Centre for Integrated
Energy Research

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Meeting energy challenges through technology and innovation

Implications for Japan and the rest of Asia

Prof. Peter Taylor

The 5th Energy Policy Roundtable, University of Tokyo
19 December 2012

Overview

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- Global energy challenges and the role of technology
- Global and Asian energy technology innovation trends
- Accelerating innovation through better and more targeted policies
- Conclusions

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Global energy challenges and the role of technology

World primary energy demand by fuel - New Policy Scenario (NPS)

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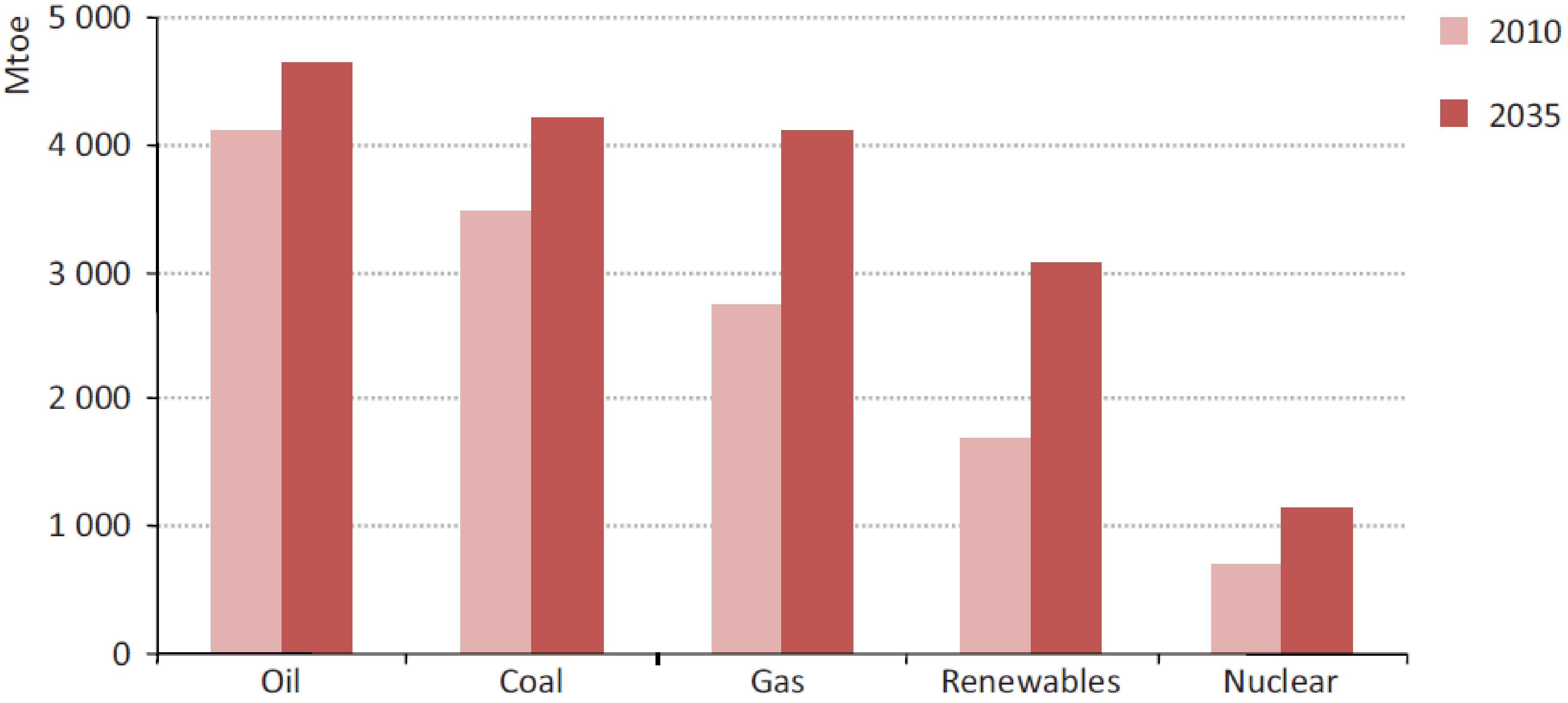

Source: IEA World Energy Outlook 2012

Primary energy demand per unit of GDP and per capita (NPS)

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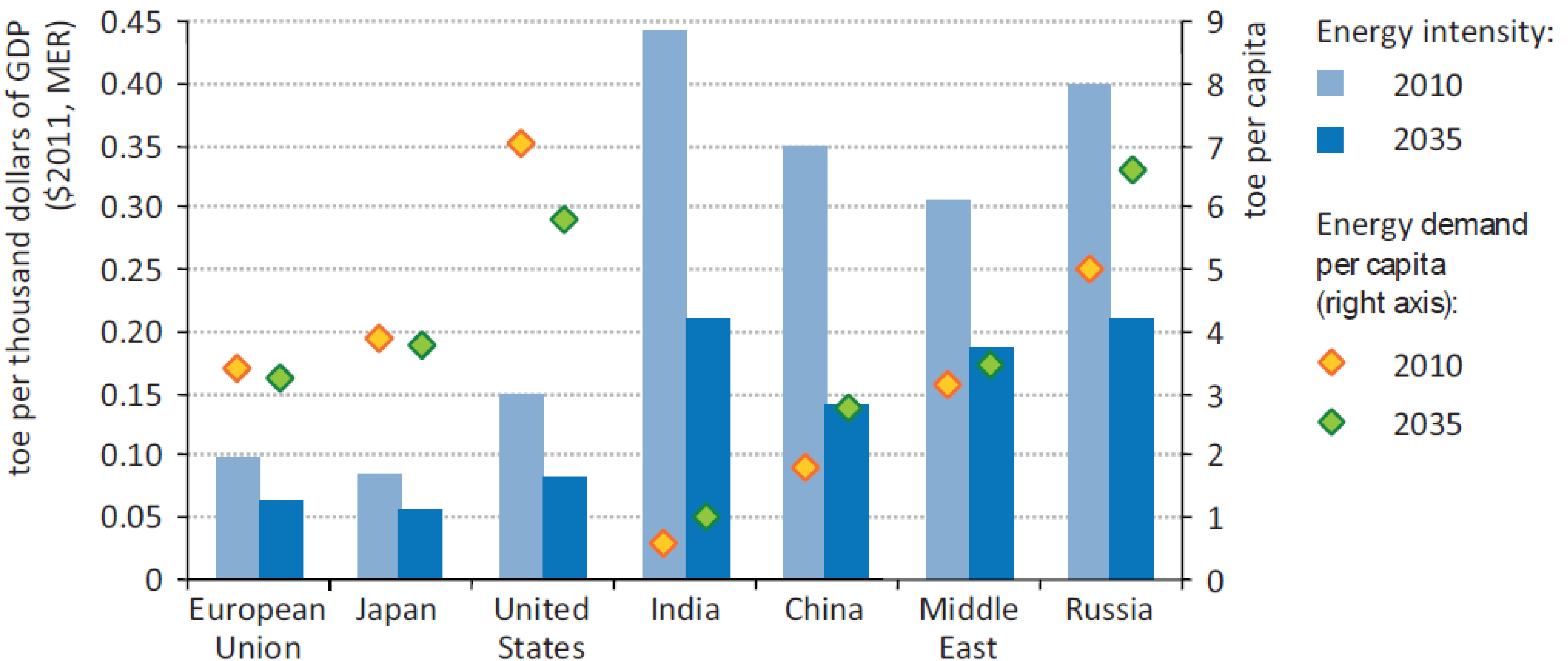

Source: IEA World Energy Outlook 2012

Net energy self-sufficiency (NPS)

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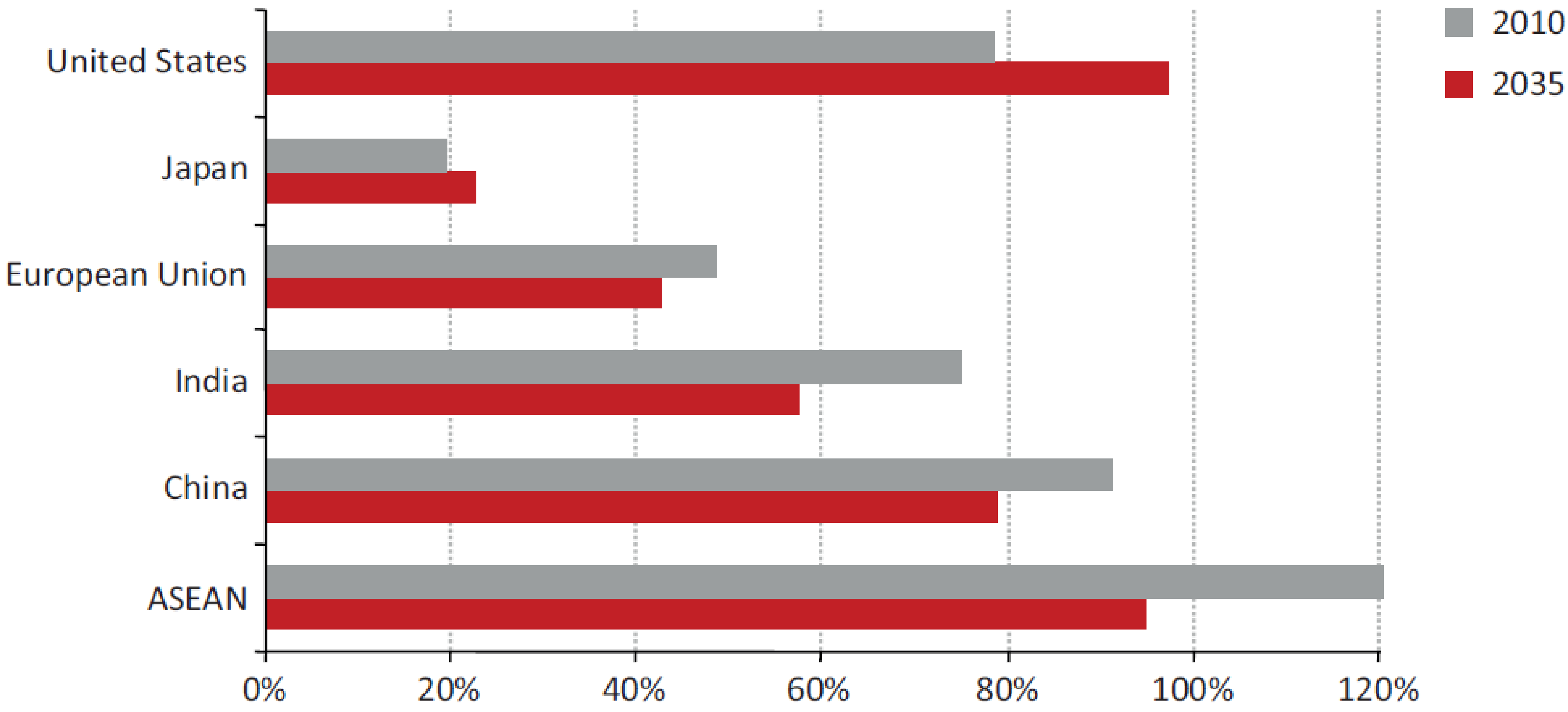

Source: IEA World Energy Outlook 2012

Spending on net imports of fossil fuels (NPS)

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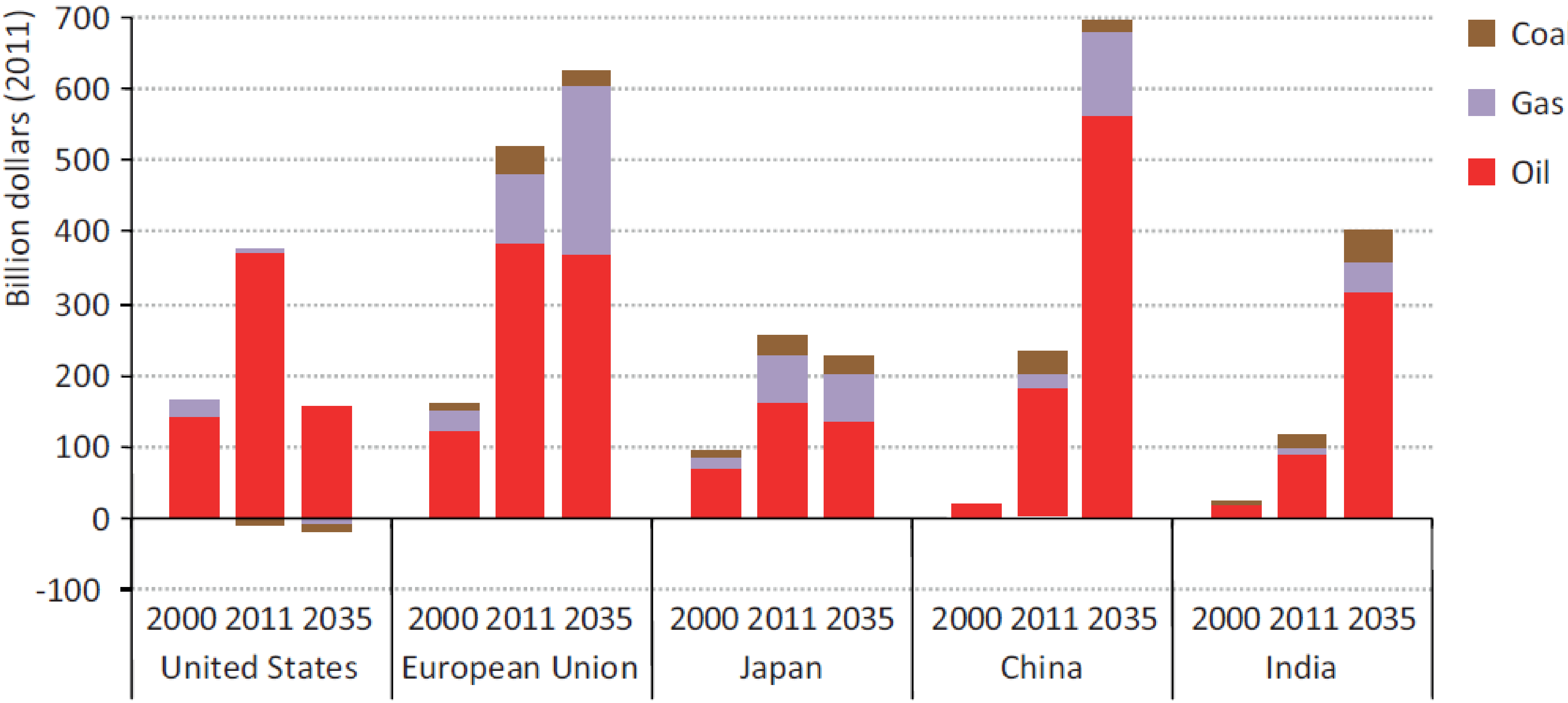

Source: IEA World Energy Outlook 2012

Energy-related CO_2 emissions (NPS)

