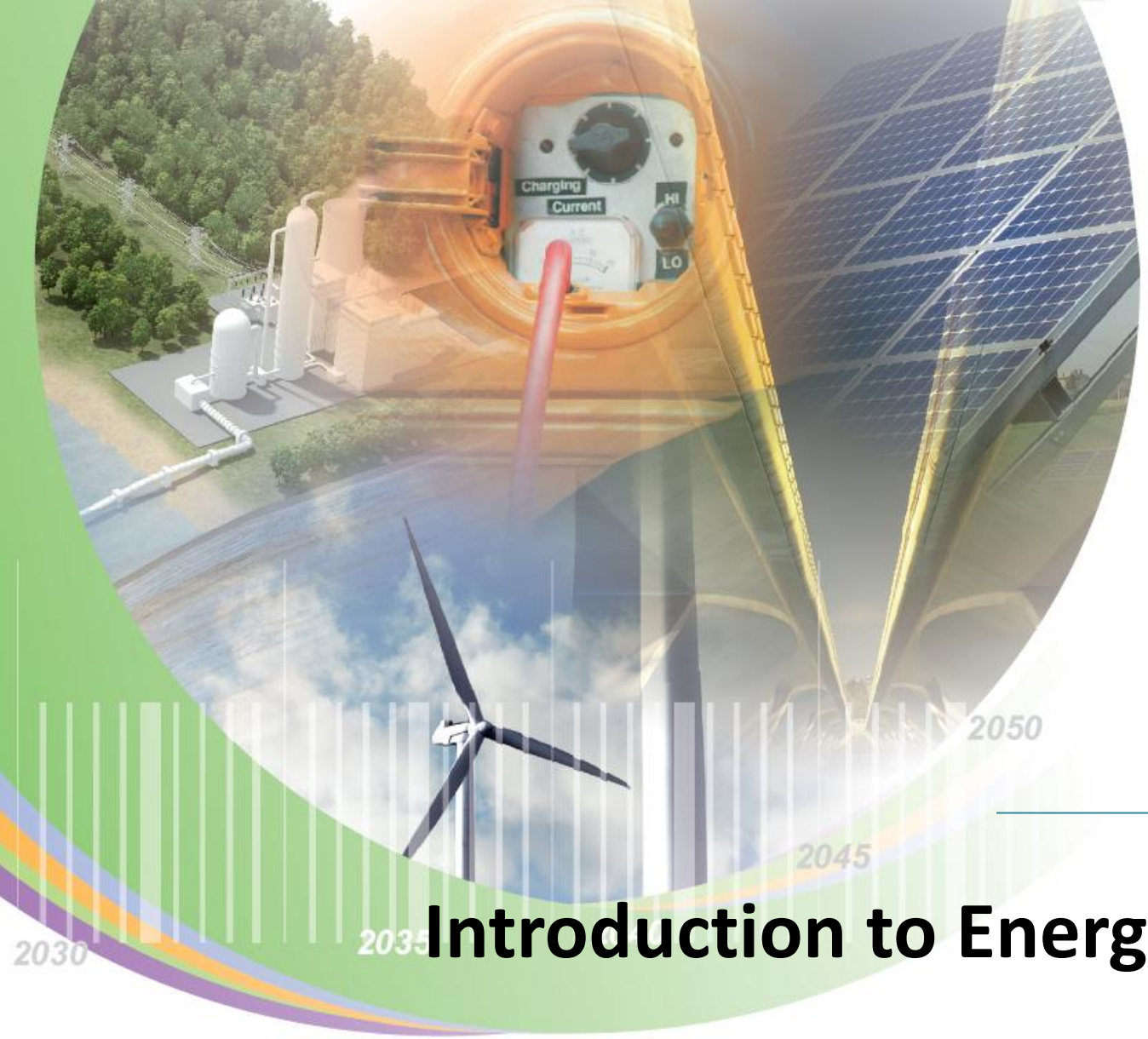


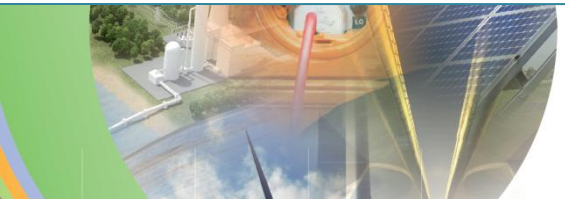
Introduction to Energy Technology Roadmaps

