

7.8 Case Example in the sugar industry

A typical South African sugar factory

The crushing season is eight to nine months, starting in April and finishing in November/December. The throughput in this example is 300 t/h or 1.5 million tons of cane per annum. At this throughput the boiler steam is just over 160 t/h at a pressure of 3000 kPa(a) and a temperature of 400°C. The steam is expanded through back pressure steam turbine prime movers and turbo alternators to 200 kPa(a). Total specific internal power requirement is 43 kWh/tc. Process steam on cane is 60% and is mainly used for multiple evaporation and juice heating. The evaporator station is a quadruple effect with vapour1 and vapour2 being used for various process duties. Cane wash water or imbibition is high at 400% on fibre resulting in an extraction of over 98%. The sugar factory is designed to meet its own power and steam requirements. Bagasse is used inefficiently to avoid the need for a costly bagasse disposal system while minimising the burning of coal. Figure 14 shows a typical configuration for a power plant with in-house power and steam requirements.

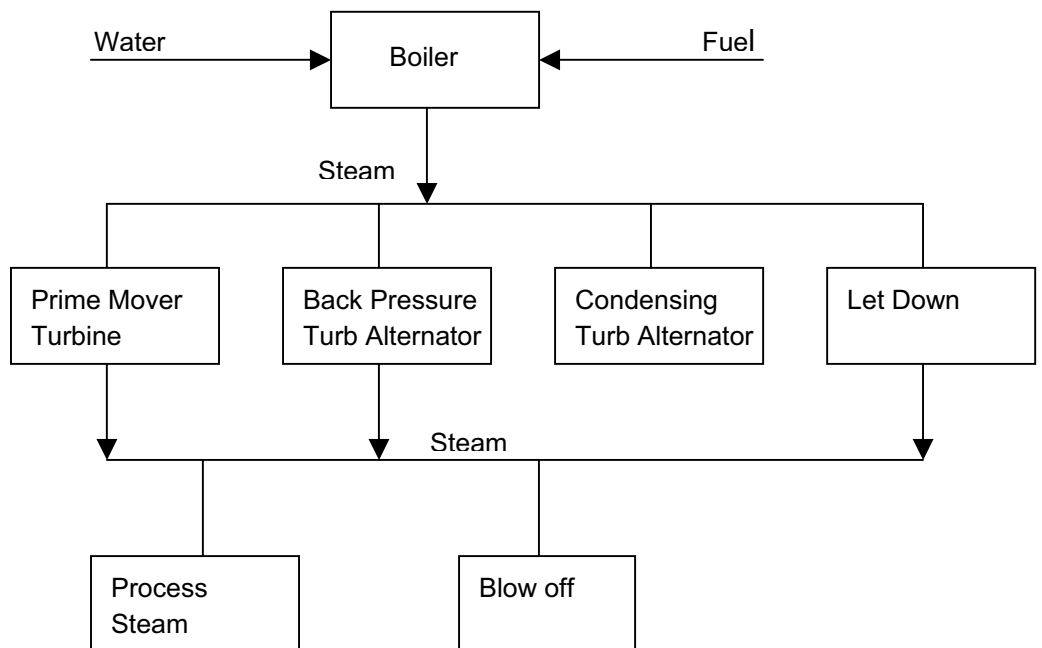


Figure 14. Typical steam and power generation with heat recovery (at present no condensing turbo alternators are installed)

General

With a declining world sugar economy, sugar producing countries worldwide (Mauritius, Brazil, Australia and India) are turning to co-products, in particular electricity and fuel alcohol, as an additional source of income. The energy market has the advantage of being a large and growing market in which a local supplier has a comparative advantage. An industry with sugar as its only significant commercial product may no longer be sustainable.

Energy savings options on demand side

Presently the power on cane is 43 kWh/tc. This includes electric power and motive power. It should be possible to operate a raw sugar factory at levels below 35 kWh/tc. Wade (2004) indicates a figure of 15 kWh/tc.

The excessive use of process steam of 60% on cane is mainly due to a high imbibition rate. Reducing imbibition decreases steam consumption but results in a loss in extraction. It is possible to reduce process steam to below 45% by a series of measures. These measures include:

- Reduce cane wash water (imbibition).
- Increase number of vacuum evaporator steps.
- Change to lower steam and water bleeding.
- Improve steam straps.
- Operate at optimum syrup brix (dry matter).
- Use continuous pans.
- Efficient sugar boiling scheme.
- Steady operation.
- Reduce pan movement water.
- Optimise condensate flashing and energy recovery.
- Improve housekeeping (insulation, leaks, maintenance etc.).

Biomass / Waste Resource Available

Bagasse is usually the main source of biomass in a sugar mill. It has the advantage that it is already at the factory. Trash and tops have the potential of doubling the amount of fuel and might be considered as fuel for the off crop or during stop days (Table 18). However, this residue has to be collected from the fields, which may not be practical and is prohibitively expensive. Equally impractical and expensive is the storage of the residue. Alternatively, consideration can be given to the use of other biomass or even coal to maximise the use of capital equipment.

Table 18. Properties of bagasse and field residue

	Mass 1000 t	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t	Energy TWh
Bagasse	450	44.00	2.00	50.00	4.00	7 117	0.89
Residue	387	41.19	4.19	51.73	2.89	6 894	0.74
Total	837	42.70	3.01	50.80	3.48	7 009	1.63

Although ways of recovering trash and tops are being explored presently bagasse is the only practical source of biomass. It should be noted however that bagasse is sometimes used as a feed stock for other industries. These industries include pulp and paper, animal feed, particle board and furfural.

Technical evaluation

Successful use of biomass energy rests largely on the conversion system adopted. Various technologies exist such as gasification, pyrolysis, combustion and digestion. The most suitable technology can vary from biomass to biomass and region to region. Factors to consider are quality of the biomass and the cost to convert and transport the biomass. While some of the new technologies are looking promising, presently combustion technology is still the most appropriate and is considered here.

Most mills have spare boiler and power generating capacity. Using this spare capacity may not result in a vast production in electricity but is cheap. Another opportunity to increase power generation at a relatively low cost is by passing let down steam through backpressure turbines.

Dedicated bagasse fired power stations are in operation in Reunion, Mauritius, Australia and India. These power stations operate at high steam pressures and temperatures of around 8 000 kPa(a) and 520°C respectively. Boiler efficiencies are high at 85% and electricity is generated by extremely efficient back pressure and condensing turbo alternators with exhaust steam conditions close to saturation. Under these conditions potential capacity is about 53 MW or 197 GWh (132 kWh/tc). The total electricity available for export is 145 GWh (97 kWh/tc).

Economic evaluation

The capital cost of a bagasse fired power station is estimated at ZAR 8 400/kW. In this example, an arbitrary selling price of e.g. 40 c/kWh provides additional revenue from cogeneration of approximately ZAR 58 million per annum. To put this into perspective, for the same factory, the proceeds from sugar, based on a cane to sugar ratio of 8.6 and an average price of ZAR 2100 per ton, is about ZAR 366 million per annum.

Detailed analysis is necessary in each case.

Environmental conditions and legislation

An independent power producer (IPP) will be subject to the usual environmental conditions and legislation that applies to every industrial plant. The most important additional regulation is the need for a generation licence from the National Electricity Regulator (NER). This licence is required for any exporter of electricity above 5 MW.

For a power station the environmental legislation governing the air and water pollution are particularly relevant. The main pollutant of a bagasse fired boiler is particulate matter. At present this particulate matter must be below 200 mg/m³ measured under standard conditions.

The Sugar Act addresses legislation specific to the sugar industry. The act dictates amongst others the division of proceeds and the ownership of the bagasse by millers. Generation of electricity from sugarcane biomass for export purpose will no doubt reopen the debate of this ownership.

Other considerations

There are other considerations one of which is ownership: ownership of the fuel and ownership of the power facility.

Bagasse is owned by millers, field residue belongs to growers and additional biomass might be sourced from outside the sugar industry. This three way split in ownership of the fuel complicates the supply chain while at the same time adding flexibility. Obviously a guarantee of fuel supply both in terms of quantity and quality is extremely important when exporting power.

The introduction of independent power producers such as sugar mills raises concern about the reliability of electricity supply. One way to deal with this concern is by placing the power facility under the control of the national power utility. This is often the case in Mauritius, Reunion and Australia.

7.9 Check List

Potential independent power producers have to consider various issues. These issues deal with energy efficiency and biomass and can be general, technical, economic or legislative in nature. Below is a list to assist potential IPP's in preparing a first feasibility check. This list is non exhaustive.

General

- Background

Efficiency

- Investigate ways of reducing in-house energy requirements

- What are the sources of biomass
- Possible competition for the biomass
- Availability of biomass through the year
- Transport and pre-treatment of the biomass
- How much biomass from each source
- Quality of the biomass (water, ash and NCV)
- Total energy content of biomass

Technical

- Transport and pre-treatment of the biomass
- Selection of energy conversion technology
- Supply of in-house energy requirements
- Use spare capacity or install additional equipment
- Use surplus heat for fuel drying
- Connecting to the grid
- Electrical system protection both ways

Financial

- Cost of electricity per kWh
- Power Purchase Agreement (PPA)
- Tariff structure
- Various financial indices
 - Internal rate of return (IRR)
 - Pay back period
 - Net present value (NPV)
- International or local financing options (e.g. mixed credits, CDM, etc.)

Legislation

- General environmental conditions and legislation
 - Occupational Health and Safety Act
 - Labour Act
 - National Environmental Management Act
- Legislation related to power generation and export
- Industry specific legislation

Other

- Ownership of plant
- Ownership of fuel
- Consultation with local communities and other relevant stakeholders

8 Conclusion and Recommendations

The total amount of available biomass in the sugar, forest, sawmilling and pulp and paper industry is estimated at 23 million tons with an energy capacity of about 50 TWh. Most of this biomass is in Mpumalanga and KwaZulu-Natal. At a conversion rate of 25% power on biomass this results in an estimated electricity production of over 13 000 GWh.

The total biomass in the sugar industry is about 11.47 million tons with an energy content of 22.33 TWh. The potential electricity that can be generated from this biomass is about 5 500 GWh. However collecting field residue might not be feasible which reduces the biomass to 6.13 million tons and 12.12 TWh. This results in a potential of 3031 GWh of electricity which is in excess of the industry's own requirements of about 700 GWh.

Biomass in the forest industry is about 3.13 million tons with an energy content of 10.89 TWh. This translates into an electricity potential of 2723 GWh. Again collecting the biomass from the plantations might be prohibitively expensive. It needs a separate infrastructure that involves extra costs.

The sawmilling industry produces 2.95 million tons of waste biomass with an energy content of 8.49 TWh. The potential electricity from that biomass is approximately 2122 GWh. However, most of this energy will be needed for internal use to replace ESKOM power, leaving little opportunity for energy export.

The total pulp and paper industry biomass waste is about 5.78 million tons with an energy content of 10.17 TWh. About 90% of this biomass is black liquor with an energy content of 9.03 TWh. The biomass has a potential electricity capacity of about 2 542 GWh. Again it is believed that most of the energy will be used to meet in-house energy requirements with little left for export to the grid.

For linking the renewable energy data to the Homer/RE GIS program two proposals are put forward. The first proposal is to update the existing biomass grid layers and make them available for HomerGIS. The second proposal is to undertake a comprehensive project for the management and continuous updating of the data.

A preliminary feasibility checklist to assist potential independent power producers has been provided. It is envisaged that any future work might contribute to supplement this list.

The most promising source of biomass is sugarcane bagasse. It is already being used to meet the sugar industry's in-house steam and power requirements. Increasing the efficient use and generation of energy within the industry can easily result in a potential capacity of 3 000 GWh with in-house requirements of only 700 GWh. Based on this study and experiences in places like Mauritius, Reunion and Australia it is recommended that bagasse be targeted for the development of renewable energy projects as it is the most promising fuel source.

9 References

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Appendix 1 – Area, Cane and Bagasse properties

Table 1. Amatikulu area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	38942	1271847	402597	44.47	1.56	50.07	3.90	7134
1995/96	39626	1318362	438044	45.54	1.34	50.15	2.97	7295
1996/97	39824	1925846	614800	46.85	1.55	49.07	2.53	7591
1997/98	40100	1663337	523457	45.15	1.52	50.12	3.21	7252
1998/99	40708	1728484	531797	46.41	1.42	49.89	2.29	7471
1999/00	38472	1655682	525923	45.77	1.55	50.47	2.21	7361
2000/01	38669	1844828	575052	46.83	1.79	48.94	2.44	7629
2001/02	39213	1624590	513791	45.99	1.94	49.86	2.21	7474
2002/03	38876	1672146	524964	46.64	1.80	49.29	2.27	7586
2003/04	38863	1160625	382569	45.42	1.84	49.79	2.95	7357

Table 2. Darnall area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	29562	1091691	364601	42.58	1.98	52.83	2.61	6786
1995/96	29672	1064052	378180	42.47	2.02	52.87	2.64	6771
1996/97	29874	1368524	429033	44.29	2.18	51.19	2.33	7169
1997/98	29084	1298974	423055	42.31	2.29	52.62	2.78	6787
1998/99	29805	1471318	452070	42.98	2.38	51.07	3.58	6961
1999/00	29843	1316241	414410	42.28	2.31	52.03	3.39	6799
2000/01	29387	1566072	459952	44.54	2.61	48.97	3.87	7334
2001/02	31328	1211236	386718	41.68	2.63	51.97	3.71	6741
2002/03	30733	1373582	432767	43.79	2.22	50.49	3.51	7099
2003/04	30789	1097397	353401	42.62	2.32	51.68	3.38	6873

Table 3. Entumeni area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	11418	274812	76974	46.67	1.60	49.49	2.24	7556
1995/96	11671	295165	86173	45.22	1.52	49.94	3.32	7268
1996/97	11938	376994	103032	46.28	1.79	49.31	2.62	7518
1997/98	11843	411120	117508	44.48	2.51	50.57	2.44	7267
1998/99	12559	462294	134081	42.17	2.55	52.79	2.49	6798
1999/00	12339	362225	105672	43.03	2.39	52.01	2.56	6950
2000/01	12468	402220	119987	44.33	2.40	51.21	2.06	7207
2001/02	12645	405585	123001	43.19	2.23	51.62	2.96	6965
2002/03	12822	409394	123700	42.87	1.93	51.34	3.86	6866
2003/04	12932	361203	113145	42.79	2.09	51.96	3.16	6861

