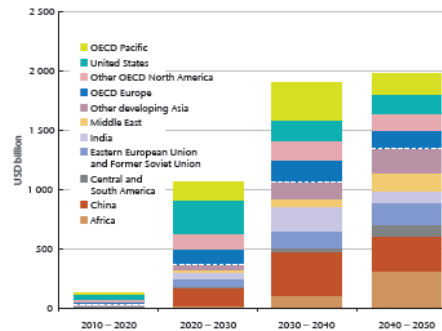
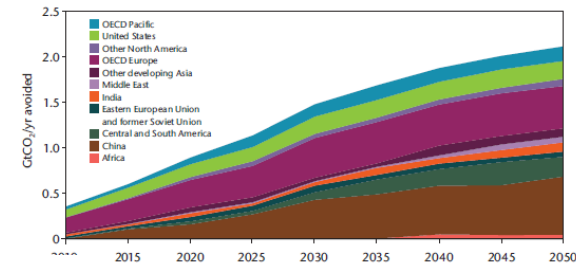
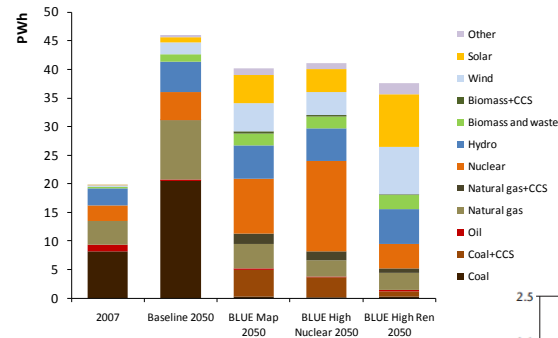


Data



Example: Results of power sector model analysis

- Future power generation mix and capacities
- Fuel demand
- Environmental impacts
- Long-term electricity prices
- Investment needs
- Effect of policy instruments
- Uncertainty analysis



Tailoring the roadmap process

- **Six considerations when designing a roadmap process:**
 - Stakeholder participation
 - Resource constraints
 - Critical inputs
 - Roadmap design
 - Buy-in and dissemination
 - Monitoring and tracking