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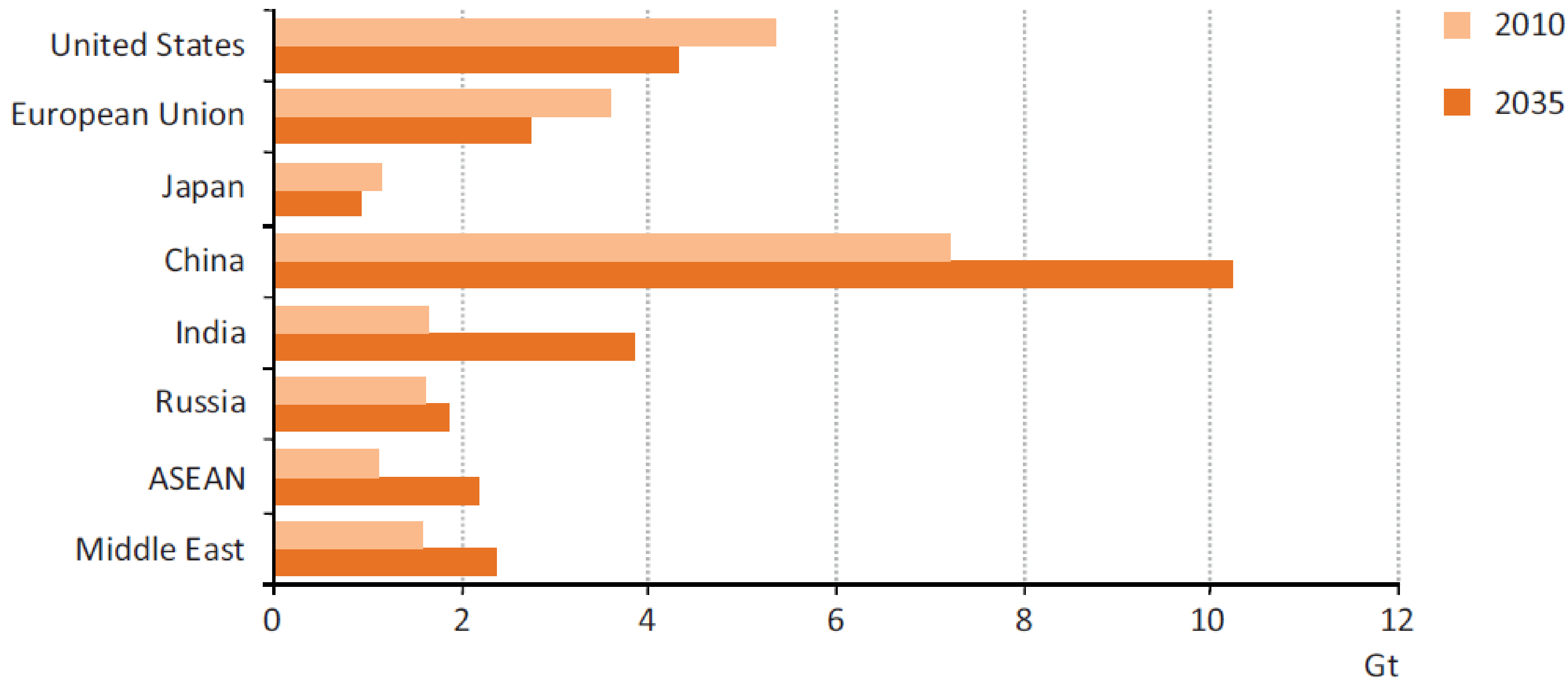
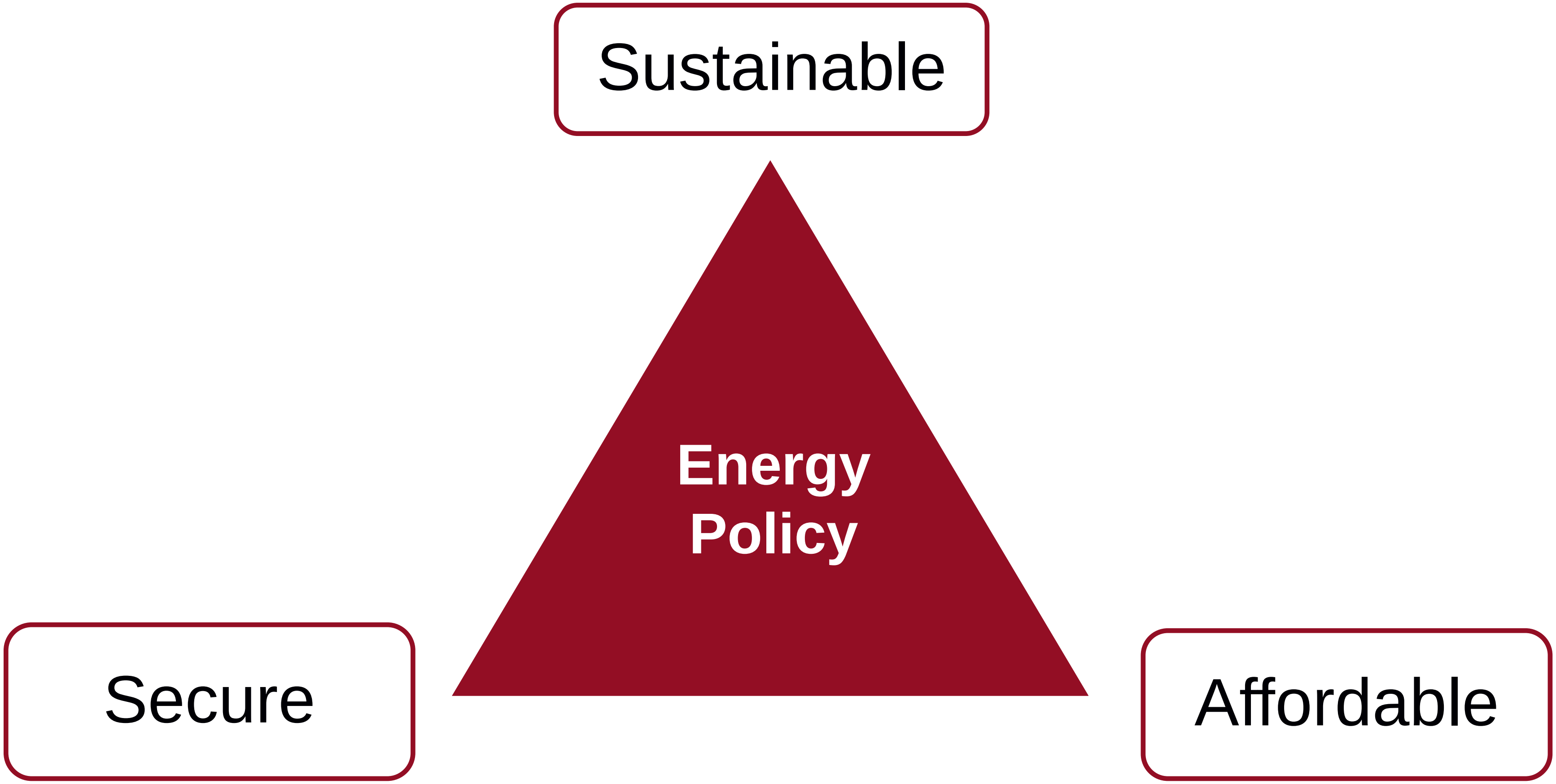


Source: IEA World Energy Outlook 2012

The energy 'trilemma'



Technology is key to a sustainable, secure and affordable energy future

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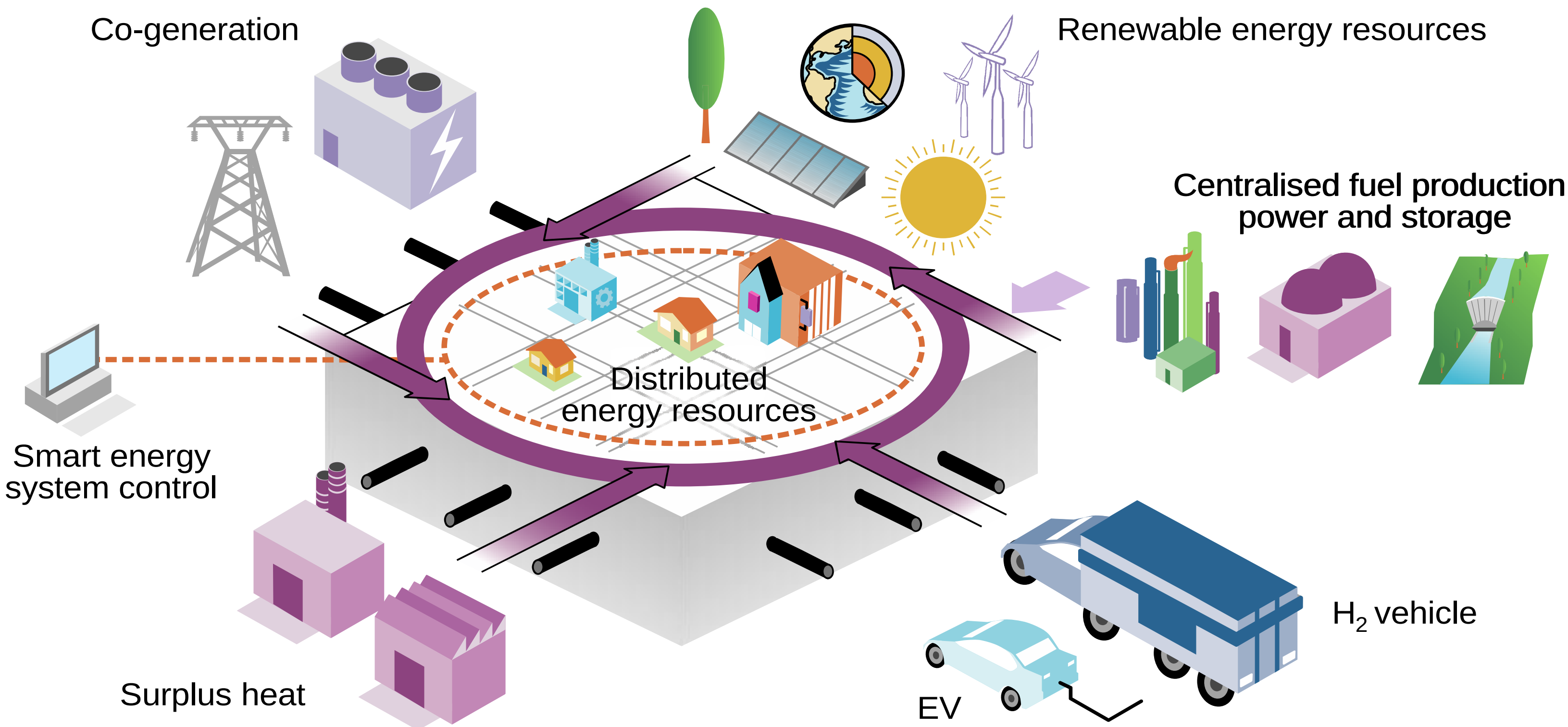

Meeting global energy challenges requires a smarter, more unified and integrated energy system

Source: IEA Energy Technology Perspectives 2012

Contributions to global emissions reductions

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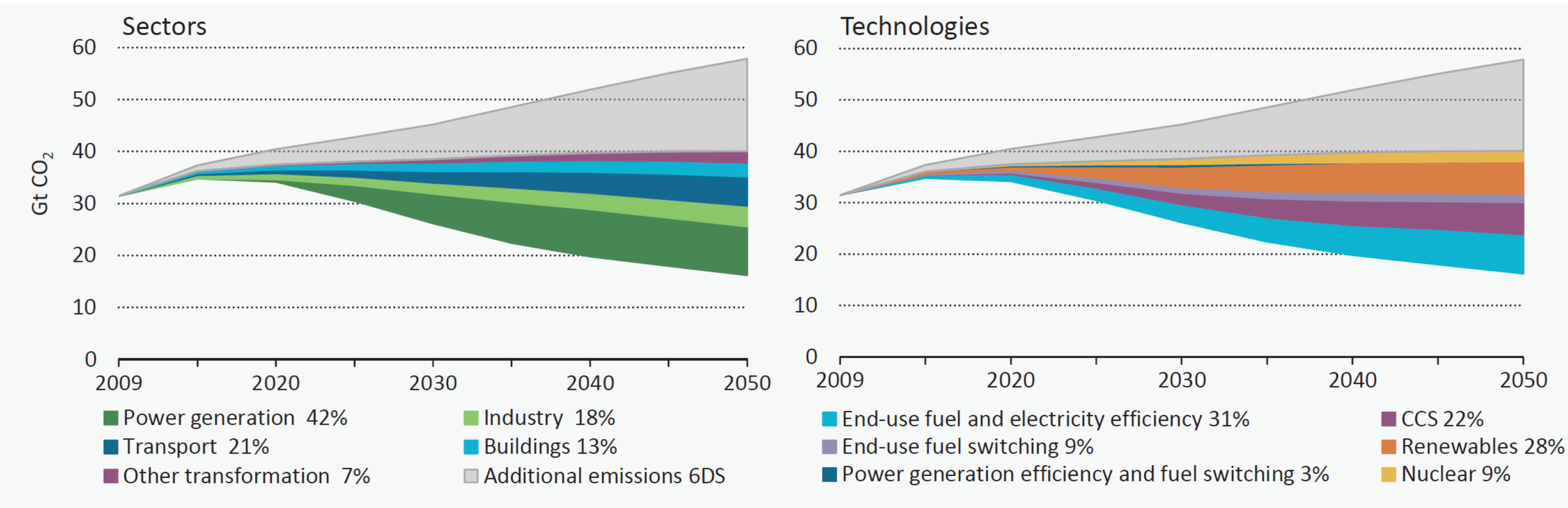

Achieving the 2DS will require contributions from all sectors and the application of a portfolio of clean technologies

Source: IEA Energy Technology Perspectives 2012

Progress with deploying clean energy technologies

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Cleaner coal power

Nuclear power

Renewable power

CCS in power

CCS in industry

Industry

Buildings

Fuel economy

Electric vehicles

Biofuels for transport

Progress is too slow in almost all technology areas

Significant action is required to get back on track

Source: IEA Energy Technology Perspectives 2012

Renewables have seen notable success

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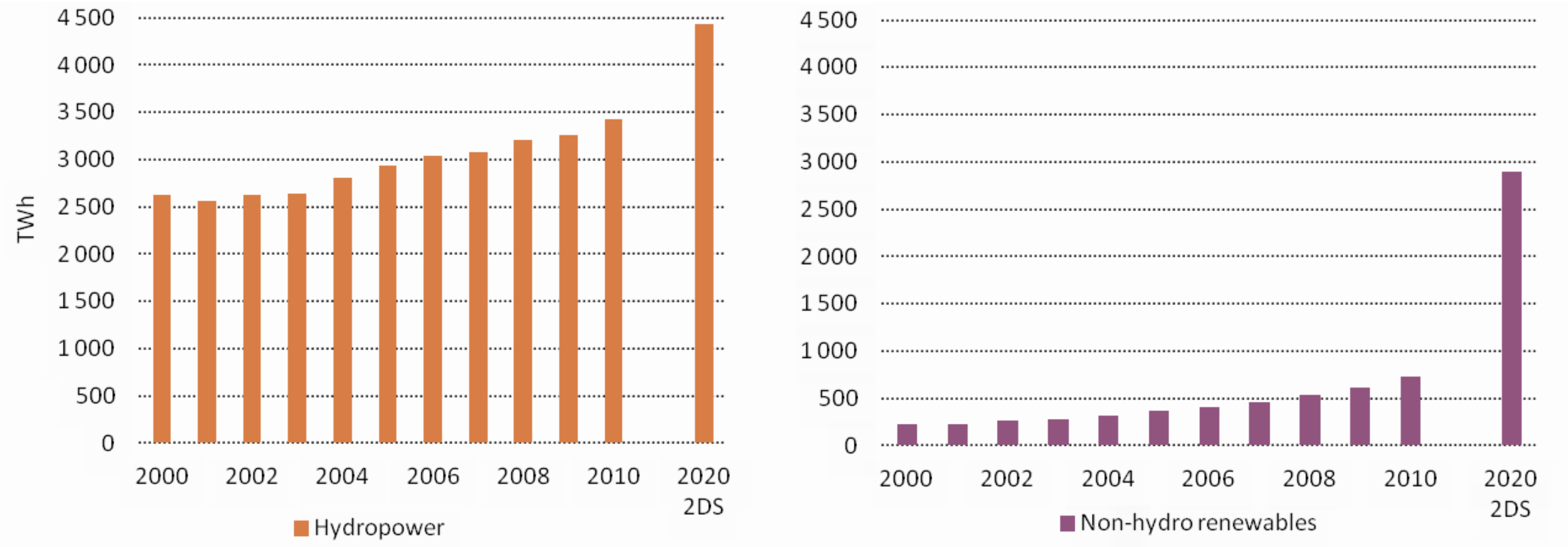
Renewable power generation



