

Republic of Botswana

STATS BRIEF

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1. Introduction

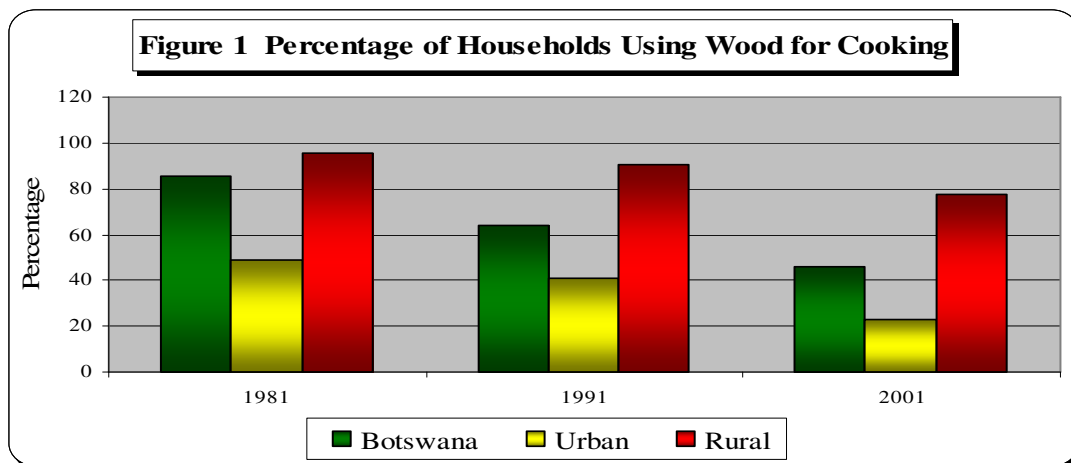
Energy has been indispensable to human beings ever since they first dwelt on earth. In the stone-age era, long before the existence of the match-box, human beings rubbed pieces of rocks together to generate energy that could be used for space heating or food preparation. Today's great advances in technology and knowledge in general have not diminished the need for energy. Rather, energy appears to have become even more indispensable, as it has gone beyond merely enhancing the provision of basic needs (food and warmth) to powering technology. Energy is an essential input in the production and provision of all goods and services and, therefore, is an indispensable ingredient in the economic development process and in improving the standard of living of people everywhere. Hence, it is not an exaggeration to say that after correcting for inefficient energy use, one can estimate the standard of living of people that live within any given economy by looking at the quantity of energy used in that economy.

However useful energy is to the well being of human beings, it also makes a significant contribution to the pollution of environmental media globally. It is, for example, the largest global contributor to greenhouse gas emissions. Therefore, data calculated by on selected Green House Gas (GHG) and non-GHG pollutant emissions from the energy sector is presented. This Stats Brief is aimed at giving CSO stakeholders a summary of the information contained in the Energy Statistics Publication while awaiting its release from the printers.

2. Energy Sources Used in Botswana

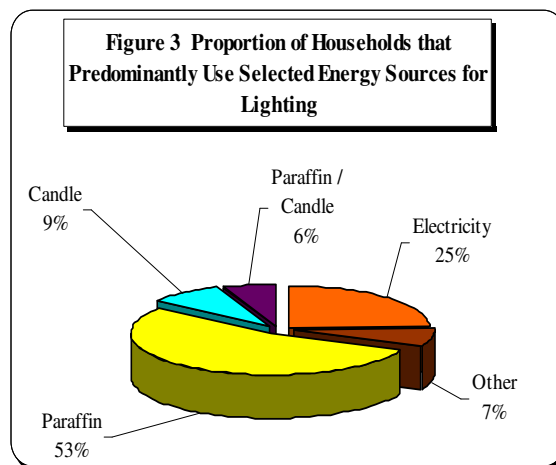
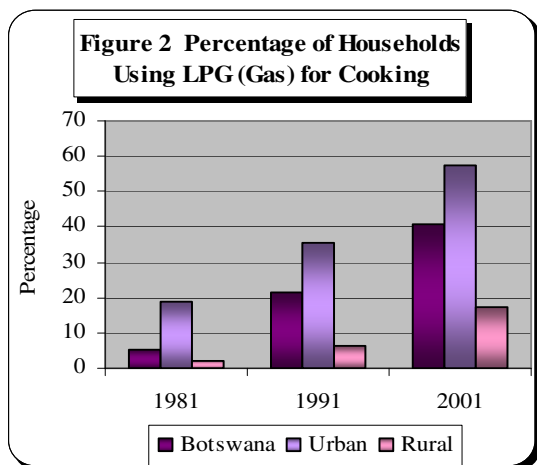
Both traditional and conventional energy sources are used in Botswana. The most prevalent traditional energy source is fuelwood while prevalent conventional energy sources are many and vary from sector to sector with the main ones being gas (LPG) and paraffin for households, diesel for Agriculture, coal for Industry and petrol for Transport and Government sectors.

Fuelwood is mainly used for food preparation and is still an indispensable fuel for many households. It is the principal energy source used for cooking in 46 percent of the households nationally; and in 77 percent of households located in rural areas. Fuelwood is also used in the Government, Industrial and Commercial sectors, particularly in rural areas. However, its dominance of the sector is on the decline. For example, its contributions dropped between 1993 and 2003 from 35 to 29 percent for Primary Energy Supply (PES) and from 45 to 34 percent for both Net Energy Supply (NES) and Final Energy Demand (FED). Similarly, the 1981, 1991 and 2001 Population and Housing Census results revealed a decline in the proportion of households using fuelwood.



