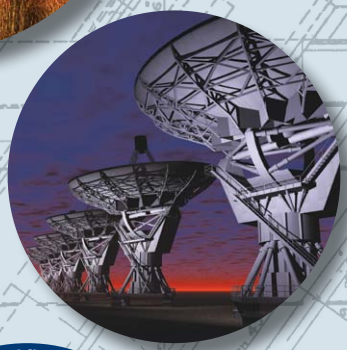

SADC

SOUTHERN AFRICAN DEVELOPMENT COMMUNITY

TOWARDS A COMMON FUTURE

Regional Infrastructure Development Master Plan

Energy Sector Plan

August 2012

Project Title:	**THE SADC REGIONAL INFRASTRUCTURE MASTER PLAN**
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List of Abbreviations & Acronyms

AfDB	African Development Bank
AFD	Agence Française de Développement
ARA	Africa Refiners Association
AICD	Africa Infrastructure Country Diagnostic
AIDS	Acquired Immune Deficiency Syndrome
APPA	African Petroleum Producers Association
AU	African Union
AUC	African Union Commission
bbl/d	billion barrels per day
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
BOT	Build-Operate and Transfer
BTL	Build-Transfer-Lease
CCS	Carbon Capture and Storage
CFL	Compact Fluorescent Lamp
COMESA	Common Market for East and Southern Africa
CTC	Central Transmission Corridor
DAM	Day Ahead Market
DBSA	Development Bank of Southern Africa
DFID	Department for International Development
DOE	Department of Energy
DRC	Democratic Republic of Congo
EAC	East African Community
EC	European Commission
ECOWAS	Economic Community of West African States
ECREEE	ECOWAS Renewable Energy and Energy Efficient Centre
EDM	Electricidade de Moçambique
EE	Energy Efficiency
EECG	Energy, Environment, Computer and Geophysical Applications
ESP	Energy Sector Plan
ESI	Electricity Supply Industry
ESKOM	Electricity Supply Commission of South Africa (now Eskom as word)
ETG	Energy Thematic Group
EU	European Union
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas emissions
GJ	Gigajoules
GTZ	Germany Agency for Technical cooperation
GWh	Gigawatt-hour
HIV	Human Immunodeficiency Virus
HTR	High Temperature Reactor
ICPs	International cooperating Partners
ICT	Information and Communications Technology
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
Ktoe	kilotonnes oil equivalence
LEAP	Long-range Energy Alternative Planning
LEC	Lesotho Electricity Company
LPG	Liquefied Petroleum Gas
LROT	Lease-Rehabilitate- Operate-Transfer
M&E	Monitoring and Evaluation
MDG	Millennium Development Goals
MOU	Memorandum of Understanding
MW	Megawatt
MS	Member States

NEPAD	New Partnership for African Development
NGO	Non-Governmental Organisation
P&G	Petroleum and Gas
PBMR	Pebble Bed Modular Reactor
PCU	Power Conversion Unit
PIDA	Programme for Infrastructure Development in Africa
PPA	Power Purchase Agreement
PPPs	Public Private Partnerships
PV	Photovoltaic
R&D	Research and Development
RE	Renewable Energy
RECs	Regional Economic Communities
REFIT	Renewable Energy Feed In Tariff
REPGA	Regional Petroleum and Gas Association
RERA	Regional Electricity Regulators Association
REASAP	SADC Regional Energy Access Study and Action Plan
RESAP	Renewable Energy Strategy and Action Plan
RIDMP	Regional Infrastructure Development Master Plan
RISDP	Regional Indicative Strategic Development Plan
RPV	Reactor Pressure Vessel
RSA	Republic of South Africa
SA	South Africa
SACU	Southern African Customs Union
SADC	Southern African Development Community
SADC-EAP	
SADC-RESAP	
SAPP	Southern African Power Pool
SAPP-CC	
SASOL	South African Synthetic Oil Limited
SPVs	Special Purpose Vehicles
SWH	Solar Water Heater
Tcf	Trillion cubic feet
TOR	Terms of Reference
UN	United Nations
US	United Sates
WAPP	West Africa Power Pool
WB	World Bank
$	dollar
ZIZABONA	

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Executive Summary

This Energy Sector Plan (ESP) is part of the SADC Regional Infrastructure Development Master Plan (RIDMP) whose aim is to define regional infrastructure requirements and conditions to facilitate the realisation of key infrastructure in the energy, water, transport, tourism, meteorology and telecommunications sectors by 2027. Such infrastructure would enable the SADC region to attain regional integration, economic growth and poverty eradication.