42%

Average annual growth in Solar PV

75%

Cost reductions in Solar PV in just three years in some countries

27%

Average annual growth in wind

Source: IEA Energy Technology Perspectives 2012

Fuel economy has improved, but large potential remains

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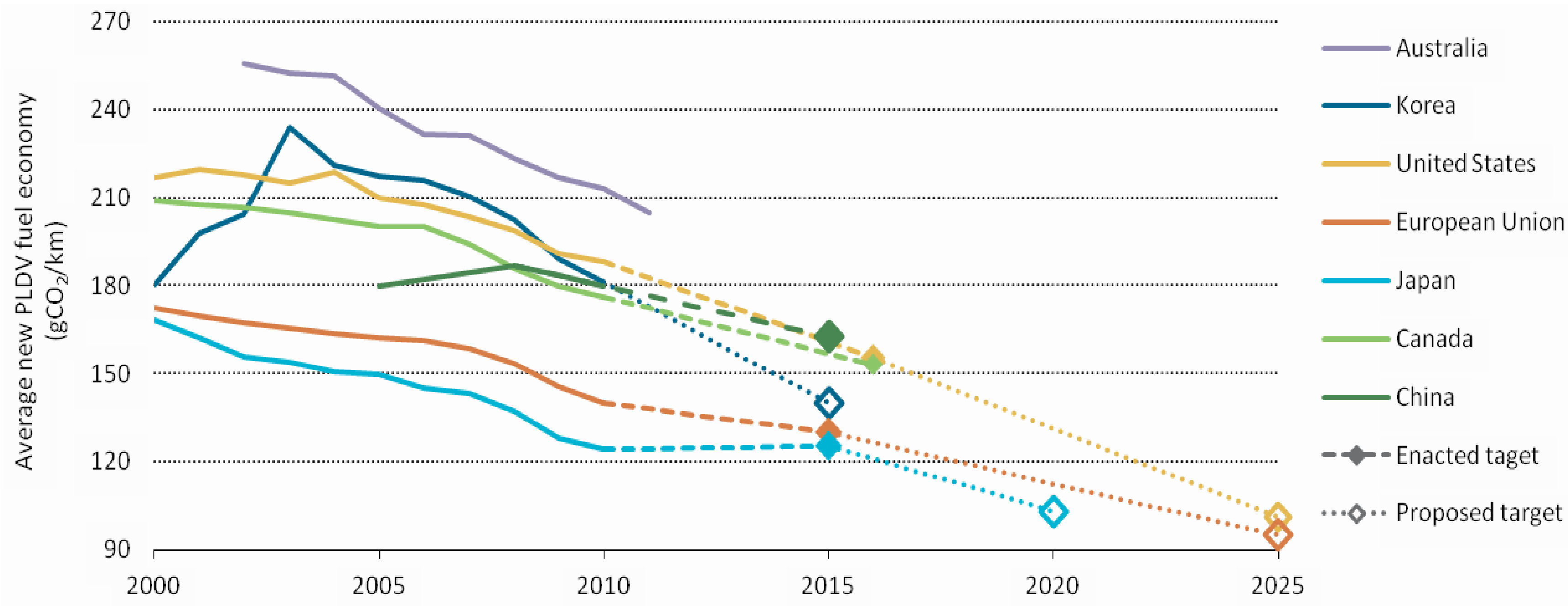
Vehicle fuel economy, enacted and proposed standards



The number one opportunity over the next decade in the transport sector, but few countries have standards in place

Source: IEA Energy Technology Perspectives 2012

Energy intensity must continue to decline

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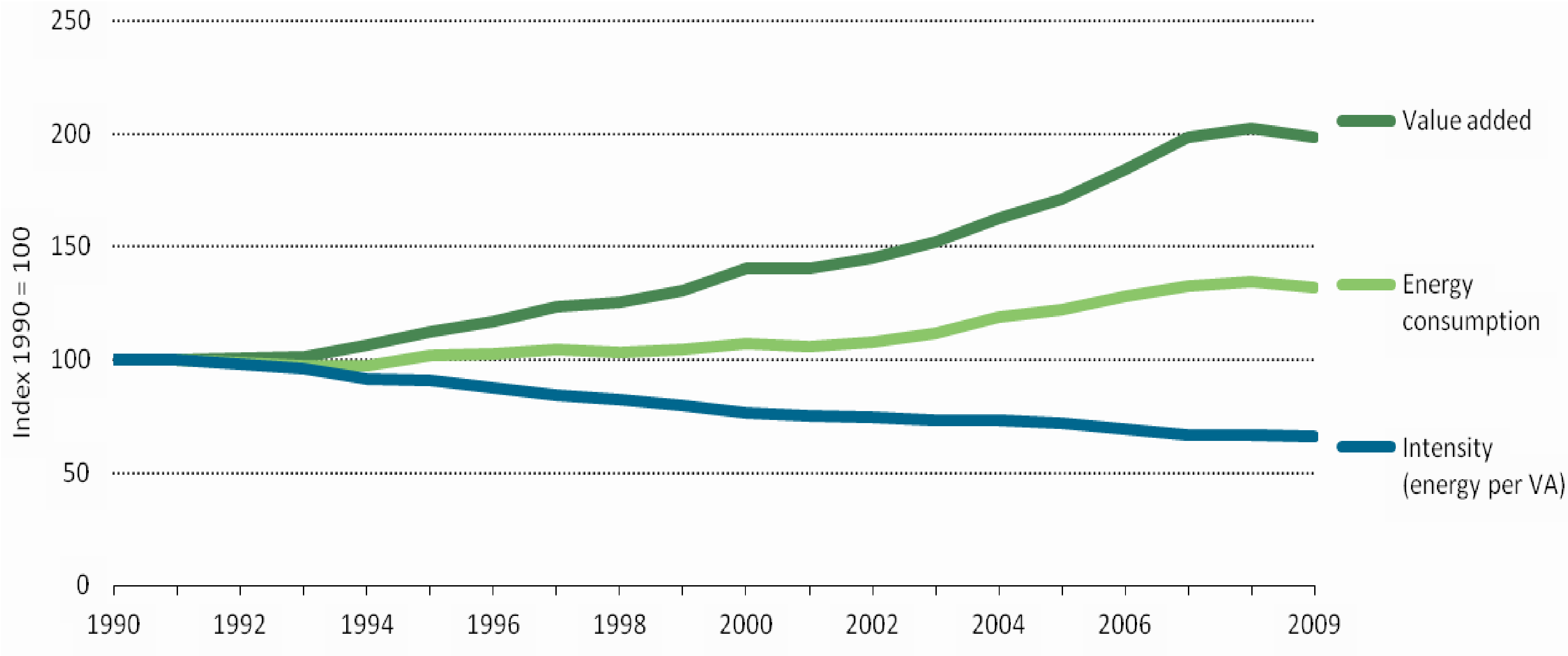
Progress in energy intensity



Significant potential for enhanced energy efficiency can be achieved through best available technologies

Source: IEA Energy Technology Perspectives 2012

Global and regional energy technology innovation trends

Deploying new energy technologies takes time

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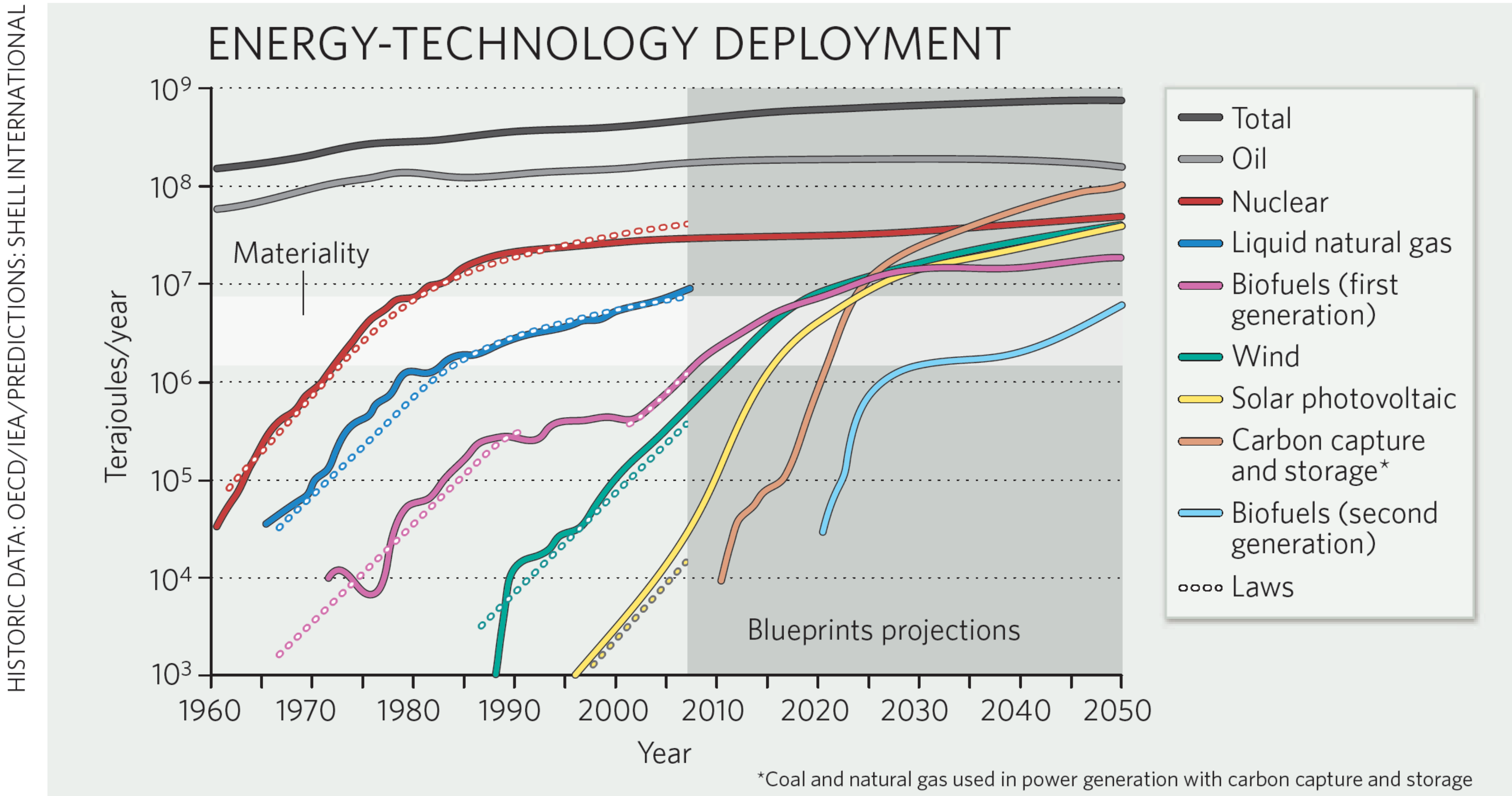

Figure 1 | Global production of primary energy sources. When a technology produces 1,000 terajoules a year (equivalent to 500 barrels of oil a day), the technology is 'available'. It can take 30 years to reach materiality (1% of world energy mix). Projections after 2007 taken from Shell's Blueprints scenario[3].

Source: Kramer and Haigh, 2009

The energy technology innovation system

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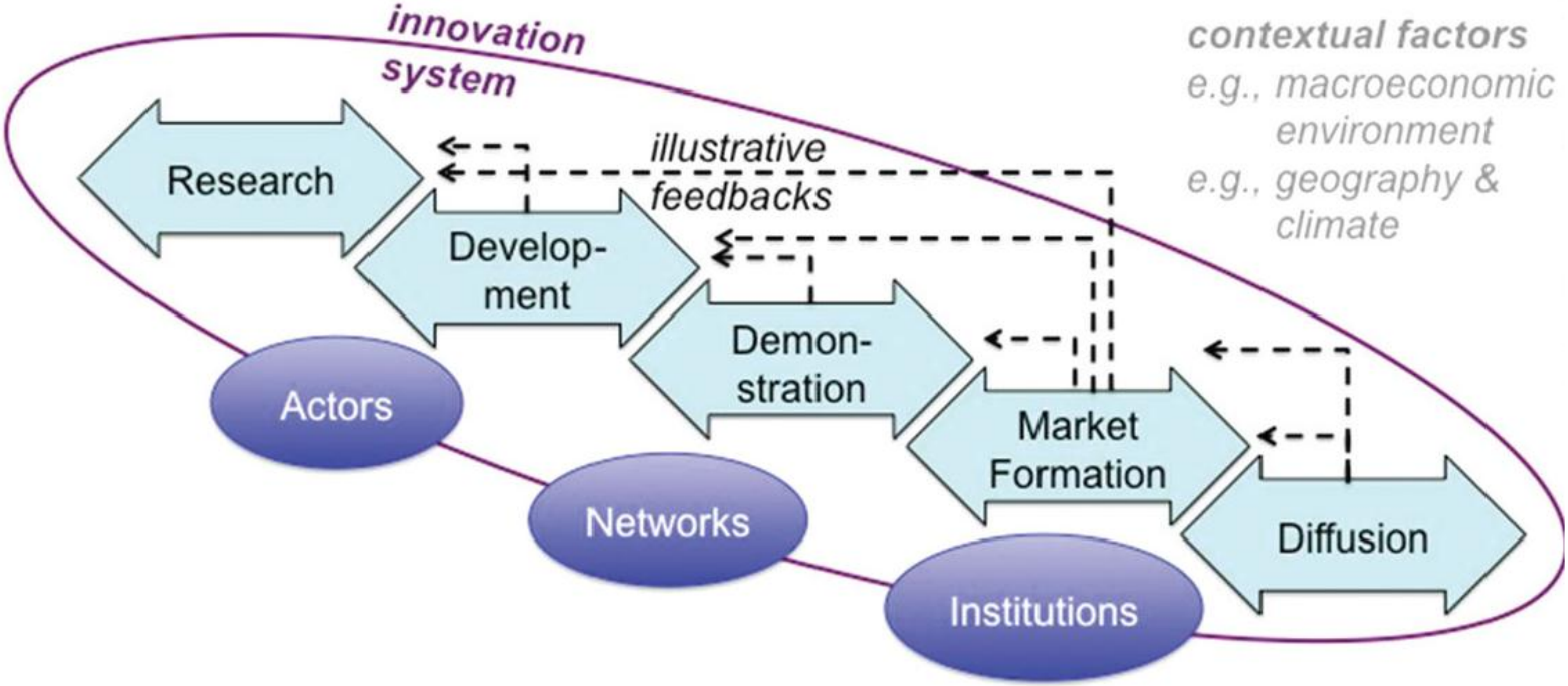

