# UNFCCC Ref No. 0177

## Corobrik Lawley: Emission Reduction Report 2006 : Version 1 for the reporting period 01.01.2006 to 31.12.2006

## SUMMARY

| | | | |
|---|---|---|---|
| **Project** | | | |
| Emissions from body coal | | 20,422 ton CO2eq | |
| Emissions from Natural Gas Combustion | | 16,329 ton CO2eq | |
| | **Sub Total** | **36,751 ton CO2eq** | |
| **Project Leakage** | | | |
| Emissions from coal transport | | 175 ton CO2eq | |
| Emissions from coal mining | | 31 ton CO2eq | |
| Fugitive natural gas emissions | | 2,138 ton CO2eq | |
| | **Sub Total** | **2,345 ton CO2eq** | |
| **Baseline** | | | |
| Baseline emissions | | **55,427 ton CO2eq** | (1) |
| Baseline leakage | | **545 ton CO2eq** | (1) |
| **TOTAL EMISSION REDUCTION PER PROJECT YEAR** | | **16,876 ton CO2eq** | |

**Notes**

(1) Refer to spreadsheet 'Lawley Baseline Calculations'
(2) The calculations in the spreadsheet were made using more decimal points than displayed, therefore manual calculation of the displayed values may produce slightly different values

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## D.2.2.C. PRODUCTION CONVERSION CALCULATION (1)

| | Baseline gross brick production (2) | 2006 Gross brick production (4) | 2006 Gross Paver production (4) | 2006 Total gross units production | Conversion factor for coal body addition (3) | Conversion factor for Sasol gas |
|---|---|---|---|---|---|---|
| January | 6215511 | 7774000 | 298000 | 8072000 | 0.800 | 0.770 |
| February | 5664135 | 4902000 | 1228000 | 6130000 | 1.000 | 0.924 |
| March | 6215511 | 8202000 | | 8202000 | 0.758 | 0.758 |
| April | 6015010 | 6115000 | 1640000 | 7755000 | 0.984 | 0.776 |
| May | 6215511 | 7511000 | 969000 | 8480000 | 0.828 | 0.733 |
| June | 6015010 | 8725000 | | 8725000 | 0.689 | 0.689 |
| July | 6215511 | 8981000 | | 8981000 | 0.692 | 0.692 |
| August | 6215511 | 8026000 | 126000 | 8152000 | 0.774 | 0.762 |
| September | 6015010 | 8305000 | | 8305000 | 0.724 | 0.724 |
| October | 6215511 | 7896000 | 464000 | 8360000 | 0.787 | 0.743 |
| November | 6015010 | 8045000 | 978000 | 9023000 | 0.748 | 0.667 |
| December | 6215511 | 7587000 | 1211000 | 8798000 | 0.819 | 0.706 |
| **Totals** | **73232750** | **92069000** | **6914000** | **98983000** | | |

**Notes:**

1 The project uses a static (fixed and non changing) baseline. The conversion factor calculates the proportion of actual output for a specific project year to the baseline production. All other calculations of fuel use is converted from total production to the project case using this factor

2 Baseline gross brick production is calculated by proportional allocation per month of the annual production used in the baseline of 73 232 750 bricks (not pavers) per annum

3 Only brick (not paver) production is included in the calculation of the conversion factor since pavers were not included in the baseline and 0% body coal is used in pavers

4 Values for gross brick and paver production from Corobrik record sheets (Reference Production Gross Green Making Book)

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## D.2.2.B. COAL CONSUMPTION - Body Fuel Addition

