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CCS – a vital technology to help achieve our goals

Asian Development Bank's Clean Energy Forum

8 June 2016

Why is CCS important?

80% 80% of the world's energy comes from fossil fuels

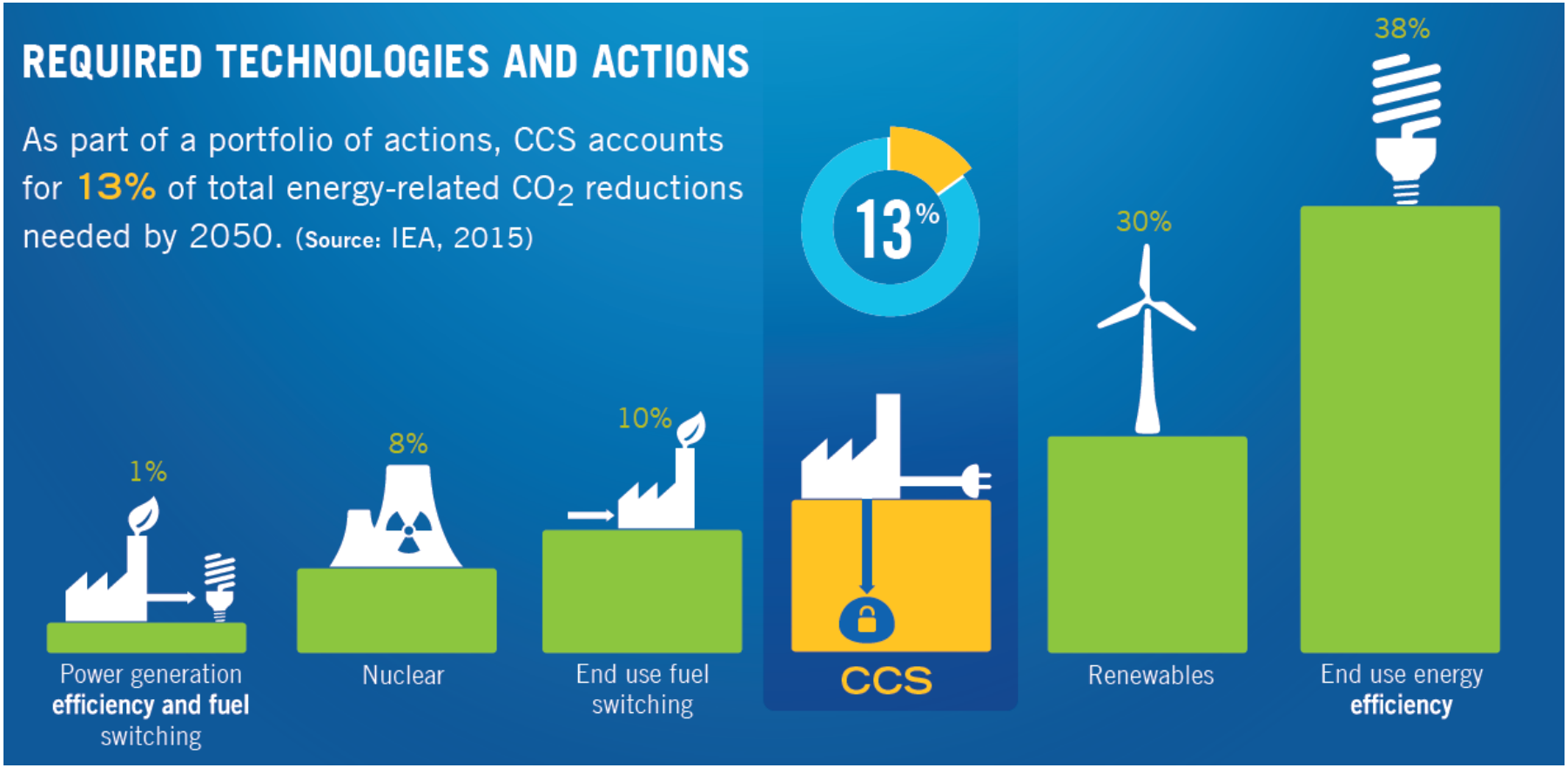
40% The power sector accounts for about 40% of global CO_2 emissions

25% 25% of global CO_2 emissions come from large-scale industrial processes

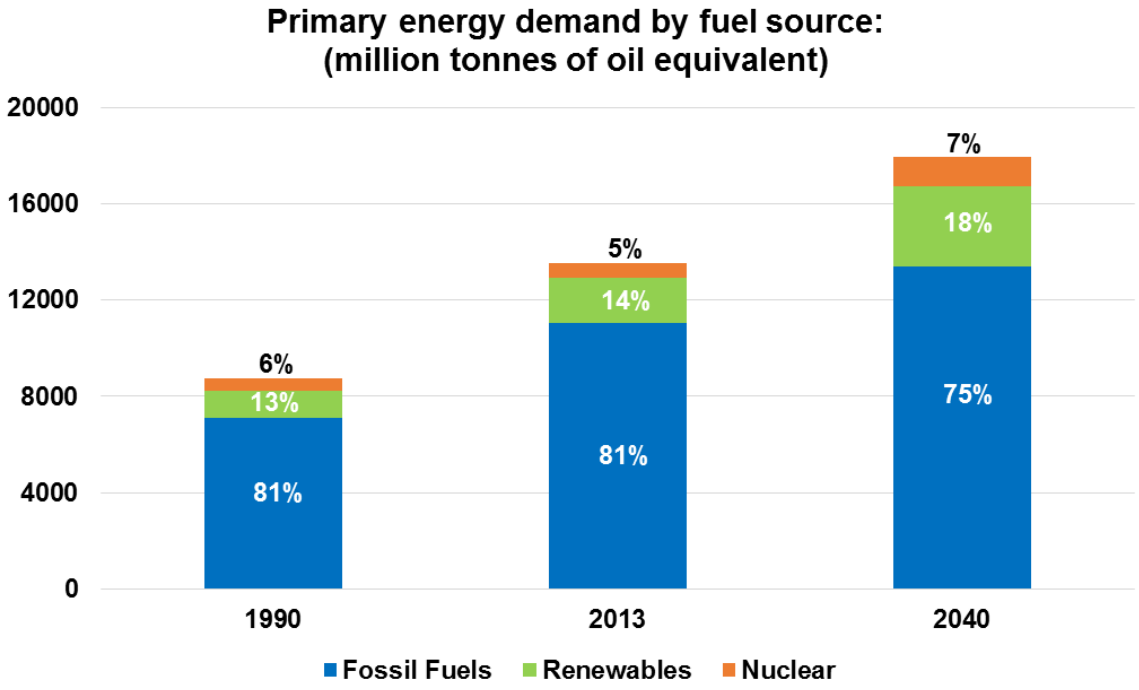
CCS is the only technology that can reduce emissions directly from fossil fuel facilities on a significant scale

