Energy Efficiency Strategy of the Republic of South Africa

Department of Minerals and Energy

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Foreword

In South Africa we take energy for granted, with the consequence that our energy consumption is higher than it should be. Indeed, our country's economy is largely based on minerals extraction and processing which is by its nature very energy-intensive. Whilst our historically low electricity price has contributed towards a competitive position, it has also meant that there has been little incentive to save electricity.

So in many respects we start with a clean slate with little energy efficiency measures having taken place, apart from many years of work by universities and other research institutions that have pointed the way. *The White Paper on Energy Policy* (1998) recognized that standards and appliance labeling should be the first measures to put in place in implementing energy efficiency. Indeed such prescriptive-type measures provide the framework on which any energy efficiency strategy is based. At the same time consumers of energy also need to perceive the cost-benefits they can derive from energy efficiency measures and it is here that demonstrations are essential. In South Africa Government is taking the lead by using Public Buildings as an example. Cabinet has approved the implementation of a programme of energy efficient measures in National Government Buildings which is currently underway and which will be extended to provincial and local government. The Commercial Building Sector is an area for potential improvement given the rapid increase in office construction.

The Industrial and Mining Sectors are the heaviest users of energy, accounting for more than two-thirds of our national electricity usage. Here lies the potential for the largest savings by replacing old technologies with new, and by employing best energy management practices. The Transport Sector uses three-quarters of South Africa's petroleum products, making it an obvious place to implement measures to improve efficiency. Promotion of energy efficient vehicles and those with lower emissions, building a public transport infrastructure and a travel demand management system are some of the key features of the approach adopted. The Residential Sector has great potential for energy savings given the National Housing Programme, since building design is the major factor determining the energy use of a household. An electrical appliance labeling initiative has recently been launched whereby the energy consumption of all new "white products" will be rated for efficiency.

Perhaps the most neglected area for implementation is the promotion of public awareness about the costs and benefits of energy efficiency. Major energy savings can only be achieved through changes in people's behaviour, and *that* depends on informing them about what options exist. The World Summit on Sustainable Development (2002) sensitised the nation about the impact that energy use has on the World's weather systems. In this era of climate change South Africa needs to take more urgent measures to reduce energy usage than in the past. It is hoped that this Energy Efficiency Strategy will provide a blueprint for this venture.

PHUMZILE MLAMBO-NGCUKA
Minister of Minerals and Energy

Executive Summary

This is the first Energy Efficiency Strategy for South Africa. It is the first consolidated Governmental document geared towards the development and implementation of energy efficiency practices in this country. The Strategy takes its mandate from the *White Paper on Energy Policy*, published in 1998, and links energy sector development with national socio-economic development plans as well as being in line with other Government departmental initiatives. In addition, it provides clear and practical guidelines for the implementation of efficient practices within our economy, including the setting of governance structures for activity development, promotion and coordination.

This Strategy allows for the immediate implementation of low-cost and no-cost interventions, as well as those higher-cost measures with short payback periods. These will be followed by medium-term and longer-term investment opportunities in energy efficiency. The Strategy acknowledges that there exists significant potential for energy efficiency improvements across all sectors of our national economy.

The vision of the Strategy is to contribute towards affordable energy for all, and to minimise the negative effects of energy usage upon human health and the environment. This will be achieved by encouraging sustainable energy development and energy use through efficient practices. The three cornerstones of sustainable development are embraced within the strategic goals of this document, these being environmental, social and economic sustainability.

The Strategy sets a national target for energy efficiency improvement of 12% by 2015. This target is expressed in relation to the forecast national energy demand at that time, and therefore allows for current expectations of economic growth. It is accepted that this target will be challenging, but at the same time it is considered to be readily achievable through the means described within the following pages.

Energy efficiency improvements will be achieved largely via enabling instruments and interventions. These will include *inter alia* economic and legislative means, efficiency labels and performance standards, energy management activities and energy audits, as well as the promotion of efficient practices.

The Strategy will cover all energy-using sectors and will be implemented through Sectoral Implementation Plans as outlined within. Systems will be put into place in order to periodically monitor progress against the target that will be reviewed at the end of each phase.

Definitions and Terminology

Appliance Labeling	Labels denoting energy consumption of appliances
CaBEERE	Capacity Building in Energy Efficiency and Renewable Energy Project
CDM	Clean Development Mechanism
CFL	Compact Fluorescent Lamp
CO_2	Carbon Dioxide
CSIR	Council for Scientific & Industrial Research
CV	Calorific Value
DME	Department of Minerals and Energy
DNA	Designated National Authority
DoH	Department of Housing
DTI	Department of Trade and Industry
DSM	Demand Side Management
EE	Energy Efficiency
Energy Intensity	Energy use per unit of output or activity
ESCO	Energy Service Company
GW	Gigawatt (10^9 Watts) unit of electric power
HVAC	Heating, Ventilation and Air Conditioning
IEP	Integrated Energy Plan
LTA	Local Transport Authority
NDoT	National Department of Transport
SANERI	South African National Energy Research Institute
NER	National Electricity Regulator
NO_x	Oxides of Nitrogen
NT	National Treasury
PJ	Petajoule (10^{15} Joules) unit of energy
RDP	Reconstruction and Development Programme
REDs	Regional Electricity Distributors
SABS	South African Bureau of Standards
SARS	South African Revenue Service
SO_2	Sulphur Dioxide
STANSA	Standards South Africa
VSD	Variable Speed Drive

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1. Introduction

1.1 Why do we need an Energy Efficiency Strategy?

Worldwide, nations are beginning to face up to the challenge of sustainable energy – in other words to alter the way that energy is utilised so that social, environmental and economic aims of sustainable development are supported.

South Africa is a developing nation with significant heavy industry, which is by its nature energy intensive. This energy intensive economy largely relies on indigenous coal reserves for its driving force. At first sight there would appear to be an apparent paradox between using less energy and developing a healthy and prosperous nation based on energy intensive activities. This is not the case. In recent years energy efficiency has significantly gained in stature and has become recognised as one of the most cost-effective ways of meeting the demands of sustainable development.

The benefits of energy efficiency upon the environment are self-evident. These benefits are of particular relevance, as South Africa remains one of the highest emitters of the Greenhouse gas CO_2 per capita in the world. At a local level the problems of SO_2 and smoke emissions have been the focus of concern for many communities living adjacent to heavily industrialised areas. Energy efficiency can address both the macroscopic and microscopic aspects of atmospheric pollution.

The economic benefits of improving energy efficiency have been well documented since the first Oil Crisis in the early 1970's. Many forward-thinking industrial and commercial concerns have already adopted energy efficiency as a key policy towards maximising profits. The national electricity utility, Eskom, has itself embarked upon a Demand Side Management programme to help reduce the requirements for investment in new power generation capacity.

Such positive contributions to both our physical and economic environments will inevitably benefit our social well-being also; the alleviation of fuel poverty, job creation, improvements to human health, better working conditions - the list goes on. All of these factors will significantly contribute towards the aims of sustainable social development.

It is for these reasons that South Africa needs an Energy Efficiency Strategy.

1.2 The Status Quo

The existing energy policy of South Africa is captured within the *White Paper on Energy Policy* (1998). The policy aims to provide the nation with wider access to energy services, by various means, whilst ensuring that the environmental impacts of energy conversion and use are minimised as far as possible. This is of relevance to Africa as a whole, as South Africa uses some 40% of the total electricity consumed within the continent.

South Africa is endowed with rich deposits of minerals and fossil fuel in the form of coal. It is no surprise, therefore, that the economic development of our country has historically been focused upon the extraction and processing of these resources. This has led to the development of a national economy heavily dependent upon energy as its driving-force, and has resulted in the core of our industries being those concerned with energy-intensive activities, such as iron and steel production and other raw materials processing. Furthermore, coal has inevitably emerged as the major source of primary energy to meet the demands of industry and the country as a whole. In 2000 the total primary energy supply to the nation was nearly 4,300 Petajoules, of which 79% was attributable to coal.

Our abundant coal reserves have partially contributed towards an economic environment wherein the unit price of electricity is amongst the cheapest in the world. One of the undesirable side effects of this has been that energy efficiency has been demoted to make way for "priority" considerations, such as plant expansions and increases in production throughput. Indeed, by international standards the South African economy uses a relatively high amount of energy per unit of national economic output, or GDP (8,1 PJ per billion US$ in 2000).

In recent years the issue of energy efficiency has attracted more interest in South Africa, and a number of initiatives and projects have proven the merits of enhanced energy performance. The 2002 World Summit on Sustainable Development, held in Johannesburg, recognised energy efficiency as a key tool to enhance clean energy development and to mitigate the negative effects of energy use upon the environment. A further development is Eskom's Demand Side Management programme, which is aimed at reducing the national peak power demand, thereby deferring the immediate need for additional power generation capacity.

In short, energy efficiency is fast gaining ground as a cost-effective means to approach all aspects of sustainability. It is generally accepted that South Africa holds numerous opportunities for energy savings, together with pollution mitigation measures of international significance. This Strategy offers a consolidated approach in order to capture these opportunities in the best interests of our nation.

1.3 The Strategic Process

The White Paper on Energy Policy, published in 1998 states:

> *"Significant potential exists for energy efficiency improvements in South Africa. In developing policies to achieve greater efficiency of energy use, government is mindful of the need to overcome shortcomings in energy markets. Government would create energy efficiency consciousness and would encourage energy efficiency in commerce and industry, will establish energy efficiency norms and standards for commercial buildings and industrial equipment and voluntary guidelines for the thermal performance of housing. A domestic appliance-labeling program will be introduced and publicity campaigns will be undertaken to ensure that appliance purchasers are aware of the purpose of the labels. Targets for industrial and commercial energy efficiency improvements will be set and monitored."*

It also states that:

> *"Vehicle purchasers do not generally consider the vehicle's fuel consumption as a major criterion. This is due in part to a lack of accurate information on vehicle fuel efficiency. The Department of Minerals and Energy will provide information on the fuel use characteristics of new vehicles. Energy consumption information should be included in all advertising, vehicle test reports and vehicle specifications."*

The *White Paper gives* a mandate to the DME to promote Energy Efficiency through various means. Although Government's present capacity to undertake energy efficiency programmes is limited, the DME will finalise and consolidate considerations to ensure appropriate leadership in the sector.

The Strategy sets a national target for energy savings, of at least 12%, to be achieved by 2015. This target is expressed in relation to the forecast national energy demand at that time, based on the 'business as usual' baseline scenario for South Africa modelled as part of the National Integrated Energy Plan (2003), which uses energy consumption data for

the year 2000. The target also assumes that the Energy Efficiency interventions outlined in this Strategy are undertaken; these measures being primarily focussed on low cost interventions that can be achieved with minimal investments.

Assuming the target is achieved in 2015 the following estimates give a very high level indication of the possible monetary savings that could be achieved by implementing the strategy.

Potential Monetary Savings achievable by implementing the Strategy

ELECTRICITY TARGET 12% BY 2015

Saving in Peta Joules	Million kWh	Average cost	Total
29	8.055555556	0.2	R1,611,111.11
45	12.5	0.2	R2,500,000.00
63	17.5	0.3	R5,250,000.00
81	22.5	0.3	R6,750,000.00
101	28.05555556	0.4	R11,222,222.22
Total for 5 years			**R27,333,333.33**

PETROL TARGET 9% BY 2015

Saving in Peta Joules	k litres	Cost per litre	Total
6	184352.9679	R4.00	R737,411,871.73
7	215078.4626	R4.50	R967,853,081.65
8	245803.9572	R4.70	R1,155,278,599.04
9	276529.4519	R4.90	R1,354,994,314.31
10	307254.9466	R5.00	R1,536,274,732.77
Total for 5 years			**R5,751,812,599.50**

In cost-benefit terms the best measurement stick is the payback period. In Phases 1 and 2 the majority of interventions will involve no cost or low cost. This means that the South African economy will make low cost gains in efficiency. In the case of low cost measures the payback period will be less than 3 years during which period the investment in equipment will be off-set by the savings.

