

Environmental sustainability

►Indicator 1: Per Capita Carbon Emissions

South Africa is one of the most carbon emissions-intensive countries in the world, due to the energy intensive economy and high dependence on coal for primary energy. South African per capita emissions are higher than those of many European countries, and near the OECD average (see Table 4). As discussed earlier, this is partly the result of energy intensive sectors such as mining, iron and steel, aluminium, ferrochrome, and chemicals to the economy – the same sectors that make up a large share of South African exports (Visser *et al.* 1999; Spalding-Fecher *et al.* 2000a). In addition, plentiful supplies of inexpensive coal have supported the development of large scale coal fired power stations and heavy reliance on coal within industry. Finally, because the specific energy efficiency of many sectors is also lower than average, emissions per unit of economic output are high. The energy sector contributed 78% of South Africa's total greenhouse gas emissions in 1994, and more than 90% of carbon dioxide emissions (RSA 2001c).

Table 4. Energy sector carbon emissions intensity and per capita, 1999

| | <i>CO₂/cap</i> <i>tonnes/capita</i> | <i>CO₂/GDP</i> <i>Kg/1995 US\$</i> | <i>CO₂/GDP PPP</i> <i>kg/1995 PPP US\$</i> |
|--------------|---------------------------------------------------|--------------------------------------------------|----------------------------------------------------------|
| South Africa | 8.23 | 2.11 | 0.96 |
| Africa | 0.09 | 1.28 | 0.49 |
| Non-OECD | 2.24 | 1.79 | 0.66 |
| OECD | 10.96 | 0.46 | 0.52 |
| World | 3.88 | 0.71 | 0.58 |

Source: (IEA 2001)

For indicator 1, the value for 1 on the vector is 1 130 kgC/capita, which is the 1990 global average of carbon emissions from fossil fuel production. The value of 0 on the vector, or the sustainability goal, is 339 kgC/capita – a 70% reduction from 1990 levels.

According to the International Energy Agency, South Africa's energy sector carbon emissions for 1999 totalled 346.31 million metric tonnes (MMT) of carbon dioxide, or 964.45 MMT of carbon (IEA 2001). On a population of 43.05 million people (SSA 1999), this is 2 194 kgC/capita. This compares to 2 205 kgC/capita in 1990. This means that the vector values for South Africa are greater than one for both years – 2.40 for 1999 and 2.26 for 1990.

Metric (actual data) for 1990: 2 205 kgC/capita and 1999 2 194 kgC/capita
Vector values for 1990: 2.26 and 1999 2.40

Discussion:

South Africa entered the climate change debate relatively late, only ratifying the UN Framework Convention on Climate Change in 1997. Government has developed a climate change policy discussion document (DEAT 1998), and is currently working on a national response strategy, which will be circulated by mid-2002. In addition, South Africa recently ratified the Kyoto Protocol. The Discussion Document mentions a wide range of possible energy strategies, including greater use of renewables and energy efficiency, as well as cleaner fossil fuels, but no specific measures. Government released a draft First National Communication to the UNFCCC, and this should be officially submitted prior to the World Summit on Sustainable Development (RSA 2001c). The DME Energy White Paper states that

government will follow a 'no regrets' approach in the energy sector with regard to the potential global environmental impacts of energy activities (DME 1998). What precisely this means is unclear, but government strategies around renewable energy and energy efficiency – discussed in more detail below – will have a major impact on emissions. In addition, the Department of Environmental Affairs and Tourism is finalising the National Strategy Study for Clean Development Mechanism (Goldblatt 2001), which will identify areas in which South Africa can attract investment into greenhouse gas reduction projects using the mechanisms of the Kyoto Protocol to the UN Framework Convention on Climate Change.

Note that the data for this vector calculation were taken from the International Energy Agency report on carbon dioxide emissions from 1971-1999. The reason for choosing this data, rather than the official inventory, is mainly timeliness. South Africa's first national communication only reports greenhouse gas inventories for 1990 and 1994 – and this is not likely to be updated on an annual basis. The reference approach energy sector emissions reported in the National Communication for 1994 are about 2% higher than those reported by the IEA, although the difference for 1990 is around 10%. The reasons for these difference are primarily the use of default emissions factors by the IEA, as opposed to local emissions factors by the SA national inventory (Howells & Solomon 2000).