The Terms of Reference required that the ESP covers Electricity, Petroleum and Gas, Coal and Renewable Energy sub-sectors. It was further proposed at a stakeholder meeting held on 22-23rd May, 2012 that sections on nuclear energy, energy efficiency and climate change[1] be included in the ESP. The ESP has also been designed to meet the SADC objectives of regional integration through collaborative infrastructure development, boosting economic development through ensuring energy security, poverty alleviation through increased access to modern energy services, promoting energy investment, and achieving environmental sustainability through addressing aspects of climate change.

The main areas of consideration for the ESP relate to implementation of "hard" infrastructure projects that include electricity generation plants, transmission lines; petroleum and gas refineries, pipelines, storage reserves, coal depots and port facilities, and nuclear demonstration plants. The "soft" interventions entail the required policies/strategies and regulatory frameworks, institutional frameworks and capacity building, financing and cooperation/collaboration arrangements that enable 'hard' projects to be realised.

The energy infrastructure development in the SADC region has been guided by the SADC instruments that include the RISDP, Energy Protocol, Energy cooperating Policy and Strategy and the Activity Plan. The emphasis from these instruments is largely to harmonise national and regional policies and regulatory frameworks, to cooperate in energy development and trading through development of the necessary infrastructure, exploiting the abundant energy resources in the region, particularly hydropower and have co-ordinated planning and institutions. These instruments were all developed before 2001 and are thus outdated and require revision to cater for emerging paradigms of biofuels, energy efficiency and climate change.

The development of the ESP was guided by the challenges that are experienced in the energy sub-sectors of electricity, petroleum and gas, coal and renewable energy, nuclear, and energy efficiency, and climate change. Consideration was also on the changing regional and global energy environment and the newly developed plans (e.g. SAPP Plan 2009) and strategies of SADC, namely the REASAP and RESAP, recent studies on the petroleum and gas sector (REPGA, 2009) and the on-going exploratory efforts for coal and gas in the SADC Member States.

Sectors Status

The highlights are that the SADC region has an electricity deficit that is expected to be met by 2014 if the planned projects are implemented on time. Experience has shown however that there is often a lag in the implementation of planned projects. The region has a low access to electricity of 24% compared to 36% for the East African Power Pool (EAPP) and 44% for the West African Power Pool (WAPP), with some of the SADC countries having below 5% rural access to electricity. Investments

[1] Climate Change strongly suggested by the AfDB

and financing are hampered by a number of barriers, which include low tariffs, poor project preparation, no off-takers that can sign Power Purchasing Agreements (PPAs) under single buyer models and other required policy/regulatory frameworks.

The petroleum and gas sub-sector is plagued by volatile prices and although the region is endowed with some petroleum and gas resources, these are not directly available to the region either due to foreign commitments or the lack of necessary infrastructure to exploit, process, store and distribute throughout the region.

The coal industry so far is the backbone of power generation in the region and a significant share of the resource is earmarked for export. Coal exports are an opportunity that can yield economic benefits to the region if carefully planned so as not to prejudice the local demand. Both mining and transport infrastructure are needed for coal redistribution and export.

The region has a large potential renewable energy estimate which includes hydropower, which is currently being exploited on a commercial scale. However, the necessary infrastructure for grid connection, manufacturing and quality testing is lacking. The prices for most renewable energy technologies are coming down but more needs to be done in the form of innovative financing.

Nuclear technology is included in the electricity sub-sector but what is required is to demonstrate that nuclear can be a safe electricity generation option and winning the confidence of civil society and governments to endorse nuclear energy deployment in the SADC region.

While energy efficiency requires infrastructure to save energy, it largely depends on creating energy efficiency regulatory/legal frameworks, incentive policies and capacity to implement it.

Climate change ought to be incorporated in national development plans to receive adequate attention and to date not much effort is being made to implement agreements that Member States have signed.

Sector Projections and Gap Analysis

For energy demand projections to 2027, three scenarios were developed, where the SADC economy develops at 3%, which is what is considered to be the current expected rate of growth. The region is also expected to grow at 5-6%, if its potential is not constrained, and if the region is to eradicate poverty and achieve the Millennium Development Goals (MDGs), the region should grow at 7-8%.

