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Energy planning in sub-Saharan Africa – facing the challenges of equitable access, secure supply and climate change



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EXECUTIVE SUMMARY

This report presents the findings of a research scoping study undertaken for DFID, with the overall objective of informing the development of a future research programme on energy planning in developing countries. Specifically it aims to identify key research areas and knowledge gaps that need to be addressed to improve medium/long-term energy planning in developing countries in Africa. The work was undertaken by a consortium of two UK and three African organisations between October 2006 and March 2007. The scoping study is a precursor to the design of a possible DFID-funded research programme on energy planning in developing countries.

The report is based on the premise that coherent medium/long-term energy planning is key to the development of optimum energy trajectories for developing countries. The current lack of adequate energy planning frameworks is considered to lead to sub optimum, ad-hoc, short-term decision making in the energy sector. The scoping study situates itself within the context of three key postulated drivers of energy planning; energy security, equitable energy access (for social and economic development) and climate change.

The study comprised three activities 1) a broad ranging literature review; 2) case study specific analysis of existing energy planning processes and institutions and primary data collection of attitudes and opinions of key stakeholders through Focus Groups and Semi-Structured Key Informant Interviews; 3) analysis and synthesis of results from both the literature review and the case study material to form the conclusions of this report. In order to ensure that the conclusions are evidence based, they have been developed to the extent that they are justified and supported by the outputs of the research.

Planning Drivers

Energy access - Levels of access to reliable, affordable and appropriate energy services are inadequate in developing countries. Poor households need energy for cooking, heating, lighting and for basic appliances. Energy is also required for economic growth. However, currently around 1.6 billion people in the developing world do not have access to electricity and 2.5 billion rely on biomass, burned in inefficient, polluting stoves. It is now recognised that one of the necessary steps to achieving the MDGs will be increasing access to energy services in developing countries, specifically for poor people.

Energy security has become an increasingly important issue on national and international agendas (G8, 2005/06 and UN CSD 14/15), although a poorly understood one. This focus has been driven by a number of factors including increasing energy demand – for example from non-traditional sources such as China and India - and geopolitical tension over supply given increasing supply concentration. However to date most analysis at the national and regional levels has focussed either on developed countries or the most rapidly developing economies (China, India, Brazil etc) whose increased energy consumption is having a major impact at a global level. There have been minimal attempts to understand the importance of energy security for poor, oil-importing countries, as well as appropriate response measures. At the macro level, recent analysis has demonstrated the serious macro-economic impacts of fossil fuel price rises and volatility on poor oil-importing developing countries. At the local level, energy security needs to be framed differently for those in developing countries with limited or no access to energy. Energy security response measures – for example increased efficiency, diversification of supplies, increased use of indigenous resources- do exist at the local, national and regional levels; the latter is evidenced by the development of regional power pools in Africa.

Climate change - There is now a wide general agreement on the importance and urgency of mitigating climate change, as well as adapting to the impacts to which the world is already committed. However, while emissions from all developing countries are due to overtake

those from developed countries, emissions from sub-Saharan Africa currently make up only 3.5% of the global total; this figure is projected to rise to less than 4% by 2030. By way of comparison China is expected to emit around 25% of global CO2 emissions in 2030. Despite the development of an active global carbon market through the Clean Development Mechanism, registered African CDM projects account for less than 3% of the total number of CDM projects. 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 because of its exposure to extreme weather events and dependence on natural resources.

The importance and inter-connectedness of the three drivers (equitable energy access, energy security of supply and climate change) framed this scoping study. While each driver individually provides a very challenging basis for analysis, policy and implementation, addressing the interactions between them adds a number of degrees of complexity. At a theoretical level, and as is demonstrated in the case studies at a practical level, there exists a lack of understanding on how to integrate the three drivers to inform policy makers and planners when deciding upon a long-term planning path. Key issues which need to be captured in any comprehensive analysis include variations in the importance of each of the drivers over different spatial and temporal scales.

Case Studies

Medium to long-term energy planning was viewed as important, or critically important, by all stakeholders interviewed in the three case study areas; South Africa, Kenya and the Southern Africa Development Community (SADC). The primary expressed motivation for such planning was to maintain and advance a country or region's economic competitiveness, since intermittent and expensive energy is not conducive to investment and economic growth. The economic impetus behind energy planning was seen to stimulate short-term instead of long-term planning and promote the capture of the planning process by interests who have the power to respond to and shape energy investment decisions. Although some interviewees thought there was not necessarily a conflict between short-term and long-term planning horizons, there are obvious tensions especially in nascent planning environments. For instance, short-term capital costs will override long-term running costs and other less tangible benefits, including energy security concerns.

Within the case studies energy access was seen as important, indeed a key driver of energy planning and linked to security of supply and economic competitiveness. Energy access is facilitated by economic growth and increased security which lifts investment and improves living standards. It is also a driver of economic growth: the greater the number of people with access to affordable energy services the better able they are to participate in the formal economy.

The need for planning to account for, and reduce, the emissions responsible for climate change was seen as a low priority by most case study participants. Even in the reviewed literature, mainly from the developed world, there was little consensus on how climate change considerations should be integrated into energy planning. The development of proxies for climate change is an example of one approach. CO2 equivalent units are commonly used to quantify the impacts of man's activities on the climate; however, for developing countries with minimal emissions but who will be impacted disproportionally such a proxy makes little sense. With the possible exception of South Africa, climate change mitigation was either viewed as a peripheral or insignificant factor in energy planning.. The extent to which respondents felt climate change should be considered was its potential impact on existing and future energy sources (eg hydro, biomass and biofuels) and the need to better exploit the investment opportunities presented through carbon finance (CDM).

Varying energy policies, states of development and resources make commonalties between countries difficult. However, common issues are apparent from both the literature and primary data collected during the case studies:

1. Long-term planning was seen as important by all stakeholders. However long-term planning frameworks were in some cases weak or disjointed and in others largely absent. The perceived importance of integrated energy planning is not translated into real and effective energy planning frameworks on the ground. In all case studies the short-term takes precedence over the long-term, driven by immediate security of supply concerns and the economic necessity of provisioning sufficient energy to facilitate development. Case study respondents felt that donor-funded research could help improve energy planning, and should be targeted at supporting existing institutions and structures rather than being invested in new planning mechanisms and institutions.

2. Both synergies and conflicts between the drivers were identified, with the situation being dependent on local specificities. Interviewees broadly expressed the view that the three drivers were complementary rather than conflicting, although differing understandings of terms such as energy security implies that this finding should be treated with caution.

3. The greatest emphasis on long-term planning is within the electricity sector. Both the liquid fuel sector, seen as requiring less central control and being more able to adapt to market forces, and the biomass sectors, do not feature prominently in survey outputs and receive less planning attention from central government. The study found examples of emerging policy and planning environments to encourage, and develop the use of bio-fuels. Bio-fuel development has risen up the agenda and many countries in sub-Saharan Africa have developed or are considering bio-fuel policies. There is however, little regional engagement on this issue and little inclusion of rural stakeholders in the policy making process. In addition it is not clear whether land-use, food security and water use issues have been given sufficient attention. The attention focused on liquid bio-fuels contrasts with that given to traditional biomass. The study found that the use of traditional biomass is not well integrated into national or regional long-term energy planning.

4. There exists a disjuncture between policy being made and policies being implemented, as expressed particularly by participants in the South African case study. The key stakeholders who hold the real power in energy planning are the institutions which make and vet investment decisions. Finance and planning ministries and national utilities are often the most influential in deciding whether new investment or new programmes are approved and funded, often circumventing approval processes and policies laid down by energy and environment ministries Future research programmes aimed at improving planning and incorporating energy access and climate change, need to place emphasis on what is driving current planning: economic development and competitiveness and security of supply; and the institutions which hold the power of decision making.

5. There is a lack of energy planning capacity in the countries studied. This is illustrated both by a lack of sufficient staff in energy planning institutions, and an absence of some of the key skills required. This has severe results: a lack of advocacy for energy planning, an inability of institutions to resist regulatory capture by other ministries and large institutions and a difficulty in processing energy data and forecasting future energy scenarios. Even in countries, like Kenya, where only a fraction of the population have access to electricity, the resources the electricity sector can muster, whether to import fuels, to import equipment, or to channel investments, dwarfs the biomass sector that supplies the bulk of the population's energy needs.

6. Evidence from case studies, and from the wider literature review, highlights that data and resources necessary to construct long-term energy scenarios are often not available in developing countries. Furthermore, the collection and analysis of such data is often hampered by the fast growing, and less predictable nature, of many developing country economies.

Identified Research Themes

Research themes in support of energy planning have been identified, supported by evidence from case studies and/or gaps in the literature. Table 4 (page 49) provides a description, together with evidence of support from the participants in focus groups and semi-structured interviews and/or the literature review. The research themes have been classified in two broad groups: applied research and conceptual / fundamental research. While DFID only supports applied research, the needs for research into some of the fundamental, theoretical underpinnings of energy planning have been included for completeness, as it is considered that given the poor theoretical basis of much current thinking, ignoring these basic research needs carries some risks for applied research. It is recognised that in practice there is no absolute boundary between applied and fundamental research. The applied research themes have been further sub-classified into: research at either the national or regional levels; research specifically applicable at the regional level; and cross-cutting themes.

Applied Research

Under the national and regional applied research theme, there was support from stakeholders in each of the case studies for the development of appropriate frameworks for medium to long term planning; such frameworks, while dealing with the medium and long terms, need to be sufficiently flexible to be able to incorporate urgent short-term objectives. Resulting planning frameworks would include supply/demand projections developed within appropriate models, taking into account institutional considerations. They could be used to develop energy system scenarios which highlight the variations of proxies (e.g. for social, economic, energy security and environmental indicators including climate change) across space and time under various policy/fuel/technology mixes.

Research also needs to address specific technical areas. For instance, to examine supply potential to improve planning of hydro-power, traditional biomass and biofuels. For bio-fuels in particular there is a need to better integrate land-use, food security and water use planning to ensure long-term viability of emerging policies.

Research needs were also identified in support of the development of appropriate regulatory and policy structures, for example to take account of the cross-sectoral nature of the biomass supply chain. Research on institutional approaches to promote improved stakeholder engagement within integrated energy planning was highlighted within the Kenya case study. The need for applied research to support the creation of mechanisms for better connecting policy and planning decisions to investment decisions was identified both in South Africa, and Kenya. Research into the possible impacts of climate change on current or planned hydro-power facilities, as well as the supply of biomass and bio-fuels was highlighted, together with means to integrate findings from such research into medium and long term energy plans.

There is a need for support - involving both research and technical assistance aspects- to allow national and regional institutions to be able to carry out their mandates. Cross-cutting applied research needs included identifying specific skills requirements for planning institutions at national and regional level and subsequently supporting energy planning capacity in target institutions. The need to evaluate appropriate procedures for energy

system data collection, reporting and modelling, as an input to energy planning, was highlighted throughout all case studies.

Conceptual and Fundamental Research

The need for fundamental research into the theoretical underpinnings of energy planning was largely derived from – and supported by - the literature review. The case studies did not explicitly highlight such fundamental research needs, partly due to the format of the data collection process and the people consulted within the case studies; case study design was guided by DFID's focus on applied research. Never-the-less there are considered to be key fundamental gaps in understanding with respect to medium and long term energy planning in developing countries which would be supported by academic research. These include an assessment of the applicability of existing energy models in developing country settings, specifically their ability to analyse the interactions and trade-offs between improving energy access (for poverty reduction and growth), energy security and climate change. One aspect of the research might involve developing appropriate risk management techniques that can insulate energy plans from external shocks such as climate impacts, supply constraint, price fluctuation and technological innovation.

Conceptual frameworks for energy planning need to have the flexibility to work at different spatial and temporal scales. Current planning paradigms are lacking in this regard, although such a gap could also be argued to exist within developed countries. Fundamental research could also support the theoretical foundations for determining appropriate, equitable institutional structures to support national and regional energy planning over medium and long timescales; important issues include means to improve engagement across a broad constituency of stakeholders and assigning ownership and responsibility for implementing processes and policies.

Research entry points and programme design considerations

As well as highlighting needs that could be filled through a DFID-funded research programme, the report outlines possible entry points and delivery mechanisms for such a programme. One overarching message was that any research programme needs to support existing institutions which currently lack the capacity to carry out their mandates effectively.

In order to take forward some of the research themes identified within this scoping study, key decisions would be required with respect to research programme design. Perhaps the most important consideration involves where to situate the research within existing institutions and processes within target countries and regions - the research entry points. The report provides an analysis of a number of relevant actors and processes for South Africa and Kenya. The choices available at the regional level, within SADC, are more limited and principally involve the SADC Secretariat. Stakeholders consulted during the scoping study stressed that donor-funded research at a national level should be targeted towards existing institutions and organisations, and not for supporting the creation of new bodies. Identified processes with which to engage included ongoing government-led energy planning processes, either at national or municipal / local level, and electricity utility and energy industry planning processes.

Another key decision involves possible partner organisations at the international level – either for joint delivery of a research programme or for co-funding. A number of possible partner organisations are identified within the report's final section. A related consideration is the structure a DFID-funded research programme might take. Five options are identified for consideration by DFID: 1) Integrated project - Research Programme Consortium model; 2) Contract separate elements of research; 3) Provide funding to an existing programme/activity; 4) Integrate within existing DFID Research Programme Consortia "Energy for Development"; 5) Invest directly in research capacity in Africa.

If a broad range of the research themes identified were to be tackled by a DFID-funded research programme, a Development Research Consortium might be the most appropriate model, given its ability to integrate and co-ordinate between themes. Whichever model is chosen, seeking co-funding for a new research programme could be considered. Given the complexity of medium/long term planning, the paucity of capacity in beneficiary countries and the need for continuity of support for delivery of results, it is recommended that DFID should – if they choose to initiate an energy planning research programme – remain engaged for a minimum period of five years, leaving open the possibility of longer term engagement

The short period over which the scoping study was undertaken did not allow for a comprehensive consultation with other donors (outside the case study countries) and international organisations or mapping of their activities. While some have been identified within this report, DFID might choose to seek the views of international donors on the study outputs and the potential to link with their activities in the energy planning space. An indication of institutions with whom DFID might consult is provided in section 5 of this report.

This scoping study has identified the importance of medium and long term energy planning, its relative immaturity in practice and how donor-funded research could improve energy planning in the future. The added value of DFID initiating an energy planning research agenda derives from its ability to take a long term view, and mobilise consistent financial resources and technical expertise. Importantly DFID is also in a position to forge links between actors in developing countries at the local, national and regional levels, and those involved with energy planning at the international level, thus improving coordination and consistency of research activities and outputs.

