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The role of innovation in meeting energy challenges

Jim Watson, Director
UK Energy Research Centre

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Overview

1. Context: why is innovation important?
2. Rationales for government policy action
   - R&D funding, carbon pricing
   - Beyond two market failures
3. Conclusions and policy implications

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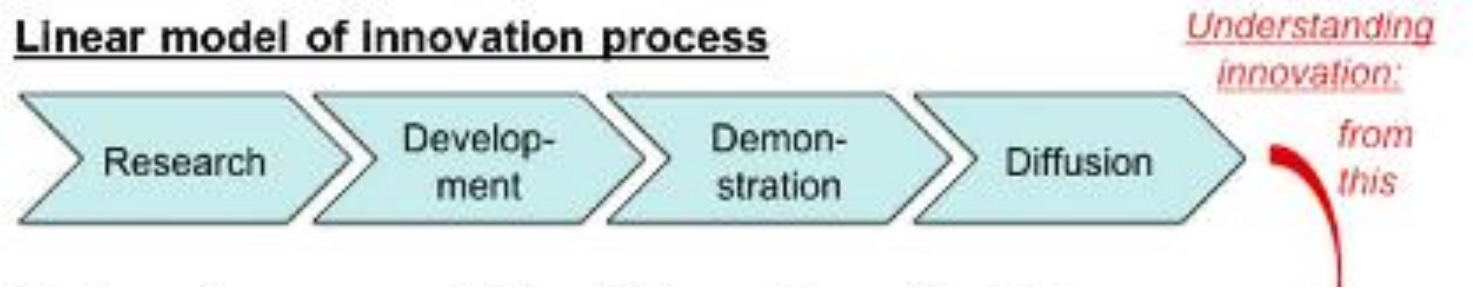
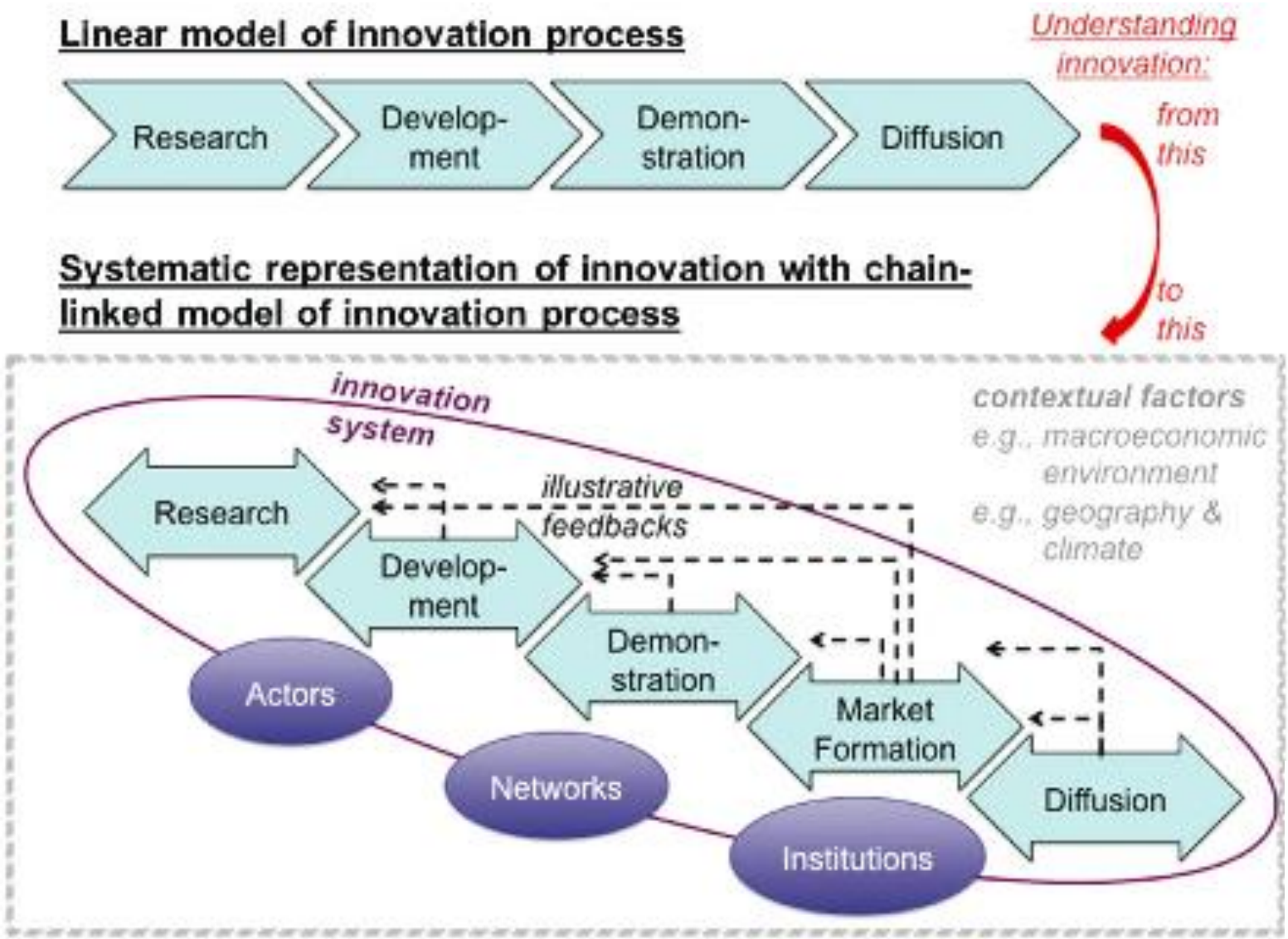
Understandings of innovation



Source:
Global Energy Assessment

Understandings of innovation



Source:
Global Energy Assessment

Understandings of innovation

- Emphasis on systems of innovation: national, regional, technological, sectoral
- Important distinctions: incremental vs radical innovation; social *and* technical innovation
- Links to literature on long-waves, paradigms and socio-technical transitions
- Measuring innovation is not easy: inputs (e.g. R&D spending); outputs (e.g. patents); outcomes (e.g. market deployment)