Energy technology roadmaps

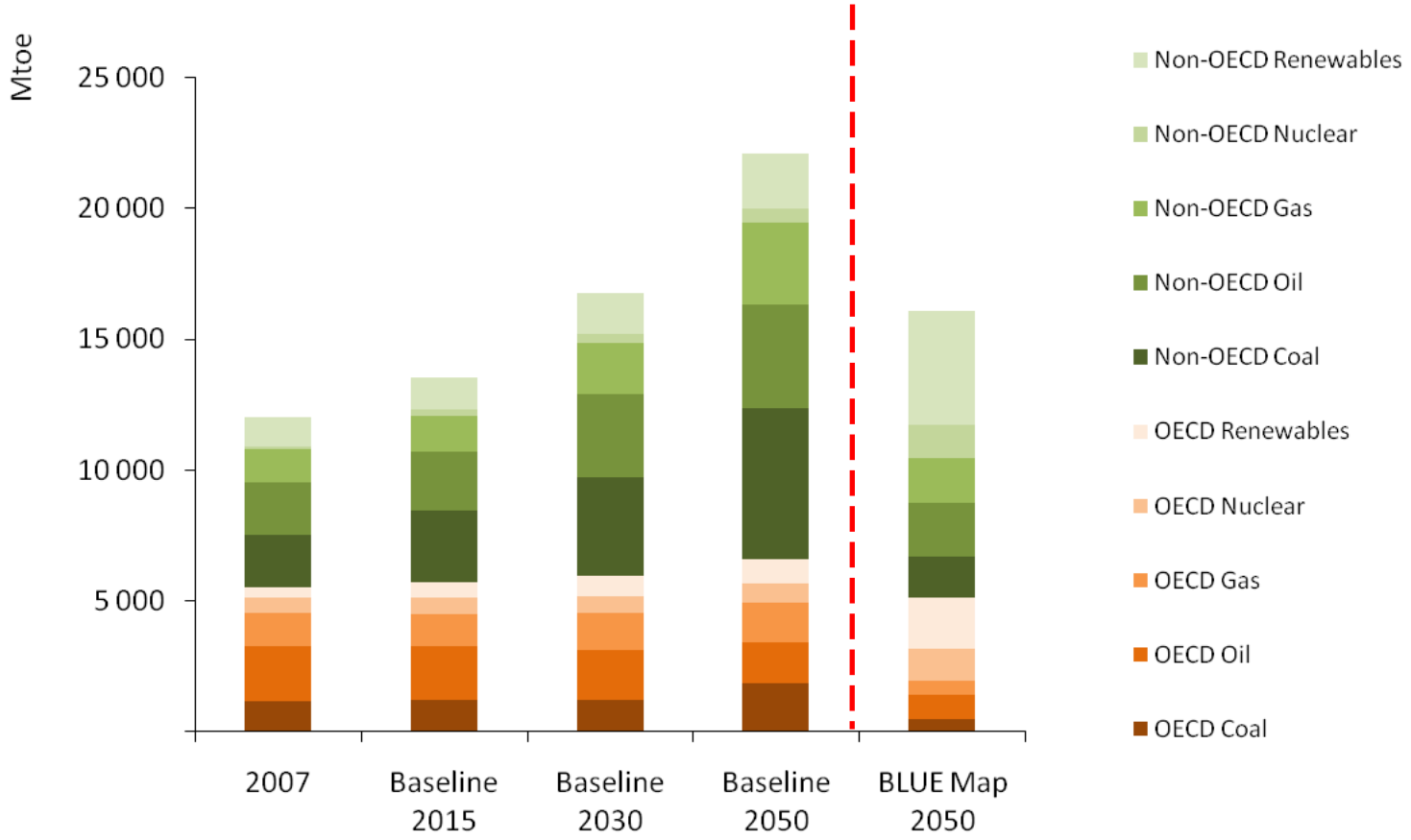
International Energy Agency

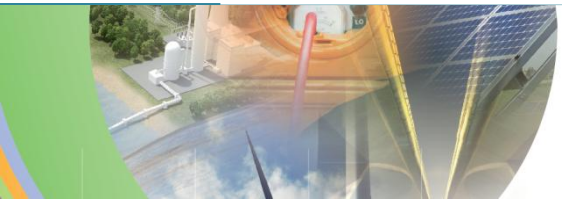
Overview

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

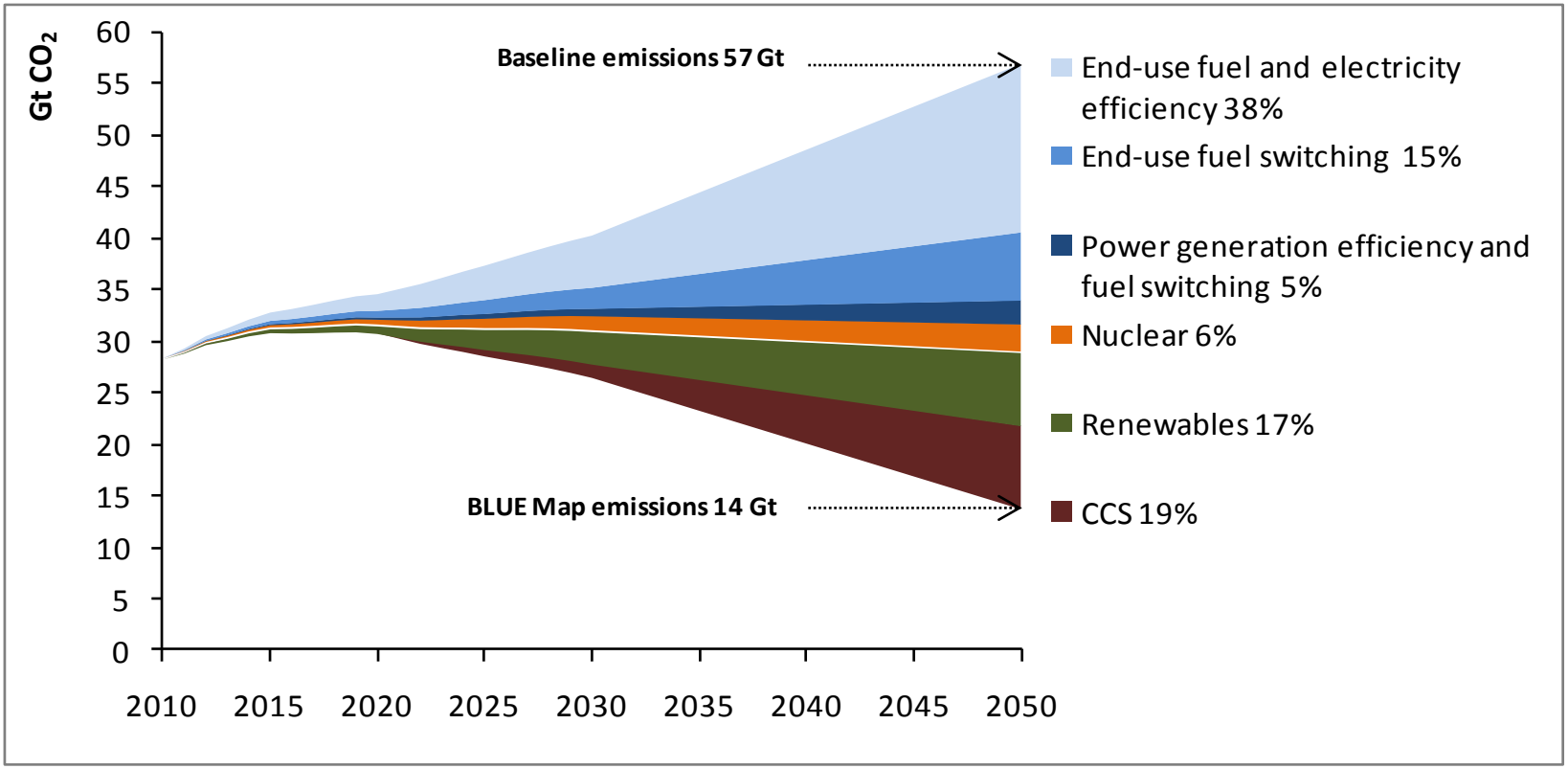


OECD and non-OECD primary energy demand





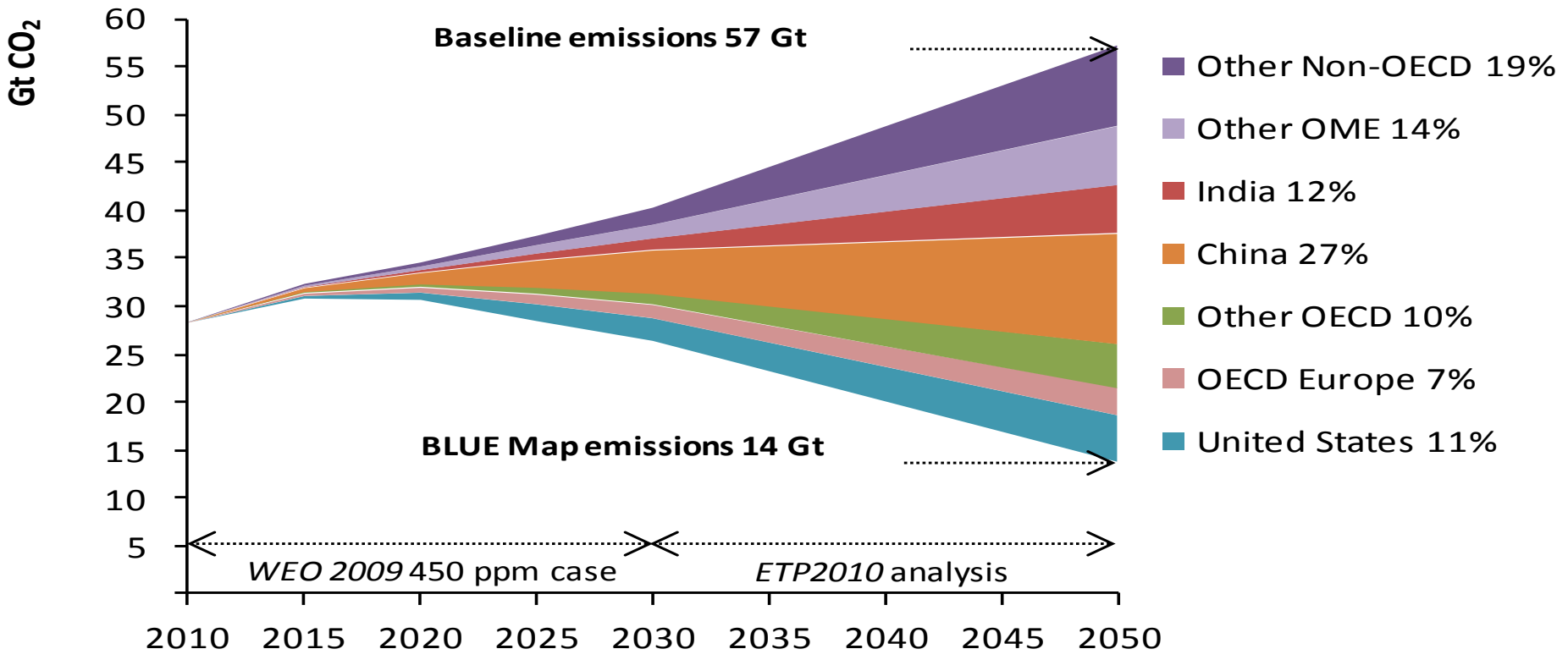
Key technologies for reducing global CO_2 emissions



source: IEA Energy Technology Perspectives 2010

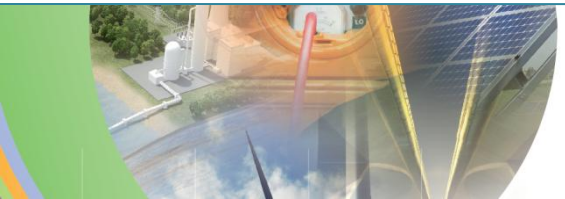
A wide range of technologies will be necessary to reduce energy-related CO_2 emissions substantially.

World energy-related CO_2 emissions abatement by region

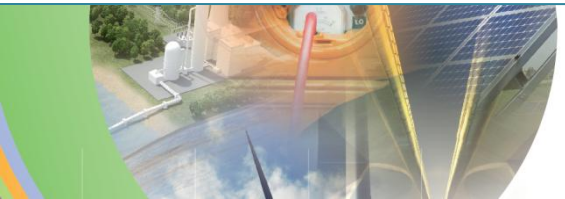


The importance of energy technology policy

- A global price for carbon is necessary
  - …but by itself insufficient to accelerate the needed energy technology advancements in time
- Greater focus on energy technology policies needed
- Technology roadmaps can support GHG goals by:
  - Identifying and addressing technology-specific barriers
  - Highlighting necessary deployment policies and incentives
  - Directing increased RD&D funding for new technologies
  - Supporting technology diffusion, knowledge sharing among countries

