Technological sustainability

►Indicator 7: Energy Intensity

As mentioned in the overview of South Africa, the South African economy is highly energy-intensive, comparable to the economies in transition in Eastern Europe and the former Soviet Union or the oil-producing countries in the Middle East. The reasons for this include the structural dependence of the economy on energy-intensive industries such as mining and metals, as well as the higher specific energy intensity of some industrial processes compared to OECD countries (Spalding-Fecher *et al.* 2000b).

Two different versions of this indicator are useful to report. The first is to report total primary energy supply (TPES) divided by GDP at nominal exchange rates. This gives a comparison with other countries on how much energy they use to generate a unit of GDP. Because of differences in the purchasing power of currencies across countries, however, using nominal exchange rates can understate GDP, and so overstate the energy intensity. A second version of the indicator, therefore, is to report commercial primary energy (ie excluding household use of biomass) per unit of GDP at purchasing power parity (PPP) exchange rates.

According to the DME, TPES and commercial energy supply for 1999 were 4 637 and 4 447 petajoules (PJ), respectively (DME 2001d). Commercial energy is estimated from TPES less household biomass use (i.e. total renewables and biomass less use for industrial cogeneration). Nominal GDP in 1999 was 796 billion Rands, or 331 billion 1990 Rands. Based on atlas exchange rates, this is 128 billion 1990 US dollars, while at purchasing power parity (PPP) rates it is 200 billion 1990 US dollars (SARB 2001). South Africa's energy intensity for 1999 was then 36.2 MJ/1990 US$ (based on TPES) or 22.2 MJ/1990 US$ PPP (based on commercial energy).

The value for 1 on this indicator is the 1990 global average energy intensity of 10.6 MJ/US$1990. The value for the zero on the vector is 1.06 MJ/US$1990, or 10% of the 1990 world average. This means that the vector value for South Africa is considerably greater than 1, or almost 4 if exchange rate GDP is used.

Metric (actual data) for 1999: 36.2 MJ/US$ 1990 GDP or 22.2 MJ/US$1990 GDP PPP
Vector values for 1998: 3.67 (using exchange rates) or 2.21 (using PPP)

Discussion:

The White Paper on Energy Policy recognises that the South African economy is highly energy-intensive, but also that low energy prices (one of the reasons for high energy intensity) have provided a competitive advantage for South African industry. South Africa has some of the lowest energy prices in the world, and the cost of electricity production is among the world's lowest (SANEA 1998). Many of the policy proposals included in the White Paper, such as greater diversity of energy supply sources, cost reflective pricing, promoting renewable energy and energy efficiency in a range of sectors, and the development of a natural gas market, have the potential to reduce energy intensity. The White Paper also calls for 'cost-reflective pricing' – in other words to move energy prices to reflect their true marginal cost of production. Current electricity prices, for example, largely reflect the fact that Eskom's power stations are already paid off and were financed at very low interest rates. Future investments, however, will likely come at much higher cost and may reflect private sector demand for higher returns if part of the industry is privatised. The price signals that people receive today, therefore, including investors in energy-intensive industry, do not reflect the marginal cost of electricity – or what it will cost to generate the next additional amount of electricity that requires new generation plant.

Furthermore, a key element of South African industrial strategy is the establishment of so-called 'spatial development initiatives', which refer to locations where government hopes to facilitate industrial development through public-private partnerships, the improvement of infrastructure, the establishment of strategic anchor projects and the creation of industrial clusters and industrial parks. The two main types of spatial development initiatives are 'industrial' and 'eco-tourism'. The former includes initiatives such as the Maputo Development Corridor and the Coega Industrial Development Zone. The key to success for these spatial development initiatives is investment in energy-intensive anchor projects, such as the proposed zinc smelter near Port Elizabeth. The risk of these policies is that, while they may promote industrial development in the short run, they carry a high risk of 'locking in' the economy into energy-intensive industries, when environmental, economic and social pressures may push South Africa in the opposite direction. The reason for this 'lock in' is that, once a major investment like a smelter is made, there are very limited opportunities to improve the energy efficiency or also the production process. Recent investments in steel and aluminium bear this out – while the processes may be optimised for that technology, the wholesale switch to a more efficient technology is very costly after construction (Visser *et al.* 1999).