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GLOSSARY

ACTS	African Centre for Technology Studies
AFREC	African Energy Commission
AU	African Union
BPC	Botswana Electrical Corporation
CCCP	Cities for Climate Change Programme
CCM	Climate change mitigation
CDM	Clean Development Mechanism
CEDIF	World Bank Clean Energy and Development Investment Framework
CO2	Carbon dioxide
CSD	UN Commission for Sustainable Development
CSIR	Centre for Scientific and Industrial Research
CSOs	Civil Society Organisations
DBSA	Development Bank of Southern Africa
DEAT	Department of Environmental Affairs and Tourism (South Africa)
DG TREN	DG Transport and Energy (European Commission)
DME	Department of Minerals and Energy (South Africa)
DPE	Department of Public Enterprise
DST	Department for Science and Technology (South Africa)
ECB	Electricity Control Board Namibia
ECOWAS	Economic Community Of West African States
EDM	Electricidade de Moçambique
EPA	Electric Power Act (Kenya)
ERB	Electricity Regulation Board (Kenya)
ERC	Energy Research Centre (University of Cape Town)
ESMAP	Energy Sector Management Assistance Programme
ESRC	Economic and Social Research Council
EUEI	EU Energy Initiative for Poverty Reduction and Sustainable Development
FAO	Food and Agriculture Organisation of the United Nations
FEMA	Forum for Energy Ministers of Africa
FG	Focus Group
FP7	EU's 7th Research Framework Programme
G77/China	Group of 77 and China
GEA	Global Energy Assessment
GHG	Greenhouse gas
GVEP	Global Village Energy Programme
IAP	Indoor Air Pollution
ICRAF	International Council for Research in Agro-Forestry
IEA	International Energy Agency
IEP	Integrated Energy Plan
IIASA	International Institute for Applied Systems Analysis
INEP	Integrated National Electrification Programme (South Africa)
IPAR	Institute of Policy Analysis and Research (Kenya)
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
ISEP	Integrated Strategic Energy Planning (South Africa)
KAM	Kenya Association of Manufacturers
KenGen	Kenya Electricity Generating Company Limited
KIPPRA	Kenya Institute of Public Policy Research and Analysis
KPLC	Kenya Light and Power Company
KPRL	Kenya Petroleum Refinery Ltd
LEAP	The Long-range Energy Alternatives Planning model
LPG	Liquid petroleum gas
MDG	Millenium Development Goal
MENR	Ministry of Environment and Natural Resources (Kenya)

MPND	Ministry of Planning and National Development (Kenya)
NEMA	National Environment Management Authority, Kenya
NePAD	New Partnership for Africa's Development
NERC	Natural Environment Research Council
NERSA	National Energy Regulator (South Africa)
NGO	Non governmental organisation
NIRP	National Integrated Resource Planning (South Africa)
NOCK	National Oil Corporation of Kenya
RECs	Regional Economic Commissions
REEEP	Renewable Energy and Energy Partnership
REP	Rural Electrification Programme (Kenya)
RERA	Regional Energy Regulators Association of Southern Africa
RETAP	Renewable Energy Technology Assistance Programme (Kenya)
SADC	Southern African Development Community
SANERI	South African National Energy Research Institute
SAPIA	South Africa Petroleum Industry Association
SAPP	Southern African Power Pool
SESCO	Specialised Energy Services Company (Kenya)
SoS	Security of supply
SSKII	Informant Structured Interviews
UNFCCC	United Nations Framework Convention on Climate Change
UNFCCC COP /MOP	UNFCCC Conference of the Parties/Meeting of the Parties
US DOE	US Department of Energy
WEC	World Energy Council
WSSD	World Summit on Sustainable Development
ZESA	Zimbabwe Electricity Supply Authority
ZESCO	Zambian electricity utility

1. INTRODUCTION AND OBJECTIVES

This report presents the findings of a research scoping study undertaken for DFID, with the overall objective of informing the development of a future research programme on energy planning in developing countries. The work was undertaken by a consortium of two UK and three African organisations[1] between October 2006 and March 2007. Tasks included both desk studies and collection of field data from two countries (Kenya and South Africa) and the Southern Africa Development Community (SADC) sub-region.

This scoping study is a precursor to the design of a possible major DFID-funded research programme on energy planning in developing countries. The study addresses the following key objectives:

- Identifying the key research areas and knowledge gaps that need to be addressed to improve energy planning in developing countries of Africa;
- Identifying the most effective means by which research can contribute to achieving better energy planning in these countries, including analysing which types of research output may best inform and influence developing country governments and their agencies.

Additionally, in order to help address these two key objectives, the study seeks to define the meaning of medium/long term energy planning, with regards to the political economy of the energy sector; and assesses existing priorities and attitudes to energy planning in developing countries, with particular reference to renewable and low carbon energy sources and equity of access issues.

1.1 Context

Energy Access

The energy sector is inherently complex and broad, encompassing issues ranging from domestic biomass stoves to industrial electricity demand, from wind resources to liquid fuel markets. Thus it is important to avoid oversimplifications such as the oft implicitly expressed view that energy equals electricity.

Poor households need energy for cooking, heating, lighting and for basic appliances. Currently around 1.6 billion people in the developing world do not have access to electricity and 2.5 billion rely on biomass, burned in inefficient, dirty stoves - Indoor Air Pollution (IAP) from the use of traditional biomass inside homes causes 1.5 million deaths a year, with women and children being worst affected[2]. These figures are not anticipated to improve without significantly enhanced policies and investment. At the same time, improvements in access to energy by other sectors, such as education, health and business, are crucial for achieving development objectives, including economic growth; DFID's recent White Paper[3] pointed out that economic growth is highly dependent on the availability and affordability of energy.

Improving access to reliable, affordable and sustainable energy services will contribute to achieving the Millennium Development Goals[4]. The IEA projects the need to provide access – over and above the business-as-usual scenario – to

[1] Led by Energy for Sustainable Development Ltd (ESD) and Environmental Change Institute, University of Oxford; with Energy for Sustainable Development Africa Ltd (ESD A); Palmer Development Group (PDG), South Africa; and the Centre for Energy, the Environment and Engineering in Zambia (CEEEZ).
[2] "Fuel for Life Household Energy and Health". World Health Organisation (WHO), 2006, PP4. ISBN 924 156316 8
[3] DFID White Paper: "Making governance work for the poor" 13 July 2006
[4] "Energy for the Poor – underpinning the Millenium Development Goals". UK Department for International Development (DFID), 2002, PP31. ISBN 1-86192-490-9.

electricity to over 500 million extra people, and to allow around 700 million additional people to switch from traditional biomass, in order to achieve the MDGs[5][6].

Energy Security

Energy security has become an important issue on national and international agendas (G8, 2005/06 and UN CSD 14/15). However to date most analysis at the national and regional levels has focussed either on developed countries or the most rapidly developing economies (China, India, Brazil etc) whose increased energy consumption is having a major impact at a global level. There have been minimal attempts to understand the importance of energy security for poor, oil-importing countries, as well as appropriate response measures. Reports from ESMAP[7] have however highlighted the very serious macro-economic impacts on poor oil-importing developing countries resulting from oil price volatility in recent years.

Climate Change

There is now a wide general agreement on the importance and urgency of mitigating climate change, as well as adapting to the impacts to which the world is already committed. Specifically intensive discussions are underway on a possible "post-2012" international climate mitigation regime under the United Nations Framework Convention on Climate Change (UNFCCC). While the science clearly indicates the need for all major emitters - including some key developing countries - to limit future emissions, the formal negotiations within the UNFCCC are currently proceeding slowly, focussing on ethical issues of equity and historical responsibility for the problem.

There is now an active carbon market, based largely on the Kyoto "flexible mechanisms" of which the Clean Development Mechanism (CDM) is key, providing opportunities for clean, sustainable energy investment in developing countries. In contrast to the mitigation negotiations, the adaptation debate moved forward to some degree at the recent UNFCCC COP/MOP in Nairobi in late 2006.

The importance and inter-connectedness of the three drivers (equitable energy access, energy security of supply and climate change) to countries in the developing world raises the question of how to integrate them into coherent energy planning frameworks.

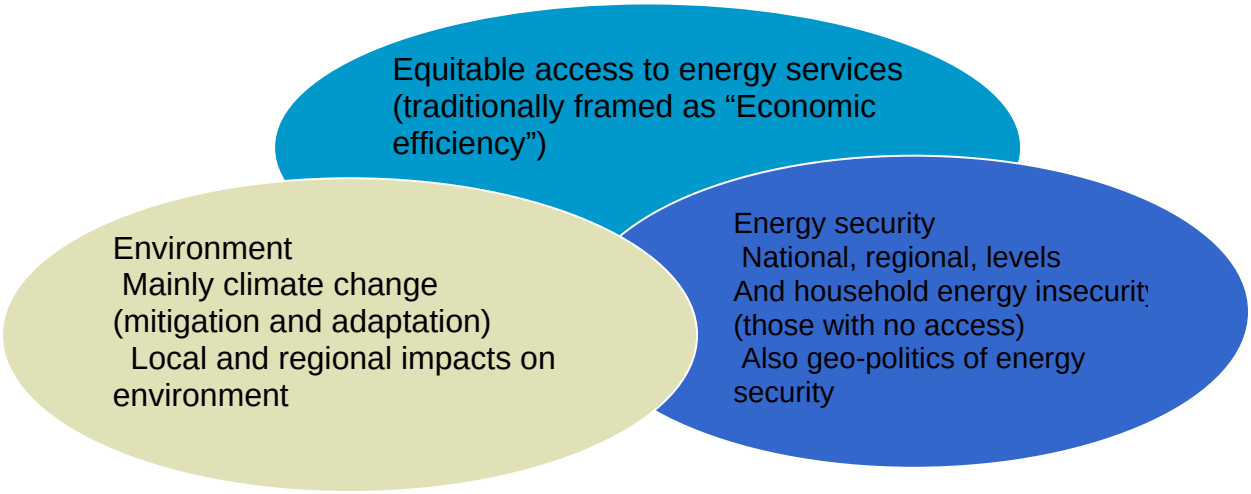
1.2 Conceptual framework for the study

Three policy drivers are posed as the building blocks of this scoping study. Each individually provides a very challenging basis for analysis, policy and implementation. The subject of this scoping study adds a number of degrees of complexity by addressing the three drivers together. Traditionally the presentation of the problem has been graphically framed in the form of three intersecting ellipses (the so-called three "Es": Economic efficiency, Energy security and Environment[8]).

[5] IEA World Energy Outlook 2006.
[6] The need to improve access to energy services in developing countries has now been fully recognised by a number of key international bodies including the World Summit for Sustainable Development, the UN "Millennium + 5" conference (UN, 2005), the G8 Gleneagles Communiqué (G8, 2005), and the report of the Commission for Africa, 2005, World Bank Investment Framework for Clean Energy and Development (2006).

[7] "Vulnerability of Africa Countries to Oil Price Shocks: major factors and policy options. The Case of Oil Importing Countries". ESMAP August 2005. and "The Impact of Higher Oil Prices on Low Income Countries and the Poor". UNDP/ESMAP, March 2005. See www.esmap.org.
[8] Note that in the case of this study the first of the three "E's" (Economic efficiency) is being replaced with "Equitable Access".

Figure 1: Simple framing of the scope of the study



However such a representation does not capture the complexity of the scope of this study, which – given the nature of a "scoping study" – has been kept deliberately broad and inclusive. Issues which need to be captured in any comprehensive analysis include important spatial and temporal complexities.

A key question this study addresses is the issue of the level at which energy planning should be addressed. For reasons of pragmatism energy planning has generally been undertaken at a national level, only occasionally at a local level, and even less frequently at a regional level. However, there are important aspects of energy planning at local, regional and international levels; some of the benefits of operating at the regional level include making better use of regional natural resources, economies of scale, regional knowledge and experience and regional infrastructure planning. Some of the benefits of local planning include the ability to mobilise stakeholders and develop grassroots support for policies, and thus identify the critical areas where action can be most effective.

Temporal issues arise due to the different timescales appropriate for to the drivers (and their institutions) being addressed. Energy security is both a short-term (e.g. supply crises), and a long-term issue. Equitable energy access needs to be improved urgently, if the MDGs are to be achieved. It is also expected to continue to be an important issue for the next few decades at least. Climate change is considered to be a medium and long-term issue, but one which requires short-term, medium-term and long-term action if its effects are to be slowed down, and eventually reduced. This study is framed in terms of medium and long term energy planning.

Lenses through which the energy planning field can be viewed include:

- ***Institutional*** issues within the energy sector include the national level (ministries, agencies etc), and regional and local levels. In addition cross-sectoral considerations are important, including co-ordination with key energy demand sectors (transport, industry, agriculture); there is currently a significant lack of co-ordination between energy policy and the key energy using sectors. It is at the international level at which climate (UNFCCC) and energy security are generally discussed. There is currently fragmentation between the international institutions addressing energy access, climate and energy security[9]. The recently completed round of the UN's Commission on Sustainable Development (CSD 15), whose

[9] The World Bank "Investment Framework for Clean Energy and Development" is attempting to address this fragmentation; this is work in progress.

remit included the linked themes of energy for sustainable development, industrial development, air pollution/atmosphere and climate change, failed to come to agreement on a negotiated text[10] .

- ***Political economy*** – closely related to the institutional issue, questions arise about who has the power (and capacity) to make decisions and at what level. What are the relative roles (desirable and in practice) of the public and private sectors[11], how are national considerations represented at international level (ref climate and access to energy resources on the world market). Issues of Equity loom large but vary between the three drivers. Climate change presents a particularly complex and current equity issue. The importance of improving equitable energy access for the poor is now generally understood. Both climate and energy security have now become geo-political issues.

However the framing of this study considers energy security only from the perspective of developing countries, not the implications of energy use by developing countries on the geo-politics of the subject.

- ***Technical*** – the scale of the technical task to integrate the three policy agendas is considerable; within developed countries some early attempts have been made to integrate climate and energy security policies; these are outlined in the literature review below. However, very little work has been undertaken on integrated planning approaches for developing countries outside of a few centrally planned economies. Traditional energy planning has taken a rather simplistic supply/demand approach.

- ***Technological*** – Planners (national and international) have alternated between placing technology development, evolution and investment as the foremost issue to address with regard to energy issues or as a side issue vis-à-vis economy, the marketplace and policy. In reality, technological development and evolution is integral to address any of the key issues of access, security of supply and climate change. While technology is not the panacea many would like, it is also not tangential to energy solutions.

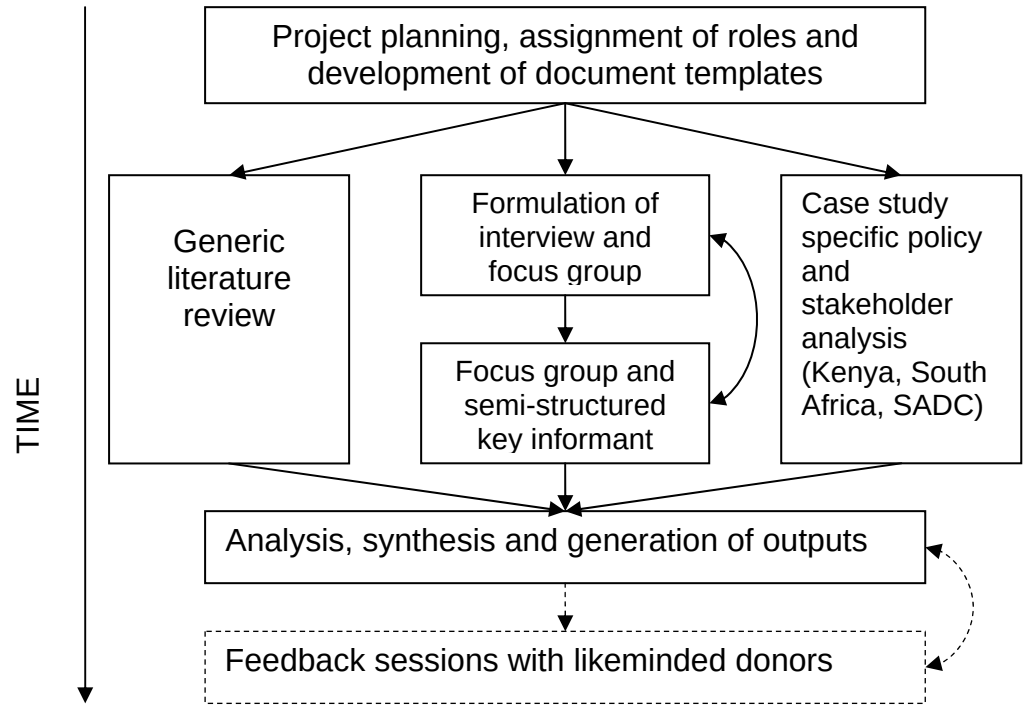
It is apparent that developing country governments, and their developmental partners, must strike a trade off, and balance, between various factors associated with the three drivers of this study. There is a clear need to forge consensus on the issues, their importance and optimal ways to address them. The development of coherent and strategic thinking for medium-term energy policy and planning for developing countries will require support from developmental partners, including DFID. This scoping study aims to set out some of the parameters, gauge the diversity of current thinking and to identify the most effective means by which research can contribute to achieving better energy planning in developing countries.

