Modelling and analyses for RDD&D priority setting

Luis Munuera
Energy Technology and Policy division

Modelling and Analysis in R&D priority-setting and innovation

IEA's programme of work in energy technology

- Where do we need to go?
- Where are we today?
- How do we get there?

This presentation

- Global perspective on the transformation required
- Modelling R&D
- Measuring R&D
- Challenges for future approaches

Scale of innovation required

- Energy innovation: Processes that take an idea for a new energy technology, device, organizational or market structure to the market

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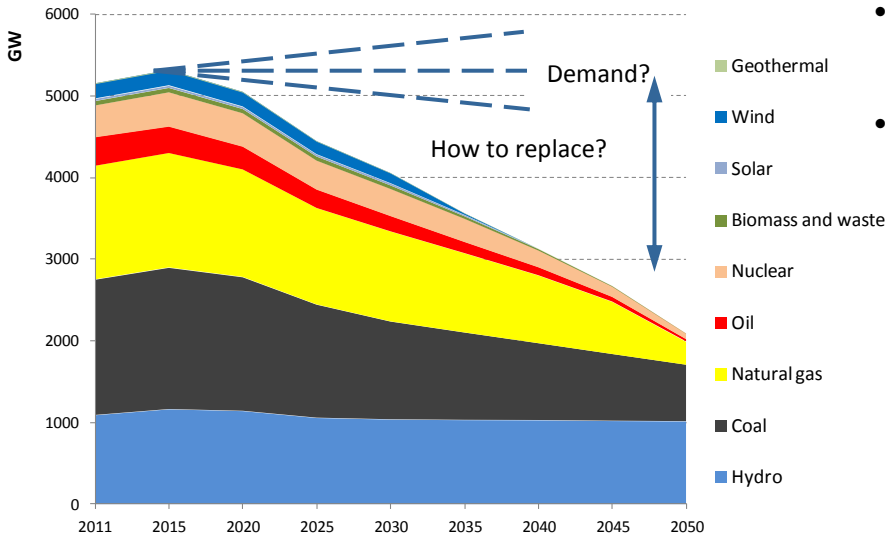
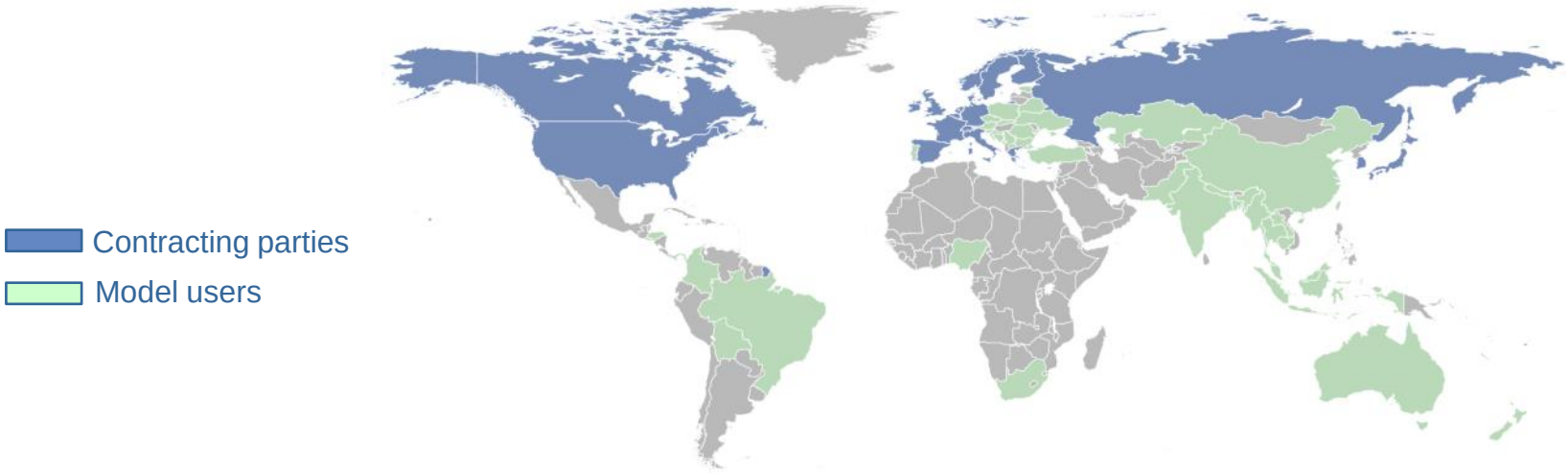


- Global decommissioning curve
- Investment characterized by long lifetime and high upfront capital demand
- Decisions have to take into account long time horizon with uncertain or unknown conditions:
  - **Technology development?**
  - Market conditions?
  - Climate impacts?
  - Long-term energy prices?
  - Economic development?
  - Climate policies?
  - Operational aspects (variable renewables, electrification)?

The IEA's long-term energy planning model

- Based on TIMES, a framework developed by ETSAP (www.etsap.org)

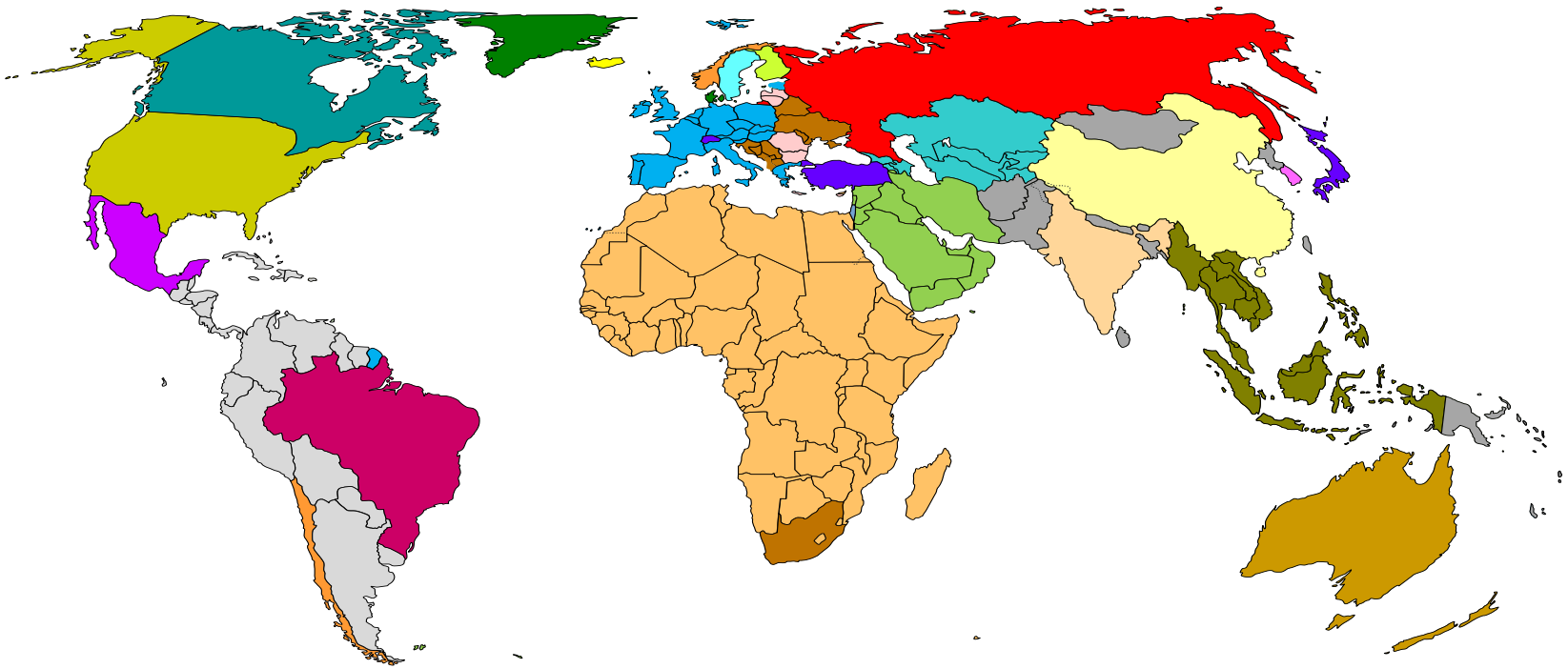


Used by more than 150 institutions in 63 countries

Energy Technology Systems Analysis Programme (ETSAP)

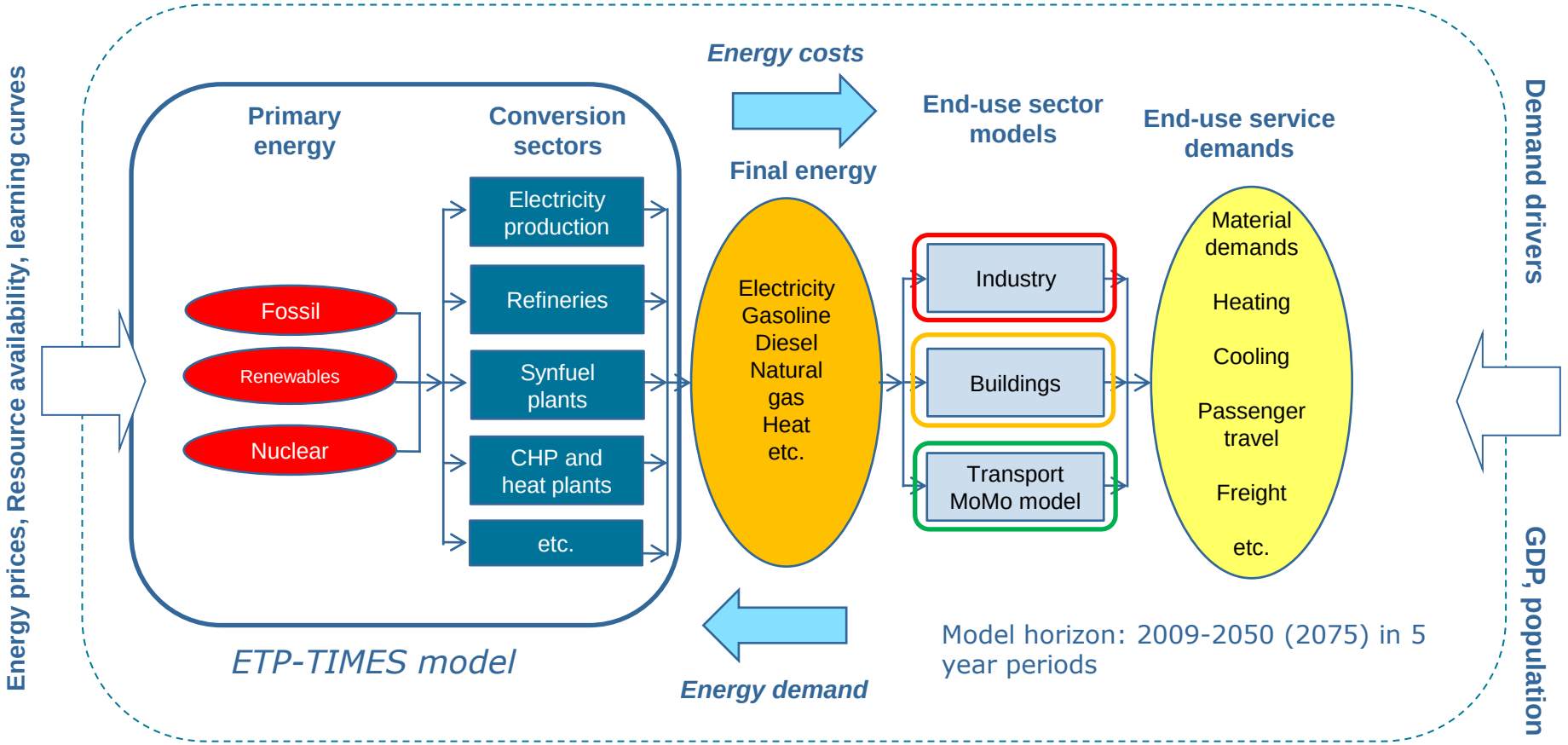
- Since 1976 (Post Oil Crisis)
- Consortium of member country teams and invited teams
- 2 workshops per year
- A common, comparable and combinable METHODOLOGY

