Senate Resources Committee

Nicholas Fulford
Senior Director, GaffneyCline

April 24th, 2024

Gaffney Cline

CCUS Customer Universe

Most Carbon Capture and Storage (CCS) projects being developed are targeting these types of emissions

Industrial processes and refining infrastructure cannot typically support CCS owing to insufficient incentives

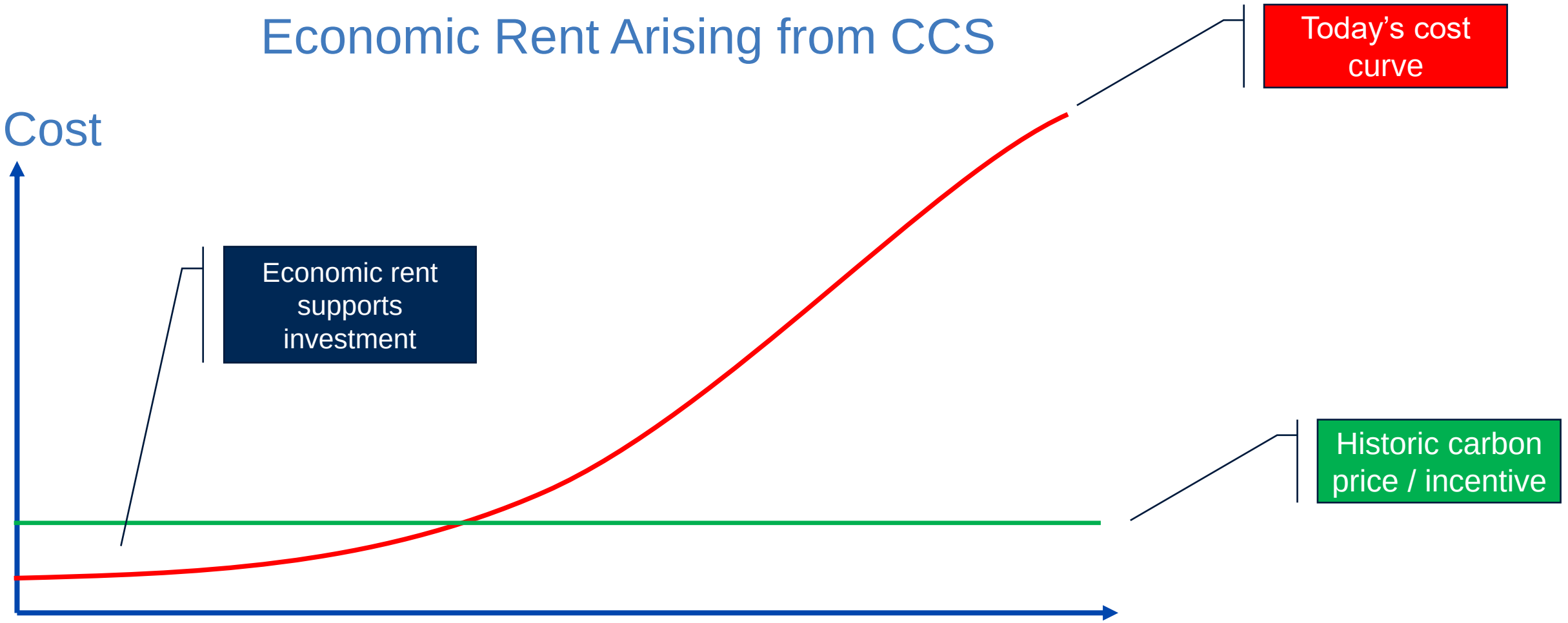
Direct Air Capture (DAC) and other carbon removal technologies benefit from higher incentives but have significantly higher costs

	High Pressure	High Purity	Dilute	Very Dilute	Extremely Dilute
CO_2 Concentration	Variable	40-100%	10-25%	3-8%	0.04-1%
Sources	Gas processing Synthesis gas	Ethanol Ammonia Ethylene Oxide Hydrogen	Coal Cement Crackers Steel & Iron	Gas Turbines Furnaces	Confined Spaces Air

This is also where the vast majority of global emissions arise

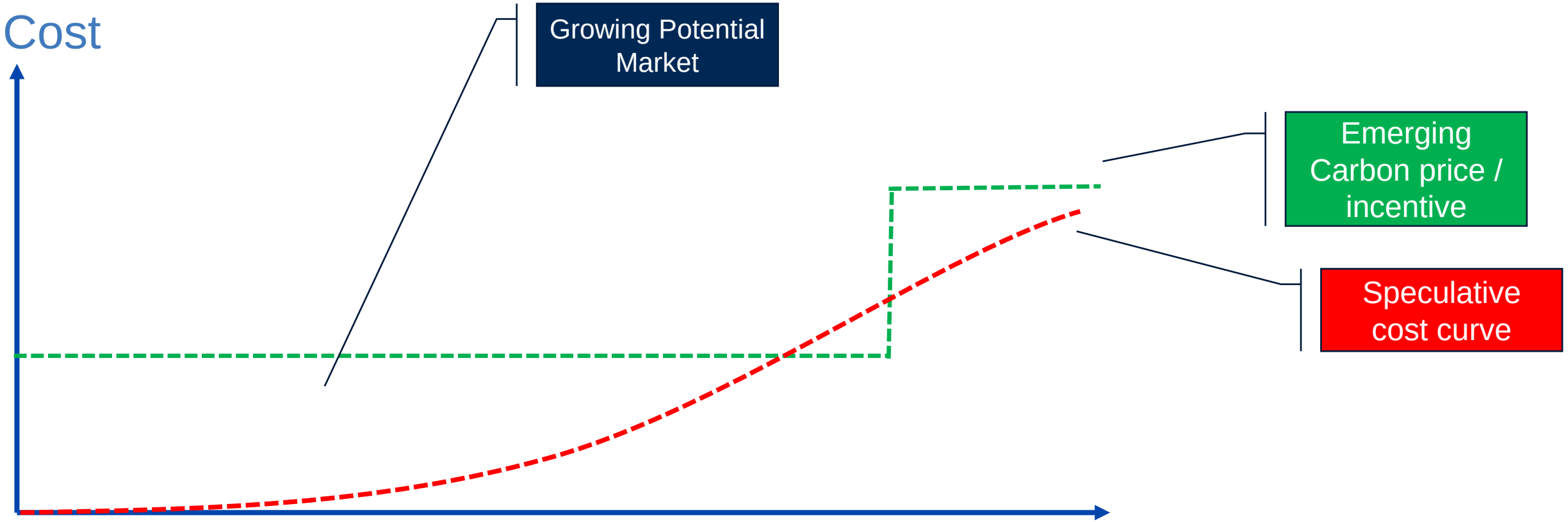
Categorization adapted from Howard Herzog, MIT Energy Initiative
CCUS = Carbon Capture, Utilisation, and Storage

Economic Rent Arising from CCS



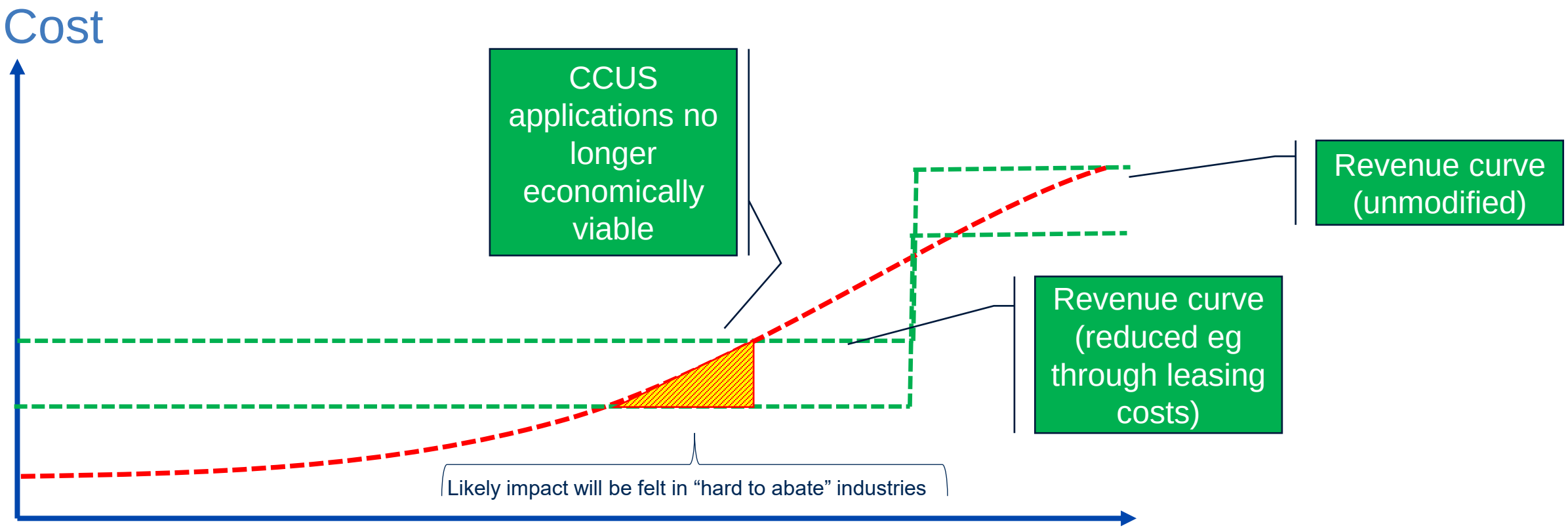
High Pressure	High Purity	Dilute	Very Dilute	Extremely Dilute
Variable	40-100%	10-25%	3-8%	0.04-1%

Economic Rent Arising from CCS



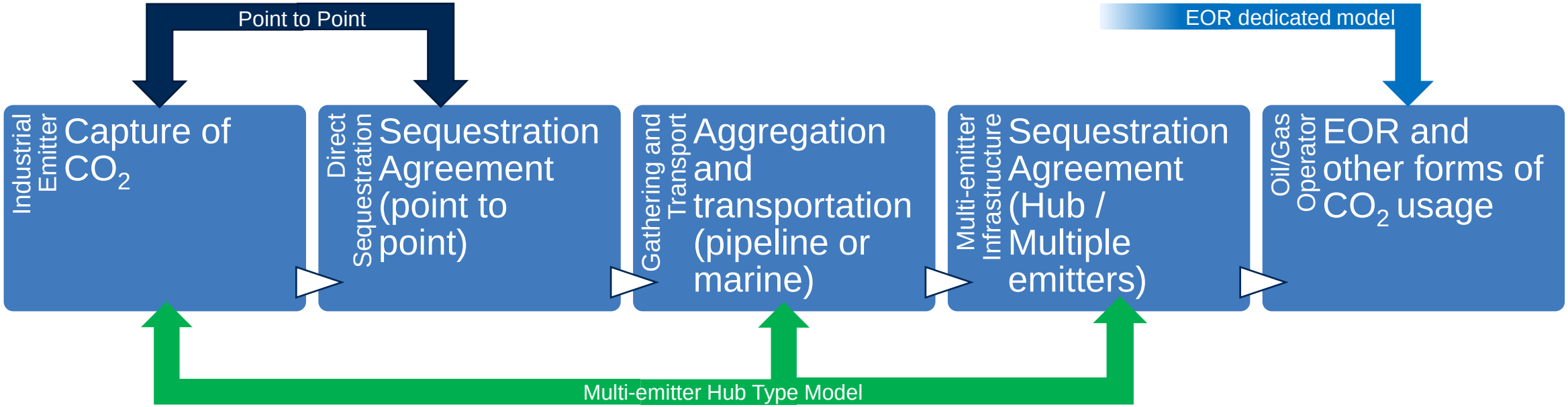
High Pressure	High Purity	Dilute	Very Dilute	Extremely Dilute
Variable	40-100%	10-25%	3-8%	0.04-1%

Higher costs will impact marginal CCS projects the most



High Pressure	High Purity	Dilute	Very Dilute	Extremely Dilute
Variable	40-100%	10-25%	3-8%	0.04-1%

Business Model Overview - Summary



- Structural risk arising from lack of economic support for capture
- Emitters unlikely to give a contractual commitment for CO2 supply
- Significant liability issues surrounding impact of capture on emitting plant operations

- Limited quantities available, and lack of economies of scale
- Economics are challenging in many situations
- Contractual volume commitments may be low, given variability of CO2 stream

- Provided contractual arrangements for CO2 inputs and outputs are clear, risks are similar to gas pipeline model
- Higher technical risks arising from long term CO2 transportation / corrosion
- Long term investment requires long term CO2 throughput commitments from gathering zone

- Very new / emerging technology
- Regulatory and technical uncertainty exist
- Long term liabilities are a major consideration
- Agencies are slow to provide required permits
- Significant cost differences exist between storage mediums

- EOR business well proven.
- Class II well permit applications are awarded in a timely manner
- Limited sequestration potential compared to permanent measures.
- 45Q incentives may have downside risk

EOR = Enhanced Oil Recovery

Tariffs depend on both project and contractual features

- Injection wells
- Monitoring wells
- Measurement, Monitoring and Verification
- CO2 pipeline costs
- Compression (potentially to super-critical pressures) and fuel
- Abandonment capex
- ***Pore space leasing and upfront fees***

Levelised Cost of Storage

- Sequestration service agreement terms
  - Volume flexibility
  - Contract duration
  - Uptime and reliability factors
  - Expansion rights
  - Warranties and indemnities
  - Liquidated damages
- EPC contract terms
  - Cost guarantees
  - Performance guarantees
- Regulatory and finance
  - Regulatory risk
  - Carbon price risk
  - Cost of debt

Arms length commercial tariff

Typical Gulf Coast onshore aquifer LCOS:
Circa $10-12 per tonne of CO2

Typical Gulf Coast onshore aquifer commercial tariff:
Circa $20 – 25 per tonne of CO2

EPC = Engineering, Procurement & Construction

Gaffney Cline

Nicholas Fulford,
Senior Director Gas & Energy Transition
nick.fulford@gaffneycline.com