With the announcement of the Paris Agreement – the importance of CCS just got bigger!

The contribution of CCS to reduce global emissions



Fossil fuel demand will increase



Source: *IEA World Energy Outlook,* 2015 (New policies scenario)

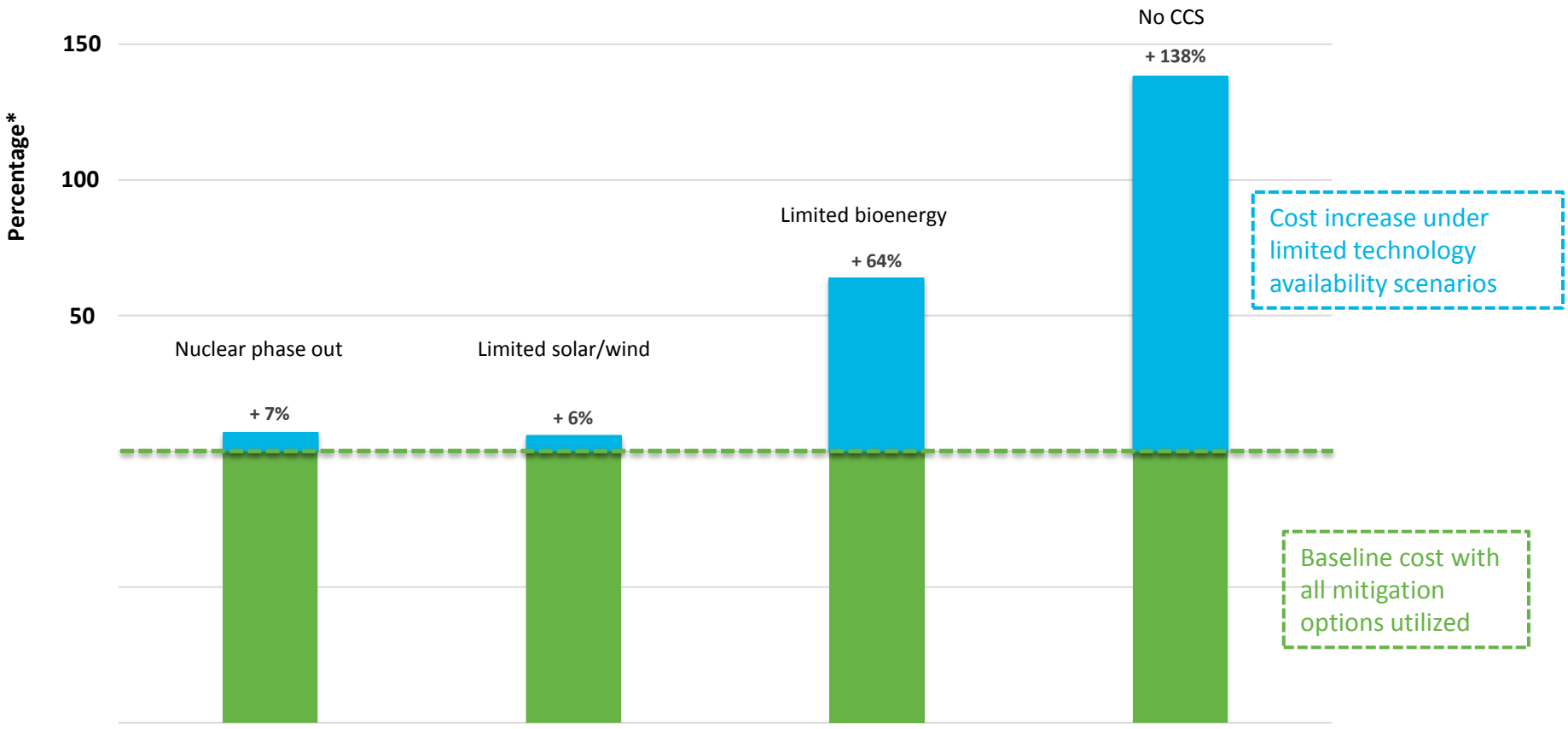
Fossil fuel proved reserves:

6 trillion barrels of oil equivalent

Reserves to production ratio: ~*75 years*

Source: *BP Statistical Review of World Energy* 2015

Mitigation costs more than double **in scenarios with** limited availability of CCS



*Percentage increase in total discounted mitigation costs (2015-2100) relative to default technology assumptions – median estimate

Source: *IPCC Fifth Assessment Synthesis Report, Summary for Policymakers, November 2014.*