Source: Global Energy Assessment 2012

Energy RD&D – IEA countries

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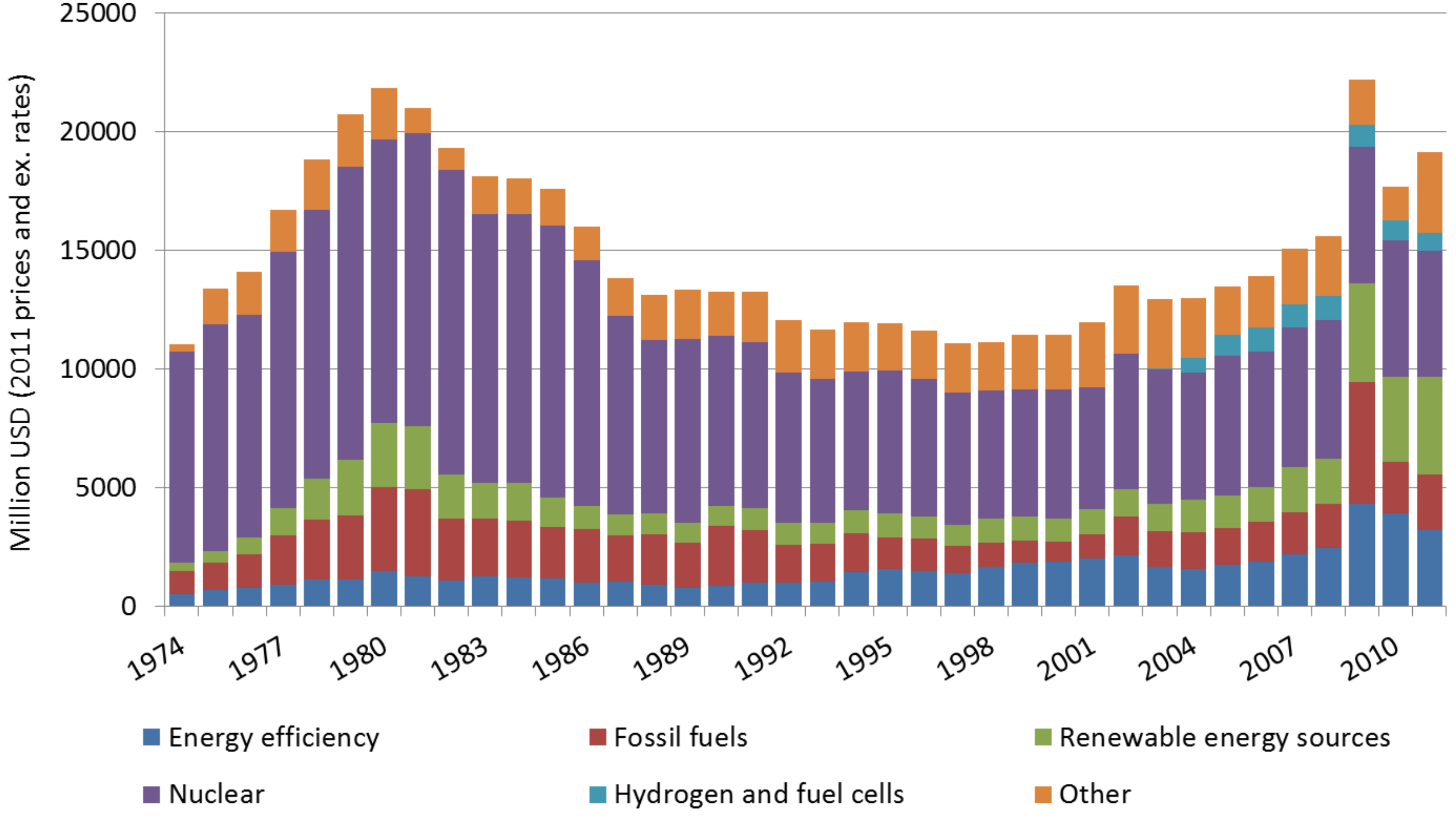
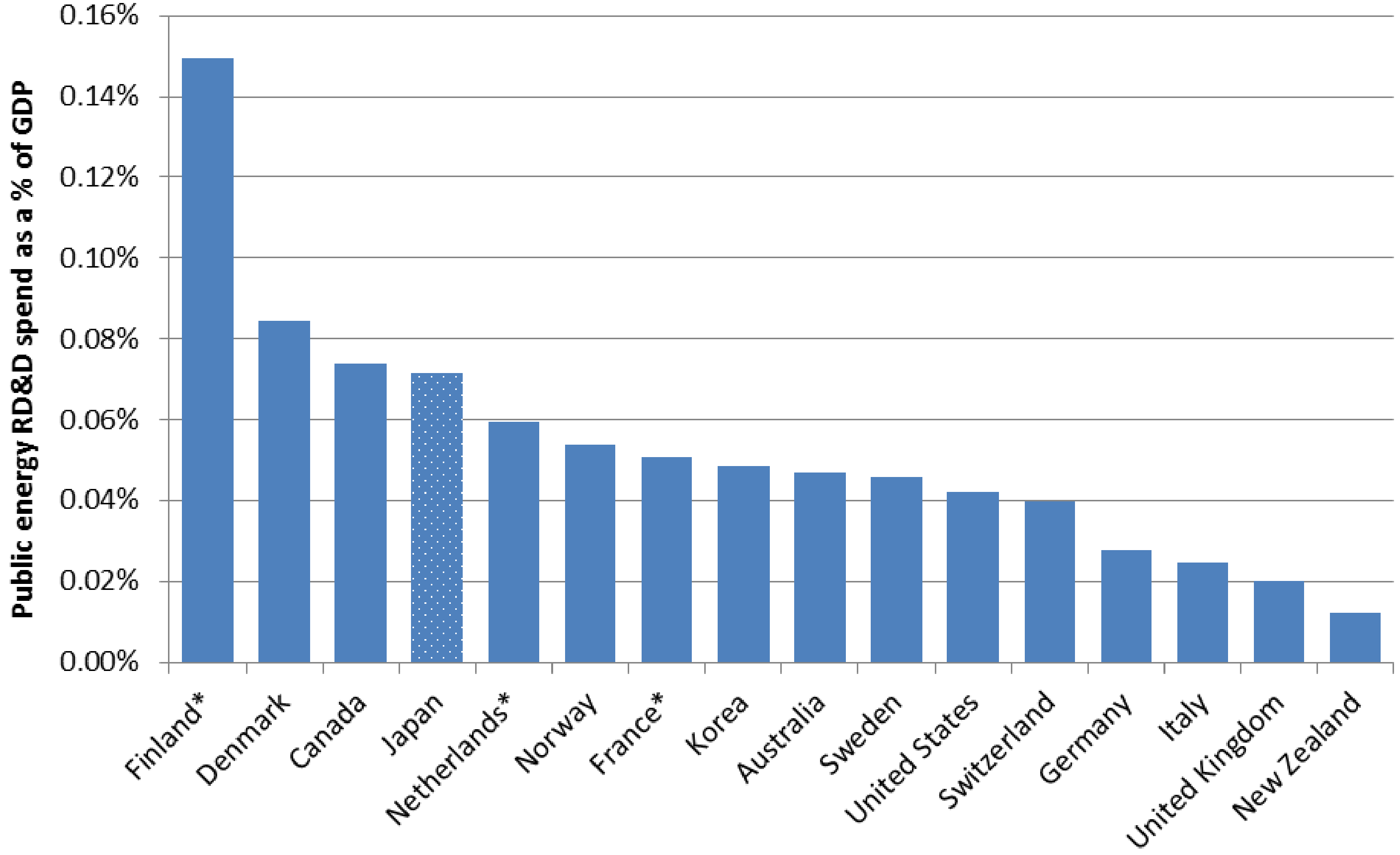


Source: Data from IEA R&D statistics

Energy RD&D relative to GDP



Source: Data from IEA R&D statistics

Energy R&D vs total R&D in the OECD

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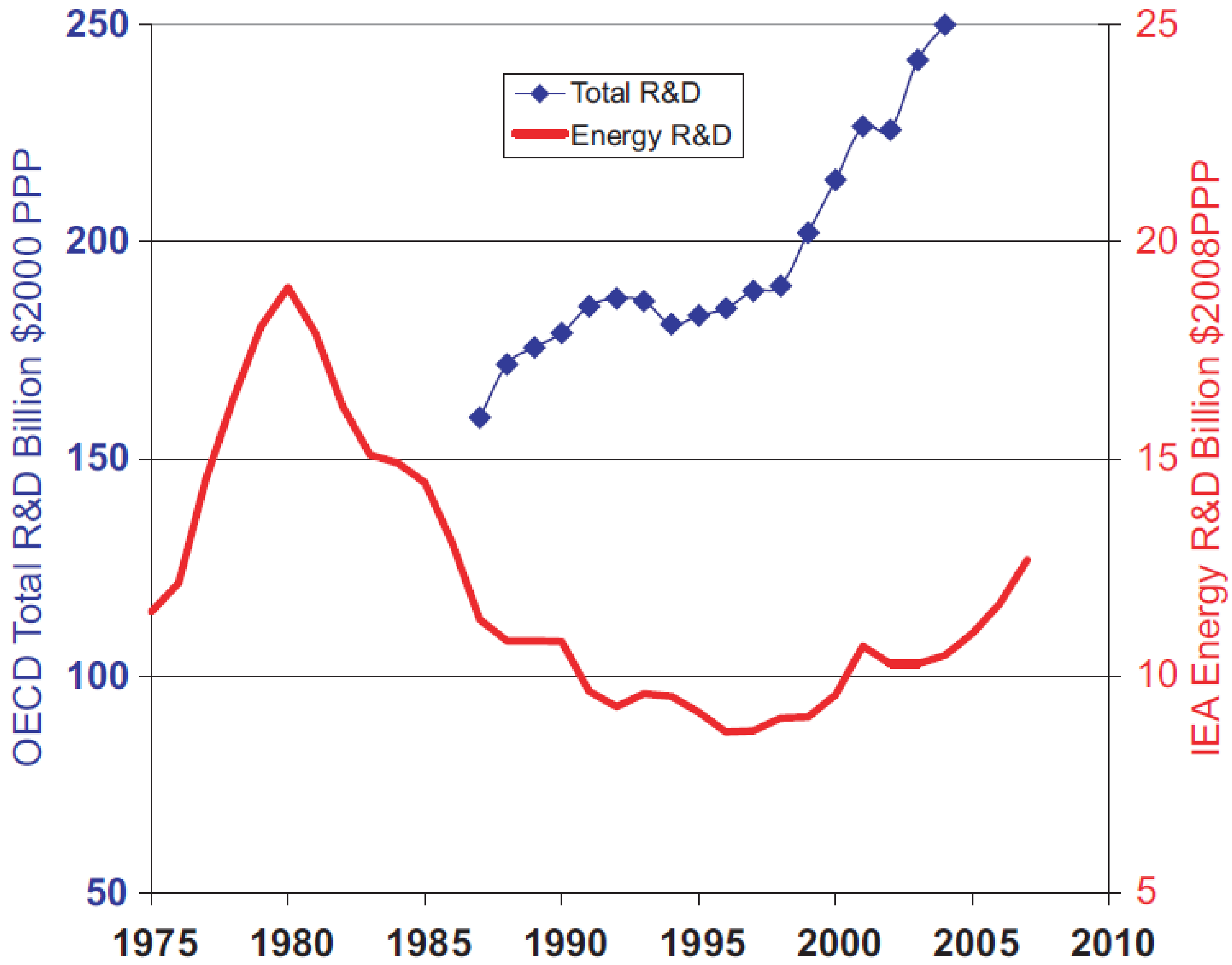

Source: Global Energy Assessment 2012

Energy RD&D – Japan

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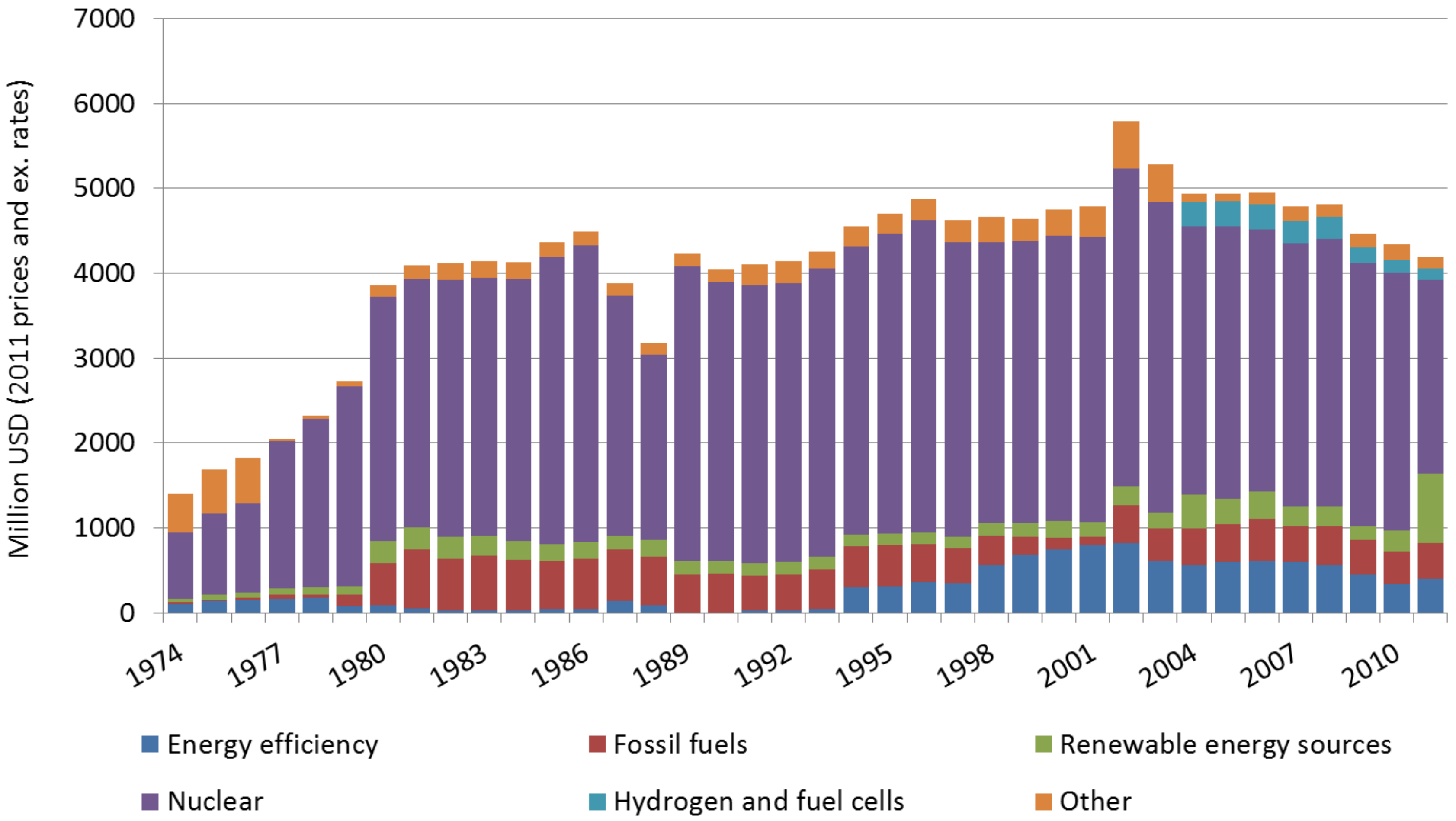