Notes to SEW or next year's Observer-Reporter:

The Department of Environmental Affairs and Tourism (DEAT) is discussing a system for regular GHG emissions inventories, which could also be linked to the DME annual energy balances to provide a 'Tier 1' Reference Approach inventory. Even if this system is put into place, however, the energy balances generally take two years to be published (the same as IEA data, which uses national energy balances as one of the main sources).

► Indicator 2: Most Significant Energy-Related Local Pollutant

As in all countries, energy production and consumption in South Africa has a wide range of local environmental impacts – from air quality and water use, to degradation of land, water and forest resources. Unlike many Northern countries, however, some of the most critical problems occur at the household level – from the consumption of fuels for cooking, heating and lighting – rather than mainly from large-scale industrial use. Similar to many developing countries, exposure to hazardous levels of indoor air pollution outstrips outdoor air pollution as a potential cause of illness and even death (Reddy *et al.* 1997; Holdren & Smith 2000). Studies on the environmental impacts of energy use, including the only study on economic valuation of these impacts, places particulate emissions at the top of the list of environmental hazards, with other indoor and local (ie ground level) pollutants close behind (Van Horen 1996a, 1996b; Freeman & Naude 1999; Lloyd *et al.* 1999). This is because these pollutants are so widespread, released in close proximity to people (often in confined space) and so damaging to human health at the concentrations common in developing countries. It is important to remember, however, that the household hazards of energy extend even beyond pollutants, to include the high risk of fires, burns and even poisoning from paraffin stove use and candle-burning in informal dwellings (Van Horen 1996b; Mehlwana 1999a, 1999c).

For the reasons above, we choose to use a measure of air quality in low-income areas as a key indicator of energy sector environmental impacts. The Soweto Air Monitoring (SAM) Project was initiated in 1991, and has tracked ambient concentrations of particulate matter in Soweto since that time (Annergarn & Sithole 1999). Results up to 1999 show that winter concentrations of total particulate matter have declined by about 15%. The intention is to update this data for 2000, but at the time of writing this was not complete, so the data presented here is the same as in the SEW 2001 report for South Africa.

For this indicator, the value for 1 on the vector is the 1990 level of pollution – or in this case, we use 1992 because this is the earliest year for which the monitoring was conducted. The 1992 measurements showed an ambient concentration of particulate matter of 180 micrograms per cubic metre. The value for 0 on the vector set at 10% of the base 1992 value, so 18 $\mu\text{g}/\text{m}^3$ for this particular pollutant measurement. The 1999 vector value is therefore 0.85.

Metric (actual data) for 1992: 180 $\mu\text{g}/\text{m}^3$ and 1999 150 $\mu\text{g}/\text{m}^3$
Vector values for 1992: 1.00 and 1999 0.85

Discussion:

For the Soweto data, it is not possible to attribute all of this change to changing energy use patterns – namely electrification and the decline household use of coal. Some of this particulate matter also comes from the burning of refuse (Annergarn & Sithole 1999), although smoke from coal is one of the largest contributors.

The problem here is the lack of a national air quality monitoring system – for either emissions or ambient air quality. While DEAT collects information on major pollutant emissions from large stationary sources, this data is all self reported and not validated by government (Spalding-Fecher *et al.* 2000a). The data also tends to be fairly out of date (eg the most recent national inventory is for 1993). Eskom probably has the most extensive air quality monitoring network in the country, although the sites are chosen to assess the impact of emissions from power stations (with generally high stacks) rather than other industry or pollutants from household energy use. If government is to implement the far-reaching National Environmental Management Act passed in 1998, therefore, significant improvements in data collection and monitoring of air quality will be essential. Otherwise, it will not be possible to track progress against any national or local goals.

Notes to SEW or next year's Observer-Reporter:

The O-R should follow up to get the 2000 trend data as soon as it is available. It may also be possible to get average air quality data near power stations from Eskom, although this data may be difficult to aggregate.

The National State of the Environment Report (www.environment.gov.za/soer/nsoer/index.htm) should also be consulted, to assess other possible indicators of environmental quality and trends – although these do not separate out the impacts of the energy sector on emissions.