GENERAL NOTICE

NOTICE 908 OF 2009

National Energy Efficiency Strategy

of the

Republic of South Africa

Department of Minerals and Energy

First Review October 2008

Foreword

In South Africa we used to take energy for granted until January 2008 when the electricity demand outstripped supply and load shedding had to take place and the fuel scarcity also made consumers aware the energy is finite and it should be used optimally. 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, coal and liquid fuels prices have contributed towards a competitive position, it has also meant that there has been little incentive to save energy.

So in many respects we started with a clean slate with little energy efficiency measures having taken place in 2005 ramping up to a significant number of energy efficiency projects in 2008. 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 labelling 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, specifically the hospitality industry is an area for potential improvement given the rapid increase in 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 labelling initiative has recently been launched whereby the energy consumption of all new "white products" will be rated for efficiency.

Perhaps the most difficult area for implementation is the changing of people's behaviour as promotion of public awareness about the costs and benefits of energy efficiency has been ongoing since 2005. Major energy savings can only be achieved through changes in people's behaviour, and *that* depends on informing them about what options exist. The recent Climate Change and Global Warming studies sensitised the nation about the impact that energy use has on the World's weather systems. In this era of climate change the Department of Environment and Tourism has taken the lead with a new modelling study called the Long Term Mitigation Study (LTMS) which looks at the required and urgent measures to reduce CO_2 emissions. It is hoped that this Energy Efficiency Strategy will provide a blueprint for this venture.

BUYELWA P SONJICA
Minister of Minerals and Energy

Executive Summary

This is the first review of the Energy Efficiency Strategy for South Africa after its publication in 2005. It is a 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 long term 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.

It should therefore not be confused with the Power Conservation Programme for electricity. Conservation by nature is only used in emergencies where there is not sufficient supply of energy and therefore will have a negative impact on production, as the only alternative for the extreme short term is to shut down activities. Whereas energy efficiency has a positive impact on production but takes place over a certain time period, more or less a 3 year cycle is followed to plan, implement and measure the implementation of energy efficiency projects.

Energy efficiency improvements are and 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 and therefore has a longer term goal.

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 Labelling	Labels denoting energy consumption of appliances
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
DEAT	Department of Environmental Affairs and Tourism
DNA	Designated National Authority
DoH	Department of Housing
The dti	Department of Trade and Industry
DSM	Demand Side Management
EE	Energy Efficiency achieving the same or improved output with a reduced input of energy
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
LED	Light Emitting Diode
LTA	Local Transport Authority
NDoT	National Department of Transport
SANERI	South African National Energy Research Institute
NERSA	National Energy Regulator of South Africa
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

List of Figures

List of Tables

1. Introduction

1.1 Introduction and Background

The first National Energy Efficiency Strategy was published in March 2005 with the proviso that it would be reviewed every 3 years. This document has been drafted after consultation with stakeholders during October 2008 and is known as the first review of the National Energy Efficiency Strategy of 2008.

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 especially since 2005 and the release of the first Energy Efficiency Strategy, energy efficiency has significantly gained in stature in South Africa 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 Minister signed the Energy Efficiency Accord with over 40 large industrial and commercial consumers and a recent report indicated that 14 of these consumers managed to invest R9.9 billion on energy efficiency improvements and saved a significant 1 441 GWh and 5 190 Terajoules of energy over the 3 year period. This is equal to the entire residential sector consumption for 2 days.

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 to further encourage the implementation of the National 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) as well as the recently promulgated Energy Act (2008). The policy and Act aim 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 2004 the total primary energy supply to the nation was over 5,240 Petajoules, of which 68% 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. This situation will not continue in the future as the energy supply in South Africa has reached a point where it is not sufficient for the demand and therefore the prices will have to increase significantly. Indeed, by international standards the South African economy uses a relatively high amount of energy per unit of national economic output, or GDP (4.96 MJ per million Rand in 2004).