Regional structure of IEA TIMES



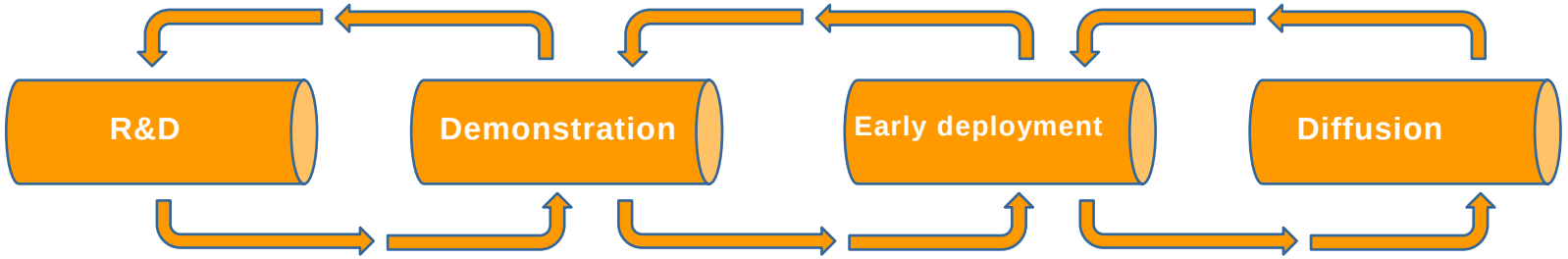
- 28 model regions representing individual countries or aggregations of countries
- One geographic point per model region

ETP modelling framework



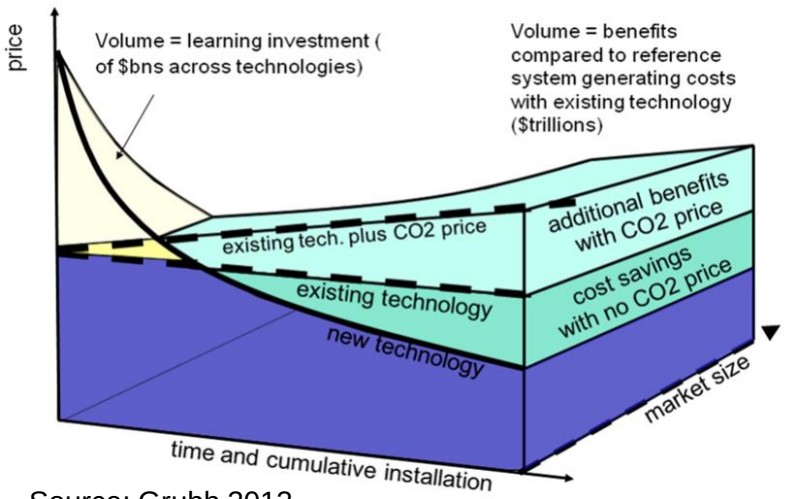
- Supply-side: least-cost optimisation model based on TIMES methodology
- End-use sectors (industry, buildings, transport): spreadsheet-based simulation models
- World divided into 28-40 regions depending on sector

Modelling the innovation system



•Capturing R&D benefits •Spillovers •High risk/Uncertainty •Long lead times	•Capturing benefits of demonstration •Spillovers •High risk/uncertainty •High capital costs •Long lead times	•Uncertain costs •Uncertain future markets •Risk (technology/policy)	•Capturing current/future markets •Finance •Information •Non-cost barriers •Behaviour

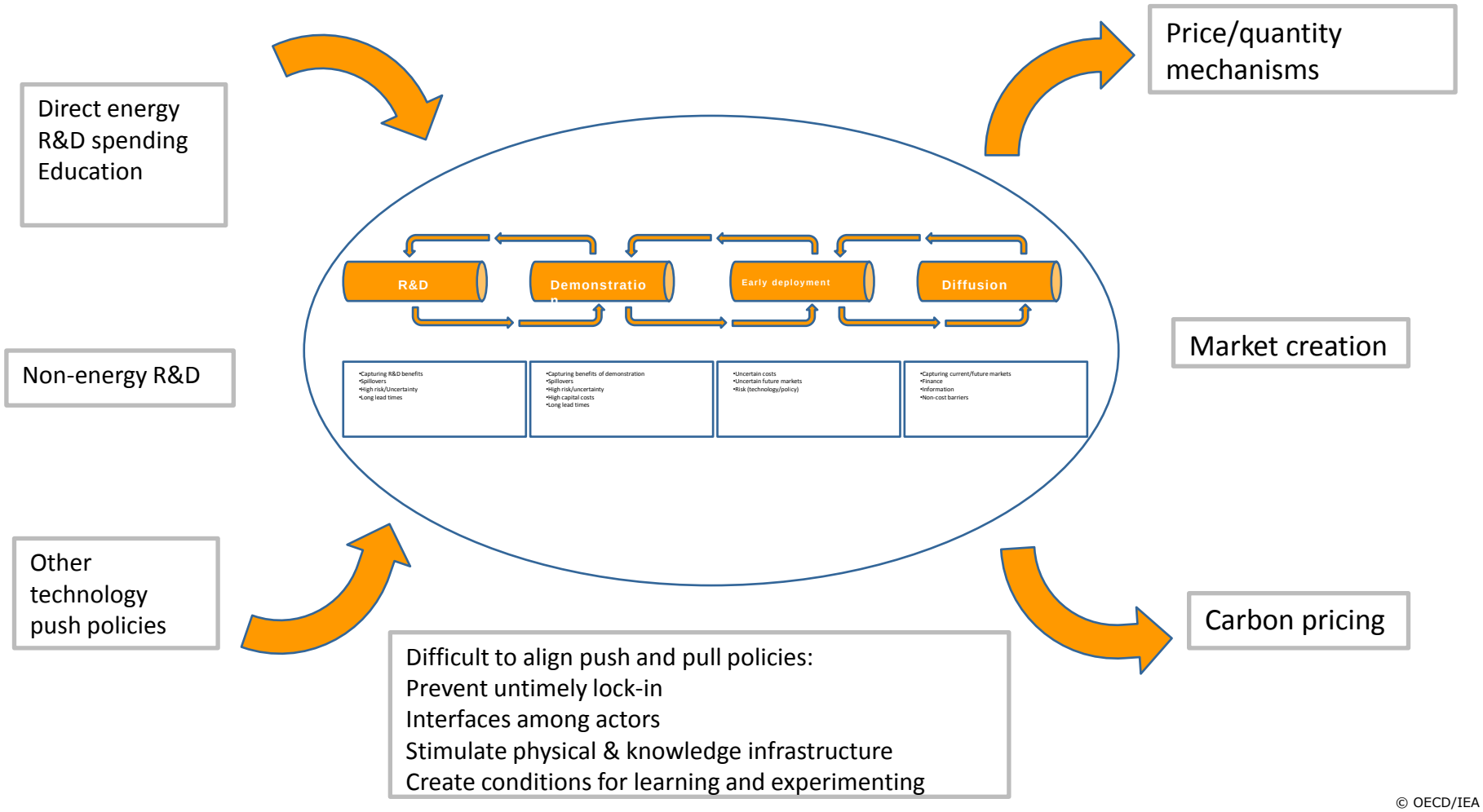
- **Estimating the impact of R&D on technology development**
  - **Limited by lack of available data**
- **Incorporating the complexity of the innovation chain**
- **Incorporating uncertainty in technology outcomes/benefits**
- **Incorporating spillovers**
- **Difficult to separate energy R&D from deployment**
- **Future market design?**



