Getting Started with Industrial CCS

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Structure of Presentation

- Why Industrial CCS?
  - Comparison with Power Generation Sector
  - Unique features of Industrial CO_2 emissions
- Where should CO_2 capture be applied in industry?
  - Industry sectors with greatest potential for CO_2 capture
- How can we make this happen?
  - Enablers and barriers to implementation of CO_2 capture
  - Potential actions to facilitate industrial CCS
- What opportunities are there for synergies to be exploited to facilitate industrial CO_2 capture?
  - Industrial symbiosis
  - Integration of CCS & CCU clusters

Power Generation versus Industry

- To date, primary focus of CCS development has been CO_2 capture from power generation sector
  - Large point sources of CO_2 emissions
  - Decarbonisation targets for sector
  - Programme to develop up to two demonstration scale CCS projects with DECC CAPEX support – FEED studies progressing
  - Contract for Difference Feed in Tariff available to offset OPEX
- BUT – Power generators have other options
  - Switch from fossil fuels to biomass
  - Nuclear, renewables, energy storage, demand site response
  - Does the power generation sector need/want CCS?
- How does industry differ?

CO_2 Emissions from Industry

- Industrial CO_2 emissions from two distinct sources:

- Combustion of fossil fuels
- Chemical conversion intrinsic to the process

- The ‘process’ emissions cannot be avoided through fuel switching or energy efficiency

- Challenge is to maintain industrial output while meeting decarbonisation obligations and targets
  - In the face of international competition

Industrial Decarbonisation

- PB and partners DNV-GL retained by DECC/BIS to develop 2050 industrial decarbonisation roadmap
- 8 industrial sectors considered
  - Represent bulk of UK industrial CO_2 emissions
- Developed series of decarbonisation Pathways for each sector by implementing range of technology options
- CO_2 capture (CCS and/or CCU) fundamental in achieving deep emissions reduction in four sectors
  - Iron & steel, refining, chemicals, cement
- Potentially important technology option in two further sectors
  - Glass, ceramics

Industrial CCS – Enablers

- Study considered Technical and Social & Business issues related to implementation of decarbonisation technologies
- Key Enablers for Industrial CO_2 capture:
  - Technically feasible and demonstrated in power generation sector
  - Government policies being developed to support growth of technology
  - Make CO_2 transportation network available to tie in to
  - R&D and technology already available: leverage from power sector
  - Grant funding, and alternative financing with low interest rates
  - Once established, networks could allow plants to “plug in” when ready
  - Existing industry clusters provide starting point for shared infrastructure
  - Deployment to NH_3 and H_2 subsectors could provide first steps
  - Smaller scale emitters offer potential for CCU

Industrial CCS – Barriers

- Key Barriers for Industrial CO_2 capture:
  - Many plants not located within likely CCS clusters
  - Large capital investment required
  - Unstable market conditions disincentivise major investments
  - Significant increases in energy consumption required
  - Need external support to develop industry-specific capture technologies
  - Availability of transport and storage infrastructure
  - Availability of funding for capital investment in CCS
  - Demonstration of commercial scale within industry sectors
  - Business value of implementing CCS when currently this merely adds cost and reduces efficiency
  - Risk of carbon leakage due to increased capital and operating cost