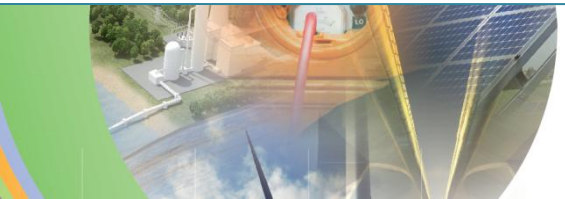


ABOUT TECHNOLOGY ROADMAPS



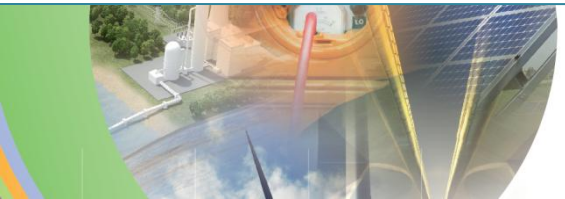
Technology roadmaps provide answers

- **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?**
  - Technology incentives
  - Technology-specific barrier identification and removal
  - R&D funding
  - Technology diffusion/transfer



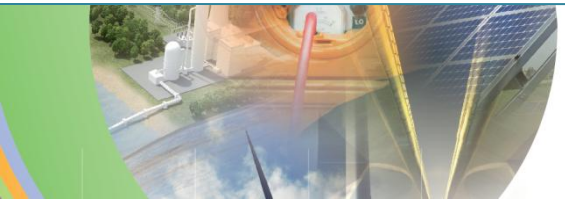
The IEA roadmap approach

- Engage cross-section of stakeholders
- Identify a baseline – where is technology today?
- Use *ETP* BLUE Map results for deployment pathway to 2050
- Identify barriers – technical, regulatory, policy, financial, public acceptance
- Develop implementation action items for stakeholders



Roadmap audiences

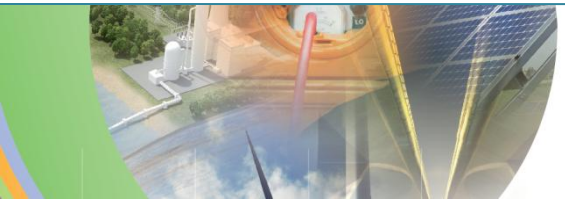
- Government decision makers
  - ministries of energy, environment, natural resources, infrastructure
  - ministries of finance, economics
- State/provincial and local policymakers and regulators
- Industry leaders
- Scientific, business, policy experts
- NGOs



Technology Roadmaps: Status

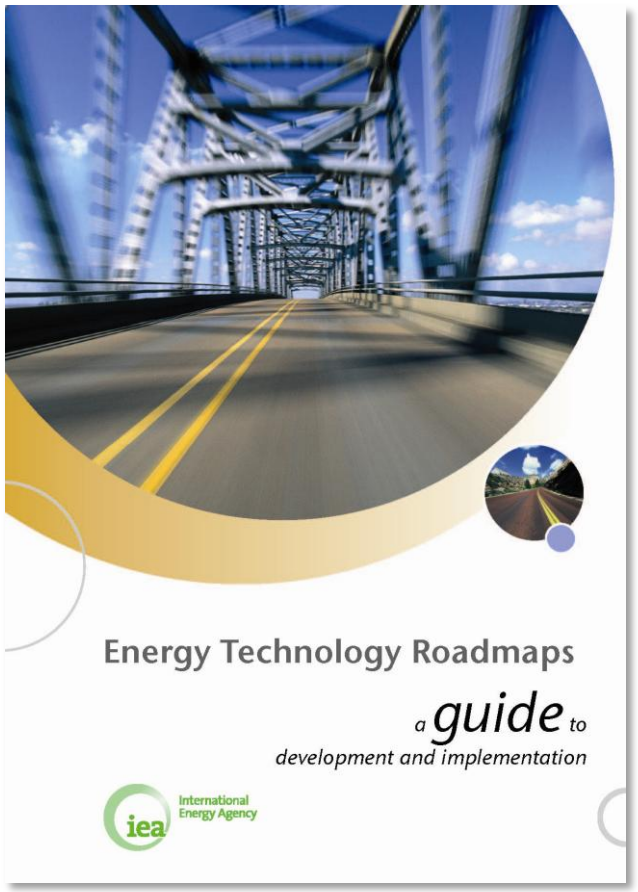
2009	2010	2011	2012
Fossil Fuels			
Carbon capture & storage			High efficiency low emissions coal
Renewables			
Wind	- Solar PV - Concentrating solar power	- Biofuels - Geothermal heat & power - Hydropower	- Biomass for heat & power -Solar heat and cooling
End-Use			
Buildings			
		Efficient buildings: Heating and cooling Systems	Efficient buildings: Building shells and design
Industry			
Cement sector		CCS in industry	Chemical sector: Catalysis
Transport			
Electric vehicles		Vehicle Fuel Economy	
Other			
	Nuclear	Smart Grids	

HOW-TO GUIDE



Energy technology roadmaps guide

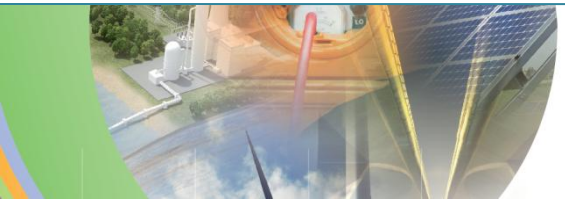
- Guide published in 2010 by IEA
  - Understanding roadmaps
  - Roadmap development process
  - Tailoring the roadmap process