[10] http://www.iisd.ca/download/pdf/enb05254e.pdf
[11] The Director of Energy in the World Bank, Saghir (2004), states "What is clear is that strategy, policy and investment plans for the energy sector are not well co-ordinated within comprehensive development planning frameworks…".

2. METHODOLOGY

The study comprised three distinct phases; two of which proceeded in parallel, with the final output dependant on results and analysis from the previous two phases.

Figure 2: Outline of study methodology



The keys phases and rational for undertaking them were as follows:

Element I: Background and literature review: A review of the wider literature was undertaken to identify the current state of knowledge of, and research into, medium to long-term energy planning in developing countries, and the drivers of the planning process. The review aimed to help further framing of the scoping study itself and its results, to highlight significant gaps in current knowledge and to develop relevant definitions of energy security, energy access and climate change. Whilst the study focuses on the developing world, literature from the developed world was also considered: some research has been done on the individual drivers in the developed world, and frameworks, including the development of tools and approaches which may be applicable, and transferable, to developing countries.

Work on the literature review was divided into 5 sub-sections to allow activities to be separated between partners, work to progress concurrently and for partners to focus on areas of individual specialisation. The following subjects were reviewed:

- Energy access;
- Energy security;
- Climate change;
- Linkages and interactions between key drivers; and
- Models and their applicability to energy planning

Element II: Energy policy and planning case studies and energy planning priorities and attitudes: Three case study areas were chosen to allow the study to

focus on the current situation on the ground in developing countries, and attitudes within those countries to the drivers of medium to long-term energy planning and policy. These were: Kenya, South Africa and the Southern Africa Development Community (SADC). The case studies allow outputs and conclusions to be based on inputs from three diverse energy producers and users. In addition, the combination of a regional and national approach allows energy planning to be considered from a different spatial perspective.

In the first part of Element II existing energy policy and planning processes were described and analysed to explore the relationships between policy and planning priorities, temporally and spatially. Specifically, examining who the key actors, stakeholders and institutions are in the energy planning and policy process and how, if at all, their activities are incorporated into policy and planning, and in what context. The planning and policy review for individual case studies also allowed commonalities and differences in planning and policy structures to be identified, and provided the context for the later consideration and analysis of the attitudes and opinions of stakeholders.

In the second part of Element II, energy planning opinions and attitudes and the role of the three drivers were evaluated in each of the case study areas through the use of focus groups (FGs) and semi-structured key informant interviews (SSKIIs)[12]. Survey structure and participants were kept as homogenous as possible (although some deviation was required, especially to account for the differences between regional and national analysis and the difficulties of arranging meetings with some of the stakeholders given the timescale imposed on the study). Interviewees were placed into the following categories:

- Policy makers;
- Energy suppliers;
- Climate change stakeholders;
- Private sector groups;
- Donor and development partner groups; and
- NGO's and academia.

For South Africa and Kenya, a mixture of FGs and SSKIIs were held, with participants being organised into the above groupings. The main sampling criteria for both FG and SSKII participants were: expertise, direct relevance of their work (or their positions) to the study and their seniority. In addition, input from FGs and feedback from introduction letters were used to select SSKII participants. For SADC, greater focus was placed on SSKIIs due to the dispersed nature of stakeholders and a lack of common energy planning institutions.

Element III: ***Identification of priority research areas and entry points:*** The final part of the study draws on the outputs from Elements I and II to produce recommendations for future research and identifies potential entry points for DfID to facilitate this research. Recommendations are grounded in the gaps identified in the existing literature and the application of methodologies and approaches used in the developed world to the developing world. Interactions, synergies and trade-offs present in the energy planning process identified during the course of FGs and SSKIIs – interviewees were explicitly asked where future research priorities should be focused - and the common nature of the survey route allowed attitudes and priorities to be compared and common themes to be identified.

Entry points were also suggested by interviewees, and the review of the existing policy and planning map in case study areas allowed the most appropriate

[12] The rationale behind the survey structure, SSKII and FG structures and introductory letter are provided in Annexes I, II, III and IV respectively.

organisations and institutions that may have the capacity to undertake future research to be identified.

The short period over which the scoping study was undertaken did not allow for a comprehensive consultation with other donors and international organisations or mapping of their activities. While some have been identified within this report DFID might choose to seek international donor opinions on the study outputs and the potential to link with their activities in the energy planning space. An indication of institutions with whom DFID might consult is provided in section 5 of this report.

3. LITERATURE REVIEW SUMMARY AND ANALYSIS

3.1 Map of literature reviewed

The generic literature review undertaken formed an important part of the Scoping Study. It involved a review of relevant literature, not related to a specific country or region, with the objectives of identifying the current state of knowledge with respect to the subject of the scoping study; helping further framing of the Scoping Study itself and its results; highlighting significant gaps in current knowledge.

The following topics/issues formed the structure of the generic literature review[13]:

i) Energy access - Most of this literature is well known to DFID.
ii) Energy security – Identifying literature, as much as possible, relating energy security to developing countries.
iii) Climate change – Both climate change mitigation and adaptation.
iv) Linkages and interactions between key drivers – This was the most important element of the generic literature review.
v) Models, planning methodologies and their applicability to energy planning - A brief review of methodologies, models and their strengths and weaknesses.

3.2 Summary of findings

3.2.1 Energy Access[14]

a) Current state of knowledge

Access to energy 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). 579 million Africans still rely primarily on traditional biomass sources for their cooking needs (IEA 2006). It is readily accepted by the development community that although there is no explicit energy MDG, 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 in Africa and is being hindered by the poor state of infrastructure and recent reductions in output from hydro-generation. Some are calling this an “energy crisis”.

Energy access needs careful definition. Energy services are required both for economic growth and direct poverty reduction. 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. 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 industry as well as transport.

Recent research has added to the knowledge base with considerable focus on the linkage between energy access and the MDGs. Academic opinion is still divided on the strength and direction of causality between energy use and economic growth (Chen 2007). However, there is increasing confidence that increased energy access is essential for development. Thus, the health effects of indoor air pollution; the challenges with providing high quality local

[13] The five papers on energy access, energy security, climate change, linkages and interactions between key drivers and energy modelling are provided in full in Annexes V, VI, VII, VIII and IX respectively.
[14] For references see Annex V

services such as health clinics; the asymmetric gender impact of a lack of energy access and the opportunity costs of time spent finding fuel – such as lost education opportunities for children, are now relatively well understood.

b) Gaps in knowledge

Further research is required on the health effects of indoor air pollution and the likely impact of policy responses. Gender issues, although now recognised, require further analysis. The economic barriers to delivering energy to local markets are not fully understood. Similarly, only limited studies have considered the most effective methods of subsidising energy service delivery – taking into account capital and running costs. Much more attention has been applied to rural areas than urban and, crucially, peri-urban environments that suffer particular challenges of rapidly increasing populations and uncertainty of tenure. Also, there is a bias in the research base towards supply side issues. Less attention has been given to gaining a greater understanding of the demand for energy – the decision process, the ability to finance initial capital outlays to benefit from energy access, the energy services in highest demand and likely willingness and ability to pay. Finally, the appropriateness of specific renewable energy technologies for the poor requires more detailed understanding.

3.2.2 Energy Security[15]

a) Current state of knowledge

Energy security, particularly with respect to oil and gas, has gained much focus in the last decade. This focus has been driven by a number of factors including increasing energy demand, geopolitical tension and threat of terrorism; significant growth in energy demand from non-traditional sources – notably China and India and recognition that supply concentration and constraint - partly due to insufficient investment in infrastructure - are beginning to affect prices, and access to supplies.

Definitions of energy security differ but usually incorporate the concepts of reliability, adequacy of supply and reasonableness of prices. However energy security needs to be framed differently for those in developing countries with limited or no access to energy. In such situations, energy security is subordinated to access to energy – security only becomes relevant when access is attained. High volatility in fossil fuel prices results in extra costs overall, particularly impacting poor oil importing countries in Africa; thus the concept of reasonable prices should also include price stability.

Energy security can be viewed along a number of dimensions: Spatially, there is increasing focus on the dynamics of the distribution of energy supplies and demand. Over a twenty year timeframe it is apparent that supplies will become more concentrated (notably in the Middle East) whilst demand will grow significantly in non-traditional markets.

Temporally, the bulk of the recent literature is focused on medium to long term effects of energy security as supply and demand patterns evolve. However, impacts from energy security issues are felt in the short term – as supplies are blocked or as price spikes impact balance of payments – which

[15] See Annex VI for the full literature review on energy security.

has been of great significance in some African economies with small economies and a huge reliance on imported oil[16].

In economic terms, the focus is on the economic growth impacts of increasing prices as well as potential growth impacts of inadequacy of supply. These concerns lie behind the significant Chinese increase in engagement in energy endowed countries in Africa.

In policy terms energy security is largely defined by two activities:

1. Risk mitigation strategies in order to decrease concentration in supplies:
   - focus on international cooperation by energy consumers;
   - endeavours to improve transparency and liquidity of energy markets;
   - efforts to diversify away from reliance on traditional fossil fuel sources.

2. The needs of physical security of supply particularly in the context of potential terrorist activity at any point in the long and fragile energy supply chain.

Response strategies for energy security focus on three approaches:
- diversification of energy resource types;
- reduction of import dependency (eg through renewables and energy efficiency);
- market concentration risk reduction.

In the context of Africa, considerable focus has been given to the development of indigenous renewable energy as a means of diversifying energy sources and reducing import dependency. There is also increasing experience of creating regional cooperative energy systems – such as the Southern African Power Pool – that enable diversification and foster mutual interdependence that strengthens security. 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. For countries reliant on hydro power the potential for reduced rain-fall due to climate change or other factors presents a key risk currently being felt in East Africa.

b) Gaps in knowledge

The energy security debate is almost entirely focused on developed country issues – along with those countries that are rapidly developing and increasing their energy demand. Focus on Africa is largely limited to those countries that have energy supplies of their own. Much work is required to better understand the long term impact of energy security issues in energy poor developing countries in Africa.

[16] ESMAP, 2005. Vulnerability of Africa Countries to Oil Price Shocks: major factors and policy options. The Case of Oil Importing Countries

3.2.3 Climate Change[17]

a) Current state of knowledge

It is important to differentiate between developing countries with respect to their various levels of greenhouse gas emissions[18]. For some of the large and rapidly growing developing economies emissions are increasingly globally significant; however, for the smaller, poorer developing countries, like many in Africa, emissions are generally not large in global terms.

[19]In 2004 Africa emitted around 3.5% of global CO2 from the consumption and flaring of fossil fuels. In 2004 Kenya emitted less than 1% of African emissions and around 0.03% of global emissions. The corresponding figures for South Africa are 44% of African emissions and 1.6% of global emissions. China on the other hand emitted 17.5% of global CO2 in 2004. By 2030 CO2 emissions from Africa are projected to make up slightly less than 4% of global emissions, while increasing in real terms. China is expected to emit around 25% of global CO2 emissions in 2030, with India emitting around 5%. The developing country mitigation debates within the UNFCCC are thus generally being focussed on the larger developing economies[20].

At the recent UNFCCC COP/MOP in Nairobi (November 2006) the G77/China 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. The G77/China continues to highlight the need for more energy for their development, and cites the principle of common but differentiated responsibilities and respective capacities as basis for rejecting any discussion on binding commitments. Developed countries argue that the principle needs to be interpreted in a way that ensures meeting the objectives of the UNFCCC[21].

Emissions equity and the related issue of historical responsibility for emissions - which mostly lies with developed countries - are key negotiating issues for developing countries. Per capita emissions inequity is prominent, with the world average being 5.7 tonnes CO2 per capita, the figure for the USA 28 t/cap, for UK 9.2 t/cap, and for the poorest countries (including most sub-Saharan African) 0.07 t/cap[22].

An interesting thought experiment[23] calculates the additional emissions that would result from the provision of basic electricity services (generated using fossil fuels) to all those currently without access (1.6 billion) and use of LPG for cooking by all those currently using traditional biomass (2.4 billion). The net result of providing these basic energy services would be an increase of 3% in current global emissions, or only around 1.5% of the emissions anticipated by 2030.

[17] For full literature review paper on climate change see Annex VII.
[18] Developing countries are often viewed as a homogenous block by the developed world and in international climate negotiations. For instance, the G77/China grouping at UNFCCC COPs.

[19] All figures in this paragraph from US DOE, Energy Information Administration, (http://www.eia.doe.gov/environment.html)
[20] A process parallel to the UNFCCC negotiations is underway involving discussions with the so-called G8+5 countries (China, India, Brazil, South Africa, Mexico)
[21] UNFCCC objective "… stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system…"
[22] Boden, 2003
[23] Robert Socolow, Princeton University,2006

African CDM registered projects accounting for only around 2-3% of the total number of CDM projects[24]. In Nairobi 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 (ranging from improved cook-stoves[25], to hydro-power); there is a need for further work to unlock this potential.

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 because of its exposure to extreme weather events and dependence on natural resources. The science of impact modelling has progressed at large scales, although modelling of scales appropriate for energy planning, policy and investment is currently at a relatively early stage; while improving there is always likely to be a significant degree of uncertainty when predicting future impacts. The IPCC[26] provides an analysis of future climate impacts in Africa with respect to energy, water availability and forestry production, concluding that there are risks to the energy system in particular hydro-power and biomass fuels. The results of impact prediction models should be one input into energy scenario planning using risk management approaches.

The issue of technology transfer continues to receive considerable attention in climate debates. A recent speech by the South African Environment Minister[27] highlighted the issue of incremental costs as a key challenge in terms of the wider deployment of climate-friendly technologies; the minister in turn linked the issue 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…"

b) Gaps in knowledge

Means are required to identify 'no regrets' (or win-win) options for developing countries, those which provide both socio-economic benefits as well as climate mitigation. It is clear that identifying these options is a complex issue requiring further research and analysis for development of policy tools and energy planning techniques. More generally, institutional analysis and research would support integration of climate and energy policy processes at national and international levels.