Botswana has over 212,383 million tonnes of *coal* resources out of which 48,576 million tonnes are classified as measured, indicated or inferred reserves and the rest are either hypothetical or speculative resources (see Table 1). Local annual coal production is still under a million tonnes. More than half of the locally produced coal (60 percent in both 2004 and 2005) is used to fire the Botswana Power Corporation's (BPC's) public thermal plant.

All *petroleum fuels* that are marketed in Botswana are imported in refined form. Petrol and diesel are primarily used in the transport sector and their proportional contributions to FED were estimated at 18.6 and 21.8 percent, respectively, in 2003.



Paraffin is the main energy source used for lighting in households at national level; and in urban and rural areas (53, 49 and 59 percent; respectively). Liquefied Petroleum Gas (LPG) is the dominant energy source that is used for cooking in households located in urban areas and villages with populations exceeding 5000 people and the proportion of households using gas for cooking is on the rise (see Figure 2). The energy source that is most commonly used for household lighting is paraffin (see Figure 3).

Since 2000, more than 50 percent of the *electricity* available for use in the country has been from imports. Until 1995, electricity generation by BPC contributed more than 50 percent to the Net

Electricity Supply (NE) in the country. The total electricity production was 991,137 MWh in 2004. In the same year, imported electricity contributed 64.6 percent to NE. The Government has implemented significant rural electrification programs. As a result, the 1981, 1991 and 2001 Population and Housing Censuses results indicate an increase in electricity uptake with the proportion of households that use electricity for lighting rising from 5% in 1981 to 25 percent in 2001.

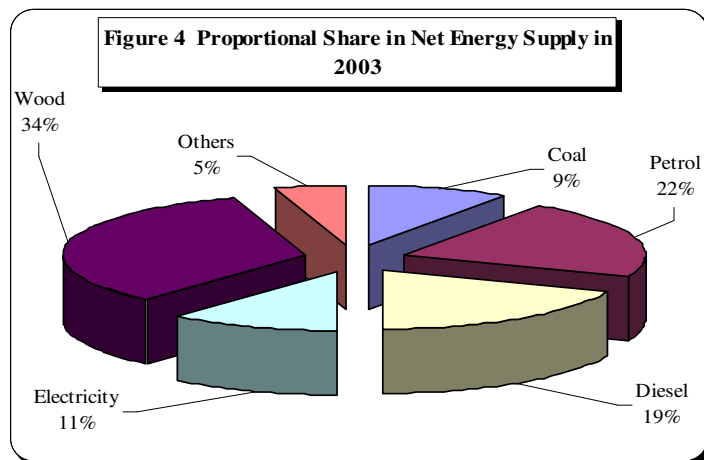
The uptake of *solar* as a source of energy for lighting is only 0.23 percent of the households countrywide and its contributions to Primary Energy Supply (PES), Net Energy Supply (NES) and Final Energy Demand (FED) are negligible. Most of the households that use solar for lighting are in rural areas (73 percent) and are located in villages with populations of less than 5000 people.

3. Energy Supply

Total PES rose from 30,799 terajoules (TJ) in 1981 to 76,342 TJ in 2003 (see Table 2). Fuelwood was the leading source of PES in Botswana in the 1980's. However, its contribution to the total PES had dropped by 2003 from 43 to 50 percent in the 1980's to 29 percent.

The second major contributor to locally available primary energy is coal, whose annual contributions ranged from 26 to 39 percent annually, in the same period. The absolute and proportional contribution of petroleum products to PES is on the increase and they contributed between 18.3 and 38.8 percent in 1981 and 2003, respectively, to total PES. During the period 1981 to 2003, most of the energy available at the primary level was locally produced (see Table 2). However, there was an upward trend in total energy imports with petroleum products contributing over 80 percent annually. Thus, although imports contributed only between 20 to 28 percent of the total PES in the 1980s, their contribution had increased to 46 percent by 2003.

Total NES in the country increased from 25,371 TJ in 1981 to 64,311 TJ in 2003. Fuelwood remains the principal contributor to NES (see Table 3) although its proportional contribution is declining (61 percent in 1981 and 34 percent in 2003). Other energy sources that made significant contributions to NES over the period are petrol, diesel and electricity.



Net Electricity Supply (NE) has increased from 546 GWh in 1981 to 2,940 GWh in 2004. The contribution of imports to NE rose over time from less than 2 percent in 1981 to above 65 percent in 2004.

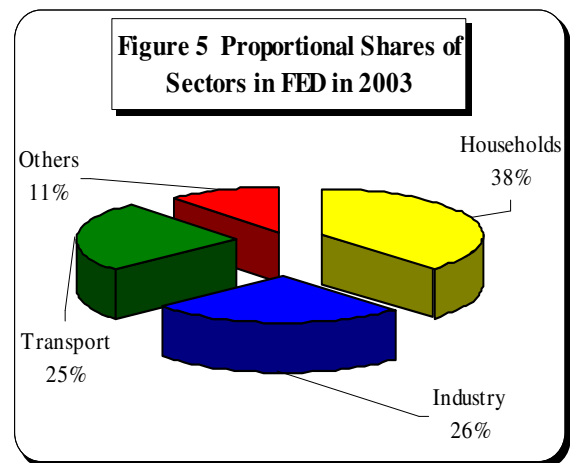
4. Energy Demand

Total FED is on the increase in Botswana due to growth in various economic sectors and rose from 26,481 TJ in 1981 to 64,696 TJ in 2003 (see Table 3). The most prevalent energy sources at

the FED level were wood, petrol, coal, diesel and electricity, in that order. However, wood's proportional contribution dropped from 58 in 1981 percent to 34 percent in 2003 (Table 3). During the period 1981 - 2003, the contribution of petrol, diesel and electricity rose from 7 to 22 percent, 10 to 19 percent and 7 to 12 percent (see Table 3.3), respectively; while that of coal followed a haphazard pattern.