Table 4. Eston area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	0	0	0	0.00	0.00	0.00	0.00	0
1995/96	0	0	0	0.00	0.00	0.00	0.00	0
1996/97	23947	932640	315019	39.15	2.47	52.49	5.89	6242
1997/98	26680	1082425	356049	39.26	1.89	51.89	6.96	6188
1998/99	26211	1429666	402937	41.81	2.19	50.68	5.32	6729
1999/00	26590	1038443	293288	43.79	1.61	50.56	4.04	7006
2000/01	31822	1336913	404687	42.51	1.90	50.58	5.01	6816
2001/02	33572	1255166	395871	41.68	2.00	51.12	5.21	6665
2002/03	34234	1418128	438414	43.12	1.92	50.38	4.57	6936
2003/04	35100	1307274	399768	43.62	2.10	49.70	4.58	7070

Table 5. Felixton area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	36947	1619122	572752	41.81	1.48	52.36	4.35	6581
1995/96	37792	1945215	707039	40.57	1.53	52.94	4.97	6347
1996/97	36680	2657958	940230	40.68	1.68	53.67	3.97	6373
1997/98	38073	2637644	896887	42.00	1.53	52.00	4.46	6632
1998/99	37805	2175156	695046	42.89	1.59	51.97	3.55	6803
1999/00	38773	2264777	768034	42.37	1.58	52.05	4.00	6706
2000/01	37865	2573257	840533	42.89	1.94	50.98	4.19	6881
2001/02	38115	2018564	681754	41.08	2.09	52.64	4.18	6534
2002/03	38439	2175081	753309	41.25	1.86	53.37	3.51	6512
2003/04	37824	1894726	683138	41.42	1.85	53.35	3.38	6541

Table 6. Gledhow area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	35306	1434249	460648	44.73	1.58	50.29	3.40	7179
1995/96	36300	1322562	445015	43.50	1.44	50.90	4.16	6919
1996/97	35741	1776818	579604	43.15	1.71	51.16	3.97	6890
1997/98	35561	1766386	554688	43.21	1.68	50.81	4.29	6904
1998/99	34352	1587143	482568	43.00	2.71	50.71	3.58	7024
1999/00	30193	1357981	410947	45.43	2.34	49.84	2.39	7434
2000/01	29817	1490845	437945	46.50	1.97	48.43	3.10	7607
2001/02	29523	1150711	346102	47.06	1.82	48.40	2.72	7687
2002/03	30102	1383225	399067	47.80	1.94	47.62	2.63	7861
2003/04	28391	1175622	361946	46.30	1.90	49.50	2.30	7534

Table 7. Komati area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	9546	441375	122257	46.99	1.36	46.63	5.02	7647
1995/96	10894	705376	184358	47.54	1.54	46.45	4.47	7781
1996/97	12812	905463	243638	49.30	1.60	45.00	4.11	8145
1997/98	15207	1415923	420650	48.27	1.84	45.32	4.57	7986
1998/99	16967	1411946	385175	48.54	1.99	45.31	4.16	8059
1999/00	18330	1815360	470540	49.28	1.52	45.81	3.39	8110
2000/01	19272	2013230	534230	46.60	1.77	47.25	4.38	7624
2001/02	20097	1907090	495583	48.98	1.82	46.53	2.66	8085
2002/03	22736	2056787	522658	47.80	1.89	46.00	4.31	7891
2003/04	23976	2137724	529150	49.63	2.20	46.28	1.89	8266

Table 8. Malelane area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	16323	990304	316172	40.44	1.75	54.30	3.51	6323
1995/96	17313	880841	273275	42.72	1.89	51.68	3.71	6825
1996/97	18177	1293927	418968	40.75	1.63	53.40	4.22	6385
1997/98	18012	1614449	528109	40.31	1.70	53.53	4.46	6312
1998/99	19461	1706003	555288	40.85	1.49	53.04	4.61	6391
1999/00	19996	1717679	553273	41.85	1.19	52.63	4.33	6537
2000/01	21331	1810312	603259	40.74	1.82	51.97	5.47	6446
2001/02	22005	1761160	597211	40.79	1.74	53.08	4.38	6417
2002/03	21796	1853104	572082	43.01	1.76	51.89	3.35	6853
2003/04	22698	1837756	534868	42.52	1.87	52.26	3.35	6772

Table 9. Maidstone area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	47378	1870056	625256	43.44	1.75	53.26	1.54	6898
1995/96	48632	1685273	651427	39.18	1.18	56.34	3.30	5958
1996/97	48521	1832811	648992	40.54	1.52	55.02	2.92	6290
1997/98	47739	2149047	749553	39.60	1.59	55.77	3.04	6110
1998/99	45821	2077934	692850	42.82	1.24	54.22	1.71	6685
1999/00	45641	1679182	542752	44.27	0.97	52.58	2.18	6947
2000/01	40694	2166647	699695	45.23	1.44	51.25	2.08	7226
2001/02	39354	1648747	559059	43.87	1.30	52.55	2.28	6926
2002/03	36079	1899923	619662	44.03	1.36	51.74	2.87	6983
2003/04	35599	1389215	465187	43.06	1.29	51.87	3.77	6793

Table 10. Noodsberg area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	30181	1108230	308580	46.55	2.23	48.42	2.80	7656
1995/96	30533	1276372	389917	42.69	2.65	51.07	3.59	6950
1996/97	31376	1357536	405664	42.67	2.05	51.51	3.78	6844
1997/98	31809	1388436	397829	43.73	2.19	50.46	3.62	7085
1998/99	32188	1723301	475928	44.73	2.41	50.55	2.31	7299
1999/00	31971	1273609	348065	44.97	2.40	50.31	2.33	7346
2000/01	32055	1396476	388019	44.15	2.25	50.49	3.12	7169
2001/02	31569	1565601	439540	42.26	2.36	51.69	3.69	6813
2002/03	31935	1673982	472056	42.74	2.21	51.12	3.93	6892
2003/04	31782	1614763	470914	44.03	2.29	49.88	3.80	7170

Table 11. Pongola area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	13821	1173815	346402	45.62	1.76	49.22	3.40	7395
1995/96	14472	992495	301075	42.16	1.89	50.09	5.85	6763
1996/97	15428	1047475	295384	45.82	1.70	47.79	4.69	7457
1997/98	16753	1276122	381291	44.32	1.87	48.27	5.54	7198
1998/99	17217	1185726	347195	44.04	2.06	49.65	4.24	7143
1999/00	17156	1275712	357789	42.10	2.31	50.26	5.32	6812
2000/01	17476	1242290	365708	42.41	2.20	49.43	5.96	6870
2001/02	17198	1355654	390795	42.31	2.18	49.12	6.39	6857
2002/03	18170	1409293	391920	43.58	2.24	49.21	4.97	7095
2003/04	18337	1426568	400000	42.63	2.22	50.89	4.26	6878

Table 12. Sezela area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	39305	1898876	620717	44.86	1.67	49.12	4.35	7246
1995/96	41239	2291244	737961	45.08	1.28	48.75	4.88	7236
1996/97	42363	2312766	711633	44.48	1.88	48.67	4.97	7220
1997/98	40872	2173070	679284	45.06	1.72	47.68	5.54	7325
1998/99	43981	2524887	755281	45.51	1.86	48.30	4.33	7413
1999/00	44300	2265266	693809	45.85	1.89	48.88	3.39	7464
2000/01	44996	2490169	777991	46.44	1.67	48.11	3.78	7558
2001/02	45933	2187376	692227	46.76	1.58	47.98	3.68	7606
2002/03	45323	2321365	723192	48.35	1.56	47.18	2.92	7912
2003/04	43248	2014283	628673	47.70	1.62	47.65	3.03	7792

Table 13. Umfolozi area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	17039	1000150	303049	42.15	2.24	51.45	4.16	6780
1995/96	17313	1140328	326811	43.16	2.20	49.95	4.70	6994
1996/97	18562	1185275	368493	40.93	2.68	51.28	5.11	6628
1997/98	18649	1263950	383457	42.39	2.21	50.59	4.82	6839
1998/99	19873	1225284	375381	41.02	2.28	51.43	5.27	6581
1999/00	20425	1321990	399254	41.50	2.06	51.87	4.56	6625
2000/01	19930	1388824	412899	42.21	2.37	50.35	5.07	6838
2001/02	20565	1172173	343007	42.42	2.02	50.90	4.66	6810
2002/03	21865	1262294	359957	43.49	2.12	50.28	4.11	7034
2003/04	22105	1087606	307435	42.76	2.19	49.91	5.13	6922

Table 14. Umzimkulu area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	26490	856994	302464	42.71	1.45	52.69	3.15	6733
1995/96	26299	1149505	392596	40.39	1.65	53.08	4.88	6330
1996/97	27834	1313252	429502	40.93	1.68	52.00	5.40	6458
1997/98	28451	1218833	389965	42.52	1.76	51.02	4.69	6786
1998/99	29432	1389799	444678	42.01	1.73	52.55	3.71	6651
1999/00	29404	1170533	359096	44.08	1.52	50.96	3.44	7036
2000/01	29558	1436380	440801	44.52	1.73	50.08	3.67	7169
2001/02	29841	1148041	369545	43.28	1.85	50.92	3.96	6939
2002/03	29664	1299759	397357	44.82	1.79	49.38	4.00	7251
2003/04	29440	1136866	353819	45.30	1.62	49.70	3.38	7305

Table 15. Union Co-op area, cane and bagasse properties

Season	Area ha	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
1994/95	17041	651769	204266	40.10	1.81	54.67	3.42	6262
1995/96	18565	646857	205176	39.01	1.86	55.32	3.81	6055
1996/97	19036	663550	191833	41.21	1.80	54.12	2.87	6477
1997/98	19703	795065	238911	41.16	2.15	53.83	2.86	6528
1998/99	21266	831383	242100	41.34	2.10	54.00	2.57	6548
1999/00	21011	708409	220831	41.60	2.10	53.87	2.43	6599
2000/01	21258	717705	235907	40.84	1.98	53.87	3.32	6441
2001/02	21820	744868	253738	38.98	1.91	56.19	2.92	6035
2002/03	21734	804492	241162	41.66	1.89	53.69	2.76	6584
2003/04	21702	777306	235840	42.91	1.86	52.49	2.74	6836

Appendix 2 – Cane and Bagasse properties 2003/04 Season

Table 1. Amatikulu cane and bagasse properties 2003/04 season

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	14212	5036	43.86	2.18	53.95	0.00	7023
2003/04	May	159494	50535	45.68	1.90	50.36	2.07	7399
2003/04	Jun	170629	54351	44.84	1.86	50.08	3.21	7247
2003/04	Jul	234726	74650	44.28	1.77	50.23	3.73	7127
2003/04	Aug	171270	56682	46.89	1.78	49.46	1.87	7624
2003/04	Sep	160008	53976	46.57	1.91	48.78	2.75	7601
2003/04	Oct	199413	69550	45.25	1.87	49.50	3.38	7338
2003/04	Nov	50873	17789	44.15	1.77	49.50	4.59	7120
2003/04	Dec	0	0	0.00	0.00	0.00	0.00	18260

Table 2. Darnall area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	46432	17071	38.05	3.39	54.68	3.88	6127
2003/04	May	159690	50294	41.61	2.80	52.28	3.31	6746
2003/04	Jun	147117	47316	42.38	2.36	51.73	3.53	6833
2003/04	Jul	187275	57490	42.48	2.18	51.84	3.50	6822
2003/04	Aug	137125	42426	43.85	2.17	51.01	2.97	7089
2003/04	Sep	135986	43213	42.55	2.04	50.92	4.50	6834
2003/04	Oct	164454	53275	43.23	2.10	51.01	3.67	6966
2003/04	Nov	119318	42316	42.12	2.20	51.75	3.93	6760
2003/04	Dec	0	0	0.00	0.00	0.00	0.00	18260

Table 3. Entumeni area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	12303	3813	42.56	1.76	52.77	2.92	6749
2003/04	May	46469	14237	43.73	1.81	52.04	2.41	6990
2003/04	Jun	46077	14090	42.68	2.04	51.82	3.46	6839
2003/04	Jul	61575	19042	41.75	2.04	53.66	2.55	6622
2003/04	Aug	46441	13786	44.26	1.90	50.96	2.88	7125
2003/04	Sep	38711	12086	43.49	2.25	50.81	3.45	7042
2003/04	Oct	54991	17092	43.13	2.28	51.08	3.52	6974
2003/04	Nov	41789	14187	42.20	2.19	51.74	3.86	6775
2003/04	Dec	12847	4812	39.20	2.58	54.38	3.84	6221

Table 4. Eston area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	53829	17692	41.47	2.70	51.66	4.17	6720
2003/04	Apr	163288	52397	42.53	2.08	50.83	4.56	6840
2003/04	May	134292	40971	42.89	2.10	51.15	3.86	6900
2003/04	Jun	153337	43723	44.93	1.99	49.55	3.53	7296
2003/04	Jul	193967	54695	45.18	2.21	49.57	3.04	7374
2003/04	Aug	154101	45177	43.96	2.20	49.55	4.29	7150
2003/04	Sep	137744	43845	42.47	1.98	49.30	6.25	6851
2003/04	Oct	182356	58303	43.42	2.05	49.02	5.51	7042
2003/04	Nov	134360	42965	44.30	1.94	47.94	5.83	7212
2003/04	Dec	0	0	0.00	0.00	0.00	0.00	18260

Table 5. Felixton area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	0	0	0.00	0.00	0.00	0.00	18260
2003/04	May	203340	69263	40.34	1.83	54.51	3.31	6313
2003/04	Jun	242945	84814	40.49	1.90	54.08	3.53	6362
2003/04	Jul	342484	121186	40.59	1.88	54.03	3.50	6376
2003/04	Aug	276085	95096	42.34	1.90	52.79	2.97	6731
2003/04	Sep	263368	97618	40.73	1.79	52.99	4.50	6414
2003/04	Oct	340664	128093	41.86	1.92	52.55	3.67	6653
2003/04	Nov	225840	87068	41.43	1.66	52.98	3.93	6523
2003/04	Dec	0	0	0.00	0.00	0.00	0.00	18260