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

Total energy consumption is available from DME, while the South African Reserve Bank reports real GDP and exchange rates.

►Indicator 8: Renewable Energy Deployment

Renewable energy has long been considered the 'poor cousin' of large-scale, centralised fossil fuel and nuclear energy production in South Africa. In fact, the phrase 'energy for development' under the apartheid-era government effectively meant that renewable energy technologies would only be used for 'developing areas' (ie poor black communities) in remote rural areas (Marquard 1999). That has changed significantly since the new government promulgated the White Paper on Energy Policy, which includes a range of initiatives to promote renewable energy. Much of this effort, however, still is only focused on rural areas, where renewable energy is more financially cost effective than extending the electricity grid. The Department of Minerals and Energy developed a renewable energy strategy, which will be tabled as a draft White Paper on Renewable Energy in 2002 (Mlambo-Ngcuka 2002).

Renewable energy in most Africa countries means biomass, first and foremost. This has also been true in South Africa. Except for a few small hydroelectric facilities, cogeneration by sugar and paper companies, and a small number of other renewable energy demonstration projects, traditional biomass use has been the only significant source of renewable energy until very recently. Quantitative research on national biomass consumption, however, has been very limited, with the DME Biomass Initiative being the most authoritative report (Williams *et al.* 1996).

As discussed above in Indicator 4, several large demonstration projects are under discussion in South Africa, including ones that would supply centralised renewable electricity generation. In addition, the off-grid concessions programme will be one of the largest programmes of its kind in the world, and will create a market for solar home systems that could top $70 million per year (EC *et al.* 2000).

According to the DME energy balances, South Africa's share of renewable energy to TPES in 1999 was 5.7%. This includes commercial and household biomass use, domestic hydropower (which are fairly small scale), and electricity imports that are sources from hydropower in Mozambique, Zambia and Democratic Republic of Congo. For this indicator, the value for 1 on the vector is the world average renewable energy supply as a share of total primary energy supply (TPES) in 1995, which was 8.64% (HELIO International 2000). The value for 0 on the vector, which is our sustainability goal, is 95%. This means that South Africa's value on this vector is 1.04.

Metric (actual data) for 1998: 5.7%
Vector value for 1998: 1.04

Discussion:

The greatest barrier to *tracking* the deployment of renewable energy in South Africa is the lack of good data on household biomass consumption. Biomass production and use reported by government statistics varies widely from year to year, largely because there is no authoritative primary data source. Even the 1998 energy balance, probably the most thorough to date, relies on a 1996 Biomass Initiative report from the DME for the biomass consumption estimates, and these data would have been based on data from earlier years (Williams *et al.* 1996; Pouris 2001). The data used here have been taken from the DME energy balance, therefore, assuming that household use of biomass has remained fairly constant at 190 PJ per year, similar to what the Biomass Initiative estimated.

Even if we knew total biomass production and consumption, however, it is not clear how much of this is 'sustainable' – in other words, how much is sustainably harvested. The level of uncertainty about land-use change, such as deforestation, impacts on South Africa's greenhouse gas emissions, for example, is high. There are no reliable estimates from government on the net changes in fuelwood stocks (Williams 2001).

For this indicator to be a useful reflection of South African energy development, and for government to have any understanding of the impact of national policy on the poor, rural populations that still depend heavily on biomass, more systematic data collection and analysis is urgently needed. For countries such as South Africa to push for renewable energy development without a major emphasis on the sustainable and efficient use of local biomass resources would be an expensive, and possibly inequitable, strategy for sustainable development.

In addition, while much of the current and proposed SADC hydropower stations are either run-or-river or have relatively small impoundment areas, there are still questions about the sustainability of large hydropower projects. This has been raised by the World Commissions on Dams (WCD) in their review of large dam projects, but it has not been possible to do a review of the sources for SA imports for this report.

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

The reporter should consult the DME and the consultant who does the energy balances (Dr A Pouris) to see if any additional research on biomass is available. The reporter should consult the WCD studies and bibliography for information on the dams from which SA imports power.