In excess of 50% of all EE measures fall within these no-cost/low-cost categories. The DME will monitor the realised cost benefits as part of the strategy implementation.

Energy efficiency improvements will be achieved through enabling instruments and interventions including economic and legislative means, information activities, energy labels, energy performance standards, energy audits, energy management and the promotion of efficient technologies.

The Strategy will cover all economic sectors, and be implemented through Sector Programmes. Systems will be put in place to monitor and evaluate progress in energy efficiency improvements and a periodic strategic review of the implementation will be undertaken.

Various public events will be organised in order to raise the profile of energy efficiency in the minds of the key stakeholders and the public at large.

2. Vision and Goals

Vision

To encourage sustainable energy sector development and energy use through efficient practices

thereby

Minimising the undesirable impacts of energy usage upon health and the environment,

and

Contributing towards secure and affordable energy for all.

Goals

The Strategy's eight goals are outlined below. The order in which the goals appear does not relate to any particular priority, although they are grouped in terms of social, environmental and economic sustainability.

Social Sustainability

Goal 1: Improve the health of the nation

- Energy efficiency reduces the atmospheric emission of harmful substances such as oxides of Sulphur, oxides of Nitrogen, and smoke. Such substances are known to have an adverse effect on health and are frequently a primary cause of common respiratory ailments.

Goal 2: Job creation

- Studies show that jobs will be created by the spin-off effects of energy efficiency implementation. Improvements in commercial economic performance, and uplifting the energy efficiency sector itself, will inevitably lead to nationwide employment opportunities.

Goal 3: Alleviate energy poverty

- Energy efficient homes not only improve occupant health and wellbeing, but also enable the adequate provision of energy services to the community at an affordable cost.

Environmental Sustainability

Goal 4: Reduce environmental pollution

- Energy efficiency will reduce the local environmental impacts of its production and use. These impacts include the atmospheric emission of harmful and odorous gases.

Goal 5: Reduce CO_2 emissions

- Energy efficiency is one of the most cost-effective methods of reducing Greenhouse Gas emissions, and thereby combating Climate Change. Addressing Climate Change opens the door to utilising novel financing mechanisms, such as the CDM, to reduce CO_2 emissions.

Economic Sustainability

Goal 6: Improve industrial competitiveness

- It has been demonstrated that one of the most cost-effective ways of maximizing commercial profitability is the adoption of appropriate energy efficiency measures. Nationwide, this will improve South Africa's export performance and improve the value that her economy derives from indigenous energy resources.

Goal 7: Enhance Energy Security

- Energy conservation will reduce the necessary volume of imported primary energy sources, crude oil in particular. This will enhance the robustness of South Africa's energy security and will increase the country's resilience against external energy supply disruptions and price fluctuations.

Goal 8: Reduce the necessity for additional power generation capacity

- It is estimated that the country's existing power generation capacity will be insufficient to meet the rising national maximum demand by 2007-2012. Energy efficiency is integral to Eskom's Demand Side Management programme, which is intended to reduce the level of load growth by a cumulative value of 4255 MW by 2025, equivalent to a saving of a six unit coal-fired power station. Efforts will be made to give Eskom responsibility for meeting a portion of the target set out in this strategy through its annual shareholder compact.

3. Targets

3.1 Baseline Statistics

The energy usage data illustrated in this section has been taken from the *Digest of South African Energy Statistics, 2000* published by the Department of Minerals and Energy. Data concerning energy intensity has been taken from the International Energy Agency's study *Energy Balances of OECD countries, published in 2002.*

Primary Energy Supply

The total *primary* energy supply to South Africa increased from 3,924PJ in 1993 to 4,295PJ in 2000, an increase of 9.5%. In 2000 coal contributed 79% of the total national primary energy supply, as illustrated in Figure 1, below.

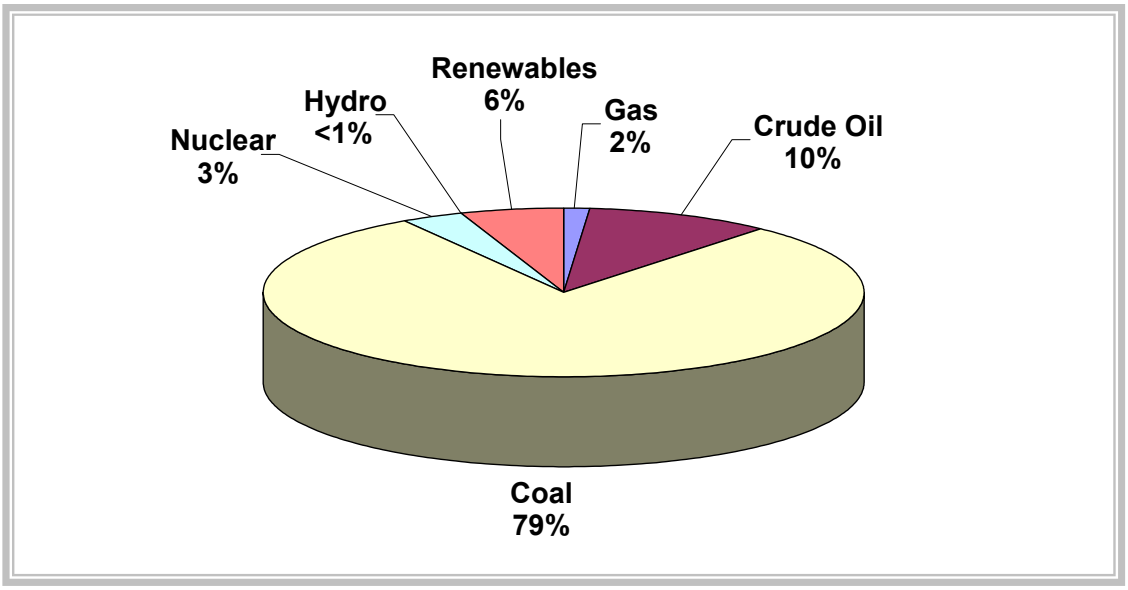


Figure 1. 2000 Primary Energy Supply

Sectoral Usage

The final *end-user* energy usage in 2000 was 2,193PJ. The three largest energy-consuming sectors were industry, residential and transport. The remaining sectors accounted for less than 10% of final energy demand in 2000. Figure 2 depicts the sectoral split of final energy use, and excludes "non-energy use" carriers, such as solvents and lubricants.

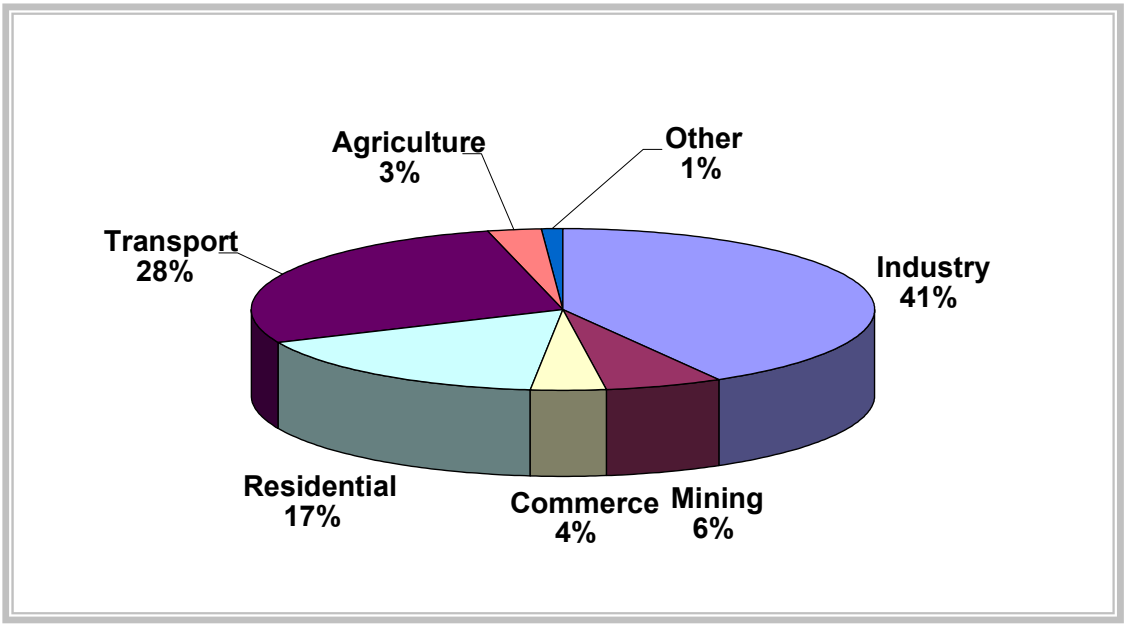


Figure 2. 2000 Final Energy Use by Sector

Figure 3, below, also refers to 2000 and illustrates the split of final energy use by each individual energy carrier. It is of significance to the national Balance of Payments that the largest of these, in energy content terms, is petroleum products. Crude oil is South Africa's single largest import, and the vast majority of the downstream products are utilised by the Transport Sector.

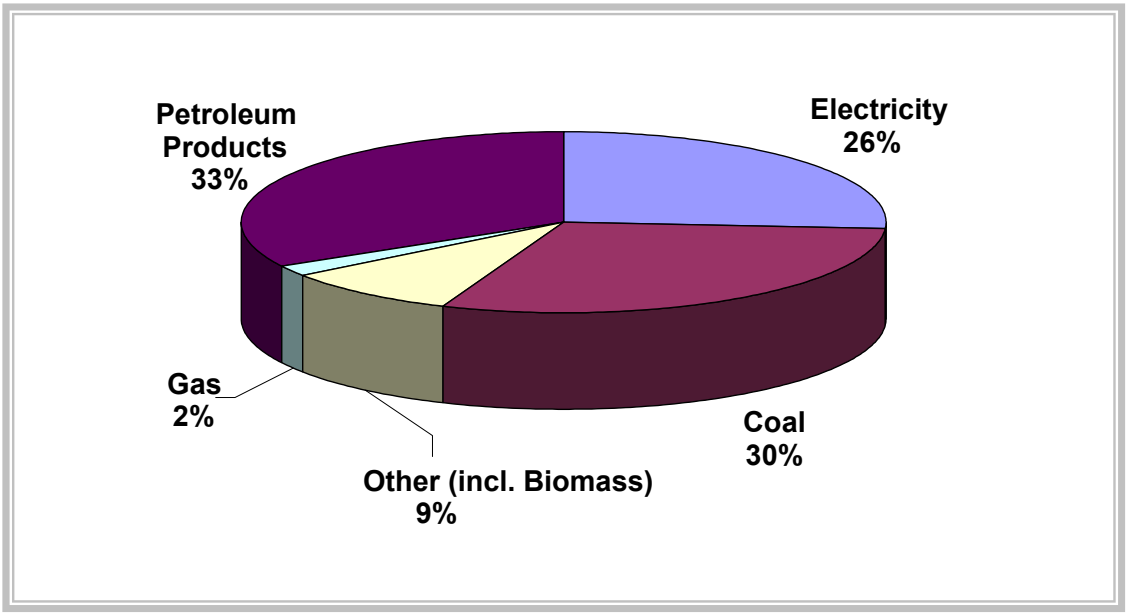


Figure 3. 2000 Final Energy Use by Carrier

Energy Intensity

Compared with developed countries, the South African economy uses a lot of energy for every Rand of value added. In 2001 South Africa had the 26th biggest GDP in the world but was the world's 16th largest consumer of energy. There are two reasons for this. The first is the nature of the activities, which dominate the economy. Mining, minerals processing, metal smelting and synfuel production are inherently intensive users of energy. South African gold mines are very deep with low ore concentrations, so it necessarily requires much energy per ounce of gold. The process used by Sasol to convert coal into liquid fuels is such that only about a third of the energy in the coal ends up in the liquid fuel. Even though South Africa's aluminium smelters are among the most efficient in the world, they still require large amounts of electricity to produce one ton of aluminium.