Source: Grubb 2013

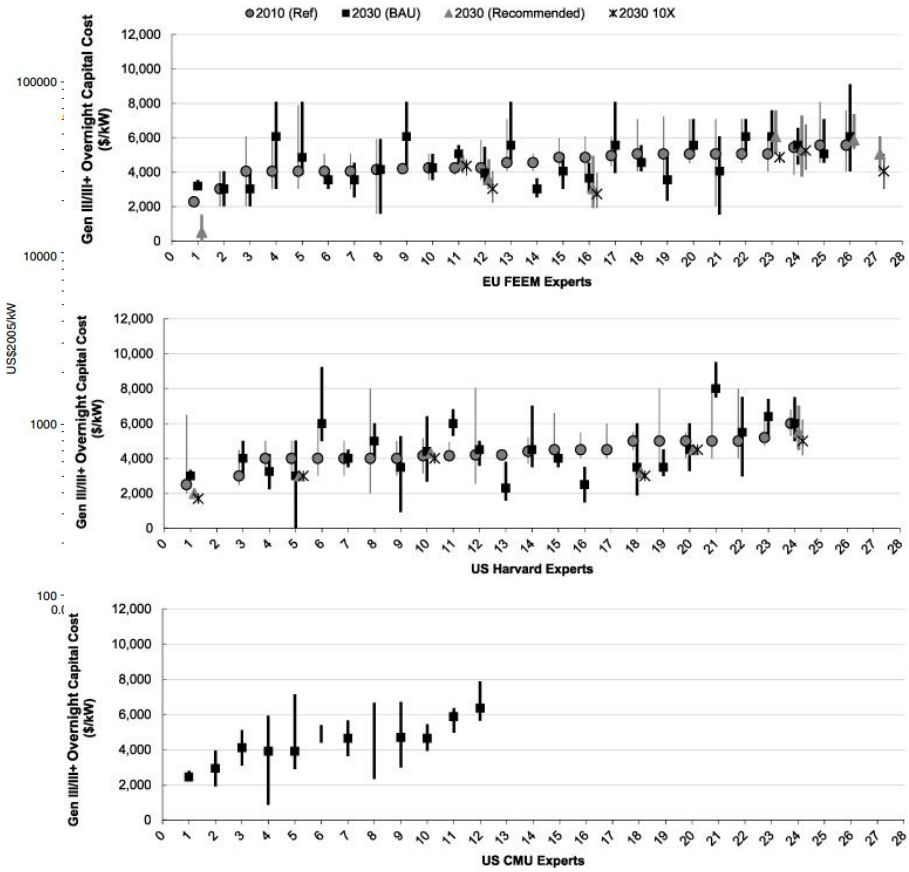
Modelling the innovation system

- Complex system where both the input and the output are difficult to measure



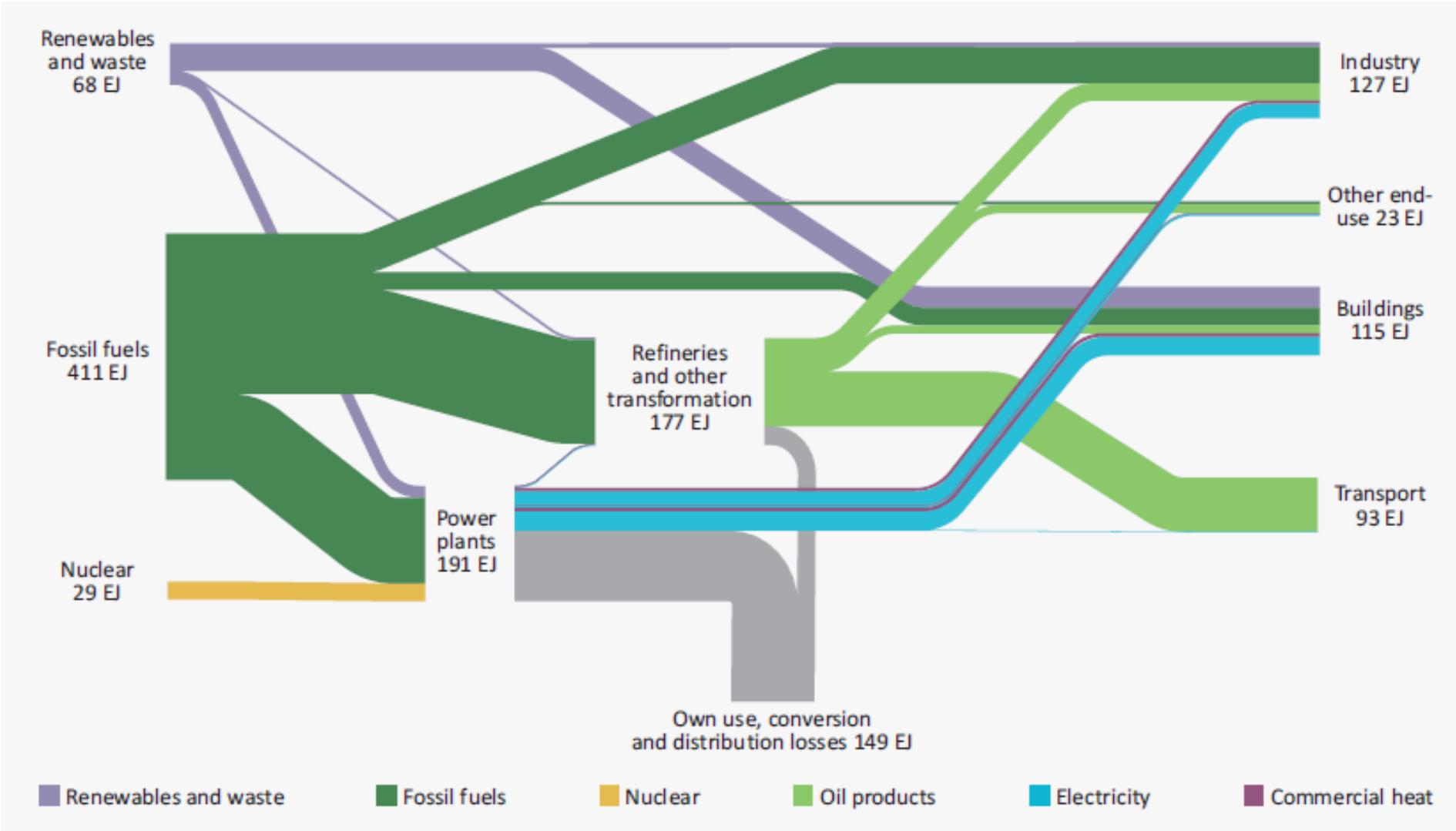
No straightforward way of measuring effectiveness of RDD&D

- Learning curves
- Expert elicitation
- Factor decomposition
  - Looking at the past
- Mixed approaches
  - (e.g. UK TINAs)



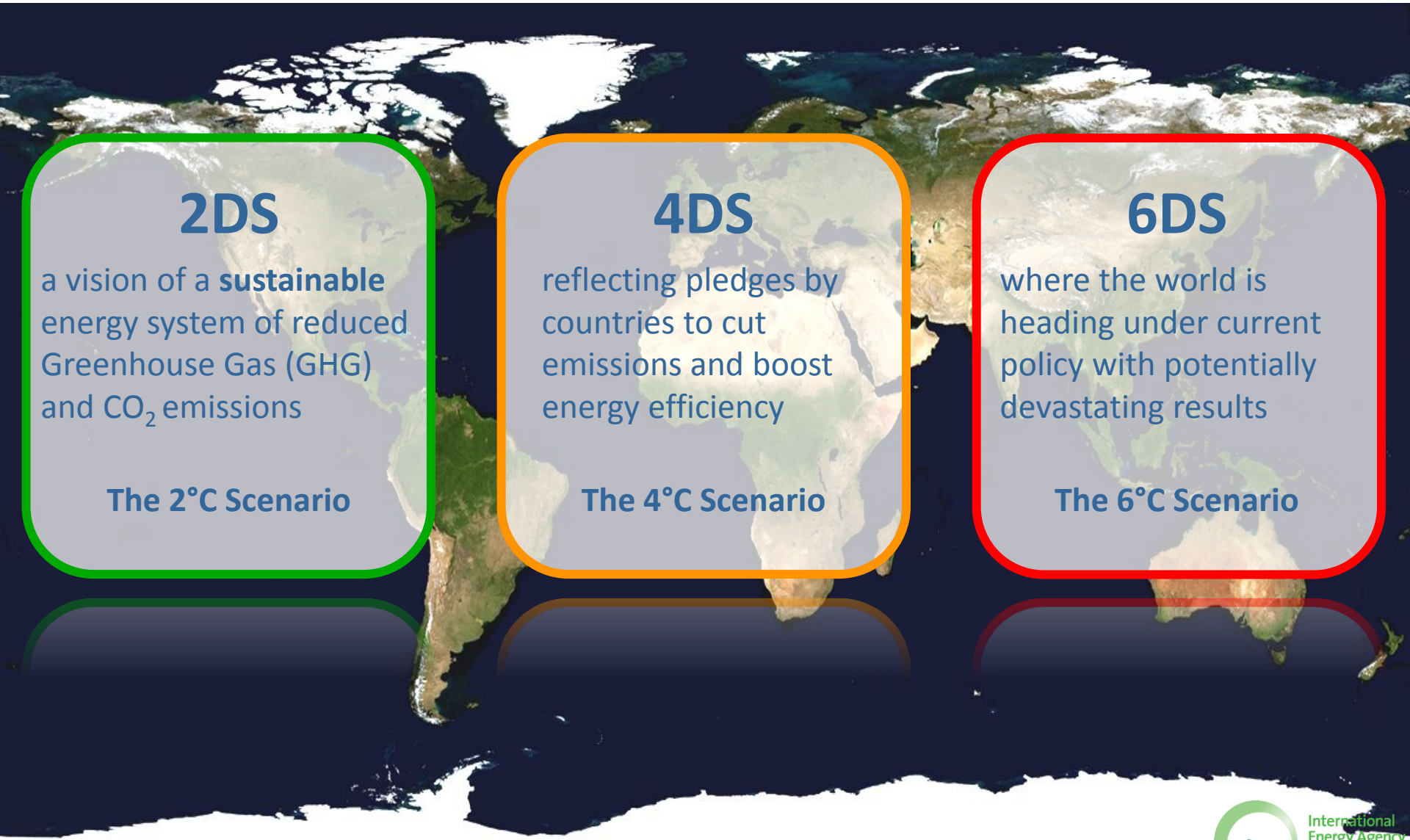
Source: Diaz-Anadon et al. 2013

The global energy system today



Global energy flows in 2011

A choice of 3 Futures



2DS

a vision of a **sustainable** energy system of reduced Greenhouse Gas (GHG) and CO_2 emissions