In addition to the importance of improving climate impact prediction at relatively small scales, and while recognising that there will always be a degree of uncertainty, there is a need to find means of linking climate impact prediction with long term energy policy making, planning and investment. Development of appropriate risk management approaches is required. Research into future frameworks for the CDM (post 2012), including sectoral approaches, could help Africa benefit more from this instrument in the future.

[24] There are currently (1st April 2007) 15 registered African CDM projects accounting for 2.7% of the total number of projects registered globally (sub-Saharan African countries account for 1.8% of projects registered globally). The only sub-Saharan African countries with projects registered are South Africa (6), Nigeria (1) and Uganda (1). Source UNEP Riso Centre (cd4cdm.org), 2007.

[25] Note that current CDM rules mean that it is very difficult for improved cook-stove projects to be developed under the CDM, despite their potential to provide both GHG reductions and significant development benefits.

[26] IPCC, Special Report on The Regional Impacts of Climate Change - An Assessment of Vulnerability

[27] 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.

3.2.4 Interactions between the main drivers (energy access, energy security and climate change)

Literature on policy interactions is particularly restricted and where it does exist it tends to be confined to the developed world, and hence does not tackle the equitable access issue. No study was identified focussing on an African country or region, although some covered rapidly developing economies such as China and India. Thus great care is required when attempting to extrapolate the literature reviewed to the case of developing countries in Africa. Issues of levels of energy access, 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 compared with African countries.

a) Current state of knowledge

Five papers were studied in the course of the literature review (See Annex VIII for more comprehensive information).

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 and an economic analysis of energy policy. The study limits itself to near-term (next decade or two) energy policy initiatives.

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) - using an interesting risk management approach - 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. Technology policies that promote SoS and GHG abatement are modelled in the form of demonstration and deployment programmes.

Energy supply security and climate change (Egging & van Oostvoorn, 2004) - This paper attempts to identify recommendations for an integrated SoS and CCM policy. It provides a rather qualitative overview of interactions between the two fields. The study focuses on current policies of four regions: China, Japan, EU and USA. 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[28].

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 CCM 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.

Energy security and climate change policy interactions: an assessment framework (Blyth & Lefevre, 2004) – Probably the most interesting of the 5

[28] The security of supply 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.

papers, the goal of this study, carried out for the IEA, was to assess the value of a quantified approach to understanding interactions between various drivers of energy policy (in this case geo-political energy security, power reliability and greenhouse gas emissions). It was applied to 4 IEA countries. The approach relies on the observation of how proxy measures evolve under various policy scenarios. 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 CO2 emissions, for mitigation; a measure of market concentration of energy suppliers for geopolitical energy security[29]; and required back-up generation to ensure reliable electricity supply given introduction of intermittent sources for power supply reliability.

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. At the time of writing the task force had not reported.

b) Interactions

The simple message from the papers reviewed is that the degree of policy synergies and trade-offs depends on the country of study. They all make some rather obvious findings, but also some more subtle ones. Among the former, there are clear synergies between energy security and climate change where security policies aim for demand side efficiency, reducing overall consumption and renewable energy technologies. However given the overarching importance of securing supply there are also policy conflicts, given that the primary concern is often to secure fossil fuel supplies, rather than finding alternative fuels that do less harm to the environment. Egging & van Oostvoorn find that all countries/regions considered (China, Japan, EU and USA) face significant and/or increasing import shares of fossil fuels, these being the most cost-effective in the short term to meet growing demands.

Smith et al find that for the USA, 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. Smith et al also usefully 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. Categories 2) and 3) are thought more likely to be of value for African countries when considering medium/long-term energy planning.

Turton & Barreto find that the strength of the GHG abatement policy signal greatly influences the synergies and trade-offs between SoS and CCM policies. Where stringent GHG policy is pursued, many of the objectives of an SoS policy with respect to oil are achieved. However these synergies appear directional in that the cheapest way of achieving deep cuts in emissions does improve security of oil supply, but the cheapest way to achieve SoS does not necessarily improve GHG emissions. It is also found that these synergies are weak. There appears to be a threshold level of abatement above which

[29] In addition the study includes political stability of trade partners and supply fluidity as proxies for geo-political energy security. 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.

greenhouse policies begin to promote oil security. It is found that 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.

Egging & van Oostvoorn find that a range of synergies appear to exist that can be captured by using the right policies. However 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 need to 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 the need for the combination of various instruments and policies that apply on different time and geographical scales.

Blyth & Lefevre highlight that 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. While absolute values for different proxy measures are found hard to interpret, the quantitative technique used is found useful in analysing how the risks associated with these elements change as energy markets and consumption patterns change. The approach highlights how a quantified methodology can improve understanding of policy interactions.

In general there is found to be policy weakness and fragmentation, in that governments in nearly all countries consider SoS and CCM as separate policy fields (the same is true of the international organisations involved). 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.

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.

c) Gaps in knowledge

Analysis of energy security/climate policy interactions, for developed countries, is clearly at a nascent stage. While all studies stress the need to take into account national and regional specificities in policy formulation, little analysis is available for developing countries. In the context of this scoping study, further analysis would need to take into account specific social and economic development goals for developing countries (energy for growth, access for poverty reduction etc). Another important element - not captured in the studies reviewed - is the relative lack of influence that poor developing countries have on world energy markets. In addition bio-fuels are not included in the studies reviewed.

There are gaps in both conceptual understanding of the planning needs of African countries, as well as tools available to evaluate policy interactions. Lack of data is often found to be a limitation of policy analysis in developed countries. This issue, as well as lack of capacity and expertise, is likely to be

a much more serious issue for developing countries, especially those in Africa.

An interesting avenue to pursue might be the development of a risk management approach to energy policy interactions for developing countries (ref Turton & Barreto and Blyth & Lefevre). This could start with a "meta-framework", which takes into account those issues (or proxies) of particular importance to developing countries (eg access for poverty reduction, electricity reliability for economic growth, vulnerability to world oil markets etc), and be followed, with caution – recognising the complexity and data demands - by development of national scenarios highlighting risks, benefits and interactions.

3.2.5 Energy planning and modelling[30]

a) Current state of knowledge

Energy planning takes numerous forms varying from a laissez faire approach through simple demand projections to full blown energy-economy modelling. In developed countries, models are commonly employed to provide insights into likely energy demand based on economic, demographic and technical factors; energy supply options from a technical perspective and linkages between the energy system and the broader economy. These models come in various forms to support different decision-making objectives but generally require a significant investment in time and a sophisticated data collection apparatus to support the data needs of the models.

Energy models have a variety of structures. Fundamentally, they follow either a top-down or bottom-up approach. Top down models look at macro-economic factors, market conditions and broad economy feedbacks. Bottom up models tend to focus on technical issues and disaggregated demand characteristics. Within these two primary structures, models follow one of a set of methodological approaches. Econometric models, which are top down in character, focus on economic general equilibrium conditions; simulation models may be either top down or bottom up and focus on building scenarios for selected aspects of the energy system (including the whole system); optimization models tend to be bottom up and look to find a technological solution that meets a defined objective – usually least cost but potentially carbon emissions or other criteria.

Medium to long term planning requires macro-economic conditions to be captured. However, technical factors are also critical to long term energy choices, particularly in developing countries where investment levels are high in comparison to installed capital equipment. Some efforts have therefore been made to integrate top down and bottom up models to attempt to deliver the best of both worlds. However, a trade-off clearly exists between selecting modelling approaches that effectively model long term macro-economic conditions and feedbacks and those that capture detailed technical supply and demand driven issues at a disaggregated level.

b) Gaps in knowledge

Existing modelling strategies have two types of challenge: the difficulty of optimizing energy policy with respect to energy access, energy security and

[30] For full literature review see Annex IX

climate change; and modelling the particular characteristics of developing countries.

Models are generally constructed to solve one problem – most commonly looking for a least cost technology mix under a defined set of conditions. To build a model to support the optimization of multiple objectives is more complex. It is necessary to define proxy variables for measuring each objective. There has been little debate on what those proxies ought to be or how many proxies are appropriate to give a balanced policy result. These challenges are compounded by time horizon –not only must credible proxies be identified and agreed but they must be measurable over potentially 50 years (for long term planning). Further challenges arise in trying to create proxies that are endogenous to a national energy model. Geopolitical security is an example of a model policy goal that is in large part outside the influence of the individual country or even region (short of having a policy to eliminate a need for energy imports).

Models have, in almost all cases, been initially developed in the context of developed economies and developed energy systems. Developing countries have a number of unique characteristics that, left uncaptured by models, may significantly weaken the value of complex modelling exercises for developing country energy systems.

Top down models have been developed in the context of neoclassical economics that implicitly assume, amongst other things, well-developed markets, perfect competition and minimal trade and other socio-economic barriers – conditions not guaranteed in developing countries.

Econometric models require historical data that may be inaccurate or incomplete for the purposes of extrapolating future directions – particularly where the pace of change in the economy is rapid.

Developing country energy systems commonly have a significant proportion of their energy needs provided outside the market economy, especially biomass. The LEAP model, most commonly employed in developing countries, supports traditional biomass but does not attempt to integrate the energy system with the wider economy.

Electricity strategies for many developing countries include consideration of off-grid supply of electricity. Models have to be able to cater for both distributed and centralised energy distribution.

Technology diffusion is of particular importance to developing countries. Models need to be able to support significant disruption through major technological change over the long term as economies develop.

Sophisticated energy models are voracious consumers of data if they are to provide robust results that can be relied on for decision-making purposes. In many developing countries it can be argued that models place a greater expectation on data availability than can be delivered.

Models, built in the context of mature developed countries with incremental economic and technical change, are challenged to support long term energy planning in developing countries that are expected to be on a much steeper trajectory of change.

4. STUDY OF KENYA, SOUTH AFRICA AND SADC SUB-REGION

This section examines energy planning and policy and the role played by the three drivers in individual case study areas. The section is split into four parts, to allow for the research approach to be explained, an overview to be given, of stakeholders, institutions and legislation which have a bearing on the policy making and planning processes in each of the case study areas, presentation of FG and SSKII results to determine attitudes and priorities, and a final analysis and synthesis of results.

4.1 Case Study Methodology[31]

The approach taken to determine the existing planning and policy framework utilised reviews of documentation, legislation and partner knowledge in each of the case study areas.

The structure of the FGs and SSKII questions are given in Annexes II and III– these were identical to the extent possible across all case studies to ensure rigour and comparability. To ensure consistency, all partners assisted in formulating the question structure, standard introduction letters were sent to participants and initial recordings were made in Kenya and South Africa and circulated to other partners. The approach and type of interviewees differed to some extent between case study areas, most notably between SADC and the two national case studies: South Africa and Kenya. Detail for individual case studies is given below:

SADC: The case study covered selected SADC countries and organisations (there are 14 nations in SADC; due to time and budgetary constraints it was not possible to visit them all). Countries were selected either because they housed regional institutions, for instance the Southern Africa Power Pool (SAPP) is headquartered in Zimbabwe and SADC itself in Botswana, or because they were electricity exporting countries or had plans to become exporters. Interviews were completed with officials and stakeholders who represented energy policy, energy supplier and private sector groupings.

In total, 19 stakeholders were interviewed from Zambia, Zimbabwe, South Africa, Mozambique, Namibia and Botswana. Interviewees were either nominated by other participants or selected based upon their seniority and position within organisations with respect to energy planning in SADC countries. It was not possible to hold FGs, due to the disbursed nature of the stakeholders, the lack of scheduled meetings of SADC bodies in January and the limited budget, which prohibited a dedicated gathering of participants for the purposes of the study.

South Africa: Five FGs were held for the South African study covering the following groupings: climate change policy makers, donor organisations, energy planning officials and policy makers, energy research and academic institutes and private sector energy suppliers. A FG was not held for the energy users group as the Energy Intensive User Group (EIUG) declined to take part in the survey – interviews were held with major users instead. FGs typically comprised 5 participants. SSKIIs were undertaken concurrently with FGs; 7 SSKIIs were undertaken in total. Interviewees were identified from recommendations from within FGs, by other key stakeholders (through interviews and the introductory letter) and through prior knowledge of the consultant.

Kenya: FGs were held for 6 categories of stakeholders, comprising an average of 5 people in each group; energy policy makers and planners, energy suppliers, climate

[31] See Annex I for full description

change stakeholders, energy users, academic and research institutions and donors and development partners. In a similar way to the other case studies participants, were invited to attend based on their seniority (e.g. position in an organisation) and suggestions from other attendees and/or responses to the introductory letters sent out. For Kenya, an introductory session for all participants was held. Most of the participants operate out of Nairobi making logistics easier than in the other two studies. Participants were familiarised with the study and its objectives in advance of category specific groupings during the introductory session. In addition to FGs, 8 individual interviews were held.

4.2 Case Studies – Stakeholders, Policies and Frameworks

4.2.1 SADC[32]

SADC consists of countries with very different energy supply infrastructures, energy needs and final demand use. For instance, South Africa is currently experiencing major electricity shortages, whereas Mozambique exports 85% of its electricity to South Africa - despite only 5% of its population having access to power - and has plans to increase its generating capacity to serve the South African market. Policy and planning is therefore driven by different perspectives such as access to the export market versus the necessity to provide electricity to rural households.

Stakeholders and Institutions:

From a regional perspective the SADC Secretariat, SAPP[33] and the Regional Energy Regulators Association of Southern Africa (RERA)[34] are the primary mechanisms for energy planning and co-operation.

SADC has a permanent secretariat based in Gaboronne, Botswana. It has standing committees on energy, environment and transport which are co-ordinated under the Infrastructure and Services Directorate which meets once a year. Despite ambitions to harmonise energy planning throughout the region, SADC does not yet have an integrated regional energy plan – efforts are currently underway to collect and harmonise energy base data from members which could be used to inform such a plan.

RERA aims to provide a platform for effective co-operation between independent regulators in the SADC region .It is concerned with facilitating smooth trade in cross-border electricity transfers through the harmonisation of regulations and the creation of clear cross border frameworks and regional systems.

SAPP has the day to day responsibility of co-ordinating, planning, monitoring and operation of the electricity system between member utilities. It operates a short-term electricity market. It also has longer term objectives to develop a world class, robust and reliable interconnected electricity system for Southern Africa and to increase power accessibility to rural communities.

National institutions and organisations provide the impetus for regional co-operation and planning. Of key importance here are the national electricity utilities such as EDM (Mozambique), Eskom (South Africa), NAMPOWER (Namibia) and BPC (Botswana). These organisations are involved in the formulation and implementation of energy plans at a national level but maintain a regional perspective in view of their membership of regional bodies.

[32] The full case study report is contained in Annex X. N.B. At the request of interviewees interview transcripts are not included in this report.
[33] SAPP comprises of the national electricity generating utility (as nominated by the government) from each of the member countries of SADC.
[34] RERA is also made up of representatives from SADC countries.

While SADC represents national governments, and SAPP represents national energy companies there is currently no forum for regional consumer associations.

Planning Process and Existing Framework:

There is currently no integrated energy plan for SADC as a whole. The difficulties of constructing an overall plan are demonstrated by the varying status of planning amongst member countries. For instance, Zimbabwe has only a draft energy plan whereas South Africa has a white paper produced in 1998 and three processes engaged in medium to long-term energy planning. However, SAPP does have a planning process, which relies on individual members providing input on their current projects and future projects and plans under consideration in the medium to long term. SADC and SAPP do not have a formal consultation process with wider stakeholders such as the general public, other industry bodies, academic institutions and NGO's - consultation is facilitated through national ministries and organisations which are then aggregated up to the regional level.