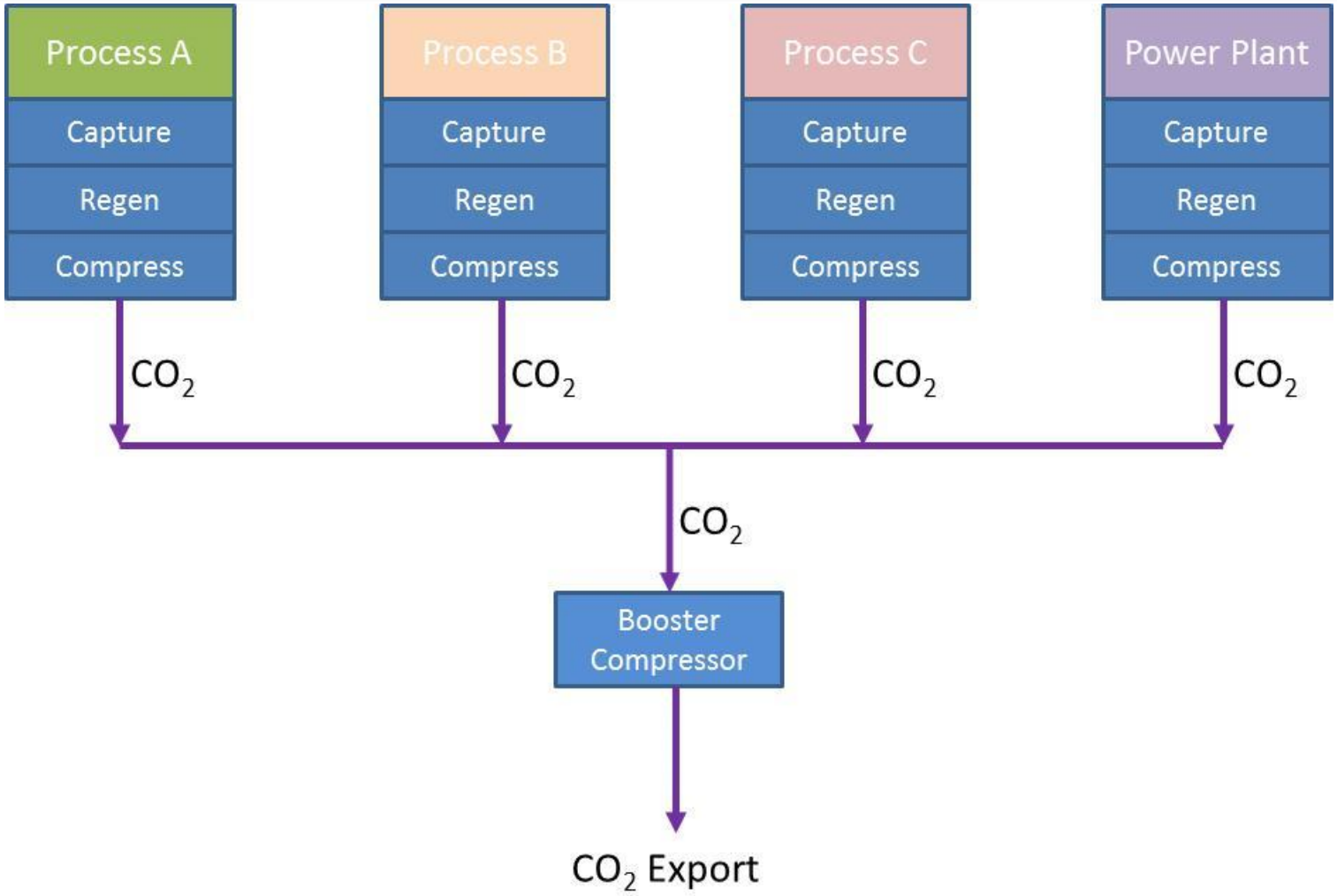
Industrial CCS – Potential Actions

- Study identified potential actions to facilitate development of industrial CO_2 capture, including:
  - Specific RD&D funding for CO_2 capture for high temperature industries will accelerate implementation; stakeholders would value equivalent emphasis & support as is being put into CCS in power sector
  - Funding sources for industrial CCS demonstration might include EU's NER400 mechanism, but requires UK Government commitment to support projects bidding for funds from this source
  - Since application of CCS increases costs, mechanisms to incentivise / compensate industry essential to facilitate CCS implementation and avoid UK industry being at commercial disadvantage to overseas competitors, otherwise effect could be carbon leakage
  - Develop a "Roadmap" for CO_2 transportation infrastructure to provide industry with knowledge of viable geographic range of CCS