At the *sectoral level*, the dominant contributors to FED are Household, Industry and Transport sectors. The total annual energy used in the three sectors accounted for at least 87 percent of annual FED through out the period 1981 – 2003. The *Household sector* is the principal user of energy in the country and was consistently responsible for over 45 percent of annual FED from 1981 to 1997. Although its proportional contribution to FED dropped after that and was 38 percent in 2003, the household sector remained the main user of final energy in the country throughout the period (see Figure 5). The main contributors to the decline in fuelwood contributions to FED is rural-to-urban migration; and increases in commercial energy consumption in the industry and transport sectors corresponding to growth in the production activities of the sectors.

The share of the *Transport sector* in FED is growing and rose from 13 percent in 1981 to 25 percent in 2003. The principal energy sources used in the sector are petrol and diesel. Economic development, increase in urban populations and corresponding expansion of urban settlements have all led to increased transport fuel consumption. The share of the *Industry sector* was 25 percent in 1981 and 26 percent in 2003. The main energy sources consumed under this sector are electricity, coal, and diesel. Total energy used in the sector increased, however, indicating an expansion of industrial activities.



The *Quantity of Energy used to produce One Unit of GDP* followed a declining trend over the period 1981 – 2003, declining from 6.83 to 3.09 terajoules per one million pula of GDP. This is an indication of improvement in energy use efficiency at the Final Energy Demand level and mitigates the twin environmental concerns of depletion of resources and pollution of the environment through energy production and use.

5. The Impact of Energy Production and Use on the Environment

The impacts of energy use on the environment are many and include contribution to depletion of natural resources, air emissions, solid waste generation, land degradation and negative impacts on water quality. Data is provided in the publication on real (1973 – 2005) and estimated (2006 -2476) depletion rates of measured coal resources and on selected Green House Gas (GHG) and non-GHG pollutant emissions.

Five GHG emissions arising from energy combustion were estimated on the basis of both the source fuels and source sectors over the period 1981 – 2003. Assessing emissions on the basis of source sectors helps cross check the estimates reached from the basis of source fuels, and is also useful in emission mitigation efforts.

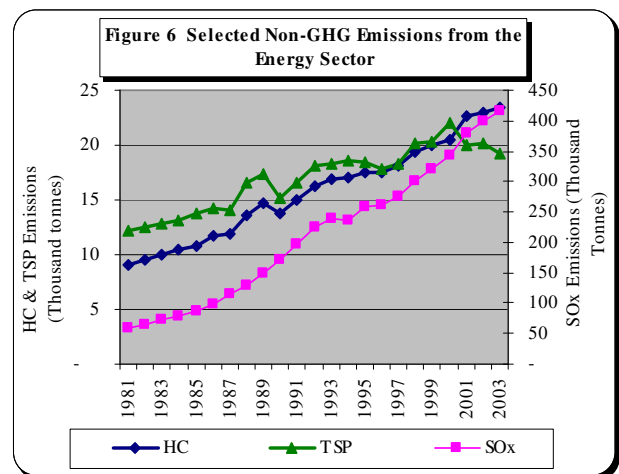
All emissions followed an increasing trend over the period (see Tables 5) – in line with increased energy use in the county. *Carbon dioxide (CO₂) emissions* ranged from 1.4 to 4.6 million tonnes per year. The main sources of the emissions are the combustion of coal, petrol and diesel; and energy use in the Transformation, Industry and Household sectors. *Methane emissions (CH₄)* ranged from 9,008 to 14,384 tonnes per year. The dominant source of CH₄ emissions is the combustion of wood and the Household sector. *Nitrous oxide (N₂O) emissions* ranged from 456 to 1,443 tonnes per year. The main sources of the emissions are the combustion of coal, petrol and diesel; and energy use in the Transformation, Transport and Industry sectors. *Annual Nitrogen Oxide (NO_x) emissions* ranged from 7,872 to 29,169 tonnes. The principal sources of the emissions are the combustion of petrol and coal; and energy use in the Transport and Transformation sectors. *Carbon monoxide (CO) Emissions from FED* followed an upward trend with total emissions ranging from 113,052 to 263,629 tonnes per year. The leading source of the emissions is the combustion of wood and energy use in the Household sector.

GHG emissions in Carbon dioxide Equivalents were estimated to enable comparability between the impacts of different gases on global warming (see Table 6). Total GHG emissions in CO₂ equivalents increased from 2.4 million tonnes in 1981 and peaked at 7.2 million tonnes in 2000; and declined after 2000 reaching 6.5 million tonnes in 2003. It is observed that with the exception of CH₄, all the other emissions had increased over 100 percent from their 1981 levels by 2003. The main pollutant contributors to GHG emissions from the energy sector in the Botswana are CO₂, NO_x and CO, in that order (see Table 7).

GHG emissions are primarily sourced from the combustion of coal, petrol, diesel and wood, in that order (see Table 8). Estimations of the GHG emissions from various sectors show that the main contributing sectors to the emissions are Households, Industry and Government sectors.

