CARBON-ZERO

MudCube - Offshore Technical Carbon Emissions Comparative

Assessment Prepared for: Cubility

Authored by: Fraser Christie, Mark Eadie

Date: 16th September 2021

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1. Executive Summary

Founded in 2005 and based in Sandnes, Norway, Cubility provide an alternative product to replace shale shakers, which are commonly used in the O & G industry to process and separate solids and mud in drilling.

Cubility's MudCube is an enclosed, lightweight and cost-efficient alternative which combines high airflow through a rotating belt with micro vibrators underneath. The process provides HSE advantages (minimising personnel exposure to gas, oil mist, noise and vibration) and a more effective separation of drilling fluids from drilled solids.

By improving separation, the MudCube helps to reduce the amount of waste product generated by increasing the volume of fluid that can be retained and reused. This outcome helps the operator to reduce their costs and reduce their associated Scope 3 Greenhouse Gas (GHG) emissions.

Drilling a well is an activity which generates a carbon footprint. Solids control is a part of this process which generates waste and this waste and its treatment is an important driver for the associated emissions with both onshore and offshore drilling activities. The equipment selected for this task will also have quite a large impact on the total emissions level.

This report has been commissioned to quantify, in the drilling and treatment of an offshore well, any GHG and carbon emissions savings realised through using Cubility's MudCube system compared to the traditional Shale Shaker method, and thereby assist operators in technology selection in order to reduce the environmental impact of oil and gas production.

This Carbon Emissions Report calculates the effective GHG emissions generated by drilling a well and what impact using a MudCube system and a Shale Shaker will have on these emissions. The comparison calculations have considered operational requirements, waste production and treatment, and any impact on drilling fluid retention. The results of the comparison for drilling a typical well are as follows:

Total Emissions Comparison				
Disposal Method	Treatment Type	Total Emissions (Tonnes C02e)	Savings (Tonnes C02e)	Savings Percentage
Oil Recovery	Shale Shaker	343	-	-
	MudCube	200	143	42%
Landfill	Shale Shaker	163	-	-
	MudCube	39	124	76%

Table 1–Emissions Summary

By reducing waste volumes, using a MudCube helps to reduce the waste treatment emissions associated with drilling by approximately 42% when disposed via the oil recovery process, and 76% when landfilled.

2. Background

Drilling mud, also referred to as drilling fluid, aids in the process of drilling for oil and gas extraction, among other drilling purposes. One of the fluid's features is to assist in bringing the drill cuttings (fragmented rock and solids) to the surface where both the mud and cuttings will be treated and either reused or disposed of. One stage in the treatment process is to use a Shale Shaker to separate the solids (cuttings) from the fluid (mud). This allows the mud to be reused in the drilling process, and cuttings to be disposed.

MudCube presents an alternative step in the treatment process that would replace the Shale Shaker. Various field trials have confirmed an ability to reduce the moisture content of the waste by extracting more of the mud which can be reused. This reduces the weight of waste for disposal while simultaneously retaining more drilling fluid, removing the requirement to replace this fluid.

Typical treatment of this waste would involve a 'skip and ship' to shore operation, where the cuttings would be treated to separate the waste into powder, water and oil. This is achieved by using technology to raise the temperature of drill cuttings to approximately 260°C in order to flash evaporate oil and water from rock dust solids; this is known as thermal desorption. The three main waste products are dealt with by differing means; recovered oil is sent to a third party as fuel for municipal incineration or used within the treatment site's processing plant; recovered water is treated onsite for discharge in line with regulatory requirements; and the recovered powder can be used in plastics as an aggregate filler material or will be sent to landfill. A full process overview has been included in section 7.

By retaining a higher volume of drilling fluid, the MudCube will produce less waste and therefore a smaller volume of material will be treated via the above method.

3. Introduction

3.1 Aims and Objectives

- Summarise the carbon emissions associated with an industry standard Shale Shaker treatment method.
- Summarise the carbon emissions associated with the operation of a MudCube treatment system.
- Provide a comparison and total carbon savings generated by using the MudCube method.

3.2 Scope

The scope of this assessment extends to all of the associated carbon emissions with the process of treating the cuttings and drilling mud produced in a single well. The emissions were calculated for two scenarios: one using a traditional shale shaker to treat and separate the by-products, and a second using a MudCube. These scenarios included: operational power usage, waste generation, waste treatment and disposal, and the impacts of increased process mud retention.

It has been agreed that the embodied emissions, shipping and installation, including plant and manpower, of both systems is out with the scope of this assessment. Both scenarios are based on the systems being already installed. End of life emissions have not been included in the scope as both systems have the ability to process drill cuttings from numerous wells over an extended time period, and this report focuses on providing a comparison of a single well.

