International Energy Agency

Energy Technology Perspectives 2010

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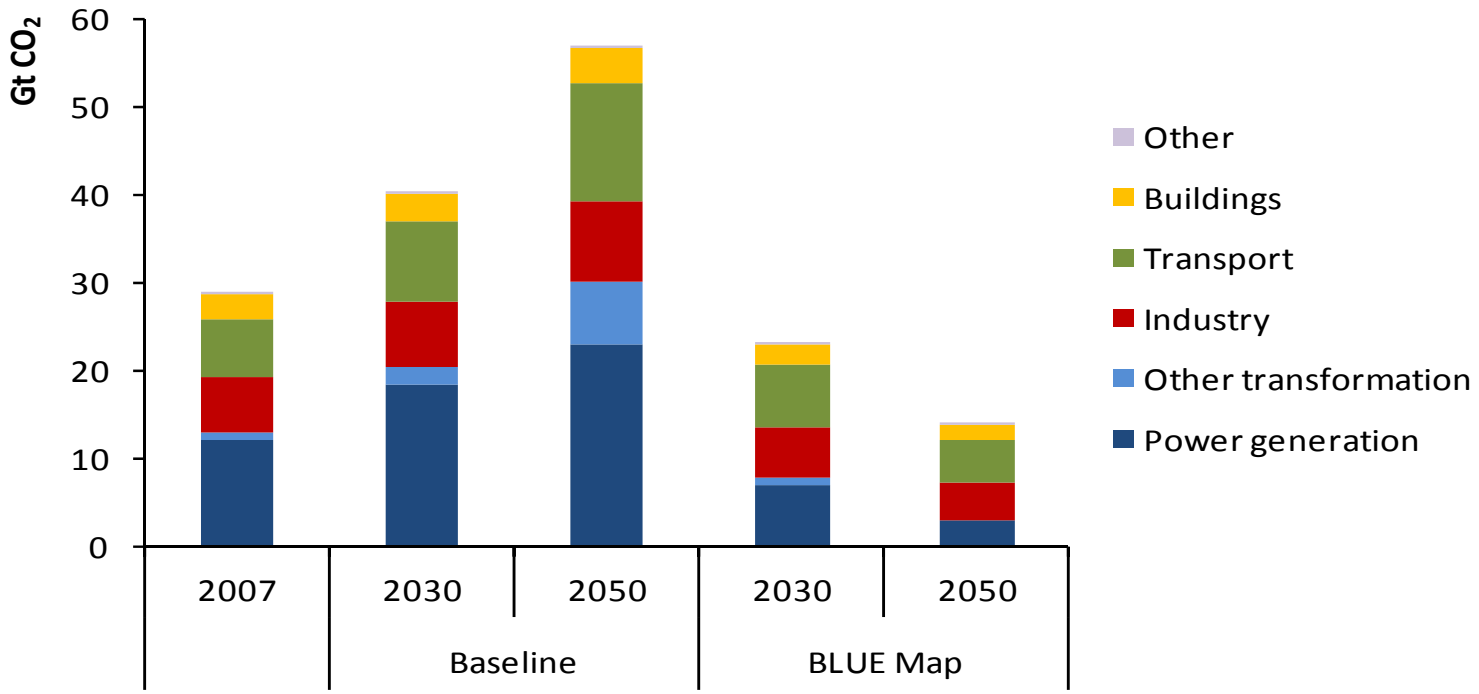
The context

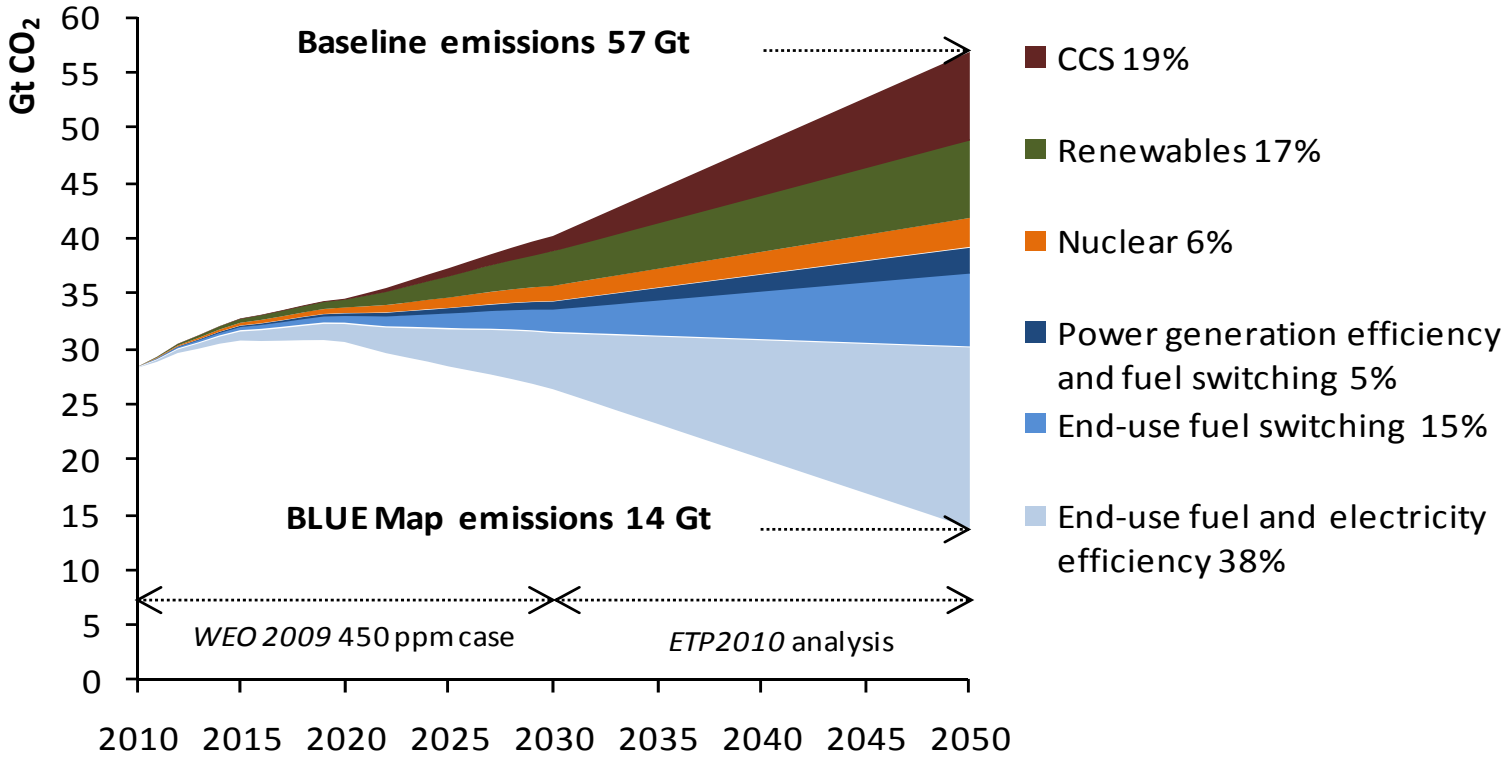
- **Need a global energy technology revolution to meet climate change and energy security challenges.**
- **Some early signs of progress, but much more needs to be done.**
  - **Which technologies can play a role?**
  - **What are the costs and benefits?**
  - **What policies are needed?**

Global energy-related CO_2 emissions in the Baseline and BLUE Map scenarios



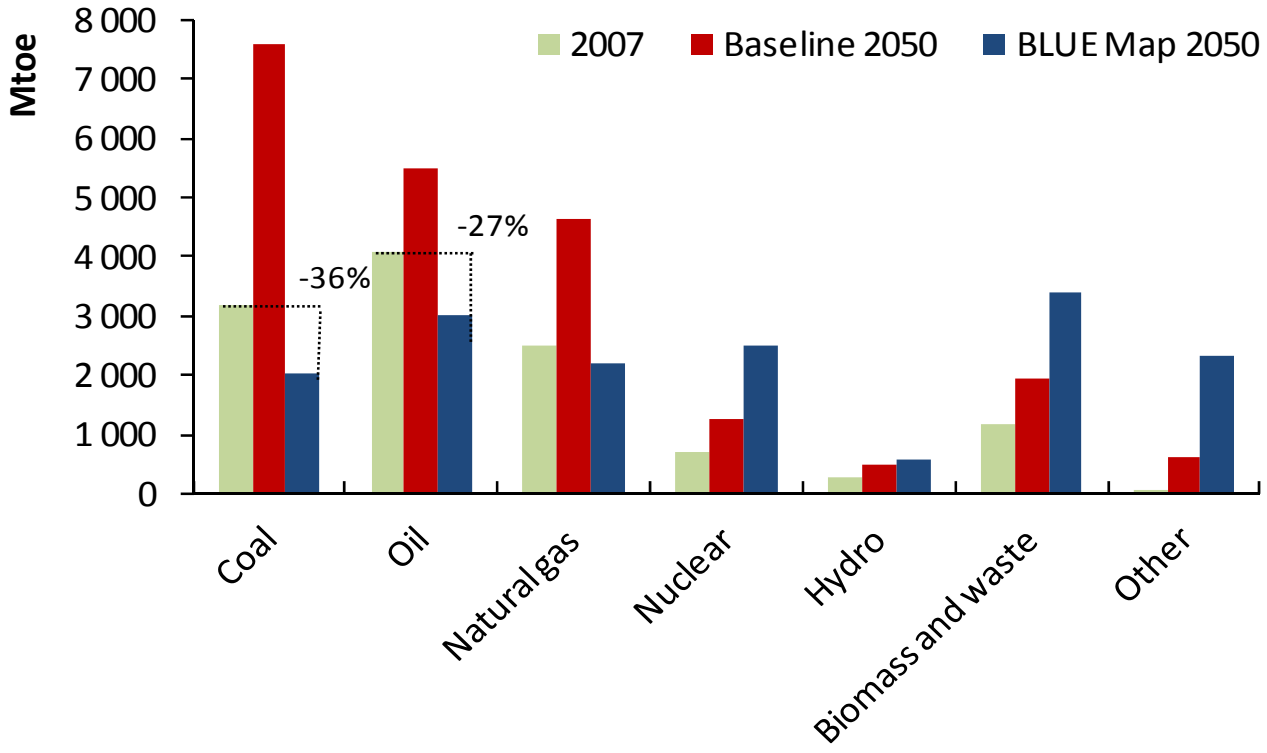
Global CO_2 emissions double in the Baseline, but in the BLUE Map scenario abatement across all sectors reduces emissions to half 2005 levels by 2050.

