esd

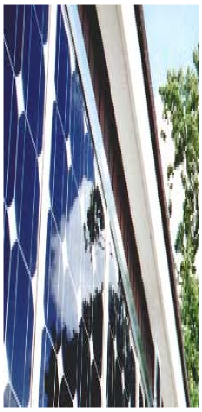
the Environmental Change Institute
CENTRE FOR RESEARCH, OUTREACH AND GRADUATE STUDIES IN ENVIRONMENTAL CHANGE AND MANAGEMENT

UNIVERSITY OF OXFORD

DFID

ANNEXES TO THE REPORT SUBMITTED TO DFID:

Energy planning in sub-Saharan Africa – facing the challenges of equitable access, secure supply and climate change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ANNEX I: METHODOLOGY FOR FOCUS GROUPS AND SEMI-STRUCTURED KEY INFORMANT INTERVIEWS

INTRODUCTION

Interviews can provide rich sources of data on people's experiences, aspirations, opinions and feelings and come in many forms, ranging from highly structured to completely unstructured (Kitchin & Tate, 2000). Both focus groups and individual semi-structured key informant interviews are a form of interviewing and are hence considered as qualitative techniques[1] (Kitchin & Tate, 2000). However, semi-structured interviews can also be used to generate quantitative data (Borrini-Feyeraband, 1997). On the other hand, questionnaire surveys generate and analyse data on a specific subject from a particular sample population. Generally, surveys use questionnaires to generate quantitative data from which they can calculate statistical information (Kitchin & Tate, 2000).

Several published research articles use focus groups combined with other methods such as in-depth, individual interviews or surveys (Morgan, 1996). Reasons for combining individual and group interviews usually stem from the greater depth of the former and greater breath of the latter (Crabtree et al., 1993). Using both individual and group interviews can optimise the strengths of both. Two ways of combining:

- Individual interviews first followed by focus groups: e.g. after individual interviews use focus groups to check conclusions drawn from analyses and increase the study population included in the research (Morgan, 1996). Advantage: obtaining reactions from wide range of participants in a relatively short time (Morgan, 1996);

- Focus groups first followed by individual interviews: e.g. use of follow-up interviews with individual participants after group discussion to explore specific experiences and opinions in more depth. Advantage: identify a wide range of perspectives and then draw from that pool to add more depth where required (Morgan, 1996).

For the purposes of this study, we propose to use route of "b", i.e. focus groups followed by individual semi-structured key informant interviews in a flexible manner in each of the case study areas: Kenya, South Africa and SADC; that is to say that in some cases interviews will need to be undertaken in advance of focus groups for reasons of pragmatism, given the time available.

Section II presents an overview of the methodology to be used for the focus groups and individual (semi-structured) key informant interviews respectively[2], followed by a set of instructions to follow in section III.

OVERVIEW OF METHODOLOGY TO BE USED

Introduction Letter

An introduction letter will be sent out to known key informants, with a threefold objective:

(1) to introduce the study;

[1] Qualitative data are generally unstructured and consist of words, pictures and sounds. Contrastingly, quantitative data are usually structured and the data consists of numbers of empirical facts that can be easily 'quantified' and analysed using numeric (statistical) techniques (Kitchin & Tate, 2000).
[2] More detailed information on each is presented in the Appendices, section V.

(2) to collect information on their availability to attend FGs and/or semi-structured key informant interviews;
(3) to collect information (name, organisation and contact details) of other potential participants.

Focus Groups

Focus Group size: 8-12 people
Number of groups: 6

Composed of the following:

KENYA and SOUTH AFRICA		SADC
01.	**Energy policy makers**, planners, and regulators – participants could also be drawn from ministries of planning, water, health, agriculture, education and transport	1. Policy perspective
02.	**Energy Suppliers** – Petroleum association, utilities, RETs suppliers, Biomass suppliers, local authorities, etc	2. Energy suppliers
03.	**Climate Change Policy Makers** and **Stakeholders** – Ministry of environment, NGOs and private sector	
04.	**Donors** and **development partner groups**	
05.	**Energy users** – eg associations of Manufacturers, agro-industry reps etc	3. Private sector perspective
06.	**Academics, Research** and **Advocacy** Organisations including NGOs	

Sampling: use of key informants. Identify info-rich participants (Krueger & Casey, 2000).

Kick-off meeting, following the same format for each of the case studies, with all key informants and stake-holders (if possible have somebody from DFID local offices in attendance). This meeting will serve as an introduction to the study and the floor will be opened for questions etc. Following this, one or two FG's could be undertaken the same day; An introduction page (for participants), instructions and a questioning route template (for interviewers) will be available and should be followed as carefully as possible by the leader of the FG to ensure consistency between groups and case study countries/regions.

At the end of the FG sessions, there will be an overall round-up discussion, highlighting key questions and issues. In addition, the FGs will be used to identify potential key informants for the SSKIIs. The FGs will be followed by SSKIIs.

Semi Structured Key Informant Interviews (SSKIIs)

SSKIIs target numbers: 15-20 per case study country/region. These SSKIIs interviews will include both closed quantitative and open-ended qualitative questions. Specific experiences and questions per SSKII can and should be explored by the interviewer. 2 people will be selected from each FG except for FG 1 where we will have more people. Sampling of key informants (see below).

An introduction page (for participants), instructions and a questioning route template (for interviewers) will be available and should be followed as carefully as possible to ensure consistency between groups and case study countries/regions.

Criteria for sampling (both FG and SSKIIs)

Identify info-rich participants (Krueger & Casey, 2000). The main criteria should be expertise, direct relevance, and seniority of people, i.e. people that hold positions of influence and have extensive knowledge. Note: It will be possible to perform SSKIIs with people that could not attend FGs. Criteria proposed:

Policy Makers:

- People directly involved in policy making on energy and climate;
- People who have been in the sector/area for a number of years, i.e. with extensive experience;
- Senior/high ranking people.
- Donors:
- Identify the most important donors in this area with respect to the scope of the study. However as few donors are active in energy in general, it may be appropriate to invite all major donors;
- As with the policy makers, select people who are directly involved in energy, infrastructure and climate sectors (if they exist) and that hold senior positions.
- Regulators: idem as policy makers;
- Civil society, NGOs and CBOs:
- Select the most important stakeholders in each of them;
- Ensure key issues such as gender are represented;
- Idem as policy makers.
- Private sector: idem as donors;
- Research Institutes and academics: Idem as donors.

Recommended Approach

Given the research context and aims, it is appropriate and advisable to use qualitative techniques, i.e. a combination of focus groups and individual semi-structured key informant interviews. Given the pilot study nature of this research and the broad ranging context, we advise that at this stage it is not desirable / useful to use questionnaire surveys to generate quantitative data.

Focus groups should be conducted with a range of stakeholders as suggested above. It would be preferable to undertake several FGs for each identified group of stakeholders – double layer multi category design (see table 1). However a decision needs to be made regarding the total number of FGs that can be undertaken within the time available.

The Introduction letter is to be sent out by the end of November or the first week of December.

It is suggested that FG groups will be run first, followed by the individual semi-structured key informant interviews. However, depending on the availability of key informants, some flexibility will be required on the proposed sequence. It may be envisaged that in some cases FGs will run back to back with SSKIIs. Furthermore, given the nature of regional cooperation, it is anticipated that fewer FGs will be possible for the SADC case study, most likely resulting in a stronger focus on SSKIIs and an increased need for flexibility for this particular case study. Moreover, it is strongly advised in the literature to undertake a pilot FG and SSKIIs before starting data collection proper, in order to iron out any difficulties that may be encountered in the larger study. To validate interview approaches, reinforce the consistency of the process and ensure there is no bias, DFID has requested that initial interviews and focus groups are recorded with recordings being circulated amongst all project partners for comment.

Note the importance DFID has placed on having a clear trace for information gained during data gathering in the case studies.

Instructions

Focus Groups Instructions:

Before Group Interview:

- Set the meeting dates, times and location;
- Make personal contact with potential participants;
- Send a personalised follow-up letter;
- Make a reminder phone call;
- Care to be taken that findings are not skewed by those who agree to attend the focus group having a certain interest in the topic (Bedford & Burgess, 2001);
- Drop out rates are a very important consideration in recruiting focus groups (Bedford & Burgess, 2001);
- Suggestion to recruit between 2-4 more members than you would ideally like (Bedford & Burgess, 2001).

During Group Interview (Bedford & Burgess, 2001):

- Offer group members some form of refreshment upon arrival;
- Provide members with a badge;
- Give a brief list of the ground rules of the group;
- Record initial focus groups[3]
- Important to make clear that no one's real name will be attached to specific quotes in analysis and writing through the FG;
- Members are asked not to make notes during the discussion;
- Group members should be asked not to talk over people and allow everybody to express their opinions;
- Imperative to introduce the rules in a chatty and relaxed way;
- FG should always start and end on time.

After FG discussion:

- Debriefing: discuss and record thoughts on group dynamics, problems encountered, topics covered, etc. (Bedford & Burgess, 2001);
- Write-up and analyse. Note that DFID has requested that we do not record and transcribe in general, although requests that initial FGs be recorded 3; hence briefs notes will have to be made during the FGs and completed soon afterwards. DFID has stressed the need to have a clear trace for all information gained during data gathering. Notes from FGs will be included as appendices to the report.

Semi Structured Key Informant Interviews Instructions

[3] Note that DFID has requested recording initial focus groups and SSKIIs, and share recordings amongst project partners, in order to validate interview approaches, reinforce the consistency of the process and ensure there is no bias.

Before Interview:

- Set the meeting dates, times and location;
- Make a reminder phone call.

During interview:

- Greet your informant in a culturally appropriate way;
- Jokes and friendly gestures can help break the ice;
- Start by introducing the subject and interview based on the introduction page;
- Assure that the person(s) being interviewed understands and trusts that the responses will be confidential; (note that DFID has requested for initial SSKIIs to be recorded 3 in these cases interviewees should be told that recordings are for quality assurance purposes only and will not be circulated outside the project)
- Ensure that you are familiar with the category coding system (see below);
- Record only brief notes during the interview.
- Remember phrases that the respondent uses and use them for your questions. Instruct you translator to do this too;
- Follow the flow of the discussion;
- Ask probing questions;
- Write answers down on each questioning sheet (i.e. paper copy);
- Take adequate notes, yet remain in eye contact with the interviewee, i.e. be engaged and listen actively, do not only look at your interview guide;
- Avoid passing opinions or judgements, treat the respondent as an equal;
- If you use shorthand, make sure that you have decided these beforehand and have noted them down on a separate page;
- Thank the respondent at the end and leave time for questions.

After Interview:

- Immediately after the interview elaborate on notes;
- then put notes into word document template (i.e. electronic copy);
- In the unfortunate case that certain sections or questions were not answered (e.g. forgotten) and this is realised when inserting the data into the word template, contact the interviewee, explain the situation and ask that particular question over the phone;
- Analyse the information at the end of each day of interviewing;
- If time and resources permit, send the electronic version back to the interviewee for him/her to check and/or comment on;
- Finalise the electronic document in flowing format: name of interviewee _date_city_country (e.g. danaemaniatis_05december2006_Oxford_England);
- Discuss the overall results of the analysis with e.g. community members, so that they can challenge the perceptions of the interview team;
- Write-up and analyse. Note that DFID has requested that we do not record and transcribe in general, although note footnote 3; hence briefs notes will have to be made during the interview and completed soon afterwards. DFID has stressed the need to have a clear trace for all information gained during data gathering. Notes from interviews will be included as appendices to the report.

Category Coding

Each category has been assigned a code:

01 Energy Policy Makers, Planners and Regulators
02 Energy Suppliers
03 Climate Change Policy Makers

04 Donors
05 Energy Users
06 Academics, Research and Advocacy Organisations
.

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Wilde, V. (2001) Field Level Handbook SEAGA
http://www.fao.org/sd/seaga/downloads/En/FieldEn.pdf

ANNEX II: QUESTIONING ROUTE FOR FOCUS GROUPS AND SEMI-STRUCTURED KEY INFORMANT INTERVIEWS

Introductory Questions

(Introduction to scoping study, welcome etc.): No leading introductory comments about this being for climate change, energy access and energy security of supply.

Warm up questions:

- What is your designation and organisational affiliation
- What is your current role in the energy planning process?
- Do you have any questions on the purpose of this exercise?

Main questions:

- How important is energy planning for your country/region?
    - Insignificant; Moderately Important; Very Important

- What is the current medium to long-term energy planning process in action in your country/region?

- Could you elaborate on this energy planning process?

  Sub questions:

    - Do you think this is fit for purpose? Do you think it achieves its internal objectives?
    - Do you think it achieves what it should do for the country?
    - If not, why? What are the main failings?

- Currently, who are the most influential players in the energy planning process?

  Sub questions:

    - Are they the most appropriate players (i.e. in the interviewees opinion are these the sort of people/organisations who should have influence over the planning process); are they capable of influencing energy planning? Do they have sufficient capacity to fulfil their role and/or mandate?
    - Who is important to the medium to long term energy planning process but is not currently actively involved?
    - Are there any particular reasons why these players are not involved?
    - Who is currently involved but should not be involved in the way that they are?

- What do you consider to be the main drivers for medium to long term energy planning? (Open question. Let the interviewee formulate her/his own answer to this question, which is the key question for the entire interview:)

[Ask questions 4 – 6 if not covered in 3]

- How important is energy security of supply for your country/region? Insignificant; Moderately Important; Very Important

Sub questions:

- What do you understand by the term "energy security" [could prompt with: balance of payments, keeping lights on, industrial competitiveness, national security etc]
- Why/how is energy security important for your country/region?
- Is its importance increasing/decreasing? How important is it compared with 5-10 years ago? Why?
- Does energy policy and planning adequately cover energy security of supply at present?

• How important is energy access for your country/region? Insignificant; Moderately Important; Very Important

Sub questions:

- What do you understand by the term "energy access"
- Why/how is energy access important for your country/region?
- Is its importance increasing/decreasing? How important is it compared with 5-10 years ago? Why?
- Does energy policy and planning adequately cover energy access at present?

• How important is climate change in medium to long term energy planning for your country/region? Insignificant; Moderately Important; Very Important

Sub questions:

- What do you understand by the term "climate change"
- Why/how is climate change important for your country/region?
- Is its importance increasing/decreasing? How important is it compared with 5-10 years ago? Why?

• Is climate change mitigation/adaptation a priority for your country/sub-region?
• Are the future impacts of climate change on energy infrastructure and resources considered in energy planning? If not, should they be?

- Does energy policy and planning adequately cover climate change at present?

• Of the three drivers (put prompt here of energy access, security of supply & climate change and any other stated by interviewee as important), please rank these in order of highest to lowest priority.

Sub questions:

- Please explain your choices

• Do you think there is tension between the drivers you have described? Yes/No
• Do you think there is complementarity between the drivers you have described? Yes/No

Sub questions:

- If there is tension and/or complimentarity, explain where and why you see this occurring (What are the trade-offs?, What are the synergies?)
- Are there any win-win-win opportunities not currently recognised/fully exploited, or are such opportunities exaggerated?

- Do you believe there is tension between short-term and long-term energy planning and policy in your country/(region for SADC interviewees)? Yes, No

  Sub questions:

  - If there is tension, what takes priority (short or long term) and why?

Future needs for support

- Do you think there is need for external support to assist the medium to long term energy planning process in your country/(region - for SADC interviewees)?

- If you think there is need for external support to assist the planning and policy process, what kind of support do you think is needed?

  Sub questions:

  - What kind of support (open ended)?
  - Do you think technical assistance is needed?
  - Do you see the need for energy policy research and if so, what kind and in what areas? [could prompt with: research of general relevance vs specific, applied research for your country/region eg scenario planning?]
  - If you think there is a research requirement, which research forum, public/private institutions, etc. are most important to promote medium to long term energy policy and planning research?
  - Are there existing research efforts which might be built upon?

Wrap-up

- Any further points you wish to raise?

ANNEX III: SURVEY INSTRUMENT - FOCUS GROUP STRUCTURE

[Note that some of the follow-up questions from the SSKIIs may be used as appropriate]

Introduction (15 mins)
- Re-cap over objectives of project, the purpose of holding today's FG and the question structure / areas which will be explored during the course of the session
- Energy Planning Process and Stakeholders
- Assessment of where FG participants sit in the policy map, what their power and influence is, what their relationships are to other stakeholders.
- Who do participants think are the key players in the energy sector at the moment and why?

Main drivers (45 mins)
- This is the main section and should focus on stakeholders' attitudes to, and priorities for energy planning.
- Open discussion around the status of medium to long-term energy planning process in host country / region;
- Open discussion about the main drivers for energy policy and planning.
- Prompts around the three drivers of climate, access and security. How important does the group think each of the drivers are? How do they think they are currently included in existing plans/policies?
- Ranking of drivers (potentially depending on discussion, possibly using: Insignificant; Moderately Important; Very Important as pointers)
- How has the relative importance of the drivers changed over the past 5-10 years (if at all) and why?

Tea (15 mins)
- Challenges in energy planning (45 mins)
- Areas where drivers may complement each other and generate synergies
- Tensions between the drivers
- Areas where participants think trade-offs will occur and how the trade-offs may be managed

Research and support needs (30 mins)
- Assess whether participants think that external support is needed for medium to long-term energy planning.
- If support is needed, what format should it take and where should it be concentrated?

ANNEX IV: INTRODUCTORY LETTER FOR FOCUS GROUP PARTICIPANTS

To whom it may concern:

I am writing to you to seek your expert input and advice as input to a research study on energy planning, commissioned by the United Kingdom's Department for International Development (DFID).

Led by Energy for Sustainable Development Ltd, a team comprised of Oxford University's Environmental Change Institute, ESD Kenya, the Centre for Environment, Energy and Engineering Zambia and Palmer Development Group, South Africa are undertaking a research scoping study for DFID. The aim of the study is to identify areas relating to medium and long term energy planning energy which might benefit from further research. As part of this study the team are seeking to identify priorities and attitudes to energy planning amongst stakeholders in three case study areas: South Africa, Kenya and the SADC region.

Three main areas of energy policy and planning have assumed major importance over the past several years: energy access, energy security of supply, and energy and climate change. These form important drivers for energy strategy, policy and planning throughout the world. They assume even more importance in Africa and the rest of the developing world as the challenges of globalisation, energy market liberalisation, increased international demand for scarce energy resources, escalating energy prices, and the focus on climate change assume ever more importance.

Yet, given these challenges, and the urgent need to address them as a whole, there is little coherence in thinking between those responsible for developing and implementing these major policy strands. Bringing these together into a coherent framework, identifying areas of conflict where trade-offs exist, as well as areas where win-win opportunities are present, would help address key elements of development policy – achieving equity and equitable development, promoting sustainable development within the framework of long-term reliability and security of energy supplies, and reducing significantly the effects of climate change, where appropriate given the principle of common but differentiated responsibility.

The project is examining medium to long term energy planning with regards to energy policy drivers of energy security, energy access and climate change. The main part of the research aims to investigate priorities and attitudes to medium to long term energy planning in Kenya, South Africa and the SADC region to understand, inter alias, how important each of the drivers are to stakeholders in the energy sector and how they are incorporated into existing energy plans. The research aims to investigate both technical and institutional issues influencing energy planning, by highlighting areas of synergy and conflict. The project is designed to give DFID a greater understanding of energy planning in sub-Saharan Africa and is a precursor to a possible larger research programme on energy planning for developing countries. The outputs of the study will be as follows:

Priorities and attitudes of stakeholders in case study areas to medium to long term energy planning;

- facing the challenges of energy and poverty alleviation, energy security, and energy and climate change.
- Identification of knowledge gaps in current energy planning research.
- Obstacles to medium/long term energy planning and ways in which research can help to overcome these obstacles.
- Identifying suitable research entry points for future studies.

Understanding and documenting the attitudes and priorities of a variety of participants within the energy sector is key to the project meeting its aims. In addition it is a requirement of the project sponsor that the interview process be as rigorous and as objective as possible. We will be using a combination of focus groups and key informant interviews with stakeholders in the following sectors:

01 Energy Policy Makers, Planners and Regulators
02 Energy Suppliers
03 Climate Change Policy Makers
04 Donors
05 Energy Users
06 Academics, Research and Advocacy Organisations

Focus groups and key informant interviews will take place over the next two months. We would like to invite you to participate in this process, and would be delighted if you would agree to attend a focus group on xxxx. We would also like to request your assistance in identifying key players in each of the categories above, whose attitudes and priorities are important to include in any study seeking to examine medium to long term energy planning.

We would be extremely grateful if you would indicate your availability to attend a focus group on the date given above and complete the attached short questionnaire in advance, returning it to the address given below. The data collected from the questionnaire will be aggregated and used to produce an objective list of key informants in each of the above sectors who we will contact for interview.

We thank you in advance for taking time to complete the attached questionnaire and for sharing your opinions on key stakeholders with us. We look forward to receiving your reply, and hope you will be able to contribute to our study.

Yours faithfully,

Request for information – Interview Participants

Case Study area: South Africa / Kenya / SADC

For each group of stakeholders involved with or influencing energy planning and policy please suggest who, in your opinion, are the key players in each sector, whose attitudes and priorities towards medium to long term energy planning in South Africa / Kenya / SADC need to be understood to identify the challenges and trade-offs for future energy planning research. For each suggestion please provide a name, organisation and contact telephone/e-mail address. Information provided will be used purely for the purposes of this DFID study and will not be passed on to any other organisations.

In your opinion who are the key stakeholders in the energy policy and planning sector, regulators and users in South Africa / Kenya / SADC?

____

____

In your opinion who are the key stakeholders from the energy supply, energy utility and fuel supply (including liquid fuels and biomass) sectors in South Africa / Kenya / SADC?

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____

In your opinion who are the key stakeholders from donor groups in South Africa / Kenya / SADC?

____

____

In your opinion who are the key stakeholders from the private sector (national or international) operating in South Africa / Kenya / SADC?

____

____

In your opinion who are the key stakeholders from the climate change sector in South Africa / Kenya / SADC?

____

____

In your opinion who are the key stakeholders from academic institutions and NGO's in South Africa / Kenya / SADC?

____

____

ANNEX V: ENERGY ACCESS LITERATURE REVIEW

Policy Background

Lack of access to affordable, reliable and appropriate energy services is a major barrier to development in many developing countries. 1.6 billion people are believed to have no access to electricity; 526 million of those are in sub-Saharan Africa (IEA 2004). There are just 32 gigawatts (GW) of installed generation capacity in SSA (excluding South Africa) for a population of 680 million. By comparison, Latin America, with 533 million people, has installed capacity of 200 GW (World Bank 2006). 579 million Africans still rely primarily on traditional biomass sources for their cooking needs (IEA 2006).

Following the signing of the Millennium Declaration in 2000 there has been increasing recognition by the multilateral organisations that energy provision is a critical component of the development process. This position was first articulated at the Commission on Sustainable Development 9th session (CSD-9) (Commission on Sustainable Development: Report on the ninth session 2001) that concluded that:

- "in order to halve the proportion of people living on less than one dollar per day by 2015, access to affordable energy services is a prerequisite."

These statements were followed by key calls for action at the World Summit on Sustainable Development in Johannesburg (WSSD 2002) – amongst other things, specifically to:

- "Improve access to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services."

- "Recognise that energy services have positive impacts on poverty eradication and the improvement of standards of living."

The World Bank has highlighted the importance of increasing energy consumption in the achievement of the Millennium Development Goals (World Bank 2006). In the Investment Framework for Clean Energy and Development, the Bank states that:

- "Although energy is not explicitly mentioned in the Millennium Declaration, the MDGs cannot be met without higher quality and larger quantities of energy services than currently available."

It is readily accepted by the development community that access to energy is a critical factor in achieving the Millennium Development Goals. However, energy access is currently not rising fast enough to meet the MDGs. For instance, World Bank data (World Bank 2006) indicates that growth in electricity access in Africa at 1% per annum is currently falling behind growth in households at 1.9% per annum. It is also being hindered by the poor state of infrastructure, high oil prices and recent reductions in output from hydro-generation. Some are calling it an "energy crisis".

Within Africa, the importance of energy is also understood. Nepad has included energy as one if its priority areas (NEPAD (NEPAD 2007) stating that:

- "Energy plays a critical role in the development process, first as a domestic necessity but also as a factor of production whose cost directly affects prices of other goods and services, and the competitiveness of enterprises."

Energy provision is also increasingly prominent in African Poverty Reduction Strategy Papers (PRSPs). Research undertaken by the UNDP has indicated that over half of African PRSPs recognise the importance of energy in alleviating poverty. Almost all make the link between energy and macro-economic development. Energy is increasingly being recognised in African national MDG reporting – although there is still some way to go before coverage is sufficiently complete. A study by UNDP (Takada, Fracchia 2007)found that15 out of 37 national MDG reports reviewed made a moderate to significant link between energy and MDG fulfilment.

Energy access must be carefully defined. Energy services are required both for economic growth and direct poverty reduction. One measure of energy poverty at the level of the poorest is the inability to cook with modern cooking fuels and the lack of a bare minimum of electric lighting to read, or for other household and productive activities after sunset. Some have suggested that these minimum needs correspond to about 50 kilograms of oil equivalent (kgoe) of annual commercial energy per capita; this estimate is based on the need for approximately 40 kgoe per capita for cooking and 10 kgoe used as fuel for electricity (Modi and McDade et al. 2006). This represents just the most basic household energy needs.

However, access requires more than the connection of a community to an electricity grid or ensuring that an LPG distribution network exists. Energy must also be affordable to the consumer and adequate in supply (i.e. sufficiently reliable to encourage a switch to a new fuel source). It is also important that there is effective provision of energy service appliances to allow poor households to benefit from improved access; improved cook-stoves for example are important example for Africa, where biomass is burned on inefficient, smoky stoves, causing significant health problems and death, especially for women and children (see below).

It is also argued that choice is critical in improving well-being. Making available a number of forms of energy and allowing the individual to choose, depending on their needs and economic means is of primary importance. The decision as to whether an individual chooses, for instance, a large number of electrical appliances is of less importance than the fact the individual has the opportunity to do so (Pachauri and Mueller et al. 2004).

Also, the poor commonly spend a greater proportion of their income on energy despite having access to relatively few energy services (Department for International Development 2002). This is due to the inefficient forms of energy and appliances to which they have access – such as traditional biomass for cooking, candles and batteries for flashlights.

Basic energy access is also of importance in a number of sectors namely household, local social services such as schools and health centres, agriculture and light industry as well as transport. The World Bank, in its Action Plan for Energy Access (World Bank 2006), identified five key parallel tracks to ensure energy access:

- Access to clean cooking, heating and lighting fuels, coupled with sustainable forest management.
- Scaled up programs of electrification.
- Additional generation capacity to serve newly connected households and enterprises, including through regional projects.
- Provision of energy services for key public facilities such as schools and clinics.
- Provision of stand-alone lighting packages for households without access to the electricity grid.

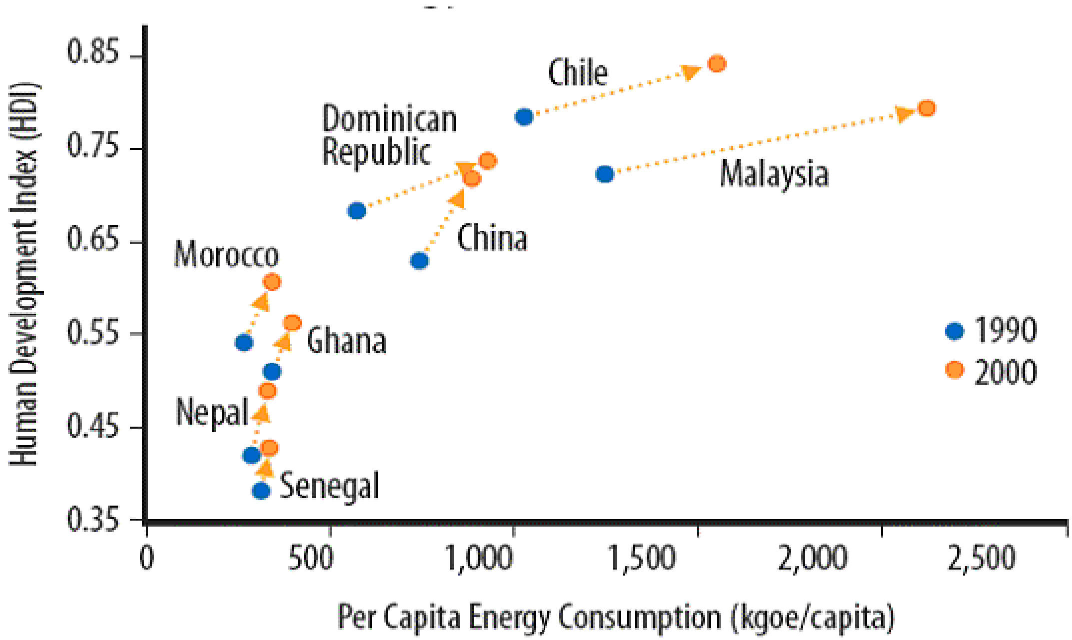
The Relationship between Energy Use and Economic Growth

The empirical analyses of the links between energy and development can best be described as inconclusive (Chen and Kuo et al. 2007). Econometric analysis of the relationship between energy and economic growth in the developing world has been demonstrated to be:

- A causal relationship running from economic growth to greater energy use (Ghosh 2002)
- A causal relationship running from greater energy use to economic growth (Shiu and Lam 2004)
- A bidirectional relationship running between the two variables (Yoo 2005)
- No relationship whatsoever in some cases (Wolde-Rufael 2005)

There are a variety of reasons cited for this inconclusiveness – including different methodological approaches, different data selections and actual differences between cases. Importantly, many studies focused on a relationship between electricity usage and economic growth rather than a broader measure of increased energy use. This approach is likely to ignore some of the complexity in fuel switching as societies evolve from a reliance on traditional biomass to a mix of modern fuel sources. Also, the econometric attempts to isolate a link between energy and development have, by definition, focused solely on growth in national income as a measure of development – a narrow definition deemed insufficient by the development community (e.g. the inclusion of longevity and education in the human development index). A clear relationship (albeit without giving an indication of causality) has been demonstrated between the human development indicator and per capita energy consumption (Figure 1).

Figure 1: The Relationship between Human Development Index and Per Capita Energy Consumption. Source: (UNDP 2005)



It is reasonable to summarize that a link between energy use and development exists - and that there have been no examples in history where development has not been accompanied by increasing levels of modern energy use - but is difficult to isolate in quantitative terms – the literature is contradictory and also limited (Toman and Jemelkova 2003).

Energy and the Millennium Development Goals

Despite the difficulties in inferring causality between energy access and economic development at the macro level recent research has added significantly to the knowledge base with a focus on the linkage between energy access and specific MDGs (e.g. (Department for International Development 2002). Work done by UNDP has provided a thorough breakdown of the kind of linkages between energy services and achievement of the MDGs (UNDP 2005).

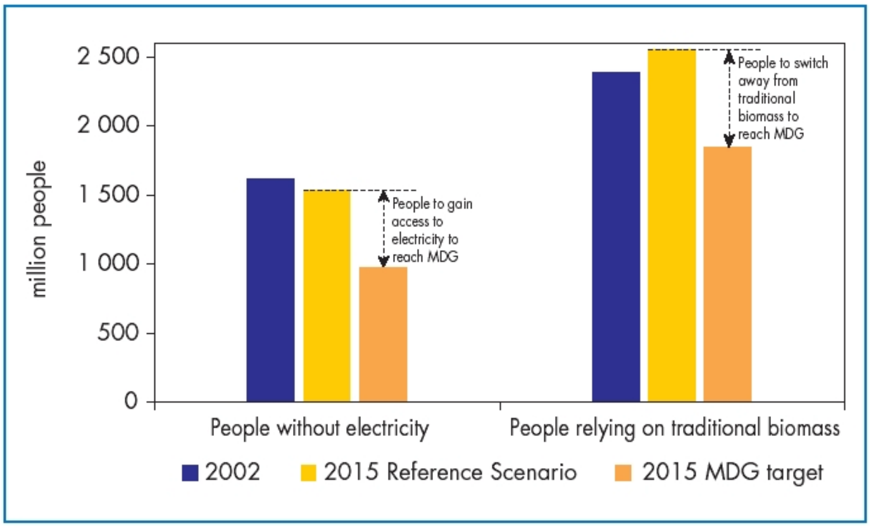
MDG 1:	**Eradicate Extreme Poverty and Hunger**
Modern energy services help drive economic growth by improving productivity and enabling local income generation through improved agricultural development and non-farm employment. When they are available to all incomes groups, modern energy services are also an invaluable means of improving social equality. Productive uses of energy are particularly important to economic growth. Modern fuels and electricity, for example, help boost household income by providing lighting that extends livelihood activities beyond daylight hours. They power machines that generate valuable timesavings and increase output and value added. By providing additional opportunities for employment, energy services also enable farmers to diversify their income sources, and thus mitigate against the inherent risks associated with agriculture-dependent livelihoods.	
MDGs 2 & 3:	**Achieve Universal Primary Education and Promote Gender Equality and Empower Women**
Access to modern energy services can play a critical role in improving educational opportunities for children. Electricity for lighting, for example, allows children to study at night, increases security, and enables the use of diverse educational media both at school and at home, including information and communication technologies. It also helps attract teachers to remote communities by increasing the standard of living in rural areas. The disproportionate amounts of time and effort women and young girls spend on basic subsistence activities like agro-processing, cooking, and collecting fuel wood and water has profound implications for gender equality. The responsibility of girls to assist their mothers with domestic chores is often one of the most important reasons—along with inadequate income—that young girls do not regularly attend school. Lack of schooling among girls in turn results in lifelong harm to the literacy and economic opportunities of adult women. Mechanical power, for example, can reduce the drudgery of hours of food grinding and threshing, thereby freeing young girls to pursue more regular schooling. The same is true for cooking fuels. Access to modern fuels like kerosene, biogas, and LPG help dramatically reduce the time and effort women and young girls devote to collecting dung, fuel wood, and agricultural wastes. Water pumping is another potential source of time savings for women and young girls. The combined amount of time and effort these services can save women—upwards of 6 hours in some countries—underscores the critical role that modern energy services have in reducing the gender bias of energy poverty.	

MDGs 4, 5 & 6:	Reduce Child Mortality, Improve Maternal Health, and Combat HIV/AIDS, Malaria and other Diseases
This availability of adequate clean energy is particularly important in reducing child mortality. Modern fuels and electricity help reduce malnutrition, related mortality by boosting food production and household incomes. They also help reduce the incidence of waterborne diseases by powering equipment for pumping, boiling, and treating water. Replacing traditional stoves that burn wood and dung with more modern appliances that burn kerosene, LPG, or modern biomass fuels further reduces the risk of child mortality by reducing harmful indoor air smoke and the risk of respiratory disease. Access to modern energy services is critical for keeping the food, water, and air that children consume both safe and in adequate supply. Modern sources of energy are also a key component of a functioning health care system; thus they contribute to improving maternal and child health and reducing the incidence of HIV/AIDS, malaria, and other major diseases. Electricity, for example, enables health clinics to refrigerate vaccines, operate and sterilize medical equipment, and provide lighting so that clinical services can be provided after sunset. It allows the use of modern tools of mass communication needed to fight the spread of HIV/AIDS and other preventable diseases. Access to electricity also helps attract and retain health and social workers, especially when it provides lighting in their accommodations	
MDG 7:	**Ensure Environmental Sustainability**
Although energy's potential for catalysing growth and development is unquestionable, current patterns of energy production and consumption are threatening the environment on both local and global scales. Emissions from the burning of fossil fuels are major contributors of urban air pollution, acidification of land and water, and the unpredictable effects of climate change. The use of fuel wood and charcoal can be unsustainable when it leads to land degradation from fuel wood gathering and to indoor air pollution from biomass combustion. The earth's environment is intrinsically linked to how energy is supplied and consumed.	
MDG 8:	**Develop a Global Partnership for Development**
Partnerships are particularly important in helping countries mainstream energy into broader development strategies and frameworks. Energy is a crosscutting issue by its very nature and thus requires participation from all development sectors in order to maximize its impact on development. To ensure that the poor benefit fully from greater access to energy, energy planning should be linked to development goals and priorities in other sectors.	

Source: UN Millennium Project 2005

The IEA has undertaken some analysis to evaluate the possible gap between energy needs in the developing world under their reference scenario (i.e. no explicit policies to influence delivery of the MDGs). Their results are shown graphically below (Figure 2) and illustrate the scale of the task to be undertaken.

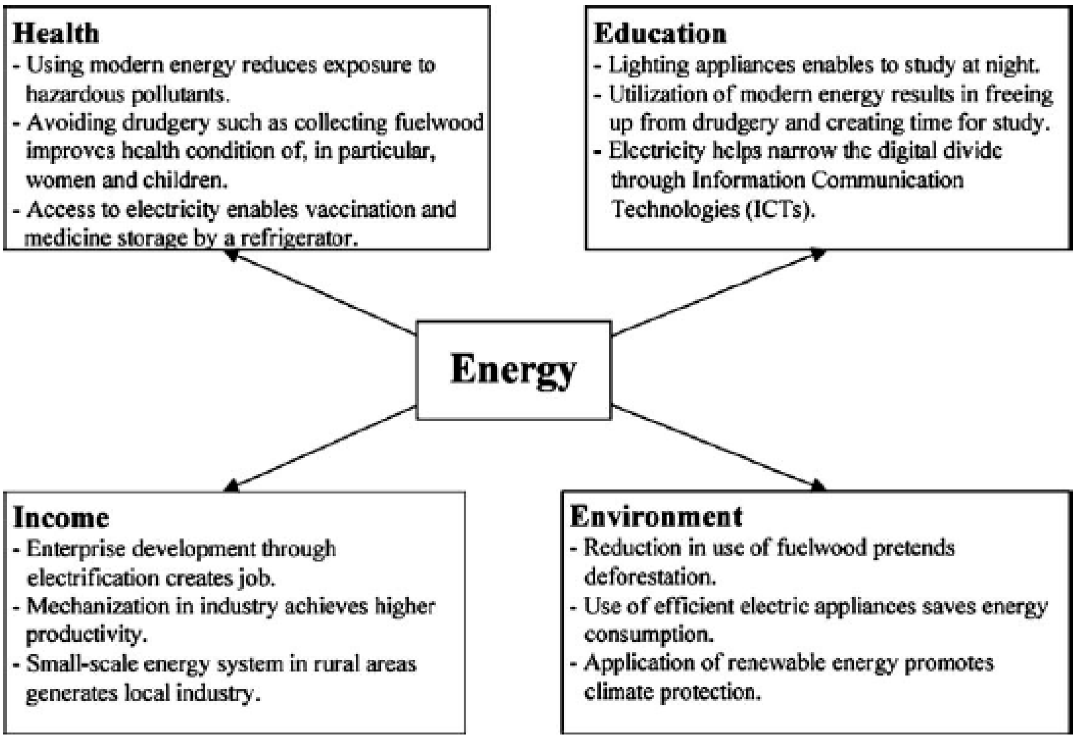
Figure 2: Analysis to evaluate the possible gap between energy needs in the developing world under their reference scenario



Source: (International Energy Agency 2004)

An increasing number of academic studies are beginning to reinforce these policy perspectives. Kanagawa and Tanaka (2006) have illustrated the dimensions on which energy access can influence broader development objectives.

Figure 3: dimensions on which energy access can influence broader development objectives



Source: (Kanagawa and Nakata 2006)

Kanagawa and Nakata have also provided some quantitative evidence of the link between improved cook stoves and health (Kanagawa, Nakata). Smith et al have provided a detailed analysis of the indoor health effects of traditional biomass use for cooking (Smith, Mehta et al. 2003).

The nature of the indoor health effects of cook stove use are complex Ezzati and Kammen have identified a number of areas where research needs to be strengthened that, unless they are explicitly related to and calibrated against local parameters, are likely to overlook important information about exposure and benefits of interventions (Ezzati and Kammen 2002). In broad terms, answers to five research questions are needed for understanding the health effects of exposure to indoor smoke so that appropriate interventions and policies can be designed and implemented:

- What factors determine human exposure, and what are the relative contributions of each factor to personal exposure? These factors include energy technology (stove–fuel combination), housing characteristics (e.g. the size of the house and the material it is built from, the number of windows, and the arrangement of rooms), and behavioural factors (e.g., the amount of time spent indoors or near the cooking area).
- What is the quantitative relationship between exposure to IAP and the incidence of disease (i.e., the exposure–response relationship)?
- Which determinants of human exposure will be influenced, and to what extent, through any given intervention strategy?
- What are the impacts of any intervention on human exposure and on health outcomes, and how would these impacts persist or change over time?
- What are the broader environmental effects of any intervention, its costs, and the social and economic institutions and infrastructure required for its success?