Projections for energy demand for electricity, petroleum and gas, coal and RE were therefore done at 3%, 5% and 8% and the expected infrastructure requirements estimated. All scenarios were taken forward to guide the necessary preparedness that is required should the region grow at these growth rates without selecting one scenario, as to do so is to presume a particular growth rate. Indications are that SADC has sufficiently planned to meet energy demand for the 3% growth rate but additional preparedness is required if SADC grows at both 5% and 8%.

For electricity where there is an existing regional plan, the deficit was measured with respect to the planned projects as stipulated in the SAPP Plan and country IRPs. For Petroleum and Gas (P&G) and coal the demand is considered in relation to baseline supply/production capacity. For renewable energy, the planned additional capacity is what is required so far to meet the region's renewable energy objectives and is also based on plans by Member States and as proposed in the draft SADC RESAP. Table 1 summarises the gap analysis in terms of the deficits that are expected to occur at the three economic growth rates.

Table 1: Summary of the gap analysis – electricity, petroleum and gas, coal and renewable energy

Electricity	Growth rate	2010	2017	2022	2027
	Generation capacity (TWh)	284	405	448	487
	Generation capacity (GW)	48	69	80	100
	3% (TWh)		349	405	469
	3% (GW)		69	74	86
	5%(TWh)		400	510	651
	55(GW)		72	93	117
	8%(TWh)		487	715	1050
	8%(GW)		85	125	184
Petroleum and gas	Growth rate	2007	2017[2]	2022	2027
Additional capacity of fuel types	Average growth rate baseline				
	Petrol-million kl	4.1	6.2	4.0	4.6
	Diesel-million kl	7.9	6.0	3.8	4.4
	Jet A1-million kl	1.1	2.2	1.5	1.9
	Paraffin-million kl	0.39	0.34	0.21	0.25
	LPG-million tonnes	0.14	0.43	0.35	0.50
	5% petrol-million kl		10.6	7.6	9.7
	Diesel-million kl		10.7	7.7	9.8
	Jet A1-million kl		2.5	1.8	2.3
	Paraffin-million kl		0.60	0.43	0.55
	LPG-tons		0.28	0.20	0.25
	8%-petrol-million kl		19.5	17.0	25.0
	Diesel-million kl		19.8	17.3	25.4
	Jet A1-million kl		4.6	4.0	5.9
	Paraffin-million kl		1.1	1.0	1.4
	LPG-tons		0.51	0.44	0.65
Coal	Growth rate	2010	2017	2022	2027
	Baseline production Mt	259	309	350	397
	3% Mt		321	373	434
	5% Mt		361	451	565
	8% Mt		430	606	861
Renewable energy	Growth rate	2010	2017	2022	2027
	RE capacity additions (MW)		+13 719	+10 345	+8 243

Nuclear energy does not have a separate target other than that which is included in the electricity sector.

The SADC Renewable Energy Strategy and Action Plan (RESAP) proposes reaching electricity savings of 5% by 2015, 10% by 2020 and 15% by 2030 of total electricity in the sectors that use electricity compared to the established baseline. In 2010, SADC managed a saving of 750MW compared to a peak demand of 50GW which was barely 1.5%.

Infrastructure Needs

In addition to the deficit in "hard" infrastructure, there are also shortfalls in the "soft" infrastructure such as a lack of co-ordinated planning, required policy and regulatory frameworks, institutions and capacity requirements, financing and investment.

The ESP is designed to address four key strategic objectives that are paramount in the energy sector of SADC namely, ensuring energy security, improving access to modern energy services, tapping the abundant energy resources and achieving financial investment and environmental sustainability. All

[2] Figures are for ten years i.e. from 2007 to 2017

these strategic objectives collectively contribute to the SADC Energy goal/vision of achieving "adequate, reliable, least cost, environmentally sustainable energy services" for economic growth and poverty eradication.

"Hard" projects have been identified in the context of developing the ESP and these include the planned electricity generation and transmission projects, the refineries, storage facilities and pipelines for petroleum and gas, transport facilities for coal distribution and exports. Most of the RE projects are already included in the ESP.

Investment Requirements

Electricity

Some investment costs have been estimated for all the planned generation projects (Table 2) by considering the known minimum and maximum estimated investment costs per kW.