Three non-GHG pollutant emissions are covered, and they are namely, *Hydrocarbons (HC)*, *Oxides of Sulphur (SO_x)* and *Total Suspended Particulates (TSPs)*. They all followed an increasing trend, on average, over the period 1981 – 2003. *HC emissions* ranged from 9,106 to 23,421 tonnes. It is observed from that the main sources of *HC emissions* are the combustion of wood and petrol; and energy use in the Household sector. *SO_x emissions* increased more than seven-fold over the period (from 58,776 to 414,928 tonnes). The principal source of the emissions was petrol and energy use in the Transport sector. *TSP emissions* ranged from 12,234 to 22,076 tonnes. The main contributor to the emissions was wood

combustion and energy use in the Household sector.



Anna Majelantle

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Government Statistician**

Table 1 Estimated Botswana Coal Inventory (Million Tonnes) before Coal Mining Started in 1973¹.

| Coalfield | Reserves | | | | Resources | | | Total Coal Inventory |
|--------------|--------------|---------------|---------------|---------------|---------------|---------------|----------------|----------------------|
| | Measured | Indicated | Inferred | Subtotal | Hypothetical | Speculative | Subtotal | |
| Morupule | 2,846 | 2,706 | 4,272 | 9,824 | 4,851 | 3,397 | 8,248 | 18,072 |
| Moijabana | - | - | 2,406 | 2,406 | - | 648 | 648 | 3,054 |
| Mmamabula | 494 | 20,215 | 2,504 | 23,213 | - | - | - | 23,213 |
| Letlhakeng | - | - | 7,213 | 7,213 | 23,340 | 39,800 | 63,140 | 70,353 |
| Ncojane | - | - | - | - | 2,025 | 2,700 | 4,725 | 4,725 |
| Dukwi | - | 32 | 1,572 | 1,604 | - | - | - | 1,604 |
| Mmamantswe | - | - | 598 | 598 | - | 2,300 | 2,300 | 2,898 |
| Serule | - | 307 | 1,341 | 1,648 | 1,766 | 6,270 | 8,036 | 9,684 |
| Dutlwe | - | - | 2,070 | 2,070 | 60,875 | 8,795 | 69,670 | 71,740 |
| Foley | - | - | - | - | 6,860 | - | 6,860 | 6,860 |
| Bobonong | - | - | - | - | - | 179 | 179 | 179 |
| Total | 3,340 | 23,260 | 21,976 | 48,576 | 99,717 | 64,089 | 163,806 | 212,382 |

The terms “Reserves” and “Resources” have been applied to conform to definitions proposed by the United Nations Solid Fuels Framework

Measured Reserves - delineated by closely spaced observation points (such as drill holes); judged accurate to +/- 20 percent; spacing should generally not exceed 0.8 km.

Indicated Reserves - delineated by observation points which are 0.8 to 2.4 km apart.

Inferred Reserves - few observation points, spacing generally ranging from 2.4 to 9.6 km; but estimates may vary depending on complexity of geological formations.

Hypothetical Resources - essentially undiscovered but occurring in same geological environment as the areas explored in detail.

Speculative Resources - undiscovered, but may, by geological inference, be projected over unexplored ground with a reasonable degree of confidence.

- Zero or less than 1 unit

Source: Department of Geological Survey

¹ Data that was released in the Environment Statistics Publication (2000) has been revised.

Table 2 Local Primary Energy Production and Imports, 1981-2003 (Terajoules)