Key technologies for reducing global CO_2 emissions



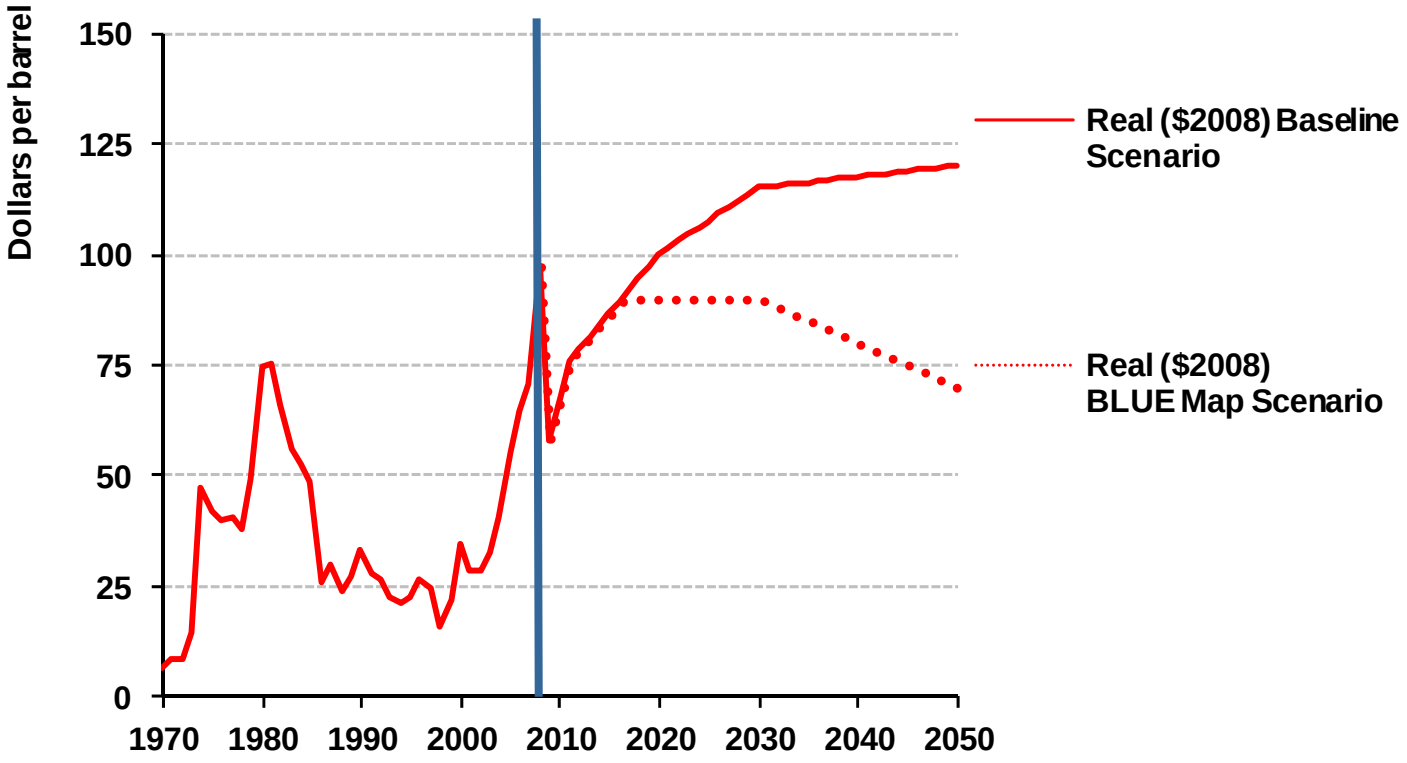
A wide range of technologies will be necessary to reduce energy-related CO_2 emissions substantially.

Primary energy demand by fuel and by scenario



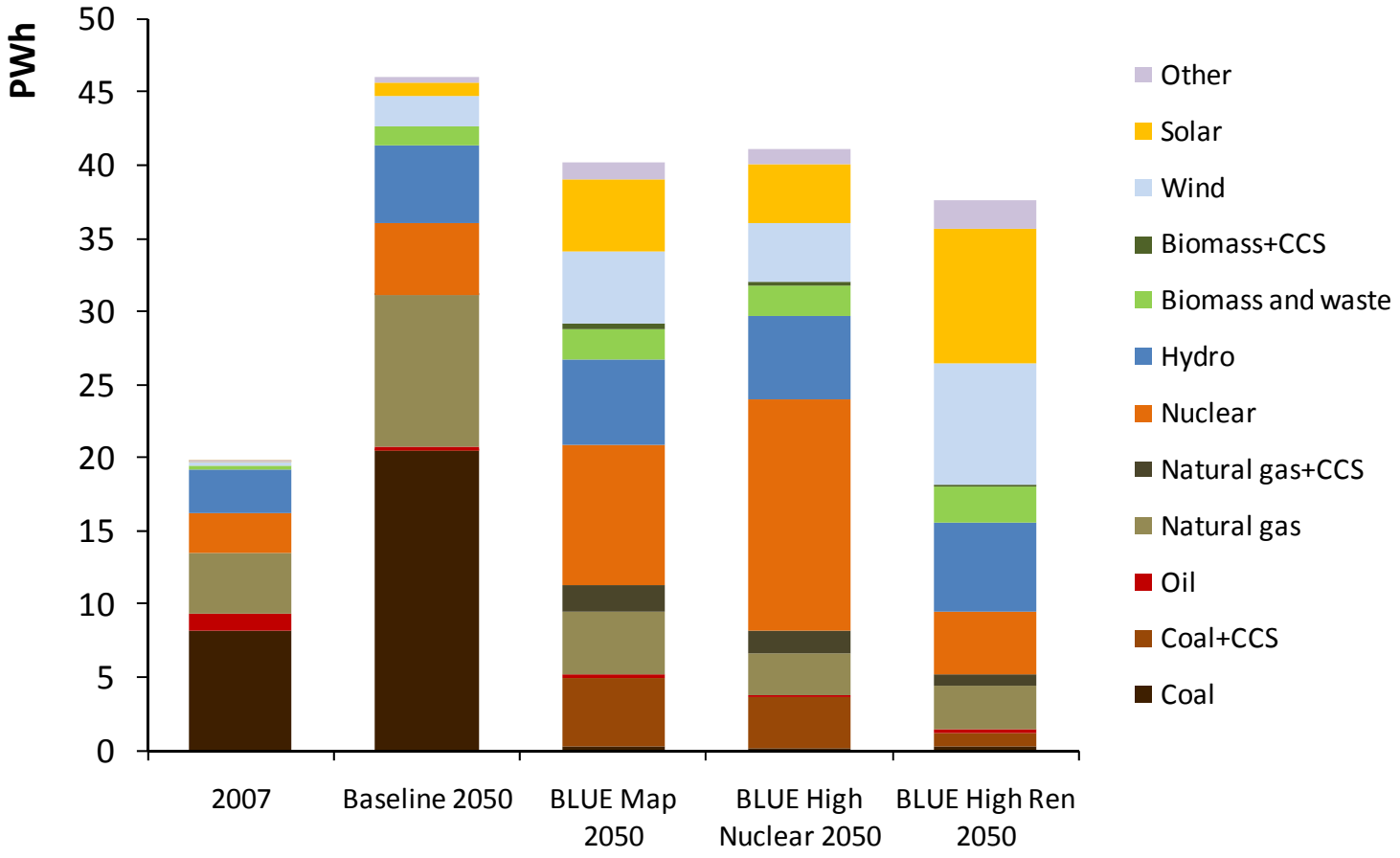
By 2050, coal, oil and gas demand are all lower than today under the BLUE Map scenario.

Crude oil price



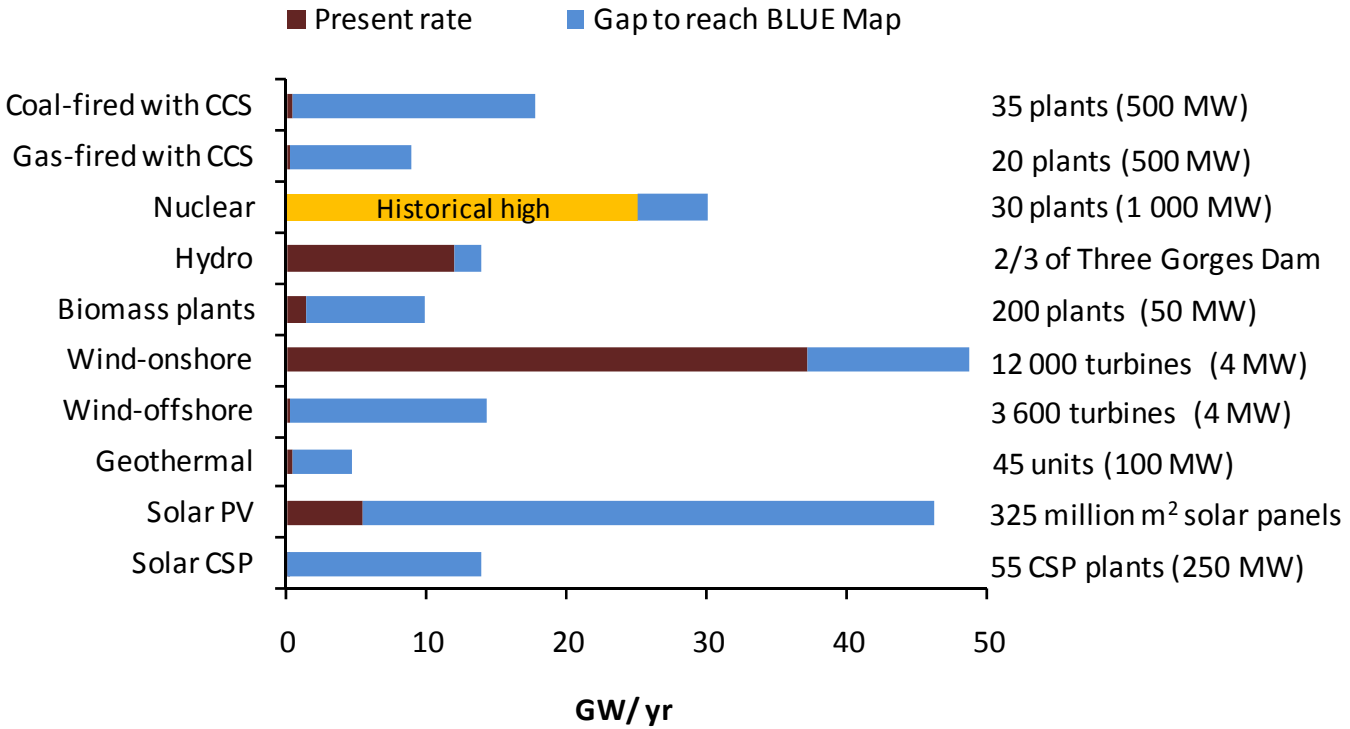
Impact of OECD CO_2 price on costs for crude oil:
2020 (50 USD/t): 90+21 =111 USD/bbl
2030 (110 USD/t): 90+43 =133 USD/bbl
2050 (175 USD/t): 70+73 =143 USD/bbl

Decarbonising the power sector – a new age of electrification?