At the national level, energy ministries involve a wider audience when formulating energy plans. However, the process is more opaque in national parastatals (e.g., national energy companies) who wield a considerable influence, with planning being carried out by internal staff – although major customers may be consulted on an ad hoc basis.

There is no harmonised biomass production and utilisation policy in the SADC region, despite around 80% of the primary energy needs of the region being met through biomass. Some national programmes do exist; energy policies in Zambia, Botswana and Namibia incorporate a section on biomass energy policy. This contrasts with efforts which are being made to develop a regional bio-fuel policy: SADC has undertaken a pre-feasibility study on bio-fuels production processing and marketing / distribution. Regional co-operation is underpinned by national policies and implementation strategies; South Africa, Botswana and Zambia are all in the process of finalising bio-fuel support mechanisms and implementation strategies.

4.2.2 South Africa[35]

The South African energy sector is an important part of the country's economy, contributing 15% to GDP and employing 250,000 people. The sector is characterised by the following features[36]:

- Strong natural resource base (especially coal)
- Well developed energy and transport and grid infrastructure
- A drive to increase access to electricity
- Extremely low electricity production cost
- Low level of competition between producers (Eskom produces 90% of the country's electricity).
- Lack of legislation to stimulate competition and efficiency
- Reluctance of government to restructure the sector.

[35] The full case study report is contained in Annex XI. N.B. At the request of interviewees interview transcripts are not included in this report.
[36] Kohler, M., 2006. The Economic Impact of Rising Energy Prices: A constraint on South Africa's Growth and Poverty Reduction Opportunities. Paper for Presentation at the TIPS Forum, Johannesburg 18-20 October 2006 "Accelerated and Shared Growth in South Africa: determinants, Constrains and Opportunities". Downloaded from http://www.commerce.uct.ac.za/Research_Units/DPRU/DPRUConference2006/Papers/KholerEconomicImpact.pdf

Stakeholders and Institutions:

Key institutions and stakeholders who have a formal role in the energy planning process are a mixture of government departments led by the Department of Minerals and Energy (DME) and including the National Energy Regulator (NERSA). Local municipalities serve as electricity distributors, and influence energy use by the transport and housing sectors. The national electricity parastatal Eskom, overseen by the Department of Public Enterprise (DPE), enjoys near monopolistic power in the supply market by virtue of its sheer size and the resources at its disposal; it also has significant interests in the SADC region. There are a small number of players in the liquid fuel sector which is regulated by NERSA, dominant amongst these is Sasol, a parastatal.

Government structures are reliant on support and input from other stakeholders not formally involved in the planning process; input is provided by user, industry and interest groups and by research organisations. These include: the Departments for Science and Technology (DST) and the Department of Environmental Affairs and Tourism (DEAT) whose mandate is to promote sustainable development in South Africa, private sector organisations like PetroSA, research institutions such as the South African National Energy Research Institute (SANERI) and modelling and technical expertise provided by the Energy Research Centre (ERC). Lastly, there are several user, industry and interest groups such as the Energy Intensive Users Groups who represent major electricity users who consumer around 60% of the country's electricity and the South Africa Petroleum Industry Association (SAPIA) representing petroleum interests.

Planning Process and Existing Framework:

Much of the legislation relating to South Africa's energy sector concerns the electricity industry, where the planning and policy framework is notably different to that of the petroleum industry. In the electricity sector, the planning process is well adapted and institutionalised with much implementation being carried out by Eskom. In the liquid fuels sector, government planning is seen as less important with suppliers responding more directly to market changes.

The most recent White Paper on Energy Policy was produced in 1998. This gave 5 main objectives for the energy sector:

- Increase access to affordable energy services;
- Improve energy governance;
- Stimulate economic development and encourage competition within the energy sector;
- Manage energy related environmental and health impacts; and
- Improve security of supply through diversity

The white paper also references the importance of integrated energy planning in providing a suitable base for future energy planning in South Africa. The first Integrated Energy Plan (IEP) was created in 2003 and its broad purpose as defined by the DME is:

> '...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'[37].

[37] Department of Minerals and Energy 2003. **Integrated Energy Plan**

The outputs from the process, which included stakeholder involvement to a limited extent, appear rather confusing and a clear plan or strategy has not been produced. Rather, the plan is essentially an analysis of two modelling scenarios: a business as usual scenario and a scenario which promoted diversification of supply and environmental improvement. A second IEP is now being produced, a draft of which in 2005 based on stakeholder consultations, produced a list of the following drivers for future planning:

- Security of supply;
- Government policies including poverty alleviation, job creation, renewable energy targets;
- International commitments, pressure and co-operation;
- Economic growth
- Availability of resources (financial, human, capital, energy reserves);
- Demographics;
- Technological developments;
- Fuel prices; and
- Political stability

It should be noted that these drivers will be refined as the process progresses (it is currently stalled in part due to the problems of integrating various energy planning processes in the country), but they obviously reflect a much broader range of drivers than those included in this study. It is also interesting to note that climate (mitigation or adaptation) are not highlighted as 'top-line' drivers even though South Africa does develop climate policy.

There are two other national energy planning processes operating in South Africa:

- **National Integrated Resource Planning (NIRP):** Setup following the 1998 white paper NIRP2 was produced in 2004 and aimed to determine the long-term least cost electricity supply options for the country independent of electricity suppliers. Results were based on different demand forecasts and the performance of various generating plants. NIRP3 is now under way and will be more ambitious, based on better data than its predecessors

- **Integrated Strategic Energy Planning (ISEP):** This process is run by Eskom, and is now on its 8th iteration. It aims to demonstrate the cost and risk of implementing supply and demand side options to meet long-term load forecasts in the electricity industry. The process is an internal process and not subject to external scrutiny or consultation.

Other long-term policies, targets and process which are material to planning South Africa's energy future include:

- **Integrated National Electrification Programme (INEP):** One of the primary means for achieving the governments stated aim of universal access to electricity for all households.
- **Draft Energy Bill:** The DME is still in the process of drafting this bill and issues raised during the consultation process are now being addressed. The first draft contained objectives to improve security of supply and a requirement for the DME to carry out integrated energy planning in line with economic, environmental, security and social principals.
- **White Paper on Renewable Energy:** Outlines government policy for renewables based on improving diversification of supply. Sets a target that in 2013 4% (10,000 GWh) of South Africa's electricity demand should originate from renewable sources.

- **Draft Bio-fuel Legislation:** Released in November 2006, sets provisional targets for bio-fuel to have an average market penetration of 4.5% by 2013 and proposes a range of support options, with incentives for fuel from crops grown in South Africa.

Theoretically South Africa has the institutions and has formulated the necessary processes to allow for effective medium to long-term energy planning. The diverse and well organised range of stakeholders should, in theory, be able to support and inform this process. In practice, the available literature and a review of the outputs to the various processes show that there is a lack of integration between the various processes and a lack of integration between stakeholders and institutions involved in the process[38]. The current planning system fails to:

- Clearly and effectively allocate responsibility for planning investment decisions in the energy sector; and
- Provide oversight over responsibility which has been allocated.

For example the NIRP and IEP processes are largely run independently of each other with little integration taking place in practice, even though NIRP outputs should be incorporated into the IEP. There is also little evidence that the results of NIRP are incorporated into Eskom's planning which has its own ISEP. The opaqueness of Eskom's planning restricts integration and the ability of key actors in the sector to influence and 'buy-in' to future plans.

Literature shows that planning could be assisted by a shared and more holistic approach to energy modelling. For instance, there is currently disagreement within the electricity industry over the assumed level of economic growth the industry needs to meet, and municipalities as retailers of half the load in South Africa, are not fully involved when predicting the level of future demand.

The mismatch between policy intention and practical activity is demonstrated by the fact that the Energy White Paper of 1998 and in the recent draft energy bill, energy security is listed as a key objective. In reality, there appears to be confusion as to who is chiefly responsible for delivering secure energy supplies. In May 2001 the cabinet approved proposals to liberalise the electricity industry which included a decision that Eskom was expected to retain no less than 70% of the existing generation market, with private generators making up the remainder. However this policy was not supported by allocation of responsibility to ensure the 30% target for IPP's was met. IPP's have subsequently failed to meet these targets, and previous forecasts underestimated the level of current demand. Agreement on demand-side management measures are also subject to confusions, with NERSA and Eskom disagreeing as to whether they should be considered as a supply side or demand side option.

The petroleum sector, whilst being heavily regulated, is not subject to the same level of planning as is found in the electricity sector, and although Sasol dominates certain areas of the market the sector is generally more competitive and open to market forces. This has led to planning issues, most notably a national petroleum shortage in 2005.

In South Africa, climate change policy and strategy is contained in the National Climate Change Response Strategy produced by the DEAT in 2004. This document is designed to support policies and strategies laid out in national policies and white papers including those related to energy, agriculture and water. It considers climate

[38] Wilson, D., and Adams, I., 2006. Review of Security of Supply in South Africa. A Report to the Department of Public Enterprise, Support to the Restructuring of Public Enterprises in South Africa (SRPESA) Programme

change a cross-cutting issue and relies on action from a range of governmental and other stakeholders, not just DEAT itself, which has relatively little mandate for the areas where implementation and action are required. However, currently there are no specific mechanisms for incorporating climate change considerations into energy planning. DEAT and DST have been collaborating on the identification of a climate change Research and Development Strategy for South Africa, but the draft strategy is not yet available.

4.2.3 Kenya[39]

Kenya has one of the most dynamic energy sectors in Africa. Lacking any developed fossil fuel resources – Kenya is dependant on the importation of coal and petroleum – the electricity sector utilises hydro power and geothermal and small scale renewables (more photovoltaic systems are sold in Kenya than in any other African country). The country is therefore vulnerable to international energy sector developments and, given the reliance on hydro power, to climatic changes.

Stakeholders and Institutions:

The Ministry of Energy (MoE), formed in 1980, is the key stakeholder in energy planning in Kenya, and has responsibilities for:

- Formulation and implementation of energy policy.
- Development and exploitation of non-conventional energy sources.
- Overseeing oil exploration.
- Overseeing the procurement of oil and other fossil fuels.
- Energy conservation.

However, it is not responsible for all energy related issues. Biomass for instance – fuel wood is the primary energy source for more than 70% of all Kenyans - is handled jointly by the MoE and the Ministry of Environment and Natural Resources (MENR), while farm forestry development falls partly under the Ministry of Agriculture and the MENR. The MoE also collaborates with the Ministry of Planning and National Development (MPND) on matters of energy planning.

Large industrial energy users are collectively represented by the Kenya Association of Manufacturers (KAM) which has a permanent secretariat and represents its member's views and concerns to government.

There are a large number of Civil Society Organisations (CSOs) and NGO's undertaking energy related work and who have an interest in energy planning in Kenya, these include: Practical Action, African Energy Policy Research Network (AFREPREN), African Centre for Technology Studies (ACTS) and the Renewable Energy Technology Assistance Programme (RETAP). Research institutes engaged in energy related activities include the Kenya Institute of Public Policy Research and Analysis (KIPPRA) and the Institute of Policy Analysis and Research (IPAR). Both organisations are government organs tasked with providing advisory services.

Planning Process and Existing Framework:

The Ministry of Energy (MoE) is responsible for formulating energy policy, and acts in concert with the Ministry of Planning and National Development to formulate energy policy in line with other development goals. The MoE also runs various energy sector development projects such as the Rural Electrification Programme (REP), wood fuels

[39] The full case study report is contained in Annex XII. N.B. At the request of interviewees interview transcripts are not included in this report.

and other renewable energy, fossil fuel exploration and energy conservation in collaboration with other development agencies and partners. Government policy is to develop affordable and sustainable rural energy.

However, to date, little has been done in this area. For example, fuel wood receives little concrete attention (although there has been considerable research and programmatic attention both from government, donors and international institutions) and falls under the remit of a number of government departments. Action in the fuel wood sector has focused on discouraging its use by moving to other energy technologies such as electricity.

The recently passed 2006 Energy Bill (which consolidated the Electric Power Act (EPA 1997) and the Petroleum Control Act) is more favourable to wood fuel and other renewable energy technologies. It also simplifies the previously rigid regulations governing IPP's, paving the way for greater investment in the power sector.

However, biomass energy policies are still largely weak and the few that exist are disjointed and lack coherence. Energy planning, despite being largely under the remit of one ministry also lacks coherence, with energy policy issues dealt with in different development plans and policy documents rather than through a common policy process. There have been recent efforts to redress this, for instance through the 2005 Forest Policy.

Climate change and its role in driving energy planning is also not currently formalised within Kenya. The 2006 Energy Bill says little about environmental and climate change issues despite environmental concerns being a key driver for sustainable development.

Up until the early 1990's the government considered policy formation and implementation as its exclusive responsibility. As the need to balance development and environmental well-being became increasingly important the government opened up and included other actors in policy and legal reforms. This has allowed CSO's and NGO's to sit on implementation committees and to use their background research and lobbying skills to influence government policies and actions. There is no formal system for integrating this research and the research of academic institutions into the planning process.

4.3 Attitudes and Priorities to Energy Planning

4.3.1 SADC

Medium to Long-term Energy Planning:

All institutions interviewed thought that medium to long term energy planning was important for the region, with the majority of interviewees stating that their organisation has a medium and long-term energy plan. For instance, SAPP has an institutionalised planning framework with a short term (between 5 and 7 years) and long-term (up to 20 years) planning horizon. No interviewees had energy plans which went beyond 20 years - the Senior Planning Manager at ZESCO stated that their previous 20 year master plan had just ended and work was needed to produce a new one. CSIR, the only research institute interviewed, thought that despite the existence of national planning strategies there was a complete lack of integrated regional planning within SADC, and where planning frameworks were in place they were often ignored or not implemented.

Stakeholders in the planning process included: national utilities, government departments and ministries, large energy users, retail consumers and donor organisations - NGO's and CSO's were rarely mentioned. This is in part because of a lack of capacity – there is no NGO dealing with energy issues on a SADC wide basis - and partly because of attitudes to the role they should be playing and the value they can add. Representatives of the South African utility Eskom thought that the role of NGO's was increasing, but that their contribution was not particularly effective as they do not have the capacity to understand the technical issues involved.

Energy Security:

Participants thought that energy security was an important or very important driver for medium to long term energy planning. This view was common to government departments and national utilities. Security drivers were twofold:
Concern over the current SADC / SAPP power supply and reliance of many countries on imported electricity and external transmission infrastructure (Nampower imports 75% of its power and Botswana imports 70% of its power) is resulting in countries developing domestic and overseas power projects. Namibia is funding projects overseas in Angola and the DRC; Zimbabwe is involved in 5GW of developments to supply the SAPP market; and Zambia is renovating and commissioning new generation capacity.
High energy prices, the lack of indigenous petroleum resources and access to imported petroleum by landlocked countries such as Zimbabwe, Zambia and Botswana – Botswana imports all of its petroleum resources.

The development of bio-fuel strategies was seen as one way to mitigate the reliance on imported fuels; SADC is developing a regional strategy, South Africa has released a draft bio-fuel policy and Botswana, Tanzania and Mozambique are all investigating the use of bio-fuels.