Source: Data from IEA R&D statistics

Energy RD&D trends in selected Asian countries

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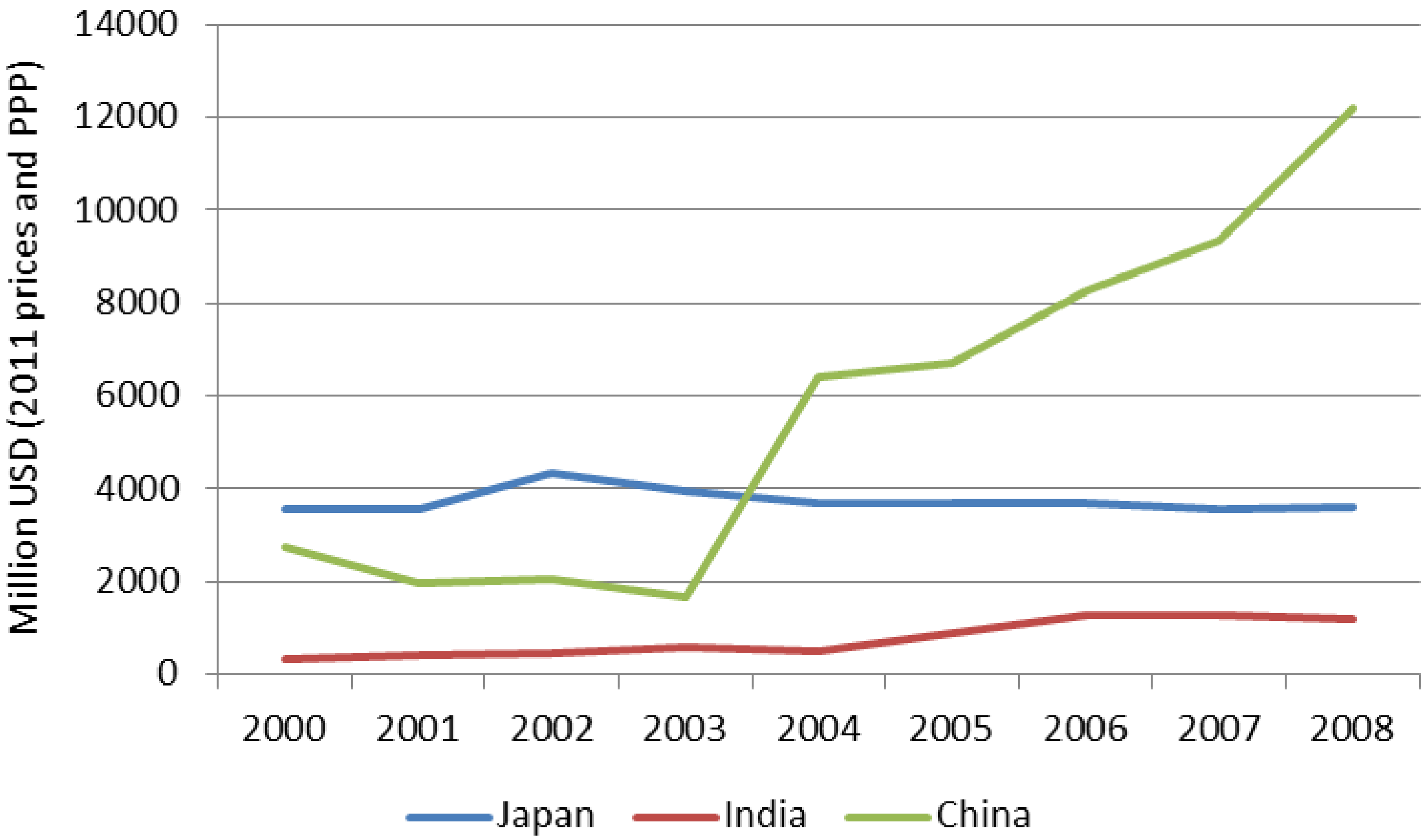

Source: Data from Kempener et al (2010) and IEA R&D statistics

Breakdown of RD&D spend (2008)

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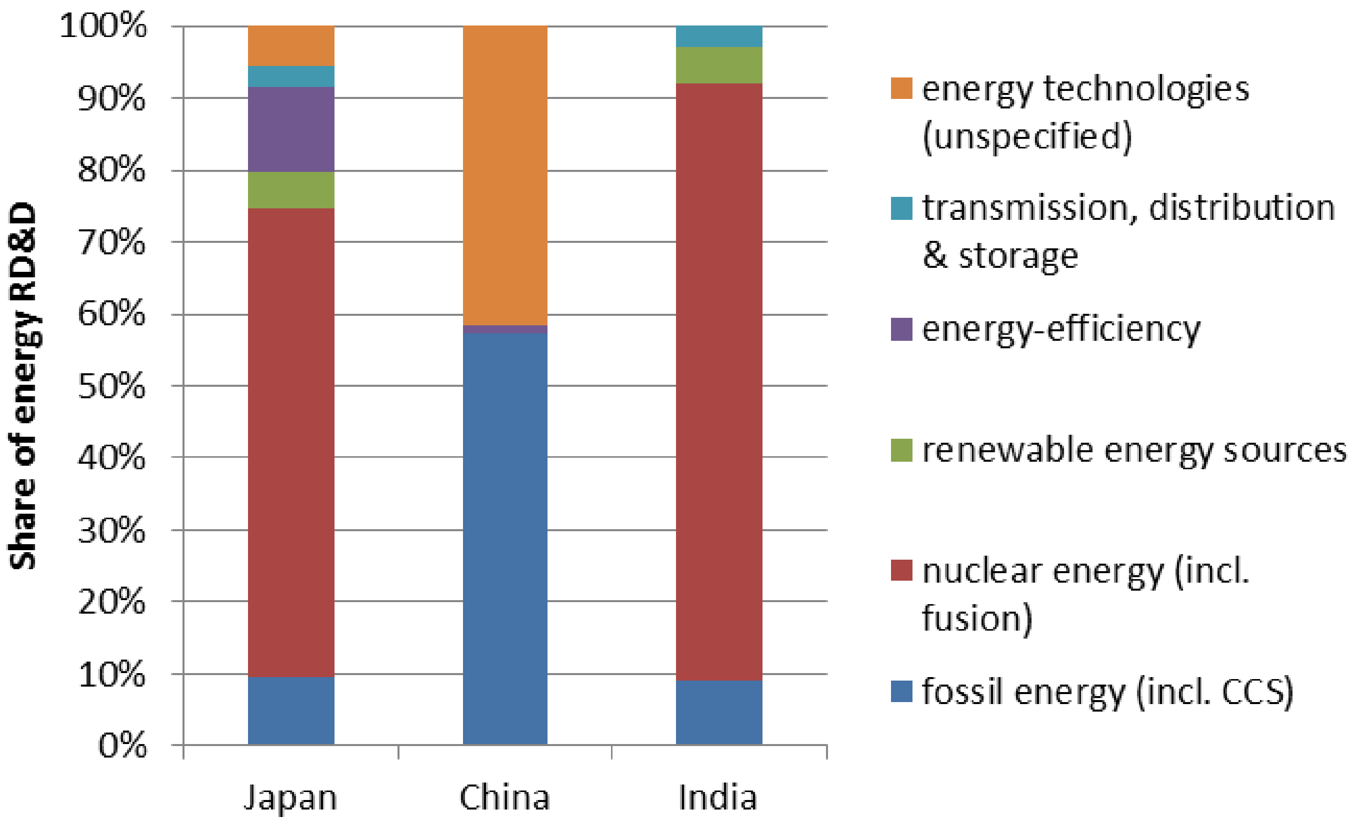

Source: Data from Kempener et al (2010) and IEA R&D statistics

Worldwide patent activity in environmental technologies

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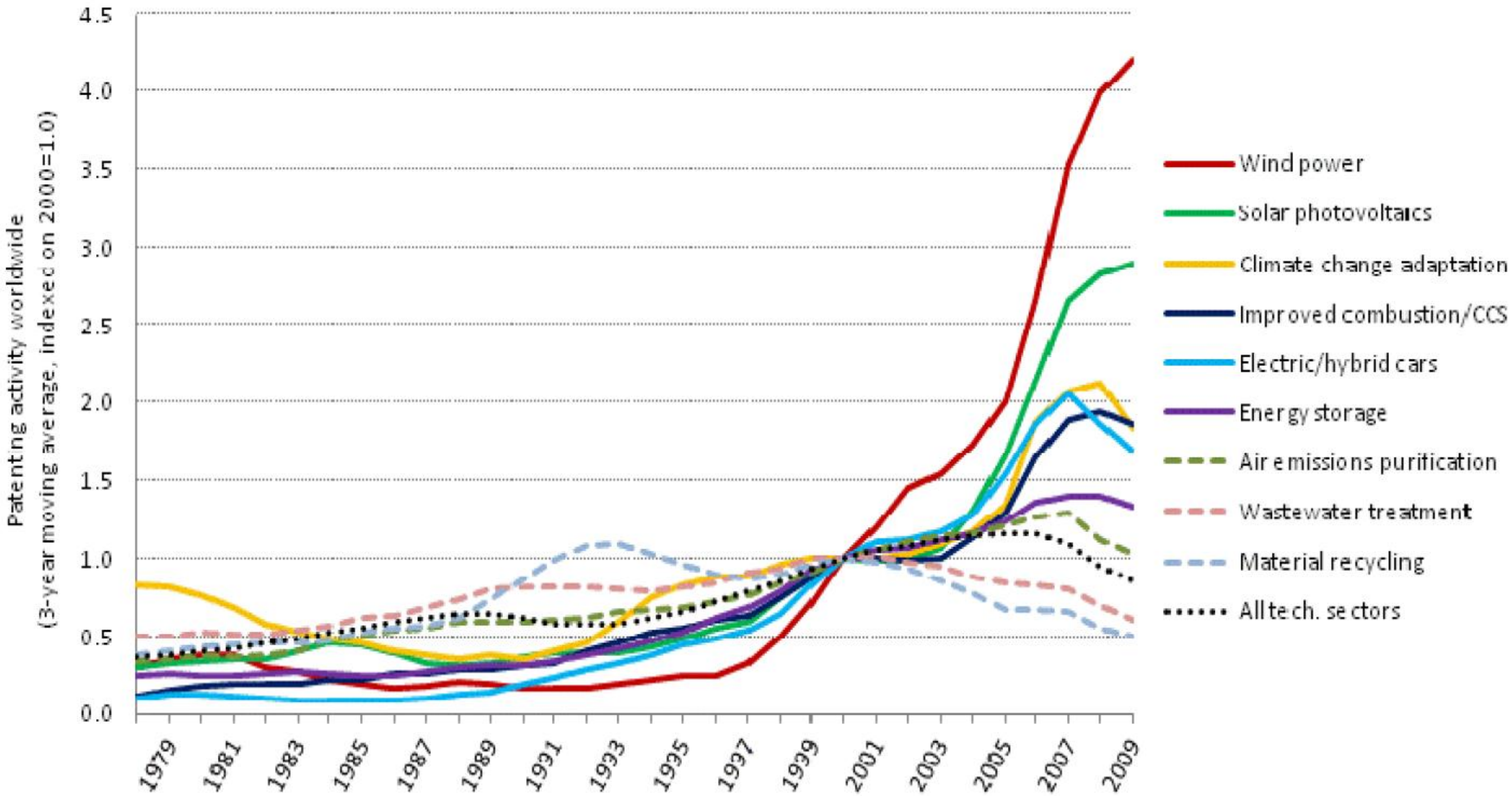

Patents filed in low-carbon technology areas have increased sharply since 2000, driven by renewable energy

Source: Haščič et al (2012)

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Accelerating innovation through better policies

Best practices on innovation policies

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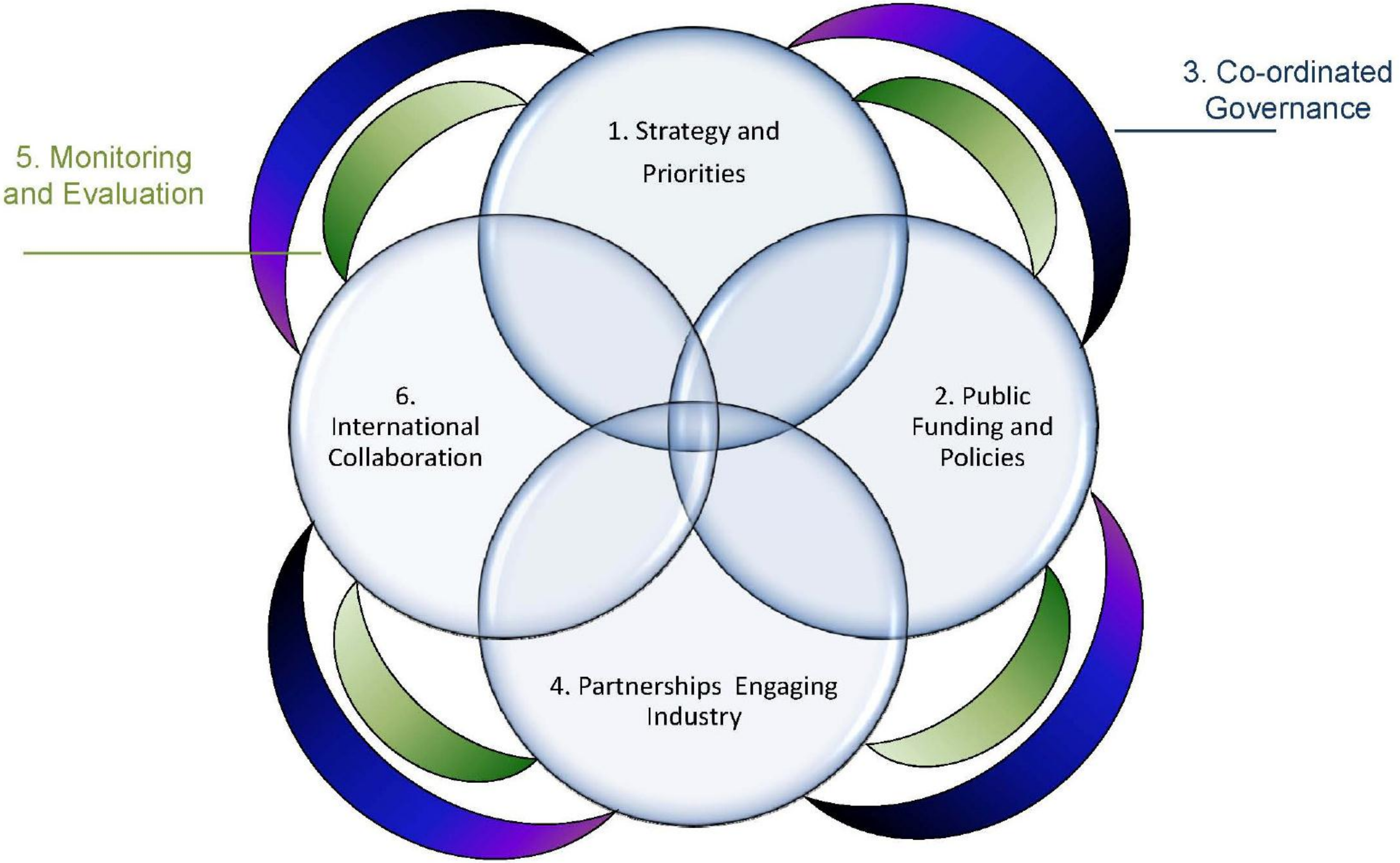

Source: IEA (2011a)