Table 2: Estimated investment costs for generation projects in SAPP and RSA-IRP

Period	Min US$ billion	Max US$ billion	Average US$ billion
2012-2017	41	83	62
2018-2022	26	52	39
2023-2027	46	98	72
Total	114	233	174

The total estimated cost of electricity generation is a minimum of US$114 billion and a maximum of US$233 billion between 2012 and 2027. The related transmission investment costs to support new generation capacity are in the region of US$540 million. This transmission investment does not include planned transmission interconnectors and national backbone lines.

SADC/SAPP has prioritised some generation and transmission projects using a SAPP agreed criteria and the list of both generation and transmission projects prioritised are presented in Appendix 1. Generation projects that scored above 50% with capacity greater than 1 000 MW were estimated in this study to cost a minimum of US$65 billion and a maximum of US$104 billion. Those projects that scored above 50% with a capacity of less than 1 000 MW were estimated to cost a minimum of US$7 billion and a maximum of US$18 billion. The total cost of the prioritised projects (>50% score) would range from US$42 billion to US$122 billion. The planned projects that scored below a 50% score of various sizes would cost a minimum of US$50 billion and a maximum of US$90 billion. The grand total of all these projects to be implemented from 2015 to 2027 would cost in the region of US$93 billion to US$212 billion, which is close to the budget for all the planned projects (Table 3).

Table 3: SAPP prioritised projects 2015 – 2027

Generation projects	**Min US$ million**	**Max US$ million**	**Period**
>50% & capacity >1000MW	4 845	12 155	2017
	5 920	17 760	2022
	24 735	74 140	2027
Subtotal	35 500	104 055	2015 – 2027
>50% score and <1 000MW	5 134	12 251	2017
	1 305	3 915	2022
	543	1 629	2027
Subtotal	6 982	17 795	2015 – 2027
Total >50%	42 482	121 850	2015 – 2027
<50% score	50 392	89 964	2015 – 2027
Grand total	**92 873**	**211 814**	**2015 – 2027**

SAPP has earmarked eleven priority transmission projects but only 5 have been "costed" totalling about US$3 billion and these are Zimbabwe/Zambia/Botswana/Namibia (ZIZABONA) (US$225 million), Zimbabwe Central Transmission Corridor (US$100 million), Zambia/Tanzania and Kenya Interconnector (US$860 million) and Mozambique Transmission Backbone Project (US$1700 million). All these projects with cost estimates are expected to be accomplished by 2017.

The Programme for Infrastructure Development in Africa (PIDA) Priority Action Plan up to 2020 for projects that affect SADC countries amount to US$28.5 billion. These projects include four generation plants namely Mpanda-Nkuwa Hydropower Plant in Mozambique (1 500 MW), the INGA III Hydro in DRC (4 200 MW), the Batoka Hydro-electric Plant on the Zambezi River (1 600 MW) and the Lesotho Highlands Water Project Phase II hydropower component (unspecified capacity); and two transmission lines, the North-South Power Transmission Corridor (8 000 km) and the Central African Interconnection (3 800 km). The transmission lines extend beyond the SADC region but the involved countries would participate in the sections of the transmission lines that pass through their countries.

Petroleum and Gas

For the planned refineries in South Africa, Mozambique and Angola investment costs were estimated to range from US$1 billion to US$5 billion based on global investment costs per bbl/day unit costs. More work is needed to develop the refinery, pipeline and storage facility projects so that a reliable estimate can be made.

Coal

Projects that are being promoted for rail and ports in Mozambique (Techobanine) and Namibia (Trans Kalahari railway to Walvis Bay) that are intended for coal exports as well, the estimates provided are US$7 billion and US$9 billion respectively. These will probably be better reflected in the transport sector plan.

Renewable Energy

The renewable energy projects to be connected to the grid have already been identified and are part of the SAPP Plan and SAPP Priority Projects. What is needed is largely "soft" infrastructure to enable the projects to be implemented.

Nuclear Energy

Nuclear is considered important in contributing to electricity generation. The full SAPP and IRP projects contain some of the nuclear projects to be deployed in 2023. Nuclear, however, faces opposition due to potential environmental and safety concerns, particularly related to plant disasters and safe storage of nuclear waste. The projects being proposed here relate to making a demonstration plant employing the newly developed Pebble Bed Modular technology and documenting safe nuclear waste disposal methods that can be audited. This will be accompanied by developing a nuclear disaster management scheme and creating awareness on the feasibility and plausibility of nuclear energy.