The 2°C Scenario

4DS

reflecting pledges by countries to cut emissions and boost energy efficiency

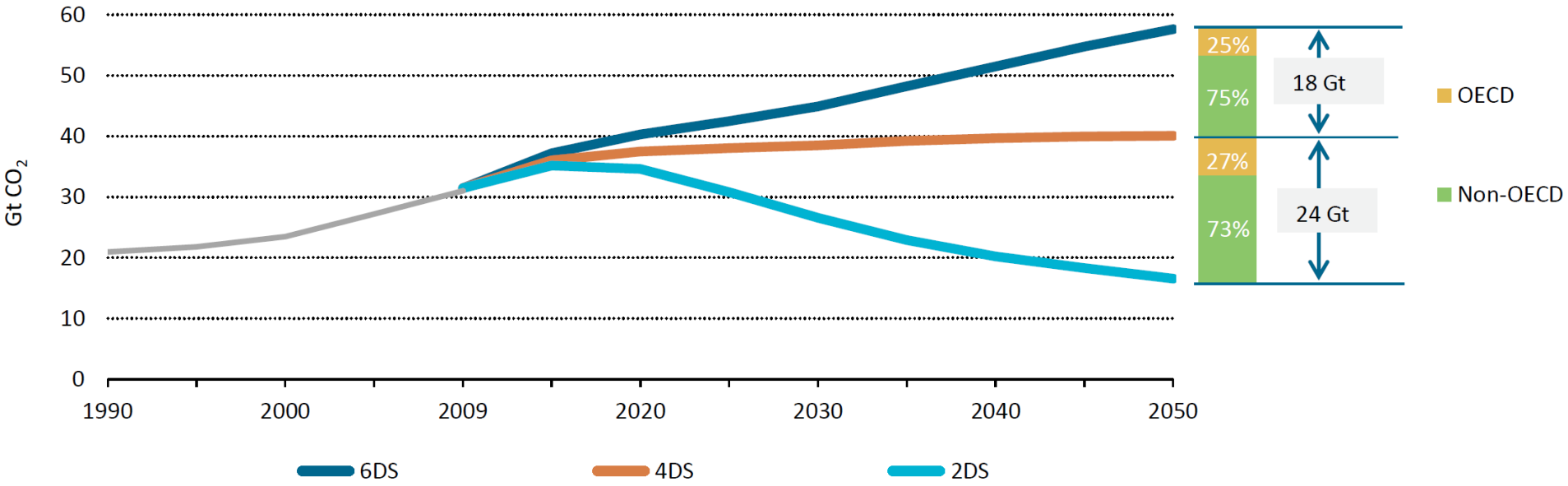
The 4°C Scenario

6DS

where the world is heading under current policy with potentially devastating results

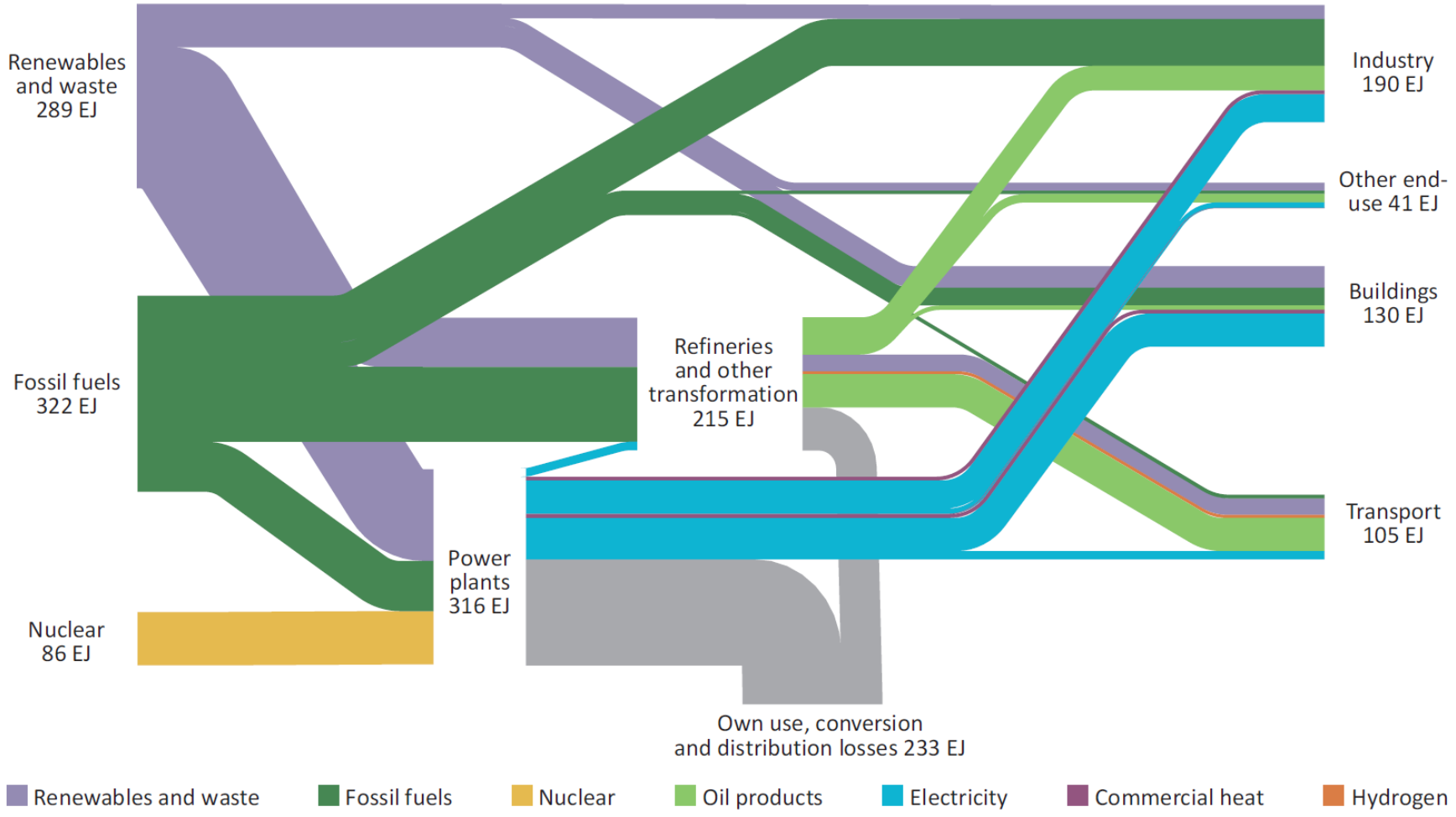
The 6°C Scenario

A choice of 3 Futures



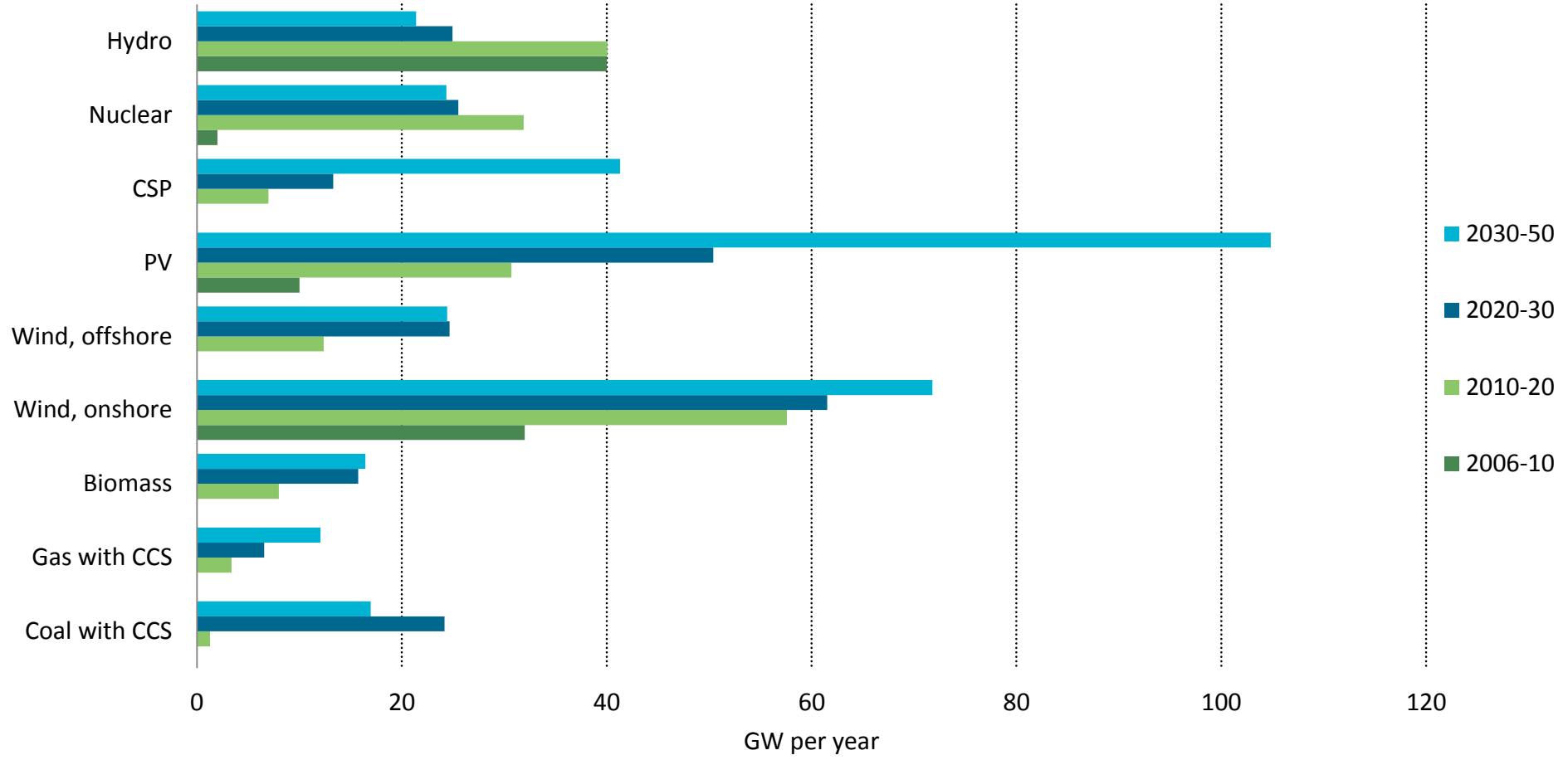
To achieve the 2DS, energy-related CO_2 emissions must be halved until 2050.

