

Streetly Hall Anaerobic Digestion Facility

Carbon Balance

Planning ref CCC/23/110/FUL

May 2024

Summary

The proposed Bioenergy Carbon Capture and Storage (BECCS) plant will utilise agricultural products, residues and wastes to provide a sustainable source of natural gas and biofertiliser. The biogas produced will exclusively displace natural gas derived from fossil sources, as the UK gas grid enables storage of gas, resulting in avoidance of equivalent CO₂ from fossil fuel combustion. Biofertiliser will replace fossil-fuel derived synthetic fertiliser, avoiding emissions from its production. CO₂ captured by the process will be transported to the Northern Lights project to be sequestered. As such, the plant is highly carbon negative.

Operations

INPUTS				
Feedstock	Quantity purchased (t)	Units	CO2 emissions	
Straw (waste)	2,500	t	0	tonnes/year
Slurry	5,000	t	0	tonnes/year
Farmyard manure	5,000	t	0	tonnes/year
Other agri related waste	12,000	t	0	tonnes/year
Dry straw (processed)	10,000	t	0	tonnes/year
Maize silage	14,000	t	784	tonnes/year
Grass silage	0	t	0	tonnes/year
Wholecrop cereal	14,000	t	343	tonnes/year
Elec input (annual)	3,369,600	kWh	741	tonnes/year
Gas input (annual)	5,054,400	kWh	910	tonnes/year
Propane input (annual)	4,912,258	kWh	1,179	tonnes/year
		Total	3,957	tonnes CO2 emitted annually
OUTPUTS				
Biomethane exported	59,445,414	kWh	-10,700	fossil gas emissions avoided
CO2 exported	7,838	t	-7,838	CO2 sequestered
Digestate (liquid)	30,000	t	-189	fertiliser production emissions avoided
Digestate (solid)	20,000	t	-372	fertiliser production emissions avoided
		Total	-19,099	tonnes CO2 emitted annually
		Net	-15,142	tonnes CO2 emitted annually

Land Use

The proposed site is currently agricultural land under intensive arable production and as such is not sequestering carbon.

Construction

Concrete area	35,000	m ²
Concrete depth	0.2	m
Concrete volume	7,000	m ³
Carbon footprint of concrete	410	kg CO ₂ e / m ³
Embodied carbon - concrete	2,870	tonnes CO ₂
Building area	3,880	m ²
Steel per unit area	0.05	tonnes/m ²
Steel mass	194	tonnes
Carbon footprint of steel	1,740	kg CO ₂ e / tonne
Embodied carbon - buildings	338	tonnes CO ₂
Embodied carbon - buildings and concrete	3,208	tonnes CO ₂
Scaling factor - other building	150%	
Embodied carbon - total	4,811	tonnes CO ₂
As proportion of embodied:		
Transport to site	3%	
Construction wastes	14%	
Construction processes	3%	
	20%	
Total construction	5,774	tonnes CO₂

Transport

Transport by road	0.107	kg CO ₂ e / tonne / km
Average round trip	12	km
Total inputs + outputs	120,500	tonnes
	155	tonnes CO₂ emitted annually

Reference Values

Description / substrate	Value	Units	Data Source
Straw (waste)	0	kg CO2e / tonne	residue - no direct carbon input
Slurry	0	kg CO2e / tonne	waste - no direct carbon input
Farmyard manure	0	kg CO2e / tonne	waste - no direct carbon input
Other agri related waste	0	kg CO2e / tonne	waste - no direct carbon input
Dry straw (processed)	0	kg CO2e / tonne	residue - no direct carbon input
Maize silage	56	kg CO2e / tonne	https://www.frontiersin.org/journals/microbiology/articles/10.3389/fmicb.2022.1092315/full
Grass silage	24.5	kg CO2e / tonne	estimated equal to wholecrop cereal (not included in feedstock mix)
Wholecrop cereal	24.5	kg CO2e / tonne	https://www.kws.com/corp/en/media-innovation/press/external-sustainability-study-confirms-the-excellent-co2-balance-of-kws-hybrid-rye/
Electricity	0.22	kg CO2e / kWh	https://www.itpenergised.com/new-uk-grid-emissions-factors-2023/
Natural gas	0.18	kg CO2e / kWh	https://www.itpenergised.com/new-uk-grid-emissions-factors-2023/
Propane	0.24	kg CO2e / kWh	https://www.open.edu/openlearn/nature-environment/energy-buildings/content-section-3.5
Fertiliser	1,112	kg CO2e / tonne	https://www.fertilizerseurope.com/wp-content/uploads/2020/01/The-carbon-footprint-of-fertilizer-production_Regional-reference-values.pdf
Fertiliser N content	335	kg/tonne	https://www.fertilizerseurope.com/wp-content/uploads/2020/01/The-carbon-footprint-of-fertilizer-production_Regional-reference-values.pdf
Digestate N content (liquid)	1.9	kg/tonne	AHDB RB209 Sec 1
Digestate N content (solid)	5.6	kg/tonne	AHDB RB209 Sec 2
Carbon footprint of concrete	410	kg CO2e / m3	Exploiting Wastes in Concrete: Proceedings of the International Seminar Held at the University of Dundee, Scotland, UK on 7 September 1999
Steel per unit building area	0.05	tonnes/m2	https://www.steelconstruction.info/Cost_planning_-_Industrial_buildings
Carbon footprint of steel	1,740	kg CO2e / tonne	https://www.building.co.uk/focus/steeling-ourselves-for-climate-change/
Transport to site	3%		https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8540435/#B20-materials-14-06094
Transport by road	0.107	kg CO2e / tonne / km	https://www.istructe.org/IStructE/media/Public/Resources/ARUP-Embodied-carbon-steel_1.pdf