4. Introduction to GHG

In response to the increased awareness of global warming, countermeasures against greenhouse gas emissions were prepared by the United Nations Conference on Environment and Development (UNCED) at the Rio Earth Summit held in Brazil in 1992. Since then, international efforts have continued to reduce greenhouse gas emissions through the Kyoto Protocol in 1997 and the Copenhagen Accord in 2009. Most Recently, the Paris Climate Agreement was signed which aims to bring all nations into a common cause to undertake more ambitious efforts to combat climate change and adapt to its effects.

Many countries around the world have outlined action plans to reduce greenhouse gas emissions and are preparing policies that include their reduction goals. Among developed countries, examples of reduction goals by the year 2020 include 34% in the UK, 20% in the EU, 17% in the US and 15% in Japan.[1]

Concern over climate change has stimulated interest in estimating the total amount of greenhouse gasses (GHG) produced during the different stages in the ―life cycle of goods and services ― i.e. their production, processing, transportation, sale, use and disposal. The outcome of these calculations is often referred to as ―product carbon footprints (PCFs), where 'carbon footprint' is the total amount of GHGs produced for a given activity and 'product' is any goods or services that are marketed. PCFs are thus distinct from GHG assessments performed at the level of projects, corporations, supply chains, municipalities, nations or individuals.

Product carbon footprinting is currently dominated by private standards and by certification schemes operated by small for-profit and not-for-profit consultancy companies and in a few cases by large retailers and manufacturers. Government support to PCF schemes and standards has been limited so far. The exceptions are the PAS 2050 standard, the development of which was supported by the UK Department for Environment, Food and Rural Affairs (Defra); Japan's pilot Carbon Footprint Scheme, launched in April 2009; and the assistance provided by the French Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME) in the development of a scheme operated by the food retailer Casino.

At the international level, PCF standards are being developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD-WRI), through its Greenhouse Gas Protocol; and by the International Office for Standardisation.[2]

[1] Woosik Jang, Hyun-Woo You (2015) Quantitative Decision-Making Model for Carbon Reduction in Road Construction Projects Using Green Technologies. Sustainability, 7 (1), pp.11240-11259

[2] Simon Bolwig, Peter Gibbon (2009) Counting Carbon in the Marketplace. Global Forum on Trade: Trade and Climate Change, OECD.

5. Data Requirements

In order to provide an appropriate comparison of the two systems, an identical baseline scenario has been applied in both use cases. This scenario outlines a typical operation for the treatment of drilling mud and the treatment and disposal of the waste produced. The key requirements for calculating the carbon footprint have been summarised as follows:

- Platform distance from shore – 264 km.
- Total well depth – 3,600m.
- Average total weight of cuttings produced per well - 1274.3mt.
- Method for waste transport to shore - Platform Support Vessel.
- Distance of treatment facility from port - 5 km.
- The waste produced will have a ratio split of 70/15/15% of powdered rock/water/oil.
- Powdered rock will be sent to a plastic factory 135 km from the treatment facility.
- Water will be treated and discharged on site.
- Oil will be transferred to third party site 135 km from the treatment facility.

Further to the baseline data mentioned above, each Scope within the footprint calculation required the collection and verification of additional data. Scope 1 emissions relate directly to fuel usage for each system and use as part of the treatment process, emissions for the items in Table 2 were included in Scope 1.

MudCube	Shale Shaker
4 units would be required for well.	4 units would be required for well.
Operation- Diesel Fuel Usage	Operation- Diesel Fuel Usage
Compressed Air - Diesel Generated	

Table 2 – Scope 1 Emissions

Within the boundaries of Scope 3 are the indirect emissions associated with third party road and vessel transportation, none of which are owned or directly controlled by the company; further to this Scope 3 also includes emissions associated with third party processes. Table 3 lists the requirements for Scope 3.

MudCube	Shale Shaker
Ship transport of cuttings bins to/from offshore platform	Ship transport of cuttings bins to/from offshore platform
Waste Treatment- Diesel Fuel Usage	Waste Treatment- Diesel Fuel Usage
Road transport of cuttings bins to/from shore	Road transport of cuttings bins to/from shore
Road transport of produced powder	Road transport of produced powder
Road transport of produced oil	Road transport of produced oil
Waste water treatment of produced water	Waste water treatment of produced water
	Production and shipping of replacement drilling mud

Table 3– Scope 3 Emissions

6. Assumptions

In addition to the baseline scenario outlined in section 5, to calculate and compare the emissions of the two systems, the following assumptions have been established:

- The drilling time for a 3,600m well is estimated to be 35 days.
- Both systems have a similar capacity for throughput, and both have comparable lifespans with routine maintenance and component parts replacement. For the well scenario provided, 4 shale shakers or 4 MudCubes would be required.
- A standard shale shaker will have an energy consumption of 6 kWh.
- A ventilation unit will be required for each shale shaker used. These are required to provide 5,400m3/hour per unit.
- A MudCube will have an energy consumption of 6.6 kWh.
- The generation of 1Nm3 compressed air, at 6 barg, requires approximately 5.62 KWh.
- The MudCube's Air Knife is only used periodically, and it has been assumed that this will operate for 5% of the total running time.
- Cubility provided case studies examining the MudCube's waste reduction potential when compared to a shale shaker. These studies were undertaken by Polyar, Slavneft and BOMCO. On average these studies calculated that the MudCube was able to reduce the tonnage of Mud waste produced by 53%. Other operations may result in lower savings. In order to ensure a conservative assessment, we assume that the MudCube will reduce waste produced by a factor of 35%.
- Solid drill cuttings waste will be the same for both methods, therefore any difference in waste volumes is assumed to be lost drilling fluid.
- All excess drilling fluid lost due to the shale shaker method will need to be replaced to enable the system to have the required mud volumes.
- Replacement drilling fluid is water-based mud for the first section and oil-based mud for the second and third sections. Both types of drilling mud will be sourced from within 5km of the port.
- Oil based replacement drilling mud will consist of 64% oil, 16% water, 10% barite, 4% salt, 3% clay and 3% sand.[4]
- A conversion factor for barite was not readily available therefore a factor was calculated by averaging the values for two metals (Cu & Zn) with similar properties and a similar extraction method.
- An average dead weight tonnage of 3500DWT for Supply Vessels used in North Sea commissioning of well cuttings has been taken.

7. Process Overview

The process for using either the Shale Shaker or the MudCube are similar, with the key difference being the volume of waste material at each stage is reduced when the MudCube has been used. There is an additional stage for the shale shaker process where the additional loss of drilling mud results in a replacement requirement, as drilling systems need certain volumes of mud to operate. This additional stage had been highlighted in red in figure 1 below.

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[3] M.Grajewski (2019) How to Reduce Cost of Compressed Air, Ingersoll Rand, Available (18) How to reduce the costs of compressed air? | LinkedIn

[4] Tapapas Rattanachaikanon (2021) Drilling Fluids, Mud and Components, Available https://petgeo.weebly.com/drilling-fluidsmud-and-components.html