Table 6. Gledhow area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	46359	14780	44.30	2.69	50.79	2.22	7256
2003/04	May	146935	44140	45.95	1.89	49.82	2.34	7461
2003/04	Jun	143278	42529	45.54	1.97	49.98	2.50	7395
2003/04	Jul	191471	56375	46.36	1.74	49.62	2.28	7518
2003/04	Aug	151904	44528	47.74	1.86	48.29	2.12	7819
2003/04	Sep	146899	44490	47.39	1.91	48.35	2.36	7761
2003/04	Oct	185396	58125	46.36	1.98	49.30	2.36	7562
2003/04	Nov	137946	47228	45.88	1.79	50.08	2.25	7426
2003/04	Dec	25434	9751	44.04	1.56	52.47	1.94	6996

Table 7. Komati area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	249788	59332	46.83	1.72	47.56	3.88	7651
2003/04	May	204108	46768	48.46	1.86	46.37	3.31	7998
2003/04	Jun	238145	54508	49.80	1.86	44.81	3.53	8282
2003/04	Jul	321075	77144	48.58	2.20	45.71	3.50	8089
2003/04	Aug	260332	63115	49.43	2.33	45.27	2.97	8274
2003/04	Sep	251604	63772	47.18	2.41	45.91	4.50	7860
2003/04	Oct	308890	80826	47.19	2.55	46.59	3.67	7866
2003/04	Nov	222155	60789	46.31	2.42	47.33	3.93	7668
2003/04	Dec	81627	22896	45.68	2.22	48.05	4.05	7504

Table 8. Malelane area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	250882	70256	42.05	1.53	53.67	2.75	6599
2003/04	May	217165	60265	43.29	1.81	51.79	3.12	6914
2003/04	Jun	206609	57806	43.21	1.76	51.59	3.44	6898
2003/04	Jul	259346	74916	43.23	1.98	52.24	2.55	6918
2003/04	Aug	192960	53929	44.62	1.87	51.52	1.99	7173
2003/04	Sep	196950	57349	38.01	1.90	51.18	8.91	5979
2003/04	Oct	226351	68415	43.19	2.19	52.40	2.22	6939
2003/04	Nov	173699	55603	42.49	1.89	52.95	2.67	6752
2003/04	Dec	113794	36329	42.36	1.92	52.91	2.80	6735

Table 9. Maidstone area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	61050	20612	43.49	1.66	52.35	2.50	6914
2003/04	May	193713	63390	42.43	1.44	52.39	3.75	6687
2003/04	Jun	203619	65910	41.65	1.29	52.74	4.33	6513
2003/04	Jul	250704	81796	42.42	1.34	52.61	3.63	6665
2003/04	Aug	188504	61935	44.27	1.22	51.37	3.14	7014
2003/04	Sep	178135	59526	44.22	1.25	50.54	3.99	7030
2003/04	Oct	222010	77392	43.70	1.13	51.15	4.02	6902
2003/04	Nov	91480	34626	42.61	1.29	52.08	4.02	6705
2003/04	Dec	0	0	0.00	0.00	0.00	0.00	18260

Table 10. Noodsberg area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	87780	29475	46.61	2.71	50.67	0.00	7686
2003/04	Apr	176736	57498	39.29	2.24	51.81	6.66	6250
2003/04	May	157916	47607	43.23	2.35	51.11	3.31	7001
2003/04	Jun	172785	47645	44.38	2.43	49.66	3.53	7259
2003/04	Jul	231845	61027	41.20	2.53	49.48	6.78	6700
2003/04	Aug	171171	45432	45.51	2.41	48.85	3.23	7483
2003/04	Sep	163666	44817	44.03	2.86	48.62	4.50	7286
2003/04	Oct	206649	58874	42.71	1.97	49.92	5.41	6877
2003/04	Nov	142149	43315	43.44	2.16	48.92	5.48	7066
2003/04	Dec	104066	35224	42.87	1.19	49.42	6.52	6802

Table 11. Pongola area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	75361	20968	39.72	1.76	51.90	6.62	6252
2003/04	Apr	166304	44073	40.84	2.11	52.79	4.26	6489
2003/04	May	138687	35391	42.42	2.16	51.30	4.11	6821
2003/04	Jun	138826	38144	42.24	2.26	51.42	4.08	6800
2003/04	Jul	185081	50865	42.59	2.33	50.81	4.27	6890
2003/04	Aug	151019	41116	42.22	2.41	51.19	4.18	6825
2003/04	Sep	153386	42885	43.40	2.35	50.16	4.09	7056
2003/04	Oct	184594	55977	43.79	2.23	49.92	4.07	7115
2003/04	Nov	132796	39772	44.22	2.14	49.71	3.94	7185
2003/04	Dec	100514	30809	43.26	2.22	50.39	4.14	7004

Table 12. Sezela area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	84574	29081	44.89	2.96	49.92	2.22	7428
2003/04	May	245942	76490	46.62	2.91	47.27	3.20	7800
2003/04	Jun	247624	71391	49.21	1.91	48.47	2.61	7691
2003/04	Jul	311542	91169	48.11	1.63	47.78	2.48	7866
2003/04	Aug	237742	73370	47.57	1.67	47.70	3.06	7774
2003/04	Sep	229192	73851	46.96	1.68	47.41	3.95	7672
2003/04	Oct	297717	94528	48.20	1.61	47.21	2.98	7892
2003/04	Nov	227137	73974	48.03	1.57	47.10	3.30	7859
2003/04	Dec	132813	44819	47.93	1.51	47.40	3.16	7824

Table 13. Umfolozi area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	30267	7686	41.62	1.78	50.88	5.71	6628
2003/04	May	129349	33766	42.10	2.10	50.30	5.50	6777
2003/04	Jun	123580	33084	42.02	2.11	49.93	5.95	6773
2003/04	Jul	157744	43738	41.95	2.17	49.34	6.53	6785
2003/04	Aug	142683	39838	43.32	2.13	50.00	4.55	7013
2003/04	Sep	126290	35842	43.07	2.57	49.47	4.89	7046
2003/04	Oct	193645	56551	43.80	2.28	49.47	4.45	7136
2003/04	Nov	140157	43011	42.76	2.04	50.75	4.45	6879
2003/04	Dec	43891	13919	42.72	2.21	50.36	4.71	6907

Table 14. Umzimkulu area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	0	0	0.00	0.00	0.00	0.00	18260
2003/04	Apr	50948	16959	42.21	1.61	52.41	3.77	6671
2003/04	May	133496	42386	44.38	1.72	50.32	3.57	7137
2003/04	Jun	143083	42365	45.31	1.54	49.59	3.56	7297
2003/04	Jul	184421	54887	45.75	1.63	50.08	2.54	7378
2003/04	Aug	145991	43845	46.66	1.73	49.07	2.54	7583
2003/04	Sep	133015	41188	45.92	1.73	48.57	3.78	7461
2003/04	Oct	181748	58108	45.53	1.55	49.57	3.35	7338
2003/04	Nov	135154	44665	44.89	1.52	49.59	4.00	7217
2003/04	Dec	29010	9416	43.96	1.44	49.38	5.21	7041

Table 15. Union Co-op area, cane and bagasse properties

Season	Month	Cane tons	Bagasse tons	Fibre %	Brix %	Moisture %	Ash %	NCV MJ/t
2003/04	Mar	49518	15745	41.60	1.79	54.29	2.32	6542
2003/04	Apr	81582	24797	42.03	1.83	53.01	3.12	6658
2003/04	May	81313	24306	43.14	1.80	52.73	2.33	6863
2003/04	Jun	84027	24367	43.34	1.84	52.23	2.59	6918
2003/04	Jul	102074	28941	44.66	1.91	52.28	1.15	7169
2003/04	Aug	81801	23688	44.30	1.93	51.93	1.84	7114
2003/04	Sep	76128	22409	43.28	1.89	51.39	3.44	6934
2003/04	Oct	96142	30367	42.83	1.91	52.38	2.87	6832
2003/04	Nov	76164	24397	41.57	1.85	52.25	4.33	6597
2003/04	Dec	48557	16823	41.10	1.80	53.19	3.91	6479

Appendix 3 – Power generation potential

Table 1. Amatikulu power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	12.02	36.08	48.11	35.00	105.07	140.07	44.51	133.63	178.15
1995/96	12.37	41.09	53.45	35.00	116.27	151.27	46.14	153.29	199.44
1996/97	13.57	45.06	58.63	35.00	116.25	151.25	67.40	223.87	291.28
1997/98	13.36	40.74	54.10	35.00	106.69	141.69	58.22	177.45	235.67
1998/99	12.44	38.30	50.74	35.00	107.78	142.78	60.50	186.30	246.80
1999/00	12.46	39.34	51.80	35.00	110.47	145.47	57.95	182.90	240.85
2000/01	12.69	41.03	53.72	35.00	113.16	148.16	64.57	208.76	273.33
2001/02	12.83	41.12	53.95	35.00	112.21	147.21	56.86	182.29	239.15
2002/03	12.12	39.27	51.38	35.00	113.41	148.41	58.53	189.65	248.17
2003/04	10.88	36.16	47.04	35.00	116.36	151.36	40.62	135.05	175.68

Table 2. Darnall power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	9.89	29.85	39.75	35.00	105.60	140.60	38.21	115.29	153.50
1995/96	9.69	31.86	41.55	35.00	115.10	150.10	37.24	122.47	159.71
1996/97	10.37	30.92	41.29	35.00	104.33	139.33	47.90	142.78	190.68
1997/98	10.73	31.22	41.96	35.00	101.83	136.83	45.46	132.28	177.74
1998/99	11.18	30.98	42.17	35.00	96.98	131.98	51.50	142.69	194.19
1999/00	10.74	29.80	40.54	35.00	97.10	132.10	46.07	127.81	173.88
2000/01	11.28	31.59	42.88	35.00	98.00	133.00	54.81	153.47	208.28
2001/02	10.69	29.90	40.59	35.00	97.89	132.89	42.39	118.57	160.96
2002/03	10.76	31.86	42.62	35.00	103.59	138.59	48.08	142.29	190.36
2003/04	10.22	29.78	39.99	35.00	102.02	137.02	38.41	111.96	150.37

Table 3. Entumeni power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	2.60	7.09	9.69	35.00	95.46	130.46	9.62	26.23	35.85
1995/96	2.66	7.29	9.96	35.00	95.83	130.83	10.33	28.29	38.62
1996/97	2.86	7.46	10.32	35.00	91.28	126.28	13.19	34.41	47.61
1997/98	3.24	8.58	11.82	35.00	92.81	127.81	14.39	38.15	52.54
1998/99	3.35	8.20	11.55	35.00	85.66	120.66	16.18	39.60	55.78
1999/00	3.03	7.74	10.76	35.00	89.45	124.45	12.68	32.40	45.08
2000/01	3.10	8.66	11.76	35.00	97.73	132.73	14.08	39.31	53.39
2001/02	3.12	8.49	11.61	35.00	95.18	130.18	14.20	38.60	52.80
2002/03	3.12	8.25	11.36	35.00	92.64	127.64	14.33	37.93	52.25
2003/04	3.01	8.39	11.40	35.00	97.68	132.68	12.64	35.28	47.92

Table 4. Eston power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995/96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1996/97	6.75	18.31	25.06	35.00	94.91	129.91	32.64	88.51	121.15
1997/98	7.73	19.88	27.62	35.00	89.99	124.99	37.88	97.40	135.29
1998/99	8.98	20.66	29.64	35.00	80.57	115.57	50.04	115.19	165.23
1999/00	8.06	19.83	27.89	35.00	86.14	121.14	36.35	89.45	125.80
2000/01	8.53	22.37	30.90	35.00	91.86	126.86	46.79	122.80	169.60
2001/02	8.18	22.07	30.24	35.00	94.49	129.49	43.93	118.59	162.53
2002/03	8.79	24.45	33.24	35.00	97.34	132.34	49.63	138.04	187.67
2003/04	8.49	23.90	32.39	35.00	98.54	133.54	45.75	128.82	174.57

Table 5. Felixton power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	15.46	48.48	63.94	35.00	109.78	144.78	56.67	177.76	234.42
1995/96	17.11	52.96	70.07	35.00	108.35	143.35	68.08	210.77	278.85
1996/97	19.86	59.45	79.31	35.00	104.79	139.79	93.03	278.53	371.56
1997/98	19.62	58.78	78.39	35.00	104.86	139.86	92.32	276.57	368.89
1998/99	18.81	53.38	72.19	35.00	99.36	134.36	76.13	216.11	292.24
1999/00	18.63	56.48	75.10	35.00	106.13	141.13	79.27	240.36	319.63
2000/01	19.20	57.25	76.45	35.00	104.35	139.35	90.06	268.51	358.57
2001/02	17.86	51.85	69.72	35.00	101.58	136.58	70.65	205.05	275.70
2002/03	17.88	53.59	71.47	35.00	104.86	139.86	76.13	228.09	304.22
2003/04	18.58	59.36	77.94	35.00	111.84	146.84	66.32	211.92	278.23

Table 6. Gledhow power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	11.01	27.65	38.66	40.00	100.43	140.43	57.37	144.04	201.41
1995/96	11.43	29.12	40.55	40.00	101.93	141.93	52.90	134.81	187.72
1996/97	11.13	26.84	37.97	40.00	96.49	136.49	71.07	171.45	242.52
1997/98	11.50	26.20	37.70	40.00	91.11	131.11	70.66	160.94	231.59
1998/99	11.92	26.49	38.41	40.00	88.91	128.91	63.49	141.11	204.60
1999/00	10.86	26.23	37.08	40.00	96.63	136.63	54.32	131.22	185.54
2000/01	11.59	27.71	39.31	40.00	95.61	135.61	59.63	142.54	202.17
2001/02	10.67	26.91	37.58	40.00	100.86	140.86	46.03	116.06	162.09
2002/03	11.05	27.03	38.08	40.00	97.86	137.86	55.33	135.37	190.70
2003/04	10.21	25.87	36.08	40.00	101.36	141.36	47.02	119.16	166.18

Table 7. Komati power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	5.16	14.10	19.26	35.00	95.58	130.58	15.45	42.19	57.64
1995/96	6.13	15.74	21.87	35.00	89.86	124.86	24.69	63.38	88.07
1996/97	7.53	21.62	29.15	35.00	100.56	135.56	31.69	91.05	122.74
1997/98	8.48	27.33	35.81	35.00	112.80	147.80	49.56	159.71	209.27
1998/99	8.81	25.41	34.22	35.00	101.01	136.01	49.42	142.62	192.04
1999/00	13.79	37.22	51.01	35.00	94.49	129.49	63.54	171.54	235.07
2000/01	14.78	37.65	52.44	35.00	89.15	124.15	70.46	179.48	249.94
2001/02	14.55	39.23	53.78	35.00	94.41	129.41	66.75	180.04	246.79
2002/03	14.74	37.03	51.77	35.00	87.93	122.93	71.99	180.85	252.84
2003/04	14.19	36.79	50.98	35.00	90.71	125.71	74.82	193.90	268.72