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 LTMS study by DEAT which indicated that the required by science reduction in emissions needs significant effort and fast tracking of policies.

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-labelling 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."*

In this regard the Minister signed the Energy Efficiency Accord with over 40 large industrial and commercial consumers and this Accord will be strengthened in the future. With the assistance of the SABS and other experts standards for, amongst others, electric motors, compact fluorescent lamps and buildings (including households) have been completed. The voluntary standard for refrigerator labelling has also been completed. It is clear that the labelling need to be extended to other products.

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."*

With the assistance of NAAMSA, SABS and other experts a labelling scheme for all new vehicles has been introduced in July 2008. The label gives an indication of the fuel consumption of the vehicle as well as the emissions.

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) and the Long Term Mitigation Scenario Study done by DEAT (2007). 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.

In cost-benefit terms the best measurement stick is the payback period. In the short and medium term 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. Due to the increase in energy prices these more and more projects will become financially viable over the next 5 years.

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 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 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 has been shown that the country's existing power generation capacity is insufficient to meet the rising national maximum demand between 2008 and 2012. Energy efficiency is integral to managing the shortage in electricity. Efforts will be made to give utilities responsibility for meeting a portion of the target set out in this strategy through its annual shareholder compacts.

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, 2004* 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 2006.*

Primary Energy Supply

The total *primary* energy supply to South Africa increased from 3,924PJ in 1993 to 5,240PJ in 2004. In 2004 coal contributed 68% of the total national primary energy supply, as illustrated in Figure 1, below.

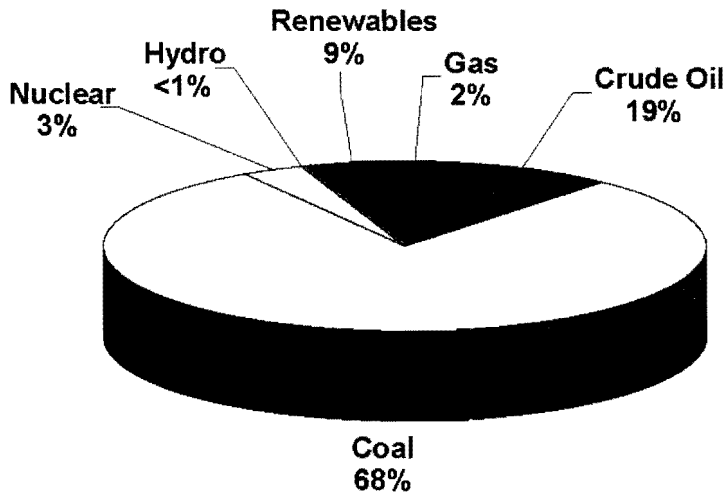

Figure 1: 2004 Primary Energy Supply

Sectoral Usage

The final *end-user* energy usage in 2004 was 2,717PJ. The three largest energy-consuming sectors were industry, residential and transport. The remaining sectors accounted for less than 10% of final energy demand in 2004. Figure 2 depicts the sectoral split of final energy use, and excludes "non-energy use" carriers, such as solvents and lubricants.

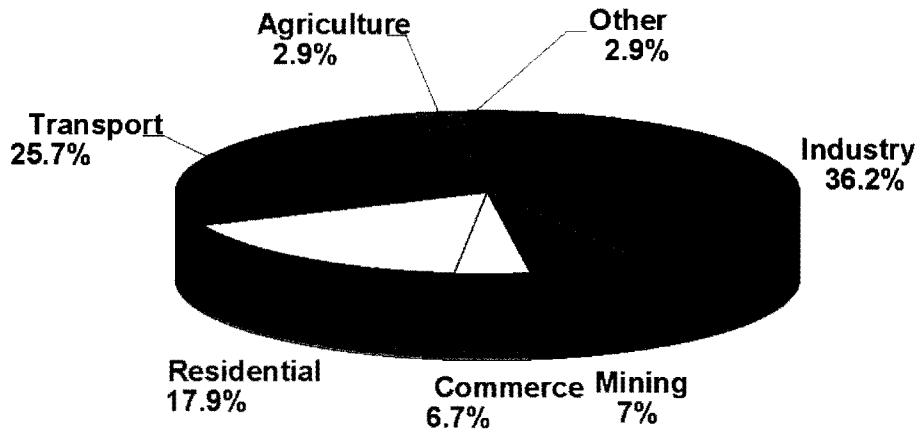

Figure 2: 2004 Final Energy Use by Sector

Figure 3, below, also refers to 2004 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.