| Year | Primary Production | | | | | Imports | | | | | | | | | | | Grand Total |
|------|--------------------|--------|-------|----------|-----------|---------|-------|--------|-------|--------|----------|--------|----------|-------|-------------|-----------|-------------|
| | Coal | Wood | Solar | Other RE | Sub-total | Coal | LPG | Av-Gas | Jet A | Petrol | Paraffin | Diesel | Fuel Oil | Lubes | Electricity | Sub total | |
| 1981 | 9,137 | 15,456 | 2 | - | 24,595 | 538 | 95 | 57 | 61 | 1,702 | 111 | 3,355 | 116 | 132 | 36 | 6,204 | 30,799 |
| 1982 | 9,955 | 15,984 | 5 | - | 25,945 | 487 | 81 | 55 | 70 | 1,937 | 137 | 3,684 | 47 | 149 | 295 | 6,942 | 32,886 |
| 1983 | 9,482 | 16,528 | 9 | - | 26,019 | 715 | 93 | 52 | 66 | 2,098 | 135 | 3,562 | 23 | 145 | 576 | 7,465 | 33,485 |
| 1984 | 9,430 | 17,088 | 12 | - | 26,530 | 653 | 103 | 59 | 79 | 2,417 | 151 | 3,454 | 18 | 138 | 670 | 7,743 | 34,272 |
| 1985 | 10,490 | 17,680 | 16 | - | 28,186 | 696 | 138 | 63 | 101 | 2,788 | 157 | 3,161 | 12 | 135 | 803 | 8,053 | 36,240 |
| 1986 | 11,748 | 18,288 | 16 | - | 30,052 | 768 | 176 | 73 | 114 | 3,162 | 233 | 3,993 | 18 | 154 | 864 | 9,554 | 39,606 |
| 1987 | 11,688 | 17,808 | 19 | - | 29,515 | 1,080 | 225 | 85 | 133 | 3,761 | 263 | 3,901 | 18 | 170 | 259 | 9,895 | 39,410 |
| 1988 | 14,618 | 20,624 | 20 | - | 35,262 | 696 | 271 | 83 | 321 | 4,069 | 320 | 4,179 | 135 | 183 | 198 | 10,455 | 45,717 |
| 1989 | 15,913 | 21,168 | 18 | 1 | 37,100 | 864 | 316 | 94 | 309 | 4,718 | 386 | 4,860 | 139 | 212 | 216 | 12,115 | 49,215 |
| 1990 | 19,056 | 17,616 | 21 | 1 | 36,694 | 864 | 364 | 83 | 498 | 5,534 | 423 | 5,760 | 139 | 232 | 302 | 14,200 | 50,894 |
| 1991 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1992 | 21,672 | 20,240 | 34 | 1 | 41,947 | 864 | 345 | 102 | 338 | 7,273 | 471 | 6,749 | 2,396 | 240 | 497 | 19,276 | 61,223 |
| 1993 | 21,360 | 21,008 | 34 | 1 | 42,403 | 240 | 239 | 57 | 188 | 7,800 | 364 | 6,203 | 2,169 | 264 | 598 | 18,122 | 60,525 |
| 1994 | 21,600 | 21,424 | 35 | 1 | 43,060 | 312 | 624 | 66 | 202 | 7,747 | 701 | 5,661 | 105 | 218 | 1,055 | 16,691 | 59,751 |
| 1995 | 21,552 | 21,168 | 21 | 1 | 42,742 | 336 | 482 | 101 | 271 | 8,504 | 736 | 6,403 | 158 | 242 | 1,202 | 18,436 | 61,178 |
| 1996 | 18,318 | 21,040 | 21 | 1 | 39,380 | 336 | 546 | 102 | 235 | 8,678 | 809 | 6,560 | 167 | 315 | 2,488 | 20,236 | 59,615 |
| 1997 | 18,696 | 21,456 | 21 | 1 | 40,174 | 490 | 733 | 102 | 259 | 9,164 | 812 | 7,457 | 233 | 261 | 2,945 | 22,454 | 62,628 |
| 1998 | 22,272 | 22,720 | 21 | 1 | 45,014 | 2,232 | 573 | 86 | 297 | 9,958 | 1,256 | 8,321 | 141 | 335 | 2,678 | 25,877 | 70,891 |
| 1999 | 22,176 | 22,720 | 21 | 1 | 44,918 | 2,232 | 699 | 163 | 340 | 10,628 | 845 | 9,484 | 3,489 | 335 | 2,678 | 30,894 | 75,812 |
| 2000 | 22,752 | 22,720 | 21 | 1 | 45,494 | 2,232 | 733 | 102 | 259 | 11,201 | 859 | 10,604 | 233 | 261 | 2,912 | 29,396 | 74,890 |
| 2001 | 21,480 | 22,720 | 21 | 1 | 44,222 | 564 | 1,083 | 163 | 290 | 12,778 | 903 | 11,309 | 249 | 226 | 4,043 | 31,608 | 75,830 |
| 2002 | 22,920 | 22,256 | 21 | 1 | 45,198 | 593 | 1,137 | 172 | 304 | 13,417 | 949 | 11,874 | 262 | 237 | 4,244 | 33,189 | 78,387 |
| 2003 | 19,776 | 21,808 | 21 | 1 | 41,606 | 629 | 1,194 | 180 | 320 | 14,088 | 996 | 12,349 | 275 | 249 | 4,457 | 34,736 | 76,342 |

- Zero or less than 0.1

.. Data unavailable

Source: Energy Affairs Division, Ministry of Minerals, Energy and Water Affairs Energy Balances.