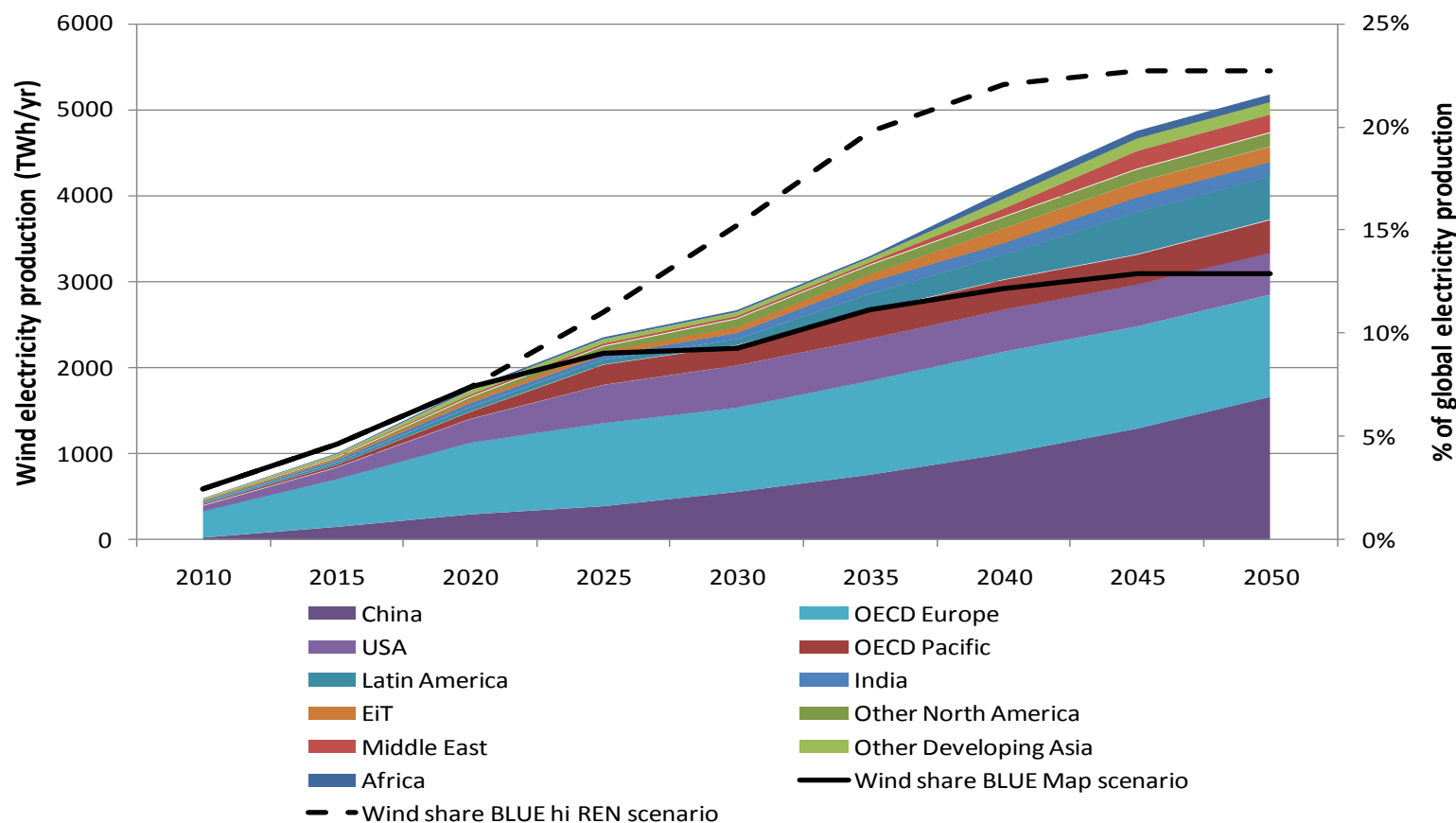
IEA ROADMAP EXAMPLES



Energy technology roadmaps



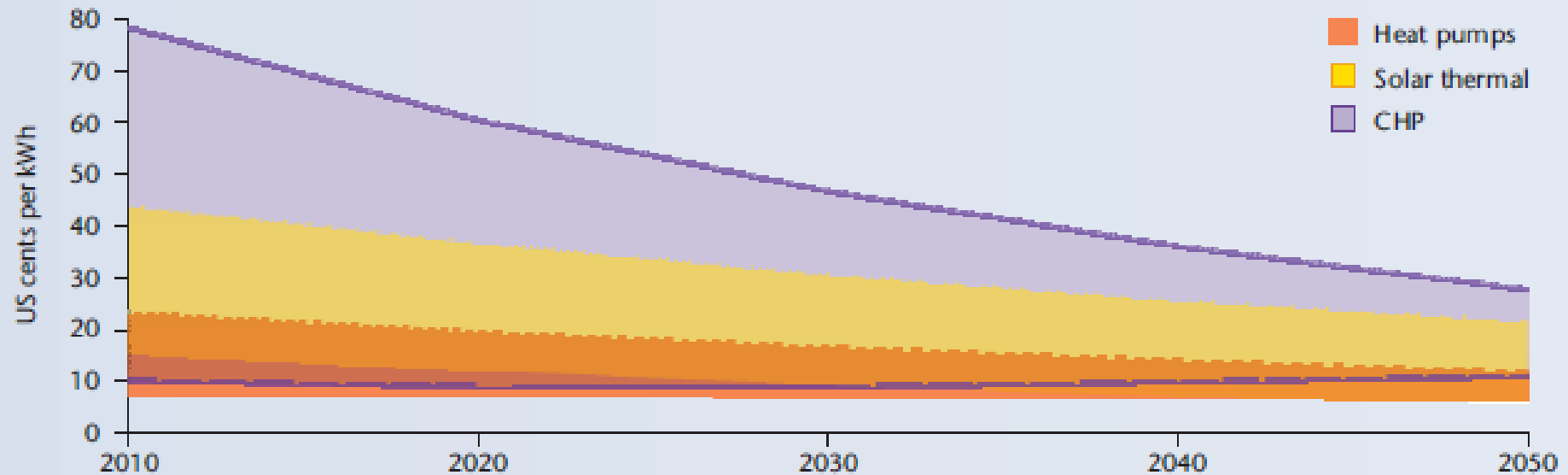
Wind Roadmap: An ambitious growth pathway



