CARBON-ZERO

MudCube - Onshore Technical Carbon Emissions Comparative Assessment

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Contents

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 follow on from a previous comparative assessment based on an offshore well scenario. This second assessment is again intended to quantify any GHG and carbon emissions savings realised using Cubility's MudCube system compared to the traditional Shale Shaker method, this time based on an onshore well scenario.

This Carbon Emissions Report calculates the effective GHG emissions generated by drilling an onshore well and the impact that 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 onshore well are as follows:

Total Emissions Comparison				
Disposal Method	Treatment Type	Total Emissions (Tonnes C02e)	Savings (Tonnes C02e)	Savings Percentage
Oil Recovery	Shale Shaker	320	-	-
	MudCube	184	136	43%
Landfill	Shale Shaker	154	-	-
	MudCube	38	116	75%

Table 1–Emissions Summary

By reducing waste volumes, using a MudCube helps to reduce the waste treatment emissions associated with drilling by approximately 43% when disposed via the oil recovery process, and 75% 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 treating the cuttings 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: shipping of the units, 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 and any emissions associated with installation, including plant and manpower, of both systems is out with the scope of this assessment. 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]

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[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:

- The well site has been assumed to be in the Permian Basin, Texas, USA.
- Total well depth – 3,300m.
- Average total weight of cuttings produced per well – 1139.7mt.
- The cuttings will be sent to a treatment facility in Houston, 720 km from the site.
- 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 in vicinity, estimated 5 km from the treatment site.
- Water will be treated and discharged on site.
- Oil will be transferred to third party site in vicinity, estimated, 5 km from the treatment site.

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
2 units would be required for well.	2 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 shipping 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
Waste Treatment- Diesel Fuel Usage	Waste Treatment- Diesel Fuel Usage
Waste Treatment- Electricity Usage	Waste Treatment- Electricity Usage
Road transport of cuttings to/from site	Road transport of cuttings to/from site
Road transport of produced powder	Road transport of produced powder
Road transport of produced oil	Road transport of produced oil
Wastewater treatment of produced water	Wastewater treatment of produced water
Delivery of 2 MudCube's to well site	Production and shipping of replacement drilling mud
	Delivery of 2 Shale Shakers to well site

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 3,300m onshore well is estimated to be 27 days[3].
- 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, 2 shale shakers or 2 MudCubes would be required.
- Emissions from transporting the units to the well site will be based on the percentage of the total load weight used by a fully loaded 33t HGV. Two MudCubes use approx. 10% of weight allowance and two Shale shakers use approx. 15% of weight allowance.
- A standard shale shaker unit will have an energy consumption of 6 kWh.
- A single MudCube unit 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 oil-based mud, which will consist of 64% oil, 16% water, 10% barite, 4% salt, 3% clay and 3% sand. It will be sourced from a facility in the center of the Permian basin with a travel distance of 250 km to the well site.[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.
- Transport of waste material will be conducted using >33t HGV.

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.

[3] Dittrick (2019) Permain Basin Operators cut drilling time, lower expense, Oil & Gas Journal Available https://www.ogj.com/general-interest/article/14036183/permian-basin-operators-cut-drilling-time-lower-expense

