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Supplementary Materials

Table S1. LCA description and results of Brinckerhoff [1]

CO_2 reuse application	Case study	Ton-CO_2 eq. emitted / Reusing act of 1 ton-CO_2
Enhanced oil recovery	Carbon capture from a coal-fired power station near the Dakota Gasification Plant in the USA, delivered via pipeline to the Weyburn CO_2-EOR	0.51
Bauxite residue carbonation	Carbon capture from a coal-fired power station in Western Australia, supplying the Kwinana Alumina Refinery via a 9 km pipeline	0.53
Urea yield boosting	Carbon capture from a coal-fired power station in China, supplying a urea plant via a 9 km pipeline	2.27
Enhanced geothermal systems	Carbon capture from coal-fired power stations in SE QLD, Australia, delivered via a 970 km pipeline to the Cooper Basin, Australia	0.58
Enhanced coal bed methane	Carbon capture from a coal-fired power station in Yancheng, China, supplying a commercial ECBM operation in the South Quinshui Basin via a 50 km pipeline	0.44
Renewable methanol	Carbon capture from the Svartsengi Geothermal Power Plant in Iceland	1.71
Formic acid production	Carbon capture from a coal-fired power station in Korea, supplying $CO_2$to the electrolysis plant via a 9 km pipeline	3.96
CO_2 concrete curing	Utilises a flue gas slipstream from a coal-fired power station in Nova Scotia, Canada, with the precast facility located in close proximity	2.2
Algae cultivation	Algae farm integrated with a coal-fired power station in Eastern Australia, with process requirementssimilar to those identified in public documents of MBD Energy	0.42
Carbon mineralization	PB estimate of requirements based on capture at a brown coal-fired power plant in Victoria, Australia, with no requirement for manufactured alkalinity	0.32
Polymers	Capture from a coal-fired power station in the USA, delivered via a 9km pipeline to the polypropylene carbonate production facility	5.52

Table S2. Inputs and outputs of microalgae photocultivation process

Inputs			Description
Flue gas		50 Nm^3/hr	Flue gas is sent to the process.
	CO_2	2.1 m^3/hr	4.21% CO_2 concentration, 14,343.5 kg/year in weight
Electricity		406 kWh/year	Energy used to operate the biophotoreactors
Water		0.13 kg/ton of CO_2 emissions utilized	More than 0.10 kg/ton of CO_2 emissions utilized (80%) is reused.
Chemicals		95.9 kg/year	Used for TAP-C medium
	NH_4CL	32.9 kg/year	0.047 kg/ton of CO_2 emissions utilized
	K_2HPO_4	25.2 kg/year	0.036 kg/ton of CO_2 emissions utilized
	Sodium bicarbonate	14.7 kg/year	0.021 kg/ton of CO_2 emissions utilized
	KH_2PO_4	12.6 kg/year	0.018 kg/ton of CO_2 emissions utilized
	$MgSO_4$	4.3 kg/year	
	$CaCl_2$	3.3 kg/year	
	$ZnSO_4$	1.1 kg/year	
	H_3BO_3	1.0 kg/year	
	$MnCl_2$	0.3 kg/year	
	$FeSO_4$	0.2 kg/year	
	$CoCl_2$	0.1 kg/year	
	$CuSO_4$	0.1 kg/year	
	$(NH_4)MoO_3$	0.1 kg/year	
Outputs			**Description**
Flue gas		-	
	CO_2	0.419 m^3/hr	0.84% CO_2 concentration (CO_2 reduction by 80.05%)
Wastewater		0.03 kg/ton of CO_2 emissions utilized	
Chlorella biomass		87.6 kg/year	Potential for conversion into sellable product

Table S3. Inputs and outputs of the CO_2 membrane separation process

Inputs			Description
Flue gas		1,200 Nm^3/hr	Flue gas is sent to the process.
	CO_2	4.5 vol%	
	O_2	10.8 vol%	
	N_2	74.7 vol%	
	H_2O	10.0 vol%	
Electricity		692.6 kWh/ton of CO_2 emissions utilized	Electricity consumption when operating at total capacity
Outputs			Description
Gas emissions to the atmosphere		1,143 Nm^3/hr	CO_2 removed through the membrane separation process
CO_2-enriched flue gas		57 Nm^3/hr	Not emitted into the atmosphere, it can be converted to liquid carbon dioxide by integrating liquefaction technology
	CO_2	79.8 vol%	Equivalent to 707 ton/year
	O_2	16.3 vol%	
	N_2	3.8 vol%	
	H_2O	0.1 vol%	

Table S4. Inputs and outputs of the carbon mineralization process

Inputs			Description
Mixed gas		57 Nm^3/hr	884 ton/year, CO_2-enriched flue gas
	CO_2	80 vol%	707 ton/year
	N_2	20 vol%	
Electricity		25.7 kWh/ton of CO_2 emissions utilized	Energy used
Water		4.30 kg/ton of CO_2 emissions utilized	Recycled and reused: 2.49 kg/ton of CO_2 emissions utilized
CaO/Mg feedstock		4.30 kg/ton of CO_2 emissions utilized	3,009.6 ton/year, aqueous solution recovered from industrial waste materials
Outputs			**Description**
Gas emissions	CO_2	10 kg/ton of CO_2 emissions utilized	Gas emitted into the atmosphere, includes 6 other substances (SOx, NOx, dioxin, CO, HCI, and dust)
$CaCO_3$		2,078kg/ton of CO_2 emissions utilized	1,454.8 ton/year
Wastewater		1.81 kg/ton of CO_2 emissions utilized	
	BOD	-	
	COD	-	
	SS	-	
	T-N	-	
	T-P	-	

References

1. Brinckerhoff P. Accelerating the uptake of CCS: industrial use of captured carbon dioxide. Global CCS Institute. 2011. 260.