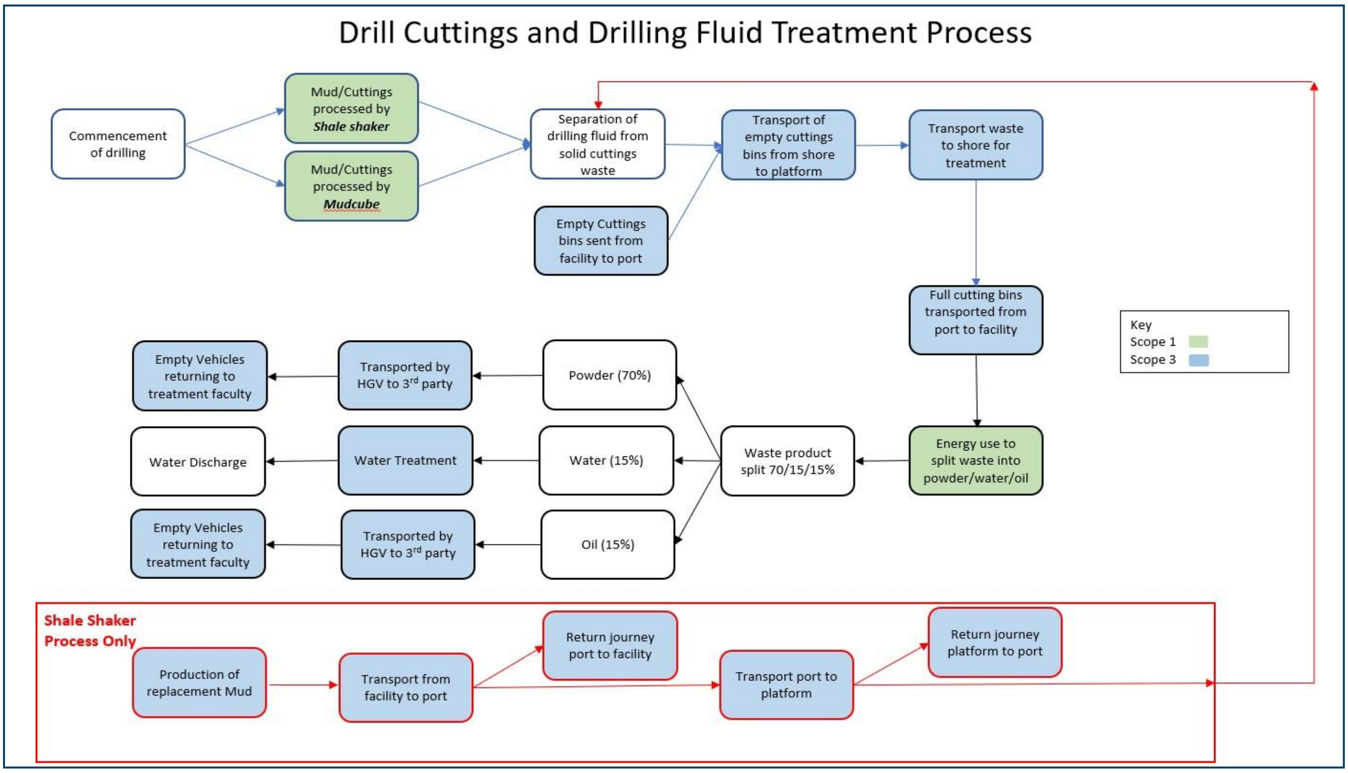

Fig.1 Process Overview

An alternate scenario has been assessed where the waste has been sent to landfill instead of treatment. The carbon emissions for landfilling the waste produced when using a Shale shaker and a MudCube as part of the process have been calculated. As this scenario is less likely, the results will be calculated however not included in this assessments summary. Figure 2 below highlights the treatment process when adjusted for landfilling.

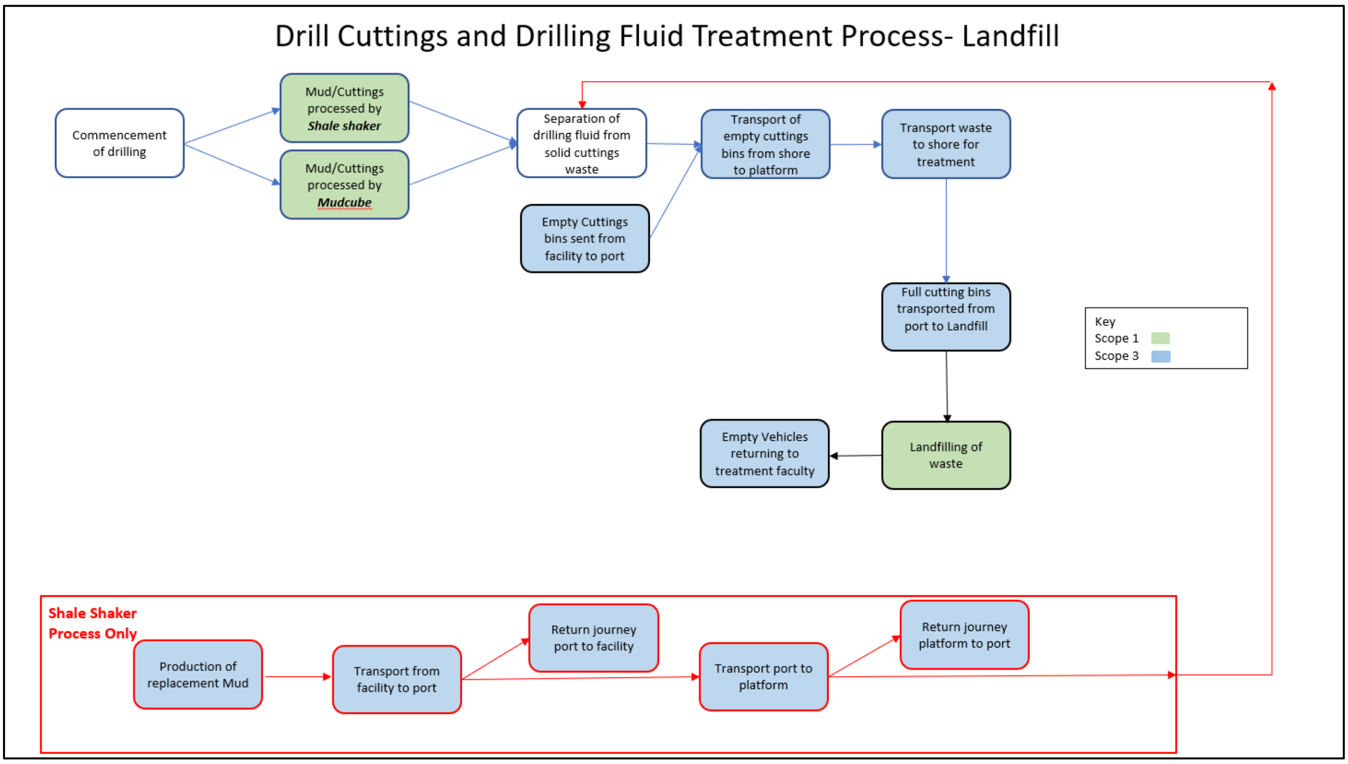

Fig.2 Process Overview Landfilling

8. Carbon Footprint Assessment

This assessment has been carried out using the UK Government GHG and BEIS Conversion Factors published July 2020. Any factors used from other sources have been referenced.