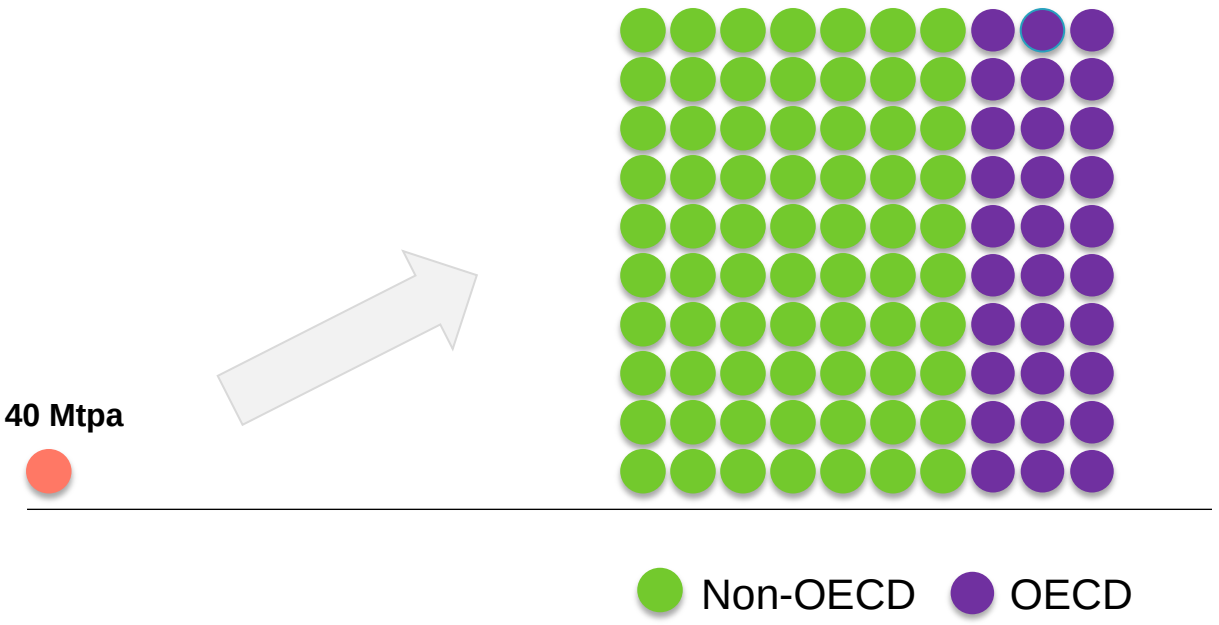
Huge scale-up required

Global Status of CCS

4,000 Mtpa of CO_2 captured by CCS by 2040
(IEA 450 Scenario)**

40 large-scale CCS projects - combined capture capacity of approximately 71 Mtpa*:

- 22 projects in operation or construction (**40 Mtpa**)
- 6 projects in advanced planning (6 Mtpa)
- 12 projects in earlier stages of planning (25 Mtpa)

