Energy and economic development: challenges for South Africa

JC Nkomo
Energy Research Centre, University of Cape Town

Abstract
Energy provision is crucial to overall development. The South African economy uses a large amount of energy, is highly energy-intensive, and heavily dominated by the extraction of raw materials and primary processing. As the demand for energy grows, the energy sector is expected to play a central role in fuelling the country's economic growth and development. Issues such as social equity and economic efficiency within the context of sustainable development, and the choice of appropriate policy instruments to minimise negative impacts of externalities associated with energy production and consumption, become crucial. Then there are also issues of economic management. If societies well-being is to improve, these challenges as well as their concomitant trade-offs have to be addressed.

Keywords: energy economy linkages, energy supply and consumption, externalities, energy for sustainable development

Introduction

South Africa's energy sector is characterised by several outstanding features fundamental to social and economic development, such as the following:

- A strong natural resource base and a variety of energy options. The economy is largely dependent on the consumption of coal. Coal reserves are vast, with estimates of their size varying considerably. Reserve estimates are a function of the resource price, the price of its substitutes, improvement in technology, exploration, development of alternatives and so forth, and change as these variables change. South Africa burns low-quality coal, allowing it to be one of the world's lowest-cost producers of electricity. The generation and production of coal is polluting and has a significant environmental impact.
- A well developed energy and transport and grid infrastructure.
- An electrification drive to increase access to disadvantaged communities. Most of those without access are low-income households. The economy is largely dependent on coal for its electricity consumption. Low-income households with access to electricity use electricity selectively and rely on wood and other inefficient fuel types for reasons associated with fuel availability, affordability, and cultural preferences.

The level of competition in the sector is low, with reasons ranging from entry barriers to the issue of regulation. This, however, is not necessarily bad for now, especially if trying to finance expansion. Apart from the high cost of capital required to enter the industry, available information is imperfect, there is lack of technology and technology transfer available to entrants, and the existing structure and regulation is not conducive to entry. All these issues are critical as the economy develops, with important social and environmental implications. They have, for example, an important bearing on the quality of life, job creation, rural development, equity improvement, improved pollution levels and technology transfer opportunities, as well as investment-led strategies promoting investment in renewables and energy efficiency as a centre of South Africa's development.

The rest of the paper is structured as follows. The first section begins with a discussion on energy and economic linkages. This lays a conceptual framework with which growth and development can be better understood. We then look at the behaviour of the economy since 1994, on issues of energy supply and demand, energy investment and pricing and the externality costs. The second section identifies critical issues that relate to energy sustainability in South Africa. This is followed by a discussion on energy outlook in the third section, and we conclude by briefly surveying some of the challenges that face the energy industry.

Energy and energy economy linkages

There are important considerations to bear in mind. The relationship between energy use, economic growth and development is complex and important.

Changes in energy demand are affected by factors such as volume effects, which reflect changes in economic activity; changes in factor inputs in production; structural change resulting in changes in energy technology used; energy conservation, mainly through substitution of old appliances; and changes in average income, distribution and growth – factors that define change in poverty, inequality and growth; and so forth. Evidence suggests that inequality could slow growth, leading to a cycle of low productivity and poverty (Wolfensohn and Bourguignon, 2004). The thinking that development is one and the same with growth has changed overtime to that incorporating social and economic change, and then linking economic growth, distribution and poverty alleviation. Development and poverty alleviation have similar themes: facilitating empowerment, enhancing security and promoting opportunity.

The understanding of poverty has also changed from a loose definition of low income and consumption to that in line with the broader views of Sen (1984) and Dreze and Sen (1989) involving the question of 'access', the creation of entitlements, improving terms of exchange and building up capabilities, and to issues of vulnerability, service by institutions and their powerlessness to influence key decisions that affect their lives. Similarly, approaches to development are also changing on at least two fronts. Firstly, the prescription to market failure, or government failure according to neoliberals, has been to move economies towards unregulated markets. This has developed to a consensus view that the state and markets are complementary, that the private sector promotes sustained economic growth but government has responsibility to ensure that the investment climate is conducive to growth and to invest in and empower its people to reduce poverty levels. Secondly, is the view that institutions and governance are both effective in achieving sustained growth and reducing poverty. In this view, weak institutions are an inequitable burden to citizens and undermine incentives to the private sector thus negatively affecting economic growth. Likewise, the erosion of institutions and a breakdown in governance lead to declines in living standards and a rise in inequality (Wolfensohn and Bourguignon, 2004).

Economic performance

The South African economy produces and uses a large amount of energy, is highly energy-intensive, and is heavily dominated by the extraction of raw materials and primary processing. The energy sector contributes 15% to Gross Domestic Product (GDP), and employs a labour force of over 250 000. Energy provision and use are crucial to South Africa's overall development, especially given the desire to attract foreign investment in the industrial sector. The demand for energy is expected to grow, with the energy sector remaining of central importance to the country's economic growth.

