RAISON

KEY ISSUES PAPER

FOR THE

BIOMASS ENERGY CONSERVATION STRATEGY AND MANAGEMENT TOOL PROJECT

PREPARED FOR:

MINISTRY OF MINES AND ENERGY

PREPARED BY:

FINAL VERSION

19 JUNE 2003

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1. INTRODUCTION

1.1. PROJECT BACKGROUND

The idea of a Key Issues Paper regarding biomass energy originated on 1 July 1999, during a biomass energy workshop sponsored by the Programme for Biomass Energy Conservation in Southern Africa (ProBEC). During this workshop, the members representing Namibia formulated a four-phase biomass energy Action Plan, which included plans for a Key Issues Paper.

In late 2002 R3E initiated the project, Biomass Energy Conservation Strategy and Management Tool, on behalf of the Ministry of Mines and Energy (MME) and with the support and collaboration of the United Nations Development Programme (UNDP). The project will accomplish the following three outputs:

A. Key Issues Paper
(Phase III of the Biomass Energy Action Plan)

B. National Strategy for Sustainable Use of Biomass Energy Resources
(Phase IV of the Biomass Energy Action Plan)

C. GIS Biomass Energy Management Tool
(Not identified in the Biomass Energy Action Plan)

The Biomass Energy Conservation Strategy and Management Tool project is being executed by a team of two consultants and one research-orientated NGO: Stewart Scott Namibia (consultant), the Desert Research Foundation of Namibia (NGO), and EMCON Consulting Group (consultant).

1.2. OBJECTIVE OF THE KEY ISSUES PAPER

The Key Issues Paper has the following objective:

To identify the most critical problems and needs with respect to the use and conservation of biomass energy resources in Namibia, according to which the objectives and prescribed actions of the National Strategy for Sustainable Use of Biomass Energy Resources will be determined.

1.3. METHODOLOGY

The Key Issues Paper has been prepared based on the findings and experiences of previous biomass projects, the findings and conclusions of previous biomass- and energy-related reports, and recent interviews with a number of biomass energy stakeholders. A bibliography and list of references is included at the end of the report. A list of the persons interviewed and a completed questionnaire for each interview are included in Appendix A.

1.4. DEFINITION OF BIOMASS ENERGY

The following is a definition of biomass energy:

> **Biomass energy is energy obtained from organic matter such as wood, agricultural crops or agricultural residues. The energy may be obtained directly, as with the burning of firewood -- or indirectly, as with the processing of agricultural crops to produce a combustible liquid such as ethanol.**

2. BACKGROUND

This Paper provides a significant amount of background information for the purpose of informing the reader about existing conditions that are relevant to the identification of the key issues. Background information is presented on the following:

- Population, Land use and Poverty
- Environment: General Ecological Conditions, Land Degradation, and Global Warming
- Energy Overview: Types, Supply and Sectors; and Urban vs. Rural Energy
- Biomass Energy: Introduction, Fuels & Technologies, and Policy

3. KEY ISSUES

Fifteen key issues are identified and discussed. The following are the key issues listed in order of priority:

- **Key Issue 1**
  An external, yet affordable, source of biomass fuel is needed in some communal farming areas where there are shortages of firewood. (Energy)

- **Key Issue 2**
  All forms of unsustainable wood consumption must be addressed due to the adverse effects they all have on the environment, such as land degradation and reduced biodiversity. (Environment)

- **Key Issue 3**
  Significant and continuous funding for the establishment of a sustainable biomass energy market and related market infrastructure is most needed to effectively address biomass energy-related problems. (Policy)

- **Key Issue 4**
  Extensive distribution networks and sales centres for biomass energy technologies and fuels must be established throughout Namibia. (Economics)

- **Key Issue 5**
  Sustained, large-scale marketing and awareness raising campaigns are essential for achieving widespread usage of fuel-efficient biomass stoves and charcoal products, and for improving people's behaviour patterns with respect to wood consumption and conservation. (Awareness Raising and Marketing)

- **Key Issue 6**
  The use of charcoal and briquettes produced from invader bush should be widely promoted to Namibians, especially in communal rural areas, because it would reduce bush encroachment and deforestation and result in a number of other benefits (Environment, Economics, Women and Children)

- **Key Issue 7**
  Existing regulations on the harvest and sale of wood need to be reviewed for their effectiveness. (Policy)

- **Key Issue 8**
  Policy-makers and technology developers need to better understand the cultural traditions and daily regimens of biomass energy users to ensure that appropriate biomass programmes and technologies are promoted. (Cultural Traditions)

- **Key Issue 9**
  The affordability of biomass technologies and fuels (other than wood) must be clearly determined. (Economics)

- **Key Issue 10**
  Continued refinement and development of inexpensive, biomass energy technologies and fuels is needed to offer more product options to potential users and to ensure that technological progress is made. (Technology)

- **Key Issue 11**
  A GIS biomass energy management tool is needed for proper management and conservation of biomass resources. (Technology)

- **Key Issue 12**
  The creation of markets and manufacturing centres for biomass technologies should be done in such a way as to maximise the economic opportunities for underprivileged Namibians, while at the same time achieving widespread use of the technologies. (Economics)

- **Key Issue 13**
  The applicability of high-tech biomass technologies in Namibia must be determined. (Technology)

- **Key Issue 14**

  Fuel-efficient biomass technologies should be promoted to rural and peri-urban households with the objectives that women and children spend less time collecting wood and improved health conditions are created. (Women and Children, Health)

- **Key Issue 15**

  The curricula of schools throughout Namibia should include lessons regarding the benefits of fuel-efficient biomass technologies and biomass energy conservation. (Awareness Raising)

KEY ISSUES PAPER

1 INTRODUCTION

1.1 PROJECT BACKGROUND

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Phase I - Assessment of Biomass Technologies (completed 2000)
(a report that identifies and assesses current biomass technologies)

Phase II - Implementation of Pilot Projects (completed 2002)
(research and development of low-cost, fuel-efficient wood stoves; establishment of five stove manufacturing and retail centres; and testing of a wood gasifier for electricity generation)

Phase III - Key Issues Paper (2003)
(a paper that identifies the key issues, or barriers, in biomass usage and conservation)

Phase IV - National Strategy for Sustainable Use of Biomass Energy Resources (2003)
(a multi-faceted report that provides solutions to the barriers identified in the Key Issues Paper)

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To identify the most critical problems and needs with respect to the use and conservation of biomass energy resources in Namibia, according to which the objectives and prescribed actions of the National Strategy for Sustainable Use of Biomass Energy Resources will be determined.

The Biomass Energy Conservation Strategy and Management Tool project is a renewable energy project; thus energy is its central theme. However, there are other types of biomass consumption that do not have an energy purposes, such as fires, land clearing for agriculture, and building of homesteads. Although a detailed study on these types of biomass consumption is not within the scope of this project, they need to be considered when evaluating the relative impact of biomass consumption for energy purposes.

1.3 METHODOLOGY

The Key Issues Paper has been prepared based on the findings and experiences of previous biomass projects, the findings and conclusions of previous biomass- and energy-related reports, and recent interviews with a number of biomass energy stakeholders. A bibliography and list of references is included at the end of the report. A list of the persons interviewed and a completed questionnaire for each interview are included in Appendix A.

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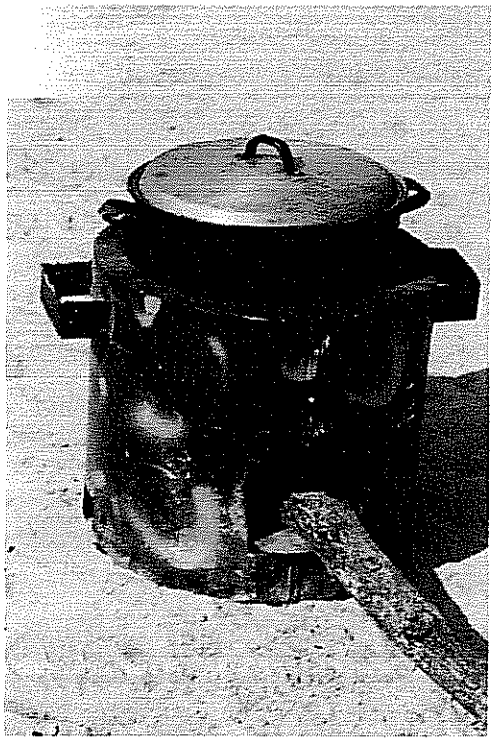

Figure 1: The Evat Stove: A Fuel-Efficient Energy Stove

2 BACKGROUND

2.1 POPULATION, LAND USE AND POVERTY

2.1.1 Population

Namibia has an estimated population of 1.83 million. The estimated annual growth rate is 3%. It is projected that the population will rise to 2,250,000 by 2010, and 2,600,000 by 2020. Approximately 50% of Namibians live in the north-central regions of Omusati, Oshana, Ohangwena, Oshikoto and Kavango. With the exception of Oshana, it is not expected that the populations of these regions will rise significantly in the future. Rather, it is expected that large numbers of people from these regions will migrate to large urban areas of other regions. Currently, the majority of Namibia's population lives in rural areas: 61% rural and 39% urban. However, the rate of urbanisation is increasing rapidly, and it is foreseen that 75-85% of Namibians will be living in urban areas by the year 2020. (Atlas of Namibia, 2002)

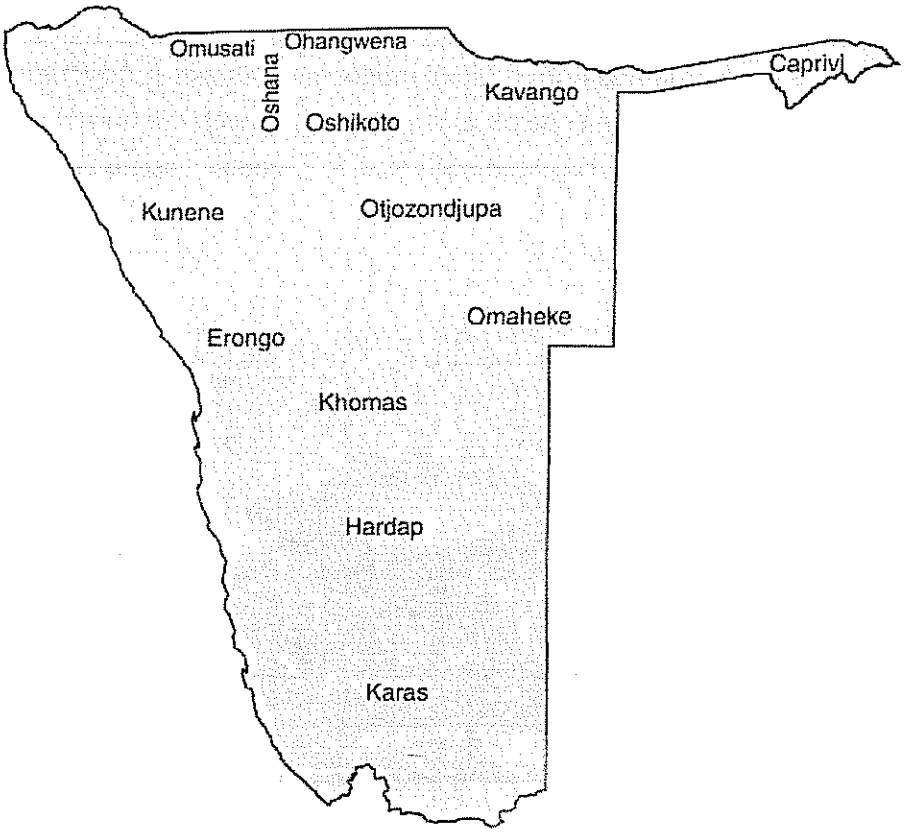

Figure 2: The 13 Regions of Namibia
(Atlas of Namibia, 2002)

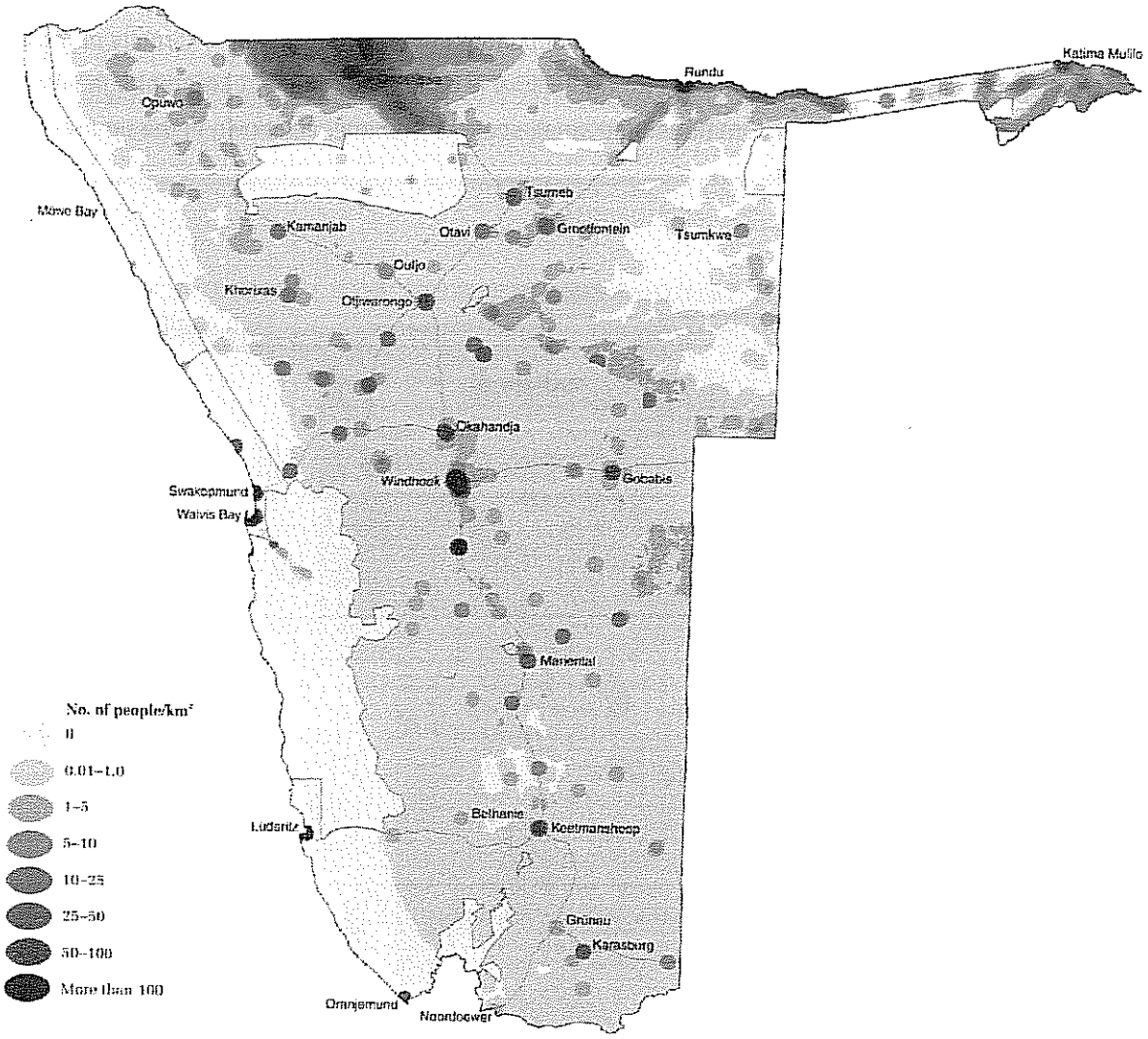

Figure 3: Population Density
(Atlas of Namibia, 2002)

2.1.2 Land Use

Agriculture is by far the largest use of land in Namibia. State-protected areas are the second largest use of land.

Approximately 85% of the total land area is used for farming, of which 90% is used for livestock farming. Approximately 70% of the Namibian population is dependent on agriculture, either directly or indirectly, for its livelihood (Tarr, 1999). The use of land for agriculture is divided among Government agriculture, freehold agriculture, large-scale communal and small-scale communal, as shown in the figure below.

Figure 4: Land Use
(Atlas of Namibia, 2002)

2.1.3 Poverty

In 1994, approximately 60% of the total population could be classified as poor or severely poor (Tarr, 1999). The greatest numbers of poor people live in northern regions in communal farming areas. Table 1 provides a comparison of the extent of poverty that exists in the 13 regions, as obtained from the Atlas of Namibia (2002). The Human Poverty Index (HPI) is used for measuring the amount of poverty that exists -- a score of 0 is the lowest level of poverty, and 50 the highest level. The regions are listed from most poor to least poor.

Region	HPI Rating	Region	HPI Rating
Caprivi	36	Hardap	25
Omaheke	32	Oshana	25
Ohangwena	31	Karas	24
Kavango	30	Khomas	18
Oshikoto	30	Erongo	17
Kunene	27	*Namibia-Overall*	25
Omusati	27	*Namibia-Rural*	29
Otjozondjupa	27	*Namibia-Urban*	17

Table 1: Relative Levels of Poverty

2.2 ENVIRONMENT

2.2.1 General Ecological Conditions

Namibia is approximately 823,680 km^2 in size. It is generally a dry country with low and variable amounts of rainfall. Annual rainfall is highest in the northeast, and is progressively lower towards the west and south. (Atlas of Namibia, 2002)

There are five biomes that occur in Namibia. The largest biome is Tree-and-shrub Savanna, which accounts for approximately 50% of Namibia's land area and which is generally located in the north and central-east. The second largest biome is Nama Karoo, which accounts for approximately 25% of Namibia's land area and which is generally located in the south and along the entire east boundary of the Namib Desert. The Tree-and-shrub Savanna biome consists of two sub-biomes: Broad-leaved Tree-and-shrub Savanna which occurs in the northeast, and Acacia Tree-and-shrub Savanna which occurs further west and south. The plant life of the Broad-leaved Tree-and-shrub Savanna is dominated by several species of tall trees. The plant life of the Acacia Tree-and-shrub Savanna is characterised by large, open grasslands that are dotted with Acacia trees. Generally speaking, the highest concentration of plant biomass occurs in the northeast, and the lowest occurs along the west coast and in the south. (Atlas of Namibia, 2002)

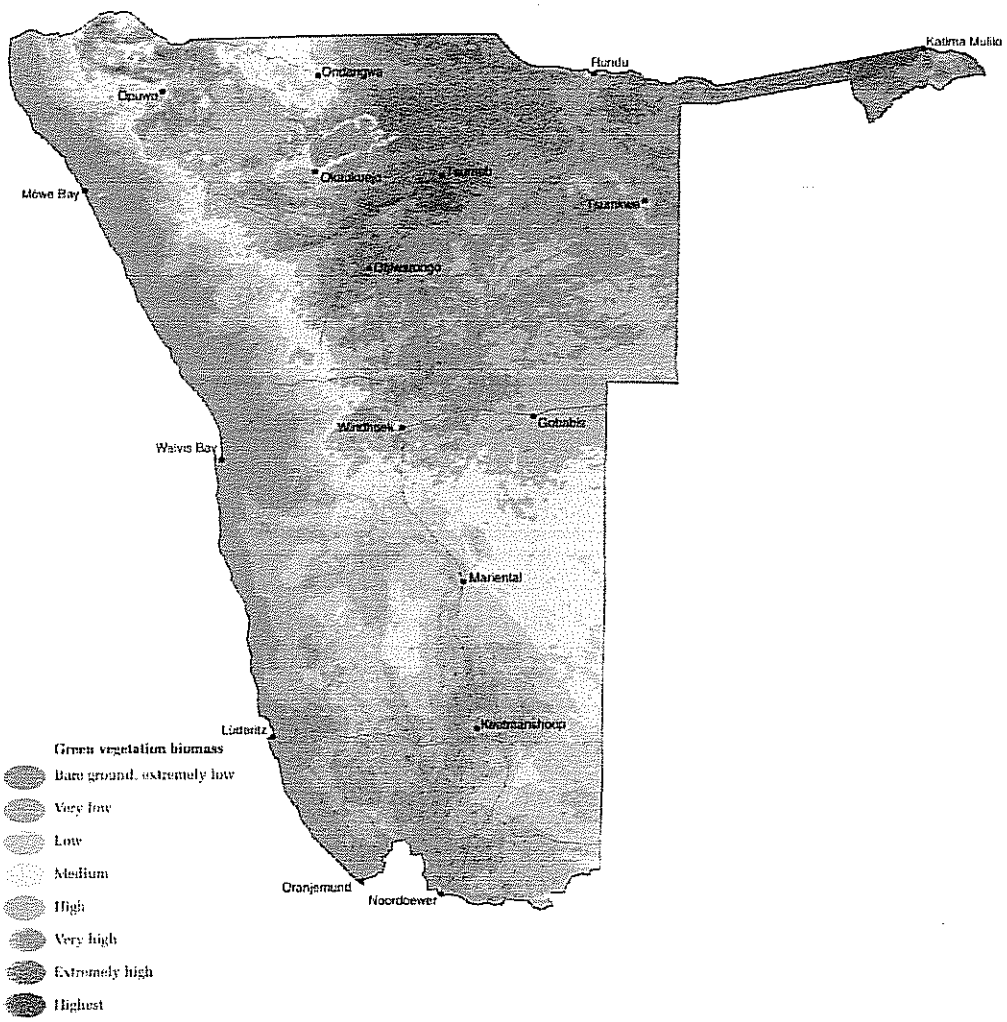

Figure 5: Biomass Density
(Atlas of Namibia, 2002)

2.2.2 Land Degradation

There are several different types of land degradation occurring in Namibia that have been described and analysed in a number of environmental studies. The types of land degradation that are most frequently mentioned include: desertification, deforestation, bush encroachment, rangeland degradation, soil erosion and soil salination. Most of these types of land degradation are inter-related. However, deforestation and bush encroachment are most relevant to biomass energy and require further discussion as follows.

2.2.2.1 Deforestation

Deforestation has occurred on a large scale in the north and, on a smaller-scale, at the outskirts of urban areas in the vicinity of informal settlements. Although information indicating the amount of land area that has been deforested could not be obtained, the figures below showing land cleared for agriculture and land impacted by bush fires indicate where the greatest amount of deforestation has occurred, or is occurring. Testimony by elders also provides information regarding the amount of deforestation that has occurred. For example, in a report by Quan *et al* (1994), all of the elders and traditional leaders interviewed in the Uukwaluudhi region (northern communal area) remembered there being substantial woodlands that have

almost entirely disappeared during their lifetime. And in a report by Marsh (1994), many of the people interviewed in the northern communal farming areas testified to a great reduction in the number of trees during their lifetimes, and to a reduction in the variety of trees. Deforestation continues to occur at an alarming rate. For example, in the wooded Caprivi region it is estimated that at the present rate of clearing, all areas with the best soils for cultivation will be cleared (deforested) by the year 2033 and then the entire region will be cleared by 2082 (Mendelsohn and Roberts, 1997).

There are several causes for deforestation: fires, land clearing for agricultural purposes, overgrazing, harvesting of wood for building purposes, and harvesting of wood for fuel. The harvesting of wood for commercial timber and for carving are not significant causes of deforestation. The greatest causes of deforestation, by far, are fires and the clearing of land for agriculture (Atlas of Namibia, 2002). It should be noted that many fires are started deliberately for the purpose of clearing/improving land for agricultural purposes.

While precise data is not available regarding the amount of land deforested by the each of the above-mentioned causes, the following data do give some indication of their relative impact on deforestation:

- Estimated total land area burned in 1997 = 5,617,000 ha (Du Plessis,1999)
- Estimated total land area cleared for cultivation in 2000 = 2,023,000 ha (Atlas of Namibia, 2002)
- Estimated wood consumption in 1998 (Du Plessis,1999 and Klaeboe et al, 1997)
  - Construction and fencing = 694,000 tons
  - Traditional firewood use = 597,000 tons
  - Wood for charcoal and industrial fuel = 64,000 tons
  - Carvings, timber, utensils = 2000 tons

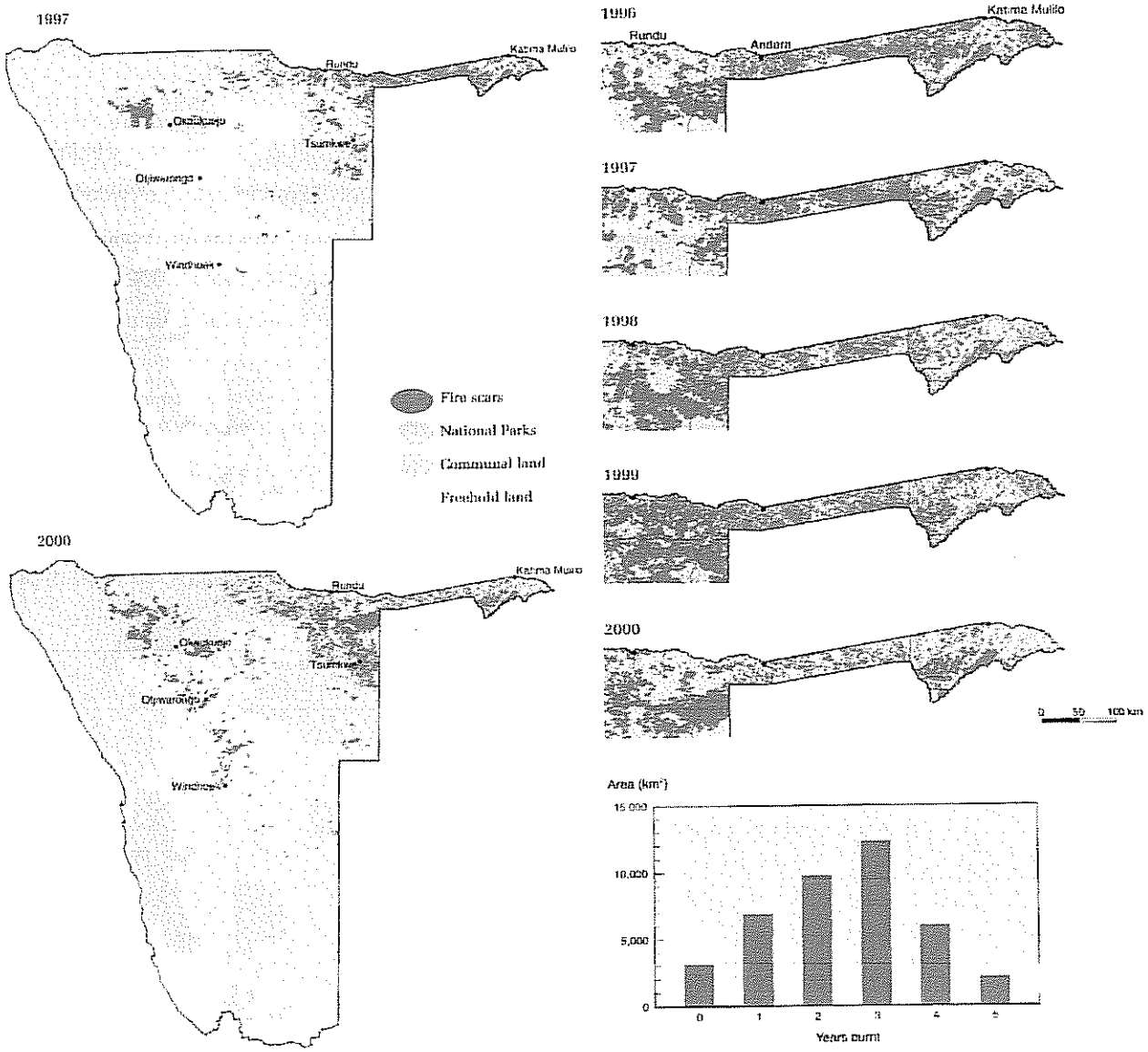

Figure 6: Bush Fires
(Atlas of Namibia, 2002

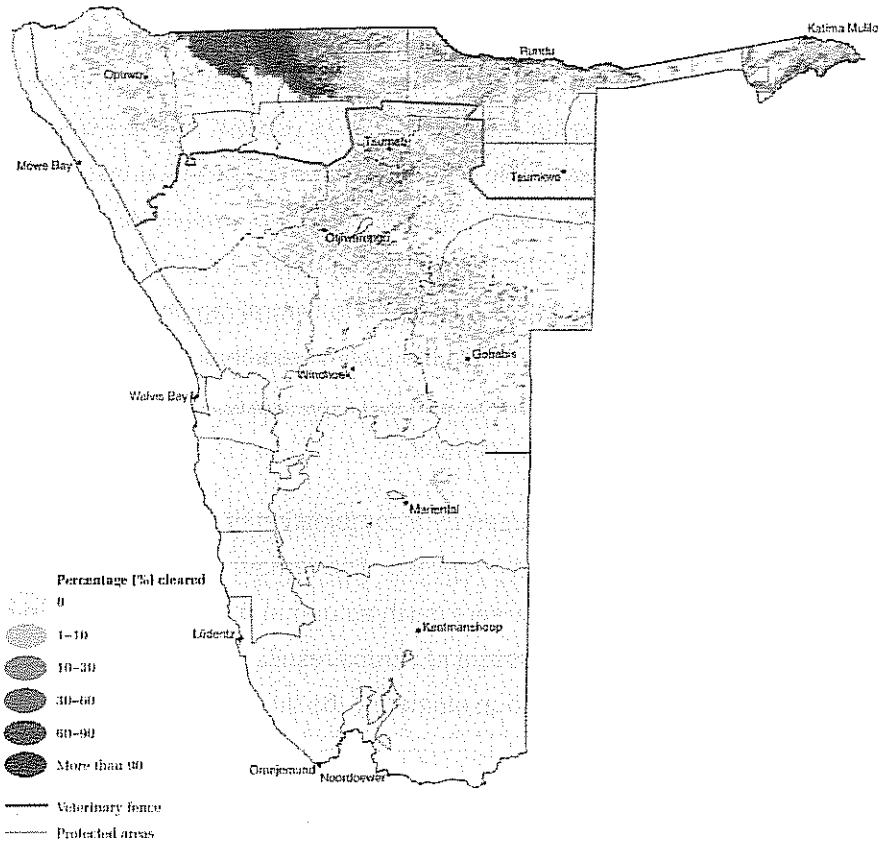

Figure 7: Land Cleared for Crop Farming
(Atlas of Namibia, 2002)

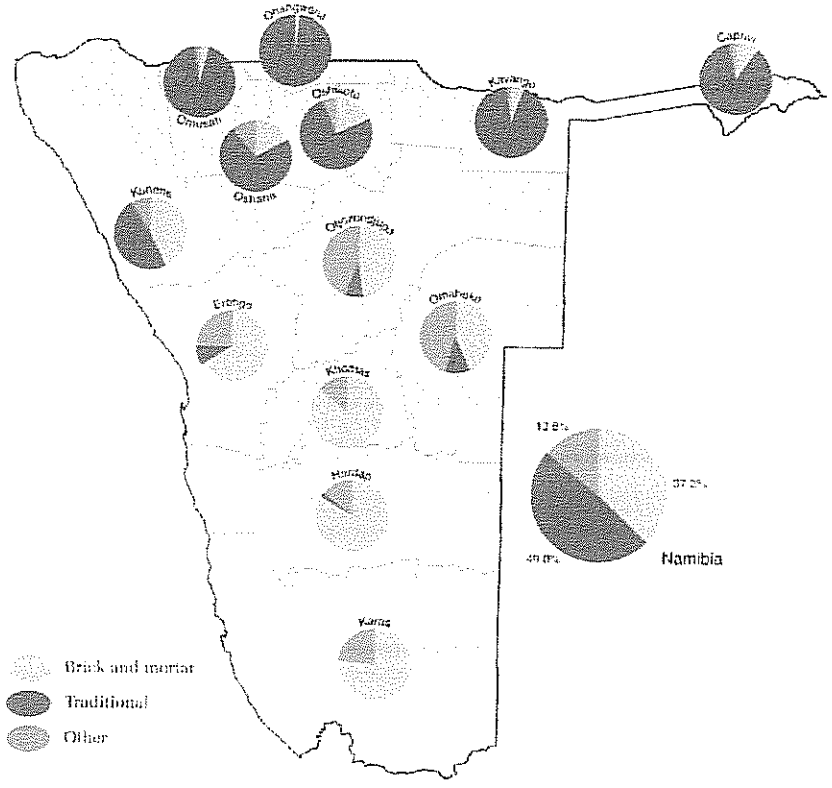

Figure 8:House Construction Materials
(Atlas of Namibia, 2002)

2.2.2.2 *Bush Encroachment*

Bush encroachment is a huge problem in Namibia that appears to have begun in the 1940's, and to have reached a stage of environmental disaster by the mid-1960's (Bester, 1996). Bush encroachment is characterised by the replacement of palatable perennial grass species by dense thickets of bush, which are unpalatable to cattle and sheep (DRFN, 1999). Approximately ten -twelve million hectares of land (12-14% of Namibia) are effected by bush encroachment. Approximately 5.3 million hectares of commercial farmland in the north is severely infested; 1.8 million in the central regions and 1.8 million in the southern regions (Bester, 1996). In addition, due to fires in the Caprivi region previously open woodland has begun to experience bush encroachment (Mendelsohn and Roberts, 1997). The figure below indicates the area that is most broadly affected by bush encroachment.

Bush encroachment has primarily been caused by a combination of overgrazing by livestock, underbrowsing, and too-frequent burning of rangeland. The removal of grass makes more water available for trees and bush, and the absence of browsers (such as game) allows bush to form dense thickets. Severe grazing of palatable perennial grasses and shrubs results in the growth of less palatable perennial grasses, annual grasses and herbs -- and then ultimately the intensive growth of bush and poisonous plants (Bester, 1996).

In 1994, it was estimated that bush encroachment costs the commercial sector N$ 102 million/annum in lost grazing, and costs the Government N$ 12.7 million/annum in lost income tax revenue (Quan *et al*, 1994). While the costs of bush encroachment are high in terms of lost agricultural production and tax revenue, the cost to combat bush encroachment is also high. For many farmers, the cost of bush removal by chemical or mechanical means is so high that it cannot be recovered from the resultant increased agricultural production. However, the production of charcoal from invader bush is one method of bush removal that has been shown to be financially feasible (Bester, 1996).

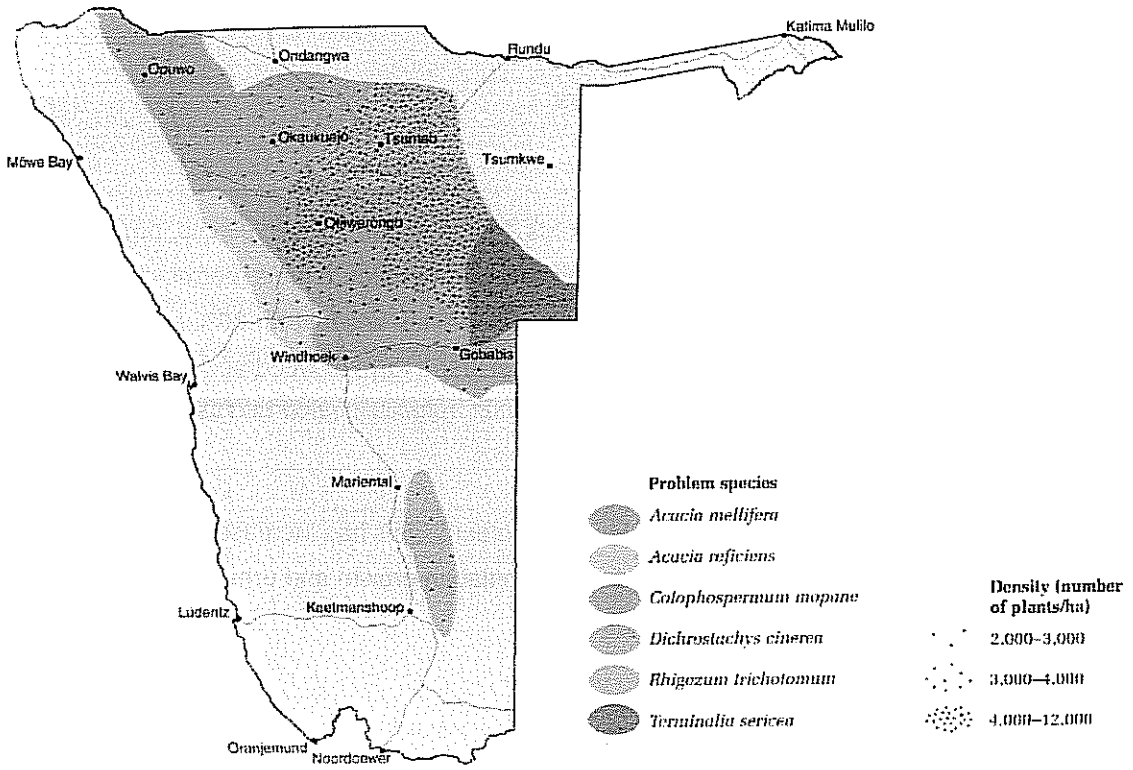

Figure 9: Bush Encroachment
(Atlas of Namibia, 2002)

2.2.3 Global Warming

2.2.3.1 Greenhouse Gases

An inventory of greenhouse gases in Namibia was prepared by Du Plessis (1999) for the United Nations Framework Convention on Climate Change (UNFCCC). The inventory shows that, overall, Namibia is a sink of carbon dioxide (CO_2) – i.e. during 1994 overall removals (5716 Gg) exceeded overall emissions (1827 Gg). However, it is noted that the overall sink is a result of the growth of invader bush, and that the estimate of growth is very rough. The inventory shows that the greatest emission of CO_2 results from fossil fuel use (1821 Gg), and the second greatest from the burning of biomass (1135 Gg). While the amount of CO_2 produced from the burning of biomass is not included in the total national debt due to UN reporting procedures, Namibia would still be a CO_2 sink if it were included (5716 Gg removed vs. 2956 Gg emitted).

2.2.3.2 Future Impacts of Global Warming

Namibia is extremely sensitive to the effects of global warming. Scientists predict that Namibia will become increasingly hotter and drier (with the exception of Caprivi, where it is expected to become wetter). A report by Hulme *et al* predicts that, by the year 2050, Namibia will experience an average warming of 1.7 ^{o}C, a 2.5 - 7.5% decrease in rainfall, a 5 - 15% increase in rainfall variability, and an 4 -16% increase in evapotranspiration. With respect to biomass energy resources, it may be that the higher, drier conditions will favour an increase in the growth of invader bush, and thus an increase in the total amount of woody biomass. (Tarr, 1999)

2.3 ENERGY OVERVIEW

2.3.1 Energy Types, Supply and Sectors

2.3.1.1 Types

In Namibia, the energy requirements of households, transportation, public places, business and industry are met by a variety of resources and technologies. Liquid petroleum fuels (petrol, diesel LPG and paraffin) and electricity are the most consumed energy resources. They account for 60% and 15% of total energy consumption, respectively (MME, 1998). Biomass fuel in the form of wood accounts for approximately 15 - 20% of the total energy consumption (NPC, 1995). Coal, batteries, solar and wind power account for the remaining portion of total energy consumption.

The annual consumption of electricity and liquid petroleum fuels has increased 4% and 7% respectively since 1990. These increases are primarily due to population growth and urbanisation (Muller, 1995).

2.3.1.2 Supply

Liquid Petroleum Fuels

Currently, 100% of the liquid petroleum fuels consumed in Namibia are imported, of which 60-70% is imported from South Africa (MME, 1998). In the future, Namibia will potentially supply a portion of its liquid petroleum needs. In 1974 the large Kudu Gas Field in Namibia was discovered; and exploration activities for oil are currently underway.

Electricity

The main sources of electricity are imported from South Africa and Zambia, the Ruacana hydropower plant, the coal-fired Van Eck power station in Windhoek, and many diesel generator plants located throughout the country. Imports from South Africa vary from year to year; however in 1997, approximately 70% of the total electricity consumed was imported from South Africa (MME, 1998). There is significant potential for increased electricity production in Namibia in the future, if new hydropower plants are developed along the Cunene and Okavango rivers. The White Paper on Energy Policy (MME, 1998) states that Government aims to supply 75% of the electricity demand by the year 2010. Figure 9 shows the extent of the existing electricity network. Figure 10 shows the areas to be electrified by the year 2020, as presented in the Rural Electricity Distribution Master Plan (MME, 2000).

Please go to the Tree Atlas site and download revised poster layouts, as well as a test section of the sharpened background for the Walvis area. Do a hi-rez printout onto that glossy paper, and see if the quality is okay. Launch photoshop, then open the jpg and save as a tiff first. Then print.

Next instruction: Notice the various treatments applied to the logo area at the bottom and let me know if you have preferences or thoughts (which I know you will have).

I will get revised print quotes once you have signed these damn posters off, as the printers tend to get gatvol if I request revised print quotes all the time.

I have scanned all the pics taken for the conservancies job and am colour retouching them at the moment and will upload jpgs onto either ftp site for you to see. Some lekker deepetch shots. By the way, what's happening with conservancies, dude?

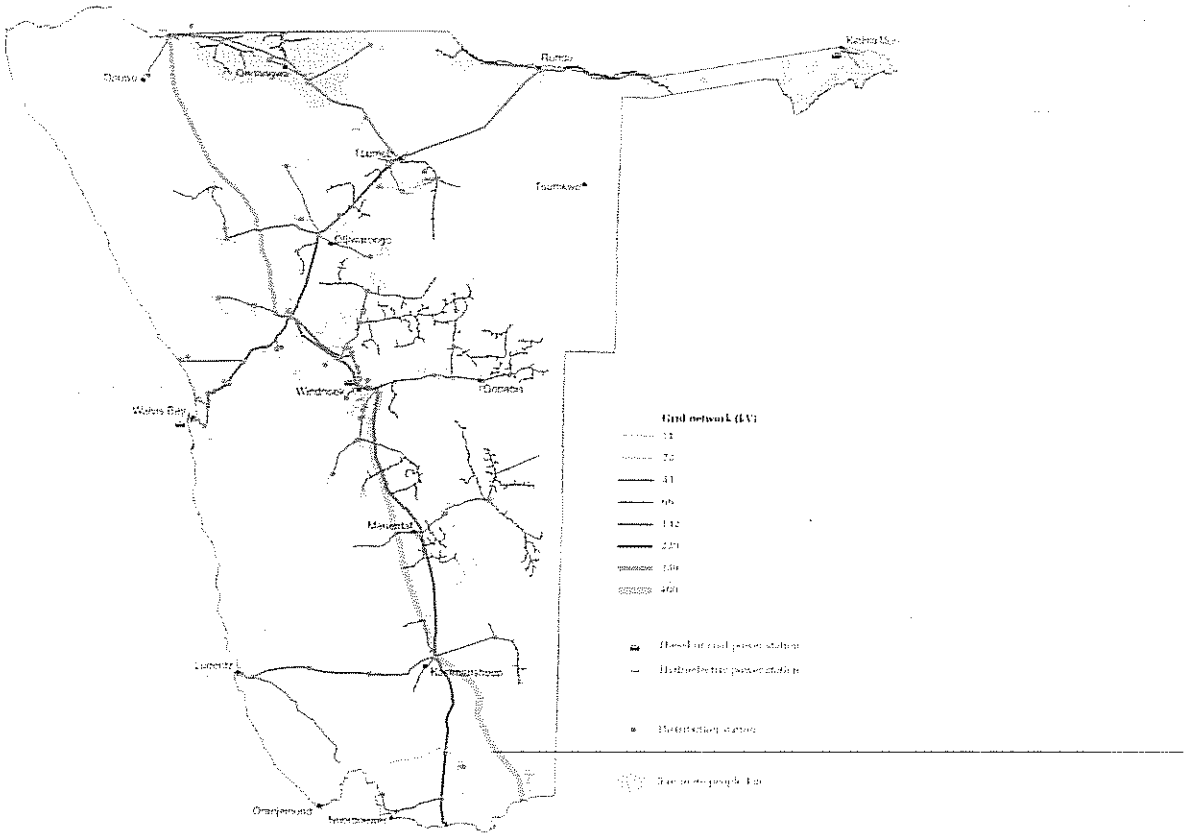

Figure 10: Existing Electrical Grid
(Atlas of Namibia, 2002)

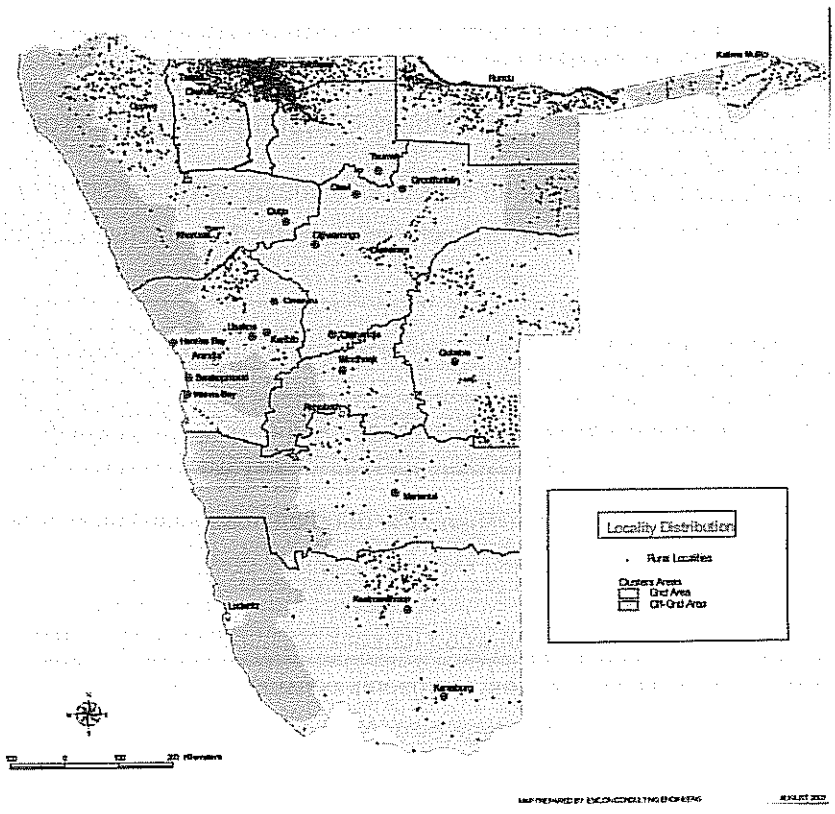

Figure 11: Future Coverage of the Electrical Grid
(MME, 2000)

Solar and Wind Energy

Namibia has excellent conditions (perhaps the best in the world) for the use of solar energy. However, the high capital costs of solar products have been a barrier to large-scale use of this renewable energy resource. Similarly, there is potential for the use of wind energy along the coast, but it has not been utilised due to high capital costs.

Biomass Energy

Nearly all of the woody biomass that is consumed in Namibia for fuel purposes is harvested in Namibia. However, woody biomass has largely been harvested from areas that are, or are becoming, deforested. A large and sustainable woody biomass resource lies in the vast amount of invader bush that exists on commercial and communal farms. The potential and benefits of using this resource on a larger-scale will be discussed later in this report.

2.3.1.3 Sectors

The percentages of the total energy that is consumed by different sectors are summarised as follows (Tarr, 1999):

Transport	55%
Industry and Commerce	30%
Households	10%
Agriculture and Fisheries	5%
Total	100%

Table 2: % of Total Energy Consumption by Sector

Note that while urban households account for 10% of total energy consumption, they also account for 50% of total electricity consumption. The mining industry accounts for 39% of electricity total electricity consumption (Muller, 1995).

2.3.2 Urban vs. Rural Energy

There are considerable differences between the patterns of energy use in urban area and in rural areas. People in urban areas generally rely on electricity for household energy (cooking, lighting & appliances), and petrol or diesel for transportation. More than 75% of urban households have access to electricity. Approximately 19% rely on wood for cooking (Atlas of Namibia, 2002).

Most people in rural areas generally rely on wood for cooking, candles and paraffin for lighting, and walk or use donkey-carts for transportation (note that the people considered here are communal farmers and commercial farm workers, not commercial farm owners). Approximately 10% of rural households have access to electricity (Atlas of Namibia, 2002). With respect to cooking, approximately 90% use wood, 34% LPG, 9% paraffin, 8% electricity, and 7% cow dung -- 30% use multiple fuels.

With respect to lighting, approximately 64% use candles, 59% paraffin, 16% electricity, and 3% LPG -- 40% use multiple fuels. Note that these figures are based on a report by L. Wamukonya (1997), in which the energy consumption patterns of eight rural villages located in seven regions were studied.

The White Paper on Energy Policy states that, by the year 2010, Government plans to supply electricity to 95% of urban households, and 25% of rural households (MME, 1998). Refer also to Figure 10 above, for an indication of the rural areas to be electrified by 2020.

The following figure provides additional information with respect to energy use for cooking in urban and rural areas (Atlas of Namibia, 2002).

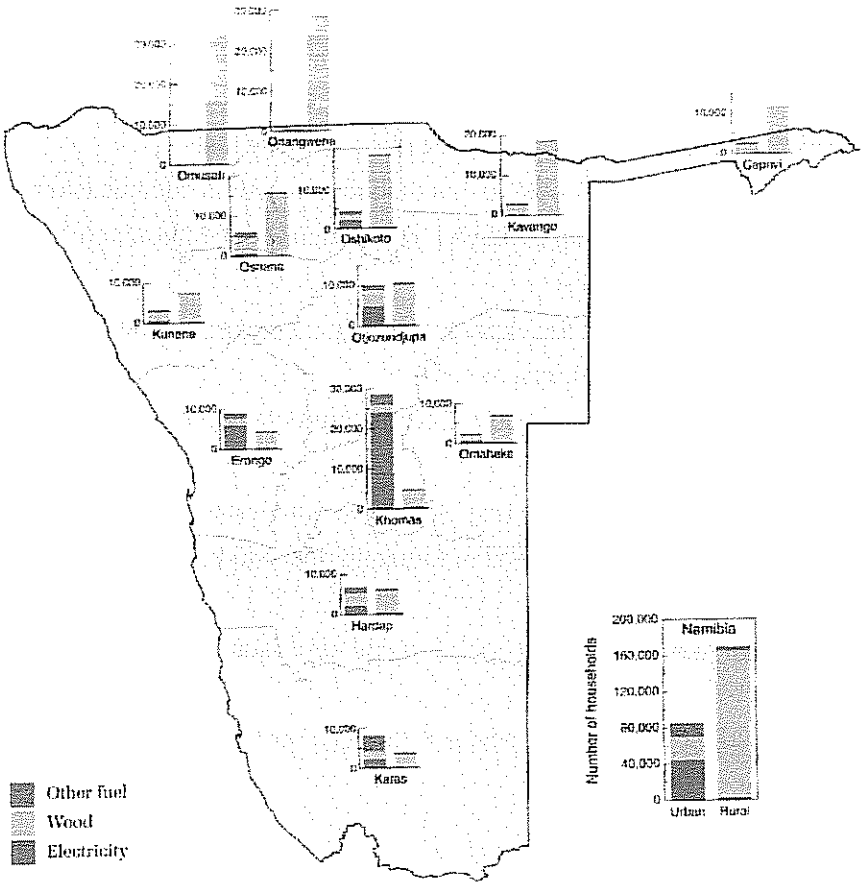

Figure 12: Use of Wood and Electricity for Cooking

(Atlas of Namibia, 2002)

2.4 BIOMASS ENERGY

2.4.1 Introduction

In Namibia the most common type of biomass energy fuel is firewood, which is typically used for cooking purposes. However, there are several other types of biomass fuels and technologies with which one should become familiar. The following is a list of commonly known, and less well known, biomass energy fuels and technologies:

- Open wood fire for cooking, lighting, heating, and people gathering
- Traditional wood stoves and ovens
- Fuel-efficient stoves and ovens -- in Namibia, the Evat stove is most popular
- Charcoal -- in Namibia, charcoal is mostly produced from invader bush
- Briquettes -- produced from charcoal fines using low-tech or high-tech equipment
- Alternative biomass fuels -- grass, dung, nut shells, paper, etc., which are burned as is or compressed into briquettes to create a higher density fuel
- Wood gas -- produced by a wood gas producer for use in combustible engines
- Ethanol combustible liquid produced from a number of different agricultural crops, most commonly from sugarcane
- Bio-diesel -- combustible liquid produced from a number of different plants and seeds, such as sunflower seeds or jatropha seeds
- Biogas -- combustible gas produced by the fermentation of sewage, primarily animal and human excrement
- Incinerator power plants -- cofiring of biomass with waste or coal
- Energy plantations -- large areas of farmland dedicated to the growth of biomass fuels, such as eucalyptus trees
- Braai's – not relevant to a National Strategy for Sustainable Use of Biomass Energy Resources
- Fireplaces – not relevant to a National Strategy for Sustainable Use of Biomass Energy Resources

A comprehensive introduction to biomass energy fuels and technologies was prepared by SSN in 2000 for Phase I of the Biomass Energy Action Plan. Please refer to it for further details.

2.4.2 Production and Use of Biomass Fuels and Technologies

2.4.2.1 Firewood and Agricultural Residues

As previously mentioned, the largest use of firewood occurs in communal rural areas. The information below regarding the use of biomass fuels in rural areas was obtained from a report by Wamukonya (1997). The report focuses on the communal rural areas of seven regions: Erongo, Karas, Oshana, Omaheke, Kavango and Oshikoto.

- Rural people generally cook outside on an open fire, but they do cook inside on a open fire when weather conditions are not good.

- Approximately 90% of the rural population uses wood in an open fire for cooking.
- Approximately 80% of firewood users in rural areas gather it themselves.
- In 63% of rural households, women and children are responsible for the collection of firewood.
- Approximately 7% of rural households use cow dung as source of cooking fuel.
- The average distance travelled to collect firewood doubled between 1987 and 1997. The average distance travelled in 1997 was 5.6 km, and was done on average 5 times per month.
- Seven regions are listed from greatest average distance travelled for firewood to least (km/trip): Omusati (15), Erongo (8), Karas (7), Oshana (5), Oshikoto (3), Kavango (3), Omaheke (1).
- Average firewood consumption is 3.8 kg per household per day.
- Households that use cow dung, use an average of 2.9 kg of dung per day. Households that mix dung and wood use an average of 2.3 kg dung and 1.9 kg firewood per day.
- Six regions are listed from greatest daily per capita consumption of firewood to lowest (kg/capita-day): Oshikoto (0.61), Kavango (0.49), Erongo (0.48), Oshana (0.42), Karas (0.38), Omaheke (0.33)

In a study by Matthew (2000), the following information was determined in communal rural areas of Ohangwena, Omusati and Oshana:

- The 3-region study area is the most vulnerable to fuel-wood shortages.
- Cooking with wood and alternatives occurs both outside and inside, but most of the time outside.
- Commercial firewood is regarded as expensive by most rural housholds.
- Agricultural residues are widely used, particularly in Oshana and Omusati. The following types of residues are used, from most used to least used in the 3 regions: animal dung, bitter bush, palm husks, marula husks, others, and crop left-overs.

2.4.2.2 Charcoal and Charcoal Briquettes

Approximately 12 kt of charcoal are produced annually in Namibia. Of this amount, approximately 5 kt are exported to Germany, 2.5 kt exported to the UK, 3 - 4 kt exported to South Africa, and 1 t or less consumed in Namibia. The quality of Namibian charcoal is generally high, since it is produced from invader bush, which is a type of hardwood. Invader bush is mainly found on commercial farms. The commercial farmers produce the charcoal with the assistance of contract workers who harvest the bush and process it in a mobile kiln. There are approximately 100 active charcoal producers in Namibia, employing 2000 contract workers. Contract workers earn approximately N$ 430 per month; and producers and marketers each make a net profit of N$ 220 per ton of charcoal.

There is currently a limited amount of charcoal briquettes being manufactured in Namibia. Briquettes are manufactured by compressing a mixture of charcoal fines and binder. Most charcoal fines are currently exported to South Africa, for approximately N$ 250 per ton.

The use of charcoal and charcoal briquettes is almost totally limited to urban areas. There is very little use of charcoal in communal farming areas because households either prefer to use free firewood or the charcoal is not available for sale where firewood is for sale.

2.4.2.3 Fuel-Efficient Stoves

As previously mentioned in the Introduction, five SME fuel-efficient stove manufacturing centres were established in 2001 -- in Onkani, Oshakati, Ondobe, Okalongo and Okahao. The centres were established as part of the second phase of the biomass energy Action Plan (Phase II - Implementation of Pilot Projects). A sixth centre was later established in Katatura, Windhoek. At the present time, only two stove manufacturing centres are functioning -- in Oshakati and Okahao. Approximately 50 persons were trained to make stoves at the six centres. They were trained to make two different types of fuel-efficient stoves: the Evat stove and the Mbwangu stove. The Mbwangu stove was not well accepted by consumers and, as a result, only the Evat stove is manufactured today in Namibia. The Evat stove is manufactured using only inexpensive, hand tools. The Evat stove generally requires 50% less wood than does an open fire for an equivalent cooking task. This allows households to spend considerably less time and money when obtaining firewood for their cooking needs.

It is estimated that the centres have sold approximately 2000 - 2500 Evat stoves, of which 750 were purchased by MME in 2002 in a bulk order. Based on the number of stoves that have been sold and the number of people who rely on firewood daily, it is evident that the market for stoves has barely been penetrated. More details regarding the pilot project for stove centres are provided in the Biomass Energy Study - Final Report by SSN (2002).

2.4.3 Policy

There is significant discussion of biomass energy in the White Paper on Energy Policy (MME, 1998). The following policy statements from the White Paper are relevant to biomass energy and to the formulation of a National Strategy for the Sustainable Use of Biomass Energy Resources.

- Government will investigate the status and use of biomass in the different regions of Namibia in order to determine which rural people are most affected by woodland depletion, as well as the nature of the problems experienced by rural people. This investigation will form the basis of a national biomass strategy which aims to address the problems experienced by rural people in the different regions.
- As a basis for future policy development, government will investigate the feasibility of charcoal production and/or wood transport to areas of need.
- Government will promote fuel-efficient cooking technologies in rural areas.
- Government will establish an appropriate inter-ministerial mechanism to ensure that rural people's woodfuel needs are integrated into the Directorate of Forestry policies and practice, especially with regard to the management and control of forests, as well as to woodlot and commercial, communal and farm forest strategies.
- Government undertakes to ensure that energy projects impact positively on rural women, the principle users of energy and energy appliances, by ensuring that they participate in the design of energy programmes and projects, as well as by educating the public about the

potential impact of these energy interventions.

- Government will establish an ongoing research strategy, which aims to understand rural household energy use and which provides information for energy policy review.
- Government will develop and implement renewable energy awareness programmes.
- As a basis for potential corrective policy, government will assess the extent to which the health and safety of rural and urban household dwellers is being affected by the use of wood, candles and paraffin within their homes.

3 KEY ISSUES

3.1 INTRODUCTION

The Key Issues Paper is the first step in the formulation of a National Strategy for Sustainable Use of Biomass Energy Resources in Namibia. The key issues are the most critical problems or needs to be addressed by the National Strategy, and thus suggest the direction to be taken by future policies and interventions.

The key issues have been determined based on a thorough review of biomass energy-related studies, an evaluation of fuel-efficient stove manufacturing centres, and several interviews with biomass energy stakeholders. They are listed from highest priority (Key Issue 1) to lowest priority (Key Issue 15) and they fall under the following subject areas:

- Energy
- Environment
- Awareness Raising and Marketing
- Women and Children
- Health
- Cultural Traditions
- Technology
- Economics
- Policy

3.2 KEY ISSUES

Key Issue 1

An external, yet affordable, source of biomass fuel is needed in communal farming areas where there are shortages of firewood.

(Energy)

There is an energy crisis occurring in some communal farming areas due to a lack of accessible firewood. It is clear that the biomass energy resources in these areas are insufficient. While a comprehensive study has not been prepared yet that clearly indicates the areas that experience the greatest shortage of firewood, the reports by Wamukonya (1997) and Matthew (2000) do provide relevant information. Based on the long average distances travelled for firewood that are given in the Wamukonya report (up to 15 km/trip), it is evident there are extreme shortages in Omusati, Erongo, and Karas – and serious shortages in Oshana, Oshikoto and Okavango. The Matthew report also indicates a serious shortage in Ohangwena.

Government should determine the areas where people have the greatest need and then take steps to provide an affordable, and accessible, source of biomass fuel – for instance low-cost firewood, charcoal and briquettes obtained from invader bush.

Key Issue 2

All forms of unsustainable wood consumption must be addressed due to the adverse effects they all have on the environment, such as land degradation and reduced biodiversity

(Environment)

It is clear from the many studies that have been performed that wood is being consumed at an unsustainable rate in much of Namibia. The studies indicate that unsustainable wood consumption is responsible for extensive deforestation, soil erosion, soil salination, loss of biodiversity, and possibly reduced rainfall. While initiatives for biomass energy conservation will help to address these environmental problems, it is equally or more important that initiatives are taken with respect to other forms of unsustainable wood consumption. The extent and frequency of fires needs to be reduced; alternative building materials for agricultural fences and homesteads need to be used; and better land clearing practices need to be employed. The formulation of detailed recommendations to address all forms of unsustainable wood consumption is not within the scope of the National Strategy for Sustainable Use of Biomass Energy Resources, but is urgently needed.

Key Issue 3

Significant and continuous funding for the establishment of sustainable biomass energy market and related market infrastructure is most needed to effectively address biomass energy-related problems

(Policy)

Government and donor organisations have funded a number of biomass energy projects, most of which have been in the form of information-gathering reports. While information gathering is important for wise decision-making and will continue to be an important activity, it is time that more funding be directed towards the establishment of a large, sustainable biomass energy market (marketing and awareness raising) and related market infrastructure (manufacturing and retail centres). Furthermore, the funding needs to be continuous so that biomass energy market grows, rather than plateau or diminish as a result of a lack of input.

Key Issue 4

Extensive distribution networks and sales centres for biomass energy technologies and fuels must be established throughout Namibia.

(Economics)

Approximately 1500 households in Namibia have fuel-efficient biomass stoves. There are approximately 366,000 households in Namibia (assuming an average household size of 5.0) of which approximately 228,000 rely on wood for cooking. Approximately 1500 of these 228,000 households use fuel-efficient biomass stoves – less than 1%. The figures for households using charcoal are likely not much higher. A major reason for the low use of fuel-efficient stoves and charcoal products by people who could benefit the

most is the serious lack of retail centres communal rural areas where the products can be purchased. At present, there are only two locations in Namibia where fuel-efficient stoves are sold, in Oshakati and Okahao. The availability of charcoal products is also extremely limited in communal rural areas. Many more retail centres need to be established if fuel-efficient biomass technologies are to be used on a large scale. Policy makers should investigate the feasibility of the products being sold at local administration offices in villages, at agricultural extension offices, and at the homesteads of community leaders.

Key Issue 5

Sustained, large-scale marketing and awareness raising campaigns are essential for achieving widespread usage of fuel-efficient biomass stoves and charcoal products, and for improving people's behaviour patterns with respect to wood consumption and conservation.

(Awareness Raising and Marketing))

As mentioned under Key Issue 4, less than 1% of households that rely on firewood use fuel-efficient biomass technologies. A major reason for the low use of fuel-efficient stoves and charcoal products by people who could benefit the most is a serious lack of marketing and awareness raising. Very little marketing has been done to date, and there are currently no organised marketing campaigns. People in communal rural areas need to be shown how to use these products, informed about the potential benefits, and told where the products can purchased. Given the need to reduce wood consumption in deforested areas and assist those experiencing a biomass energy crisis, significant resources should be dedicated to this purpose. Marketing and awareness raising campaigns should utilise the radio, posters, personal demonstrations in villages and homestead areas, and educational institutions.

Key Issue 6

The use of charcoal and briquettes produced from invader bush should be widely promoted to Namibians, especially in communal rural areas, because it would reduce bush encroachment and deforestation and result in a number of other benefits.

(Environment, Economics, Women and Children)

As mentioned in Section 2.2.2.1, approximately 600,000 tons of wood is used annually for fuel purposes. Most of this wood is consumed in rural areas that are deforested, or are in danger of being deforested. If 1/3 of the total fuel wood consumption (200,000 tons) was replaced by 100,000 tons of charcoal and briquette consumption (made from invader bush), the following benefits would occur:

- 50,000 hectares of bush encroached land would be cleared per year (using a figure of 2 tons of charcoal per hectare from Quan *et al*, 1994)
- Approximately 2 million trees/year would be saved (assuming a rough average 10 trees/ton of firewood)
- Commercial farmers would realise nett profits of approximately N$ 500,000/year from increased meat production and N$ 21 million/year from charcoal production (using figures from Quan *et al*, 1994 and Aigams, 1997).
- Charcoal marketers would realise nett profits of N$21 million/ year (using figures from Aigams, 1997).
- Approximately 15,000 new jobs would be created.

- Women and children would spend much less time and travel much shorter distances for the collection of firewood.

Key Issue 7

Existing regulations on the harvest and sale of wood need to be reviewed for their effectiveness.

(Policy)

In light of the amount of deforestation that has occurred, and is occurring, the existing regulations pertaining to the harvest and sale of wood need be reviewed. Two recommendations for new regulations were made in the report by Klaboe *et al*, 1997. These recommendations include raising of tariffs on commercial firewood sellers, and banning commercial wood harvesting in regions where deforestation is most severe. These recommendations should be re-evaluated and possibly included in the National Strategy for Sustainable Use of Biomass Energy Resources. Existing and proposed regulations should be evaluated for their effectiveness in reducing deforestation and promoting the consumption of charcoal products made from invader bush.

Key Issue 8

Policy-makers and technology developers need to better understand the cultural traditions and daily regimens of biomass energy users to ensure that appropriate biomass programmes and technologies are promoted.

(Cultural Traditions)

It is important that policy-makers and technology developers are realistic in the objectives of their programmes and products. For example, it is not realistic to expect that all open fires will be replaced by the use of fuel-efficient stoves, since for some people open fires have much more significance than just places for cooking. Similarly, large amounts of money should not be wasted on the development and promotion of products if the intended users will not eventually accept them. Policy-makers and technology developers need to be acquainted with the details of cultural traditions and daily regimens. For example, the policy-makers and technology developers should be able to answer the following types of questions:

- Why are open fires important, and for whom are they important?
- What are the methods of cooking in rural households? Are they different in different regions of the country? How many pots are typically used? How much heat is needed for each pot? What is the demand for ovens? What are the demands for hot water? How often do people cook inside?
- What are the demands and methods for household heating?

Key Issue 9

The affordability of biomass technologies and fuels (other than wood) must be clearly determined

(Economics)

As previously mentioned under Key Issues 4 and 5, less than 1% of households that rely on firewood use fuel-efficient biomass technologies. One reason for this may be that, at N$ 150, the Evat stove is too expensive for households in communal rural areas. More research is needed regarding the buying power of

poor, rural households, as this could be critical to the success fuel-efficient biomass technologies in areas of greatest need.

Key Issue 10

Continued refinement and development of inexpensive, biomass energy technologies and fuels is needed to offer more product options to potential users and to ensure that technological progress is made

(Technology)

While the Evat stove has an excellent design in that it can reduce wood consumption by approximately 50% and be manufactured using only inexpensive hand tools, there are possibilities for its refinement. Furthermore, other fuel-efficient stoves should be developed and/or introduced into the Namibian market. This would help create a more competitive market and would offer more variety to potential purchasers. Through continued research, it may be a stove is developed that is more desirable than the Evat stove. For example, the Biomass Energy Study - Final Report (SSN, 2002) recommends the development of a clay stove made from local clay resources. This type of stove would potentially be both less expensive and more efficient than the Evat stove. Other possibilities include the development of technologies such as low-cost briquette manufacturing equipment, alternative briquette "recipes", fancier fuel-efficient stove/oven/heater combinations -- and the import of the technologies such as the Vesto stove and the Makoti stove from South Africa.

The refinement and development of inexpensive, biomass technologies is also needed so that the products offered produce a minimal amount of smoke, and thus are more beneficial with respect to health and the environment.

Key Issue 11

A GIS biomass energy management tool is needed for proper management and conservation of biomass resources.

(Technology)

While studies on patterns of biomass energy usage have been performed in the past for MME -- and significant efforts have been made to map Namibia's biomass resources for the Department of Forestry and the Ministry of Agricultural, Water and Rural Development -- policy-makers need a tool whereby they can easily compare data regarding woody biomass supply and demand, sales data for fuel-efficient technologies, environmental problem areas, etc. The need for this biomass management tool will increase in the future as more and more biomass interventions are implemented and more and more data needs to be recorded and organised. GIS offers the best platform for the management tool because it allows the integration of spatial data and numerical data, and allows the comparison of different sets of data in a quick and efficient manner.

Key Issue 12

The creation of markets and manufacturing centres for biomass technologies should be done in such a way as to maximise the economic opportunities for underprivileged Namibians, while at the same time achieving widespread use of the technologies.

(Economics)

Thousands of new jobs could potentially be created for the manufacture, distribution and sale of fuel-efficient biomass technologies and charcoal products. As mentioned under Key Issue 6, approximately 15,000 new jobs could be created if 1/3 of the current firewood consumption was replaced by charcoal product consumption. While a much smaller number of jobs would be created if a similar percentage of open fire users started using fuel-efficient stoves, a few hundred jobs would likely be created.

The level of technology and skills needed to manufacture stoves and charcoal products does not need be high to achieve the biomass energy objectives of Namibia. Therefore, every effort should be made to utilise Namibian labour when possible, to establish as many self-sustaining SME's as possible in Namibia, and to generally use the promotion of biomass energy products to empower as many people as possible who face economic hardship.

Key Issue 13

The applicability of high-tech biomass technologies in Namibia must be determined.

(Economics)

There are a few types of high-tech biomass technologies that may be suitable for Namibia. These technologies include the production of substitutes for liquid petroleum products, i.e. bio-diesel and ethanol, and the generation of electricity for mini-grids using wood gas producers. In the Biomass Energy Study - Final Report (SSN, 2002), these technologies are recommended for further study regarding their feasibility. A small-scale wood gas producer was also procured and successfully operated during a demonstration in Talismanis in 2001. Since Namibia imports large and expensive amounts of liquid petroleum products, the grounds for performing feasibility studies for ethanol and bio-diesel production are self-evident. The potential for electricity production using invader bush is also highly-attractive with respect to off-grid electricity supply.

Key Issue 14

Fuel-efficient biomass technologies should be promoted to rural and peri-urban households with the objectives that women and children spend less time collecting wood and improved health conditions are created.

(Women and Children, Health)

As mentioned in Section 2.4.2.1, women and children are responsible for wood collection in 63% of rural households. The average distance travelled for wood collection is 5.6 km, and this is done an average of 5 times/month. In most cases, women and children travel on foot when collecting wood. The above figures are averages. For many households the average distances travelled are much longer, and the frequencies greater. The large amount of time spent on wood collection by women and children could be better spent

on other activities, such as attending school (women & children) or working in agricultural fields or at nearby places of employment (women). The use of fuel-efficient biomass technologies and charcoal products by women will result in significant timesaving from which their families will benefit.

While the link between the use of fuel-efficient technologies and improved health has not been scientifically established in Namibia, it is likely the case. The use of fuel-efficient technologies potentially has the following health-related benefits:

- Less smoke emitted during cooking results in less smoke inhaled by persons who do the cooking or who are often near the cooking area, i.e. women and young children. Reduced smoke inhalation may help to reduce incidences of acute respiratory illness (ARI), eye infections, and cancer.
- Less time spent collecting wood results in less chance of wood collectors getting bitten by snakes.
- Reduced wood requirements result in lighter loads to be carried and less physical strain.

It is recommended that the Evat stove and any other stove that is promoted in Namibia should be tested for its capacity to reduce smoke emissions, as this is potentially the greatest health benefit.

Key Issue 15

The curricula of schools throughout Namibia should include lessons regarding the benefits of fuel-efficient biomass technologies and biomass energy conservation

(Awareness Raising)

Children, and not just adults, should be informed of the benefits of fuel-efficient biomass technologies and biomass energy conservation. This information should be included in the curricula of schools throughout Namibia, and should be part of a larger education initiative regarding the benefits of renewable energy and environmental conservation practices. The education initiative would be both a long-term and short-term investment: long-term, in that the children would be better prepared to make wise energy and environmental decisions when they are adults; and short-term, in that many children are likely to pass on the lessons they have learned to their families.

4 CONCLUSION

The Key Issues Paper has been prepared as a first step in the formulation of a National Strategy for Sustainable Use of Biomass Energy Resources in Namibia. A significant amount of background information was presented in Section 2 for the purpose of acquainting the reader with existing conditions that are relevant to the identification of key issues. Fifteen key issues were presented in Section 3.2 that will serve as the most important problems and needs to be addressed in the National Strategy.

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ADDENDUM A

INTERVIEWS

LIST OF PERSONS INTERVIEWED

Ms. L. Amaambo	Head of Solar Energy Projects, Premier Electric (Previously at MME on Biomass Energy Projects)
Mr. M. Amagulu	Projects Coordinator, Women's Action for Development
Dr. P. Barnard	National Coordinator, Namibia Biodiversity Programme
Mr. K. B. Chisanga	Researcher and Biomass Expert, Energy and Environmental Concerns for Zambia
Ms. M. Coetzee	Researcher, Ministry of Agriculture, Water and Rural Development
Mr. N. De Klerk	Coordinator Bush Encroachment Research Monitoring & Management Project, Directorate of Environmental Affairs, Ministry of Environment and Tourism
Dr. L. DuPisani	Researcher, Ministry of Agriculture, Water and Rural Development
Mr. I. Galloway	Director of Jumbo Charcoal and Stewart Scott Namibia
Mr. A. Golding	Deputy Director, Dept of Minerals and Energy, South Africa
Ms. R. Mabakeng	Deputy Director: Women and Family Development and Gender Mainstreaming, Ministry of Women Affairs and Child Welfare
Mr. J. Mendelsohn	Director, RAISON, Windhoek
Mr. P. M. J. Mushamba	Energy & Environment Consultant, Ecosynchron P/L, Zimbabwe

Mr. T. Scott	Professor, University of California, Riverside & Berkeley Currently working with the Biodiversity Programme in Namibia
Mr. P. Smit	Senior Lecturer Geo-Ecology, Dept of Geography and Environmental Studies, UNAM
Mr. Ben Strohbach	Researcher, National Botanical Research Institute