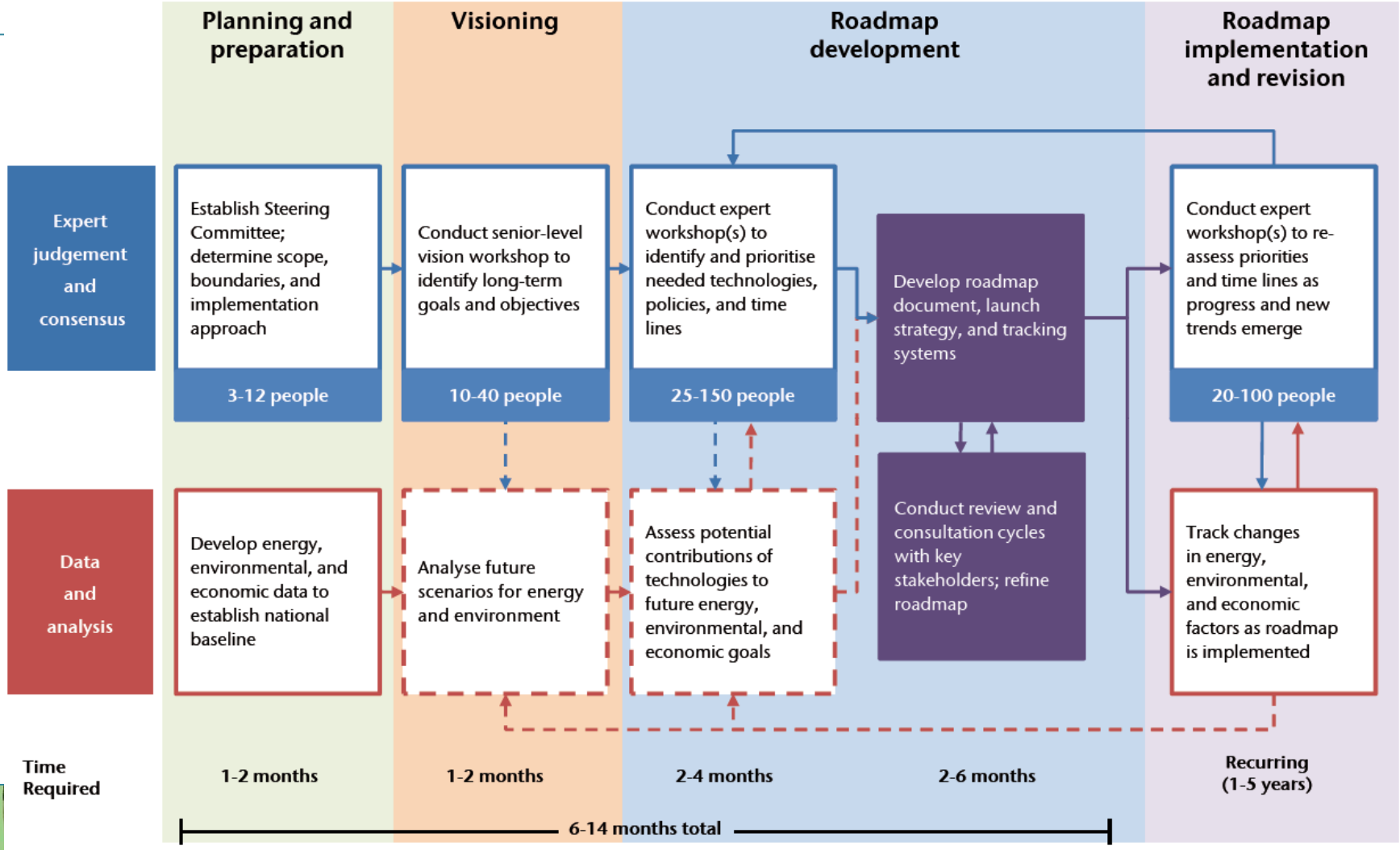
http://www.iea.org/publications/free_new_Desc.asp?PUBS_ID=2291