Figure 1 shows fluctuations in economic growth rates overtime. The economy experienced high growth rates in the 1960s, with high growth rates coming from mining and raw materials, and from a tightly controlled economy. Factors such as the world oil crises and the changing gold prices (notice the spike in 1980) added to the economic slowdown of the 1970s. From then on until 1993, increased public spending, economic sanctions and the effects of political instability stifled the economy. The period was characterised by poor growth performance, low levels of investments, rising unemployment, political instability, currency instability, widening deficits, falling living standards and growing inequalities. Growth rates have been relatively low since 1994.

Since 1994, the government has been adamant about getting the macroeconomic balance right, to attract investors, to reduce the budget deficit, to fight inflation through high interest rates, and to

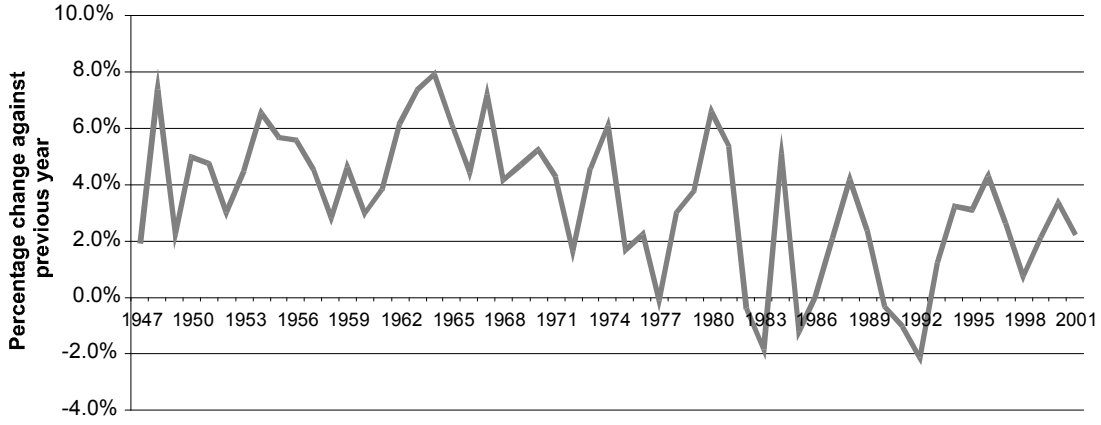

Figure 1: Annual real economic growth from 1947 to 2002
Source: Based on SA data, SA Reserve Bank, various years

step up spending on social programmes to combat inequality. Expected economic objectives could be achieved by economic growth creating employment, and with growth leading to less inequality and poverty through employment creation. Despite the GEAR strategy to promote positive trends, the economy has not achieved higher rates of economic growth as predicted (see Table 1). Income inequality worsened after 1994, because of unabated rising unemployment. Some studies (UNDP, 2003) show the following: despite economic growth and efforts to extend basic services, 48.5% of the population now falls below the poverty line; a highly unequal income distribution exhibited by a deteriorating Gini-coefficient from 0.56 in 1995 to 0.635 in 2001, thus making South Africa the third most unequal society in the world, surpassed only by Brazil and Guatemala; and declining economic and social well-being with the Human Development Index rising from 0.72 in 1990 to 0.73 in 1995, then falling to 0.67 in 2003. Private sector investment (a driving force behind growth) grew by 2.7% instead of the predicted average of 12% (see Table 1).

Despite the above problems, the government has met its key fiscal and monetary targets, and has been successful in reducing the fiscal deficit, inflation, and interest rates. Notwithstanding, economic growth has been less than expected. GDP growth averaged 2.5 between 1996 and 2000 against the predicted average of 4.2% (see Table 1).

Table 1: GEAR's predictions and actual outcomes for key indicators
Source: Naledi (2000)

	Gear predicted av.	*Actual av. 1996 – 2000*
GDP growth (real)	4.2	2.5
Inflation	8.2	6.6
Fiscal deficit	-3.7	-2.9
Employment growth	2.9	-2.0
Private sector investment growth	11.7	2.7

Some studies show that even given the sluggish growth overtime, there has been rapid substitution of unskilled and low-skilled labour by capital equipment in almost all sectors (Bhorat et al., 1998). This is a major source of productivity movements. Increase in capital intensity influences production methods and accounts for an increased demand for energy. On average, then, the economy has become more capital-intensive, because of past incentives to invest in capital-intensive methods of production, and less labour-intensive because of the structure of growth. The economy is more unequal, as exhibited by increasing job losses and increased labour productivity, with jobless growth providing strong evidence that the 'trickle-down' development paradigm is not working, giving rise to the need to equalise opportunities and to improve both efficiency and equity. Because energy is cheap, the economy has also become highly energy-intensive, with more energy used to produce economic output than in most countries in the world.