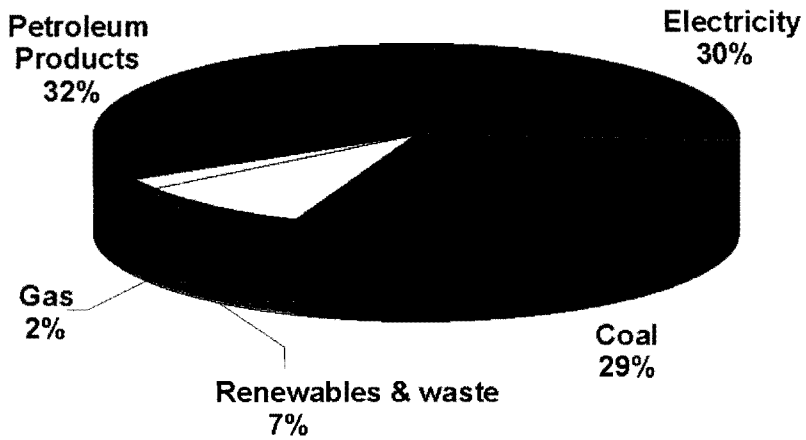

Figure 3: 2004 Final Energy Use by Carrier

Energy Intensity

Compared with developed countries, the South African economy uses a lot of energy for every Rand of value added. In 2006 South Africa had the 42nd biggest GDP in the world but was the world's 21st 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 in the past did give 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 from now on 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 when the Market Exchange Rate (MER) is used rather than the Purchase Power Parity (PPP).

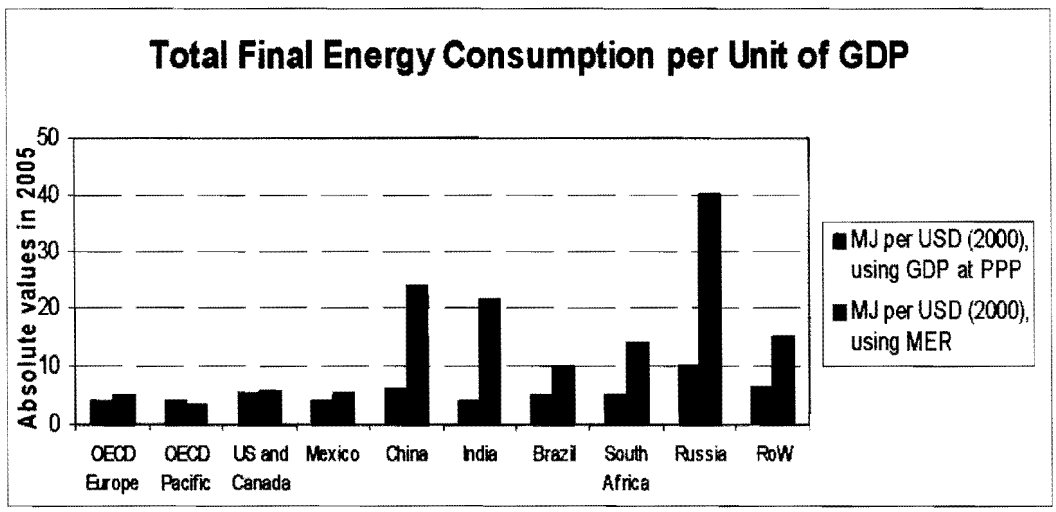

Figure 4: Final energy demand per capita (2005) (IEA Worldwide Trends in Energy Use and Efficiency, 2008)

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.