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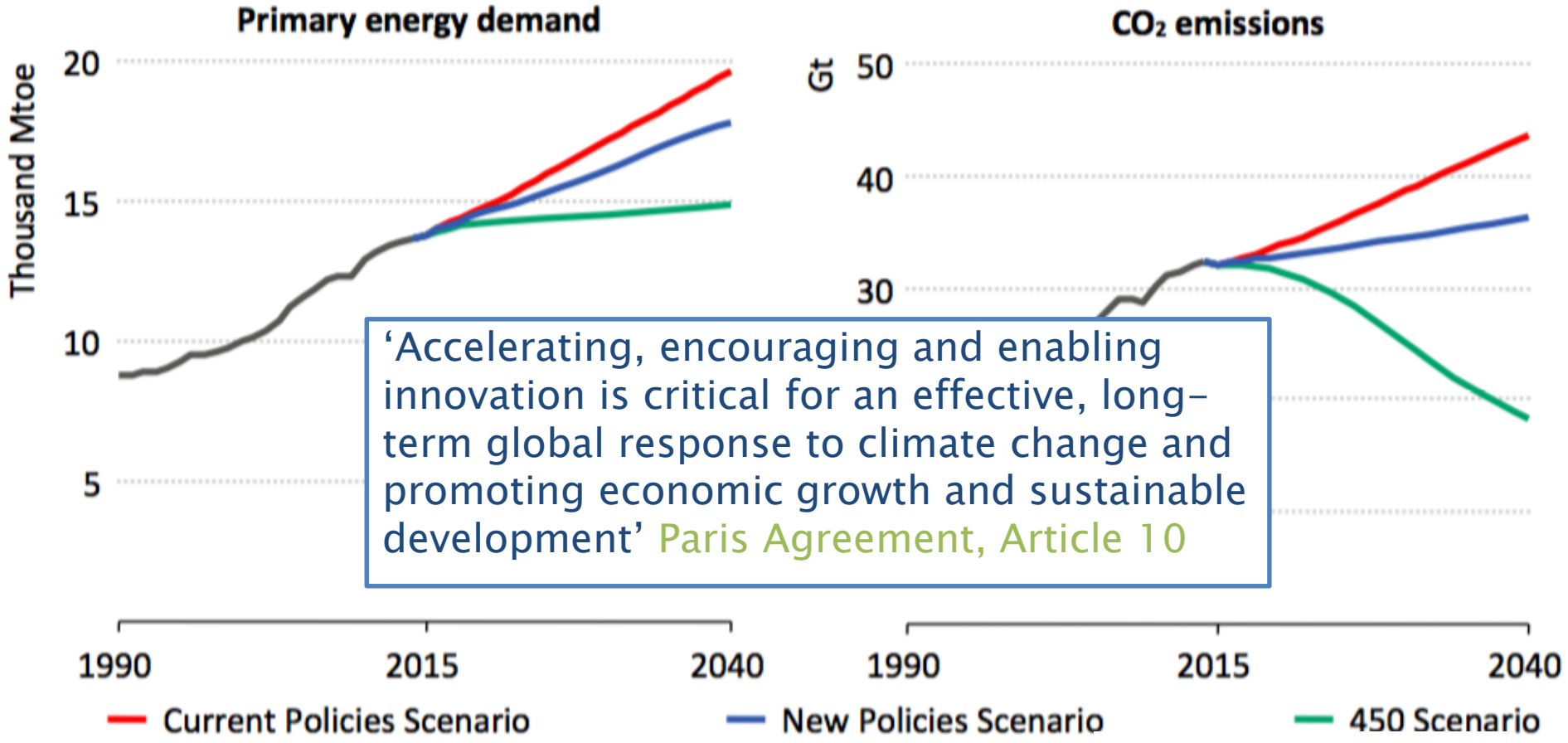
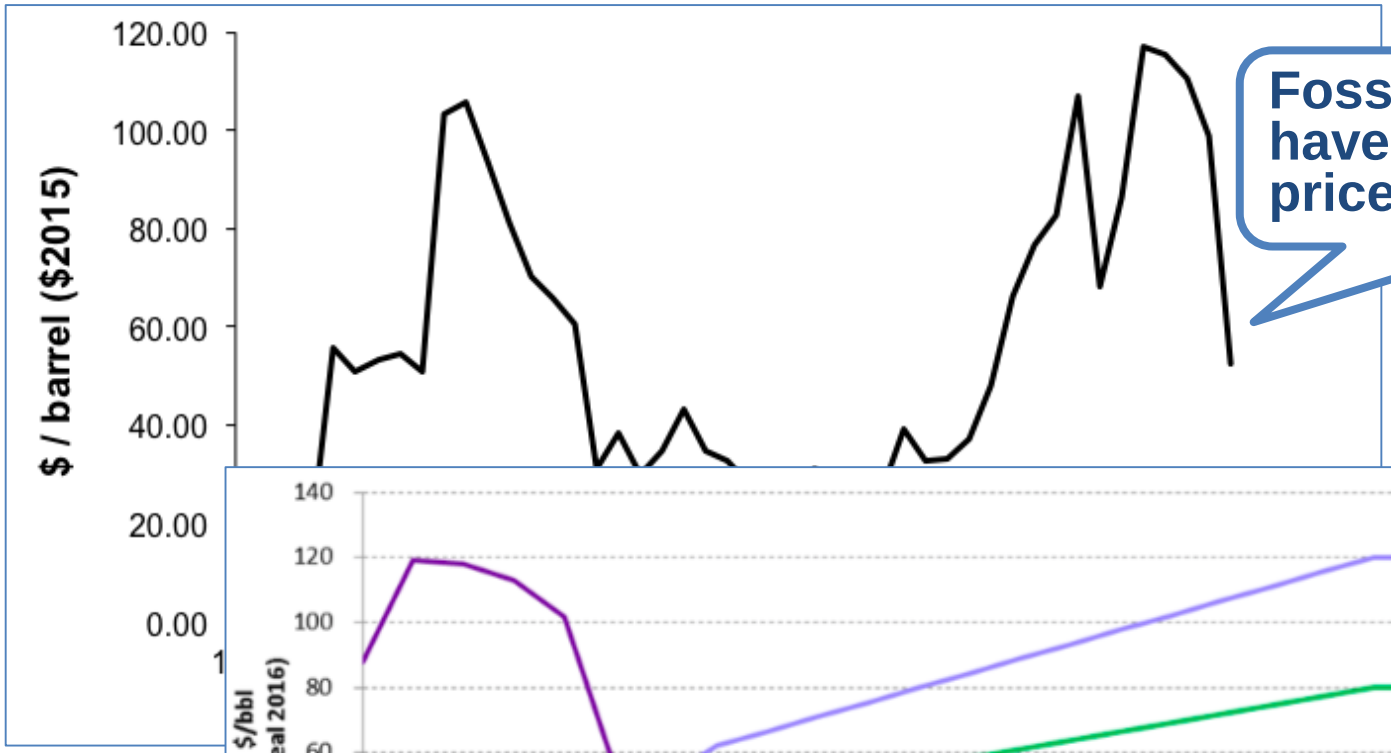
Global energy trends



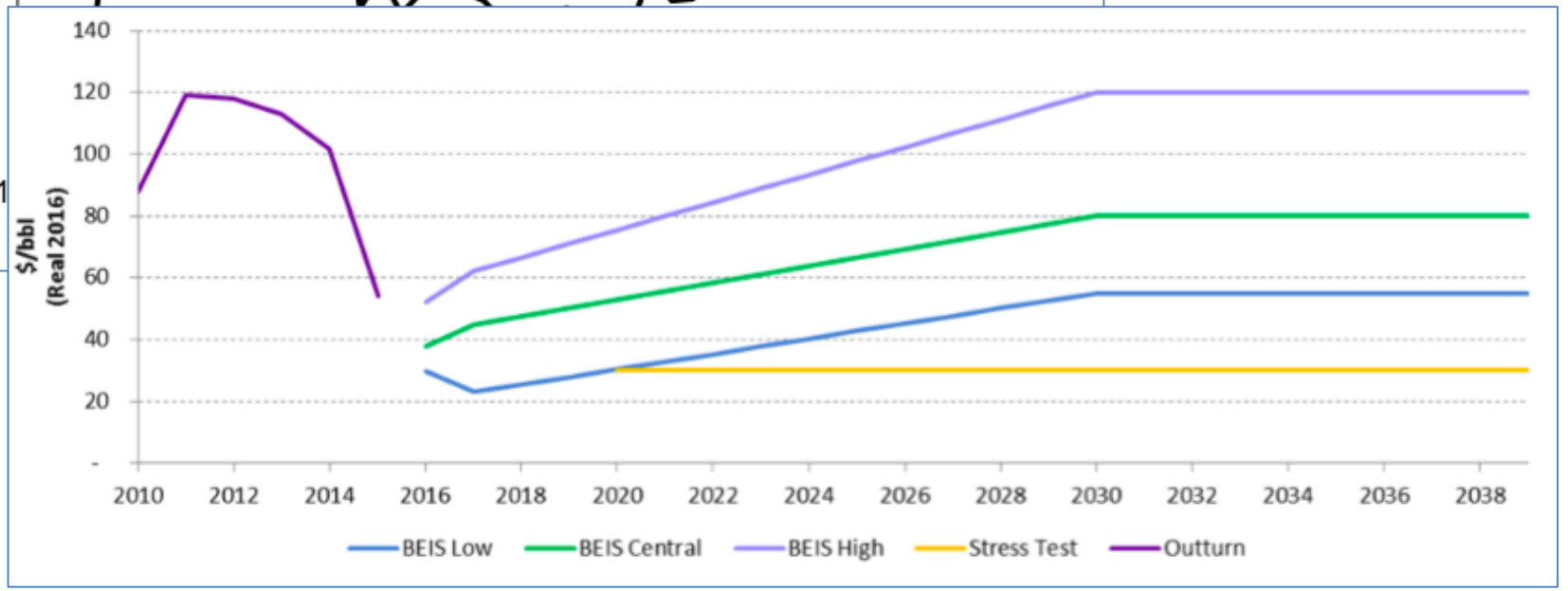
'Accelerating, encouraging and enabling innovation is critical for an effective, long-term global response to climate change and promoting economic growth and sustainable development' Paris Agreement, Article 10

Source: IEA World Energy Outlook (2016)