2050 – electricity; integration; end-use efficiency



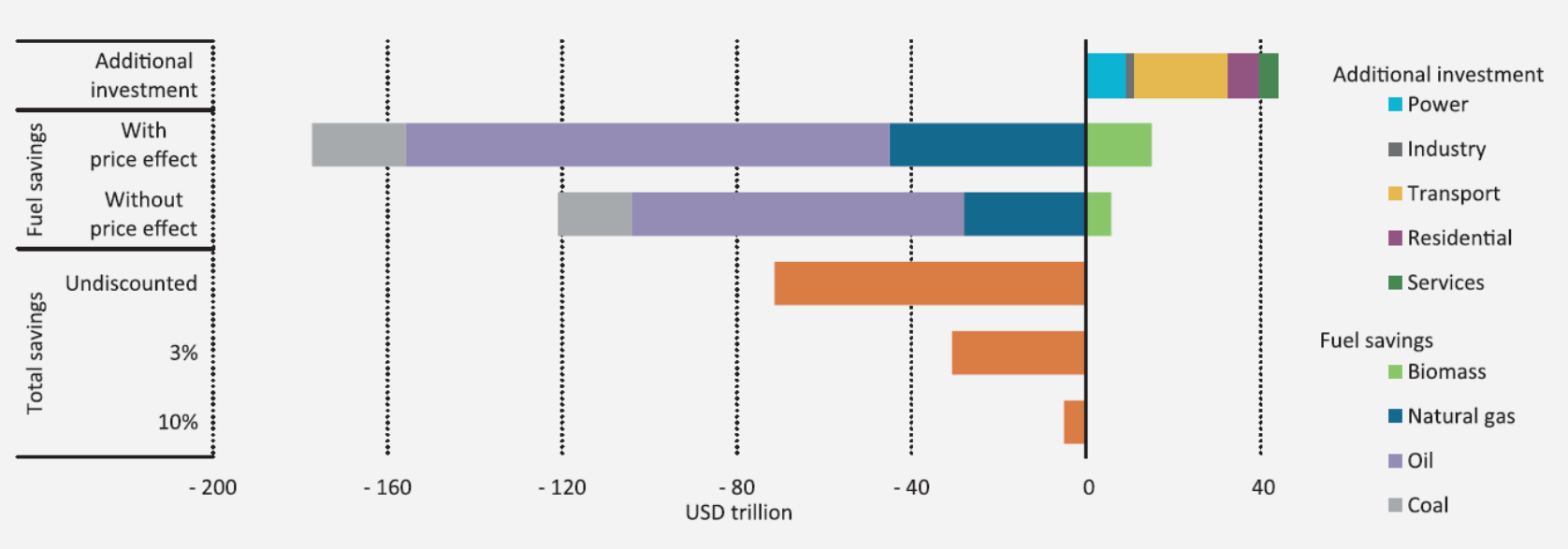
Global energy flows in 2050

Scale of the challenge

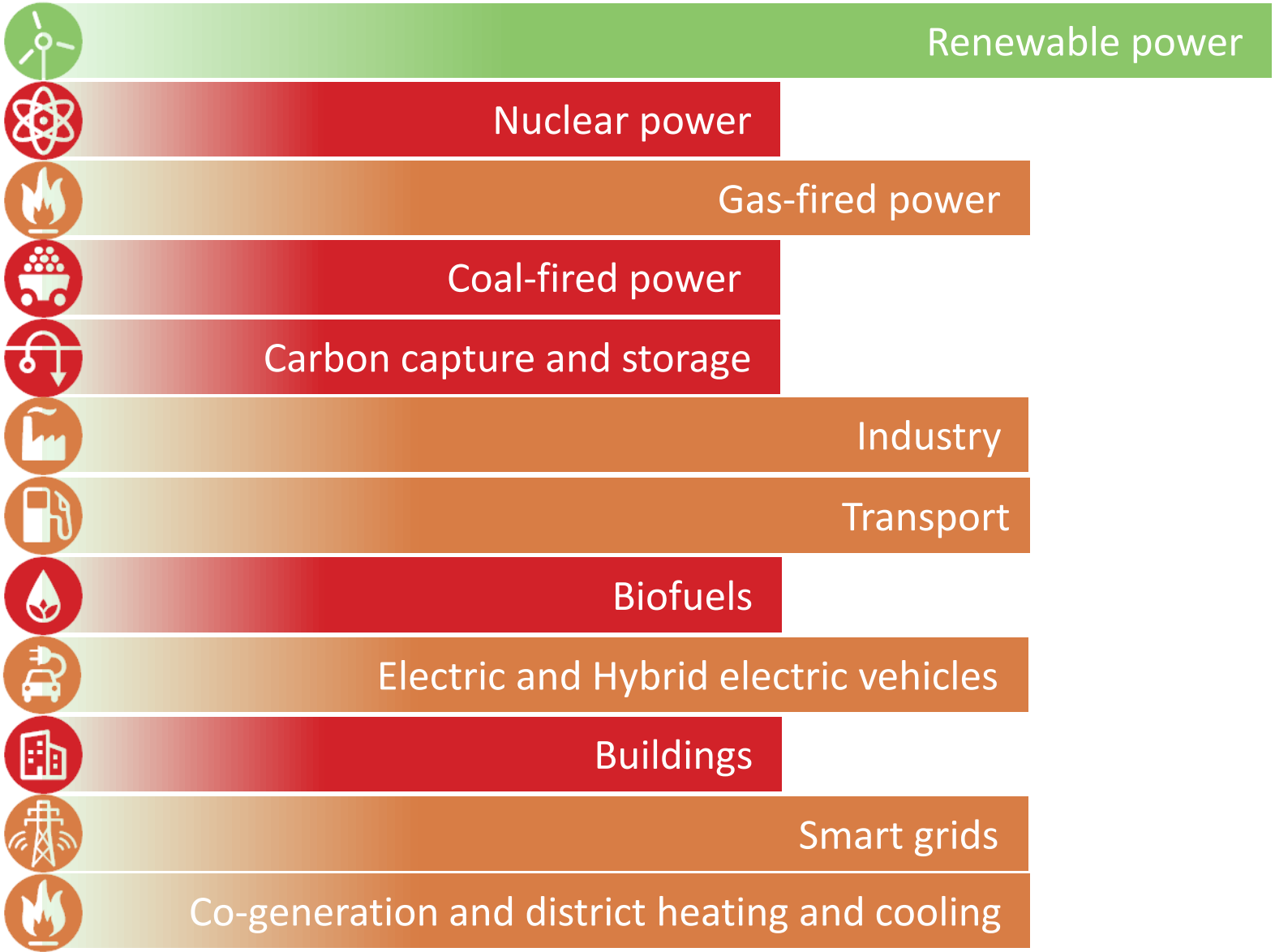


Massive acceleration of deployment of low-carbon power technologies is needed over the next four decades.

Clean energy pays off – but how to allocate resources efficiently?



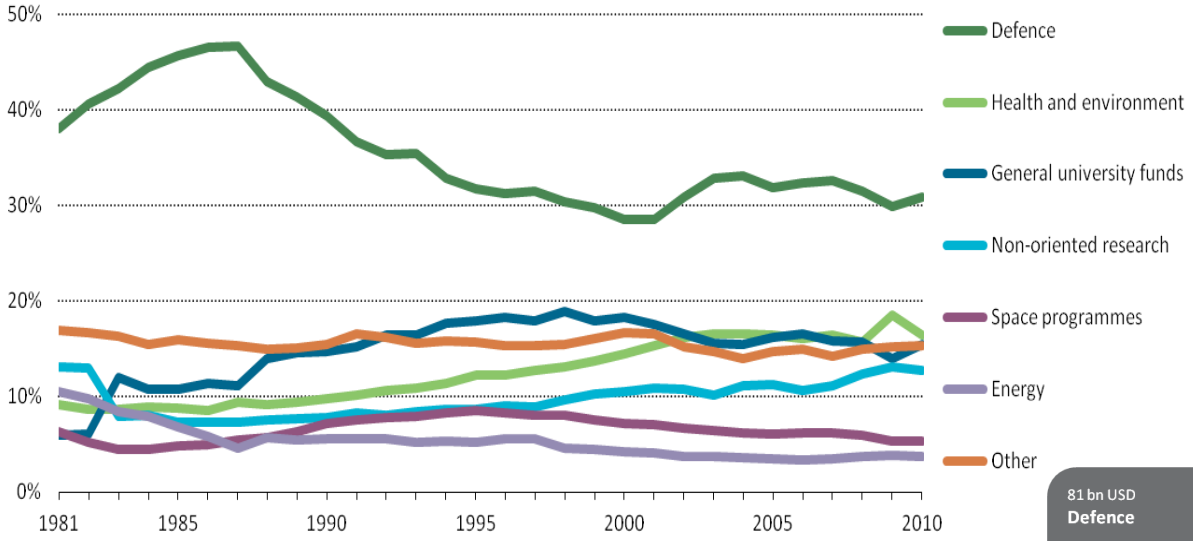
How are we doing?