| | Coal receipts 'As Received' (2) kg 000 | Coal Issues 'As Received' kg 000 | Production Conversion Factor | Project coal body addition 'As received' (4) kg 000 | Average energy value (4) GJ/ton | Total Project body coal energy GJ | CO2 emission (5) kg 000 | CH4 emission (6) kg 000 | N20 emission (7) kg 000 | Total CO2eq emission kg 000 |
|---|---|---|---|---|---|---|---|---|---|---|
| Opening stock | 1372 | | | | | | | | | |
| January | 717.23 | 1119 | 0.800 | 895 | 19.717 | 17,640 | 1,695 | 0.0176 | 0.0282 | 1,703.8 |
| February | 858.38 | 706 | 1.000 | 706 | 19.398 | 13,695 | 1,316 | 0.0137 | 0.0219 | 1,322.8 |
| March | 949.62 | 1181 | 0.758 | 895 | 19.513 | 17,463 | 1,678 | 0.0175 | 0.0279 | 1,686.7 |
| April | 1403.2 | 880 | 0.984 | 866 | 19.734 | 17,082 | 1,641 | 0.0171 | 0.0273 | 1,649.9 |
| May | 2808.62 | 1082 | 0.828 | 895 | 19.149 | 17,146 | 1,647 | 0.0171 | 0.0274 | 1,656.0 |
| June | 1231.12 | 1256 | 0.689 | 866 | 19.298 | 16,710 | 1,605 | 0.0167 | 0.0267 | 1,614.0 |
| July | 1869.32 | 1293 | 0.692 | 895 | 20.009 | 17,905 | 1,720 | 0.0179 | 0.0286 | 1,729.4 |
| August | 1332.48 | 1156 | 0.774 | 895 | 21.469 | 19,220 | 1,846 | 0.0192 | 0.0308 | 1,856.4 |
| September | 1600.06 | 1196 | 0.724 | 866 | 20.386 | 17,659 | 1,696 | 0.0177 | 0.0283 | 1,705.6 |
| October | 929.44 | 1137 | 0.787 | 895 | 21.484 | 19,228 | 1,847 | 0.0192 | 0.0308 | 1,857.2 |
| November | 1551.84 | 1158 | 0.748 | 866 | 21.606 | 18,706 | 1,797 | 0.0187 | 0.0299 | 1,806.8 |
| December | 994.22 | 3091 | 0.819 | 2532 | 21.371 | 54,117 | 5,199 | 0.0541 | 0.0866 | 5,227.0 |
| Closing stock | 2362.53 | | | | | | | | | |
| **Sub Totals (8)** | **15,255** | **15,255** | | **12,072** | **20.261** | **246,572** | **23,688** | **0.2466** | **0.3945** | **23,816** |
| **Correction factors** | | | | | | | | | | |
| Weighbridge error (10) | -3.888 | | | | | | | | | |
| Calorific value error (9) | | | | | 1.00400270 | | | | | |
| Moisture correction factor (11) | | | | 86.10% | | | | | | |
| **Total (1)** | **15,251** | | | **10,394** | **20.342** | **211,435** | **20,313** | **0.2114** | **0.3383** | **20,422** |

**Notes**

The actual CO2 emissions for the project year are calculated as the product of the annual coal usage, the annual production factor and the annual average CV of the coal which yields the annual GJ energy usage for the project year

2 Coal Issues 'As Received' basis are the body coal addition values, tons, used for the monthly factory production costs and monthly financial statements. Ensures that receipts balance with issues at the end of each accounting period.

3 Total coal issues, 'As received' adjusted by 'Production Conversion' factor to arrive at the project coal body addition. Project production based on static baseline production, refer 'Production Conversion' spreadsheet.

4 Laboratory determination of CV from composite coal sample from body fuel addition measuring station.

5 CO2 emission factor for coal combustion: IPPCC default value see inputs sheet

6 CH4 emission factor for coal combustion: IPPCC default value see inputs sheet

7 N2O emission factor for coal combustion: IPPCC default value see inputs sheet

8 Sub totals based on monthly figures used for control purposes only. Final annual figure takes into account manually entered values on opening and closing stock of "As Received" coal

9 Annual figure for average annual CV value is the product of the average annual CV and the laboratory correction factor: refer Input Schedule