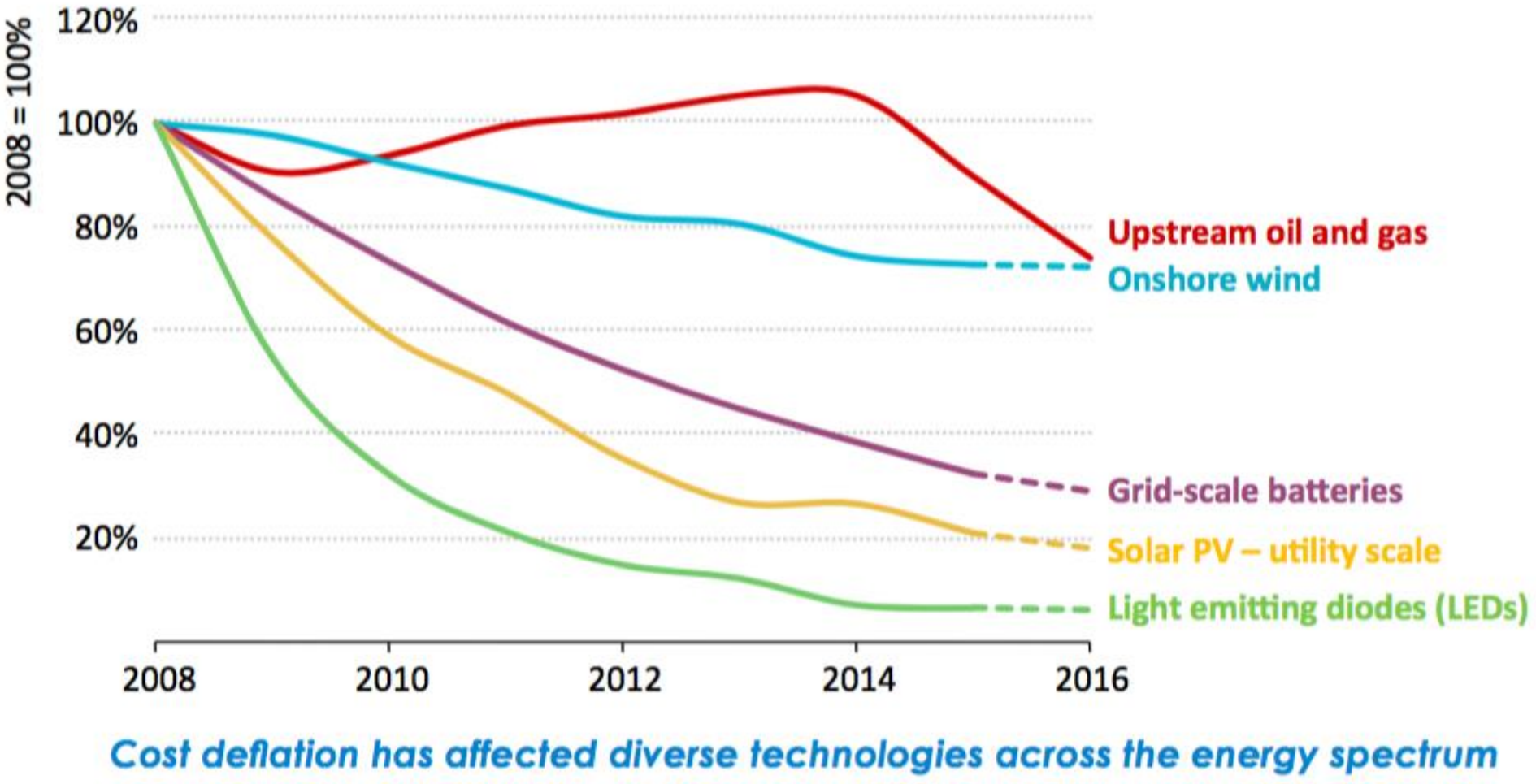
Global energy trends: oil prices



Fossil fuel prices have fallen, but future prices hard to predict

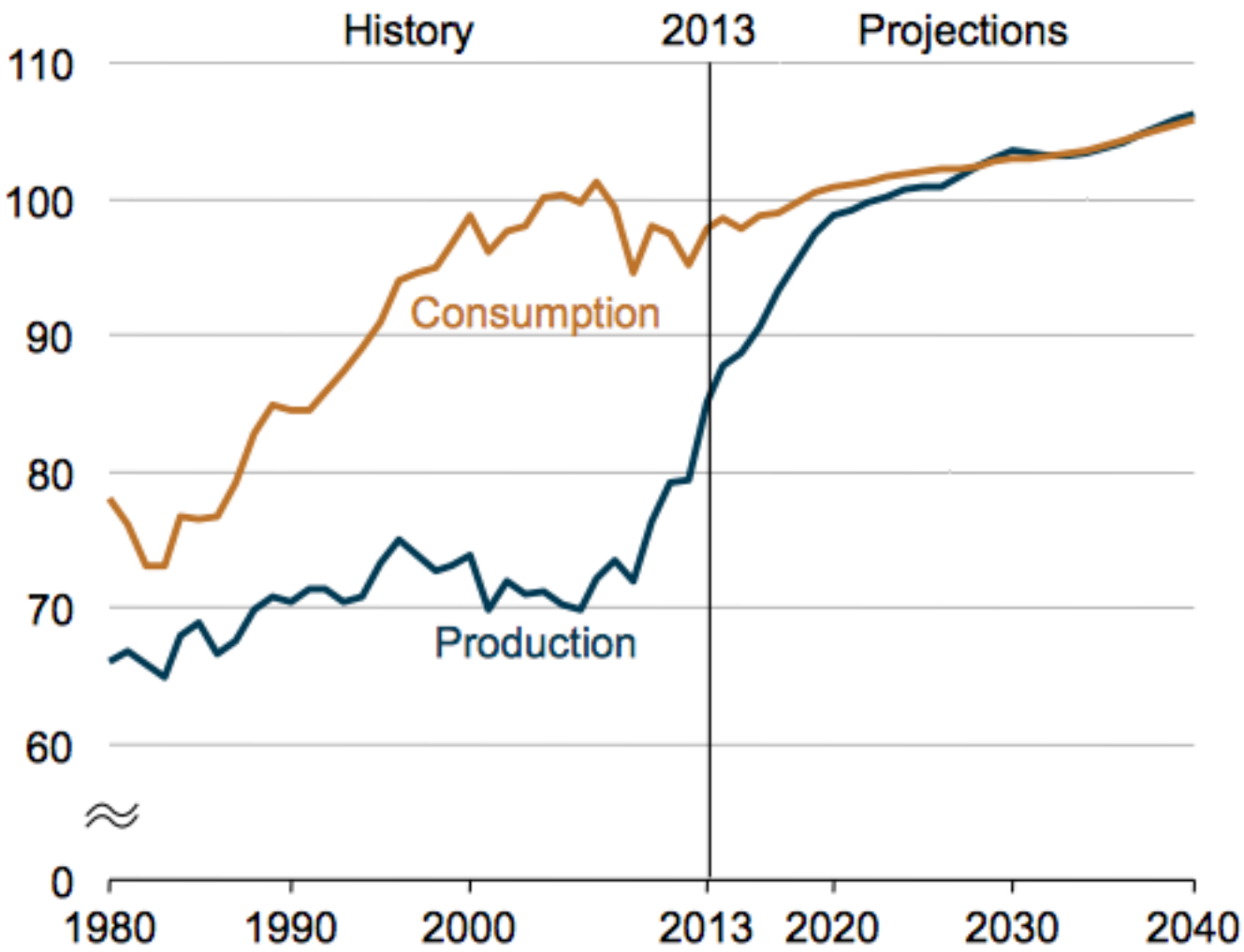


Global energy trends: technology costs