Energy Efficiency

Some gains have been realised in deploying energy efficiency and conservation measures particularly in relation to avoided electricity generation. Projects proposed relate legal/regulatory frameworks to ensure that adopted measures can be sustainable, creating incentives and energy management schemes and capacity building.

Climate Change

Projects proposed under climate change relate to developing a low carbon development path e.g. by ensuring that clean energy projects benefit from carbon revenue. The other project is developing a climate change impact monitoring framework and related adaptation measures on the energy resources and infrastructure.

Both low carbon development path and impact assessment and adaptation frameworks ought to be in national development plans in order to be implemented.

Strategic Priority Goals

Table 4 summarises the proposed strategic priority goals for electricity, petroleum and gas, coal and RE for the ESP in order to realise investments in the "hard" projects. These priority goals are supported by the actual actions/activities that will be taken to achieve these priority goals. The activities are elaborated on in the body of the report.

Table 4: Strategic priority goals proposed for the ESP to address the energy infrastructure gaps

Electricity priority goals	P&G priority goals	Coal priority goals	RE priority goals
Adequate generation and transmission capacity	Joint exploration, development of trans-boundary petroleum and gas infrastructure (refineries, pipelines, storage facilities)	Adequate coal production, adequate distribution network and well-designed stock facilities	Exploited abundant renewable energy resources increasing clean energy in the generation mix and also contributing to clean energy access
Improved energy access	Joint procurement of petroleum products	Planning and application of clean coal technologies	Regional manufacturing of RE products
Harmonised cross border policy and regulatory frameworks	Harmonised policies, regulations and legislation to facilitate cross border trade and improve capacity utilisation	Coordinated planning with mining and transport sector for production and delivery of coal	Adequate grid capacity for connection of RE plants
Strong SADC institutions with a stronger mandate	Co-ordinated planning of trans-boundary oil and gas systems	Regional coal development and export strategy	Dedicated institutional framework for RE/EE
Centralised planning	Dedicated institution for petroleum and gas planning	Co-ordinating institutional arrangements	R&D and testing facilities for RE
Investment and financing plan			

The priority goals for nuclear energy efficiency and climate change have also been added in Table 5.

Table 5: Priority goals for nuclear energy, energy efficiency and climate change

Nuclear	Energy efficiency	Climate change
Demonstration plant of Pebble Bed Modular Plant	Putting appropriate laws for adoption of energy efficiency e.g. making energy audits mandatory; banning production and retailing of incandescent lamps.	Inclusion of climate change in national development plans, low carbon development path and adaptation measures
Documentation of safe nuclear waste	Reward policies for energy efficiency and energy conservation	Ensuring that clean energy infrastructure projects include carbon revenue element
Development of a disaster management scheme for nuclear plant disaster	Developing energy management schemes in member states	Developing an impact assessment framework for energy infrastructure projects and related adaptation measures
Creating an awareness campaign to educate civil society on the feasibility and plausibility of deploying nuclear energy in the region.		

Sources of Finance

The ESP should exploit the various financing options that exist.

The conventional source of funding for infrastructure in the Member States is public funding in the form of national budgets and this is considered important in delivering the needed energy infrastructure including both "hard" and "soft" types.

Private sector participation in the form of Build-Operate-Transfer (BOT), Build-Own-Operate (BOO), Build-Own-Operate-and-Transfer (BOOT) and Public Private Partnerships (PPP) are feasible modes of financing large infrastructure projects. These sources qualify for all the energy sub-sectors. Lately, infrastructure bonds and pension funds have been mobilised to finance infrastructure projects or leverage more financing from other sources such as commercial banks or multilateral banks such as the European Investment Bank, World Bank and AfDB. Utilities should also use their balance sheets to borrow from the banks for their equity share. Close cooperation with the emerging economies of China, India and Brazil will also yield new financial resources.

The International cooperating Partners (ICPs) have been a major source of financing "soft" projects such as studies, policy/regulatory framework formulations, planning and capacity building projects. Their resources can also be used to leverage financing from the banks. The soft projects that are presented in Table 2 will need to be implemented in the short term to facilitate implementation of the physical projects. The costs of implementing these strategic options will be determined on a case by case basis. PIDA estimates that project preparation costs about 7% of the investment costs, which collectively would cost about US$18 billion when all the estimated projects are to be prepared for funding.

Project preparation can be co-ordinated through a project development fund such as the NEPAD Infrastructure Project Preparation Fund and DBSA support.

Tapping into climate funds should be considered and therefore capacity developed to access innovative financing mechanisms.

