Incentivizing CCS on the path to net zero emissions

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Key messages

• It is not too late to achieve the goals of the Paris Climate Agreement.
• But doing so typically requires CCS of around 10% of fossil fuel consumption by the 2030s, rising to 100% between 2050 and 2100.
• Carbon pricing is very unlikely to achieve this, even if implemented globally.
• A sequestration obligation on fossil fuel importers and extractors provides a promising alternative.
Can we limit warming to 1.5°C?
It likely requires net negative emissions before 2100, possibly as early as 2050

Figure courtesy of Richard Millar – adaptive variant of RCP2.6
From Millar et al, 2017a
Conventional mitigation scenarios driven by a global carbon price

Figure courtesy of Euan Graham based on IPCC WG3 scenarios
Carbon prices in conventional mitigation scenarios

Note log scale!
Carbon prices in conventional mitigation scenarios normalized by GDP per capita
Why do we see carbon prices exceeding the cost of free-air-capture and sequestration?

• Ambitious mitigation scenarios in Integrated Assessment Models are typically limited by allowed technology deployment rates.

• CCS in particular is deployed initially very gradually, and only when carbon prices reach levels making it economically attractive at the margin.

• This increases the risks associated with precipitate deployment mid-century.
Emissions and mitigation costs in “well-below 2°C” scenarios

Total emissions in scenarios in IPCC WGIII “430-480ppm” (lowest) scenario category

Colours show total policy cost in US$\text{$_{2005}$}

Figures courtesy of Richard Millar based on IIASA database
Another way of looking “well below 2°C” scenarios

Net fraction of extracted carbon that is re-injected through CCS, BECCS or DAC

Figures courtesy of Richard Millar based on IIASA database
How can we avoid delayed deployment of CCS? A path to net zero and beyond

A scenario for progressive deployment of CO$_2$ disposal

1% by mid-2020s
15% by mid-2030s
100% before temperatures reach 2°C

Figures courtesy of Richard Millar based on IIASA database
The incredible economics of mandatory sequestration

• Suppose CO$_2$ disposal initially costs $50/tCO$_2$ *sequestered* (exploit EOR opportunities, pure CO$_2$ sources), rising to $250/tCO$_2$ at net zero (combined CCS, BECCS & DAC).

• Cost per tCO$_2$ fossil carbon *sold*: $S(50+200S)$ where $S$ is sequestered fraction.

• This is equivalent to a carbon price of:
  - $0.52/ tCO$_2$ at $S=1\%$ (mid-2020s)
  - $12.00/ tCO$_2$ at $S=15\%$ (mid-2030s)
  - $250/ tCO$_2$ at $S=100\%$ (before 2100)
Mandatory sequestration works

Gorgon gas project, Western Australia
So the choice is very simple

• How do we get to 15% sequestration in the 2030s?
  – Definitely not through carbon pricing.
  – The only feasible option is a certificate system, making sequestration a licensing requirement of fossil fuel extraction and import (c.f. WBCSD proposal).

• If we get to 15% by the time warming reaches 1.2°C, the industry will be able to reach 100% well below 2°C.

• So either we introduce mandatory sequestration now, or we won’t meet the goals of the Paris Climate Agreement.
We were so close…

• “Within one year of this Act coming into force, the Secretary of State shall undertake a consultation on the measures requiring extractors and importers of petroleum to contribute to the development of carbon capture and storage.” (Amendment 35b of the Energy Bill, tabled by Lord Oxburgh, September, 2015)

• http://www.publications.parliament.uk/pa/ld201516/ldhansrd/text/150909-0001.htm#15090934000396
Why are fossil fuel companies supporting a global carbon price?

• The “Carbon-Bail-Out” scenario:
  – Modest carbon prices fail to incentivize CCS & CDR and also fail to stop climate change.
  – Rapid increase in carbon prices to pay for CDR or geo-engineering is equivalent to state seizure of fossil fuel rents.

• A safer and more independent future:
  – Demonstrate scale-relevant CO$_2$-disposal without state support (e.g. 1% of fossil fuel extraction by 2025, 15% by 2035).
  – Prepare to increase sequestered fraction as climate impacts emerge and climate goals evolve.