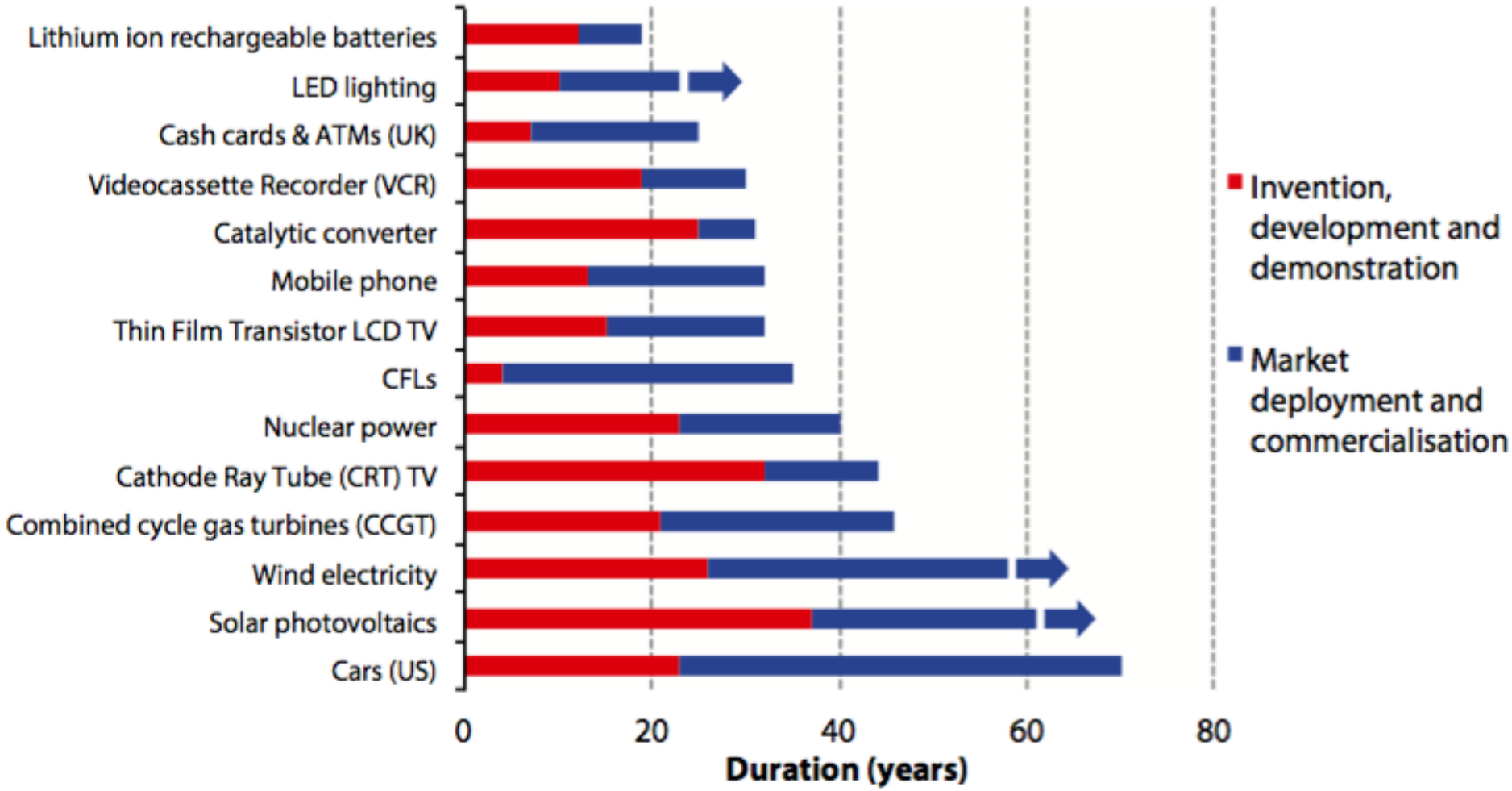
Source: IEA World Energy Outlook (2016)

Global energy trends: US energy independence?



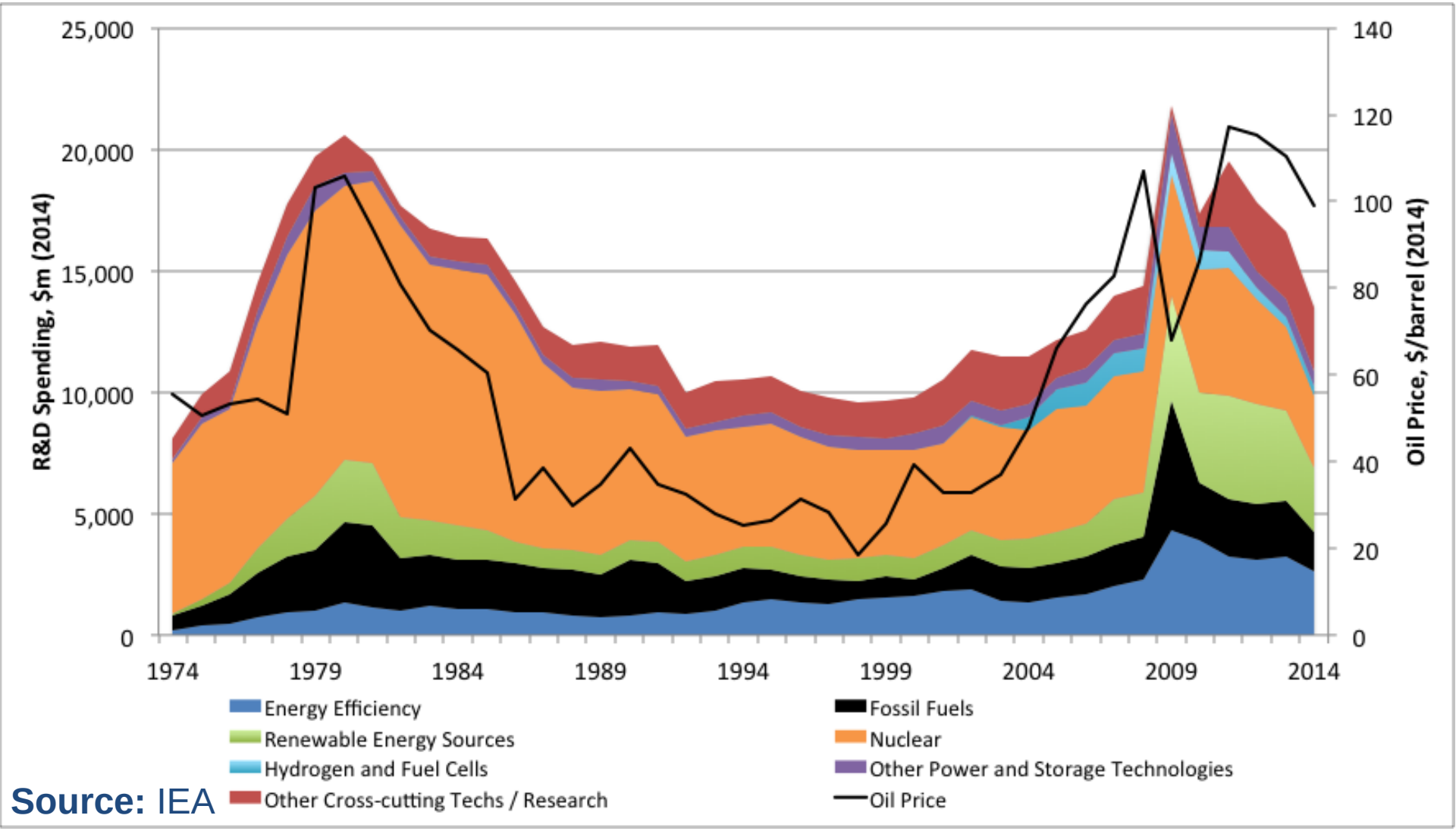
Source:
US DoE Annual Energy Outlook (2015)