Table 3 Final Energy Demand (Percentages) by Energy Source, 1981 - 2003

| Year | Coal | LPG | AvGas | Jet A | Petrol | Paraffin | Diesel | Fuel Oil | Lubes | Electricity | Wood | Solar | Other RE | Total |
|------|------|-----|-------|-------|--------|----------|--------|----------|-------|-------------|------|-------|----------|-------|
| 1981 | 16.0 | 0.3 | 0.2 | 0.2 | 6.6 | 0.5 | 10.4 | 0.1 | 0.4 | 6.9 | 58.3 | - | - | 100 |
| 1982 | 15.1 | 0.3 | 0.2 | 0.2 | 7.2 | 0.5 | 10.1 | 0.1 | 0.4 | 7.4 | 58.3 | - | - | 100 |
| 1983 | 14.6 | 0.4 | 0.2 | 0.2 | 7.9 | 0.5 | 10.0 | 0.1 | 0.4 | 7.7 | 58.1 | - | - | 100 |
| 1984 | 15.5 | 0.4 | 0.2 | 0.2 | 8.4 | 0.5 | 9.6 | - | 0.4 | 7.4 | 57.3 | - | - | 100 |
| 1985 | 15.9 | 0.5 | 0.2 | 0.3 | 8.9 | 0.5 | 9.4 | - | 0.4 | 7.2 | 56.8 | 0.1 | - | 100 |
| 1986 | 15.1 | 0.5 | 0.2 | 0.3 | 9.6 | 0.7 | 10.3 | - | 0.4 | 7.1 | 55.7 | - | - | 100 |
| 1987 | 14.9 | 0.6 | 0.3 | 0.4 | 11.3 | 0.7 | 10.2 | - | 0.4 | 7.3 | 53.8 | - | - | 100 |
| 1988 | 14.0 | 0.8 | 0.2 | 0.9 | 10.9 | 0.9 | 9.8 | 0.1 | 0.4 | 7.1 | 55.1 | - | - | 100 |
| 1989 | 12.6 | 1.2 | 0.2 | 0.8 | 11.9 | 1.0 | 11.3 | 0.4 | 0.5 | 6.8 | 53.3 | - | - | 100 |
| 1990 | 11.8 | 1.3 | 0.2 | 1.3 | 14.6 | 1.2 | 14.2 | 0.5 | 0.6 | 7.6 | 46.6 | 0.1 | - | 100 |
| 1991 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| 1992 | 9.6 | 1.2 | 0.2 | 0.7 | 15.8 | 1.0 | 13.7 | 5.2 | 0.5 | 7.8 | 44.2 | 0.1 | - | 100 |
| 1993 | 9.4 | 1.2 | 0.1 | 0.4 | 16.8 | 1.1 | 12.5 | 4.5 | 0.5 | 8.1 | 45.3 | 0.1 | - | 100 |
| 1994 | 9.7 | 1.3 | 0.1 | 0.4 | 17.2 | 1.1 | 11.9 | 0.1 | 0.5 | 9.7 | 47.7 | 0.1 | - | 100 |
| 1995 | 7.3 | 1.2 | 0.2 | 0.6 | 18.7 | 1.1 | 13.4 | 0.2 | 0.5 | 10.0 | 46.6 | - | - | 100 |
| 1996 | 10.0 | 1.2 | 0.2 | 0.5 | 18.2 | 1.0 | 13.1 | 0.2 | 0.6 | 10.7 | 44.1 | - | - | 100 |
| 1997 | 8.8 | 1.1 | 0.2 | 0.5 | 18.6 | 1.0 | 14.5 | 0.3 | 0.5 | 10.9 | 43.5 | - | - | 100 |
| 1998 | 18.1 | 1.4 | 0.1 | 0.5 | 16.9 | 0.8 | 13.6 | 0.1 | 0.6 | 9.2 | 38.6 | - | - | 100 |
| 1999 | 12.0 | 1.0 | 0.3 | 0.6 | 18.6 | 0.9 | 16.0 | 0.3 | 0.6 | 10.1 | 39.7 | - | - | 100 |
| 2000 | 12.3 | 0.9 | 0.2 | 0.4 | 18.5 | 0.8 | 17.0 | 0.3 | 0.4 | 11.6 | 37.5 | - | - | 100 |
| 2001 | 13.7 | 1.7 | 0.3 | 0.4 | 19.6 | 1.4 | 16.9 | 0.2 | 0.3 | 10.6 | 34.8 | - | - | 100 |
| 2002 | 14.5 | 1.7 | 0.3 | 0.5 | 19.9 | 1.4 | 17.2 | 0.2 | 0.3 | 10.8 | 33.1 | - | - | 100 |
| 2003 | 9.2 | 1.8 | 0.3 | 0.5 | 21.8 | 1.6 | 18.6 | 0.2 | 0.4 | 11.8 | 33.7 | - | - | 100 |

.. Data unavailable

- Zero or less than 0.1

Source: Computed from the Energy Affairs Division, Ministry of Minerals, Energy and Water Affairs Energy Balances.

Table 5 Total GHG Emissions (Tonnes) Summed over all Sectors by Emission Type, 1981 – 2003*

| All Sectors | CO ₂ | CH ₄ | N ₂ O | NO _x | CO |
|-------------|-----------------|-----------------|------------------|-----------------|------------|
| 1981 | 1,376,392.59 | 9,007.74 | 455.58 | 7,871.46 | 112,978.75 |
| 1982 | 1,383,694.11 | 9,335.91 | 460.39 | 8,145.78 | 118,442.39 |
| 1983 | 1,350,552.39 | 9,661.66 | 453.27 | 8,246.74 | 124,035.48 |
| 1984 | 1,384,514.12 | 10,007.23 | 464.94 | 8,637.78 | 129,909.57 |
| 1985 | 1,467,684.27 | 10,377.00 | 489.04 | 9,211.30 | 135,734.75 |
| 1986 | 1,594,025.73 | 10,767.74 | 531.32 | 10,074.89 | 143,250.71 |
| 1987 | 1,702,387.11 | 10,564.39 | 562.61 | 10,960.46 | 145,336.09 |
| 1988 | 2,062,250.95 | 12,223.10 | 675.49 | 12,796.19 | 166,035.34 |
| 1989 | 2,342,062.63 | 12,619.36 | 763.63 | 14,413.39 | 175,443.20 |
| 1990 | 2,434,144.87 | 10,696.83 | 787.25 | 15,272.30 | 160,632.92 |
| 1992 | 3,315,557.61 | 12,515.93 | 1,061.32 | 19,801.58 | 193,425.09 |
| 1993 | 3,190,369.71 | 12,896.96 | 1,025.13 | 19,832.83 | 201,596.90 |
| 1994 | 3,022,859.41 | 13,125.25 | 967.52 | 19,744.20 | 203,628.48 |
| 1995 | 3,132,168.67 | 13,062.57 | 1,003.07 | 20,815.73 | 208,770.88 |
| 1996 | 2,864,160.33 | 12,965.47 | 930.06 | 19,829.81 | 209,442.80 |
| 1997 | 3,019,338.12 | 13,257.11 | 981.48 | 20,879.76 | 216,544.34 |
| 1998 | 3,627,053.22 | 14,113.06 | 1,163.92 | 24,115.35 | 231,755.05 |
| 1999 | 3,753,860.37 | 14,188.52 | 1,205.51 | 25,254.48 | 238,206.73 |
| 2000 | 4,583,779.68 | 14,337.81 | 1,442.94 | 29,168.56 | 243,149.55 |
| 2001 | 3,877,505.37 | 14,384.00 | 1,263.65 | 27,282.37 | 257,570.86 |
| 2002 | 4,104,354.88 | 14,206.79 | 1,331.17 | 28,703.71 | 260,454.11 |
| 2003 | 3,914,682.26 | 13,986.76 | 1,282.88 | 28,416.26 | 263,629.49 |