Energy supply

Coal dominates the energy picture in South Africa, providing approximately 70% of the primary energy. The country has large reserves of low-grade and low-cost extractable coal. Most of the coal is used for electricity generation (coal dominates electricity generation with a share of 92%), and for the production of synthetic liquid fuel with Sasol and PetroSA as major players in the market. Imported crude oil accounts for 20% of primary energy used – mainly by the transport sector. Proven reserves (owned by PetroSA, Energy Africa, and Pioneer) were estimated at 49 million barrels in 2002 with production (from the Oribi / Orys Fields) at 4.6 million barrels (Kenny, 2004). Nuclear, natural gas, renewables including biomass account for the rest of the energy needs. Eskom, a state owned utility enterprise, accounts for over 90% of South Africa's electricity, and it owns and operates the generation and transmission system. Eight municipalities generate the rest of the electricity for their own use.

The high degree of reliance on imported crude oil has serious implications for the economy. An increase in international oil prices reinforces rising interest rates and restricts household consumption expenditure particularly on discretionary goods, and places a constraint on firms hiring new workers because of higher energy costs. While the impact of rising oil prices slows down global economic growth rates, it also has a deleterious effect on exports, a situation worsened by the firming of the country's currency particularly in the last few years.

The positive impact of higher international oil prices should encourage import substitution investments. The coal–based syn-fuel industry can be increased given the significant availability of low-grade coal resources and improvement in technology. A sustained rise in oil prices has potential of creating new opportunities of increasing efficiency in oil supplies, in turn, reducing vulnerabilities due to increasing international prices, thereby strengthening the balance of payments position.

Energy consumption

The industrial sector (industry and mining) accounts for the largest proportion, 45%, of energy consumed (SANEA, 2003). Industries can be assumed to choose energy inputs to minimise the total cost of energy subject to energy-burning appliances. Technologies differ across industries and so is the nature of their energy demand. Energy con-

sumption levels and energy intensity, particularly of electricity, are high compared to all of Africa and of the world average. Large industrial consumers of electricity are gold production, because of declining ore grades and mines therefore going deeper, and non-ferrous metals. Coal is the main energy source for the following industries: iron and steel, chemicals (it is used as feedstock), non-metallic minerals (where coal is mainly burnt in clamp kilns), pulp and paper (which rely heavily on the black liquor to produce most of their energy requirements), food, tobacco, and beverages. Coal-based industries have low energy conversion efficiencies compared with oil, gas and hydro plants (Eberhard & van Horen, 1995).

Since 1994, the government has made 'access of electricity to all' fundamental in its development policy. This is bearing fruit: between 1995 and 2001 rural households with access to electricity increased from 21% to 49%, compared to some 76% to 77% of all urban households (NER, 2001). One of the key objectives of the 1998 White Paper on Energy is to achieve household universal access to electricity, while alleviating the negative environmental impacts. Since access to electricity shows a huge imbalance, the government has embarked upon a non-grid rural electrification programme that will expand the use of climate-friendly renewable energy technologies to meet the needs of the poor and to contribute to the alleviation of energy poverty.

Residential energy demand is complex and is often explained in terms of both the 'transition' and 'ladder' concepts, representing the positions of households and their transition from low-cost high-emission non-commercial forms of energy (for example, wood and coal) to much costlier modern or less polluting commercial fuels like electricity. Household fuel choice is influenced by a wide range of factors such as educational levels, the degree of mobility and the length of time urbanised (Viljoen, 1990), the relative availability (or access) of fuels, income and affordability of energy resources (Eberhard & van Horen (1995), and cultural preferences. The phenomenon of multi-fuel use, however, is widespread, with households selecting fuels for different end-uses, as well as using more than a single fuel for the same end-use.

Relative to other groups, poor rural households have fewer energy options. Primary sources for low-income households are paraffin and candles, and to a lesser extent, liquefied petroleum gas (LPG), and wood fuel. Their consumption of electricity is low, although it is preferred for reasons of convenience, cleanliness and better light quality. The extent of mix of fuels varies and is subject to factors such as households fluctuating incomes, fuel availability and seasonal conditions affecting the labour market.

Investment

Massive investment in coal-fired power plants overtime has led to excess capacity, with licensed capacity exceeding peak demand for at least the last 25 years. Figure 2 shows the degree of excess capacity (in MW) as well as exports and imports (G Wh) between 1996 and 2000. Overinvestment was based on the assumption of rapid and continued electricity demand, and this has left Eskom with a large surplus of generation capacity. With little need for new investment in recent decades, debt has been reduced as most of the capacity has already been paid off.