But: new innovation takes time



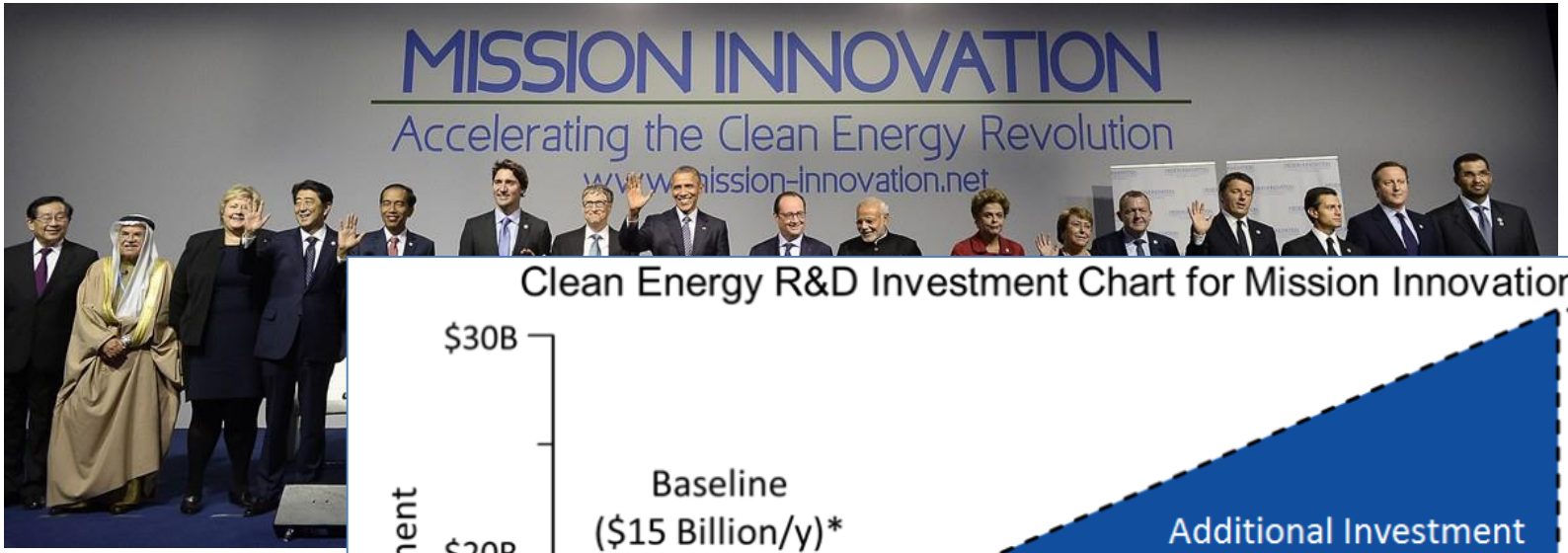
Source: UKERC / CCC

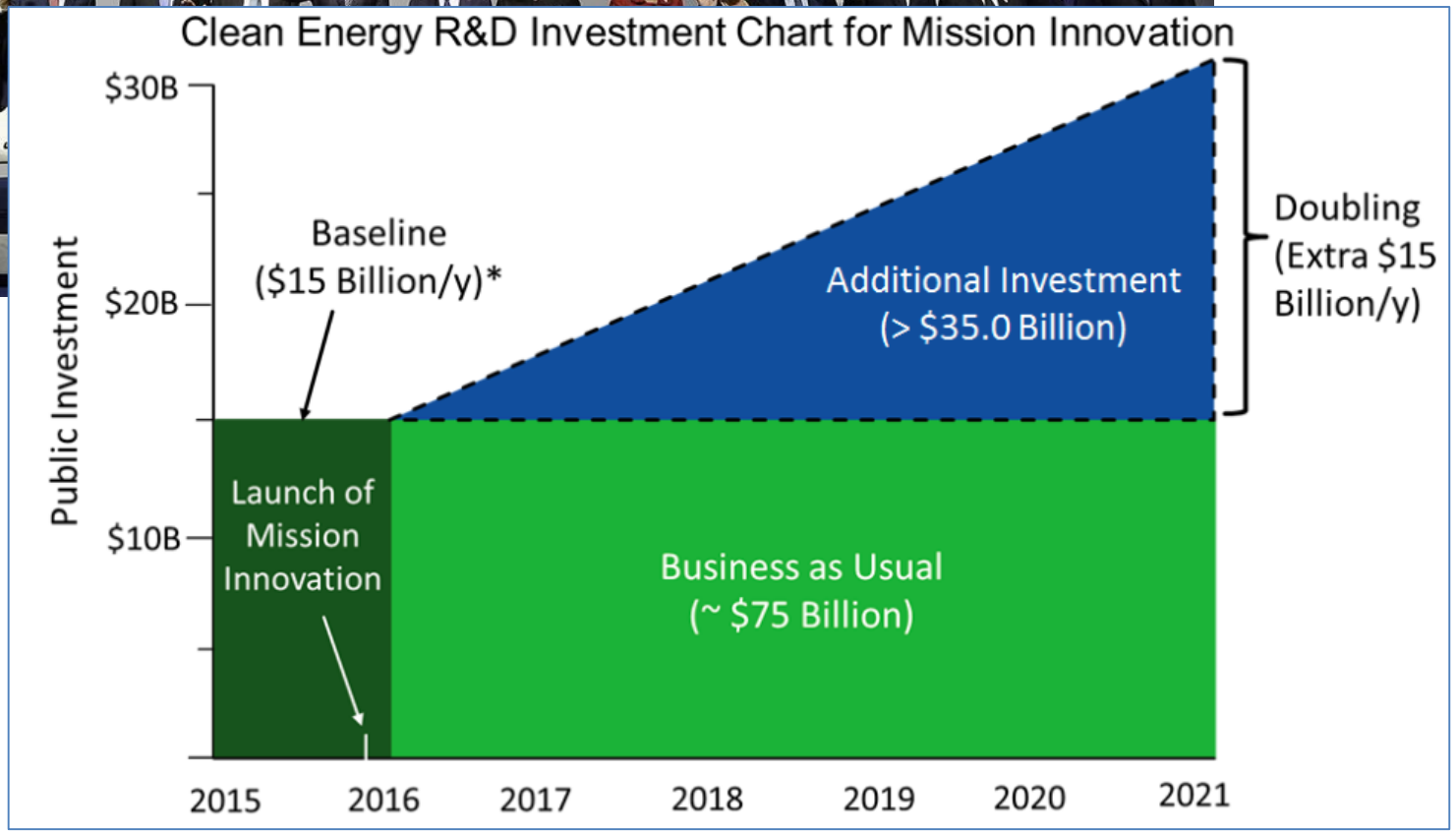
Correcting market failures: R,D&D spending