A mix of renewables, nuclear and fossil-fuels with CCS will be needed to decarbonise the electricity sector.

Average annual electricity capacity additions to 2050, BLUE Map scenario



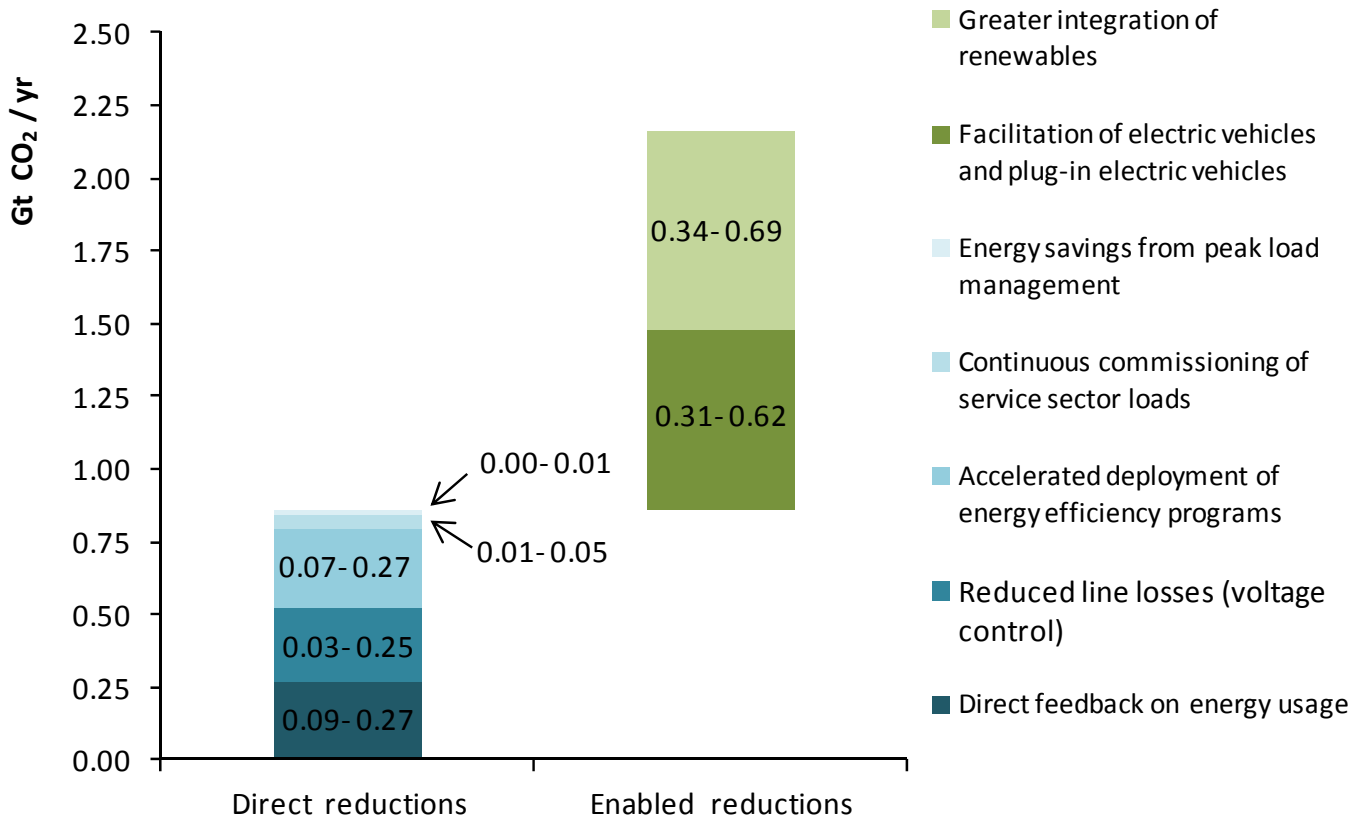
Annual rates of investment in many low-carbon technologies must be massively increased from today's levels.

Environmental co-impacts of electricity generation technologies

Energy Technologies	Life Cycle Impacts (Pre- and Post-Generation)			Power Generation Impacts			CO_2 Emissions t/MWh
	Air	Water	Land	Air	Water	Land	
Coal - USC	*Baseline Technology for Relative Assessments Below*						0.777
Coal - Biomass	Positive	Positive	Variable / Uncertain	Variable / Uncertain	Minimal	Minimal	0.622
Coal - CCS	Negative	Negative	Negative	Variable / Uncertain	Negative	Minimal	0.142
Coal - IGCC	Minimal	Variable / Uncertain	Minimal	Positive	Positive	Minimal	0.708
NGCC	Positive	Positive	Positive	Positive	Positive	Positive	0.403
Nuclear	Positive	Variable / Uncertain	Variable / Uncertain	Positive	Negative	Positive	0.005
Solar - CSP	Positive	Positive	Positive	Positive	Negative	Minimal	0.017
Solar - PV	Positive	Positive	Positive	Positive	Positive	Minimal	0.009
Wind	Positive	Positive	Positive	Positive	Positive	Variable / Uncertain	0.002

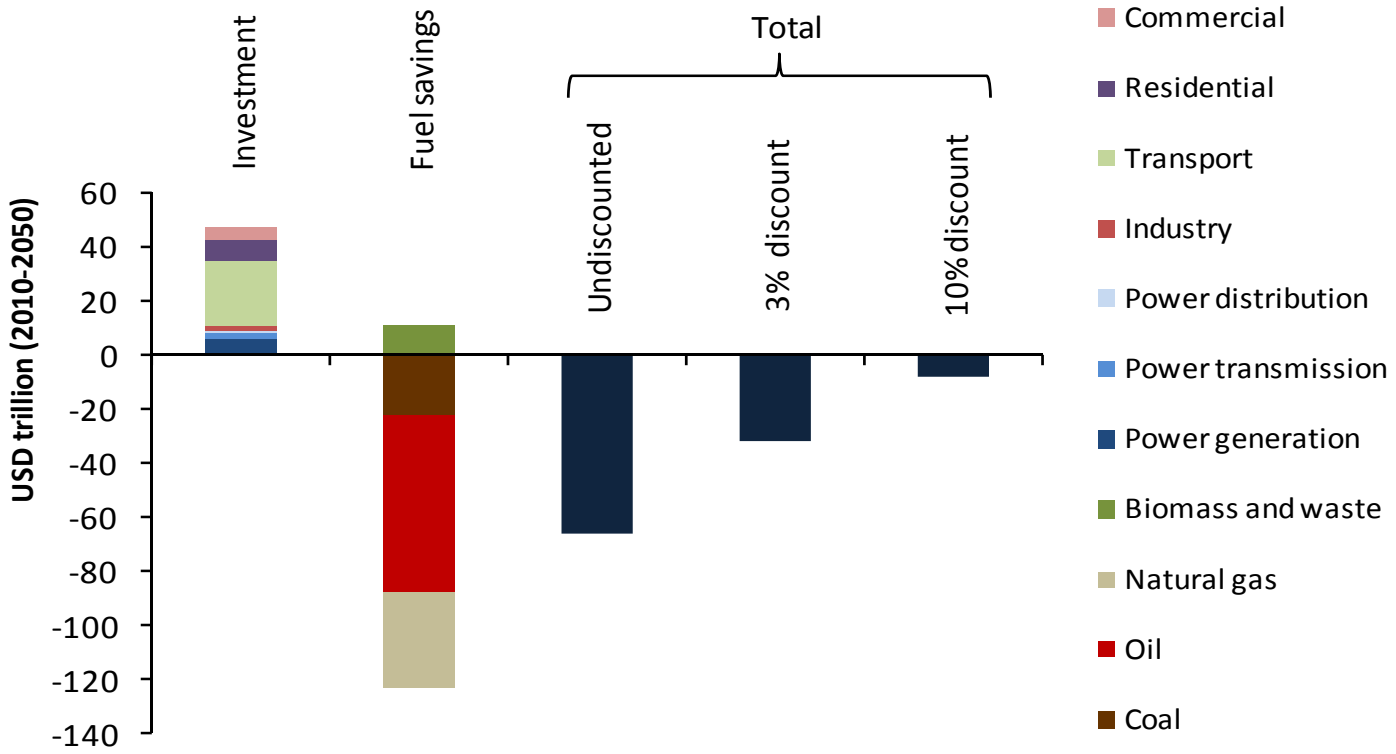
Most renewable technologies have positive environmental co-impacts.