Monitoring and Evaluation Framework

A Monitoring and Evaluation framework has been presented to monitor implementation of the strategic interventions proposed, and implementation of projects to deliver modern energy services for economic growth and poverty eradication.

The M&E framework consists of high level indicators to show if the ESP is delivering on the priority goals and also project management indicators that will be used as checklist on the activities that are to be executed.

Critical Factors for Success

The following factors are considered critical for the successful implementation of the ESP:

- Member States' commitment to support regional initiatives and to allocate resources for that purpose;
- Capacity for project preparation and implementation at utility and Member States level;
- Demand for energy services to sustain growth in the energy sector;
- Financial sustainability for continued sector development;

- Strength of SADC institutions to co-ordinate the energy sector activities in the region; and
- Updating of the plans to ensure that the ESP remains relevant to the circumstances of the time.

Way forward

This has provided specific actions that need to be taken to address the identified challenges in each sub-sector, stipulating the responsibility and timeline.

1. Introduction

1.1 Sector Purpose and Objectives

1.1.1 Sector Purpose

This Energy Sector Plan (ESP) presents the findings of the Regional Infrastructure Development Master Plan (RIDMP) Study as it relates to the energy sector. The ESP covers electricity, petroleum and gas, coal, renewable energy, nuclear energy and energy efficiency sub-sectors covering both the regional (SADC) and Member States perspectives. The ESP aims to meet the SADC objectives of ensuring regional integration through collaborative infrastructure development, boosting economic development through establishing energy security, poverty alleviation through increased access to modern energy services, creating an environment conducive to energy investment and achieving environmental sustainability through addressing aspects of climate change.

The main areas of consideration for the ESP are related to the implementation of "hard" infrastructure projects such as electricity generation plants, transmission lines; petroleum and gas refineries, pipelines, storage reserves, etc. and "soft" interventions, which entail the required policies/strategies and regulatory frameworks, institutional frameworks and capacity building, financing and cooperation/collaboration arrangements that enable "hard" projects to be realised.

The duration of the ESP in accordance with the RIDMP is for 15 years from 2012 to 2027. The deployment of projects has been divided into short-, medium- and long-term periods spanning five years to 2017, 2022 and 2027 respectively.

1.1.2 Study Objective

The main objectives of the study in relation to the energy sector are to:

- Review the current energy supply-demand balance and future projections up to 2027;
- Assess the effectiveness and adequacy of the SADC energy policies/strategies and regulatory frameworks, institutional frameworks, capacity and financing opportunities to support energy infrastructure development; and
- Propose deployment of both 'hard' and 'soft' infrastructure to meet SADC energy vision and strategic and priority goals.

Specific objectives were to:

- Analyse the energy enabling environment as stipulated in SADC instruments;
- Analyse the situation in each of the energy sub-sectors of electricity, petroleum and gas, coal, renewable energy, nuclear, energy efficiency and aspects of climate change;
- Analyse the development internationally, regionally and at Member State level in terms of how they influence development of the ESP;
- Develop demand projections for each sub-sector and supply options to meet demand in the periods to 2017, 2022 and 2027;
- Undertake gap analysis in terms of what 'hard' and 'soft' projects will be required to meet energy demand by 2027;
- Develop a strategic framework with vision, strategic and priority goals, required policy and regulatory environment, institutional arrangements, projects and other interventions to meet the priority goals in each sub-sector;

- Develop an implementation plan with an action plan, implementation modalities, milestones and key steps, monitoring and evaluation framework and critical factors for success; and
- Present the way forward in terms of what needs to be done for the ESP to be implemented and yield the desired results.

1.2 Policy/Legal Basis Guiding the Energy Sector

The SADC Treaty sets the SADC agenda and is built on the premise of creating an enabling environment for economic cooperation among SADC Member States. The main focus of the Treaty is on greater regional integration with the principle of promoting economic development, creating political stability and eradicating poverty in the region. On energy aspects, the Treaty is supported by sector governance instruments including the Regional Strategic Development Plan (RISDP), the Energy Protocol, Energy Sector cooperation Policy and Strategy and the Activity Plan, which outline the region's strategic development priorities for the energy sector.

These instruments have been assessed on how they address the energy sub-sectors of electricity, petroleum and gas, coal, nuclear energy, renewable energy and energy efficiency.