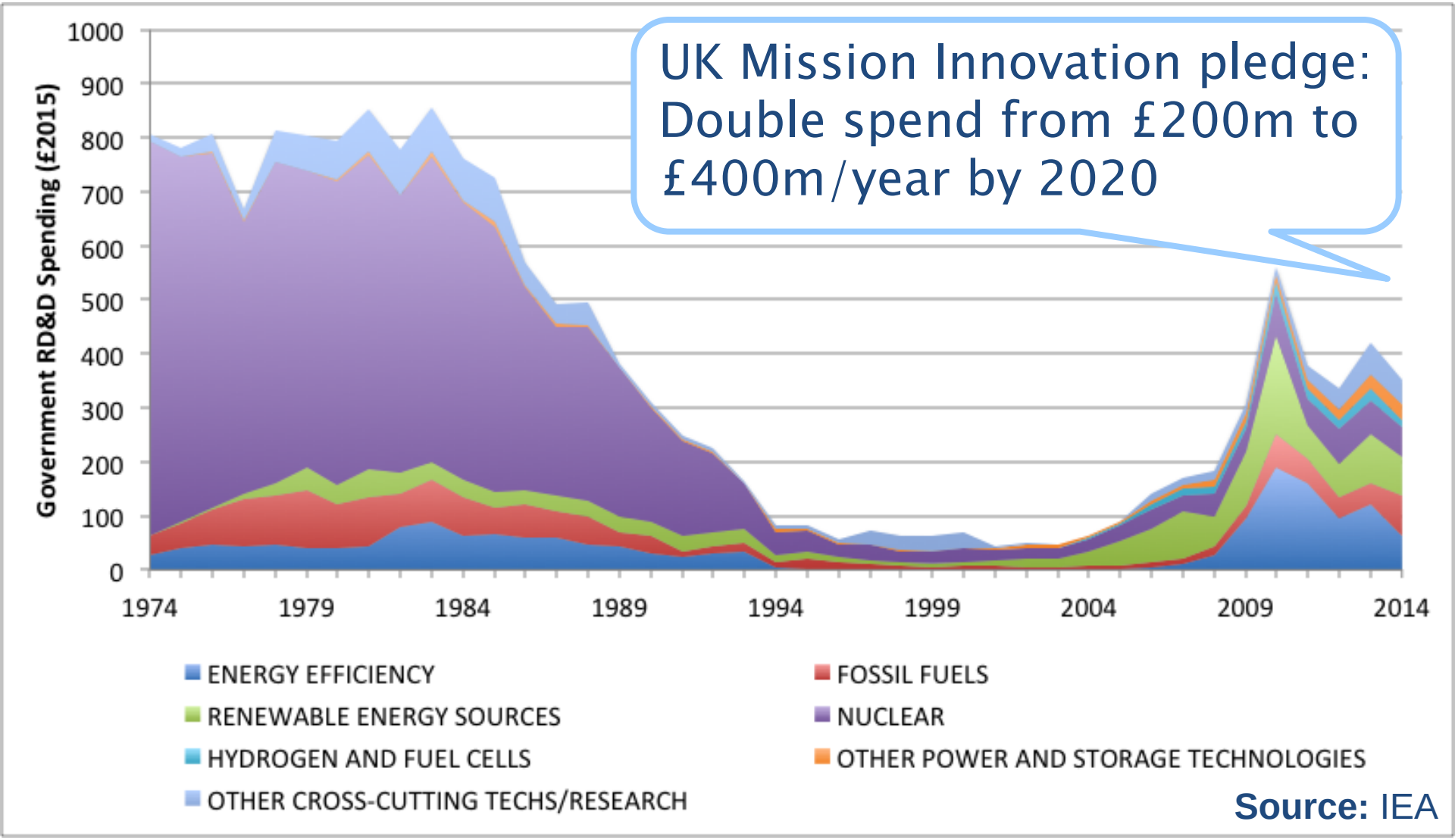
Source: IEA

Correcting market failures: R,D&D spending



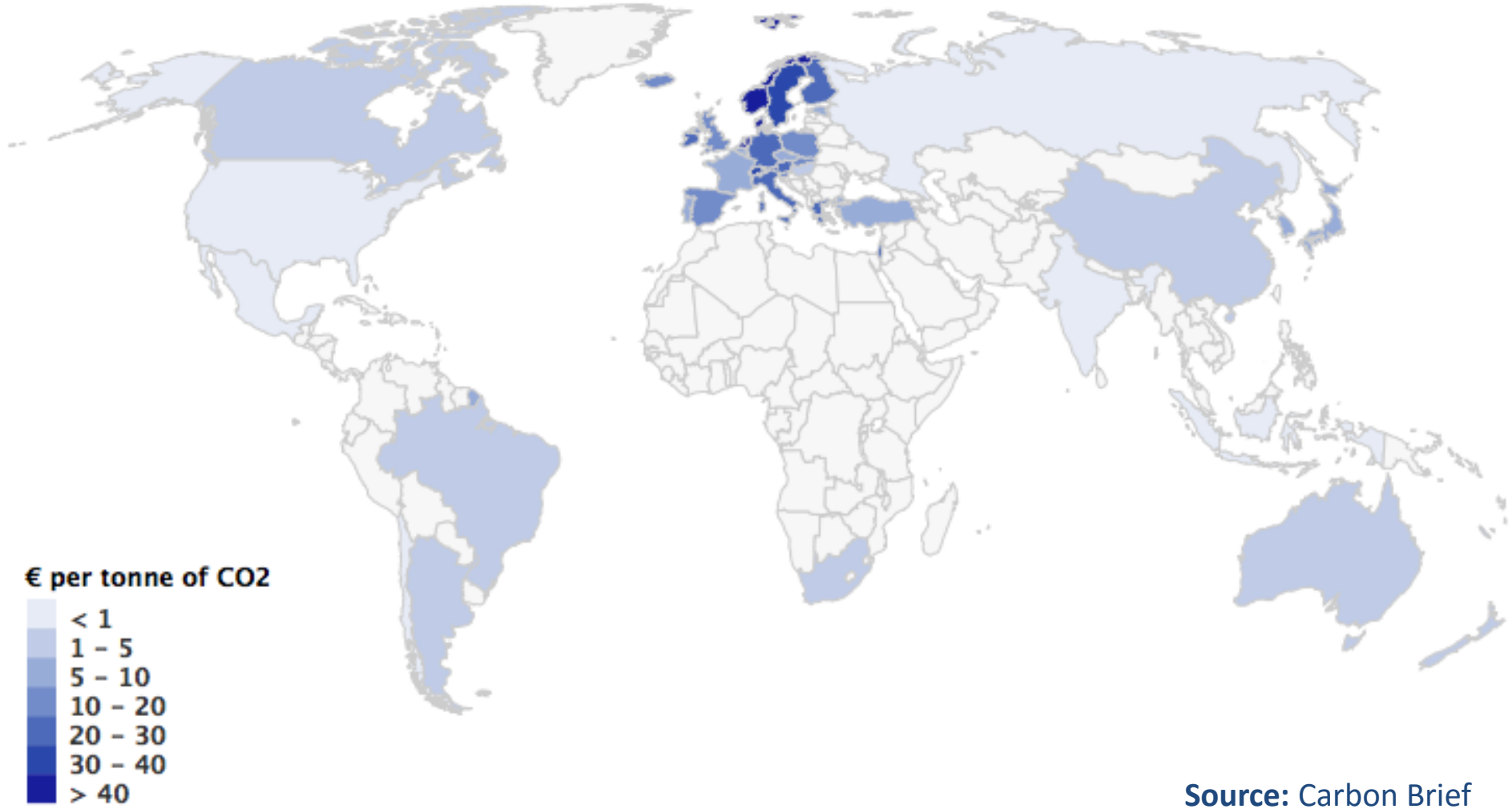


Correcting market failures: UK R,D&D spending



Source: IEA

Correcting market failures: Carbon pricing

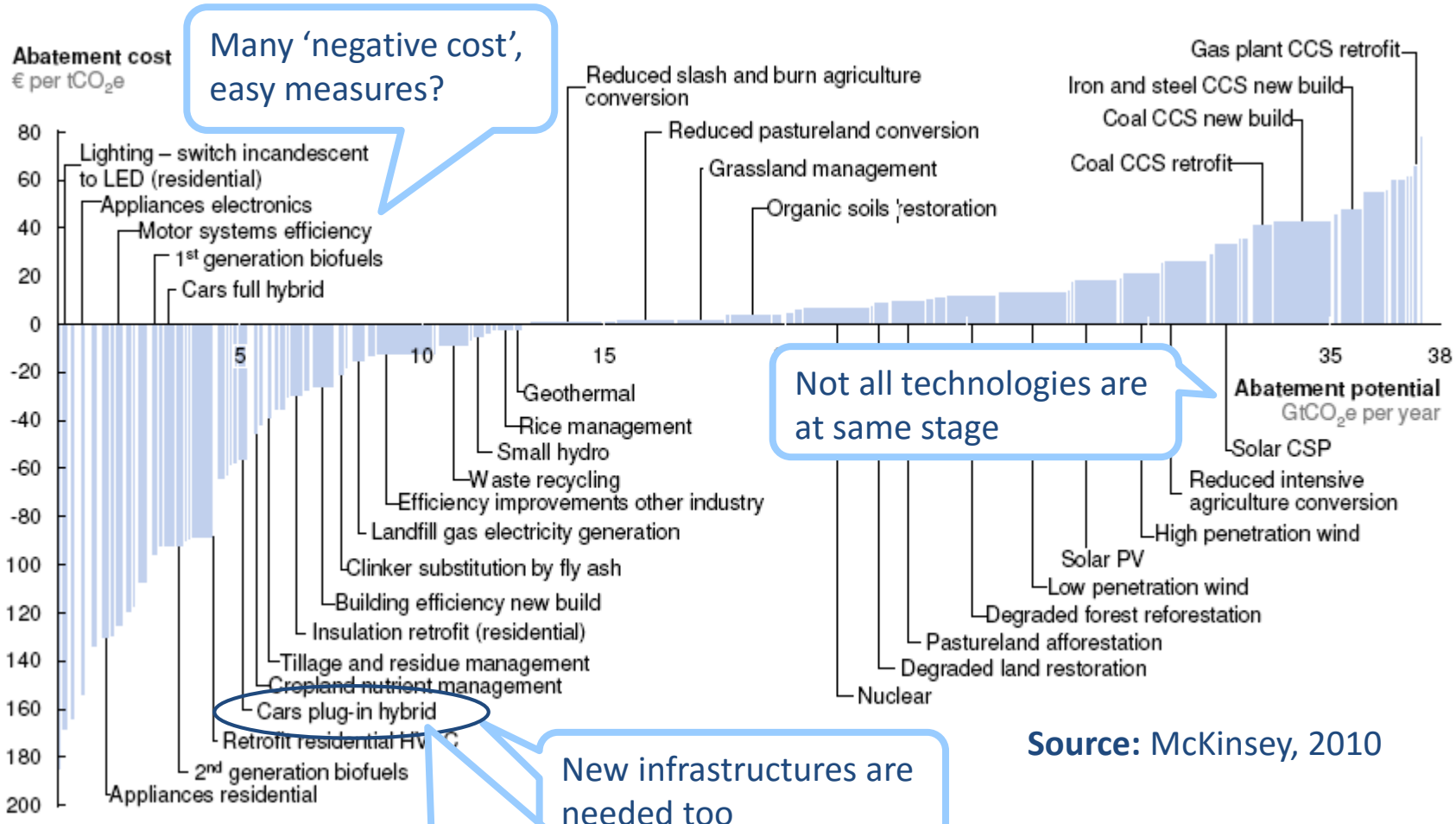


Source: Carbon Brief

Correcting market failures: Carbon pricing

Source: Sandbag

Further policy action may be required:
Multiple low carbon markets & technologies