Smart grid CO_2 reductions in 2050



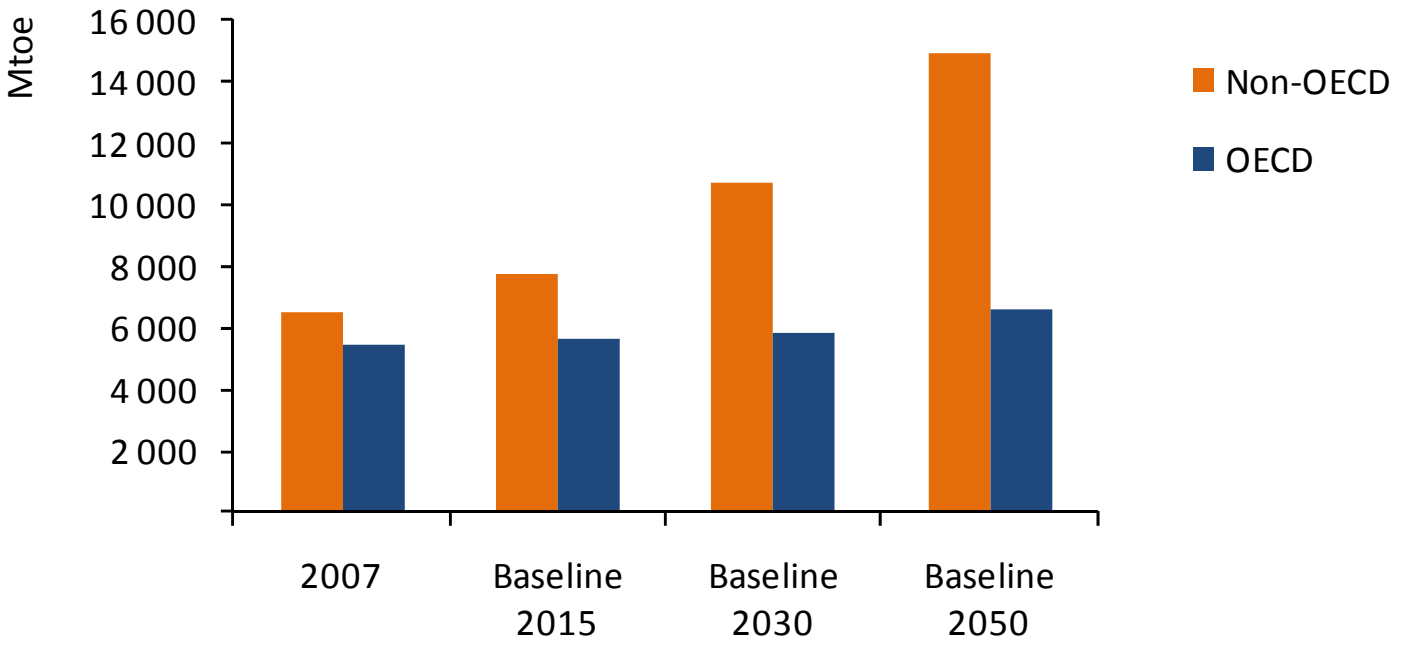
Smart grids allow better management of the grid and can facilitate the deployment of low-carbon technologies, such as renewables and electric vehicles.

Additional investment and fuel savings, 2010-2050



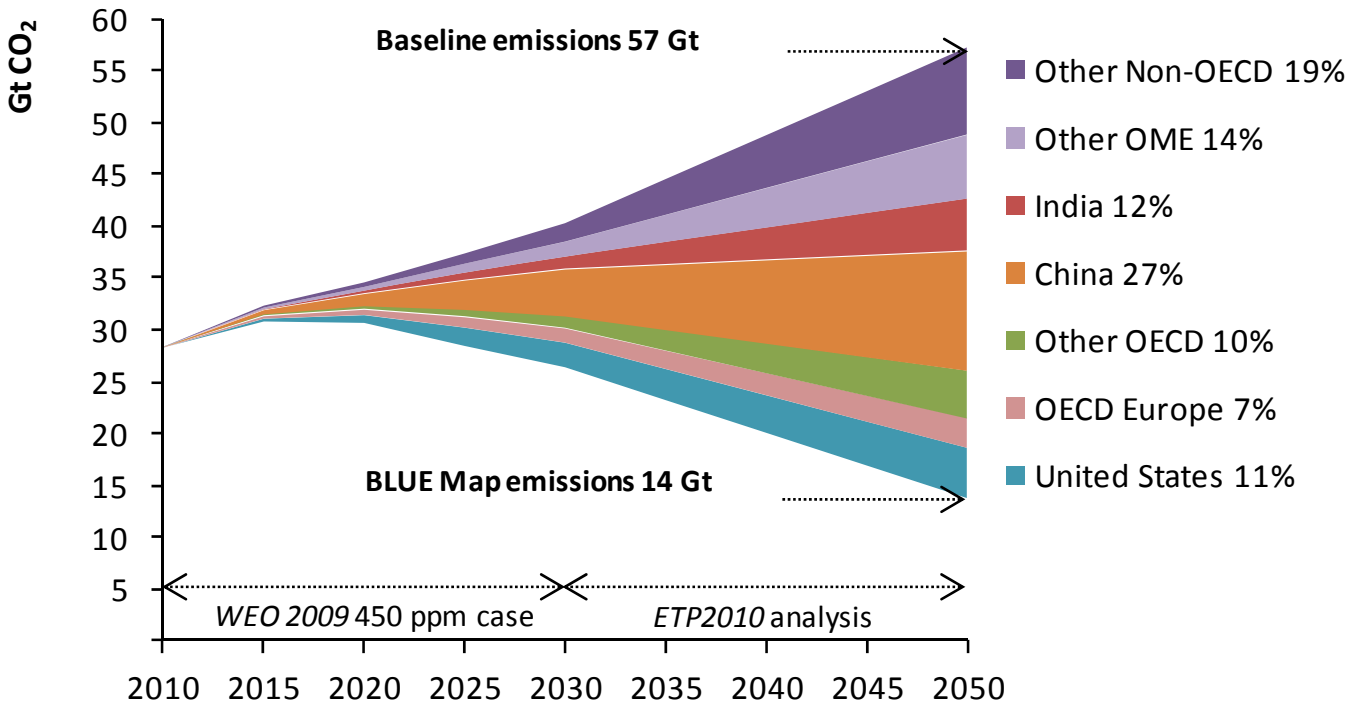
Even using a 10% discount rate, fuel savings in the BLUE Map scenario more than offset the additional investment required.

OECD and non-OECD primary energy demand in the Baseline scenario



Primary energy demand in non-OECD countries is projected to increase much faster than in OECD countries in the Baseline scenario.

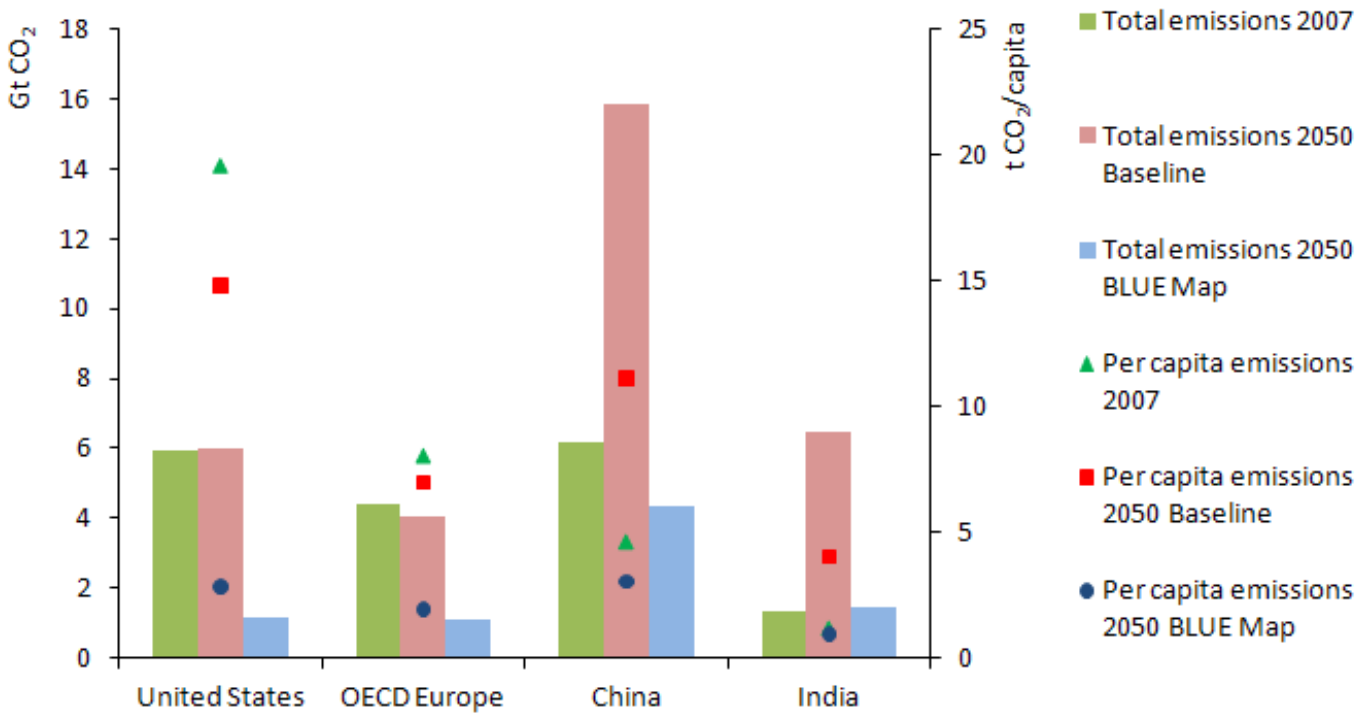
World energy-related CO_2 emissions abatement by region



In the BLUE Map scenario, most of the reductions in energy-related CO_2 emissions are in non-OECD countries.