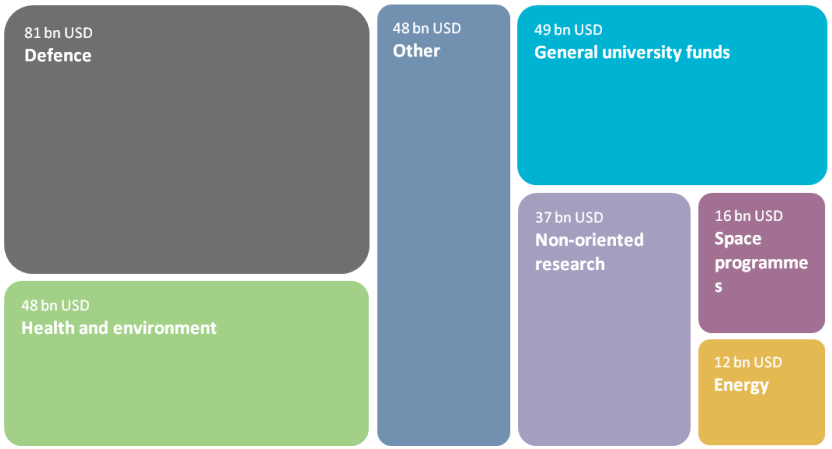


Measuring R&D - indicators

International Energy Agency

Tracking clean energy (innovation) progress



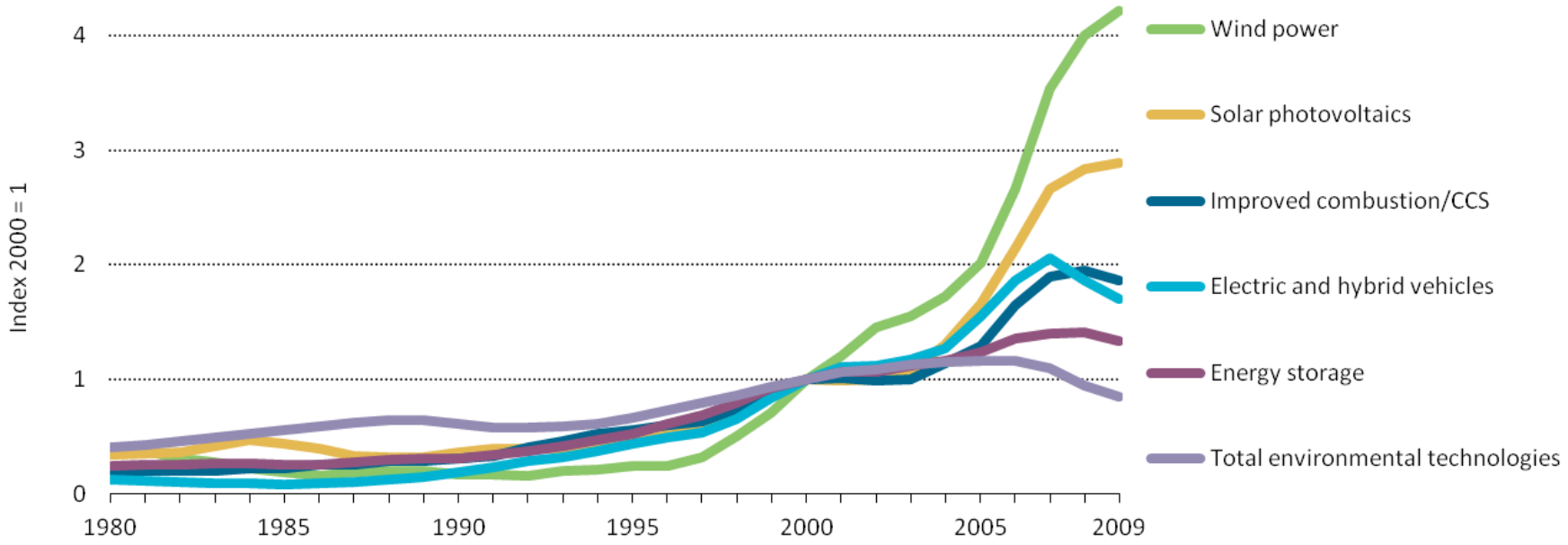


- Energy's share in OECD RD&D budgets has gradually been decreasing since 1980s

Measuring R&D - indicators

Low carbon innovation activity is accelerating

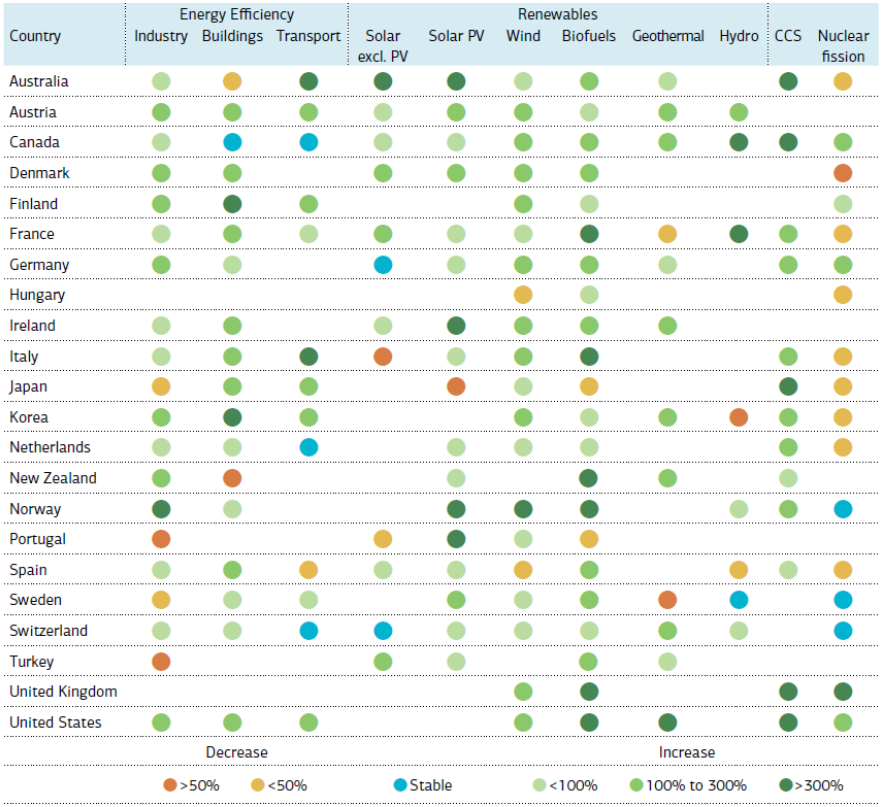
- Annual growth rate of low carbon technology patenting



Measuring R&D - indicators

International Energy Agency

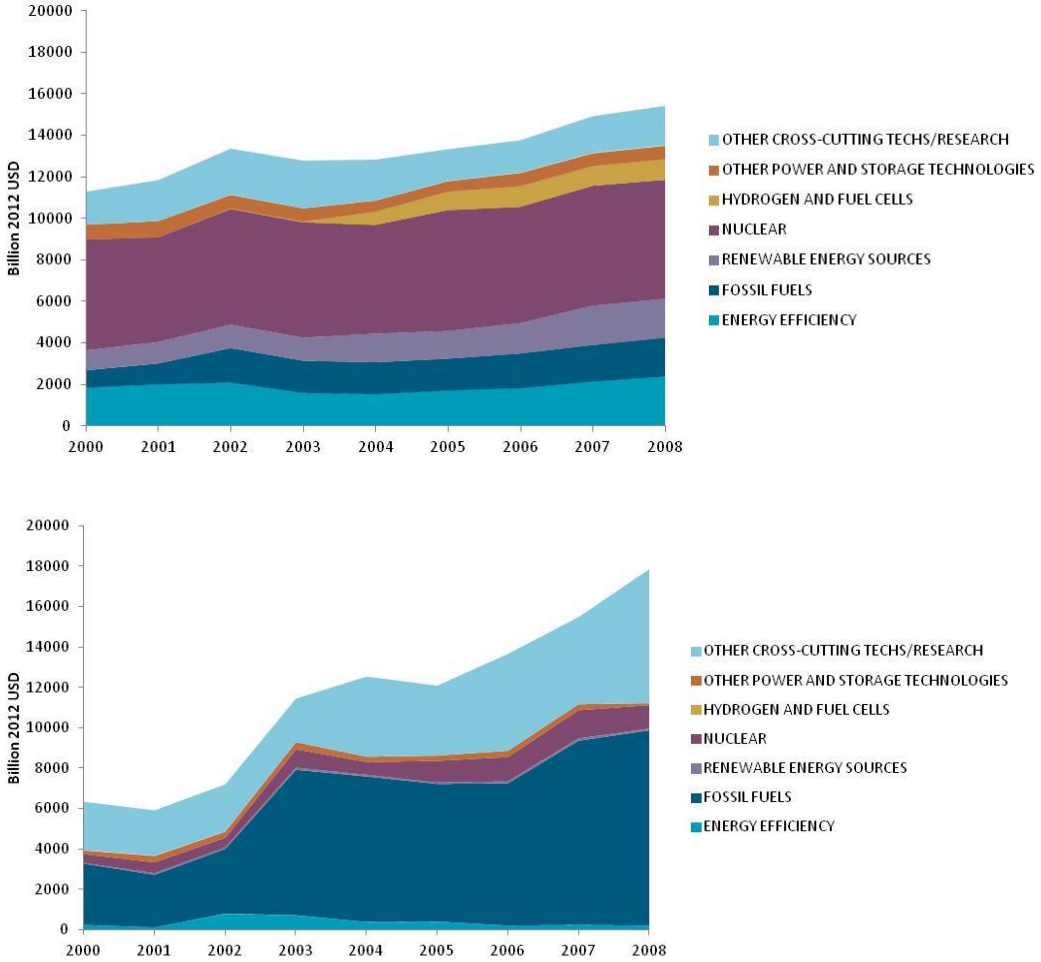
IEA investment data shows other positive trends



- Change in R&D investment by technology/area, 2003-07 vs 2008-12

Measuring R&D - indicators

Change in geography of energy innovation?

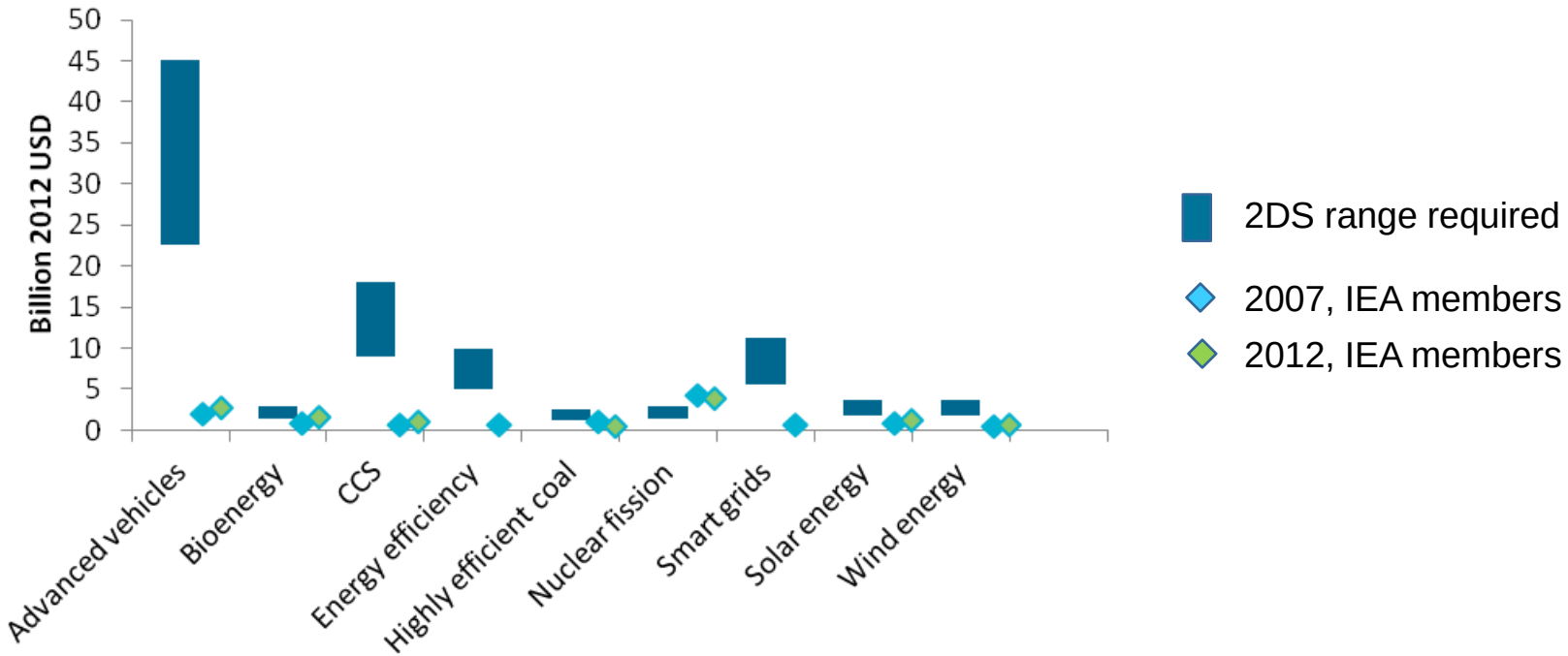


Data source: IEA R&D database, and Kempener, R., Laura D. Anadon, Condor, J., "Database of Energy RD&D Investments in Brazil, Russia, India, Mexico, China, and South Africa," Energy Technology Innovation Policy, John F. Kennedy School of Government, Harvard University, November 8, 2010.