This will change as South Africa moves into high value manufacturing and service industries, which is already happening. It will also change with changes to processes, for example, when Sasol swaps from coal to natural gas as a feedstock for chemical production at Sasolburg, making production more efficient. However, it must be noted that the low prices of electricity gives South Africa a comparative advantage in high energy intensive industries such as aluminium smelting. If the aluminium could be beneficiated into products of higher value, South Africa would gain even more.

The second reason for the high energy intensity is that South Africa is sometimes wasteful in the use of energy. Low energy costs have not encouraged industry, commerce, transport and households to adopt energy efficiency measures. There is a lack of awareness of energy efficiency. However, with the prospects of higher energy prices in future and with growing environmental awareness, especially about the emission of greenhouse gases, there is a growing concern in South Africa to promote energy efficiency.

The figure below gives an indication of the energy consumption in Petajoules per capita of some selected developed and developing countries. It is clear that South Africa is closer to the developed countries in terms of energy intensity than to the developing countries.

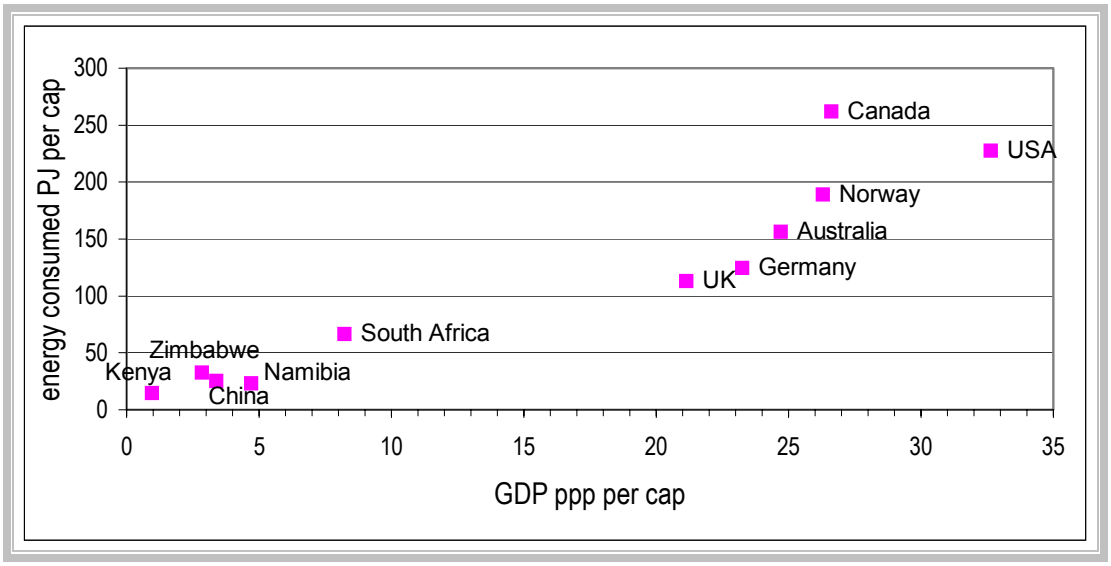


Figure 4. Energy consumption per GDP per capita (2000)

The practice of 'benchmarking', comparing the energy intensities of different sectors in other countries, aids in estimating where reductions in energy use may be achieved in South Africa, and thus determining those interventions which have worked internationally will be likely to be successful in South Africa.

The trend over recent years has been for energy consumption in both the industrial and mining sectors to increase at a steady rate generally concomitant with growth in that sector (exceptions exist such as gold mining where increased mining depth and decreased ore quality have resulted in increased energy consumption per unit output), whereas the trend for other sectors has been to remain level or even decrease where new, more efficient, technology has been introduced to replace old technology eg. private motor cars.

Climate Change

At the Rio de Janeiro Earth Summit of 1992 the United Nations Framework Convention on Climate Change stated that its fundamental objective was to achieve stabilisation of the concentrations of Greenhouse gases (GHGs) in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. South Africa ratified the Convention in 1997, which enables South Africa to apply for financial assistance for climate change related activities from the Global Environmental Facility.

The Kyoto Protocol (1997) is an agreement under which industrialised countries (Annex 1 countries) will reduce their combined greenhouse gas emissions by at least 5% compared to 1990 levels by the period 2008 to 2012. Following recent ratification by Russia the United Nations Protocol has become legally binding on 16 February 2005, thereby committing the Annex 1 parties accounting for 61,6% of the total 1990 carbon dioxide emissions to achieve the 5% reduction by 2012.

South Africa acceded to the Kyoto Protocol in March 2002. Although the Kyoto Protocol does not commit the non-Annex 1 (developing) countries, like South Africa, to any quantified emission targets in the first commitment period (2008 to 2012), there is potential for low cost emission reduction options in these countries. The Clean Development Mechanism provides for trade in certified emission reductions between non-Annex 1 countries and Annex 1 countries and thus supports sustainable development with respect to greenhouse gas emissions in developing countries while helping Annex 1 countries to comply with their commitments under the Kyoto Protocol.

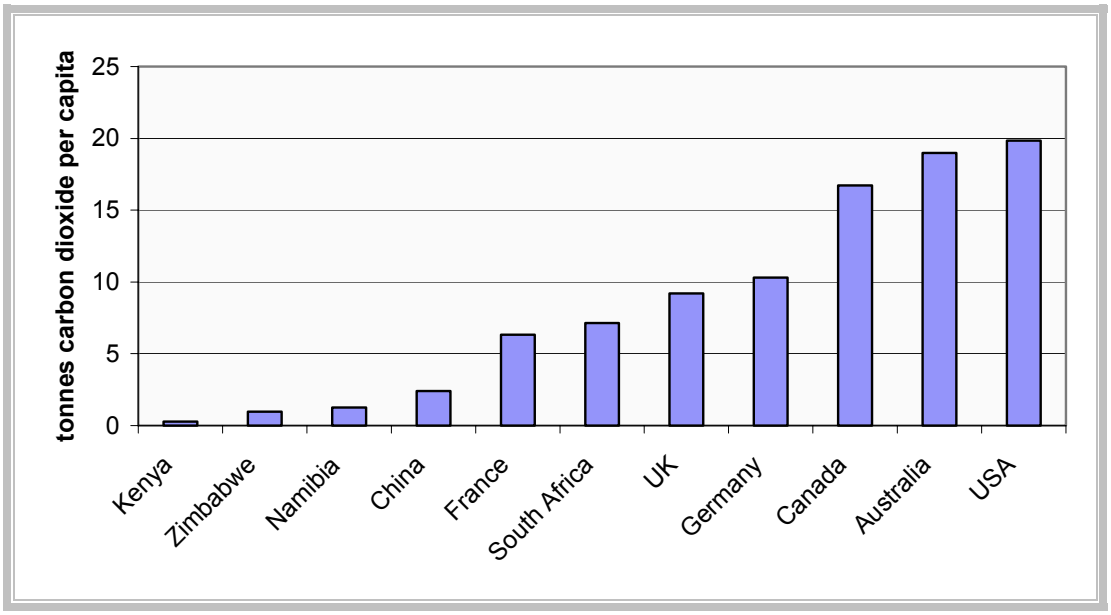


Figure 5: Carbon Dioxide Emissions per capita (IEA, 2001)

South Africa is by far the largest emitter of GHGs in Africa and one of the most carbon emission-intensive countries in the world, annually emitting some 7 tonnes of carbon dioxide per capita, as shown in figure 6, due to the energy intensive economy and high dependence on coal for primary energy. Certain energy efficiency initiatives have potential for financial support under the Clean Development Mechanism. Nevertheless over the past few years with the restructuring of the economy there has been a decline in several energy intensive activities. The DME has also established the Designated National Authority to process CDM projects and certain other clean development initiatives have taken place such as the publication of a draft "Cleaner Fuels Strategy" (*Joint Implementation Strategy for the Control of Exhaust Emissions from Road-going Vehicles in the Republic of South Africa, 2003*) for public comment. It is expected to be finalised in 2005.

3.2 Barriers

One of the fundamental steps necessary to enable successful implementation of any Strategy is the need to understand the barriers confronting it, and how to overcome those.

Several of the more traditional barriers are self-evident, and are described briefly below. In addition to these, however, is a barrier relating to the state of the country itself; the argument being that energy efficiency should be a relatively low priority when compared with other pressing national issues such as quality of life and education. It is important to bear in mind that energy plays an integral part in the solution of these problems, and that without clean and affordable energy such issues will be difficult to resolve.

Energy Pricing

This is a perceived barrier that stems from South Africa's historically low unit price of coal and electricity, although there has been a gradual and incremental rise in energy prices over recent years. This barrier still holds strong amongst the mind-set of many commercial and industrial organisations that argue that medium and high-cost interventions cannot be justified due to the lengthy paybacks involved.

Energy efficiency makes sound economic sense. Although the unit price of energy may be low, for the time being, the overall *cost* per unit to many industries is high because of the energy-intensive nature of their operations. If energy efficiency is approached correctly and with the right emphasis, payback on investment is frequently less than three years. Education and awareness programmes are some of the first steps to take towards overcoming this barrier.

Lack of knowledge and understanding of Energy Efficiency

Energy efficiency opportunities are frequently overlooked due to the simple fact that industry and other consumers are unaware that they exist. It is the intention of the Strategy to enhance awareness in such matters and to bring knowledge and understanding into the various sectors. This will be achieved through awareness campaigns, demonstration programmes, audits and education, and publicising corporate commitment programmes, and public building sector energy efficiency implementation initiatives. Use of the mass media and electronic options such as websites will be fully explored to publicise energy-saving tips, energy management tools and best practice methods. Where possible joint resources for Demand-Side Management and Energy Efficiency will be capitalised upon for the purposes of promotion, since the cost of awareness campaigns and related measures is too high to be sustained continually if executed individually.

Institutional barriers, and resistance to change

Institutional barriers often stem from a fear that outsiders will identify previously overlooked opportunities, thereby uncovering apparent incompetence. There is also a frequently encountered misconception, particularly within industry, that energy efficiency will disrupt production processes and that changes should not be made unless absolutely necessary. Typically energy audits are conducted at a plant level in order to determine the costs and benefits of various energy efficiency options that present themselves. Energy service companies do this and advise their clients on the optimal path to follow.

It is important to understand that to a large extent these are emotional barriers. An approach is required, therefore, that is not only professional and technically competent, but also sensitive to such issues.

Lack of investment confidence

Achieving optimum energy performance sometimes involves the installation of costly plant and equipment, and investors may be reluctant to tie-up financial resources in long-term projects. Recent history has seen a degree of uncertainty, both nationally and internationally, due to the fluctuations in the strength of our currency. This is an ongoing problem, and investors as well as local stakeholders and institutions should be encouraged to cost all externalities when considering energy efficiency investment opportunities. Furthermore, appropriate risk-weightings should be attributed to fossil fuel prices when considering plant lifetime running costs. The notion of introducing incentives on energy efficient appliances and equipment will be considered during the lifetime of this Strategy.

The practice of "bounded rationality"

Decision making with limited management resources requires the use of imperfect, or incomplete, information and less than fully rational procedures. This is significant as the majority of energy consumers currently have imperfect information regarding the range

and performance of energy efficient products. This fact inevitably results in poor decision-making when purchasing goods or specifying equipment.

It is an intention of the Strategy to enhance the decision-makers' awareness of issues such as running costs, environmental costs, etc. This will be achieved via the adoption of appropriate standards, awareness and education, and by the use of instruments such as appliance labeling.