Table 8. Malelane power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	11.14	22.57	33.71	40.00	81.00	121.00	39.61	80.21	119.83
1995/96	8.76	19.21	27.97	40.00	87.68	127.68	35.23	77.23	112.46
1996/97	12.37	26.06	38.43	40.00	84.29	124.29	51.76	109.06	160.82
1997/98	12.74	26.78	39.52	40.00	84.12	124.12	64.58	135.80	200.38
1998/99	12.68	26.99	39.66	40.00	85.17	125.17	68.24	145.30	213.54
1999/00	13.37	29.04	42.40	40.00	86.88	126.88	68.71	149.23	217.94
2000/01	13.02	29.22	42.25	40.00	89.75	129.75	72.41	162.47	234.88
2001/02	13.02	29.82	42.83	40.00	91.64	131.64	70.45	161.39	231.84
2002/03	13.71	30.01	43.72	40.00	87.55	127.55	74.12	162.24	236.36
2003/04	12.38	24.07	36.45	40.00	77.75	117.75	73.51	142.89	216.40

Table 9. Maidstone power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	12.47	41.77	54.24	35.00	117.20	152.20	65.45	219.18	284.63
1995/96	13.44	41.50	54.94	35.00	108.09	143.09	58.98	182.16	241.14
1996/97	15.40	45.31	60.71	35.00	102.96	137.96	64.15	188.70	252.85
1997/98	15.73	43.36	59.09	35.00	96.46	131.46	75.22	207.29	282.51
1998/99	14.66	43.18	57.84	35.00	103.07	138.07	72.73	214.17	286.90
1999/00	14.01	41.71	55.73	35.00	104.19	139.19	58.77	174.95	233.72
2000/01	14.90	46.89	61.79	35.00	110.17	145.17	75.83	238.70	314.53
2001/02	13.55	43.04	56.59	35.00	111.16	146.16	57.71	183.28	240.99
2002/03	13.27	40.32	53.58	35.00	106.36	141.36	66.50	202.08	268.58
2003/04	11.59	35.16	46.75	35.00	106.17	141.17	48.62	147.50	196.12

Table 10. Noodsberg power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	11.04	24.47	35.50	40.00	88.66	128.66	44.33	98.25	142.58
1995/96	11.39	25.08	36.47	40.00	88.08	128.08	51.05	112.42	163.47
1996/97	11.34	23.47	34.82	40.00	82.78	122.78	54.30	112.38	166.68
1997/98	11.44	23.39	34.83	40.00	81.76	121.76	55.54	113.52	169.06
1998/99	11.54	23.32	34.86	40.00	80.79	120.79	68.93	139.23	208.16
1999/00	11.25	22.56	33.81	40.00	80.24	120.24	50.94	102.19	153.13
2000/01	11.65	23.05	34.70	40.00	79.18	119.18	55.86	110.57	166.43
2001/02	12.15	22.42	34.57	40.00	73.81	113.81	62.62	115.56	178.19
2002/03	11.88	22.55	34.43	40.00	75.90	115.90	66.96	127.06	194.02
2003/04	11.31	24.28	35.58	40.00	85.88	125.88	64.59	138.68	203.27

Table 11. Pongola power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	8.08	18.60	26.68	40.00	92.07	132.07	46.95	108.07	155.03
1995/96	8.06	16.78	24.84	40.00	83.22	123.22	39.70	82.60	122.30
1996/97	8.66	18.76	27.42	40.00	86.69	126.69	41.90	90.81	132.71
1997/98	8.98	20.18	29.16	40.00	89.93	129.93	51.04	114.76	165.81
1998/99	9.33	20.04	29.37	40.00	85.92	125.92	47.43	101.88	149.31
1999/00	9.55	17.59	27.13	40.00	73.66	113.66	51.03	93.97	145.00
2000/01	9.97	20.24	30.21	40.00	81.25	121.25	49.69	100.93	150.62
2001/02	9.97	19.47	29.44	40.00	78.15	118.15	54.23	105.95	160.17
2002/03	10.16	19.78	29.94	40.00	77.91	117.91	56.37	109.80	166.18
2003/04	10.05	18.82	28.87	40.00	74.90	114.90	57.06	106.85	163.91

Table 12. Sezela power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	13.78	44.32	58.10	35.00	112.53	147.53	66.46	213.68	280.14
1995/96	14.57	45.76	60.33	35.00	109.97	144.97	80.19	251.96	332.15
1996/97	14.52	42.54	57.06	35.00	102.57	137.57	80.95	237.22	318.17
1997/98	14.88	45.58	60.46	35.00	107.18	142.18	76.06	232.92	308.98
1998/99	15.57	45.49	61.06	35.00	102.30	137.30	88.37	258.29	346.66
1999/00	14.87	45.43	60.29	35.00	106.94	141.94	79.28	242.26	321.54
2000/01	14.64	46.87	61.51	35.00	112.04	147.04	87.16	279.01	366.16
2001/02	14.95	49.17	64.12	35.00	115.14	150.14	76.56	251.86	328.41
2002/03	14.82	50.42	65.24	35.00	119.06	154.06	81.25	276.38	357.62
2003/04	13.84	46.20	60.04	35.00	116.82	151.82	70.50	235.31	305.81

Table 13. Umfolozi power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	9.94	20.72	30.66	40.00	83.40	123.40	40.01	83.41	123.42
1995/96	9.88	19.76	29.64	40.00	80.02	120.02	45.61	91.25	136.86
1996/97	10.00	20.96	30.97	40.00	83.83	123.83	47.41	99.36	146.77
1997/98	10.22	21.67	31.89	40.00	84.80	124.80	50.56	107.18	157.74
1998/99	11.45	23.13	34.57	40.00	80.82	120.82	49.01	99.03	148.04
1999/00	11.47	22.88	34.36	40.00	79.79	119.79	52.88	105.48	158.36
2000/01	11.00	22.54	33.54	40.00	81.95	121.95	55.55	113.81	169.37
2001/02	10.29	20.38	30.67	40.00	79.23	119.23	46.89	92.87	139.76
2002/03	10.43	20.89	31.32	40.00	80.13	120.13	50.49	101.14	151.64
2003/04	9.96	19.12	29.08	40.00	76.80	116.80	43.50	83.53	127.03

Table 14. Umzimkulu power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	7.37	23.81	31.19	35.00	113.05	148.05	29.99	96.88	126.88
1995/96	7.91	22.27	30.18	35.00	98.54	133.54	40.23	113.27	153.51
1996/97	8.22	22.35	30.57	35.00	95.17	130.17	45.96	124.98	170.94
1997/98	8.62	24.44	33.06	35.00	99.17	134.17	42.66	120.87	163.53
1998/99	8.91	24.50	33.41	35.00	96.24	131.24	48.64	133.76	182.40
1999/00	8.14	22.86	31.00	35.00	98.30	133.30	40.97	115.07	156.04
2000/01	8.38	24.21	32.59	35.00	101.12	136.12	50.27	145.25	195.52
2001/02	8.49	25.07	33.56	35.00	103.40	138.40	40.18	118.71	158.89
2002/03	9.00	26.30	35.30	35.00	102.25	137.25	45.49	132.90	178.39
2003/04	8.74	26.50	35.25	35.00	106.09	141.09	39.79	120.61	160.40

Table 15. Union Co-op power generation potential

	Local MW	Export MW	Total MW	Local kWh/t	Export kWh/t	Total kWh/t	Local GWh	Export GWh	Total GWh
1994/95	4.72	11.47	16.19	35.00	85.03	120.03	22.81	55.42	78.23
1995/96	4.74	11.13	15.87	35.00	82.20	117.20	22.64	53.17	75.81
1996/97	4.84	10.93	15.77	35.00	78.96	113.96	23.22	52.39	75.62
1997/98	5.15	12.51	17.67	35.00	84.98	119.98	27.83	67.56	95.39
1998/99	5.05	11.72	16.76	35.00	81.26	116.26	29.10	67.56	96.66
1999/00	4.77	12.45	17.22	35.00	91.44	126.44	24.79	64.78	89.57
2000/01	4.74	12.94	17.68	35.00	95.51	130.51	25.12	68.55	93.67
2001/02	4.69	12.24	16.93	35.00	91.37	126.37	26.07	68.06	94.13
2002/03	4.95	12.12	17.07	35.00	85.79	120.79	28.16	69.02	97.18
2003/04	4.75	12.57	17.32	35.00	92.60	127.60	27.21	71.98	99.19

Appendix 4 – Sugar mill Questionnaire

General

1		
2	Name of interviewee	
3	Position of interviewee	
4	Date	

Cane throughput

1	Cane supply area (hectares)	
2	Cane crushed per annum (tons/annum)	
3	Gross available time (hours)	
4	Overall time efficiency (%)	

Bagasse throughput and properties

1	Bagasse produced per annum	
2	Fibre content of bagasse (%)	
3	Brix content of bagasse (%)	
4	Moisture content of bagasse (%)	
5	Ash content of bagasse (%)	
6	Net calorific value of bagasse (kJ/kg)	

Steam and power generation.

1	Existing boiler capacity (t/h)	
2	High pressure steam pressure (kPa(abs))	
3	High pressure steam temperature (°C)	
4	Existing power generation capacity (kW)	
5	Exhaust steam pressure (kPa(abs))	
6	High Pressure steam production (t/h)	
7	Process steam requirements (t/h)	
8	Process power requirements (kW)	
9	Let down steam (t/h)	

Biomass, steam and power export

1	Bagasse export (t/h)	
2	Steam export (t/h)	
3	Power export (kW)	

Obstacles for co-generation

1		
2		
3		

Tongaat Hulett - Amatikulu**General**

1	Company name	Hulett - Amatikulu
2	Name of interviewee	D M Van Den Berg
3	Position of interviewee	Regional Operations Manager
4	Date	21/9/2004

Cane throughput

1	Cane supply area (hectares)	51 791
2	Cane crushed per annum (tons/annum)	1 750 000
3	Gross available time (hours)	5 019
4	Overall time efficiency (%)	83

Bagasse throughput and properties

1	Bagasse produced per annum	280 000
2	Fibre content of bagasse (%)	48.5
3	Brix content of bagasse (%)	1,75
4	Moisture content of bagasse (%)	49,5
5	Ash content of bagasse (%)	2,65
6	Net calorific value of bagasse (kJ/kg)	7 425

Steam and power generation.

1	Existing boiler capacity (t/h)	233
2	High pressure steam pressure (kPa(abs))	3 200
3	High pressure steam temperature (°C)	370 (388)
4	Existing power generation capacity (kW)	12 000
5	Exhaust steam pressure (kPa(abs))	140
6	High Pressure steam production (t/h)	225
7	Process steam requirements (t/h)	145
8	Process power requirements (kW)	8 750
9	Let down steam (t/h)	35

Biomass, steam and power export

1	Bagasse export (t/h) Fibre to sappi	15000
2	Steam export (t/h)	0
3	Power export (kW)can do 2500 kW	1000

Obstacles for co-generation

1	Price paid is too low and more lucrative to export Fibre
2	Eskom a major stumbling block to deal with re pricing
3	Current price in SA in US\$2 per kW/h, Brazil is US\$20 per kW/h

Tongaat Hulett - Darnall**General**

1	Company name	Hulett - Darnall
2	Name of interviewee	Nigel Simmonds
3	Position of interviewee	Engineering Manager
4	Date	

Cane throughput

1	Cane supply area (hectares)	29150
2	Cane crushed per annum (tons/annum)	1 350 000
3	Gross available time (hours)	5 028
4	Overall time efficiency (%)	82

Bagasse throughput and properties

1	Bagasse produced per annum	447 492
2	Fibre content of bagasse (%)	45
3	Brix content of bagasse (%)	1.1
4	Moisture content of bagasse (%)	51,8
5	Ash content of bagasse (%)	2.6
6	Net calorific value of bagasse (kJ/kg)	6 873

Steam and power generation.

1	Existing boiler capacity (t/h)	280
2	High pressure steam pressure (kPa(abs))	3 200
3	High pressure steam temperature (°C)	380
4	Existing power generation capacity (kW)	12000
5	Exhaust steam pressure (kPa(abs))	200
6	High Pressure steam production (t/h)	185
7	Process steam requirements (t/h)	180
8	Process power requirements (kW)	5500
9	Let down steam (t/h)	30

Biomass, steam and power export

1	Bagasse export (t/h)	BDF 15000 TONS AVERAGE
2	Steam export (t/h)	0
3	Power export (kW)	0

Obstacles for co-generation

1	Can not synchronise with Eskom
2	Obviously no protection between Eskom and ourselves
3	Sell Fibre to Sappi so price plays an important role

Tongaat Hulett - Entumeni**General**

1	Company name	Hulett - Entumeni
2	Name of interviewee	A Wiense
3	Position of interviewee	Head Engineering SMRI
4	Date	20 August 2004

Cane throughput

1	Cane supply area (hectares)	12 932
2	Cane crushed per annum (tons/annum)	361 203
3	Gross available time (hours)	5 501
4	Overall time efficiency (%)	76

Bagasse throughput and properties

1	Bagasse produced per annum	113 145
2	Fibre content of bagasse (%)	45,95
3	Brix content of bagasse (%)	2,09
4	Moisture content of bagasse (%)	51,96
5	Ash content of bagasse (%)	3,16
6	Net calorific value of bagasse (kJ/kg)	6 861

Steam and power generation.

1	Existing boiler capacity (t/h)	21 (46)
2	High pressure steam pressure (kPa(abs))	2 600 (1 800)
3	High pressure steam temperature (°C)	370 (330)
4	Existing power generation capacity (kW)	1 000 (3 000)
5	Exhaust steam pressure (kPa(abs))	180
6	High Pressure steam production (t/h)	
7	Process steam requirements (t/h)	
8	Process power requirements (kW)	
9	Let down steam (t/h)	

Biomass, steam and power export

1	Bagasse export (t/h)	
2	Steam export (t/h)	
3	Power export (kW)	

Obstacles for co-generation

1	
2	
3	

Illovo - Eston**General**

1	Company name	Illovo - Eston
2	Name of interviewee	B Holmes
3	Position of interviewee	Factory Manager
4	Date	21/09/04

Cane throughput

1	Cane supply area (hectares)	35 100
2	Cane crushed per annum (tons/annum)	1 307 274
3	Gross available time (hours)	6 290
4	Overall time efficiency (%)	86

Bagasse throughput and properties

1	Bagasse produced per annum	399 768
2	Fibre content of bagasse (%)	48,20
3	Brix content of bagasse (%)	2,10
4	Moisture content of bagasse (%)	49,70
5	Ash content of bagasse (%)	4,58
6	Net calorific value of bagasse (kJ/kg)	7 070

Steam and power generation.