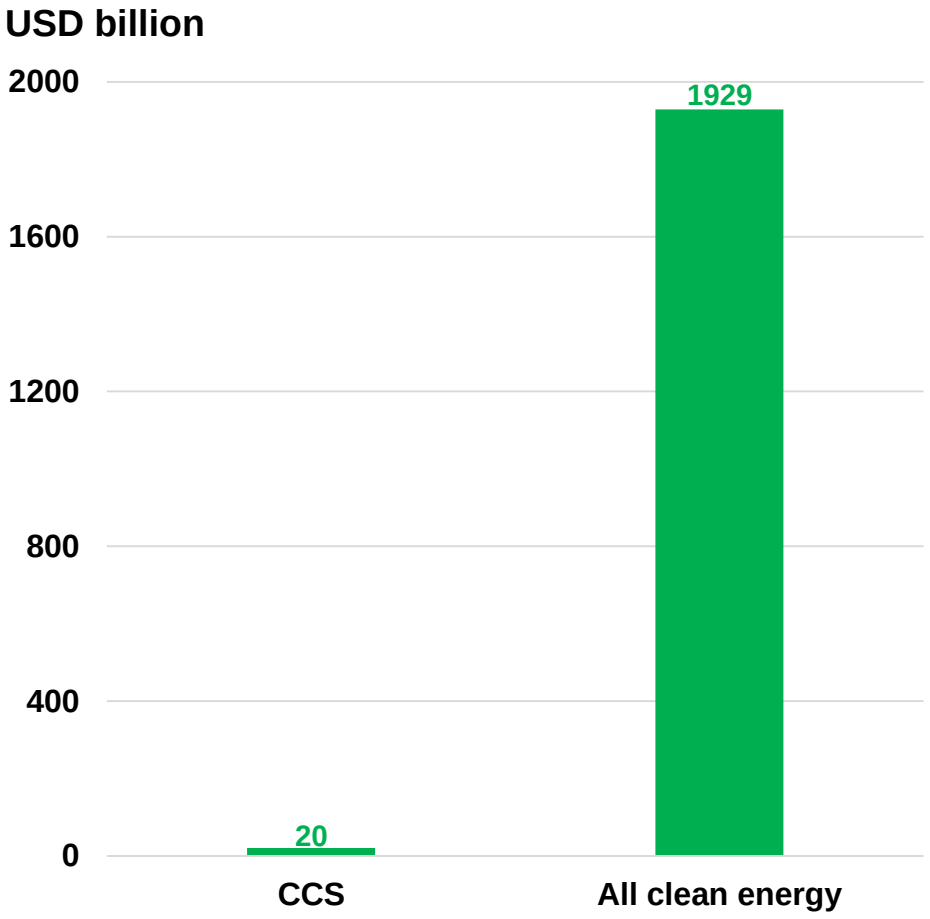


*Mtpa = million tonnes per annum

****Source**: *IEA, Energy Technology Perspectives (2015).*

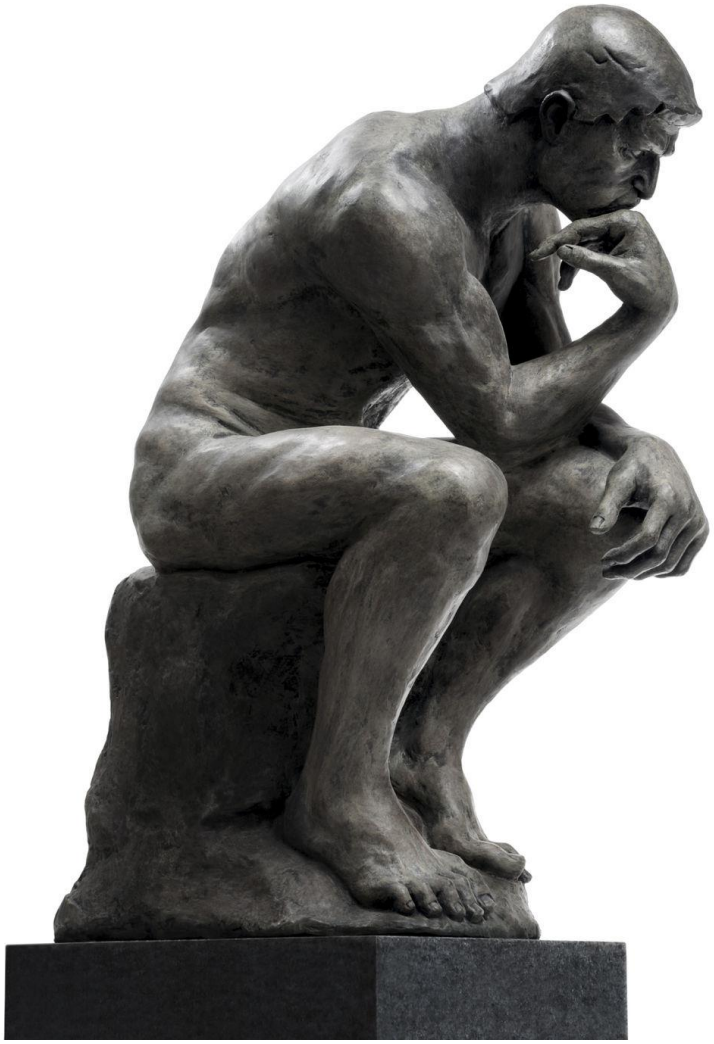
Strong policy drives investment

- Scale of renewables investment is instructive
- CCS has not enjoyed commensurate policy support
- EOR has provided impetus in North America
- Policy parity is essential
- How do we get CCS onto a similar curve?

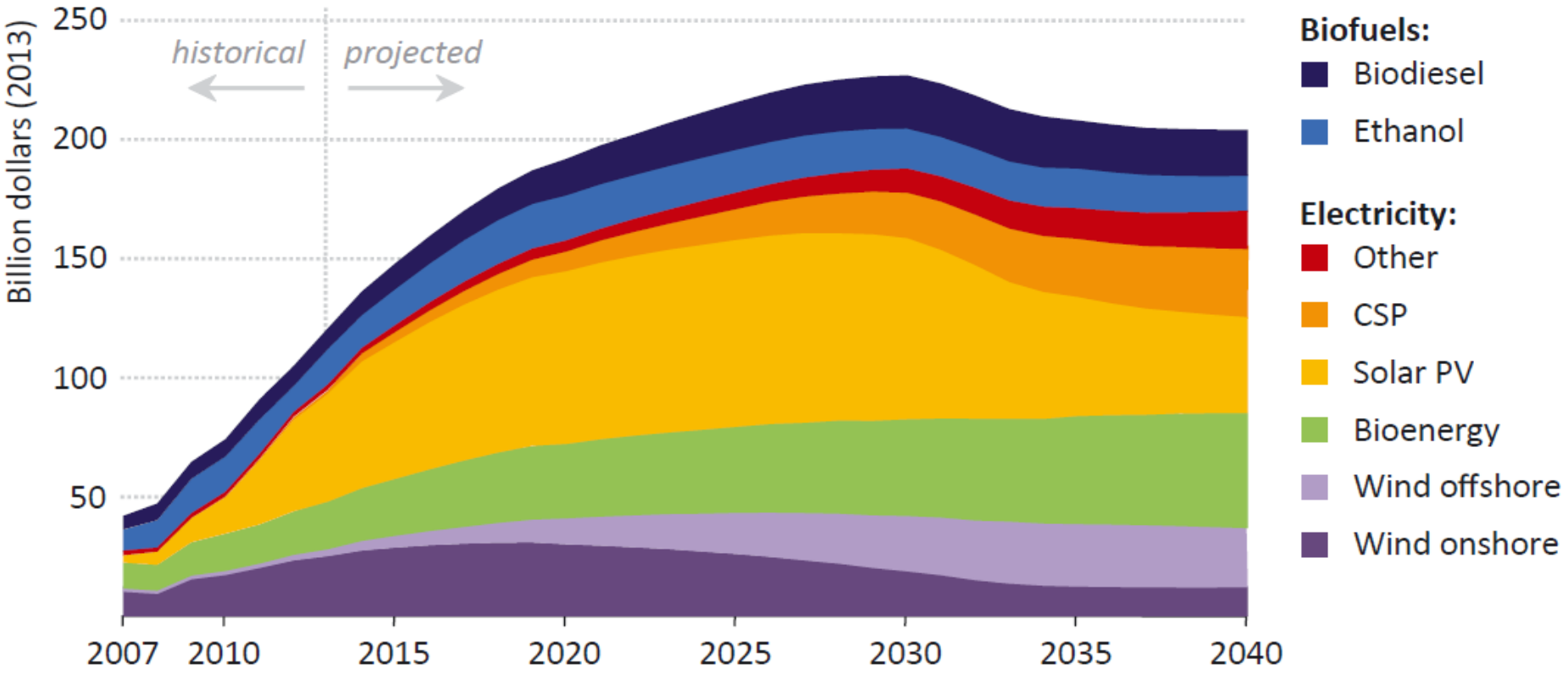


Data source: Bloomberg New Energy Finance as shown in IEA presentation "*Carbon Capture and Storage: Perspectives from the International Energy Agency",* presented at National CCS week in Australia, September 2014.