1.2.1 Governance Instruments

1.2.1.1 Electricity Sub-sector

The SADC instruments statements of purpose on the electricity sub-sector are summarised in Table 1.1.

Table 1-1: Summarised objectives of SADC energy instruments for the electricity sector

RISDP objectives	Energy protocol	cooperation policy/strategy/charter	Activity plan
Energy security Access for rural needs and development	Harmonise national and regional policies cooperate in development of energy and energy pooling R&D for low cost technologies	Effective power system management Extensive use of hydropower resources Commercialisation of public utilities Power interconnections to improve reliability and security of supply	Electricity associations Harmonisation of policies, laws and regulations Investment for regional interconnectors, hydropower development Energy planning infrastructure

The RISDP emphasises energy security and access to energy services to meet rural energy needs and development.

The other energy instruments aim for the following in the electricity sub-sector infrastructure development:

- "Hard" infrastructure:
  - Exploiting and developing the huge hydropower resources in the region; and
  - Developing regional interconnectors and hence energy pooling to improve reliability and security of supply.

- "Soft" infrastructure
  - Harmonised policies;
  - cooperation in energy development and trading;
  - Electricity planning; and
  - Institutional associations.

1.2.1.2 Petroleum and Gas

Table 1.2 below summarises the objectives for the petroleum and gas (P&G) sectors as stipulated in the RISDP, SADC Energy Protocol, cooperation Policy and Strategy and Activity Plan.

The RISDP promotes joint exploration and development of resources and the harmonisation of policies, regulations and legislation to facilitate cross-border trade, improve capacity utilisation and cooperation in the joint procurement of petroleum products on the world market

Table 1-2: Summarised objectives of SADC energy instruments for the P&G sector

RISDP objectives	Energy protocol	Cooperation policy/strategy/charter	Activity plan
Promote joint exploration and development of resources and the harmonisation of policies, regulations and legislation to facilitate cross-border trade. Improve capacity utilisation and cooperation in the joint procurement of petroleum products on the world market.	Promote cooperation in the development of all aspects of the Region's petroleum and natural gas resources[3] and their use. Create an enabling legal and fiscal environment to facilitate cross-border trade and transport of petroleum and natural gas	**Oil** • Procurement and responsibility for supply routes, transport and cross-border pipelines, • Refinery operational efficiency, location and capacity for least cost supplies • Competitive markets creation • Policies-fiscal, investment, pricing • Laws and Rules • Standards specifications • Regulation environment protection and safety **Gas** • Pipeline development through policy, legislation, regulatory and fiscal incentives • Lowest cost pipeline routes • Technical specifications for gas pipelines • Development of gas industry	Harmonisation of petroleum sector policies, regulations and legislation; Regional petroleum sector training; Establishment of the Regional petroleum and gas association; Coal bed methane investigation and promotion.

The other SADC instruments aim for the following in the petroleum and gas sector:

- "Hard" infrastructure
  - Develop strategically located refineries, storage and distribution facilities, and pipelines for both crude/white products and natural gas.

- "Soft" infrastructure
  - Form a Regional petroleum and gas association and training to co-ordinate the activities of the P&G activities in the region;
  - cooperate in petroleum and gas resource development and use;
  - Establish legal and fiscal environment for cross-border trade and transportation of petroleum and gas products;

[3] Coal bed methane is also of significance

- Create strong oil and gas markets, and harmonised policies, laws/rules, regulation and standards, including technical specifications of products; and
- Investigate coal bed methane as an energy source.

1.2.1.3 Coal

The existing SADC instruments do not address coal as an energy source. However, the objectives that could be applicable to coal are summarised in the Table 1.3 below. The objectives of the SADC instruments on coal are general and apply to the other sub-sectors as well. Those selected in Table 1.3 could cater for development of clean coal technologies, environmental standards when exploiting and utilising coal, and planning the related infrastructure which tends to be in conjunction with the transport and mining sectors.

Table 1-3: Summarised objectives of the SADC energy instruments for the coal sector

RISDP objectives	Energy protocol	Cooperation policy/ strategy/charter	Activity plan
Energy security access for rural needs and development	Harmonise national and regional policies R&D for low cost technologies	Development of joint rail transport for coal export to international markets Development of dry ports to facilitate coal exports from landlocked member states.	Harmonisation of policies, laws and regulations Energy planning infrastructure

1.2.1.4 Renewable Energy

The objectives stipulated in the RISDP, Protocol, policies/strategy, SADC Energy Protocol and Activity Plan that may cater for Renewable Energy (RE) are summarised in Table 1.4. It should be noted that the SADC instruments do not adequately cater for renewable energy, apart from the focus on the hydropower resource development and use. The rest are similar to the other sub-sectors.