A mix of policies is needed

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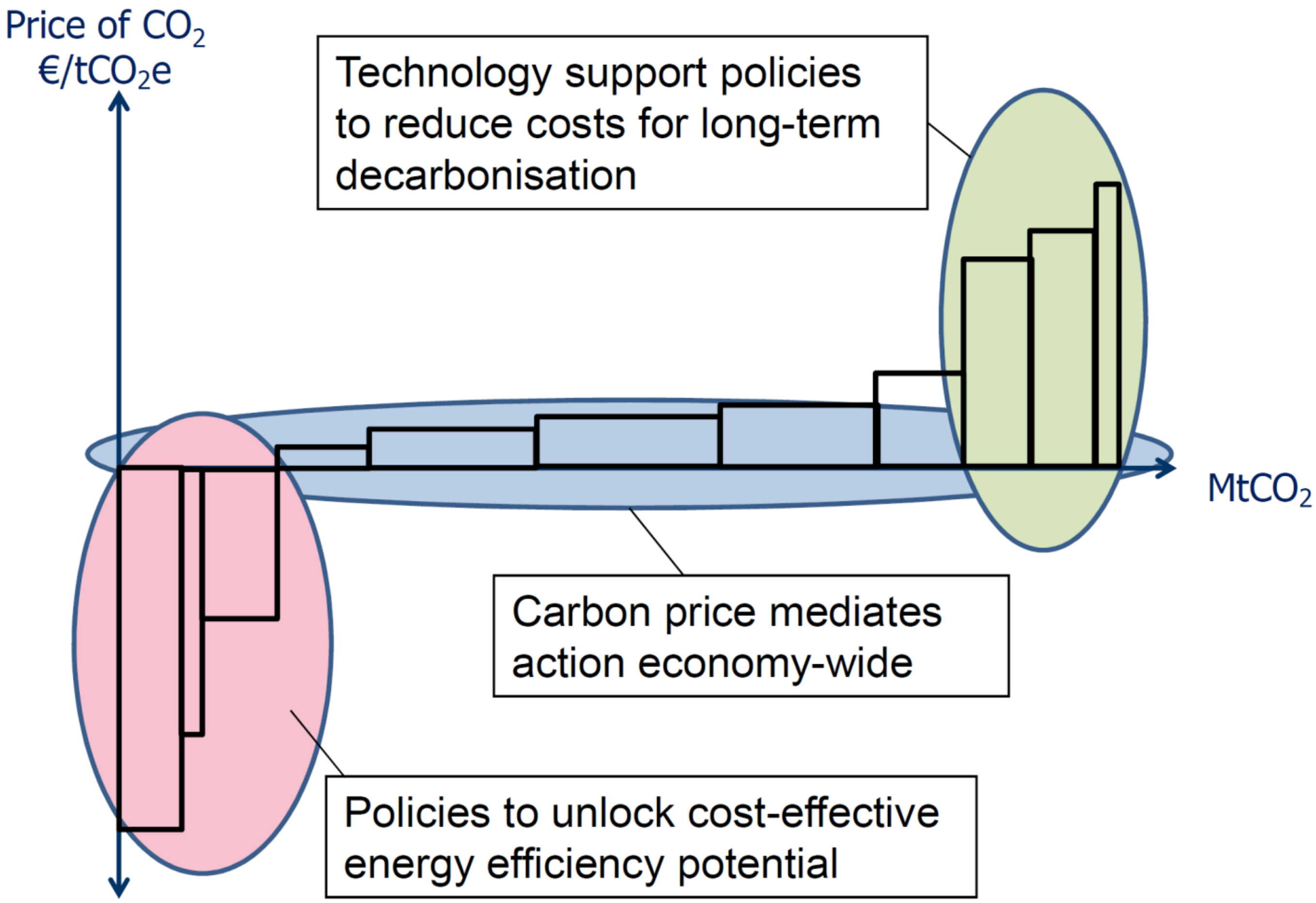

Source: Hood (2011)

Technology policies tailored to technology & market characteristics

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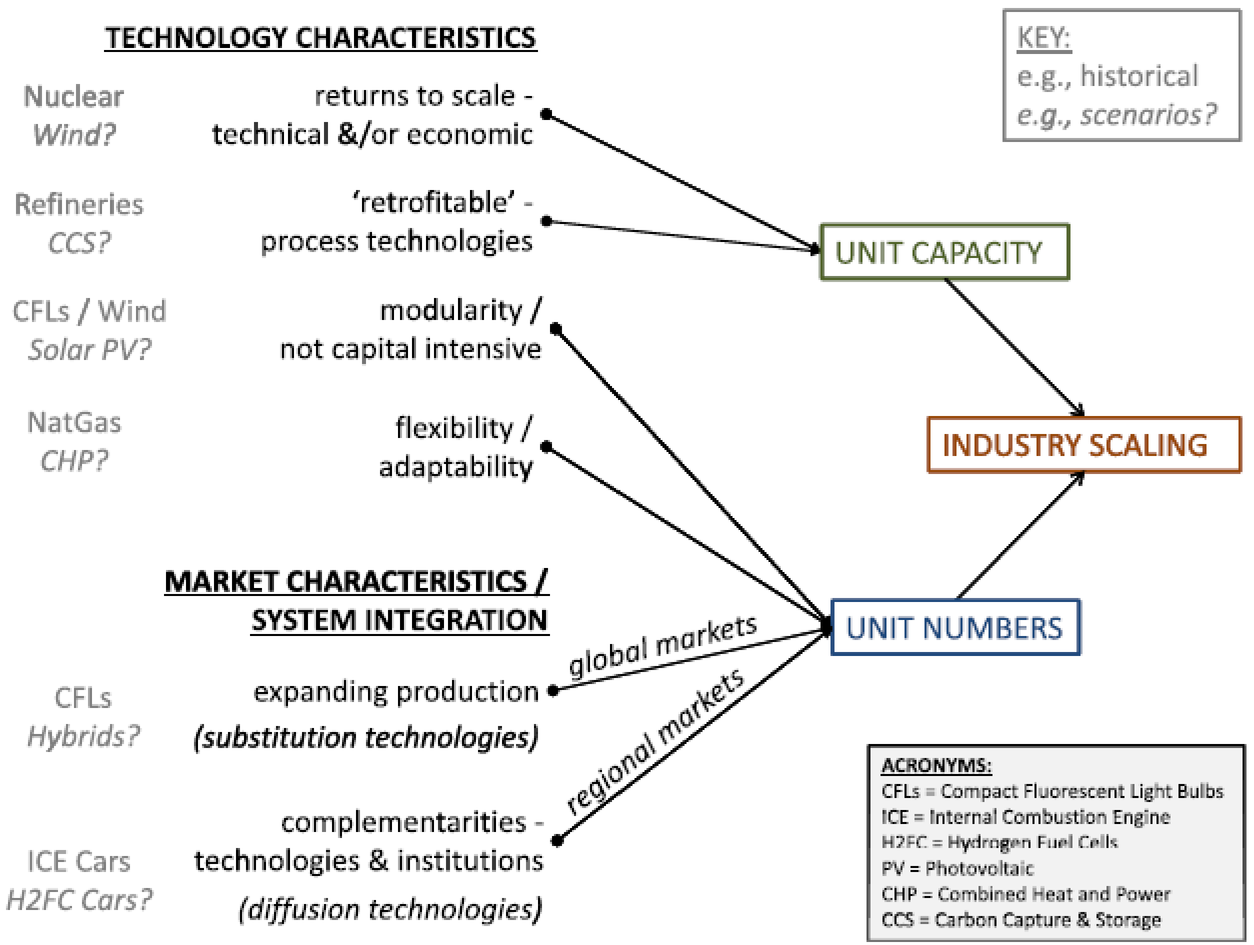

Source: Wilson (2012)

Policies for supporting low-carbon technologies

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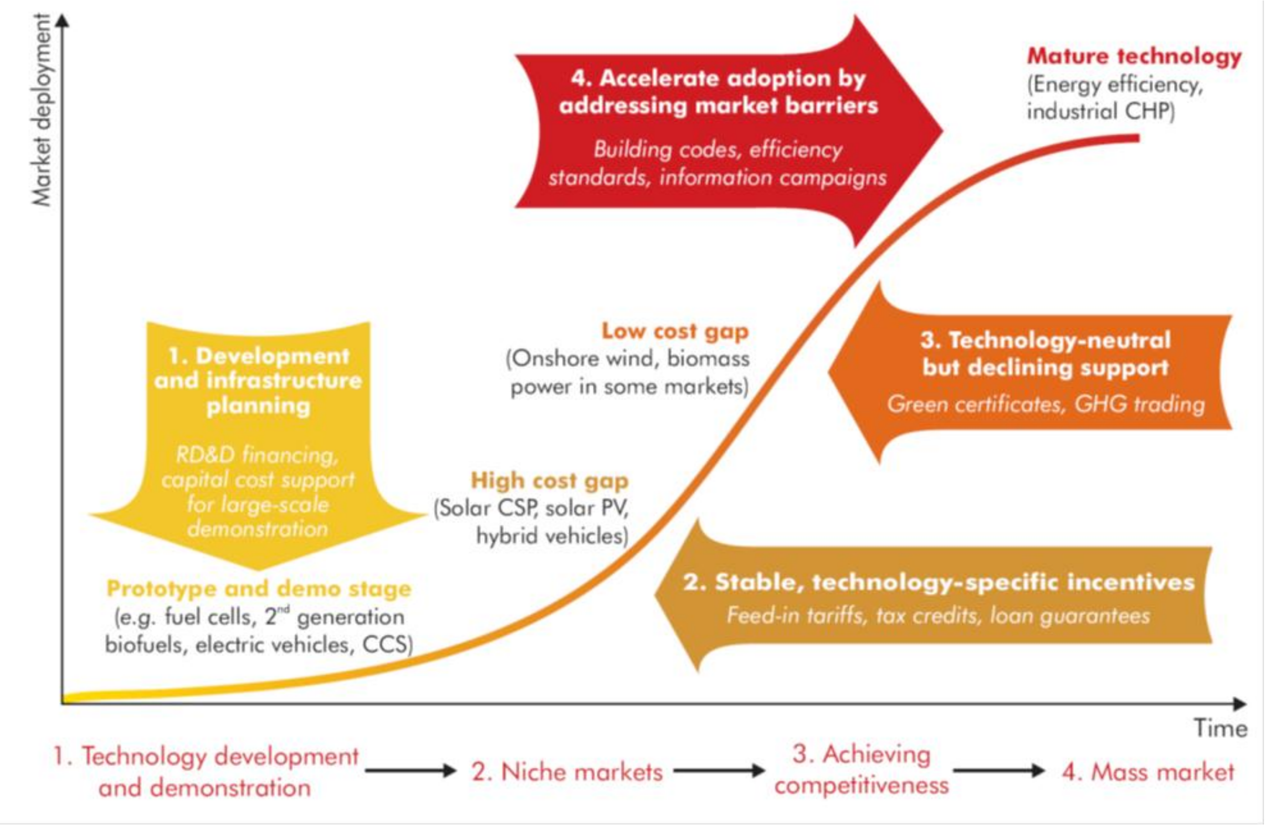

Government support policies need to be appropriately tailored to the stage(s) of technological development

Source: IEA Energy Technology Perspectives 2010

Financial support alone is not enough

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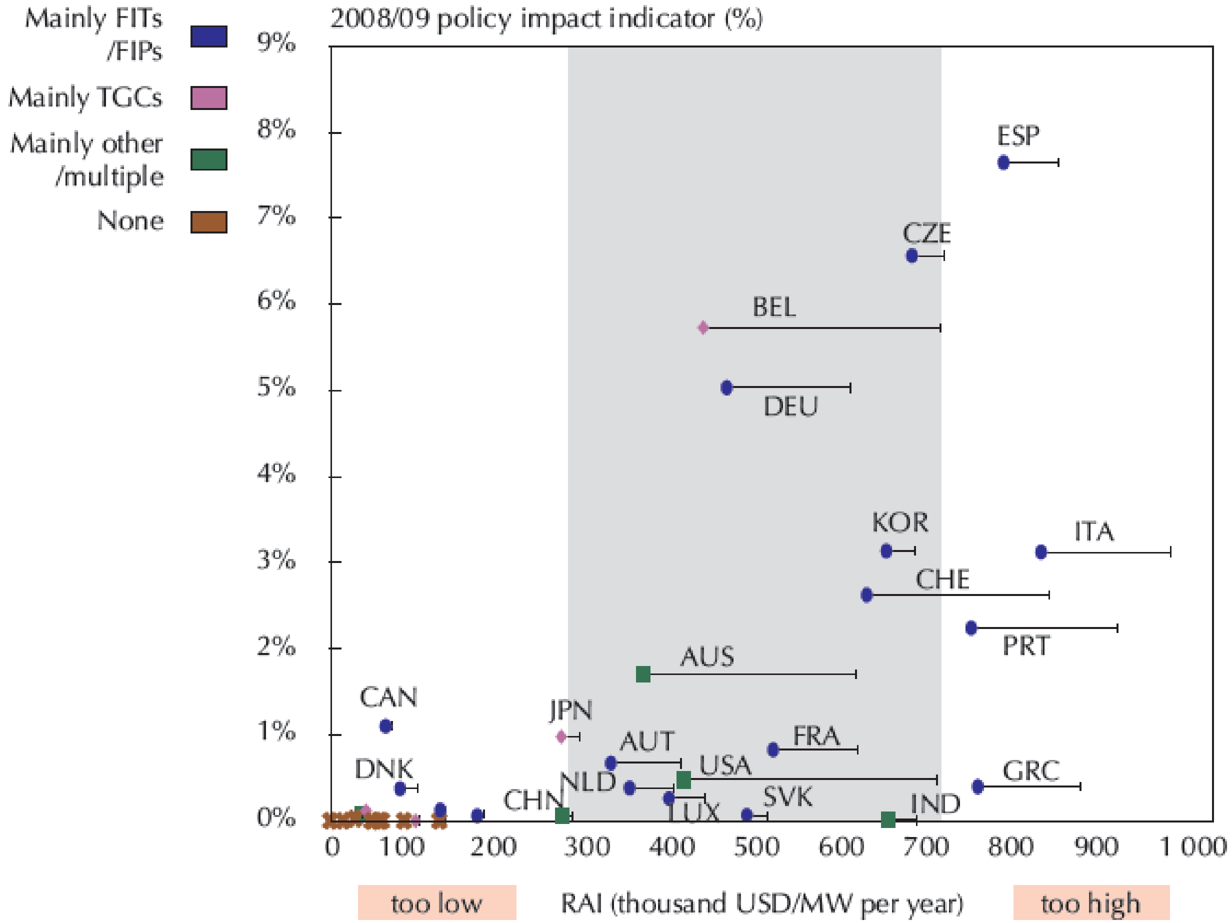
Impact vs remuneration for solar photovoltaics



Source: IEA (2011b)

Market barriers need to be addressed

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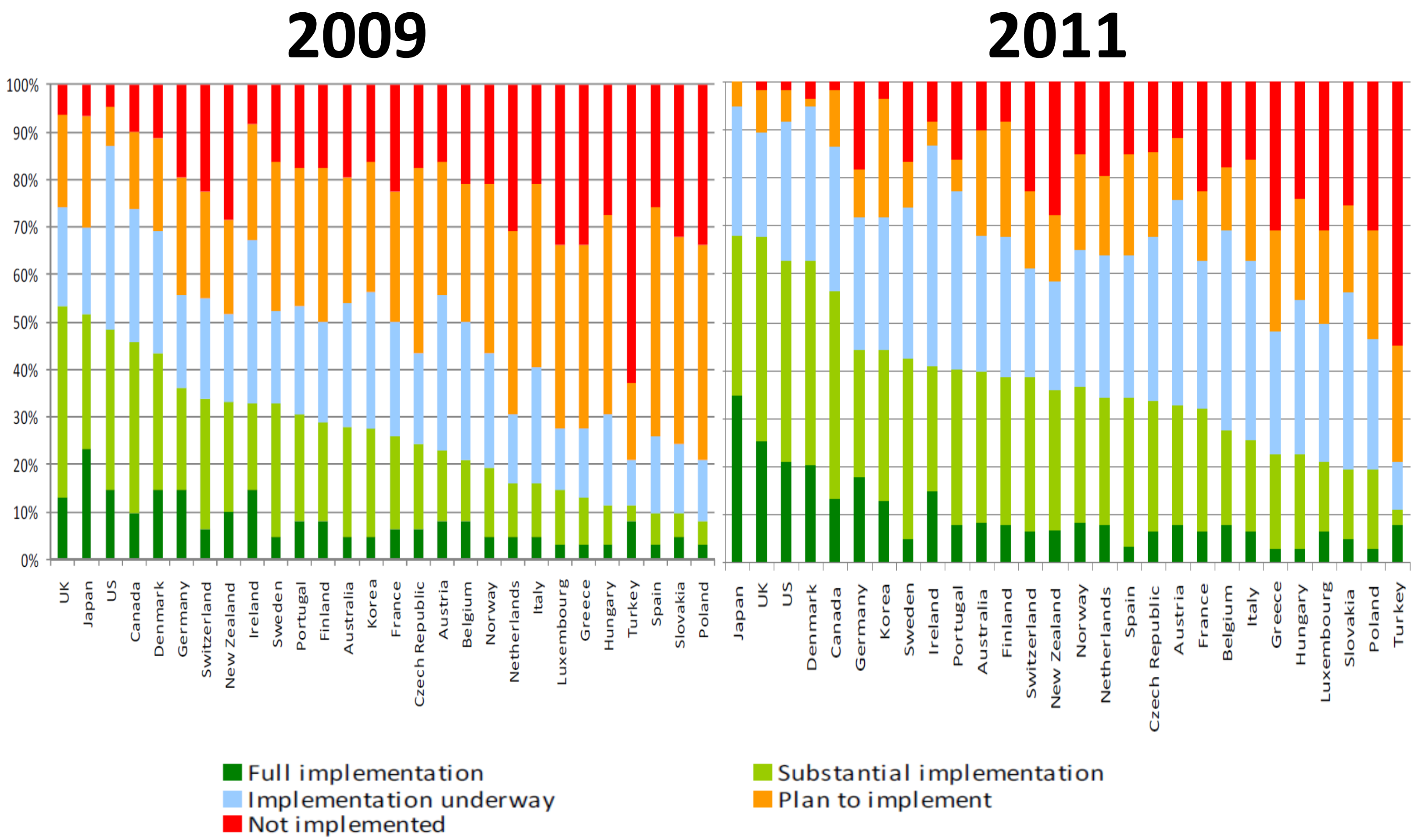