3.3 Targets

To date, only a handful of countries worldwide have set comprehensive targets for energy efficiency improvements. These countries include Slovenia, Japan, The Netherlands and New Zealand. The World Energy Assessment, published by the UN and the World Energy Council, suggests that specific energy usage in industrialised countries could be cost-effectively reduced by 35% over a period of 20 years, if accompanied by effective policies. In the United States, the Electric Power Research Institute (EPRI) has proposed an energy efficiency improvement target of 2% per annum.

This Strategy provides for the implementation of sector programmes in a three-phase approach, timed as follows:

- Phase 1: March 2005 to February 2008;
- Phase 2: March 2008 to February 2011;
- Phase 3: March 2011 to February 2015.

The broad principle of this phased approach is to initiate actions with rapid returns during the early phases. However, it is likely that interventions such as technical standards will also be addressed at an early stage to enable the long-term benefits to be maximised.

This Strategy proposes the following energy efficiency target for South Africa:

A Final Energy Demand Reduction of 12% by 2015

The target stated above is expressed as a percentage reduction against the projected national energy usage in 2015. The target will be monitored continuously for progress, using a monitoring system, and an annual report will be issued. The projected usage is forecast at the present increase in economic development over the period and without any additional efficiency interventions. The forecast is derived from the Long range Energy Alternatives Planning tool (LEAP) utilised for developing the National Integrated Energy Plan for South Africa. The baseline scenario is similar to the base case scenario of the IEP ('business-as-usual') in which the following assumptions are made:

- Population growth: 2000=44 million, 2015=53,3 million (1,3% per annum)
- GDP growth: 2,8% average per annum growth over period
- Economic growth: 2,8% over period
- Fuel switching limited apart from general increase in electricity consumption in residential sector

The target is voluntary at present but sub-sectoral targets may become mandatory in the course of time.

The national target is illustrated further in Figure 6, where final energy demand is shown as a total of all sectors and is expressed in Petajoules. The *Projected Demand to 2015* is as forecast at an annual growth rate of 2,8% per annum. The *Target Outcome to 2015* is shown assuming that the national target is achieved, and that savings are implemented uniformly across the three phases of the Strategy. In actuality it is likely that savings will begin to materialise towards the latter stages of Phase 1 and into Phase 2.

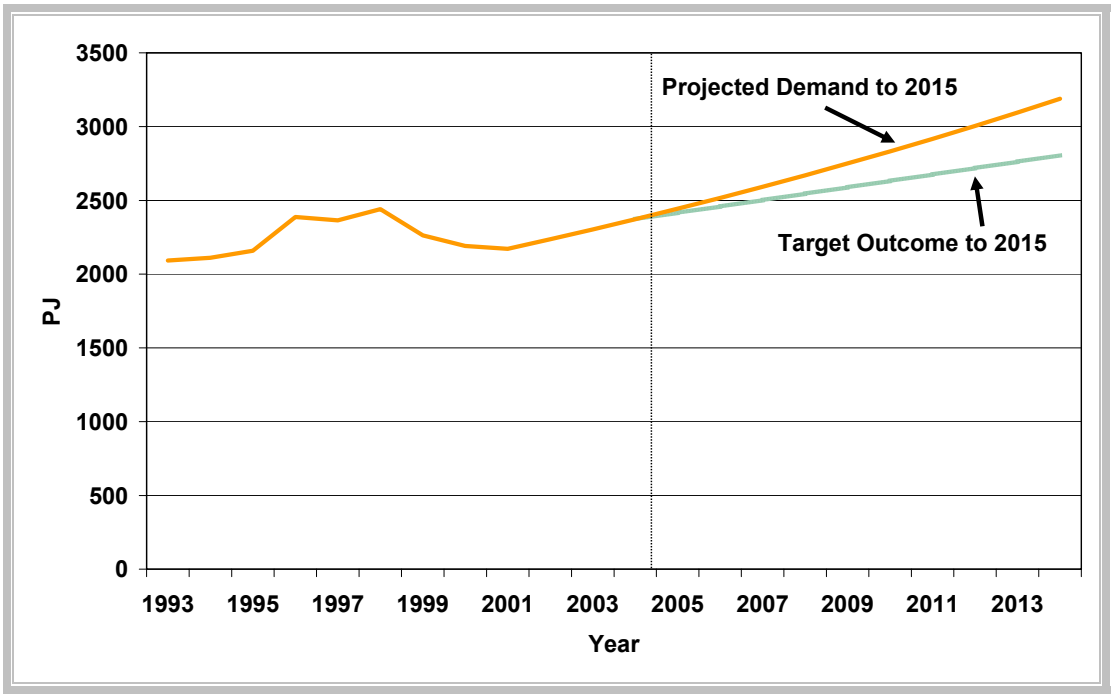


Figure 6: Final Energy Demand – Target Outcome to 2015

The national target is calculated using the individual targets for each economic sector, and by weighting these according the sectoral contribution to final demand, as previously shown in Figure 2. A great deal of research has been undertaken prior to deriving the specific targets for each economic sector. The DME commissioned detailed research projects (referenced in Section 7) to assess the baseline scenario of energy usage in South Africa, together with modelling the outcomes of technical efficiency interventions across the full range of sub-sectors. The emphasis of the DME research projects has been upon technical interventions alone, and the assumptions made in arriving at sectoral targets are considered to be conservative. Additionally, and of equal importance, are the non-technical opportunities for energy savings which exist within most sectors, in particular the buildings, industry and mining sectors. Such opportunities can be broadly defined as *Energy Management Best Practice*, and by inference tend to revolve around "soft" issues such as behavioural change arising from increased awareness, training, accountability and information systems. The importance of effective Energy Management has been demonstrated time-and-again, both in South Africa and abroad, and numerous case studies bear testament to this fact. This Strategy recognizes that Energy Management Best Practice will play a vital role in achieving the national target. DME has commenced an initiative to develop and roll-out an Energy Management training and awareness programme to be implemented within the industry and mining sectors.

Review of Targets

A review of the national and sectoral targets will be undertaken at the end of each phase. This review will be carried out by the DME with the objective of assessing progress towards targeted outcomes and to address any areas where additional input may be required from stakeholders. The monitoring and measurement of targets is discussed in more detail in Section 3.5.

It is important that the targets are seen to be both *challenging* and *achievable*. In most cases the sectoral targets comprise a conservative estimate of the likely impact of technical interventions, coupled with the additional impact of Energy Management initiatives and behavioral changes described above.

Industry and Mining Sector

A Target Final Energy Demand Reduction of 15% by 2015

The industrial and mining sectors combined are the largest users of energy in South Africa. A relatively high theoretical potential for energy saving exists, in the magnitude of 50% of current consumption in comparison with international best practice, on a sector-by-sector basis. Notwithstanding this, research has shown that a savings potential of at least 11% is readily achievable using low-cost to medium-cost technical interventions. Furthermore, an additional 5% - 15% energy saving would be achievable via proven no-cost and low-cost techniques of energy management and good housekeeping. It is considered, therefore, that the prescribed target of 15% is realistic and achievable.

Power Generation

An interim Target of 15% reduction in "parasitic" electrical usage by 2015

The issue of targeting energy efficiency improvements within the power generation sector has been the subject of much dialogue between the DME and Eskom throughout the development of this Strategy. When addressing energy efficiency in fossil fuel power stations, there are two generic areas within which savings may lie:

- **Within the core business activity**. This constitutes the central thermal plant and steam turbines in existing power stations, together with their immediate ancillary equipment. The efficiency of energy conversion in the core activity is largely dictated by the technology, size and age of plant, together with its prevailing loading characteristics. In the majority of cases these aspects are largely outside the control of the generator and efficiency improvements can usually only be expected upon major capital refurbishments. Notwithstanding this, Eskom is developing its own detailed strategy to address long-term Supply Side issues and to establish targets for its existing fossil fuel stations. Eskom's Supply Side Management strategy and associated target are expected to be released during 2005.

- **Within non-core ancillary equipment**. This is plant and equipment peripheral to the core business, such as minor pumps and fans, compressed air, lighting and air conditioning. It is reasonable to expect that energy savings opportunities for non-core users would be in-line with those expected within industry in general and, where appropriate, within the buildings sector.

An interim target of 15% is therefore set for this sector based upon *savings measures applicable to parasitic electricity losses only*. Subsequent to issuing its Supply Side Management Strategy during 2005, Eskom will incorporate the longer-term savings associated with its core business activity into the overall target for this sector. It is expected to review the target for this sector, therefore, early during Phase 1.

Commercial and Public Building Sector

A Target Final Energy Demand Reduction of 15% by 2015

Although this sector contributes a relatively minor percentage to national energy usage, savings here are known to be significant. Research and experience have shown that savings through low-cost and medium-cost technical interventions can exceed 25%. In order to allow for partial sectoral penetration of technical measures, however, a figure of 11% has been calculated using detailed modeling analysis. Additionally, a further 4% is thought to be realistically achievable through managerial intervention and behavioral changes.

Residential Sector

A Target Final Energy Demand Reduction of 10% by 2015

If a target of 10% by 2015 is anticipated that would mean 1% to be achieved per year and the bi-annual target would then be half a percent every 6 months.

This sector used 360.5 PJ in 2000 in the form of coal (11%), petroleum products (7%), biomass (53%) and electricity (29%). The transition towards the use of higher calorific value fuels and a reduction in the use of thermal energy consumption will be driven by energy efficiency standards in housing, generally higher standards of living accompanying economic growth of 2.8% pa, and the electrification programme. The measures outlined in the interventions section (see 5.4 Residential Sector Programme); mandatory standards, appliance labeling, efficient lighting and standards for non-electric appliances such as energy efficient coal stoves, wood stoves and liquid fuel stoves, should be comprehensive enough to achieve the goals proposed. However, the sector is very diverse, and many energy saving decisions lie at the individual household level, requiring an initial investment. Therefore an ongoing public awareness drive will be necessary to achieve a saving of 10% by the year 2015, based on a projection from the present consumption. An easy to follow guide for households will be developed, such as energy savings tips, taking into consideration that changing people's lifestyle is by no means straightforward.

Transport Sector

A Target Final Energy Demand Reduction of 9% by 2015

Transport is the second largest sectoral consumer of energy and is expected to grow considerably in the medium-term. Measures to address energy efficiency will not necessarily be easy to implement, as has been the experience internationally where motor vehicles have become the main means of transport. The projected savings will, therefore, only begin to impact during Phases 2 and 3 when planned interventions have begun to be

implemented. Several measures will be regulatory in nature, but in order to be effective will rely heavily upon behavioral changes. Such changes are, by experience, the most intractable elements to influence. Another major challenge is the rapid swing in demand towards low efficiency 4x4s and sports utility vehicles.

A target of 9% has, therefore, been established as a realistic but challenging objective for 2015. This target has assumed the introduction of a labeling system for vehicle energy consumption accompanied by other measures (legislative and otherwise) to promote vehicle energy efficiency on South Africa's roads, technology upgrade leading to more efficient vehicles/turnover in the vehicle park, but has excluded taxi-recapitalisation. As the impacts of taxi-recapitalisation may only be evident in the later phases of this Strategy the target will be reviewed in Phase 3. The impact of measures such as public transport systems, moving road to rail and spatial planning are also difficult to assess at this stage and remain interventions with impacts in the long-term.

3.4 Outcomes

Table 1 summarises outcomes by the eight goal areas of the Strategy, assuming that all targets are met. The goals are largely an expression of the objectives of the *White Paper on Energy Policy* which represent Government's commitment on a number of socio-economic aims. It should be noted that not all goal outcomes are quantifiable at this stage, so qualitative commentary is provided against some outcomes. In addition outcomes such as job creation, energy poverty alleviation and improved industrial competitiveness are factually substantiated by international experience and studies, although no local investigations have been done in South Africa yet.