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

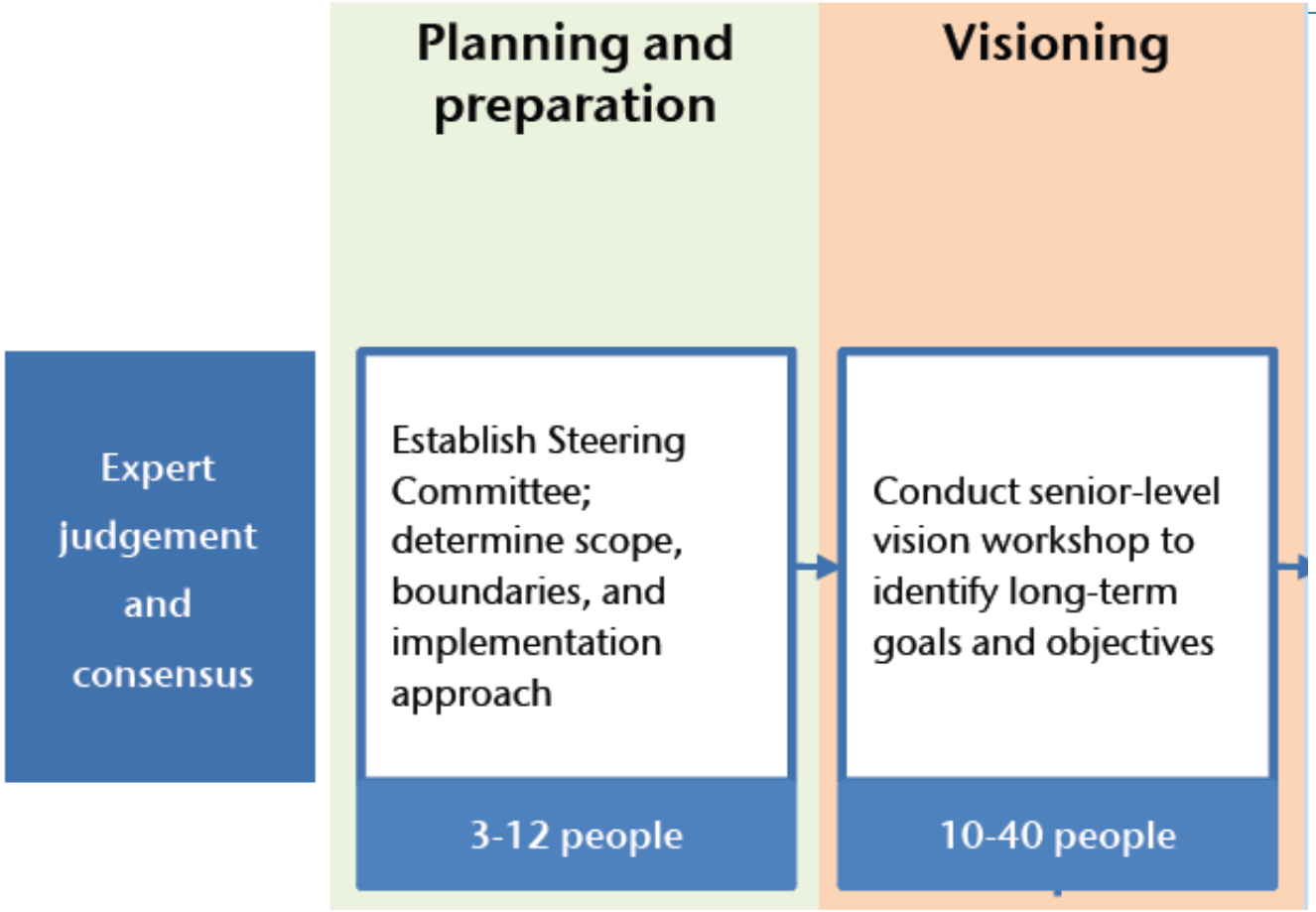


Roadmap process outline

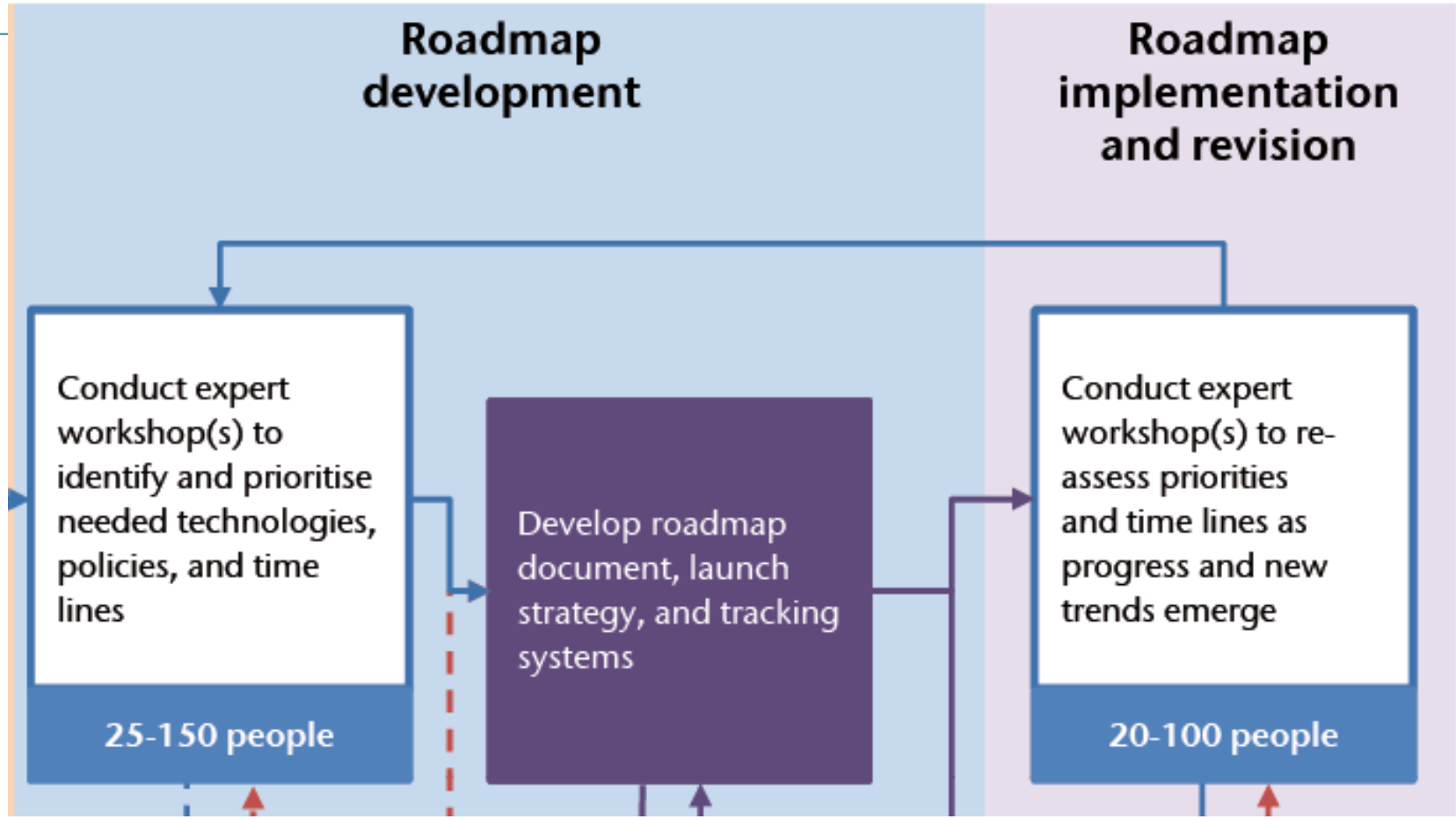


Note: Dotted lines indicate optional steps, based on analysis capabilities and resources.