What does strong policy look like??

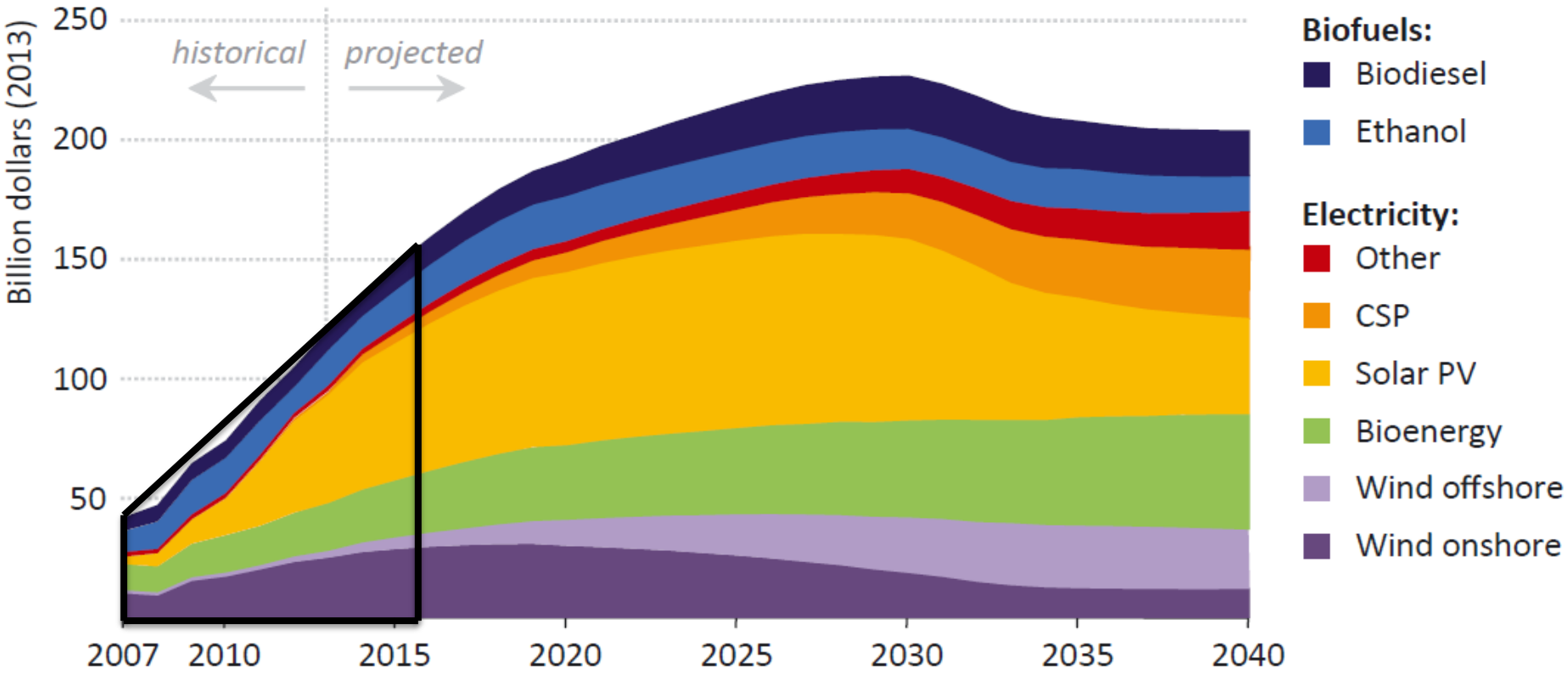


Renewables – a fantastic success story!



Data source:IEA, World Energy Outlook 2014

CCS needs stronger policy support



In the period 2007 to 2016, value of policy support for renewable energy deployment is around US$800B.

Total value of policy support for deployment of CCS over all time is around $20B

Data source:IEA, World Energy Outlook 2014, GCCSI Global Status of CCS 2013

Are there other benefits of CCS?