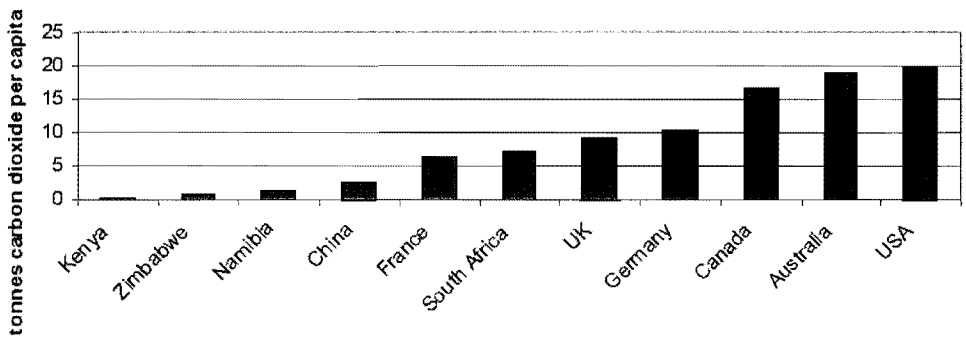

Figure 5: Carbon Dioxide Emissions per capita (IEA, 2001)

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 5, 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 "Cleaner Fuels Strategy" (*Joint Implementation Strategy for the Control of Exhaust Emissions from Road-going Vehicles in the Republic of South Africa, 2003*).

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 will be a steep and incremental rise in energy prices over the next few years. However, 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 paybacks involved.

Energy efficiency makes sound economic sense. Although the unit price of energy may be low, for large industrial consumers, 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 labelling.

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; Completed and this document is the review of the first phase.
- 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 7, 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.

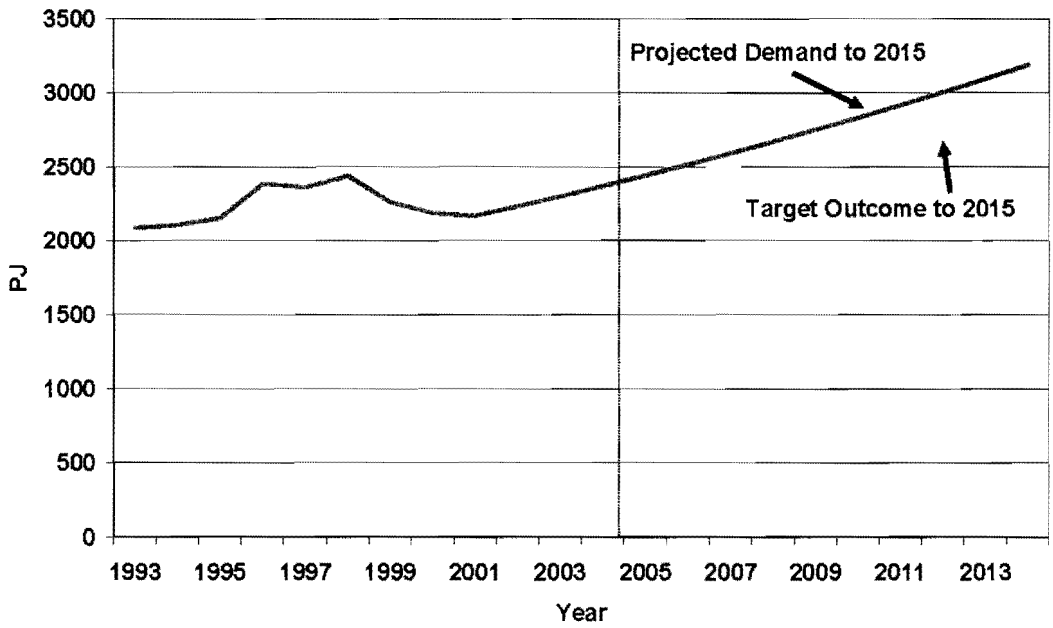

Figure 6: Final Energy Demand – Target Outcome to 2015

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.