Measuring R&D - indicators

International Energy Agency

The current level of investment in R&D is 3-6 times lower than required

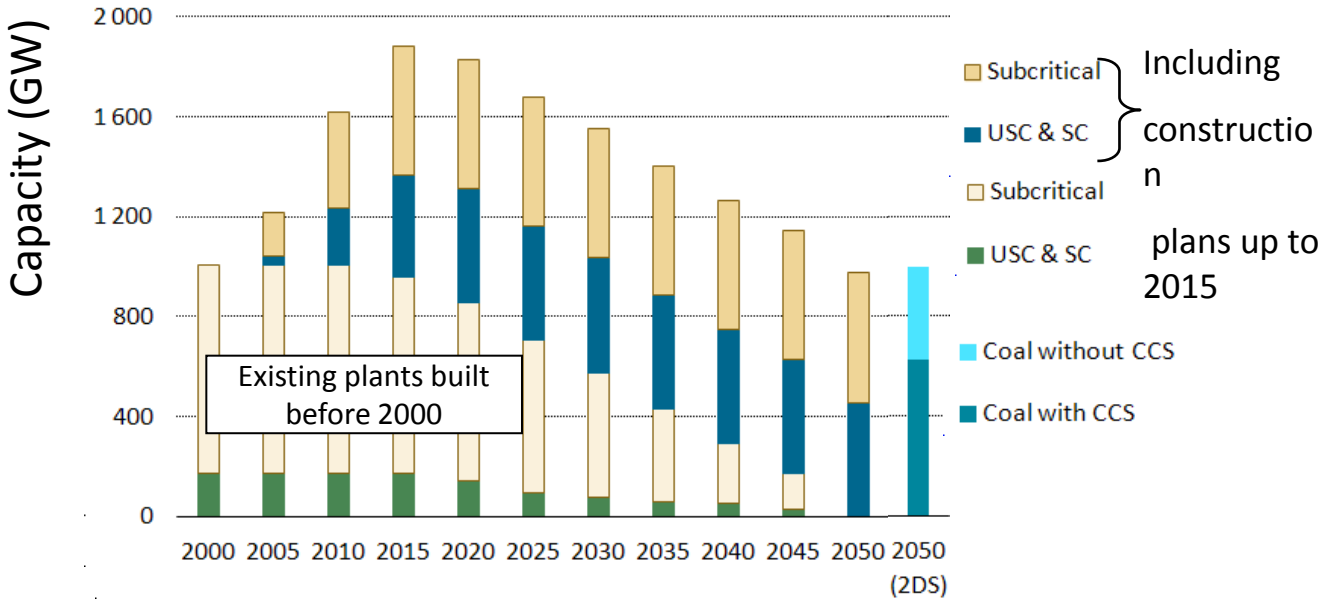


Key challenges/barriers to be addressed

- High capital investment, esp. for low carbon technology (CCS?)
- Need to innovate with existing infrastructure
- Transformation required in some of the least innovative sectors
- In a low carbon world, innovation is as much about technology as it is about system design, usage and markets
- Delivering innovation at scale

Key challenges/barriers to be addressed

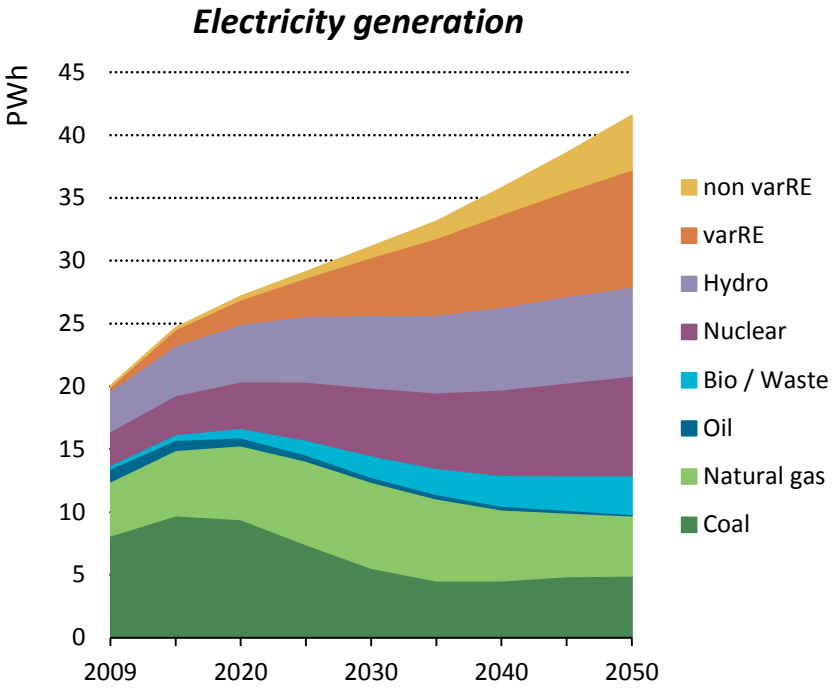
- High capital investment, esp. for low carbon technology (CCS?)



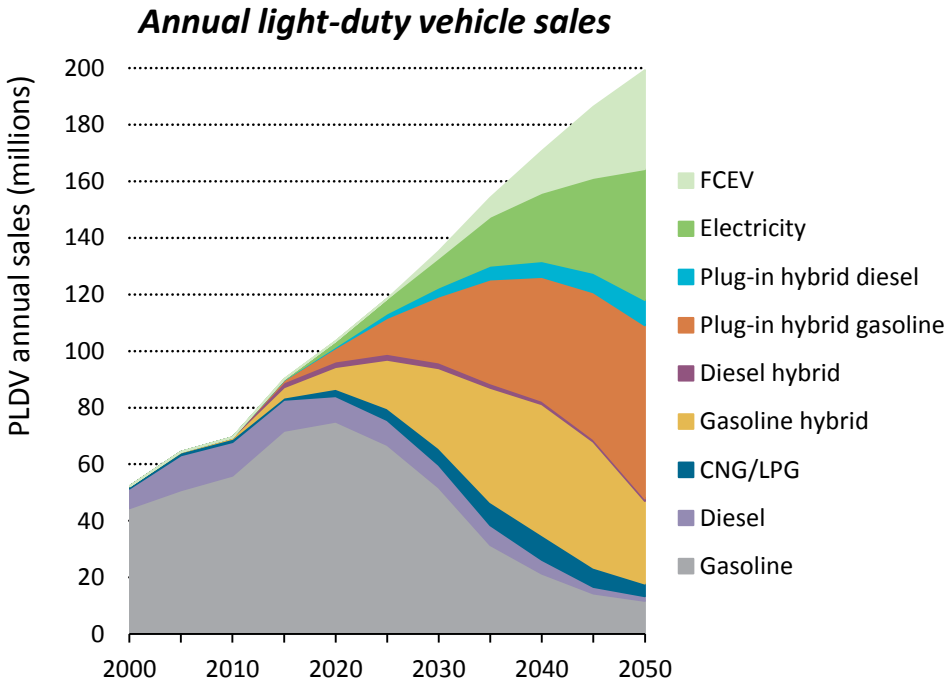
To meet the 2DS, generation from subcritical plants would need to cease before end of their technical lifetimes.

Key challenges/barriers to be addressed

- Need to innovate with existing infrastructure



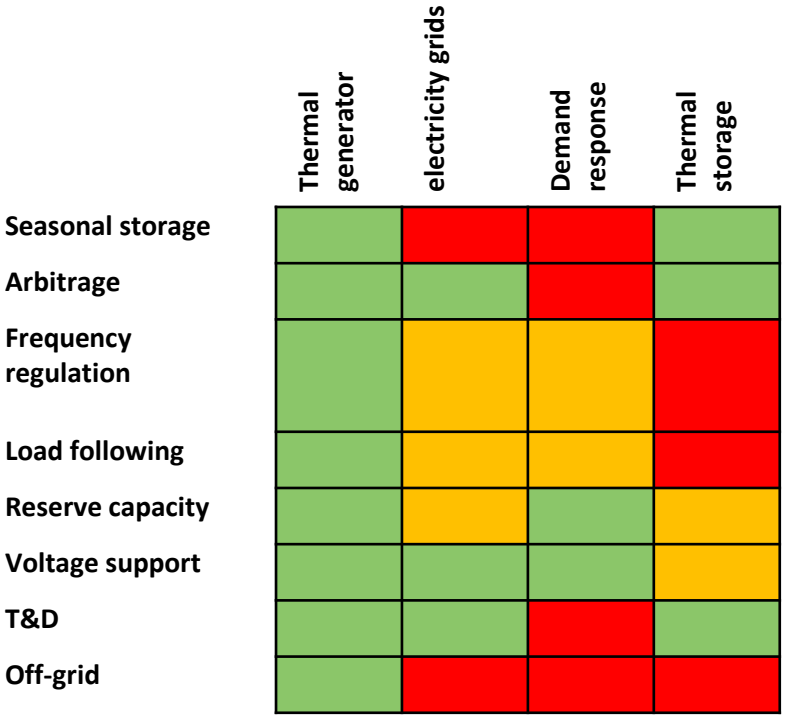
35% from variable renewables in 2050

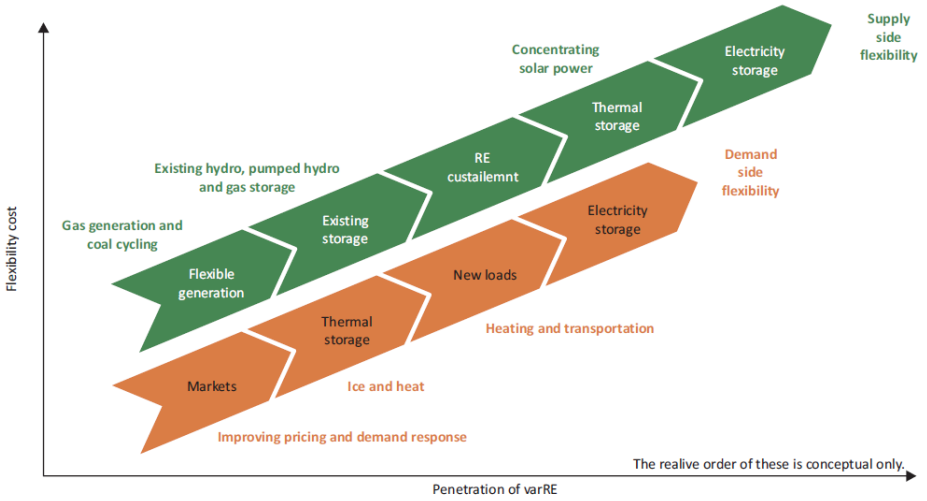


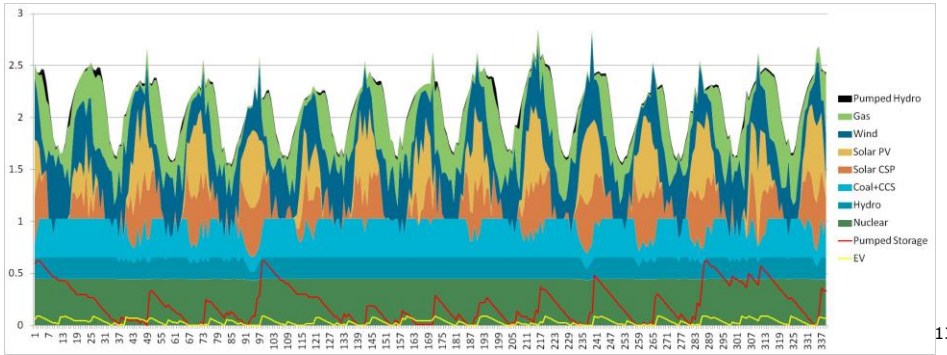
Almost 60% of LDV sales are EVs or PHEVs in 2050