Table 1. Projected Outcomes by 2015

Goal Area	Outcomes
Goal 1 Improve the health of the nation	• Health benefits realised through reduced atmospheric pollution and improved living conditions, in particular a reduction in respiratory-related illnesses;
Goal 2 Creation of Jobs	• Long-term employment opportunities increased by reducing costs in commerce and industry; • Employment opportunities increased within the energy efficiency sector and related activities.
Goal 3 Energy Poverty Alleviation	• Access to affordable energy services improved by promoting low energy alternatives in the marketplace; • Lower energy costs for households by improving domestic energy efficiency.
Goal 4 Reduce local Pollution	• Atmospheric pollutant levels reduced by a reduction in fossil fuel combustion at power stations; • Local atmospheric pollutant levels reduced by a reduction in fossil fuel combustion within industry and commerce; • Transport-related atmospheric pollutant levels reduced by a reduction in combustion of petroleum products in motor vehicles.
Goal 5 Reduce CO_2 Emissions	• National CO_2 emissions reduced by improving energy efficiency across all economic sectors;
Goal 6 Improve Industrial Competitiveness	• Improved industrial and commercial profitability by controlling and minimising energy overheads; • Improved international acceptability of South African products by minimising the environmental impacts of their manufacture.
Goal 7 Increase Energy Security	• Increased national resilience against oil price fluctuations by reducing the country's dependence upon imported crude oil supplies; • Increased resilience against internal supply disruptions by reducing load demands placed upon power distribution systems.
Goal 8 Defer Additional Generation Capacity	• Construction of additional power generation plant deferred as far as practicable by contributing towards Eskom's peak load reduction target.

3.5 Monitoring and Measurement

The *White Paper on Energy Policy* states that:

> "*Government will ensure that the necessary resources are made available to establish structures, systems and legislation to facilitate the specification, collection, storage, maintenance and supply of energy data, and energy-related data, according to the requirements of integrated energy planning and international standards*."

Government must be able to measure the effectiveness and efficiency of measures implemented and initiatives put in place for the promotion of energy efficiency, as prescribed by Energy Policy, and must sustain this capacity.

There is a need to establish a system for continuous updating and registration of figures related to energy efficiency; in particular, indicators for efficiency measurement. A formalised system for collecting, managing data and calculating indicators is necessary for monitoring the implementation and success of activities initiated as part of the strategies for energy efficiency. It is DME's responsibility to establish such a monitoring and verification system and ensure that it is implemented. This is also a compliance measure that fulfils requirements by the Draft Energy Bill (section 17 (1) (2)) on the collection of energy information. The DME will take responsibility to ensure that progress towards targets is reviewed and monitored on a continual basis.

The success of such a system will inevitably depend upon using a multi-stakeholder approach, including consultation with representative bodies within each sector. The relevant players are outlined in Section 4.4, Figure 8. The DME has embarked upon a programme to develop detailed methodologies for the monitoring and tracking of sectoral targets. The monitoring plan will take into account all sectoral variables, which are likely to impinge upon the targets prescribed for each sector. Such variables will include factors such as *actual* economic and sectoral growth per sector, thereby enabling energy usage data to be normalised against representative data, which describe sectoral activity over time.

Independent external parties may be used to verify the Department's methodologies and findings.

4. Implementing Instruments

The Strategy makes use of a range of generic implementing instruments, which are applied as appropriate to meet specific needs within each Sector Programme. The relative maturity of the marketplace will determine which instrument is used where, and how. For example, where interventions are seen as novel and may require some development, the appropriate instruments may include trials and incentives. By contrast, where interventions are already somewhat developed awareness may be the driving need.

4.1 Support Mechanisms

The following paragraphs illustrate and describe the main supporting mechanisms and instruments used with each sectoral programme. Such mechanisms are intended to be independent of financial and policy instruments.

Efficiency Standards

Efficiency standards have been successfully applied overseas and have brought about significant improvements in efficiencies. South Africa has a well-developed system of standards and codes of practice that, in some cases, may be amended to include efficiency aspects without the need to establish completely new standards. The Draft Energy Bill gives the Minister of Minerals and Energy substantial authority to make standards compulsory.

Mandatory energy efficiency standards will be an important and integral part of the Strategy.

Appliance Labeling

Energy labeling of appliances is an internationally tried and tested tool to build awareness and raising capacity about energy consumption.

A number of studies, the latest completed as recently as 2003, have looked into the feasibility of introducing labeling for some household appliances in South Africa. Potential savings with labeling or higher efficiency standards are estimated at 3 PJ in 2012.

The adoption of European Union standards for labeling is considered, as this has already been tested and is widely approved. Furthermore, the success of the EU standards in conveying the message of efficiency to a diverse target-group, comprising a variety of cultural backgrounds, would be of particular benefit to South Africa.

In addition, energy efficiency labeling of motor vehicles will be introduced.

Mandatory appliance labeling for household appliances forms an important element of the Strategy and will be promoted and implemented.

Certification and Accreditation

The Strategy makes use of several instruments where inspectors or auditors will be expected to carry out certain technical functions, or studies. These functions will necessarily require a minimum level of technical competence on behalf of the party concerned. Examples include the certification of energy auditors for buildings, industrial plant, and the accreditation of inspectors for Efficiency Standards. The outline requirements of relevant accreditation procedures will be specified by the DME, professional associations and the certification made by SABS.

It is the intention of the Strategy to help develop such accreditation procedures and to enable appropriate certification to be awarded to the relevant aspirants.

Education, Information and Awareness

Information and general awareness are key elements to achieve success in terms of changing South Africa into a more energy efficient society. Once laws and regulations are established, architects will need guidance (from standards, codes of practice, etc.) on how to design houses according to the new regulations, and plumbers should also have be informed about the need to insulate geysers.

Awareness-raising starts with pre-schooling education and runs through all learning fields into the adult education system, under the auspices of the National Qualification Framework (NQF) up to level 8. The DME will engage with the institutions responsible for

education and support, and facilitate the inclusion of appropriate education on energy efficiency in the curriculum.

The DME will strive to ensure that:

- *Energy Efficiency is taught and examined at all levels in all appropriate subjects, in particular engineering and architecture;*

- *Energy Efficiency is a competence requirement under the National Qualifications Framework training programmes for skilled workers in the relevant construction and buildings services trades*

Research and Technology

Technological options represent significant potential for energy efficiency improvements and, in many instances, are well researched and already developed. However, the majority of these technologies are not manufactured locally and require importation. The latter point will represent a challenge for the Government, particularly as the drive to promote energy efficiency gains momentum.

The South African National Energy Research Institute will be funded to carry out a dedicated programme of research and development for energy efficiency.

The Strategy will support appropriate research and the possible adaptation of internationally available technologies and processes.

Regulation

The historically low unit price of energy, coupled with limited awareness on energy savings potential, may result in only modest success arising from voluntary measures and other non-legislative instruments. For this reason, regulatory means will be applied to achieve further improvements where necessary. Efficiency Standards will have limited impact unless made mandatory, and energy audits should be accompanied by an obligation to implement, for example, all no-cost recommendations identified. The NER will contribute to or develop regulatory measures for guiding reporting and compliance.

Energy Audits

Energy audits have internationally been used across all sectors to identify efficiency measures that can be implemented in a cost-effective manner. However, to be effective it has often required both the audits as well as the implementation of measures to be compulsory and to be paid for by the client.

The Strategy will promote energy audits as a means of improving efficiency. Studies will be undertaken to design ways in which audits will achieve the greatest impact.

Energy Management Systems

Energy management enables the formalisation of monitoring, evaluating and targeting energy consumption as well as providing sector-specific benchmarking information. Within industrial and commercial applications, the concept of energy management must also embody other key areas, including Training, Motivation and Awareness, Green Accounts (where companies audit the environmental performance of their operation, as well as its economic performance), Energy Policy and formalised Monitoring and

Targeting (M&T). The importance of effective M&T cannot be over-emphasised, as it provides the yardstick against which savings are targeted and improvements are measured. Without the key information that M&T provides, attempts to save energy within an organisation can be frustrating, futile and de-motivating.

The implementation plan for the industrial sector will execute a special project designed to develop a monitoring and targeting system in collaboration with the database function at the DME.

The Strategy will support the proliferation of energy management and the establishment of necessary information, including the introduction of Monitoring and Targeting and "Green Accounts".

4.2 Policy, Mandate and Governance

The mandate to govern and undertake energy efficiency initiatives is derived from the following documents:

- The South African Constitution;
- The White Paper on Energy Policy, 1998;
- The Municipal Systems Act No. 32 of 2000;
- The Electricity Act No. 41 of 1987 (as amended);
- The Draft Energy Bill;
- The Standards Act;
- The Draft Electricity Regulation Bill

The DME will prepare appropriate legislation and regulations for the Governance and Implementation of this Energy Efficiency Strategy. The regulations will take into account the capacity of the Government to enforce implementation.

The mandate given by the *White Paper on Energy Policy* says that the DME should promote Energy Efficiency through various means as well as consider the establishment of an agency to be instrumental for the Coordination, Leadership and sector capacity development for the implementation of Efficiency. Government's present capacity to undertake energy efficiency programmes is limited. Other countries in similar circumstances have found the establishment of an agency to be an effective means of providing the necessary leadership and capacity to implement programmes.

The DME will, during the early stages of implementation, finalise and consolidate considerations to ensure appropriate leadership in the sector.

4.3 Finance Instruments

The formulation and implementation of this Strategy is geared towards self-finance, positive savings and job creation. The majority of Energy Efficiency improvements will materialise through the implementation of standards, regulation and management tools, which at the end of the day lead to short pay back periods for the individual enterprises, house owners and government.

Costs related to investments in equipment or refurbishing of production flows, houses, etc. are to be born by the direct beneficiaries, which is reasonable to expect, due to the short payback periods. Where payback periods are less favourable, the option to partake in

other enabling mechanisms should be encouraged. Such mechanisms include the Clean Development Mechanism (CDM), developed under the 1997 Kyoto Protocol.

For Government the real costs to implement this Strategy relate to the massive information and coordination requirements – such costs are to some degree flexible and therefore, kept at the implementation level rather than the Strategy level.

As an example, the successful implementation of energy efficiency in the electricity sector leads to reduction in costs to end users due to deferred generation investments. Therefore subsidising energy efficiency to accelerate implementation will prove beneficial to all users of electricity. This is the justification for the current subsidising of DSM and energy efficiency projects through the Eskom DSM Fund. The costs of intervention to the end consumer are at this stage best quantified by comparison with the costs of a 'business-as-usual' alternative – increasing electricity tariffs to pay for new generating plant. The justification for an energy efficiency strategy is identical to Eskom's DSM programme vis-à-vis deferred capacity.

Incentives

At this stage of South Africa's development it is difficult to justify government subsidies for Energy Efficiency when there are so many other pressing needs nationwide.

However, the continuous process of fiscal reform does present opportunities to promote energy efficiency as part and parcel of the reform process. For example, National Treasury has announced that it is reviewing the current vehicle allowances in personal income tax that favour larger (and therefore less efficient) engines.

Fee Bates

Fee bates are under consideration for vehicles. The basic principle of fee bates is that levies are imposed upon less efficient vehicles and the funds collected used to cross-subsidise more efficient vehicles. National Treasury is simultaneously developing "*A Framework for Considering Market-Based Instruments to Support Environmental Fiscal Reform on South Africa"*. These two developments are being aligned to achieve the desired impact.

The Government's Motor Industry Development Plan has already enjoyed some success in shifting demand towards small more efficient cars. It presents an alternative instrument that could be used.

Financing the Public Sector Implementation Plan

Presently it appears that some cost effective capital measures in the Public Building Sector remain unimplemented because there are no specific budgets to cater for them. However, National Treasury have approved that within an existing Medium-Term Expenditure Framework it is possible to transfer operating cost budget items to capital cost budgets on the proviso that this is accomplished within the normal three year budget cycle. This three-year cycle constraint will probably require energy efficiency investments to be divided up and staggered over several years. The incentive for National Departments will be that they will be able to retain the savings that arise from the energy efficiency measures that they implement, once they have paid off the costs thereof.