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

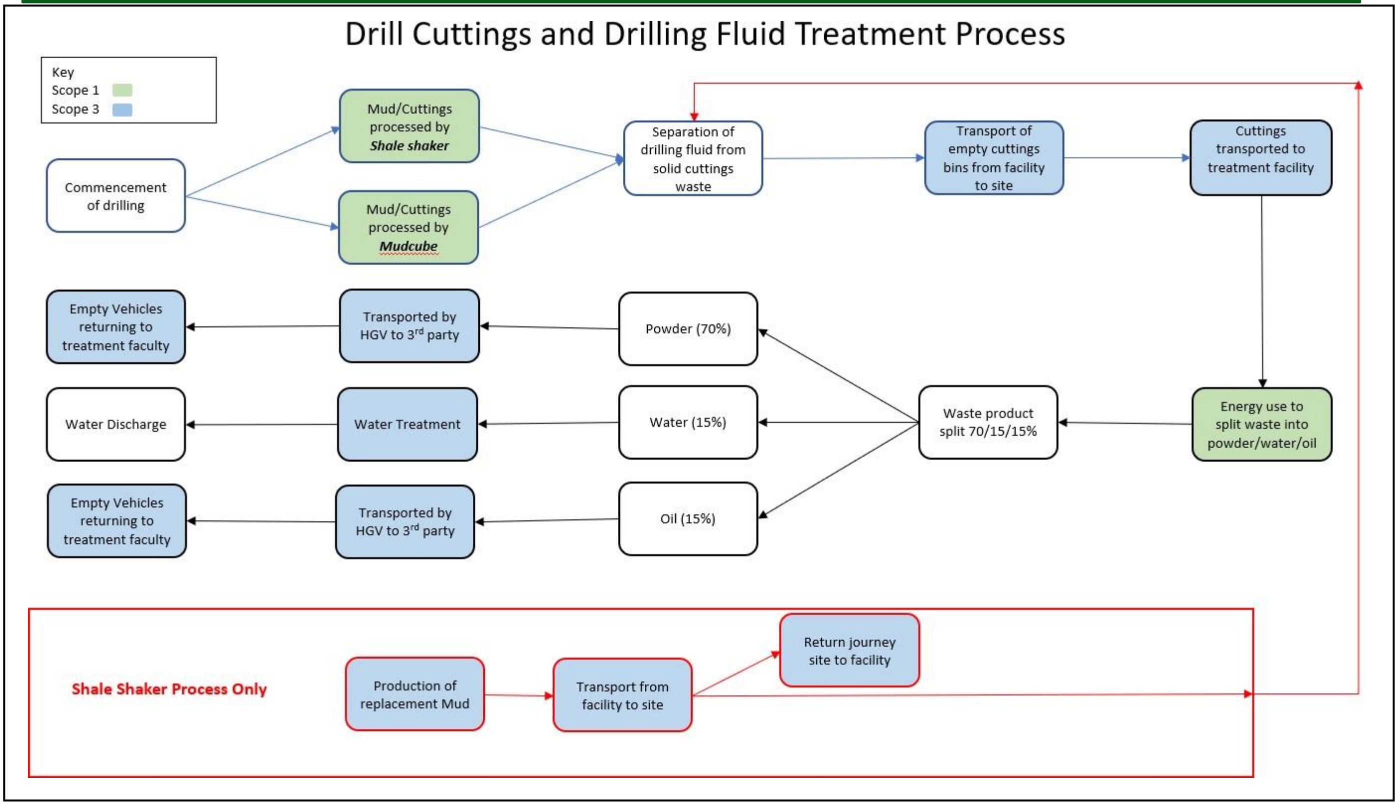

Fig.1 Process Overview

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.