*Data for the 1991 Energy Data is unavailable hence related emissions could not be calculated

Source: Emission levels are calculated by CSO using Energy Activity Data from Energy Affairs Division, MMEWA

Table 6 Total GHG Emissions in Carbon dioxide Equivalents Summed over All Sectors by Emission Type, 1981 – 2003*

| All Sectors | CO ₂ | CH ₄ | N ₂ O | NOx | CO | Total |
|-------------|-----------------|-----------------|------------------|--------------|------------|--------------|
| 1981 | 1,376,392.59 | 189,162.63 | 141,230.81 | 314,858.50 | 338,936.24 | 2,360,580.77 |
| 1982 | 1,383,694.11 | 196,054.05 | 142,720.48 | 325,831.11 | 355,327.17 | 2,403,626.92 |
| 1983 | 1,350,552.39 | 202,894.90 | 140,513.96 | 329,869.64 | 372,106.45 | 2,395,937.34 |
| 1984 | 1,384,514.12 | 210,151.92 | 144,132.53 | 345,511.03 | 389,728.71 | 2,474,038.31 |
| 1985 | 1,467,684.27 | 217,917.10 | 151,601.21 | 368,451.85 | 407,204.24 | 2,612,858.68 |
| 1986 | 1,594,025.73 | 226,122.54 | 164,709.49 | 402,995.57 | 429,752.12 | 2,817,605.44 |
| 1987 | 1,702,387.11 | 221,852.14 | 174,409.16 | 438,418.36 | 436,008.27 | 2,973,075.04 |
| 1988 | 2,062,250.95 | 256,685.16 | 209,402.20 | 511,847.47 | 498,106.02 | 3,538,291.79 |
| 1989 | 2,342,062.63 | 265,006.59 | 236,724.42 | 576,535.77 | 526,329.61 | 3,946,659.02 |
| 1990 | 2,434,144.87 | 224,633.40 | 244,048.54 | 610,892.13 | 481,898.77 | 3,995,617.71 |
| 1992 | 3,315,557.61 | 262,834.61 | 329,010.19 | 792,063.24 | 580,275.28 | 5,279,740.94 |
| 1993 | 3,190,369.71 | 270,836.19 | 317,791.46 | 793,313.14 | 604,790.69 | 5,177,101.19 |
| 1994 | 3,022,859.41 | 275,630.32 | 299,932.73 | 789,768.04 | 610,885.43 | 4,999,075.93 |
| 1995 | 3,132,168.67 | 274,313.91 | 310,952.28 | 832,629.04 | 626,312.65 | 5,176,376.54 |
| 1996 | 2,864,160.33 | 272,274.79 | 288,318.56 | 793,192.50 | 628,328.40 | 4,846,274.57 |
| 1997 | 3,019,338.12 | 278,399.30 | 304,259.67 | 835,190.28 | 649,633.01 | 5,086,820.38 |
| 1998 | 3,627,053.22 | 296,374.35 | 360,815.95 | 964,613.95 | 695,265.15 | 5,944,122.63 |
| 1999 | 3,753,860.37 | 297,958.93 | 373,708.39 | 1,010,179.27 | 714,620.19 | 6,150,327.15 |
| 2000 | 4,583,779.68 | 301,094.06 | 447,312.44 | 1,166,742.21 | 729,448.65 | 7,228,377.05 |
| 2001 | 3,877,505.37 | 302,063.92 | 391,730.54 | 1,091,294.91 | 772,712.58 | 6,435,307.32 |
| 2002 | 4,104,354.88 | 298,342.51 | 412,662.94 | 1,148,148.56 | 781,362.32 | 6,744,871.21 |
| 2003 | 3,914,682.26 | 293,721.92 | 397,691.61 | 1,136,650.43 | 790,888.46 | 6,533,634.68 |

*Data for the 1991 Energy Data is unavailable hence related emissions could not be calculated

Source: Emission levels are calculated by CSO using Energy Activity Data from Energy Affairs Division, MMEWA

Table 7 Total GHG Emissions in Global Warming Potentials (Percentages) Summed over All Sectors by Emission Type, 1981 – 2003*