The same budgeting and delivery mode will be extended to all Provincial and Local Government authorities and state owned entities that are funded by Parliamentary appropriations

This presents another enabling instrument for cost effective capital measures with short to medium term payback periods.

Energy Service Companies

The business of an Energy Service Company (ESCO) is to sell energy services. Energy management being one of the most common activities with saved energy as the main product. The ESCO meets client needs to reduce costs, improve energy efficiency, manage risk and enhance a competitive edge. The ESCO will typically offer this through a package, which includes a comprehensive energy audit service, financing mechanism, equipment procurement, and installation and commissioning, operation monitoring and performance guarantees. This addresses those situations where companies do not have the expertise and resources to devote to energy management activities themselves.

Saved energy cost is typically used to meet the implementation cost of saving energy. There are several payments options that include lump sum payment or once off payment and performance contracting paid through shared savings where a percentage of the cost savings are split between owner and the ESCO. This approach can be used to implement resource management measures, such as energy management in industrial and commercial and even in the residential sectors. The strength of the approach is in the delivery of results i.e. actual energy cost savings by the ESCO enabling the customer to focus on their core business.

Although the ESCO concept is not new, it is not yet fully developed in South Africa. Players do exist in the marketplace, but they are relatively few and many of them have limited experience. As a result a confidence gap exists in the market where customers are sceptical and reluctant to use this service delivery mode. This is exacerbated by an absence of a well-established performance standard and service provider certification and accreditation. DME's role in respect of ESCOs will be primarily devoted to addressing this deficit by creating a more formal framework within which they can operate. This will consist of accredited performance standards and approved methodologies for energy efficiency audits as well as skills training accreditation.

Despite this, it is accepted that the ESCO model does have an important role to play in the delivery of energy management services in South Africa. Indeed Eskom's own Demand Side Management programme uses the ESCO concept as its key delivery mechanism. There is, therefore, merit in supporting and strengthening this service delivery mode given the potential to achieve energy savings at minimum cost to the Fiscus. Regulation of ESCOs is probably unnecessary as the risk of non-delivery is carried by the ESCO. However, the type of contract is quite crucial.

Clean Development Mechanism

The Kyoto Protocol was adopted at the third Conference of the Parties in 1997. The Protocol provides that developed nations accept commitments to limit, or reduce, the emission of greenhouse gases according to differentiated targets. For the signatory parties, termed Annex 1 countries, this represents an overall reduction of 5% by the period 2008 to 2012 in relation to their combined emissions of greenhouse gases in 1990. South Africa ratified the UNFCCC in August 1997 and acceded to the Kyoto Protocol in March 2002 as a non-Annex 1 signatory.

Achieving such goals will result in significant costs to the economies of each Annex 1 country, and a number of mechanisms were developed to assist these countries to comply

with their respective targets. One of these mechanisms is the Clean Development Mechanism, or CDM. The basic principle of the CDM is simple: developed countries can invest in low-cost abatement opportunities in developing countries and receive credits for the resulting emissions reduction. Such credits would then count towards their own abatement targets.

The CDM can positively contribute towards the sustainability objectives of a developing nation by:

- Transferring technology and financial resources;
- Developing sustainable methods of energy production;
- Increasing awareness of energy efficiency and environmental issues;
- Alleviating poverty through income and employment generation;
- Helping define investment priorities in projects that meet sustainability goals.

The CDM encourages developing countries to participate by promising that their own development priorities will be addressed as part of the package. This recognises that only through long-term development will all countries be able to play a role in protecting the environment.

Demand Side Management

At current energy usage levels and national economic development projections, it is estimated that without any interventions to reduce peak electricity demand, there will be a need to invest in new power generating capacity by around 2007. As the construction of additional generation plant is an extremely costly and lengthy process, Eskom has embarked upon a Demand Side Management (DSM) programme in order to reduce the capacity and costs of such an investment, by using a combination of energy efficiency measures, load management and negotiated interruptible supplies.

The DSM provision in Eskom's current Integrated Energy Plan is for a peak load reduction target of 1.37GW by 2015. In addition, there is an interruptible supply agreement target of 1.511GW by 2007 and 0.409GW by 2015. This target is likely to change dynamically over time in response to the actual requirement for DSM in South Africa. It is also likely to change in response to the effectiveness of interruptible supply agreements. Presently, however, the load reduction target is comprised of the following elements:

- 0.81GW from load shifting;
- 0.56GW from energy efficiency measures.

Eskom has adopted the ESCO methodology as the key tool to implement the DSM process. Energy efficiency and load management projects are implemented and managed via a third-party (the ESCO) and savings resulting from the intervention are shared between the host site, Eskom and the ESCO in approximately equal proportions. Capital funds are currently gathered through supply tariffs and administered by Eskom. The NER is responsible for ensuring that Eskom meets its Energy Efficiency and DSM targets. (The current funding mechanism is under review and discussion between Eskom and NER).

It is acknowledged that this methodology is inherently subject to the constraints and barriers previously outlined for ESCOs in the section above. Despite this there are 80 ESCOs already registered and projects have been implemented yielding a demand

reduction of 187,2MW in 2004. The aim is to achieve an annual target of 153MW over the period 2003-2010. In addition, approximately 500MW worth of potential projects are in the pipeline (as at end of October 2004).

Energy Pricing

Following from the specific policy objectives of the *White Paper on Energy Policy* (1998), energy pricing will be based on an assessment of the full economic, social and environmental costs and benefits of policies, plans, programmes and activities of energy production and utilisation. That is to say, a process of moving away from cross-subsidies towards cost-reflective prices will generally be adopted.

4.4 Stakeholders

The South African energy arena is characterised by a number of diverse role players each with a mandate within the fields of energy supply, conversion, efficiency and regulation. Only through well co-ordinated initiatives and promotion to activate the different role players will South Africa be able to effectively promote energy efficiency.

The DME will prompt the different stakeholders to take a leading role in their areas of responsibility on a sector by sector basis. The means will be information, regulation, promotion, and facilitation of an enabling capacity development framework, as well as the coordination of knowledge and actions where necessary, as well as publicised public comments.

Figure 7 shows how the key stakeholders will be involved in the strategic processes described in this document. Stakeholder relationships are shown against each implementing instrument, or focal area, in terms of primary stakeholders and secondary stakeholders. Primary stakeholders may be broadly defined as those whose main functionality deals directly with the associated focus area. Secondary stakeholders may be described as those whose responsibilities partly overlap with a particular focus area, or where their involvement would be of an *ad hoc* nature.

Figure 8 compares the major roles of the primary stakeholders across the sectoral initiatives proposed. These roles are defined in terms of strategic responsibility, implementation, regulation and monitoring. The figure also indicates which stakeholders will be responsible for the Monitoring and Verification (M&V) of sectoral initiatives, as indicated in Section 3.5.

Figure 7. Stakeholder Responsibilities

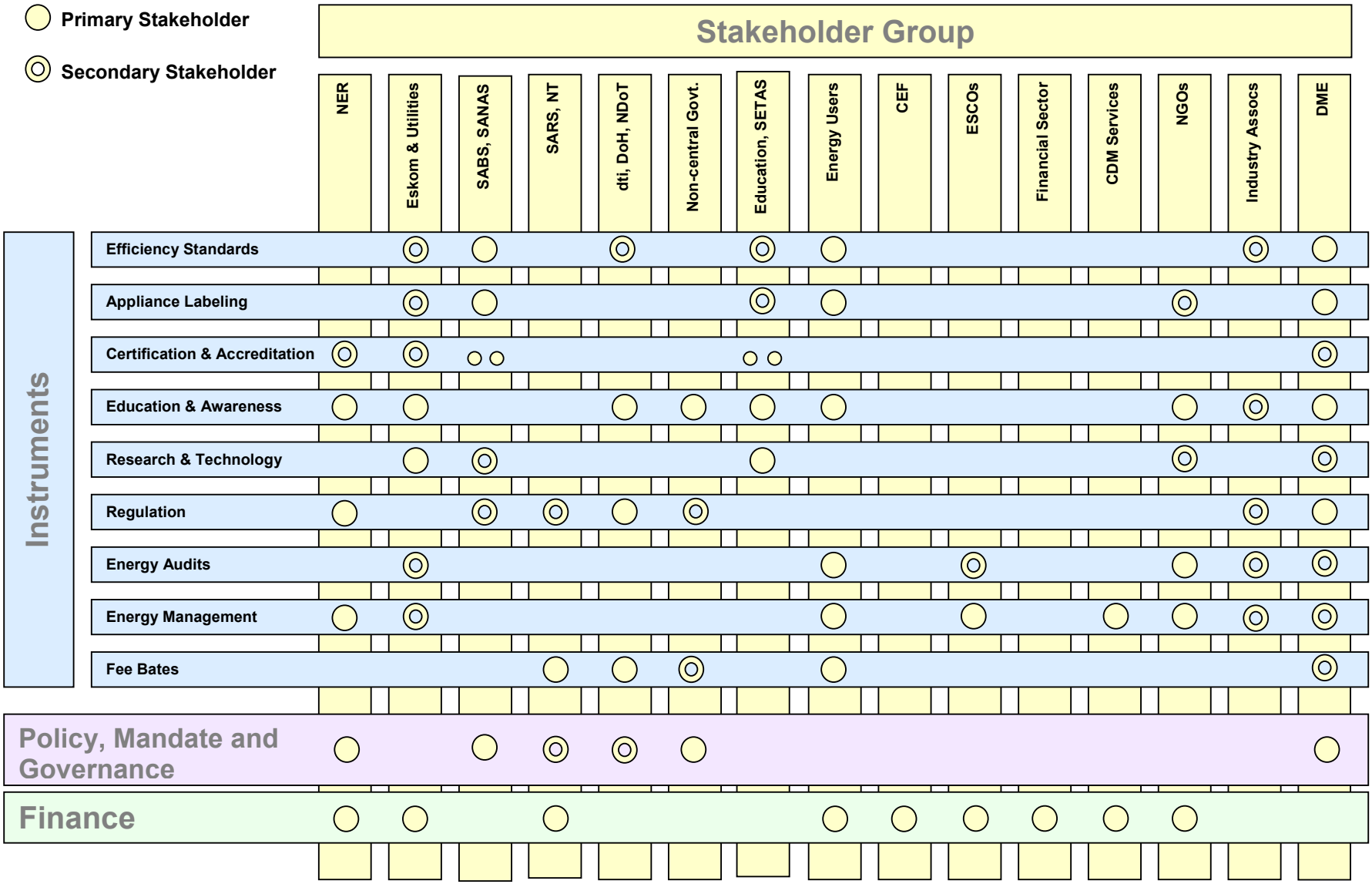
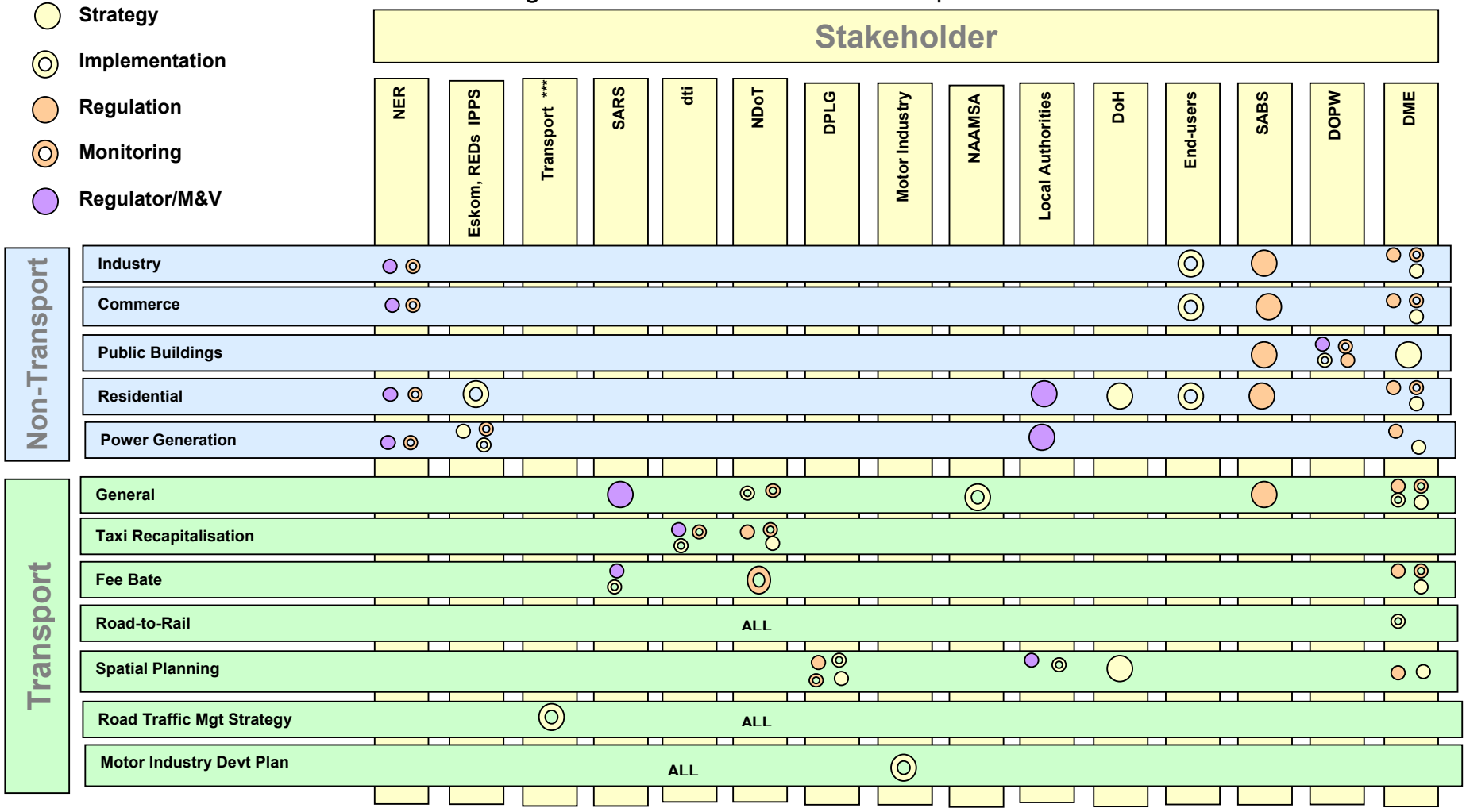