Source: McKinsey, 2010

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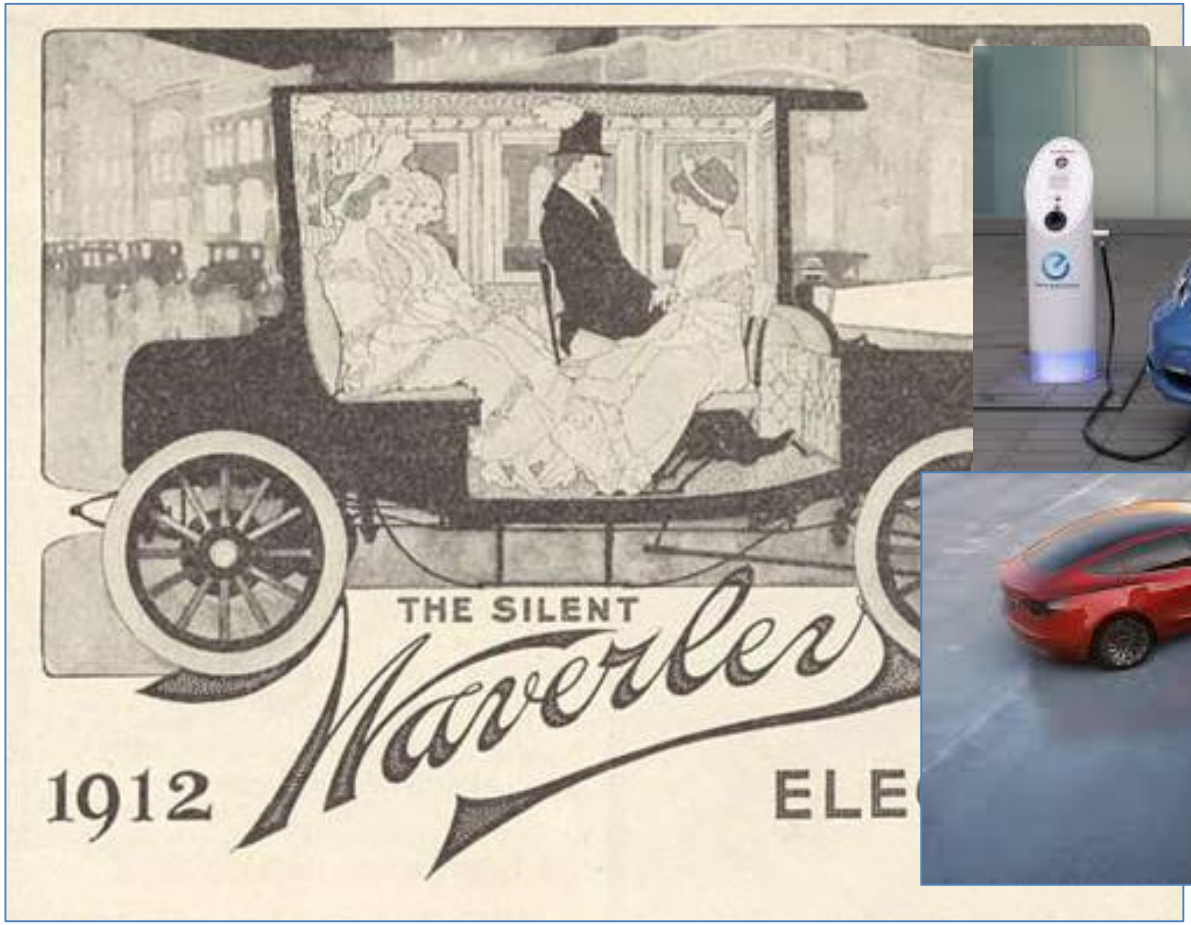
Electric Vehicles



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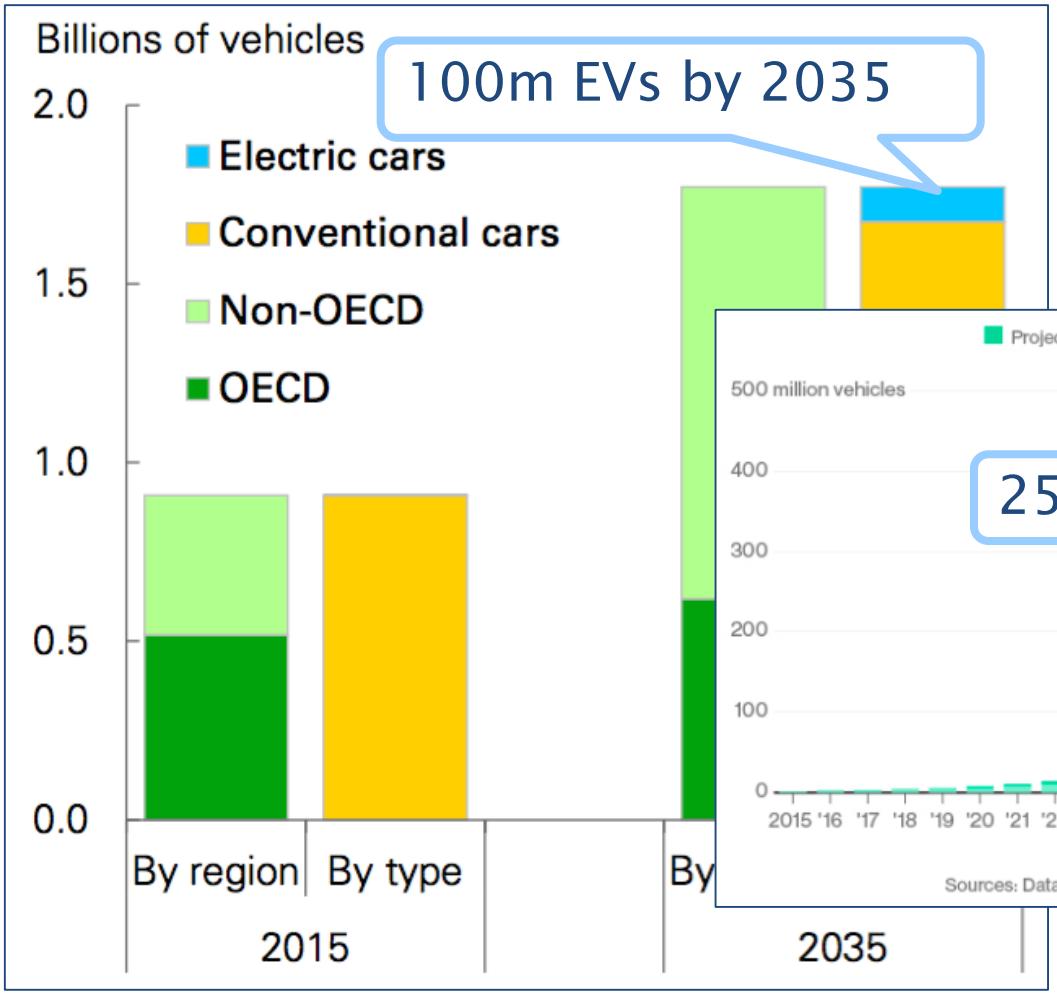
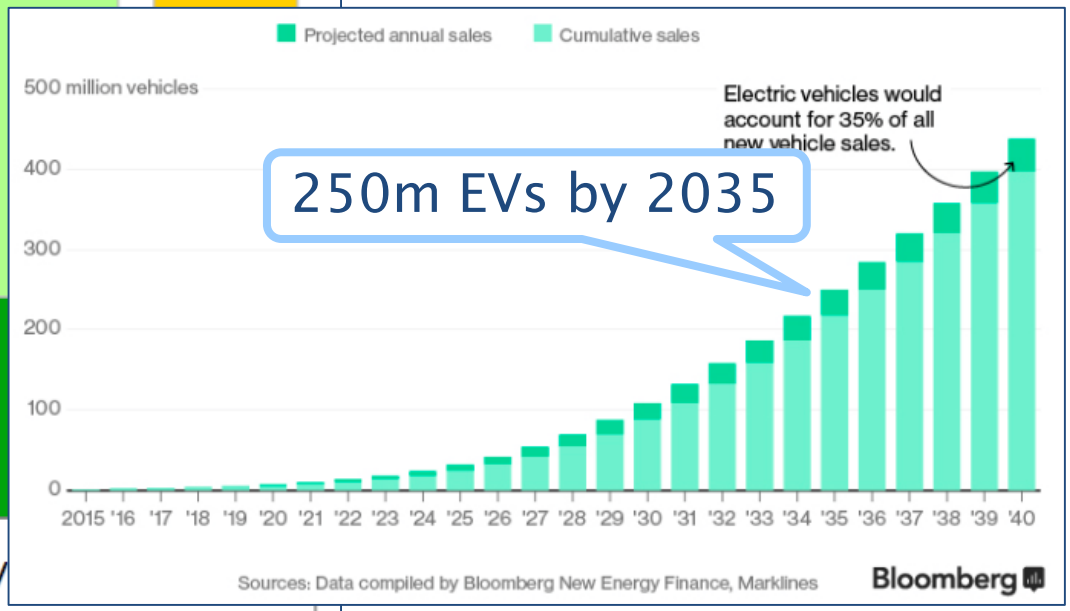
Electric Vehicles