The Long Term Mitigation Study (LTMS) of Department of Environment and Tourism

The LTMS was completed in October 2007 and was undertaken under the leadership of the Department of Environment and Tourism but including all major departments, industry and relevant stakeholders. The study used the most recent data available and did a modelling exercise to determine what the emission reduction should be by 2050 to mitigate against global warming and climate change.

Due to the fact that energy production and consumption amounts to almost 80% of total emissions energy efficiency and renewable energy developments will play a significant role in the reduction of emissions. This document will only focus on the energy efficiency side of the modelling work done.

The following energy efficiency initiatives are required in terms of the LTMS study to achieve the required by science reduction in emissions:

	Mt CO2 in 2050	1.1 tonne = 1 MWh	Peta Joules
Limit on Sport Utility Vehicles	0.95	863,636	3.1
Commercial Energy Efficiency	22	20,000,000	72.0
Residential Energy Efficiency	14	12,727,273	45.8
Electric Vehicles	24	21,818,182	78.5
Vehicle Efficiencies	55	50,000,000	180.0
Modal shift	30	27,272,727	98.2
Industrial Energy Efficiency	248	225,454,545	811.6
Total	**393.95**	**358,136,364**	**1,289.3**

Table 1: Energy Efficiency requirements as per the LTMS study

If these figures and the requirement of a saving of 1 289 Petajoules by 2050 is extrapolated onto the current energy efficiency targets the following graph emerges which gives an indication of the exponential increase required in energy efficiency measures to achieve this target.

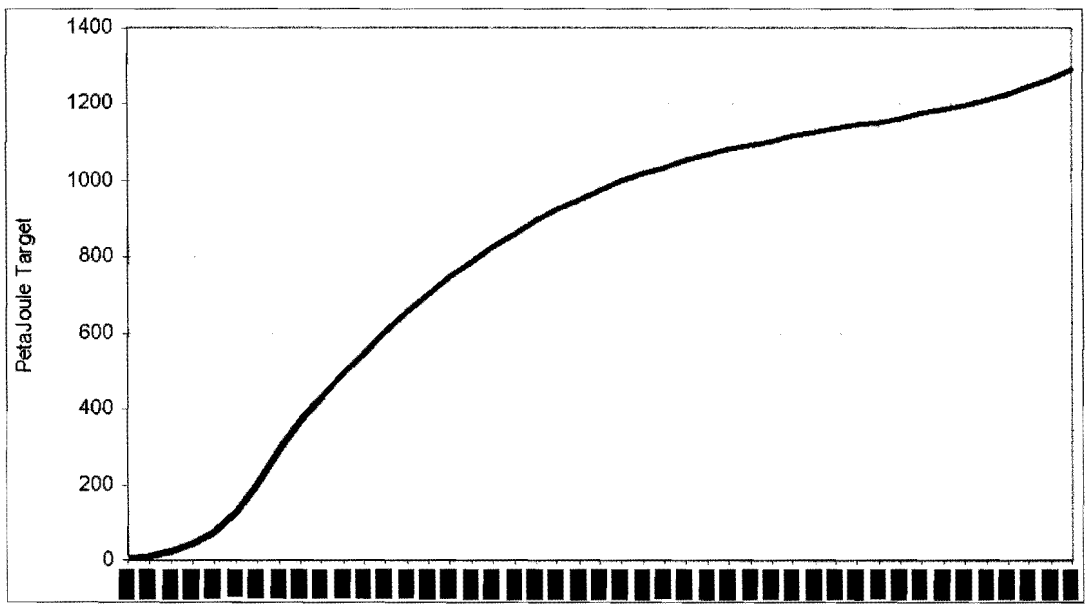

Figure 7: LTMS long term target for energy efficiency extrapolated on current target

The red line represents the current target of 12% by 2015 and the blue line represents the LTMS target going forward until 2050.