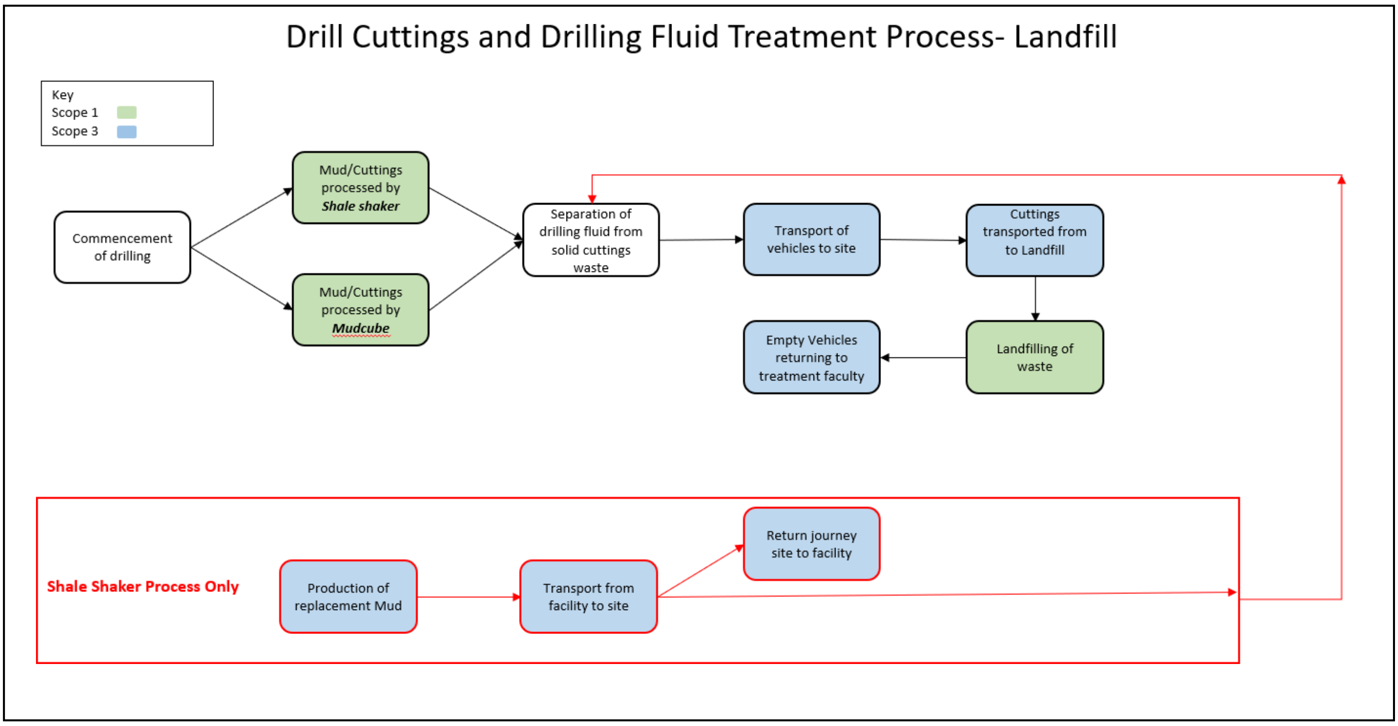

Fig.2 Process Overview Landfilling

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 1,139.7 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 757.3 tonnes and the mud accounts for 382.4 tonnes of the total waste.

It has been assumed the 134 tonnes of 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	85.568	134
Water	16	21.392	
Barite	10	13.37	
Clay	3	4.011	
Sand	3	4.011	
Salt	4	5.348	

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	15,552	0.25278	SS Power Consumption @ 6kW	1,966
Total Scope 1 Emissions					**1,966**
Scope 3					
Freighting Goods-HGV	km	25,200	1.076	Road- Cuttings Transport	27,124
Freighting Goods-HGV	km	25,200	0.652	Road- Cuttings Return Journey	16,436
Freighting Goods-HGV	km	125	1.076	Road- Powder Transport	135
Freighting Goods-HGV	km	125	0.652	Road- Powder Return Journey	82
Freighting Goods-HGV	km	30	1.076	Road- Oil Transport	32
Freighting Goods-HGV	km	30	0.652	Road- Oil Return Journey	20
Freighting Goods-HGV	km	1,250	1.076	Road- Mud Replacement Transport	1,345
Freighting Goods-HGV	Km	1,250	0.652	Road- Mud Return Journey	815
Freighting Goods-HGV	Km	108	1.076	Road- Shaker Delivery to site	116
Managed Assets- Electricity	kWh	8,584	0.446[5]	Treatment Power Usage	3,830
Water Treatment	M3	171	0.708	Water Treatment	121
Material Use	Tonnes	4	0.9968	Clay for Mud Production	4
Material Use	Tonnes	4	7.4696[6]	Sand for Mud Production	30
Material Use	Tonnes	13	3775	Barite for Mud Production	50,472
Material Use	Tonnes	5	0.344	Salt for Mud Production	2
WTT-Fuels	Tonnes	86	746.95	Oil for Mud Production	63,915
Water Supply	M3	21	0.344	Water for Mud Production	7
Diesel	litres	284,925	2.688	RotoMill Treatment	153,168
Total Scope 3 Emissions					**317,654**
TOTAL KGCO2e EMISSIONS					**319,620**
TONNES CO2e					**320**

[5] Carbon Footprint (2020) Country Specific electricity Grid Greenhouse Gas Emissions Factors

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

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 320 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 1,139.7 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 1,006 tonnes. This waste consists of 757.3 tonnes of drill cuttings and 248.6 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	8,554	0.25278	MudCube Power Consumption	2,162
Diesel	Kwh	15,667	0.25278	6.6kW Compressed Air	3,960
Total Scope 1 Emissions					**6,122**
Scope 3					
Freighting Goods-HGV	km	22,309	1.076	Road- Cuttings Transport	24,012
Freighting Goods-HGV	km	22,309	0.652	Road- Cuttings Return Journey	14,551
Freighting Goods-HGV	km	110	1.076	Road- Powder Transport	118
Freighting Goods-HGV	km	110	0.652	Road- Powder Return Journey	72
Freighting Goods-HGV	km	25	1.076	Road- Oil Transport	27
Freighting Goods-HGV	km	25	0.652	Road- Oil Return Journey	16
Freighting Goods-HGV	km	72	1.076	Road- MudCube Delivery to site	77
Freighting Goods-Container Ship	tonne.km	28,418	0.01614	Sea- MudCube Delivery to site	459
Managed Assets- Electricity	kWh	7,577	0.446	Treatment Power Usage	3,381
Water Treatment	M3	151	0.708	Water Treatment	107
Diesel	litres	50,300	0.253	RotoMill Treatment	135,200
Total Scope 3 Emissions					**178,020**
TOTAL KGCO2e EMISSIONS					**184,142**
TONNES CO2e					**184**

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 184 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, road transport of waste and Mud replacement would remain unchanged from section 8.1 and 8.2. For this scenario it has been assumed the waste will be transported to the nearest city, San Antonio, for disposal.