Growing electricity demand and economic growth imply that more capacity, however, will be needed before long. This, in turn, points to the need to embark on a capacity expansion programme. The medium term capital requirements are large, and may, given the electricity intensive nature of the economy, exert pressure on costs and prices. To guarantee security of supply, the capacity develop-

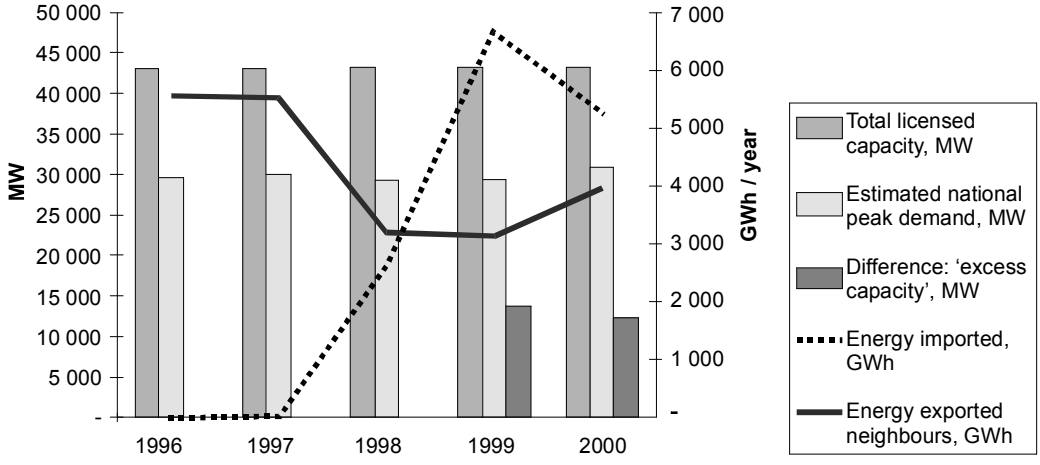

Figure 2: Excess capacity for all power stations 1996-2000
Source: NER (2004)

ment programme should minimise price increases, without threatening the financial viability of the industry.

Electricity tariffs

Eskom sells electricity to distributors who then resell to residential consumers, commerce and industry. The average price, per kilowatt-hour, is among the cheapest in the world. This is attributable to several factors such as:

- Access to large resources of low-grade coal and use of technologies that maximise economies of scale. To add to this, power stations are located near coal mines and enjoy the benefits of long-term contracts.
- Overcapacity from power stations, which are already paid for. This reduces Eskom's finance costs and enables it to peg electricity prices at a low marginal cost.
- Environmental costs are not included in the price of electricity.
- Eskom's investment has been subsidised through the Reserve Bank forward cover thus protecting Eskom against exchange rate fluctuations. Further financial benefits are that Eskom is exempted from taxation and dividends.
- Ultimately, the price of electricity does not reflect economic costs, the long term costs of increasing capacity, and excludes the externality costs.

Undoubtedly, the low tariffs give the local industries competitive advantage and drive much of new investment in industry. For example, the manufacturing and mining sectors are linked through beneficiation and metals production (Spalding-Fecher, 2002). These activities are energy–intensive, and rely on low prices for coal and electricity, which, in turn, have contributed to the development of an energy-intensive primary sector.

Electricity price increases have remained below those of inflation, providing sound reasons for Eskom to allow prices to rise in real terms, so as to earn an acceptable rate of return on capital invested and ensure sufficient generation of dividends and interest. But this raises the problem of affordability by poorer households, especially given the government's commitment to making electricity accessible to all its citizens. Although the price of electricity is low compared to that of other countries, providing a good foundation for economic growth, it has not had a significant impact in promoting poor households' access to affordable electricity services.

Externality costs

Low-income households rely on wood, coal and paraffin as energy sources. These energy sources contribute to high levels of indoor pollution. Of serious concern are particulates, carbon monoxide, respiratory illness (the second highest cause of death after gastro-illness), and fires. These problems persist despite the GEAR strategy that aims to bring low-income households into the modern economy through economic growth. Quantified impacts of the external cost of household fuels reveal that greater damages are from candles, paraffin and the use of wood as fuel (see Table 2).

Table 2: Summary of external costs of households fuels (1999 rands/GJ)
Source: Spalding-Fecher and Matibe (2003)

Energy type	Low	Central	High
Coal	2.37	5.32	9.51
Paraffin[1]	10.31	60.84	151.48
Candles[2]	12.04	93.16	174.68
Wood[3]	10.46	38.20	92.60

Notes

1. Includes paraffin poisoning and 30% of costs of fires and burns.
2. Includes 70% of the costs of fires and burns.
3. Includes indoor air pollution and the social cost of fuel wood scarcity.

South Africa's best quality coal is exported and earns the country its third-largest export revenues after gold and platinum. The use of low quality coal contributes to GHG emissions levels and other environmental problems (such as the ash produced and emitted and the pollution of water sources). Although South Africa has no obligation to reduce its GHG emission level under the Kyoto Protocol, its carbon emissions are higher than those of most developed countries partly because of the energy-intensive sectors (such as mining, iron and steel, aluminium, ferrochrome, and chemicals), which rely heavily on low quality coal. This illustrates a classical conflict in resource use. Just as the exploitation of cheap and low quality coal is seen to fuel growth (accompanied by arguments that this ultimately leads to social upliftment), there are also environmental reasons to minimise the negative effects of this energy use, especially in terms of pollution and climate change.