Energy Access:

Similar to energy security, interviewees viewed energy access as an important or very important driver for long-term energy planning. Governments have set a range of targets and created Rural Electrification Agency's to improve household access to power. EDM of Mozambique aim to increase access by 70,000 households a year out to 2019, meaning access is a central pillar in their energy planning. For countries which have a higher degree of electricity access the focus is slightly different: emphasis is placed on making sure energy supplies are affordable. South Africa, which has been active in electrifying households, now offers 50 KWh or power free each year. The Ministry of Energy in Botswana and the Botswana Power Company also emphasised the affordability of energy and customer relations. Eskom in particular thought that energy access equalled 'accessibility to modern energy services'.

Climate Change:

Climate change was considered far less important in influencing medium to long-term energy planning. A number of energy ministries and utilities considered that it was not something they needed to be aware of. For instance the SAPP policy advisor interviewed thought that there was a very low awareness of climate change amongst utilities. The Energy Ministries in Zambia, Mozambique and Botswana all reported that climate change was not a consideration in energy planning – the ZESCO SAPP policy adviser reported that climate change was not integrated into planning cycles. Some interviewees thought that climate change should be considered because:
Potential opportunities exist to generate investment under the CDM (Eskom, ECB, SADC)

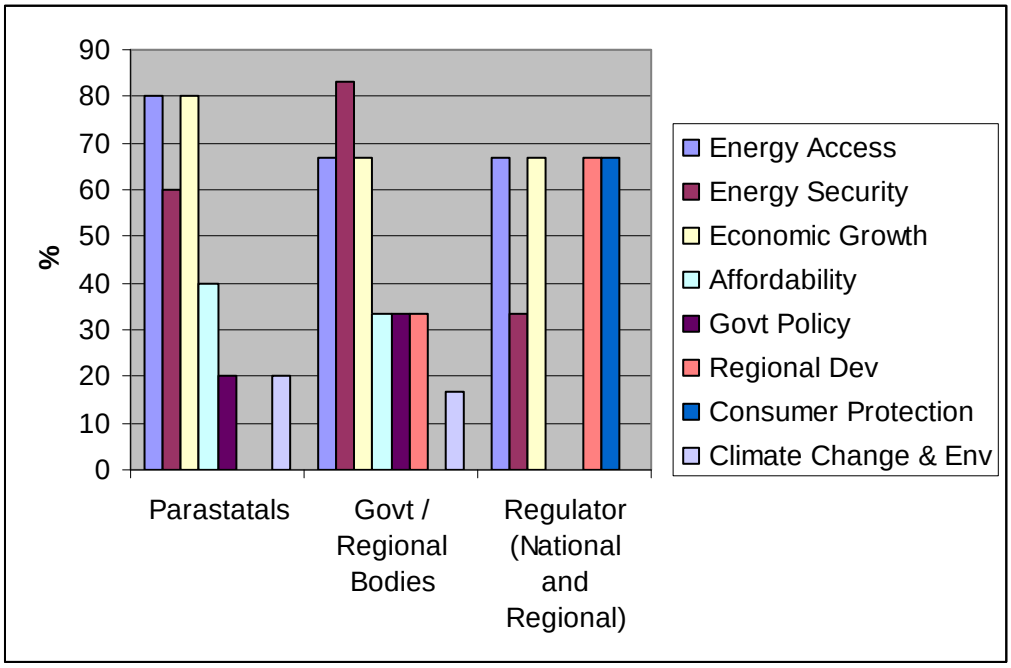
Climate impacts need to be accounted for when considering hydro investments (Nampower, EDM)

It is also interesting to note the opinions of Eskom, who probably have the most awareness of climate change and its future impacts out of any utility in the region. These were that the focus of climate change policies should be on adaptation and not mitigation. Their primary concern was the impact of regulation and the impact of any future climate agreement on their business.

Other:

Other drivers did emerge; figure 3 aggregates the opinions of interviewee categories on the drivers mentioned. A key driver is for future plans to encourage investment and economic growth and, for governments and regulators, the need to contribute to wider regional development.

Figure 3: Importance of drivers to the planning process reported by different stakeholder groupings[40]



Interactions and Synergies:

The focus here was on the synergies and trade-offs between energy access and energy security in future planning regimes. Climate change was mentioned but was not thought a key driver in informing future plans.

Positive synergies between energy security and access were given as:
Increased energy security creates a more stable economic environment, attracting investors and promoting growth therefore generating the means for people to obtain access to power (SAPP, ECB).
Energy access and security are complementary because one is dependent on the other (Ministry of Energy, Botswana, ZESCO, BPC).

[40] N.B. Sample size of 14 interviewees. Some interviewees did not explicitly rank the drivers and interviewees representing organisations which did not fit into the given categories were excluded.

Many examples where increased access leads to greater security, e.g. growing Jatropha to produce biodiesel and generating power increases access and security (Ministry of Energy, Mozambique)

Areas where trade-offs occur between security and access were given as:
Where affordability is increased, prices may be lowered or kept low; reducing the incentive to invest and harming future security (CSIR).
Tension between the costs necessary to increase access and the pressure to keep tariffs low (EDM, ECB, Nampower).

Participants also identified a number of areas where they thought policies to reduce GHG emissions would impact on energy security considerations. For instance, tension between the use of large indigenous coal reserves and the impact of generation from thermal sources on the climate (ZESA, ECB). Eskom also identified environmental tensions, such as environmental pressure to use less water in coal fired power stations resulting in lower efficiencies and increased GHG emissions.

4.3.2 South Africa

Medium to Long-term Energy Planning:

All participants thought that long-term energy planning was important to South Africa. There were a variety of views on the effectiveness of the current planning process: Energy policy makers thought that the IEP had fallen apart and that in the absence of an energy bill no effective energy planning framework existed. In contrast, the DME disagreed, saying that the IEP2 process had reached an advanced stage and was still ongoing. Overall, it was felt that planning was not adequate in South Africa due to:

- The current emphasis on short-term decisions being taken to avert the supply crisis in the electricity sector;
- confusion over who was responsible for formulating and implementing long-term plans (currently the DME, but actual implementation decisions are taken elsewhere);
- The lack of integration between planning decisions and private and public sector investment frameworks (for instance, the existence of multiple planning processes administered by the DME, NERSA and Eskom) and the uncertainty on how the results from these processes will be utilised;
- The need for a consistent modelling environment (IEP and NIRP processes overlap), more accurate input data and agreement on the basic assumptions and data used; and
- The lack of capacity and shortage of skills at the DME. This repeatedly emerged as an issue in many interviews (Energy Planners FG, SAPIA, Donor FG). The capacity shortage is exacerbated by staff leaving the ministry for other, better paid positions.

Donors, and to a certain extent energy planners, considered biomass as an important aspect to long-term energy plans given its importance to poor households and rural communities, and one that was not adequately covered at present.

Key stakeholders were stated by all interviewees as: government departments such as the DME, the DPE, the Treasury and DEAT (although the DME and DEAT formulate policy, investment decisions are taken by the DPE and the Treasury); NERSA; Eskom, who were viewed as having a large influence over the planning process and who have personnel seconded to the DME and the IEP; private sector players such as Sasol and business associations such as the Petroleum Industry Association (SAPIA). The was general consensus that civil society and user groups

were under represented in the process (Energy Planners FG, SAPIA, Academic FG, Eskom) and merited further inclusion. In addition, municipalities and local authorities were also thought to be under represented (Energy Planners FG) with little integration between national and local plans (where they exist) (SEA, Climate Change FG).

Planning Drivers:

FG attendees identified a number of additional energy planning drivers with the most common being economic growth and economic development.

Table 1: Stakeholder ranking of drivers

Stakeholder groups	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[41]	• 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

Energy Security:

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 – however, it was clearly a greater consideration for certain groupings (see table 1). Major energy users stressed the importance of reliability, quality of power supply and future assurance of price for their operations; linking energy security with economic development. Representatives from other groupings considered other components of energy security as important drivers. For instance, the climate change grouping stressed the affordability and energy diversity elements of energy security – they also saw energy security as important for extending energy access.

[41] Insufficient evidence was obtained from private sector suppliers to list long-term planning drivers in South Africa.

Energy security has been brought sharply into focus by the recent petroleum supply disruption and current power shortages. One impact, noted by academics, was that the current planning process had been halted to steer resources towards addressing the current crises, storing up future problems. NGO's largely felt that the current crisis had meant that investment was occurring outside of the planning framework, undermining the process. For instance the crisis could allow Eskom and the government to push through a new nuclear programme driven by the need to be seen to be taking action.

Energy Access:

The centrality of energy access was in many respects regarded as a given by many stakeholders. Proxies for access such as affordability and the incorporation of the provision of energy services into development plans were considered as important to future plans (DANIDA, Energy Planners FG).

Climate Change:

In general, climate change ranked at, or towards the bottom, of priorities for all stakeholder groups, although all participants though that the importance of climate for energy planners was increasing. Climate change policy makers felt that their impact on the energy planning process was small and completely reliant on other processes and organisations to implement. For instance the IEP2 process did start with broad representation from all relevant government departments (including DEAT) but this involvement was not sustained (DEAT were no invited to later consultations). One area identified where climate change issues were feeding into energy planning discussions was through local government activities. 9 of South Africa's cities participated in the Cities for Climate Change Programme (CCCP) which finished in 2006 and as a result have implemented sustainable energy related projects. As a follow-up many cities have created Climate Change and Renewable Energy Strategies but it is unclear whether these will be adopted at a high level and how they will be driven forward now that the CCCP initiative has ended.

Interactions, Synergies and Tensions:

Interactions identified by stakeholders in the energy planning process were not limited to the three drivers focused on in this study, where interactions exist between other identified energy planning drivers they have been included below:

There exists a difference between stated policy and de facto importance of drivers. The climate change FG thought that although household access has been identified as a key political priority and driver, the economic importance of energy and the dominance of a few users meant that industrial concerns take priority.

Donors thought that obvious tensions exist between investment in cheap technology to alleviate the current power crisis and the need to plan for the longer term, i.e. between climate change and economic growth. The need to provide short-term power locks the country into a higher carbon development path in future (Energy Policy FG).

The threat power export commitments have on the local economy. This was countered by the view that greater regional security and planning leads to greater national security.

Tension exists between energy access through the electrification programme and the planning of supply. It was noted by a number of stakeholders that the impact of

greater supply had not been properly addressed in the planning process. In particular, the impact on peaking power requirements from domestic households and the free basic supply policy were not sufficiently understood or planned for.

4.3.3. Kenya

Medium to long-term 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 it. 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.
- exclusive and does not take account of certain key stakeholders and other, inter-sectoral aspects.
- mainly reactive in nature.
- dominated by politicians and provincial administrators who have an overbearing influence that can hinder implementation.

For these reasons, they felt that the process is not fit-for-purpose. Participants thought that the most influential players in the energy planning process were the ministries of Energy, Finance and Planning, the Electricity Regulation Board (ERB), power utilities; Kenya Light and Power Company (KPLC) and KENGEN and petroleum institutions KPRL, NOCK and other private sector companies. International donors such as the World Bank and the IMF were also influential. Participants were of the opinion that all the actors who are currently involved in the planning process should be, but that in most cases the net should be widened to include other players.

End users and civil society were also mentioned as important players by Solarnet which thought that although involved, their influence was small and lacked formality. KAM echoed the views of most stakeholders on the influence of government, utilities and the ERB but thought that end users, academic institutions and representative bodies should be more involved. The reason they were not was because of the historical role and dominance of the MoE and large parastatals. The lack of involvement of households using traditional biomass energy resources was highlighted by Fridah Mugo representing a biomass supply company.

Planning Drivers:

A variety of drivers of medium to long-term energy planning were given by participants. These are summarised in table 2 below.

Table 2: Drivers in medium to long-term energy planning reported during interviews

Driver	Organisation
Energy Security	SESCO, Thuyia, UNDP
Energy Demand	KENGEN, KAM
End user requirements	Solarnet
Economic growth	KAM
Development plans	KAM
Climate change	Ministry of Environment, UNDP
Local air pollution	Academia
Biodiversity	Academia
Energy cost and access	Acadmia, Thuiya
Donor pressure	UNDP

Energy Security:

Energy security was listed by interviewees from the power sector as the most important driver behind medium to long-term energy planning in Kenya. All participants thought that energy security was becoming more important to the planning process for a number of reasons:

- The need to attract investment and ensure existing industry remains competitive (KENGEN, SESCO, KAM).
- The impacts of globalisation and high energy prices making future security less certain (UNDP, KAM)

All organisations surveyed, bar Solarnet, thought that energy security was not adequately factored into long-term energy plans (Solarnet thought that planning was becoming more organised but that policies needed updating). In particular, current policy places emphasis on reaction to security issues as they occur and on short-term fixes (SESCO). KAM stated that the country has experienced power shortages or has had to resort to using emergency power in each of the last 7 years.

Energy Access:

Access to energy was also considered as an important part of the energy planning process. Representatives from the academic community and from the private company Thuiya, thought that energy access was the most important driver out of the three given. Private sector organisations thought that the importance of planning for energy access was because energy services were necessary for economic growth and development (KAM, SECSO, KENGEN), whereas donors and academics felt that its role in increasing welfare and alleviating poverty made it important to incorporate into future plans (UNDP, University of Nairobi). Whilst in most cases energy access was defined as the access to affordable, accessible and adequate energy (KAM, Thuiya) others thought that energy access meant grid connection and access to modern energy services (SESCO, University of Nairobi). Only the state utility KENGEN thought that energy access was adequately covered by existing energy plans

Climate Change:

All participants thought that climate change was important to long-term energy planning, and felt that its importance for energy planners had become more important compared with 5 to 10 years ago but was not currently considered in the existing

planning process. Interviewees gave 2 reasons for energy planners to be aware of climate change

The most oft cited was the impact changes in the climate system might have on existing generation capacity. Hydropower accounts for 80% of Kenya's generating capacity and participants felt that there was a lack of sufficient planning to allow the energy system to cope with lower rainfall and water levels (KAM, SESCO, KENGEN, Thuiya, UNDP)

The opportunities presented by the carbon markets could increase investment in the power sector. Energy plans should take account of this (UNDP)

Climate change was viewed by all as not being adequately considered in the energy planning process, but ranked lowest of the three given drivers (UNDP ranked climate change first).

Interactions, Synergies and Trade-offs:

Synergies between the drivers were identified as:

- Planning for the impacts of climate change would have a positive impact on energy access and energy security (UNDP, Thuiya).
- Attracting carbon finance will increase energy sector investment and in turn, increase energy access and energy security

Tension was suggested as being between the short-term and long-term planning process rather than between the individual drivers (although tension was identified by KENGEN between increased energy access and the corresponding need for supply increases affecting security). KAM highlighted the existing tension of consumer demand for electrification and emergency power, resulting in grid extension and the provision of expensive emergency power units; a longer term plan may be less effective in achieving near-term goals, but would be cheaper and more secure in the long term. Thuiya highlighted the short-term planning bias of modern energy planners which disadvantaged energy sources that require longer term planning such as biomass and planning for the long-term affects of climate change. KENGEN reinforced this view, by stating that short-term priorities focused on achieving political objectives and economic development. There was also some disagreement over which should take priority; short-term or long-term planning: SESCO and Solarnet felt that short-term planning should take priority and should be structured to effect long-term change, whereas KAM wanted to see a longer term plan take precedence over short-term priorities.