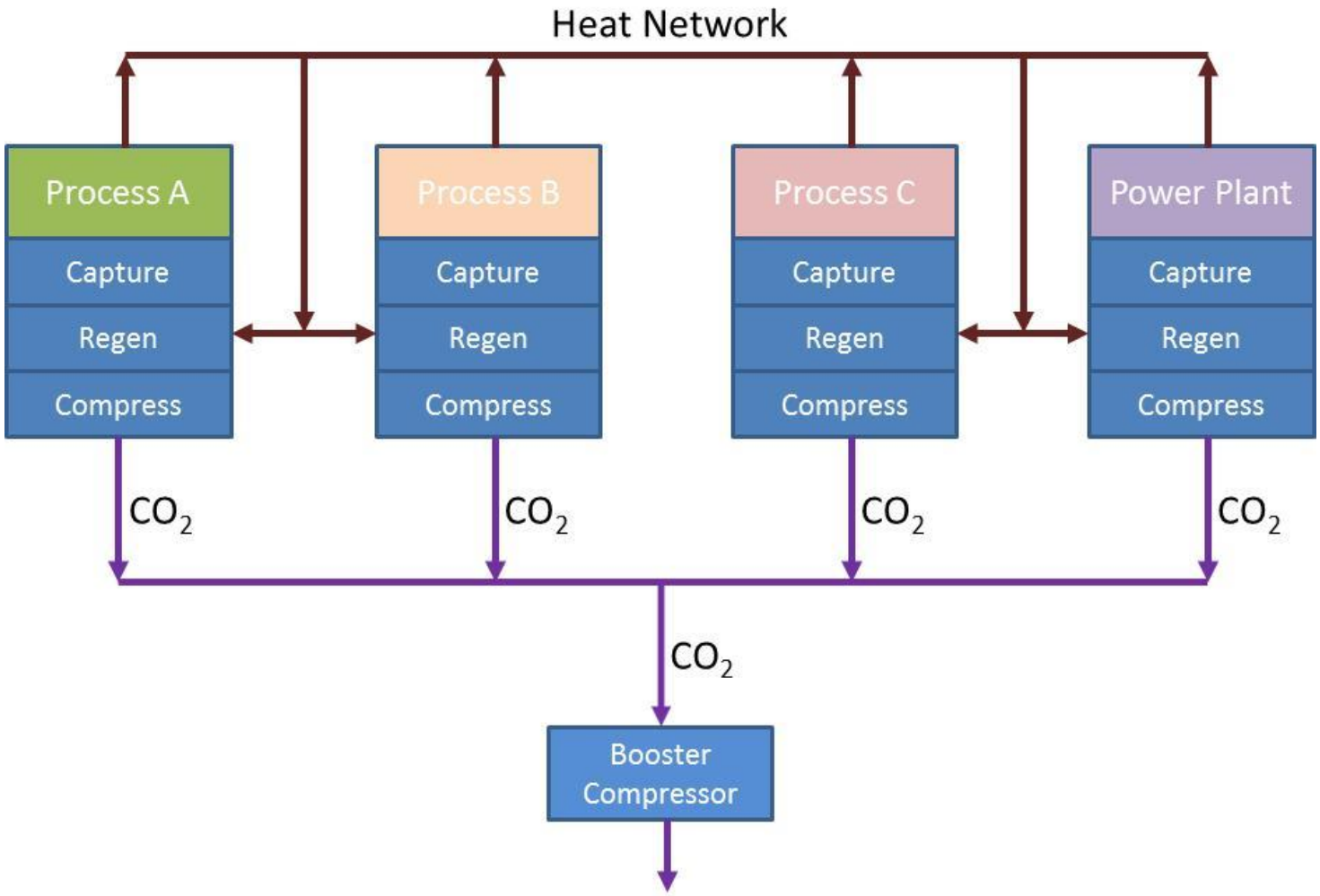
Industrial CCS – Potential Synergies

- PB participated in EU Framework 7 Project – LOCIMAP
  - **LO**w **C**arbon **I**ndustrial **M**anufacturing **P**arks
  - 14 partners, led by NEPIC; details at: www.locimap.eu
- Focus of project was to identify synergistic and symbiotic benefits from the co-location of multiple industries & industry sectors on integrated industry parks
  - Energy stream integration, material stream integration, other benefits
- 'Clustering' of industry to share CO_2 transport and storage infrastructure previously identified
- Industrial parks offer the opportunity to go further through integration and synergy
  - Cost reduction, efficiency improvement, performance advantage