8.1 Shale Shaker Carbon Footprint

Using the well data for the outlined scenario, provided by Cubility, it has been calculated that the drilling process will create 1274.3 tonnes of drilling waste when using a shale shaker as part of the process. This waste will be a mixture of both drill cuttings and drilling mud. The drill cuttings account for 850.8 tonnes and the mud accounts for 423.5 tonnes of the total waste volume.

It has been assumed the any additional mud lost as a result of using a shale shaker instead of a MudCube will need replaced. The composition of the additional mud to be generated has been summarised below.

Replacement Mud Requirements			
Material	Composition (%)	Weight (Tonnes)	Total (Tonnes)
Oil	64	95.04	148.5
Water	16	23.76	
Barite	10	14.85	
Clay	3	4.46	
Sand	3	4.46	
Salt	4	5.94	

Table 4. Replacement Mud Requirements

The figure below contains an overview of the scope 1, 2 & 3 emissions associated with the traditional shale shaker treatment method. There were no scope 2 emissions as part of the baseline scenario, therefore no values are present in the table.

Waste Treatment Carbon Emissions Using Shale Shaker					
Results	**Unit**	**Quantity**	**BEIS Emissions Factor**	**Description**	**Carbon Emissions (KgCO2e)**
Scope 1					
Diesel	kWh	20,160	0.25278	SS Power Consumption @ 6kW	5,096
Diesel	kWh	1,848	0.25278	Ventilation Fans (x4)	467
Total Scope 1 Emissions					**5,563**
Scope 3					
Freighting Goods-HGV	km	250	0.864	Road- Empty Cuttings Bins	216
Freighting Goods-HGV	km	250	1.076	Road- Full Cuttings Bins	269
Freighting Goods-HGV	km	3649	1.076	Road- Powder Transport	3,928
Freighting Goods-HGV	km	3,649	0.652	Road- Powder Return Journey	2,380
Freighting Goods-HGV	km	1,650	1.076	Road- Oil Transport	1,776
Freighting Goods-HGV	km	1,650	0.652	Road- Oil Return Journey	1,076
Freighting Goods-HGV	km	40	1.076	Road- Mud Replacement Transport	43
Freighting Goods-HGV	km	40	0.652	Road- Mud Return Journey	26
Freighting Goods-Sea Tanker	tonne.km	98,267	0.046	Sea- Empty Cuttings Bins	4,484
Freighting Goods-Sea Tanker	tonne.km	434,682	0.046	Sea- Full Cuttings Bins	19,835
Freighting Goods-Sea Tanker	tonne.km	66,238	0.046	Sea- Mud Replacement Transport	3,022
Freighting Goods-Sea Tanker	tonne.km	7,286	0.046	Sea- Mud Return Journey	332
Managed Assets- Electricity	kWh	9,598	0.233	Treatment Power Usage	2,238
Water Treatment	M3	191	0.708	Water Treatment	135
Material Use	Tonnes	4.46	0.9968	Clay for Mud Production	4
Material Use	Tonnes	4.46	7.4696[5]	Sand for Mud Production	33
Material Use	Tonnes	14.85	3775	Barite for Mud Production	56,059
Material Use	Tonnes	5.94	0.344	Salt for Mud Production	2
WTT-Fuels	Tonnes	95.04	746.95	Oil for Mud Production	70,990

[5] Inventory of Carbon & Energy (ICE) (2019) V3 Available https://circularecology.com/embodied-carbon-footprint-database.ht

Water Supply	M3	23.76	0.344	Water for Mud Production	8
Diesel	litres	63,715	0.253	RotoMill Treatment	171,258
Total Scope 3 Emissions					**338,115**
TOTAL KGCO2e EMISSIONS					**343,678**
TONNES CO2e					**344**

Fig.3 Shale Shaker Carbon Emissions

- Using the traditional shale shaker method to assist with the drilling process of the outlined scenario, there would be an emissions total of 344 tonnes CO2e.