1	Existing boiler capacity (t/h)	160
2	High pressure steam pressure (kPa(abs))	3 200
3	High pressure steam temperature (°C)	400
4	Existing power generation capacity (kW)	8 500
5	Exhaust steam pressure (kPa(abs))	200
6	High Pressure steam production (t/h)	134
7	Process steam requirements (t/h)	145
8	Process power requirements (kW)	12750
9	Let down steam (t/h)	43

Biomass, steam and power export

1	Bagasse export (t/h)	0
2	Steam export (t/h)	0
3	Power export (kW)	0

Obstacles for co-generation

1	
2	
3	

Tongaat Hulett - Felixton**General**

1	Company name	Hulett - Felixton
2	Name of interviewee	J.de Jager
3	Position of interviewee	Eng. Manager
4	Date	20 Sep. 04

Cane throughput

1	Cane supply area (hectares)	37 824
2	Cane crushed per annum (tons/annum)	1 894 726
3	Gross available time (hours)	4 888
4	Overall time efficiency (%)	73

Bagasse throughput and properties

1	Bagasse produced per annum	683 138
2	Fibre content of bagasse (%)	44,80
3	Brix content of bagasse (%)	1,85
4	Moisture content of bagasse (%)	53,35
5	Ash content of bagasse (%)	3,38
6	Net calorific value of bagasse (kJ/kg)	6 541

Steam and power generation.

1	Existing boiler capacity (t/h)	450
2	High pressure steam pressure (kPa(abs))	3 200
3	High pressure steam temperature (°C)	400
4	Existing power generation capacity (kW)	31 500
5	Exhaust steam pressure (kPa(abs))	200
6	High Pressure steam production (t/h)	Up to 290
7	Process steam requirements (t/h)	Up to 115
8	Process power requirements (kW)	Up to 21000
9	Let down steam (t/h)	Up to 90

Biomass, steam and power export

1	Bagasse export (t/h)	160
2	Steam export (t/h)	0
3	Power export (kW)	Not exporting at present (5MW capacity)

Obstacles for co-generation

1	Not economical (Eskom pricing)
2	Intertipping protection not adequate
3	System connection limitations

uShukela - Gledhow**General**

1	Company name	Ushukela Milling
2	Name of interviewee	Eckard Lucht
3	Position of interviewee	Factory Manager
4	Date	22/09/04

Cane throughput

1	Cane supply area (hectares)	28 391
2	Cane crushed per annum (tons/annum)	1 175 622
3	Gross available time (hours)	5 425
4	Overall time efficiency (%)	85

Bagasse throughput and properties

1	Bagasse produced per annum	361 946
2	Fibre content of bagasse (%)	48,60
3	Brix content of bagasse (%)	1,90
4	Moisture content of bagasse (%)	49,50
5	Ash content of bagasse (%)	2,30
6	Net calorific value of bagasse (kJ/kg)	7 534

Steam and power generation.

1	Existing boiler capacity (t/h)	234
2	High pressure steam pressure (kPa(abs))	3 200
3	High pressure steam temperature (°C)	390 (370)
4	Existing power generation capacity (kW)	13 650
5	Exhaust steam pressure (kPa(abs))	200
6	High Pressure steam production (t/h)	155
7	Process steam requirements (t/h)	155
8	Process power requirements (kW)	8 000
9	Let down steam (t/h)	5

Biomass, steam and power export

1	Bagasse export (t/h)	33
2	Steam export (t/h)	0
3	Power export (kW)	0

Obstacles for co-generation

1	Presently all fibre exported of which 60% is returned as pith for fuel.
2	
3	

Transvaal Sugar - Komati**General**

1	Company name	TSB - Komati
2	Name of interviewee	G M Rolfe
3	Position of interviewee	Komati Mill – General Manager
4	Date	20 th September 2004

Cane throughput

1	Cane supply area (hectares)	23 976
2	Cane crushed per annum (tons/annum)	2 137 724
3	Gross available time (hours)	6 153
4	Overall time efficiency (%)	86

Bagasse throughput and properties

1	Bagasse produced per annum	529 150
2	Fibre content of bagasse (%)	51,52
3	Brix content of bagasse (%)	2,20
4	Moisture content of bagasse (%)	46,28
5	Ash content of bagasse (%)	1,89
6	Net calorific value of bagasse (kJ/kg)	8 266

Steam and power generation.

1	Existing boiler capacity (t/h)	220
2	High pressure steam pressure (kPa(abs))	3 200
3	High pressure steam temperature (°C)	410
4	Existing power generation capacity (kW)	20 000
5	Exhaust steam pressure (kPa(abs))	200
6	High Pressure steam production (t/h)	210
7	Process steam requirements (t/h)	230
8	Process power requirements (kW)	14 000
9	Let down steam (t/h)	105

Biomass, steam and power export

1	Bagasse export (t/h)	9
2	Steam export (t/h)	18.75
3	Power export (kW)	2 500

Obstacles for co-generation

1	Regulatory framework for Renewable Energy not in place (Market rules)
2	Renewable Energy Targets not mandatory – Limited RE market
3	Network access and wheeling cost

Transvaal Sugar - Malelane**General**

1	Company name	TSB - Malelane
2	Name of interviewee	Franco Weyers
3	Position of interviewee	Factory Manager
4	Date	21 September 2004

Cane throughput

1	Cane supply area (hectares)	22 698
2	Cane crushed per annum (tons/annum)	1 837 756
3	Gross available time (hours)	6 415
4	Overall time efficiency (%)	93

Bagasse throughput and properties

1	Bagasse produced per annum	534 868
2	Fibre content of bagasse (%)	45,87
3	Brix content of bagasse (%)	1,87
4	Moisture content of bagasse (%)	52,26
5	Ash content of bagasse (%)	3,35
6	Net calorific value of bagasse (kJ/kg)	6 772

Steam and power generation.

1	Existing boiler capacity (t/h)	442
2	High pressure steam pressure (kPa(abs))	3 200
3	High pressure steam temperature (°C)	400
4	Existing power generation capacity (kW)	32 400
5	Exhaust steam pressure (kPa(abs))	200
6	High Pressure steam production (t/h)	204
7	Process steam requirements (t/h)	210
8	Process power requirements (kW)	12 000
9	Let down steam (t/h)	15

Biomass, steam and power export

1	Bagasse export (t/h)	62 000
2	Steam export (t/h)	0
3	Power export (kW)	2 500

Obstacles for co-generation

1	Low tariff / income from co-generation
2	Eskom network stability – risk to plant
3	Capital outlay required to upgrade export systems

Tongaat Hulett - Maidstone**General**

1	Company name	Hulett - Maidstone
2	Name of interviewee	Stuart Watson
3	Position of interviewee	Engineering Manager
4	Date	

Cane throughput

1	Cane supply area (hectares)	35 599
2	Cane crushed per annum (tons/annum)	1 420 000
3	Gross available time (hours)	4890
4	Overall time efficiency (%)	85

Bagasse throughput and properties

1	Bagasse produced per annum	442000
2	Fibre content of bagasse (%)	46,83
3	Brix content of bagasse (%)	1,29
4	Moisture content of bagasse (%)	51,00
5	Ash content of bagasse (%)	3.77
6	Net calorific value of bagasse (kJ/kg)	6 793

Steam and power generation.

1	Existing boiler capacity (t/h)	370 (25)
2	High pressure steam pressure (kPa(abs))	3 200 (1 500)
3	High pressure steam temperature (°C)	400 (280)
4	Existing power generation capacity (kW)	22 500 (6 000)
5	Exhaust steam pressure (kPa(abs))	200 (1 500)
6	High Pressure steam production (t/h)	250
7	Process steam requirements (t/h)	200
8	Process power requirements (kW)	12500
9	Let down steam (t/h)	Reduced to min levels – focus on co-gen

Biomass, steam and power export

1	Bagasse export (t/h)	75-100
2	Steam export (t/h)	15 – 20
3	Power export (kW)	5000

Obstacles for co-generation

1	Available MW on the Maidstone Major Bus- bar.
2	Factory constraints ito steam usage
3	

Illovo - Noodsberg**General**

1	Company name	Illovo – Noodsberg
2	Name of interviewee	Johan Jansen van Rensburg
3	Position of interviewee	Engineering Manager
4	Date	20 September 2004

Cane throughput

1	Cane supply area (hectares)	31 782
2	Cane crushed per annum (tons/annum)	1 614 763
3	Gross available time (hours)	6 792
4	Overall time efficiency (%)	84

Bagasse throughput and properties

1	Bagasse produced per annum	470 914
2	Fibre content of bagasse (%)	47,83
3	Brix content of bagasse (%)	2,29
4	Moisture content of bagasse (%)	50.2
5	Ash content of bagasse (%)	3,80
6	Net calorific value of bagasse (kJ/kg)	7 170

Steam and power generation.

1	Existing boiler capacity (t/h)	190
2	High pressure steam pressure (kPa(abs))	3 200
3	High pressure steam temperature (°C)	400
4	Existing power generation capacity (kW)	17 000
5	Exhaust steam pressure (kPa(abs))	220
6	High Pressure steam production (t/h)	160
7	Process steam requirements (t/h)	150
8	Process power requirements (kW)	16 500
9	Let down steam (t/h)	35

Biomass, steam and power export

1	Bagasse export (t/h)	0
2	Steam export (t/h)	0
3	Power export (kW)	500

Obstacles for co-generation

1	Due to the refinery shortfall of bagasse made up by coal
2	Electrical consumption very high and most of the power consumed by mill
3	3 X Old boilers very inefficient and con not be operated on a continuous basis – de-dashed 1 boiler every week

Illovo - Pongola**General**

1	Company name	Illovo - Pongola
2	Name of interviewee	John Hulley
3	Position of interviewee	Factory Manager
4	Date	26/10/2004

Cane throughput

1	Cane supply area (hectares)	18 337
2	Cane crushed per annum (tons/annum)	1 426 568
3	Gross available time (hours)	6 804
4	Overall time efficiency (%)	83

Bagasse throughput and properties

1	Bagasse produced per annum	400 000
2	Fibre content of bagasse (%)	46,89
3	Brix content of bagasse (%)	2,22
4	Moisture content of bagasse (%)	50,89
5	Ash content of bagasse (%)	4,26
6	Net calorific value of bagasse (kJ/kg)	6 878

Steam and power generation.

1	Existing boiler capacity (t/h)	140 (46)
2	High pressure steam pressure (kPa(abs))	3 200 (1 800)
3	High pressure steam temperature (°C)	400 (260)
4	Existing power generation capacity (kW)	10 000 (1 500)
5	Exhaust steam pressure (kPa(abs))	200
6	High Pressure steam production (t/h)	127 (18)
7	Process steam requirements (t/h)	145
7	Process power requirements (kW)	7.2 mw elect power plus 3.9 mw steam
8	Let down steam (t/h)	8 tons/hr to 700 kpa range and 10 tons/hr

Biomass, steam and power export

1	Bagasse export (t/h)	None
2	Steam export (t/h)	None
3	Power export (kW)	1 mw to village and effluent plant

Obstacles for co-generation

1	Low fibre % cane at start of season, resulting in coal firing. Profitability of Co Gen ?	
2	T.A. set installed capacity wrt. reliability of 1.5 mw set	
3	Currently little or no letdown margin when running 1.5 mw T.A. with two 5 mw sets	

Illovo - Sezela**General**

1	Company name	Illovo - Sezela
2	Name of interviewee	Vis Pillay
3	Position of interviewee	Factory Manager
4	Date	23 September 2004

Cane throughput

1	Cane supply area (hectares)	42384
2	Cane crushed per annum (tons/annum)	2 014 283
3	Gross available time (hours)	5 762
4	Overall time efficiency (%)	88

Bagasse throughput and properties

1	Bagasse produced per annum	628 673
2	Fibre content of bagasse (%)	50,73
3	Brix content of bagasse (%)	1,62
4	Moisture content of bagasse (%)	47,65
5	Ash content of bagasse (%)	3,03
6	Net calorific value of bagasse (kJ/kg)	7 792

Steam and power generation.

1	Existing boiler capacity (t/h)	360 (100)
2	High pressure steam pressure (kPa(abs))	3 200 (2 200)
3	High pressure steam temperature (°C)	390 (330)
4	Existing power generation capacity (kW)	19 000
5	Exhaust steam pressure (kPa(abs))	210
6	High Pressure steam production (t/h)	320
7	Process steam requirements (t/h)	240
8	Process power requirements (kW)	10 000
9	Let down steam (t/h)	15

Biomass, steam and power export (supplied to Downstream plant)

1	Bagasse export (t/h)	95% of total bagasse sent to DS plant
2	Steam export (t/h)	150tph 2100kpa and 75tph return of
3	Power export (kW)	nil

Obstacles for co-generation

1	No available bagasse, burning coal for DS steam requirement	
2	Alternator low power factor	
3		

Illovo - Umfolozi**General**

1	Company name	Illovo - Umfolozi
2	Name of interviewee	Morne Bester
3	Position of interviewee	Plant Engineer, Front End and Boilers
4	Date	28-9-2004

Cane throughput

1	Cane supply area (hectares)	22 105
2	Cane crushed per annum (tons/annum)	1 087 606
3	Gross available time (hours)	5 485
4	Overall time efficiency (%)	80

Bagasse throughput and properties

1	Bagasse produced per annum	307 435
2	Fibre content of bagasse (%)	47,89
3	Brix content of bagasse (%)	2,19
4	Moisture content of bagasse (%)	49,91
5	Ash content of bagasse (%)	5,13
6	Net calorific value of bagasse (kJ/kg)	6 922

Steam and power generation.