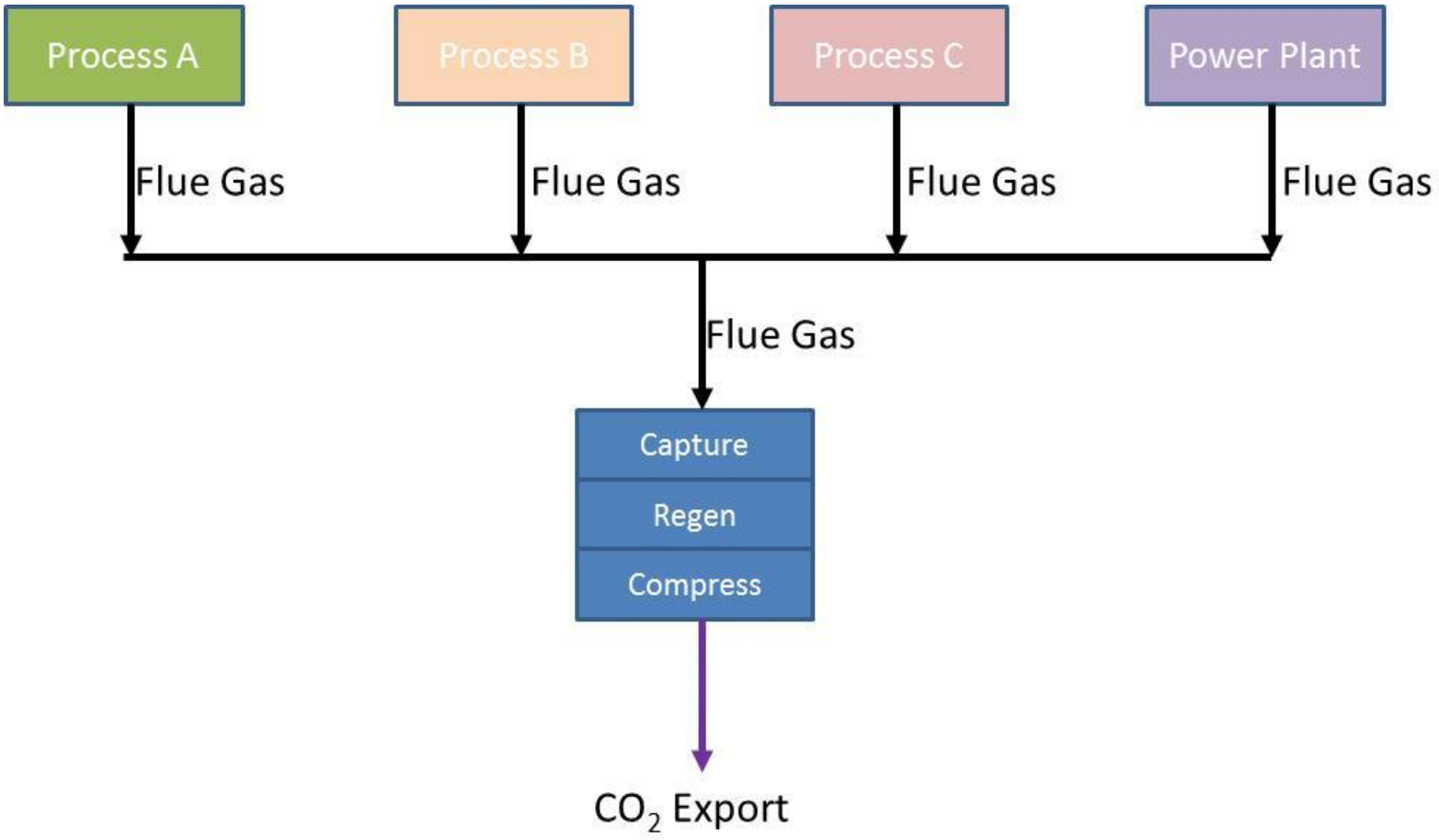
CCS Cluster with Shared Transport Network



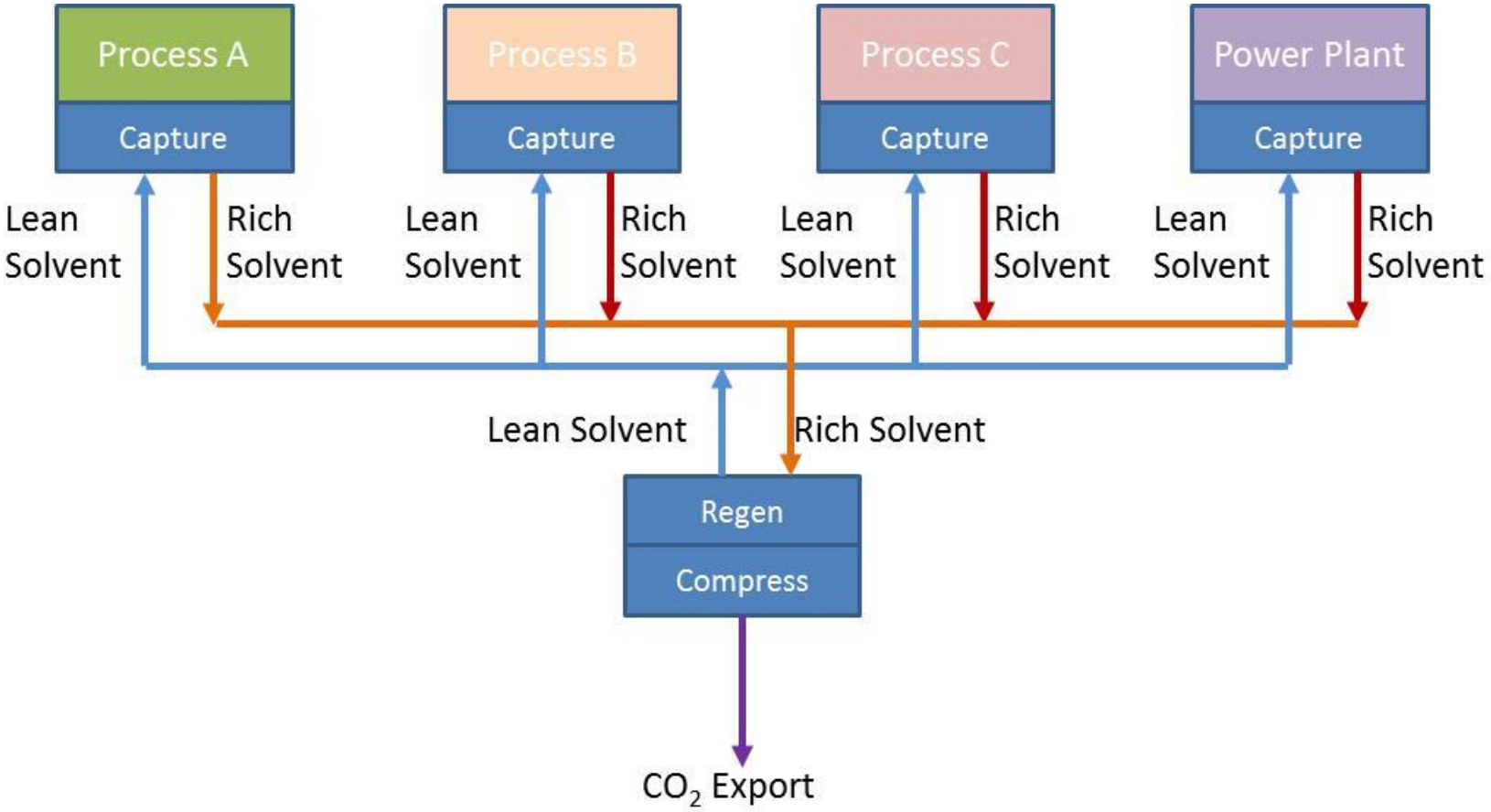
Heat Integration for CCS



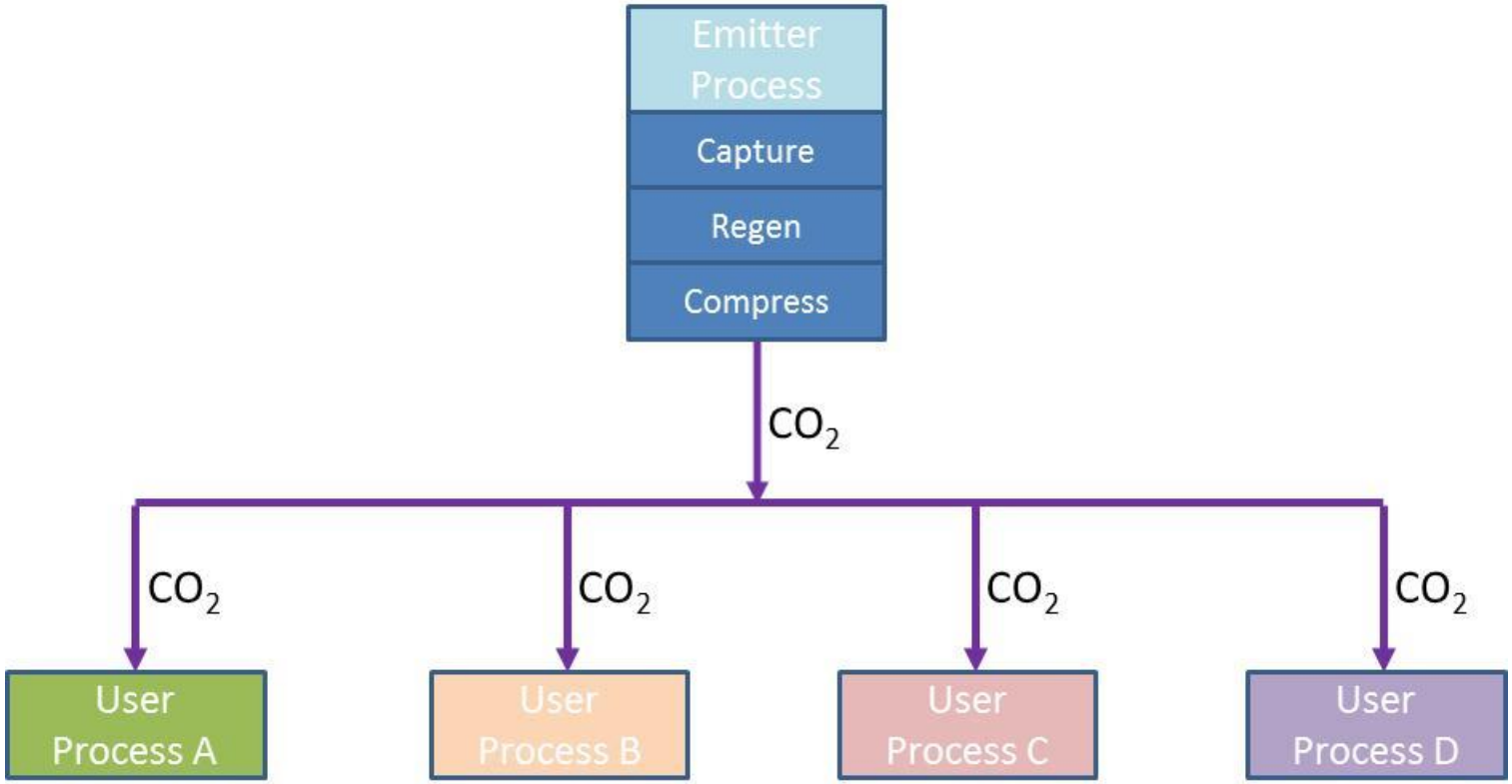
Flue Gas Manifolding for CCS Integration



Solvent Distribution for CCS Integration



CCU Industrial Cluster



Conclusions

- Decarbonisation challenges faced by industry differ from those faced by power generation sector
- CO_2 capture a key technology for industrial decarbonisation
- Enablers & barriers to industrial capture identified
- Potential actions to facilitate industrial capture proposed
- Within an integrated industrial park, several opportunities for synergy, facilitating the implementation of CCS/CCU at lower cost, with reduced impact on efficiency and performance
- Access to existing CCS network could become positive differentiator for locations looking to attract new industries for whom low carbon is key, adding to existing synergistic advantages of co-location

Thank you!

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