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IMPLEMENTING ENERGY EFFICIENCY – LESSONS FOR SOUTH AFRICA

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A project report submitted to the Faculty of Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

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ABSTRACT

The cornerstone of a successful energy efficiency strategy is strong and unequivocal government support, through the promulgation of appropriate legislation that accurately locates energy efficiency within an integrated energy strategy. Energy legislation that accurately captures the true cost of energy in the pricing thereof, is yet another important lessons to be learnt from countries that have had a measure of success in implementing energy efficiency. The legislation must also bring into existence the energy efficiency agency - the key ingredient of a successful energy efficiency strategy.

Lack of consumer awareness in South Africa, about the social, environmental and financial benefits of energy efficiency, as well as the long-term cost of energy, need to be prioritised, and addressed through a comprehensive multi-media campaign reaching both rural and metropolitan energy consumers. An implementation strategy that takes account of the country's developmental priorities, as well as the needs of different energy users would be the recommended approach.

THE DECLARATION

I, Moroasereme Tommy Ntsoane declare that this project report is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university

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----------day of----------

THE DEDICATION

This report is dedicated to my grandmother, Mologadi Sina Soafo, and my mother, Evah Ramadimetshe Ntsoane, for being the pillars of strength in my life, and showing me the value of sacrifice, dedication, passion, resilience and tenacity in the face of adversity.

This report is also dedicated to my son Katlego Monchu Ntsoane, for having borne the full brunt of my studies. I owe you a lot.

ACKNOWLEDGEMENTS

I would like to acknowledge the enduring patience and encouragement of my supervisor, Professor Fred Ahwireng-Obeng, without whom I would not have been able to complete this project report. I also acknowledge all my respondents, for affording me the opportunity to interview them for this project report.

CONTENTS Page No.

TITLE PAGE i

ABSTRACT ii

THE DECLARATION iii

THE DEDICATION iv

ACKNOWLEDGEMENT v

CONTENTS vi

LIST OF TABLES vii

LIST OF FIGURES viii

LIST OF APPENDICES ix

1 INTRODUCTION....1

1.1 CONTEXT OF THE STUDY....1

1.2 PURPOSE OF THE STUDY....2

1.3 THE PROBLEM....2

1.4 THE SUB-PROBLEMS....2

1.5 DELIMITATIONS AND LIMITATIONS....3

1.6 SIGNIFICANCE OF THE STUDY....3

1.7 ASSUMPTIONS....4

2 LITERATURE REVIEW....5

2.1 GLOBAL ENERGY DEMAND....5

2.2 SOUTH AFRICAN ENERGY OVERVIEW....6

2.2.1 Energy supply....6

2.2.2 Energy demand....6

2.2.3 Energy balance....7

2.2.4 Energy intensity....10

2.3 ENERGY EFFICIENCY....12

2.3.1 Defining energy efficiency....12

2.3.2 Rationale for implementing energy efficiency....14

2.3.3 Other aspects of energy efficiency....16

2.4 ENERGY EFFICIENCY IN SOUTH AFRICA....22

2.4.1 Government policy *22*
2.4.2 Potential for energy efficiency *23*
2.5 ENERGY EFFICIENCY IN THE DEVELOPING WORLD 25
2.6 ENERGY EFFICIENCY AND THE DEVELOPED WORLD 28
2.7 GLOBAL EXPERIENCES IN ENERGY EFFICIENCY (COUNTRY CASE STUDIES) ..30
2.7.1 Latin America *30*
2.7.2 North America *39*
2.7.3 Energy Efficiency in Europe *42*
2.7.4 Energy Efficiency in Asia *51*
2.7.5 Energy Efficiency in Africa *64*
2.8 IMPLEMENTATION STRATEGIES FOR ENERGY EFFICIENCY 79
2.8.1 Energy Efficiency Policy Interventions *79*
2.8.2 Energy efficiency programs *82*
2.8.3 Equipment and Appliance energy efficiency standards *85*
2.8.4 Demand-Side Management *85*
2.8.5 Assessment of Probability of Success of Strategy *86*
2.8.6 Implementing strategy *87*
2.9 SUMMARY OF LITERATURE REVIEWED 89
2.10 INSTITUTIONAL INFRASTRUCTURE 89
2.11 LEGISLATIVE FRAMEWORK 90
2.12 ENERGY PRICING POLICY 91
2.13 BUILDING CODES AND REGULATIONS 91
2.14 APPLIANCE AND EQUIPMENT LABELLING AND ENERGY EFFICIENCY STANDARDS 92
2.15 PUBLICITY AND INFORMATION 93
2.16 PRIVATE AND PUBLIC SECTOR COLLABORATION 94
2.17 A COMPREHENSIVE APPROACH TO ENERGY EFFICIENCY 95
2.18 RESEARCH, DEVELOPMENT, DEMONSTRATION AND TESTING 95
2.19 GOVERNMENT INITIATIVES VERSUS PRIVATELY DRIVEN INITIATIVES 95
2.20 SOURCE OF FUNDING 96
2.21 MONITORING AND POST-IMPLEMENTATION EVALUATION OF PROGRAMS 96
2.22 DONOR SUPPORT 96

2.23 INCENTIVES 97
2.24 RECOGNITION AND CELEBRATION OF SUCCESSES 97
2.25 CAPACITY BUILDING 98

3 RESEARCH QUESTIONS 98

4 RESEARCH METHODOLOGY 98

5 PROPOSED IMPLEMENTATION STRATEGY 99

5.1 COMPREHENSIVE DATABASE OF THE ENERGY SECTOR IN SOUTH AFRICA 99
5.2 LEGISLATION AND ENFORCEMENT 100
5.3 INSTITUTIONAL FRAMEWORK 100
5.3.1 Energy efficiency Agency (co-ordination) 100
5.3.2 Funding 102
5.3.3 Communication and information dissemination 104
5.3.4 Education and training 105
5.3.5 Donor agencies 106
5.4 FOCUS ON HIGH ENERGY INTENSITY SECTORS OF THE ECONOMY 107

6 POTENTIAL SUCCESS OF IMPLEMENTATION 108

6.1 ASSESSMENT METHODOLOGY 108
6.2 SUMMARY OF RESULTS OF ASSESSMENT OF FEASIBILITY OF PROPOSED STRATEGY 108
6.2.1 The role of government in energy efficiency 108
6.2.2 The single most important infrastructure 109
6.2.3 How does low electricity pricing affect energy efficiency 110
6.2.4 Energy efficiency programs that are suitable for South African conditions. 111
6.2.5 How to raise awareness and disseminate information 112
6.2.6 Role of Public Private Partnership in energy efficiency 113
6.2.7 Do we have R&D capacity locally to support energy efficiency? ... 113
6.2.8 How should energy efficiency be funded 114
6.2.9 What is the role of donors 115
6.2.10 How important is recognition and reward in energy efficiency 115

7 CONCLUSION 116

7.1 SUMMARY OF MAJOR FINDINGS 116

7.1.1 Literature review 116

7.1.2 Survey 117

7.2 RECOMMENDATIONS 118

7.2.1 Legislation 118

7.2.2 Institutional infrastructure 119

7.2.3 Publicity and information dissemination 120

7.3 IMPLICATIONS FOR SOUTH AFRICA 120

7.3.1 Skills shortage 121

7.3.2 Government support 121

7.3.3 Industry restructuring 122

8 REFERENCES 123

9 APPENDICES 133

LIST OF TABLES

		Page No.
Table 1(a):	South Africa's energy balance for 2000	8
Table 1(b):	Consumption balance for 2000	9
Table 2:	Energy intensive industries	24
Table 3:	Factors directly correlating with difference in Developing and developed world's efficiency of energy production end-use	27
Table 4:	Energy efficiency actors and their roles	32
Table 5:	Some of the activities of EST	45
Table 6:	Energy efficiency week activities	71
Table 7:	Integrated comparative table	75
Table 8:	Policy measures	83

LIST OF FIGURES

		Page No.
Figure 1:	Energy consumption per GDP 1995$ and GDP 1995$	10
Figure 2:	Residential energy intensity	12
Figure 3:	Role of Government	109
Figure 4:	What is the single most important infrastructure	110
Figure 5:	How does electricity pricing affect energy efficiency	111
Figure 6:	Which energy efficiency program should SA pursue	111
Figure 7:	How to raise awareness and disseminate information	112
Figure 8:	How can PPP assist energy efficiency	113
Figure 9:	Do we have adequate R&D capacity to support energy efficiency	114
Figure 10:	How should energy efficiency be funded	114
Figure 11:	What is the role of donors and NGOs	115
Figure 12:	Is recognition and reward important	115

LIST OF APPENDINCES

		Page No.
APPENDIX A:	South African Energy Balance for 2000	134
APPENDIX B:	Detailed Consumption Balance for 2000	135
APPENDIX C:	Energy efficiency reports by DME	137
APPENDIX D:	Interview questionnaire	140
APPENDIX E:	Interview questionnaire responses	141

1 INTRODUCTION

1.1 Context of the Study

South Africa is well endowed with abundant energy mineral resources, especially coal. Due in a large measure to the abundance of this natural resource, the country has developed an extensive network of fossil-fired power generation plants, which deliver one of the lowest priced electricity in the world.

Fossil fuels such as coal, uranium, liquid fuels and natural gas play a significant role in the growth of the South African economy, as the Department of Minerals and Energy (DME) (1998) state in the energy policy document. The economy is therefore of necessity, dominated by primary industries that are highly energy intensive. Cheap electricity is therefore a critical driver of South Africa's economic development. For that reason, coal will therefore remain a major source of energy in South Africa for the foreseeable future. Indeed, the cheap electricity positions South Africa as an attractive investment destination for energy intensive industries.

The use of coal however has significant implications for the environment and sustainability of economic development. There is global consensus that threats posed by the unrestricted usage of coal must be ameliorated, and that solution lies in the promotion of more efficient use of coal through energy efficient processes and technologies.

Energy efficiency is one way in which energy can be provided in a sustainable manner while maintaining simultaneously acceptable levels of carbon dioxide emissions in the atmosphere. The desire to reach acceptable levels of carbon dioxide emissions is not the only driver for energy efficiency. Because energy consumption expenditure in South Africa constitutes 15% of GDP, and particularly, a large portion of poor household's expenditure, it is important to give attention to the efficient utilisation of energy (DME, 1998).

In the energy policy white paper, DME notes that there exists significant scope in South Africa for improved energy efficiency within the energy demand sectors (1998). Notwithstanding this opportunity, no coordinated and meaningful efforts have been made to implement energy efficiency to realise this potential. Instead, both government, ESKOM and a number of private sector companies, in a highly haphazard and uncoordinated approach, have instituted a number of studies dealing with various energy efficiency and conservation issues. A lot of the information dealing with recommendations on policy guidelines, strategies and plans remains unimplemented for various reasons.

There is therefore, a need to firstly, understand the state of energy efficiency in South Africa, and to outline the reasons that stand in the way of the implementation of a successful energy efficiency strategy.

1.2 Purpose of the Study

The purpose of the study is to review global trends and experiences in the implementation of energy efficiency, and to apply such theory in developing a comprehensive strategy for implementation of energy efficiency in South Africa.

1.3 The Problem

The key problem to be addressed by the study is the formulation of an implementation strategy for energy efficiency in South Africa.

1.4 The Sub-Problems

The sub-problems of the study can be stated as follows:

- The first sub-problem: To seek an understanding (definition) of energy efficiency and the various aspects that impact upon it, and to establish the rational for pursuing it.

- The second sub-problem: To detail the global experience of implementing energy efficiency, for purposes of identifying common lessons arising from specific energy efficiency programs.
- The third sub-problem: To establish the current state of energy efficiency in South Africa and to identify the key drivers shaping its status.

- The fourth sub-problem: To formulate an implementation strategy for energy efficiency in South Africa, including an assessment of its feasibility.

1.5 Delimitations and limitations

The study will concern itself only with secondary data. Thus, no primary data collection will be undertaken. But a rigorous analysis of the secondary data will be undertaken.

1.6 Significance of the Study

The significance of the study lies in its attempt to understand the rational and key success factors for the development and implementation of sustainable energy efficiency strategy, and to investigate reasons why South Africa has thus far failed to take advantage of the potential that exists for energy efficiency. The study's key impact will be in the design of an implementation strategy for energy efficiency in South Africa.

A successful and sustainable energy efficiency programme has a material, positive and long-lasting implications for the South African economy. South Africa has ratified a number of international protocols for the protection of the environment, especially in view of its dependence on the exploitation of natural resources, and therefore the concomitant environmental degradation entailed. Energy efficiency presents a unique opportunity for sustainable utilisation of the natural energy resources.

1.7 Assumptions

The study assumes the availability and access to sufficient published and unpublished literature on energy efficiency in South Africa, and specifically, on the rest of the African continent.

2 LITERATURE REVIEW

2.1 Global Energy Demand

Even in an energy efficient scenario, world energy demand is set to grow to very high levels on account of the growth of demands from developing regions. Current per capita consumption of commercial energy in developing countries is exceedingly low compared with industrialized nations. Anderson (1995) captures the existing global disparities in current energy consumption when he states:

> *"In the Unites States, per capita consumption of commercial energy is 8 tonnes of oil equivalent energy per year, or 80 times more than in Africa, 40 times more than in South Asia, 15 times more than in East Asia, and 8 times more than in Latin America…"*

These disparities clearly points to a very large demand in energy, assuming economic progress.

Anderson (1995) further anticipates large energy demand increases from developing countries on account of the more than two billion people in developing world still without electricity, the rise in world population and rising per capita incomes an industrialisation in developing countries. Anderson (1995) further notes that such rapid expansion in electricity demand occurred in the industrial countries for the first three-quarters of the present century even as energy efficiency improved. Developing countries are going through the same sort of expansion, but with populations rising to 10 times those of the rich countries in the Organisation for Economic Cooperation and Development (OECD).

2.2 South African energy overview

The South African energy situation is best described by van Horen, Eberhard, Trollip & Thorne (1993:623) when they state that “South Africa’s energy sector is characterised by an exceedingly high dependence on coal, unique and massive investments in oil from coal plants and large coal fired power stations, intensive use of abundant and cheap energy supplies in the mining, industrial and commercial sectors of the economy, and energy scarcity among large numbers of poorer households”

2.2.1 Energy supply

Coal contributes about 80% of primary energy use in South Africa, with about half going to Eskom, the national electricity utility – which generates 98% of electricity sold in the country, and more than half of the electricity produced on the African continent (Van Horen, Eberhard, Trollip & Thorne, 1993).

Eskom has a licensed capacity of 43 142 MW and a net maximum generating capacity of 35 324 MW and operates a series of large 3600 MW stations, which are concentrated around the coalfields of Mpumalanga Province (NER, 2002).

Nuclear energy provides 1% of South Africa’s primary energy and hydro-electricity from two small stations on the Orange River provides less than 1%. The remaining 6% of primary energy is provided by biomass, comprising mainly wood fuel and dung (NER, 2002; Van Horen *et al*, 1993).

2.2.2 Energy demand

The following demand sectors have been identified.

- Households
- Industry, Commerce and Mining
- Transport
- Agriculture

South African households consume some 24% of the country's energy, and by 1997, about 60% of households had access to electricity, yet electricity contributes only 20% of household energy consumption. Most energy is derived from fuel wood and other fuels as follows (DME, 1998):

Electricity	20%
Wood fuel	65%
Coal	9%
Illuminating paraffin	8%

2.2.3 Energy balance

A summary of South Africa's energy balance for the year 2000, as determined by Hughes, Howells & Kenny (2002) is as shown in Table 1. Refer to Annexure A for further detail.

From the information in Table 1, it is clear that South Africa produces a substantial portion of its energy needs. However, it is not totally self reliant as it still imports a substantial amount of energy in the form of crude oil. Industry is by far the major energy consumer, followed by transport, residential and agricultural consumers in that order. Within the industrial sector, the iron and steel, as well as the chemicals industry consume the most energy, whilst road transportation is the dominant energy consumer by a substantial degree. Within the building sector, residential consumers are the largest energy consumers, whilst commercial farming accounts for the most energy consumed by the sector.

Table 1(a): South Africa's energy balance for 2000

SECTORS	TOTAL (FIGURES IN Peta joules
Production	6000
Imports	991
Exports	-2758
Marine Bunkers	-123
Total primary energy supply	**4110**
Electricity plants	-1187
Petroleum refineries	-358
Own use	0
Distribution losses	-98
Total transformation	**-1362**
Agriculture	100
Transport	581
Other	51
Commerce	78
Residential	283
Industry	1272
Non energy	483
Total demand	**2972**

Source: Adapted Hughes, Howells & Kenny, 2002

Table 1(b) – Consumption balance for 2000

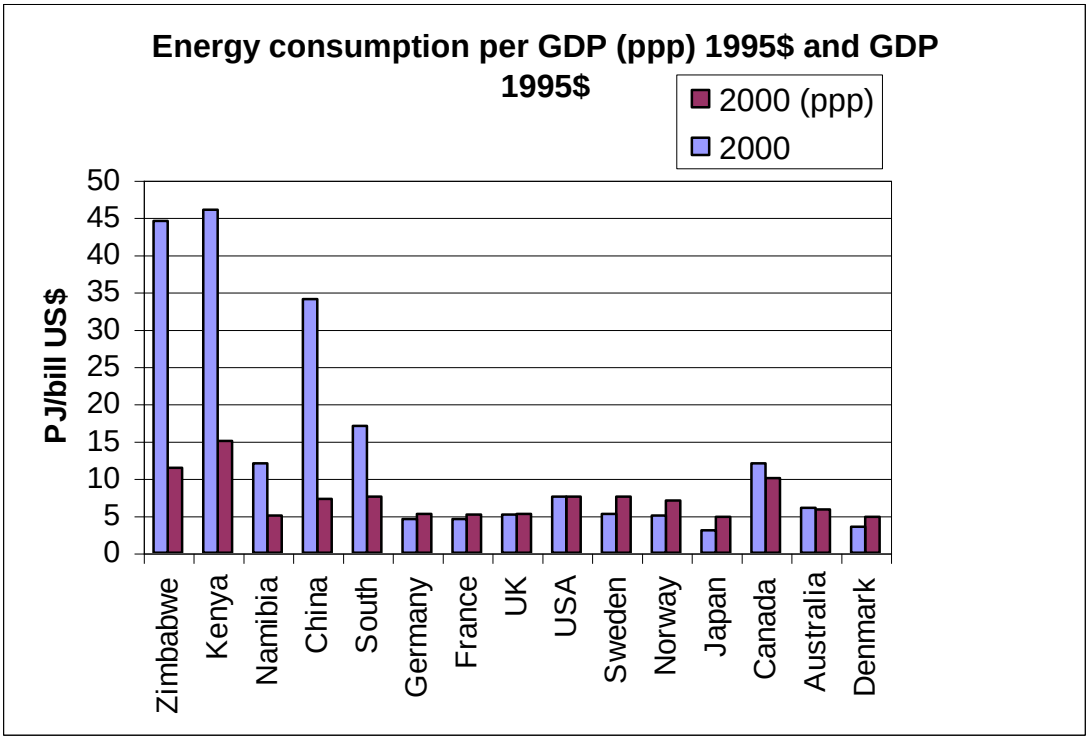
Sector		Total in Peta Joule
Industry	Iron & Steel	363.2
	Chemicals and Petrochemical	282.9
	Non-ferrous metal	63.9
	Non-metallic minerals	63.6
	Transport equipment	0.22
	Machinery	6.46
	Mining & quarrying	150.9
	Food & Tobacco	113.2
	Paper, Pulp and Print	113.2
	Wood & wood products	-
	Construction	12.5
	Textile & leather	13.9
	Others	87.8
Transport	Aviation	70
	Road	489.7
	Rail	21
	Pipeline transport	-
	Internal navigation	-
	Others	0.4
Building	Public buildings	41.58
	Commercial buildings	35.92
	Residential - urban	72.17
	Residential - rural	94.15
	Residential - township	66.53
	Residential – low cost	47.25
	Residential - others	-
Farming	Commercial farming	86.1
	Subsistence farming	-
	Other	-
TOTAL		**2296.6**

Source: Adapted from Hughes, Howells & Kenny, 2002

2.2.4 Energy intensity

By comparing South Africa's energy consumption per GDP (purchasing power parity), to that of several countries, Howells *et al* (2002) were able to show that South Africa's energy use per capita is comparably low, but its energy intensity in terms of GDP is high, when compared to that of developed countries, as depicted in Figure 1. Developing countries such as China, Zimbabwe and Kenya have energy intensities that are comparably higher than those of South Africa. This phenomenon is ascribable to low income per capita, low energy intensity of the transport and residential sectors and the high-energy intensive nature of mining and minerals processing.

Figure1: Energy consumption per GDP (ppp) 1995$ and GDP 1995$



Source: Howells et al (2002)

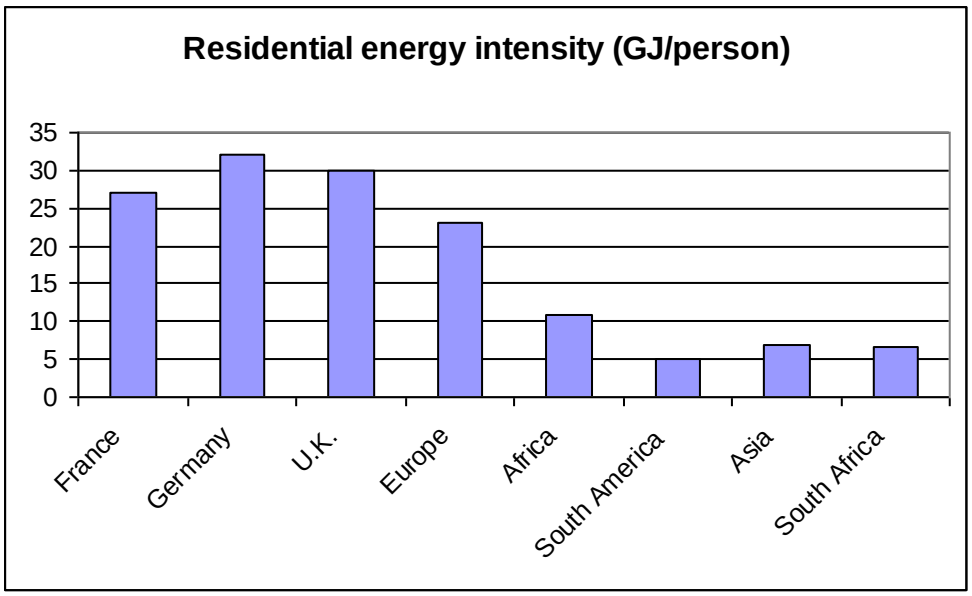
Howells *et al* (2002) were able to show clearly that the largest consumers of energy in the industrial sector in South Africa are the sub-sectors of iron and steel, chemicals, paper and pulp and mining. This profile of energy usage reveals domination in industry of processes that require a high input of energy per value added output or a higher energy requirement per contribution to GDP.

Energy audits in the commercial sector in South Africa have identified considerable opportunity for energy savings. The commercial sector uses mainly electricity, and consumes 2.5% of the energy produced in South Africa, and provides 43% of the GDP (Howells *et al*, 2002).

Residential energy efficiency and fuel use differs widely between affluent and poor households in South Africa. Affluent households use electricity as a primary fuel, and township and RDP houses use kerosene and coal as primary fuel and rural households use wood as primary fuel (Howells *et al*, 2002).

South Africa has low energy intensity per household, and a large proportion thereof is renewable. A key determinant of household energy demand in the residential sector is disposable income. South Africa's residential energy intensity against that of the rest of the African continent, South America, Asia and Europe is illustrated Figure 2 (Chipman, 1999), (IEA, 2002). It clearly shows how South Africa lags behind some of the industrialised nations like Germany and France in residential energy intensity, and the fact that it is instead comparable to developing nations of Asia, South America and African continent.

Figure 2: Residential energy intensity (GJ/person)



Source: Chipman (1999); IEA (2002).

Although the transport sector energy intensity in South Africa is lower than that of most developed economies, South Africa is experiencing increasing road congestion and pollution due to over-reliance on private vehicles and mini-bus taxis. Transport related pollution is also higher than that of developed countries, with emissions from the transport sector currently accounting for about 23% of TFC carbon dioxide emissions (Howells *et al*, 2002).

2.3 Energy Efficiency

2.3.1 Defining energy efficiency

Definitions of energy efficiency from various sources abound. However, the World Bank (1998) concedes that energy efficiency is not a well-defined concept. The DME (1998) defines energy efficiency as a measure of the savings of energy, which is used to provide goods and services, while maintaining the desired levels of benefits. Chriestie and Ritchie's (1992) definition of energy efficiency is that it relates to the reduction of energy

inputs per unit output, where the latter is measured in terms of useful heat, light and mechanical work, etc. Anderson (1995) defines energy efficiency as follows:

> *"Energy efficiency is a technical term for the amount of heat, light, motive power, or refrigeration delivered for a particular service per unit of energy consumed…"*

Other definitions fail to differentiate energy efficiency from energy intensity. Energy intensity on the other hand relates to energy consumed per unit of output.

Snow (1997) makes the important point that energy costs are controllable and that it is worthwhile expending time, effort and capital to achieve that control. He further points out that energy efficiency does not necessarily entail deprivation, rather that it seeks to derive the greatest benefit from the application of available energy carriers.

Some definitions do not seem to make a distinction between energy efficiency and energy conservation. However Summers, Kruger, Mant & Childs (1998) distinguish between energy efficiency and energy conservation. They define energy efficiency as a scientific concept whilst the idea of energy conservation refers to saving or using less energy, i.e. it describes human action. Smith (1998) also makes a distinction between energy efficiency and energy conservation when he states "Energy conservation reduces the amount of energy used in a building without regard to employees' comfort or productivity. Turning back thermostats in the winter and up in the summer will save energy. Energy savings occur, but at the expense of occupant's comfort. Energy efficiency also reduces the amount of energy used, but the occupant's comfort level is maintained or improved."

In his paper, Torleif (1996) regards energy conservation as policy measures other than price and tax changes intended to improve the efficiency in end-use of energy.

2.3.2 Rationale for implementing energy efficiency

DME (1998) cites economic drivers for seeking to implement energy efficiency by stating that since expenditure on energy constitutes a large portion of the country's GDP (15%), and a particularly large proportion of poor households' expenditure, it is necessary to give attention to the effective and efficient use of energy.

Steeg (1991) cites environmental benefits as a motivation for implementing energy efficiency when he states that the most immediate and direct environmental benefit of improving the efficiency of energy use is a reduction in the use of energy resources and in the emission of many air pollutants, as well as carbon dioxide.

The World Bank (1993) adopts both an economic and environmental perspective on rationalising the need for energy efficiency when they state that " … there is also increasing pressure to produce and consume energy more efficiently, partly because of financing constraints on new energy supply. Increased focus on energy efficiency is also driven by environmental implications of growth in energy demand. It is a fact that energy production and end-use are major contributors to environmental degradation".

Rega (1991) identifies the macro-objectives of actions to promote the rational use of energy particularly in the field of domestic end-use as the security of supply and environmental protection policy.

Chriestie and Ritchie (1992) cover similar justifications for implementing energy efficiency, such as energy depletion, security of energy supply, economic competitiveness, broader social and welfare policy and environmental policy.

On the other hand, Anderson (1993) distinguishes four different reasons for advocating energy efficiency, with no inherent conflict between them, viz:

- A means of saving money – the conventional non-economic rationale for energy efficiency policies;
- Reducing energy dependence;
- The need to avoid severe worsening of the greenhouse effect; and
- Shift towards sustainability or resource efficiency.

Anderson (1993) however, also holds the view that environmental considerations generally can be addressed most cost-effectively through emission charges, trade-able allowances or environmental standards, rather than through programs to promote lower energy consumption and energy efficiency. He cites United States and other developed countries as examples of countries where the bulk of environmental gains have come from such measures-which reduce environmental damage per unit of output – rather from reduction in energy use.

Nichols (1995) is however less uncertain than Anderson in rejecting the use of demand side rebates in developing countries, due to differences that exist between developing and developed countries. Although raising the price of electricity to cover costs would address the developing world problem of the price of electricity that is far less than its marginal cost of production, this may not be possible in the developing countries – in which case there might be a legitimate role for the kind of subsidies offered by demand side management programmes in the USA. Another difference lies in the stringent environmental regulations in the United States, as compared to the relatively weak regulations in developing countries – so that conservation of energy may yield significant environmental improvements (Nichols, 1995).

In spite of what appears to be a comprehensive set of policy drivers for energy efficiency, there still exists lack of a coherent articulation of the economic significance of energy efficiency. As Chriestie and Ritchie (1992) point out, supply side issues within the energy sector are couched along macro-economic contexts, such as balance of payment and exchange rate, employment and regional policy issues and technology policy objectives, however no strategic and macro-economic justification has been formulated for a more vigorous energy efficiency policy.

According to Torleif (1996), energy conservation measures have been promoted as a win-win option, meaning that appropriate conservation measures will benefit both the environment and provide energy consumers and society in general with a net economic gain. The win-win situation apparently draws its inspiration from a large body of engineering studies showing that energy consumption can profitably be reduced by 20% or more (Torleif, 1996).

2.3.3 Other aspects of energy efficiency

2.3.3.1 Environmental aspects

Consensus within the scientific community is that continued emissions of green house gas (principally carbon dioxide and methane) due to human activity may bring catastrophic and long-term changes in the functioning of the earth (DME, 1998).

South Africa is responsible for 1.6% of global greenhouse gas emissions, and the energy sector alone is the single largest source of greenhouse gas emissions on the African continent, predominantly because of its dependence upon coal (DME, 1998). These high levels are due to high levels of coal use for electricity generation and synthetic fuels industries and the high levels of industrialisation, coupled with high levels of energy intensity (DME, 1998).

2.3.3.2 Economic aspects

The economic potential of energy efficiency alludes to how much could be saved within a specified investment criteria, such as rate of return or payback period of investment (Christie & Ritchie, 1992). As a result, the economic potential is dependent upon judgements about the prevailing and expected fuel prices, the availability and cost of capital, technological change and the underlying rate of replacement of capital stocks of energy using appliances, plant and equipment. While investment criteria are important to economists, there is the danger that their importance can be over-emphasised (Chriestie & Ritchie, 1992).

The evaluation of the cost-effectiveness of an energy efficiency improvement depends largely on the discount rate used; however there is hardly agreement on what is the appropriate discount rate (Steeg, 1991). However, most individual consumers make investment decisions without direct reference to discount rate and discounted capital flows. If one is to refer to discount rates, then it should be implied discount rates that are calculated on the basis of the actual purchase behaviour of consumers, and these can range from 35% to 279%, as Steeg (1991) points out.

There are those, such as Thompson (2002), that content that application of the standard investment analysis, which states that consumers would adopt energy efficiency measures whose present value of energy cost reduction exceeds the initial capital expenditure tends to undervalue energy efficiency improvements to consumers. This occurs even if the present value equation used is adjusted to account for other cost and risk factors, according to Thompson (2002). This underestimate of efficiency benefits is the result of assuming that the consumer will continue to choose the same level of energy services after the investment is made while ignoring the increase in utility accruing to the purchase of energy efficient capital goods.

2.3.3.3 Social aspects

"Some commentators in the energy efficiency debate have chosen to imbue the drive for energy efficiency (or, as they might prefer to call it, energy conservation) with a more fundamental moral dimension. Mindful of the finite nature of fossil fuel reserves, or of the limited capacity of the universe to diffuse or absorb energy-related pollution, these commentators have powerfully advocated for the reduction of energy use at almost any cost" (Chriestie & Ritchie, 1992:50).

2.3.3.4 Technology aspects

Estimates of the technical potential for energy efficiency indicate how much energy could be saved by the wide adoption of current best practice or readily identified future best-practice technology (Christie & Ritchie,992).

The OECD/EIA (1991) identifies the following broad technological solution for energy efficiency:

- Advanced road vehicle design including reduced size and weight, and advanced engines;
- Improvements in energy efficiency of air conditioning;
- Use of heat pumps in buildings;
- Improved heat efficiency through highly efficient insulating materials;
- Windows which adjust opacity to maximise solar gains;
- Improved electromechanical drives and motors to increase efficiency in manufacturing machinery.

Organisations such as the European Household Appliance Industry have as one of its goals the supply of durable and sustainable technology to conserve the natural resources (Haase, 2001). The household appliance industry has managed to develop some new technology, which has culminated in savings. Haase (2001) does not merely encourage the production of more efficient appliances by industry, and their deployment into the market, he further suggests that they be chosen and installed in households, and that existing

households appliances be changed to more efficient ones (early retirement of existing appliances).

In order to reduce the quantity of electricity consumption and carbon dioxide emissions related to lighting, Guzzini (2001) suggest leveraging the benefits offered by lighting technology by promoting the adoption of compact fluorescent lamps.

2.3.3.5 Market aspects

Most programmes in energy efficiency assume that market mechanisms can deliver cost effective energy efficiency policies, however empirical evidence seems to suggest failures in the market mechanism intended to address energy efficiency.

According to the OECD/EIA (1991), four categories of market distortions that favour inefficiency are identifiable, namely:

- Lack of adequate information about energy efficiency and its market;
- Organisational and structural problems necessary to address energy efficiency;
- Lack of access to affordable finance for energy efficiency investments; and
- Environmental degradation and dependence problems.

2.3.3.6 Energy Efficiency Gap

Grubb (1990) defines the potential for profitable, but unrealised, energy efficiency gain as the efficiency gap. Most international estimates of the efficiency gap are in the range of 15% to 30% of total energy consumption, and inclusion of environmental benefits would increase the efficiency gap (EIA, 1987).

Estimates of this gap for Norway show that the largest gap exists in the residential sector where 21% of the energy use theoretically can be saved without additional costs (Torleif, 1996). Estimates of the gap in UK indicate

that a reduction of 25% in carbon dioxide emissions is achievable if the efficiency gap were eliminated (Jackson, 1991).

A study of the European Community estimate the potential in industry to be 30%, and in Japan and the US, various estimates range between 20% and 40% (EIA, 1987). The variations in the estimation of efficiency gap not withstanding, and probably ascribable to calculation methods, there exist a considerable number of investment projects with an apparent high rate of return, to which energy consumers are indifferent.

Energy efficiency gap has been put forward forcefully as an argument for a revitalisation of energy conservation policy (Torleif, 1996).

It is however debateable whether the efficiency gap can be converted into a net social benefit (Grubb, 1990). The simple engineering studies that give rise to this efficiency gap do not take account of behavioural features of consumers. And since consumers fail to take advantage of the efficiency gap, they must be persuaded to capture the opportunities, which conceivably are in their own interest, and this in turn requires initiatives, which entail administrative costs and may produce side effects. Typical side effects are distortions of economic efficiency caused by taxes needed to finance the conservation programs, and leakages such as free riding and conservation rebound, which undermine the effectiveness of programs (Torleif, 1996).

2.3.3.7 Demand Side Management (DSM)

The World Bank (1993) defines DSM as the process of identifying and implementing initiatives that improve the use of energy-supply capacity by altering the characteristics of the demand for energy. DSM consists of a mix of pricing, load management and conservation strategies designed to increase the incentives for a more efficient use of energy.

Iacovoni & Massini (2001) content that DSM is based on a series of activities (planning, execution, monitoring and evaluation) designed, promoted and executed by utilities, government agencies or private ESCOs to encourage users to modify the amount and type of energy consumption in order to benefit the companies, the users themselves and society in general.

Supporters of DSM programs have hailed them as costless ways to achieve environmental goals, in particular reduction in emissions of carbon dioxide – with the more enthusiastic supporters arguing that conservation measures introduced by DSM programs are akin to the proverbial free lunch: "It is a lunch you are paid to eat" (Nichols, 1995). The success of DSM programs is borne by evaluations that suggest that they are highly cost-effective, with savings in generation and distribution costs exceeding the cost of the programs.

Other economists, like Nichols (1995) and Anderson (1995) have criticized DSM programs – particularly those relying upon subsidies for the purchase of energy-efficient equipment – as economically inefficient. Some of the reasons around which the key criticism revolves is that many studies of the effectiveness of DMS programs fail to measure the energy savings appropriately, and that analysis used to illustrate that DSM programs are cost-beneficial typically omit some potentially important costs – and often use far lower discount rates than those employed by households and firms in making investment decisions.

Many economists are opposed to utility-sponsored DSM programs, whilst other economists are supportive of utilities that sponsor DMS programs as stand-alone businesses and that the market should be left to determine the appropriate amount of end-user energy conservation (Cicchetti, 1995). However other economists counter this by saying that various externalities and market failures exist that work to distort consumer demand and prohibit the markets from functioning efficiently – given this, a proactive response in

the form of utility-sponsored DSM programs seem necessary to redress economic losses, according to Cicchetti (1995).

Cicchetti (1995) further states that to encourage DSM activities, an incentive program should make DSM as profitable as other utility activities, and that the accuracy of DSM savings measurements will become more accurate as utility DSM programs and incentive mechanisms become more prevalent, as more dollars are spent on DSM, and as a greater percentage of utility profit depends on the claimed savings and DSM incentives.

2.4 Energy efficiency in South Africa

2.4.1 Government policy

The White Paper clearly outlines Government's position on energy efficiency as follows:

> *"Government commits itself to the promotion of energy efficiency and the development of holistic programmes for industry, mining and commerce"* (DME, 1998).

DME (1998) further recognises that energy efficiency and energy conservation must form part of an overall energy policy, and energy efficiency should be considered within a framework of Integrated Resources Planning, which considers both supply side and demand side options for meeting energy service requirements. This approach also reveals how DME does not differentiate between energy conservation and energy efficiency.

In formulating energy efficiency policy, government moves from the understanding that efficient energy use is best achieved through creation of awareness of benefits of energy efficiency and energy conservation, and the deployment of incentives to encourage desired behaviour (DME, 1998).

2.4.2 Potential for energy efficiency

The government fully recognises the potential for energy efficiency in South Africa and the significant benefits to the economy than can accrue from the implementation of a successful and sustainable energy efficiency programme. Government further acknowledges failure of the market mechanism to fully exploit this potential, and suggest a need for government institutions to play a facilitator role in increasing efforts to implement energy efficiency (DME, 1998).

In the White Paper on energy (DME, 1998), the government talks about the significant opportunities for the promotion of energy efficiency and energy conservation measures in building low cost housing during the national housing campaign, and great potential to stimulate adoption of energy demand management in middle and high income households using strategies such as time-of-use tariffs, energy efficient lighting and solar water heaters.

It is also clear that such saving in energy consumption would free resources and delay the need to make new and further investment in generating plant capacity.

Typical estimates of energy efficiency savings in South Africa, according to DME (1998), are between 10% and 20% of current energy consumption levels. It is therefore clear that significant scope for improved energy efficiency exists within the industrial, commercial, domestic and transport demand sectors.

Giovannini & Pain (1990) identify specific branches within industry where substantial potential for substantial energy efficiency improvements exists, and these tend to be those where energy represents a large share of total production costs as shown in the table below:

Table 2: Energy intensive industries

Industrial sector	Energy costs as % of total costs
Aluminium	20% - 30%
Iron and Steel	20% - 40%
Cement	30% - 50%
Gypsum	40% - 60%
Glass	10% - 20%
Synthetic fibres	12% - 20%
Food preparation	4% - 6%
Paper and Board	25%

Source: Giovannini & Pain (1990)

Fecher (1999) correctly points out that in South Africa, energy efficiency and demand side management have thus far been the exclusive domain of Eskom, the national electricity utility, and not part of an integrated national energy policy. Triebel's (1996) assessment of the state of energy efficiency in South Africa is equally damning, describing the implementation thereof as fragmented and ad-hoc, and there being no single institution or organisation that has as yet been involved in the development and implementation of energy efficiency actions that can be termed effective on a national basis or long term nature.

A key finding of a study conducted by ESTU (1999) into the possibility of exporting energy efficient equipment to South Africa also came to a similar conclusion when it established that energy efficiency in South Africa is not developed enough to simply promote hard technologies – that what is needed is awareness raising, capacity building, training and promotion of information networks. The same study suggested reasons why energy efficiency has not been given much attention in South Africa:

- The low cost of energy
- A surplus of electrical generating capacity (*rapidly being depleted*)
- Energy efficiency has not been given a government priority
- High cost of capital

- Large industry has made successful efforts to keep electricity prices low
- Plans to liberalise the electricity market have diverted attention from energy efficiency
- The level of awareness, understanding, skills and knowledge surrounding energy efficiency is extremely low. There is little application of energy management, and low or no cost measures to improve energy efficiency
- There are only a few drivers that encourage improved energy efficiency
- Previously industry saved by cutting labour costs.

2.5 Energy Efficiency in the developing world

According to the World Bank (1993), while in the developed countries the demand for many energy-using consumer and producer goods were met in part through consumer and producer goods that incorporate newer, more energy-efficient technologies, and as levels of service rose, overall per capita energy demand decreased, developing countries have continued to experience increasing levels of energy intensity (energy consumed per unit of output).

A number of factors account for this dismal performance by developing countries in energy efficiency (World Bank, 1993):

- Governments failure to pass on all of the increases in energy prices to domestic producers and consumers (subsidisation of energy prices)
- A large portion of the total consumption is in the hands of non-household consumers which are dominated by inefficient state-owned enterprises and protected industries
- Failure of subsidised publicly owned monopoly enterprises to provide a conducive environment for effective built-in incentives for higher levels of efficiency while supplying energy in cost-plus conditions.

Because of non-competitive market structures and subsidised energy prices, it has not been profitable for market intermediaries to develop in order to arbitrate information on energy efficiency or on financial and technology options in developing countries.

A number of developing countries have implemented energy efficiency audit schemes and demonstration projects, sometimes with great success. In the past, energy efficiency was not encouraged in developing countries. But, as Madhu & Zilberman (1999) contend, improvements in energy efficiency are relevant to developing countries particularly because they tend to rely on energy intensive technology to achieve economic growth, and thus leading to rapid increase in their contribution to global greenhouse gas emission.

The World Bank (1993) identifies a number of congruent forces that compel developing countries to address long neglected issues of wastage of energy both in the demand and supply side:

- Rapidly growing demand for energy;
- Major constraints on the financing of available energy;
- Increased pressure to sustain the environment;
- Poor energy sector performance and unsatisfied customers; and
- A reappraisal of the roles of government and the public and private sectors in development

The World Bank (1993) in comparing the experiences and performance of developing and developed countries in implementing energy efficiency, highlights four critical factors that directly correlate with differences in the efficiency of energy production and end-use. These factors are presented in the table below:

Table 3: Factors directly correlating with differences in developing and developed World's energy production and end-use efficiency.

Some aspects of energy policy in developing countries	**Some aspects of energy policy in developed countries**
Developing countries price energy, especially electricity, below the cost of generation and distribution.	Developed countries tend to recover the full cost.
Many industrial and commercial sectors in developing countries are dominated by relatively few large monopolies or highly protected state enterprises.	Developed countries tend to have less protection and more competitive industrial and commercial sectors.
Developing country governments treat their monopoly public energy enterprises as a direct extension of government with little differentiation among the ownership, regulatory and management functions	Developed countries tend to have a more formal and transparent relationship where the rules of the game are more clearly spelled out.
Barriers to the effective functioning of markets are more pronounced in developing countries due to a relative lack of information intermediation, which results in relatively higher costs of information, financing and management expertise	Developing countries are blessed with effectively functioning markets that significantly reduce the cost of information, financing and management expertise.

Source: World Bank, 1993

Even in the face of generally low energy prices in the developing countries, there still remains a significant potential for energy savings by implementing energy efficiency measures, as noted by the World Bank (1993):

> *At current relatively low energy prices and with the present state of technology, a saving of 20% to 25% of energy consumed could be achieved economically in many developing countries with existing capital stock. If investments were made in a new, more efficient capital equipment, a saving of the order of 30% to 60% would be possible.*

Faberi, Mebane & Presutto (2001) were able to show that even in developed countries, low-income families experience barriers to achieving high energy efficiency in their household appliances – the higher prices of energy

efficiency models represent obstacles to low income families to overcome energy efficiency and energy poverty.

2.6 Energy Efficiency and the developed world

Energy efficiency and conservation of energy in general has been a concern of most developed nations for a while. Chriestie and Ritchie (1992) ascribe this heightened awareness of energy efficiency in the developed world, especially during the 1970s, to a mere temporary consequence of the oil crisis of 1973/74 and later in 1979. The need for security of oil supply and also to reduce dependence on imported fuel seem to have been the key drivers for politicians and government's focus on energy efficiency. These drivers soon fell away with the discovery and successful exploitation North Sea oil and gas reserves for some western European nations (Chriestie & Ritchie, 1992).

"By the early 1970s, most countries had experienced decades of low energy prices and plentiful fuel supplies, with a consequent high and growing per capita use of energy. This high usage was of little concern to most governments until the first oil shocks, when rapidly rising energy prices and interruptions in supplies forced examination of existing policies" (World Bank, 1993).

There is currently a new and growing awareness for energy efficiency with its origins in the 1990s. This awareness is a consequence of rising worldwide concern about global environmental threats from the greenhouse effect (Christie & Ritchie, 1992). The environmental threat is now the leading driver for energy efficiency within he developed world.

Most of the EIA countries have successfully reduced the amount of energy needed to provide goods and service (Steeg, 1991), having recognised that improving the efficiency of energy use is a promising strategy to achieve both energy security and environmental goals. Steeg (1991) identifies four main

features of the energy sector in the developed countries that have a strong influence on the relative contribution of end-use sectors to total carbon dioxide emission:

- The size and structure of the industrial sector – where the industry is dominated by energy-intensive production such as iron and steel. This sector is usually the largest contributor to national carbon dioxide emission, ahead of the residential and commercial sector.
- The importance of road transport and its consequent oil consumption – road transport is absorbing an ever-growing share of oil consumption, and is, as a result, an increasingly large contributor to carbon dioxide emissions.
- The share of fossil fuels in electricity generation and the mix of fuels used to heat buildings – in countries where non-fossil energy sources (hydro or nuclear energy) account for a large share of electricity production, transport fuels and heat used in buildings and for industrial processes are major areas where energy efficiency improvements would produce significant carbon dioxide emission reductions. In other countries, and particularly those that rely heavily on coal for electricity generation, large benefits can be expected from electricity end-use efficiency, particularly in the residential and commercial sectors and in industry.

A number of regulatory policy measures, such as information programmes, energy pricing, taxation and financial inducements such as grants, low interest loans, tax deductions, as well as fairly new approaches such as third-party financing have also contributed to improvement in overall efficiency of the economies of EIA member countries (Steeg, 1991).

Williams (1986) notes the presence of a close correlation between the success of efforts in several countries to improve energy efficiency through the introduction of programmes and the clear focus of government. He further notes that in countries such as Denmark, France and Germany,

where governments have placed a high priority in establishing programmes for determining what conservation measures to implement, there has been great success.

According to Williams (1986) there is an advantage in having an agency independent to government to assist with policy formulation, in order to exploit the potential for vigorous promotion of energy conservation and not that of caution normally followed by government.

2.7 Global experiences in energy efficiency (country case studies)

2.7.1 Latin America

2.7.1.1 Chile

The government in Chile is yet to make improved energy efficiency an official policy. The country does not have energy performance standards or utility incentives for demand-side management. The government has however supported selected efficiency projects like improved street lighting and large industry cogeneration. The National Energy Commission is showing an increasing commitment to energy efficiency and development of non-conventional energy resources. Performance standards for appliances, motors, pumps and drives are planned over the next few years (Lord, 1999).

Efficiency Street lighting

In the commercial sector, installation of energy efficient lighting and energy management systems is growing. Given Chile's high electricity prices, the private sector has teamed up with municipalities, universities and the National Energy Commission to demonstrate the viability of energy efficiency. For example, in excess of 150 municipalities in Chile are implementing the model street lighting project implemented by the municipality of Antofagasta, which first piloted the program (1999).

The municipality replaced over 7000 streetlights in the city with energy efficient streetlights at a cost of US$675000. Leasing companies were used

as financing mechanism for the project. The municipality of Antofagasta firstly petitioned the Treasury Ministry for permission to finance the project using a leasing company. The leasing company would purchase the equipment and lease it to the municipality in exchange for monthly payments, with the equipment eventually reverting to the municipality. The Ministry approved the financing arranging but refused to guarantee payments to the leasing company. The energy-efficient lighting was installed by the installation company, with the leasing company paying it for the installation. Upon completion of the installation, the municipality began repaying the leasing company monthly with interest (average 12%), using revenue from the energy savings (Lord, 1999).

In 1994, Chile's largest lighting distribution company teamed up with Philips to test compact fluorescent lamps in the Santiago region. They replaced 80% of the lamps in 10 houses with CFLs and reduced average household electricity consumption by 30%. This initial test was followed by a technical study to evaluate the impact of a large number of CFLs on the power system (Lord, 1999).

Government Agencies

National Energy Commission (CNE) was established in 1978 with a law decree in the Ministry of Mines. It is charged with coordinating plans, policies and standards of the energy sector, particularly the electricity sub sector. CNE created three committees to work on energy efficiency, amongst others (Lord, 1999).

2.7.1.2 Mexico

Government agencies

The main government players in the Mexican energy sector are the Comision Federal de Electricidad (CFE) and Luz y Fuerza del Centro (LyFC). CFE serves the entire country with the exception of the metropolitan area pf Mexico City, which is served by LyFC.

Electricity tariffs

Average electricity tariffs are still subsidized, making it harder for energy efficiency to compete. The residential and agricultural sectors receive large subsidies (around 50%), while the other sectors have tariffs that reflect the cost of service. Tariffs have however been modified lately to reduce subsidies and to entice consumers to be more efficient. CFE also tool steps to reduce system peaks by implementing time-of-use tariffs for the industrial sector. Although it is well known that higher electricity tariffs would curtail the rate of electricity demand growth, tariffs will however be kept below cost for the foreseeable future, for the benefit of low incomes of most Mexicans and for political considerations (Friedmann & Sheinbaum, 1998).

Energy efficiency stakeholders

Since 1989, Mexico has created new institutions and defined their roles and established a wide a network of government, private, academia and non-governmental organisation actors to promote end-use energy efficiency. Table 4 presents the various actors (Friedmann & Sheinbaum, 1998).

Table 4: Energy efficiency actors and their roles

Actor	Role
CONAE	CONAE was created by presidential decree, owing to increasing interest in government for energy efficiency initiatives, as well as external pressure. It was created for purposes of functioning as the technical organism for consultation on energy efficiency and conservation with other federal entities, state and municipal governments, and private actors. It has always considered itself as a coordinator and promoter of government efforts, and a centre for the collection and dissemination of energy efficiency information. CONAE uses the internet as a clearinghouse for information. CONAE continues to push for more stringent minimum energy-efficiency standards and building codes. It will also promote energy efficiency in the government's own facilities and procurement practices.
PAESE	The president's interest in energy efficiency led CFE to create Programa de Ahorro de Energia del Sector Electrico (PAESE) as a separate entity from CFE. PAESE's role has been to identify and design interventions to save electricity within the electric sector and among electric customers. PAESE has provided local support for energy efficiency programs through its offices

	at CFE divisions.
FIDE	Due to limited budget of PAESE, FIDE, the revolving-loan trust fund to save electricity was established. The initial budget of FIDE was created by donations from the electric utilities, providers and subcontractors of the electric sector and the electrical workers union. Its budget has become more secure as it increasingly comes from repayment of its past loans to energy efficiency implementers. FIDE has been very successful because it is a private, non-profit organization with close ties to PAESE. Its private nature has freed it from the public sector bureaucracy and afforded it dynamism. Its Board comprises of entrepreneurs, leading to easier and faster implementation of demonstration projects. FIDE works closely with PAESE (they are headed by the same individual) and therefore the private/public duality of FIDE/PAESE is an important innovation for Mexico. FIDE has become the main agency for implementing electric efficiency programs and its projects are either pilot demonstrations for replication within the same corporation and competing firms, or recently, incentives programs, through which a combination of rebates, discounts, and financing is offered to customers who buy efficient equipment. FIDE's vision for attaining a mature market for energy efficiency entails four stages of exploration, demonstration, discharge and finally, consolidation and generalisation. During exploration, activities focus on identifying areas of energy efficiency opportunities. In the next stage, pilot and demonstration projects are used to verify viability and size of the benefits identified previously. Experts are trained to apply the programs and diverse dissemination materials are prepared using results from the pilot programs. This allows other similar establishments to apply lessons learned. During discharge, the dissemination and promotion focuses on large entrepreneurial groups, chain stores, trade associations and large residential groups. The purpose is to have these groups replicate in all their facilities the lessons learned in the pilot and demonstration projects. Technical assistance is provided and savings committees are established to ensure continued oversight and attention to efficiency. The enactment of minimum efficiency standards is also pursued here in a way of fostering a mature market for efficient products. In the last stage the objective is to consolidate the multiplicative (free rider) effect, leading to generalised application of the measures that will maximise the efficiency of electricity use. At this stage, economic incentives are provided to promote the adoption of efficient technologies and practices amongst end-users. To

	ensure permanence of efficiency, standards and efficiency labels
CFE sub-directorates	The distribution and planning subdirectorates of CFE plays a role in utility demand side management. The disctribution subdirectorate has been involved in all residential efficient lighting campaigns and project undertaken.
IIE	The Electric Research Institute has been the key research institution behind the elaboration of the minimum efficiency standards and summer savings-time programs developed y CONAE.
ACADEMIA	Academics at most university in Mexico have been involved in providing research support to energy-efficiency programs. They have also been instrumental in the formation and development of human capacity. The key intervention of the universities has therefore been in conducting research, training of students and being repositories of information.
PRIVATE SECTOR	Private manufacturers of efficient appliances and equipments, including their industry association, have often collaborated and lobbied against increasing government regulation of their product attributes or efficiency programs. They have also added value through their marketing experience to enhance the success of government efficiency programs.
ATPAE	This Association of Technicians and Professionals in Energy Applications is the main civil association involved in energy efficiency. Membership includes academics and most government officials active in the promotion of energy efficiency.
Foreigners	Foreginers have been successful in focussing the attention of Mexican decision makers on energy efficiency as an option for electric sector development. They have sponsored both institutions and major projects and have generally been neutral third-party catalysts for government and private sector collaborative efforts. Most prominent actors have been the European Union Cooperation Program (EUC), the Unitied States Agency for International Development (USAID), the United States Department of Energy (USDOE), the World Bank Group (WBG), the Inter-American Development Bank (IADB), the Lawrence Berkley National Laboratory (LBNL), IIEC, etc. They have also provided funding for feasibility studies and financial support for programs managed by FIDE.

Source: (Friedmann & Sheinbaum, 1998)

Industrial efficiency programs

The most intensive focus of energy efficiency is in industry and specifically, electric motors are seen as the largest opportunity to save electricity.

CONAE initially pushed for minimum efficiency standards for electric motors. A committee presided by CONAE and incorporating government agencies,

private motor manufacturers and their associations and academics was established to elaborate on the consensus standards. Mexican manufacturers had no difficulty agreeing to the standards as they helped to protect their market especially in the smaller sizes. Compliance with the standards became obligatory and resulted in improving their efficiency. Implementation of the standards fell to SECOFI, who have not had a clear success in enforcement. The standards will become law soon (Friedmann & Sheinbaum).

FIDE has also decided to include motors with certain level of efficiency (efficiency within 15% of the top class) in SELLO FIDE (equivalent to efficiency stamp of approval), which then entitles them for promotion to a wide market (Friedmann & Sheinbaum, 1998

CONAE and FIDE have also promoted energy efficiency by assisting in the development of an infrastructure of trained personnel for industrial audits. They have paid for the audits where industry sign a contract promising to implement all measures identified in the audit with a payback of less than two years. Between 1990 and 1997, a total of 350 audits were sponsored by the two organisations (Friedmann & Sheinbaum, 1998).

Lighting efficiency programs

Mexico is by far the leader of the developing world in respect of the reach, complexity and experience of its compact fluorescent lamp (CFL) program for residential lighting efficiency.

Initially pilot program were set up to promote CFLs in Mexican homes and these pilot programs then formed the basis for Ilumex, the larges rollout of about 1.2 million CFLs into Mexican homes. It was funded with US$10 million grant from GEF, a US$3million grant from Norwegian government, a US$5.7million loan from the World Bank and US4.3 million from CFE. Residential consumers could either pay cash for the CFLs or finance them

over various time periods at no interest, paying for them as part of their electric bill. The consumer price was subsidised up to 60%, with the average price varying between US$13 and US$15. Key to the marketing success is deemed to be the financing options for the purchase, including CFE's ability to sell the CFLs at their local offices and thereby avoid the costly sales channels such as door to door.

Appliance efficiency programs

IIE was contracted by CONAE to examine the technical and economic aspects of minimum energy efficiency standards for appliances. Standards for refrigerators, window air conditioners, clothes washers and household water pumps ensured significant improvement in efficiency. Although early mistrust between government and private entities made the implementation of standards harder, including problems with enforcement arising from CONAE's lack of legal right to enact and enforce them, standards have significantly improved efficiency of the products available in the Mexican market. It has also lead to improved relations between government and industry, and created human resources infrastructure, institutional capacity and infrastructure and laboratories to continuously monitor and upgrade the standard (Friedmann & Sheinbaum, 1998).

Electricity tariffs

Amongst Mexico's more important effort to further enhance efficiency of electricity use in the home are continued attempts to increase residential electric tariffs so they reflect the true cost of service, simplification of the residential structure to improve bill comprehension and ease customer evaluation of monetary savings achievable by adopting more efficient technologies, and household energy audits including financing of the efficiency-enhancing measures identified. Metering efforts in support of standards have allowed analysts to conduct more robust estimates of end-use energy distribution and savings impacts of past programs or possible potential of future projects (Friedmann & Sheinbaum, 1998).

Commercial energy efficiency programs

FIDE has led most of the significant efforts in the commercial sector. Demonstration projects have been done in buildings, education facilities, commercial malls, department stores, restaurants, hotels, self-service stores, hospitals and other establishments. To foster multiplicative effect, energy savings committees have been formed in the large hotel and commercial trade associations. Most projects have involved lighting improvements (Friedmann & Sheinbaum, 1998).

Education and dissemination

A number of programs have been embarked upon for purposes of educating consumers, preparing consultants and encouraging new companies to promote energy efficiency by CONAE, FIDE and PAESE. These programs have included mass media advertising, pamphlets, classroom materials, courses, seminars, workshops, the National Energy Savings Prize and the product efficiency stamp (SELLO FIDE) (Friedmann & Sheinbaum, 1998).

FIDE publishes a quarterly and has developed case-study sheets to describe each project undertaken. It also prepares pamphlets on possible efficiency improvements for various indutrial and commercial establishments (Friedmann & Sheinbaum, 1998).

CONAE has also focussed on creating an energy efficiency consciousness among the population, forming human resources skilled in energy efficiency and increasing interactions between academia and industry (Friedmann & Sheinbaum, 1998).

Other lessons learned from Mexico's experience (Friedmann & Sheinbaum, 1998)

- Government has a role to pay in fostering a mature market for energy efficiency, with initial efforts directed at enhancing awareness and

information, and ensuring a level-playing field for all energy user, and nurturing consumer actions and investment in energy efficiency.

- Minimum energy efficiency standards require constant monitoring and upgrading and enhanced enforcement
- Incentives and demonstration programs help accelerate the adoption of more efficiency technologies and the maturing of the efficiency infrastructure and market
- Eliminating subsidies in the energy prices improves the viability of energy efficiency measures.
- In future, a move towards less government-led efficiency effort in favour of a mature efficiency marketplace is important
- Government can use its own procurement and fisdal policies as market pull mechanism, and push the market with environmental taxes and marginal cost pricing.
- Subsidies for energy efficiency equipment must be phased out as the market matures
- Combining rebates with subsidy schemes to promote efficient technologies is likely to succeed in the early stages of awareness creation
- Consensus minimum energy standards can be introduced with relative ease. The challenge lies in enforcement.
- The optimal level of government intervention must be sought.
- Promotion efforts will need to be multifaceted, flexible, and emphasize evaluation to allow for learning-while-doing
- Private sector parties to help establish a mature market and to also learn from their marketing expertise
- Foreign actors must provide support, ideas, and serve as neutral catalysts.
- The need to create public-private partnership in infrastructure is crucial

- Evaluation of program results and process are crucial to ensure that current lessons are incorporated in future endeavours – learn while doing
- Seek out and form alliances with government, private, foreign, development and finance, academia, and NGO organisations
- For end-use efficiency programs to succeed, marketing is critical.

2.7.2 North America

2.7.2.1 United States of America

According to the Organisation for Economic Cooperation and Development (OECD), United States is by far the most energy efficient major country on earth (Bartlett, 2001). USA made use of the equivalent energy of 1.4 billion tons of oil in 1998 – 40% of total OECD energy use – did far more with that energy and got more value out of it than any other country. For every 1$million of GDP produced, just 76 tons of oil-equivalent were needed.

The potential for energy efficiency improvements in the USA are still substantial, even with the relative success that previous programmes have achieved. It is estimated that in the USA alone, a saving of around $6 billion in energy costs is and reduction of carbon emissions alone by more than 20 million is possible simply by choosing the most efficient lighting fixtures available when it is time to replace existing once (Bonsignore, 1999).

To this day, the current USA energy policy places appropriate importance to energy efficiency, as evidenced by its intention to “modernise and increase conservation by increasing funding for energy efficiency programmes and create suitable tax credits”(Bush, 2000. During the same speech, and on the basis that conservation and efficiency re important elements of a sound energy policy, the President also directed his Government to undertake a review of existing energy efficiency and renewable development program to ensure future budget allocations are performance based and modelled as private public partnerships.

Over the past 20 years, the USA economy has managed to cut its average energy consumption needs per dollar of product by more than one fourth – attributable mostly to the setting of efficiency standards and demand-side activism (Anderson 1995b). Over the same period, energy consumption by the average new automobile and refrigerator has been cut in half, and the USA economy used less oil in 1994 than it did two decades earlier. As Cavanagh (1995) remarks, these improvements were not solely ascribable to energy prices, which have been dropping across the board in recent years. In fact, USA got more energy efficient my mobilising public and private institutions to seek out energy savings through the setting of minimum standards for vehicles, buildings, and appliances, and which were gradually raised over time, and the electric and gas utilities began investing in energy savings as well as new energy production.

But prices also played a large role in cutting consumption, as shown by Socolow's (1977) remark that "the most significant pressure toward lower energy intensities is exerted by [being] exerted by rising energy prices". Jorgenson and Wicoxen also concluded that "price–induced energy conservation" acted to stabilize CO2 emission over the period during the oil price shocks of 1972 – 1987.

Anderson (1995b) also supported the role of prices in affecting energy consumption when he stated that gradual changes in prices over time will bring about changes in energy demand, and that differences in energy prices between countries help to explain much of the observed differences in their energy demand and supply patterns, such as the large differences between North America and Europe in vehicle fuel efficiency in the 1970s and before. Therefore the evidence is conclusive and consistently points to the importance of prices from the perspective of finance, economic efficiency, energy efficiency and the environment (Bates, 1993).

Household energy efficiency

A review of several local and national consumer preference studies for energy efficiency in the USA, undertaken by Walsh, Bashford, Pijawka, Carinci & Upton (2002) found that energy efficiency features in new building stock are not the most exciting to potential customers, and therefore the focus of builders is on other features that are likely to accelerate sales. Because most energy efficiency initiatives are predicated on moral or ethical environmental protection arguments, with some financial overtones, there is conflicting evidence regarding the degree to which homebuyers are motivated by these arguments. It seems clear that only aggressive government action is likely to create significant changes in the energy efficiency of the housing stock (Walsh *et al*, 2002).

Appliance labelling

Energy conservation standards for appliance and equipment have long been a feature of the regulatory regime for manufacturers in the United States. The Energy Policy and Conservation Act (EPCA) prescribes federal minimum efficiency standards for a wide variety of appliances and equipment, and it also, periodically directs the USA Department of Energy to update the standards. The Gas Appliance Manufacturers Association was the leading supporter of the National Appliance Energy Conservation Act of 1987, to establish federal minimum efficiency standards for household kitchen and laundry appliances, water heaters and heating, ventilation and air conditioning equipment (Mattingly, 2001).

According to Cavanagh (1995), in spite of the immense success in the USA, there still remains a lot of work to be done, especially in areas such as improving the energy efficiency of automobiles, lights and computers in commercial buildings, as well as home appliances like refrigerators.

2.7.3 Energy Efficiency in Europe

2.7.3.1 United Kingdom

Energy efficiency achievements

Energy demand in the United Kingdom's domestic (residential) sector has grown only mildly over the last thirty years, and due to the marked dominance of space heating, and whatever peak have been experienced in energy demand are due to unusually cold winters that prevailed at the time. A range of energy efficiency measures has reduced energy demand in the UK, especially in the 1980s (Chriestie & Ritchie, 1992). Natural gas has been the largest beneficiary of fuel switching in the domestic sector. This is highlighted by the rise in market share of natural gas from 24% in 1970 to over 63% in 1990 (Chriestie & Ritchie, 1992).

Although in general, energy efficiency has been on the rise in the United Kingdom, there remains much ground to be covered, and much scope remains for further cost-effective energy efficiency investment, as illustrated by the following statement by Uk government, in evidence to the Intergovernmental Panel on Climate Change:

> *"A typical householder can achieve a 20 per cent saving in energy by investments with what he or she may regard as an acceptable payback period (3 to 5 years at most)…"(Energy Paper No. 58, 1989).*

Government policy

Chriestie and Ritchie (1992) content that the government's policy stance is less than satisfactory. They further point out that although considerable effort has been devoted to identifying the barriers to the effective operation of market forces in energy efficiency, government continues to place supremacy of emphasis on the believe of the efficacy of the market system. Chriestie and Ritchie's views are also echoed by Williams (1986), who concluded that government policy in energy efficiency is highly fragmented and has met with limited success.

Williams (1986) is also of the view that market mechanism, especially higher energy prices, cannot be overlooked as a basic stimulus for energy efficiency responses, however barriers still exist, especially in the domestic sector, and therefore a much more proactive role is required from government to successfully overcome them.

Domestic sector programs

Within the domestic sector, the UK employs energy efficiency measures such as building regulations, energy labelling of buildings, home energy efficiency schemes, estate action programme, appliance labelling and energy efficiency standards and research in energy efficiency

Private Rented Energy Savings (PRESS) scheme

UK introduced a project to promote energy efficiency in the private rented accommodation sector, known as the PRESS scheme. This was subsequent to the English House Condition Survey (EHCS) for 1991 showing that energy efficiency levels in private rented property was significantly lower than other sectors (DoE, 1996).

The research indicated the presence of considerable technical potential for improving energy efficiency. It also revealed that the necessary upgrading costs would hamper the installation of efficiency measures because landlords have no incentive to undertake such measures. It became clear that future policies to address this gap faced huge challenges without support and appropriate encouragement from landlords (Wilkinsons & Goodacre, 2002).

The PRESS scheme had adopted measures such as incentives, energy assessment of property, as well as 50% contribution to all energy improvements undertaken. However the scheme suffered significant initial withdrawals, with further dropouts prompted by reasons associated with the requirements and the administration of the scheme. The success of the

scheme lay in the fact that some landlords did upgrade their properties' energy efficiency. Evaluation of the PRESS scheme showed that landlords must be given access to the resources, products, information and skilled assistance to help them make informed decisions regarding energy efficiency products (Wilkinson & Goodacre, 2002).

Energy Saving Trust (EST)

EST is a quasi-government non-profit organisation co-funded by government and private sector. It was established in 1992 following the Earth Summit in Rio de Janeiro to stimulate energy efficiency in the UK domestic sector – pointing to environmental concerns as the key stimulus for certain energy efficiency initiatives. Its annual energy efficiency work plans for domestic activities are approved by the Department for Environment, Food and Rural Affairs, whilst those addressing transport activities are approved by Department of Transport, Local Government and the Regions (Banks, 2002). Some of the EST activities established under EST are shown in Table 4.

Table 5: Some of the activities of EST

Program	Role played by EST
Energy efficiency branding and awareness, for purposes of increasing sales of energy efficient products and services through a logo running alongside a national adverting campaign.	Publicity and information communication
Energy efficiency partnership for homes, bringing together a broad based organisations with an interest in delivering energy efficiency.	Coordination, facilitation ad planning support
Established energy efficiency advice centres across UK, for purposes of giving free, impartial advice to householders and small businesses on all aspects of energy efficiency around the home.	Information dissemination
Established a network of accredited energy efficient installers (glaziers, plumbers, insulation trade), to whom customers will then be referred to by energy efficiency advice centres.	Mobilisation of service providers
Running programmes on behalf of suppliers, concerned with getting inefficient refrigerators and fridge freezers out of the stock and their replacement with efficient models.	Technology access
Joint management of the UK government's community energy program for the refurbishment of existing and the installation of new community heating scheme.	Program management
Commissioning research on behalf of government to assess its own energy efficiency interventions.	Research and program evaluation
Availing interest free loans of between 2000 – 25000 pounds for small businesses to promote energy efficiency.	Access to finance
Working with local councils and local press to boost energy efficiency, get distributed renewable energy into homes and businesses, transform markets for clean fuelled cards and efficient appliances, raise awareness generally and create jobs.	Information dissemination, industry mobilisation and market transformation
Running the Home Energy Conservation Program for helping local authorities to set up energy efficiency initiatives to achieve targets imposed upon Local Authorities to reduce the energy use of all domestic housing within their boundaries by 30% by 2010, as required by the Home Energy Conservation Act (1995).	Policy implementation support
School energy program, for purposes of energy audits of premises of school, energy management plan, inclusion of energy efficiency in the curriculum, education materials and grants for measures undertaken.	Program management and information packaging and

	dissemination
Offering rebates to small business of up to 6000 pounds for the installation of lighting controls and the purchase of energy efficiency lighting products.	Incentives for efficient lighting programs
Establishing energy services, i.e., a package of measures delivering heat, light and power rather than units of energy	Market transformation

Source: Banks (2002)

2.7.3.2 Norway

Norway launched a conservation program in 1991, called the Program, for purposes of providing financial support to energy efficiency investments in industry, commerce, public sector and private households (Torleif, 1996). Evaluation of the Program showed that about 70% of the participants were "free riders" who would have invested in the efficiency improvements even in the absence of the Program. The economic efficiency of the Program was further reduced by economic distortions caused by taxes needed to finance the program (Torleif, 1996). However, energy savings did yield environmental benefits through reduced atmospheric emissions, though this effect was somewhat diluted by a "conservation rebound", where the actual reduction in energy consumption was less than the theoretical savings.

The Ministry of Petroleum and Energy and three state banks administered the program, each of the banks having a large investment portfolio in industrial, household, public services and commercial sectors. Utilities assisted in the dissemination of information about the program. A semi-public research institution reviewed applications for industrial sector initiatives, whilst a federation of utilities reviewed grants for other sectors. Only projects that had a stipulated rate of return of between 7% and 30% were eligible for grants. Applications with a rate of return of above 30% were rejected on the grounds that proponents thereof would primarily be free riders, because they would have made the investment in energy efficiency even in the absence of the Program (Torleif, 1996).

2.7.3.3 Hungary

Hungary is an energy-poor country, relying on imports for over half of its primary energy requirements, and electricity prices remain regulated, and are still below economic levels (IIEC, 1999a).

The most important policy document governing energy efficiency in Hungary is the National Energy Efficiency Improvement and Energy Conservation Program, developed in 1994. The government then adopted a ten-point Energy Saving Action Plan, the important elements of which were improvement and certification of building energy performance and the raising of awareness of energy issues.

The Hungarian Energy Efficiency Business Council was launched in 1999, with the support of US-based Alliance to Save Energy. It is an NGO whose mission is to promote energy efficiency policies, programmes and technologies that create jobs, foster economic growth and reduce greenhouse gas emissions. As one of its outputs, the Business Council would produce a directory of energy efficiency businesses in Hungary. Its membership is drawn from all manufacturers, suppliers and users if energy efficiency products and services (IIEC, 1999a).

Efficient lighting

Considerable attention has been paid to the energy saving possibilities of replacing mercury vapour street lighting with high-pressure sodium lamps. As early as 1989, an organisation called Credilux was formed for purposes providing third party financing for street lighting upgrades (IIEC, 1999a).

Household appliances

Hungary is in the process of introducing mandatory energy labelling of a range of household appliances, in conformity with the relevant EU Directives (IIEC, 1999a).

Sources of funds

The German Coal Aid Revolving Fund was created in 1992 for purposes of supporting investment in energy conservation, principally by the private sector, although municipalities have also successfully borrowed. Hungarian Credit Bank administers the fund (IIEC, 1999a).

Hungarian Energy Office undertakes technical management of the Energy Saving Credit Program. The fund is intended to support energy efficiency investments by municipalities in schools, hospitals and other public institutions, with loans of up to HUF30 million being made available at half commercial interest rates. The condition is that borrowers must be able to put up at least 10% as equity (IIEC, 1999a).

Central Environmental Fund has also made thermal insulation grants available to individuals wishing to improve the thermal insulation of their apartment (IIEC, 1999a).

The Hungary Energy Efficiency Co-financing Fund was created in 1997 with US$5 million of GEF money, administered by IFC. The fund combines with local sources to leverage an estimated $30 million into energy efficiency investments in three target sectors of lighting, district heating and industrial motors (IIEC, 1999a).

2.7.3.4 Romania

The number of programmes specifically aimed at promoting energy efficiency in Romania is relatively limited, and is as follows (IIEC, 1999b):

- The 1998 Energy Law contains some elements placing responsibilities on utility companies to promote energy efficiency.
- Funds have been provided under the EU- PHARE program to promote energy efficiency improvement in SMEs.
- Energy efficiency standards have been introduced for most household appliances and for buildings

In the buildings sector, regulations mandate minimum insulation standards on new buildings, although considerably less stringent than in many Western European countries.

Efficient lighting

A number of assessments have been made of the potential for street-lighting retrofits. In one city, a pilot lighting project in one street resulted in annual savings of about 860 kWh per luminaire, with a payback period of 1.26 years. The project however revealed difficulties with harmonic distortions, which required further attention. The greatest obstacle to wider replication of these pilot projects was found to be the non-availability of finance (IIEC, 1999b).

Although steps have been taken to promote efficient lighting, such as baring manufacturers and importers from supplying lamps with an efficiency of less than 8.5 lm/W for incandescent and 25 lm/W for fluorescents, unfortunately most households have insufficient spending power to invest in the recommended energy efficiency lamps. Some form of financial assistance would be needed to achieve a significant market penetration for the most efficient models of lamp (IIEC, 1999b).

2.7.3.5 Poland

The 1997 Energy Act is the most significant piece of legislation, which contains provisions explicitly creating a framework for DSM activities. The same Act also provides the basis for energy efficiency labelling of equipment, requiring that manufacturers and importers of equipment specify energy efficiency technical data, and that energy efficiency performance be displayed on a label (IIEC, 1999c).

Sources of funds

Funds for energy efficiency measures include the National Fund for Environmental Protection which is made up of fees and fines paid by firms exceeding various pollution emission limits. ECOFund was created by converting 10% of Poland's debt, and also supports certain eligible energy

efficiency projects with grants of up to 30% of the investment cost available (IIEC, 1999c).

Efficient lighting

Considerable attention has been paid to stimulating the market for efficient lighting products in Poland, with the result that the country probably ranks among the most efficiently lit countries in Central and Eastern Europe (IIEC, 1999c). Poland Efficient Lighting Project was instrumental in this regard. It was financed by GEF and commenced in 1995, using a combination of producer subsidies and targeted marketing to stimulate the market for CFLs (IIEC, 1999c).

Household appliances

As Poland prepares to enter the EU, energy labelling of a range of household appliances will become mandatory, and minimum energy efficiency standards will apply. Currently domestic production of household appliances, particularly the higher quality energy-efficient models is outstripped by demand, with the effect that more than 50% of the demand is met from imports, which are invariably more energy efficient, thus forcing local producers to move into production of more energy efficient models. However, even with appliance labelling, energy efficiency does not feature very highly in the criteria used by purchasers in selecting appliances (IIEC, 1999c).

2.7.3.6 France

Energy efficiency in France is in the hands of a semi-autonomous body, which was launched in 1982. The agency is under the control of the Ministry of Industry and Technology. It has a research development and demonstration programme. It offers the following incentives for promoting energy efficiency (Hughes *et al*, 2002):

- Tax deductions for investment in energy saving processes and equipment

- Offers long and medium term loans at preferential rates
- Accelerated depreciation of energy saving investments
- Support for investment in return for setting agreed energy targets

2.7.4 Energy Efficiency in Asia

2.7.4.1 The Philippines

While the Department of Energy (DOE) has focussed on a number of initiatives to promote energy efficiency, such as energy audits and training programs, the highlight of its intervention however has been its industrial initiative, the highly successful Technology Transfer for Energy Management program (Rumsey & Flamigan, 1995).

Technology Transfer for Energy Management (TTEM)

The primary purpose of TTEM was to promote and accelerate the adoption of energy-efficient technologies and operational practices by industrial consumers. The program not only provided information and technical assistance for Filipino, foreign and multinational industrial and commercial establishments in the Philippines, but also backed these services with financing at below-market interests rates.

Half of the funding provided by the donors was earmarked for provision of information and technical assistance, whilst the other half was for an innovative loan program.

The program was coordinated and supported by in-kind assistance from Bureau of energy Utilisation within DOE, and received substantial input from steering committee composed of representatives from the DOE, The Philippine Central Bank, Department of Budget and Management, Department of Finance, National Economic and Development Administration, and Board of Investments. The private sector was also represented through the Philippine Chamber of Commerce and Industry, the Energy Management Association of the Philippines, and the Bankers Association of the

Philippines. A project staff composed of a director, staff engineers, information officers, and an administrative complement undertook the program. The project also benefited from technical assistance provided a U.S. firm, Resource Management Associates.

The centrepiece of the TTEM program was the Demonstration Loan Fund, which was established to finance energy efficiency at below market interest rates. The fund was intended to demonstrate efficiency technologies and practices not widely used in the Philippines.

The program provided the following useful lessons, amongst others:

- Move a higher fraction of the donor funding from technical assistance, information and administration, directly to customers for energy efficiency retrofits.
- Interest rates need only be slightly concessionary - Low interest rate loans must not be favoured for fear of creating a distortion and thereby hampering future ability of commercial lenders to make efficiency loans at market rates.

Building codes

The mandatory codes came into effect in 1994, but by 1995, they were yet to be fully implemented. The success of the code would depend on how well government inspectors have been educated, and on the rigor with which penalties are imposed on non-compliant buildings.

Air conditioner program

The program established minimum standard and labels for levels of efficiency that all residential air conditioner units must meet in order to receive government certification to be sold in the country. The labelling of components educated consumers on the benefits of energy efficient appliances, and as consumers became energy conscious, manufacturers were provided with an incentive to use efficiency as a marketing tool.

The program took all of ten years to implement, owing to the painstaking process of obtaining buy-in from the private sector into the negotiations in order to develop reasonable standards that could be improved over time.

The Fuels and Appliance Testing Laboratory is a key component of the program, serving as an independent testing laboratory to verify manufacturer's assertions of the efficiency of their units. The standards applied initially to locally produced units, but were later extended to cover imported units. Similar programs were planned for other household electricity appliances.

2.7.4.2 China

Energy conservation centres

Energy conservation centres (ECC) are the most common energy efficiency programs in Asia - outside government information campaigns, due to the relative ease and low cost of establishment. They are established as semi-autonomous bodies overseeing several types of energy conservation activities, such as educating the public about energy conservation, conducting energy audits or feasibility studies for large business, as well as training professionals within energy efficiency.

The U.S. Department of Energy, the U.S. Environmental Protection Agency, and the World Wildlife Fund, funded the establishment of the Beijing Energy Efficiency Center (BECon) in 1993, as a non-profit, non-governmental institution whose purpose was "to promote energy efficiency policies".

BECon has four primary activities:

- Policy research
- Business development
- Training

- Information dissemination.

The business development activity was the unique focus area of the organisation. It included market research for private companies, consulting services, technology demonstrations, and project financing – all of which are income-generating activities contributing towards the sustainability of BECon. It also enjoys logistical assistance from the Chinese government's Energy Research Institute.

Industrial efficiency regulations

China's programs have been by far the most successful in Asia, in achieving actual energy savings both in gross amounts and percentage savings (Rumsey & Flanigan, 1995).

The program focuses on improving industrial energy efficiency, and includes major policy directives, procedures, regulations, technical assistance programs and project financing initiatives. The Chinese program is notable for its comprehensive network of energy conservation centres, its monitoring and tracking of energy use and its promotion of energy awareness. Technical assistance facilities in the form of an extensive network of energy conservation centres have been established throughout the country to assist enterprises in their energy conservation initiatives.

The program develops detailed targets, guidelines and standards on industrial energy consumption and energy conservation, and individual industrial corporations are required to report regularly on their energy use to government. Each enterprise is allocated an energy consumption quota, and prices for energy consumption beyond the quota amount are substantially higher than prices up to the quota. Enterprises, which consistently consume within the quota, are rewarded.

Appliance labelling

Energy efficiency standards have been developed for various electricity-using equipment, and while most are mandatory, some are used as guideline, and compliance is strengthened by publication of lists of banned as well as energy saving equipment.

Sources of funds

Investment funds for energy efficiency improvements have been established both by national government and by local government. The funds are provided to enterprises as loans at subsidised interest rates.

2.7.4.3 Singapore

Building energy codes

The importance of building energy codes, as a means to achieve energy efficiency is best illustrated by Rumsey & Flanigan (1995), when they state "Energy codes for commercial buildings are one way to avoid missing the opportunity of making buildings efficient from the start. Efficiency in new buildings, if ignored, is often referred to as a "lost opportunity." While it is possible to retrofit existing buildings, it is always substantially more expensive than designing efficiency into new buildings."

Singapore was the first South East Asian country to fully institute enforceable building energy codes. The codes focus on improving the efficiency of building shells (exterior or envelope), cooling equipment and lighting systems. Primary focus is on the building envelope.

Means of establishing standards fall into the two basic categories of prescriptive and performance. Prescriptive standards require that buildings use certain materials such as double-pane glass, etc. These standards are easier to understand and implement, but they offer very little flexibility. Performance-based codes offer greater degree of flexibility to building designers, but are more complex to implement. Such codes call for computer simulation of energy use, based on the interaction between the

buildings envelope, lighting system and cooling system, be performed prior to construction – and thus allow trade-off between the various measures that can be implemented to meet the required efficiency standard.

Singapore first implemented its standards in 1979, both for new and existing buildings. New buildings have to comply with energy codes prior to issuance of a building permit, whilst existing buildings were given two-year period to be upgraded to reach compliance. A carrot and stick approach ensured compliance, especially in new buildings. Those buildings that complied with the standards obtained permits and those that failed to do so were not issued with permits. Enforcing compliance in existing buildings was however a challenge.

As an incentive, owners of existing buildings were allowed a 40% total cost of retrofitting an existing building to be claimed as income tax or property tax deduction by the government. An additional scheme by government of an accelerated depreciation allowance on energy saving equipment was also implemented. A 20% surcharge on the electricity bill of existing buildings that did not comply with the standards was levied. The surcharge was increased to 50% after a few years, and by 1987, all existing buildings were upgraded to be compliant.

2.7.4.4 Indonesia

Energy conservation centres

The Indonesian Industrial Energy Conservation Corporation (KONEBA) was established as a quasi-private industrial energy conservation corporation in 1984. It was established as an income-generating centre that focussed on income generating services at the expense of the more traditional energy centre role such as education, promotion, policy analysis, and training activities. It concentrated its efforts on large industrial customers with ability to make energy conservation investments. It issued services including

energy audits of facilities, detailed engineering designs and in rare cases, financing –complete with shared-benefits arrangements.

Its original mission came to an abrupt end in 1991, at which point the Indonesian government took it over due to financial difficulties. It was radically transformed and incorporated into government under the national Ministry of Mines and Energy, and primarily focuses on serving facilities owned and operated by the Ministry.

Building codes

Voluntary building codes were instituted as guidelines in 1990. Experience on the ground is that no privately owned buildings have been built to meet the code, and even government buildings do not meet the code. The cost of education and enforcement is believed to be a major reason for the government hesitancy to implement a mandatory code.

Energy labelling program

In Indonesia, consumer awareness of the need to save energy is still very low, owing to the fact that the government subsidises electricity and thereby making it cheap (Dalimi, 2001).

The government prepared a Master Plan for implementation of energy labelling program, and internally accredited laboratories for testing equipment are being prepared (Dalimi, 2001). The labelling program is being introduced to the consumers through various public awareness campaigns and the targeted equipment is refrigerators, air conditioner, lamp and electric fans.

As Dalimi (2001) remarks, the activities of the Energy Labelling Program are not directly to produce the saving of energy per se, but rather to encourage electrical equipment manufacturers to improve the efficiency of their products

in terms of energy consumed, and to assist in changing the attitude of consumers about the role of energy consumption in the buying decision.

2.7.4.5 Pakistan

Energy conservation centre

The National Energy Conservation Centre (ENERCON) was established through financial aid of USAID grant, in 1986. The government later took over the funding responsibility from USAID in the funding.

During the tenure of USAID, the centre offered a full set of energy conservation services, including industrial energy audits, energy analysis, and outreach and information dissemination.

Evaluation of the program revealed that industry is likely to undertake comprehensive energy efficiency measures if the first measures they undertook were low-cost and had fast payback. These initial successes often resulted in further investments in measures with longer payback periods (Rumsey & Flanigan, 1995).

ENERCON utilised several private Pakistani consulting firms, thus building capacity within the private sector and support for energy efficiency within the private sector.

ENERCON continues to be dependent upon donor funding to sustain its activities.

2.7.4.6 South Korea

South Korea has, since mid-1970, ran one of the most aggressive energy conservation programme, with more than one hundred separate conservation initiatives across all energy end-use sectors (Rumsey & Flanigan, 1997).

As early as 1970, the government offered financial and tax credits to homeowners and business to promote the installation of energy efficient equipment in the industrial, commercial, and residential sectors. In September 1992, the government of South Korea initiated a comprehensive program called Energy Efficiency Management System in Korea – Standards and Labelling, with the Ministry of Trade, Industry and Energy as authorized by the Rationalisation of Energy Utilization Act, sets rules for energy efficiency standards and labels. The South Korean Energy Management Corporation (KEMCO), a public agency, supervises their implementation and enforces these rules, and the testing associated with the standards and designated testing laboratories carry out product compliance.

KEMCO implemented energy efficiency regulations by grouping them into three categories: efficiency standards, commercial efficiency labelling program and efficiency rating labelling program for consumer goods.

The efficiency standards program establishing efficiency levels for electrical appliances and passenger cars was introduces in two phases, a minimum efficiency level was required for manufacturers by the end of 1993, and target efficiency levels were required to be in place by 1995.

Commercial efficiency labelling program established labels indicating energy efficiency of many kinds of commercial and industrial equipment. Importers and domestic manufacturers were required to submit designated products for testing by authorised agencies. The test results are to be clearly indicated on the product label, and to be explicitly stated in almost all product advertising. While this step help to raise awareness of the public about energy efficiency in general, and a major selling and competitive point, labelling encourages manufacturers to increase the efficiency of their products in order to maintain a competitive edge.

Efficiency rating labelling program was the final component of the overall program, and entailed labelling consumer goods with an efficiency rating on a scale from one to five, with the most efficient product receiving a rating of one.

Whilst KEMCO manages the labelling and rating, eight different laboratories and research institutions provide testing services. KEMCO also conducts random verification of efficiency claims made about designated products up to three times a year.

As Rumsey & Flanigan (1995), state, the success of the Korean energy efficiency program has proved again that the twin manufacturer/consumer effect of "…higher-efficiency products available from manufacturers coupled with greater levels of purchases of energy-efficient equipment by consumers – is the key reason standards and labels are such powerful tools for promoting energy efficiency."

2.7.4.7 Thailand

The Royal Thai government has emphasised and continued their policy on energy efficiency programs, focussing on the commercial and industrial sectors, which consume large portions of energy (Santisirisomboon, Limmeechokchai & Chungpaibulpatana, 2000).

In 1992, the Royal Thai government passed the Energy Conservation Promotion Act. The act blended incentives with mandatory regulations to facilitate the implementation of mandated energy efficiency measures. The energy conservation programs consist of compulsory programs, voluntary programs and complementary programs. The compulsory programs cover the implementation of energy conservation activities in designated factories and buildings. A designated building or factory is one whose electrical demand is greater than 1000 kWe or whose total commercial energy consumption is greater than 20 million MJ per year (NEPO, 1997). The voluntary program involves rural and small industries program, the research

and development program, and the industrial liaison program. The complementary program involves the provision of education and training programs on energy conservation for concerned personnel.

The methodology used in the industrial sector to introduce the energy efficiency program is based on the energy intensity approach. The improvement of energy intensity will reflect the change in energy consumption due to the implementation of energy conservation activities (Santisirisomboon *et al*, 2000). The methodology used in the commercial sector is to emphasise the efficiency improvement of electric end-use devices, and since electricity is used mainly for air conditioning and lighting, the energy efficiency improvement of these two devices is the main target.

Energy conservation centre

Energy Conservation Center of Thailand (ECCT) was approved by the Thai cabinet in 1985 and was established in 1988, and is modelled along the lines of the Japanese energy conservation centre.

Although, initially the intention was for the centre to be funded jointly by the Thai government and Federation of Thai Industries (FTI), ECCT has enjoyed success with government-only funding. Although its now financially viable, it faces operational barriers and exclusions arising from its initial dependence on government funding. Its income generating activities include:

- Assistance to the Department of Energy Development and Promotion (DEDP) – a government department- for energy audit training, industrial efficiency feasibility studies and industrial energy audits
- Services to industry and commercial buildings
- Contacts with foreign organisations
- Independently organised training courses

Building codes

The codes in Thailand are part of the larger energy conservation act passed in 1992. The code was introduced on a voluntary basis as a guideline well before it became mandatory. Unlike in the Philippines, education and public awareness was embarked upon well before the code became mandatory, whilst the Philippines made the code mandatory before it became well publicised.

The code applies to commercial and industrial buildings, both new and old, with actual or expected peak electricity consumption of greater than 1MW. Existing building and those under construction during enactment of the law were given three years during which to comply with the code. Non-compliance is penalized by an electricity consumption surcharge.

Fluorescent lamp campaign

Thailand began its fluorescent lamp campaign in 1993, to promote the use of 36-watt, T8 lamps. The Electricity Generating Authority of Thailand (EGAT) had to convince all existing fluorescent lamp manufacturers such a Philips, Osram, Toshiba, Asea Lamp, Saffi and Daichi to switch from the manufacturer of 40-watt lamps to 36-watt lamps. In exchange, EGAT would work to change the perception of Thai consumers of the technology, and thereby use its corporate strength and financial resources to transform the market demand for fluorescent lamps.

A series of negotiations culminated in a MoU signed between EGAT, Thai government and manufacturers. The manufacturers undertook to change over their production within two years, whilst EGAT in turn, agreed to undertake advertising and awareness building campaign.

The campaign has been successful in accelerating the use of more efficient fluorescent tubes, and another pointer to the success of the campaign is how

the manufacturers are now using energy efficiency aspects of their products as a marketing tool.

2.7.4.8 Japan

The Ministry of Internal Trade and Industry (MITI) run the energy conservation programme in Japan. The government also enacted a law for Rationalization of Energy Consumption in 1997. A number of incentives on offer to promote energy efficiency include the following:

- Loans from the Japan Development Bank and Medium and Small Enterprise finance corporation
- Tax measures in terms of accelerated depreciation

The Moonlight project started in 1978 is a national project for the promotion of research and development into energy conservation technology.

Energy conservation centre

This was established in 1978, with authorization of the MITI. It is one of the oldest and most respected in Asia.

Energy conservation was introduced into the electric power sector when the National Coordination Committee for the Rational Use of Electricity (ECCJ) was established. ECCJ enacts key area of the regulations including energy management certification, public information dissemination and training. The organisation is divided into eight functional departments (Rumsey & Flanigan, 1995):

- Public relations
- Research
- Education and training
- Technical
- International cooperation
- Publications
- Examinations
- Administration

The centre currently offers a comprehensive suite of energy conservation services except financing assistance, which is currently provided by various government-controlled loan facilities established as part of the national energy conservation policy.

The centre is financial viable, and by 1994, 18% of its budget came from subsidies or government funds, 7% was earned from membership fees, while the vast difference of 73% was derived from services provided to customers.

2.7.5 Energy Efficiency in Africa

2.7.5.1 SADC

According to Murove (1997), within SADC, South Africa and Zimbabwe are the most energy intensive countries, followed by Swaziland, Tanzania and Zambia, and potential for improvement in industrial energy efficiency estimates range from 20% to 60%, and perhaps more in areas where there's gross capacity under-utilisation.

In most SADC countries, response to energy management initiatives is extremely slow or non-existent, owing to low energy prices that prevail (Murove, 1997). So take-up of initiatives supported and promoted by donors in the region have been disappointing. There have been small activities going on, with the noteworthy ones being in Tanzania, Zambia, Zimbabwe and Mocambique. These however have been of a stop-start nature, as and when donor funds were available or became depleted.

Role of donor funding

While in industrial countries, energy management programmes aimed at industry have succeeded in part, some would say, primarily because industry is able to develop or readily access the skills required to identify and implement efficiency opportunities, on the other hand, in developing countries, little information on energy management is systemically available to users – unless from sources in the industrial countries, and specialist training on the topic is limited to donor-supported, short term programmes

(Stiles, 1997). Stiles (1997) further points out that much of the donor-driven work in the SADC region has been centred not on development of information and training systems, but rather on delivery of energy audits to individual industrial facilities and development of innovative financing mechanism for energy efficiency implementation.

Donor and lender involvement in energy efficiency and energy management programmes within the SADC region conforms to the technology transfer model of technical development which assumes that introducing short-term technical assistance programmes – involving specialists with the appropriate skills and technologies from outside the country, who carry out plant and building audits or other assessment activities – will eventually spawn comparable development within the target country (Stiles, 1997). It is quite clear, according to Stiles (1997), that the technology transfer model, which has been applied in Zimbabwe, Malawi, Tanzania, Zambia, Lesotho and Mocambique, ignores the two most basic requirements for sustainability. These are the development of a market for energy management services and technologies, and an internally supported program of human resource development. Without exception, this model has failed.

There are available alternative models such as the Linkage Model and the Agency Mode, which could be considered (Stiles, 1997). This model is used to deliver courses in rural energy planning. Rather than establish counterpart groups within government or parastatals, this model focuses on local training institutions and attempts to facilitate delivery of courses by the industrial country institution through the local institution. According to Stiles (1997), the weakness in the model lies in the fact that external organisations are the prime movers and there's little consideration to the establishment of intermediary organisation, which might provide energy services.

The Agency Model has been tried with mixed success in Asia and Latin America, but so far, not at all in Africa. Both South Africa and Zimbabwe

have considered this model and its promotion in the former country has been primarily a homegrown phenomenon (Stiles, 1997). The attraction of this model is that it relieves government of responsibility for programme design and implementation, allowing it to concentrate instead on developing policies, which will ensure an enabling environment for efficiency investments.

2.7.5.2 South Africa

In the White Paper on Energy Policy (1998), the South African Government recognises the importance and potential of energy efficiency, and commits itself to promoting the efficient use of energy in all demand sectors. The Government also commits itself to investigation the establishment of appropriate institutional infrastructure and capacity for the implementation of energy efficiency strategies (White Paper on Energy Policy, 1998). This policy has however not been implemented with the same vigour and intensity that matches that which accompanied its publishing. No comprehensive strategy to implement this policy, or legislation of any kind has been enacted to implement this policy.

What the Government through the Department of Minerals and Energy (DME) has however carried out with passion, less so the current Government, is to commission a plethora of studies into energy efficiency over the years, and in so doing, managed to accumulate useful information on energy efficiency, non. Regrettably, none of the recommendations contained in the reports have been implemented in a comprehensive and focussed approach. Refer to Annexure B for a list of studies and reports.

Efficient lighting initiatives

South Africa launched its own version of Efficient Lighting Initiatives through a company called Bonesa, in July 2000. The aim of the program was to penetrate the South African market with 18 million CFLs over a period of fifteen years (ESI Africa 4, 2000).

Bonesa is a joint venture between local partners consisting of TSI – a subsidiary of Eskom Enterprises, Africon and Umongi-Karebo, formed for purposes of implementing the South African ELI, a program designed by Eskom and IFC. The program is a USD 10 million three-year initiative, funded by Eskom (R48 million) and the Global Environment Facility (GEF) for R15 million. South Africa was one of seven countries participating in this initiative (ESI Africa 4, 2000).

Bonesa strategies included financing the bulbs through residential electricity bill, bulk buy-downs from suppliers and subsidization of the cost of the bulbs to consumers through electrification and housing programs (ESI Africa 4, 2000). The three broad markets targeted were newly electrified households, existing and new mid- to upper-income households and commercial and institutional buildings and industrial facilities. Fifty percent of its budget allocation would be spent on educating the public.

Philips Lighting and Eskom Demand Side Management (DSM) jointly promoted the Mega-Watt Savings Project, an initiative that encourages the use of energy efficient lighting. Philips Lighting made its energy efficient Genie lam range available at reduced prices. Its 14-Watt Genie lamp was offered for R15.99 at popular retailers and agricultural co-operatives/companies. One of the leading retailers also offered an 11-Watt "house brand" lamp at R14.99 (Sawubona SAA Magazine, 2004).

Demand Side Management (DSM)

Eskom formally recognised DSM in 1992, when integrated electricity planning (IEP) was first introduced, with the first DSM plan being produced in 1994 (Africa, 2003). The concerted residential (historically black) electrification program had tremendous impact on the system level demand profile, with the proportion of energy sales to the residential sector as a whole experiencing increased from 15% to 20% in only ten years (Africa, 2003).

Eskom introduced DSM therefore for purposes of limiting residential demand growth or mitigation of the impacts through the provision of incentives for industry and commerce to move load out of peak demand periods (Africa, 2003).

Through this program, funding is provided for residential energy efficiency, residential load management and industrial and commercial energy efficiency and load management. Eskom funds the capital expenditure necessary to achieve energy savings and the measuring equipment. The ESCO is tasked with the responsibility of implementing and maintaining the project. A portion of the clients energy cost savings is then shared with the ESCO to pay the resources committed to sustain the project. Because the benefit to the client (energy consumer) is the saving on the monthly energy bill for which there was no capital outlay, the client is therefore obliged to pay a portion of the saving to Eskom and the ESCO. The Eskom portion is partial reimbursement for the revenue loss, whilst the ESCO portion is payment for sustaining the saving for the client (Eskom Demand Side Management, 2002).

Private Sector Initiatives

- The MTN 14th Avenue Campus Building on 14th avenue off-ramp was completed in December 2002, and it has been developed as a "green" building and demand side management principles have played an important role in the design concepts used for the building. The electrical installation was planned in accordance with CSIR Green guidelines and the building façade complies with South African Energy and Demand Efficiency Standards (SAEDES) guidelines (Eskom News, 2002).

- A two-day study at Parmalat's processing plant in Parow indicated that the processing plant could save R144 297 a year with energy efficiency improvements costing only R71 605 (Kenny, 2003).

  The study was jointly conducted by Energy Research Institute (ERI) of the University of Cape Town and an energy management team, called Industrial Technology and Energy Management (ITEM), from the University City Science Centre from USA. ERI co-ordinates the South African Energy Management Association (SEMA), whose aim is to educate industry and commerce about the benefits of improved energy efficiency and how to implement it (Kenny, 2003).

  The audit took place in July 2002, and was intended to help educate industrialists, government officials and students about energy efficiency, using Parmalat as a case study (Kenny, 2003).

- Eskom developed four branded advisory services focussing on specific segments of their electricity consumer market for purposes of growing the commercial market by selling more electricity and encouraging customers to be more efficient (Elektroserve, 2002). Elektroserve (commercial and service sector), Industrilek (industrial sector), Agrelek (agricultural sector) and Elektrowise (household consumer sector) are all energy advisory services created with the aim of educating and advising commercial customers on efficient and effective use of energy and specifically electricity in their business. Other services rendered include energy audits and advice on electro-technologies and suppliers thereof. The predominant intervention of the advisory services was to replace or convert coal fired steam boilers with electrical point of use system. The most significant impact was experienced in the health and correctional services sectors where coal still enjoys 59% and 57% of market share respectively (Electroserve, 2002).

- that focus on specific segments of their traditional electricity consumer market, namely electroserve, industrilek, electrowise and agrelek.

Joint initiatives by DME and Eskom

- The National Energy Efficiency Week has over the last number of years been organised by the Department of Minerals and Energy and Eskom Demand-Side Management. The purpose is to create awareness and build capacity in the energy-consuming sector. A number of activities promoting energy efficiency are hosted during the week at national, provincial and municipal level. The activities include events promoting energy efficiency at various nodal points, promotions in communities, joint ventures with prominent stakeholders and a national energy efficiency week (DME, 2003). Worthy of note is that unlike in the past where the program lasted for a week. Typically the program for the week would feature events highlighted in Table 5.

Table 6: Energy efficiency week activities

Program	Program detail
Energy Efficiency Improvements at DME head office	Head office of DME replaced all its old light fittings with new energy efficient ones ,and plans are afoot to roll it out to other government departments and the private sector
Energy Standards and Appliance Labelling	South African Bureau of Standards (SABS) is developing SAEDES into technical standards for energy efficiency improvements of old and new commercial and public buildings. Potchefstroom and City Council and MTN have applied SAEDES during their construction projects. The appliance labelling technical committee intends to consider standards and appliance labelling of washing machines, refrigerators, freezers and geysers.
International collaboration on Energy Efficiency	DME is involved in a number of projects for purposes of capacity building on Energy efficiency, namely: • Danish supported Capacity Building Project on Renewable Energy and Energy Efficiency • USAID supported project for the Communication of the DME's EE best practice, in other departments, with the view of developing energy efficiency procurement strategy for the South African government

Source: (DME, 2003)

- The *eta* awards (Greek symbol for efficiency), under the auspices of Minister of Minerals and Energy, Phumzile Mlambo-Ngcuka, and sponsored by Eskom, has been running for the last fourteen years. The objectives are to honour those individuals within the industrial, commercial, agricultural, and residential sectors who have made a worthwhile contribution in promoting energy efficiency in South Africa (Engineering News, 2003).

Donor-supported initiatives

- SADC Industrial Energy Management Project (SIEMP) was established as a regional initiative to develop energy management skills, and sponsored by Canadian Development Agency (CIDA). The

project was born out of appreciation of the fact that whilst SADC countries can still produce qualified engineers and technicians able to meet the basic skills requirements of industry and the power sector, they have however failed to equip them with an understanding of how to optimise the use of energy in production, design and construction of commercial and institutional buildings (Stiles, 2001).

The program's general objective is to improve the efficiency of energy use in the region's industries by promoting the development of locally delivered energy management training. The project team delivers training to industry personnel in SADC member countries and training of trainers to a variety of public and private training providers in the same countries. They also provide a wide variety of locally developed reading materials on energy management for use by SADC trainers and educators (SADC Industrial Energy Management Project, 2004).

- The Capacity Building Project in Energy Efficiency and Renewable Energy (CaBEERE Project) is a joint project between the Governments of South Africa and Denmark. The Danish Government finances the project with a contribution of 27 million DKK (Danish Kroner), and the DME and COWI Consulting Engineers and Planners A/S, Denmark implement it (CaBEERE Project, 2004).

  The overall objective of the project is to increase the use of renewable energy and energy efficiency throughout South Africa to maximize energy sectors contribution towards sustainable development. The immediate objective is to ensure that DME and relevant stakeholders are resourced and capacitated to formulate and facilitate implementation of strategies and legislation promoting energy efficiency at the demand side and renewable energy in both rural and urban areas. At the conclusion of the project, it is anticipated that DME will be able to effectively and efficiently meet its renewable

energy and energy efficiency mandate as set out in the White Paper on Energy Policy and to sustain this capacity

2.7.5.3 Tanzania and Zambia

There has been a long history of subsidised industrial energy auditing programmes in both these countries, supported by donor organisations. These have been delivered by either Department of Energy or through the Tanzanian Industrial Research and Development Organisation (Murove, 1997).

Currently, these two same countries through the World Bank support to the power sector have embarked on further energy efficiency programs, with the model applied this time around not being through governments, but through electricity utilities. The programs are DMS type, with a strong emphasis on training of energy auditors, carries out by Tanzanian and Zambian utilities, TANESCO and ZESCO respectively. The expectation is that the trained auditors would offer the same service to industry as well (Murove, 1997). It is early days yet to assess the impact of these initiatives.

2.7.5.4 Lesotho

The country is planning to introduce Regulations and Guidelines for Energy Conservation in buildings, because the energy balance of the country indicates that the building sector is more energy intensive in the country, compared to the small industrial and commercial demand for energy that exists in the country (Murove, 1997).

2.7.5.5 Zimbabwe

Zimbabwe has an all-embracing National Energy Efficiency Programme, which is seen as the umbrella or focal point for all energy management programmes in the country. Zimbabwe is currently striving towards a national energy policy with an active energy efficiency component, which encompasses information programmes and regulations (Murove, 1997). Plans are also afoot to set up an implementing agency outside the

Department of Energy, for purposes of being responsible for executing programmes possibly on contract to Department of Energy. Another possible component of the programme is revolving fund for the implementation of energy efficiency measures, according to Murove (1997).

Murove (1997) goes on to identify barriers to better energy management in these countries, and a lot of the barriers are the universally recognised ones. He however sums up the major barrier as being “Insufficient commitment to Energy Efficiency by governments as demonstrated by non provision of resources be they financial or human.” However, Murove (1997) also concedes that the situation is changing somewhat for the better. He further suggests areas which are the ambit of government and, which, if resolved, will create the enabling environment for energy management to flourish:

- Clear energy management policy, advocacy and information and awareness programmes;
- Legal and institutional framework and capacity building for energy efficiency standards, energy performance testing, procedures and protocols, as well as enforcement and compliance of regulations and laws;
- Incentives programmes (e.g. removal or reduction of duties and taxes on imported high efficiency energy products);
- Cost reflective energy pricing.

Table 7: Integrated comparative table (summary of country experiences)

Region		Energy Efficiency Intervention							
		Funding	Incentives	EE standards/regulations	Institutions	Energy price	Legislation	R&D	Education
Europe	UK	-Access to finance	-Efficient lighting incentives	-Building industry -Buildings, appliances	-Energy Savings Trust	-High energy prices	-Policy Implementation support	-Research Institutions	-Information campaign
	Norway	-Grants for EE investments			Semi			-Parastatal R&D institution	I-information dissemination
	Hungary	-Third party finance -Environmental Fund -CO-financing fund	-Energy saving credit program	-Building energy performance -Mandatory labels for household appliance	-EE Business Council (NGO)		-National EE program		-Awareness raising
	Romania	EE funds		-Buildings and appliances -Street lighting standards -Restrictions of imports			-Energy Law		
	Poland	Fund for environmental protection		-Equipment labels -Appliance technical standards			-Energy Act		-Targeted marketing of CFLs
	France	-Loans at preferential rates	-Tax deductions for EE investments -depreciation allowance	-Agreed energy targets	-Semi-autonomous agency			-Research development and demonstration	

Asia	Philippines	-Loans at below market rates -Demonstration loan fund		-Mandatory building codes -Minimum standards and labels for appliances -	-EE advisory committee -Technical assistance from donors			Independent testing laboratory	-Information and Technology assistance -Consumer education -Private sector buy-in
	China	-Subsidised loans		Energy audits and feasibility studies -Policies, regulations, directives and procedures for EE -Targets, guidelines and standards -Reporting of energy use by private sector -Energy quotas for industry -Mandatory standards for equipment and appliances -"Name and Shame" approach	-Network of semi-autonomous Energy conservation Centre -Donor support _			Monitoring and tracking energy usage	-Public education -Training -Promoting energy awareness
	Singapore		-Accelerated depreciation -Tax allowance	-Prescriptive standards for buildings -"carot and stick" approach		Surcharge on energy bill			

	Indonesia	Funds for EE investments		-Energy audits -Voluntary building codes -Energy labelling program	Energy conservation corporation (parastatal)			-International accredited laboratories	Public awareness campaign
	Pakistan			-Energy audits	-National energy conservation centre (parastatal) -Donor support-			-Energy usage analysis	-Private sector capacity building -Outreach -Information dissemination
	South Korea	-Financial credits	-Tax credits	-Standards and labels for appliances and equipment -Testing of imported appliances and equipment -Efficiency ratings		-Energy consumption surchage	-Rationalisation of energy utilisation Act -Energy management corporation	-Designated testing laboratories -	-Consumer awareness
	Thailand		Incentives	-Mandatory regulations -Voluntary, compulsory and complementary EE programs -Building codes -Industry mobilisation	-Energy Conservation centre	-Focus on commercial and industrial consumers	-Energy Conservation Promotion Act -Energy Conservation Act		-Education and training program -Education and public awareness -alter consumer perception
	Japan	-Development bank loans -SMME finance corporation -Government loans	-Accelerated depreciation	-Energy conservation program	-Energy conservation centre		-Law for rationalisation of energy consumption		

North America	USA	Federal budget	Tax credits	Minimum standards	Mobilised Public and Private institutions	Rising	Energy Policy and Conservation Act		
South America	Chile	-Leasing -Low interest rate loans		-Street lighting projects -Large industry cogeneration	-National energy commission				
	Mexico	-Revolving loan fund -Rebates -Discounts -Commercial loans -Feasibility study funds -Grant funding	-Energy saving prize	-minimum energy efficiency standards -Building codes -Energy efficiency labels -Demand side management -Residential efficient lighting -Energy audits -Product efficiency stamp	-Comision Federal de Electricidad (CFE) -Luz y Fuerza del Centro (LyFC) -CONAE -PAESE -FIDE -IIE -ATPAE -Academia	-Time=of-use tariffs -Highly subsidized average tariffs		-Electricity research institute -Academic research	-Internet as clearing house of information -Training of students -Mass media advertising -Pamphlets -Classroom courses -Seminars -quarterly publications
Africa	SADC *			-Technology transfer -Energy audits	-Donor organisations				-Uniform EE curriculum
	South Africa	-Eskom DSM funding		-DSM -Energy audits -Bonesa (CFLs)	-DME -NER Eskom -Donor Agencies	-Low energy prices	-Energy Policy	-SABS -TSI	-Energy efficiency week

2.8 Implementation Strategies for Energy Efficiency

In spite of the well-detailed interventions to promote energy efficiency, DME (1998) laments its current lack of capacity to undertake the energy efficiency programmes. It notes that other countries in similar circumstances have found the establishment of an agency to be an effective means of providing the necessary capacity and flexibility to implement such programmes. The functions of such an agency typically includes:

- Building consumer awareness of energy utilisation and cost-saving measures
- Demonstrating to consumers the benefits of energy efficiency measures through audits, demonstrations, sectoral analyses and other activities
- Building the capacity to implement targeted energy efficiency programmes
- Training people in energy efficiency methods, and
- Identifying and facilitating the removal of barriers to energy efficiency

DME (1998) also leaves an opportunity for specific and non-mandatory targets to be set to monitor progress on energy efficiency by various industries and commercial organisations.

Triebel (1996) suggested that government should get involved in energy efficiency programmes through a three phase approach:

- Preparatory phase
- Penetration phase
- Reinforcement phase

2.8.1 Energy Efficiency Policy Interventions

Ample empirical evidence exists, showing the success of various energy efficiency policies, and thus pointing towards the failure of market mechanism to address problems of energy efficiency. If consumers seemingly ignore compelling evidence of cost-effective energy efficiency

investments, with no visible hidden costs or time lags, then there exists market failure.

Levine, Koomey, McMahon & Sanstad (1995) have come with two essential conditions that must be met for energy efficiency policies to be considered good public policies:

- Evidence showing that the market is rejecting energy-efficiency technologies or systems that are cost effective, and
- Careful evaluation showing that the benefits of the policies outweigh its costs

Without a more detailed knowledge of why consumers fail to adequately invest in energy efficiency, designing policies to overcome the barriers is more difficult. However, often, a trial-and-error approach, in which policies are designed on best available information, implemented (at times on a trial basis), evaluated, modified, and implemented (often on a very extensive basis), can be highly effective (Levine *et al*, 1995).

The OECD/IEA (1991) holds the view that a mixture of policies is more effective and efficient than a concentration on a single policy instrument, i.e. the scale of the energy efficiency policies is more important than a specific policy success. A possible mixture of policy instruments is suggested:

- Publicity and Information
- Regulations and Standards
- Research, Development and Demonstration
- Governments as energy consumers
- The organisation of energy efficiency
- Pricing and taxation policies
- Grants, tax incentives and loans

Anderson (1992) suggested the levying of taxes as a possible measure to reduce carbon dioxide emissions. The idea being that a user of carbon-

based fossil fuel pays twice for usage of the fuel, firstly for the fuel itself and secondly for the use of the atmosphere and the pollution caused. The amount of tax levied should be a function of the carbon it burns, according to Anderson (1993). Anderson (1993) further suggests the following measures to address non-price barriers:

- Publicity and information campaigns to inform energy users about the energy efficiency and running costs of particular products and buildings, about methods of managing energy use, and about the general importance of energy efficiency;
- Minimum standards for efficiency in energy use to be laid down by legislation, especially for cars and buildings;
- Public sector energy efficiency to be improved, especially in public service infrastructure
- Organisation of energy efficiency provision should be improved, including energy efficiency consideration into the planning by organisations primarily concerned with energy supply.
- Grants, tax incentives and loans should be used to promote energy efficiency.

The World Bank (1993) is of the view that decisions on country priorities for taking action to improve energy efficiency in developing countries should be made within the overall integrated energy strategy. The World Bank (1993) also identifies improvement of the institutional and energy efficiency-incentive structures relating to energy as the highest priority for improving the efficiency of energy supply and end-use in many developing countries. The World Bank (1993) therefore prioritises the following policy interventions:

- Energy prices must reflect the real cost of supply, including pollution abatement and damage costs;
- To stimulate supply and end-use efficiency, developing countries must also reduce barriers to the establishment of dynamic private commercial and industrial sectors operating in a competitive environment;

- Creation of institutional frameworks to encourage efficient energy production and distribution including initiatives on restructuring the energy supply enterprises and facilitating a transparent regulatory mechanism between government and the energy-supply enterprises.

2.8.2 Energy efficiency programs

Hanreich (1991) identifies standards and equipment labelling actions for domestic appliances and lighting as the most important energy policy instrument at the centre of the EU strategy for improving energy efficiency. Hanreich (1991) further mentions opportunities for energy savings in the domestic sector through usage of compact fluorescent lamps, whose utilisation is unfortunately hampered by a lack of information and high costs, compared to conventional lamps.

Stand-by energy consumption is also identified as a major source of energy wastage in the domestic sector, with a recent IEA study having identifies that about 1% of global carbon dioxide emissions are due to stand-by energy consumption, which by definition is wastage of energy (Hanreich, 1991).

Labels depicting the energy use of home appliances are in use in many countries as part of national demand-side management and market transformation targeted towards reduction in energy consumption, however most labels are complex or overly technical, making it hard for a significant proportion of consumers to understand them (Egan, 2001).

Egan (2001) tested five graphical designs of energy labels on appliances, namely

- The Energy Guide label;
- European-style letter-based graphic;
- Australian-style star-based graphic;
- A speedometer-style graphic; and
- A thermometer-style graphic

The market viewed the star label more favourably due to the fact that it was simple to interpret and most consumers were already familiar with the concept of stars to connote performance.

Hassan, Rahman, Majid & Kannan (2001) identify standardisation and labelling as the two cornerstones of any energy efficiency strategy, and that they both combine "market pull" and "market push" to increase the supply and demand for energy efficient products – energy performance standards eliminate the least efficient products from the market and labelling communicates directly with the consumers, encouraging them to purchase the efficient products on the market, with the overriding principle here being that a consumer who is adequately educated about energy consumption is a better consumer.

Triebel (1996) lists the following policies and programmes as the most commonly used to encourage energy efficiency in industry and commerce:

Table 8: Policy measures

Policy measure/programme	**Target group**
Information and technical assistance	Aimed at encouraging energy efficiency. They would typically involve energy audits and information dissemination. It could also include identifying best practice benchmarks.
Technology development and commercialisation	This covers the promotion of energy efficient end-use equipment, including research into the efficiency. Development could be in the area of sector-specific processes or technologies for producing steam, compressed air, motors, etc.
Corporate commitment and recognition	This involves the recognition by government of companies that have adopted energy efficiency
Tax and fiscal measures	These include environmentally orientated energy taxation and fiscal incentives aimed at encouraging energy efficiency
Standards and regulatory instruments	It is difficult to establish industry standards because of the different nature of energy use in industry. Standards can relate to performance requirements, or conduct requirements such as performing energy audits.

Anderson (1995) identifies eight elements of an effective energy policy, to address rapidly rising energy demand whilst sustaining demands for cleaner environment:

- Economic stability and growth – a stable and growing economy, free of budgetary distresses and high inflation, is a pre-requisite for the success of any microeconomic or social policy.
- Price efficiency – good pricing policies would reduce the eventual level of electricity demand in developing countries by about 30%.
- Regulatory reform and openness to private investment – regulatory reforms requiring the public utilities to work on commercial principles, and the growth of private investment in the industry, are forces for both price and cost efficiency, and hence for energy efficiency.
- DSM programs (Non-price measures) – marginal cost pricing, which generally requires prices to vary according to time of day, voltage level and season, is central to DSM.
- Environmental policies – when the social costs of pollution exceed the costs of abating it, this is another source of economic and energy inefficiency
- Rural energy supplies – failure to expand commercial energy supplies to developing countries, whose people are dependent on fuel wood for cooking, will lead to an environmentally and socially untenable situation
- Research and development – recent development in environmentally improved practices and energy efficient technologies have depended on a successful mix of public and private policies.

Most economists, including Anderson, all agree on six targeted policies to address energy efficiency:

- Better metering and itemised billing systems (part of DSM) – developments in metering and communications technologies that permit itemised billing, including not only billing by time of use, but by

the main appliance categories, would indeed present significant progress toward the achievement of price and energy efficiency.

- External costs – external costs, if un-addressed, are a source of economic inefficiency.
- Removing unnecessary subsidies – electric power subsidies pose the greatest problem in the developing countries where a removal of subsidies would likely reduce waste in electricity consumption by as much as 30%, relative to trend levels and greatly improve their fiscal situations.
- Dismantling unnecessary government interventions – introducing non-price measures in developing countries also requires care
- Subsidies for innovation – the case for public financial support for research and development and the demonstration of new technologies is a generally accepted policy intervention
- Standards and Codes for Equipment and Buildings – standards have improved energy efficiency in the United States.
- Institutions – other industries are often better placed than the electric utilities to deliver innovative products and services for energy efficiency.

2.8.3 Equipment and Appliance energy efficiency standards

This policy has been pursued very actively in the USA since 1987, and it has resulted in substantial gains in both energy and economic efficiency.

2.8.4 Demand-Side Management

Joskow and Marron (1993a, 1993b) published a number of studies that led to the conclusion that utility DSM programmes are not likely to be cost-effective in many cases. In evaluating DSM programs from ten utilities in the USA, the authors found that the average cost of such programs were higher than the average cost of electricity in most regions, and thus they concluded that the programs were in the main "…either only marginally cost effective or clearly wasteful."

Levine *et al* (1995) however seem to favour DSM programs and therefore refute the conclusions arrived at by Joskow and Marron. The former maintain that DSM programs are desirable public policy instruments because they present a means of opening up large markets for better energy technology, which is to the benefit of energy users.

Geller and Nadel (1994) also provide a comprehensive review of programs that have in the past decade or so, begun to effect market transformation:

- Appliance standards
- Utility DSM programs
- Research and development
- Demonstration programs
- Incentives to commercialise new technologies
- Education programs
- Bulk purchases
- Building codes

Most of these programs have resulted in major changes in the energy efficiency of many energy-consuming products.

2.8.5 Assessment of Probability of Success of Strategy

Zarnikau (1999) suggest that national indices be developed to monitor energy efficiency achievements. Such information might prove useful in the formulation and evaluation of public policy initiatives to address energy efficiency, and it can be in the form of a regularly published statistic to monitor energy efficiency achievements, not dissimilar to measures of gross-domestic-product, inflation, or employment.

Case studies from outside South Africa, covering the implementation of energy efficiency, although crucial for success, have limited appeal to South African industries due to different conditions (ETSU, 1999).

The World Bank (1993) further identifies a number of factors that are associated with low levels of energy efficiency:

- Lack of government's consistency, predictability and credibility in designing and implementing policies to encourage energy efficiency
- Information gaps on energy losses, loss reduction techniques, technology and process options, financing and joint venture opportunities, all due to lack of market intermediation and consequent high transaction costs.
- Household energy consumers usually not facing real costs of energy use because households are often not adequately metered, because investment decisions are often split between tenant, owners and contractors.
- The general unavailability of energy-efficient appliances, equipment and structures due partly to an absence of minimum energy efficiency codes and standards for commercial buildings and for small consumer items such as appliances and motor vehicles and a weak institutional capacity to enforce such codes and standards.
- The fact that for a variety of reasons, end-use energy consumers tend to have higher implied discount rates than do supply-side utilities and those household sector discount rates are inversely correlated with income.

2.8.6 Implementing strategy

A number of options to address the current barriers to energy efficiency have been suggested by the World Bank (1993):

- Increased demand side management;
- Setting up or strengthening national, local or industrial energy resource centres or efficiency institutions to help improve training and information intermediation and to promote demand side management;
- Putting in place energy-efficiency standards and codes; and

- Focussing more on energy efficiency in transport

The impact of price changes in improving energy efficiency might not necessarily be large in the short term, but the long-term impacts thereof are clearly significant, as illustrated by the oil price shocks on 1970s and early 1980s, and their impact on the long-term efficiency challenge. The World Bank approach is to focus on country-wide policy and institutional issues, with specific attention to the following aspects (World Bank, 1993):

- Energy prices;
- Supply side institutional reform;
- Competitive markets;
- Market intermediation; and
- Technology transfer is the key to designing effective policies for reducing carbon emissions.

2.9 Summary of literature reviewed

2.10 Institutional infrastructure

Energy centres appear to be the preferred type of energy conservation promotion activity in Asia. The popularity, Rumsey & Flanigan (1995) suggest that it is due to local initiatives as well as the attraction that they hold for foreign donors. Donors, it appears, seem comfortable with financing energy centres because they are physical, tangible facilities capable of coordinating ranging activities.

Energy centres can be government funded, and perhaps also undertake income-generating activities as well. However, focussing on income generating activities can cause energy conservation centres to neglect more traditional energy centre roles of education promotion, policy analysis and training activities. They would also tend to neglect smaller customers in favour of big corporations as the source of income.

The following aspects of energy centres were found to be successful and worthy of replication in appropriate circumstances:

- They facilitate an integrated approach to energy efficiency – sort of a clearinghouse for a range of energy conservation activities and information resources
- Training and energy audits are the two most common, and certainly successful facets of energy centres
- A lot of them avoid having to provide financing for energy efficiency projects, although being a one-stop shop seems to be logical. Offering project financing with energy audits could be popular with industrial and commercial customers.
- Financial sustainability of centres is an illusive goal, but one that can be achieved.
- The independent status of energy conservation centres can be a help and a hindrance

Institutional configuration of the energy conversation centres can either be autonomous, semi-autonomous or completely government controlled. A network of energy conservation centres deployed throughout the country rendering assistance to enterprises in their energy saving initiatives, and reporting regularly on enterprise energy use to government, seems to be preferred approach.

Majority of the energy conservation centres seems address themselves to focussing on improving industrial energy efficiency, including major policy directives, procedures, regulations, energy audits, energy analysis, outreach and information dissemination, technical assistance programmes and project financing initiatives, all of which can be broadly categorised under the following activities:

- Policy research
- Business development
- Training
- Information dissemination

Funding of energy conservation centres should also be arranged through assistance from donors in the initial stages, with future, long term funding from industry and government, especially once donors withdraw their funds.

Energy conservation centres should also promote measures with low cost and short payback period. These have been shown to lead to investment in measures with slightly longer payback periods in some instances.

2.11 Legislative framework

An Act that governs the country's response to the energy efficiency challenge is the first cornerstone of a successful energy efficiency policy. The thorough collection and maintaining of reliable data followed by regular maintenance and piercing analysis thereof, cannot be overemphasised.

2.12 Energy pricing policy

Pricing policy that fail to fully account for the full cost of producing energy, inclusive of the environmental consequences thereof, has let to a weakening of the ability of a country to tackle energy efficiency deficiencies with any measure of success. This problem is prevalent in the developing countries.

2.13 Building codes and regulations

Efficiency in new buildings, if ignored, is often referred to as lost opportunity. Whilst you can retrofit existing buildings, it is more affordable to include energy efficiency in new buildings. This approach has special relevance in view of the huge housing backlog that the government is currently addressing vigorously.

Building codes have been shown to have tremendous success in effecting energy conservation especially in commercial and industrial buildings. However, the following lessons must be considered during implementation:

- Construction professionals must be educated prior to enforcement of the code
- A strong penalty-reward system must be enacted to ensure compliance
- In making the codes mandatory or the opposite, political barriers seem to be greater than technical barriers
- Voluntary codes have minimal impact on energy usage

Enforceable building codes, focussing on improving the efficiency of building shells (exterior or envelope), cooling equipment and lighting systems, with a primary focus on building envelopes, seems to be the preferred approach within the building industry.

2.14 Appliance and equipment labelling and energy efficiency standards

The twin manufacturer/consumer effect of higher efficiency products available from manufacturers, coupled with greater levels of purchase of energy efficient equipment by consumers, is the key reason why standards and labelling have proved to be such a powerful tool for promoting and improving energy efficiency. A blend of both voluntary and compulsory programs, with an intensive complementary program of education and training on efficiency, is highly recommended.

Regulations and standards can be prescriptive, such as those requiring new buildings to utilise certain materials such as double plane glass. Although these are easy to understand and implement, they offer very little flexibility.

Performance based standards on the other hand offer flexibility to building designers, although they are complex to implement. They allow a trade-off between various measures that can be implemented to meet required efficiency standards.

The Singapore approach for new and old buildings, where new buildings have to comply with energy codes prior to issuance of a building permit, whilst existing buildings were given a period within which to comply, seemed to have achieved tremendous compliance

Another common approach in respect of equipment and appliance energy efficiency standards is to introduce, in two phases, a minimum efficiency level required for manufactures and importers by a certain period, and then to proceed to targeted efficiency levels at a later stage.

Appliance and equipment labelling programmes mainly focus encouraging manufacturers to improve the efficiency of products in terms of energy consumed and to assist in changing consumer attitude about the role of

energy consumption in the buying decision, and to directly produce energy savings.

Labels indicate energy efficiency of many kinds of commercial, industrial and household equipment and appliances. Importers and manufacturers are often required to submit designated products for testing by authorised agencies, with results clearly indicated on product labels and advertisements Such an approach has been found to raise the awareness of the public on energy efficiency and to position it as a major product selling point for manufacturers and retailers. Accredited, independent network of laboratories are needed to test the claims made on the equipment and appliance labels, and such checks must be performed on a random basis.

Compliance enforcement in some instances is achieved through the publishing of lists of banned appliances and energy saving equipment that does not comply. In the housing sector, non-compliance can also be penalised by introducing an electricity consumption surcharge payable by the consumer.

2.15 Publicity and information

The importance of public awareness of the benefits of energy efficiency cannot be over-emphasised. To illustrate how important this element of energy efficiency programmes is, the Thai government's experience in implementing fluorescent lamps campaign is illustrative, if not substantively, then for the sheer scale thereof, and the resources deployed:

- USD 8.8 million was set aside for the campaign over a two-year period
- Posters extolling the virtues of fluorescent lamps were distributed
- Six "spots" were aired on television daily for the duration of the campaign
- Celebrities as well as Prime Minister were featured on the advertisement on television

- Radio and newspaper advertisement were ran regularly, highlighting benefits consumers of changing to the more energy efficient lamps and how that is benefiting the country by minimising the need for expanding power generation capacity
- Demonstrations and campaigns were held in 26 provinces
- Around the country, sixteen city halls and 45 schools were retrofitted with the fluorescent lamps
- Lecturers and seminars were held to reinforce the benefits of the lamps
- Marches with school children raised awareness of the program and its national importance

A package of promotional activities including billboards and radio advertising campaign, distribution of pamphlets to families through electricity bills and the possibility of payment through bimonthly instalments, have proved quite successful in growing the market for CFLs in the EU countries (Guzzini, 2001).

Energy efficiency call centres approach, for purposes of addressing energy efficiency related queries from the public are highly effective in disseminating information.

2.16 Private and Public sector collaboration

The collaborative support by the government, together with private sector manufacturers is crucial. Carefully crafted efforts between public and private sector generally have marked success. Rather than ramming a tough set of standards down the throat of manufacturers, rather work diligently to reach consensus on the most appropriate course of action.

Support from key policymakers or top utility management is critical to program success and sustainability. In order to minimize the downfall, bilateral and multilateral assistance programs should devote considerable

time and attention to building working relationships with policy makers and utility management in designing programs that meet their objectives.

2.17 A comprehensive approach to energy efficiency

Programs offering a full range of assistance, including technical advice and training for all stakeholders, monitoring of energy utilisation, information dissemination and financial assistance – provision of the means as well as incentives/disincentives lead to success.

2.18 Research, development, demonstration and testing

Establishing equipment-testing procedures that are agreeable to government and industry is critical. Manufacturers must be assured that a government-operated laboratory with restricted funding can be accurate and reliable, and should the government not accredit an independent laboratory to undertake the testing. A series of national or regional energy efficiency research and demonstration centres are often utilised successfully in other country's experiences.

2.19 Government initiatives versus privately driven initiatives

It is clear that government-backed initiatives are more popular in Asia than in North America, for example. Very few initiatives in Asia have been driven by utilities, for example. But government programs can be successful, although they tend to be slow and under-funded, and they improve the baseline conditions rather than pushing the markets at the upper margins of efficiency. Unlike private utilities, which can fund, design, and implement customer energy efficiency programs in a few years, government programs tend to be products of lengthy legislative process that seek consensus, and are bogged down by red tape and under funding.

2.20 Source of funding

Internally funded programs tend to be the most successful. While foreign investment in energy efficiency is crucial especially in the gestation phase, domestic financial commitments to energy efficiency will be key to sustaining energy efficiency in the long term. Total reliance on foreign funding certainly guarantees that the program will collapse one those foreign funds run out. The recommended approach is to arrange for long term and more sustainable finance from industry contribution or levies, as well as ongoing government funding support, once the donor funds have been withdrawn.

2.21 Monitoring and post-implementation evaluation of programs

Rigorous evaluation of past programs is crucial. Feedback is vital in developing effective future initiatives as well as communicating experiences to other energy policy makers, domestically and in the region. Evaluation of successful and failed programs must be undertaken. Impact data, as well as comprehensive evaluation of the process and impact efficacy of the programs must be undertaken.

2.22 Donor support

Foreign initiatives, especially from a skills base support, while well intentioned, and apparently well designed, often are insensitive to the local conditions on the ground. Rather than supporting locally grown programs, donors often impose programs from afar. The lack of local support for such programs means that they are not as effective as they could be.

The suggested approach is perhaps to support local initiatives and to build local capacity and capability within the private sector.

Donor funding in the early stage is crucial, and should concentrate a large portion of the funds to actual programs, as opposed to administrative

expenditure. A long-term source of funding, for use, long after the donor programmes have run their course, should be encouraged and grown.

It appears that a number of models are available in respect of donor support for energy efficiency programs in developing countries. Stiles (1997) election of the Agency model, over the technology transfer as well as the linkage model, seems to be relevant for developing countries. The attraction of the model over the others lies the fact that it relieves government of the burden of program design and implementation, allowing to focus on policy development instead. The development of a market for energy efficiency services and technologies, and internally supported program of human resources development and an institutional development strategy, with a bias towards the private sector, and a careful deployment of donor assisted specialist skills is crucial.

2.23 Incentives

Financial and tax credits to households and businesses in order to promote installation of energy efficiency measures is most popular. Some incentives are typically in the form of subsidisation of the cost of energy efficiency audits. The incentives are also more effective if disincentives for failure to comply are also strong – the so-called carrot and stick approach is also found to be effective under specific circumstances.

2.24 Recognition and celebration of successes

Celebration of success is often frowned upon as a luxury that cannot be countenanced, but in fact, it is a crucial element of communication and information dissemination, which also serves the purposes of reinforcing good behaviour and dispelling popular myths that hamper successful deployment of energy efficiency programs.

2.25 Capacity building

In order to create and enhance skills and management capacity building, energy efficiency programmes must employ local firms to build capacity of the local private sector to drive and sustain future initiatives.

3 RESEARCH QUESTIONS

The study will address the following research questions:

1. What is the current state of energy efficiency globally and in South Africa?
2. What is the institutional infrastructure necessary for the successful implementation of energy efficiency?
3. Who are the main role players in the implementation process and what role should they fulfil?
4. What should be the key policy intervention in initiating energy efficiency programmes in South Africa?
5. Which energy efficiency implementation program would be suitable for South Africa?
6. How successful would an implementation strategy be in South Africa?

4 RESEARCH METHODOLOGY

The research methodology will be by way of a detailed review of literature on energy efficiency, including a review of other countries' experiences in implementing energy efficiency. The study will first present an outline of the energy sector in South Africa, followed by an attempt to locate energy efficiency and its potential role within the sector, as envisaged in the Energy Policy White Paper. Experiences from other countries, in the form of case studies, will be reviewed, with a view to distilling specific lessons, which, with minor customisation, would be suitable for replication within the local context. A review of previous and current initiatives to implement energy efficiency in South Africa as well as evaluation of the reasons for the perceived failure of such efforts will be presented – the rationale being to isolate the key barriers.

An objective analysis of the likelihood of success of the proposed implementation strategy will complete the study. This will be done by way of a telephonic and, where feasible, a face-to-face interview with a selection of representative specialists, role players, stakeholders, practitioners and researches of energy efficiency for an objective assessment of its feasibility.

A non-probability sample will be taken from respondents, all of who must be actively involved in energy efficiency, as detailed above. This purposive judgement sampling technique is necessitated by the fact that we are merely gauging their opinions or feelings about the likely success if a proposed energy efficiency implementation methodology.

5 PROPOSED IMPLEMENTATION STRATEGY

5.1 Comprehensive database of the energy sector in South Africa

In the implementation of energy efficiency, the presence of a reliable, and accurate repository of up to date data on the entire energy sector in South Africa cannot be over-emphasised. No other country, which has had a measure of success, appears to have been able to do so without the presence of reliable, comprehensive and accurate database of information and statistics on the energy sector. In South Africa, this function is best performed by a quasi-government agency, with the full corporation of DME, and other agencies of government such as NER (or its successor, i.e. Energy Regulator), Eskom, SABS and other industry players. This institution would of necessity be co-financed by government allocation and industry levies generated from the sale of the information gathered. The institution can also be located either in the energy agency or in the planned energy research institute.

5.2 Legislation and enforcement

This aspect of the strategy is considered to be the most crucial and whose impact is easily far-reaching. Although the current energy legislation commits government to promote energy efficiency as part of its overall integrated energy strategy, a lot of work still is lacking to translate the policy pronouncements into plans that can be implemented. Legislation within the South African energy industry is the most crucial intervention.

Legislation must be implemented to establish the legal framework within which energy efficiency will be implemented. Most importantly, enactment of legislation will force energy efficiency issues onto the agenda of government and the minds of legislators. The envisaged legislation will establish institutional infrastructure, including resource allocation as well as full mandates to each of the institutions for purposes of implementing energy efficiency. This is most important in that failure to firstly establish the necessary institutional infrastructure, together with clearly articulated and demarcated mandate and scope of responsibility will lead to confusion and blunting if the ability of the institutional infrastructure to fulfil its responsibility. A clear pronouncement will be made by the legislation as to resourcing of the various institutions established. Both financial and human resources must be adequately rationed to enable the institutions not only to be effective, but to also sustain them. The institutions established will be given a strong enough mandate to introduce various energy efficiency programs without undue interference from other stakeholders in the industry, including government itself.

5.3 Institutional framework

5.3.1 Energy efficiency Agency (co-ordination)

Judging from the institutional infrastructure that permeates in most countries that have had a measure of notable success in implementing energy efficiency, it appears the most important institution is The Energy Agency. This institution must be created by statute, thus making it a wholly

government owned institution. It would report directly to DME, whence its mandate will emanate. DME or government will appoint its stewards, in the form of a board representative of all stakeholders as far as possible.

The governance of the institution will be similar to that which prevails currently in similar agencies of government. The Board would be constituted from all stakeholders in the energy sector, including appliance and equipment manufacturers and private enterprises. The Board will retain its independence although Cabinet would ratify its selection.

Initially, government would be expected to fully finance the operation of the institution, but with a clear understanding that over a period of five years from its inception, it must gradually move to a full financial independence. All profits accruing from its activities over that time would be ploughed back into financing its various programs. Thus there would be no requirement to declare a dividend to the shareholder. Sources of funding would therefore initially be an allocation from DME, and then with proven success, would be easier to motivate for a dedicated allocation from National Treasury. Quite early in its existence, the Agency must undertake remunerative work by exploiting opportunities that exist with large industrial and commercial users of energy. The proceeds would then be diverted towards programs aimed at household consumer sector. In undertaking such activities, the Agency must be weary of crowding out the private sector. It must also not pursue income generating projects, to the detriment of the more traditional and non-income generating activities such as education and capacity creation, policy analysis and training activities.

The energy conservation centres would address themselves to focussing on improving industrial energy efficiency, including major policy directives, procedures, regulations, energy audits, energy analysis, outreach and information dissemination, technical assistance programmes and project

financing initiatives, all of which can be broadly categorised under the following activities:

- Policy research
- Business development
- Training
- Information dissemination

The Agency would be expected to oversee the establishment of energy conservation centres throughout the nine provinces in the country, including all the major cities and industrial clusters which boast heavy industrial energy consumers. The primary purposes of such centres would be communication and information dissemination, with the added ability to conduct energy audits. More intensive energy efficiency interventions would be devolved to the Agency.

5.3.2 Funding

Funding of energy efficiency implementation programs is an immense challenge in all societies, especially in developing economies such as South Africa, where there's intense competition for scarce public funds. Unfortunately, adequate funding is a prerequisite for an effective energy efficiency implementation initiative.

Although donor funding (grants) is important, it cannot be allowed to be the key source pf liquidity for projects. The local institutions in the country must be mobilised to assist drive energy efficiency initiatives by bringing the necessary liquidity. Both donor funds such as GEF, World Bank, Danida, etc. and funds from development finance institutions such as Industrial Development Corporation (IDC), Development Bank of South Africa (DBSA), National Empowerment Fund (NEF), Public Investment Commissioners (PIC), etc. all of them government institutions must be pooled to leverage their financial muscle and thereby lessen the funding burden in energy efficiency projects.

Development finance institutions cited above have a special responsibility to play a catalytic role in eliminating most of the early stage project risk in energy efficiency. Their current mandates must therefore be extended to include a focus on energy efficiency projects. Dedicated investment funds must be created to purposes of funding energy efficiency projects.

Commercial banks in the long term must be able to fund viable projects with acceptable investment pay-back times and demonstrable economic and commercial merit. It is therefore important that funds availed by development finance institutions must not be excessively concessionary, lest they create an unsustainable expectation in the market that energy efficiency projects cannot be financed on a pure commercial basis, and thus discourage commercial banks to finance them.

Generally speaking, internally funded programs tend to be the most successful and sustainable. Whilst donor grants are crucial, local financial commitment to energy efficiency will be key to sustaining energy efficiency in the long term. Possible alternative funds could be raised from levies imposed upon polluting firms and other environmental protection levies.

5.3.2.1 Incentives

Financial incentives such as accelerated depreciation on energy efficient capital equipment is a viable option to be considered. Government should also consider the possibility of scrapping import tax on energy efficient equipment in the short term, and in the long term to encourage local production of energy efficient equipment. Although the local market might not be big enough to sustain a local manufacturing facility, export into neighbouring countries in SADC and the rest of the continent is an option for purposes of creating a market.

Other financial and tax credits to households and business in order to promote installation of energy efficiency measures can be implemented.

It is instructive to realise that a scan of the current suite of industry incentives made available by Department of Trade and Industry, fails to relieve as much as a single incentive dedicated towards energy efficiency initiatives, in support of government policy. This reveals a need for some level of alignment in the incentives to encourage the kind of behaviour that would assist government in achieving its objectives in respect of energy efficiency.

5.3.3 Communication and information dissemination

In the South African energy industry, there's an alarming lack of information about energy usage in general and specifically about energy efficiency and its role within the energy sector. This ignorance is prevalent not only in the household sector, but also among commercial and industrial consumers of energy. Similar information gap exists between middle class and lower income households. There are communities in South Africa where the emphasis is regrettable still on universal to energy. Energy efficiency is an unthinkable proposition for these communities. Informal settlements are such examples.

It is for this reason that education and information communication will be the single most important intervention for purposes of promoting energy efficiency in South African. Different categories of energy consumers will respond to different communications messages. The success or failure of energy interventions will be directly traced to how effective and comprehensive awareness building, education and information communication is regarded. One might even venture to say that, if South Africa could only do one thin for purposes of energy efficiency promotion, then this is it. Education and awareness building, as well as information dissemination around energy efficiency would give energy consumers the information and knowledge to make informed decision about energy usage. Successfully implemented energy efficiency programs especially in developed countries are founded on solid base of informed energy consumers.

The Energy Agency, through its nine provincial centres must be the force behind a massive information and communication campaign. Adequate financial resources must be earmarked for this very important program. The information campaign must be outsourced to a specialist firm with proven expertise to successfully deliver on such a massive campaign.

The type of message being communicated must be tailor-made for the targeted consumer. This is most important especially in the South African environment, where among household consumers; one encounters varying levels of literacy and indeed awareness about energy.

South Africa has a highly developed and sophisticated call centre industry. A call centre therefore can be considered for information dissemination about energy efficiency. Students from tertiary institutions with the necessary technical and scientific background can staff the call centre. A basic instruction on energy efficiency could get them the necessary skills and knowledge about energy efficiency, to be able to adequately address queries from energy consumers.

The comprehensive information and communication campaign must be adequately funded, and be made up of posters, television advertisement “spots”, promotion by popular celebrities, television and entertainment personalities and politicians, radio and newspaper advertisements, demonstration campaigns, lecturers and seminars, marches with school children, sports related promotions, as well as billboards, pamphlets and advertisement on electricity utility bills.

5.3.4 Education and training

Education and training will play an important role in developing the capacity to implement energy efficiency projects. Various levels of education and training interventions are possible. However, the most critical intervention, especially at an early stage in the implementation of energy efficiency, is on-

the-job training for engineers and technicians on energy efficiency. This type of training can be facilitated through industry associations and organisations. The various Sector Education and Training Authorities (SETAs) can play a crucial role in facilitating education and training in energy efficiency, especially the energy SETA. Dedicated education and training of electricians and other artisans and builders would go a long way towards building capacity within the home-improvement and home repair sector.

Coordination and quality assurance of the education and training would be the joint responsibility of SETA's and the Energy Agency.

5.3.5 Donor agencies

Donor agencies have an indispensable role among the network of institutional players that implement energy efficiency. Not only do they provide technical and financial resources to developing countries, they also contribute significantly to local capacity building in energy efficiency.

In many cases it is obvious that, donor countries do not make donations for philanthropic reasons. They also simultaneously create and grow markets within which their industrial and commercial production capacity can expand into. They also infiltrate the host country with their skills and philosophies pertaining to a specific program. This is more evident in energy efficiency, especially when one considers that donor countries are the source of energy efficient equipment and appliances, especially in the early stages.

It is important to manage donor agencies very carefully, ensuring all the time that they also benefit the recipient of the donations. A very strong and assertive liaisons mechanism must be established at the level of government for purposes of firstly drafting a mutually beneficial terms of collaboration and engagement, and more importantly, holding the donor to the terms of the remit.

However, very often, owing to lack of skills and knowledge in host countries, government find it impossible to engage meaningfully with donor agency in order to influence and direct the character of their intervention in the host government. It is for this reason that donor agencies run loose in South Africa, implementing duplicative and ad-hoc programs, which are often totally misaligned with the objectives of government. It is a “chicken and egg” situation in that often donor agencies come to impart the necessary skills which are firstly necessary to direct the kind of engagement they should be making with the host country.

5.4 Focus on high energy intensity sectors of the economy

Very early in the program, South Africa must focus on promoting energy efficiency among energy intensive industrial consumers such as cement manufacturers, mining, textiles and chemicals and paper and pulp, and iron and steel. Invariably, these companies are large and have access to substantial financial resources to be able to implement energy efficiency interventions. More importantly, with the present attention being paid to corporate governance and triple bottom line financial reporting, these companies may be compelled to report on their energy management strategies in their financial reports.

6 POTENTIAL SUCCESS OF IMPLEMENTATION

6.1 Assessment methodology

The response from the interviews will be systematically analysed through content analysis, with a focus on views, assessment, opinions, ideas and suggestions about the feasibility of the proposed implementation, especially within the local context.

6.2 Summary of results of assessment of feasibility of proposed strategy

The results of the expert interviews are presented below

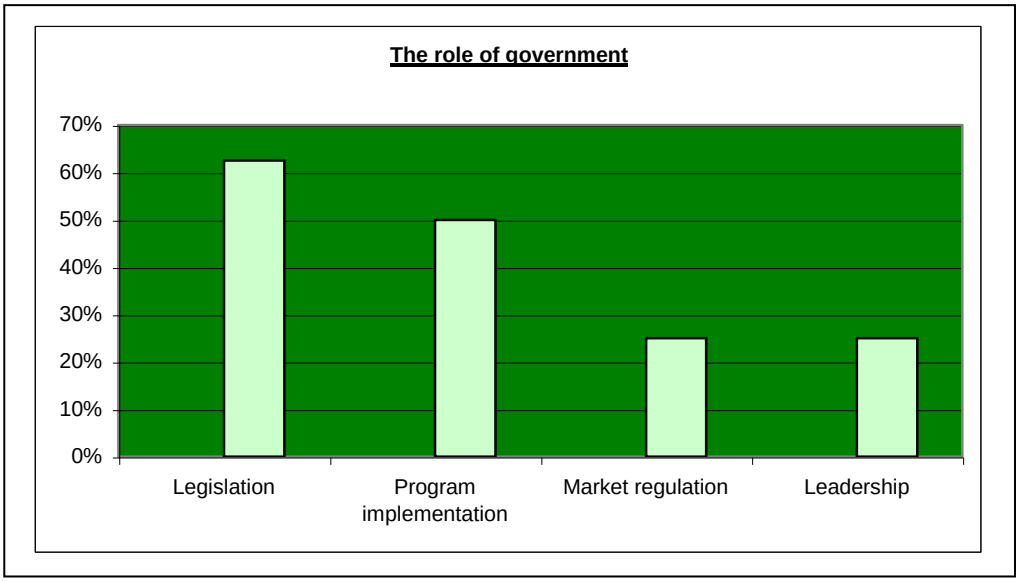
6.2.1 The role of government in energy efficiency

The predominant response was that which clearly positions government role as that of creating and introducing legislations that government energy efficiency. This role for government was cited in more than 60% of the expert interviewed.

The experts also cited the role of government as implementer of energy efficiency programs with a frequency of 50%.

Experts also mentioned the role of government as market regulator and occupying a leadership position. It is not clear in what context the government would play a role in these two categories.

Figure 3: The role of government

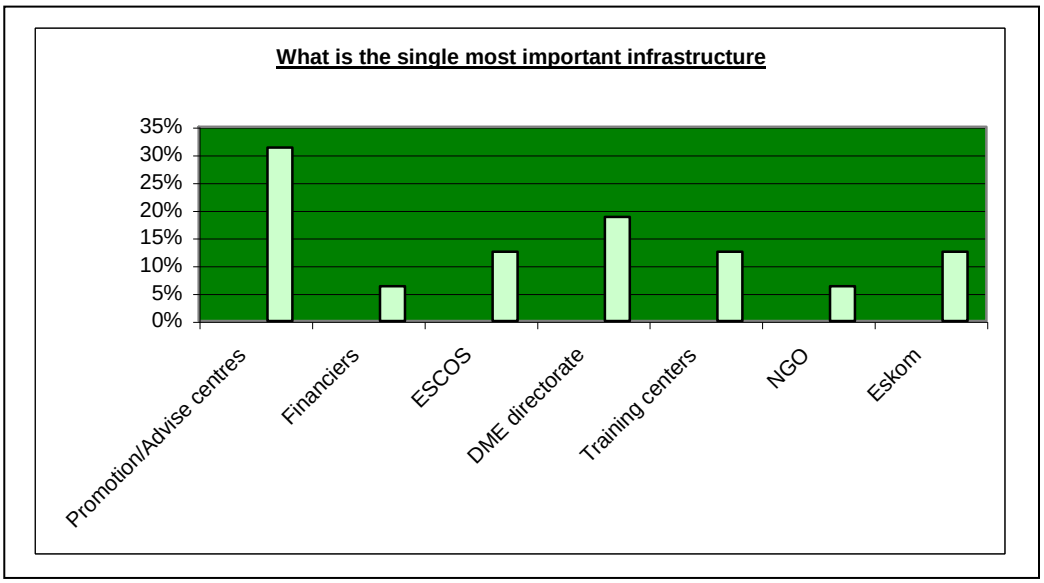


The chart above illustrates the responses received.

6.2.2 The single most important infrastructure

Around 30% of the expert cited energy efficiency advice centres or promotion centres as very important institutional infrastructure for purposes of implementing energy efficiency. The second most important institution was DME and specifically, a dedicated energy efficiency directorate within the department. Escos, training centres and Eskom were also considered important, as was a network of financiers and non-governmental organisations that are active in the field. Although funding is important for the successful implementation of energy efficiency, it rated very low in the minds of the experts.

Figure 4: What is the single most important infrastructure



Therefore, in varying degrees of importance, institutional infrastructure that is indispensable for implementation of energy efficiency was clearly the institutions listed in the graph above.

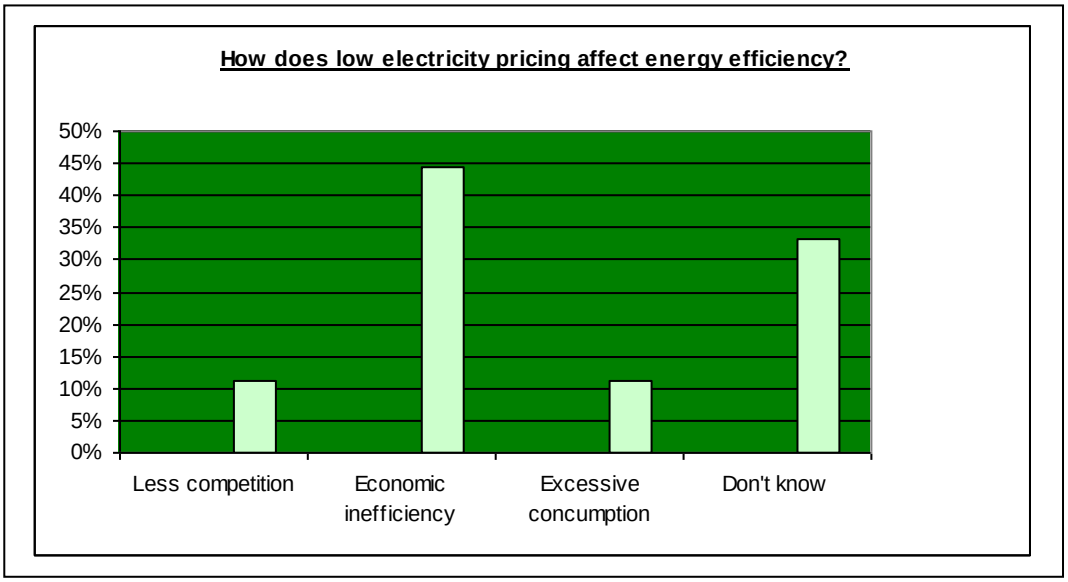
6.2.3 How does low electricity pricing affect energy efficiency

The overwhelming response was that low price charged by Eskom was serving as a dis-incentive for energy efficiency. The expert opinion was that it rendered the majority of energy efficiency programs economically inefficient. The other, not so overwhelming position was that it stifled competition and also promoted excessive (careless) consumption of the energy resource.

There was high “don’t know” response (33%) as well. Some expert interviews either did not understand the question, or they failed to make the connection between energy prices and energy efficiency.

The chart below illustrates the response obtained.

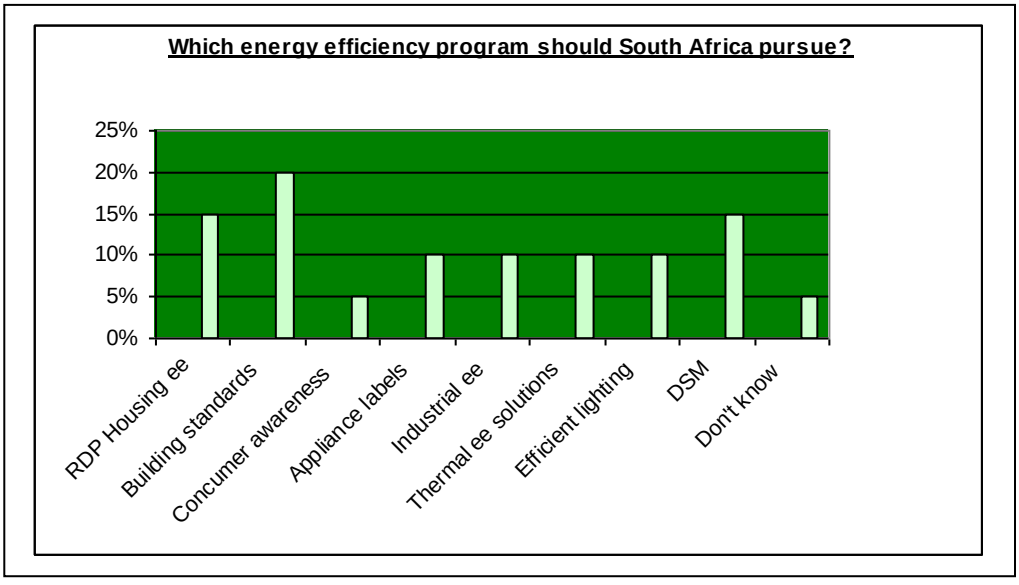
Figure 5: How does low electricity pricing affect energy efficiency



6.2.4 Energy efficiency programs that are suitable for South African conditions.

The experts, as illustrated by the chart below, listed a number of energy efficiency programs that could be suited to South Africa.

Figure 6: Which energy efficiency program should South Africa pursue?

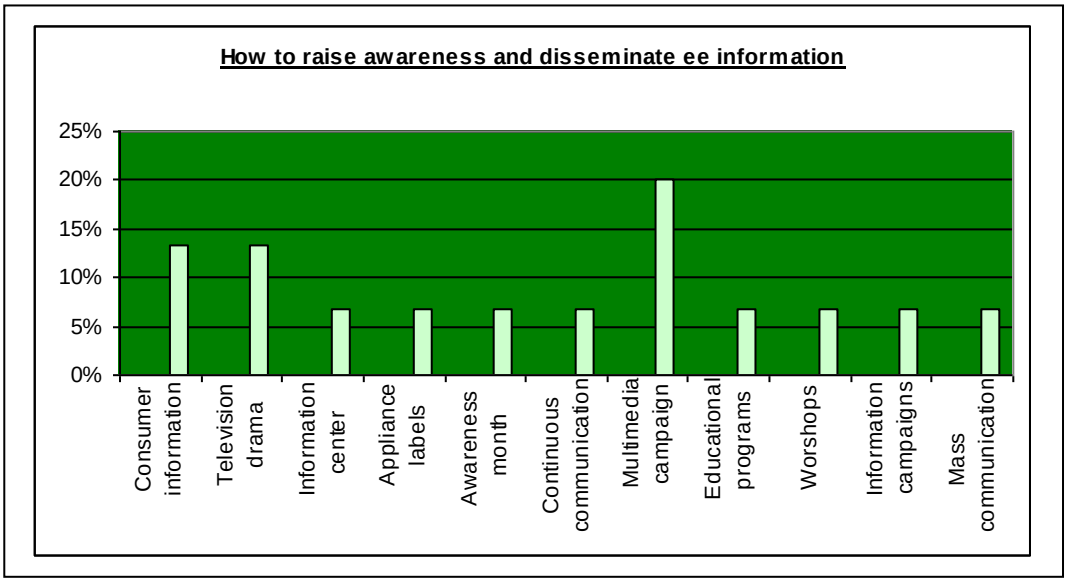


DSM programs and building standards both were the popular choices. Other experts cited RDP building standards, distinct from regular buildings, as an important program that must be implemented. In fact, energy efficiency in RDP housing was cited an equal number of times as DSM programs, and both were second to building standards in general, in their level of popularity.

6.2.5 How to raise awareness and disseminate information

Experts favoured a multimedia campaign, which encompassed print, television, radio, billboards, brochures, etc. as the overwhelming choice by far. Consumer information in the form of more meaningful consumption information on energy bills was considered crucial by some of the experts. Others felt that television could be an important medium, which could promote energy efficiency through some of the popular “sopies” that, are currently available for watching on television. Other forms of communication channels are cited below:-

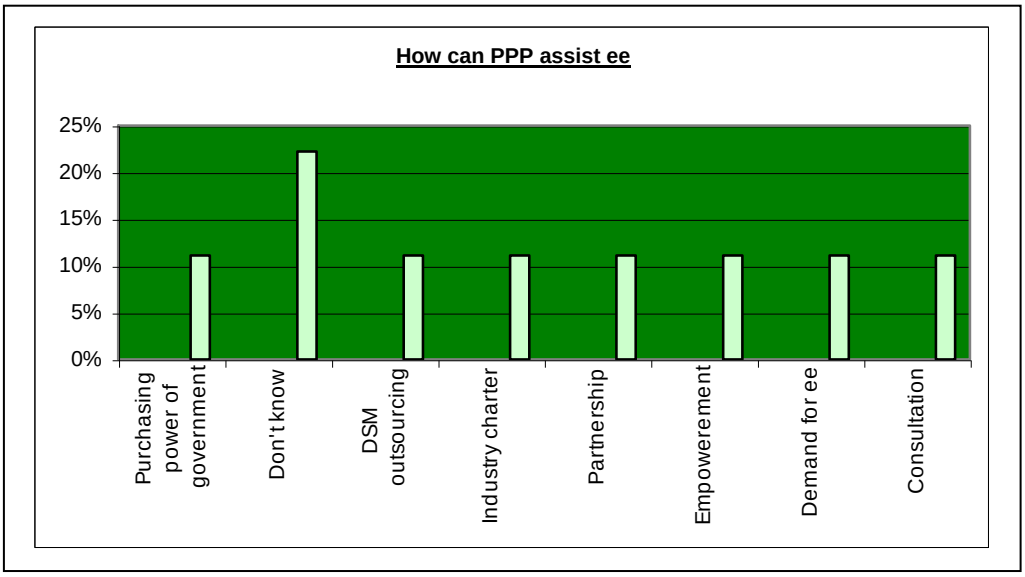
Figure 7: How to raise awareness and disseminate energy efficiency information



6.2.6 Role of Public Private Partnership in energy efficiency

Judging from the overwhelming “don’t know” response from experts on this question, it is clear that it was not clearly stated. The analysis of the associated response will therefore not be undertaken here. Suffice to say that the results of the responses are illustrated in the chart below.

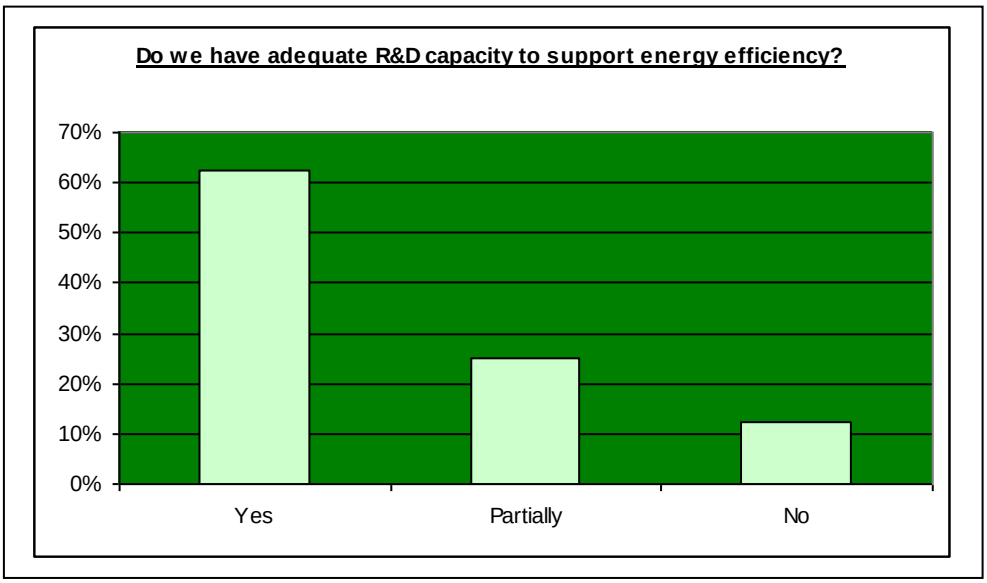
Figure 8: How can Public Private Partnerships assist energy efficiency?



6.2.7 Do we have R&D capacity locally to support energy efficiency?

The majority of the experts were adamant that we have adequate R&D capacity for purposes of implementing energy efficiency. More than 60% of the respondents were in agreement. Around 25% of the experts were partial in their response, whilst a small number were of the view that we did not have the capacity. The chart below illustrates the results.

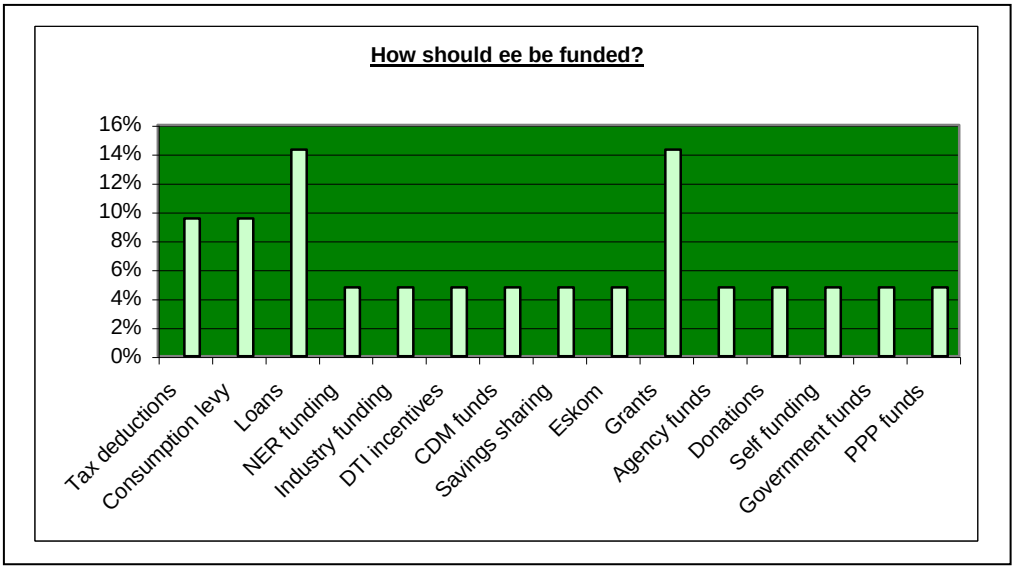
Figure 9: Do we have adequate R&D capacity to support energy efficiency?



6.2.8 How should energy efficiency be funded

Various funding sources were suggested, however most experts cited loans and grants as the best sources of funding for energy efficiency programs. The loans included all forms of loans, concessionary or normal commercial loans. Tax deductions for investment expenditure in capital goods for energy efficiency and an energy consumption levy were also cited by more of the experts. Refer to the chart below for further detail.

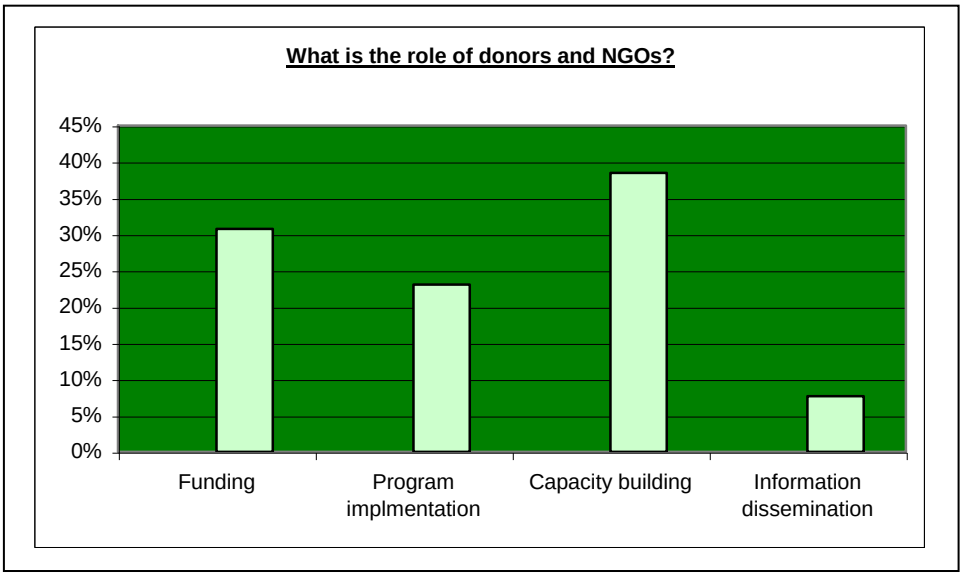
Figure 10: How should energy efficiency be funded?



6.2.9 What is the role of donors

Donors and NGO's were clearly identified as sources of capacity building, program implementation and funding. The chart illustrates the frequencies obtained.

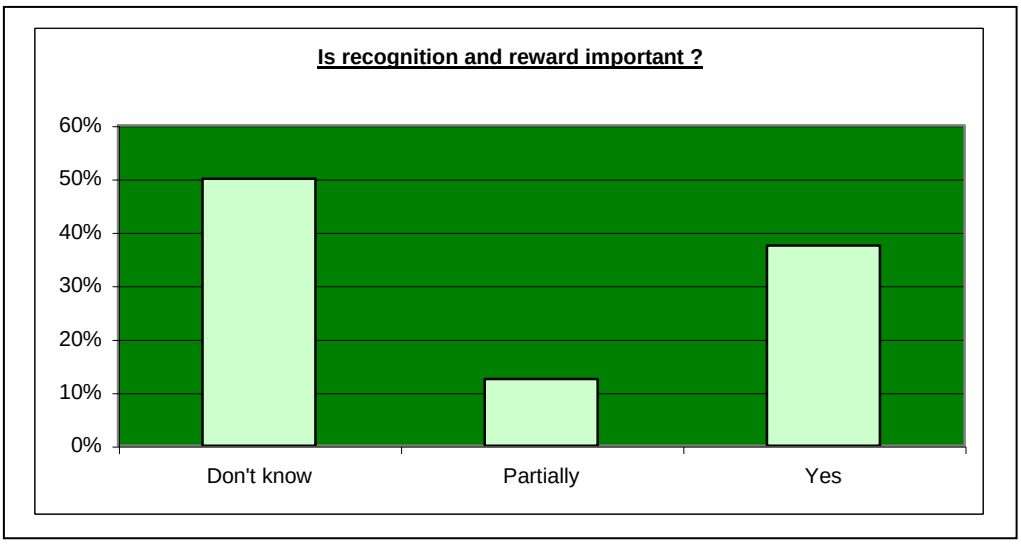
Figure 11: What is the role of donors and NGOs?



6.2.10 How important is recognition and reward in energy efficiency

An overwhelming "don't know" response was obtained, seeming to indicate that the experts struggled to interpret the question. A 30% frequency of "yes" response was however obtained, as illustrated in the chart below.

Figure 12: Is recognition and reward important in energy efficiency?



7 CONCLUSION

7.1 Summary of major findings

7.1.1 Literature review

- The body of literature reviewed is unequivocal in its support for a strong role of government in the successful introduction of energy efficiency. The President of the country, or a senior Minister responsible for energy must repeatedly articulate a clear role for energy efficiency within the energy strategy of the country. This must be followed by the enactment of appropriate legislation, setting out the institutional framework as well as implementation program for various energy efficiency programs, which must be aligned with the developmental and social priorities of the country. The legislation must also seek to create a level playing field within the energy industry, by ensuring that the cost of energy provision is fully reflected in the pricing policies applied by the utilities. Failure to satisfactorily address this issue will create a competitive barrier for energy efficiency interventions.

- Government must be prepared to play a leading role in the implementation of energy efficiency programs in the public sector, drawing on its immense financial and human resources at its disposal, as well as its overwhelming spending power, which it could correctly wield to encourage requisite behaviour in the private sector – the ultimate custodians of energy efficiency initiatives.

- Energy conservation centres appear to be the preferred institutions in most developing countries, for locating the control of practical energy efficiency interventions. Their attraction seems to stem from the fact that they are physical, tangible, facilities located separate from government, and capable of coordinating a range of activities, without having to content with the constraints associated with manoeuvring within a government bureaucracy. They can also be funded either

partially or entirely by government, or perhaps also engage in income generating activities. Their primary focus areas should however remain those of education promotion, policy analysis and training activities.

- It appears that the emphasis for developing countries must be on creating a general awareness among the energy consumers of the social, environmental and financial benefits of implementing energy efficiency, and also, most importantly, dismantling the widely held view that energy efficiency is costly to implement. Therefore, in the early phase of the implementation process, an overwhelming proportion of the budget must be dedicated towards a comprehensive, country-wide, multi-media publicity and information campaign intended to locate energy efficiency in the everyday, energy consuming decision-making process.

7.1.2 Survey

The results of the survey conducted among practitioners of energy efficiency in South Africa, who represented a wide range of institutions revealed gaping information gaps about energy efficiency in general, and most importantly, what are the key ingredients of a successful implementation policy. It was clear that only employees of the Directorate of energy efficiency within DME, as well as employees of donor organisations have a satisfactory grasp of all the issues around energy efficiency, which is hardly surprising. Having said so, the results obtained, whilst similar in some respects to the recommended approaches emanating from the literature, they also yielded peculiar and customised solutions to addressing energy efficiency within the unique energy sector in South Africa.

Firstly, prominent government support in the form of policy and legislations which brings into existences specific institutional infrastructure for implementing energy efficiency, as well as specific programs, were suggested. Energy conservation centre, which is replicated throughout the

nine provinces through satellite offices was clearly a more frequent choice. However, other role players such as ESCOs were also mentioned. A number of mediums were suggested for implementing a comprehensive publicity and information dissemination technique. Notable of these was through the medium of radio, w medium which is available in almost all households in South Africa. Also suggested, was to dramatise the whole energy efficiency as a subliminal message in the popular television soap operas that are currently being televised on South African television. Funding also featured prominently. What was clear was that loans were the preferred source of funding.

7.2 Recommendations

South Africa cannot successfully implement energy efficiency by adopting a "big bang" approach. A phased approach is needed. The initial focus must be on laying the groundwork and creating an environment that can serve as a fertile ground to launch other more subtle energy efficiency programs.

Although energy efficiency manifests in a variety of ways, for South Africa, the initial focus should be underpinned by only three key components, namely:

- Legislation
- Institutional infrastructure
- Public awareness

7.2.1 Legislation

Perhaps the reason why South Africa has thus far dabbled in energy efficiency through various studies undertaken, without making meaningful progress is due to lack of legislation dealing with energy efficiency. Being a developing country, the government needs to play a far more prominent role, not only through introducing legislation, but also through embarking on energy efficiency programs in the public sector. This can be in the form of government mandating that all government buildings must meet a certain

minimum energy efficiency level. This could serve as a powerful message to all energy consumers, and thereby encourage them to seek to emulate the example set by government. Government should be able to achieve this easily, owing to the large resources that they have in their command. Furthermore, government as one of the largest employers, has the advantage of serving as an example to its employees, who in turn are household energy consumers.

A coordinated approach is recommended from government. A number of departments have embarked on social development initiatives, one of which is the eradication of informal settle settlements in ten years time, and another is the recapitalisation of the mini-bus taxi industry, and yet another is the roll-out of schools and clinics in the rural areas, including the electrification thereof. These examples are but a few of the programs that are spearheaded by government departments, and all of which entail energy costs and therefore efficient utilisation becomes an issue. However, none of these programs even consider energy efficiency and the role that it plays. These programs are all un-integrated efforts all of which are taking place in isolation, albeit within government. Better integration of these programs is necessary, as is the inclusion of energy costs and efficiency issues.

The current energy pricing in South Africa is not fully reflective of the cost of generating energy. As such the low price of energy has bread an enduring complacency and carelessness that accompanies energy consumption. The cost of energy is therefore hardly a consideration, except perhaps in a few energy-intense industries where energy cost makeup a large share of operating costs. A restructuring of the current electricity industry, which is already underway, must be intensified to encourage more responsible energy consumption.

7.2.2 Institutional infrastructure

The literature survey has demonstrated that all countries that have had a measure of success in implementing energy efficiency have had to establish

a number of specific dedicated institutions. Energy Agency is one such infrastructure, and an important one too. The Agency would be semi-autonomous from government, and although it must be financed from budget allocation by DME, it must have a long-term plan to become self-funding in the future. Its main activities must encompass the following:

- Policy research
- Program implementation
- Funding
- Education and training, and
- Capacity building

The Energy Agency will be the centre focus of all energy efficiency efforts. It will have the advantage of being able to implement programs decisively with the backing of government.

7.2.3 Publicity and information dissemination

Due to the complacency in consumption borne out of cheap electricity prices, the consuming public have a very limited awareness of energy and an appreciation of the real costs thereof. As such, all efforts to implement energy efficiency without a massive campaign to inform consumers about the real costs and long term costs of energy are destined to fail in the long run.

A massive and continuous information campaign spearheaded by the newly established Energy Agency must be embarked upon. The intervention must be in the form of a massive and multifaceted campaign, rolled out with assistance of professionals in the private sector, through a multimedia campaign that seeks to reach all energy consumers in the land. The idea is to build an awareness of energy and its real costs, and the various measures that are in place to improve efficient use of energy.

7.3 Implications for South Africa

The implementation of the proposed strategy has a number of implications for the South African energy industry.

7.3.1 Skills shortage

The proposed implementation strategy places a large burden on government, through the DME, to introduce a comprehensive set of legislation to usher in energy efficiency. The ability of the DME to engage with the legislators to come up with the necessary legislation is not in doubt. What is of concern is the ability of the DME to implement the laws. DME, like other government departments, currently suffers chronic skills shortages in key areas of delivery. Energy efficiency is one such area, where the policies are in place but implementation is lacking. Although the energy policy is clear in terms of the role that energy efficiency should play, the creation and implementation of appropriate legislation has been sorely missing. Chronic skills shortage in the country generally, and more specifically in government is at the centre of the problem. Therefore, the inability of government to implement energy efficiency, owing to skills shortage, will be the main hindrance. Greater reliance must be placed upon the private sector to assist government in implementation.

7.3.2 Government support

Government buy-in and support, coming all the way from the President's office even, has contributed significantly to successes achieved by other countries in implementing energy efficiency. South Africa must learn from these experiences and enlist the help of the highest office in the land. Thus far, it appears this level of support is not forthcoming. Government and indeed the DME seem to be pre-occupied with issues of universal and equitable access to energy for all its citizens. Energy efficiency does not appear to be a priority at all. Energy efficiency, in the mind of government, cannot win you elections. What the politicians miss is the fact that energy efficient can address some of the social ills that currently bedevil society. Greater support and buy-in from government must be fostered by creating awareness among politicians and exposing the tremendous potential of energy efficiency to address some of the social ills foremost in the mind of politicians. Indeed, energy efficiency has a role to play in eradicating poverty

and creating jobs. Once this important message is encapsulated in conversations with politicians, their support would be assured.

7.3.3 Industry restructuring

The impending restructuring of the energy industry must be undertaken without any delay. The creation of ring-fenced generation, distribution and transmission businesses is a necessary development in the industry, which will reduce the dominance of Eskom, and open the way for other actors to come into the industry. Such a restructuring will result in a competitive energy industry, where the real cost of producing electricity will be the prime determinant of pricing. As matters stand, new generation capacity will lead to higher energy cost, and thus turn the attention of energy consumers to the cost of energy. Energy efficiency will then become economically sustainable.

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9 APPENDICES

Appendix A

South African Energy Balance for 2000 (Source: Hughes, Howells & Kenny, 2002)

Figure in PJ	Hard coal	Coking coal	Bituminous coal	Coke oven coal	Coal gas	Coke oven gas	Blast furnace gas	Solid biomass	Natural gas	Crude and NGL feedstock	Crude oil	Natural gas liquid	Syn-crude	LPG	Avgas	Petrol	Jet fuels	Other kerosene	Diesel	Residual fuel	White spirits	Lubricants	Butimen	Paraffin	Other petroleum products	Nuclear	Hydro	Electricity	Others	TOTAL
Production	6000	0	6000	0	0	0		0	58		0			0		0			0	0				0						6000
Imports	0	0	0	0	0	0		0			852			0		6			6	0				0		34	25			991
Exports	-2621	0	2621	0	0	0		0	0		0			0		-28			-70	-14				-9				-16		-2758
Marine bunkers	0	0	0	0	0	0		0	0		0			0		0			0	-123				0						-123
Total Primary Supply	**3379**	**0**	**3379**	**0**	**0**	**0**	**0**	**0**	**58**	**0**	**852**	**0**	**0**	**0**		**-22**	**0**	**0**	**-64**	**-137**	**0**	**0**	**0**	**-9**	**0**	**34**	**25**	**-16**	**0**	**4110**
Electricity plants	-1852	0	-1852	0	0	0		-2	2		0			0		0			0	0				0		-34	-25	734		-1187
Petroleum refineries	-463	0	-463	0	0	0		0	-52		-805			14		378			301	159				110						-358
Own use	0	0	0	0	0	0		0	0		0			0		0			0	0				0				0		0
Distribution losses	0	0	0	0	0	0		0	0		0			0		0			0	0				0				-98		-98
Total transformation	**-2422**	**-122**	**-2484**	**62**	**36**	**60**		**415**	**-54**		**-805**			**14**		**378**			**301**	**159**				**110**		**-34**	**-25**	**637**		**-1362**
Agriculture	9	0	9	0	0	0		10	0		0			1		3			53	0				3				21		100
Transport	1	0	1	0	0	0		0	0		0			0		352	69		147	0								12		581
Other	37	0	37	0	5	0		0	0		0			2		0			6	1				0				0		51
Commerce	15	0	15	0	1	0		0	0		0			2		0			1	2				0				57		78
Residential	58	0	58	0	0	0		89	0		0			5		0			0	0				25				106		283
Industry	633	0	571	62	30	60		85	0		0			5		0			30	19				4				406		1272
Non energy	205	0	205	0	0	0		231	0		0			0		0			0	0				0				0		483
Total demand	**957**	**0**	**895**	**62**	**36**	**60**		**415**	**0**		**0**			**14**		**356**			**237**	**145**				**102**				**603**		**2972**

Appendix B

Detailed consumption balance for 2000

Figure in PJ		Hard coal	Coking coal	Bituminous coal	Coke oven coal	Coal gas	Coke oven gas	Blast furnace gas	Solid biomass	Natural gas	Crude and NGL feedstock	Crude oil	Natural gas liquid	Syn-crude	LPG	Avgas	Petrol	Jet fuels	Other kerosene	Diesel	Residual fuel	White spirits	Lubricants	Butimen	Paraffin	Other petroleum products	Nuclear	Hydro	Electricity	Others	TOTAL
Industry	Iron & Steel	197.4	53.9	143.5		10.1	59.9														8.9								86.9		363.2
	Chemical & Petrochemical	230.4		230.4		2.6															0.5								49.4		282.9
	Non-ferrous metal	1.5		1.5		1.4																							61		63.9
	Non-metallic minerals	33.6		33.6		6.6															3.5								19.9		63.6
	Transport equipment					**0.22**																									**0.22**
	Machinery					5.91																							0.55		6.46
	Mining & quarrying	17.2		17.2		0.6									0.1					17.7	0.6				0.4				114.3		150.9
	Food & Tobacco	48.9		48.9		0.9			49.5												1.3								12.6		113.2
	Paper, Pulp & Print	51.8		51.8		0.4			34.7																				26.3		113.2
	Wood & wood products																														
	Construction														0.07		0.16			10.15					0.17				1.97		12.52
	Textile & leather	9.3		9.3		2.38									0.31					0.04	2.23				0.03				1.97		13.88
	Others	42.9	8.2	34.7					0.4						4.22					1.92	1.67				3.1				31.21		87.79
Transport	Aviation															1.1		68.9													70
	Road																350.7			139											489.7
	Rail	0.6		0.6																8.1									12.3		21
	Pipeline transport																														
	Internal navigation																														
	Others																								**0.4**						**0.4**

Detailed consumption balance for 2000 (continued)

Figure in PJ	Hard coal	Coking coal	Bituminous coal	Coke oven coal	Coal gas	Coke oven gas	Blast furnace gas	Solid biomass	Natural gas	Crude and NGL	Crude oil	Natural gas liquid	Syn-crude	LPG	Avgas	Petrol	Jet fuels	Other kerosene	Diesel	Residual fuel	White spirits	Lubricants	Butimen	Paraffin	Other petroleum products	Nuclear	Hydro	Electricity	Others	TOTAL	Figure in PJ
Commerce & public																															
Building	Public buildings	**7.99**		**7.99**		**0.43**									**0.91**					**0.59**	**1.13**				**0.05**				**30.48**		**41.58**
	Commercial buildings	**6.91**		**6.91**		**0.37**									**0.79**					**0.1**	**0.97**				**0.05**				**2632**		**35.92**
	Residential-urban														**2.91**														**72.17**		**72.17**
	Residential-rural	**9.8**		**9.8**					**69.58**						**0.68**										**6.33**				**6.62**		**94.15**
	Residential-townships	**24.33**		**24.33**					**13.43**						**0.77**										**14.09**				**12.63**		**66.53**
	Residential-low cost	**23.87**		**23.87**					**2.79**						**0.24**										**4.88**				**14.99**		**47.25**
	Residential-others																														
Farming	Commercial farming	**8.6**		**8.6**											**0.7**					**52.7**	**0.1**				**2.8**				**21.2**		**86.1**
	Subsistence farming																														
	Other																														
TOTAL		**715.1**	**62.1**	**653**		**31.91**	**59.9**		**170.4**						**11.7**	**1.1**	**350.86**	**68.9**		**230.7**	**20.9**				**32.3**				**602.8**		**2296.56**

Appendix C

Energy efficiency reports commissioned by DME over the years

1. Demand-side management-database and knowledge tools
2. National Energy Efficiency policy synthesis study
3. Energy consumption statistics according to International Standard Industrial Classification
4. Energy Efficiency indicators for South Africa
5. A new computer program for the design and management of energy efficient buildings and HVAC (heating ventilation air conditioning) systems as well as their control: a total (ly) new approach
6. Electricity end-user response to DSM (Demand-side management) and energy efficiency measures for the developed domestic sector in Gauteng
7. Electricity substitution and efficiency technologies in specific sectors
8. Computer program for energy policy support and energy savings in buildings
9. Demand-side management options for supply authorities in the manufacturing sector
10. Demand-side management options for the domestic sector
11. Energy and energy efficient courses aimed at primary, secondary and tertiary levels
12. Energy audits in the food industry
13. Feasibility study and simulations to develop DSM potential in the mining sector
14. Methodology for the establishment of a subsidized national energy audit scheme
15. Appliance energy performance labelling program and awareness campaign
16. Awareness campaign to save household energy, Final report on Phase 1

17. Energy savings potential and guidelines for effective energy use in the office buildings
18. Development of a business plan for an energy efficiency agency
19. Development of an energy efficiency database, Phase 1
20. Energy efficiency communication programme in the domestic sector, Phase 2
21. National domestic energy efficiency (NADEE) task team working document
22. Development of a working document for the NADEE
23. National Domestic Energy use Database system for integrated energy planning
24. Development of energy and energy efficiency educational material for the curricula at primary, secondary, tertiary and industrial levels
25. Progress Report No.1 SAEDES Pilot Study
26. National energy efficiency workshop proceedings
27. Energy efficiency baseline study
28. Energy efficiency in Households (Appliance labelling project)
29. Energy Efficiency in Commercial buildings: DME Energy Audit and NER

- Alternative communication approaches to promote effective and efficient energy use in the domestic sector
- Development of a draft manufacturing and mining energy effective strategy for South Africa
- A five-year energy efficiency plan
- The communication programme in the domestic sector Phase 1 and 2
- Energy efficiency week
- Development of energy efficiency educational material for the curricula at primary, secondary and tertiary and industrial levels
- The strategy for the establishment of an energy performance contracting (EPC) industry in South Africa

- Methodology for the establishment of a subsidized national energy audit scheme
- Development of a business plan for an energy efficiency agency

Appendix D

Interview Questionnaire

	Category of Strategy	Question (Including guiding notes for the questionnaire administrator)
1	Role of Government	• What is the role of Government in implementing energy efficiency?
2	Institutional infrastructures	• What is the single most important institutional infrastructure creation during the implementation of energy efficiency?
	icing	• How does the current low electricity pricing affect implementation of energy efficiency?
4	Energy efficiency Programs	• Which energy efficiency programs should South Africa choose, to drive energy efficiency
5	Publicity and information dissemination	• How should awareness and information dissemination about energy efficiency be implemented:
6	Public and private collaboration	• How should PPP be achieved in aid of energy efficiency
7	Research, Development, Demonstration and testing	• Who should be responsible for R&D in respect of energy efficiency
	Funding	• How should energy efficiency be financed?
	Donor support	• What role should donors play in the implementation of energy efficiency
7	Research, Development, Demonstration and testing	• Who should be responsible for R&D in respect of energy efficiency
	Funding	• How should energy efficiency be financed?
	Donor support	• What role should donors play in the implementation of energy efficiency
10	Monitoring and post-implementation evaluation	• What role does post-implementation monitoring and evaluation of projects play?

Appendix E

Interview responses