

MEMORANDUM



To: Kalium Lakes Ltd
From: DRA Pacific Pty Ltd
CC: Riaan Taylor
Date: 18 September 2018
Revision: BSOPP-DRA-0000-EP-CA-0100] [Rev C]
RE: **Beyondie CO₂ emission calculations**

Background and Basis of Calculation

Kalium Lakes supplied operating cost estimate (OPEX) to DRA (180913-KLL Beyondie OPEX Estimate (RvN) to extract diesel and natural gas (NG) consumption figures for Beyondie site, for purposes of calculating the overall CO₂ emissions for site.

A density of 0.85 t/m³ was used for diesel in converting from litres to tonnes. The consumers of diesel for different SOP production scenarios are summarised in the following table:

Table 1 Diesel Consumers inside the SOP Purification Plant

Location	Unit	50 ktpa	75 ktpa	82 ktpa	90 ktpa	125 ktpa	150 ktpa	164 ktpa
Brine Supply	t/year	458	622	622	737	1,024	1,229	1,343
Harvesting	t/year	160	225	244	265	357	422	459
Vehicles	t/year	136	204	213	230	265	296	302
Water Supply	t/year	39	39	39	39	39	39	39

Natural Gas is used to generate steam in the purification plant and for power generation. When converting from GJ to tonnes on NG, a gas heating value of 48GJ/t was used. Consumption of NG for different production scenarios are summarised below:

Table 2 Consumption of Natural Gas for Different Production Scenarios

Location	Unit	50 ktpa	75 ktpa	82 ktpa	90 ktpa	125 ktpa	150 ktpa	164 ktpa
Process Plant	GJ/year	76,650	113,150	131,400	131,400	189,800	229,950	262,800
Power Generation	GJ/year	160,600	244,550	266,450	292,000	419,750	503,700	551,150

CO₂ Emissions

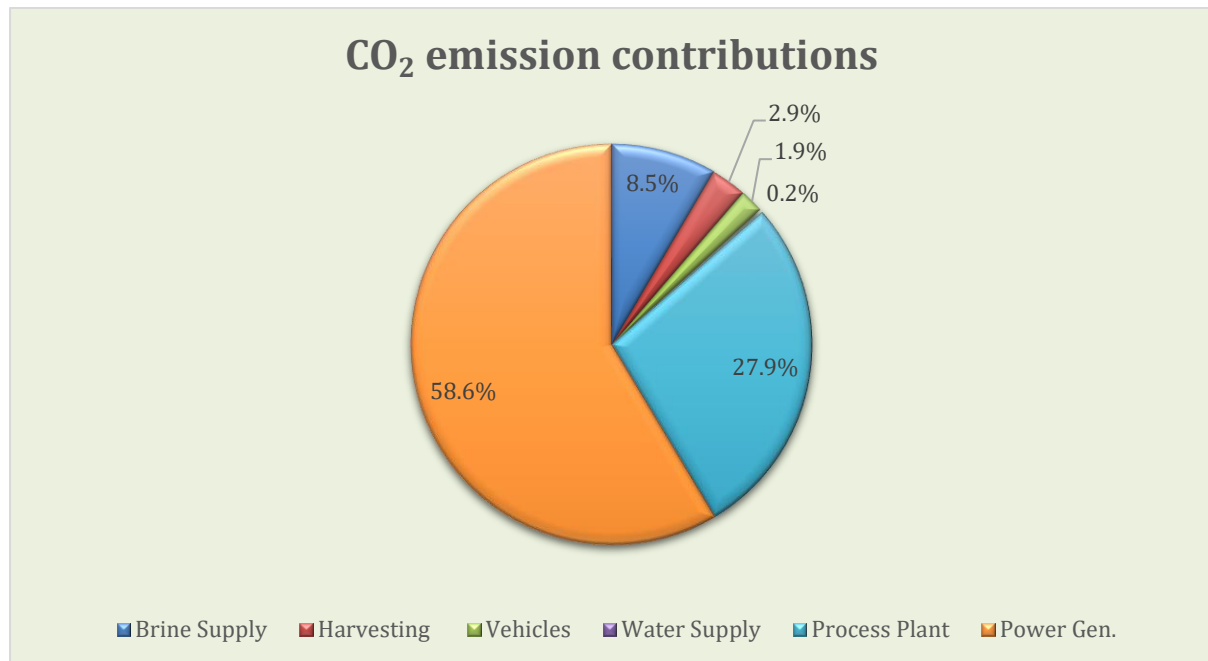
In calculating CO₂ emissions, we used the following to convert from tonnes of gas or tonnes of diesel to tonnes of CO₂ generated during combustion: 1 tonne of diesel → 3.1 tonnes of CO₂ and 1 tonne of gas → 2.6 tonnes of CO₂. The CO₂ contribution of the different diesel and NG consumers are summarised in the following table:

Table 3 CO₂ Emissions by Diesel and Gas Consumers

Location	Unit	50 ktpa	75 ktpa	82 ktpa	90 ktpa	125 ktpa	150 ktpa	164 ktpa
Brine Supply	t/year	1,438	1,951	1,951	2,313	3,212	3,854	4,214
Harvesting	t/year	500	707	764	830	1,119	1,325	1,441
Vehicles	t/year	428	640	668	722	832	929	949
Water Supply	t/year	123	123	123	123	123	123	123
Process Plant	t/year	4,055	5,986	6,951	6,951	10,041	12,165	13,903
Power Generation	t/year	8,496	12,937	14,096	15,447	22,206	26,647	29,157
Total	t/year	15,040	22,343	24,552	26,387	37,532	45,043	49,785

We have carried out spot checks of the above reported values against the guidelines in the *Technical Guidelines for the Estimation of Greenhouse Gas Emissions by Facilities in Australia (2014)* and found the differences of 0.05% for diesel and 3% for the natural gas CO₂ estimates. We viewed these as acceptable because our estimate was based on the calculation from the first principal considering the actual combustion reactions.

The CO₂ contributions are depicted in the following chart, which shows the percentage contribution of each area:



By: Enej Catovic
Principal Process Engineer