Landfill Disposal Emissions					
	Waste Type	Weight (Tonnes)*	Conversion Factor	Kg Co2e	Total
Using Shale Shaker in Process	Cuttings	757.3	1.249	946	1,521
	Oil	244.7	1.249	306	
	Barite	38.2	1.264	48	
	Water	61.2	0.0	0	
	Sand	11.5	1.249	14	
	Clay	11.5	17.592	202	
	Salt	15.3	0.334	5	
Using MudCube in process	Cuttings	757.3	1.249	946	1,320
	Oil	159.2	1.249	199	
	Barite	24.9	1.264	31	
	Water	39.8	0	0	
	Sand	7.5	1.249	9	
	Clay	7.5	17.592	131	
	Salt	9.9	0.334	3	

Table 5 Landfilling Emissions. *Weight based on composition on Mud outlined in table 4.

- 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.

Landfill Option- Carbon Emissions Using Shale Shaker in Process					
Results	Unit	Quantity	BEIS Emissions Factor	Description	Carbon Emissions (KgCO2e)
Scope 1					
Diesel	Kwh	15,552	0.25278	SS Power Consumption @ 6kW	1,966
Total Scope 1 Emissions					**1,966**
Scope 3					
Freighting Goods-HGV	km	19,320	1.076	Road- Cuttings Transport	20,795
Freighting Goods-HGV	km	19,320	0.652	Road- Cuttings Return Journey	12,601
Freighting Goods-HGV	km	1,250	1.076	Road- Mud Replacement Transport	1,345
Freighting Goods-HGV	Km	1,250	0.652	Road- Mud Return Journey	815
Freighting Goods-HGV	km	108	1.076	Road- Shaker Delivery to site	116
Material Use	Tonnes	4	0.9968	Clay for Mud Production	4
Material Use	Tonnes	4	7.4696[6]	Sand for Mud Production	30
Material Use	Tonnes	13	3775	Barite for Mud Production	50,472
Material Use	Tonnes	5	0.344	Salt for Mud Production	2
WTT-Fuels	Tonnes	86	746.95	Oil for Mud Production	63,915
Water Supply	M3	21	0.344	Water for Mud Production	7
Landfilling	Tonnes	Above	Above	Landfilling all waste	1,521
Total Scope 3 Emissions					**151,623**
TOTAL KGCO2e EMISSIONS					**153,589**
TONNES CO2e					**154**

Fig 5. Landfill Adjusted- Shale Shaker

Landfill Option- Carbon Emissions Using MudCube in Process					
Results	Unit	Quantity	BEIS Emissions Factor	Description	Carbon Emissions (KgCO2e)
Scope 1					
Diesel	Kwh	8,554	0.25278	MudCube Power Consumption 6.6kW	2,162
Diesel	Kwh	15,667	0.25278	Compressed Air	3,960
Total Scope 1 Emissions					**6,122**
Scope 3					
Freighting Goods-HGV	km	17,112	1.076	Road- Cuttings Transport	18,419
Freighting Goods-HGV	km	17,112	0.652	Road- Cuttings Return Journey	11,161
Freighting Goods-HGV	km	72	1.076	Road- MudCube Delivery to site	77
Freighting Goods-Container Ship	tonne.km	28,418	0.01614	Sea- MudCube Delivery to site	459
Waste Disposal	Tonnes	Above	Above	Landfilling all waste	1,320
Total Scope 3 Emissions					**31,436**
TOTAL KGCO2e EMISSIONS					**37,558**
TONNES CO2e					**38**

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	320	-	-
Using MudCube	184	136	43%

Table 6. Total Emissions Comparison

Total Emissions Comparison (with landfill)			
	Total Emissions (T/C02e)	Savings (T/C02e)	Savings Percentage
Using Shale Shaker	154	-	-
Using MudCube	38	116	75%

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 43%, when compared to using a shale shaker.

The primary source of GHG emissions savings is achieved through the retention of drilling mud which reduces the requirement of producing additional Mud and shipping this to the site. There is a secondary saving 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 waste treatment requirements.