Figure 8. Sectoral Stakeholder Responsibilities



**** Transport includes the Department of Public Enterprises, Transnet, Spoornet, the SAA, the Ports Authority and Port Operations

5. Sector Programmes

This section outlines the planned programme of interventions relating to each economic sector.

In order to meet the objectives of this Strategy, it is intended that energy efficiency interventions will be implemented through a phased approach. The timing of the three Phases is as follows:

- Phase 1: March 2005 to February 2008;
- Phase 2: March 2008 to February 2011;
- Phase 3: March 2011 to February 2015.

It is the broad intention of the Strategy that these phases will be linked to the economic characteristics of each activity. For example, it is probable that a low-cost intervention with a rapid payback would be implemented during the early stages of Phase 1. Conversely, a high-cost or complex intervention may only be initiated during the latter phases of the Strategy.

Whilst the economic criteria are important in determining the phasing of interventions, issues such as technical standards will be addressed at an early stage so as to maximise the long-term benefits. The Strategy will be reviewed at the end of each Phase. It should be noted that the different Phases are not mutually exclusive and that some interventions may transverse more than one Phase.

The interventions for each sector are described in outline on the following pages. These sections will form the basis for the elaboration of detailed implementation plans that will be developed for each sector. Implementation plans for the Industrial Sector and Commercial and Public Building Sector are currently being finalised for action following approval of the Strategy. Plans for the Residential and Transport Sectors will be developed during 2005.

5.1 Industry and Mining Sector Programme

Key Facts

- Industry and Mining account for 47% of total end-user energy demand in South Africa;
- Industrial energy usage is dominated by a small number of energy-intensive industries. These include ferrous and non-ferrous metals processing, mining, pulp and paper, and the petrochemical industry;
- The energy intensities in these industrial sectors are typically higher than those of other first world countries;

Core Objectives

- To decouple the rate of growth of industrial energy consumption from the rate of growth in industrial output;
- To bring the energy intensities of major industrial sectors into-line with international standards and best practice.

Approach

- A suite of "leadership by demonstration" programmes will be implemented. The DME will drive this activity, which, it is intended, will be actioned by voluntary initiatives within industry itself. There may be opportunity to utilise donor funding for certain specific projects. These programmes are intended to build industrial capacity in the area of energy management and best practice, and to give incentive for replication nationwide;
- A series of mandatory standards will be introduced in phases. The intention is to ensure that life-cycle costs are considered where the purchase of "horizontal technologies" is concerned. The term horizontal technology refers to any specific technology which is commonly used across many industrial sectors;
- An obligation to carry out energy audits within the energy-intensive industries will be introduced in phases. This will assist in awareness raising and in ongoing improvements in energy efficiency.

Table 2. Industry and Mining Sector Programme

Output Activity	Measures	Timeframe	Responsibilities
Norms and standards for horizontal technologies Technical standards to be developed for Industrial boiler efficiency, electric motors and thermal insulation. These horizontal technologies are common to many industries and such standards will encourage lifetime cost assessments to be carried out when purchasing new plant.	• Research into existing national and international standards • Formulation and adoption of standards • Training of inspectors and operators • Implementation of standards • Monitoring and results dissemination	Phase 1 Phase 1 Phase 1 - 2 Phase 2 Phase 3	DME, dti, SABS, Education Providers, Energy Services Industry engaging with Industry Associations and wider industry
Energy Audit Scheme This will encourage capacity building within audit providers and will promote energy efficiency best practice within industry itself. The scheme will be tested initially via a series of trial audits in industry. It is intended that regular energy auditing will be made mandatory for high energy users in due course.	• Develop certification process for auditors • Certification of auditors • Trial audit scheme through specific sectors • Ongoing mandatory scheme (non-subsidised) in specific sectors • Monitoring and results dissemination	Phase 1 Phase 1 Phase 1 - 2 Phase 2 - 3 Phase 1 - 3	DME, NER, SANAS, ESETA and Education Providers engaging with Industry Associations and Industry generally
Energy Management Best Practice A solid Energy Management foundation is essential in any firm in order to optimize energy efficiency best practice. The key tenets of good Energy Management are information (Monitoring & Targeting), Training & Awareness (Motivation) and corporate commitment (company policy). The importance of these will be demonstrated and promoted.	• Undertake Monitoring and Targeting demonstration projects • Investigate suitable industrial training schemes and develop a programme of industry training support • Establish a Corporate Commitment programme to encourage adoption of energy efficiency policy into existing corporate policies. • Monitoring and results dissemination	Phase 1 Phase 1 Phase 1 - 2 Phase 2 - 3	DME, NER, Eskom, Education Providers, Funding Agencies engaging with industry
Technology Information and Research It is important to have a sound technology information base to industry in general. This will ensure that appropriate efficient technology is adopted and will potentially lead to further research-based projects.	• International benchmarking study to enable more meaningful benchmarking by industrial sector • Establish a technology and information base, using existing literature • Promote awareness of available information	Phase 1 Phase 2 Phase 2 - 3	DME, Education Providers, International EE Agencies, Industrial Associations
Promotion of Energy Service Companies (ESCOs) ESCOs are already playing a vital role in Eskom's Demand Side Management (DSM) programme. There is potential to further develop the energy service provision market to encourage greater energy efficiency within the industrial sector.	• Investigate the status of the existing ESCO market • Establish means of enhancing the promotion of ESCOs within industry	Phase 1 Phase 1, ongoing	DME, Eskom DSM and NER engaging with ESCOs and wider industry
Maximise the Value of Energy Efficiency Investments This activity will encourage and facilitate the conversion of eligible Carbon Credits into real cash benefits for industry, via the Clean Development Mechanism (CDM).	• Establish DNA function and procedures • Improve CDM awareness and publicise successful CDM projects	Phase 1 Phase 1, ongoing	DME, dti and CDM service providers engaging with industry

5.2 Commercial and Public Buildings Sector Programme

Key Facts

- Commercial and Public Buildings account for 3.5% of final energy demand. The Commercial sector alone contributes 45% towards total national GDP;
- The majority of energy is used in the form of electricity, the main end-uses being HVAC systems, lighting and office equipment;
- The Commercial sector is undergoing significant growth which presents the opportunity to capture energy efficiency at the design stage of new stock.

Core Objectives

- To demonstrate the Government's commitment to sustainable energy development within its own building stock;
- To progressively upgrade the energy performance of existing public and commercial building stock;
- To achieve best practice energy performance in new public and commercial building stock.

Approach

- The Government will lead by example through raising energy efficiency awareness and by implementing specific measures within its own estate;
- Energy efficiency standards for buildings will be introduced and made mandatory, together with a building Energy Audit programme;
- Emphasis will be placed on incorporating energy efficiency into building design and energy efficient technologies will be introduced in existing buildings;
- Energy management systems for buildings will be tested, demonstrated and promoted;
- In conjunction with the implementation of SANS 204, energy labels will be developed to assist with compliance rating.
- The standard for office buildings (SANS 204) will be made mandatory by its incorporation into the National Building Regulations.

Table 3. Commercial and Public Buildings Sector Programme			
Output Activity	**Measures**	**Timeframe**	**Responsibilities**
Energy Efficiency Standards for Commercial and Public Buildings	• Develop Energy Efficiency Standard for Office Buildings (SANS 204) • Research knowledge gaps • Stakeholder consultation • Finalise SANS 204 • Incorporate SANS 204 in National Building Regulations • Energy Labels (Compliance Rating –re SANS 204) • Implementation of standards	Phase 1 Phase 2 Phase 3	DME, SABS, CSIR, Architects, Building Industry Government Departments, dti, DME, National Treasury, Legislature, SABS DME, SABS, Building Industry
Mandatory Energy Audits for Commercial Buildings	• Prepare audit standard and framework • Prepare monitoring and evaluation protocol • Identify and prioritise categories of buildings to be audited • Identify/train/certify both trainer and trainee auditors (BEE) • Determine/clarify financing mechanisms • Prepare and commission audit scheme • Monitor quality of audits as well as effect on overall consumption	Phase 1 Phase 2 Phase 3	DME, Training Certification Authorities – SETAs, Public Works DME Treasury/DPW/DME DME DME
Energy Management Systems	• Test and showcase energy management systems • Promote energy management systems • Initiate Green Accounts systems • Implement Green Accounts	 Phase 1 Phase 1	SABS, Manufacturers, DME, NER, DPW, Building Industry DPW, DME, NER
Technologies **Thermal Measures (HVAC)**	• Efficient Lights Programme • Part of SANS 204 • Monitor Programme	Phase 1 Phase 2	DPW, DME, NER DPW, DME, NER

5.3 Residential Sector Programme

Key Facts

- The Residential Sector accounts for 16,4% (2000) of final energy demand;
- Much of this energy is consumed in the form of biomass in the rural areas, but an increasing amount of electricity is used in middle and high income homes and as the national electrification programme reaches more users
- Savings can be anticipated in thermal energy demand from the incorporation of energy efficiency measures (thermal insulation) in new housing, from the implementation of appliance labeling and standards and through massive education and awareness campaigns

Core Objectives

- To combat pollution on health grounds;
- To mitigate the effects of Peak Demand on power capacity;
- To introduce standards for housing and labeling/efficiency standards for household appliances;
- To introduce state-of-the-art technologies.