4.4 Analysis of Case Study Outputs

Energy planning was viewed by all stakeholders as important to individual countries and the wider region, with medium to long-term energy planning being a key part to this process. Documentary evidence also shows that energy plans do exist, and that planning frameworks are being developed; albeit by a variety of different actors and in different guises. For instance, South Africa has a number of long-term planning processes supported by government policy in the form of the 1998 Energy White paper. Kenya has the recently enacted 2006 Energy Bill and a number of countries and supra-national institutions in the wider the SADC region have planning frameworks in place.

The areas studied differ markedly in their current energy systems, markets and energy planning frameworks: South Africa is the dominant energy user and supplier

in the region and has a highly developed energy sector; Kenya is reliant on hydro power and imported fuels; the majority of its primary energy comes from traditional biomass and; SADC encompasses national governments, utilities and supra-national bodies such as SAPP and RERA. Whilst care needs to be applied when comparing results from one area to all, common themes and issues do emerge,

Although long-term energy planning was viewed as important and even critical to the areas studied, the vast majority of interviewees stated that long-term planning is currently not working, and in some cases is not fit for purpose. The fragmented nature of the planning process, the lack of transparency and consistency, the dominance of short-term plans which may contradict longer term policies and the lack of human capacity are some of the reasons given for existing ineffectual processes.

Views on the importance of the drivers were also similar across the case studies with both energy access and energy security being seen as very important to long-term planning and climate change mitigation of lower importance. The importance of climate change as a driver varied: in South Africa, which has the most developed policy on climate change of the areas studied, stakeholders thought that its importance as a driver would only grow and that long-term plans needed to be mindful of future international regulations and agreements. In SADC and Kenya, concern was expressed about the need to plan for the impact of climate change on existing methods of energy generation (such as hydro). But there was little mention of the impact of post-2012 regulations, or the need to cut back on emissions to mitigate the longer-term effects of climate change (although SAPP and SADC thought that mitigation and adaptation should go hand-in-hand). Future plans should also plan for, and acknowledge, the potential for investment in the energy sector through carbon finance.

Case Studies – Key Points:

The greatest emphasis on long-term planning is within the electricity sector. Both the liquid fuel sector, seen as requiring less central control and being more able to adapt to market forces, and the biomass sectors, do not feature prominently in survey outputs and receive less planning attention from central government. Juxtaposing existing plans and interviewee opinions with the current sources of primary energy in the region; biomass is used for 70% of primary energy in Kenya, for 14% of household energy in South Africa and is dominant as an energy source in other SADC countries, it is apparent that it does not feature strongly in existing energy plans or legislation. Indeed, the rush to develop national and regional liquid bio-fuel plans is in contrast to the absence of regional biomass plans and effective national biomass frameworks. Three reasons for lack of effective long-term biomass planning emerge from the case studies:

- The **absence** of a clear authority overseeing biomass for energy usage: the sector is covered by a range of government actors including; the ministries of agriculture, energy, planning, environment.
- The **decentralised** and long-term nature of biomass production does not sit well with the capture of the planning process by large, centralised organisations and the short-term nature of planning.
- The **misconception** that development and access to energy mean connection to the grid.

In all case studies, the issue of lack of capacity within organisations responsible for planning, and the need for frameworks to integrate the views and opinions of stakeholders not directly involved in the planning process was highlighted. The different approaches taken to planning in the electricity, liquid fuel and biomass sectors demonstrate the diversity of planning structures. Although large parastatal

producers such as Eskom, and industry associations such as KAM are often represented when plans are being formulated, smaller, more diverse stakeholders find it difficult to make their views heard. This is true at both a national and regional level. Processes do exist for integrating local and municipal plans (where they exist) into national plans in South Africa but the case study outputs suggest that central government and large players still dominate the planning space.

Regional planning was also viewed as important but apart from a few organisations such as SAPP, integrated regional planning remains an aspiration, which to be fulfilled, needs existing structures such as SADC to develop further capacity (the SADC energy committee only meets once a year and does not possess a regional integrated plan) and for individual nations to develop consistent national plans.

The absence of models and tools to aid and inform planning decisions is likely to prove a barrier to consistent and evidence based decision making. With the exception of South Africa, where a number of tools are used by government, utilities and research institutes to inform government policy, there is little evidence of the use of models informing the planning process at a regional or national level. Allied to this is a lack of detailed demand and resource data, necessary to create scenarios which can forecast future energy systems based on the importance of drivers and policy decisions.

A key finding was the insufficient linkage and lack of consistency between energy plans (where they exist) and energy policy and investment decisions. This was most pronounced in the South African case study, but implied in the results from other case studies. Although the DME is responsible for the planning process, real power to vet and influence investment decisions resides elsewhere: in the Treasury and DPE, and with the large energy corporations Sasol and Eskom.

Synergies & Tensions:

In general there was more emphasis on the synergies between drivers than conflicts (in particular between access and security). However, there are problems of different understandings and definitions, hence caution is required when interpreting the results.

Table 3 Synergies and tensions emerging from case studies

Drivers	Synergy	Tension
Energy Access & Energy Security	Increased security generates increased investment	Increased electricity access strains existing capacity
	Innovative methods to electrify rural communities diversifies supply	Tariffs for poor rarely reflect marginal cost to increase capacity
	Utilisation of local resources (bio-fuel, traditional biomass) reduces import dependence	
All Drivers	Carbon finance to generate increased investment	Impacts of climate change on existing generation capacity
		Environmentally friendly generation options are more costly
Short-term vs Long-term		Climate change friendly options may increase short-term generation cost
		Short-term supply crises
		Fast growing economies increase pressure to respond rapidly to short-term energy needs.

Interactions between the drivers do not give a complete picture of the decisions facing energy planners, with additional tensions and complementarities existing when other drivers are factored in and when spatial differences (local, national and regional) and temporal (short-term versus long-term) have to be accounted for. A key driver emerging from interviews and in driving forward SADC co-operation is economic development. However, unforeseen demand pressures lead to short-term supply shortages and pressure to increase the supply of energy. Whilst justifying the importance of long-term planning, these pressures occupy planners and government and make it harder to plan, build capacity and allocate resources effectively over the medium to long-term.

5 ANALYSIS OF RESULTS AND RECOMMENDATIONS

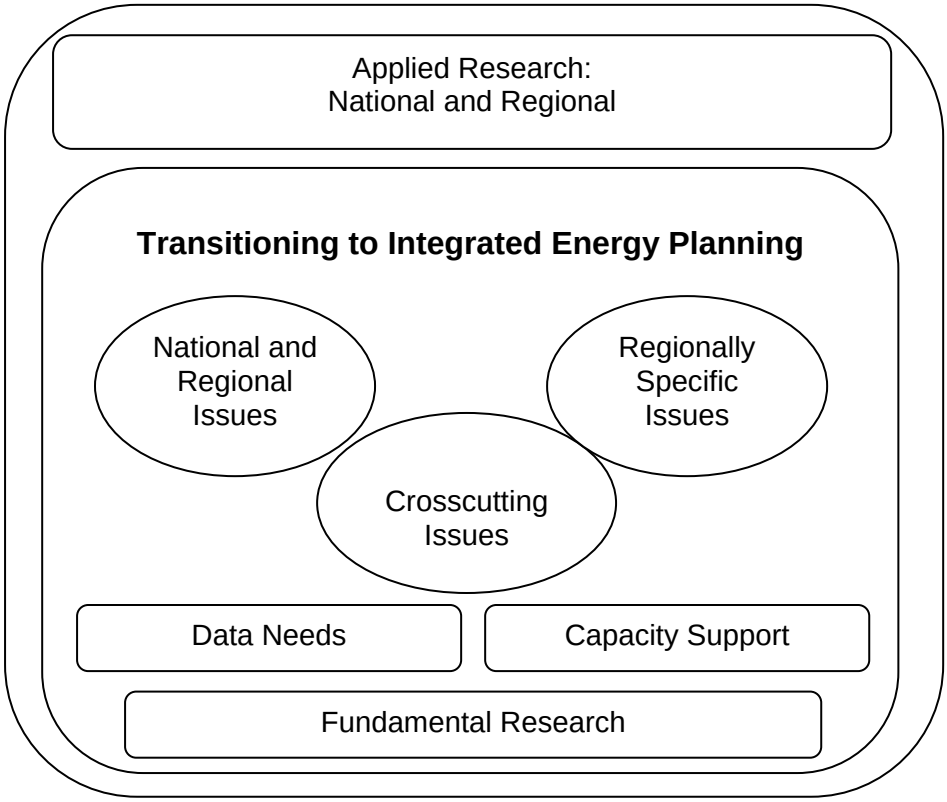
5.1 Research Needs

A number of research needs have become apparent through the course of the analysis of case study results and the literature review (see table below).

There is extensive literature on energy planning but it is not comprehensive, especially for developing countries. Indeed, frameworks incorporating the key drivers of access, security and climate change are limited and the interactions between all three are little explored. The few studies that have attempted to analyse these interactions suggest that synergies do exist and can be captured with careful policy planning. However the interactions identified are complex, context specific and frequently directional. Also, further analysis would need to consider social and economic development goals specific to developing countries (energy for growth, access for poverty reduction).

To support the presentation of the identified research needs, an organising structure has been developed focused on supporting a transition towards integrated energy planning. This is shown graphically with illustrative research clusters that are expanded on below.

Figure 4: Energy planning research components



In the course of this study it has been found that both applied and fundamental streams of research are relevant and necessary. There are immediate needs which could be addressed through applied research at the national and regional levels. At the same time energy planning in developing economies does not have a rich theoretical foundation. There is significant and unrealistic reliance on planning

approaches evolved in mature developed economies that should be translated to developing economies only with great care.

It is anticipated that the applied research themes and fundamental research themes be mutually reinforcing; the former can be thought of as 'problem solving' based, while that latter are based more on re-framing of fundamental issues.

The case studies selected identified a broad range of existing planning strategies and capabilities. Discussion of particular research needs is placed in this context – with needs differing according to the level of maturity of existing capacities and planning approaches.

Recognising that the research needs will ultimately need to be tailored carefully in partnership with recipients and may also differ according to the selected entry points and mechanisms chosen, the research needs defined are purposefully stated at a relatively high and non-prescriptive level.

National and regional applied research:

Medium to long term planning was, almost universally, considered to be of high importance. However, little rigorous long term planning was actually being undertaken. Most of the planning activities actually occurring were short term in reaction to challenges. There was also little clarity over which planning - and particularly modelling - approaches to take (backed up by concerns expressed in the literature over the applicability of some models for developing countries). Capacity limitations also deter sophisticated planning activities. Further, data availability both for planning purposes and evaluation is also sparse – pointing to a need to improve the standard and consistency of data collection as part of a capacity building activity.

Many of the planning activities discussed in the case studies related solely to electricity provision. There was less mention of planning for biomass (despite the fact that traditional biomass is the largest energy source in Kenya and many of the SADC countries covered) and of the oil and gas sectors. These case study findings ought to be evaluated with care as it is undetermined whether these needs are unrecognised by the stakeholders, less valued by the stakeholders, or overlooked because of the type of stakeholders engaged in the research.

Case study findings did not point to consistent, broad inclusion of different perspectives on energy planning. Civil society groups, NGOs and consumers were not consistently engaged in planning. There was also a lack of consistency in planning approaches where multiple institutions had a direct planning role.

The long term sustainability of energy markets was raised with reference to the tensions between affordability and the need for energy delivery systems to cover their capital and running costs.

Climate change was given less weight in the cases studied than the energy access and security drivers. Greenhouse gas emissions are, with the exception of South Africa, not material at the global level. However, the potential adaptation challenges from the climate change already underway, while recognised to some extent, do not appear to be adequately addressed – specifically feeding hydropower output projections back into long term electricity plans and considering rainfall projections as part of bio-fuel development plans.

The need for a number of applied research activities came out of an analysis of the case studies and literature review. The key focus was to provide support for medium to long term energy planning.

Regional applied research:

The value of regional energy planning was raised throughout the case study research. However other than some regional electricity planning through SAPP there was little evidence of a regional vision for energy planning. Given the size of many economies in Africa and increasing energy interdependence across the continent through shared hydro facilities and gas pipelines, additional support for planning at the regional level is justified. Regional research efforts should focus on how to enable and support the added value offered by co-operation between stakeholders and institutions at the regional level.

Crosscutting applied research:

A number of research themes cut across all the case studies and research needs at the regional and national level. Engagement in these activities will provide support for each of the applied research needs defined.

Fundamental research:

The literature review highlighted the relative weakness of the academic foundations available to support policy recommendations for energy planning in developing countries. These weaknesses may introduce implementation risks into any selected applied research strategies. Given that DFID's remit does not include the generation or funding of fundamental research, these issues may provide opportunities to engage with the UK Research Councils or EU FP7 programme to support essential fundamental research in parallel with the applied research outlined above.

Table 4: Identified Research Needs

Research Theme	Stakeholder Support / Justification
National and regional applied research	
Support the development of frameworks for medium to long term planning including the incorporation of urgent short-term objectives and flexibility: Develop energy system scenarios which include issues of fuel/technology mixes including oil and gas, risks and benefits of different energy (and industry, transport etc) paths, taking into account energy prices, availability (under resource constraint), carbon prices, technology developments etc.	SADC: EDM Mozambique, SAPP Zimbabwe Kenya: Support from all stakeholders with strong support from NOCK and energy policy research (specifically KIPPRA). KAM (Kenya association of manufacturers). South Africa: Planners, Suppliers, Academics Energy modelling, climate change and policy interactions literature reviews
Undertake demand projections and supply assessments (particularly biomass and hydro potential) at the regional and national level.	SADC: Eskom Kenya: KENGEN South Africa: Donors, Planners
Provide support for the planning of the inclusion of modern bio-fuels in the energy system (integrating land-use planning and water use)	SADC: Zimbabwe Electricity Commission, Zesco Zambia, Ministry of Energy Mozambique, Energy Division Botswana, SADC Kenya: Ministry of Energy, NOCK, NGOs, Donors, Academics, KAM. South Africa: Planners, Donors, Academics Energy policy interactions literature review
Provide support for inclusion of traditional biomass as a central part of long-term energy planning. Research could focus on learning from past failures, developing appropriate regulatory and policy structures that take account of the cross-sectoral nature of the biomass supply chain and developing mechanisms to empower biomass stakeholders.	Kenya: Donors, Academics, NGOs, UNDP, GTZ South Africa: Planners Energy access, energy security, modelling literature reviews
Develop and roll out consistent and appropriate modelling tools and definitions (including data collection) for energy planning across the stakeholders in a target country or region.	Kenya: KAM, UNDP, GVEP, policy makers South Africa: Planners, Academics Energy modelling and policy interactions literature reviews
Develop approaches and capacity for analyses of climate change adaptation, share knowledge of regional climate projects, integrate climate considerations into evolving medium and long term plans – particularly with respect to hydro, biomass and bio-fuels potential.	Kenya: NEMA, GTZ, UNDP South Africa: Planners Climate change literature review
Identification and application of innovative policies to provide sustainable tariff support to the poor (e.g. South Africa's 50 KWh allowance).	SADC: Eskom, Department of Energy Zambia, CSIR, South Africa Kenya: KENGEN Energy access literature review