1	Existing boiler capacity (t/h)	220 (rated at MCR of boilers)
2	High pressure steam pressure (kPa(abs))	3 200
3	High pressure steam temperature (°C)	400 (bagasse firing),360 (coal firing)
4	Existing power generation capacity (kW)	14 000
5	Exhaust steam pressure (kPa(abs))	210
6	High Pressure steam production (t/h)	140 t/h (at average crush rate of 300 tch)
7	Process steam requirements (t/h)	140 t/h (at average crush rate of 300 tch)
8	Process power requirements (kW)	10 MW (Tot Plant),5 MW (RawH & Ref)
9	Let down steam (t/h)	60 t/h (at average crush rate of 300 tch)

Biomass, steam and power export

1	Bagasse export (t/h)	None
2	Steam export (t/h)	None
3	Power export (kW)	None

Obstacles for co-generation

1	Unstable Firing Conditions in Boilers
2	ESKOM HT reticulation in a bad state
3	Not enough installed electrical generating capacity

Illovo - Umzimkulu**General**

1	Company name	Illovo - Umzimkulu
2	Name of interviewee	Lal Bachan
3	Position of interviewee	Factory Manager
4	Date	27/09/2004

Cane throughput

1	Cane supply area (hectares)	29 440
2	Cane crushed per annum (tons/annum)	1 136 866
3	Gross available time (hours)	5 463
4	Overall time efficiency (%)	83

Bagasse throughput and properties

1	Bagasse produced per annum	353 819
2	Fibre content of bagasse (%)	48,68
3	Brix content of bagasse (%)	1,62
4	Moisture content of bagasse (%)	49,70
5	Ash content of bagasse (%)	3,38
6	Net calorific value of bagasse (kJ/kg)	7 305

Steam and power generation.

1	Existing boiler capacity (t/h)	130 (72)
2	High pressure steam pressure (kPa(abs))	3 200 (1 800)
3	High pressure steam temperature (°C)	400 (260)
4	Existing power generation capacity (kW)	3 750 (5 500)
5	Exhaust steam pressure (kPa(abs))	210
6	High Pressure steam production (t/h)	Approx 150
7	Process steam requirements (t/h)	Approx 155
8	Process power requirements (kW)	+ - 5 000
9	Let down steam (t/h)	+ - 70

Biomass, steam and power export

1	Bagasse export (t/h)	nil
2	Steam export (t/h)	nil
3	Power export (kW)	nil

Obstacles for co-generation

1	The price that Eskom is prepared to pay for electricity is too low	
2	Capital costs are high	
3		

Union Co-op**General**

1	Company name	Union Co-op
2	Name of interviewee	Karl Schröder
3	Position of interviewee	Engineering Manager
4	Date	22 September 2004

Cane throughput

1	Cane supply area (hectares)	21 702
2	Cane crushed per annum (tons/annum)	777 306
3	Gross available time (hours)	6 763
4	Overall time efficiency (%)	85

Bagasse throughput and properties

1	Bagasse produced per annum	235 840
2	Fibre content of bagasse (%)	45,65
3	Brix content of bagasse (%)	1,86
4	Moisture content of bagasse (%)	52,49
5	Ash content of bagasse (%)	2,74
6	Net calorific value of bagasse (kJ/kg)	6 836

Steam and power generation.

1	Existing boiler capacity (t/h)	165
2	High pressure steam pressure (kPa(abs))	2 000
3	High pressure steam temperature (°C)	282
4	Existing power generation capacity (kW)	4 500
5	Exhaust steam pressure (kPa(abs))	170
6	High Pressure steam production (t/h)	See attached Word Document
7	Process steam requirements (t/h)	Approx. 90
8	Process power requirements (kW)	Approx. 3 500
9	Let down steam (t/h)	Approx. 17.5

Biomass, steam and power export

1	Bagasse export (t/h)	Approx. 3
2	Steam export (t/h)	Approx. 28 426
3	Power export (kW)	1 000 from beginning of Sep. to end of

Obstacles for co-generation

1	
2	
3	

Appendix 5 – Sawmill Questionnaire

General

1	Sawmill name and location	
2	Details of interviewee	
3	Position of interviewee	

Roundwood log intake, sawntimber production and plant operating time, 2004

		solid-m ³	t
1	Softwood log intake Hardwood log intake		
2	Sawn timber output (total), Of which output of dried timber		
3	Number of operating days / year Number of operating days / week Number of operating hours / day		

Wood processing waste production volumes, 2004

		solid-m ³	t (as received)
1	Chips (total production volume) - own use in energy production (%) - sales outside (%) - landfilling or other use (%)		
2	Sawdust (total production volume) - own use in energy production (%) - sales outside (%) - landfilling or other use (%)		
3	Bark (total production volume) - own use in energy production (%) - sales outside (%) - landfilling or other use (%)		

Wood processing waste properties

		Chips	Sawdust	Bark
1	Moisture content, fresh waste (%)			
2	Ash content in dry matter (%)			
3	Net calorific value, fresh waste (kJ/kg)			
4	Net calorific value in dry matter (kJ/kg)			
5	Bulk density as received (kg/loose-m ³)			

Steam and power generation

1	Existing boiler (main boiler): - capacity (t/h) - age (years) - boiler type (e.g. grate) - fuels used (e.g. 50% coal, 50% bark)	
2	High pressure steam pressure (kPa(abs))	
3	High pressure steam temperature (°C)	
4	Existing power generation capacity (kW)	
5	Exhaust steam pressure (kPa(abs))	
6	Process steam requirements (t/h)	
7	Process power requirements (kW)	
8	Let down steam (t/h)	

Steam and power export

2	Steam export (t/h)	
3	Power export (kW)	

Obstacles for co-generation (to invest to modernization or to new co-generation plant)

1	
2	
3	

Interest of the company to study possibilities to utilize process waste in energy production

1	Are there existing studies made ?
2	

Appendix 6 – Pulp and Paper Questionnaire

General

1	Paper mill name and location	
2	Details of interviewee	
3	Position of interviewee	
4	Date	

Roundwood log intake, pulp ,waste paper,filler and plant operating time

1	Softwood log intake (t/a) Hardwood log intake (t/a)	
2	Chemical pulp (softwood) (t/a)	
3	Chemical pulp (hardwood) (t/a)	
4	Waste paper (t/a)	
5	Filler (t/a)	
6	Operating days / year	

Pulping output (t/a)

1	Bleached Kraft (softwood)	
2	Bleached Kraft (hardwood)	
3	Deinked and/or screened waste paper pulp	
4	TMP/GWD	
5	NSCC	
6	Other	

Paper output (t/a).

1	Printing and writing grade papers	
2	Packaging grade papers	
3	Tissue	
4	Other	

Steam and power generation.

1	Existing boiler (main boiler): - capacity (t/h) - age (years) - boiler type (e.g. grate) - fuels used (e.g. 50% coal, 50% bark)	
2	High pressure steam pressure (kPa(abs))	
3	High pressure steam temperature (°C)	
4	Existing power generation capacity (kW)	
5	Exhaust steam pressure (kPa(abs))	
6	Process steam requirements (t/h)	
7	Process power requirements (kW)	
8	Let down steam (t/h)	

Waste material (t/a)

1	Bark (total production volume) (t/a) - own use in energy production (%) - sales outside (%) - landfilling or other use (%)	
2	Sludge (t/a) own use in energy production (%) - landfilling or other use (%) -moisture (%) -ash content (%)	

Obstacles for co-generation

1	
2	
3	
4	
5	

Interest of the company to study possibilities to utilize process waste in energy production

1	Have studies been made?
2	

Mondi – Piet Retief

Date: 07/09/2004

General

1	Company name & Mill name and location	Mondi, Piet Retief Mill, Vroegeveld farm, Ermelo road, Piet Retief
2	Name of interviewee	Johan Viviers
3	Position of interviewee	Technical Manager
4	Operating days	365

Roundwood log intake, pulp ,waste paper,filler and plant operating time

1	Softwood log intake (t/a) Hardwood log intake (t/a)	SW chips 90 000 HW logs 70 000
2	Chemical pulp (softwood) (t/a)	
3	Chemical pulp (hardwood) (t/a)	55 000
4	Waste paper (t/a)	70 000
5	Filler (t/a)	0
6	Operating days / year	365

Pulping output (t/a)

1	Bleached Kraft (softwood)	
2	Bleached Kraft (hardwood)	
3	Deinked and/or screened waste paper pulp	63 000
4	TMP/GWD	
5	NSCC	
6	Other	12 000 bought in pulp

Paper output (t/a).

1	Printing and writing grade papers	
2	Packaging grade papers	130 000
3	Tissue	
4	Other	

Steam and power generation.

1	Existing boiler (main boiler): - capacity (t/h) - age (years) - boiler type (e.g. grate) - fuels used (e.g. 50% coal, 50% bark)	(1) 26 (2) 26 (3) 16 (4) 12 grate type 100% coal
2	High pressure steam pressure (kPa(abs))	(1) 30 bar (2) 30 bar (3) 10 bar (4) 15 bar
3	High pressure steam temperature (°C)	(1) 400 (2) 400 (3) 186 (4) 220
4	Existing power generation capacity (kW)	7.9 MW
5	Exhaust steam pressure (kPa(abs))	340 kPa
6	Process steam requirements (t/h)	52
7	Process power requirements (kW)	16 MW
8	Let down steam (t/h)	

Waste material (t/a)

1	Bark (total production volume) (t/a) - own use in energy production (%) - sales outside (%) - landfilling or other use (%)	0
2	Sludge (t/a) own use in energy production (%) - landfilling or other use (%) -moisture (%) -ash content (%)	0

Obstacles for co-generation

1	Burning waste pulp containing plastics will cause an environmental problem.
2	No heat recovery possible from Copeland because the heat is already used.
3	Burning bark will cause heavy metal problem in the ash that must be disposed of which will required an upgrade to solid waste site specifications.
4	
5	

Interest of the company to study possibilities to utilize process waste in energy production

1	Have studies been made?
2	

Sappi– Saiccor
Date: 19/08/2004

General

1	Company name & Mill name and location	Sappi Saiccor
2	Name of interviewee	Derek Airey
3	Position of interviewee	Environmentalist
4	Operating days	365

Roundwood log intake, pulp ,waste paper,filler and plant operating time

1	Softwood log intake (t/a) Hardwood log intake (t/a)	2 000 000
2	Chemical pulp (softwood) (t/a)	-
3	Chemical pulp (hardwood) (t/a)	-
4	Waste paper (t/a)	-
5	Filler (t/a)	-
6	Operating days / year	365

Pulping output (t/a)

1	Bleached Kraft (softwood)	-
2	Bleached Kraft (hardwood)	-
3	Deinked and/or screened waste paper pulp	-
4	TMP/GWD	-
5	NSCC	-
6	Other: Chemical Cellulose	600 000

Paper output (t/a).

1	Printing and writing grade papers	-
2	Packaging grade papers	-
3	Tissue	-
4	Other	-

Steam and power generation.

1	Existing boiler (main boiler): - capacity (t/h) - age (years) - boiler type (e.g. grate) - fuels used (e.g. 50% coal, 50% bark)	MgO Recovery 180 t/h 20 yrs - liquor	6 Coal Boilers 240 t/h 30 – 50 yrs grate + spreader coal
2	High pressure steam pressure (kPa(abs))	8 500	4 500
3	High pressure steam temperature (°C)	490	450
4	Existing power generation capacity (kW)	28 000	18 000
5	Exhaust steam pressure (kPa(abs))	500 kPa	
6	Process steam requirements (t/h)	380	
7	Process power requirements (kW)	70	
8	Let down steam (t/h)	-	

Waste material (t/a)

1	Bark (total production volume) (t/a) - own use in energy production (%) - sales outside (%) - landfilling or other use (%)	-
2	Sludge (t/a) own use in energy production (%) - landfilling or other use (%) -moisture (%) -ash content (%)	-

Obstacles for co-generation

1	Process steam demand / non-condensing sets
2	
3	
4	
5	

Interest of the company to study possibilities to utilize process waste in energy production

1	Have studies been made? Yes
2	

Sappi– Stanger

Date: 23/10/2004

General

1	Company name & Mill name and location	Sappi Stanger
2	Name of interviewee	Stephen Trickett
3	Position of interviewee	Senior Project Engineer
4	Operating days	365

Roundwood log intake, pulp ,waste paper,filler and plant operating time

1	Softwood log intake (t/a) Hardwood log intake (t/a)	0 t/a
2	Chemical pulp (softwood) (t/a)	25000
3	Chemical pulp (hardwood) (t/a)	2000
4	Waste paper (t/a)	500
5	Filler (t/a)	8600
6	Bagasse (t/a)	56000
7	Operating days / year	365

Pulping output (t/a)

1	Bleached Kraft (softwood)	0 t/a
2	Bleached Kraft (hardwood)	0 t/a
3	Deinked and/or screened waste paper pulp	0 t/a
4	TMP/GWD	0 t/a
5	NSSC	0 t/a
6	Other	57,000 ADTPA Bagasse Pulp Soda Cook

Paper output (t/a).

1	Printing and writing grade papers	75000
2	Packaging grade papers	0 t/a
3	Tissue	29000
4	Other	19000 Soda Ash Byproduct

Steam and power generation.

1	Existing boiler (main boiler): - capacity (t/h) - age (years) - boiler type (e.g. grate) - fuels used (e.g. 50% coal, 50% bark)	4x boilers. 2x 32t/h & 2x 28t/h 25 years on site but bought 2 nd hand Chain Grate A Grade Coal
2	High pressure steam pressure (kPa(abs))	21,000 kPa
3	High pressure steam temperature (°C)	350 deg C
4	Existing power generation capacity (kW)	0 kW
5	Exhaust steam pressure (kPa(abs))	305
6	Process steam requirements (t/h)	75 to 85 t/h
7	Process power requirements (kW)	14000 MWH average per month
8	Let down steam (t/h)	Item 6 less 19 tons

Waste material (t/a)

1	Bark (total production volume) (t/a) - own use in energy production (%) - sales outside (%) - landfilling or other use (%)	0 t/a
2	Sludge (t/a) own use in energy production (%) - landfilling or other use (%) -moisture (%) -ash content (%)	4 to 12 t/d Landfilling 100% Ash content?
3	Sugar Cane Pith	55 to 70 BDTPD at 80% moisture content
4	Soda Ash (Na ₂ CO ₃) from black cooking liquor	Sold

Obstacles for co-generation

1	Capital
2	Economies of scale
3	
4	
5	

Interest of the company to study possibilities to utilize process waste in energy production

1	Have studies been made? Yes. Installation of 8 t/hr low pressure boiler fuelled by waste (pith and sludge). Insufficient payback on R20m of capital.
2	SASAQ Project to use black liquor in modern gasification technology to generate steam and recover chemicals. Element of pulp capacity debottlenecking. Capital R485m with insufficient payback. In conjunction we also looked at cogeneration. Capital for small scale operation excessive ±R600m

Mondi – Richards Bay

Date: 11/08/2004

General

1	Company name & Mill name and location	Mondi Richards Bay
2	Name of interviewee	Ciska Terblanche
3	Position of interviewee	Environmental Manager
4	Operating days	

Roundwood log intake, pulp ,waste paper,filler and plant operating time

1	Softwood log intake (t/a) Hardwood log intake (t/a)	410.000 T/a 1.88 m t/a
2	Chemical pulp (softwood) (t/a)	-
3	Chemical pulp (hardwood) (t/a)	-
4	Waste paper (t/a)	
5	Filler (t/a)	
6	Bagasse (t/a)	
7	Operating days / year	350

Pulping output (t/a)

1	Bleached Kraft (softwood)	Unbleached – 130 000
2	Bleached Kraft (hardwood)	590 000 ad/a
3	Deinked and/or screened waste paper pulp	-
4	TMP/GWD	-
5	NSCC	-
6	Other	-

Paper output (t/a).