10 Weighbridge error based on 6kg /load over reading as per calibration certificate and 648 loads/year

11 Reduce coal mass by moisture content of 13.9%

12 December coal issues includes a reconciling figure of 1998 tons for the 2006 year.

## D.2.2.A. NATURAL GAS CONSUMPTION

| | Measured gas consumption (1) m3 | Natural gas energy value (3) GJ/m3 | Conversion factor (2) | Project natural gas consumption GJ | Natural Gas CO2 emissions (4) kg 000 | Natural Gas CH4 emissions (5) kg 000 | Natural Gas N20 emissions (6) kg 000 | Total CO2eq emissions from NG combustion kg 000 | Natural gas Fugitive CO2eq Emissions (7) kg 000 |
|---|---|---|---|---|---|---|---|---|---|
| January | 1,015,644 | 0.04057 | 0.770 | 31,728 | 1,503 | 0.03490 | 0.0730 | 1526 | 200 |
| February | 826,031 | 0.04063 | 0.924 | 31,011 | 1,469 | 0.03411 | 0.0713 | 1492 | 195 |
| March | 1,033,113 | 0.04036 | 0.758 | 31,598 | 1,497 | 0.03476 | 0.0727 | 1520 | 199 |
| April | 947,062 | 0.04009 | 0.776 | 29,449 | 1,395 | 0.03239 | 0.0677 | 1417 | 186 |
| May | 1,131,426 | 0.039859 | 0.733 | 33,055 | 1,566 | 0.03636 | 0.0760 | 1590 | 208 |
| June | 1,089,427 | 0.039697 | 0.689 | 29,814 | 1,412 | 0.03280 | 0.0686 | 1434 | 188 |
| July | 919,309 | 0.040178 | 0.692 | 25,562 | 1,211 | 0.02812 | 0.0588 | 1230 | 161 |
| August | 796,080 | 0.040095 | 0.762 | 24,337 | 1,153 | 0.02677 | 0.0560 | 1171 | 153 |
| September | 895,412 | 0.039874 | 0.724 | 25,859 | 1,225 | 0.02844 | 0.0595 | 1244 | 163 |
| October | 915,900 | 0.040195 | 0.743 | 27,371 | 1,297 | 0.03011 | 0.0630 | 1317 | 172 |
| November | 865,581 | 0.040353 | 0.667 | 23,285 | 1,103 | 0.02561 | 0.0536 | 1120 | 147 |
| December | 869,256 | 0.040195 | 0.706 | 24,684 | 1,169 | 0.02715 | 0.0568 | 1187 | 156 |
| **Sub Totals** | **11,304,241** | | | **337,752** | **15,999** | **0.3715** | **0.7768** | **16,248** | **2,128** |
| **Correction factor** | | | | | | | | | |
| Natural gas meter error (8) | | | | 1.005 | | | | | |
| **Totals** | **11,304,241** | **0.04017** | | **339,441** | **16,079** | **0.3734** | **0.7807** | **16,329** | **2,138** |

**Notes**

1 Monthly totals from consumption recorded at Sasol Meter station (Reference: Sasol Monthly Invoic
2 Refer to sheet 'Production Conversion Factor'
3 Monthly average from values provided by Sasol (Reference: Sasol Monthly Invoice)
4 Emission factor = 0.04737kgCO2/MJ. Reference: Sasol Model Calculation Data Sheet
5 Emission Factor =1.1kg CH4/TJ. IPCC default
6 Emission Factor = 2.3kg N2O/TJ. IPCC default
7 Reference for IPPC default value is used.
8 The gas supply meter calibration certificate shows a 0.5%per volume error. Natural gas consumption is therefore increased by this value

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## D.2.2.E. COAL MINE METHANE EMISSIONS

| | Project coal consumption GJ | CH4 emissions (1) kg 000 | CO2eq emissions kg 000 |
|---|---|---|---|
| January | 17640 | 0.1057 | 2.22 |
| February | 13695 | 0.0820 | 1.72 |
| March | 17463 | 0.1046 | 2.20 |
| April | 17082 | 0.1023 | 2.15 |
| May | 17146 | 0.1027 | 2.16 |
| June | 16710 | 0.1001 | 2.10 |
| July | 17905 | 0.1073 | 2.25 |
| August | 19220 | 0.1151 | 2.42 |
| September | 17659 | 0.1058 | 2.22 |
| October | 19228 | 0.1152 | 2.42 |
| November | 18706 | 0.1121 | 2.35 |
| December | 54117 | 0.3242 | 6.81 |
| **Totals** | **246572** | **1.48** | **31.02** |