8.2 MudCube System Carbon Footprint

Using the well data for the outlined scenario, provided by Cubility, it has been calculated that the drilling process will create 1,274.3 tonnes of drilling waste when using a shale shaker as part of the process. Replacing the shale shaker with a MudCube reduces the Mud waste tonnage by 35% therefore the adjusted waste weight is 1,125.8 tonnes. This waste consists of 850.8 tonnes of drill cuttings and 275 tonnes of drilling mud.

The figure below contains an overview of the scope 1, 2 & 3 emissions associated with the MudCube system. There were no scope 2 emissions as part of the baseline scenario, therefore no values are present in the table.

Waste Treatment Carbon Emissions Using MudCube					
Results	**Unit**	**Quantity**	**BEIS Emissions Factor**	**Description**	**Carbon Emissions (KgCO2e)**
Scope 1					
Diesel	Kwh	22,176	0.25278	MudCube Power Consumption 6.6kW	5,606
Diesel	Kwh	40,616	0.25278	Compressed Air	10,267
Total Scope 1 Emissions					**15,873**
Scope 3					
Freighting Goods-HGV	km	220	0.864	Road- Empty Cuttings Bins	190
Freighting Goods-HGV	km	220	1.076	Road- Full Cuttings Bins	237
Freighting Goods-HGV	km	3240	1.076	Road- Powder Transport	3,487
Freighting Goods-HGV	km	3,240	0.652	Road- Powder Return Journey	2,113
Freighting Goods-HGV	km	1,651	1.076	Road- Oil Transport	1,777
Freighting Goods-HGV	km	1,651	0.652	Road- Oil Return Journey	1,077
Freighting Goods-Sea Tanker	tonne.km	86,856	0.046	Sea- Empty Cuttings Bins	3,963
Freighting Goods-Sea Tanker	tonne.km	384,027	0.046	Sea- Full Cuttings Bins	17,523
Managed Assets- Electricity	kWh	8,480	0.233	Treatment Power Usage	1,977
Water Treatment	M3	169	0.708	Water Treatment	120
Diesel	litres	56,290	2.688	RotoMill Treatment	151,300
Total Scope 3 Emissions					**183,764**
TOTAL KGCO2e EMISSIONS					**199,637**
TONNES CO2e					**200**

Fig.4 MudCube Carbon Emissions

- Using a MudCube to assist with the drilling process of the outlined scenario, there would be an emissions total of 200 tonnes CO2e.

8.3 Impact of Landfilling Waste

Due to the inert nature of most of the waste materials the emissions associated with landfilling are lower than treatment. While the total emissions for landfilling may be lower than the treatment and transport option, landfilling will involve other challenges such as financial costs and changing legislation. The emissions from operational use, sea transport of waste and bins and road transport of waste and bins would remain unchanged from section 8.1 and 8.2.

Landfill Disposal Emissions					
	Waste Type	Weight (Tonnes)*	Conversion Factor	Kg Co2e	Total
Using Shale Shaker in Process	Cuttings	850.8	1.249	1,063	1,694
	Oil	271.0	1.249	339	
	Barite	42.4	1.264	54	
	Water	67.8	0.0	0	
	Sand	12.7	1.249	16	
	Clay	12.7	17.592	224	
Using MudCube in process	Cuttings	850.8	1.249	1,063	1,473
	Oil	176.0	1.249	220	
	Barite	27.5	1.264	35	
	Water	44.0	0.0	0	
	Sand	8.3	1.249	10	
	Clay	8.3	17.592	145	
	Salt	11.0	0.0	0	

Table 5 Landfilling Emissions
*Weight based on composition on Mud outlined in table 3.

- There would be additional carbon emissions associated with the landfilling scenario as the treatment option is able to recycle plastic and oil which if landfilled will need to be sourced elsewhere. These calculations are out with the scope of this report.

The tables below contain the adjusted assessment for landfilling as the disposal option.