1	Printing and writing grade papers	
2	Packaging grade papers	230.000
3	Tissue	
4	Other	

Steam and power generation.

1	Existing boiler (main boiler): - capacity (t/h) - age (years)	Recovery 1 80 kg/s 2 32 kg/s 3 x PB – 20 kg/s
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	- boiler type (e.g. grate) - fuels used (e.g. 50% coal, 50% bark)	
2	High pressure steam pressure (kPa(abs))	
3	High pressure steam temperature (°C)	
4	Existing power generation capacity (kW)	0.88 mwh/t
5	Exhaust steam pressure (kPa(abs))	
6	Process steam requirements (t/h)	9.1 t/adt
7	Process power requirements (kW)	1.28 mwh/t
8	Let down steam (t/h)	

Waste material (t/a)

1	Bark (total production volume) (t/a) - own use in energy production (%) - sales outside (%) - landfilling or other use (%)	300 t/d (wet) 100%
2	Sludge (t/a) own use in energy production (%) - landfilling or other use (%) -moisture (%) -ash content (%)	120 t/month (dry) Felixton 12-25-35 calcium carb.
		Total = wet (t) x dry content Wet = $\frac{\text{total dry}}{\text{Dry cont.}}$ $\frac{120}{0.44} = 272 \text{ t/d}$

Obstacles for co-generation

1	
2	
3	
4	
5	

Interest of the company to study possibilities to utilize process waste in energy production

1	
2	

600 t/d capacity of boiler.

Sappi- Ngodwana

Date: 11/08/2004

General

1	Company name & Mill name and location	Sappi Ngodwana Mill
2	Name of interviewee	Kobus Geldenhuys
3	Position of interviewee	Pulp Sales Manager
4	Operating days	24 hours all year round

Roundwood log intake, pulp ,waste paper,filler and plant operating time

1	Softwood log intake (t/a) Hardwood log intake (t/a)	1.6 million tons softwood and 0.3 million ton hardwood
2	Chemical pulp (softwood) (t/a)	Nil
3	Chemical pulp (hardwood) (t/a)	Nil
4	Waste paper (t/a)	± 40 000 tons
5	Filler (t/a)	± 8 000 tons
7	Operating days / year	365

Pulping output (t/a)

1	Bleached Kraft (softwood)	200,000 tpa
2	Bleached Kraft (hardwood)	25,000 tpa
3	Deinked and/or screened waste paper pulp	36,000 tpa
4	TMP/GWD	100 000 tpa
5	NSCC	Nil
6	Other	200,000 tpa unbleached pulp

Paper output (t/a).

1	Printing and writing grade papers	Nil
2	Packaging grade papers	250,000 tpa liner board
3	Tissue	Nil
4	Other	

Steam and power generation.

1	Existing boiler (main boiler): - capacity (t/h) - age (years) - boiler type (e.g. grate) - fuels used (e.g. 50% coal, 50% bark)	
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2	High pressure steam pressure (kPa(abs))	
3	High pressure steam temperature (°C)	
4	Existing power generation capacity (kW)	
5	Exhaust steam pressure (kPa(abs))	
6	Process steam requirements (t/h)	
7	Process power requirements (kW)	
8	Let down steam (t/h)	

Waste material (t/a)

1	Bark (total production volume) (t/a) - own use in energy production (%) - sales outside (%) - landfilling or other use (%)	Production 120,000 tpa Own use 50,000 tons Sales 70,000 tons Nil as from Sept 2004
2	Sludge (t/a) own use in energy production (%) - landfilling or other use (%) -moisture (%) -ash content (%)	Production 84,000 tpa Nil as from Sept 04 85% moisture

Obstacles for co-generation

1	
2	
3	
4	
5	

Interest of the company to study possibilities to utilize process waste in energy production

1	Have studies been made? Not that I'm aware of.
2	As can be seen from the above we will convert all bark and fibre sludge into compost as from September 2004. It took us years to get this so far, but in doing this we will reduce our landfill by 50% and extend the life of the landfill. The real cost savings come in the long term because the whole process of expanding the landfill sites is delayed. The abovementioned volumes are estimated numbers and this info should not be used in any publications, it is merely info to better understand the situation at the mill. Technical data from the mill is not available at this point in time and we would expect the DME to inform us of their intention to do a survey and your involvement in the project.

Sappi– Tugela
Date: 11/08/20054

General

1	Company name & Mill name and location	Sappi Tugela
2	Name of interviewee	Kobus Geldenhuys
3	Position of interviewee	Pulp Sales Manager
4	Operating days	24 hours all year

Roundwood log intake, pulp ,waste paper,filler and plant operating time

1	Softwood log intake (t/a) Hardwood log intake (t/a)	0.9 million tons softwood and 0.4 million ton hardwood
2	Chemical pulp (softwood) (t/a)	Nil
3	Chemical pulp (hardwood) (t/a)	Nil
4	Waste paper (t/a)	± 75,000 tons
5	Filler (t/a)	± 10,000 tons
7	Operating days / year	365

Pulping output (t/a)

1	Bleached Kraft (softwood)	Nil
2	Bleached Kraft (hardwood)	Nil
3	Deinked and/or screened waste paper pulp	60,000 tpa
4	TMP/GWD	Nil
5	NSSC	120,000 tpa
6	Other	220,000 tpa unbleached pine pulp

Paper output (t/a).

1	Printing and writing grade papers	Nil
2	Packaging grade papers	400,000 tpa liner board
3	Tissue	Nil
4	Other	

Steam and power generation.

1	Existing boiler (main boiler): - capacity (t/h) - age (years) - boiler type (e.g. grate) - fuels used (e.g. 50% coal, 50% bark)	
2	High pressure steam pressure (kPa(abs))	
3	High pressure steam temperature (°C)	
4	Existing power generation capacity (kW)	
5	Exhaust steam pressure (kPa(abs))	
6	Process steam requirements (t/h)	
7	Process power requirements (kW)	
8	Let down steam (t/h)	

Waste material (t/a)

1	Bark (total production volume) (t/a) - own use in energy production (%) - sales outside (%) - landfilling or other use (%)	Production 70,000 tpa Own use nil tons Sales 70,000 tons Nil
2	Sludge (t/a) own use in energy production (%) - landfilling or other use (%) -moisture (%) -ash content (%)	Production 60,000 tpa Nil to landfill Mixed with bark for composting 85% moisture

Obstacles for co-generation

1	
2	
3	
4	
5	

Interest of the company to study possibilities to utilize process waste in energy production

1	Have studies been made? Not that I'm aware of.
2	As can be seen from the above we will convert all bark and fibre sludge into compost as from September 2004. It took us years to get this so far, but in doing this we will reduce our landfill by 55% and extend the life of the landfill. The real cost savings come in the long term because the whole process of expanding the landfill sites is delayed. The abovementioned volumes are estimated numbers and this info should not be used in any publications, it is merely info to better understand the situation at the mill. Technical data from the mill is not available at this point in time and we would expect the DME to inform us of their intention to do a survey and your involvement in the project.

Appendix 7 – Terms of Reference



DEPARTMENT OF MINERALS AND ENERGY

DME-Danida Capacity Building in Energy Efficiency & Renewable Energy

Terms of Reference

Title of Assignment: Assessment of commercially exploitable biomass resources: bagasse, wood and sawmill waste and pulp, in South Africa	Approved by Project Director, DME
Consultants(s):	Approved by Counterpart, DME
Counterparts: Mr Andre Otto, Deputy Director, DME	Approved by CTA, COWI
Time frame: 100 days during the period 01 July 2004 to 30 November 2004.	
Budget Line: Special Project	Project Number: P-54126

1 Background

The Department of Minerals and Energy (DME), South Africa is responsible for formulating strategies and drafting legislation for the South African energy sector.

As a result of a dialogue between the DME and Danida over the years 1999 to 2001 the Project "Capacity Building in DME in Energy Efficiency (EE) and Renewable Energy (RE) (CaBEERE), has been formulated.

The CaBEERE Project aims at enhancing DME's capacity and performance by assisting in developing programmatic approaches through strategies and actions plans for energy efficiency and renewable energy in transparent co-operation with relevant stakeholders. The project aims at making the DME a "learning organisation" better able to update, develop and implement strategies and action plans within EE and RE. The project approach is primarily built on learning by doing through on the job training of DME staff and other stakeholders. At the end of the project DME will be able to effectively and efficiently meet its energy efficiency and renewable energy mandate as prescribed by the White Paper on Energy Policy and to sustain this capacity.

These ToR relates to the exploitation of commercially based biomass resources for electricity generation. According to a macro economic study on utilising renewable energy resources in South Africa, electricity production based on commercially based biomass is among the most cost effective for renewable energy applications. Assuming a least-cost approach for implementation of renewable energy applications, a major contribution to the RE target can be derived from commercially available biomass resources. Detailed data on biomass resources (bagasse, pulp and forest wood waste and sawmill wood waste), energy content and physical/chemical characteristics are presently not available. This information is needed to determine the actual potential of power generation from biomass and to establish a reliable basis to enable possible IPP's to carry out due diligence studies as part of possible project preparations.



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DME-Danida Capacity Building in Energy Efficiency & Renewable Energy

2 Overall objective of the CaBEERE Project

Increased use of renewable energy and energy efficiency throughout South Africa to maximise the energy sector's contribution towards sustainable development.

3 Immediate Objectives

3.1 Immediate objective of the CaBEERE Project

DME and relevant stakeholders are resourced and capacitated to formulate and facilitate implementation of strategies and legislation promoting energy efficiency and renewable energy production and use in both rural and urban areas.

3.2 Immediate objectives of these Terms of Reference

Commercially exploitable biomass resources (bagasse, wood and sawmill waste and pulp) are identified for electricity generation. The identification includes data on the quantity and locality of the resources, the characteristics of the biomass including the energy content of the resources and ownership of these resources. The objective is also to develop a guideline for technical and economical evaluation of specific project proposals.

4 Output of these terms of reference

- 4.1 Data on the quantity of the various types of commercially based biomass resources (bagasse, wood waste, sawmill waste and pulp) available for energy generation in various regions in South Africa
- 4.2 Overview of the industry producing these resources. This would include information such as ownership, industry size and other economic indicators.
- 4.3 Biomass characteristics such as moisture content, calorific content and wood classification (shape/size etc.) per sector.
- 4.4 The handling, storage and transportation of these materials and impact on final costs.
- 4.5 Proposal regarding linkage of data to the Homer/Re GIS developed by CSIR/DME/Eskom. It will then be the responsibility of the DME to drive this process forward.
- 4.6 A feasibility check list to assist potential IPP's
- 4.7 To conduct a workshop with relevant stakeholders for each of the three sectors ie. Bagasse, wood and sawmill waste and pulp).
- 4.8 Publish feasibility check list to ensure that relevant stakeholders have access to the information.
- 4.9



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DME-Danida Capacity Building in Energy Efficiency & Renewable Energy

5 Scope of Work

The scope of works includes but is not necessary limited to:

a) Identification of industries/persons to be selected for conducting interviews. Representatives from large and medium size companies in the different sectors are visited (sugar industry, sawmill, forest industry and paper industry). Questionnaires are prepared before the visits are performed. The number of planned visits are:

- visit to 5 large scale industries in each of the sectors: sugar industry, forest industry, saw mill and paper industries, totally 20 visits
- visit to 5 medium scale industries in each of the sectors: sugar industry, forest industry, saw mill and paper industries, totally 20 visits

The planned visits will be approved by DME.

b) Data collection

Key data on the production and availability of the different types of biomass is collected, including:

- Average annual production of biomass at the different sectors per province
- Annual variations in the production
- Processes for collecting the resources and storage thereof
- Treatment of biomass waste and the uses thereof.

c) Characteristics for biomass resources

In order to know the energy content of the biomass and the costs for possible processing/storage of the biomass before it can be utilised for energy generation, a number of physical and chemical characteristics shall be determined. This includes:

- Energy content
- Moisture content
- Classification of biomass waste according to shape and size

d) Proposal on incorporating data into Homer/RE GIS database

The collected data needs to be fed into the Homer/RE GIS, which was developed by DME/Eskom/CSIR. A proposal will be needed to detail the activities surrounding this task. The DME will be tasked with ensuring that this proposal is implemented.

e) Develop a biomass feasibility checklist

Key data and other information are required in order to evaluate the technical and economical feasibility of possible biomass projects. This data will be used to compile a check list for evaluation purposes to assist IPP's when selecting potentially viable options for renewable energy projects. The DME will be



DEPARTMENT OF MINERALS AND ENERGY

DME-Danida Capacity Building in Energy Efficiency & Renewable Energy

tasked with the dissemination of the feasibility checklist and it is envisaged that it will be published on the DME/CaBEERE website.

f) Workshops

The consultant will conduct a workshop with relevant stakeholders for each of the three sectors. The consultant will drive this process in close consultation and interaction with the DME and Local Renewable Energy Adviser. The workshop participants will be decided by both the consultant and DME/CaBEERE personnel. The cost associated with the workshop (i.e venue, catering etc.) shall be borne by the consultant. The consultant will be tasked with inviting the participants and managing the workshop database and responses thereof.

g) Publish Feasibility check List

The Local Renewable Energy Adviser will ensure that the relevant stakeholders have access to the feasibility check list by ensuring that it gets published on the DME/CaBEERE website.

