

3.4 Economic Assessment

The 10 ton/day plant will produce 75 006 litres/year of diesel equivalent bio methane at base substrate parameters of 11% TS and 78% VS of TS (see Table 1). Total income before tax is estimated at R1 112086. However, at a 5% discounting rate, the 10 ton/day plant will not break even during the 20 years assumed project life span. Increasing the substrate characteristics to 15% TS and 85% VS, the plant will produce 117 328 litres/year of diesel equivalent bio methane sufficient to fuel two metro buses and will break even in the 13th year after start up as presented in Table 1 with an internal rate of return (IRR) of 8.3% .

3.4.1 Economic potential to run a 50 tons/day biogas plant

Due to the long duration of payback period for the 10 ton/day plant, the second option investigated the economic viability of diverting all JM fruit and vegetable waste and the organic fraction into an anaerobic digester. A 50 ton/day plant capacity was therefore investigated. Capital expenditure (CAPEX) was estimated to be at R35 313 750 and annual operating expenditure at 3% CAPEX (R1 060 500) with 2.5% yearly escalation rate. At base conditions of 11% TS and 78% VS of TS, 161 365 litres/year of diesel equivalent of bio methane will be produced (see Table 2). This fuel is sufficient to fuel four (4) metro buses per year. At the base condition, the plant will break even in the 14th year after start-up. Increasing the TS to 15% and VS to 85%, which is practicable, 381 961 litres/year of diesel equivalent of bio methane will be produced as shown in Table 2. The payback period will be 8 years with an internal rate of return (IRR) of 14.3%.

If grass-residues are co-digested with JM fruit and vegetable waste, TS can be increased to 25%. At 85% VS, 831 617 litres/year of diesel equivalent bio methane can be produced. This is sufficient to fuel 20 metro buses per year. A break even of 4.4 years with an IRR of 26.0% is achievable as presented in Table 3.

Table 2: Economic assessment for setting a 50 tons/day biogas plant

TS = 11%						
VS	78% (base case)	80% (Medium case)	85% (High case)	78% (base case)	80% (Medium case)	85% (High case)
Biogas yield (m ³ /year)	832 517	853 864	907 231	1 135	1 164 360	1 237
Net biogas	295 973	317 320	370 687	598 707	627 816	700
Bio methane (m ³ /year)	171 664	202 450	214 998	347 250	364 133	406
Diesel (L/year)	161 365	173 002	202 098	326 415	342 285	381
Metro bus fuelled/year (100%)	4	4	5	8	8	9
Metro bus fuelled/year (30-	10	10	12	20	21	23
Annual sales income before tax	5,092,715	5,204,558	5,484,164	6,678,849	6,831,362	7,212,643
Break even (years)	10	9.7	9	7	6.9	6.4
Break even (years) @ 5% discount.	14.6	13.8	12.6	9	8.6	8
IRR (%)	7.7	8.0	9.0	1	13.1	14.3

Table 3: Bio methane potential for a 50 tons/day with TS of 25%

Description	Values
Biogas yield (m ³ /year)	2 061 888
CHP Self usage (m ³ /year)	536 544
Net biogas (m ³ /year)	1 525 344
Energy value (MJ)	34 777 832
Energy MJ/kg/LPG	709 752
Bio methane (m ³ /year)	884 669
Mass of bio methane	973 169
Diesel (L/year)	831 617
Metro bus fuelled/year (100%)	20
Metro bus fuelled/year on fuel mix (30-70%)	51
Annual sales income before tax (ZAR)	11 533 842
Break even (years)	3.9
Break even (years) @ 5% discount.	4.4
IRR (%)	26.0

4. Social Impact Assessment

Several benefits are obtained from the usage of biogas as a source of energy. These include the fact that the biogas is a renewable source of energy since waste is generated on a daily basis. Furthermore, the amount of greenhouse gases emitted to the environment is reduced due to the reduced amount of carbon dioxide and methane emitted to the environment from the rotting of the carbon dioxide. Digestion of waste to biogas also reduces the amount of waste that ends up at landfills, increasing the lifespan of the landfills. The living conditions of people are also improved by having a clean and sanitary environment.

5. Conclusion

The waste quantification conducted indicated that all organic wastes discharged at a local landfill are available for energy recovery as they are presently being covered with top soil to degenerate. If all organic wastes are converted into bio methane, about 100 Metro buses can be fuelled. The 20% is a conservative estimate of the theoretically calculated 157, representing 29%, metro buses that can be fuelled. There is a low likelihood for return on investment for a 10 ton/day plant and high potential for return on investment for a 50 ton/day plant especially when co-digested with grass residues. A 50 ton/day which holds higher return on investment with a shorter payback period is highly recommended for investment.

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