**Notes**

1 Coal Mine Emission Factor = 0.00000599kgCH4/MJ. Refer to inputs sheet

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## D.2.2.D. TRANSPORT

| | Number of loads received (1) | Energy Consumption per load MJ | Production conversion factor | CO2 emissions (2) kg 000 |
|---|---|---|---|---|
| January | 28 | 4733.66 | 0.800 | 7.64 |
| February | 34 | 4733.66 | 1.000 | 11.60 |
| March | 39 | 4733.66 | 0.758 | 10.09 |
| April | 56 | 4733.66 | 0.984 | 18.80 |
| May | 109 | 4733.66 | 0.828 | 30.78 |
| June | 50 | 4733.66 | 0.689 | 11.76 |
| July | 75 | 4733.66 | 0.692 | 17.71 |
| August | 52 | 4733.66 | 0.774 | 13.74 |
| September | 64 | 4733.66 | 0.724 | 15.82 |
| October | 38 | 4733.66 | 0.787 | 10.21 |
| November | 63 | 4733.66 | 0.748 | 16.08 |
| December | 40 | 4733.66 | 0.819 | 11.18 |
| **Totals** | **648** | | | **175.42** |

**Notes**

1 Reference: Clean Development Mechanism Project: Corobrik Lawley Data Collection Procedures:Appendix 2: Emissions Monitoring Monthly Data Summary

2 Transport emission factor = 72.098g CO2/MJ. IPCC default value 260km round trip; 20 ton trucks; fuel consumption 47 L/100km

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## Inputs to calculations

| Variable used in Calculations | Variable description | Value | Unit |
|---|---|---|---|
| | **Brick production** | | |
| | Annual Gross green brick production (4 year average) | 73,232,750 | bricks |
| | Mass dry green brick | 3.1 | kg/brick |
| | **Coal energy values** | | |
| | Annual average CV based on weekly composite sample | 20.261 | MJ/kg |
| | Annual CV Correction Factor | 1.0040027 | |
| | Average Moisture content in duff coal as delivered | 13.90% | |
| | CV: Boschmans duff coal | 20.261 | MJ/kg |
| | **Project body coal consumption** | | |
| | Opening coal stocks: 1 January 2006 | 1372 | Tons |
| | Annual receipts: 1 January 2006 to 31 December 2006 | 16,246 | Tons |
| Q_Fbcj | Closing stocks: 31 December 2006 | 2,180 | Tons |
| | **CO2 emissions from coal combustion** | | |
| EF_Fbc | CO2 Emission factor per unit body coal | 0.00009607 | tonCO2/MJ |
| EF_Fcc | CO2 Emission factor per unit combustion coal | 0.00009607 | tonCO2/MJ |
| | **Natural gas consumption** | | |
| | Energy/1000 bricks: Gross green | 4.402 | GJ/1000 |
| Q_NG | Annual Natural gas consumption | 322,370,566 | MJ |
| | Sasol natural gas density | 55.71 | GJ/ton |
| | **CO2 Emission Equivalent Sasol Natural Gas (Weighted Average)** | | |
| EF_NG | Sasol natural gas CO2 emission factor | 0.00004737 | tonC02/MJ |
| | **GWP CO2 equivalent values** | | |
| GWP_CH4 | $CH_4$ | 21 | ton CO2/ton CH4 |
| GWP_N2O | $N_2O$ | 310 | ton CO2/ton N2O |
| | **Natural gas emission factors** | | |
| | $CH_4$ emission factor | 1.1 | kg/TJ |
| FC_NG_CH4 | $CH_4$ emission factor from natural gas combustion | 0.00000000110 | tonCH4/MJ |
| | N2O emission factor | 2.3 | kg/TJ |
| FC_NG_N2O | N2O emission factor from natural gas combustion | 0.00000000230 | tonN20/MJ |
| | **Coal combustion emission factors** | | |
| | CH4 emission factor | 1 | g/GJ |
| FC_Fcc_CH4 | CH4 emission factor associate with combustion of coal | 0.00000000100 | ton CH4/MJ |
| | N2O emission factor | 1.6 | g/GJ |
| FC_Fcc_N2O | N2O emission factor associate with combustion of coal | 0.0000000016 | ton N2O/MJ |
| | **Fugitive CH4 from gas pipeline leaks** | | |
| | Total fugitive emission factor associated with natural gas | 0.3 | kg $CH_4$/GJ |
| FE_NG_CH4 | Total fugitive emission factor associated with natural gas | 0.0000003 | ton CH4/MJ |
| | **Fugitive CH4 from Coal mining** | | |
| | CH4 emissions from coal mining | 0.21 | m3 CH4/ton coal |
| | CH4 emissions from coal mining | 0.12138 | kg CH4/ton coal |