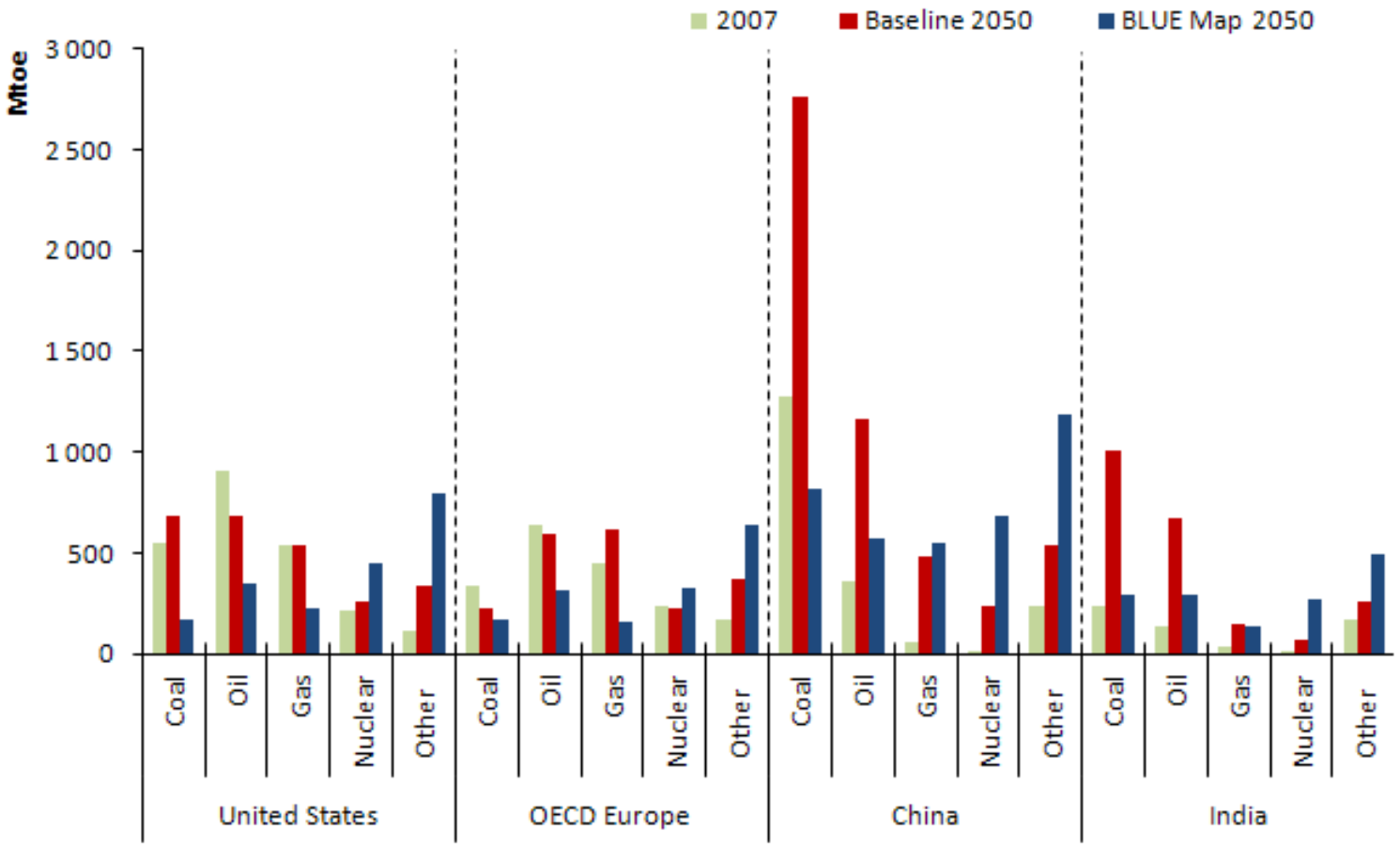
Regional Implications

CO_2 emissions by region/country



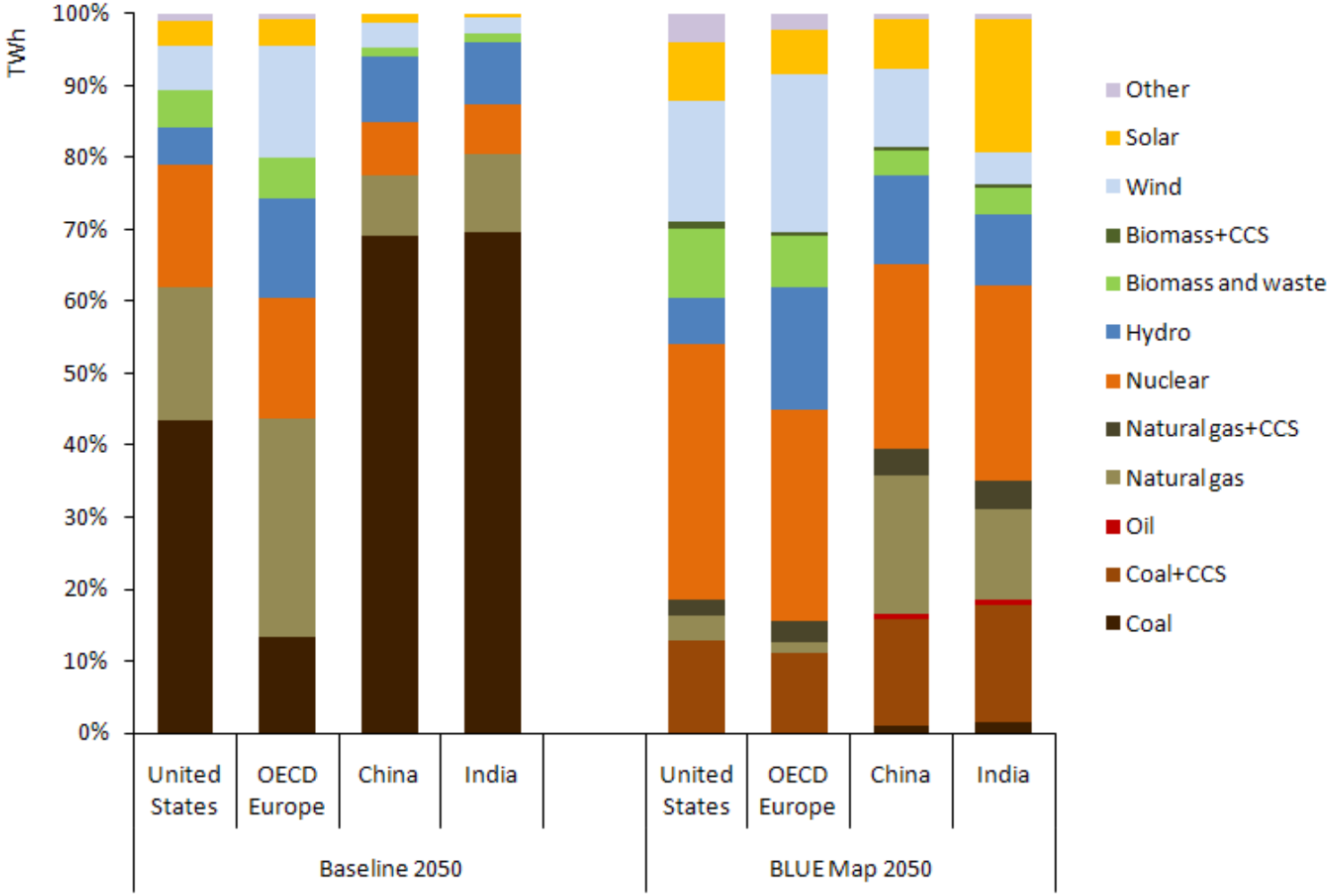
Regions/countries have very different CO_2 trends under both Baseline and BLUE Map scenarios. Per capita CO_2 emissions converge substantially under BLUE Map.

Primary energy demand by fuel and by scenario



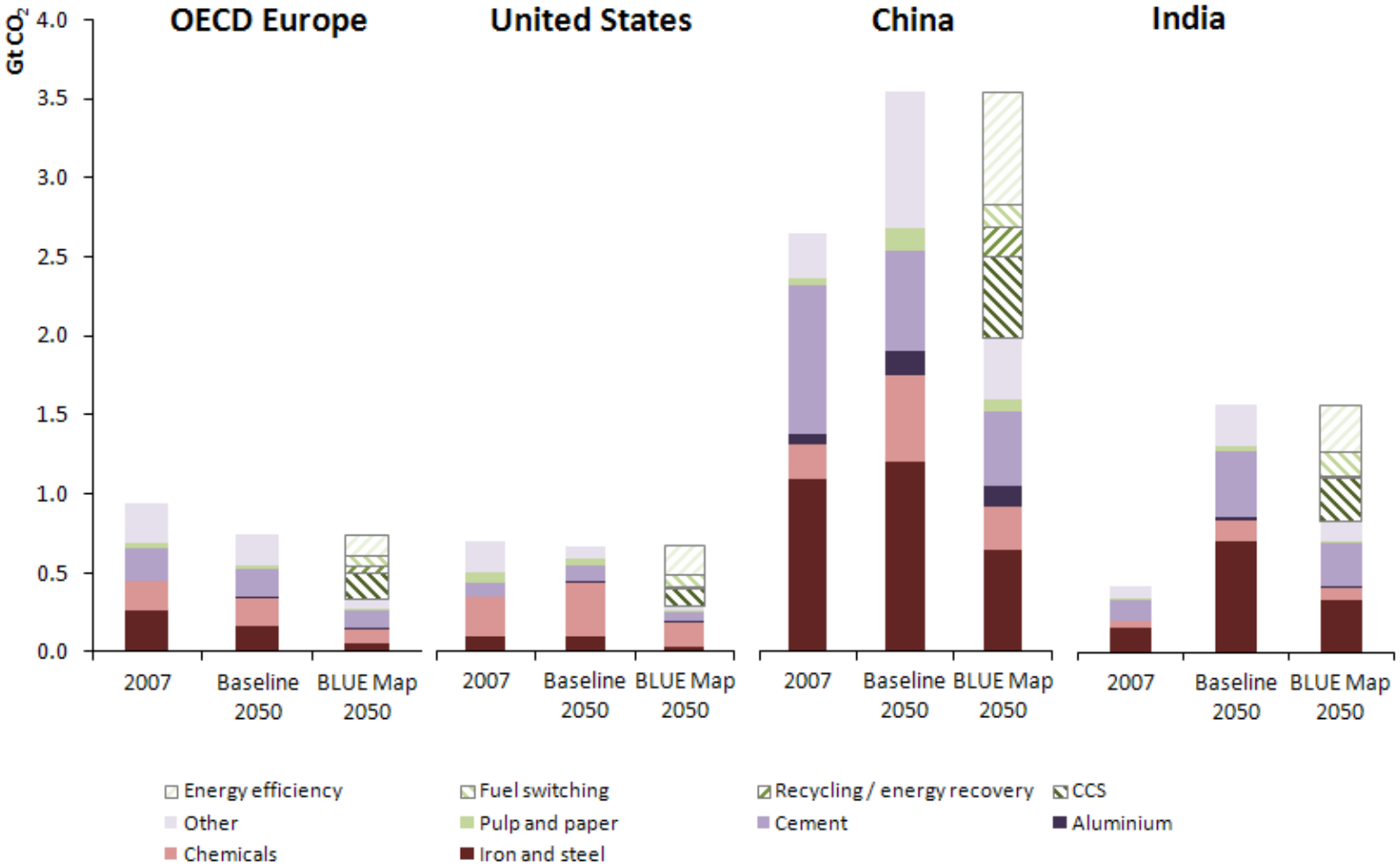
Under the BLUE Map scenario fossil fuel demand growth is offset by the growth in nuclear power and the use of renewable energy.