Review of Targets

A review of the national and sectoral targets will continue to 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 behavioural 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.

Sub-Sector Targets

Due to the industrial and mining sectors in South Africa being of a variety of different industries, it was agreed that sub-sectoral targets should be implemented as all industries are not able to achieve the same energy efficiency improvements.

The sub-sectoral targets are as follows:

An improvement in energy intensity of 1% per annum for the Iron and Steel Industry

An improvement in energy intensity of 1% per annum for the chemical and petrochemical industries

A final energy demand reduction of 10% for the mining sector by 2015 (using an adjustable baseline)

An improvement in energy intensity of 2% per annum for the paper and pulp and printing industries

An improvement in energy intensity of 2% per annum for the cement industry

Power Generation

A Target of 15% reduction in "parasitic" electrical usage by 2015.

This target shall apply to non-essential consumption[1] within all assets under the ownership and control of the power sector.

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. Since 2005 a systematic review of Eskom's energy usage has been categorised within the major operational / technical sub-sectors: power generation, transmission, distribution and administrative buildings. 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.

- **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.

The outcome of the recent study could be summarised as follows:

- **Power Generation**: Whilst the initial investigations addressed all Auxiliary loads within existing thermal power stations, it has been established that the majority of these are necessary for ongoing generation function and cannot be termed truly parasitic. True parasitic (non-essential) loads are limited to lighting, air-conditioning and administrative functions associated with the power plant. Whilst the majority of these non-essential loads are not specifically sub-metered at present, a project has been implemented to allocate sub-meters per power station for coverage of parasitic loads. At this stage, therefore, the total lighting, heating ventilation air-conditioning (HVAC) and administration loads are currently based on estimates which will be refined as more data arises.

- **Transmission**: Non-essential loads have been provisionally identified as substation lighting, HVAC and fans, which combined are estimated at 1.8GWh per site per annum based on sample audits. A significant percentage of this load is attributable to HVAC, which is presently subject to a review regarding savings opportunities. There are 160

[1] Non-essential consumption defined as: administrative buildings, depots and service centers, administrative buildings within power plants focusing on lighting and HVAC (i.e. non-process loads) and plant lighting, and substations focusing on lighting.

substations within the transmission division of Eskom, none of which are metered at present. A programme is in place to roll-out electricity metering across the division.

- **Distribution**: The non-essential loads within the distribution division have been identified as substation lighting, HVAC and fans, as well as all energy usage accountable to Eskom's Technical Service Centres (TSC's). Most TSC's are metered for electricity, whereas no distribution substations have metering installed. Substation energy usage will, therefore, be confirmed by sample metering to firmly establish the baseline data.

- **Administrative buildings**: Metered data for all administrative facilities nationwide has been collated for the baseline year April 2006 to March 2007. Some metering upgrades and improved data management have been implemented.

- **Other initiatives**: Generation will target a reduction in Heat Rate (MJ/kWh) as measured for thermal power stations by the end of January 2009. If successful, the initiative will result in an improvement in efficiency at power stations. Whilst this might not necessarily directly translate to increased electricity output, it will support energy-responsible behaviour, and deliver benefits to plant reliability.

A target of 15% is therefore set for this sector based upon *savings measures of non-essential consumption (see footnote on previous page) within all assets under the ownership and control of the power sector taking into consideration other national priorities (e.g. Long Term Mitigation Scenario's, and the Energy Conservation Scheme.*

Commercial and Public Building Sector

A Target Final Energy Demand Reduction of 20% 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 modelling analysis. Additionally, a further 4% is thought to be realistically achievable through managerial intervention and behavioural 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 485 PJ in 2004 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 labelling, efficient lighting and standards for non-electric appliances such as energy efficient coal stoves, wood stoves, and liquid fuel stoves, as well as

subsidies for solar water heating 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 behavioural 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 already existing labelling 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 2 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 2. 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	• Access to affordable energy services improved by promoting low energy