Approach

- Awareness raising to communicate the cost-benefits of energy efficiency in the home;
- Introduction of appliance labeling;
- Demonstration projects to create an incentive to invest in energy efficiency;
- The approach will initially address higher income (i.e. higher usage) homes and state-subsidised housing incorporating energy efficiency measures as a standard feature
- The standard for energy efficient housing (SANS 283) will be made mandatory by its incorporation into the National Building Regulations.

Table 4. Residential Sector Programme			
Output Activity	**Measures**	**Timeframe**	**Responsibilities**
Standard for Housing	• Standard 283 for energy efficient housing • Incorporate SANS 283 in National Building Regulations • Monitoring and dissemination of results	Phase 1 Phase 2	DoH, EE Experts, CSIR, Building Industry, Thermal Insulation Industry, DoH, Building Industry, DoH, Building Industry, DoH, DME
Appliance labeling	• Establish standards for household appliances • Label household appliances • Make the Label mandatory • Market appliances with labels • Monitor progress	Phase 1 ongoing	DME, SABS, Eskom, NER, Appliance Manufacturers, retailers, servicing industry
Awareness Raising Program	• Development of specific program • Implementation	Phase 1 ongoing	DME, NER, Eskom DSM
Efficient Lighting Program	• Demonstration in all sectors • Implementation • Monitoring	Phase 1 Ongoing ongoing	DME, NER, Eskom DSM, DPW
Non-electric Appliance Standards	• Study of fossil and biomass-using appliances • Draft standards developed • Standards (mandatory for some appliances) • Implementation	Phase 1 Phase 2	DME, Manufacturers, Eskom, SABS DME, Manufacturers, Eskom, SABS
Fuel Standards	• Studies • Development of standards • Implementation	Phase 1 Phase 2	DME, Manufacturers, SABS DME, Manufacturers, SABS

5.4 Transport Sector Programme

Key Facts

- Transport was responsible for 27% of final energy demand in 2000. Petroleum products represented 97% and electricity 3% of energy demand in this sector. Road transport represents 84% of energy use;
- Petrol and diesel are mainly used for road transport of passengers and freight. In terms of primary energy supply, nearly 80% is from imported oil - representing the largest item on South Africa's import account;
- Transport fuels represent a significant portion of the country's imports into the economy. Government is concerned that the impact of crude oil imports on the economy should be contained.

Core Objectives

- Build the user base for public transport through provision of quality public transport and non-motorised transport services and infrastructure;
- Incorporate international best practice into new developments for housing, government services, sports and entertainment that support the public transport objective;
- Put in place a regime of monitoring mechanisms, penalties and rewards. Conduct research to articulate the value of energy efficiency to local transport managers and customers and use results to develop target-based performance objectives for local authorities to meet in terms of public transport provision;
- Increase public knowledge and awareness of efficiency issues, including specific efficiency indicators, as well as the engendering of a "civil responsibility" regarding environmental and sustainability issues;
- Finalise an appropriate mode freight logistics policy that incorporates the energy efficiency objective

Approach

- Include transport fuel efficiency promotion in ongoing fiscal reform
- Fuel efficiency labelling of vehicles;
- Conduct and support fleet audits stressing regular vehicle maintenance;
- Support Taxi-Recapitalisation process by showing efficiency potential;

- Regulations, standards and codes of practice which will stimulate the supply of energy efficient vehicle technologies
- Public information programmes that would sensitise the motoring public to the benefits of efficiency measures.
- Complimentary programmes to change the country's transport infrastructure (moving from road to rail), and the demand placed upon it by users (spatial planning) can be viewed as longer term interventions

Table 5. Transport Sector Programme				
Fundamental Goal	**Output Activity**	**Measures**	**Timeframe**	**Responsibilities**
Optimise Passenger & goods transport	**Passenger Transport Management policy and regulatory/incentive dispensation**	• Draft appropriate goods and passenger transport policy, accompanying regulations and necessary fiscal and budgetary reform	Phase 1	NDoT, NT, DME, SARS, Local Government
	Establish local Transport Authorities (LTAs)	• Finance establishment of local Transport Authorities • Audit local Integrated Transport Plans for energy efficiency • Quantify EE baseline with TAs and establish targets	Phase 2 Phase 3 Phase 3	NDoT, DME, Local Government
Introduce Energy Management Measures in Passenger Transport	**Fee Bate**	• Vehicle licensing • Differential licensing fee • Implementation, monitoring and dissemination of results	Phase 1 Phase 2	NT, SARS, NDoT, DME, Local Government
	Efficiency labels for motor vehicles	• Development of energy efficiency label • Introduction and marketing of label	Phase 1 Phase 2	DME, NDoT, STANSA, NAAMSA, SAPIA
	Emission standards for vehicles	• Development of mandatory standard • Implement standard	Phase 1 Phase 2	STANSA, DME, DEAT, NAAMSA, SAPIA
	Promote diesel vehicles	• Taxi re-capitalization • Tax differential on petrol and diesel	Phase 3 Phase 2	NDoT, DTI NT, SARS, DME
	Audits on vehicle fleet operators	• Develop audit standards for fleet operators • Implementation and monitoring	Phase 2	NDoT
	Awareness Raising Program	• Awareness and education on driving efficiently • Influence learner driver curriculum	Phase 1/ongoing	DME, NDoT, AA, Local Government
	Roadworthy test including emission test	• Include emission standards in Roadworthy Certificate • Develop training curriculum for vehicle inspectors	Phase 2	NDoT, STANSA, DME, DEAT, Local Government
Facilitate Energy Efficiency in Freight Logistics	**Advance Appropriate Mode Freight Logistics Policy**	• Finalise research on impacts of shifts between road and rail • Audit EE of goods moved via range of freight modes • Explore implementation of an energy efficiency levy on freight movements consistent with energy impacts	Phase 2 Phase 3 Phase 3	NDoT, DME
	Exploration of renewable energy in the freight logistics sector	• Study regenerative braking systems on electric locomotives • Run pilot project to detail costs and benefits of bio-fuel mixes to road freight sector • Ensure that energy efficiency criteria are included in the capital investment plan.	Phase 3 Phase 3	NDoT, DPE, Spoornet, SAPIA

	Intelligent transportation System data management	• Establish ITS forum with key stakeholders in freight sector	Phase 3	NDoT, STANSA, SAPS, freight logistics companies, IT sector

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6. Cross-cutting Issues

6.1 Integrated Energy Planning

Expenditure on energy constitutes some 15% of South Africa's GDP. Therefore energy efficiency is an important facet of the Integrated Energy Planning process carried out by the DME. By virtue of its size and economic importance, the energy sector periodically requires considerable investments in new supply capacity, which impacts on the economy. Integrated resource planning decisions around the world now consider not only maintaining security of supply but give full consideration to the economic, environmental and social impacts of all alternatives, such as demand-side management and energy efficiency programmes. This Energy Efficiency Strategy will be used to inform the National Integrated Resource Plan of the National Electricity Regulator as well as the National Integrated Energy Plan of the DME.

6.2 Renewable Energy

There are several areas of overlap between Renewable Energy and Energy Efficiency that warrant a brief discussion.

A widespread installation of solar water heating in industrial and commercial buildings and houses has the potential to defer the need for building new power plants, as the combined heating requirements of these sectors consume the energy produced by three average power stations. The main constraint on implementing a national solar water heating programme in the Residential Sector relates to cost, which is a function of the current small market and lack of economies of scale. This lack of demand in itself is due to low public awareness of the technology or its economic benefits. Currently the cost of a domestic solar water heater would take in excess of 5 years to pay back.

However, it is a different story when it comes to large commercial installations. Because of the size, and electricity tariff at peak times, these solar water heaters are competitive with electric geysers and hotels are installing them. The main barrier again remains lack of information about the technology.

Thermally efficient housing – houses designed to save energy, can reduce household space heating requirements. The Department of Housing in collaboration with the Department of Minerals and Energy, has developed appropriate guidelines for the construction of thermally designed housing incorporating passive solar design.

The household sector requires the following measures:

- Regulation of low-cost energy efficiency measures in housing;
- Incorporating passive solar design;
- Heat insulation in homes;
- Replacement of electric geysers by solar water heaters.

Currently the Department of Housing is re-appraising its subsidised housing strategy in preference of quality rather than quantity and will revise the Housing Code to incorporate heat insulation. . A similar approach will be followed through energy

efficiency standards developed by STANSA for both buildings which are naturally ventilated (such as houses) and for office buildings that are artificially ventilated.

The implementation of the measures mentioned above will clearly reduce the need for power, mostly during periods of peak demand eg. solar water heating, heat insulation, passive solar design; and can therefore be viewed as energy efficiency interventions which reduce demand. As such DME would view such projects as eligible for funding from appropriate sources, such as the Eskom DSM Fund and indeed the NER has approved an amount of money for exactly this purpose.

In terms of bio-fuels the Transport Sector presents an important opportunity for exploring energy efficiency measures in the fuel mix in road freight. Renewable power in rail freight using regenerative braking systems in locomotives will be investigated (which also provide a means of generating power for the National Grid). Government has announced a massive investment programme for Spoornet to improve its efficiencies and thus to win back customers lost to road transport. Efforts will be made to introduce energy efficiency criteria when these investment decisions are made.

Raising awareness regarding the economic benefits of energy efficiency and renewable energy is an important step in increasing the market demand for these technologies. The development of an information strategy for both energy efficiency and renewable energy is therefore an immediate short-term priority.

6.3 Environment and Health

The lack of infrastructure and inadequate living conditions in many areas of South Africa has meant that millions of people are routinely exposed to fuels, which emit several noxious gases, and particulates, which can be deadly. National statistics show that Acute Respiratory Illness, associated with exposure to particulates, is the second highest cause of mortality in children under the age of five.

The medium term priorities of the *White Paper on Energy Policy* include the mitigation of the negative environmental and health effects of air pollution from coal and wood use in household environments. From this, two initiatives are currently being pursued by the DME:

Low Smoke Fuel Strategy

This Strategy addresses the winter coal-burning households that create a pollution problem. Several options have been assessed from a cost perspective, ranging from energy management interventions such as the 'Basa Njengo Magogo Project', to developing and manufacturing cleaner fuels for use in conventional coal stoves, to using other fuels such as liquid petroleum gas, to designing houses to require less space heating by means of insulation and ceilings. The first approach is outlined briefly below.

Basa Njengo Magogo Project - The local name for the so-called 'Scotch' Method of lighting a coal fire by inverting the contents, so that the volatiles are burned off first, dramatically reduces the time during which a fire produces smoke and creates a slower-burning fire in a matter of minutes, and in so doing reduces energy consumption by up to 30% or more (depending on the user). This is a 10-year project targeting the 1 million homes in the winter coal-burning area.

Improved Woodstoves

The Programme for Biomass Energy Conservation (a Southern African Development Community regional programme) is directed at energy conservation by the use of improved energy efficient woodstoves, which require a fraction of the wood normally required. Reductions from 30-50% are achievable, depending on the stove efficiency and the proficiency of the user. As biomass is approximately 9% of energy demand (as compared to electricity at 22%), this sector is important from a national point of view.

6.4 The Cleaner Fuels Programme

Cabinet has approved the phase-out of leaded petrol from 2006, the reduction of sulphur in diesel to a maximum of 0,05% from 2006 and that DME determine the other relevant fuel specification parameters in consultation with the relevant stakeholders. This initiative is in line with the global move towards phasing out leaded petroleum where 86% of the world's supply is unleaded.

This initiative is driven primarily by human health, environmental and air quality criteria but it is also in line with the global harmonisation of standards that are employed in Europe and Japan – those countries whose automotive manufacturers dominate the South African market. The revision of standards and their deployment fits in with the measures proposed in this document to increase energy efficiency in the transport sector.

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