Gender issues with respect to access to energy have been understood for some time (Cecelski 1987). They are now receiving more academic attention. However, there are many gaps in knowledge that require focus (Cecelski 2003):

- Data needs and analysis. Disaggregating energy use, supply, and impacts by gender to provide a better basis for applying well-known field methods and analytic tools for incorporating gender in project design and implementation, as well as at the micro- and macro-policy levels.
- Wood energy, cooking, and health. Seeking integrated approaches and various solutions (including fossil fuels and perhaps electric cooking) that recognize the importance of wood energy and cooking for poor women and its health implications.
- Women's specific electricity needs. Addressing water pumping, agricultural processing, security, work productivity, and health in the framework of sectoral development initiatives.
- Equal access to credit, extension, training. Assuring energy and electricity supplies for women's domestic tasks as well as their micro enterprise activities.

The productive application of delivered energy is receiving increasing attention – recognising the need to deliver income improvements to support a mainstreamed and sustainable energy market. Productive use of energy may be defined broadly to include health and education effects as well as effects that lessen some of the drudgery roles still undertaken by women and girls (Cabraal, Barnes et al. 2005).

Financial Considerations

Macro Scale: Investment Needs

The World Bank, through the creation of the Investment Framework for Clean Energy and Development, has done a detailed analysis of the financial gap in delivering energy access (World Bank 2006).

There is currently a large financing gap in the energy sector — about $80 billion per year for developing countries, or about 50 percent of the actual needs for electricity generation. It is estimated that developing countries need an annual investment for electricity supply of US$165 billion through to 2010, increasing at about 3 percent per annum through to 2030. Out of the US$165 billion, the investment needed for electricity access for the poor is in the order of approximately US$34 billion per annum. Of the US$165 billion investment needs, financing for half of this is readily identifiable. The under-investment in energy is estimated to reduce GDP growth in some countries by as much as 1 to 4 percent per annum, depending on the severity of the problem. The financial health of the energy sector is an important component of meeting the energy needs of poor people. And poor people without access to modern energy suffer from health effects of indoor air pollution; are constrained from engaging in productive activities; and suffer from poor health and education services.

The IEA has also done analyses of the energy investment needs up to 2030 at the regional level with the following results (International Energy Agency 2003):

- Developing countries energy sectors require investment of US$ 7.9 trillion between 2000 and 2030 of which:

    - Africa requires US$1.2 trillion (4% of GDP)
    - China requires US$2.2 trillion (2.5% of GDP)

Developing countries' electricity investment needs total US$71 billion per year. In 2000, US$30 billion was available from the private sector and only $1.3 billion of overseas development aid was avail able – which illustrates that ODA can play a catalytic role but is an order of magnitude lower than investment needs.)

Micro scale – economics of ability to pay

The issue of ability to pay for energy services is critical for mainstreaming and sustaining energy access to the poor. This is also highlighted in the World Bank Investment Framework for Clean Energy and Development (World Bank 2006):

- "Energy access programs need a pro-poor focus and need to be implemented in ways that do not discriminate against poor people. This approach requires good regulatory policies that protect poor people and promote access by poor people to electricity and other forms of modern energy. This includes design of pro-poor subsidy mechanisms. Subsidies should be transparent, linked to the delivery of services to poor people, and where-ever possible focus on demand-side, and provide strong cost-minimization incentives. Subsidy schemes should also be technology neutral to avoid biases against off-grid solutions or non-state providers. "
- Particular challenges can face the poor living in peri-urban slum communities (Modi, McDade et al. 2006). Many factors can hamper access to electricity services, such as lack of street addressing, lack of formal housing registration, and tariff structures and payment mechanisms that are not adapted to the customer base. A combination of these factors and other broader issues affecting the performance of the utilities (for example, theft of electricity, legal structures to enforce power purchase contracts, the institutional

structure of the utility itself, and the inability to enforce bill collection) can lead to lack of investment in electricity generation and distribution networks, or in development of fuel supply infrastructure, making it even more difficult to extend services to those not served.

The Energy Mix

The Emphasis on Electricity in Energy Planning for the Poor

Energy services in poor households tend to be concentrated on lighting and cooking (including water heating). Of these needs, cooking has been shown to account for as much as 90% of this total (Bhattacharyya 2006/4). Electricity is unlikely to gain a foothold as a form of energy for cooking for a number of reasons – capital costs of appliances, running costs in comparison to alternatives and reliability – for an energy service that is critical every day. Energy planning needs to give a broad consideration of the fuel types available – including liquid fuels and gas as well as traditional and modern forms of biomass.

It is also argued that the provision of access to electricity in rural areas can lead to increases in inequity as the non-poor benefit disproportionately from the energy services available with electricity (Cecelski 2003), (Foley 1990)

The Role of Renewables

Renewable energy projects are commonly framed as win-win opportunities from a sustainable energy development perspective (Cecelski 2003). However, the literature does not always back up this policy assertion. (Martinot, Chaurey et al. 2002) reviewed the available literature on the development value of renewables in developing countries. The results are mixed with some clear evidence for improved social welfare but less clear benefit in economic terms. Bhattacharyya has supported this view in the context of rural electrification in India. (Bhattacharyya 2006/12). Separation should be made between the use of renewables in electricity generation and the use of renewables in other forms such as biogas cook stoves, solar cook stoves and solar water heating. (Wentzel and Pouris 2006) and Bhattacharyya (Bhattacharyya 2006/12) (2006) identified degrees of success with using solar cook stoves (in South Africa and India respectively). It is also important not to consider all electricity generating renewables similarly. For instance, experience with micro-hydro has been, on the whole, successful. PV has often been less successful.(Wamukonya 2001). Further research on the appropriateness of renewables with a focus on specific technologies and use cases in providing energy access to the poor is necessary.

Bio fuels are receiving significant attention as an opportunity for developing countries to gain some energy independence as well as provide more sustainable long term solution for energy needs – particularly in the transportation sector. There is, as yet, little literature to provide support for the potential impacts of a significant land use switch to bio fuels. Research is required on the energy planning sustainability implications of switching from food production, the effects on water resources and the potential climate effects of land-use switching and feedback effects from climate change induced changes in rainfall patterns to water availability for irrigation of bio fuels and food crops.

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ANNEX VI: ENERGY SECURITY LITERATURE REVIEW – DEFINITIONS, CONTEXTS AND GAPS IN UNDERSTANDING

'Safety and certainty in oil' he said, 'lie in variety and variety alone'…

Winston Churchill, eve of World War I (Yergin, 2006)

Introduction

This paper examines the literature on one of the three key drivers of this report, energy security. The body of literature on this subject is vast, dealing with various aspects of the issue from different angles. Since Churchill's decision to shift the power source of the British navy from coal to oil, thereby relying on insecure supplies from what was then Persia, energy security has emerged repeatedly as an issue of great importance (Yergin, 2006). Energy security concerns previously reached their peak during the 1970s when the world economy struggled to overcome the damaging effects of the oil crises of 1973 - 74 and 1979 - 80 (Bielecki, 2002). Presently, energy security once again features as a top priority item on the agenda of many countries and international meetings. Dorian et al. (2006) go as far as to state that concern over energy security is so important that a sense of urgency or even panic exists in some countries leading to uneconomic or risky investments in an attempt to gain access to energy. The paradigm of energy security has been fluid, and is in need of some re-framing in order to develop a coherent agenda in the current context; this is especially the case for poorer, weaker developing countries which have been largely ignored in recent analyses in favour of those developing countries with globally significant demands for fossil fuels, notably China and India. Oil importing African countries represent features of the energy security debate not generally analysed given their particular vulnerability to increases in global fossil fuel prices, and their relative lack of power in the fight for resources generally.

This study concerns medium to long term energy planning and hence does not specifically include within its scope issues of short-run energy insecurity (due to short term price shocks, or interruptions in supply). However as improved medium to long term planning aims to reduce vulnerability to such short-run insecurities, the paper addresses the temporal dimension of the issue.

The paper is divided into four sections; and examines differing definitions of energy security; energy security in today's environment; the energy security debate in the context of developing countries; and finally suggests gaps which exist in the current literature. The focus is on reviewing energy security literature in general, with an outline of some of the issues which may need to be considered from a developing country perspective.

Definitions

The economies of all countries, particularly those of developed countries, are dependent on secure supplies of energy. Moreover, successfully providing adequate and affordable energy is essential for eradicating poverty, improving human welfare, and raising living standards worldwide (Asif & Muneer, 2007). However, across the globe, governments define energy security differently and the means by which they look to enhance their own security varies even more widely (Dorian et al., 2006).

Most definitions share certain key words, including: 'reliable', 'adequate supply of energy' and 'reasonable prices'. For example Bauen, 2006 and Bielecki, 2002 use "a reliable and adequate supply of energy at reasonable prices" as a definition. Such conditions need to prevail over the long-term if energy is to contribute to sustainable development (Asif & Muneer, 2007). The issue of stable energy prices is also important in some definitions, high volatility resulting in extra costs overall. It is worthwhile considering each of the key words in some more depth. A 'reliable and adequate supply of energy' is straightforward, implying an uninterrupted supply that fully meets the needs of the global (or national) economy (Bielecki, 2002). 'Reasonable prices' is somewhat less straightforward, as it is perceived differently by energy consumers and producers, and by different classes of energy consumer; the poor pay a higher proportion of their incomes for energy than the wealthy[1]. However the concept of 'reasonable prices', at least at a system-wide (national) level is generally taken to mean that prices are cost based and determined by the market based on supply/demand balances (Bielecki, 2002); cost-recovery at the system level is the aim. Reasonable prices also refer to countries not experiencing excessive price spikes over the short and medium terms, a situation that has caused serious macro-economic impacts in African countries in recent years. Affordability of energy by poor people can be made possible through the use of 'smart' cross-subsidies.

Fossil fuel (oil and gas) energy security refers to all aspects of the energy chain, from upstream security considerations such as geopolitical supply issues and resource scarcity, through to downstream transmission concerns and grid failures. Issues of physical supply security - including security of supply routes (pipelines, shipping lanes etc) due to political instability or terrorism play into the energy security debate. Fossil fuelled electricity generation infrastructure is also a major issue in Africa due to the age and very poor maintenance of much of the electricity generating capacity. It is therefore important to consider not only wider issues arising from concerns over the supply of primary energy sources but the state of generating infrastructure within a country, terrorism and conflict (which may interrupt external and internal supplies) and the mechanisms which are used to price energy within countries; a mechanism which maintains the price of energy below the cost of sourcing, transmission and processing is unlikely to offer a secure long term future as there will be little incentive for additional investment and maintenance.

Energy Security in Developing Countries

Referring specifically to poor developing countries in Africa, a number of specific issues are relevant. Firstly as large proportions of the population have no access to modern energy services (electricity, fossil fuels for motive power etc) the classic definitions of energy security do not apply.

For those relying on biomass as their primary energy source, the immediate security priority is a secure, affordable supply in order to have access to the essential services of cooking and heating. Security of biomass supply is a risk for increasing numbers in certain areas, especially around growing peri-urban population centres. The supply of charcoal to cities is increasing in Africa, leading to price resource depletion in some cases and consequent price rises; there are reports that in some parts of Africa biomass for cooking is out of the price range of the poorer segments of society. Strategies to increase supply security of biomass have included community forest management, planting of wood-lots. On the demand side improved, more efficient, cook-stoves have been promoted in many parts of Africa – and the developing world more broadly. The focus of improved cook-stove programmes (ICS), originally on reducing demand, has increasingly turned to health issues in an attempt to reduce very high-levels of indoor air pollution from unvented stoves. However the penetration of ICS programmes has been limited in many cases and has not been sufficient to counter the impact on resources due to growing populations. In addition some early ICS designs did not deliver the anticipated efficiency improvements. Newer designs (eg the 'Rocket' stove) present the promise of much greater efficiency savings.

[1] In Africa the poorest 20% pay 15-20% of their income for energy. The figure for the richest is 7-10%.

In general developing countries are less able to adapt to energy shocks on the global market, as they have less storage capacity and less leverage in the global market place. While this is a current threat, there is an opportunity to reduce the risk of future energy insecurity through increasing the use of technologies relying on indigenous energy sources. Much has been written about renewable energy potential in Africa; there is considerable untapped hydro-power potential (eg Inga in DR Congo) and lessons to be learned from the Brazil's development of bio-ethanol. These and other renewable technologies offer an opportunity for Africa to reduce – although not eliminate – its future reliance on imported fossil fuels.

Developing countries are more vulnerable to the impacts of climate change on their energy infrastructure and resources. For those countries reliant on hydro power the potential for reduced rain-fall due to climate change presents a key risk. East Africa is currently suffering from an 'energy crisis' partly due to reduced output from hydro plants because of lack of water. While the science of climate change is not sufficiently developed to attribute the current lack of water to climate change, regional climate modelling is developing and may in the future be able to predict with some degree of certainty medium and long term changes in rainfall.

Climate change is also likely to impact on the availability of biomass as a fuel. This could affect both the availability of traditional biomass for cooking, as well as the energy crops being grown for the production of bio-ethanol or bio-diesel.

Response Strategies

Common features of response strategies to improve energy security include:

- diversification of energy resource types;
- reduction of import dependency
- market concentration risk reduction (Kessels & Bakker, 2005).

The World Bank Investment Framework for Clean Energy and Development (World Bank 2006) slices the issue in a slightly different manner and identifies three key pillars for improving energy security:

- **Diversification**. Diversification of energy supplies in terms of fuel types and location of the source of supply directly impact energy security. Increasing the diversity of supply will address both energy security and a transition to low-carbon economy.

- **Efficiency**. Energy efficiency investments can reduce the environmental impact of energy and reduce the pressure on energy supply options. Projected economic returns for such investments can be large while the risks can be relatively low.

- **Risks**. By diversifying the energy portfolio, overall investor risks can be reduced, increasing the likelihood of investor participation. This issue is of particular importance to developing country markets where investors are already concerned with other uncertainties. An energy strategy that diversifies supply (including low-carbon technologies) and decreases the upward pressure on primary energy prices helps to encourage investors to allocate equity to energy investments.

Energy technologies clearly play a key role in strategies to improve energy security, with both energy efficiency and renewable energy representing a "win-win" on both security and climate. However the economics of renewables, in particular up-front costs, present a barrier to wide-spread penetration in developing countries.

Given the external risk factors present (whether related to volumes, prices, investment levels, geopolitical factors, etc.), the best guarantee of security of energy supply is clearly to maintain a diversity of energy sources and supplies (EU Commission Green Paper, 2001).

With regards to the future, energy security concerns will influence the world energy industry in a number of ways (Dorian et al., 2006). Strategies identified include:

- Decreasing dependence on Middle East oil due to perceived threats;
- Increase domestically produced or available resources including nuclear power and coal (combined with CO2 sequestration);
- Increase energy conservation, improved efficiency and use of renewable energy to reduce reliance on fossil fuels;
- Promote reliance on advanced energy technologies (ultra light diesel powered hybrids and combined cycle heat and power systems and distributed generation);
- Building new global alliances between producer and consumer countries.

The Current Global Debate and its Dimensions

Geopolitical developments following the World Trade Centre disaster have revived energy security as a critical policy concern (Huntington & Brown, 2004). Attention to energy security is critical because of the uneven distribution of fossil fuel resources on which most countries currently rely. Energy supply may become more vulnerable in the near term due to the growing global demand for oil and gas (Asif & Muneer, 2007). "Peak Oil", or Hubbert's"[2] refers to the maximum rate of the production of oil in any area under consideration, recognising that it is a finite natural resource, subject to depletion."[3] In global terms it is a single historical event at which time the peak of the entire planet's oil production occurs. After Peak Oil, according to the Hubbert Peak Theory, the rate of oil production on Earth will enter a terminal decline. The timing of global "peak oil" remains hotly contested, although most agree that with rapidly rising global demand and a reduction in discoveries of significant new reserves, resource constraint will be an issue in the decades to come.

Energy security debates continue to be determined mainly by oil (with gas considered to have a longer time-frame before the Hubbert Peak) (Bielecki, 2002). However some have described it as 'one of the most overused and misunderstood concepts in the energy debate' (Helm, 2002), presumably due to lack of clear definition and use of the term, and the wide spatial and temporal dimensions which the term can encompass.

Peel & Hoyos, 2006 claim that the whole energy security debate is divided by political suspicion and misunderstandings, indicating that tensions are likely to increase as resource scarcity becomes an issue. The recent geopolitics of energy has been shaped by the major international economic players aiming to achieve a position of strength in the energy markets. On the side of developing countries, China is an increasingly significant player in the scramble for energy resources, a situation being played out visibly in Africa (Angola for example). Chinese energy consumption is anticipated to double in the next 15 years, with oil imports to China increasing from just over 3 million barrels/day in 2004 to over 10 million barrels/day in 2030 (note current global oil consumption in 2007 is around 85 million barrels / day).

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[2] The Hubbert peak theory is based on the key observation that the amount of oil under the ground is finite. It posits that for any given geographical area, from an individual oil field to the whole planet, the rate of petroleum production tends to follow a bell-shaped curve. It also shows how to calculate the point of maximum production in advance based on discovery rates, production rates and cumulative production. Early in the curve (pre-peak), the production rate increases due to the discovery rate and the addition of infrastructure. Late in the curve (post-peak), production declines due to resource depletion.

[3] Colin Campbell quoted on The Association for the Study of Peak Oil and Gas web site http://www.peakoil.net/

At the G8 summit in July 2006, global energy security featured as a key item of debate. It was striking to follow how the key players viewed energy security from opposite ends of the same telescope (Peel & Hoyos, 2006). On one hand, Russia, a huge gas and oil exporter, requested 'security of demand', while the big consumers of the original G7 want 'security of supply'.

Jonathan Stern, director of gas research at the Oxford Institute for Energy Studies suggests at least four different drivers of the energy security problem (in Peel & Hoyos, 2006):

- Insufficient investment in energy supply and infrastructure to meet future demand;
- Increasing dependency of developed countries on imported energy from unstable countries or regions (such as Middle East oil or Russian gas);
- Huge volume of energy needs for China and India for future industrialisation placing a strain on resources;
- Rising oil and gas prices threatening to deprive the poorest countries of affordable energy.

As a recent development, the European Union adopted new proposals for an ambitious energy policy for Europe in March 2007[4], with the aim of pursuing a sustainable, competitive and secure supply of energy; climate mitigation was a key driver. It also suggests an international agreement on energy efficiency.

Dimensions

The concept of energy security has many different dimensions, ranging from political and military (security issues) to economic, technical (Bielecki, 2002) and physical supply concerns[5].

Spatial dimension: energy security is normally discussed along national lines, that being the natural level of governance for such discussions. However there is also a regional aspect with some blocks recognising the advantage of acting in regional coalitions (eg EU – attempting joint diplomacy with Russia). The International Energy Agency was formed in the 1970s by developed countries to improve supply security, build up storage capacity and provide a counter weight to OPEC. Opportunities exist for Africa to act on a regional level to improve energy security. Although it is unlikely these would have much sway in geopolitical terms, they may be able to improve security through regional energy trade, infrastructure and common fuel policies. For example the Southern Africa Power Pool has been established and others are in the process of development (in East Africa and West Africa). The West Africa Gas Pipeline is about to come on-stream to deliver Nigerian gas to other West African countries. Finally regional policy approaches have been developed to a limited extent in Africa, the most recent being the ECOWAS White Paper[6].

The global - or geo-political dimension of energy security has become increasingly important in recent years, as global demand continues to grow, with the largest increases from the large developing economies (eg China and India), and discoveries of large new reserves reduce. China has been exercising its economic power in Africa, largely in pursuit of natural resources, in particular oil.

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[4] Presidency Conclusions, European Council, 8/9 March 2007, 7224/07

[5] The environmental dimension, most notable greenhouse gas abatement obligations of several countries, is becoming increasingly important. The paper on policy interactions examines the policy relationships between energy security and climate change in more depth.

[6] ECOWAS/UEMOA White Paper 2006: "Increasing Access to Energy Services for Rural and Sub Urban Areas in Order to achieve the MDGs"

Political dimension: From a political perspective, a country's energy security policy refers to measures taken to minimise the risks of supply disruptions below a certain tolerable level (Blyth & Lefevre, 2004). According to the Institute for the Analysis of Global Security, of the trillion barrels of the proven oil reserves currently estimated, 6% are in North America, 9% in Central and Latin America, 2% in Europe, 4% in Asia Pacific, 7% in Africa and 6% in the Former Soviet Union. Presently 66% of global oil reserves are distributed amongst Middle Eastern countries: Saudi Arabia (25%), Iraq (11%), Iran (8%), UAE (9%), Kuwait (9%), and Libya (2%). Oil and gas reserves in non-Middle East countries are being depleted more rapidly than those of Middle East producers. If production continues at the present rate, many of the largest, non-Middle Eastern, producers in 2002 (e.g. Russia, Mexico, US, Norway, China and Brazil) will stop being relevant players in the oil market in less than two decades. At that point, the Middle East will be the only major reservoir of abundant crude oil meaning that within 20 years or so about four-fifths of oil reserves could be in the hands of the Middle Eastern countries some of which are politically unstable (IAGS, 2007). Moreover, for most countries, access to competitive energy depends on access to the energy available in the world trading system and it is protection of that system in general (rather than specifically the energy component) that is critical to security (Mitchell, 2002). In turn, that protection depends on international cooperation, alliances, the support of the UN and as a last resort, military action (Mitchell, 2002).

The Energy Charter Treaty, signed in 1994, is an attempt to develop multilateral rules to tackle the increasing interdependence between net exporters of energy and net importers. The Energy Charter Treaty "…therefore plays an important role as part of an international effort to build a legal foundation for energy security, based on the principles of open, competitive markets and sustainable development…".[7] The Treaty has been signed or acceded to by fifty-one states plus the European Communities (the total number of its Signatories is therefore fifty-two).

Politicians in the developed world are responding to energy security concerns generally by:

- Grouping together to exert more influence on suppliers (EU, IEA)
- Investing in and researching other forms of energy (Renewables, Nuclear, Bio-fuels)
- Promoting a freer international market in fuels (EU energy liberalisation)
- Increasing physical integration in infrastructure on a regional basis – gas and oil pipelines, LNG facilities etc

While politicians in African countries recognise the importance of energy security, it is not clear that collective action at the level of the African continent would have sufficient leverage on the global oil markets.

Military dimension: Getting oil from the well to the refinery and from there to a service station involves a complex transportation and storage system. This dimension is mainly fuelled by the fear of terrorist attacks on energy infrastructure in general and more specifically on oil tankers and pipelines (Peel & Hoyos, 2006).

Economic dimension: Concerns here are mainly about the macroeconomic impacts of high energy prices and the danger of economic losses resulting from potential shortfalls in energy supply (Bielecki, 2002). Long term security involves affordable and stable energy prices. Affordability means that the energy price has to be as low as, or lower than similar countries to allow a nation's economy to compete. Given the concentration of resources in other

[7] http://www.encharter.org/index.php?id=7

countries, the best way to do this may be to promote free, fair and transparent international markets which provide the correct long term price signals.

A recent report from the World Bank (ESMAP 2005) has highlighted the severe macro-economic consequences of recent rises in oil prices for the oil importing countries of Africa. The report highlights how oil price increases (72% between 2003 and early 2005) had the greatest impact on poor oil importing countries, and resulted in a significant loss of GDP growth for importing sub Saharan African countries. This is particularly the case due to the high vulnerability to oil prices (measured as a ratio of net oil imports: GDP. Section 4 below provides further details.

Time frames - Energy security issues involve various time dimensions from short to long-term. Short-term security covers the risks of disruption to existing supplies due to technical problems, extreme weather conditions or political disruptions. On the other hand, long-term security focuses on the risks that new supplies may not be brought on stream in time to meet growing demand. This may be due to economic, financial or political factors that inhibit necessary investment in production and transport capacity (Bielecki, 2002). Sudden price hikes will have different effects on both the economy and society than a long-term price increase (Blyth & Lefevre, 2004). Some have expressed the view (eg Buchan 2002) that a liberalised electricity market does not provide long term security because there is insufficient incentive for companies to upgrade, and commission long-distance gas pipelines, and the building of new nuclear power plants and renewable energy generators. The UK could be considered an example, since the only new power plant to be commissioned in the last 10 years uses gas as a fuel, and the dependence on imported gas is projected to swiftly increase.

Developing Countries – Africa

During the next few decades the energy requirements of the industrialising developing world will continue to grow to fuel economic growth and meet the expectations of rising living standards (Dorian et al., 2006). According to the IEA (2004), more than 1.6 billion of the world's population remains without power today, limiting economic prospects, adequate health care, and communications. If major successful government incentives do not take place, roughly 18% of the world's population will still be without power in 2030, despite advances in energy technologies and global economic expansion (Dorian et al., 2006). In most developing countries, poor people rely on traditional biomass - wood, dung, and agricultural residues - for their basic energy requirements (Dorian et al., 2006).

For those with no access to modern energy services 'energy security' has a very different meaning to inhabitants of the developed world where energy access is taken for granted.

High energy prices are especially damaging for developing countries (EC Communication, 10 Jan. 2007). Although a few developing countries might benefit as producers, others can find the increased costs of energy imports outstripping their development aid receipts[8] (ESMAP, 2005).

Some sub-Saharan African countries spend more than 50% of their trade surpluses on energy imports. Because the overall size of many African economies is small, the energy effect is a significant. Apart from a few exporters, most of sub Saharan Africa is highly dependent on oil imports. The Impact of oil price rise 2003-2005 on GDP for some African countries was highlighted in ESMAP, August 2005:

[8] 137 billion US$ annually for developing oil importers against an ODA of 84 billion US$ in 2005, net of additional debt relief. See "The Vulnerability of African Countries to Oil Price Shocks: Major factors and Policy Options. The Case of Oil Importing Countries". ESMAP Report 308/05, World Bank, August 2005.

- Guinea Bissau – loss of 7.4% GDP
- Sierra Leone – loss of 5.9% GDP
- Uganda – loss of 1.1% GDP.

The ESMAP report explains that "…what distinguishes Africa from other regions is its almost complete reliance on imported oil (apart from the net oil exporters) and its very high oil fuel dependence for its primary energy consumption besides biomass. For example, South Asia's share of oil in total primary energy consumed is about one half of that of Africa, due to the significant use of coal and biomass. These extreme values are partially offset by its lower total energy intensity and oil intensity, but these may actually increase as the region experiences further development. …"

The ESMAP report investigates:

- How vulnerable African countries are to a sustained oil price rise measured in terms of the ratio of net oil imports to gross domestic product (GDP), and in terms of its ability to pay as indexed by the ratio of net external debt to GDP; a number of African nations have been damaged by the terms of trade as exports get cheaper and imports get more expensive.

- What are the energy and oil intensities of the economies, and what are the recent trends (measured by the ratio of energy use to GDP);
- What is the oil fuel dependence of the economy, and what is its recent history (measured as the share of the use of oil and oil products in total primary energy use).

The importance of Africa as an energy supplier has increased significantly in recent years and has a much larger potential. The EC Communication of 10 January 2007 briefly addresses the case of Africa, and the recent Africa-EU Energy conference in Berlin (March 2007), under the auspices of the German Presidency of the EU, highlighted the shared interest of the EU and Africa in energy security. It is also important to note the rapid acquisition by China of oil resources in Africa.

Like Europe, Africa and other developing regions have a vital interest, to boost diversification and energy efficiency, also making a major contribution to the Millennium Development Goals. The EU makes the commitment to support developing countries in promoting sustainable and secure energy supply and use. Furthermore, the Communication suggests that Africa offers a unique opportunity to install renewable energy technology in a competitive manner, by by-passing the need to build expensive transmission grids and 'leap-frog' to a new generation of clean, local low carbon energy sources and technologies. The EU sees this as a real 'win - win' opportunity, increasing the penetration of clean renewable energy and bringing electrification to some of the world's poorest citizens. Given the frequently high up-front costs of renewables, it remains to be seen whether renewable energy can provide a significant contribution to energy access and energy security in Africa.

In relation to this study, energy security has in the past and is today, being considered largely from a developed country perspective and to some extent by economies in transition. Developing countries, including Africa, have seemingly been side-lined in the global debate. There is now a need to focus more on the energy security of developing countries in general, from the perspective of those countries and not only those of the EU, Russia or US. Achieving energy security of poor countries in the developing world is essential if development gains are to be maintained and strengthened. There is little in the current literature on the challenges facing developing countries aiming to secure their energy future; this is a gap which needs to be filled.

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ANNEX VII: CLIMATE CHANGE LITERATURE REVIEW

Introduction

s paper examines the literature on climate change, one of the three key drivers of this report, and a subject of intense current scientific, political and public debate. The body of literature on this subject is wide-ranging, and this paper touches on those aspects considered of most interest for this study.

The paper is divided into four main sections: the context, specifically with regard to greenhouse gas emissions and adaptation; the international climate change debate including developing country perspective; and gaps in current knowledge and understanding with respect to the subject of this study.

Context

Greenhouse gas emissions and mitigation

It is important to differentiate between the varying impacts developing countries have on the climate: for some of the large and rapidly growing developing economies emissions are globally significant and rapidly rising, however, for the smaller, poorer developing countries, those in Africa for example, emissions are generally not large in global terms.

This section aims to set the context for greenhouse gas (GHG) emissions in developing countries, using data for 2004 and projected to 2030 sourced from the U.S. Energy Information Administration. Note that figures relate to CO2 emissions from fossil fuel use, and do not include emissions from land-use change (deforestation etc).

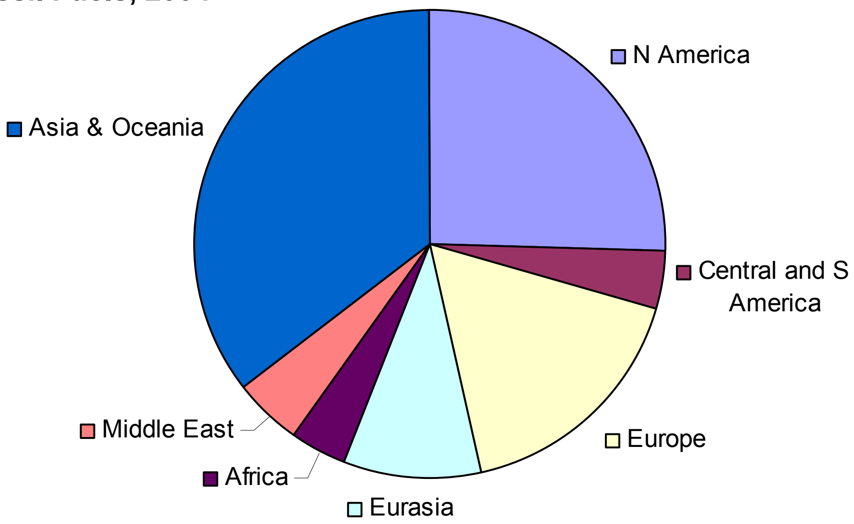
Table 1: World Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 2004 (Million Metric Tons of Carbon Dioxide)

	CO2 emissions (million metric tonnes	Percentage of global
N America	6,887	25.5%
Central and S America	1,041	3.8%
Europe	4,653	17.2%
Eurasia	2,550	9.4%
Africa	986	3.6%
Middle East	1,319	4.9%
Asia & Oceania	9,604	35.5%
World	27,040	

Source: Energy Information Administration, International Energy Annual 2004, table Posted: July 19, 2006 (http://www.eia.doe.gov/environment.html)

The same data in graphical terms shows the relatively minimal contribution of Africa to global greenhouse gases:

Chart 1: Proportion of world Carbon Dioxide Emissions from the Consumption and Flaring of Fossil Fuels, 2004



It is interesting to note that in 2004 Kenya emitted 8.51 M tonnes CO2 from fossil fuels, less than 1% of African emissions and around 0.03% of global emissions. The corresponding figures for South Africa are 430 M tonnes CO2 from fossil fuels (43.61% of African emissions and 1.6% of global emissions) – stripping out South African emissions, Africa's emissions make up only 2% of world totals.

The 2004 CO2 emissions from fossil fuels by the so-called "G8+5" countries were:

Table 2: CO2 emissions from fossil fuels

	CO2 emissions (million metric tonnes)	Percentage of global
China	4,707	17.5%
India	1,113	4.1%
Brazil	337	1.2%
South Africa	430	1.6%
Mexico	386	1.4%

Table 3: Carbon Dioxide Emissions by Region (and for China, India and Brazil) Reference Case, 2030 (Million Metric tonnes Carbon Dioxide)

Region/Country	Projected CO2 emissions 2030 (M tonnes)	Average Annual Percent Change 2003-2030
OECD North America	9,735	1.3%
Central and South America	1,933	2.4%
OECD Europe	5,123	0.7%
Non-OECD Europe and Eurasia	4,352	1.7%
Africa	1,733	2.5%
Middle East	2,177	2.3%
OECD Asia	2,638	0.9%
Non-OECD Asia	15,984	
World	43,675	2.1%
China	10,716	
India	2,205	
Brazil	610	

Source: International Energy Outlook 2006, Report#: DOE/EIA-0484(2006), Release Date: June 2006

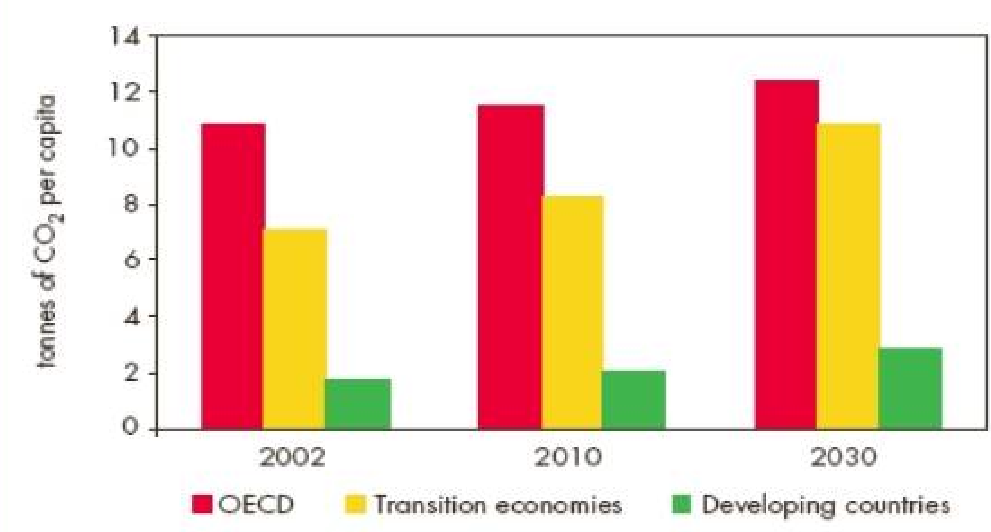
Thus by 2030 Africa's emissions of CO2 are projected to almost double compared to 2004. However by 2030 CO2 emissions from Africa will make up slightly less than 4% of global emissions, according to this scenario, only a small proportional increase from 3.6% in 2004. China on the other hand is expected to emit around 25% of global CO2 emissions, with the corresponding figure for India being around 5%.

It is a reflection of the data presented that little pressure has been placed on most African countries to agree to quantified emissions reductions under the UNFCCC/Kyoto process. However South Africa is included as one of the G8+5 countries, the others being China, India, Mexico and Brazil.

The data presented do not reflect the issue of historical responsibility for greenhouse gas emissions, an issue of emerging importance, and creates a significant challenge to involving developing countries in future mitigation efforts. It is universally recognised that it is the developed world which has historically emitted the vast majority of greenhouse gases, mostly since the middle of the 19th century.

To place the data in an equity context, per capita emissions are often presented.

Chart 2: Per capita emissions for different world regions



Source: IEA World Energy Outlook 2004

Breaking these figures down further, the per capita emissions in 2000 were approximately as follows,:

Table 4: CO2 emission per capita in 2000

CO2 Emissions Per Capita, 2000 (tonnes CO2 per capita)	
World Average	5.7
USA	28
UK	9.2
Middle income nations	2.2
Poorest countries (including most sub-Saharan African)	0.07

Source: Boden, 2003

Access to basic energy services and greenhouse gas emissions

Another means of differentiating actors with regard to greenhouse gas emissions is to separate so-called “luxury emissions” those resulting from personal car transport for example, from emissions relating to basic needs of those in poverty. The table below provides an estimate of the limited additional emissions resulting from provision of basic electricity services to all those currently without access (1.6 billion) and use of LPG for cooking by all those currently using traditional biomass. While the assumptions regarding the quantity of energy services required could be questioned, the conclusion – that provision of basic energy services to the poor does not significantly increase global greenhouse gas emissions - is clear. The net result, in this thought experiment, of providing basic energy access to all those currently without would be an increase of 3% in current global emissions, or around 1.5% of the emissions anticipated by 2030.

Basic Human Need	People without access (billions)	Sufficiency (per capita-year)	Carbon required (GtC/yr)
Electricity	1.6	50W	0.15* *using global average C-intensity of power in 2002: 160 kgC/kWh
Clean cooking fuel	2.6	35 kg propane	0.07
Total			0.22† †current global carbon emissions: 7 GtC/yr

Source: Robert Socolow, Princeton University,2006

Impacts and Adaptation

It is generally recognised that while Africa is a minor contributor to greenhouse gas emissions, it is one of the most vulnerable to the impacts of climate change. The UN Secretary-General Kofi Annan reinforced this during his address to delegates at the recent UNFCCC COP/MOP in Nairobi in November 2006, as he called for renewed urgency on adaptation for the poor. Developing countries are particularly vulnerable to climate change impacts because of their exposure to extreme weather events and dependence on natural resources. Understanding how societies will adapt to climate change, and how successful adaptations can be facilitated, is a critical element of current research, that is attempting to provide appropriate advice for policy and practice[1].

The research agenda is progressing along two broad fronts: science of predicting and attributing impacts; and responses from policy and practice.

While the global science of climate prediction has progressed to the point where the international scientific consensus (as presented by the IPCC in 2007[2]) has become increasingly strong at the global scale, work continues at continental and national scales and there is much uncertainty when dealing at these levels. IPCC 2007 made the following statements:

“The understanding of anthropogenic warming and cooling influences on climate has improved since the Third Assessment Report (TAR), leading to very high confidence that the globally averaged net effect of human activities since 1750 has been one of warming”.

“The equilibrium climate sensitivity is a measure of the climate system response to sustained radioactive forcing. It is not a projection but is defined as the global average surface warming following a doubling of carbon dioxide concentrations. It is likely to be in the range 2 to 4.5°C with a best estimate of about 3°C, and is very unlikely to be less than 1.5°C.” It is to be

[1] Example research project: “Adaptations to climate change amongst natural resource-dependant societies in the developing world: across the southern African climate gradient” Funding body: Tyndall Centre for Climate Change Research. Oxfam-GB, University of Cape Town, Potchefstroom University.
[2] The Physical Science Basis - Summary for Policymakers Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change” February 2007

noted that the pre-industrial concentration of CO2 pre-1750 was 280 ppmv while CO2 concentration in 2004 was 377 ppmv (note that these figures do not include non-CO2 greenhouse gases).

On attribution the IPCC says: “Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations”.

The science of impact modelling at large scales is also progressing, with the IPCC saying “At continental, regional, and ocean basin scales, numerous long-term changes in climate have been observed. These include changes in Arctic temperatures and ice, widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heat waves and the intensity of tropical cyclones”. On prediction: “Increases in the amount of precipitation are very likely in high-latitudes, while decreases are likely in most subtropical land regions (by as much as about 20%...)”. and “Anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized.”

However modelling of future impacts at smaller scales is in its infancy and much uncertainty remains. There is also considerable debate over attempts at attributing particular events to climate change. However, the IPCC “Special Report on The Regional Impacts of Climate Change - An Assessment of Vulnerability” does provide an analysis of the climate impacts on water, forestry and energy in Africa. On water the report says “The major effects of climate change on African water systems will be through changes in the hydrological cycle, the balance of temperature, and rainfall… The Nile and Zambezi basins are the second and fourth largest river systems in Africa...and both have a high sensitivity to climate change. Although the severity of the impacts of climate change depended primarily on the magnitude of change, the different hydrological sensitivities of the basins are also important. The Nile and Zambezi are especially sensitive to climate warming: Runoff decreases in these basins even when precipitation increases, due to the large hydrological role played by evaporation.” Regarding the energy sector in Africa, the IPCC report says that “the impacts of climate change on the energy sector will be felt primarily through losses or changes in hydropower potential for electricity generation and the effects of increased runoff (and consequent siltation) on hydrogeneration, as well as changes in the growth rates of trees used for fuelwood… The most vulnerable areas of the energy sector to climate change in Africa are the provision of energy services for rural areas and, to some extent, for urban low-income needs. The extent of biomass dependence for the African energy sector is high; this dependence is critical because the source of biomass is supported only by the natural regeneration of indigenous natural forests. In addition to the primary energy sources, dependence on charcoal is high in east and southern Africa, in countries such as Zambia and Tanzania; in Zambia, where charcoal provides 80% of urban household energy needs, 3.5 million tons of charcoal are produced annually from indigenous forests.” The same report states that forestry plantations may be most vulnerable to climate change through increased stress resulting from drought, which makes conditions ideal for new or old pests and diseases.

The science of predicting rainfall and other climate dependant issues at scales appropriate for national energy planning is considered to be at an early stage of development. However the results of emerging science are becoming available[3] and it is considered important for these to be considered during energy policy, planning and investment processes, particularly with regard to hydro-power and biomass/bio-fuels. It is important to consider that uncertainty

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[3] For example see New, M. (2002). "Climate change and water resources in the southwest Cape, South Africa." South African Journal of Science 98(7/8): 369-376.

is always likely to exist when modelling future climate impacts, and the need will be to use the results of climate impact models as an input to energy scenario planning, using risk analysis techniques. Further research will be required however to translate the results of the science of local impacts into a useable format to inform decisions in the energy sector.

The International Climate Change Debate [4]

The most recent expression of the international debate occurred at the recent climate COP/MOP in Nairobi, which took place from 6-17 November 2006. This event has been branded the African COP/MOP.

Adaptation

Adaptation and development issues are normally sidelined during the COP process. However the 2006 Nairobi conference was able to finalise a five-year programme of work on impacts, vulnerability and adaptation to climate change, which enables work to start immediately on a wide range of activities to support adaptation efforts and exchange best practice. These efforts will ensure that developing countries in particular are able to make informed decisions, taking into account current and future climate change and variability in their development agendas. Negotiators also took an important step towards bringing on stream the Kyoto Protocol's Adaptation Fund for developing countries, which could eventually be worth €300 million or more, by reaching agreement on its governance structure and overarching principles for its operation.

Mitigation

The official negotiations on mitigation were somewhat subordinate to the adaptation agenda. This had been predicted in advance and resulted in limited progress in the official fora, although it could be argued that some trust-building took place and laid some of the ground for a future substantive negotiation. The media contrasted the lack of progress on an agreement on post 2012 commitments with the urgency implied by the latest science and other new research presented by a number of different stakeholders at the COP/MOP.

Positions of different parties to post 2012 mitigation commitments were not significantly different from those expressed in the previous COP/MOP in 2005 and before. Developing countries (represented by South Africa, speaking on behalf of the G/77-China), pressed the view that the responsibility for mitigation lies with developed countries, while they in turn expressed the need for all major emitters, including large developing country emitters, to take responsibility for limiting emissions. It was widely agreed amongst all parties that a deal on post 2012 is required soon, in order to achieve the deeper cuts the science says are necessary and send a clear signal to the carbon markets. It was also widely accepted that global emission reductions must be much deeper than those adopted during the first commitment period. However the official negotiations generally lacked urgency, and indicated that most parties are waiting for others to show their cards.

The Montréal COP in 2005 had resulted in a twin-track process to take forward dialogue on a post 2012 regime: the "Dialogue on long-term cooperative action to address climate change by enhancing implementation of the Convention" (Dialogue) and a new subsidiary body, the "Ad Hoc Working Group on Further Commitments for Annex I parties under the Kyoto Protocol" (AWG). These debates clearly highlighted the difficult question of which

[4] This section of the report draws on a Tyndall Centre Working Paper in press at the time of writing "Assessment of key negotiating issues at COP12/MOP2 in Nairobi and thoughts on what it means for the future of the climate regime" Lead authors: Chukwumerije Okereke, University of East Anglia and Philip Mann, ECI, University of Oxford

countries should contribute to climate mitigation in a post 2012 regime. The EU, Australia and other developed countries argued that the mitigation efforts of Annex I countries alone would be insufficient to tackle the climate challenge, and that a post 2012 regime should include all significant emitters. G/77-China focussed their interventions on the need for deeper and timely Annex I commitments for post 2012 in order to provide a signal to the carbon markets. The debate resulted in the conclusion that Annex I Parties should continue to take a lead on emission reductions beyond 2012.

The EU clearly expressed the need to make deep cuts in global emissions by mid-century. The EU has recently agreed to a unilateral 20% cut in emissions by 2020 (from a 1990 baseline), which it will increase to 30% if joined by other key developed countries.

The G-77/China generally remained a coherent negotiating block during the meeting, even though some differences of opinion were apparent, on topics such as avoided deforestation. The G77/China frequently raised concern about rising greenhouse gas emissions in a number of Annex I countries, making it clear that this was no basis on which to discuss developing country binding commitments under a 2nd commitment period. While the G77/China continues to cite the principle of common but differentiated responsibilities and respective capacities as basis for rejecting any discussion on binding commitments, developed countries argued that the principle needs to be interpreted in a way that ensures meeting the objectives of the Convention[5]. Discussions on the need for an agreed quantified target (temperature or concentration of CO_2e) were prevalent during the meeting although no agreement was reached.

The G77/China expressed the view that quantified, binding commitments are inappropriate for them given the need for rapid economic and social development, and rapid population increases in many parts of the developing world. Another widely expressed view is that developing countries have limited capacity to affect mitigation. For many developing countries per capita emissions equity remains the basis of negotiation, although interestingly some Brazilian representatives were promoting the use of historical responsibility as a basis for future negotiations (possibly responsibility for temperature increase).

While developing countries were not willing to discuss quantified binding absolute commitments, there were some signs that certain larger developing countries are starting to give consideration to climate mitigation using various frameworks and metrics. The latest Chinese Five Year Plan includes a commitment to reduce energy intensity by 20% by 2010, although it is to be noted that with the current rate of economic growth this will result in an increase in absolute emissions. Other options for developing country involvement in post 2012 climate mitigation include sustainable development policies and measures (SD-PAMs) – either quantitative or qualitative - and taking on voluntary sectoral commitments.

Interest in sectoral agreements or targets seems to be developing (including within the CDM and possibly including avoided deforestation – see below) although, as with any architecture for mitigation the difficulty lies in agreeing the details; several negotiators admitted that targets would only be adopted, even if on a voluntary basis, after ensuring that competitiveness of national industries would not be compromised. This highlights the importance of identifying no regrets (or win-wins) options for developing countries, those which provide both socio-economic benefits as well as climate mitigation[6]. It is clear that

[5] UNFCCC objective "… stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system…"

[6] An example of a no regrets options is the switch of transport fuel for public vehicles in New Delhi from diesel to LPG, a policy implemented for reasons of public health (air pollution) but which also yields climate benefits due to the switch to a less carbon intensive fuel.

identifying no regrets options is a complex issue requiring further research and analysis for development of policy tools such as energy planning.

Several 'package proposals' for a possible post 2012 regime were put forward by groups of researchers and NGOs, including the "Basic" project's[7] "Sao Paulo Proposal for an Agreement on Future International Climate Policy"; the Basic project, funded by EC, UK and others, originally aimed at supporting the implementation of the Convention and Protocol by Brazil, India China and South Africa. The Sao Paulo Proposal incorporates the issue of historical responsibility for GHG emissions, and recognises that Annex I/B type commitments are not appropriate for developing countries due to their limited capacity, and rapid economic, social and demographic changes. It proposes inter alia a possible "…new annex listing Non-Annex I Parties that agree to quantify and report the emission reductions achieved by their sustainable development actions…" earning "…political recognition but not generating tradable credits …"

The Clean Development Mechanism (CDM)

The CDM continued to receive considerable attention throughout the Nairobi event, with many citing the mechanism as a success given the rapidly increased number of projects in the pipeline. African parties, and other countries not benefiting from the CDM, highlighted the lack of benefit accrued to Africa through the CDM, with African CDM projects accounting for only around 2% of the total number of CDM projects. The UN Secretary General Kofi Annan announced the launch of a new initiative, the Nairobi Framework, which aims to support the participation of developing – in particular African - countries in the CDM through capacity building. While recognising that the current framework for the CDM in the first commitment period (2008-2012) is unlikely to provide significant benefit to Africa, the potential of CDM (or son of CDM) as a source of investment funds into Africa should be recognised. Africa has a number of low cost mitigation options that should be of value to CDM developers, and there is a need for further work to unlock this potential. More broadly the private sector made calls for improvements in the investment environment in Africa, without which it claimed the CDM would continue to be difficult to implement in less developed countries. The World Bank launched its Clean Energy Investment Framework in 2006, and the EU announced the development of an Africa-EU Infrastructure Partnership Initiative, including significant investment in regional energy infrastructure in Africa. These activities will, inter alia aim to support the improvement in the investment environment.

In addition to concern expressed by some developing countries that the CDM is not providing the expected "development dividend" (ref the high proportion of HFC-23 projects in the current portfolio), a number of specific technical CDM-related issues were also discussed in Nairobi. Geological carbon capture and storage (CCS) was promoted by some for inclusion in the CDM. However a number of parties felt that the uncertainties remained regarding the technology, as well as how to define emission reductions under the CDM (eg issues of project boundaries and leakage); a decision about inclusion of CCS in the CDM was thus postponed, pending further discussion of the uncertainties involved. It is interesting to note comments by some in the corridors of the Nairobi event that the real reason for preventing inclusion of CCS (and avoided deforestation) in the CDM is that the CER market would be flooded, thus reducing the value of these credits; such an outcome is clearly not in the interest of those countries currently benefiting from CDM investment.

Discussions continued on methodologies for calculating emission reductions from small-scale projects, including improved cooking stoves, which account for large proportions of energy use in most poor countries through the burning of biomass, presenting significant health hazard for women and children through exposure to very high levels of indoor air

[7] BASIC is an EC project led by the Institute for Development Studies in Brighton, UK

pollutions. The decision to ask the CDM Executive Board to seek proposals for new methodologies for the switch from non-renewable to renewable biomass, missed the point since most improved cooking projects improve the efficiency of non-renewable biomass use; thus an opportunity was lost in Nairobi to promote CDM projects which could be of most benefit to the poorest populations in developing countries.

Technology Transfer

The issue of technology transfer was high on the agenda in the Nairobi COP. This was partly due to the terms of reference for the Expert Group on Technology Transfer (EGTT) which was up for review. The developing countries sought important transformation on the approach via several key proposals. First, they demanded that the mandate of the EGTT should not be extended but rather called for the establishment of a completely new body under the Convention to be known as the Technology Development and Transfer Board (TDTB). Second, they proposed the establishment of a Multilateral Technology Acquisition Fund (MTAF) to sponsor joint research and the development of environmentally friendly technologies. Such a Fund, they argued would also be used to 'buy out intellectual property rights' (IPR) and put them in the public domain. China in its proposal added that such a Fund, apart from helping in the purchase IPR, should also assist in providing 'export credit, export taxation reduction and exemption and export subsidies'. The developed countries, on the other hand, objected to both of these proposals and little progress was made, with decisions deferred to future meetings.

The current overall position of developing countries to the international climate debate is perhaps best captured in the Keynote Address By The South African Minister Of Environmental Affairs And Tourism at the G8+5 Environment Ministerial Meeting, Potsdam, Germany, 15 – 17 March 2007. The Minister talked about the need to develop so-called "package deals" which would "…balance different interests and concerns; broad enough to enable trade-offs…"

He highlighted a list of possible elements to a future agreement to ensure a fair and equitable balance:

- on mitigation, in line with the principle of common but differentiated responsibilities, targets for all developed countries, and enhanced action for developing countries. This is important to create the demand and supply required to fuel the carbon market and investment in low carbon economic growth in developing countries. Evolution of the CDM and the creative development of market mechanisms underpin this area of work.
- adaptation, particularly for the poor, but ultimately for all.
- managing the unintended consequences of our adaptation and mitigation policies and response measures for the economies of other countries.
- the cross-cutting area of technology, with an emphasis on research, development and diffusion in support of adaptation, the decarbonisation of our economies, and economic diversification.
- the means of implementation, which includes financing, capacity-building and awareness.

He also highlighted the issue of incremental costs as a key challenge in terms of the wider deployment of climate-friendly technologies, which he in turn linked to the area of intellectual property right barriers and trade, suggesting that the G8 should "…give real substance to the often proposed Technology Acquisition Fund…". This raised the key issues of technology and financing as key parts of the multilateral climate architecture, including the demand that "…that additional financial resources, apart from those already available through ODA, are directed to developing countries; and that collaborative research for new technologies, involving both developed and developing countries, are encouraged…"

Gaps in Knowledge

In terms of options for mitigating future climate emissions through changes to the energy sector, two scenarios present themselves:

- 'No-regrets' or 'win-win' situations, in which a solution which is beneficial for economic and social development also aids in reducing future greenhouse gas emissions;
- Situations that provide mitigation at an additional cost (incremental cost). It appears that most (if not all) developing countries are not ready to pursue such options unless the incremental costs are provided by others (through carbon markets, or grants – GEF and others)

While there is much debate about identifying 'no regrets' or 'win-win' opportunities, there is very little in the literature about how to achieve this. This clearly highlights the need for further, more sophisticated medium and long term energy planning (and associated modelling) incorporating climate mitigation.

More generally it appears that as the climate regime develops, the need to strengthen the links between climate and energy communities, in the pursuit of "win-wins" or "no regrets" options becomes more apparent. Indeed, as several delegates in Nairobi stressed the need for parties to keep in mind that the climate change regime aims not only to stabilize CO2 emission but also to achieve sustainable development. There is a need for a closer relationship in the future between climate and energy policy, recognizing the inherent synergies and trade-offs involved. Further institutional analysis of the current climate regime would be required to uncover practical ways to achieve such integration.

While the science of climate change has progressed rapidly in recent years, there is a need to improve understanding of impacts, in particular at regional and local levels. Allied to this is the need to integrate climate impacts into energy planning, policy and investment decisions, especially important for hydro-power, biomass and bio-fuels development; research is required with respect to means of integrating climate risk management approaches into energy planning. This will require an inter-disciplinary framework to allow the results of the science to be translated into formats that can be used by policy makers and investors.

While it is recognised that the CDM is not currently working well for Africa, further research is considered useful into what changes to the CDM would make a future CDM (after 2012) attractive for investment in Africa. Sectoral or programmatic CDM approaches are interesting in this regard, given their potential to reduce transaction costs. An improved CDM has the potential to unlock significant potential financial flows, providing the underlying investment environment is attractive.

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ANNEX VIII: POLICY INTERACTIONS LITERATURE REVIEW – EQUITABLE ACCESS, ENERGY SECURITY AND CLIMATE CHANGE

Introduction

Considering the aims of the scoping study and after having provided an overview of the three drivers of energy security, climate change and equitable energy access separately, this paper examines the literature on the policy interactions between them. It appears that studies dealing specifically with policy interactions between all three of these drivers specifically do not exist. Literature in this area is particularly restricted and where it does exist it tends to be confined to the developed world; no study has focused specifically on any African developing country or region, with only mentions of some rapidly developing economies such as Brazil, China and India. Thus great care is required when attempting to extrapolate the results of the studies below to the case of developing countries in Africa, as the literature reviewed covers countries with very different social and economic policy objectives. In addition issues of capacity and governance, relative power in world markets, and the proportion of currency spent on energy are very different for African countries compared to developed countries. Finally the degree to which policy objectives highlight climate change mitigation are currently very different in developed countries as compared with African countries. Thus the studies reviewed below place far greater emphasis on climate than those that might relate to African countries.

This section thus provides an overview of work already carried out, mainly in the field of interactions between energy security and climate change in order to identify tools that have already been developed which may be applicable in a developing country or regional context. The studies that are examined focus on the policy interactions between energy security and climate change, in the U.S., the E.U. and the Former Soviet Union (FSU).

The paper is divided into four sections, and looks at the context, the state of the art, and possible gaps in the existing literature, and finally provides some future outlooks.

Context

The potential synergies and trade-offs between policy options regarding the three key drivers deserve greater attention. The International Energy Agency (2004) states it is a government's task to design rules for the marketplace and to include externalities (security, climate) that are not accounted for in a free market (Kessels & Bakker, 2005). Security of supply is of key concern to national governments; securing reliable and affordable energy is vital for economic growth. There are obvious synergies between energy security and climate change: a sound security of supply concept calls for, among others, a diversification of technologies and energy sources, as well as measures which encourage demand side efficiency, reducing overall consumption and renewable energy technologies, which can assist in achieving security of supply outcomes, while simultaneously promoting sustainability goals (EC, 2001).

However given the overarching importance of securing supply there are also policy conflicts between energy security and climate mitigation. The first concern of many countries is to secure fossil fuel supplies, rather than finding alternative fuels that do less harm to the environment or reducing negative impacts from fossil fuels. Thus in many cases securing energy supply to meet growing demands, while simultaneously reducing the share of fossil fuel use, is an area of tension (Egging & van Oostvoorn, 2004); this is – for example – particularly the case for many countries needing to increase the level of access to energy services for the poor. The policy tension is, for example, particularly the case for those countries with large indigenous reserves or coal (eg South Africa and China).

State of the Art

As a means of providing an understanding of the current state of the art, the following section highlights five important studies that have been undertaken in this field.

Existing work on policy interactions between energy security and climate change

Designing a climate-friendly energy policy, options for the near term (Smith et al., 2002)

This study focuses on the U.S. and gives an overview of the energy policy context, current energy picture, current greenhouse gas (GHG) emissions picture and an economic analysis of energy policy. Subsequently, the authors examine energy policy choices available for the five principal U.S. energy sectors: fossil fuel supply, electricity production, buildings, industrial processes and transportation. In reviewing policy options, the authors identify four key objectives that drive energy policy in the U.S.:

(1) secure, plentiful and diverse primary energy supply;
(2) robust, reliable infrastructure for energy conversion and delivery;
(3) affordable and stable energy prices and
(4) environmentally sustainable energy production and use. In its analysis, the study does not consider climate policies that lack a direct energy policy nexus and limits itself to near-term (next decade or two) energy policy initiatives.

The authors identify three categories of energy policies that are climate friendly:

(1) immediate reduction of GHG emissions;
(2) promotion of infrastructure development or technology advancement that will reduce the costs of achieving GHG emissions reductions in the future and
(3) curtailing the amount of new capital investment in assets that would be considerably devaluated if a GHG program were implemented. These categories highlight an important temporal dimension to the subject.

The results highlight key elements of a climate-friendly energy policy for each of the five principal U.S. energy sectors:

- **Fossil fuel supply**: increase natural gas production and expanded gas transportation infrastructure;
- **Electricity**: deployment of efficient electricity production technologies; maintaining a role for hydroelectric and nuclear power and deployment of renewable energy technologies;
- **Building and Industrial Efficiency**: enhancing end-use efficiency in industry and buildings;
- **Transportation**: enhancing efficiency of light trucks and automobiles;
- **Research and development (R&D)**: increase R&D on non-fossil fuels and carbon sequestration and efficient technologies in all sectors.

Smith et al. (2002) find that substantial convergence between energy and climate change policy objectives does exist in that climate-friendly energy policies advance overall energy policy objectives. Taken together, such measures would build on policies implemented to date (such as increasing the diversity of the country's energy mix). Moreover, the authors come to the conclusion that in this case study, trying to achieve climate goals indirectly through energy policy tools will be more expensive than achieving identical climate goals through a well designed, market based GHG regulatory program covering all sectors of economy and that a climate-friendly energy policy does advance energy policy objectives for the U.S. They also argue that the paper's general finding – that a range of energy-sector policies can not only promote traditional energy policy objectives but also contribute to GHG emissions reduction goals – holds true across all countries with highly developed energy sectors. Additionally, the elements of the 'climate-friendly' energy policy outlined in the paper reflect general approaches that could be effective in many other countries, such as promoting end-use efficiency and encouraging the development of renewable energy policies.

Long-term security of energy supply and climate change (Turton & Barreto, 2006)

This paper examines the synergies, trade-offs and interactions between security of supply (SoS) risk management and climate change mitigation (CCM) policies, and investigates the role of technology in achieving these policy goals.

The analysis uses the ERIS multi regional energy systems bottom up optimisation model with technology learning for the 21st century. The model includes:

(1) the number of technologies that have the potential to reduce regional dependence on scarcer and less evenly distributed sources of energy, notably gas and oil and
(2) eleven world regions (five regions portray the so-called industrialised regions and the economies in transition and six additional regions represent the developing world). It excludes energy or transportation demand reduction. Three policy initiatives are modelled:

SoS policies: assumed that SoS policy is actively pursued in OECD, Central and Eastern Europe and Centrally Planned Asia. These regions depend highly on imports for oil and gas, consume the largest amount of these fuels and are expected to account for a majority of global oil consumption over long term.

Two different CCM policies and their interaction with the SoS policy. The first CCM policy is a dynamic cap on global emissions of the three main GHGs and was designed to have almost the same cost as the SoS policy so as to facilitate comparison of these two policies. The second CCM policy, which is the more stringent of the two, is an aggregate cap on emissions designed to result in stabilisation in atmospheric CO2 concentration at 650ppmv. The authors also investigate the impact of both the GHG abatement policies and the SoS policy, on the technology strategies followed by the global energy system.

Technology policies that promote SoS and GHG abatement are modelled in the form of demonstration and deployment programmes applied in the base year of the analysis period.

Trade-offs occur when the best ways of achieving the policies separately are very different; hence achieving the policy goals simultaneously is more challenging. Whereas synergies occur when actions are mutual to the two policy goals. The strength of the GHG abatement policy signal greatly influences the synergies and trade-offs between SoS and CCM policies. In other words, if the stringent GHG policy is pursued, many of the objectives of a SoS policy with respect to oil are achieved, indicating that some strong synergies exist between these two policies in some areas (e.g. promotion of the shift towards a hydrogen economy and the adoption of fuel cells in many applications). Nevertheless, these synergies appear directional in the sense that the cheapest way of achieving deep cuts in emissions does improve security of oil supply, although the cheapest way to achieve SoS does not necessarily improve GHG emissions. By contrast, although there are positive synergies between a supply security policy and a less stringent abatement policy, a significant additional cost associated with achieving both policy goals compared to a single goal exists, indicating that these synergies are weak. Consequently, there appears to be a threshold level of abatement above which greenhouse policies begin to promote oil security.

Turton & Barreto find that the most notable feature in common between security of supply and resource sustainability is that indefinite maintenance of SoS must ultimately manifest as sustainable resource consumption, eventually requiring a shift to renewable resources over the very long term. Hence, a shift from oil and natural gas to a combination of uranium, coal, biomass and other renewables, should be seen as the first step in a centuries-long transition. However such very long-term planning is not considered a priority for most developing countries, who are mostly focused on increasing levels of access to energy services for their economic and social development.

On the other hand, the authors find that sustainability and SoS diverge where the latter considers only the impact of resource availability, and not the impact of consumption. However, policies that promote SoS may go some way towards promoting broader sustainability goals, such as by reducing GHG emissions, or at least reducing the cost of pursuing future abatement, as long as these policies promote a shift to low carbon primary energy resources. Additionally, they may contribute to the political, economic and social stability that are preconditions for the implementation of policies needed to achieve long-term sustainability.

The study reveals that efforts to manage one of the risks (SoS or CCM) may actually reduce the costs of managing the second risk, meaning that there are some synergies in a combined policy environment, but that the interaction is by no means simple. Importantly, there may be risks associated with pursing one policy goal whilst ignoring the other, locking the energy system into a particular development path, hence limiting its flexibility to respond to uncertain future challenges.

An important limitation of this study is that the available risk management options for the two policy goals are restricted. Notably, it does not model reducing demand in itself, nor does it include demand reductions as a market response to policies designed to address security of supply or climate change. This simultaneously focuses the analysis specifically on (1) the role of fuel mix and technologies and (2) highlights the implications of attempting to manage these risks without reducing energy demand.

The energy supply security and climate change (Egging & van Oostvoorn, 2004)

This paper attempts to identify preferred options and provide recommendations for an integrated SoS and CCM policy. It provides an overview of interactions between the two fields and options to capture synergies. The study focuses on:

Policies that have lasting effects on the fuel mix and strategic and long-term energy supply security risks;

- Current policies of four regions: China, Japan, EU and USA;
- Current and medium-term future (2025-2030) quantitative energy dependence indicators for six regions: China, Japan, Brazil, India, EU and USA. The indicators examined are: population size, GDP, total energy use, the correlation between energy use and population size, the correlation between energy use relative to GDP, numbers relating to energy use and CO2 emissions by showing fuel mixes, CO2 emissions relative to GDP, population to Total Primary Energy Supply, relative and geographical import dependencies per fuel per country and presents the fuel mixes for the industry and power generation sectors respectively.
- Policy recommendations for integrating CCM and SoS objectives.

Egging & van Oostvoorn find that all considered countries/regions considered face significant and/or increasing import shares of fossil fuels, these being the most cost-effective in the short term.

In order to assess SoS policies and their impacts on climate change, the authors use a scoring mechanism to address environmental, political, economic, technical and institutional criteria. The scoring mechanism incorporates the impact on CO2 emissions, other environmental considerations and effects on the SoS. A worst-case SoS scenario would be a country that only uses one type of fuel, relying entirely on imports that must be transported using unreliable means of transportation, where this fuel is provided by another single country, located in a highly politically unstable far away region, which itself has only limited reserves.

A SoS scoring mechanism aims to help identify means of moving away from the undesired situation. The SoS scores are determined by measures that positively influence: (1) diversification of energy sources in energy supply; (2) diversification of imports from different sources; (3) long-term political stability in regions of fuel origin and (4) the resource base in regions of origin. The numbers 0 to 5 are used in the score; 5 indicating a highly positive effect and 0 indicating a negligible effect. The CCM scoring mechanism is generally based on the impact of measures and instruments on CO2 emissions. The scores are based on the CO2 emission factors of the respective fuels. The results of the ranking of preferred options for integrated SoS and CCM are presented in table 1.

Table 1: Ranking of options (Egging & van Oostvoorn)

Rank	Measure		Reason	Comments
1.	Demand-reduction measures		Attractive from all perspectives	
2.	RES	Biomass (+ CCS)	Feasible sustainable production; widely available and applicable	Arable areas must be available; careful with food-energy competition; combining biomass with CCS may actually have a positive CO_2 balance
		Small-scale hydro, geothermal power	Minor impact on landscape	Only an option in specific geographical circumstances; much cost-effective locations are used already
		Wind	Generally cheaper than solar, proven technology	Feasible onshore or offshore locations must be available; intermittency limits application
		Biofuels	Main short-term RES petrol alternative	For the transport sector
3.	RES	Solar	Small-scale applicability, Generally rather expensive	Mainly in near-equator areas; intermittency limits application
4.	Nuclear power			From an SoS and CO_2 perspective
5.	RES	Large-scale hydropower		When limited negative impact on nature and social criteria
6.	Fossil fuels with CCS			Mainly for coal; feasible for gas but relatively expensive
7.	Natural gas		Lowest CO_2 content among fossil fuels	Replacing coal or oil As CNG in the transport sector

A range of synergies appear to exist which can be captured by using the right policies. Nonetheless, there appear to be weaknesses and fragmentations in that governments in nearly all countries consider SoS and CCM separate policy fields although both of these policy areas will have direct influence on technology choice by industry and emission reductions from the use of energy. This is an important point and is especially applicable to the developing world where the capacity to formulate policy is much lower than that in developed countries.

Furthermore, measures enhancing SoS may conflict with CCM targets and vice versa, meaning that a coherent view of both policy fields is needed and that integrated policies should be developed to meet both SoS and CCM targets. As can be expected, starting points which are specific to each country have significant impact on preference order of measures and options. Furthermore, the authors highlight (1) the need for the combination of various instruments and policies that apply on different time and geographical scales; (2) the importance of the involvement of oil and gas producing countries and companies in order to obtain a broader climate change community and (3) that in many, but not all regions, SoS could be an extra argument for deploying climate-mitigating technologies.

The sobering, but probably realistic, conclusion is that real policy integration does not appear to be in sight in practice. Egging & van Oostvoorn further conclude and recommend that (1) integrating SoS and CCM demands a policy package aiming at demand reduction, cleaner fossil fuel use (presumably more efficient and possibly employing CCS), application of renewables and incentives for the development of new clean techniques.

ESCAPE: Energy Security & Climate Policy Evaluation (Kessels & Bakker, 2005)

This paper focuses on the US and has a two-fold aim: (1) exploring to what extent SoS and CC policy interact and can be linked on a national level and (2) exploring what the options are for linking SoS concerns into post-2012 climate change negotiations on an international level. The study follows the ESCAPE approach: Energy Security and Climate Policy Evaluation - suggests that linking climate change policy with SoS may improve climate policy at both national and international level. The paper puts forward a number of options that reduce import dependency as well as GHG emissions.

The interaction between SoS and CC policy can be synergistic in nature, or trade-offs may occur (Aerts et al., 2004). In other words, reducing greenhouse gas emissions may yield considerable benefits in other areas but not in all cases. Many measures that are taken in order to enhance SoS are synergetic with CC measures, such as renewable electricity, bio-fuels, nuclear power, hydrogen fuel (from renewable sources or fossil-based with carbon dioxide capture and storage – for example where large reserves of coal exist). For carbon capture and storage, implementation mainly depends on the price of CO2. Possibly more significant is the fact that policy measures in other areas may have a positive or negative impact on GHG reduction.

Kessels & Bakker find that if US policy is to enhance energy self-reliance, most measures would be synergistic with CCM. Concerns of SoS are typically national or perhaps regional (in the case of the EU) issues. As opposed to a country's GHG emissions, a country's energy security situation is of minor impact to another country – this is arguable: as nations seek to compete for an ever smaller resource base; for instance, the effects of increased Chinese demand for oil has increased prices and encouraged new exploration in Africa in particular and China and Japan are very much in competition to secure rights to Russian gas. As the fight for dwindling resources increases in the coming decades – which most commentators anticipate – and given the fact that ultimately competition will be on price, poor countries are likely to lose out in global markets.

The SoS issue has to date not been included in climate policy negotiations and is also not mentioned in any post-2012 climate regime proposal. However, as it deals with national interest, the authors suggest it could be a means to address the difficult issue of collective action in climate negotiations. Kessels & Bakker recommend that SoS interests be integrated in post-2012 climate policy strategies where possible, appealing to all major climate relevant world regions and therefore, can streamline this issue into climate negotiations to reap the synergies.

The study concludes that the advantage of energy security as a national interest is also an inhibiting factor for streamlining this issue into an international climate regime in the form of global targets similar to the top-down approaches in currently proposed post-2012 frameworks. The authors suggest that as the synergies between the two policy areas are mainly on a technological level, post-2012 regimes that include sectoral bottom-up elements or technology-based approaches would provide the most promising linking options. In general, linking SoS and climate policy on an international level entails some potential benefits as well as drawbacks.

Potential benefits:

- Appeals to basic national interests, opening up a new dimension in climate negotiations that serve in essence supra-national interests;
- Measures or projects that improve security of supply and thereby add to sustainable development are favoured over those that do not;
- By serving multiple objectives, costs of policy implementation may be reduced;
- Will encourage sustainable technology innovation and implementation.

Potential drawbacks:

- Main issue is increased complexity of design of a post-2012 climate regime. A common strategy, e.g. on technology development and diffusion, for climate change as well as energy security needs to be established between groups of countries. Both designing the combined polices between countries on these issues as well as reaching common ground, will require numerous rounds of negotiation and policy-making;
- Including an energy security criterion in carbon credits in emission trading, will also add to complexity in markets that are in early stages of development.

Energy security and climate change policy interactions: an assessment framework (Blyth & Lefevre, 2004)

The goal of this study, carried out for the IEA, was to assess whether a quantified approach can contribute to a better understanding of interactions between various drivers of energy policy, and eventually be useful to define a more efficient approach to achieving different policy objectives. In order to do this, it relies on the observation of how proxy measures evolve under various policy scenarios. It is important to note that the quantified assessment allows a study of the policy interactions, but does not attempt to define an intrinsic value for the proxies. The key premise is that policy drivers are eventually linked through the fuel and technology mix of the country in question.

The proxy measures that are used in the study are:

For climate change mitigation (CO2 emissions);

- For geopolitical energy security, a measure of market concentration of energy suppliers;[1] in addition the study includes political stability of trade partners and supply fluidity as proxies. It also highlights the option of including “remaining resources” as an additional proxy in the future. In addition a proxy for “concentration of physical energy supply routes” could yield useful information for certain countries.

[1] The study assumes that OPEC will act as a single supplier for the coming decades to 2030.

- For power supply reliability, the proxy measure used is the back-up capacity required to ensure reliable system operation when intermittent generation sources are added to the system.

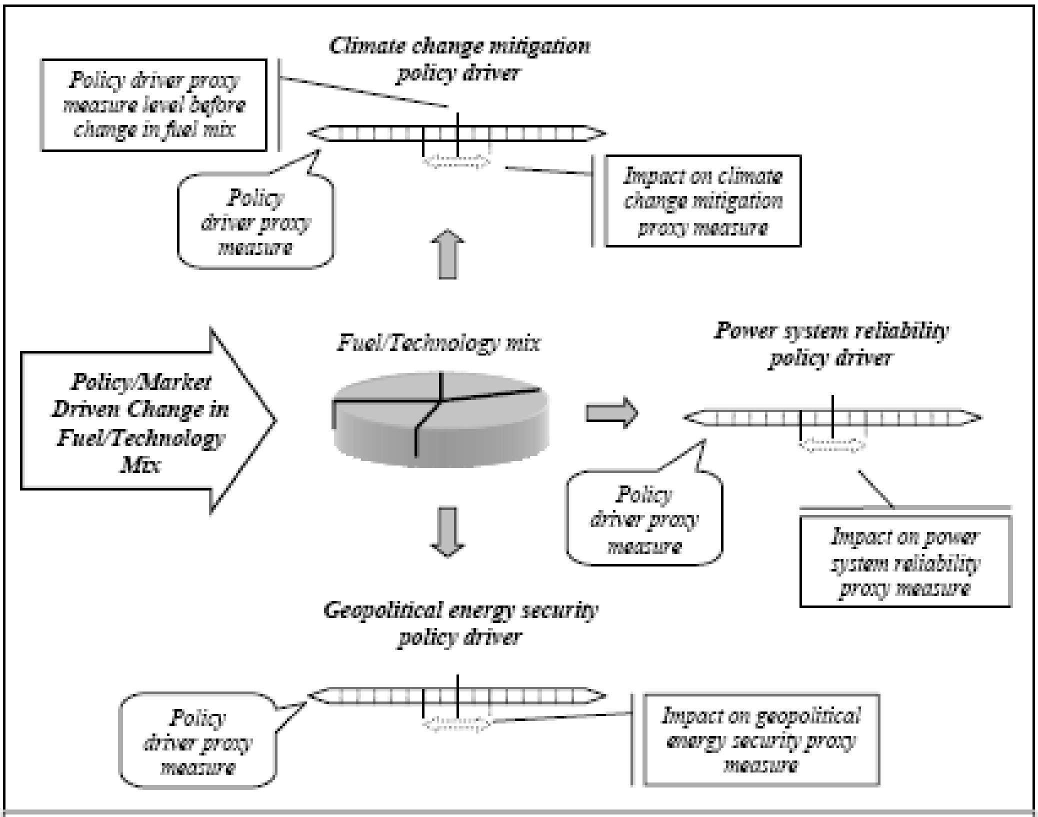
The impact of a change in a country's fuel and technology mix on CO2 emissions, geopolitical energy security and power system reliability depends on the characteristics of the country's existing mix and of the fuels and technologies that will be displaced. It was found that absolute values for different proxy measures are hard to interpret; however the quantitative technique used is found useful in analysing how the risks associated with these elements change as energy markets and consumption patterns change.

Four case study countries were used for the analysis: the U.S, the U.K., Italy and Australia. Firstly the study looked at a base case scenario or Business As Usual (BAU) scenario for the four countries from 2001 till 2030. The preliminary analysis indicates a worsening of the situation in the four illustrative countries in terms of both CCM and geopolitical SoS under BAU conditions, although differences identified among countries are important.

Using a numerical framework to evaluate the magnitude of interactions, the study subsequently examined the effect on the proxies defined of four different simplified energy policy cases applied to the four countries:

- Changes to power generation mix;
- Changes in mix of transport fuels;
- Oil and gas infrastructure improvements;
- Energy efficiency.

Figure 1: Assessing policy driver interaction (IEA 2004)



For each policy driver considered, a proxy measure is defined which responds to changes in the fuel / technology mix. An assessment is then made of the effect of a market- or policy-driven change in the fuel / technology mix on each of the different policy drivers, so that the resulting interactions between the drivers can be assessed

The approach highlights how a quantified methodology can improve understanding of policy interactions. Qualitative approaches can identify whether policy interactions are synergistic or conflicting. However a quantified approach has the added benefit of evaluating the magnitude of the interaction.

The authors find that, for example, although policies targeted at substituting oil consumption (e.g. in the transport sector) do improve CO2, they have an even stronger effect on improving geopolitical energy security. On the other hand, policies aimed at reducing coal and gas (e.g. in the power sector) are more strongly weighted towards improvements in CO2 emissions than in geopolitical energy security.

This approach contributes to understanding how policies may have different implications in different country contexts. The impact in terms of power system reliability, CO2 emissions and geopolitical energy security of a change in the fuel/technology mix depends on the characteristics of the country's existing mix and of the fuels and technologies that will be displaced.

The authors also suggest some improvements and possibilities for the approach they adopted:

- Include more proxy measures, for example more proxies for energy security, as indicated above, as well as other aspects of energy policy including local environment, employment etc.
- Refine the proxy's already introduced;
- Apply the approach to internally consistent energy model runs.

The study concludes that continued policy intervention and that the interactions between energy security and climate change are likely to become increasingly important. In order to address this there is a need for more sophisticated tools to evaluate policy drivers and their interactions, taking into account national specificities.

Oxford University High-Level Taskforce on Reconciling Energy Security, Climate Change, and Development (2006-7)

A high-level task force was formed in 2006, organised by the Global Economic Governance Programme, University College[2]. This task force includes prominent former members of government and government advisors, leading Oxford academics, the Deputy Chairman of Royal Dutch Shell, a former British Ambassador to Russia, the Environmental Policy Advisor to Rio Tinto and former Environmental Advisor to BP, the Associate Editor of the Financial Times, the Director of the Development Research Group at the World Bank, and the Director of the United Nations Human Development Report Office.

At the time of writing the task force has not reported. However the main terms of reference for the task force are set out below.

Extract from the web site: "The energy environment has changed dramatically for the UK over the past 10 years – low prices for oil and gas have become high; self-sufficiency in oil and especially gas has given way to increasing dependence on international imports; those providing these imports are increasingly willing to use their energy weapon; an excess of electricity generation capacity has been run down and now the emphasis is on replacement; and the rise of China and India has created new international competition for resources. All of this has created fears of a crisis in Britain's energy security – reflected in Tony Blair's

[2] http://www.globaleconomicgovernance.org/

remarks that 'Without action to ensure reliable supplies and replace power plants, there will be a dramatic shortfall in our energy capacity and risk to our energy security over the next few decades.' And that 'in the future energy security will be almost as important as important as defence to our national security.'

Britain's policy response has been focused almost entirely on domestic and international actions to deliver energy security. At the same time, however, Britain has ambitious goals for climate security and international development. The connections between these three areas have been almost entirely ignored in public discussions, and the UK government has certainly not found convincing ways of reconciling these competing goals. As a result, there are fears that an aggressively single-minded pursuit of energy security will compromise these other goals.

The Oxford Taskforce has been assembled to examine the underlying linkages between the three policy goals – energy security, international development and climate security – and to recommend actions to reconcile them. "

Finally the World Bank Investment Framework for Clean Energy and Development (2006) states that "Approaches to addressing energy security are consistent with those needed to transition to a low-carbon economy. Diversification of energy supply and improvements in energy efficiency can address both issues simultaneously". However there is limited analysis to back up this claim.

Overview of Studies

Each of the five studies suggest that there are potential synergies and trade-offs for SoS and CC policy:

- Smith et al. (2002) find that climate-friendly energy policies advance overall energy policy objectives;
- Turton & Barreto (2006) propose that when a stringent GHG policy is pursued, many of the objectives of SoS regarding, at least for oil, are achieved;
- Egging & van Oostvoorn (2004) find that a range of synergies exist which can be captured using the right policies;
- Kessels & Bakker (2005) state that many measures that can be taken in order to enhance SoS are synergetic with CC measures;
- Finally, Blyth and Lefevre (2004) find that policies targeted at substituting oil consumption do improve CO2 and that these have an even stronger effect on improving geopolitical energy security.

Hence, although each of the studies take a different approach to the question of policy interactions, there is a strong indication that synergies do exist and can be captured with careful policy planning. However the interactions identified are not straightforward and are frequently directional. Each of the studies highlights the complexities of streamlining SoS and CC policies, that trade-offs exist. They all stress the need for to take into account national and regional specificities, and stress the necessity of capturing interaction synergies through locally appropriate policy measures. In particular, in the context of this scoping study, further analysis would need to take into account social and economic development goals for developing countries (energy for growth, access for poverty reduction); as these studies did not address African countries, these elements are missing from the studies included in this literature review.

Temporal and Geographical Aspects

The geographical and temporal aspects of SoS and CC policies add a complex dimension to the policy interactions. Policies are often made under short term time horizons and are responsive to mercurial politicians and changes in national governments or they are hostage to reactive policies in response to changes in the global energy situation – the oil crisis of the 1970s promoted increased interest in renewables, but as the oil price declines during the 1980s government policy changed. However, policy interactions between the three drivers clearly need to be addressed on a medium-term timescale if they are to be effective in practical, environmental, political, technological and economic ways. This is a considerable difficulty for policy makers as it requires foresight, consistency and the implementation of perhaps unpopular measures. Furthermore, it is apparent that long-term SoS has a number of features in common with long-term sustainability, although important differences exist (Schrattenholzer et al., 2004). The studies presented looked at different temporal scales, ranging from the current, 21st century, medium future (2025-2030), post-2012 and 2001-2030. It is important to bear in mind that different timescales used in different studies will identify different preferences in the types of policies and technologies that are recommended in order to bring SoS and CC policy closer together. As Turton & Barreto (2006) suggest, the period over which SoS needs to be maintained may have an impact on the choice of fuels and hence technologies.

A few issues should also be taken into account concerning geographical aspects. Countries that rely heavily on imports of fossil fuels for example will have different SoS concerns than major fossil fuel suppliers. Likewise, politically unstable countries may be more vulnerable to attacks on their physical energy infrastructure. Also, the SoS profile for a country like Australia - physically cut off from other countries - will also play an important role in its energy policy decisions.

On the question of renewables, some similar points arise in the sense that the renewable potential will be country or region specific, as well as how this potential can be incorporated in SoS and CC policies. Furthermore, from a developed versus developing perspective (North / South), CC policies mostly concern the developed world and is nowhere nearly as high on the agenda's of developing countries. Likewise, for SoS, the developed countries are concerned in order to keep their economies and the increasing living standards running, while developing countries are mainly concerned in the initial stages of their economic growth.

Where there is intense competition for energy resources – an existing situation, likely to increase given increases in global energy demand and relative reductions in identification of significant new fossil fuel reserves- the poorer, weaker developing countries are likely to lose out to the more powerful. Policy choices and their interactions will be very different depending on the geographical aspects of the countries and/or regions in question.

Technology

It is important to bear in mind that technologies may take decades to develop and may not even be possible or commercially viable (Blanchard & Perkaus, 2004). Although new and advanced technologies have the potential to help achieve a given policy outcome for a lower cost, Turton & Barreto (2006) show that it is important to consider the extent to which the choice of technology for policy support may limit flexibility to pursue additional policy goals. The interaction between technology and other policies highlights that a technological development alone will not necessarily result in the best social outcome, particularly where market imperfections promote the use of a technology in undesirable ways (Turton & Barreto, 2006).

There exist obvious synergies between technologies which may improve SoS and also aid CCM, providing a 'win-win' scenario for governments. However, there are also technologies which may promote SoS but not aid in CCM, such as enhanced energy storage and transmission facilities and coal to liquids technology. But, energy policy choices can impede or enhance development and deployment of new technology and infrastructure that will reduce the cost of controlling GHG emissions in the future (Smith et al., 2002). Furthermore, technology deployment policies can influence the efficacy of energy security and GHG abatement policies, but simultaneously the impact of these policies on the energy system also depends in large part on the broader policy context (Turton & Barreto, 2006).

Drivers, Weighting and Proxies

Different weighting can be given to different drivers, and this is apparent from the studies presented above. Additionally the drivers looked at are energy security and climate change. As all of these studies are focused on a developed world context, it is evident that equitable energy access does not feature as a driver in any of the analyses.

One of the extensions of the proxy measures that Blyth & Lefevre (2004) suggest, and which may be particularly important in a developing country context and in our particular case studies, are physical energy security supply drivers and concentration of physical supply routes, particularly when considering oil and gas supply routes.

As stated previously and as is apparent from the case study results, most developing countries weigh CC rather lightly in the policy context, while this is not the case in developed countries.

Gaps in Knowledge

While work has been undertaken in this area, the gaps in this research area are large in general and very large with respect to poor, oil-importing, developing countries. A sound understanding of the policy interactions between SoS and CC, as far as this is possible for such a complex issue, remains out of sight. The policy interactions between the three drivers (i.e. including equitable energy access), is yet to be instigated. Amongst others, there is a lack of data, capacity and as mentioned at the outset, there has been no attempt to look at this issue for developing countries.

Concerning the lack of data in particular, the information required to carry out policy interactions analysis is already hard to find in the U.S. and E.U., and almost non-existent in many developing countries. Hence, a system to generate such data in a consistent and useful manner will have to be at the basis of any framework/research effort in order to efficiently investigate policy interactions between the three drivers on national, regional and international scales.

There is thus a need to enhance conceptual understanding of the interactions between the three policy drivers for developing countries. This needs to be followed by the development of some developing country-relevant studies, possibly based on proxies for energy security, CCM and access (especially for national energy security.

For developing countries the trade balance is often a troublesome issue. Modern renewable energy sources could greatly increase their access to energy supplies and thereby be a prerequisite for development, while simultaneously decreasing the amount of cash needed for energy imports (Egging & van Oostvoorn, 2004).

Conclusion and Future Outlooks

As very little has been done in this area, there is a great opportunity to initiate it in a structured and harmonised manner. This should include a framework for collecting and filing data and a structured yet flexible methodology to obtain informative and useful information on how to best direct policies regarding energy security, climate change and equitable energy access.

The concept of using proxy measures - climate change mitigation, geopolitical energy security and power supply reliability - (Blyth & Lefevre, 2004) is appealing, as it allows a quantified approach with proxy measures evolving under different policy scenarios. However this approach would need to be developed for poor countries in the developing world, and it remains to be seen whether such an approach would be possible given the lack of data, capacity etc. Drawing on the other four studies, each of the approaches could be turned into some sort of proxy measures. For example, in Smith et al (2002) the three categories of energy polices that are climate friendly[3] could be turned into more appropriate proxy measures. The same could be done for the three policy initiatives in Turton & Barreto (2006), the four points[4] that are scored in Egging & van Oostvoorn (2004) and so forth. Developing a common set of proxy measures that can be used in various countries, developing or developed, would appear to be an option to consistently and effectively study policy interactions between the drivers. This would also help to identify the gaps in data and where efforts for data production and collection should be focused. However care is required to ensure that the "meta-framework" provided by the proxies defined are adequate to cover the particular policy goals of each country and do not prescribe from a simplistic menu of options. Also it has to be recognised that any framework for developing countries would need to be useable given the limited data available in developing countries.

From the above analysis, it could be concluded that considerable further work would be required to develop a framework to examine policy interactions consistently for developing countries. One approach would be to develop a meta-framework appropriate for developing countries, followed by a scenario or risk management approach for individual each country/region. Issues to consider include:

- Identify key objectives that drive energy policy in developing countries, assess the weighting of different drivers, using a framework appropriate for poor countries (including increasing energy access, relative vulnerability to oil price volatility and weakness in international markets etc);
- Develop more sophisticated tools to evaluate policy drivers and their interactions, taking into account national specificities in developing countries; this could possibly be based on a risk management approach.
- Improve the availability of data for energy planning, including from key energy using sectors (transport, industry, agriculture etc).

[3] (1) immediate reduction of GHG emissions; (2) promotion of infrastructure development or technology advancement that will reduce the costs of achieving GHG emissions reductions in the future and (3) curtail the amount of new capital investment in assets that would be considerably devaluated if a GHG program were implemented.

[4] (1) diversification of energy sources in energy supply; (2) diversification of imports with respect to imported energy sources; (3) long-term political stability in regions of fuel origin and (4) the resource base in regions of origin.

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ANNEX IX: ENERGY MODELS AND ENERGY PLANNING LITERATURE REVIEW – APPLICATION OF MODELS FOR ENERGY PLANNING IN DEVELOPING COUNTRIES.

Introduction

This paper examines the current state of play, and potential of energy models to assist developing countries to face the challenges of energy access, energy security and climate change in medium to long-term energy plans. With a view on the stated aims of the overall report the paper reviews existing literature to review the applicability of various modelling approaches. A number of existing energy models are also reviewed to gain an understanding of their capabilities, their area of geographic focus and their relevance to the task in hand. In conclusion, the paper does not seek to define a new approach to energy modelling in developing countries, rather suggests which modelling approaches and which aspects of existing models may lead to greater optimisation of the three drivers for the purpose of medium to long-term energy planning and policy.

The Challenge

The 'energy chain' or factors influencing the production and use of energy is large and complex. It directly encompasses; energy services (heat, light, transport etc..), economic activity, energy-related infrastructures, energy technologies and fuel supply (IEA, 1998). Mapping the relationships and interactions between these factors and adding in exogenous factors such as trade policies and geopolitical security issues makes energy modelling a complex business. Energy models have traditionally been used to forecast such things as energy's effect on GDP, or the behaviour of energy markets. In recent years much attention has been focused on climate change issues, and the relation between economic activities and greenhouse gas (GHG) emissions. Given the potential economic impact of climate change policies, modelling can be a cost-effective way to avoid costly policy mistakes (Gielen and Karbuz, 2003).

Energy models are needed to both evaluate how policy can be optimised to integrate environmental, economic and energy security drivers, and to simulate the effects of energy policies on each of the drivers and their interactions. In summary, energy models allow:

- Investigation of functional relationships through a systematic introduction of information;
- Objective evaluation of results, providing the basis for future action
- Ability to view the energy sector on different scales, from detailed micro process models through to macro models of national, regional and world systems or economies, and;
- Simulation of the effects of policy measures on the energy sector and production of further projections.

Much of the existing modelling work is focused on the developed world, with few models focusing on developing countries (Pandey, 2002). Developed world models can be categorised in a variety of different ways such as objective based models seeking to predict future energy demand, through to supply focused models predicting which primary energy sources will be used to meet a given demand scenario. However, developing countries differ significantly from developed countries. Characteristics such as the existence of large scale inequity and poverty, dominance of traditional lifestyles and markets in rural areas, transition of populations from traditional to modern markets, existence of multiple social and economic barriers to capital flow and technological diffusion, and the radical nature of policy changes being currently witnessed in energy industries are important considerations for energy and economy policy, and therefore must be accounted for or represented in energy models in developing countries.

The medium to long-term timescale - Kydes et al, define medium term modelling as between 5-25 years and long-term modelling from 25-50 years (Kydes et al, 1995) – increases the cumulative effect of gradual structural changes and the chances of a revolutionary event (e.g. technological innovation) occurring reduce the certainty of modelling outputs; especially in developing economies which for many of the reasons given in the previous paragraph are undergoing much faster structural changes than more mature, developed economies. Thus far, modelling applications in developing countries have imitated the paradigms of developed economies, leading to a low degree of confidence in their results and policy prescriptions. Their capability for enabling a comprehensive policy analysis for developing countries is limited (Pandey, 2002).

There are also few examples of existing models which attempt to quantify interactions between energy related factors which are of primary concern in the developed world; energy security, climate change and economic efficiency' (Blyth and Levèvre, 2004) - models which seek to do this for developing economies are also correspondingly few. One of the difficulties is defining appropriate proxies for each of the drivers and assessing the value of the trade-offs between them. For instance, a common proxy for climate change is CO2 emissions; however the emissions of one country (especially a small developing country) will have a minimal effect on overall global emissions. Other proxies for global warming which may be more relevant, could be the extent to which local impacts and risks of global warming are reduced by future energy policy; however, it is difficult to see how this could be easily quantified. There are no straightforward, and well established, proxy measures for energy security (Blyth and Levèvre, 2004). Import dependency, power system reliability and geopolitical risk exemplified by long-run price distortions in the energy market or a combination of all three could all be used as proxies but national policy is unlikely to have a strong impact on wider geopolitical security. Energy access is perhaps easier to measure. Often not a factor in developed world models, it is usually a key aim of energy policies in the developing world. Proxies such as access to electricity, heat and fuel are all relevant here.

Different Model Structures

Energy models may be characterised in many different ways. One method does not need to exclude the other, van der Zwaan states that energy models can be divided into two different categories (bottom-up and top-down) (van der Zwaan, 2002). This may be true when viewed from a perspective standpoint, but ignores other ways of sub-dividing energy models; for instance, by overall objective, by technique or methodology and model breadth (sub-regional, national, regional etc..). The bottom-up and top-down perspectives and approach of different modelling techniques, and their suitability for developing countries are described below.

Econometric Models

Econometric models are most commonly use for demand projections, using input parameters such as population, income and the price of goods. Using statistical techniques they determine values based on analysis of historical relationships with other (input) parameters. A key assumption is that observed behaviour from historical time-series can be used to predict future outcomes. It can obviously be difficult to forecast future scenarios where limited previous data exists and where future scenarios may be unreliant on the past. This is especially true in developing economies where previous data may be incomplete, inaccurate or unavailable and where future energy scenarios are likely to differ significantly from the previous energy environment. For instance, external trade and technological change will react depending on inter alia exogenous policy changes, trade barriers, and the rate and impact of climate change (Gielen and Karbuz, 2003). Econometric models may have a role in predicting the size and type of future demand assisting energy planners to predict supply but they are unlikely to be able to inform planners how their policies will impact on energy security or climate change considerations.

Simulation

Simulation models aim to simulate an energy system by representing relationships between the key parts of it. This can range from simple relationships between a few 'actors' or factors of interest to complex representations of many factors interacting. There is some overlap between simulation models and econometric and optimisation models. For instance simulation models may aim to predict energy demand through a GDP / Population function in a similar way to econometric models. Simulation models may seek general (where inputs are automatically adjusted to be consistent with calculated outputs) or partial equilibrium (where external manipulations are used to make inputs and outputs consistent). General equilibrium simulation and system dynamics simulation approaches have been adopted for analysing long term implications of macro-economic policies such as market based instruments, the effects of privatisation on prices and capacity investment. These give energy supply and demand patterns in a unified framework but lose the detail gained from energy sector models which incorporate energy-economy interactions. Indeed, the trade-off between displaying energy sector detail and providing a fully unified treatment of energy-economy interactions, including their changes over time, remains a key challenge to effective long-term modelling (Kydes et al., 1995).

Optimisation

Optimisation models seek to optimise some goal or objective, and are commonly used to minimise energy supply costs for a given demand. For instance, optimisation models can simulate the competition among fuels and technologies and choose the most cost-efficient mix of technologies and fuels to meet exogenously-determined energy demands and to comply with the emission limits, if the minimization of cost over the entire planning horizon is chosen as the objective function (Zhang and Folmer, 1998). Typically they seek to simulate a given energy system and to then add:

- an objective function (e.g. minimise cost).
- Specified constraints (e.g. power supply must exceed demand by 10%)

Minimisation of cost is not an explicit driver for this energy planning study, but this objective can be substituted for a carbon based objective, however optimising energy security may be more difficult to model as many factors will be exogenous to a countries energy system. Proxies for energy security could include geopolitical security and power system reliability (Blyth & Lefèvre, 2004), it is difficult to envisage how a national or even regional optimisation model could seek to maximise geopolitical security.

Modelling Perspectives

Table 1 gives an overview of the inputs and structure of top-down and bottom-up energy modelling. A top-down model is based on macro economic modelling principles, and techniques, and is intended to include all important economic aspects of the system being modelled. These models are used to inform aspects of energy policy which are concerned with implications for macroeconomic indicators and economy-wide emissions. The particular focus of the top-down approach is market and economy wide feedbacks and interactions, often sacrificing the technological richness of the bottom-up approach. (McFarland et al, 2004). Computable General Equilibrium Models are the most complete in representing economy-wide interactions, including international trade, energy supply and demand, inter-industry demand and supply for goods and services; on the other hand they are least rich in their representation of technological details. Indeed, CGE models rely on substitution elasticities to forecast the cost of substitution between different energy technologies under different energy policy constraints, even in developed countries the data available to estimate these elasticities are difficult to accurately obtain (Bohringer, 1998).

Bottom-up approaches in contrast, are highly detailed at an end-user level, and are based on desegregation and technical parameters. They are able to represent energy supply processes, conversion technologies and end-use demand patterns in detail due to explicit absence of activities external to the energy sector (Kydes et al., 1995). Whereas top-down models use econometric analysis and exogenous inputs to determine technological change (van der Zwaan, 2002), bottom-up models are able to predict technological change by incorporating learning curves and projections of technological efficiency.

Jacobsen 1998 summarises the suitability of each approach thus:

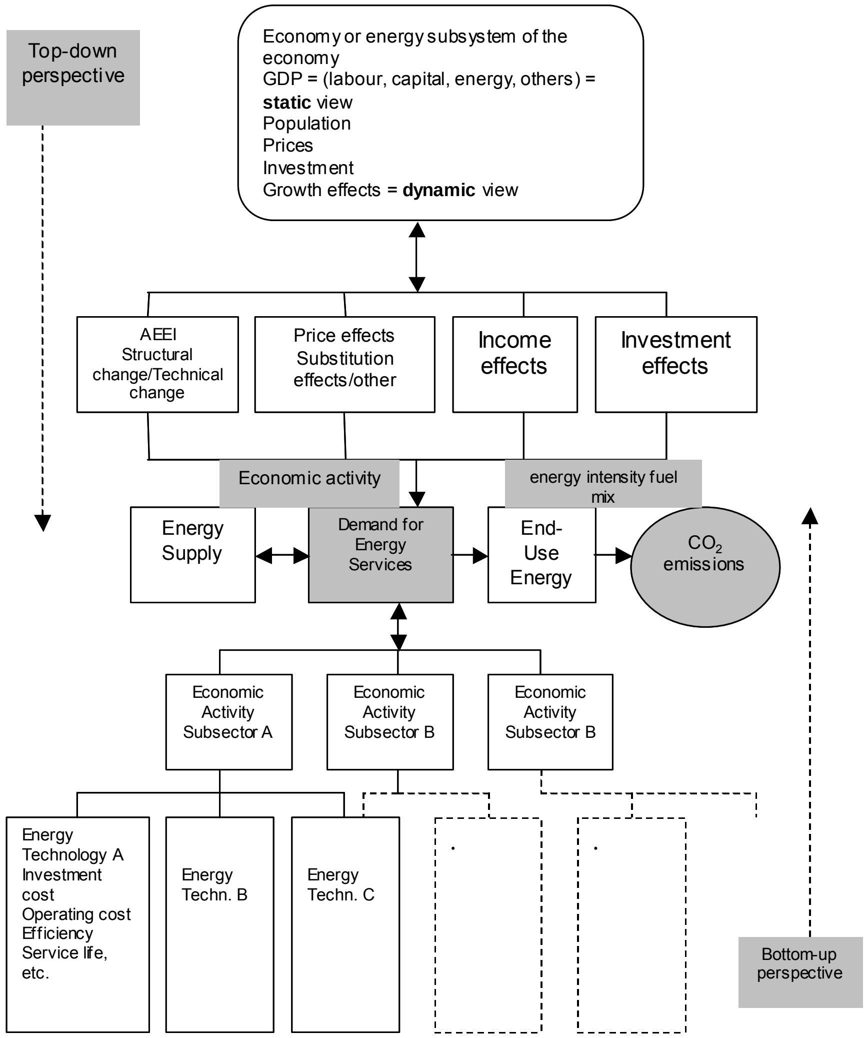
Bottom-up

- Regulation and detailed energy planning;
- Restructuring of energy supply sector;
- Using standards for housing insulation or electric appliances; and
- Project the technological development in order to quantify the aggregated development in energy efficiency

Top-down

- Energy taxes;
- Effect of different economic scenarios on energy and environment;
- Macroeconomic consequences of changes in the energy system; and
- General equilibrium effects

Table 1: Modelling Approaches



Source (IEA, 1998)

Model Requirements

For energy models to inform policy makers facing the three challenges of equitable access, energy security and climate change in energy planning in developing countries, they must; display the impacts of different policies on each of the drivers; account for feedback effects between the drivers, and the effects from wider national or regional economic policies; and account for the transitional nature of many developing country economies. The first two criteria will also apply to developed country modelling exercises. However, the need to foresee the wider impact of the development of emerging economies and the variety of investment paths which may occur is much more relevant to developing countries.

Energy Models and Developing Countries

Given the requirement to look at energy planning over a medium to long-term timeframe, the national or regional scale of this exercise and the need to account for the impact of other aspects of the economy, a top-down modelling paradigm is an obvious candidate for a modelling approach. Markets in many developing countries are growing rapidly and there are a variety of different investment paths which may occur. Policies with respect to these choices (for instance R&D policies, tax policy and trade policy) will have a significant impact on the outlook and competitiveness of various technologies in the long run as well as on levels of consumption, making bottom-up technologically based modelling approaches unsuitable to the long-term timeframe. Macro economic variables and changes in energy markets (liberalisation etc.) can have a big effect on energy scenarios, for instance higher interest rates decrease the attractiveness of capital intensive projects such as hydro/nuclear relative to projects which have low capital costs but high running costs such as gas.

Developing countries also witness greater levels of uncertainty because they are far behind their economic stabilisation levels. Uncertainties can be classed into two categories: policy uncertainties such as the rate of infrastructure development, R&D and privatisation, and non-policy uncertainties largely exogenous to national decision makers such as the price of imported goods, international policy (e.g. environmental / carbon taxes) and the availability of fossil fuels. Most developing countries have still to make most of their investment decisions before the growth of their economies approach saturation – their economies will continue to witness changes in almost all industries over the next several decades. These uncertainties need to be fed into any long term developing country model as they may materially affect the energy infrastructure and generation path.

However, there is also a need for the more short term, micro level decisions in technological choices, fuels and operational decisions to be modelled from the ground-up, and for the impacts of these decisions to 'feedback' into longer term effects on the economy (Pandy, 2002). For instance, policy decisions relating to the energy sector will influence the investments and prices in other sectors of the economy over the short to medium term. These changes will feedback into the energy sector and depending upon their impacts on supply, prices and technological choice will affect long-term consumption patterns and technology mix.

Bottom-up models are useful for evaluating and implementing short-term options in technologies and fuels because micro-level technologies and operational options offer significant scope for improvement in developing countries – perhaps not so in developed economies where technological efficiencies and rate of capital investments have reached close to saturation levels.

For the purposes of lowering climate impacts, bottom up models have the ability to determine least-cost technology mix and can assess cost and emission implications of different technology-mix scenarios. They are however limited in their policy prescriptions because they do not incorporate the effect of change in market structure and consequent changes in norms for technology and fuel selection. These models assume the old government regulated centralised planning regime for laying down the criteria for technology and fuel selection for the future.

For an economy which is growing quickly (many developing economies have high, if volatile growth rates and sub-Saharan Africa's electricity demand is growing by 7% a year) electricity is essential. Incorporating available technological options and their future potential versus their climate impact through a bottom-up approach will to some extent be necessary to plan effectively with regards to the planning drivers. A bottom-up approach is also necessary to quantify the decentralized off-grid approach to electrification which occurs in many developing countries. There are examples of isolated bottom-up models estimating electricity demand and evaluating supply options for decentralized grid electrification (Banerjee et al, 2000, Pandey, 2002) but these have not been combined to address the bigger picture. Another important aspect requiring the use of bottom-up techniques to account for decentralized energy usage is the modelling of the transition towards modern energy systems in many rural areas. Modelling how this change occurs, and over what timescale, is important for assessing the impact on energy access and through the fuels used, climate change. Such changes are likely to be dependent on cost, proximity, ease of use, reliability and availability of technology. Studies and models developed in industrially advanced countries assume well-developed markets, perfect competition, minimal trade and other social-economic barriers, and non-existence or traditional economies; therefore they are unable to model the policy priorities of equity of distribution and sustainable resource use (Pandey, 2002). Existing models also used for developing countries also suffer from this bias. Consideration of modern use of biomass for energy will require modelling of the transition from traditional to modern markets – representing such dynamics is still unexplored but key challenge for energy policy modellers of developing countries (ibid).

There is therefore a need for a complete framework which includes centralized and decentralized options. Integration of both top-down and bottom up models may allow a better and more complete demonstration of the short term decisions and improvements in operational practices married with the long-term policy decisions which will affect investment, technologies and market structures and the feedback effects.

Overview of Existing Models

The models described below were all developed to analyse energy systems of modern economies; in some cases they have been modified for use in the developing world. They are intended to give an illustration of how existing energy models are able to assist policy makers in developing countries today.

MARKAL

MARKAL is a linear optimisation tool developed by the IEA, which can be used to identify least cost energy systems, to identify cost-effective responses to restrictions on emissions and to project future greenhouse gas emissions under a range of different energy scenarios for a time period of up to 50 years in the future. The model requires a series of input projections to run on both the final demand side (room space to be heated, lighting demand, miles travelled) and from the supply perspective (cost of fuel, availability of fuel). Regulations and taxes can be added which may increase the cost of more carbon intensive forms of generation, or explicit emissions limits can be specific. The model is also able to incorporate endogenous technological learning to simulate lower costs for new technologies in future. Once all supply and demand inputs have been added the model is run and depending upon the input variables produces a least cost mix of generation options to meet future demand. As more restrictions are added, the model can be re-run to estimate the impact and cost of additional measures. MARKAL MACRO combines MARKAL with wider macro economic models to simulate economy wide feedbacks and was specifically designed to estimate the costs and analyse alternative policies proposed for reducing environmental risks such as climate change. Unlike MARKAL, MARKAL-MACRO energy prices and demands are calculated within the model through the interaction of the energy system with the rest of the economy.

MARKAL and MARKAL-MACRO are widely in use in OECD countries – the UK Energy Research Centre has been setting up a UK specific model for several years. Indeed, one of the disadvantages of MARKAL is the amount of data needed to run the model effectively. The MATTER MARKAL model, (a more complex version) requires around 10 man years of data collection and 1 man year of modelling to run. The highly aggregated description of the economy in the MARKAL-MACRO version is also unable to provide detailed information on the impacts of compliance with CO_2 emission limits of individual industries. This may be sufficient for global studies but is not helpful for individual country analysis.

Long Range Energy Alternatives Planning Model (LEAP)

LEAP is a bottom-up simulation energy planning model that covers energy demand, transformation and supply. It is used to represent the current energy situation for a given area – it does not attempt to estimate the impact of energy policies on the wider economy or generate general equilibrium scenarios - and to then develop forecasts for the future under certain assumptions. LEAP is used mostly in developing countries, (for instance Thailand and South Africa) mainly because it includes the supply of biomass as an energy source (Siteur, 2007) and has been supported by a number of donor agencies (SIDA, GTZ, USAid and UNDP), currently major funding is provided by the Dutch government.

LEAP uses scenarios constructed to depict how energy systems might evolve over time in a particular socio-economic setting and under a particular set of policy conditions. Scenarios can then be compared to assess their energy requirements, social costs and benefits and environmental impacts. For instance, a series of individual policy measures can be combined to create a scenario aimed at reducing Greenhouse Gas Emissions and compared to another scenario containing measures aiming to improve local air quality. Each scenario may then be evaluated in response to a number of local objectives such as increased energy access or improving air quality.

LEAP is being used in Thailand to provide support towards Thailand's energy policy targets which are being driven by the need to improve energy security and economic competitiveness, to minimize environmental impacts of energy production and the need to contribute towards global efforts to reduce GHG emissions (Du Pont, 2006). Policy targets such as reducing total energy consumption by 20% by 2009; reducing oil use for transportation by 25% by 2009, increasing the contribution of bio diesel to 8.5 million litres per day by 2012. LEAP will be used to integrate outputs from individual research groups to come up with overall assessment of costs, benefits, and environmental and social impacts of the proposed set of RE and EE policies and measures. Work is currently underway dividing the Thai energy sector into different demand and supply sectors with historical data being entered into LEAP. Overall, it is planned that 40 scenarios containing energy saving measures, application of renewable energy technologies and sensitivity analyses will be developed and then combined with each other and the results compared to rank the measures according to their helpfulness to reach energy policy goals. Following this other steps in the project may be to research GHG emissions and enter them into LEAP, the model can then simulate how technology improvements and policy measures could be used to reduce them.

The ease of use and applicability of LEAP to developing country needs are obvious advantages to the model: set-up costs are reduced and flexibility reduces maintenance costs and allows new developments to be easily modelled. Some of the drawbacks of LEAP may be its simulation rather than optimisation nature and if a large number of scenarios are constructed it may be difficult to keep track of and compare outputs. Again, the model is only as good as the reliability of the data entered, in Thailand's case, the major problem is the availability and accuracy of data, with often contradictory reports offering illogical values (Du Pont, 2006).

Prospective Outlook on Long-term Energy Systems (POLES)

The POLES model is a long term partial equilibrium simulation model built up of interconnected sub-models at the international, regional and national level. For each region (and key countries) the model articulates energy demand, primary energy supply and the technology mix. Energy prices (i.e. fossil fuels) are endogenously determined in separate sub-modules (for oil this is calculated on a global scale, gas and coal are calculated using three regional models) using data on the ultimate recoverable resources in key countries and historical production rates. Demand is disaggregated into 14 sub sectors such as the steel industry, road freight transport, agriculture and the tertiary sector. The demand module uses behavioural equations to take into account the combination of price effects, techno-economic constraints and trade using price elasticities and technological trends which can be programmed for each sector. Unlike larger CGE models POLES incorporates an element of learning and feedback for predicting future technology mix through the use of learning curves, and niche-markets for specific technologies.

The model allows energy planners to simulate detailed long term energy demand, supply and price projection, CO2 marginal abatement cost curves, and future technology scenarios. Both energy supply considerations and CO2 costs are useful for the purposes of this study. However, the model is very much driven from a developed country perspective (it was commissioned by the EU and has been used by to aid policy makers in DG-TREN, DG-ENV and DG-RESEARCH): only five developing countries are represented (sub-Saharan Africa is considered as one region), traditional resources such as biomass are not represented and the lack of feedbacks with the wider economy make it difficult to account for the impact of favourable or less favourable economic conditions on technology choices and the transition towards modern energy sources. Endogenously determining fossil fuel supply, and price, also makes it difficult for energy planners to quantify the impact of higher costs on the energy system, and to understand how different sectors will respond rapid price changes.

Conclusions

There are a variety of different modelling approaches and techniques in use, driven by the need for different outputs and results; top down general equilibrium models can aid governments to plan and forecast the effects on the economy of changing energy prices and emissions taxes whereas more technical, bottom-up models, are better suited to forecasting the impact of detailed energy regulations or changes in energy demand on the energy system. The trade-off between displaying energy sector detail and providing a fully unified treatment of energy-economy interactions, including their changes over time, remains a key challenge to effective long-term modelling.

Modelling to date has been focused on the developed world and highly centralised and mature energy markets, often ignoring many of the characteristics and needs of developing countries such as the dominance of traditional lifestyles and markets in rural areas, the lack of centralised generation and infrastructure, the existence of multiple social and economic barriers to capital flow and technological diffusion and the need to focus of different objectives such as energy access. Indeed, rapidly growing, dynamic and changing developing world economies present a major difficultly when trying to model the medium to long term energy environment. Another difficulty which needs to be overcome is the availability and accuracy of data. The use of locally sourced biomass for cooking and heating, and the lack of reliable historic data mean that large scale models may find it difficult to accurately reflect what is occurring in the unofficial economy. Coupled with this is the efforts and resources necessary to collect and input data into the model – the UK Energy Research Centre have spent 3 person years setting up MARKAL for the UK.

To model the effects of energy planning and the drivers of energy access, energy security and climate change at a national level requires a top-down partial or general equilibrium approach as the effects on, and of, the wider economy will be of high importance to policy makers. For instance, a policy to promote use of bio-fuels from domestic crops will need to consider the impact on food prices, the reduction in petroleum imports and a possible rise in fuel bills on the wider economy. This approach however requires greater effort to adapt models primarily used in the developed world to the developing world, and for these models to be made simpler and more flexible. Further research may also allow the LEAP model, popular in developing countries, and which allows scenarios to be developed that are able to simulate the trade-offs and synergies of different policy choices (and which is also able to model the use of traditional biomass and access to energy) to be adapted to feedback scenario outputs into the wider economy – integrating a bottom-up and top-down approach.

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ANNEX X: ENERGY PLANNING IN DEVELOPING COUNTRIES. FACING THE CHALLENGES OF EQUITABLE ACCESS, ENERGY SECURITY AND CLIMATE CHANGE

SADC - A Case Study

Case Study prepared by CEEEZ

METHODOLOGY

Case study Methodology

Structure of case study

The case study covered selected SADC countries and organizations. The countries covered included Zambia, Botswana, Zimbabwe, South Africa, Mozambique, and Namibia. Most of the countries selected housed regional institutions-SAPP(Zimbabwe), SADC(Botswana), and RERA(Namibia). The remaining countries were selected because either they were electricity exporting countries or had plans to develop new plants or additional capacity to export to SAPP.

The case study involved visiting the countries and institutions above. The initial strategy involved making and finalizing the appointment before travel was undertaken. The case study started in Zambia and then followed with a visit to Zimbabwe. A round trip was then made to South Africa, Mozambique, Namibia, and Botswana. The interviewing time was an average of two and half hours per interview.

Detail on literature collected (both primary and secondary)

The literature collected included energy plans, business plans, prospectus, annual reports, and newsletters. Most of the literature collected contained useful information on current energy consumption/forecasts, future plans, policies, and organizational structures.

Role of FG's and SSI's.

In view of the timeline of the case study, it was only possible to undertake SSI´s in all the countries covered. Although, it can also be said that within the interviews covered there was an element of FG´s taking place since in some cases there were three or more interviewees participating.

Focus Groups

Composition of each of the groups

Composition of SSI´s varied from country to country, and organization from organization. Most of the interviews was at very senior level involving CEOs and Senior Directors. Besides the com position included experts in various fields to include energy planning and relevant knowledge in energy security and energy and climate change.

Key Informant Interviews

Reason informants were selected

The regional institutions to include SAPP, SADC, and RERA were selected since there were all involved in SADC cooperation in electricity supply and energy planning in one way or the other. The other countries were selected because they were either exporting countries within the SADC countries or had plans to invest in new plants or rehabilitate existing plants to increase capacity for export.

Interview timeline

The schedule of interview timeline, institutions visited and nature of activity whether policy, energy supply or private sector/NGO/research is shown below

Table 1: Interview Timeline

No.	Date of travel/ Appointment	Time of Appointment	Contact Person	Institution	Category
1	29/12/06	09:30-13:00	Director	Department of Energy, Zambia	Policy
2	5/01/07	09:30-13:00	Dr Lawrence Musaba	SAPP-Harare Zimbabwe	Policy
3	09/01/07	09:30-13:00hrs	Managing Director	ZESCO-Lusaka, Zambia	Energy Supply
4	30/01/07	09:30-13:00hrs	Mrs Mwelwa	ZESCO-SAPP	Energy Supply
5	22/01/07	09:30-13:00hrs	Maria Cauto	ESKOM limited-JHB, South Africa	Energy Supplier
6	22/01/07	14:00-17:00hrs	CEO	SADELEC	Private sector
7	23/01/07	10:00-12:00hrs	Agency Unit Manager	DBSA-JHB, South Africa	Private Sector
8	24/01/07	08:30hrs:-10:00	CEO	EDM, Maputo, Mozambique	Energy supplier
9	24/01/07	10:30:12:30hrs	Ms Marcelina on behalf of Mr António Saíde	Department of Energy-Maputo, Mozambique	Policy
10	25/01/07		Executive Secretary	SADC Regulators Association	Policy
11	26/01/07	09:00-1100hrs	Freddie O. Motlhatl hedi Senior Programme Manager- Energy	Energy SADC	Policy
12	22/01/07	14:00-17:00hrs	Mr Arnot Hepburn	PIESA-JHB, South Africa	Private Sector
13	25/01/07	14:00-16:00hrs	Mr Paulinas Shilamba, MD	NAMPOWER, Windhoek , Namibia	Energy Supply
14	25/01/07	09:00-13:00hrs	Mr Elijah Sichone	RERA SADC, Windhoek , Namibia	
15	8/01/07	08:00-13:00hrs	Mr L. Nyahuma	ZESA, Zimbabwe	Energy Supply
16	25/01/07	11:00-13:00hrs	Mr Simasiku, CEO	ECB, Windhoek , Namibia	
17	26/01/07	11:00-13:00hrs	Mr Mathangwane, Director	Director, DoE, Botswana	Policy
18	23/01/07	14:00-16:00hrs	Mr Monga, Mehlwana	CSIR, Pretoria, South Africa	
19	26/01/07	14:30-16:00hrs	Mr J. Kaluzi, CEO	BPC, Gaberon, Botswana	Energy supplier

Question Structure

The question structure was based on the agreed upon structure which included a component on ice breaking through asking questions concerning background issues and then followed by knowing view on importance of energy planning. The main component involved ascertaining the relation between energy planning on one side, and energy access, energy security, and energy and climate change.

Background - Setting the Scene

Institutions

Key institutions in energy planning (regulators, energy ministries, donors
The key regional and national institutions selected and involved in energy planning were from three perspectives: energy policy formulation and guidance to include SAPP, SADC, and RERA on one hand, and Departments of Energy(DOE) from the other hand, energy supplier, private sector and NGO/research: Energy suppliers to include ZESCO(Zambia), EDM(Mozambique), ESKOM(South Africa),NAMPOWER(Namibia,) and BPC(Botswana) were involved both in energy planning formulation and implementation and national level but with regional perspective in view of their membership of SAPP, RERA, and SADC. On the other hand SAPP, RERA, and SADC were involved in both energy planning and implementation on a regional basis.

Key Stakeholders

Description of the key actors in the sector

The key actors and stakeholders varied from institution to institution and the nature of each institution mandate. Another factor which influenced the type of stakeholders was the type of energy whether electricity supply or petroleum. For the latter the main stakeholders included: Oil marketing companies(OMCs), Biofuels Associations and consumers and Energy regulation Boards were applicable like in the case of Zambia. For electricity the main stakeholders included utilities, independent power producers(IPPs), Industrial association and major companies., consumer associations, and NGOs/Academia.

For regional institutions for example SAPP, major stakeholders include utilities in their capacity as members of SAPP, and key consumers and industrial concerns. For RERA, the main actors include Energy/Electricity Regulation Boards in their capacity as members, SAPP, SADC, and consumer associations. However, for the latter, there is currently no regional consumer association existing.

Other stakeholders of importance are research/NGOs who undertake research and studies aimed at providing in depth inputs in energy planning. Most of the stakeholders identified in the case study are involved mainly in advocacy in one hand, and ensuring competitive and reasonable tariffs are charged, on the other.

Policy Environment

Overview of energy planning framework

Energy planning framework will differ depending on whether it is a regional institution or national DOE. In the former, especially SAPP, each member utility provides an input of its plan in terms of projects current, medium term and long term. The SAPP secretariat then consolidates into one SAPP regional plan. SAPP in addition, organizing forums for investment promotion and making contacts with interested investors, undertakes forecasting/ projection analysis with help of planning tools.

The SADC standing committees on energy, transport and environment are permanent and meet once per year. These Committee is coordinated under the Infrastructure and Services Directorate of SADC. The Energy committee does influence energy planning in SADC. For Example the committee has been responsible for recommending to the Council of Ministers on the starting and implementation SAPP(Southern African power Pool) and RERA(Regulators Association Of Southern Africa) They are also in the process of initiating the harmonisation of a regional energy policy. The energy committee comprises of national energy committees from member states.

At the national level, all the DOEs involve stakeholders in their planning process mostly based on bottom up approach. However, national energy suppliers planning involves only internal staff although at times major customers are consulted on their individual plans and projections.

The majority of the populace living mainly in rural areas of Southern Africa rely on wood, crop residues and dung to satisfy their household needs, whilst those living in urban areas depend on charcoal for their cooking needs. Cooking in Southern Africa represents the largest end use of biomass accounting for about 80% of the total energy in Southern Africa.

Existing energy policy tools

With an exception of SAPP and ESKOM who use planning tools for forecasting and projections, most of the utilities use mainly an assumed growth rate for their projections. Botswana on the other hand, is in the process of introducing integrated energy planning.

Existing legislation

Policy implementation – how is policy implemented in reality? What is the inter-play between institutions, regulators and the private sector? Policy map to show the interaction of stakeholders and institutions.

In terms of implementation, two approaches were being used for the countries consulted in the case study. The first approach involved preparation of a white paper which initially goes to cabinet for approval, and in some cases later to parliament for approval. This is the case for South Africa, Namibia, and Botswana. Mozambique is the process of formulating a policy to go through this route. The other approach involves preparation of energy policy with cabinet approval only and without legislation through parliament. This is the case for Zambia.

An important factor for energy planning is the need to have an implementation strategy with timeline and budget resources for implementation. Only Botswana and South Africa had such a system in place.

In the case study, there was no evidence of interactions occurring between the policy makers and stakeholders during implementation stage both at national and utility levels. However, this interaction was evident at regional level in SAPP and in RERA.

Energy Planning; climate change, energy access and energy security

Table 2: Summary of the responses from the interviews

Respondent	Energy planning			Existence of energy plans			Players	Drivers	Ranking of drivers	Tension /Synergy		Category
	VI	I	M	ST	MT	LT				T	S	
ESKOM South Africa	√				√	√	SAPP DME Industry Consumers	Economic growth Security Access SAPP development Resources Climate change	1. Access/ Security 2. CC	√	√	Energy supply
DOE Zambia		√		√	√	√	OMCs ZESCO CEC IPP Consumers Academia NGOs	Access Security Economic growth Political relations	1. Access 2. Security		√	Policy
SAPP Zimbabwe		√		√	√	√	SAPP utilities Key customers Regulators Donors	Economic activities No investment Access Security	1. Security 2. Economic growth 3. CC 4. Access		√	Regional policy/ Energy supply
DBSA South Africa		√					Due diligence Committee Board DME	Commercial viability	1. Commercial viability 2. Due diligence		√	Financial institutions
RERA Namibia		√			√		RERA members SAPP SADC Donors	Attract investment Harmonization Cross boarder trade Access Standards Efficiency	1. Attract investment 2. Energy security 3. Integrated resource planning		√	Regional policy

Respondent	Energy planning			Existence of energy plans			Players	Drivers	Ranking of drivers	Tension /Synergy		Category
	VI	I	M	ST	MT	LT				T	S	
ECB Namibia	√			√	√	√	Ministry of Energy Nampower ECB	Break monopoly policy Security Regional Integration Integrated resource planning Economic growth	1. Economic growth 2. Competition 3. Integrated regional planning 4. Capacity building		√	Regulators
Nampower Namibia		√		√	√	√	Government ECB Project developers Industry Consumers	Government policy Affordability Customer base	1. Affordability 2. Security	√		Energy supply
SADC		√					Member countries Donors	Energy security Energy policy Biofuels	1. Access 2. Policy	√		Regional policy
Energy Division - Botswana		√			√	√	Utilities Government Oil industry NGOs	Economic efficiency Access and affordability Environmental sustainability Security Gender equity	1. Security 2. Access			
EDM Mozambique		√		√	√	√	Government Business houses Local population Investors Donors	Standard of living Access Financial sustainability National development	1. Access 2. Infrastructure development 3. Low cost 4. SAPP		√	Energy supply
Ministry of Energy Mozambique	√				√	√	Provincial Directorate Government Consumers REF Ministry of Agriculture Donors	Poverty reduction Access Security Economics of supply	1. Security 2. Access		√	Policy

Respondent	Energy planning			Existence of energy plans			Players	Drivers	Ranking of drivers	Tension /Synergy		Category
	VI	I	M	ST	MT	LT				T	S	
Zimbabwe Electricity Commission		√					ZESA National oil Company IPPs Consumers Industry NGOs	Access Consumer protection Investor protection	1. Access 2. Investor and consumer protection 3. Environmental sustainability	√		Regulator
BPC Botswana		√			√	√	Government Consumers Industry SAPP	Security Access Customer operating efficiency Financial performance	1. Access/ security		√	Energy supply
ZESCO Zambia		√			√	√	Internal departments Government Consumers Industry	Growth businesses Access Security	1. Security 2. Access	√	√	Energy supply
ZESCO/SAPP	√						SAPP environmental sustainability Utilities/ ZESCO	Business plan SAPP	1. Security 2. Access		√	Policy
CSIR South Africa	√				√	√	ESKOM SASOL Government Shell Scientific community Industry	NEPAD Vision Private sector Social economic development Resources Security Access Climate change	1. Security 2. Access	√		Research

Energy Security

Description of official policy on energy security

It is evident that from the responses that both the regional and national plans had elements of energy security explicitly or implicitly. However what was evident was that the SADC/SAPP energy supply was exhausted and there are frantic plans to reverse this trend through regional energy supply projects. The key stakeholders in investment plans are SAPP and the utilities from different perspective reasons: SAPP is concerned with economic growth and attracting investments. RERA priority on energy security is for the consumers. Deficit countries like Namibia and Botswana through their utilities are keen to invest in national and regional projects to avoid current shortfall in supply and corresponding load shedding. Stakeholders like major industrial houses are pushing for more energy security for their planned businesses. Equally Rural Electrification Agencies are keen to have increased access to ensure there is adequate energy supply for increases access for rural areas. Consumers including household and industrial houses are worried about current load shedding in the region.

Energy Access

Most national and regional plans have energy access explicitly mentioned and ranked second to energy security. most contend that without energy security, there would be no energy access. The stakeholders who are most concerned with energy access are RERA ,Energy/Electricity Regulation Boards, Rural Electrification Agencies, and both industrial and consumer associations. Their view is that more is required to be done by utilities to ensure accessibility.

Climate Change

With an exception of South Africa and ESKOM, no other country in SADC has integrated energy and climate change in their national and utility plans. To some extent SAPP at the Sub Environmental Sub Committee is aware of the need to integrate energy and climate change. However, even in ESKOM awareness is more pronounced at the top and directors level and not at the operating levels.

Interaction between drivers

The case study responses revealed both conflicts and synergies For example ESKOM and ZESCO had both tension and synergies. DOE(Zambia and Mozambique), SAPP, DBSA, RERA, and EDM had synergies only. Whilst NAMPOWER, SADC, CSIR, and ZIM Electricity Board had Tension only. Specific examples are amplified in the appendix under each institution under the title ‘Synergies and Conflict’.

SUMMARY AND ANALYSIS

Summary of key points

Policies and legislation

Energy planning framework will differ depending on whether it is a regional institution or national DOE. In the former, especially SAPP, each member utility provides an input of its plan in terms of projects current, medium term and long term. The SAPP secretariat then consolidates into one SAPP regional plan.

SAPP in addition, organizing forums for investment promotion and making contacts with interested investors, undertakes forecasting/ projection analysis with help of planning tools.

The survey revealed that SADC is actively involved in formulating biofuels development policies and implementation strategies. As initial step SADC has undertaken a pre-feasibility study on biofuels production processing and marketing/distribution. The survey and literature also indicate that individual countries particularly South Africa, Botswana and Zambia are in the process of finalizing their biofuels implementation strategies. The survey conducted in SADC reveals that there is no harmonized biomass production and utilization policy in the SADC region. However, the energy policies of some of the countries visited –Zambia, Botswana, and Namibia do have a section on biomass energy policy in their respective energy plans.

In terms of programmes, the GTZ supported ProBec is making attempts to ensure that biomass improved stoves are dissimulated in Southern Africa, covering Zambia , Malawi, Tanzania and South Africa. The objectives of this project are as follows:

- To ensure lower income population groups satisfy their energy requirements in a socially and environmentally sustainable manner

- To ensure biomass energy related institutions and private sector in the SADC region have the expertise, resources and commitment to ensure that affordable energy-efficient technologies and techniques for cooking and heating are commercially available and widely used in the region.

Attitudes of stakeholders

The key stakeholders in investment plans are SAPP and the utilities from different perspective reasons: SAPP is concerned with economic growth and attracting investments. RERA priority on energy security is for the consumers. Deficit countries like Namibia and Botswana through their utilities are keen to invest in national and regional projects to avoid current shortfall in supply and corresponding load shedding. Stakeholders like major industrial houses are pushing for more energy security for their planned businesses. Equally Rural Electrification Agencies are keen to have increased access to ensure there is adequate energy supply for increases access for rural areas. Consumers including household and industrial houses are worried about current load shedding in the region

Most national and regional plans have energy access explicitly mentioned and ranked second to energy security. most contend that without energy security, there would be no energy access. The stakeholders who are most concerned with energy access are RERA ,Energy/Electricity Regulation Boards, Rural Electrification Agencies, and both industrial and consumer associations. Their view is that more is required to be done by utilities to ensure accessibility.

There are three institutions in Zambia involved in energy research in general and this include National Institute for Industrial and Scientific Research (NISIR), who have pioneered work in improved biomass stoves, and biogas production and utilization, University of Zambia; schools of engineering and agricultural sciences who have focused on biofuels research related to harnessing sweet sorghum as a complementary feedstock to sugar cane, and CEEEZ whose research work has concentrated on climate related studies, energy to include energy modelling, planning, management and analysis, environment related studies and enterprise development

Potential Focus of Future Research

Table 3: Summary of research needs and gaps

Respondent	Project Idea/concepts
ESKOM South Africa	• Develop sustainable electricity demand and markets to support generation investment • Regional integrated energy planning for the SADC region. • Regional resource assessment and integrated planning for hydroelectric power and biomass • Development of regional baseline for CDM projects
DOE Zambia	• Barrier removal to access to en4ergy • Packaging of energy supply technology options • Innovative financing mechanism for increased access.
SAPP Zimbabwe	• Simulation model for energy demand forecasting • Energy planning expertise at SAPP and utilities
DBSA South Africa	• Regional research initiative into environmental practices and policy in the SADC region aimed at bringing on board practices from SADC countries which are acceptable to DBSA environmental strategy. • Regional baseline study to assist SADC countries who are hydro-based in their energy supply. • Awareness on climate change issues and CDM for DBSA staff since currently only 2 or 3 staff are familiar out of a staff of 500 staff in DBSA
RERA Namibia	• Study on potential conflicts between energy access and security • Formulation of regional frameworks on energy efficiency, standards and norm, and monitoring and compliance. • Integrated regional planning supported b y various tools/models – integrated resource assessment. • Information on energy statistics, standards, etc. • Capacity building
ECB Namibia	• Regional integration, planning supported by integrated resource assessment and energy scenarios and modelling • Study on market penetration monopoly tendencies • Setting up information data base for RERA to ensure that competition tendencies are introduced.
Nampower Namibia	• Study on Renewable Energy technologies not demonstrated/proven to create win-win situations. • Capacity building due to skills gap presently being felt.
SADC	• Regional Integrated Planning backed up by models • Biofuels development policies and implementation strategies
Energy Division. Botswana	• In-depth data collection and analysis to support integrated planning • Resource and technology assessment for biomass utilization to provide modern energy service e.g. biofuels electricity, households fuels etc. • Formulation of policies on biofuels.
EDM Mozambique	• Innovative technologies to low cost electricity supply • Financial resources to review plans • Bottom-up planning tools – since currently using top-down tools which are not deep enough in relation to issues elaboration. • Integrated regional and national plan. • Studies on optional and sustainable interaction of grid and off grid systems.

Respondent	Project Idea/concepts
Ministry of Energy Mozambique	• Studies on integrated use of biomass into various products and services to include electricity generation, biofuels --- and industrial briquettes • Cost effective technology options to provide least cost electricity • Pilot projects to demonstrate suitability of biogas use taking into account socio-economic conditions
Zimbabwe Electricity Commission	• Need to quantify resources • Biomass resource assessment for electricity generation • Technology packages to support energy access and security applications
BPC Botswana	• CDM project development • Regional baseline.
ZESCO Zambia	• Reliability of supply studies in terms of technical issues like voltage profile, load flow. • Study on alternative energy supplies other than hydropower due to climate change affecting run-off to include biomass and solar energy
ZESCO/SAPP	• Effects of poor access on catchment areas due to depletion of tree cover resulting from cutting of trees for charcoal production- for hydropower based systems
CSIR South Africa	• Study on economic tariffs restructuring which takes account of return on investment and externalities. • Integrated and comprehensive regional planning which addresses disparities, and brings harmonization • Study on most suitable technology choices for energy related activities aimed at enhancing energisation of rural areas.

Methods to Undertake Research

Responses from the case revealed that research funds once made available have to be channelled to local and regional institutions for them to undertake research in identified areas and needs. With an exception of ESKOM, all the institutions requested for donor support for research.

ANNEX XI: ENERGY PLANNING IN DEVELOPING COUNTRIES - FACING THE CHALLENGES OF EQUITABLE ACCESS, ENERGY SECURITY AND CLIMATE CHANGE

South Africa – A Case Study

Case Study prepared by PDG

METHODOLOGY

Case study Methodology

Structure of case study

The case study follows the structure agreed with the client.

Detail on literature collected

Literature was collected on the South African energy sector from publicly available sources. The bulk of the literature was government policy and legislation, however a number of critiques of government policy and reviews of the energy planning and the energy sector where also reviewed. A reference list is included at the end of the case study report.

Role of FG's and SSI's

The focus groups were used to allow discussion and debate on the energy planning process in South Africa. They were structured to follow a standard discussion path but at the same time to allow free flowing discussion. In this way all the focus groups considered all the questions posed. Where discussion left the immediate topic, but was still answering other questions of the study, it was allowed to continue for a reasonable time.

The key stakeholder interviews were held with individuals who occupied particularly influential positions within the energy policy debate – either by virtue of their position in key institutions or by virtue of their role as independent critics of energy policy in the country. Key stakeholders were identified by recommendations from within the focus groups, by recommendations by other key stakeholders and by prior knowledge of the energy sector. The stakeholder interviews were typically aimed at providing important views which may have been missed in the focus groups.

Focus Groups

Four focus groups were held for the South African study with the following stakeholder groups:

- Climate change policy makers
- Donor organisations
- Energy planning officials and policy makers
- Energy research and academic institutes

Although there was not a separate Non-Governmental Organisation (NGO) and advocacy organisation focus group NGOs were invited to attend the subject specific focus groups noted above since most of these organisations in South Africa are focused on specific subjects and regularly interact with the policy makers in subject specific areas (such as climate change).

It was intended to hold a focus group for:

- Major energy using organisations; and
- Private sector energy suppliers

However these two focus groups were not carried out due to difficulties in arranging a suitably representative meeting of key organisations in these sectors. The focus groups were replaced with interviews with key stakeholders or informants in these two sectors.

With respect to the major energy users focus group the major organised body of the sector, the Energy Intensive User Group (EIUG) declined the invitation to participate as an organisation. The EIUG said that the time allowed in which to hold the focus group was too short to allow for a reasonable sample of their members to participate. The EIUG secretariat also refused to facilitate access to individual members of the group. After initially agreeing to facilitate the completion of a written questionnaire by a representative member of the group the EIUG secretariat failed to follow through with this agreement.

The gap left by the energy intensive user focus group was filled by a number of individual interviews with some of the major energy users who were willing to provide a direct interview . These interviews were extremely helpful and were much appreciated. PDG is confident that the key issues of concern to this stakeholder grouping have been ascertained through this approach. It was important to solicit the views of these users because of their importance in the South African energy system – the approximately 25 largest energy users in the country use about 60% of the total electricity generated.

Similar problems were experienced with arranging the energy suppliers focus group. This group is very diverse – on the one hand made up of the large petroleum industry firms and on the other a number of very small and emerging independent power producers (IPPs) in the electricity and bio-fuels sector. The South African Petroleum Industry Association (SAPIA) is also located in Cape Town, with the other organisations located nationwide. It therefore provided impossible to arrange a single focus group for this sector. Individual interviews were held with SAPIA and with a number of the smaller independent emerging IPPs.

Composition & Attendance of Focus Groups

Table 6 in Appendix 0 contains the details of the individuals who attended each focus group held, including organisations and institutions represented. Those who were invited but could not attend are also included in this table for information.

Focus Group structure and timeline

The focus groups were held as follows:

Focus Group	Date
Climate change policy makers	11 January 2007
Donor organisations	9 February 2007
Energy planning officials and policy makers	13 February 2007
Energy research and academic institutes	28 February 2007

Question structure

The agreed methodology was followed. The focus group discussion structure is included as an appendix to this report.

Key Informant Interviews

Interviews were held with a range of key informants in addition to the focus groups outlined above. Some of the interviews were conducted over the telephone were the respondent was in a different city and one interview was conducted solely through a written response to the questionnaire. Table 1 in Appendix 5 below contains the details of each informant interviewed.

Reason informants were selected

The key stakeholder and informant interviews were held with individuals who occupied particularly influential positions within the energy policy debate – either by virtue of their position in key institutions or by virtue of their role as independent critics of energy policy in the country. Key stakeholders were identified by recommendations from within the focus groups, by recommendations by other key stakeholders and by prior knowledge of the energy sector. The stakeholder interviews were typically aimed at providing important views which may have been missed in the focus groups.

Some of the informants were specifically chosen to ensure that sufficient insight was gained into those sectors in which the focus groups were not held.

Question Structure

The interview structure largely followed the questionnaire structure but allowed respondents to speak to their own area of expertise. Some of the interviewees were very senior officials or stakeholders who did not want to be constrained by a strict questionnaire structure. It was felt that the views of these people could be best understood if they were allowed to respond to the broad research questions in their own manner. This proved very successful and highly useful information was obtained through the interview process.

Attendance

See Table 5 in Appendix A for list of attendees.

BACKGROUND – SETTING THE SCENE

An outline of the energy balance in South Africa is provided below as well as an overview of existing policies and legislation, institutions, and stakeholders in the energy planning process.

Outline of Energy Balance

Kohler (2006) provides a concise overview of the Energy Sector in South Africa. This is contained in Box 1 for information.

Box 1: Overview of Energy Sector in South Africa (taken from Kohler 2006)
The South African economy produces and uses a large amount of energy. It is highly energy-intensive and heavily dominated by extraction of raw materials and primary processing. The energy sector as a producer contributes 15% to GDP and employs a labour force of over 250,000. The demand for energy is expected to grow, with the energy sector remaining of central importance to the country's economic growth, especially with regard to attracting foreign investment in the industrial sector. The South African energy sector is characterised by several important features, including the following: A strong natural resource base with a variety of energy options. The country has vast coal reserves, although estimates of their size vary considerably. Besides the geological quantities, the value of coal reserves is also a function of the resource price, the price of coal substitutes, and improvements in technology, exploration, and the development of alternatives. A well-developed energy and transport and grid infrastructure. An electrification drive to increase access to electricity in disadvantaged communities. Most of those without access to electricity are low-income households. To produce electricity at a cost that is among the lowest in the world, the South African economy depends heavily on coal, despite that fact that the generation and production of coal is polluting, and has a significantly negative environmental impact. The level of competition between producers in the energy sector is low. Apart from the high cost of capital required to enter the energy industry, there are other barriers to entry. The technology is specialised and the existing structure and regulatory environment is not conducive to entry. The government seems to be reluctant to restructure the energy sector and there is lack of legislation to stimulate competition and efficiency (Kohler 2006, p5)

In terms of Energy Balance, a summary of supply and demand profiles for South Africa is presented in Boxes 2, 3 & 4 overleaf (also from Kohler 2006).

In addition to the basic description of supply and demand characteristics, it is important to note that the following are also important in the context of the South Africa energy balance:

Energy Intensity & Efficiency: By international standards, South Africa has a high energy intensity (DME 2003). The best areas for improvements are those industries that require high levels of energy per unit of output – mining, iron and steel, aluminium, ferrochrome, and chemicals – the same sectors that make up a large share of South African exports. Low energy prices do not provide much incentive for energy efficiency, because it makes economic sense to use more energy if energy is cheap. Nonetheless, South Africa has made improvements in some sectors, notably iron and steel. (Kohler 2006)

Energy Investment and Electricity Supply: South Africa's massive investment in coal-fired power plants, particularly in the late 1970s and the 1980s led to excess energy capacity, with the country's licensed capacity having exceeded peak demand for at least 25 years. However, as demand growth has caught up with excess supply the picture has recently changed. South Africa, along with many other developing countries, now faces renewed calls for capacity investment (Eberhard, 2004). Recent short term supply crises and consequent blackouts have raised the issue of electricity supply capacity high in the national consciousness and it is important to note that the study took place in this context.

Energy Prices: South Africa's low energy prices, mainly because of coal-generated electricity, has been one of the country's key competitive advantages, and continues to a large extent to drive new investment in industry. However, according to Winkler et al. (2006) such low energy costs have also had the effect of retarding investment in the development of new energy sources, thus limiting the diversity of the fuel mix, its associated supply security, and possible efficiency improvements. The recent burgeoning of South Africa's economic growth indicates that before long there will need to be new investment in electricity generation capacity. Electricity customers have become used to cheap power from the previous generation of plant expansion whose capital has largely been depreciated. It is clear that when the required new investment occurs electricity prices will rise in real terms.

Box 2: Summary of Energy Supply Characteristics for South Africa (taken from Kohler 2006)
"Guaranteeing a sustainable supply of affordable energy is one of the best ways to address poverty, inequality, and environmental degradation everywhere on the planet."(NEPAD 2002).South Africa has a well-developed energy supply and production system. The country is well endowed with large resources of coal. As can be seen from Figure 1 coal dominates the energy picture in South Africa, providing approximately 64% of the primary energy. Crude oil production is very limited and consequently the bulk of crude oil is imported. Imported crude oil accounts for 22% of primary energy used, mainly by the transport sector. Uranium reserves are large. Nuclear energy, natural gas, and renewables including biomass, account for the rest of the energy needs. Renewable energy plays a limited but significant role, particularly biomass energy which is still an important source of primary energy in rural areas. The country generally has a low rainfall, which limits the exploitation of large hydropower. South Africa's abundant sunshine is only beginning to be tapped in more remote areas for electricity generation for domestic and institutional application. Wind energy is a potential source of commercial energy in some parts, but like other renewable energy technologies it struggles to match the lower costs basis of conventional energy, in particular cheap coal. Eskom produces over 90% of South Africa's electricity, and it owns and operates the generation and transmission system. Eight municipalities generate the remaining electricity for their own use. Electricity production costs, in South Africa based on its large coal reserves are among the cheapest in the world. This together with a natural resource based economy, resulted in the country becoming a large energy user with high energy-intensity. The total primary energy supply increased from 1,898PJ in 1971 to 4,629PJ in 2002, an increase of 144%. Recent energy and GDP data indicates that energy intensity of South Africa reached a peak of 5.42 TJ/GDP and appears to be declining as the economy is restructuring.

Primary Energy Supply - 2002

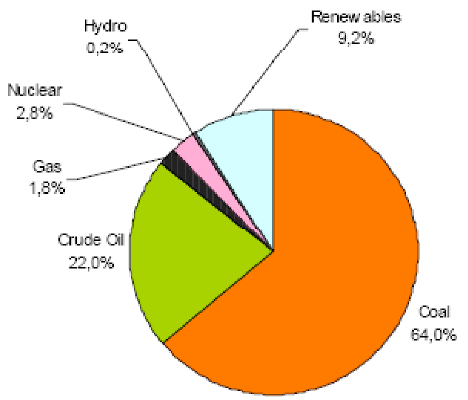


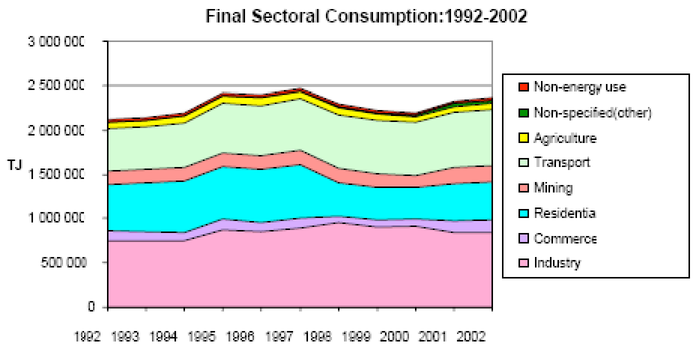
Figure 1: Primary Energy Supply
Source DME 2005

Total Primary Energy Supply - TJ

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	200
Coal	2 990 691	3 028 745	3 117 230	3 243 737	3 299 767	3 370 254	3 268 198	3 413 499	3 425 725	3 065 619	2 961 02
Crude Oil	414 946	334 047	428 321	459 980	376 059	450 863	933 682	764 067	420 746	452 895	1 018 76
Gas	11 969	71 814	71 814	71 814	71 814	71 814	53 983	70 628	65 024	84 478	83 76
Nuclear	101 324	79 145	105 785	123 284	128 455	137 967	148 375	140 040	141 927	116 935	130 81
Hydro	2 707	526	3 866	1 904	4 748	7 531	5 742	2 614	4 835	7 420	8 48
Renewables	414 000	419 000	433 432	408 739	408 739	408 739	237 400	237 400	237 400	237 400	426 46
TOTAL	**3 935 637**	**3 933 277**	**4 160 448**	**4 309 458**	**4 289 602**	**4 447 168**	**4 647 379**	**4 628 248**	**4 295 657**	**3 964 746**	**4 629 32**

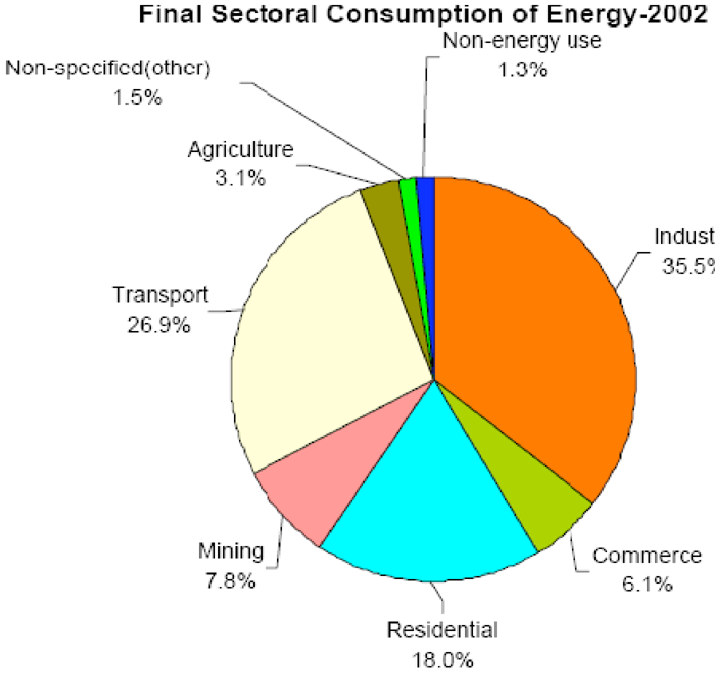
Box 3: Overview of Energy Demand Characteristics for South Africa (taken from Kohler 2006)

Energy remains a key factor in the growth and development of South Africa's economy. Historically, electricity supply was driven by demand from the mining industry. Concerned about energy security, the apartheid government developed a synthetic fuels programme to meet demand for liquid fuels and to lessen the country's dependence on energy imports. South Africa's massive investment in the 1960s, 1970s and 1980s in coal-fired power plants (including some nuclear capacity) left the national utility with large excess capacity in the 1980s and 1990s. The excess capacity has helped to keep electricity prices low, but it is now practically exhausted (Eskom 2000). Source: DME (2005)In recent years, industrial demand has been the major source of demand across all energy carriers (see figure above). Some growth can be seen in the transport sector, while in mining production the demand declined slightly towards the end of the past decade. Historically, energy demand in South Africa has been dominated by heavy industry and mining, which have determined the economic and energy structure of the country. Much of the manufacturing sector is linked to mining activities through minerals beneficiation and metals production. These industries are all energy intensive, and rely on the availability of inexpensive coal and electricity. An analysis of consumption by sector is proved in Box 4 below (summarized from Kohler 2006).



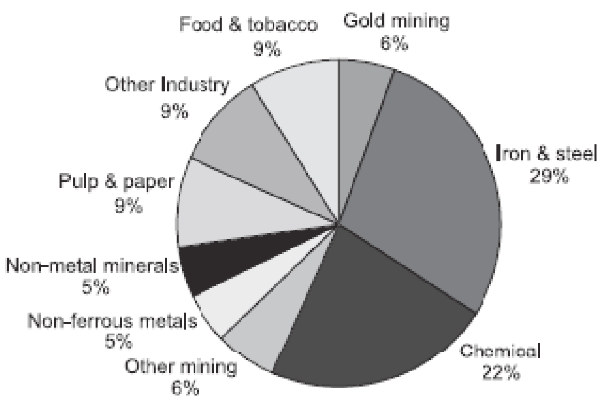
Box 4: Energy Consumption by Sector (summarised from Kohler 2006)

The breakdown of final energy consumption by economic sector has been described in some detail in the preliminary energy outlook for South Africa (ERI 2001), a document which sets out the basis for an integrated energy plan (IEP). Another recent publication is the Digest of South African Energy Statistics (DME 2005), although most of the data is for 2001/2. The figure below illustrates the consumption by sector as per 2002 data.(DME data 2005). The following sections within the box describe the various energy consuming sector in some more detail.



Source: Sectoral Consumption of Energy 2002

Industry and Mining: The industrial sector (35.5%), together with mining (7.8%) accounts for the largest proportion of energy consumed (43.3%), as can be seen from Figure * (DME 2005). Gold mining in particular consumes a large amount of South Africa's energy requirements.



Final Industrial Energy Consumption by sub-sector (2002 total: 1036PJ). Source: DME (2005) & Kohler 2006

The need to mine gold at very deep levels due to declining ore grades accounts for the subs-sectors high-energy demands, this demand is however on the decrease. Although this may be true for gold mining, the demand for energy from 'other-mining' is growing. Unlike other economic sectors of the South African economy whose demand for energy is expected to keep pace with or even exceed the rate of economic growth, the mining sub-sector's demand for energy is expected to grow more slowly than gross domestic product (GDP) (SANEA 2003).

The major industrial sectors with high-energy demands include: iron and steel, pulp and paper, non-ferrous metals, chemicals and petro-chemicals, and food and tobacco, (see figure). In terms of energy carriers - gold mining and non-ferrous metals consume the largest amount of electricity. Coal is the main energy source for the production of iron and steel, chemicals (as feedstock), non-metallic minerals (where coal is mainly burnt in clamp kilns), pulp and paper (which relies heavily on 'black liquor' to produce most energy requirements), food, tobacco, and beverages. According to Eberhard & Van Horen (1995) coal-based industries have low energy conversion efficiencies compared with oil, gas and hydro plants. Undoubtedly, the low cost of energy has given South Africa a competitive advantage, and encouraged the investment in and growth of energy-intensive industries such as aluminium smelting and mining. Energy intensities for the industry and mining sectors are high relative to Organisation for Economic Cooperation and Development (OECD) countries, and certain industries consume up to twice as much energy per ton of output.

Transport: The transport sector currently consumes 27% of final energy consumption, of which about 97% is petroleum products, 3% electricity, and 0,2% coal (DME 2005). Energy intensities in this sector (see: Appendix D) are high due to various inherited problems and poor fiscal control. The national transport fleet is old, poorly maintained, and has low occupancy. Commuting patterns, shaped by the geography of apartheid settlements have resulted in high fuel consumption patterns for the sector. (Winkler et al 2006). The use of energy for transport is expected to grow more quickly than GDP (SANEA 2003).

Commercial: The commercial sector consumes only 6% of the total primary energy consumption, in the proportion of electricity 64%, coal 35% and gas 1% (DME 2005). Currently there are no thermal efficiency standards for South African buildings, which means the costs of temperature control remain high. Utilities costs are normally borne by tenants, so there is little incentive for developers and property owners to focus on energy efficiencies. If energy- efficiency standards were made mandatory for commercial buildings, significant savings could be made. (Winkler et al 2006). Some studies (IEA 1996) estimate that 20-40% energy savings are possible in this sector. The commercial sector, like transport, shows higher growth rates in energy consumption than other sectors, and energy consumption can be expected to grow faster than economic output (SANEA 2003).

Residential: The residential sector consumes 18% of final energy, of which biomass contributes 14%, electricity 62%, coal 8%, paraffin 12%, and LPG and candles 2% each (DME 2005). Electrification is taking place rapidly. Recent estimates suggest that by 2025, 92% of households will be electrified, with 87% using electricity only, and 5% using electricity together with other fuels. (Winkler et al 2006). Within this sector, as with commercial buildings, there is significant potential for energy-efficiency improvements. An important distinction needs to be made, however, between the low-income residential sector and those of other income levels. Relatively cheap energy conservation interventions (such as installation of ceilings) are mostly not affordable for poor households and would probably require subsidies; on the other hand middle- and upper income households generally have the means to invest in various forms of energy saving, for example by installing solar water heaters. The three major challenges faced by the residential sector are: the provision of energy needs and environment reclamation, where population pressure on fuel-wood gathering has depleted traditional biomass supplies and damaged large areas of land; the provision of lighting as a precursor for the education and economic empowerment of rural people; and, a more widespread adoption of 'clean energy' in order to reduce concentrations of pollutants within residential houses.

Energy costs for the poor are high; thus improved efficiencies are of special importance. In the current low-cost housing programmes, 50- 90% efficiency savings are attainable with only a 1% to 5% increase in costs (IEA 1996) – a significant opportunity to improve the energy efficiencies of residential dwellings as by 2015, an estimated 7 million new houses will be constructed in South Africa. (Winkler et al 2006).

Agriculture: Agriculture's share of the economy has been in decline for many years. In 1965 its share of GDP was 9.1% and by 1998 it was only 4.0% (NDA 2000). This trend is likely to continue in future. With a declining share of GDP, agriculture can expect very slow growth in energy demand. Agriculture requires energy primarily for draft power and other tasks of land preparation, which are necessary for the effective utilisation of land. Energy for water pumping is the second major use, followed by smaller energy demands for activities such as crop processing, transport and lighting. (Winkler et al 2006). Energy in agriculture is used primarily in the form of diesel, followed by electricity and coal (DME 2005).

INSTITUTIONS

Institutions are defined as those state institutions with a direct legal mandate to undertake or oversee energy planning.

Key institutions in energy planning

The following institutions have an important role in energy planning in South Africa. The table provides a brief description of each institution and its role in the energy planning process. It should be noted that there are a range of other institutions in the energy planning process and the table is not comprehensive.

Section 0 below outlines the general role of the various institutions in the formal energy planning system.

Table 1: Key Institutions in Energy Planning

Name	Description and broad function
Government Departments, institutions and structures	
National Department of Minerals and Energy: **Directorate: Energy Planning & Development**	National government department with mandate to provide services for effectual transformation and governance of minerals and energy industries for economic growth and development. DME has a directorate dedicated to energy planning. Its objectives are: • Actively contribute to sustainable development through energy interventions; • Redress past imbalances and bridge the gap between the first and second economies; • Implement energy economic policies and legislation; and • Provide Operational Energy Information and Petroleum Licensing Systems.
National Department of Public Enterprises (DPE)	The DPE is the formal 100% shareholder of Eskom. In this regard it is also the conduit of state finance to Eskom and is in a position to influence capital investment decisions of the utility.
National Energy Regulator of South Africa (NERSA)	The National Energy Regulator (NERSA) is the regulatory authority established in terms of the National Energy Regulator Act, 2004 (Act No. 40 of 2004) with the mandate to undertake the functions of the Gas Regulator as set out in the Gas Act of 2001, the Petroleum Pipelines Regulatory Authority as set out in the Petroleum Pipelines Act of 2003 and the National Electricity Regulator as set out in the Electricity Act of 1987 as amended.
Central Energy Fund	CEF is a private company but is governed by the CEF Act. Its purpose is to finance and promote the acquisition of coal, the exploitation of coal deposits, the manufacture of liquid fuel, oil and other products from coal, the marketing of these products and any matter connected with their acquisition, exploitation, manufacture and marketing. CEF is also mandated to address the acquisition, generation, manufacture, marketing or distribution of any other forms of energy and research connected therewith.

Name	Description and broad function
Central Energy Fund cont…	The CEF group of companies focuses on gas and oil exploration, oil trading, petroleum products, promoting offshore and onshore exploration, tank terminal management, pollution prevention and control, gas infrastructure development, renewable energy and low-smoke fuels. It consists of eight operating subsidiaries, each performing quite distinct functions, which are listed below CEF Subsidiaries: • PetroSA; • iGas; • Petroleum Agency SA • Oil Pollution Control SA (OPCSA) • South African National Energy Research Institute (SANERI) • The National Energy Efficiency Agency (NEEA); • The Strategic Fuel Fund Association (SFF); and • Energy Development Corporation (focusing specifically on renewable energy resources)
	Municipalities in South Africa are constitutionally mandated to provide electricity services and are thus key players in the electricity distribution industry. Municipalities are also important role-players in determining other energy use patterns, especially in the housing and transport sectors. SALGA represents municipalities in South Africa and has a strong engagement with national government on issues affecting the electricity supply industry.
Energy Producers	
Eskom	Eskom Holdings Limited is a public company created by the Eskom Conversion Act 2001. Eskom generates, transmits and distributes electricity. It generates 95% of electricity used in South Africa. Eskom bears direct responsibility for its own investment plans in generation, transmission and distribution under the regulatory oversight of NERSA.

Role in Policy Formation

The various institutions outlined above play different roles in the energy planning process. Of the national government departments the Department of Minerals and Energy has the principle remit to manage the Integrated Energy Planning (IEP) process, the purpose and guiding principles for which are contained in official policy and legislation (Energy Policy White Paper and draft Energy Bill). This IEP process is intended to cover the entire energy sector.

The other departments are, however, influential in energy planning via other mechanisms. The Department of Public Enterprises has the ability to strongly influence investments in the electricity sector as the single shareholder of Eskom, although it appears from the focus groups and stakeholder interviews that until recently the DPE has been relatively removed from the detailed energy planning processes. The Department of Science and Technology is influential in funding energy research and development, while the Department of Environmental Affairs and Tourism plays an important role in placing climate change and local environmental quality issues into the energy planning framework.

The first IEP was conducted in an open manner and allowed for a range of inputs from stakeholders and experts. In this regard many of the stakeholders tabled above played some role in the planning process. The second IEP, IEP2, is intended to follow a similarly transparent approach but has been stalled for some time. Information gained from the energy planning focus groups suggests that it will be shortly re-started, and will attempt to again bring in various stakeholders.

Government regulatory capacity over energy has been consolidated into a single energy regulator, the National Energy Regulator (NERSA). NERSA is clearly a key player in all those areas of energy amenable to state regulation and planning. With respect to electricity supply NERSA has established a formal planning process called the National Integrated Resource Planning (NIRP) process. This NIRP is meant to act as an independent information source to stakeholders and decision-makers for ensuring security of the electricity supply. It is also aimed at assisting NERSA in its regulatory objectives.

The IEP and the NIRP rely on a range of demand information that has to be sourced from research institutions, major energy users and major energy providers (for example, the refining sector). These various stakeholders therefore play a crucial role in allowing effective energy planning to occur through information provision.

The government structures also rely fairly extensively on research institutions and both local and internal consultants for specialist energy planning and modelling support.

Various organized groupings will act as lobbies within the process. For example, the Energy Intensive Users Group seeks to influence the energy planning process to protect its key interests of energy security and low electricity prices. The government sector is itself not homogenous and municipalities, as a key example, play an important role in protecting their interests as the major electricity distributors. There interest in this role includes protecting their constitutional mandate and also protecting the large revenue surpluses that are generated from electricity distribution.

In the electricity sector Eskom also runs its own internal planning process termed the Integrated Strategic Electricity Plan (ISEP). Eskom's ISEP is an internal and confidential document and is not developed via a transparent process. ISEP is intended to provide strategic projections of supply-side and demand-side options to be implemented to meet long-term load forecasts. It provides the framework for Eskom to optimise investments and returns.

It is notable that the planning process is well accepted and institutionalised in the electricity sector and is seen as an important process backed by all the major stakeholders. This is contrasted with the situation in the liquid fuels sector which has much more of a competitive market structure (albeit one dominated by a few large players), where government planning is typically seen as less important and suppliers respond more directly to demand from the market.

Sub-national Energy Planning

As mentioned above Municipalities play a limited but important role in the energy planning process – with their operations largely restricted to electricity distribution. Municipal level energy planning has therefore tended to focus on access to electricity and management of distribution systems. Key planning issues for the municipalities relate to maintenance and extension of distribution infrastructure and to the financing of distribution systems.

Municipalities do not play a formal role in national level planning of transmission or generation, but because they are important electricity purchasers are seen as key stakeholders in these planning processes. Municipalities make significant profits as

retailers of electricity and therefore are highly interested in any policy or planning decisions which may affect these revenue sources.
The recent energy supply problems have resulted in increased levels of power outages at the municipal level and have tended to enhance the interest of municipalities in the energy planning process. Current policy debates about the restructuring of the distribution sector into six Regional Electricity Distributors (REDs) have a direct and significant potential impact on this key asset for municipalities. The policy developments and planning around the introduction of the REDs has been the major focus of municipalities within the energy sector.
The recent electricity and liquid fuel supply problems, as well as growing concern about climate change and local environmental quality has also led a number of municipalities to start considering local energy planning more broadly than simply electricity distribution. This has led to the development of a number of local state of energy reports from some of the larger metropolitan municipalities and increasing policy interventions in the delivery of energy, as opposed to electricity services, at the municipal level.

All indications are that the role of local government in energy planning is set to increase – specifically in areas such as the provision of broader energy services, demand-side management and energy efficiency.

Role in Policy Implementation

The policy implementation role largely falls to Eskom in the electricity sector, as the national electricity utility. Over time it is the government intention that Independent Power Producers will claim a larger stake, with the target being 30%, of power generation. However, at present Eskom dominates electricity generation and transmission. Local authorities do have an important role alongside Eskom in the distribution sector and provide the majority of household and small and medium size industry connections. The structure of the distribution industry is therefore of great importance to local authorities.

The liquid fuels sector is dominated by a small number of refiners and retailers who address the importation, local refining and distribution of liquid fuels under the regulation of NERSA. Sasol is the dominant firm amongst these and also is very influential in natural gas transmission via its pipeline transporting natural gas from Mozambique.

As discussed the role of local authorities in policy implementation is largely around the distribution of electricity and ensuring access to electricity and energy services.

Key Stakeholders

The following stakeholders have an important role in energy planning in South Africa. The table provides a brief description of each stakeholders institution and its role in the energy planning process. It should be noted that there are a range of other stakeholders in the energy planning process and the table is not comprehensive.

Description of the key actors in the sector

The actors or stakeholders are distinguished from the key energy planning institutions by their relative roles in the energy planning process – with the stakeholders having a less direct role in energy planning that the key institutions. There is a degree of judgement in this distinction, as some stakeholders could at times be classified as key institutions. This is particularly so in the liquid fuels sector where there are less formal national planning processes. Nevertheless, the distinction made should be generally valid. Similarly, the list is not comprehensive and a judgment has been made as to the most important actors.

Table 2: Key Stakeholders in Energy Planning

Name	Description and Broad function
Government Departments, institutions and structures	
National Department of Science & Technology (DST)	The mandate of this department is to develop science and technology in South Africa. It does this primarily through its National System of Innovation, for communities, researchers, industry and government. The DST is responsible for R&D strategy, including climate change related R&D and other areas relevant to energy planning.
National Department of Environmental Affairs & Tourism (DEAT)	DEAT's mandate covers both environment and tourism. Re. the environment, its mandate is to ensure the protection and improvement of the quality and safety of the environment and to promote sustainable development and the conservation of natural resources. South Africa's input to the Kyoto Protocol and UNFCCC is supported and administered through the Chief Directorate Air Quality within DEAT.
NCCC National Committee for Climate Change	This committee is made up of a wide range of stakeholders and advises DEAT on national climate change policy and assists DEAT in its role with regards to UNFCCC and KP
Energy Producers	
PetroSA (Petroleum Oil & Gas Corporation of SA)	Established in June 2000 (merging Soekor and Mossgas). Its goal is to be the leading integrated provider of oil, gas and petrochemicals competitively in South Africa (falls under CEF)
Academic& Research Institutions	
Energy Research Centre	Multi-disciplinary energy research centre. Part of the University of Cape Town. The ERC has been very influential in its role in providing technical energy modelling and planning support to the DME, ESKOM and NERSA in the various energy planning processes.
South African National Energy Research Institute (SANERI)	SANERI is a subsidiary of the CEF and is responsible for facilitating skills development and undertaking research and technology development which will ensure the full utilisation and optimisation of South Africa's energy resources. The research institute is newly established and is based at the CEF's head offices.
Council for Scientific and Industrial Research (CSIR)	The CSIR was established by an Act of Parliament in 1945 and is one of the leading scientific and technology research, development and implementation organisations in Africa . It is situated in Pretoria and represented in each of the nine provinces of South Africa. The CSIR undertakes and applies directed research and innovation in science and technology to improve the quality of life of the country's people.
Industry associations	
Energy Intensive Users Group	Established to promote the interests of large energy users to ensure that low cost, good quality and reliable energy is available to industry in South Africa. The EIUG represents energy users who in combination use about 60% of the country's electricity.

South African Petroleum Industries Association (SAPIA)	SAPIA was established in 1994 to represent the common interests of the petroleum refining and marketing industry in South Africa and to promote an understanding of the industry's contribution to economic and social progress.
Chamber of Mines	The Chamber of Mines of South Africa is a prominent industry employers' organisation which exists to serve its members and promote their interests in the South African mining industry. Its primary role is to provide strategic support and advisory input to its members. It facilitates interaction among mine employers to examine policy issues and other matters of mutual concern to define desirable industry-level stances.
Other	
South African National Energy Association (SANEA)	SANEA represents a hub for the exchange of energy related information between South Africans and between South Africa and players internationally, via the World Energy Council networks. In so doing, SANEA stimulates original thought and catalyses transformation of the Energy Sector. Its purpose is to promote the sustainable supply and use of energy.
Sustainable Energy and Climate Change Project (SECCP)	The objective of the Sustainable Energy and Climate Change Project (SECCP) is the promotion of policies and measures for sustainable energy and climate change response in South African development and energy planning.

Role in policy formation

The role of the various stakeholders has partly been outlined in Section 0 above. In addition, many of the stakeholders enter the planning process in a lobby role. For example, the DEAT and the National Climate Change Coordinating Committee, develop and contribute to policy around climate change mitigation which influences energy planning. However, aside from being involved as stakeholders in consultations around national energy planning they do not have direct mandates over energy planning at present. The DEAT can also influence energy policy via such instruments as air emissions standards from power stations. Similar roles are played by other national departments, which may influence energy planning, while not having a direct energy mandate.

The research institutions, both state and academic or private sector, have been very influential stakeholders in providing energy planning capacity to Eskom, the DME and other institutions, and in determining energy research agendas. They have also been important in placing policy research around energy into the public domain for use by others.

The non-governmental organisations, such as the SECCP are important lobbyists in the energy policy process but also have no formal role in energy planning. Industry organisations like SAPIA and EIUG similarly act as lobbyists to government, and represent their member's interest. They also may play some internal planning function, through sharing of industry information on issues such as refinery production capacity and future energy demand.

Role in policy implementation

The role of the various stakeholders has largely been outlined in Section 0 above. In large measure it is only the large private sector energy firms/associations that have a direct role in energy planning implementation.

Policy Environment

Legislation and Policy Framework
A relatively complete list of all legislation, white papers and other policy documents and tools is provided on the DME website at www.dme.gov.za/energy/documents.stm. Links are provided on this site to copies of most of the legislation and policies listed.

Legislation

In summary, the following pieces of legislation have shaped the structure and function of the energy sector in South Africa (ERC 2004). It is notable that much of it relates to electricity, particularly the early legislation.

Petroleum Products Act 1977
Relates to the saving of petroleum products and an economy in the cost of their distribution

Eskom Act 40 of 1987
Defines the responsibilities of Eskom.

Electricity Act 41 of 1987
Defines the structure, functions and responsibilities of the Electricity Control Board, and assigns the sole right of electricity supply within municipal boundaries to local government authorities.

Electricity Amendment Act 58 of 1989
Amends the Electricity Act, 1987 to provide for a levy on electricity; ensuring that a license shall not be required for the generation of electricity; and to provide for the transfer of servitudes on the transfer of undertakings; and other incidental matters.

Nuclear Energy Act 3 of 1993
To bring all nuclear activities funded by the state under the control of the atomic energy, with specified exceptions.

Electricity Amendment Act 46 of 1994
Amending the Electricity Act, 1987 by providing for the continued existence of the Electricity Control Board as the National Electricity Regulator (NER), and applying certain provisions of the Act to other institutions and bodies.

Electricity Amendment Act 60 of 1995
The Electricity Act of 1987 was further amended to establish the National Energy Regulator as a juristic body; to make provision for the appointment, conditions of employment and functions of the chief executive officer and employees; and for the funding and accountability of the NER.

The 1999 National Nuclear Regulation Act
The Act amended the governance of nuclear energy.

Recent regulatory reforms

In 2000, the national debates on power sector reform heated up. Regulation in the context of a deregulated marketed received attention, starting in the gas and electricity sectors. Concerns to extend the social benefits of electrification were reflected in the 'poverty tariff'. New policy, for example on renewable energy, continued to emerge. Many of these considerations were combined in the first official integrated energy plan (2003) – see below.

The 2001 Gas Act
Made for the orderly development of the piped gas industry and established a National Gas Regulator.

The 2001 Eskom Conversion Act
The Act changed Eskom into a public company.

Mineral and Petroleum Resources Development Act 2002
Makes provision for equitable access to and sustainable development of nation's mineral and petroleum resources

The 2002 Gas Regulator Levies Act
The Act provided for the imposition of levies by the National Gas Regulator.

The 2003 Petroleum Pipelines Bill
The Bill seeks the establishment of a national regulatory framework for petroleum pipelines, and provides for the licensing of persons involved in the manufacturing or sale of petroleum products.

National Energy Regulator Act 2004
Established the National Energy Regulator of South Africa (NERSA) with the mandate to undertake the functions of the Gas Regulator as set out in the Gas Act of 2001, the Petroleum Pipelines Regulatory Authority as set out in the Petroleum Pipelines Act of 2003 and the National Electricity Regulator as set out in the Electricity Act of 1987 as amended. It replaced the National Electricity Regulator in this latter function.

Electricity Regulation Act 2006
Establishes a national regulatory framework for the electricity supply industry and makes the National Energy Regulator the custodian and enforcer of the national electricity regulatory framework. It also provides for licences and registration as the manner in which generation, transmission, distribution, trading and the import and export of electricity are regulated.

White Papers

Most of the existing recent policy for the energy sector is contained within two White Papers:
- White Paper on Energy Policy of Republic of South Africa December 1998
- White Paper on Renewable Energy Policy 2003

White Paper on Energy Policy of Republic of South Africa December 1998

An initial white paper on energy policy was produced in 1986. This was superseded in 1998 by the most recent 'White Paper on Energy Policy'. The development of this White Paper was triggered by the change of government in 1994, the need make energy policy more transparent and the various changes in the sector which had been brought into being via the democratisation of South African Society.

The paper is set within the context of the National Growth, Employment and Redistribution programme (GEAR) which places overall national priorities on two core strategies:

- promoting growth through exports and investment; and

- promoting redistribution by creating jobs and reallocating resources through the budget.

Within this context, the White Paper defines a number of objectives for the energy sector. In summary:

1. Increasing access to affordable energy services.
2. Improving energy governance – clarification of the relative roles and functions of various energy institutions within the context of accountability, transparency and inclusive membership, particularly participation by the previously disadvantaged.
3. Stimulating economic development – encouragement of competition within energy markets.
4. Managing energy-related environmental and health effects – promotion of access to energy services for poor households while reducing negative health impacts arising energy activities.
5. Securing supply through diversity – increased opportunities for energy trade, particularly within the Southern African region, and diversity of both supply sources and primary energy carriers.

Energy planning is included within the White Paper as a cross cutting issue. Integrated Energy Planning is acknowledged to require significant amounts of data (and it is also acknowledged that this data is 'scarce' in South Africa). However, the paper goes on to identify IEP as the most suitable base for Energy planning processes in South Africa and identifies the following technical functions of Integrated Energy Planning:

- interpreting the requirements of national economic, social and environmental policies for the energy sector;
- analysing energy needs in terms of how their fulfilment will contribute towards attaining national economic and social goals;
- analysing the potential of energy supply systems and demand side management to meet current and potential future energy needs. This would include analyses of individual supply sub-sectors and the linkages between sub-sectors;
- analysing energy sector linkages to the macro-economy;
- analysing the potential effects on the energy sector of global and technological developments;
- evaluating the effects of legislative, institutional and industry structure arrangements on energy supply and demand; and
- specifying, sourcing and presenting data on energy supply and demand, energy sector institutions, and linkages with economic and social factors in order to provide a statistical description of the energy sector's historic evolution and current impact on economic and social development.

White Paper on Renewable Energy

This Paper built on sections in the White Paper on Energy Policy on the subject of renewable energy and sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy.

The White Paper on Energy Policy's position with respect to renewable energy is based on the integrated resource planning criterion of "ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options".

The White Paper on Renewable Energy does not specifically mention Integrated Energy Planning, but it does provide policy on issues of energy security (of specific interest in the context of this paper). It re-emphasises that a key goal for South Africa remains “energy security through diversification of supply” (as stated in the White Paper on Energy Policy). It then states that renewable energy is a mechanism for achieving this and states a desire to establish a renewable energy industry in South Africa “producing modern energy carriers that will offer in future years a sustainable, fully non-subsidised alternative to fossil fuels”.
A medium-term (10 year) target is then set of:

“10 000 GWh (0.8 Mtoe) renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. The renewable energy is to be utilised for power generation and non-electric technologies such as solar water heating and bio-fuels. This is approximately 4% (1667 MW) of the projected electricity demand for 2013 (41539 MW).

This is equivalent to replacing two (2x 660 MW) units of Eskom's combined coal fired power stations. This is in addition to the estimated existing (in 2000) renewable energy contribution of 115 278 GWh/annum (mainly from fuel-wood and waste”.

Forthcoming legislation

The DME is in the process of drafting an Energy Bill. An initial draft of this Bill was produced and circulated for consultation in 2004. Various issues raised during the consultation process are now being addressed and subsequent drafts have not yet been released. The 1st draft of the Bill had numerous objectives, one of which is to:

(b) provide for the supply, transformation, transportation, storage and demand of energy that is planned, organised and implemented in accordance with a balanced consideration (Energy Bill 2004 section 2(b)).

The Bill goes on to provide for various elements required for planning and organization of energy provision, including the creation of a national energy data base and information management system. Chapter 5 of the Bill relates directly to Integrated Energy Planning and (if promulgated) would make it a requirement for DME to carry out integrated energy planning, guided by a specific set of principles. See relevant section in Box 5 below.

Box 5: Section of Draft National Energy Bill dealing with Integrated Energy Planning
16. (1) The Minister must establish and maintain an integrated energy planning capability to inform energy policy and policy implementation. (2) Integrated energy planning shall incorporate energy supply, transformation, transport, storage and demand in such a way that it takes into account a balanced consideration for security of supply, economically available resources, affordability, accessibility, environment and consumer protection. (3) Integrated energy planning must use the principles of (a) sustainable development; (b) optimal use of indigenous and regional resources; (c) balance between supply and demand, and their characteristics; (d) economic viability; (e) environment, health and safety impacts; and (f) developmental impacts in the Southern African region. (4) A national integrated energy plan shall be produced at least once in every five years.

National Strategies and Programmes

A number of energy strategies and programmes have also been developed within the framework of the energy policy White Paper and the legislation governing the sector. The more important of these are noted below.

Energy Efficiency Strategy South Africa 2005

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

The Strategy sets a national target for energy efficiency improvement of 12% by 2015. It is accepted that this target will be challenging, but at the same time it is considered to be readily achievable. The strategy foresees that energy efficiency improvements will be achieved largely via enabling instruments and interventions such as economic and legislative means, efficiency labels and performance standards, energy management activities and energy audits, as well as the promotion of efficient practices. Sectoral Implementation Plans will be produced to facilitate implementation of the strategy.

Draft Bio-fuels Industry Strategy 2006

This document presents the proposed South African Biofuels Industry Draft Strategy and further outlines the Government support and approach to addressing policy, regulations and incentives for Biofuels.

Integrated National Electrification Programme (INEP)

The government's intention is to achieve universal household access to basic electricity and the INEP remains one of the primary means for achieving this.

The precursor to the INEP was the National Electrification Programme run by Eskom which was established in the mid 1990s. This was converted into the Integrated National Electrification Programme and since 2002 has been run by the DME. By May 2005, the INEP had delivered connections to:

- 232 287 households (at a cost of R582-million);
- 233 school connections (R100-million); and
- 50 clinic connections (R118-million).
-

The INEP can provide either grid or non-grid connections to customers.

Free Basic Electricity

The National Electricity Basic Services Support Tariff Policy (i.e. the Free Basic Electricity policy) was gazetted in July 2003. This policy aims to bring relief , through government intervention, to low income households and to ensure optimum socio-economic benefits from the INEP. Qualifying customers are eligible for 50kWh of free electricity per month but pay normal tariffs for any consumption exceeding this. Eskom is the service provider for FBE in its areas of supply. The Department for Provincial and Local Government now oversees the implementation of this policy.

The FBE policy also provides for provision of free non-grid electricity to all non-grid electrified households (connected through the national electrification programme).

Integrated Household Clean Energy Strategy

The DME has developed an Integrated Household Clean Energy Strategy, which incorporates, among others, measures such as the low-smoke generating top-down ignition of coal fires, low-smoke fuels manufacture and distribution and housing insulation and design, as well as also in the longer term measures such as cleaner fuels (liquids & gases) and stoves. The strategy is seen as providing cleaner household fuels in the transition period during which many households are using coal in preference to other fuels or because they do not yet have access to electricity.

Biomass

Biomass fuels in their unprocessed form comprise of wood, straw, animal dung, vegetable matter, agricultural waste, while processed biomass include methane, charcoal, sawdust and alcohol produced from fermentation processes. This section is restricted to a discussion on the use of wood biomass for fuel.

Based on 2000 figures, biomass accounted for approximately 9% of final energy use in South Africa and within the residential sector, of the total 360.5 PJ consumed in 2000, 53% of this energy was in the form of biomass fuels in the rural areas (DME 2005). The burning of biomass energy in rural household is mostly done in open fires. In some areas the open fires are sheltered from the wind. Wood is also burned in mbawulas (paint or oil tins punched with holes). Making a fire in these appliances result in bothersome and unhealthy smoke emissions. Other biomass users include enterprises such as street restaurants, beer brewing, bakeries and traditional healing. Biomass collection and burning is a significant issue in both poverty and gender related policy as it has the greatest impact on poor rural communities and on the women who have the greatest responsibility for its collection on a daily basis.

Woodfuel is harvested from natural woodlands, forests, commercial plantations, and communal woodlots, among others. It is collected and carried as headloads by women and children. It is also collected by men and transported using vehicles. Where fuelwood shortages occur, the fuel is commercialised. The total annual sustainable supply of wood from natural woodlands in communal areas is about 12 million tons. Commercial plantations produce an estimated 3.5 m tons of forest residues. The clearing of invasive alien plants that cover over 10 million hectares of South African land provides wood for various uses including fuelwood and charcoal. The use of charcoal in South Africa is limited to leisure. Most of charcoal produced in South Africa is exported (see www.probec.org for more information).

In terms of policy, the main issues to be addressed relate to:

- Reliance on large proportions of rural communities in South Africa on fuel wood as a primary energy source (and its impact particularly on rural women)
- How this need can be addressed through sustainable management of woodland
- How the significant environmental impacts of fuelwood harvesting can be mitigated
- How the need for fuelwood can be linked to public programmes for clearing of invasive alien tree species (e.g. DWAF's Working for Water).
- How the efficiency of use of fuelwood can be improved through the development of technologies (such as improved woodstoves).

These issues are given some discussion within the White Paper on Renewable Energy (2003) and the White Paper on Energy Policy.

In terms of government initiatives in this area, in 1992 the Department of Mineral and Energy (DME) initiated a programme called the Biomass Initiative (Plant for Life). The programme was overseen by a steering committee comprising various government departments and institutions with a research and development focus. The objectives of the programme included the assessment of the biomass energy resource and energy use patterns as well as pilot testing of social forestry elements and biogas digesters.

The efforts and outputs of the Biomass Initiative contributed immensely to forestry policy development and culminated in an agreement that the Department of Water Affairs and Forestry (DWAF) is the government department responsible for this issue. DWAF has recently published its Woodland Strategy Framework (June 2005) which proposes various approaches to the issues around fuelwood energy. For example, included in its proposed incentives for sustainable woodland management would be the introduction of a Basic energy grant.

DWAF states that "The option of an alternative basic energy grant should be considered for communities who cannot benefit Free Basic Electricity Grant. This could be implemented in a number of ways. It could be a grant payable to individual homesteads that could then use the energy grant to purchase the most accessible or affordable fuels in their area. It could also be a grant payable to communities to enable them to manage or rehabilitate their woodlands or support tree growing or other initiatives that would enhance their access to biomass energy." (DWAF 2005)

The main strategies within the DWAF document include a strategy for alternative energy and biomass resources for rural (and urban) communities. Within this strategy a primary activity will be the development and implementation of a strategy for wood fuel and integration of its activities in this area with those of other departments (e.g. Department of Agriculture, who include woodland management in their agricultural extension activities) (DWAF 2005).

The White Paper on Energy Policy, 1998, confines the DME's role on fuelwood to that of monitoring the situation on community forestry. Regarding the combustion of biomass energy in households, the White Paper stipulates that the DME will have responsibility to promote adoption and use of efficient wood burning stoves and alternative technologies such as solar cookers and LPG. The DME is in the process of finalizing a policy for the Promotion of Renewable Energy and Clean Air Development. strategy.

The National Department of Agriculture has over 800 extension workers to provide rural development services that include tree-related interventions and are envisaged to take over responsibility for or lead role in providing support services in the future. At provincial level, the Premier's Offices and local government have responsibility for woodland management and community greening activities. Other initiatives in this area in South Africa include the GTZ funded ProBec programme (Programme for Biomass Energy Conservation in Southern Africa) which is working on these issues within the SADC region (www.probec.org).

Overview of energy planning framework

Three distinct energy planning processes operate at a national level in South Africa. These have already been briefly described above and some more detail is provided in this section.

Integrated Energy Planning: run by the Department of Minerals and Energy and covering all energy sectors

Integrated Strategic Electricity Planning : carried out by Eskom and relating to electricity only
National Integrated Resource Planning (NIRP): carried out by the National Energy Regulator (NERSA) and related to electricity only.

Integrated Energy Planning

The legislative basis for carrying out national level integrated energy planning comes from the White Paper on Energy Policy (1998). The process is new to South Africa and one initial version of a plan has been produced (2003) with a second version currently in preparation.

The process of preparing the IEP is coordinated by Department of Minerals and Energy (DME), Directorate Energy Planning & Development (sub Directorate: Integrated Energy Planning). The broad purpose of Integrated Energy Planning has been defined by DME (in IEP (1)) as:

" to balance energy demand with supply resources in concert with safety, health and environmental considerations. An integrated energy plan or strategy is not a precise blueprint for the energy sector, but is a framework within which specific energy development decisions can be made" (DME 2003, p5).

DME admits that the process followed during the preparation of the first plan was a 'learning process' and that several gaps and deficiencies were present (to be addressed following the publication of the plan through follow up work by DME) (DME 2003, p5).

IEP(1) was based on scenario modelling commissioned by DME and Eskom and carried out by the University of Cape Town, Energy Research Institute.

The methodology followed in preparation of the IEP (1) has been described by DME as follows:

- Calculations were done under likely scenarios. Two basic scenarios were used: a "Baseline" or business as usual scenario, and a "Siyaphambili" (we are going forward) scenario that promoted diversification of supply and environmental improvement.

- With respect to environmental aspects, the Treasury and the Department of Environmental Affairs and Tourism were set the task (within IEP (1) to investigate the financial internalisation of environmental externalities. Because the internalisation of externalities could not be quantified in time for the IEP (1), environmental aspects were primarily addressed through efficiency measures and renewable energy.

- The two scenarios were used both in a simulated and an optimised mode. The simulated mode is where options are prescribed.

- Key parameters and drivers for inclusion in the scenario modelling were decided by specialists during public participation workshops.

A set of assumptions and constraints was also agreed at a public workshop and included in the IEP (1).

DME acknowledges that the modelling processes for an IEP should take 2-3 years. However, the modelling process for IEP (1) was carried out over only 8 months. Thus, they admit that the use of the models needs to be optimised for future application (DME 2003; p13).

Gaps in the IEP (1) process were cited as follows in the table below. At the time, DME stated that these would be addressed in the next phase of the IEP programme (i.e. preparation of IEP 2)
.

Table 3: Gaps Identified in the Integrated Energy Planning Process (DME, 2003)

Governance	The process did not consider in any detail the legislative, regulatory and institutional aspects in the energy sector for the implementation of the recommendations. Where decisions are based on considerations other than only economic, and in a changing environment where previous monopolies are being replaced by a multitude of players, the government needs to intervene for example to facilitate the expansion of renewable energy and energy efficiency measures.
Stakeholder Participation:	The process included inputs from the Department of Trade and Industry, Treasury, Department of Environmental Affairs and Tourism as well as other interested and affected parties through two workshops. Future endeavours should intensify the participation of relevant government departments as well as other stakeholders, especially when it comes to fixing assumptions such as growth rates etc.
Energy Data:	The modelling processes required large amounts of accurate energy and other (eg economic growth, exchange rates, population growth, sector inflations) data. Some data were not available (eg the provision of energy data is not currently mandatory) and some available data were inconsistent. Data quantities vary from source to source, and energy balances are not well disaggregated. The exception is electricity, which is well described by Eskom.
Models Programs	During the current integrated energy planning process, the development of optimal calculation programs were traded off against the need to expedite results. This has been identified is a major gap in the current process. To advance the process, the calculation programs should be optimised to allow more ready facilities to change driver parameters and baseline data both up-front and over the planning period.
Environmental Externalities	The process did not explicitly include environmental externalities because of the uncertainty of current policy developments in this regard, reliable local data and uncertainty as to how such external costs would be constituted in a policy void
Environmental Funding:	Environmental funding (especially international funding) was not included in the modelling as policy regarding national environmental taxing/funding is not yet resolved and some uncertainties with international funding remain.
Industry Restructuring	The effect of privatisation costs and security of supply was not addressed directly. The calculations were based on providing the most economic energy system for the country. This was assumed to be realisable, and did not take into account investment patterns of various sectors. This means that the calculated result might require policy instruments beyond simple deregulation.
Other	For example the trade off between least cost energy production and other factors such as job creation and social development.

IEP (2) process

Work commenced on the second phase of the IEP programme (IEP (2) but has been suspended for the time being in order to address problems with the process (particularly lack of integration and communication between the various energy planning processes taking place in the country)

However, prior to suspension of activity, scenarios had been reviewed and 3 new scenarios developed. Assumptions and drivers identified up on which to base this phase of the planning process were also identified. The new scenarios identified were:

- Business as Usual: scenario based on current realities
- Diversification: Modification of base line scenario. Looks at an optimal diversified solution (I.e. least cost energy mix after policy intervention) through blend of various energy sources
- Low Carbon : scenario incorporating interventions aimed at lowering greenhouse gases.

It is worth noting, that whilst the IEP (1) was called an integrated energy plan, it cannot be considered to be a plan, or indeed a strategy of any kind. It is essentially an analysis of the various scenarios generated and provides little in the way of guidance or direction for future energy decision-making.

National Integrated Resource Planning

Following the Energy Policy White Paper, the National Electricity regulator (as it was then) introduced the development of a National Integrated Resource Plan (NIRP). The NIRP was to be seen as an independent information source to stakeholders and decision-makers for ensuring security of the electricity supply.

Two National Integrated Resource Plans (NIRPs) have been produced to date, The first in 2002 and the second in 2003/04. Preparation of the third (NIRP3) has recently started. NIRP 1 was produced in 2002 and was based mostly on Eskom's growth plans.

A NIRP Advisory and Review Committee was established in 2003 to provide stakeholder guidance and contribution to the NIRP process. NIRP 2 was then produced in 2003/04 by a team comprising Eskom Resources and Strategy Group, Energy Research Institute of UCT and the NER (and guided by the Advisory Review Committee)

The objective of the NIRP 2 was to determine the long-term least-cost electricity supply options for the country, independent of Electricity Supply Industry (ESI). It provided moderate, high electricity and demand forecasts, complete database of the cost and performance of the generation plant considered in the optimisation, detailed output results, methodology applied in the planning process & risk and sensitivity analyses (the latter were not part of the NIRP1 and were considered to be a significant improvement and addition to the content of the NIRP).

NERSA has stated that NIRP 3 will be more ambitious and will be based on more information and data than its predecessors. NIRP3 is being prepared by international consultants, whose appointment includes the development of capacity and skills transfer to NERSA as part of the NIRP3 development process (engineering news 21/04/2006).

Integrated Strategic Energy Planning

Eskom's Integrated Strategic Electricity Planning (ISEP) process is intended to provide strategic projections of supply-side and demand-side options to be implemented to meet long-term load forecasts. It provides the framework for Eskom to investigate a wide range of new supply-side and demand-side technologies with a view to optimising investments and returns. Eskom's ISEP is not in the public domain but remains an internal document. Eskom state that this is necessary due to the confidential nature of much of its content.

Eskom is now working to ISEP 8. In its planning process, the focus is to provide as robust a plan as possible, taking into account Eskom's and the shareholder's objectives. Specific attention is given to those uncertainties that would influence decisions on the timing and mix of new capacity.

According to Eskom the difference between the DME and the NER plans on the one hand and Eskom's plan on the other is that the Eskom plan is risk-adjusted. For example, it may have been calculated that a thousand more megawatts are needed, which would be indicated in the DME's plan, but when Eskom looks at the additional thousand megawatts needed, it takes care of the risk involved by adding more capacity than that laid down in the national plan. Eskom does this against the background of its knowledge of what should not be totally relied upon and it factors in the risk. Eskom realises that NERSA would like to see greater alignment of the two plans. (Engineering News: 24 May 2005).

Policy Implementation

A key issue with regards to the various energy planning processes outlined above that has emerged from both the literature and from the focus groups and interviews is the absence of true integration in national energy planning. Linked to this is the failure of the current planning system to clearly and effectively allocate responsibility for planning and investment decisions in the energy sector and to provide for oversight over the implementation of that responsibility that has been allocated.

A recent report, sponsored by DFID, to the Department of Public Enterprises (DPE) on energy security in South Africa described the integration of energy planning processes in South Africa as 'theoretical' – not the 'true' integration that should be taking place in practice (Wilson and Adams 2006).

For example, the NIRP produced by NERSA is supposed to be incorporated into the DME IEP – and it may be true that elements of the NIRP document find their way into the DME documents. However, according to the key informants within this project, the two planning processes are run largely independently from each other and little integration takes place in practice.

The DPE report is quoted quite extensively below as it confirms and supports in large measure what has been learnt in this project via direct interviews and discussions with stakeholders. The report states that:

"…the main finding of the study, with regard to demand forecasting, is the need for a truly integrated approach. At present, a theoretically integrated approach exists within the National Integrated Resource Plan (NIRP), under the jurisdiction of NERSA. However, in practice it is apparent that the NIRP is largely irrelevant to Eskom's planning, which is based on its own Integrated Strategic Electricity Plan (ISEP). It is appropriate that planning should be under the control of an independent body and there are aspects of the new approach, adopted within NIRP3, that are advantageous.

However, the current NIRP approach fails to take sufficient account of the considerable expertise on demand forecasting that has been developed within Eskom. In addition, municipalities, as retailers to around one-half of the customer load in South Africa, need to be more fully involved. There is strong case for the two separate planning processes, ISEP and NIRP, to be brought together in a fully transparent process, open to all parties and managed on a consistent and regular basis.

A major input to the demand forecast is the assumed level of economic growth in South Africa. It has been argued by Eskom that Government targets for growth may be optimistic but recent figures suggest that GDP growth is currently strong and there are grounds for remaining optimistic about the future. Currently, however, there is lack of agreement, within the electricity industry, about the assumed level of economic growth that the industry is preparing to meet. This is not a good basis for planning." (Adam and Wilson, 2006)."

An important issue implicitly raised in the above quote is the fact that the DTI and National Treasury do not play a significant role in supporting energy planning, despite the key role of energy in the South African economy.

The DPE report goes on to discuss other failures of implementation of the current energy planning system, as follows:

"Over the past 10 years the reserve margin has fallen very significantly as a result of growth in electricity demand of around 3% per annum (which equates to approximately 1,000MW of additional peak demand each year) and the very limited amount of new generating plant that has been commissioned. However, the monitoring of reserve margin is inadequate and inconsistent. There is no agreement between NERSA and Eskom on whether to include demand-side management (DSM) measures as part of demand or as a supply-side option and there is lack of clarity concerning the distinction between the reserve margin adopted for long-term planning purposes and that used for short-term operational purposes. It is recommended that these anomalies should be removed and that a consistent, transparent and regular monitoring system be established to track the reserve margin and the availability of generating plant and the transmission system.

Eskom's plans for generation capacity expansion (ISEP) concentrate on the long term supply position and do not focus on alleviating the shortfall in supply security in the short term. If the return to service of mothballed plant, the commissioning of any of the new gas turbines run behind schedule or the forecast level of Demand-Side Management (DSM) fails to materialise, the capacity situation in the short term will become tighter. Contingency measures for dealing with such possibilities should be in place."

The final point that is reflected from the DPE study relates to the opaque manner in which Eskom undertakes its internal planning. Again, this view was supported by many stakeholders in the focus groups and interviews. The DPE report states that, "…in South Africa, almost all of Eskom's documents on security of supply and reserve margin are either unpublished or specifically deemed to be confidential. Whilst Eskom may argue that their ISEP results are confidential, the argument is invalid, particularly for a dominant state-owned entity not in competition with other utilities. International experience shows that in both competitive and monopolistic markets, the type of information produced in Eskom's ISEP is deemed to be public domain information, in order to ensure that all interested parties are aware of the plans, issues and options under consideration. It is also likely that a more open process may have revealed the serious disjoint that exists, between the long-term planning process and the process of delivering the required capacity additions. The lessons are that, where key decisions are being made, it is vital that the plans and the associated assumptions have the widest possible exposure to enable alternative ideas and options to be considered. Eskom does not have a monopoly on good ideas. ." (Adam and Wilson, 2006)."

Energy Planning: security, access and climate change

This section explores the three main drivers in more detail and brings in results from the primary data collection process.

Drivers of energy planning in the South African context

A number of drivers of energy planning have been formally identified in the various South African energy planning processes, specifically the IEP process of the DME. Although in large measure these can be aligned with the three broad drivers of security, access and climate change the locally expressed drivers reflect the particularities of South Africa. Thus we see specific issues around population dynamics including impacts of HIV/AIDS on population growth, contained in the drivers identified within the draft IEP2 process which are listed below (DME, 2005):

- Security of Supply
- Government Policies
  - Diversification
  - Poverty alleviation
  - Job creation
  - Energy efficiency targets
  - Renewable energy targets
  - Energisation policies
- International Commitments, Pressure and Co-operation
  - CDM, Kyoto, Carbon trading, globalisation
- Economic Growth
- Availability of Resources
  - Financial,
  - Human
  - Capital
  - Energy reserves
- Demographics
  - Population growth
  - Urbanisation and migration
  - Health hazards (HIV, TB etc.)
- Technological Developments
  - Research and Development
- Fuel Prices
- Political Stability

It should be noted that this list is a draft set of drivers identified in the IEP2 process. These are likely to be refined as the process continues. They also do not reflect other drivers contained within the envisaged scenarios to be analysed via the IEP2.

Nevertheless, it can be seen from this list the drivers do not directly reflect the issues of energy security, access and climate change, although many of the drivers can be seen as sub-sets or alternative formulations of these three concerns. For example, energy access is directly addressed by the driver termed poverty alleviation.

Other drivers reflect the South African perspective – for example, whereas climate change may be seen as a direct driver within developed country energy planning, within the IEP2 process it is expressed as a driver that impacts indirectly on the SA energy planning system via international commitments and pressures.

Again, it must be stressed that the above list does not reflect official policy on considerations to be taken into account in the energy planning process – but rather reflects an interim set of drivers that were beginning to be incorporated into the IEP2 process.

Energy sector policy objectives

The White Paper on Energy Policy (DME, 1998) outlines a set of energy sector policy objectives. Although policy objectives do differ from energy planning drivers they do provide the policy context for energy planning. The specific objectives are:

- Increasing access to affordable energy services
- Improving energy governance
- Stimulating economic development
- Managing energy-related environmental and health impacts
- Securing supply through diversity

There is a clear synergy between these policy objectives and the various drivers of energy planning discussed above. The issue of energy governance, which also was raised in some of the focus groups, is clearly of central importance for the success of the local energy planning processes. The White Paper specifically notes that:

- Governance of the energy sector will be improved. The relative roles and functions of the various energy governance institutions will be clarified, the operation of these institutions will become more accountable and transparent, and their membership will become more representative, particularly in terms of participation by blacks and women.

- Stakeholders will be consulted in the formulation and implementation of new energy policies, in order to ensure that policies are sympathetic to the needs of a wider range of stakeholder communities.

- Co-ordination between government departments, government policies, and the various spheres of government will be improved in order to achieve greater integration in energy policy formulation and implementation.

- Government capacity will be strengthened in order to better formulate and implement energy policies.

Stakeholder perceptions

The focus groups and interviews conducted have been instructive in providing an updated and simpler indication of the perceived drivers of energy planning amongst key stakeholder groups (see Table 5). It is apparent from the focus groups that in broad terms energy security and energy access are seen the main drivers of energy planning, with energy security typically being seen as the ability to provide a reliable and adequate supply of energy for the country's economic development needs. Climate change is certainly seen as an important driver, but is generally seen as both less important than the other drivers and also as being more influential in the medium to long term than in the present.

It was consistently noted that energy access, meaning household energy access, was also a central element driving energy sector planning but that access could only be provided if there was security of supply. The issues of access and security are further linked in stakeholders' minds by the affordability component of access, with stakeholders noting that security of supply must imply affordable supply if accessibility goals are to be achieved.

The current electricity supply crisis in the country possibly has some influence over the views expressed in the stakeholder discussions. It is natural to expect that in a period where the electricity planning system has manifestly led to a critical mismatch between supply and demand there will be some greater focus on ensuring that the planning system is improved to prevent further threats to energy security. That being said, the focus groups did attempt to provide a balanced and considered view on the energy planning process.

Table 4: Stakeholder Ranking of Drivers

Sectors	Drivers	
	Short-Term	Long-Term
Climate Change	• Economic Development • Access (more in terms of high energy users access) • Security • Local Environmental Issues • Climate Change	• Economic Development • Access • Climate Change • Local Environmental Issues • Security
Donors	• Economic Development • Social Development • Security for Access • Regional Security	• Climate Change • Economic Development • Regional Integration and Security
Energy Intensive Users	• Security • Stability of Supply • Price	• Economic Development • Security • Climate Change • Access
Energy Policy and Planning	• Supply and Security • Economic Growth • Climate Change Accessibility	• Supply and Security • Economic Growth • Population Growth • Climate Change • Accessibility
Private Sector Suppliers	• Economic Growth • Climate Change and Environmental Issues	
Researchers	• Economic Growth • Security • Poverty Alleviation • Accessibility • Local Environmental Issues	• Economic Growth • Security • Poverty Alleviation • Accessibility • Local Environmental Issues

Table 4 shows how the various interest groups ranked the proposed drivers of energy planning as well as additional drivers that were felt important.

Definitions of drivers and approaches to rankings

There was some difficulty in arriving at consistent definitions or categorisations of drivers between the focus groups and key informants. For example, the climate change focus group saw energy access as incorporating access to energy by both the industrial sector and by households for basic consumption.

The same grouping also noted the difficulties of simply ranking drivers in terms of importance. For example, the group agreed that in terms of political importance and possibly in terms of planning effort, basic energy access may be highest ranked, whereas in terms of expenditure, energy security for economic development would be highest ranked.

Possibly a more useful distinction that emerged was between the "economic" driver and the "social" driver – with the economic driver encompassing notions of energy security for economic growth and development and the social driver encompassing the notion of energy supply for basic needs, local economic development and employment creation.

A range of other specific drivers were also raised in the course of the focus groups. These included:

- Diversity of supply and the appropriate mix of supply sources
- Fossil fuel resource depletion
- Accessibility to safe energy sources
- Biomass protection
- Energy governance
- Economic development nodes
- International developments including regional instability and international instability and energy markets
- Regional commitments and supply agreements
- Local environmental quality including
    - Air quality
    - Land degradation
    - Water quality

These drivers are discussed further below when they naturally fit within the three main drivers posited by DFID.

Energy Security

An overview of the role of energy security in energy planning in South Africa, and the views of stakeholders towards energy security as a driver are discussed below.

Policy on energy security

There is a stark difference between planning and regulation in the electricity sector, which is dominated by a single monopoly supplier, and the liquid fuels and gas sectors which have much more competitive and internationally open market structures. These sectors are therefore discussed separately below.

Electricity Sector

Energy security is an important consideration within formal government energy policy and planning. For example, in the Renewable Energy White Paper the DME (2004) noted that "the driving force for energy security through diversification of supply in South Africa has remained one of the White Paper On Energy Policy's key goals, since a major portion of the nation's energy expenditure is via dollar-denominated imported fuels that impose a heavy burden on the economy. Further, the South Africa economy, which is highly dependent on income generated from the production, processing, export and consumption of coal, is vulnerable to the possible climate change response measures implemented or to be implemented by developed countries."

The White Paper on Energy Policy (DME, 1998) itself notes under the objective of securing supply through diversity that, "given increased opportunities for energy trade, particularly within the Southern African region, government will pursue energy security by encouraging a diversity of both supply sources and primary energy carriers."

Although the new policy framework brought in by the White Paper retained energy security as an important focus the policy did not place security of supply centrally within the energy industry reform process. According to Eberhard (2004) the new energy policy framework "was a sharp break from the earlier apartheid-era energy policy, which had emphasized state provision of energy services and security of supply at any cost - epitomized in the state-controlled programs for nuclear power, the synthetic fuels program, and Eskom's costly overbuilding of the power system."

An important element of the envisaged reform of the electricity sector, of which the Energy White Paper was a part, was a reduction in Eskom's generation monopoly. In May 2001, the Cabinet approved proposals for the reform of the electricity supply industry through a "managed liberalization" process. This included a decision that Eskom was expected to retain no less than 70% of the existing electricity generation market, with privatisation of the remainder (Eberhard, 2004).

This policy decision was however not supported by sufficient allocation of responsibility for meeting the country's energy security needs. Adam and Wilson (2006) in the recent report prepared for the DPE on energy security note that "There is no clear direction concerning how the obligation to supply should be implemented, under the current policy of a 30/70 split between IPPs and Eskom. Currently, there is no mechanism to ensure that an agreed security standard is met and maintained over the planning period in an economic and efficient manner."

Subsequent events have brought security of supply back to the forefront of energy planning. These include the failure of independent power producers to fill the 30% slice of the generation pie created by the Cabinet decision, as well as under-estimates of electricity demand growth and inadequate new investment by Eskom.

Eberhard records that in early 2004, the National Electricity Regulator conducted a survey of electricity stakeholders on their perceptions of risks facing the industry. Most stakeholders stated "that the quality and reliability of supply were deteriorating and rated the risk of electricity service failure as likely and serious. They expressed concern about the capacity of government to lead the reforms and argued that policy uncertainty was having the effect of inhibiting investment in distribution systems as well as new generation capacity."

The immediate and practical response to the electricity supply crunch has been a renewed reliance on Eskom by the state for the provision of a secure electricity supply. The recent implied policy towards electricity provision is, in Eberhard's words that "security of electricity supply is seen as paramount." To support this he quotes the Minister of Minerals and Energy who stated in parliament on 22 June 2004 that "the state has to put security of supply above all and above competition especially".

Petroleum and Gas Sector

South Africa produced 23 571 million litres of liquid fuels product in 2005, according to the South African Petroleum Industry Association. About 36% of the demand is met by synthetic fuels (synfuels), which are produced locally, largely from coal and from natural gas. Products refined locally from imported crude oil meet the remaining 64%.

The petrol price in South Africa is linked to the price of crude oil in international markets and is quoted in US dollars (US$) per barrel. International petrol prices are essentially driven by supply and demand for product in a particular market. Crude oil prices combined with the Rand/US$ exchange rate therefore have a major impact on petrol prices.

The petroleum industry in SA is highly regulated in terms of market access and price. Recent regulation also contains relatively strong provision to promote the involvement of previously disadvantaged South Africans in the sector.

On the upstream side, the Minerals and Petroleum Resources Development Act of 2002 provides for the granting of exploration and production rights and the issuing of technical co-operation permits and reconnaissance permits by the Petroleum Agency on behalf of the Minister of Minerals and Energy. The downstream industry is controlled by the Petroleum Products Act (Act no. 120 of 1977) and a number of industry agreements. The government controls the importation of petroleum products as well as the ex-refinery gate price, the wholesale margin and the retail margin.

A new Gas Act was passed in 2001 that makes provision for the national regulator to issue licences for the construction and/or operation of gas transmission, storage and distribution facilities, and specifies licence application and issuing procedures. Licences contain conditions with regard to ring-fencing of gas transmission, storage and distribution businesses; third-party access to pipelines; exclusive geographic areas for distributors; and the setting of tariffs for consumers and distributors where there is inadequate competition (Eberhard, 2004).

Despite the extensive regulation of the sector there is not the same level of planning as is found in the electricity sector. Although Sasol is dominant in certain areas, such as natural gas, the industry is generally more competitive and open to market forces than the electricity sector.

The absence of sector planning has led to certain problems in the past, for example the national petroleum supply shortage in December 2005. The Moerane Commission (DME, 2005) established to investigate this supply shortage noted a number of problems related to the regulatory and planning framework for the sector. The Commission recommended that "the DME convene regular meetings with the petroleum companies to discuss industry related matters such as the submission of production and stock data, refinery shutdown planning, supply disruptions, pipeline or infrastructural damage, or any other matter that is necessary to secure the stability of the Industry and the economy."

Mechanisms

The key mechanisms in place to address security of supply have been outlined above. These include the long term IEP processes of the DME; the regulatory and planning framework of the NERSA; and the internal ISEP and corresponding Generation Plan of

Eskom

Key stakeholders

Security of supply is a key consideration for all those stakeholders involved in the process – however, it is clearly a greater consideration for certain groupings. Overall, security of supply was ranked as the most important driver – with many stakeholders linking this to security of supply for economic growth and development.

The interviews conducted with representatives of the major energy using sectors of the economy stressed the crucial importance of both reliability and quality of power supply for their operations. Also very important to these stakeholders was future certainty about the availability and price of electricity. For these consumers security therefore encompassed reliability, quality and long term stability. Other stakeholders, for example those in the climate change focus group, considered other components of energy security as more important drivers. The climate change focus group stressed the affordability and energy diversity elements of energy security. They also saw energy security as important for extending energy access.

The South African electricity sector is very skewed towards a small number of large users – the approximately 25 members of the Energy Intensive Users Group (EIUG) account for about 60% of the total electricity demand in the country and are clearly key stakeholders. Other key stakeholders are Eskom, who hold the primary mandate for electricity security of supply, and the large municipalities who purchase bulk power from Eskom for distribution.

At both the national and local levels security of power supply is evidently a highly political issue and neither sphere of government wants to be seen to be responsible for inadequate power to the economy or to households.

Liquid fuels

The liquid fuels sector is closer to a competitive market than the electricity sector. However there are some important incumbents who have significant market power that are worth mentioning. These include PetroSA, a state owned utility, and Sasol, a now private petro-chemicals and fuel company established and previously owned by the state.

PetroSA, or the National Petroleum, Gas and Oil Corporation of South Africa, is the country's national oil company. It owns, operates and manages the South African government's commercial assets in the petroleum industry. The company was registered in January 2002 as a commercial, non-listed entity. PetroSA is engaged in two worldwide businesses: oil and gas exploration and production; and the production and marketing of synthetic fuels and petrochemicals.

Sasol is an integrated oil and gas company with substantial chemical interests. In South Africa, these operations are supported by mining coal and converting it into synthetic fuels and chemicals through proprietary Fischer-Tropsch technology. The company also has chemical manufacturing and marketing operations. The group explores for and produces crude oil in offshore Gabon, refines crude oil into liquid fuels in South Africa, and retails liquid fuels and lubricants through a growing network of Sasol retail centres. Sasol also supplies Mozambique natural gas to customers and to its petrochemical plants in South Africa.

Stakeholder attitudes

It is relatively clear that energy security is seen by the majority of stakeholders as the most important short and long term driver of energy planning. As noted, security encompasses differing issues for different stakeholders, but in broad terms most stakeholders viewed the continued provision of energy at affordable levels to fuel economic growth and development as the most important driver of energy planning.

For the major users their views are typically that security of supply is paramount. These users noted that even if security of supply is seen as the most important driver by government there remains an under-appreciation by government and other energy planners of the importance of energy to the economy. For example – the mining sector noted that the health and safety implications of supply interruptions, aside from the economic implications, are considerable in deep level mining. These issues are not always factored into energy planning. Other major users noted the importance of future assured and low priced electricity for investments in certain economic sectors. They noted that both Eskom and government departments sometimes did not give enough cognisance to issues such as transparency about future electricity supply prices that were crucial to industrial investment decisions.

Most stakeholders referred to the current power supply crisis. It is clear that the recent supply problems in the electricity (and liquid fuels) sector have raised the issue of security of supply higher up the agenda – many stakeholders noted in various ways the impacts of the current crisis. Some, such as academics, felt that the integrated energy planning process had been halted so as to steer resources towards addressing immediate energy supply problems. This was seen as understandable but counter-productive as the current supply crisis was caused in part by inadequate planning processes. Others, such as some NGOs felt that the current crisis allowed energy investments to occur outside of the planning framework which undermined the process. For example, it was felt that government and Eskom could push through massive investments in nuclear energy due to the political need to demonstrate immediate action to secure future energy supplies.

It was also noted by some respondents that under the Energy Act the Minister is responsible for security of supply but it is not clear how she does this as. In particular it was noted that there are no national energy security standards so it is hard to define whether this requirement is being met.

Energy Access

An overview of the role of access to energy services in energy planning in South Africa, and the views of stakeholders towards energy access as a driver are discussed below.

Policy on energy access

The first policy objective of the White Paper on Energy Policy (DME, 1998) was increasing access to affordable energy services. Government made it a policy priority to promote access to affordable energy services for disadvantaged households, small businesses, small farms and community services. Within the White Paper, the analysis of energy for households placed the focus on low-income and rural areas and identified the need to address problems of inadequate energy services and inconvenient and unhealthy fuels. Issues such as access to fuels and their associated appliances, fuel availability and pricing were considered. Building thermally efficient low-cost housing, presenting an opportunity to promote energy efficiency and conservation, was also considered.

The need to provide of equitable access to affordable public transport was noted, but the challenges to this goal were identified. The provision of energy for smallholder agriculture, rural schools, clinics, roads, and communication infrastructure were also addressed.

Inclusion in energy planning

The government is aiming for universal electricity access, despite the fact that increased electrification will increase generation demand. (McNamara, 2004) points out that the DME has itself shown that not only would it be more 'economically' feasible for non-electrified households to continue to use coal as a direct energy source, but a movement away from grid electricity to coal or gas would further delay the need for new and expensive supply side initiatives. He quotes the DME (2003) IEP (1) as noting that "strategies aimed at switching some thermal energy requirements from electricity to coal or gas would result in significant savings to the economy by deferring investment in expensive new electricity supply options, as well as being physically more energy efficient. It is more economic to switch from electricity to coal rather than gas if environmental externalities are not considered." In other words, the government's universal access programme, by promoting the use of grid based electricity away from high pollution primary sources such as coal and wood, is prioritising human needs – via impacts on quality of life, health and dignity, over pure economic concerns.

The environmental health component of current energy practices in low income households is particularly important. The direct burning of low-grade coal and wood, mostly for thermal and cooking purposes has a severe negative environmental impact on domestic and ambient air quality and human health. After gastrointestinal related illnesses, acute respiratory infections are responsible for the highest number of deaths among children in SA. Urban areas such as Sebokeng, Soweto and Lekoa, have all recorded pollution levels above those stipulated by the World Health Organisation (WHO) and the United States Environmental Protection Agency (EPA). The direct use of fuel-wood for energy results in even higher levels of particulate emissions than the use of coal. In one study of rural households exposure levels were found to exceed the WHO lowest-observed-effect level by 26 times. (McNamara, 2004).

Mechanisms

A range of mechanisms to ensure access to energy have been established since 1994. Only the most significant are discussed below.

Electrification Programme

The most visible and effective outcome of the government policy on energy access was the National Electrification Programme which was implemented between 1994 and 1999, its objective was to electrify rural and urban low-income households that were deprived of access to electricity during the apartheid period. Phase 1 of the programme aimed at electrifying an additional 2.5 million households over the three million already electrified by 1993; which would increase the national proportion of households electrified to 66% (ERC, 2004).

Integrated National Electrification Programme (INEP)

The National Electrification Programme was run by Eskom. This was converted into the Integrated National Electrification Programme and since 2002 has been run by the DME. By May 2005, the INEP had delivered connections to:

- 232,287 households (at a cost of R582-million);
- 233 school connections (R100-million); and
- 50 clinic connections (R118-million).

The INEP provides both grid and non-grid connections to customers.

Electricity Basic Support Service Tariff (EBSST)

The National Electricity Basic Services Support Tariff Policy (i.e. the Free Basic Electricity policy) was gazetted in July 2003. This policy aims to bring relief , through government intervention, to low income households and to ensure optimum socio-economic benefits from the INEP. Qualifying customers are eligible for 50kWh of free electricity per month but pay normal tariffs for any consumption exceeding this. Eskom is the service provider for the EBSST in its areas of supply. The Department for Provincial and Local Government now oversees the implementation of this policy.

The FBE policy also provides for provision of free non-grid electricity to all non-grid electrified households (connected through the national electrification programme). A major impact of the EBSST has been a reduction of the fee paid by the users of solar home systems in the non-grid electrification programme. Households are expected to pay R58 per month, which was reduced to R18 as a result of the EBSST.

Key Stakeholders

The key stakeholders, in the sense of those most directly concerned with the issue, with regards to energy access are civic organisations; organisations representing consumers and local authorities. The DME is also a key stakeholder, as energy access is of central political importance to the Department. The national electrification programme has been one of the most important, successful and visible service delivery programmes of the post-apartheid government. Eskom, largely responsible for the initial phases of the electrification drive, and now local authorities, are the major implementation agents of the electrification process.

A concern with the stakeholder groupings identified above is that there has been a decline in the number and organisational capacity and influence of community based civic organisations since the end of apartheid. These have not yet been replaced with strong consumer organisations representing the interests of electricity consumers. Of course, the decline in these civic organisations has been balanced by the advent of democratic local authorities who, through the democratic process, should be responsive to citizen's needs.
Stakeholder attitudes

Although the above stakeholders are directly involved in providing basic energy access all stakeholders noted the key importance of energy access in the energy planning process. In many respects the centrality of energy access was regarded as a given to most stakeholders. However, the centrality of importance of the energy access should be distinguished from the importance of it as a driver of energy planning. Most stakeholders ranked energy access below security of supply and economic development as a driver of energy planning.

Obviously at the municipal level the majority of planning is related to energy access – as local authorities are largely only responsible for electricity distribution. In this regards it can be argued that energy access is the main driver in planning for electrification at the local level. Although in general the focus of municipalities is on providing access to electricity services many local authorities are beginning to focus on broader issues of energy planning that extend beyond electrification – these include integrated energy planning across different sectors, including transport and other municipal services; examination of different energy carriers aside from electricity; the role of urban planning in sustainable energy management and energy efficiency; and even local renewable energy generation options.
Climate Change

An overview of the current climate change policy in South Africa and its relationship to energy planning is provided. The views of stakeholders on the role of climate change, and climate change policy as a driver for energy planning are then discussed.

Policy on Climate Change

Climate Change policy in place in South Africa is contained primarily within the main documents South Africa has been required to prepare as part of its obligations under the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

The key document in terms of policy and strategy is the National Climate Change Response Strategy which was produced in 2004. The strategy was prepared by the Department of Environmental Affairs & Tourism (DEAT) with input from a wide range of stakeholders (represented mostly through the National Committee on Climate Change, the NCCC). It should be noted that all relevant national government departments were included in the processes, including the Department of Minerals and Energy.

The need for a response strategy was identified by stakeholders as a more action-oriented alternative to a specific policy white paper on climate change, as had originally been envisaged. The strategy was designed to support the policies and principles laid out in the government White Paper on Integrated Pollution and Waste Management, as well as other national policies including those related to energy, agriculture and water. It is important to note, that it considers climate change as a cross-cutting issue within government and the strategy itself relies on action from a range of governmental and other stakeholders. The department responsible for development of the strategy (DEAT) has relatively little mandate for the areas where implementation and action are required.

The strategy contains the following references to energy and energy planning:

A key element of the Response Strategy is the development of a sustainable energy programme.

> *" there could be benefits to be derived from adopting a future strategy that is designed to move the economy towards a cleaner path. This will further require development of a strategy to access investment through the Clean Development Mechanism (CDM) of the Kyoto Protocol, technology transfer and donor funding opportunities" (DEAT 2004: p9)*

It is important to note, that the above must be achieved within overarching national priorities, including poverty alleviation, access to basic amenities, rural development, foreign investment, human resource development and improved health, leading to sustainable economic growth (DEAT 2004: p12).

In terms of energy and mitigation, renewable energy is given particular focus and the DEAT document specifically notes that the best way to achieve climate change mitigation is through supporting the existing energy policies of the DME:

> *"Intervention: the efforts of all stakeholders will be harnessed to achieve the objectives of the Government's White Paper on Renewable Energy (2003) and the Energy Efficiency Strategy, promoting a sustainable development path through coordinated government policy" (DEAT 2004:p23)*

The IEP process is also supported as it is seen as a useful mitigation tool which would help to ensure the optimum overall mix of energy sources.

The coal sector is also targeted for intervention, again in collaboration with the DME, this being to "Develop and implement an appropriate coal mining sector mitigation programme through the Department of Minerals and Energy and the mining industry".

White Paper on Energy Policy (1998)

The White paper contains the following broad statement related to reduction of emissions harmful to the environment:

Section 3.2.2.4: "Government will work towards the establishment and acceptance of broad national targets for the reduction of energy-related emissions that are harmful to the environment and to human health. Government will ensure a balance between exploiting fossil fuels and maintenance of acceptable environmental requirements".

Climate Change and Energy Planning

The IEP (1) produced by DME in 2003 contained a consideration of the CO2 emissions of each of the 4 scenarios considered in the plan (3 scenarios and baseline). In all three scenarios a reduction in CO2 emissions is predicted although this reduction takes place more significantly in one of the scenarios based on the reduced use of coal (for both power generation and as an end use fuel).

The IEP (2) process contains a specific scenario driven by low carbon emissions. However, interviews with key informants suggest that the IEP process is not yet significantly influenced by climate change concerns.

Climate Change R&D Strategy for South Africa

A recent document of important with regard to climate change and research, is the Climate Change Research and Development Strategy.

The Department of Environmental Affairs & Tourism and the Department of Science and Technology have been collaborating on the identification of a climate change Research & Development Strategy for South Africa. Key government actors involved in the preparation and subsequent implementation of such a strategy include:

Government Departments	Parastatal Institutions
• Department of Environmental Affairs & Tourism • Department of Science and Technology • Department of Minerals and Energy • Department of Water Affairs & Forestry • Provincial Government Departments	• National research Foundation • Council for Scientific and Industrial Research (CSIR) • Agricultural Research Council • Water Research Commission • Medical Research Council • South African National Biodiversity Institute • Mintek • South African Energy Research Institute/ Energy Development Corporation • South African Weather Bureau • South African Environmental Observation Network

An initial workshop for this process was held in September 2006 and the outputs are currently being compiled into a draft strategy. This is not yet available. However, prior to the workshop an initial discussion document had been produced on R&D requirements related to climate change (DST 2006). This obviously covered the range of research issues related broadly to climate change. It did not mention 'energy planning' processes specifically but did highlight several research themes which are considered high priority with regard to climate change. Several of these are related to mitigation and so have a relationship with the energy sector:

- Economic modelling of climate mitigation ("economic modelling is very important to understand the microeconomic costs of different mitigation options and to assess through overall macroeconomic impacts. Key indicators such as employment, distribution of costs and benefits across different socio-economic sectors, and contribution to economic growth are all necessary to make informed policy decisions, particularly on allocating public funding for investments." DTS 2006, p28)

- National GHG Mitigation Strategy. The need for such a strategy is a constant theme in South Africa's climate change response strategy and it is needed in preparation for the Second National Communication.

- Mitigation, poverty and sustainable development. This is of great concern in South Africa given the national prioritisation of poverty alleviation and sustainable development. The real need is to better understand the links between climate mitigation opportunities, the economy and poverty reduction. Indicators are also required to measure impacts and progress in this area.

It is intended that a series of Action Plans will be prepared by the actors involved in implementing the strategy once it is finalised. In terms of oversight of the implementation, it is intended that the National Committee for Climate Change (NCCC) will play an important role, since this forum brings together all of the key stakeholders and also has input from research sectors. It is likely that a Cabinet Approval of the final strategy will be sought which will also determine ultimate departmental responsibility for the strategy (i.e. DEAT or DST).

Mechanisms

These are contained in the discussions of the strategies above. There are no specific mechanisms for integrating climate change into national energy planning aside from the stakeholder planning processes discussed above.

The DEAT has recently launched a “Long Term Mitigation Scenario” process. This process will look at mitigation options in the South African economy and will inform energy planning by researching and modelling mitigation options including macro-economic studies.

Key Stakeholders

The DEAT is the national custodian of climate change policy and is responsible for implementing or coordinating the implementation of this policy. Increasingly, sub-national spheres of government are taking responsibility for addressing both the adaptation and mitigation aspects of climate change and a number of municipalities as well as one province are developing local and regional climate response programmes.

There are also a number of NGOs active in promoting climate change mitigation and adaptation activities. They have been influential in the policy and planning processes around climate change and in linking climate change to energy planning.
The private sector see climate change as an important issue and are involved both as separate firms and as organised business in climate change policy processes. They clearly see the links between climate change and energy planning.

Stakeholder Attitudes

It is useful to start this section with a reflection of the perceptions held by climate change policy makers and stakeholders of the energy planning process and of the main drivers for energy planning. From the focus groups and interviews it appears that climate policy community see themselves as somewhat ‘peripheral’ to the energy planning process in South Africa (few of them are directly involved in the national IEP process, for example). However, most of the individuals are influenced by broad energy policy and strongly concerned about its impact on climate change policy and priorities.

All the climate change stakeholders agreed that economic development and the availability of energy for industry was the primary driver of energy policy in South Africa. However, there was also some conflict noted with the policy of ‘access’ to electricity for all. This was felt by many to have a high profile and was often stated as a ‘priority’ (for example, the official priority of the DME is the national electrification programme), yet in reality it was felt to take second place behind ensuring access to electricity for industry and economic development. This comment was made based on the fact that more expenditure is channelled into provision of energy for industry – than to the provision of electricity to citizens and communities.

Security of supply was identified as the third most important driver, and one in which climate and renewable energy related issues could be given a higher priority than in the past especially given their link to diversity of supply. The climate focus group largely interpreted security of supply as a long term issue and as an issue of diversity of generation sources rather than as a short term issue of providing sufficient energy to consumers – this latter issue was defined as the primary driver of the availability of energy for industry.

Broad environmental pressures such as local air quality and climate change were felt to rank below these in terms of influence within broad energy planning and priority setting. It is important to note that the climate change focus group felt that local environmental issues were a more important driver in energy planning than global (climate change) issues. This was not necessarily seen as incorrect prioritisation.

National Energy and Climate Planning Processes

The national climate change policy and planning frameworks have been outlined above.

Key points to note about the relationship between energy and climate change mitigation planning are:

- The climate change policy makers prepared a fairly cross-cutting response strategy but this is almost completely reliant on others (including the energy sector) to implement

- The IEP2 process, did start with broad representation from all relevant government departments (including the climate change policy makers from DEAT) – but their involvement was not sustained. There is a feeling among the climate change policy makers that the IEP2 process is thus not sufficiently inclusive of climate change issues and concerns.

- The conclusion is that the climate response and energy planning process take place in relative isolation and result in two 'stand alone' plans which do not sufficiently reference or 'talk to' each other.

- Climate change issues are considered to have relatively little 'power' in determining the direction or overall strategy of energy planning, although the profile of these issues within energy planning has increased in recent years. The primary reason for this is the accepted position[1] that renewable energy sources provide options for increased energy security in South Africa (through diversification of supply). There is also an increased political acceptance of climate change as an important issue for South Africa, and a growing awareness that international pressures and obligations on climate change may have a far-reaching effect on the country and its economy.

    - It is important to note that there were some counter views expressed by key informants that climate change is a very important driver in current power sector investments. There are some indications that climate change is a more important driver than is generally recognised, even by the climate change policy community. For example it appears from Eskom response to the study that climate change and environmental Issues are ranked as the most important drivers in the current internal Eskom energy planning processes, followed by economic growth and affordability jointly; and then energy security. Other respondents outside of Eskom supported this by stating that in their view the current Eskom drive towards increasing investments in nuclear power is largely driven by future climate change risks.

- Provincial and local government representatives are included in the national energy planning processes (although not the climate or renewable energy officials) – and representation tends to be through umbrella associations such as SALGA[2]. Local Government officials consulted in this process tended to see their role in the process as one of implementing national plans and ensuring that local level plans were aligned to national documents.

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[1] See Renewable Energy White Paper – and the Energy Policy White Paper for statements supporting this.
[2] South African Local Government Association

Provincial and Local Government Activity

The role of the three spheres of government in energy & climate change planning is a subject of interest. Provincial government is only recently being brought into the process (note the forthcoming provincial climate change conference to be held in June 2007). They have relatively little impact on planning for climate change mitigation at present.

Important activity in this area has, however, been taking place in local government – particularly the major cities. Nine of South Africa's cities have been participating in the ICLEI Cities for Climate Protection Programme, which completed its final phase in South Africa in 2006. This programme has been hailed as the primary reason that cities in South Africa are currently leading the way in sustainable energy planning at a local level. All cities involved in the CCP programme implemented sustainable energy related projects which created an awareness and momentum in this area which has continued. Some cities have now prepared internal Climate Change and/or Energy Strategies (often paid for through internal funds). These documents are being adopted at high level within the City Councils and it is hoped they will become influential strategies. There is still some debate, however, as to how easy it will be to convince the 'non-environmental' departments within local governments to adopt the approaches and become more accepting of sustainable energy approaches and technologies.

The important issue to note is that the ICLEI programme was primarily responsible for this activity. This programme no longer exists and thus there is no method through which the activity at the city level can be shared with or encouraged in other local governments in the Country. The forums ICLEI created for knowledge sharing have also been discontinued and are sorely missed by the officials who participated in them. Importantly, despite internal momentum created through the CCP programme, cities remain reliant on external organisations (often international) and networks for continued knowledge transfer, capacity building and funding for projects (e.g. enerkey).

Despite the work being done in major cities, the role of local government in sustainable energy and climate change mitigation seems to be poorly understood by municipalities in general. In a recent review of the local government 'Integrated Development Plans' (IDPs) (the primary planning tool for local government in South Africa), very few medium or small size municipalities had included energy or climate change issues within these important documents. As implied above, a large effort will be required in South Africa to achieve general local government awareness and prioritisation of these issues.

Private sector

From the interviews it was clear that the private sector sees climate change as an important strategic issues. There was a clear recognition that action towards greenhouse gas reduction will be required by the country and by individual firms. This was seen as a reality of doing business in a globally connected market and the private sector seemed willing to.

Future Research priorities for climate and energy

The Research and Development Strategy for climate change was noted above. This is a recent document and not yet completed, yet marks important progress by climate change policy makers to identify research needs and in particular, research to provide information required by policy makers. It will be used directly by government to prioritise and channel funding for research.

A second document on the technology needs of South Africa has also been produced by DEAT as part of its requirements under the UNFCCC. This document identifies the existing access to and need for access to external technologies.

Interaction between drivers

A numbers of area of interaction between the drivers were raised by stakeholders. In general the view was that many of the drivers could be seen as complementary if they were combined within a truly integrated planning process. Many of the areas of tension which exist between the drivers were seen as being due to shortcomings in the planning processes. However, some respondents did identify real tensions between some of the drivers – where the achievement of one objective (driver) could impede the achievement of another objective (driver). For example – some respondents noted the tension between the driver of climate change mitigation via renewable energy and the driver of affordable and secure energy. This tension was seen as being due to the greater expense and lower reliability of many available renewable energy resources.

Tensions

The tension between short and long term energy planning was seen as particularly important given the acute energy supply shortage within the country. This has led to a focus on the short term – with a number of respondents seeing this focus as problematic as it is at the expense of the long term planning processes. It is important to note that there are differing views on this issue. Some respondents, especially the major energy users, felt that it was appropriate that the DME and Eskom address the short term energy needs first and that they should not be distracted by long term planning while in the midst of a short term crisis. This does not mean that these respondents negated the need for a long term vision but they were emphasising the importance of a practical approach to short term energy needs.

Despite these differences most stakeholders tended to feel that it was an absence of effective long term planning that led to the current supply problems and that more attention must be focused on improving medium and long term planning.

Other tensions noted are:

- The possible tensions between climate change and local environmental concerns and security of supply were noted by many stakeholders. Less environmentally damaging energy resources are seen by a number of stakeholders as more costly and as providing less secure energy sources.

- Tensions between regional security and local energy security were also raised by a number of stakeholders in various ways.

- There is a practical tension between energy access via the electrification programme and planning of supply. It was noted by a number of stakeholders that the feedback from access to supply has not been properly addressed in the planning process. In particular the impact on peaking power requirements of the electrification programme and the free basic supply policy were not sufficiently understood or planned for.

- May be a tension between economic growth and climate change. Climate change focused approach would suggest more expensive technologies for environmental protection than least cost solutions.

- A trade-off between energy access and security was identified. It was noted that more expenditure on energy sources equals more reliability and more options but reduces affordability for the poor.

Synergies

- A counter view to the tension between alternative energy sources and energy security was raised. This view was that diversification of supply sources could improve energy security, including less environmental harmful sources.

- Similarly in relation to regional integration some stakeholders felt that there were also synergies between regional cooperation and energy security.

- There was fairly general agreement that the drivers of energy access, security and economic development could be seen as complementary within the context of a balanced economic growth path.

Other issues related to drivers of energy planning

Other issues raised by stakeholders with regards to understanding what really drives energy planning and decisions are:

- There are often differences between stated policy and de facto importance of drivers. For example while household access is stated as a government priority some stakeholders felt that the actual priority was energy security for industry
- The lack of integration between planning frameworks means that it is hard to actually assess which drivers are ultimately leading to energy planning outcomes and to energy investment decisions.

- The drivers of energy planning are related to the relative power of the various organisations. A number of stakeholders felt that Eskom has co-opted the space that government has not filled and that Eskom has much greater capacity than the energy planning related departments – therefore those drivers of importance to Eskom will ultimately be the most important in the planning process.

- Regional cooperation raises particularly severe challenges with regards to short term energy planning. This is because of the significant regional uncertainties and long-timeframes to develop regional cooperation agreements.

Additional drivers

A number of other drivers, aside from the three put to respondents, were identified. These included:

- **National prestige:** some respondents felt that national prestige was a driver behind some energy planning decisions (such as the large nuclear investments)

- **Human resource constraints:** planning energy delivery in a way that takes cognisance of scare skilled human resources

- **Economic development through energy technology:** some respondents felt that the energy sector was being used as a means to develop new export technologies such as the pebble-bed nuclear reactors and that this was driving investment decisions more than the internal energy requirements of the country.

Other drivers noted have been identified earlier through the report.

Summary and Analysis

This section provides a summary of some of the key responses from the questionnaire and focus groups and outlines some implications for a research programme on energy planning.
Involvement of role-Players

The generally held view was that the DME and Eskom were the predominant forces in energy planning – with important roles being played by some other national departments, particularly the Department of Public Enterprises (DPE) and NERSA. Within this context it appears from an overview of the focus groups and interviews that there was no strong feeling that any important government stakeholders were excluded from energy planning processes.

However, there were views expressed that some stakeholders should be playing more important roles. In particular, the climate change focus group noted that those Departments (primarily DEAT) and other stakeholders involved in climate change policy had little access to or power over the key energy planning processes. There were some views expressed that given the important investment and financing role of the DPE they could be more directly and visibly involved in the energy planning processes and consultations. A similar view was expressed of the National Treasury.

In the climate change focus group and in other interviews it was also noted that municipalities have a limited role in macro-energy planning outside of the distribution sector. With an increase in municipal interest in integrated energy planning and the importance of demand-side measures and energy efficiency in national energy planning it was felt that municipalities could be more integrated into the energy planning process.

Outside of government a number of stakeholders noted that labour and community groups and consumers were under-represented in the energy planning process. Different stakeholders saw the importance of these groups in different ways. For example, some felt that rural communities should be involved with regards to rural development planning and the bio-fuels strategy. Similarly it was felt important that the IEP process should receive input from civil society and the end users of energy.

Others felt that issues of affordability of energy services could best be raised and promoted by community or consumer groups.

Some stakeholders felt that the large energy users are under-represented in the process. In particular that they should be more involved in helping government to understand demand and future demand trends. However, those large users interviewed themselves did not express strong views about feeling under-represented in the planning processes.

There were no opinions that any stakeholders currently involved in energy planning should not be involved or were inappropriately involved, apart from a number of respondents feelings that Eskom had excessive independent decision making power in the energy planning process.

Summary of key points

In general, it can safely be said that the general view from focus groups and respondents was that the energy planning process in South Africa was not adequate to address the perceived high importance of sound energy planning for the economy. The process is generally not seen as being very well suited to its purpose and, as one respondent put is, is largely viewed as being "dangerously disorganised".

An overview of the focus group minutes and the stakeholder interviews suggests that the following issues are of importance in understanding where improvements in the energy planning process are needed and where external research could possibly assist:

- Differences within the energy sector: there are important difference between the electricity sector and other energy sectors. Formal electricity sector planning processes, while imperfect, do exist. These have been established in the context of an historical monopoly industry. There are not similar planning processes in the liquid fuels, biomass and other energy sectors. These sectors are driven to a far greater extent by laissez faire approaches. In some regards this is appropriate as these sectors, especially liquid fuels, are closer to competitive market industries. However there are important public good, planning and market power issues that may be being missed in these sectors due to the absence of planning. Some issues around supply and demand mismatches in liquid fuels and gas were specifically noted.

- Lack of integration in the three "integrated" energy planning processes: It is commonly agreed that the three "integrated" energy planning processes of the DME, NERSA and Eskom (IEP, NIRP and ISEP) do not integrate well with each other. The planning processes themselves are not designed to work together. There is not consistent shared information between the processes and there is no clarity as to the expected relationship between the final plans.
- Relationship between planning and investment: A key issue that was raised in different ways by most stakeholders was that the current energy planning processes do not provide a clear and transparent link between planning and investment decisions. There are no clear policy or legislative mechanisms that define the relationship between the various energy plans and ultimate investment decisions in the sector. Final decision-making around investments are often not made in a transparent way or justified by available energy planning frameworks.

    - There are many issues raised around this point including improved clarity on the relationships and coordination between the DME,NERSA and Eskom.

    - There are no obligations linked to the IEP process. It is seen by many stakeholder as more of an information gathering exercise.

- Insufficient basic information: a number of stakeholders noted that the energy planning processes are not well supported by comprehensive and accurate information on energy demand, energy costs and pricing, and energy trends. It was felt that legislative reform and the establishment of SANERI may help to address this but it was clearly one cause of previous planning failures.

    - Need to have a clear sense of what the real growth rates are. Better understanding of demand growth. Also important in the liquid fuel sector where there are also transport and logistical bottlenecks.

- Also – transparency / information on future energy prices

- Lack of integration across fuel carriers: related to the above point was the view expressed by a number of respondents that the planning processes in both electricity and other fuels was not sufficiently informed by an understanding of impacts of switching fuel carriers. For example, it was noted that the Eskom push towards promoting gas in the Western Cape to address the electricity supply shortage did not take sufficient cognisance of gas availability and the price impacts of the jump in demand. Similar problems were noted elsewhere.

- Inadequate focus on biomass: a number of respondents from the donor focus group noted that planning around biomass, an important fuel for rural households, was not well integrated into energy planning despite having major poverty relief and environmental implications. This was seen as an important gap in the energy planning system.

- Lack of integration between climate change policy and energy planning: many stakeholders felt that climate change issues were not sufficiently addressed in energy planning and that adequate channels did not exist for climate change policy to interact with energy policy. As pointed out earlier there were some differences of opinion on this matter – where while climate change is not seen the most influential driver in the energy planning process by most external stakeholders and energy planners outside of Eskom within Eskom it is ranked as the most important driver in the medium to long term planning process underway

- Reliance on relatively small group of consultants/academics: the relative shortage of skills in the energy planning field was noted. The result of this is that a relatively small energy planning network in the country plays an important role in advising various stakeholders on energy planning. This was seen as both positive and negative by various stakeholders.
- Government capacity limitations: the issue of insufficient human resource capacity within the DME and NERSA was raised many times. The perceived causes of this include the shortage of energy planning skills in the country; significant staff turnover within the DME; and insufficient budget being allocated to energy planning. It was, however, noted by the DME that there is a current plan to significantly strengthen their internal energy planning capacity.

  - It was also felt by a number of respondents that institutional arrangements within DME are perhaps not optimal with regard to energy planning

- Construction lead times and resource constraints: Many respondents noted that a key issue with regards to successful energy planning was the ability to properly take into account human resource and technical capacity availability and the lead times required to implement investment decisions. It appears that lead times have consistently been under-estimated or not well understood by senior policy-makers and this is a potential area for future policy support.

Potential Focus Areas for Energy Planning Research

An important contribution by a number of respondents was that the South African experience with the evolution of the energy sector and energy planning was similar in many respects to that experienced in many other developing countries. This being the transition from a vertically integrated monopoly utility to a increasingly open, market-based energy system. In theory, under the more open system the market is expected to take care of investment decisions. However, in South Africa, as in many other countries, there is not yet really wholesale competition but rather a mixed market with a previous state utility as the major incumbent and some space provided by the state for private IPPs.

Under such a market structure a range of energy planning questions are raised which the energy planning system never used to need to address. These include such issues as what is the role of the incumbent; who indicates when we need knew power; and how are investment decisions made and enforced? It appears clear that the current approach in South Africa, with the three distinct energy planning processes described, is not fit for the purpose of addressing the challenges posed by the structure of the energy sector. Future research needs should be informed by the basic problem of understanding energy planning in this evolving market structure.

In response to the identified planning inadequacies some respondents recommended a three tier approach as outlined below as a possible “framework” for further research:

1. Energy management system: short time frames (annual or less), to manage the current supply and demand of energy and to make immediate decisions resolving immediate energy problems as they arise

2. Short term energy planning: energy planning within the framework of the lifespan of current investments, largely about allocation of resources given capital stock constraints

3. Medium/Long term energy planning: planning of new investments and the introduction of new energy resources to provide a structured framework for new infrastructure investments in the sector.

Arising from the above discussion a number of possible research areas can be suggested. These are not in any particular order or priority:

- Procedural and regulatory approaches to link energy planning **to investment decisions**
    - Understanding investment drivers in the energy sector
    - Regulation of investment decisions including but not limited to licensing of energy investments

- Understanding lead time for investments and planning implications

- **Energy planning** information and information management
    - Approaches and methods for information gathering including regulatory options
    - Establishment of information collection and management systems
    - Information analysis and presentation
    - Improved analysis of energy growth rates and energy demand. growth.
        - In the liquid fuel sector where there are also transport and logistical bottlenecks improved understanding of the linkage between planning in the energy and transport sectors.

- Better understanding of the different **energy planning tools** available internationally.
    - Information on what energy planning approaches are being applied internationally (benchmarking)
    - International examples of institutional and organizational arrangements with regard to energy planning.

- Technical tools and models that may be of use in South Africa

- Development of **national energy security** standards

- Research **into bio-fuels development** and how to integrate bio-fuels into the energy sector and energy planning – including such issues as transport, impacts on land and water, standards, and integration with existing infrastructure.

- **Biomass use and availability** to allow for an improved understanding and baseline information on the use of biomass, the sustainability of this use and strategies to improve the sustainability of use. It was noted that there is inadequate understanding of biomass use in South Africa given the importance of biomass as a primary fuel for poor households.

- Full costs of **energy generation** – this would include studies on environmental externalities of various energy generation options and approaches to include full cost analysis into energy planning

Methods to Undertake Research

From the responses from the focus groups and stakeholders it is possible to make some recommendations about possible approaches to research, as opposed to research areas.

- Linkage of research to government capacity building: the need to improve and expand the internal human resource capacity of government, and the DME in particular, was noted by many focus groups. A range of suggestions were made in this regards including

  - Bringing expertise into the DME in a mentorship role or sending DME people internationally (with a proper process) for exposure to other energy planning processes.

  - Use an approach similar to ESKOM's skills streaming approach that feeds people into the organization at a starter level (e.g. starts with bursaries at the secondary or tertiary education level and brings graduates into the organisation.)

  - Linking research to capacity building and training and contractual approaches to keeping staff within government

  - Using research programmes to develop institutional memory within government departments. For example, the development of systems and processes that can exist even within the context of staff turnover.

- Use of existing research institutes: The academic and research focus group in particular, as well as other respondents, stressed the importance of using existing research institutes and channels in both the design and implementation of any externally supported research programmes. These would include state and parastatal institutions such as the Department of Science and Technology; the new South African National Energy Research Institute; and the CSIR. In addition there are a number of academic institutions with centres of excellence in energy research whose experience can be built on. Some of the larger firms/utilities have large research capacity – specifically Sasol and Eskom. It would also be important to include these and similar private sector research centres in the future design of research programmes on energy planning.

- The donor focus group and individual donor interviews noted that there were other donor supported programmes in South and Southern Africa in energy delivery, biomass energy, energy planning and closely related areas (such as climate change and urban sustainability). It was seen as very important that DFID collaborate with these other donor initiatives through established donor forums and direct engagement.