Decarbonisation of power generation



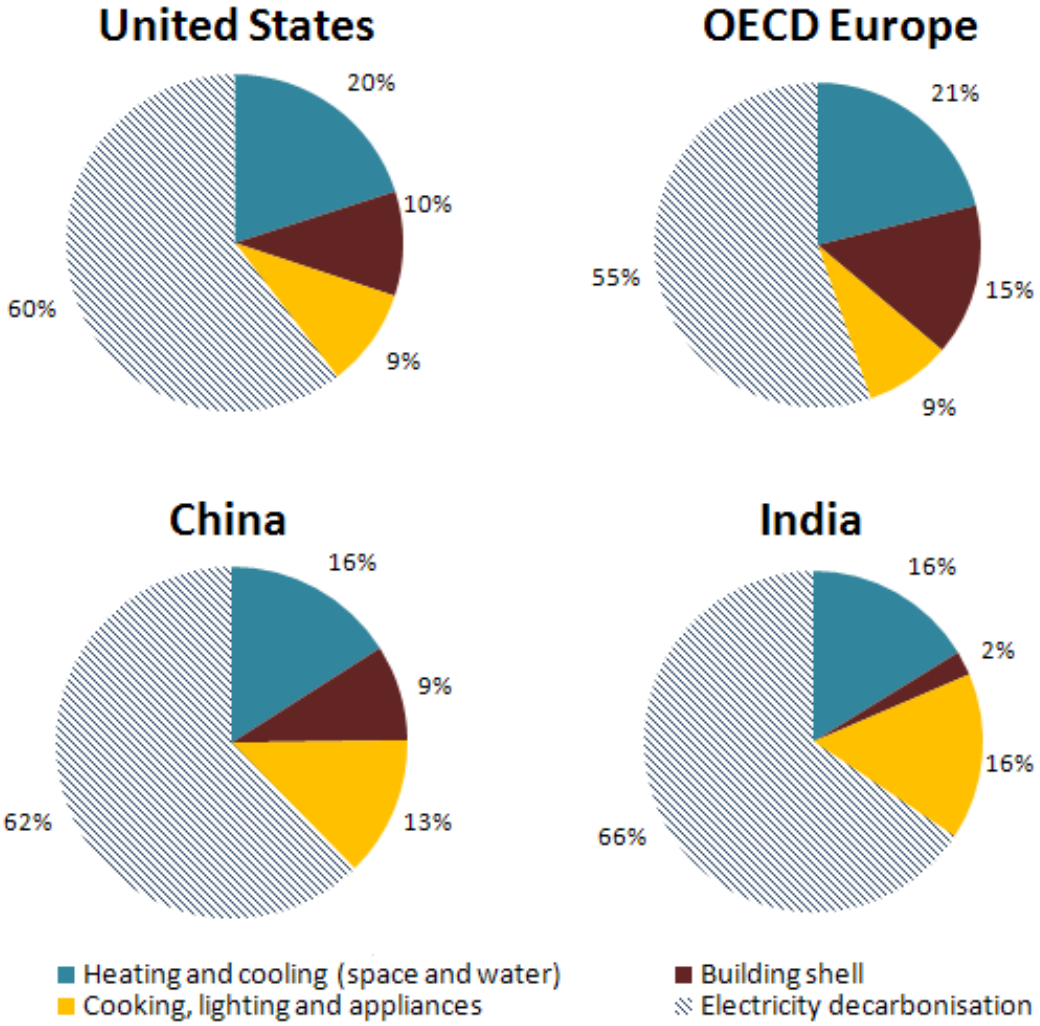
Decarbonising the power sector requires all countries to dramatically change their generation mix.

Direct energy and process CO_2 emissions in industry by sector



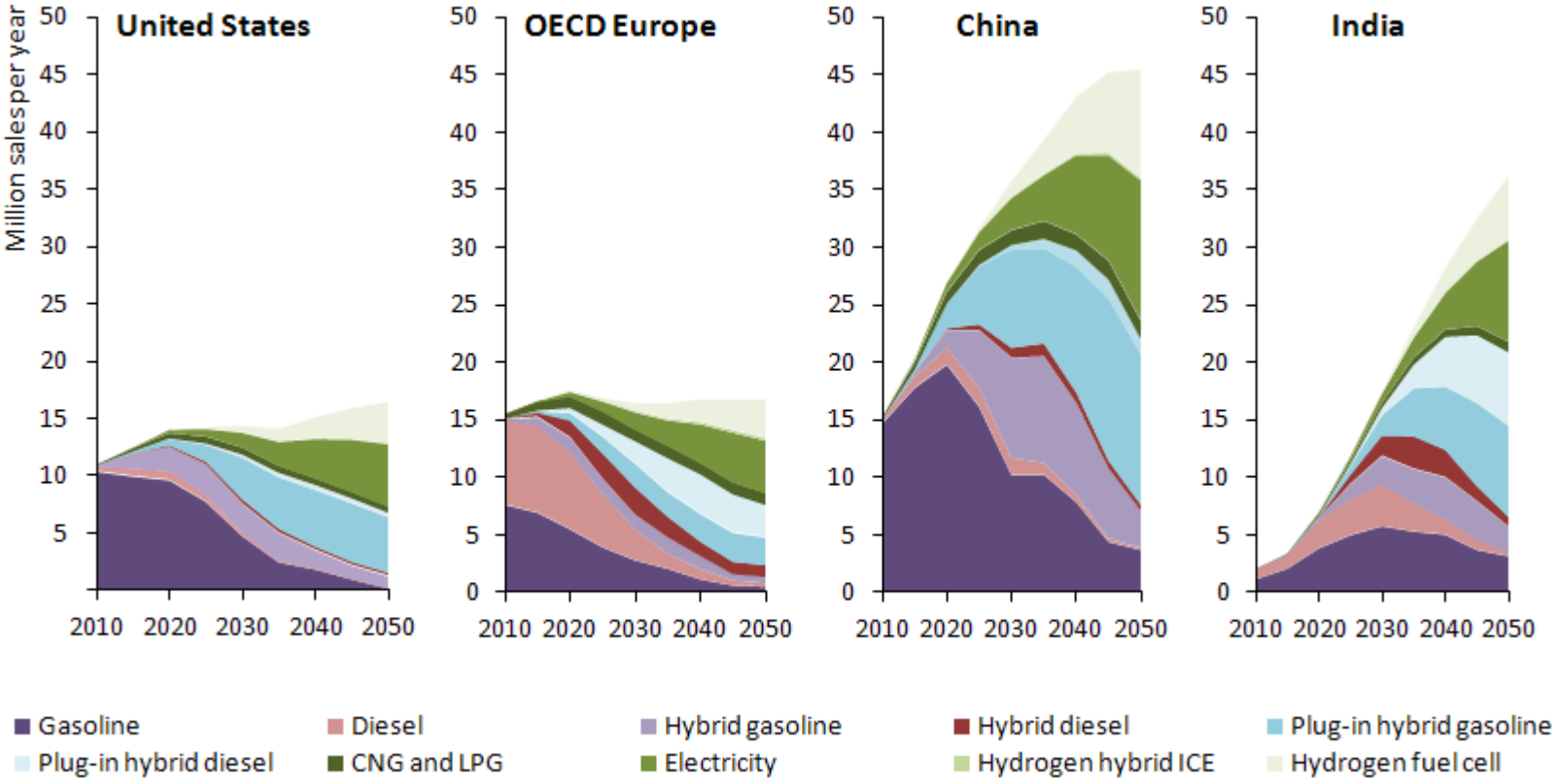
Energy efficiency and CCS are the two most important abatement options in industry.

CO_2 emissions reduction in the buildings sector



Decarbonisation of the electricity sector contributes two-thirds to emissions reduction in the buildings sector.

Passenger light-duty vehicles sales by technology BLUE Map scenarios

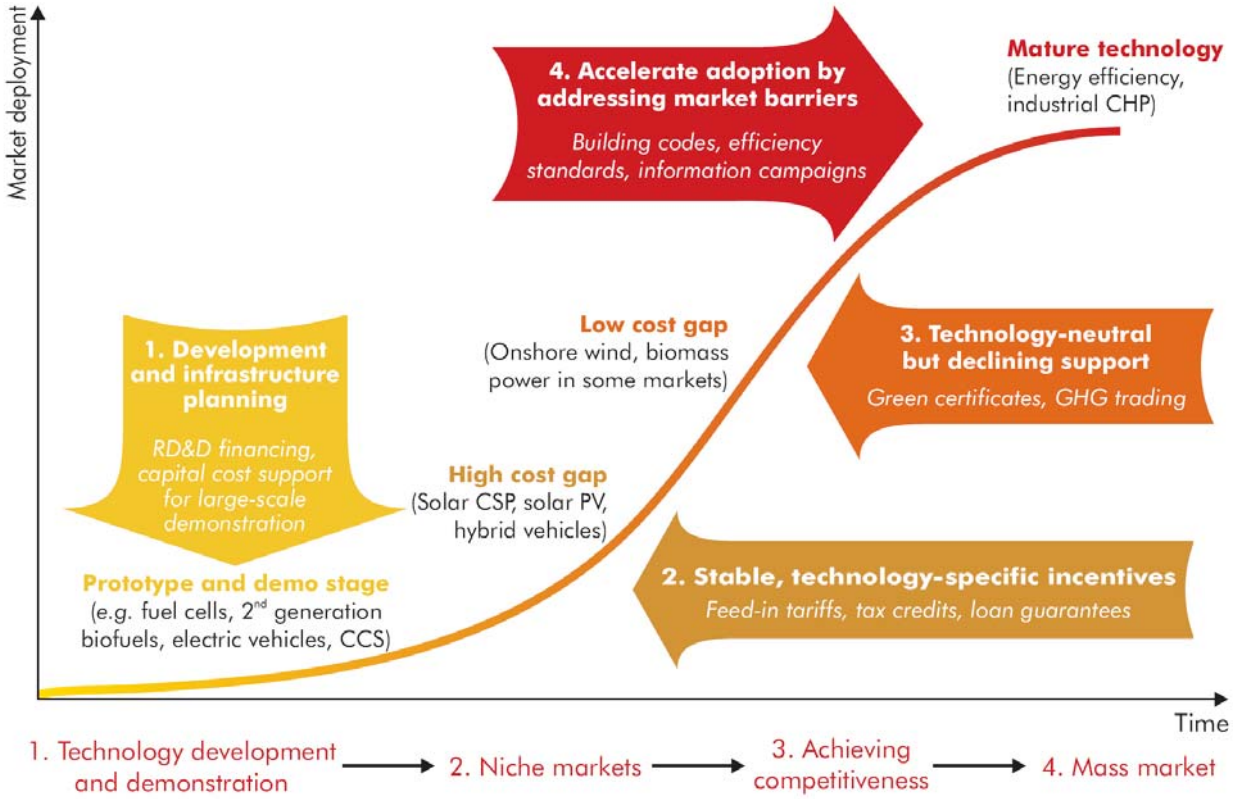


The BLUE Map scenario envisions rapid successive introduction of new generations of advanced vehicles in all major economies.