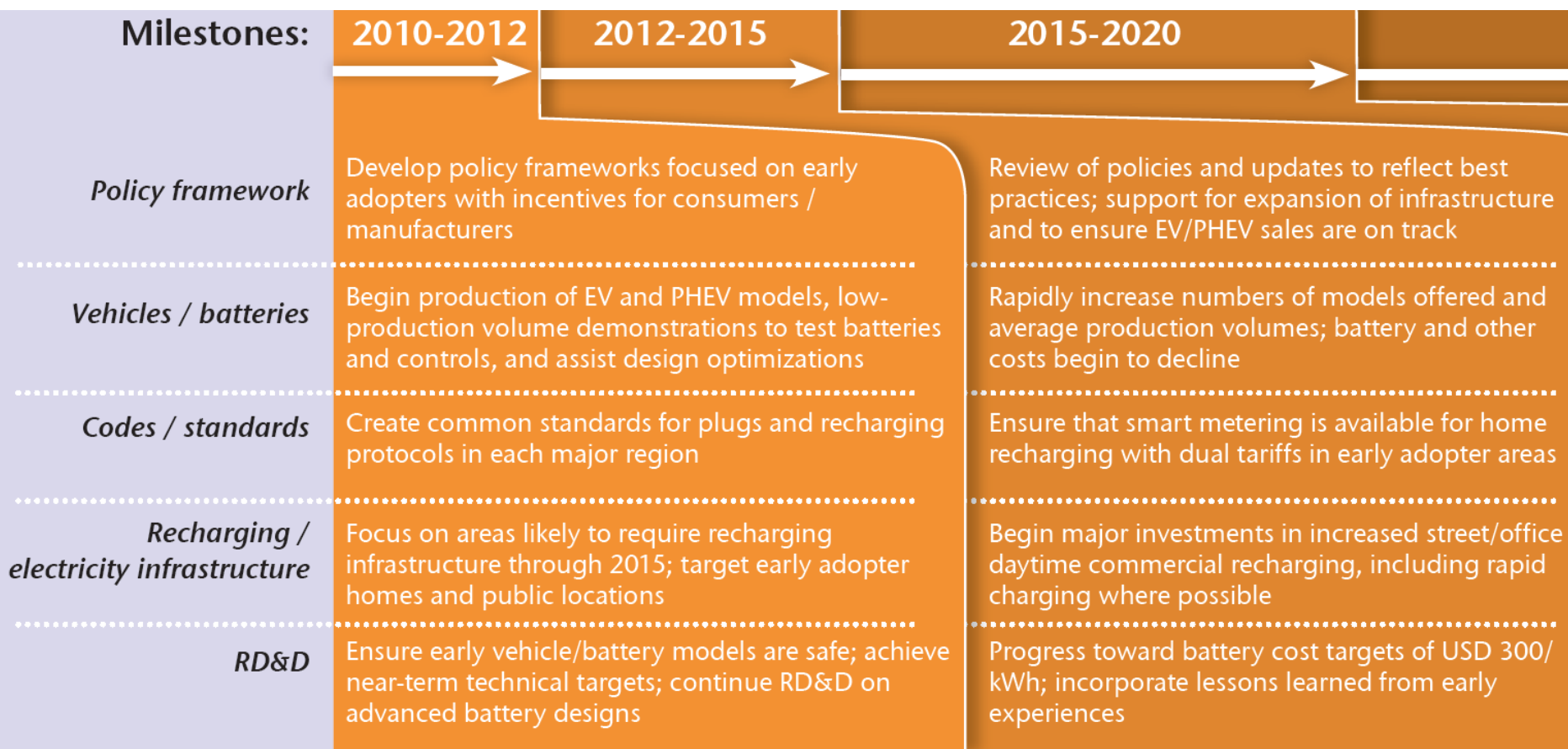
Energy technology roadmaps

EE in Buildings roadmap example: Cost reduction goals

Delivered energy cost reduction goals



EV/PHEV roadmap example: milestones



NATIONAL ROADMAPS



Energy technology roadmaps



China wind roadmap

- 1000 GW of wind, 17% of electricity production in 2050
- Cumulative investment of USD 600 bn by 2030 and USD 1.9 tn by 2050
- CO₂ savings of 1.5 Gt and reduction of 660 m tce
- Two possible pathways developed for transmission



Technology Roadmap
China Wind Energy Development Roadmap 2050



能源技术路线图
中国风电发展路线图2050



Cement in India Roadmap

India Cement Technology
Roadmap partners



wbcsd



In consultation with



Principal supporter



Industry supporters



HEIDELBERGCEMENT



Roadmap development process

Phase I

Technology
papers
(CII/NCBM)

Cement demand
data, data modeling
and analysis (IEA)

Data coverage
(>70% of
Indian
industry)



Partner and
stakeholder
review

Stakeholder outreach

Technology

Financing

Policy

Phase II

unit-level
analysis at 6-9 CSI
member
company cement
plants

A final thought

- **Roadmaps can be powerful tools for**
 - **Aligning interests and skills of diverse stakeholders**
 - **Identifying steps and timing needed to achieve a chosen future**
 - **Generating buy-in and support that leads to real action**
 - **Monitoring progress against stated milestones and adjusting the plan as needed**



For more information

- Download the guide:

<http://www.iea.org/papers/roadmaps/guide.pdf>

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