Spalding-Fecher and Matibe (2003) evaluate potential external costs of coal-fired power generation on health and climate change damages caused by GHG emissions for the South African economy. Findings expressed in Table 3 indicate that the estimated damages resulting from GHG emissions and climate change are significantly higher than those from local air pollution. The negative values are estimated benefits, and are total avoided health costs for 1999 for all low-income households electrified. They relate to health costs of the fuels displaced by electricity use in 1999. The damage costs

Table 3: Summary of external costs of Eskom electricity generation, 1999 (per unit of coal-fired power produced / delivered, c/kWh))
Source: Spalding-Fecher and Matibe (2003)

(1999R m)	Low	Central	High
Air pollution and health	852 (0.5/0.5)	1 177 (0.7/0.7)	1 450 (0.9/0.8)
Electrification	-173 (-0.1/-0.1)	-958 (-0.6/-0.5)	-2 324 (-1.4/-1.3)
Climate change	1 625 (1.0/0.9)	7 043 (4.3/4.1)	16 258 (9.8/9.4)

from GHG emissions range from R1.6 to R16.3 billion, and that the global warming externality of coal based electricity production may be in the order of R0.01 and R0.095, with the total global damage per tonne of coal ranging from R18 to R186. These estimates are not plant specific because of lack of data. Furthermore, the estimates do not include coal-fired power stations owned by municipalities. If these are taken into account, the impact on human health will be greater given that the power stations are older, are used during peak periods, have lower stack heights and are in major urban areas.

Critical issues relating to energy for sustainable development

In Table 4 (overleaf) we summarise key issues for energy development spelt out in the 1998 White Paper on Energy, categorising them by a sustainable development dimension and showing the progress made, and then discussing these issues in no particular order. The objectives show a clear shift from a pre-1994 policy dominated by the need to secure energy supplies (a period dominated by international boycotts and oil sanctions), to post-1994 policies that strive for social equity and economic efficiency within the context of sustainable development.

Crucial issues for sustainability stand out as follows:

- The one key issue that seems missing here is value added. This relates to the structure of the economy. Growth in economic output, measured by GDP, is a necessary but not sufficient condition for improvements in the welfare of South Africans. The more the economy is structured towards value-added sectors, rather than exporting raw materials, the greater the local benefits. Clearly this involves changes that go far beyond the energy sector, but there are important implications for energy. One example is whether the country attracts facilities like aluminium smelters, which process raw material for export at Coega, or goes a step further in manufacturing products from aluminium. Another case is building up local manufacturing capacity in the energy sector, and is only a small part of this.
- Increasing access to affordable energy services. Residential energy use is characterised by poor access and inefficient and hazardous energy sources. The electrification programme is central to the development of the country, and is increasing the number of people connected to the national grid. Estimates show that households with grid electricity increased from 50% in 1995 to 66% in 2001, and the number of people using electricity (including non-grid electricity) increased from 58% in 1996 to 70% in 2001 (SANEA, 2003). The main problems are that poorer households cannot afford enough electricity to render connection economic, and cannot afford to pay for electrical appliances. Davidson et al. (2003) argue that the existing system of electricity financing and implementation, while successful in meeting RDP targets, is not sustainable. Lack of access make fighting poverty and promoting greater inclusivity in growth difficult as it hampers individual efforts to advance social and economic development goals.
- Electricity access will not necessarily result in development. Access programmes must fit into a broader rural development strategy that enables the rural poor to be productive with their time and efforts and contribute to local economic development, growth and poverty alleviation.
- The economy exhibits high carbon-intensity due to the energy-intensive economy and heavy use of coal. Plentiful supplies of inexpensive coal have supported the development of large-scale coal-fired power stations. Emissions per unit of economic output are high because the specific energy efficiencies of many sectors are lower than average, making emissions control a viable option.
- Energy efficiency standards are generally lacking. Even given benefits of energy efficiency, most of the standards have not been implemented because of low-cost energy supply in coal, lack of public awareness, the unaffordability of appliances, and the inadequate long-term policies and absence of codes and standards.
- Energy pricing, particularly electricity pricing, deserves more attention. Electricity is generated from coal of low quality, and its price does not account for the environmental externality of this resource. The full cost of producing electricity is higher than that borne by Eskom, and the exter-