Source: IEA (2011c)

Japanese roof-top PV systems

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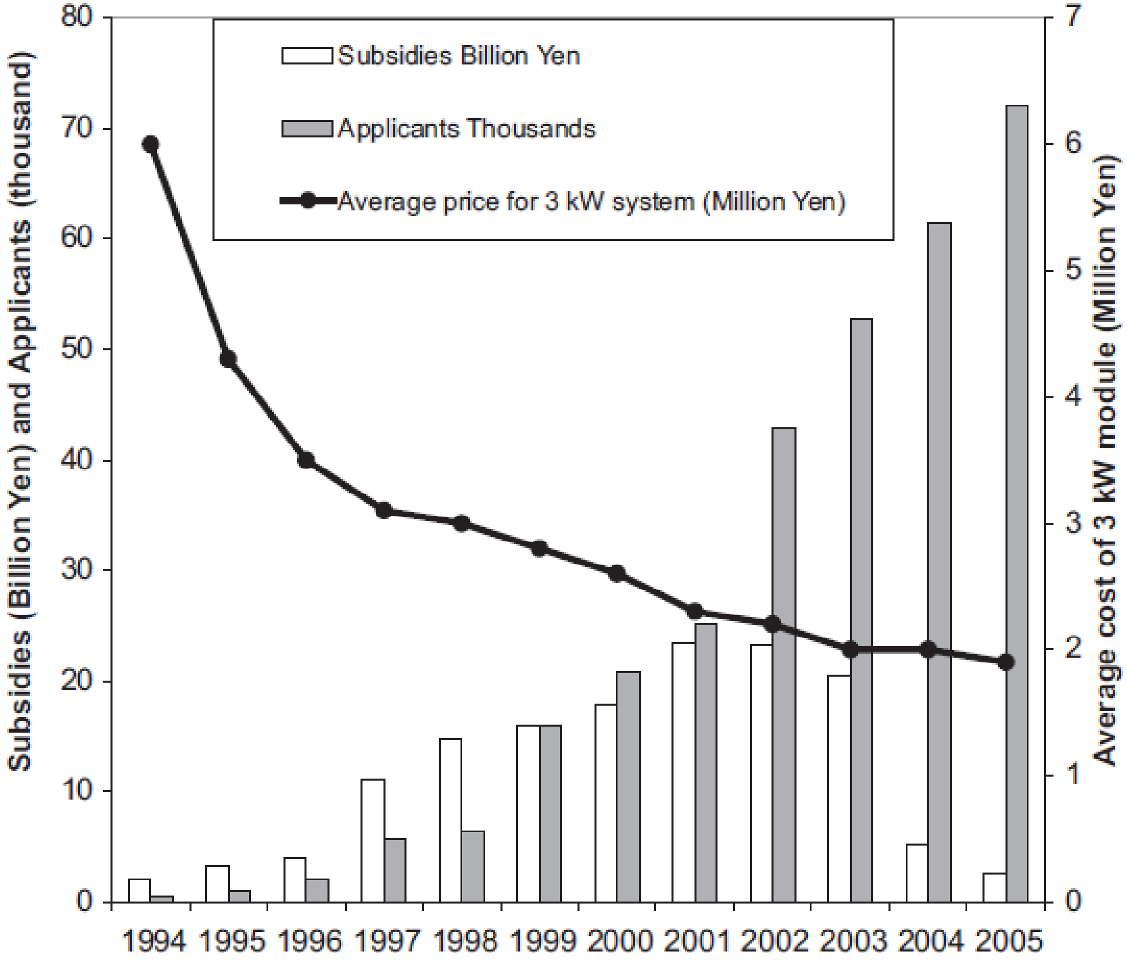

Source: Global Energy Assessment 2012

Heat pumps in Sweden and Switzerland

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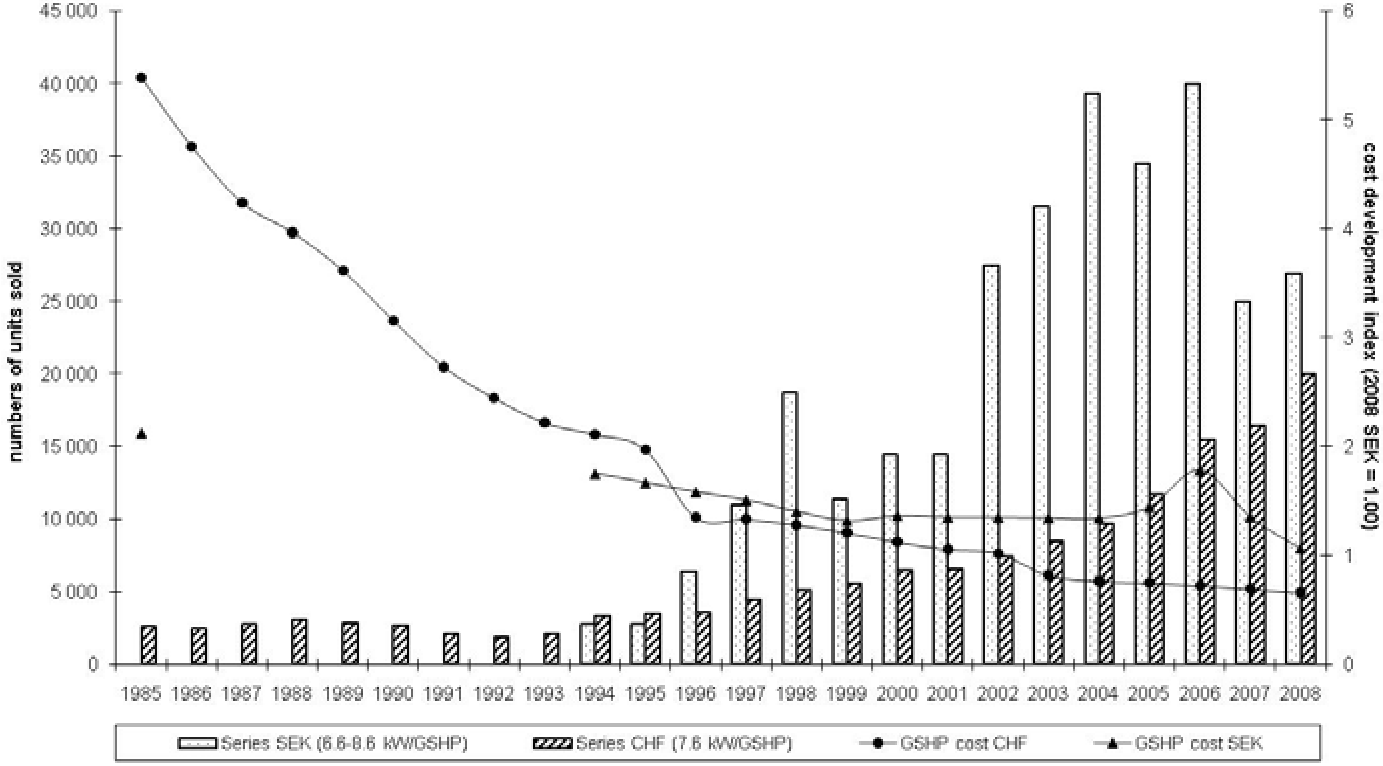

Source: Global Energy Assessment 2012

Top-Runner programme in Japan

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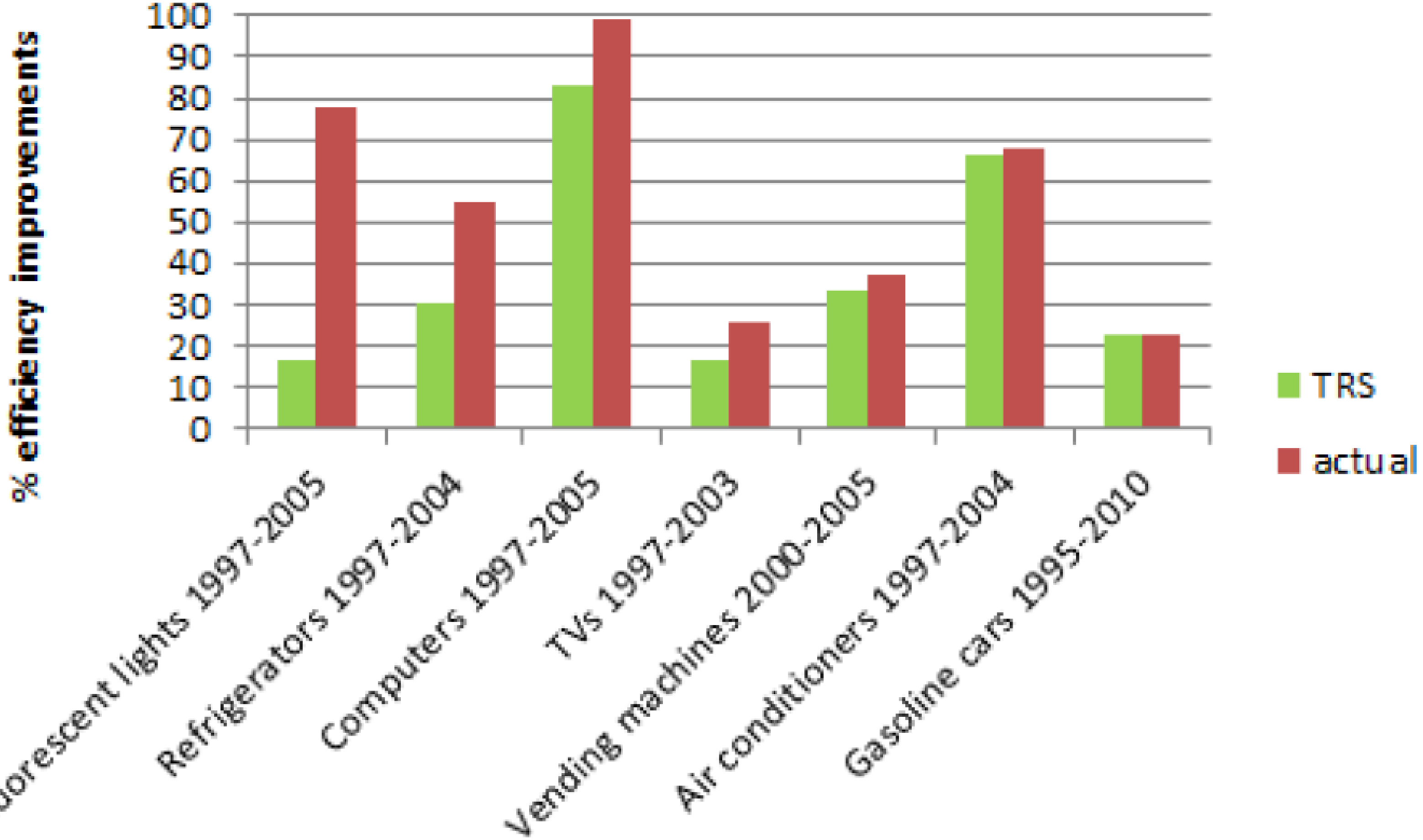

Source: Arnulf Grübler

International co-operation leads to increases in co-invention

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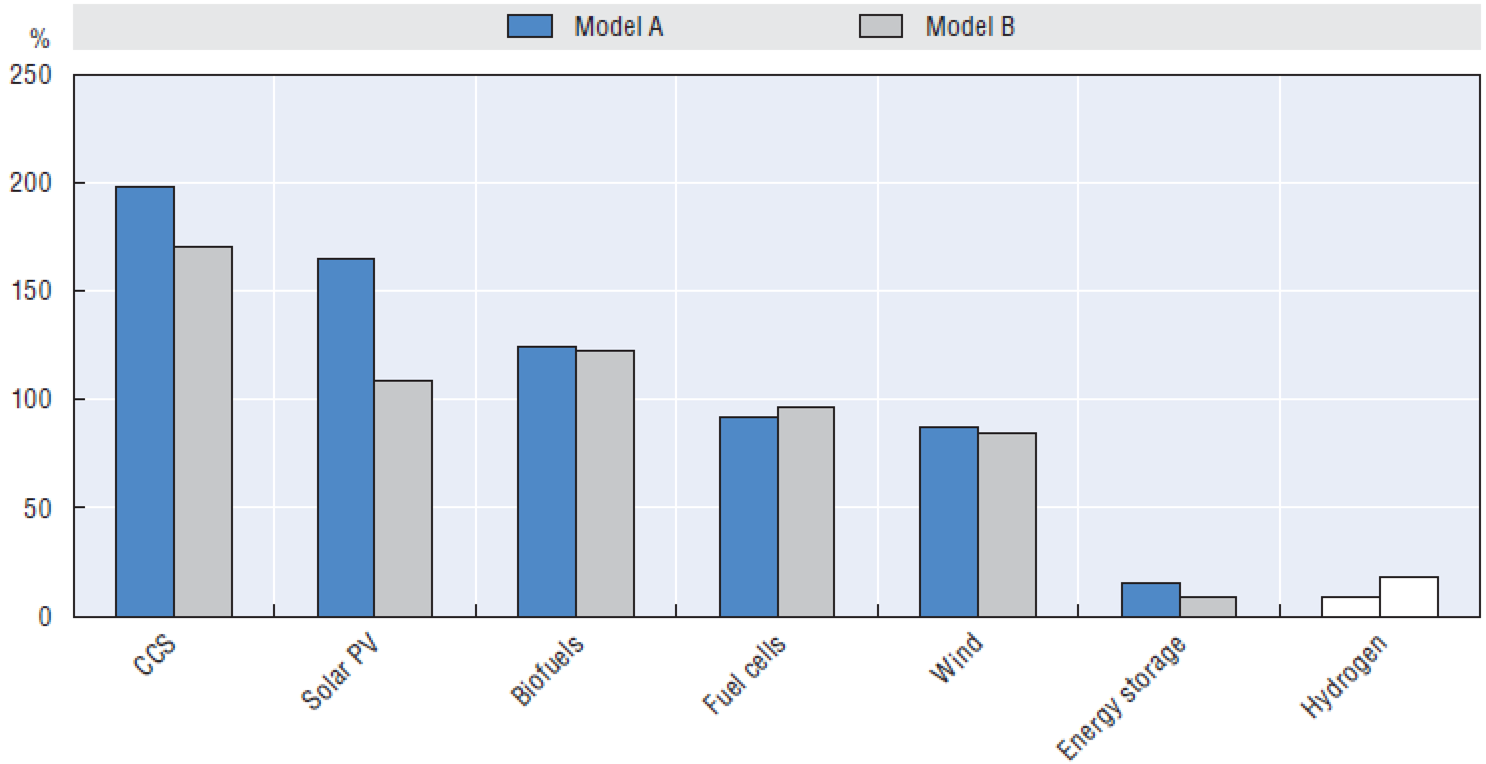

Joining an IA increases co-invention by 150% - 200% for CCS and PV, and by 100% for biofuels, fuel cells and wind power

Source: OECD (2012)