Key challenges/barriers to be addressed

- Need to innovate with existing infrastructure

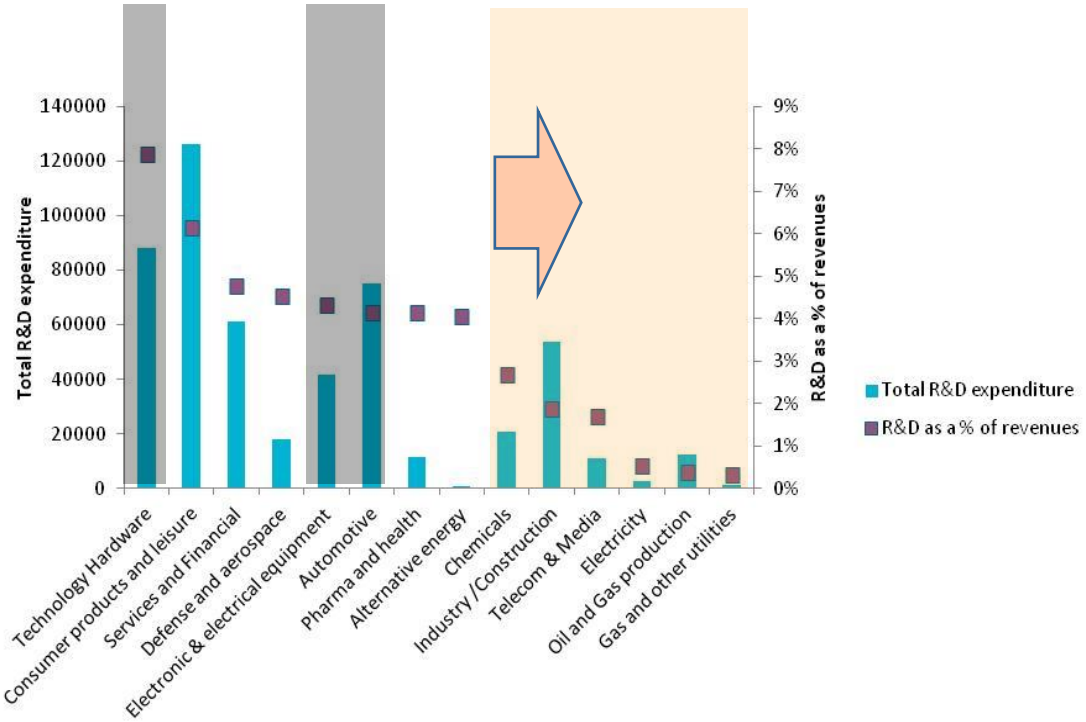






Key challenges/barriers to be addressed

- Transformation required in some of the least innovative sectors

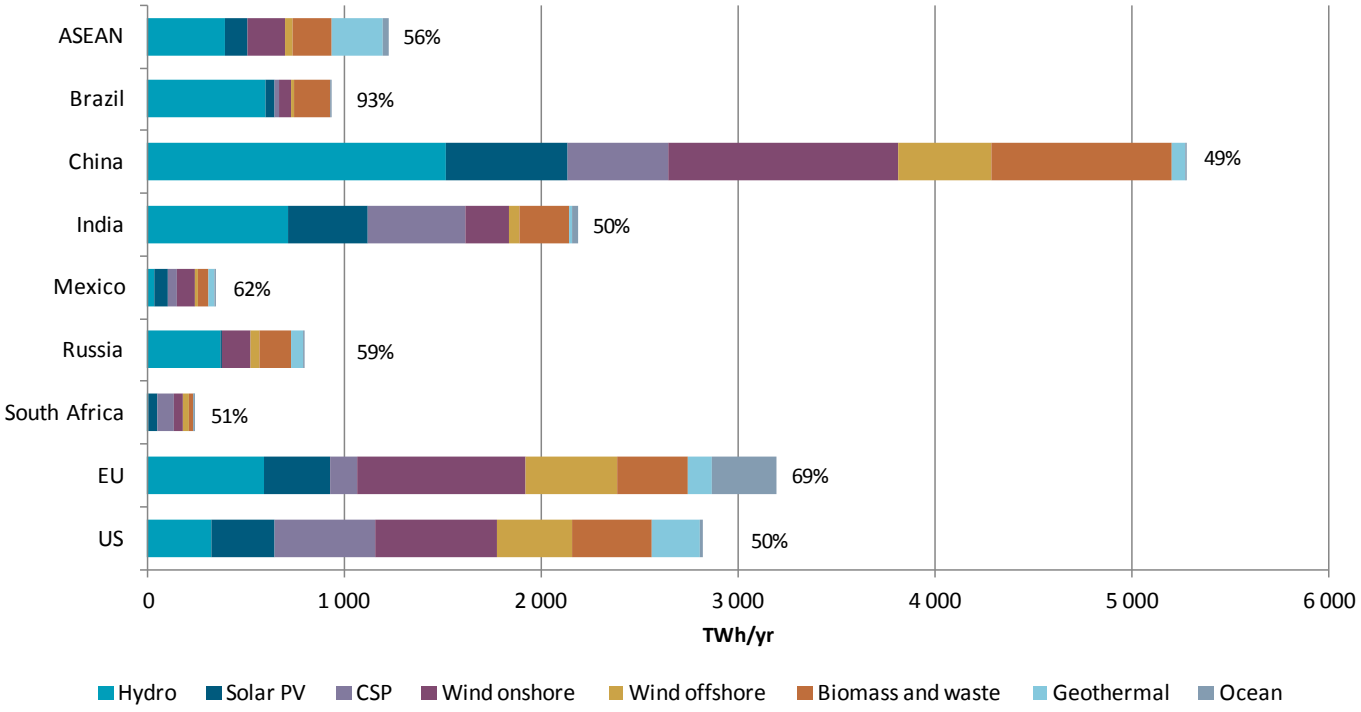


Key challenges/barriers to be addressed

- Transformation required in some of the least innovative sectors
- Private sector is key - we don’t have enough information on:
  - Level and type of R&D investment
  - Where benefits of innovation are accrued
  - Process of prioritisation
- Difficult to characterise the impact of market-pull policies on technology development

Key challenges/barriers to be addressed

Delivering innovation at scale

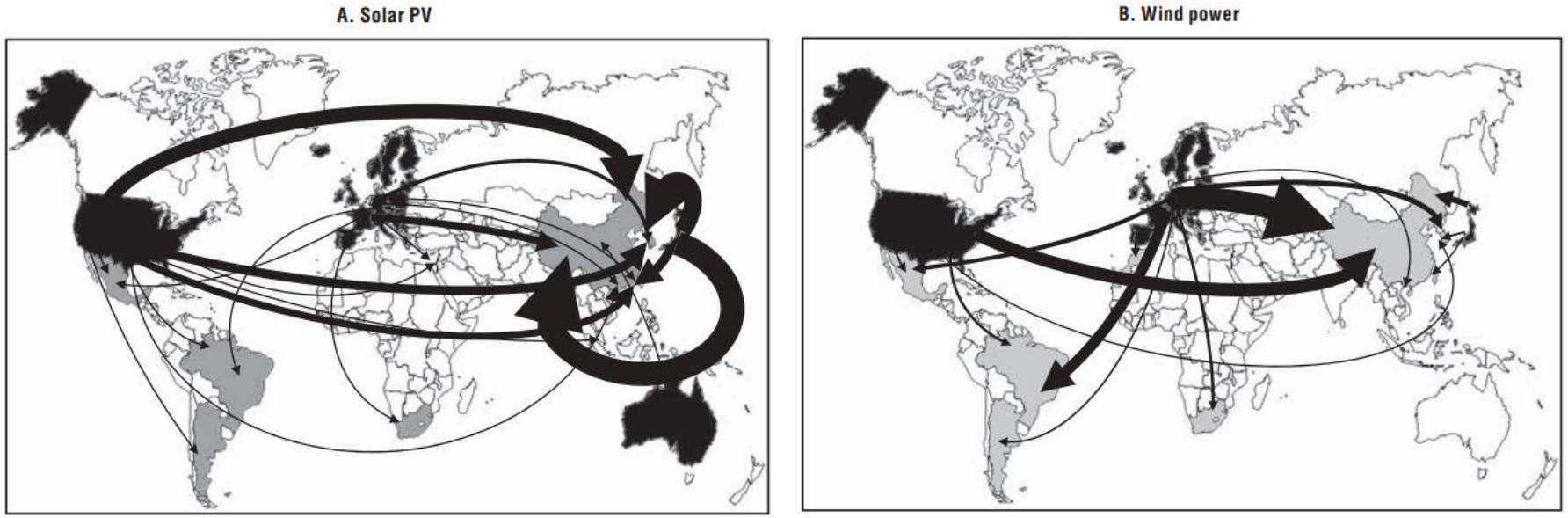


Vastly different decarbonisation strategies across countries

Key challenges/barriers to be addressed

Delivering innovation at scale

- Literature on evolution of energy technology costs in non-OECD countries is lacking
- Important to understand dynamics of technology transfer and mature technologies in other markets
- Role of innovation policy in other countries



OECD analysis on clean energy technology knowledge flows in 2011 (Johnstone and Hascic)

Thank you

luis.munuera@iea.org