Table 4: Sustainable energy development priorities and progress

Sustainable development dimension	*Energy objectives (White Paper on Energy 1998)*	*Priorities (DACS Foresight, Energy 1999)*	*Progress (Spalding-Fecher 2002)*
Economic	Secure supply through diversity	Develop Southern African Power Pool	SAPP regional co-ordination centre established
		Develop gas markets	Mozambique gas to Sasol and Namibia under discussion
		Stimulate use of new and renewable energy sources	Renewable Energy White Paper in 2002
		Stimulate energy research	Declining research fund
Social	Increase access to affordable energy	Electrification policy and implementation	Initiate second phase of electrification programme, including renewables
		Addressing off-grid electrification	Initiate pilots of free electricity
		Facilitate management of woodlands for rural households	No progress
		Establishing thermal housing guidelines	Voluntary guidelines only
Environmental	Managing energy related environmental impacts	Improve residential air quality	Proposal of ambient air quality standards under debate
		Monitor reduction of candle/paraffin resulting from electrification	Hazards still significant
		Introduce safely standards for paraffin stoves	Under discussion
		Develop policy on nuclear waste management	Under discussion
		Investigate environmental levy	Not investigated
Interlinkages	Improve energy governance	Promulgate electricity regulatory bill	No petroleum regulator, petroleum Products and Pipelines Bills in 2002
		Manage deregulation of oil industry	Nuclear regulator established
		Implement new regulation of nuclear	Eskom conversion bill passed
		Restructuring of state assets	PetroSA formed
		Establish information systems and research strategy	iGas formed
			Limited activity

nal costs are borne by society. However, low prices benefit the poor, give South Africa a comparative advantage, are an incentive for energy-intensive mainly exports oriented industries, and provide a subsidy to foreign markets. But the low price of coal has not promoted incentives for investments in both energy efficient technologies and renewable energy.

- Another major contributor to air pollution is the country's four refineries. These contribute to high levels of pollution and emit high levels of sulphur dioxide and other harmful chemicals that cause health problems. There are no legally binding air pollution regulations, but only non-binding guidelines with no enforcement authority.
- Energy governance should be improved by clarifying the roles of various government institutions, and making them accountable, transparent, and representative of the population – par-

ticularly of the previously disadvantaged groups. Economic and social losses from poor energy sector governance manifest themselves in/through: misdirection of growth (through subsidies) and losses of growth; continued economic, social and gender inequalities; negative environmental impacts and high direct consumption subsidies.

- Good governance also entails designing policy and making institutional changes to free both the internal and external markets for goods, services and capital. Useful instruments include tariff reduction and removal of exchange controls.
- Maintaining security of supply through diversity. There is still a challenge for an integrated planning for future supply options. While coal remains an important energy source, the following activities also deserve serious consideration: introducing other primary energy carriers; encouraging research and development partnerships; and facilitating regional co-operation on energy.
- Managing the energy-related environmental and health effects by promoting access to cleaner energy so as to minimise the negative health effects arising from the use of certain types of fuels.
- Macroeconomic stability is a prerequisite for sustainable growth. Sustainable development cannot be expected when the economy is exposed to macroeconomic shocks stemming from energy price increases and supply disruptions. Fortunately, this has not happened to South Africa. While it may be argued that subsidies promote economic activity in rural areas, subsidies are often poorly targeted and usually benefit a small segment of the population.

Energy outlook

The government is expected to continue to pursue the critical issues in the previous section, and to address the issue of externality associated with the energy supply and use. As the economy develops, energy supply and use should not only be sustainable but should also improve the quality of life of South African citizens. With increasing commercialisation and competitiveness, more attention has to be given to internalising the adverse impacts of energy usage as well as how energy can better serve development, continue to promote growth through exports and investments, and create jobs.

Energy demand issues

The Energy White Paper (1998) commits the government to improving the plight of the low income and rural population by addressing issues of inadequate energy services and less convenient and less healthy fuels. Success of this drive will depend on the responses such as pricing and financing on affordability, appropriate appliance/fuel combinations, and availability of efficient appliances. Potential benefits can, for example, be illustrated by the retrofit housing project in Kuyasa, Cape Town. This project entails installation of solar water heaters, ceiling and ceiling insulation, and compact fluorescent light bulbs in existing RDP houses. Expected benefits are in terms of reduction in CO_2 emissions, contributing towards health and energy cost benefits and savings in the cost of energy services of approximately R685 and R626, respectively, per household per annum. Building of thermally efficient low-cost housing can therefore be expected to promote energy efficiency and conservation.

Greater energy efficiency will also yield potential financial and environmental benefits to industry, commerce and mining sectors, with industry becoming more internationally competitive. Although cheap energy results in foreign exchange earnings, the harmful environmental and health factors are not included in energy pricing, thereby raising the need to balance energy pricing with sustainable environmental standards. South Africa's relatively high energy intensity has negative effects on the environment because of the combustion of more coal and the greenhouse gases burden. SANEA (2003) estimates that greater energy efficiency could save between 10 and 20% of current consumption. This, in turn, would lead to an increase of between 1.5 and 3% in the GDP. But to achieve this, a solution has to be sought to critical barriers in the uptake of such technologies such as inappropriate economic signals, lack of awareness, and the high capital costs.