Technology policies

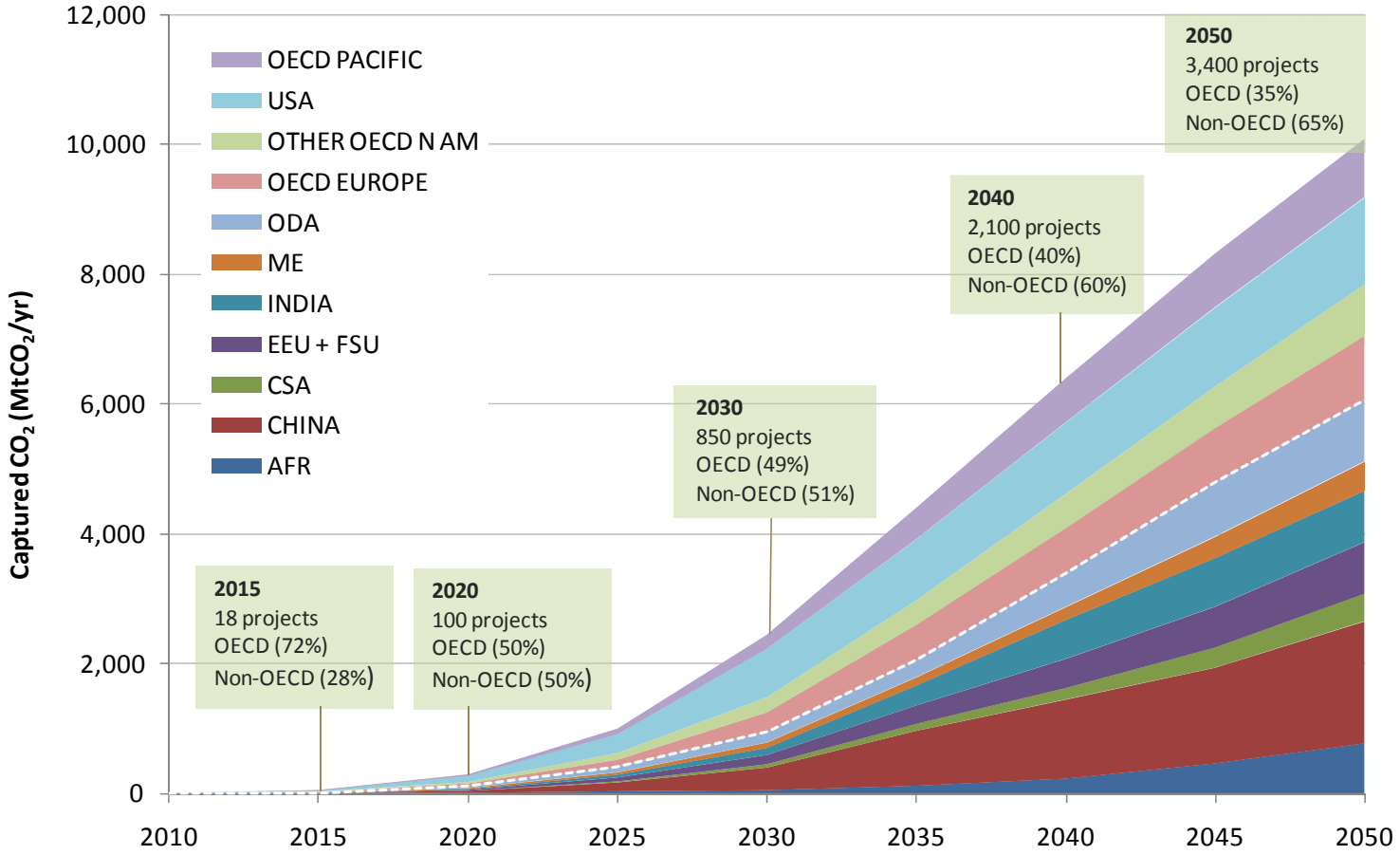
- Carbon pricing is important, but should be complemented by other policies
- Policies must be tailored to the technology's stage of development and reflect good design principles
- Public RD&D spending must at least double
- Governments need to implement best practices in energy RD&D
- A number of enabling actions are also needed:
  - Private sector leadership
  - Expanded human capacity
  - Greater government outreach and planning on infrastructure needs
  - Expanded, more effective international collaboration

Policies for supporting low-carbon technologies



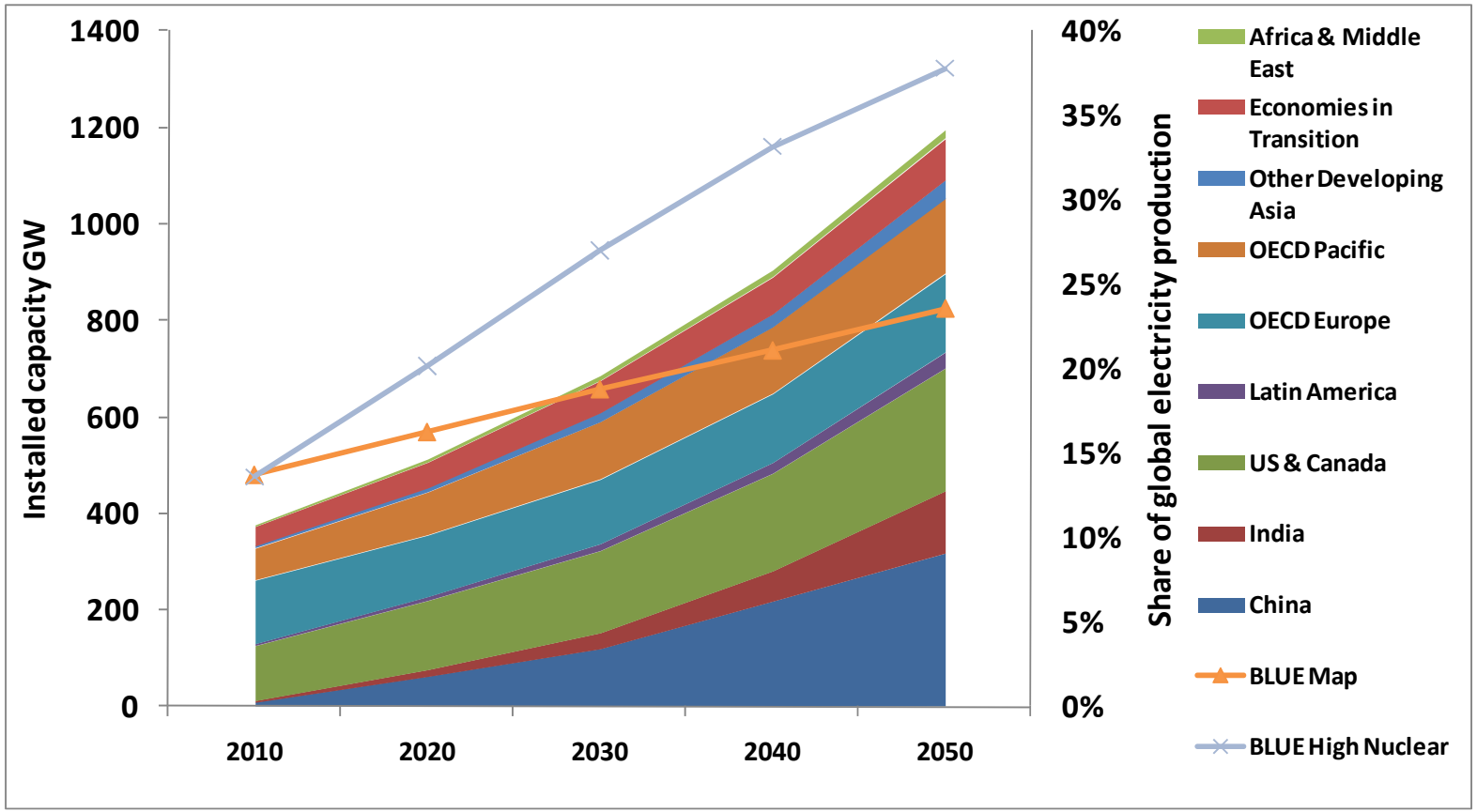
Government support policies need to be appropriately tailored to the stage(s) of technological development.

CCS Roadmap



More than 3000 CCS plants are needed by 2050 under the BLUE Map scenario

Nuclear Energy Roadmap



Nuclear is a proven technology and can play an important role in a low-carbon strategy