Waste Treatment Carbon Emissions Using Shale Shaker					
Results	**Unit**	**Quantity**	**BEIS Emissions Factor**	**Description**	**Carbon Emissions (KgCO2e)**
Scope 1					
Diesel	kWh	20,160	0.25278	SS Power Consumption @ 6kW	5,096
Diesel	kWh	1,848	0.25278	Ventilation Fans (x4)	467
Total Scope 1 Emissions					**5,563**
Scope 3					
Freighting Goods-HGV	km	250	0.864	Road- Empty Cuttings Bins	216
Freighting Goods-HGV	km	250	1.076	Road- Full Cuttings Bins	269
Freighting Goods-HGV	km	40	1.076	Road- Mud Replacement Transport	43
Freighting Goods-HGV	km	40	0.652	Road- Mud Return Journey	26
Freighting Goods-Sea Tanker	tonne.km	98,267	0.046	Sea- Empty Cuttings Bins	4,484
Freighting Goods-Sea Tanker	tonne.km	434,682	0.046	Sea- Full Cuttings Bins	19,835
Freighting Goods-Sea Tanker	tonne.km	66,238	0.046	Sea- Mud Replacement Transport	3,022
Freighting Goods-Sea Tanker	tonne.km	7,286	0.046	Sea- Mud Return Journey	332
Material Use	Tonnes	4.46	0.9968	Clay for Mud Production	4
Material Use	Tonnes	4.46	7.4696[5]	Sand for Mud Production	33
Material Use	Tonnes	14.85	3775	Barite for Mud Production	56,059
Material Use	Tonnes	5.94	0.344	Salt for Mud Production	2
WTT-Fuels	Tonnes	95.04	610.7	Oil for Mud Production	70,990
Water Supply	M3	23.76	0.344	Water for Mud Production	8
Landfilling	Tonnes	1,257	Above		1,694
Total Scope 3 Emissions					**157,017**
TOTAL KGCO2e EMISSIONS					**162,580**
TONNES CO2e					**163**

Fig 5. Landfill Adjusted- Shale Shaker

[5] Inventory of Carbon & Energy (ICE) (2019) V3 Available https://circularecology.com/embodied-carbon-footprint-database.ht

Waste Treatment Carbon Emissions Using MudCube					
Results	Unit	Quantity	BEIS Emissions Factor	Description	Carbon Emissions (KgCO2e)
Scope 1					
Diesel	Kwh	22,176	0.25278	MudCube Power Consumption 6.6kW	5,606
Diesel	Kwh	40,616	0.25278	Compressed Air	10,267
Total Scope 1 Emissions					**15,873**
Scope 3					
Freighting Goods-HGV	km	220	0.864	Road- Empty Cuttings Bins	190
Freighting Goods-HGV	km	220	1.076	Road- Full Cuttings Bins	237
Freighting Goods-Sea Tanker	tonne.km	86,856	0.046	Sea- Empty Cuttings Bins	3,963
Freighting Goods-Sea Tanker	tonne.km	384,027	0.046	Sea- Full Cuttings Bins	17,523
Waste Disposal	Tonnes	1,226	Various	Landfilling Waste- Based on Table 5	1,473
Total Scope 3 Emissions					**23,386**
TOTAL KGCO2e EMISSIONS					**39,259**
TONNES CO2e					**39**

Fig 6. Landfill Adjusted- MudCube

- Using the MudCube as part of the drilling process would reduce the waste disposal emissions by approximately 76% if the waste material was landfilled.

9. Emissions Summary

Total Emissions Comparison (with oil separation and recovery)			
	Total Emissions (T/C02e)	Savings (T/C02e)	Savings Percentage
Using Shale Shaker	344	-	-
Using MudCube	200	144	42%

Table 6. Total Emissions Comparison

Total Emissions Comparison (with landfill)			
	Total Emissions (T/C02e)	Savings (T/C02e)	Savings Percentage
Using Shale Shaker	163	-	-
Using MudCube	39	124	76%

Table 7. Total Emissions Comparison

By reducing the quantity of waste created in the drilling process the MudCube is able to reduce the emissions associated with the waste transport and treatment by approximately 42%, when compared to using a shale shaker.

The primary source of GHG emissions savings is achieved through the reduction in weight and quantity of waste cuttings and mud, and is seen both in the reduction in associated transport and in any third party onshore waste processing requirements. There is a secondary saving through the retention of drilling mud which reduces the requirement of producing additional Mud and shipping this to the site.

Emissions Summary Comparison			
	Process Using a Shale Shaker (Tonnes C02e)	Process Using a MudCube (Tonnes C02e)	Increase/Savings Percentage
Operational Emissions	6	15.87	185%*
Activities Associated with Waste Transport	34	30.37	11%
Waste Treatment Emissions	174	153.40	12%

Mud Replacement Emissions	130	-	100%
Total	**344**	**200**	**42%**

*Increase
Table 8. Emissions Summary Comparison

10. Contact Details

Carbon-Zero UK (A division of Data Engineering Projects Limited)
100 Union Street
Aberdeen
AB10 1QR
Email: meadie@carbon-zero.uk
fchristie@dataenp.co.uk
Website: www.carbon-zero.uk
Telephone: 01224 049169

