Date: 3/05/22

Prepared by: Alex Safran - senior associate, PwC Sustainability and Climate Change team

Westland Mineral Sands - Carbon emissions savings calculations

This model calculates the GHG emissions associated with transporting materials from Westland Mineral Sands Co. Ltd (Westland Mineral Sands) depots and from its partners depots. The purpose is to understand the potential GHG emissions savings from using shipping freight forwarders instead of trucks and trains to transport materials across New Zealand.

Please note that these calculations are based on information provided by Westland Minerals Sands. It is understood that the tonnages provided only represent the minimum amount of materials and additional product will be shipped rather than transported on the road that isn't included in the calculations. PwC cannot confirm the accuracy of the data provided in relation to the tonnages of materials being transported or the distances travelled. Embodied carbon emissions and operational emissions associated with the construction and operations of the port have not been taken into consideration into these calculations and comparisons.

Restrictions:

This model has been prepared for Westland Mineral Sands Co. Limited (Westland Mineral Sands) to provide high level calculations of your estimated greenhouse gas (GHG) emissions savings from using shipping vessels instead of roads and rails to transport materials and goods across New Zealand. This model has been prepared solely for this purpose and should not be relied upon for any other purpose. We accept no liability to any party should it be used for any purpose other than that for which it was prepared.

This model has been prepared solely for use by Westland Mineral Sands and may not be copied or distributed to third parties without our prior written consent.

To the fullest extent permitted by law, PwC accepts no duty of care to any third party in connection with the provision of this model and/or any related information or explanation (together, the “Information”). Accordingly, regardless of the form of action, whether in contract, tort (including without limitation, negligence) or otherwise, and to the extent permitted by applicable law, PwC accepts no liability of any kind to any third party and disclaims all responsibility for the consequences of any third party acting or refraining to act in reliance on the Information.

We have not independently verified the accuracy of information provided to us, and have not conducted any form of audit in respect of Westland Mineral Sands. Accordingly, we express no opinion on the reliability, accuracy, or completeness of the information provided to us and upon which we have relied.

The statements and opinions expressed herein have been made in good faith, and on the basis that all information relied upon is true and accurate in all material respects, and not misleading by reason of omission or otherwise.

The statements and opinions expressed in this information are based on information available as at the date of the model.

We reserve the right, but will be under no obligation, to review or amend our model, if any additional information, which was in existence on the date of this model, was not brought to our attention, or subsequently comes to light.

This letter is issued pursuant to terms and conditions set out in our letter of engagement dated 29 April 2022.

Avoided emissions from this proposal

The calculations show that Westland Mineral Sands will avoid emissions equivalent to 0.066 Mt CO2 - e if it stops using heavy diesel trucks and shifts to shipping its products (heavy mineral sands, sand, aggregates and imported goods) from the operational port in Westport.

Westland Mineral Sands currently emits 0.077 MT CO2 - e transporting its products via road, which represents 0.2% of total national transport emissions (38 MT CO2 - e). It has been calculated that shipping would emit just 0.011 MT CO2 - e. This is 0.13% of total national transport emissions.

Total road emissions using trucks	**76,573**	**tons CO2e**
Total emissions if using rail instead of road where possible	**42,095**	**tons CO2e**
Total emissions from shipping	**10,906**	**tons CO2e**

Contribution of this proposal to the 2050 net zero carbon goal

To achieve the net zero carbon goal, the Climate Change Response Act 2020 now establishes a system of emissions budgets to act as stepping stones towards the long-term target. The first three, five yearly emissions budgets have been provisionally set (table below) and the first emissions reduction plan (due to launch in late May) will outline the policies that the Government will implement to achieve the first emission budget, with a view to the following two emissions budgets.

The emissions budget is currently sector neutral - it is not clear if this will remain the case. However, the planned shift for Westland Marine Sands from using heavy diesel trucks in favour of shipping would contribute 0.5% towards the first planned emissions budget of 12.2 Mt CO2 - e. This is a significant single contribution, and represents a fraction of the potential savings likely to be made by Westland Marine Sands: additional product will be shipped rather than transported on the road that isn't included in the calculations.