Roadmap process outline

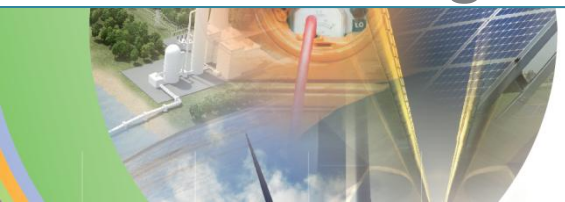


Roadmap process outline

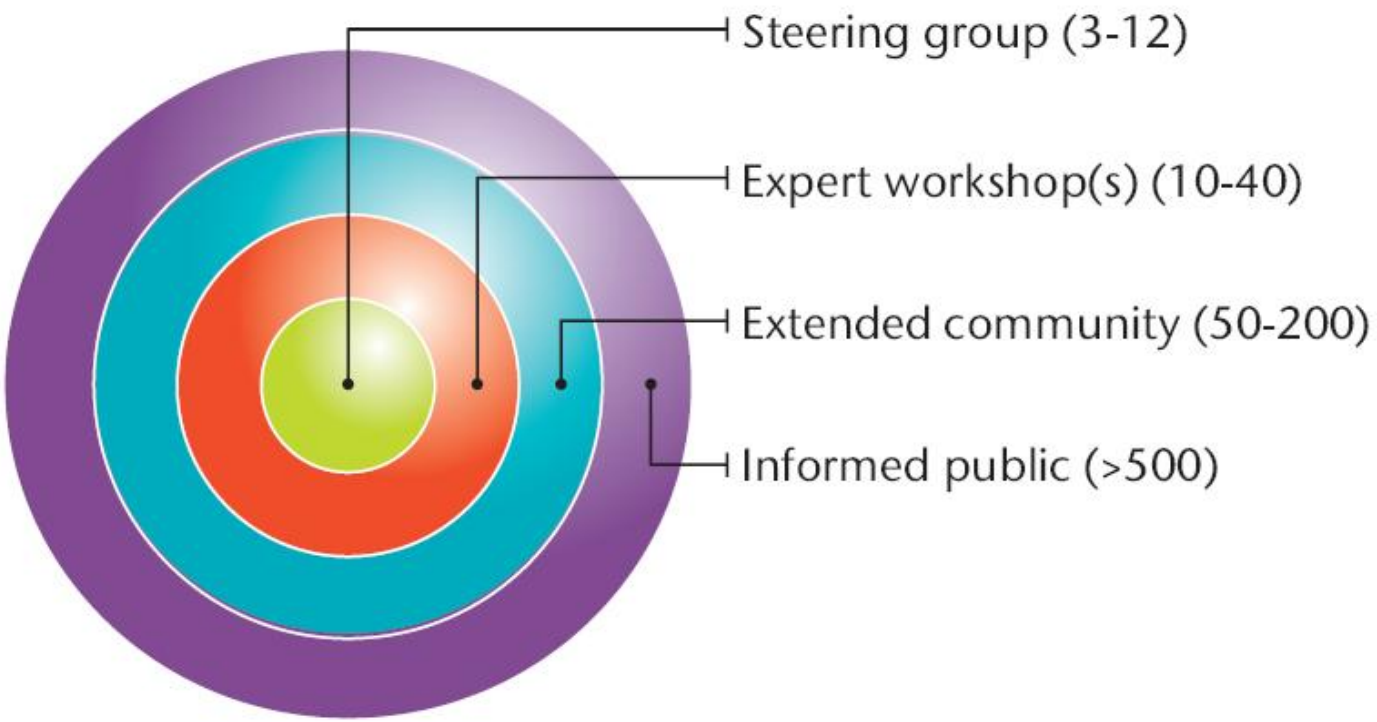


Expert judgment and consensus: roadmap workshops

- 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

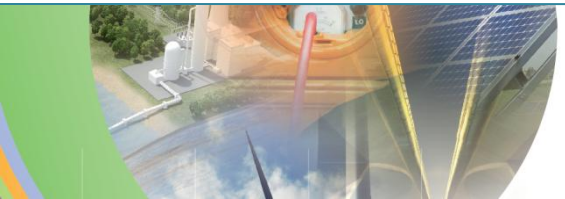


Managing engagement

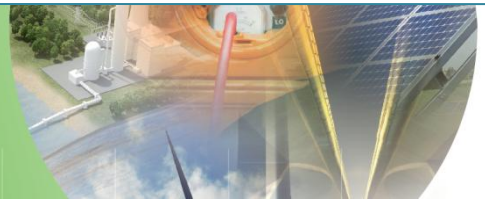


Tailoring the roadmap process

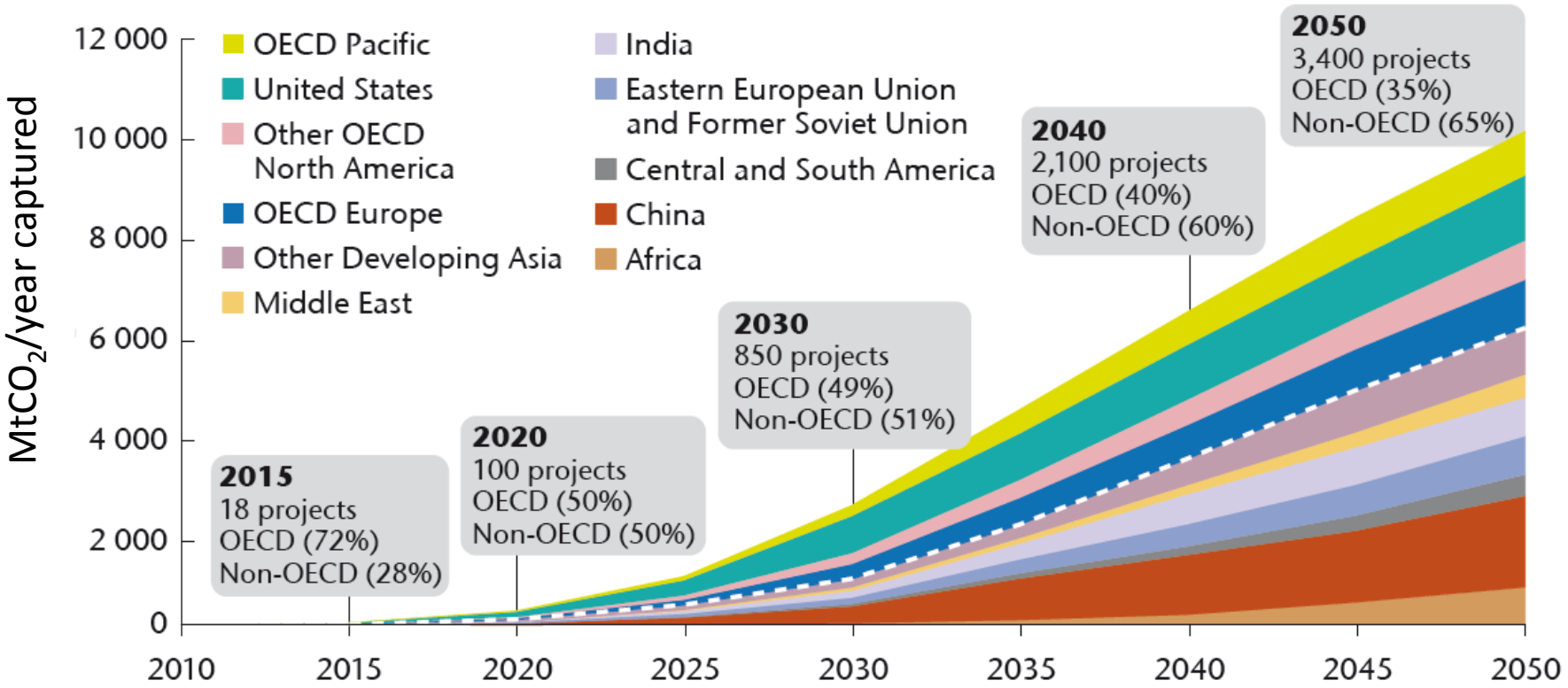
- Six considerations when designing a roadmap process:
  - Stakeholder participation
  - Resource constraints
  - Critical inputs
  - Roadmap design
  - Buy-in and dissemination
  - Monitoring and tracking