6 Methodology and Time Frames

6.1 Methodology

The collection of the data and information is made via direct visits to relevant industries and is based on a questionnaire approach. After the first visit a review of the prepared questionnaire is made and revisions are made if necessary.

Existing parameters used for describing the various types of biomass are reviewed. If necessary additional parameters are identified in order to describe the biomass from an energy resource point of view. Proposed standards for measuring the parameters shall be specified.

6.2 Time schedule

The consultant will be responsible for delivery of the tasks as described in these terms of reference.

The consultant will treat all information with confidentiality and only reproduce or speak about work outside the project with the prior knowledge of the DME and CaBEERE. The consultant will further sign a declaration of confidentiality.

This project shall be completed within a period of 5 months starting from the date of contract signing. The consultant shall during the project period prepare progress reports in order to monitor the achievement of the objectives.

The total amount of working days cannot be exceeded without the prior approval of CaBEERE.

The time schedule and the milestones for the project are indicated in the table below.



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DME-Danida Capacity Building in Energy Efficiency & Renewable Energy

Milestone	Dead line after date of contract signing
Contract signing between SP and DME/COWI	
Inception meeting including consultants proposal on detailed time schedule and methodology	Week 1
Draft questionnaire prepared by the consultant submitted to the project team for approval	Week 2
Progress meeting	Week 4
Completion of data collection	Week 8
Progress meeting	Week 8
Completion of characteristics for biomass resources	Week 10
Complete proposal incorporating data into Homer/RE GIS database	Week 10
Progress meeting	Week 12
Compile feasibility check list	Week 12
Workshops completed with all relevant stakeholders for each of the sectors	Week 16
Progress meeting	Week 17
Draft report submitted to project team for comments	Week 18
Final report submitted to project team	Week 20

7 Counterparts and resources

The Counterpart will be DME. A project team will be established to assist with all issues related to the project. The consultant is responsible for the supply of sufficient resources to complete the study. The consultant may obtain support from DME in connection with identification of relevant contact persons and/or identification of reports etc.



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DME-Danida Capacity Building in Energy Efficiency & Renewable Energy

It is envisaged that the successful consulting team will consist of the following key expertise:

- Thorough knowledge of the sugar/bagasse sector, the pulp and paper sector and sawmill/timber sector in South Africa and documented experience (national/international) of work done in these three sectors.
- Knowledge of the Electricity and Renewable Energy sector in South Africa
- Documented experience in terms of conducting feasibility studies in the abovementioned sectors.
- Documented evidence of conducting and arranging workshops
- Linkages with other national/international consultants is encouraged, to obtain the right project team composition.

Daily DME and Project Counterpart:

Andre Otto, Deputy- Director (DME)	Phone number: (012) 317 9225	Andre.Otto@dme.gov.za
Kumesh Naidoo – Local Renewable Energy Advisor	Phone number: (012) 317 9597	Kumesh.Naidoo@dme.gov.za

8 Reporting

At the inception meeting the consultant shall present the methodology to be utilised and the detailed time schedule for the visits.

The final report of the study shall include a description of the applied methodology, companies visited, results of the visits, presentation of the collected data and information as well as a presentation of the proposed data base structure.

An outline of the main headings in the report are:

1. Introduction
2. Methodology
3. Visited companies/persons



DEPARTMENT OF MINERALS AND ENERGY

DME-Danida Capacity Building in Energy Efficiency & Renewable Energy

4. Biomass resources and their characteristics
 - 4.1 Bagasse
 - 4.2 Wood waste
 - 4.3 Sawmill waste
 - 4.4 Pulp and paper
5. Proposal of linking data to Homer/RE GIS.
6. Feasibility checklist.

The draft and final reports shall be submitted in one original and six copies. An electronic version will also be required.

CaBEERE will supply a standard report format for the purposes of compiling the report.

9 List of Material

- Energy White Paper 1998, DME
- Renewable Energy White Paper 2003, DME
- Economic and Financial Calculations and Modelling for the Renewable Energy Strategy Formulation, DME/Danida 2004.

Appendix 8 – Contacts in Biomass

Forest Industry

Name	Organisation	Position	Phone	Cell	E-mail
Mike Chetty	Inst. Commercial Forestry Research		(033) 3862314		michael@icfr.unp.ac.za
Patrick Kime	NCT Forest	General Manager	(033) 8978500		patrick@nctforest.com
Peter Keyworth	NCT Forest	General Manager Special Projects	(033) 8978522	082 8028950	peter@nctforest.com
Mike Edwards	Forestry South Africa	Executive Director			trees@global.co.za
Roger Godsmark	Forestry South Africa	Assistant Director	(011) 8033403		forest@global.co.za
Schalk Kapp	Global Forest Products			082 8886524	skapp@globalforestproducts.net
Lorraine McNamara	Global Forest Products	Silviculture and Technology Manager		082 8986238	lmcnamara@globalforestproducts.net
Shaun McCartney	Global Forest Products	Environmental Manager		083 6274188	smccartney@globalforestproducts.net

Sawmilling Industry

Name	Organisation	Position	Phone	Cell	E-mail
Ian Perry	Crickmay & Associates	Director	(031) 5084354		ian@crickmay.co.za
Faan Struweg	Hans Merensky – Singisi	Production Manager	(039) 553 0504		faans@hansmerensky.co.za
Gert Kruger	Hans Merensky – Tweefontein	Despatch Superintendent	(013) 764 1251		gertk@hansmerensky.co.za
Sarvaas Nieuwoudt	Graskop Sawmill	Owner/Manager	(013) 764 2158		gsmill@soft.co.za
Jeffroy Hawkes	Global Forest Products - Sabie	Chief Engineer	(013) 764 1649		jeffawk@mweb.co.za
Anthony Wilson	Global Forest Products	Product Co-ordinator	(013) 764 9122	082 8026226	awilson@globalforestproducts.net

Pulp and Paper Industry

Name	Organisation	Position	Phone	Cell	E-mail
Stefan Eriksson	Jaakko Poyry South Africa	Manager-Process Section	(031) 2500381	082 5550407	Stefan.eriksson@poyry.co.za
Iain Kerr	Paper Manufacturers Ass of SA	Senior Research Fellow	(031) 2602186	082 8794748	kerr@ukzn.ac.za
John Hunt	Paper Manufactures Ass of SA	Executive Director		082 8936230	john_hunt@pamsa.co.za
Kobus Geldenhuys	Sappi - Ngodwana	Sales Manager	(013) 7346192	083 6616398	Kobus.Geldenhuys@sappi.com
Shane Ramcour	Sappi - Tugela	SHEQ Manager	(032) 456 1111		
Derek Airey	Sappi - Saiccor	Environmentalist	(039) 973 8911		derek.airey@sappi.com
Stephen Walker	Sappi - Enstra	Safety Manager	(011) 360 0000		
Stephen Trickett	Sappi - Stanger	Senior Project Engineer	(032) 437 2212		Stephen.Tricket@sappi.com
Ciska Terblanche	Mondi – Richards Bay	Environmental Manager	(035) 9022322		ciska_terblanche@mondi.co.za
Theo van Rooyen	Mondi - Merebank	Technical Manager	(032) 451 2111		
Johan Viviers	Mondi – Piet Retief	Technical Manager	(032) 451 2111		Johan_a_viviers@mondi.co.za

Sugar Industry

Name	Organisation	Position	Phone	Cell	E-mail
Arnoud Wienese	Sugar Milling Research Institute	Head Engineering Division	(031) 2731356	083 718 8294	awienese@smri.org
Stephen Walford	Sugar Milling Research Institute	Senior Research Officer	(031) 2731377		swalford@smri.org
Adrian Wynne	SA Cane Growers	Liaison Manager	(031) 5087200	083 457 8208	AWynne@canegrowers.co.za
Denis Tomlinson	Illovo Sugar	Corp. Affairs Development Manager	(031) 5084442		dtomlinson@illovo.co.za
Graham Mann	Illovo - Noodsberg	General Manager	(033) 5011650		gmann@illovo.co.za
Johan v Rensburg	Illovo - Noodsberg	Engineering Manager	(033) 5011650		JvRensburg@illovo.co.za
Barry Holmes	Illovo - Eston	Factory Manager	(031) 7811092		BHolmes@illovo.co.za
John Hulley	Illovo - Pongola	Factory Manager	(03441) 31301		JHulley@illovo.co.za
Vis Pillay	Illovo – Sezela	Factory Manager	(039) 9751106		VisPillay@illovo
Morne Bester	Illovo – Umfolozi	Plant Engineer	(0355) 500031	082 923 6322	MBester@illovo.co.za
Lal Bachan	Illovo – Umzimkulu	Factory Manager	(0396) 824202	083 627 4188	LBachan@illovo.co.za
Allan Ferguson	Tongaat-Hulett	Group Engineer	(032) 4394328		Allan.Ferguson@hulett.co.za
Dave Meadows	Tongaat-Hulett	Manager TEG	(032) 4394311		Dave.Meadows@hulett.co.z
Deon v/d Berg	Tongaat-Hulett	Regional Operational Manager	(0357) 915000	082 808 5163	Deon.VanDenBerg@hulett.co.za
Nigel Simmonds	Tongaat-Hulett – Darnall	Engineering Manager	(0324) 392231	082 806 7975	Nigel.Simmonds@hulett.co.za
Jonathan de Jager	Tongaat-Hulett – Felixton	Engineering Manager	(035) 7915000		Jonathan.deJager@hulett.co.za
Stuart Watson	Tongaat-Hulett – Maidstone	Engineering Manager	(032) 4395502	082 3780817	Stuart.Watson@hulett.co.za
Franco Weyers	Transvaal Suiker BPK - Malelane	Factory Manager	(013) 7911000	082 8794748	WeyersF@tsb.co.za
Graham Rolfe	Transvaal Suiker BPK - Komati	General Manager	(013) 7234860		rolfe@tsb.co.za
Peter von Fintel	Union Co-op Sugar Mill	Mill Manager	(033) 5011600	082 4932775	agm@ucl.co.za
Karl Schroder	Union Co-op Sugar Mill	Engineering Manager	(033) 5011600		enineering@ucl.co.za
Eckard Lucht	UShukela Milling	Factory Manager	(0325) 513031)		ELucht@illovo.co.za

Government

Name	Organisation	Position	Phone	Cell	E-mail
Kevin Nassiep	Department of minerals & energy	Chief Director	(012) 317 8617		Kevin.Nassiep@dme.gov.za
Brett Dawson	Department of minerals & energy	Director Renewable Energy	(012) 317 8468		Brett.Dawson@dme.gov.za
Andre Otto	Department of minerals & energy	Deputy Director Renewable Energy	(012) 317 8225		Andre.Otto@dme.gov.za
Marcus Phago	Department of minerals & energy		(012) 317 8568		Marcus.Phago@dme.gov.za
Nadia Hamid	Department of minerals & energy		(012) 317 8657		Nadia.Hamid@dme.gov.za
Sandiswa Tshaka	Department of minerals & energy		(012) 317 8569		Sandiswa.Tshaka@dme.gov.za
Olga Lindiwe	Department of minerals & energy		(012) 317 8565		Lindiwe.Olga@dme.gov.za
Nomawabo Mtshabe	Department of minerals & energy		(012) 317 8347		Nomawabo.Mtshabe@dme.gov.za
Helene Rask Gron	COWI	International Project Manager	(012) 317 8532		Helene.Gron@dme.gov.za
Kumesh Naidoo	COWI	Local Renewable Energy Advisor	(012) 317 8597	082 5631363	Kumesh.Naidoo@dme.gov.za
Sibusiso Ngubane	Central Energy Fund (CEF/EDC)	Renewable Energy Manager	(011) 535 7039	082 413 0475	SibusisoN@cef.org.za
Sizwe Madondo	Central Energy Fund (CEF/EDC)	Manager Business Services	(011) 535 7041	082 3749777	SizweM@cef.org.za
Jabulani Shabalala	Central Energy Fund (CEF/EDC)	Project Officer	(011) 535 7048	082 5660522	JabulaniS@cef.org.za
N Singh	National Energy Regulator (NER)		(012) 401 4617		
Smolly Lebepe	National Energy Regulator (NER)		(012) 401 4600		smolly.lebepe@ner.org.za
Jeffrey Quvane	National Energy Regulator (NER)		(012) 401 4600		jeffrey.quvane@ner.org.za
Johan Crous	ESKOM		(011) 800 4457		Johan.crous@eskom.co.za
Ronel Clark	ESKOM TSI		(011) 629 5062		
Shanita Makardood	ESKOM TSI		(011) 629 5122		
Callie Nkomo	ESKOM				
Izak van Gass	ESKOM TSI		(011) 629 5413		
Johan Bester	DWAF		(012) 336 8171	082 808 5634	besterj@dwaf.gov.za
Sam Falatsa	DWAF working for water		(021) 441 2725		falatss@dwaf.gov.za

Others

Name	Organisation	Position	Phone	Cell	E-mail
D Dintchev	University of Pretoria	Professor	(012) 799 9512	082 847 5039	dintchev@icon.co.za
Dave Hancock	GTZ		(011) 535 7027		
Anton Louis Olivier	NU Planet		(012) 349 1901		AL@nuplanet.nl
Sadvir Bissoon	SA Bureau of Standards		(012) 428 6761		bassoon@sabs.co.za
Erica Roberts	Palma Development Consultants		(012) 349 1901		erica@pdc1.co.za
Edward James Smith	Roskilde University Denmark		(011) 728 8002		ejs@ruc.dk
Rob Short	Sustainable Transactions			082 454 2193	Rob.short@telkomsa.net
Jason Schaffler	Nano Energy	Managing Director		072 444 3445	Jason@nano.co.za
David Chown	Genesis Eco Energy		(021) 783 5814	083 460 3898	davinc@icon.co.za
Wallie Menne	Timber Watch			082 444 2083	plantnet@iafrica.com
Charles Liebenberg	MethCap (pty) ltd		(011) 660 5035	072 954 7116	cjliebenberg@mweb.co.za
Richard Worthington	Earthlife Africa			082 446 6392	richardw@earthlife.org.za
Sandile Ndawonde	GreenNetwork		(033) 345 2045		info@greennetwork.org.za
Mike Page	SAD-ELEC		(011) 803 1314	082 416 2875	mike@sad-elec.com
Ruth Modipa	Gendes RE Program				
Victor Taylor				082 493 8343	vicarina@mweb.co.za