| | | | |
|---|---|---|---|
| FE_Ftc_CH4 | CH4 emissions from coal mining | 0.00000000599 | ton CH4/MJ |

**Transport fuel use and emissions**

| | | | |
|---|---|---|---|
| | Energy density diesel | 38.737 | MJ/l |
| | amount of coal transported per trip | 19.6 | tons |
| | Truck fuel consumption | 47.00 | l/100km |
| | Number of coal deliveries per annum | 648 | |
| | Project total distance transported | 215,508.16 | km |
| | Project fuel used | 79,185.60 | l/annum |
| Q_TEk | Total transport energy used during project | 3,923,625.67 | MJ/annum |
| | Distance round trip from Boschmans colliery to Lawley | 260.00 | km |
| | Diesel emission factor | 72.098 | g CO2/MJ |
| EF_TE | | 0.000072098 | tonCO2/MJ |

**Errors and Correction factors**

| | | | |
|---|---|---|---|
| | Weighbridge error | 6 | kg/load |
| | Annual CV Correction Factor | 0.40% | |
| | Sasol meter error | 1.005 | per volume |

| Reference |
| --- |
| Corobrik data for baseline<br>Corobrik |
| Corobrik central laboratories: Midrand<br>Corobrik central laboratories: Monthly round robin with other laboratories<br>Boschmans Colliery |
| Corobrik Lawley Monthly Project Emissions Monitoring File: January 2005<br>Corobrik Lawley Monthly Project Emissions Monitoring Files: January 2005 to December 2005<br>Corobrik Lawley Monthly Project Emissions Monitoring File: December 2005 |
| IPCC guidelines for Nat. GHG Inventories: Ref. Manual vol 3, 1996. Table 1-1<br>IPCC guidelines for Nat. GHG Inventories: Ref. Manual vol 3, 1996. Table 1-1 |
| Corobrik<br>Calculated<br>Sasol |
| Sasol Model Calculation: 0.023959473 m3 CO2/MJ x 1.9772 kg/m3= 47.37 kg CO2/GJ |
| IPCC default value<br>IPCC default value |
| http://www.ipcc-nggip.iges.or.jp/EFDB/find_ef.php,  EF ID : 18551<br>Calculated<br><br>http://www.ipcc-nggip.iges.or.jp/EFDB/find_ef.php,  EF ID: 18631<br>Calculated |
| IPCC guidelines for Nat. GHG Inventories: Ref. Manual vol 3, 1996. Table 1-6<br>Calculated<br><br>IPCC guidelines for Nat. GHG Inventories: Ref. Manual vol 3, 1996. Table 1-16<br>Calculated |
| IPCC guidelines for Nat. GHG Inventories: Ref. Manual vol 3, 1996. Table 1-64<br>Calculated |
| Boschmans Colliery |

South Africa Road Freight Association 2004
South Africa Road Freight Association 2004 Vehicle Cost Schedule.Type 08 Vehicle 19.6 ton, 4 axle, drop side body
South Africa Road Freight Association 2004 Vehicle Cost Schedule.Type 08 Vehicle 19.6 ton, 4 axle, drop side body
Corobrik Lawley records
Calculated
Calculated
Calculated
Corobrik
http://www.ipcc-nggip.iges.or.jp/EFDB/find_ef.php , ID18919
Calculated

Error on weighbridge calibration
Comparison of Corobrik laboratory with accredited laboratories
Sasol