Benefits of Boundary Dam CCS project

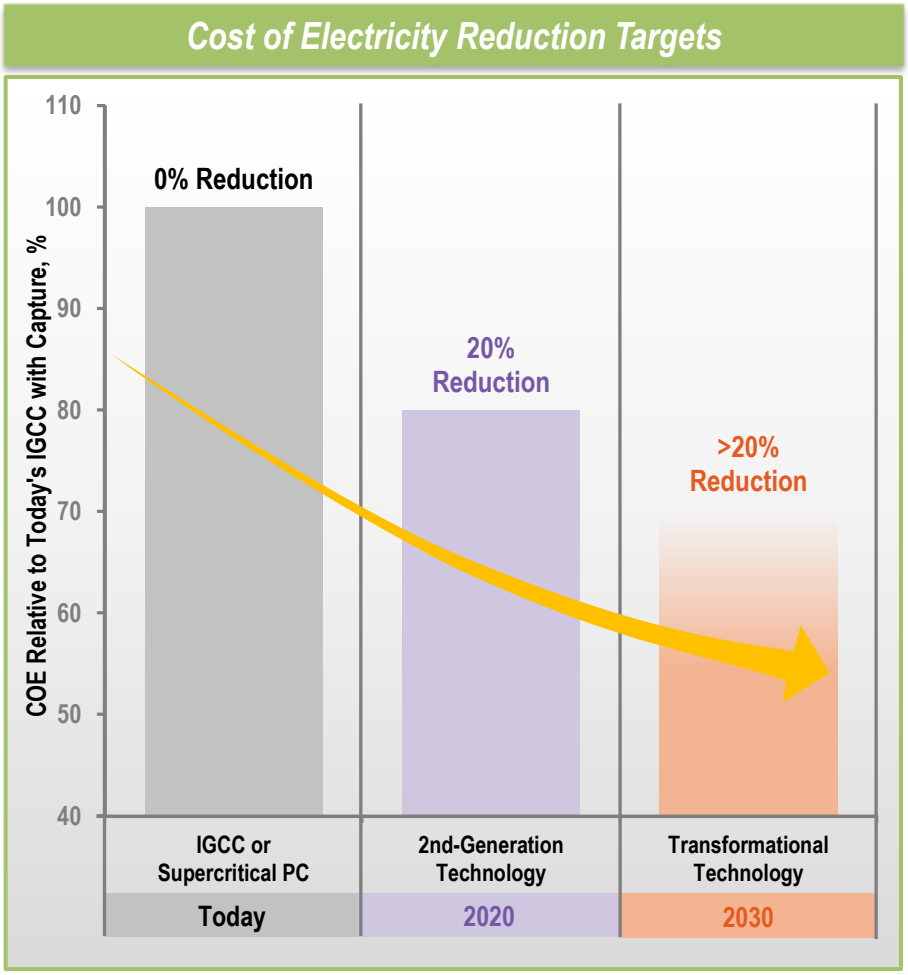
Economic benefits	Direct employment	1,500 workers on site for the project
Environmental benefits	CO_2 emissions	Reduction by ~1 million tonnes per annum (at full capture capacity)
	Sulphur dioxide	Reduced by 100%
	Nox emissions	Reduced by 27%
	Particulate emissions	Reduced by 70-90% (depending on particulate)

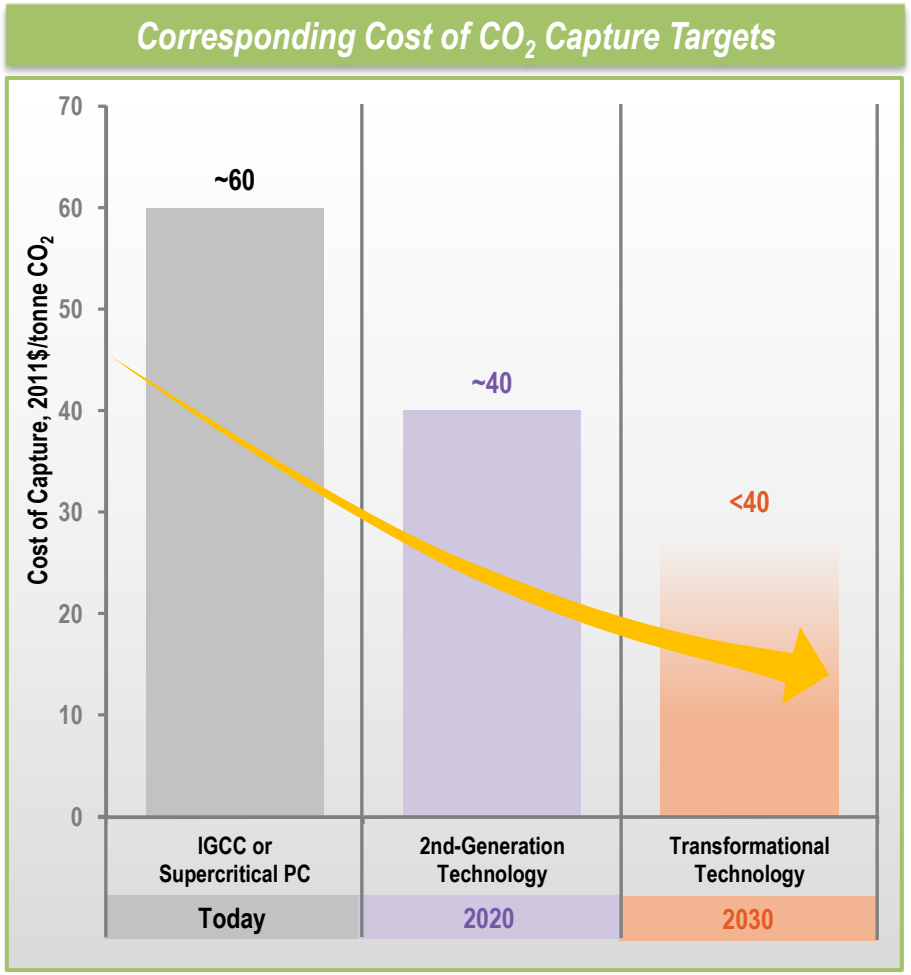
Plus…

- Negligible fuel cost risk (economic)
- All the grid services associated with dispatchable baseload power synchronous generation with inertia that become increasingly valuable as renewable penetration increases (energy security)

What are the expected cost reduction rates for CCS?

Relative US DOE cost reduction targets and timing for second generation and transformational carbon capture technologies





Source: *Fueling the Future: Safe, affordable, secure energy*, Plasynski (2015)

How does CCS contribute to affordable and clean energy for all?