| All Sectors | CO₂ | CH₄ | N₂O | NO_x | CO | Total |
|--------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------|--------------|
| 1981 | 58.31 | 8.01 | 5.98 | 13.34 | 14.36 | 100.00 |
| 1982 | 57.57 | 8.16 | 5.94 | 13.56 | 14.78 | 100.00 |
| 1983 | 56.37 | 8.47 | 5.86 | 13.77 | 15.53 | 100.00 |
| 1984 | 55.96 | 8.49 | 5.83 | 13.97 | 15.75 | 100.00 |
| 1985 | 56.17 | 8.34 | 5.80 | 14.10 | 15.58 | 100.00 |
| 1986 | 56.57 | 8.03 | 5.85 | 14.30 | 15.25 | 100.00 |
| 1987 | 57.26 | 7.46 | 5.87 | 14.75 | 14.67 | 100.00 |
| 1988 | 58.28 | 7.25 | 5.92 | 14.47 | 14.08 | 100.00 |
| 1989 | 59.34 | 6.71 | 6.00 | 14.61 | 13.34 | 100.00 |
| 1990 | 60.92 | 5.62 | 6.11 | 15.29 | 12.06 | 100.00 |
| 1992 | 62.80 | 4.98 | 6.23 | 15.00 | 10.99 | 100.00 |
| 1993 | 61.62 | 5.23 | 6.14 | 15.32 | 11.68 | 100.00 |
| 1994 | 60.47 | 5.51 | 6.00 | 15.80 | 12.22 | 100.00 |
| 1995 | 60.51 | 5.30 | 6.01 | 16.09 | 12.10 | 100.00 |
| 1996 | 59.10 | 5.62 | 5.95 | 16.37 | 12.97 | 100.00 |
| 1997 | 59.36 | 5.47 | 5.98 | 16.42 | 12.77 | 100.00 |
| 1998 | 61.02 | 4.99 | 6.07 | 16.23 | 11.70 | 100.00 |
| 1999 | 61.04 | 4.84 | 6.08 | 16.42 | 11.62 | 100.00 |
| 2000 | 63.41 | 4.17 | 6.19 | 16.14 | 10.09 | 100.00 |
| 2001 | 60.25 | 4.69 | 6.09 | 16.96 | 12.01 | 100.00 |
| 2002 | 60.85 | 4.42 | 6.12 | 17.02 | 11.58 | 100.00 |
| 2003 | 59.92 | 4.50 | 6.09 | 17.40 | 12.10 | 100.00 |

*Data for the 1991 Energy Data is unavailable hence related emissions could not be calculated

Source: Percentages are calculated by CSO from respective Emission Tables

Table 8 Total GHG Emissions From Energy Combustion in CO₂ Equivalent (Tonnes and Percentages, 1993 - 2003)

| Energy Source | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|--------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| <i>Tonnes</i> | | | | | | | | | | | |
| Coal | 2,445,142 | 2,480,460 | 2,477,766 | 2,111,961 | 2,171,276 | 2,773,877 | 2,763,010 | 3,670,429 | 2,495,425 | 2,661,627 | 2,309,844 |
| LPG | 41,687 | 44,857 | 39,277 | 41,299 | 42,547 | 62,006 | 43,790 | 42,429 | 81,303 | 85,365 | 89,632 |
| Av Gas | 4,525 | 5,255 | 8,048 | 8,112 | 8,112 | 6,813 | 12,970 | 8,112 | 12,970 | 13,616 | 14,297 |
| Jet A | 16,928 | 18,129 | 24,375 | 21,105 | 23,250 | 26,712 | 30,566 | 23,250 | 26,047 | 27,348 | 28,715 |
| Petrol | 1,149,898 | 1,142,117 | 1,253,700 | 1,279,351 | 1,350,957 | 1,468,116 | 1,574,221 | 1,651,320 | 1,883,816 | 1,978,007 | 2,076,907 |
| Paraffin | 40,370 | 42,201 | 40,326 | 40,411 | 41,620 | 40,394 | 41,383 | 41,747 | 75,972 | 79,771 | 83,757 |
| Diesel | 591,025 | 539,364 | 610,058 | 625,002 | 710,499 | 793,126 | 903,489 | 1,010,266 | 1,077,460 | 1,131,329 | 1,176,572 |
| Fuel Oil | 183,695 | 8,925 | 13,396 | 14,136 | 19,706 | 11,882 | 19,713 | 19,622 | 21,126 | 22,164 | 23,276 |
| Wood | 703,831 | 717,768 | 709,430 | 704,903 | 718,840 | 761,188 | 761,188 | 761,188 | 761,188 | 745,643 | 730,633 |
| Total Tonnes | 5,177,101 | 4,999,076 | 5,176,377 | 4,846,279 | 5,086,807 | 5,944,114 | 6,150,330 | 7,228,363 | 6,435,307 | 6,744,871 | 6,533,635 |
| <i>Percentages</i> | | | | | | | | | | | |
| Coal | 47.23 | 49.62 | 47.87 | 43.58 | 42.68 | 46.67 | 44.92 | 50.78 | 38.78 | 39.46 | 35.35 |
| LPG | 0.81 | 0.90 | 0.76 | 0.85 | 0.84 | 1.04 | 0.71 | 0.59 | 1.26 | 1.27 | 1.37 |
| Av Gas | 0.09 | 0.11 | 0.16 | 0.17 | 0.16 | 0.11 | 0.21 | 0.11 | 0.20 | 0.20 | 0.22 |
| Jet A | 0.33 | 0.36 | 0.47 | 0.44 | 0.46 | 0.45 | 0.50 | 0.32 | 0.40 | 0.41 | 0.44 |
| Petrol | 22.21 | 22.85 | 24.22 | 26.40 | 26.56 | 24.70 | 25.60 | 22.85 | 29.27 | 29.33 | 31.79 |
| Paraffin | 0.78 | 0.84 | 0.78 | 0.83 | 0.82 | 0.68 | 0.67 | 0.58 | 1.18 | 1.18 | 1.28 |
| Diesel | 11.42 | 10.79 | 11.79 | 12.90 | 13.97 | 13.34 | 14.69 | 13.98 | 16.74 | 16.77 | 18.01 |
| Fuel Oil | 3.55 | 0.18 | 0.26 | 0.29 | 0.39 | 0.20 | 0.32 | 0.27 | 0.33 | 0.33 | 0.36 |
| Wood | 13.60 | 14.36 | 13.71 | 14.55 | 14.13 | 12.81 | 12.38 | 10.53 | 11.83 | 11.05 | 11.18 |
| Total Percentages | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |