Action 804
0498/0502 Assessment of Environmental Impacts Supplementary Information

Teesside Gas
Processing Plant

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Background

- CATS/TGPP existing CO_2 spec is 2.9 mol%
- CATS & TGLP have requested a revised CO_2 spec to 4 mol%
- Two main benefits
  - Avoid restricting throughput of existing gas fields
  - Avoid risk of potential new gas fields not being developed e.g. Jackdaw
- BP assessment of forward CO_2 content
  - 2014-2018
    - CO_2 levels of >2.9 mol% for max of 5% of time at a peak of 4 mol%
    - Occur in summer (2-3 days)
    - Estimate total impact 0.03 mol% on annual average
  - 2019+
    - Potential new gas fields developed
    - Summer months between 2.66 mol% and 3.6 mol% (max 4 mol%)
    - Non-summer months between 2.66 mol% and 3 mol% (max 3.57 mol%)

Action 804 – Assessment of Environmental Impact

- Considered max CO_2 emissions and annual forecast cost for 3 scenarios around a new gas field project in period 2019 to 2040
- Scenario1 – Offshore CO_2 removal
  - Amine unit installed offshore to remove CO_2 down to 2.9 mol% prior to entry into CATS pipeline
- Scenario 2 – Onshore CO_2 removal
  - Amine unit installed onshore to remove CO_2 down to 2.9 mol% prior to entry on to the NTS
- Scenario 3 – NTS Delivery at 4mol%
  - Natural gas is delivered to NTS with a 4 mol% CO_2 content
- In all scenarios the following are calculated:
  - Amount of CO_2 removed plus emissions from associated fuel gas
  - Forecast cost of the amine installation where required
  - Forecast cost of annual emissions from the process

Action 804 – Assessment of Environmental Impact

Total Impact of Gas From Field Development over Field Life

Assessment of CO_2 Removal Cost For Field Development (2019-2040)	Scenario 1 Offshore CO2 Removal	Scenario 2 Onshore CO2 Removal	Scenario 3 NTS Delivery at 4 mol % CO2
CO_2 Removed by Amine unit (4 mol% to 2.9 mol%) (te)	566,214	612,989	0
CO_2 in fuel gas consumed by Amine unit (te)	261,121	266,040	0
CO_2 above 2.9 mol% emitted by consumers (te)	0	0	545,022
Total additional CO_2 emissions (te)	**827,335**	**879,029**	**545,022**
CO_2 Total ETS Traded Cost (£)	£12,831,701	£13,197,852	£2,198,459
CO_2 Total Traded Cost with Carbon Price Support (£)	£0	£0	£7,352,646
CO_2 Total Non-Traded Cost (£) (non-ETS consumption)	£0	£0	£20,869,531
Cost of Amine Unit (£)	£122,000,000	£200,000,000	£0
Total Cost (£)	**£134,831,701**	**£213,197,852**	**£30,420,636**
Cost per Tonne (£)	**£163**	**£243**	**£56**
Cost per Tonne (excluding Non-Traded) (£)	**£163**	**£243**	**£18**

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Average Annual Impact of Gas From Field Development

Assessment of CO_2 Removal Cost For Field Development (2019-2040) Annual Average	Scenario 1 Offshore CO2 Removal	Scenario 2 Onshore CO2 Removal	Scenario 3 NTS Delivery at 4 mol % CO2
CO_2 Removed by Amine unit (4 mol% to 2.9 mol%) (te/yr)	25,737	27,863	0
CO_2 in fuel gas consumed by Amine unit (te/yr)	11,869	12,093	0
CO_2 above 2.9 mol% emitted by consumers (te/yr)	0	0	24,774
Total additional CO_2 emissions (te/yr)	**37,606**	**39,956**	**24,774**
CO_2 Total ETS Traded Cost (£/yr)	£583,259	£599,902	£99,930
CO_2 Total Traded Cost with Carbon Price Support (£/yr)			£334,211
CO_2 Total Non-Traded Cost (£/yr) (non-ETS consumption)			£948,615
Cost of Amine Unit (£/yr)	£5,545,455	£9,090,909	
Total Cost (£/yr)	**£6,128,714**	**£9,690,811**	**£1,382,756**

Impact on Total UK CO_2 Emissions

Additional CO_2 Emissions as a % of total UK CO_2 Emissions (%)	**0.0125%**	**0.0133%**	**0.0082%**

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Action 804 – Calculation Assumptions

Data	Source
CO_2 Content	Operator estimate - single field at 4 mol%. Expect CATS commingled gas to be lower on average
Amine Unit costs	BP estimates - Amine unit fully installed cost
Field Profile	Field Operator
ETS Carbon Valuation	DECC Updated Energy & Emissions Projections - September 2014, 'Carbon Prices - Industry and Services' upto 2035 (2036+ Traded price equals non-traded price)
Carbon Valuation with Carbon Price Support	DECC Updated Energy & Emissions Projections - September 2014, 'Carbon Prices - Electricity Supply Sector' up to 2035 (2036+ inflated at 6% per year)
Carbon Valuation 'Non Traded'	DECC Appraisal Guide 2014, Table 1-20: supporting the toolkit and guidance - Central Prices
Total UK Forecast CO_2 Emissions	DECC Updated Energy & Emissions Projections - September 2014, Annex B Carbon Dioxide Emissions by Source
Emissions cost by User Group	Gas Usage split by gas demand Users (ETS, Carbon Support, non-ETS) - Nationalgrid, Future-Energy-Scenarios pg.168

Action 804 – Conclusions

- Single field case is the max impact case – assume full field CO_2 at 4 mol%, in reality will be diluted by other gas
- CO_2 removal at "source" (scenarios 1 & 2) creates 60% more CO_2 emissions than emitting by user (scenario 3)
- Increased electrical load to drive amine units will further add to emission in Scenarios 1 & 2 but are not included in model
- No account taken of additional Benzene and Methane emitted from amine units
- Cost of mitigation at "source" is between 3x and 4.5x more costly per tonne of CO_2 than emitting by user (and between 9x and 14x more costly when non-traded uses are excluded)
- Dilution of CO_2 by other gas will reduce overall additional CO_2 emissions but will make amine solutions (scenarios 1 & 2) more costly relative to scenario 3 – similar capital to remove less CO_2