Lessons from best practice policies

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- Establish clear, stable, aligned support framework - to attract investments
- Support a wide portfolio of technologies – there are no silver bullets.
- Set up transitional incentives decreasing over time – to foster technological innovation and move towards market competitiveness
- Support knowledge flows and strengthen collaborative links between actors
- Engage in appropriate international collaboration
- Don’t be afraid to experiment – failure is an inherent part of the innovation process

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Rebalancing the innovation portfolio

Supply is important, but demand is even more so

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	Innovation (RD&D)	Market formation	Diffusion
End-use & efficiency	>>8	5	300 – 3500
Fossil fuel supply	>12	>>2	200 – 550
Nuclear	>10	0	3 – 8
Renewables	>12	~20	>20
Electricity (gen & T+D)	>>1	~100	450 – 520
Other & unspecified	>>4	<15	-
Total	>50	<150	1000 - <5000

Source: Global Energy Assessment 2012

RD&D portfolios vs mitigation needs

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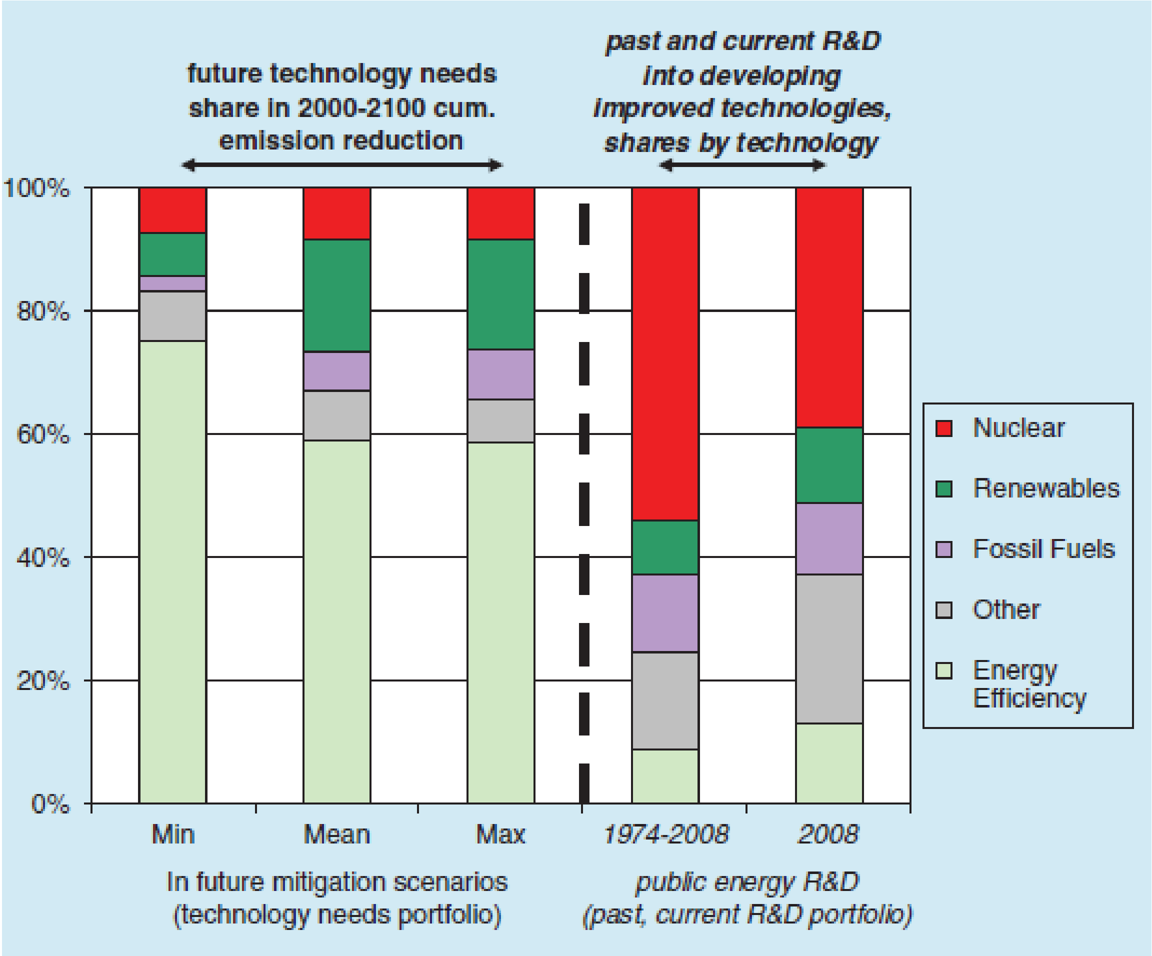

Source: Global Energy Assessment 2012

Phases of technology diffusion

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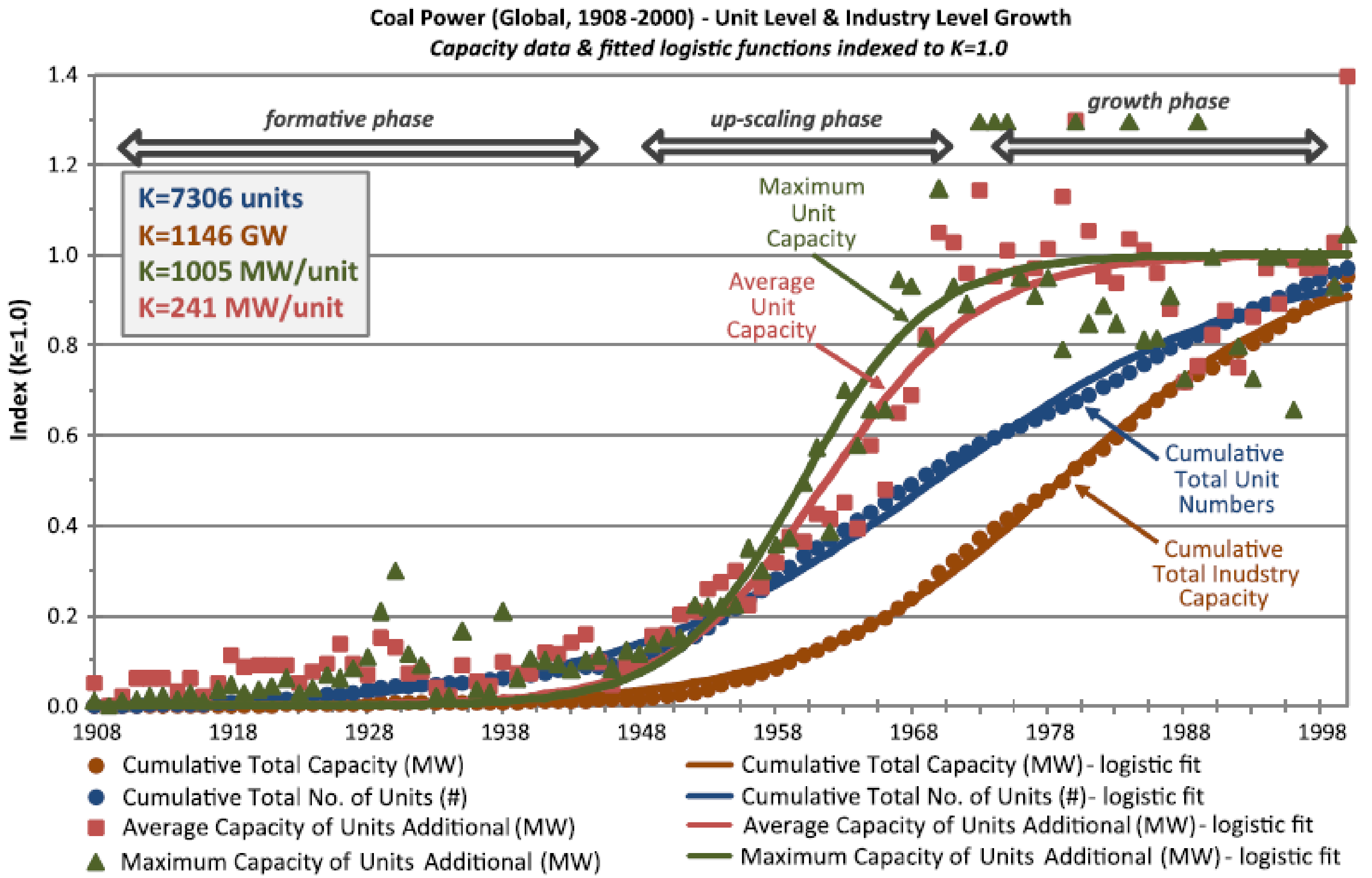

Source: Wilson (2012)

Learning rates for supply and end-use technologies

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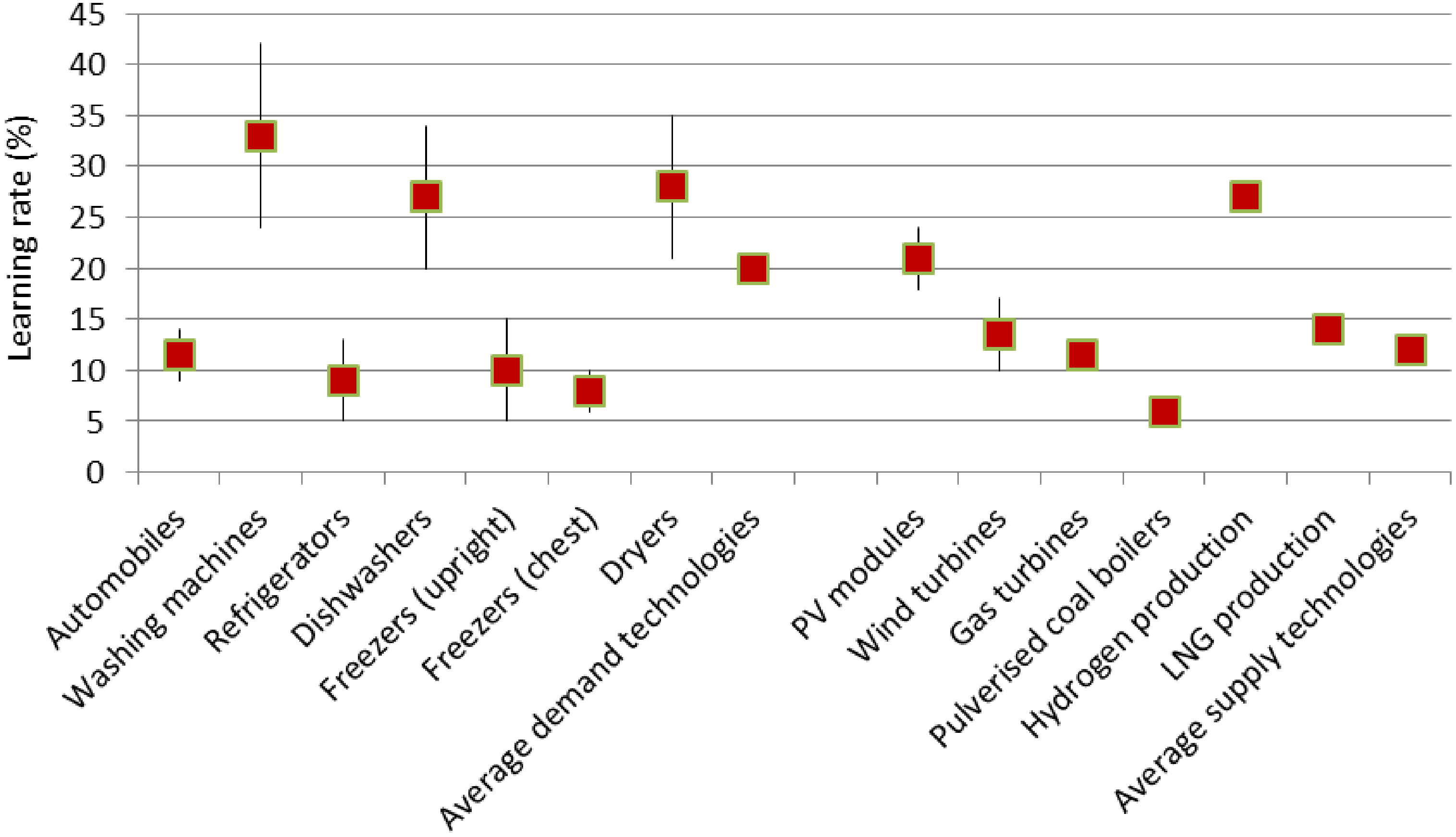

Source: Data from Arnulf Grübler

Future direction of Japan's energy policy?

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1. Realising the world's most advanced energy-saving society: Reform of the demand structure

2. Realising a distributed next-generation energy system: Reform of the supply structure

3. Need for technical innovation to support the energy mix conversion and reform of the energy supply-demand structure

Source: Presentation by Hiroshi Asahi, ANRE, June 2012

Impacts of improved energy efficiency for Japan

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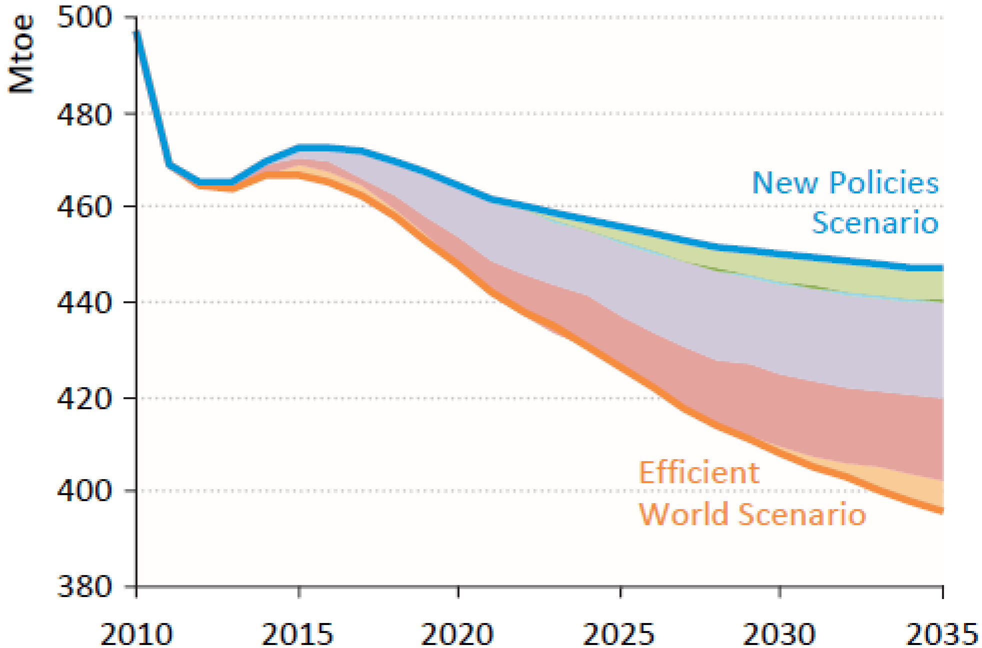

EWS total primary energy demand	Mtoe	
	2010	2035
Other renewables	4	32
Bioenergy	7	15
Hydro	7	9
Nuclear	75	45
Gas	86	82
Oil	203	27
Coal	115	85

Source: IEA World Energy Outlook 2012

Conclusions (1)

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- Accelerating the development and deployment of clean energy technologies is central to meeting global energy challenges
- Range of possible technology options, with energy efficiency and renewables some of the most important
- Current progress on deployment is not sufficient
- Appropriate technology policies have an important role to play in accelerating progress
- Need to learn from best practice policies and ensure a balanced innovation portfolio

Conclusions (2)

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- Current review of energy policy likely to see Japan increase its focus on distributed supply technologies and energy efficiency
- Provides opportunity for Japan to build on its global leadership in energy RD&D
- Asia is a major driver of energy trends and fast becoming a global force in energy innovation
- Chance for Japan to work with other Asian nations to drive forward successful energy innovation to meet global and regional energy challenges

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