- The academic and research interviews and focus group stressed that any large scale energy planning research programme should be designed in such as way as to ensure that research leads to the development of local expertise within or outside of government. Possible approaches suggested were the funding of post-graduate research and training or the funding of academic centres for research and training. It was noted that if there is not capacity in government to absorb research and capacity building then academic and research institutions should be an alternative focus.

- A number of stakeholders, including the DME, indicated that applied research with an implementation element and with a technology transfer element was preferred. Research should be linked to practical applications and also provide for ongoing updating of the research outputs (for example, externalities research should train people and develop sustainable systems that annually updates and improves the underlying datasets).

- Some respondents, largely from the NGO and climate sector, suggested that research could be linked to supporting the development of political will and support for adequate energy planning.

- NGO stakeholders and others in the energy planning focus group were appreciative of the DFID process in ascertaining research needs directly from stakeholders and it was further felt that any research programmes should allow for involvement of stakeholders in the energy planning process. Some respondents further suggested that there should be support for public participation in energy planning processes. And support for better communication around such processes.

- NGO respondents suggested that civil society organisations could be a useful means to conduct and disseminate research: Such organisations would be able to lobby around research results and thereby increase the influence and public benefit of research conducted.
- The academic and research focus group requested that any research programmes be designed to develop strong link between the government's needs and the outputs of academic research – in other words to close the policy research gap.

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APPENDIX A: LIST OF INTERVIEWS AND FOCUS GROUPS

Table 5: Details of Interview and Focus Groups

Name	Organization and Designation	Contact Details		Sector	Workshop or Interview
Afrane-Okese, Yaw (Mr.)	Renewable Energy Specialist, National Energy Regulator of South Africa (NERSA)	Tel: 012 401 4721 Fax: 012 401 4700	Cell: 084 564 2965 E-mail:	Energy Policy	Workshop
De Smidt, Saskia (Ms)	Economic and Trade Section, Embassy of the Kingdom of the Netherlands in Pretoria	Tel: 012 425 4533 Fax: 012 425 4531	Cell: E-mail: saskia-de.smidt@minbuza.nl	Donors	Could not attend workshop but wishes to be kept in touch with the process.
Diedericks, Jonathan (Mr.)	Environmental Programme Officer, Royal Danish Embassy	Tel: 012 430 9340 Fax: 012 342 7620	Cell: E-mail: jondie@um.dk	Donors	Interview
Golino, Christina (Ms)	Manager – Agency Unit, Development Bank of Southern Africa (DBSA)	Tel: 011 313 3802 Fax:	Cell: E-mail: christnag@dbsa.org	Donors	Workshop
Hancock, Dave (Mr.)	Programme Manager – Programme for Biomass Energy Conservation, German Agency for Technical Co-operation (GTZ).	Tel: 011 447 2203 Fax: 011 880 8113	Cell: 082 902 8907 E-mail: david.hancock@gtz.de	Donors	Workshop
Hemraj, Sharlin (Ms)	Senior Economist, Tax Policy Unit, National Treasury.	Tel: 012 317 8023 Fax: 012 315 5516	Cell: 083 5277 387 E-mail: Sharlin.hemraj@treasury.gov.za	Energy Policy	Workshop
Jorgensen, Troels Bruun (Mr.)	Counsellor (Environment)	Tel: 012 430 9340 Fax: 012 342 7620	Cell: E-mail: trojor@um.dk	Donors	Interview
Khan, Zaheer (Mr.)	Manager: Integrated Strategic Electricity Planning (ISEP), ESKOM	Tel: 011 800 4700 Fax:	Cell: 082 802 2903 E-mail: Zaheer.khan@eskom.co.za	Private Sector Suppliers and Energy Policy and Planning	Interview
Mailula, Bridget	Energy Officer, Integrated Energy Planning, Department of Minerals and Energy	Tel: 012 317 8609 Fax: 012 322 3416	Cell: 076 486 0604 E-mail: bridget.mailula@dme.gov.za	Energy Policy	Workshop
McCelland, Colin	Director, South African Petroleum Industry Association (SAPIA)	Tel: 012 419 8054 Fax:	Cell: 082 807 3400 E-mail:	Private Sector	Interview

Name	Organization and Designation	Contact Details		Sector	Workshop or Interview
Naidoo, Kumesh	Programme Manager, Agency Unit, Development Bank of Southern Africa (DBSA)	Tel: 011 313 3911 Fax:	Cell: E-mail: kumeshn@dbsa.org	Energy Policy	Workshop
Ndlovu, Nkosiphambili (Mr.)	Programme Manager, USAID	Tel: 012 452 2000 Fax:	Cell: E-mail: nndlovu@usaid.gov	Donors	Could not attend workshop but wishes to be kept in touch with the process
Ngwenya, Phindile (Ms)	Deputy Director: Macroeconomic Policy Unit, National Treasury	Tel: 012 315 5327 Fax: 012 325 1048	Cell: 072 639 3321 E-mail: Phindile.ngwenya@treasury.gov.za	Energy Policy	Workshop
Olivier, Anton-Louis (Mr.)	Director, Bethlehem Hydro (Pty) Ltd and NuPlanet (Pty) Ltd	Tel: 012 349 2944 Fax:	Cell: 082 938 0682 E-mail: al@nuplanet.nl	Private Sector	Interview
Roset, Gunn Jorid (Ms.)	First Secretary, Royal Norwegian Embassy	Tel: 012 Fax:	Cell: 082 809 3546 E-mail: **gur@mfa.no**	Donors	Workshop
Subramoney, Jeff (Mr.)	Director: Integrated Energy Planning, Department of Minerals and Energy	Tel: 012 317 8662 Fax: 012 317 8962	Cell: 082 780 2278 E-mail: jeff.subramoney@dme.gov.za	Energy Policy	Workshop
Tromp, Mark (Mr.)	Project Engineer (Liquid Fuels) NERSA	Tel: 012 401 4021 Fax: 012 401 4700	Cell: 076 040 8158 E-mail: mark.tromp@nersa.org.za	Energy Policy	Workshop
Tyatya, Sandile (Mr.)	Chief Director: Clean Energy, Department of Minerals and Energy	Tel: 012 317 8585 Fax:	Cell: E-mail: Sandile.tyatya@dme.gov.za	Energy Policy	Completed the questionnaire for us.
Weidema, Janneke (Ms)	Deputy-Director: Integrated Energy Planning, Department of Minerals and Energy	Tel: 012 317 8023 Fax: 012 322 3416	Cell: 083 399 2028 E-mail: **janneke.weidema@dme.gov.za**	Energy Policy	Workshop
Worthington, Richard (Mr.)	Earthlife Africa and South African Climate Action Network	Tel: 011 339 3662 Fax: 011 339 3270	Cell: 082 446 6392 E-mail: richardw@earthlife.org.za	Energy Policy	Workshop and Interview

Climate Change Policy Makers		
Name	**Position & Organisation**	**Attended (Y/N)**
Ms Shirley Moroka	Director: Atmospheric Policy, Planning and Regulation. National Department of Environmental Affairs & Tourism	Y
Mr Mazwe Lushaba	Director: Air Quality Management National Department of Environmental Affairs & Tourism	Y
Ms Smangele Mgquba	Senior Energy & Climate Change Negotiator National Department of Minerals and Energy	Y
Ms Katherine Bunney	Climate Change officer South African Climate Action Network (NGO)	Y
Mr Enoch Liphoto	Cities for Climate Protection Officer City of Johannesburg Municipality	Y
Mr Juan Mostert	Chief Air Quality Officer City of Tshwane Municipality	Y
Mr Sam Mutswari	SEED Advisor (Sustainable Energy for Environment and Development) City of Tshwane Municipality	Y
Ms Cecilia	Environmental Impact Management Department Ekhuruleni Metropolitan Municipality	Y
Ms Linda Manyuchi	Department of Science and Technology	Y
Ms Many Rambaros	Eskom	N
Mr Tshenge Demana	National Department of Trade and Industry	N
Mr Tsietsi Mahema	Director: Atmospheric Quality Information National Department of Environmental Affairs & Tourism	N
Donors		
Energy Planning Policy Makers		

APPENDIX B: LIST OF ENERGY POLICES AND URLS

Major Policies

- Air Quality Act, February 2005
- Integrated Energy Plan, March 2003
- Energy Efficiency Strategy of the Republic of South Africa, March 2005
- Electricity Basic Services Support Tariff (Free Basic Electricity): Policy, July 2003
- Electricity Distribution Industry Restructuring Draft Bill April 2003
- Energy Policy White Paper, December 1998
- National Energy Draft Bill, September 2004
- Promotion of Renewable Energy and Clean Energy Development White Paper: Part One: Promotion of Renewable Energy, August 2002
- Renewable Energy Policy of South Africa White Paper May 2004

Government and parastatals

- www.ner.org, National Electricity Regulator
- www.nnr.co.za, National Nuclear Regulator
- www.dme.gov.za, Department of Minerals and Energy
- www.eskom.co.za, Eskom
- www.environment.gov.za, Department of Environmental Affairs and Tourism
- www.housing.gov.za, Department of Housing

International Frameworks

- www.reeep.org, Renewable Energy and Energy Efficiency Partnership
- www.gvep.org, Global Village Energy Partnership
- www.ieabioenergy.com, IEA Bioenergy (South Africa has full membership of Task 39, and observer status for Task 29)
- www.localpower.org, World Alliance for Decentralised Energy
- www.iclei.org, International Council for Local Environmental Initiatives

Local organisations

- www.sessa.org.za, Sustainable Energy Society of South Africa
- www.sustainable.org.za, Sustainable Energy Africa
- www.erc.uct.ac.za, Energy Research Centre, University of Cape Town
- www.earthlife.org.za, Earthlife Africa
- www.southsouthnorth.org, SouthSouthNorth
- www.pasasa.org, Paraffin Safety Association of Southern Africa

Local industry associations

- www.sapia.org.za, South African Petroleum Industry Association
- Other resources
- www.hedon.info, HEDON Household Energy Network
- www.sparknet.info, Knowledge Network on Energy for Low-income Households in Southern and East Africa

1. List of legislation applying to energy security.
2. List of legislation applying to energy access.
3. List of legislation applying to climate change.
4. List of other country specific literature reviewed.
5. List of existing research / donor programmes in the energy planning sector.
6. Data Collected from Focus Groups.
7. Data Collected from Key Informant Interviews.

ANNEX XII: ENERGY PLANNING IN DEVELOPING COUNTRIES - FACING THE CHALLENGES OF EQUITABLE ACCESS, ENERGY SECURITY AND CLIMATE CHANGE

Kenya – A Case Study

Case Study prepared by ESDA

Methodology

Data collection was an iterative process. Existing legislation, policies and stakeholders for the case study area were examined and written into the case study template.

Case study Methodology

Primary data collection methodology

Focus groups and key informant interviews were used. Stakeholders groups were identified, including:

- Policy makers, planners and regulators in the energy sector and in the agriculture, water, transport, environment and health sectors, etc.
- Energy suppliers – Petroleum Institute of East Africa (PIEA), Renewable Energy supplier represented by Solarnet and Thuiya enterprises (biomass), etc
- Climate change stakeholders and their linkages.
- Energy users focusing on huge consumers such as Kenya Association of Manufacturers (KAM), Kenya Tea Development Agency (KTDA) etc, .
- Academic and Research institutions, Civil society, NGO's, CBO's.
- Donors and Development partners.

Data from focus groups and key informant interviews was used to inform the case studies through identifying the attitudes and priorities of the main actors in the energy planning process in the countries. Groups of selected stakeholders were asked to participate in focus groups with each group replicated at least twice (a double layer multi-category design).

An introductory kick-off session attended by all participants was held in which the stakeholders were introduced to the project and its objectives. The key informants for interviews were selected from each category based on their influence and knowledge of the energy planning process in the country. A short write-up outlining the purposes of the study and methodological approach was sent to Focus Group participants in advance. This was followed up by one on one interview.

Secondary data collection methodology

Secondary data were collected by review of relevant literature touching on energy planning and policy making in Kenya. The literature gives a historical perspective of energy policymaking in Kenya and traces its developments up to the current status.

Background - Setting the Scene

ESD Africa as part of ESD UK, Oxford University's Environmental Change Institute, The Centre for Environment, Energy and Engineering Zambia and Palmer Development Group, South Africa undertook a research scoping study for DFID. The aim of the study was to identify areas relating to medium and long term energy planning which might benefit from further research. As part of this study, the team identified priorities and attitudes to energy planning amongst stakeholders in three case study areas: South Africa, Kenya and the SADC region.

Below are the findings of ESDA research study.

Policy Environment

Overview of energy planning framework

Adequate energy services are integral to poverty alleviation and environmentally sound social and economic development. Provision of adequate energy to meet ever-increasing demand requires improved planning to facilitate the achievement of long-term economic and social development goals. Improved planning facilitates the supply of energy resources of the proper type and magnitude to sustain growth, and their utilization through cost-effective pathways, i.e., proper management.

Management is the process of designing and maintaining an environment in which individuals, working together in groups, efficiently accomplish selected aims. In this context therefore, energy management is the process of designing and maintaining a system for efficiently accomplishing selected energy supply, demand and end-use objectives. Demand management in particular, whose purpose is to reduce energy consumption per unit GDP, is crucial for Kenya and is justified by:

1. The heavy burden imported crude oil imports continues to impose on the country's limited foreign exchange resources;
2. The lack of broad based indigenous energy resources;
3. The diversity of commercial energy end-users within the Kenyan economy;
4. The low capacity of the Kenyan industrial sector to improve the use of energy;
5. The potential demand for commercial energy sources existing in the rural or subsistence economy, and
6. It is seen as one of the vital strategies requiring minimal capital injection for overall macro-economic structural adjustment.

Planning on the other hand is the selection of missions and objectives and the actions to achieve them, which implies the selection of future courses of action from among alternatives, and involves a commitment of human or material resources. Proper planning is essential for better management, and as defined, involves choosing future courses of action from among alternatives. Many energy advisors are increasingly recommending a systems approach as the conceptual basis for planning and decision making in energy production, utilization and energy resources management[1]. The systems approach is very useful in energy planning and management, since it integrates the energy technologies with their attendant delivery and consumption characteristics. Key issues in energy planning include:

i. Supply and demand projections;
ii. Planning shortages e.g. energy input and capital input;
iii. Planning for uncertainty;
iv. Social factors e.g. assessing impacts of energy availabilities or demands;
v. Supply enhancement, e.g. the trade-off between grid extension costs and benefits;
vi. Resource allocation.

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[1] Theuri, D. K. (2002). "Systems Approach to Sustainable Energy". In: Impact. October. pp20 – 22.
Johansson, T.B. and J. Goldemberg (2002). Overview and a Policy Agenda" in: *Energy for Sustainable Development: a Policy Agenda.* Johansson, T.B. and J. Goldemberg (eds.). UNDP, New York.

Linking Long-term energy management and planning to energy security, energy access and climate change

The link between energy, poverty alleviation and economic development, and the environment is no longer a point of discussion. Rather, the challenge today is how to meet the triple goal of sustainable economic development, energy security and sound environmental management. Therefore, adequate energy services are integral to poverty alleviation and environmentally sound social and economic development[2]. Since independence, Kenya has made significant advances in both social and economic development, yet the energy use patterns over the same period have hardly altered. The rapid annual urbanization rate of almost 7% in the 1970's posed challenges to the problem of adequate energy supply in Kenya[3]. This called for improved energy planning to facilitate the achievement of long-term economic and social development goals. To achieve this requires energy resources of the proper type and magnitude to sustain growth, and these resources must be utilized through cost-effective pathways. The central theme of the integrated energy plan or systems approach to planning is therefore to prepare coordinated energy plans to meet energy needs for subsistence and development of alternate energy sources at least cost to the economy and environment.

Because energy production and use is the overwhelming source of greenhouse gas emissions (hence leading to climate change), strategies to curb emissions are focused on energy efficiency, alternative fuels and renewable energy sources. Many of the strategies recommended result in direct cost savings from lower energy costs. Mitigation of climate change also helps to avoid significant costs from the adverse impacts of increased sea level, more severe weather, changes in natural resources, and health impacts.

Energy Management and Planning Tools

The systems approach is very useful in energy planning and management, since it integrates the energy technologies with their attendant delivery and consumption characteristics. Hence the essentials tools in the management of energy systems would include 1) policy instruments, 2) energy use habits, 3) technology, 4) incentives and 5) economics.

Background to Energy Policy in Kenya

Kenya's Ministry of Energy was created in 1979 and was charged with energy policy formulation among other duties. It brought together different energy policies such as electricity and petroleum management, which previously had been in the hands of different government institutions or private companies[4]. The first draft energy policy document was prepared in 1987, and although for a long time it was the guiding policy document, it was not formally adopted, neither did it evolve fast enough to accommodate the realities in the country. The energy institutions in the country are characterised by poor structure, duplication of activities and redundancy. Furthermore, because the Ministry of Energy was formed as a response to the Oil Crisis of the late 1970's, the draft policy was skewed in favour of modern energy types like electricity and petroleum, paying little heed to biomass. Another anomaly in the Ministry both then and now, is that although both energy conservation and environmental responsibility are core concerns, they are given marginal consideration[5]. The government has yet to develop an integrated and comprehensive national energy policy that links the energy sector with the

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[2] Johansson, T.B. and J. Goldemberg (2002). Overview and a Policy Agenda" in: Energy for Sustainable Development: a Policy Agenda. Johansson, T.B. and J. Goldemberg (eds.). UNDP, New York.

[3] O'Keefe, P., P. Raskin and S. Bernow (eds.)(1984). *Energy and Development in Kenya: Opportunities and Constraints.* Energy, Environment and Development in Africa Series No. 1. The Beijer Institute/SEI. Stockholm, Sweden.

[4] Nyoike, P.M., and B.A. Okech (1992). "The Case of Kenya" in: *Energy Management in Africa*. Bhagavan, M.R. & S. Karekezi (eds.). Zed Books Ltd and AFREPREN, Gaborone.

[5] Nyoike, P.M., and B.A. Okech (1996). "Comparative Analysis of Energy Sector Institutions" in: *Energy Utilities and Institutions in Africa.* Bhagavan, M.R. (ed.). Zed Books Ltd and AFREPREN, Nairobi.

rest of the economy[6]. An attempt to rectify this breach was made in 2000 when the Government of Kenya commissioned a study on Kenya's energy demand, supply and policy strategy for households, small-scale industries and service establishments[7]. However, few of the recommendations in the report have been officially adopted. Another significant attempt at improving energy supply in Kenya was the Electric Oower Act of 1997, which sought to liberalise the power sector[8].

Although Kenya has undertaken significant energy planning work compared to other African countries, planning and policy guidance for further development, especially of RETs, has been lacking for a long time[9]. This is in spite of the success achieved with the Kenya Ceramic Jiko (KCJ).

The success of future energy planning requires that planners focus on the economic and demographic futures with which energy constraints and requirements must be associated, such as: changes in income distribution, sector-specific growth in output, energy intensiveness, and fuel mix. Consideration should also be given to the changing local and global environmental values, especially pertaining to climate change. Such a focused approach will enable the specification of needs and establishment of timely programmes that will make available energy resources of the proper type and magnitude that can sustain the evolution of various sectors of society.

Establishment of the Ministry of Energy

After its establishment in 1979, the functions of Kenya's Ministry of Energy were specified in Presidential Circular No. 1 of 1980 as:

- Formulation and implementation of energy policy.
- Development of hydro-electric power.
- Development and exploitation of non-conventional energy sources: wind biogas, biogas, geothermal, solar and wood fuel.
- Overseeing oil exploration.
- Overseeing the procurement of oil and other fossil fuels.
- Energy conservation.

The establishment of the Ministry of Energy (MoE) was motivated in part by the challenges posed to socio-economic development and the oil crises of 1973-4 and 1979-80, which caused dramatic price increases. However, this was not the first attempt at an institution-oriented approach to energy issues in the country. Prior to the establishment of a full-fledged MoE, there existed a National Committee on Energy Policy within the National Council for Science and Technology, under the Ministry of Power and Communications. The committee was credited with three important achievements:

1. Commissioning a detailed national rural household energy consumption survey.

2. An econometric study of energy demand in the modern urban sector of the economy.

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[6] Nyoike, P.M., and B.A. Okech (1990). "Rationality of Kenyan Energy Demand Management" in: *African Energy Issues in Planning and Practice.* Zed Books Ltd., London.
[7] Kituyi, E. (2002). *Lost Opportunities: Woodfuel Data and Policy Development Concerns in Kenya*. African Centre for Technology Studies (ACTS). Nairobi, Kenya.
[8] Energy Alternative Africa (2003). Sustainable Energy in Kenya Series- policy Briefing No. 5. EAA, Nairobi, Kenya.
[9] Karekezi, S. (1990). "Review of Mature Renewable Energy Technologies in sub-Saharan Africa" in: *African Energy Issues in Planning and Practice.* Zed Books Ltd., London.

3. Organizing a national energy symposium involving government, the public, private sector and academia; this symposium formed the basis for developing a cohesive national energy policy.

However, the imitations owing to the fact that energy was only a part of its mandate, its lean personnel and lack of commitment among the members, denied it the wherewithal to fully influence energy policy. Furthermore, its role was only seen as advisory and therefore its recommendations seldom reached the highest decision-making authority. To its credit though, it recommended the establishment of the Department of Energy within the same ministry, which was a precursor to the MoE. The MoE had the executive powers to deliberate on energy issues within the government, and finally enabled the consolidation of issues, which hitherto had been handled by various government bodies, under a single authority. Issues such as electricity, petroleum pricing, electricity power tariffs, and woodfuel development and management rested respectively with the Ministries of Power and Communication, Finance, Environment and Natural Resources or jointly handled. With the formation of the MoE, there was marked reduction in the duplication of roles among the various authorities, though by no means total. Even now, issues relating to biomass energy are separately handled by both the MoE and MENR, while the farm forestry development function partly falls within the Ministry of Agriculture and MENR.

Energy Policy Formulation and Planning

The MoE has followed a policy-making pattern where it collaborates with the Ministry of Planning and National Development to formulate the energy policy in line with other development goals. Thus it has contributed to writing of Sessional Papers and National Development Plans over the years. The MoE also runs various energy sector development projects, such as the Rural Electrification Programme, geothermal power development, woodfuels and other renewables, fossil fuel exploration, energy conservation and industrial energy management[10][11], in collaboration with other development agencies and partners. Nevertheless, this involvement is by no means satisfactory. Although it has been government policy for example, to develop affordable and sustainable rural energy, little has actually been done. For example, fuel wood is the energy source for more than 70% of Kenyans and while all evidence shows that attention should focus there, whatever action has been done regarding it is to discourage its use. It has even been suggested that many intervention policies intended to help low-income groups end up as expensive failures having left them untouched while benefiting the middle- and high-income groups who do not need them anyway. Although the recently passed Energy Bill (2006) is a bit more favourable to wood fuel and other RETs development, biomass energy policies are still largely weak and the few that exist are disjoint and scattered in various departments or ministries and lack coherence. One commonly finds diffuse energy policy issues within different development plan and policy documents. However, the stage appears set for better things especially when these policies are harmonised. For example, even the newly passed Forest Policy (2005)[12] provides for:

- Promotion of sustainable and efficient utilization of woodfuel;
- The promotion of efficient wood energy technologies;
- The regulation and production and marketing of charcoal.

[10] GEF-KAM Industrial Energy Efficiency Project (2006). Lowering Energy Costs: A Guide to Energy Efficiency and Conservation in Kenya. GEF-KAM, Nairobi. pp. 78 – 80.
[11] Nyoike, P. E. (1993). "National Industrial Energy Conservation in Kenya". In: Energy Options for Kenya – Environmentally Sustainable Alternatives. Karekezi, S. and G.A. Mackenzie (eds). Zed Books Ltd & UNEP Collaborating Centre for Energy and Environment, London, UK.
[12] Ludeki, J.V., G.M. Wamukoya & D. Walubengo (2006). Environmental Management in Kenya: A Framework for Sustainable Forest Management in Kenya. Understanding the new Forest Policy and Forests Act, 2005. MENR, FAN, WWF, CREEL, Nairobi, Kenya.

Yet the Energy Bill (2006) is still deficient, in that it remains silent on environment and climate change, a key driver of sustainable development. It also does not deal conclusively with matters relating to the exploration and exploitation of fossil energy resources. To its credit however, it now simplifies the previously rigid regulations on independent power producers, paving way for greater investment in the sub-sector.

Private Sector Large Energy Users - Kenya Association of Manufacturers

The big manufacturing industrial energy users are collectively represented by the Kenya Association of Manufacturers (KAM), who are the voice of industry and premier representative organisation for manufacturing value-add industries and other related sectors in Kenya. KAM was established in 1959 as a private sector body, and over the years has transformed itself into a dynamic, vibrant, credible and respected business association with a professional Secretariat. The Association provides an essential link for co-operation, dialogue and understanding with the Government by promoting trade and investment, upholding standards and representing members' views and concerns to the relevant authorities.

KAM's Strategy

KAM encourages the formulation, enactment and administration of sound policies in order to improve the business environment, reduce the cost of doing business, and ensures that Kenyan firms attain and maintain world-class competitiveness. This is intended to deepen Kenya's industrial sector and improve competitiveness. According to the secretariat, the KAM Strategy is facilitated by three support pillars namely:

- **Policy Research & Advocacy:** Provides proactive evidence-based intelligence to effectively deliver policy advocacy services to members.

- **Business Support Services:** Provides demand-driven, value-added, fee-based services to members to facilitate firm-level interventions and continuous improvements aimed at enhancing industry's performance and profitability.

- **Membership Development & Communication:** Promotes membership, services, information and networking to ensure that KAM remains the preference of value-adding industries and is recognised by Government partners.

The strategic objectives of KAM include:

- To advise the Government and lobby for its support on policy matters;
- To provide and make available relevant business information services to our members;
- To provide for and encourage discussions between the private and public sectors on issues which affect the manufacturing industry;
- To promote participation in trade fairs, trade exhibitions and trade missions in order to identify new markets and expand existing ones;
- To enhance members' understanding of the implications of global trade and regional trade agreements;
- To promote fair trade and business practices, environmentally friendly manufacturing and socially responsible employment;
- To promote value addition to local raw materials and encourage the transfer of appropriate technology;
- To advise and encourage cooperation with other trade and micro-enterprise associations;
- To promote inward capital investments in manufacturing in the region.
- Civil Society Organizations (CSOs) and NGOs
- A number of CSOs and NGOs undertake energy related work in Kenya, including Practical Action, African Energy Policy Research Network (AFREPREN), African Centre for

Technology Studies (ACTS), Renewable Energy Technology Assistance Programme (RETAP), Federation of Kenya Employers (FKE),and many small CBOs. Up to the early 1990s the Kenyan Government considered policy formulation and the enactment of laws as its main domain. However, as the need to balance development and environmental well-being became increasingly important, the government was forced to open up and include other actors in policy and legal reforms. Each CSO/NGO had its own strategy to influence the policy process.

The invited institutions representatives are allowed to sit in implementation committees. Although KAM is included in this group, the magnitude of the private sector members it represents merits its treatment as a separate entity. The CSOs/NGOs use their negotiation and lobbying skills to influence some government policies. Experts attend the appropriate committees and carry out the necessary background research and lobbying actions for their various institutions.

Research Institutions

A number of research institutions engage in energy-related research in Kenya. They include public institutions like Kenya Institute of Public Policy Research and Analysis (KIPPRA) and Institute of Policy Analysis and Research (IPAR), and academic institutions. Both IPAR and KIPPRA are government organs charged with the responsibility to give advisory services to the government. However, although other research institutions conduct fairly good research in terms of energy technologies and policy, the government is under no obligation to adopt the recommendations of their findings, hence many research reports remain in shelves, waiting only to be used by other researchers. There is no coordinated system for integrating such research into government implementation and action plans.3.0 Energy Planning; climate change, energy access and energy security

After a kick-off meeting where the stakeholders were introduced to the project and its goals, subsequent interviews were held with individuals and the six groups representing policy makers, energy suppliers, energy users, climate change stakeholders, donors and development partners and the academic and research institutions including civil society engaged in energy planning in one way or another. Below is the summary of their views on the energy planning process, their attitudes and priorities towards energy planning and policy.

Planning

Role in Planning

Because of the nature of the various institutions represented, the individuals interviewed played various roles in the energy planning process. Although a few were specific based on the institution’s/organization’s raison d’être, a number of the roles performed are similar and therefore may imply duplication of efforts. Other roles are complementary in nature and provide synergy in implementing various planning functions. The outstanding roles mentioned included:

Institution	Role in Energy
Ministry of Energy	Policy making and implementation Formulation of laws and regulations that govern all aspects of energy Coordination of energy planning process amongst different stakeholders
UNDP, Universities, KAM, NGOs	Policy analysis and development of options Advisory role on energy policy Assist in policy formulation
UNDP	Technical and financial support
KAM (Private sector umbrella body)	Collating demand forecast information from members (KAM) Represent manufacturing/private sector in planning committees (KAM)
KENGEN – Govt power generating company	Planning for electricity production and capacity expansion
Specialized Energy Services Company - SESCO	Implementation of new energy projects in renewable energies. e.g. wind power Exploring new renewable energy resources
Solar energy Network (Solarnet) - Energy NGO	Stakeholders Umbrella group, Regional (Renewable) Energy industry mouthpiece Disseminate policy, Product campaigns, Technical appraisals, System Design and highlighting industry goings-on
African Centre for Technology Studies	Policy analysis and dissemination of information, and capacity building targeting mid-level (junior) policy implementers
Academia	To integrate science and technological innovations in energy policy and planning at national and international level.

Energy Planning

All respondents answered in the affirmative regarding the importance of energy planning in the country. Although all agreed that there is an energy planning process in the country, there was general dissatisfaction with the planning process. The opinion of most respondents is that the current planning process is:

- Restricted to modern conventional energy types, i.e. electricity and petroleum-based fuels.
- Mostly short-term and consists mainly of stop-gap measures and ad hoc planning.
- The process does not take into consideration all aspects of a planning process; key stakeholders, inter-sectoral aspects and other key aspects are not considered.
- The process is mainly reactive in nature.
- It is exclusive, i.e. does not take on board all stakeholders who ideally should be.
- Politicians and provincial administration have overbearing influence that can be a hindrance to implementers.

Hence for these reasons, they felt that the process is not fit-for-purpose. Those who said the planning process is fit-for-purpose (e.g. UNDP) said so in reference to their specific institutions/organizations, rather than the whole national process.

Influential Players and their Capacity

The Government, through the ministries of Energy, Finance and Planning and energy utilities including the Electricity Regulation Board and other power utilities (KPLC and KENGEN), and the Petroleum Institutions (KPRL, NOCK and petroleum companies) were mentioned as the most influential players in the planning process. Other influential players included donors and donor institutions such as World Bank and IMF. A few respondents mentioned end users, private sector and market forces, and civil society as having influence on the planning process. Most said that the current players currently lack the capacity to adequately influence the planning process, especially when considered as individual entities. Some felt that this capacity would be greatly enhanced if the players worked together and complemented each other. Only one respondent (KAM) expressed confidence in the capacity of the players to influence the planning process.

Main drivers for short-term and long-term energy planning

Different stakeholders mentioned different things as being the main drivers for short-term and long-term energy planning. These included:

- Good energy policies and medium and long-term plans to address energy security (SESCO – Specialized Energy Services Company, Thuiya, UNDP)
- Demand for energy (KENGEN, KAM)
- End user requirements and government policy framework and regulation planning (Solarnet)
- Economic growth (KAM)
- Development plans, e.g. rural electrification, biomass substitution (KAM)
- Climate change (Ministry of Environment, Academia, UNDP)
- Indoor air pollution (Academia)
- Dwindling biodiversity (Academia)
- Cost of energy, limited access (Academia, Thuiya)
- Local and regional air pollution (Academia)
- Donor pressure (UNDP)

Energy Security

All the respondents agreed that energy security is very important for the country. Although their understanding of energy security differed as would be expected for such a varied group of individuals, there were common elements of what constitutes energy security. According to the respondents, the things that define energy security include:

- Reliable energy supply;
- Available, Adequate, Affordable and protected energy resources;
- Ability to control the long-term availability of sustainable, affordable/competitively priced energy in the required quantity and quality;
- Not only available and accessible, but also acceptable;
- All the above, but also safe to use.

All said that energy security is increasingly becoming important, more so in the last 5 –10 years. Similarly, they said that current energy planning and policy does not adequately cover energy security. The reasons for making this judgement included:

- Current policy is mostly geared towards abating short-term shortages.
- The policy and planning process is outdated and needs updating.

Some respondents cited reasons why energy security is increasing in importance, including:

- The role of energy in stimulating economic and social development
- Increasing concerns over climate change
- Higher competition
- Increasing uncertainty over energy supply

Energy Access

All respondents again were in agreement over the importance of energy access. Like energy security, although they gave different explanations to give their understanding of energy access, there were key elements which appeared common to the different definitions. According to them, the elements which define energy access include:

- **Availability**
- **Affordability** and
- **Adequacy** of energy supply

According to them, its importance, which is ever increasing stems from its role in economic and social development; its role in agricultural production, which is the mainstay of Kenya's economy; Kenya's need to industrialize; and the fact that only a small proportion of Kenyans have access to modern sources of clean, efficient energy.

Most individuals representing government institutions said that relative to other energy issues, energy access was adequately covered by current energy planning and policy, in contrast to civil society and private sector representatives who said it was not adequately covered. The greatest success was cited with regard to electricity supply, where the respondents said there is a more organised approach in planning in terms of tariffs and establishment of new power plants, and that the government is now more aware of the role of electricity in industrialization. However, they emphasized on the need to update current planning and policy, and streamline energy legislation.

Climate Change

Climate change was also said to be very important for Kenya. This is especially so because:

- The country depends mostly on hydropower for its electricity, and this is highly dependent on climate;
- Vulnerability of the country to climate change owing to its dependence on agriculture and natural resources which in turn are dependent on climate stability;

Climate change was defined in terms of permanent or long-term changes on climate patterns, manifesting itself in changes in rainfall patterns and quantity, temperatures, and increased frequency of unusual climatic phenomena. All these factors can unite and threaten agricultural production, energy supply and ultimately, economic growth.

Although all respondents said climate change is a priority for the country, they were similarly in agreement that current energy planning and policy does not even remotely cover climate change.

Interaction between drivers

Although a few respondents said that there was both tension and complementarity between the drivers for energy planning, most of them said only complementarity was apparent. Those who saw tension said it was mainly between access, security and climate change, which was mainly due to competing commercial interests. Those who saw complementarity said it was particularly apparent between energy security and access, and between security and climate change. Tension was also mentioned between the development of renewables versus imported fossil fuels, where they felt fossil fuels were cheaper in the short-term, thereby negating the need to develop renewable resources which would give long-term security. However, they felt that this could be developed into advantages, and greater access can be realised by exploiting renewable resources and distributed power systems. Other areas where tension and complementarity were observed were:

- **Tension:** Cost implications (between access and security e.g. electricity vs fossils); sources of energy (access and climate change e.g. charcoal); climate change and security (e.g. HEP supply)

- **Complimentarity:** Regular supply often results in security. Climate change complements access and security e.g. HEP, plantations can fetch carbon credits and at the same time improve access and security.

- **Trade-off:** Social and economic development at all cost regardless of the impacts on climate change.

Tension was also observed between short-term and long-term planning. Most respondents felt that short term planning took priority to satisfy immediate demand using stopgap measures due to initial poor planning. There was no effective initial long-term plan.

Summary and Analysis

Summary of key points

Although there have been significant developments in energy policy since the Ministry of Energy was formed in response to the Oil Crisis of the late 1970's, culminating in the Energy Bill of 2006 and the recognition of energy types other than petroleum and electricity – at least on paper – there still exist gaps in the implementation of the policies.

The energy institutions are still characterised by poor structure, duplication of activities and redundancy. There still is little commitment to the development of an integrated and comprehensive energy policy that effectively promotes renewable energy alongside conventional and links energy to other livelihood aspects such as environment and climate change. The development and dissemination of RETs has largely been left to the private sector and civil society. Another anomaly is that even in this age, climate change and environmental impacts of energy are given little attention, if any.

Policies and legislation

While appreciating the developments over the decades, most of the respondents expressed dissatisfaction in the current energy policymaking and planning process. They pointed out the electric power shortages or resorted to expensive emergency power in the past 7 years, and said this indicated there is a problem with either the planning process or its implementation. The committee has previously not been inclusive of the users of power, especially the private sector, depriving it of resources and crucial demand information. Similarly, there are indications that the fossil fuel transport capacity has been overtaken by demand and yet there has been no structured process for determining this demand. The country has vast renewable energy potential, which has not been tapped, indicating a planning shortcoming. There is also lack of commitment in regulating the RETs sub-sector, e.g. in legislating for a regulated charcoal industry. The main shortcomings identified in the planning process included:

- Non-inclusive planning committees.
- Inadequate consultation especially with users of energy.
- Weak on implementation of even existing plan – delays, cost overruns, etc.
- Over-dependence on donor support even for planning.
- Poor linkage with national development plan, e.g. rapid economic growth in the last two years has caught the energy sector by surprise.
- Failure to link energy security, access and climate change and ignoring the possible synergies that potentially exist.
- Giving priority to short-term planning, and over-reliance on ad hoc planning.

Attitudes of stakeholders

Although some government employees were reluctant to speak out on the shortcomings of the policymaking process, they were all unanimous on the need for wider stakeholder involvement in energy planning and the need for a comprehensive policy that links energy to other development priorities. Climate change was singled out as one issue that has been given a total blackout in all subsequent energy policy including the most recent.

Currently Climate change is a priority for Kenya but its future impacts on energy infrastructure are not considered in the energy planning process. They felt that it should be considered to facilitate budgeting for, and guiding public projects and programmes to mitigate the adverse impacts of climate change. Current policy and energy planning does not adequately cover climate change.

Potential Focus of Future Research

The policymaking framework and planning in Kenya is a mixture of bottom-up and top-down approach, depending on the nature of a particular policy; the process ranges from simple presidential decrees to a fairly organized system involving various experts. In normal circumstances, policies undergo a process of discussions and are adopted if passed. The Ministry of Planning and National Development gives broad policy direction through the coordination and writing of District Development Plans (DDPs), National Development Plans (NDPs) and Sessional Papers (SP).

Research institutions, [there is no specific one on energy] are supposed to generate intellectual capital which becomes a critical input in the policy making process. They conduct research in different fields and on the basis of domestically available data and best practice elsewhere, endeavours to advice the government and its development partners. The research institutions, [mostly universities department of electrical, environment or appropriate technology] conduct fairly good research in terms of energy technologies and policy as part of their daily fare but the government is under no obligation to adopt the recommendations of their findings. There exists no coordinated system for integrating such research into government implementation and action plans.

Up to the early 1990s, the Kenyan Government considered policy formulation and the enactment of laws as its main domain. However, as the need to balance development and environmental well-being became increasingly important, the government was forced to open up and include other actors in policy and legal reforms. Even with this development though, there is still no body formally set up to engage in energy research for purposes of informing the planning process. What normally happens is that the minister of Energy has the mandate to set up ad hoc committees to address specific energy issues. Institutions outside government may have lobby groups to advocate energy matters.

There exist institutions (governmental, quasi-governmental and non-governmental, regional, international and donor-based) such as the National Council for Science and Technology, National Academy of Sciences, universities, Institute of Policy Analysis and Research (IPAR), Kenya Institute of Public Policy Research and Analysis (KIPPRA) which individually or in collaboration with others may undertake energy research. However, only IPAR and KIPPRA and perhaps donor-based institutions hold much sway in influencing government policy. IPAR for example, endeavours to strengthen the national capacity to develop, implement and evaluate public policy by undertaking independent and objective research and policy analysis, and sharing the results with the Kenyan government and its development partners. It also seeks to serve as an institutional and resource centre by offering technical, research and information support for national development. On the other hand, the other institutions' interest in energy depends on particular issues and is need-based and specific to each institution.

Sectors which may be the most receptive

All respondents agreed on the need for external support to assist the medium to long-term energy planning, especially technical and financial support. There is need for energy policy research, especially covering the following areas:

- Sources (actual production, processing, marketing) e.g. biofuels
- Supply chain
- Efficient production and use
- Policy formulation process
- Health impacts of energy use and production
- Alternative fuels.
- Institutional support
- All institutions should be involved in the research programmes, including the government institutions, private sector, academic and research institutions and civil society. The following institutions were cited as the most suitable to conduct relevant research:
- Public institutions, e.g. KIPPRA, KIRDI
- Learning institutions
- Private institutions
- End users (small and large scale)
- NGOs
- CBOs
- Foreign energy institutions that have experience in various areas of energy research

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Energy for Sustainable Development Limited
Overmoor
Neston
Corsham
Wiltshire
United Kingdom
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