Emissions reduction required to meet the proposed budgets		
	Mt CO2 - e	Percentage reduction
First budget period 2022 - 2025	12.2	4.20%
(Provisional) Second budget period 2026-2030	30.8	9.30%
(Provisional) Third budget period 2031-2035	61.1	20.30%

3/05/2022

Prepared by: Alex Safran - senior associate, PwC Sustainability and Climate Change team

Westland Mineral Sands - GHG emissions savings calculations

				Road
Calculations	1nm =	1.852	km	Rail
				Ship

Note: return trips have not been taken into consideration as it is uncertain whether the trucks or the ships would be carrying any loads on the return trips to maximise efficiency)

West Coast

Road emissions:

West Coast to Lyttelton	354,000,000	tkm
	37,170,000	**kg CO2e**
	Additional road and shipping emissions for imported goods	
Ship from East Coast	2,222,400	kg CO2e
Road via Timaru	4,746,000	kg CO2e
Total additional	**6,968,400**	**kg CO2e**
Total Road emissions	**44,138,400**	**kg CO2e**

Rail emissions:

West Coast to Lyttelton	**9,660,000**	**kg CO2e**

Shipping emissions:

Heavy Mineral Sands	166,680	kg CO2e
Additional Sands (3rd party)	166,680	kg CO2e
Aggregates for Auckland	5,517,108	kg CO2e
Imported goods	1,122,312	kg CO2e
Total Shipping emissions	**6,972,780**	**kg CO2e**

Tainui Kawhia

Road emissions:

Logs via Port of Tauranga	12,789,000	kg CO2e
Iron sand via Port of Tauranga	9,135,000	kg CO2e
Total Road emissions	**21,924,000**	**kg CO2e**

Shipping emissions:

Logs	116,676	kg CO2e
Iron sand (via New Plymouth Port)	2,083,500	kg CO2e
Total Shipping emissions	**2,200,176**	**kg CO2e**

Te Rimu Trust

Road emissions:

Logs via Gisborne	5,292,000	kg CO2e
Aggregate and lime	5,218,500	kg CO2e
Total Road emissions	**10,510,500**	**kg CO2e**

Shipping emissions:

Logs	1,300,104	
Aggregate and lime	433,368	
Total Shipping emissions	**1,733,472**	**kg CO2e**

Total emissions and total emissions avoided

Total road emissions (trucks)	**76,573**	**tons CO2e**
Total emissions if using rail instea	**42,095**	**tons CO2e**
Total emissions from shipping	**10,906**	**tons CO2e**

Compared to New Zealand's gross emissions			
Total emissions avoided by Westland Mineral Sands	**65,666.5**	**tons CO2e**	**Total GHG emissions avoided by using shipping vessels instead of just trucking materials and goods across New Zealand**
National emissions	82,300,000	tons CO2e	In 2019 New Zealand's gross greenhouse gas emissions were 82.3 million tonnes of CO2e
	0.08	%	The emissions avoided by using shipping vessels instead of trucks to transport materials across New Zealand, is equivalent to nearly 0.1% of New Zealand's 2019 gross greenhouse gas emissions.
Transport contributes 47% of total emissions in NZ	38,681,000	tons CO2e	(47% of the national emissions)
Westland Mineral Sands contribution to transport	0.20%	By using	
Proposed first emissions reduction budget is to cut emissions by 12.2 Mtons CO2e	12,200,000	tons CO2e	(National emissions reduction target from 2022 to 2025)
Westland Mineral Sands proposal would help contribute to the proposed emissions reduction budget	0.54%	Westland Mineral Sands would contribute 0.54% of the first emissions reduction plan budget	

Information provided by the client

West Coast

1,000,000 tons of Heavy Mineral Sands/year

Road to Lyttelton:

354 km one way
Truck would need to return back to depot so consider that we need a return trip as well
Truck capacity: 28 tons, standard fuel burn

Rail to Lyttelton:

345 km one way

Shipping :

3 Nautical Miles each way
Shipping fuel burn: 0.6 L/ton Note: vessel can carry 6500 tons per trip

Additional cargoes

1,000,000 tons of Sands through third party

300,000 tons/year of aggregates for Auckland
331 nm (Westport to Onehunga)