Research Theme	Stakeholder Support / Justification
Review existing best practice and provide support for the creation of frameworks for connecting policy and planning decisions to investment decisions.	South Africa: Academics, private sector, energy planners Kenya: Academics
Increase the awareness of and potential for penetration of carbon finance in energy plans.	SADC: BPC Botswana, Eskom, DBSA South Africa Kenya: NEMA, KAM, KENGEN, KIPPRA Climate change literature review
Regional applied research	
Support consensus processes to identify further opportunities for regional energy planning and support the development of consistent approaches and tools for energy planning at the regional level.	SADC: EDM Mozambique, CSIR South Africa, ECB Namibia, Eskom, DBSA South Africa, RERA, BCP Botswana Kenya: KENGEN, Academics Energy modelling literature review
Provide capacity and support for regional energy planning initiatives.	SADC: SAPP Zimbabwe Kenya: KENGEN, Academics
Crosscutting applied research	
Identify specific skills needs and develop energy planning capacity in target institutions.	SADC: RERA, Nampower Namibia, EDM Mozambique Kenya: KIPPRA, Academics
Define and implement a stakeholder engagement approach for integrated energy planning.	Kenya: All stakeholders
Evaluate, recommend and implement procedures for energy system data collection and reporting as an input to energy planning.	SADC: Energy Division Botswana, RERA, ECB Namibia, Zimbabwe Electricity Commission Kenya: All stakeholders Energy modelling and energy policy interactions literature reviews
Fundamental research	
Assessment of the applicability of existing energy models in a developing country setting, accounting for energy access (for poverty reduction and growth), energy security and climate change (impacts).	Energy modelling and policy interactions literature reviews
Theoretical foundations for determining appropriate institutional structures to support national and regional energy planning over medium and long timescales	Energy modelling and climate change literature reviews

Research Theme	Stakeholder Support / Justification
Develop a conceptual framework with the flexibility to work at different spatial levels that is able to address long-term energy planning issues across a broad constituency of stakeholders and assigns ownership and responsibility for implementing processes and policies.	Energy policy interactions literature review
Investigation into the energy security gains to be made through regional cooperation in energy planning.	Energy security literature review
Increase understanding of demand characteristics of providing energy to the poor, including supply impacts and perceptions of risk etc.	Energy access literature review
Develop a means of analysing the interactions and trade-offs necessary in long-term planning scenarios in developing countries: Tools such as proxy indicators to evaluate the effects of policies in energy planning drivers. Risk management techniques that can insulate energy plans from external shocks such as climate impacts, supply constraint, price fluctuation and technological innovation.	Energy policy interactions, energy security, climate change literature reviews

5.2 Research entry points

5.2.1 Historical context and ongoing research

It is important to situate recommendations for a possible DFID-funded research activity within a context of past, ongoing and planned activities.

Historically, DFID and other bilateral and multi-lateral donors have had a number of entry points for undertaking research in the energy policy, planning and strategy fields in developing countries. In DFID's case, one of the key instruments was the 'Knowledge and Research/KAR' grant programme, initiated by an open call for proposals, and resulting in applied research through a number of entry points, from government agencies to private companies, NGOs, to multi- and bi-lateral partners. Other relevant programmes and processes include:

- European Commission DG Development 'budget lines' on environment (with climate change included), and tropical forestry (including traditional energy).

- European Commission DG TREN (DG Transport and Energy) activities under ex-ALTENER (renewable energy), SAVE (energy efficiency and Rational Use of Energy/RUE), Inco and most recently COOPENER. Entry points include government agencies, private sector consultancies, NGOs.

- European Commission research programmes. DG Research programmes, under various 'calls' and different programmes envelopes (currently the Seventh Framework Programme/FP7) including INCO. Entry points have generally been within the EU, although often with 'third country' participants (including developing countries), involving a wide range of institutions, from research institutes, to trade organisations, financing institutions, other bilateral and multi-lateral donors, to name a few. DG TREN has issued similar 'calls for proposals', with more of an 'applied research' element. Programmes involving developing countries have often had more of a research focus than those only with EU or other European partners, with research entry points that have tended to be more 'official', whether through government agencies, or government sponsored research and/or development agencies.

- The Energy Sector Management Assistance Programme (ESMAP, www.esmap.org) has undertaken applied research and supported innovative policy and strategic planning, including modelling and long-term planning in the energy sector over the past two decades. ESMAP, managed by the World Bank (but with bilateral donors from a number of UN Member States), has tended to work primarily with developing country governments, government agencies, and R&D agencies in the energy sector.

- DFID is a contributor to other programmes that have developed numerous entry points for research, planning and policy in the renewable energy and energy efficiency field including the REEEP (Renewable Energy and Energy Partnership, www.reeep.org) programme, and various multi-lateral programmes sponsored by the United Nations (e.g., the Global Village Energy Partnership, http://www.gvep.org/). DFID supported the initial stages of the development of the World Bank's 'Africa Rural and Renewable Energy Initiative/AFRREI, with entry points generally through national host country agencies, and with partners from a number of sectors. Most recently DFID has been engaged with the World Bank Clean Energy and Development Investment Framework (CEDIF) developed at the request of the Gleneagles G8 meeting. One proposal for CEDIF is to develop

'energy prospectuses' at national level in beneficiary countries; this represents a possible entry point for an energy planning research programme.

- DFID's support for various aspects of the G8 and Gleneagles Summit follow-ups has been instrumental in raising energy policy and planning at a number of levels, from governmental to non-governmental. DFID's support for the UN's 2002 Johannesburg World Summit on Sustainable Development/WSSD (www.johannesburgsummit.org) resulted in major initiatives in the energy sector, including the EU Energy Initiative (www.euei.org) with entry points through a number of entities, including developing country governments, government agencies and potentially the private sector...

DFID has provided support for the international 'Household Energy Network Forum/HEDON', which undertakes policy, networking and research, with entry points through NGOs, private companies, research institutions, universities and a variety of government entities.

Other potentially relevant regional and international actors and processes include:

- **IEA** – International Energy Agency, particularly its work in climate change, sustainable development, energy access, renewable energy and energy planning.
- **NePAD / AU / FEMA / AFREC** – continental level organisations in Africa all dealing with, or focussing specifically on energy for development.
- **Regional bodies** – especially the Regional Economic Commissions (RECs) in Africa: SADC, ECOWAS (recently developed White Paper), EAC etc.
- **International Institute for Applied Systems Analysis (IIASA)** - an international research organization. In January 2007 IIASA together with a host of international partners launched the Global Energy Assessment (GEA)[42]. This is proposed to be a long-term (ending 2010) initiative seeking to identify integrated solutions for ameliorating existing and emerging threats associated with major global energy challenges, such as providing energy services for poverty alleviation and development, maintaining energy security, and mitigating local, regional and global environmental impacts.
- **ICRAF** – International Council for Research in Agro-Forestry, with particular reference to integrated agriculture and forestry (for energy)
- **FAO** – Food and Agriculture Organisation of the United Nations, focusing particularly on forestry for wood energy production, planning and policy;

These are but a few of the programmes, processes and agencies, representing a wide range of possible entry points and partners.

5.2.2 Research context within South Africa and Kenya

South Africa - In South Africa there is a well developed research system – coordinated by the Department of Science and Technology (DST) and its various underlying academies and advisory bodies, funding agencies, science councils and higher education institutions. It is advised to engage with the DST on any significant new research programme in South Africa at the design stage to prevent overlap with other initiatives and to ensure that local priorities are being addressed.

The new South African National Energy Research Institute (SANERI) currently located within the Central Energy Fund focuses on research and development within the energy sector. Its primary roles include the development of an energy research

[42] http://www.iiasa.ac.at/Research/ENE/GEA/index_gea.html

and development agenda that is supportive of government plans of action. Energy planning and modelling is one of their initial research themes. The energy planners, academics and researchers, and donor focus groups all identified SANERI as an important partner institution for any future energy planning research in South Africa.

Certain academic institutions have been key in supporting energy planning in South Africa, including the Energy Research Centre at the University of Cape Town and the Institute for Energy Studies at the University of Johannesburg. There are also other emergent energy research institutions being supported by SANERI. It is important to note that other institutions, such as the Centre for Scientific and Industrial Research (CSIR), other tertiary institutions and also private sector research units, such as Eskom's Technology Services International (TSI), are important loci for energy planning and modelling research in the country.

Kenya - There is no specific research institution on energy. In general Kenyan research institutions conduct research in different fields on the basis of domestically available data and best practice elsewhere. The research institutions, [mostly university departments of electrical, environment or appropriate technology] conduct some research in terms of energy technologies and policy 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 however, there is still no body formally set up to engage in energy research for purposes of informing the planning process. Generally the Minister of Energy uses his mandate to set up ad hoc committees to address specific energy issues.

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.

5.2.3 Possible entry points for energy planning research

Entry points have been considered in the table below, giving indications of who, where and when a DFID research programme might engage, either in beneficiary countries and regions or with existing processes within donors and international organisations.

It is important to note that stakeholders consulted during the course of this exercise stressed that research at a national level should be targeted towards existing institutions and organisations, highlighted in 5.2.2, as opposed to funding the creation of new energy planning bodies.

5.3 Mechanisms for delivering a DFID research programme

This section outlines options for how DFID might deliver a research programme on medium/long term energy planning. Five main options are presented. However DFID may decide to choose a combination of the options presented.

Integrated project - Research Programme Consortium model: including elements of both applied and fundamental research. The research could be based in one or two countries (preferably with different levels of planning capacity and experience to aid south-south learning) and one sub-region, in order to capture benefits of planning at regional level. Co-funding might be sought for the fundamental aspect of the research which is not DFID's traditional domain.

Contract separate elements of research: such as planning for biomass, bio-fuels; electricity planning – integrating grid and off-grid; inclusive processes for planning involving stakeholders; development of approaches and tools for integrated energy planning.

Provide funding to an existing programme/activity: either directly to researchers and other stakeholders in beneficiary countries, or at regional level (eg RECs) or engage with international processes (eg IIASA, IEA, World Bank), specifying particular focus/outputs required by DFID.

Existing DFID Research Programme Consortia "Energy for Development": incorporate energy planning aspects into this recently contracted RPC.

Invest directly in research capacity in Africa: by providing funding and technical assistance on energy planning to existing institutions (including government departments and agencies) and research centres at national or regional level (possibly RECs), or supporting the creation of institutions where none exist.

Whichever delivery mechanism is deemed appropriate, co-funding could be sought, in particular to support fundamental research which is not within the remit of DFID's research programme but is considered essential for long term success. Co-funding might be sought from UK research councils (ESRC, NERC), European Commission's FP7 programme (with €140 million for energy in developing countries[43]). Opportunities for co-funding for specific activities could also be investigated on an opportunistic basis[44].

Given the complexity of medium/long term planning, the paucity of capacity in beneficiary countries and the need for continuity of support for delivery of results, it is recommended that DFID should – if they choose to initiate an energy planning research programme – remain engaged for a minimum period of five years, leaving open the possibility of longer term engagement.

[43] Note that the focus of FP7 may be on China and India, although some activities in Africa are likely to be retained.
[44] It is likely that University California Berkeley will soon be initiating a bio-fuels programme of up to US$ 1 billion [part funded by private sector, state government and venture capital].

Table 5: Possible research entry points

Level	Entry points	Considerations
Action Research		
Country level	National planning processes (government departments for energy, planning, climate, industry, transport etc)	• Integrated energy planning processes underway in some countries (eg South Africa, Botswana, Bangladesh etc). • Important to engage with planning processes for key energy using sectors possibly within framework of PRSPs, and climate processes • Consider engaging with existing data gathering processes (eg national census) • On biomass, engage with energy, planning, agriculture/forestry departments, and other institutions (eg FAO, GTZ, ICRAF etc) • Important to build planning capacity and skills within ministries and to develop an 'institutional memory' for process frameworks
	Municipal / local level planning processes (local level administrations, civil society)	• Especially important in countries where decentralisation agenda has progressed e.g. South Africa
	Utility and energy industry planning processes	• Some utilities have sophisticated planning processes underway (eg ESKOM).
	National research organisations Private sector	• Engage with oil/gas organisations and trade bodies
	Donors, international organisations	• Consider building capacity of existing organisations
	Investors	• ESMAP, GVEP, UNDP supported national energy planning processes • IIASA Global Energy Assessment, World Bank under the Clean Energy and Development Investment Framework, IEA • Engage international and local private sectors • Consider engaging with China, given considerable investment in energy infrastructure in Africa

Level	Entry points	Considerations
Regional level	Regional Economic Commissions (RECs) National governments	• Support capacity within RECs eg SADC (some planning under SAPP), ECOWAS (recent energy white paper), EAC etc.
	Research organisations with regional reach	• As above e g ERC Cape Town, ENDA, KITE
	Continental bodies engaged with energy	• FEMA and AFREC focus on energy. NePAD and AU both include energy within their remit.
Fundamental Research		
In support of national / regional action research	Existing/new applied research on energy planning approaches and models	• Research Council funded research, EU's FP7 research programme • IEA • IIASA • Climate impact modelling in Africa (eg research within African and UK universities)
"Global public good" research	Existing/new fundamental research into energy planning and modelling	• Research Council funded research, EU's FP7 research programme • IIASA • Ongoing research within UK universities

5.4 Conclusions and Recommendations

Integrated energy planning has been found to be essential for the medium and long term development of the energy sector in the two countries and one-sub region included within this study. However most current planning processes are short term, and reactive to immediate needs. Where medium/long term planning has been attempted (eg South Africa) it is not found to sufficiently integrate the complex issues, drivers and stakeholders involved, and is insufficiently linked with policy and investment processes. A study of literature and stakeholders in the three case studies highlighted the importance of improved access to energy services, energy security and other drivers including economic growth and competitiveness. Climate change mitigation is not high on the reported list of priorities for energy planning in the case studies; however stakeholders highlighted the need for further consideration of the impacts of climate on energy infrastructure and resources.

Synergies were identified between energy access and energy security in the case studies, although insufficient analysis has been undertaken in these countries to allow for a full understanding of the interactions between drivers. The literature includes some analysis of the interactions between energy security and climate change, although this work is at an early stage and refers almost exclusively to developed economies. The limitations of human capacity and data availability were identified as significant barriers to energy planning in the case studies.

At this stage of the process the views of donors and international organisations have not been sought. However after the reviewing the report DFID may decide that a process of consultation with others who may be engaged with, or wish to be engaged with, research on energy planning in developing countries would be useful. In this case a process of consultation could be undertaken by electronic means, or alongside planned meetings (eg EUEI Advisory Group) with key donors including the World Bank, EU bi-laterals, European Commission etc and relevant international organisations including the IEA, IIASA etc. The purpose of such a consultation would be three-fold: to validate the findings of the scoping study amongst this group of actors; to identify any relevant planned activities; and to identify possible collaboration partners for a new research programme.

This study has clearly identified the essential need for energy planning research, both applied (at national and regional levels) and fundamental research to support improved understanding of the theoretical underpinnings of energy planning in developing economies. A number of research needs are identified, resulting from an analysis of the literature and data collection from the case studies. Research entry points and possible programme structures are suggested, providing options for DFID to consider when commissioning a new research programme on energy planning in developing countries.

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