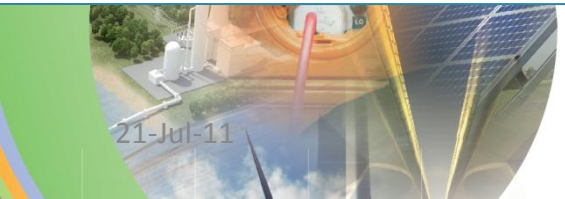


IEA ROADMAP EXAMPLES



Roadmap example:
CCS - an ambitious growth pathway

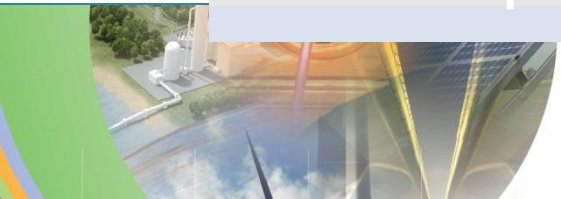




Solar PV roadmap example: technology performance milestones

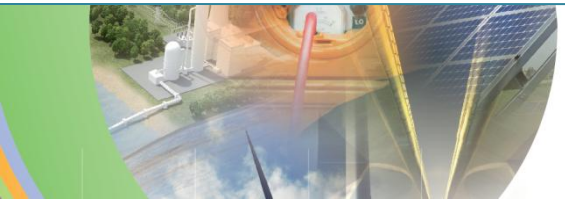
Crystalline Silicon Technologies	2010 - 2015	2015 - 2020	2020 - 2030 / 2050
Efficiency targets in %	• Single-crystalline: 21% • Multi-crystalline: 16%	• Single-crystalline: 23% • Multi-crystalline: 18%	• Single-crystalline: 27% • Multi-crystalline: 21%
Industry manufacturing aspects	• Si consumption <5g/Wp	• Si consumption <3g/Wp	• Si consumption <2g/Wp
R&D aspects	• New silicon materials and processing • Cell contacts, emitters and passivation	• Low defect silicon wafers • Improved device structures	• Wafer equivalent technologies • New device structures with novel concepts

Thin Film Technologies	2010 - 2015	2015 - 2020	2020 - 2030
Efficiency targets in %	• Thin film Si: 10% • CIGS: 14% • CdTe: 12%	• Thin film Si: 12% • CIGS: 15% • CdTe: 15%	• Thin film Si: 15% • CIGS: 18% • CdTe: 18%
Industry manufacturing aspects	• High rate deposition • Roll-to-roll manufacturing • Packaging	• Simplified production processes • Low cost packaging	• Large high-efficiency production units
R&D aspects	• Large area deposition processes • Improved substrates and transparent conductive oxides	• Improved cell structures • Improved deposition techniques	• Advances materials and concepts



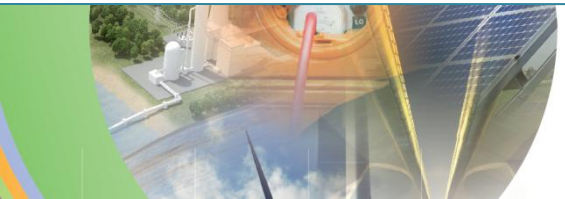
EV/PHEV roadmap example: milestones

Milestones:	2010-2012	2012-2015	2015-2020
Policy framework	Develop policy frameworks focused on early adopters with incentives for consumers / manufacturers		Review of policies and updates to reflect best practices; support for expansion of infrastructure and to ensure EV/PHEV sales are on track
Vehicles / batteries	Begin production of EV and PHEV models, low-production volume demonstrations to test batteries and controls, and assist design optimizations		Rapidly increase numbers of models offered and average production volumes; battery and other costs begin to decline
Codes / standards	Create common standards for plugs and recharging protocols in each major region		Ensure that smart metering is available for home recharging with dual tariffs in early adopter areas
Recharging / electricity infrastructure	Focus on areas likely to require recharging infrastructure through 2015; target early adopter homes and public locations		Begin major investments in increased street/office daytime commercial recharging, including rapid charging where possible
RD&D	Ensure early vehicle/battery models are safe; achieve near-term technical targets; continue RD&D on advanced battery designs		Progress toward battery cost targets of USD 300/ kWh; incorporate lessons learned from early experiences



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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