Projected electric and plug-in hybrid vehicle sales

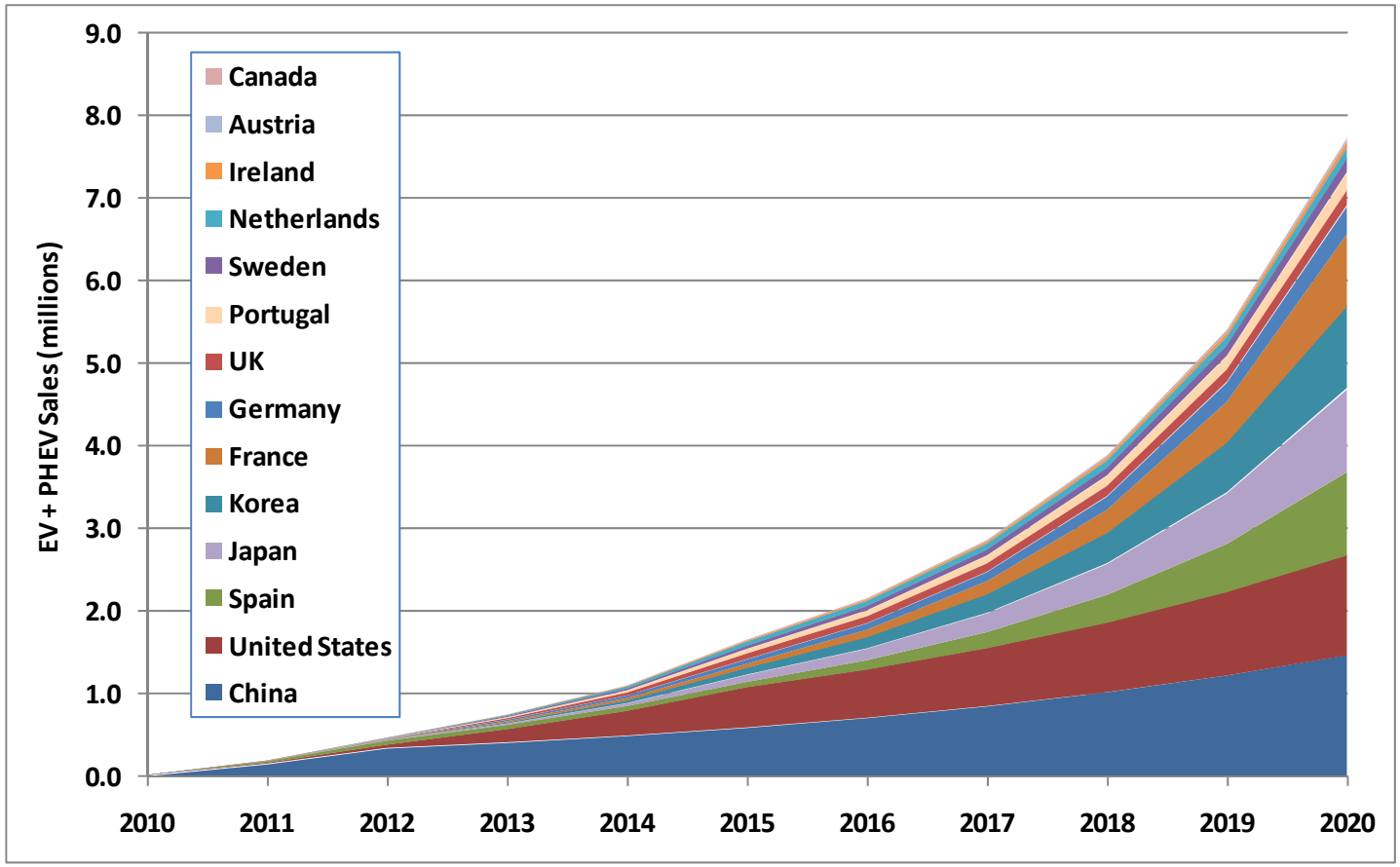


Figure based on announced national sales and stock targets, with assumed 20% annual sales growth after target is met, if target is before 2020 (e.g. China's target is for end of 2011).

EV / PHEV sales could reach nearly eight million vehicles by 2020

International Low-carbon Energy Technology Platform

Timeline and approach

Copenhagen, December 2009

Experts Group Meeting

(Planning & Presentation Work)
31 May/1 June 2010

Senior Officials Meeting

(Decision Meeting)
15 October 2010

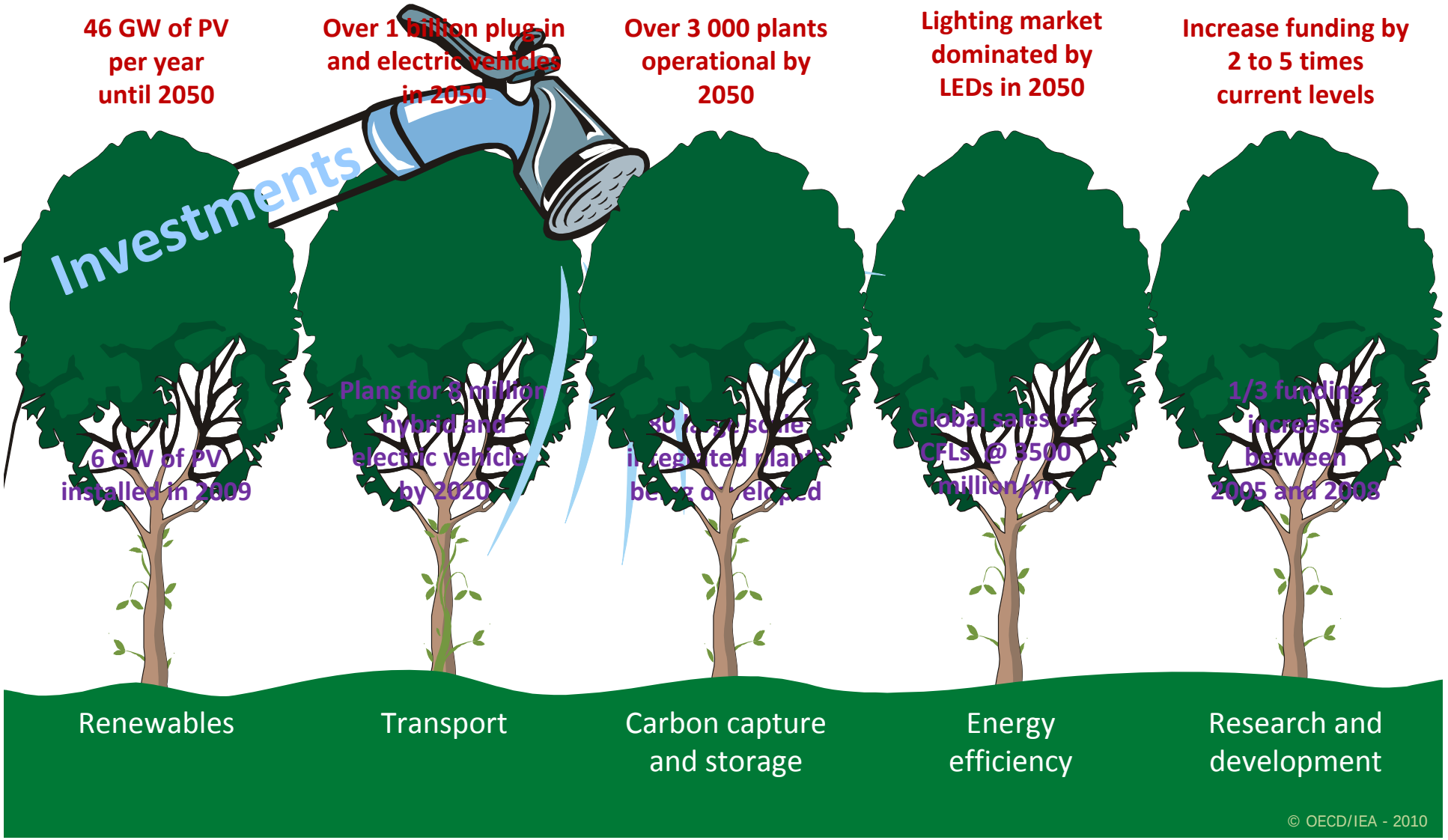
Regional Workshops

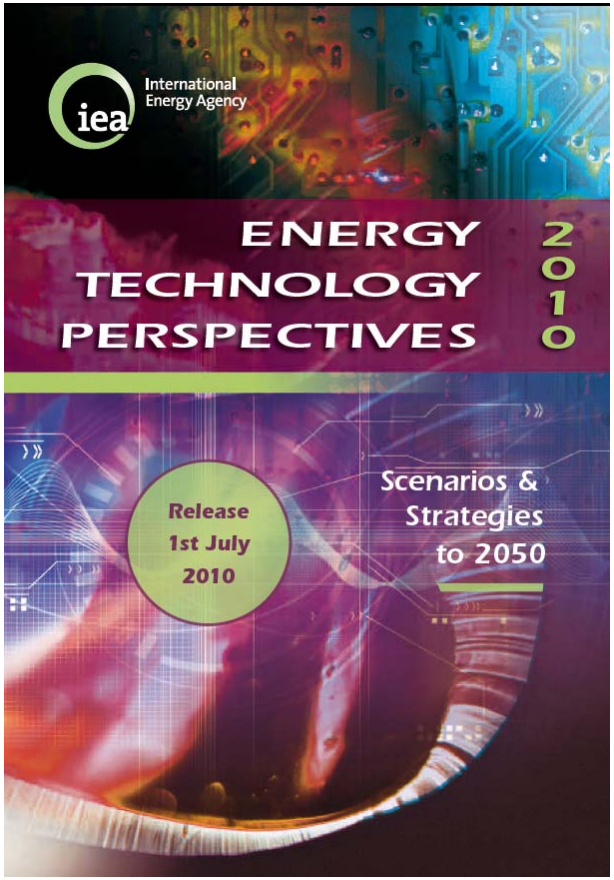
Asia
IEA
Europe
S. America
S. Africa

1st year: Gauge interest, define goals and work programme

Q2 2010 → Q3 2010

The first green shoots …much more needs to be done of an energy technology revolution…





Thank You

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ANNEX

GDP projections

	2007-2015	2015-2030	2030-2050
OECD	**1.4**	**1.9**	**1.2**
OECD North America	1.8	2.3	1.4
United States	1.8	2.2	1.3
OECD Europe	1.0	1.8	0.7
OECD Pacific	1.3	1.3	1.7
Non-OECD	**5.7**	**4.1**	**3.4**
Economies in transition and non-OECD Europe	3.3	3.3	3.5
Middle East	4.5	4.0	2.5
Africa	4.7	3.1	3.1
Latin America	3.1	2.5	2.5
China	8.8	4.4	3.8
India	7.0	5.9	3.3
Other developing Asia	3.2	3.5	2.6
World	**3.3**	**3.0**	**2.6**

(% per year based on purchasing power parity)

Oil, gas and coal price assumptions

Baseline Scenarios (in USD per unit)

	Unit	2008	2030	2050
IEA crude oil imports	Barrel	97	90	70
Natural gas				
United States imports	*MBtu*	*8.3*	*10.2*	*7.9*
European imports	*MBtu*	*10.3*	*11.0*	*8.6*
Japanese imports	*MBtu*	*12.6*	*12.5*	*9.7*
OECD steam coal imports	Tonne	121	65	58

BLUE Scenarios (in USD per unit)

	Unit	2008	2030	2050
IEA crude oil imports	Barrel	97	115	120
Natural gas				
United States imports	*MBtu*	*8.3*	*11.4*	*11.9*
European imports	*MBtu*	*10.3*	*14.0*	*14.7*
Japanese imports	*MBtu*	*12.6*	*15.9*	*16.7*
OECD steam coal imports	Tonne	121	109	115

Carbon prices in the BLUE Map scenario

USD / t CO_2	2020	2030	2050
OECD	50	110	175
Non-OECD	0	65	175

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