Emissions Summary Comparison			
	Process Using a Shale Shaker (Tonnes C02e)	Process Using a MudCube (Tonnes C02e)	Increase/Savings Percentage
Operational Emissions	2.08	6.66	220%*
Activities Associated with Waste Transport	43.83	38.80	11%
Waste Treatment Emissions	157.12	138.58	12%
Mud Replacement Emissions	116.59	-	100%
Total	**320**	**184**	**43%**

Table 8. Emissions Summary Comparison.
*Increase

10. Contact Details

Carbon-Zero UK (A division of Data Engineering Projects Limited)
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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							1,966	1.97	
	Fuels	Liquid fuels	Diesel (100% mineral diesel)	Energy - Gross CV	kWh	7,776	1,966	1.97	Power Consumption
Scope 2									
Scope 3							319,935	319.9	
	Freighting goods	HGV (all diesel)	Articulated (>33t)	100% Laden	km	25,200	27,124	27.12	Transport of Cuttings from site
			Articulated (>33t)	0% Laden	km	25,200	16,436	16.44	Return HGV Journey
			Articulated (>33t)	100% Laden	km	125	135	0.13	Transport Powder to Factory
			Articulated (>33t)	0% Laden	km	125	82	0.08	Return HGV Journey
			Articulated (>33t)	100% Laden	km	30	32	0.03	Transport of Oil to 3rd Party
			Articulated (>33t)	0% Laden	km	30	20	0.02	Return HGV Journey
			Articulated (>33t)	100% Laden	km	1,750	1,873	1.87	Transport of Replacement Mud
			Articulated (>33t)	0% Laden	km	1,750	1,141	1.14	Return HGV Journey
			Articulated (>33t)	100% Laden	km	108	116	0.12	Delivery of Shaker to site
	Fuels	Liquid fuels	Diesel (100% mineral diesel)	Volume	litres	56,985	153,168	153.17	RotoMill Treatment
	Managed assets-electricity	electricity generated	Electricity: Texas	Electricity: kWh	kWh	8,584	3,830	3.83	Treatment Power Usage
		Water treatment	Water treatment	Water treatment	M3	170.96	121	0.12	
	Material use	Construction	Soils	Closed-loop source	tonnes	4.011	4	0.00	Clay for Mud Production
			Sand	Closed-loop source	tonnes	4.011	30	0.03	Sand for Mud Production
			Barite	Closed-loop source	tonnes	13.37	50,471.8	50.47	Barite for Mud Production
			Salt	Closed-loop source	tonnes	5.348	1.8	0.00	Salt for Mud Production
	WTT-Fuels	Liquid Fuels	Fuel Oil	tonnes	tonnes	85.57	63,915	63.92	Oil for Mud Production
	Water supply	Water supply	Water supply	water supply	M3	21.39	7.4	0.01	Water for Mud Production
Total Emissions							**319,621**	**320**	

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							6,122	6.12	
Fuels	Fuels	Liquid fuels	Diesel (100% mineral diesel)	Energy - Gross CV	kWh	8,553.6	2,162.4	2.16	Operational Usage
			Diesel (100% mineral diesel)	Energy - Gross CV	kWh	15,667.0	3,960	3.96	Compressed Air
Scope 2									
Scope 3							166,207	166.2	
	Freighting goods	HGV (all diesel)	Articulated (>33t)	100% Laden	km	22309	24,012.3	24.01	Road- Cuttings
			Articulated (>33t)	0% Laden	km	22309	14,550.8	14.55	Road- Cuttings Return Journey
			Articulated (>33t)	100% Laden	km	110	118.4	0.12	Powder Transport
			Articulated (>33t)	0% Laden	km	110	71.7	0.07	Powder Return Journey
			Articulated (>33t)	100% Laden	km	25	27	0.03	Oil Transport
			Articulated (>33t)	0% Laden	km	25	16	0.02	Oil Transport Return Journey
			Articulated (>33t)	100% Laden	km	72	77	0.07	Road- MudCube to site
	Water treatment	Water treatment	Water treatment	Water treatment	M3	141	100	0.1	Water treatment
		Cargo Ship	Container Ship	Average Container Ship	Tonne.km	28,418	459	0.46	Shipping MudCube
	Managed assets-electricity	UK electricity generated	Electricity: UK	Electricity: UK kWh	kWh	7577	3,380.7	3.38	Treatment Power
	Fuels	Liquid fuels	Diesel (100% mineral diesel)	Volume	litres	50300	135,199.9	135.20	Treatment Usage
Total Emissions							**184,142.50**	**184.14**	