Restructuring and energy diversification

Restructuring has long been expected in the Electricity Distribution Industry (EDI) given its fragmented nature and lack of viability, and the Electricity Supply Industry (ESI) into separate generation and transmission companies. Expected policy goals are to promote universal household access to electricity, allow for greater private participation and to move the industry towards competitive electricity. The Coal industry, on the other hand, will remain deregulated, with coal remaining a dominant energy source and least expensive option in the planning horizon. Pursuing clean coal technologies thus become important. The restructuring of electricity generation is likely to result in some of Eskom's power stations being sold, as well as in allowing independent power producers to enter the generation market. Merits of this policy action are in reducing the financial burden of Eskom, providing opportunities to secure private capital for capacity expansion, promoting opportunities for black economic empowerment, introducing choice of supply, and widening access to the poor.

Regardless of coal's dominance, it is also important to diversify energy resources to other energy forms such as natural gas and renewable energies. This will be in line with the policy objectives of improving energy security, flexibility of supply, and environmental performance. Power stations in future will depend on the following energy sources: coal, nuclear, gas and hydro-power. Nuclear energy as a viable future source of electricity generation depends much on the environmental and economic merits of other energy sources, and is likely to come from the next generation of simpler and safer reactors. The main concern with gas is its price, given the limited reserves in the country. Importation of gas from other countries is therefore a strong possibility. South Africa's limited potential for hydropower implies that there will be some reliance on the imported hydropower. Liquid fuels are to be met with a minimum government intervention and regulation, with emphasis on environmental and safety standards, and investment and promotion of black economic empowerment.

Realising potential benefits of energy efficiency

Low energy costs have not induced industry and households to adopt energy efficiency measures, and the growing GHG emissions are a source of growing concern and promoting energy efficiency standards. Demand-side management can be used to limit residential demand growth or mitigate the impacts through the provision of incentives for industry and commerce to move load out of the peak periods. Benefits of this include avoiding high price increases through the deferment or avoidance of certain generation capacity construction.

The residential electrification programme, with a final target of five million additional connections by 2007, raises various issues of public policy interest. Electrification connection of poor households (where coal, wood, paraffin and liquid petroleum gas were the primary household energy sources), promotes the use of clean, versatile and convenient form of energy that connects them to the modern economy. This raises the proportion of energy sales, leading to a rise in peak demand, with the residential sector contributing more than 30% because of the peaky nature of the load (Africa, 2003), and implies that Eskom has to construct a new plant to meet this load type. For the residential sector, necessary interventions to defer building a new plant and to achieve energy efficiency include energy efficiency lighting, thermal insulation, energy management and energy saving appliances.

There is substantial scope for energy savings for the commercial and industrial sectors. For the commercial sector, the opportunity is through better design of buildings and improved management of energy use. A relatively high potential for energy savings exists in the industrial sector, with focal areas being as follows: energy management and good housekeeping, providing incentives to adopt specific technologies, conducting energy assessments to identify areas for energy savings, and implementation or adoption of standards for electrical equipment. The main challenge rests with the adoption and promotion of economically efficient energy measures. This, in turn, would guarantee achievement of market transformation and demand side management sustainability.

Challenges

Challenges facing the energy sector and crucial to economic development are as follows:

- Dealing with the problem of negative externalities associated with energy production and consumption. South Africa relies on low-grade coals for generating electricity, and the poor communities depend on inefficient sources of energy. Use of low quality coals is the main contributor of GHG emission. The energy-intensive sectors of the economy emit carbon emissions that are higher than those of most developed economies. Eskom is thus vulnerable to impacts of international response measures that may be taken to reduce GHG emissions (Davidson et al., 2002), for which South Africa has no commitments. The biggest problem is that poor communities use inefficient energy sources that contribute to high levels of indoor air pollution with negative health effects.
- Adoption and promotion of energy efficient measures. While such measures are being pursued in the residential sector, there is also high potential for energy savings in the industrial and commercial sectors.
- Achieving social equity and economic efficiency, within the context of sustainable development within the energy sector. The White Paper on Energy (1998) focuses on the security of supply through diversity, increasing access to affordable energy, managing the energy related environmental impacts and improving energy governance.
- Choosing appropriate policy instruments to minimise the negative impact of externalities. Such an instrument should incentivise carbon intensity reduction, encourage investment in energy saving measures and generate revenue for the economy. A most effective way is to encourage adoption of improved technologies, which may be much more efficient and more economically accessible that technology switching, and to improve society's well-being.
- Government commitment to privatisation as a key instrument in the economic reform process. Privatisation makes a bold statement about its commitment to open market-driven economy,

with potential benefits, at least, at a macroeconomic level and accruing to consumers. If successful, privatisation leads to higher growth rates, attracts foreign investment, leads to increased competition and a better allocation of economic resources. Expected benefits to consumers include a higher return on investment, a greater distribution of wealth, and wider energy choice at a lower cost. Government commitment should be accompanied by the strengthening of basic institutions of a market economy.