CCS and affordable, clean energy

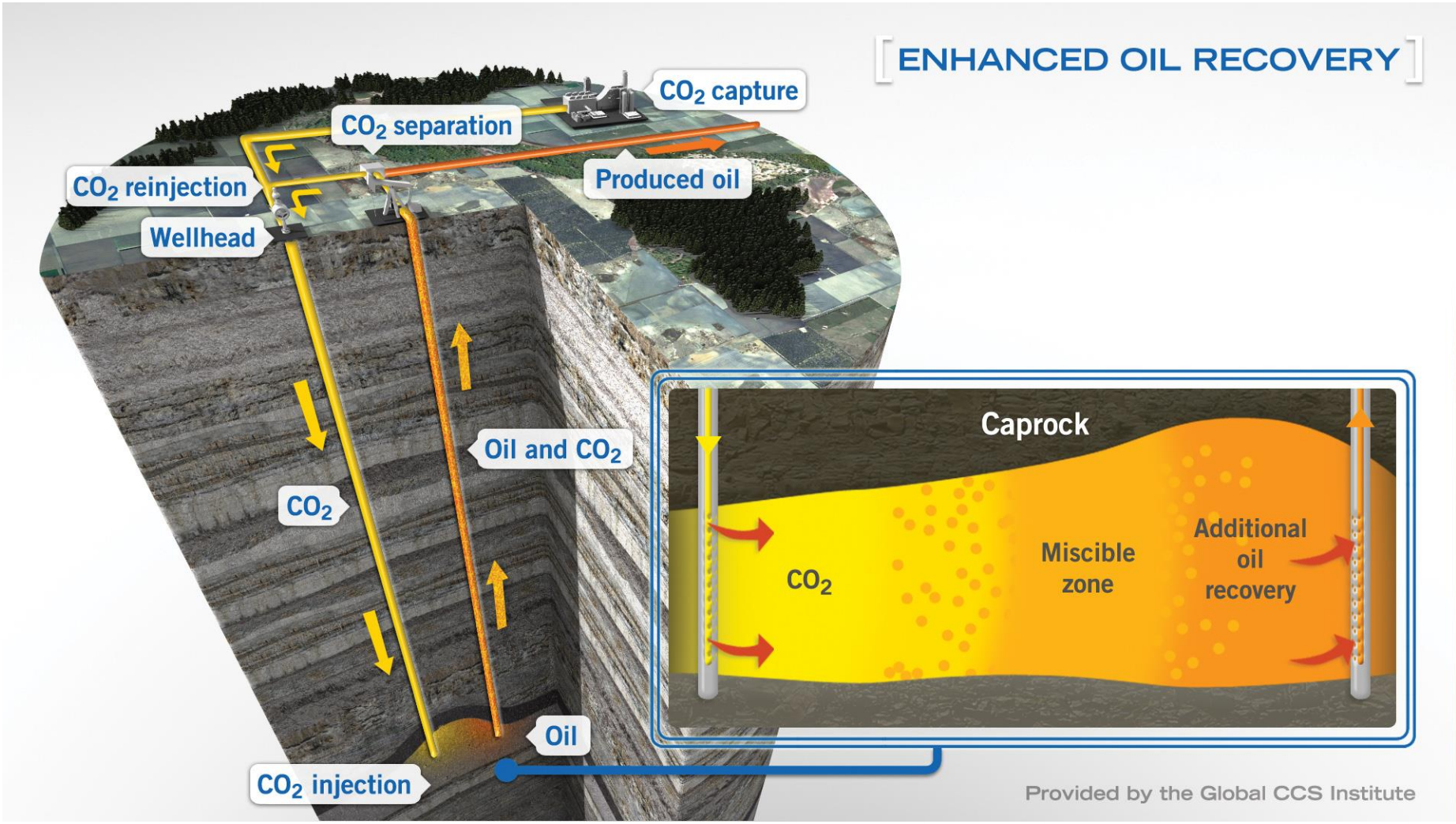
- Climate Tracker estimates 2,4000 new coal generational plants estimated to be built by 2030
  - Demonstrating a continued need for stable, continuous, controllable, large-scale energy supply

- CCS enables continued use of fossil fuel at the same time meeting low-emission targets

- CCS enables continued use of indigenous energy supply which facilitates energy security

CCS and enhanced oil recovery

Enhanced oil recovery (EOR)