100,000 tons/year of imported goods
400 nm (imported goods shipped from East Coast to Timaru via ship)
452 km (imported goods are then transported via road from Timaru to Westport)
By shipping the imported goods directly via ship, we would avoid shipping these goods across the south Island and avoid sending them via road.
202 nm (Taranaki to Westport; by shipping the imported goods directly via ship, it would only be a distance of 202nm)

Tainui Kawhia

700,000 tons of logs
174 km each way via road to Port of Tauranga
3 Nautical miles each way

500,000 tons per year of iron sand
174 km each way via road to Port of Tauranga
75 Nautical miles each way (via New Plymouth port)

Te Rimu Trust

300,000 tons of logs/year
168 km each way via road to Gisborne
78 Nautical miles

100,000 tons of aggregate and lime/year
497 km via road
Shipping metrics same as above according to Westland Mineral Sands

Emission factors

Source: Ministry for the Environment. 2020. Measuring Emissions: A Guide for Organisations: 2020 Detailed Guide. Wellington: Ministry for the Environment.

Road emission factor: P.74

8.2.3 GHG inventory development

If an organisation uses freight vehicles, they can calculate the emissions from the kilometres travelled. Multiply the distances by the emission factors in table 43 to table 50. Applying the equation in section 2, this means:

Q = km travelled by specific freight vehicle
F = appropriate emission factors from table 43 to table 50

For emissions from freighting goods, users need to know the weight in tonnes of the goods freighted as well as the kilometres travelled. These two numbers multiplied together is the tkm. Multiply the tkm by the emission factors in table 51. Applying the equation in section 2, this means:

Q = tonne × kilometres travelled
F = appropriate emission factors from table 51

Table 51 contains emission factors for freighting goods.

Table 51: Emission factors for freighting goods by road

Emission source	Unit	kg CO_2-e/unit	kg CO_2/unit (kg CO_2-e)	kg CH_4/unit (kg CO_2-e)	kg N_2O/unit (kg CO_2-e)
Long-haul heavy truck	tkm	0.105	0.103	0.0001	0.002
Urban delivery heavy truck	tkm	0.390	0.383	0.0005	0.006
All trucks	tkm	0.135	0.133	0.0002	0.002

Note: These numbers are rounded to three decimal places unless the number is significantly small.

Truck emissions factor 0.105 kg CO2e/unit

Note: we understand that Westland Mineral Sands will be partnering with other organisations for this proposal as an Alliance. As such, it is difficult to ascertain the details of the Alliance's fleet. Therefore, the emission factor for freighting goods by roads shall

Rail emission factor p. 78

In New Zealand, KiwiRail owns the rail infrastructure and has provided the information to calculate the emission factor. The emission factor for freighting goods by rail is in table 56.

Table 56: Emission factors for rail freight

Emission source	Unit	kg CO_2-e/unit	kg CO_2/unit (kg CO_2-e)	kg CH_4/unit (kg CO_2-e)	kg N_2O/unit (kg CO_2-e)
Rail freight	tkm	0.028	0.028	0.00005	0.0004

Note: These numbers are rounded to three decimal places unless the number is significantly small.

Rail emissions factor 0.028 kg CO2e/unit

Shipping emission factors p. 81

We calculated the domestic coastal shipping emission factor, table 60, based on the findings from the MoT presentation 'Real-world fuel economy of heavy trucks',[47] prepared for the 2019 Transport Knowledge Conference. We adopted the international shipping emission factors in table 61 from the UK BEIS emission factors.

Table 60: Coastal shipping emission factors

Emission source	Unit	kg CO_2-e/unit	kg CO_2/unit (kg CO_2-e)	kg CH_4/unit (kg CO_2-e)	kg N_2O/unit (kg CO_2-e)
Oil products	tkm	0.016	0.016	0.00004	0.0001
Other bulk shipping	tkm	0.030	0.030	0.00007	0.0002
Container freight	tkm	0.046	0.046	0.0001	0.0004

Note: These numbers are rounded to three decimal places unless the number is significantly small.

Shipping emissions factor 0.030 kg CO2e/unit