Appendix A – Online Calculator

Shale Shaker Method Scopes 1,2 & 3 Emissions Summary

							kg Co2e	Tonnes Co2e	Notes
Scope	**Classification**	**Category**	**Sub-Category**	**Units**	**UOM**	**Quantity**	**kgCo2e**	**TeCo2e**	
Scope 1							5,563	5.57	
	Fuels	Liquid fuels	Diesel (100% mineral diesel)	Energy - Gross CV	kWh	20,160.00	5,096	5.1	Power Consumption
			Diesel (100% mineral diesel)	Energy - Gross CV	kWh	1,848.00	467	0.5	Fan Power Consumption
Scope 2									
Scope 3							338,115	338	
	Freighting goods	HGV (all diesel)	Articulated (>33t)	50% Laden	km	250	216	0.2	Road- Empty Bins Return Journey
			Articulated (>33t)	100% Laden	km	250	269	0.3	Road- Cuttings
			Articulated (>33t)	100% Laden	km	3649	3,928	3.9	Powder Transport
			Articulated (>33t)	0% Laden	km	3649	2,380	2.4	Powder Transport Return Journey
			Articulated (>33t)	100% Laden	km	1650	1,776	1.8	Oil Transport
			Articulated (>33t)	0% Laden	km	1650	1,076	1.1	Oil Transport Return Journey
			Articulated (>33t)	100% Laden	km	40	43	0.04	Mud Replacement Journey
			Articulated (>33t)	0% Laden	km	40	26	0.03	Replacement Return Journey
		Sea tanker	Products tanker	Products tanker	tonne.km	98267.00	4,484	4.5	Sea- Empty Bins Return Journey
			Products tanker	Products tanker	tonne.km	434682.0799	19,835	19.8	Sea- Cuttings
			Products tanker	Products tanker	tonne.km	66238.00	3,022	3.0	Mud Replacement Journey
			Products tanker	Products tanker	tonne.km	7286.00	333	0.3	Replacement Return Journey
	Managed assets-electricity	UK electricity generated	Electricity: UK	Electricity: UK kWh	kWh	9,598.03	2,238	2.2	Treatment Power Usage
		Water treatment	Water treatment	Water treatment	M3	191.15	135	0.1	
	Material use	Construction	Soils	Closed-loop source	tonnes	4.46	4	0.004	Clay for Mud Production
			Sand	Closed-loop source	tonnes	4.46	33	0.03	Sand for Mud Production
			Barite	Closed-loop source	tonnes	14.85	56,059	56.06	Barite for Mud Production
			Salt	Closed-loop source	tonnes	5.94	2	0.002	Salt for Mud Production
	WTT-Fuels	Liquid Fuels	Fuel Oil	tonnes	tonnes	95.04	70,990	70.99	Oil for Mud Production
	Water supply	Water supply	Water supply	water supply	M3	23.76	8	0.01	Water for Mud Production
	Fuels	Liquid fuels	Diesel (100% mineral diesel)	Volume	litres	63,715.00	171,258	171.3	RotoMill Treatment
Total Emissions							**343,678**	**344**	

MudCube Method Scopes 1,2 & 3 Emissions Summary									
							kg Co2e	Tonnes Co2e	**Notes**
Scope	**Classification**	**Category**	**Sub-Category**	**Units**	**UOM**	**Quantity**	**kgCo2e**	**TeCo2e**	
Scope 1							15,873	15.9	
Fuels	Fuels	Liquid fuels	Diesel (100% mineral diesel)	Energy - Gross CV	kWh	22,176.0	5,606	5.6	Operational Usage
			Diesel (100% mineral diesel)	Energy - Gross CV	kWh	40,616.0	10,267	10.3	Compressed Air
Scope 2									
Scope 3							183,765	184	
	Freighting goods	HGV (all diesel)	Articulated (>33t)	50% Laden	km	220	190	0.2	Road- Empty Bins Return Journey
			Articulated (>33t)	100% Laden	km	220	237	0.2	Road- Cuttings
			Articulated (>33t)	100% Laden	km	3240	3,487	3.5	Powder Transport
			Articulated (>33t)	0% Laden	km	3240	2,113	2.1	Powder Transport Return Journey
			Articulated (>33t)	100% Laden	km	1651.2	1,777	1.8	Oil Transport
			Articulated (>33t)	0% Laden	km	1651.2	1,077	1.1	Oil Transport Return Journey
		Sea tanker	Products tanker	Products tanker	tonne.km	86856	3,963	4.0	Sea Freight- Empty Bins
			Products tanker	Products tanker	tonne.km	384026.6	17,523	17.5	Sea Freight- Cuttings
	Managed assets- electricity	UK electricity generated	Electricity: UK	Electricity: UK kWh	kWh	8479.526	1,977	2.0	Treatment Power
	Water treatment	Water treatment	Water treatment	Water treatment	M3	168.87	120	0.1	Water treatment
	Fuels	Liquid fuels	Diesel (100% mineral diesel)	Volume	litres	56,290	151,300	151.3	Treatment Usage
Total Emissions							**199,637**	**200**	