Thank you for your attention

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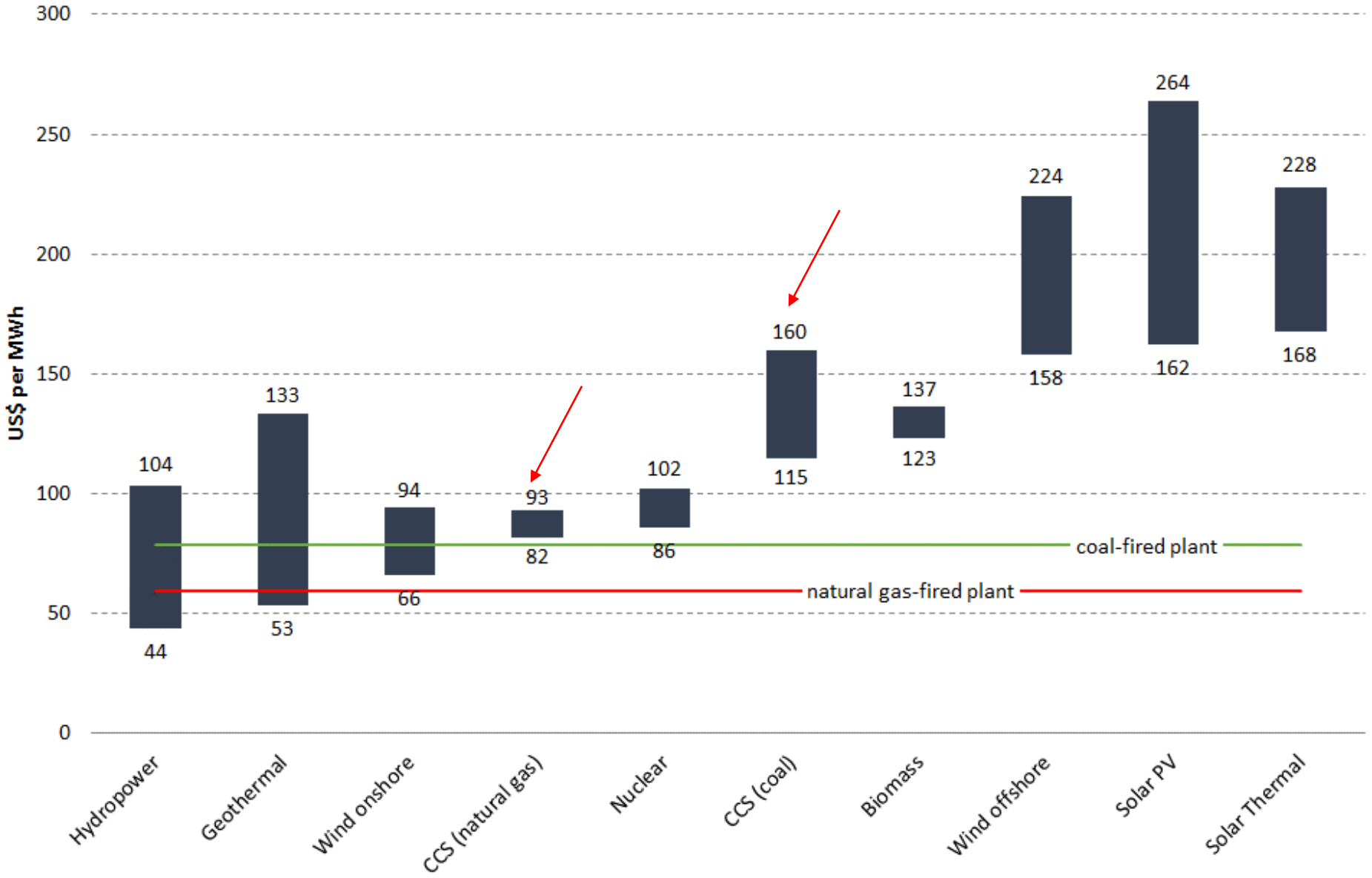
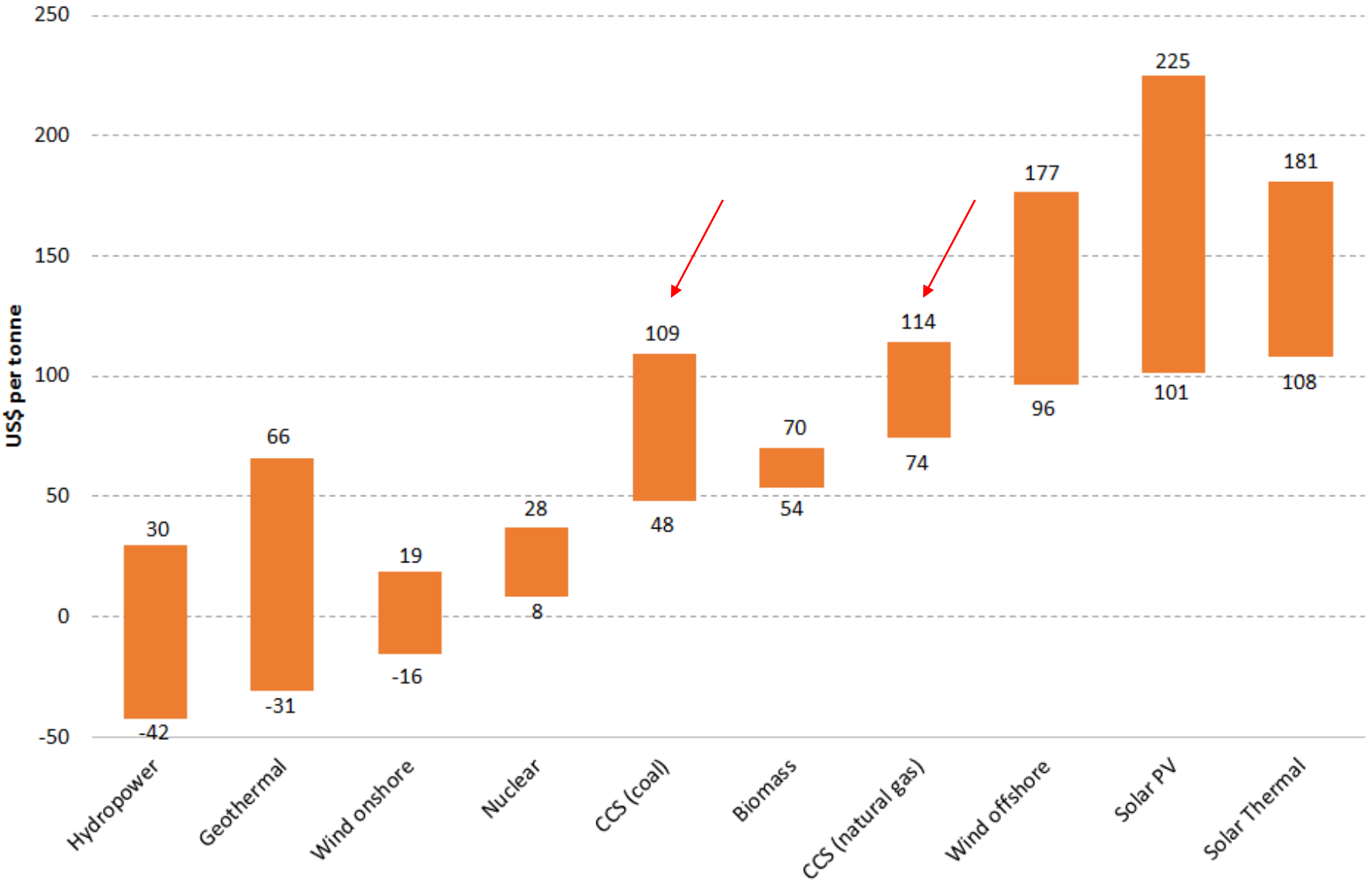
Appendix Slides

Power generation levelised costs



Power generational – costs of CO2 avoided



Energy Penalty Considerations

1. R&D aimed at reducing energy penalty

2. Renewables could potentially be used to generate some additional power requirements

3. New build – can scale up to offset parasitic load
   - Not a significant cost driver