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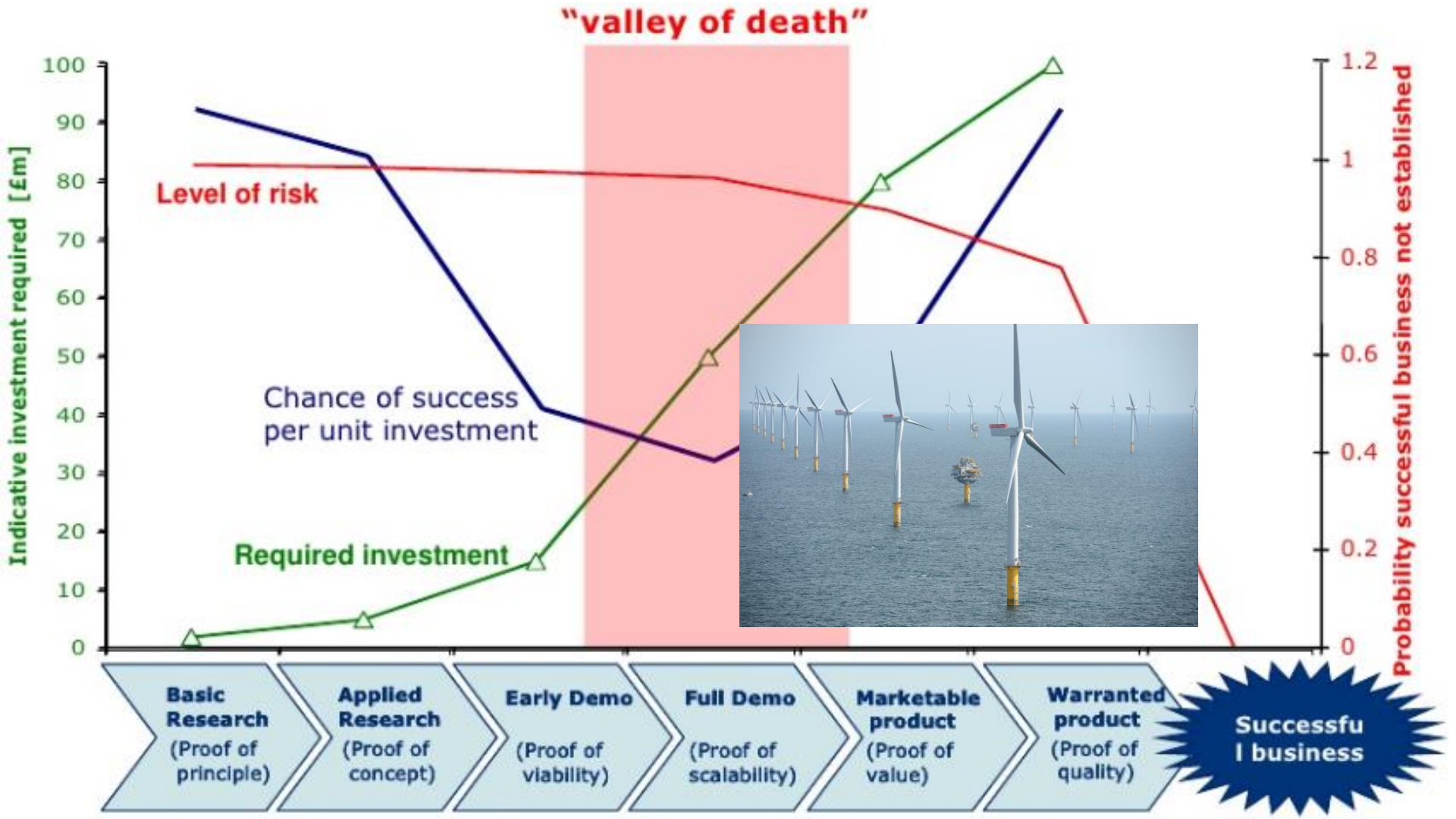
Source: BP / Bloomberg New Energy Finance

Further policy action may be required:
Bridging the 'valley of death'



Source: The Carbon Trust / Infrastructure Intelligence

Carbon capture and storage

Source: Global CCS Institute: 2016 Global Status Report

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Carbon capture and storage

Developing new technologies is an inherently risky undertaking. Taking calculated risks is perfectly acceptable if those risks are managed effectively; but in this case DECC, and its predecessor, took too long to get to grips with the significant technical, commercial and regulatory risks involved …

The Department must learn the lessons of the failure of this project if further time is not to be lost, and value for money achieved on future projects

Amyas Morse, Head of National Audit Office

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Further policy action may be required:
Countering 'carbon lock-in'

Large scale technology, such as electric light and power systems, incorporate not only technical and physical things such as generators, transformers and high-voltage transmission lines, but also utility companies, electrical manufacturers and reinforcing institutions such as regulatory agencies and laws …

Large technological systems represent powerful vested interests … [They] construct a bulwark of organisational structures, ideological commitments, and political power to protect themselves and the systems

Thomas Hughes (1989) *American Genesis*

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Further policy action may be required:
Countering 'carbon lock-in'

Industrial economies have become locked in to fossil fuel-based technological systems through path a dependent process driven by technological and institutional increasing returns to scale.

This condition, termed carbon lock-in, arises through a combination of systematic forces that perpetuate fossil fuel-based infrastructures in spite of their known environmental externalities and the apparent existence of cost-neutral or cost effective remedies

Greg Unruh (2000) *Understanding carbon lock-in*

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Energy systems innovation

Smart meter trials & roll out by 2020

ofgem

Low Carbon Networks Fund: £500m from consumers for innovation projects

energy technologies institute

Smart systems and heat demonstration programme

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Implications for policy

- Government policies have a significant impact on the level and direction of innovation
- Public R&D funding significant, but part of a wider policy approach by successful countries
- Government spending on innovation should be increased, but not just on fundamental R&D
- But energy technologies also developed and owned by firms, many of which are multinational
- Most countries prioritise support for innovation: based on resources, capabilities, political economy

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Implications for policy
Mission Innovation

- Mission Innovation a welcome boost to public R&D, linked to private Breakthrough Energy Coalition
- But risks a return to a linear innovation model
- Challenges ahead:
  - How will Mission Innovation and BEC work together?
  - Tensions between international collaboration and national search for competitive advantage
  - Wider questions abut momentum for clean energy innovation: will the rise of protectionism, Brexit, Trump Presidency etc have a negative impact?

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Thanks

http://www.ukerc.ac.uk
https://twitter.com/watsonjim2