- Electricity is currently a non-tradable good, while coal can be exported directly. Volatile exchange rates make planning in the energy sector a real challenge.

While linkages between these challenges may seem clear, all endeavouring to contribute to economic development and to improve society's well-being, there are sharp conflicts over the understanding of sustainable development and its implications for policy making. If, for example, economic efficiency is the prime objective, then energy subsidisation to help poverty alleviation will receive limited attention. This, on the other hand, limits the role of energy as an essential precursor to both social and economic development and redress challenges, especially given the social and economic inequities that exist. It is reasonable that ' trade-offs' should take into account the need to improve social equity by addressing the energy requirements of the poor; and promoting both efficiency and competitiveness of the economy by providing low-cost and high quality energy inputs (Eberhard & van Horne, 1995). Obviously, the economy will not be able to develop without the abundant, easily mined and low-cost coal. When we include the environmental equation, then, apart from addressing short-term environmental problems, there has to be serious planning for a long-term transition towards renewable energy sources that have less negative externalities.

We are not aware of any comprehensive policy position on environmental taxes in South Africa. Data limitation, on the other hand, poses a serious problem for assessment of instruments. Lack of meaningful data limits effective decision-making on the location of subsidies, the number of qualifying households, and assessing the cost and impact of the subsidies to the economy. Furthermore, there is no established network for the delivery of information on the consequences of industrial pollution and available technological options, nor are there awareness programmes for industrial managers on the consequences of pollution.

Acknowledgement

This paper was originally written for the UNDESA Phase 1 final report, REC, 2003.

References

Africa, A. 2003. Demand side management in South Africa. Electricity Supply Industry. Issue 1, pages 44 – 46.

Bhorat, H. Dieden, S. & Hodge, J. 1998. The impact of structural and production method changes on employment growth of occupational groups in South Africa. Document produced for the Human Science Research Council, South Africa.

Chriteinsen, G. & Haveman, R. 1981. Public regulations and the slowdown in productivity growth. American Economic Review, 71. Pages 41 –16.

DACS (Department of Arts, Culture, Science and Technology). The National Research and Technology Foresight Project. Pretoria: DACST1999.

Davidson, O. Tyani, L. & Afrane-Okese, Y. 2002. Climate change, sustainable development and energy: Future Perspectives for South Africa. OECD.

Dreze, J and Sen, A. 1989. Hunger and public action. Oxford, UK: Claredon Press.

Eberhard, A. & van Horen, C. 1995. Poverty and power. London: Pluto Press.

Friedman, M. 1995. Getting back to real growth. Wall Street Journal, A 14, August 1.

Guasch, J.L. & Hahn, R.W. 1997. The costs and benefits of regulation: Some implications for developing countries. Background paper for the World Bank, World Development Report.

IEA (International Energy Agency) 2002. Energy balances for non-OECD countries. Paris, IEA.

IEA (International Energy Agency) 2002. World Energy Outlook: Energy and Poverty. Paris, IEA.

Kenny, A. 2004 'Energy Supply in South Africa' in Energy for sustainable development: South African profile. Energy Research Centre, University of Cape Town.

Koedijk, K. & Kremers, J. 1996. Market opening, regulation and growth in Europe. Economic Policy: A European Forum. (23). Pages 445 – 467.

Naledi. 2001. Highlights of current labour market conditions in South Africa. Paper submitted to Global Policy Network.

NER (National Electricity Regulator) 2001. Lighting up South Africa 2001. Pretoria, NER.

NER (National Electricity Regulator) 2004. Electricity supply statistics for South Africa 2004. Pretoria, NER.

SANEA 2003. South African Energy Profile 2003. Melville, South Africa.

Sen, A. 1984. Poverty and famines: An essay on entitlements and deprivation. Oxford University Press.

Spalding-Fecher, R. 2002. Energy sustainability indicators for South Africa. Energy and Development Research Centre, University of Cape Town.

Spalding-Fecher, R. & Matibe, D. 2003. Electricity and

externalities in South Africa. Energy policy 31. Pages 721 – 734.

UNDP (United Nations Development Programme) 2003. South Africa Human Development Report 2003. Oxford University Press.

Van Horen, C. 1996. Counting the social costs: Electricity and externalities in South Africa. Cape Town: Elan.

Viljoen, R. P. 1990. Energy use in low income dwellings in the winter rainfall area. Energy Research Institute.

Wolfensohn, J.D. & Bourguignon, F. 2004. Development and poverty reduction: Looking back, looking ahead. The World Bank.

Received 10 August 2004; revised 28 April 2005