Table 1-4: Summarised objectives of the SADC energy instruments for the RE sector

RISDP objectives	Energy protocol	Cooperation policy/strategy/charter	Activity plan
Energy security access for rural needs and development	Harmonise national and regional policies Cooperate in the development of energy and energy pooling R&D for low cost technologies	Effective power system management Extensive use of hydropower resources	Harmonisation of policies, laws and regulations Investment for regional interconnectors, hydropower development Energy planning infrastructure

Apart from the existence of energy policies and to some limited extent renewable energy policy in all SADC Member States, comprehensive RE strategies and action plans do not exist except in Mauritius and South Africa. Botswana, Mauritius and South Africa have put renewable energy electrification targets into their energy systems. In addition, Mauritius, Zambia and Swaziland have proposed blending ratios for biofuels. Only two countries (South Africa and Namibia) have a renewable energy regulatory framework. Five countries (Botswana, Mozambique, Tanzania, Zambia and Zimbabwe) have integrated the deployment of renewable energy in their rural energy/electrification agencies.

1.2.1.5 Nuclear Energy and Energy Efficiency

Aspects of nuclear energy as they pertain to infrastructure development are covered under those of the electricity sub-sector. Table 1.5 provides a summary of how energy efficiency and conversation issues are addressed in SADC's policy framework.

Table 1-5: Summarised objectives of the SADC instruments for energy efficiency and conservation

RISDP objectives	Energy protocol	Cooperation policy/strategy/ charter	Activity plan
Cooperate in the development and utilisation of energy in the region in the energy efficiency and conservation subsector.	Establishment of sub-committees on energy efficiency and conservation Involve utilities and other energy providers in energy efficiency schemes	Effective energy utilisation	Encourage the development of national energy efficiency and conservation plans; training opportunities Target reduction in commercial energy intensity Promote demand side management Utilise pricing as an instrument of energy efficiency and conservation; and Identify and minimise constraints for more efficient use of energy.

1.2.1.6 Climate Change

There is nothing in the SADC instruments related to the effect of energy on climate change, as these instruments were developed long before climate change was an issue. However, climate change is loosely referred to in the RISDP on its potential impact on social and human development. The potential impact of climate change on regional infrastructure is not addressed at all in the SADC instruments.

2. Situation Analysis

The situational analysis is largely based on the Diagnostic Report where the details of each energy sub-sector have been presented. In this ESP, the situational analysis only highlights the issues that need to be addressed by the strategic framework in support of availing adequate, least cost and environmentally sustainable energy services as per the SADC energy vision/goal.

2.1 Current Sector Status

The current sector status for each of the sub-sectors of electricity, petroleum and gas, coal and renewable energy are presented below based on the provided Terms of Reference. In addition, the status of nuclear, energy efficiency/energy conservation and climate change are also included as requested at stakeholder workshops.

2.1.1 Electricity Sub-sector

There are many sources of electricity production in the SADC region, namely hydropower, coal, nuclear, natural gas and the distillate/diesel-based power generation.

The SADC generation mix is dominated by coal, which in 2010 accounted for 74.3% of the energy mix, hydro 20.1%, nuclear 4% and diesel 1.6%. To date, medium- to large-scale renewable energy projects from wind and solar (concentrated solar power) are still being deployed for power generation. So far, the development of these technologies is rather slow and their contribution to the generation mix is very small. South Africa is the only country in SADC that produces electricity from nuclear technology.

2.1.1.1 Status

The focus for the region in the electricity subsector is to connect all twelve (12) mainland Member States to the regional grid, to install adequate generation and transmission capacity to meet the forecasted demands and to increase access to electricity, based on least cost project options. Currently, three of the SADC Member States on the mainland namely; Angola, Malawi and Tanzania; are not yet connected to the SAPP grid.

The region is currently facing a critical shortage of power and this situation is expected to persist until the year 2014. As of May 2011, the region had a total installed capacity of 56 GW out of which 50 GW was available. According to the forecast, peak loads are expected to rise to 77 GW by 2020 and 115 GW in 2030. The supply/demand situation reflects a deficit and commissioning of new generation capacity is lagging behind the target schedule.

The SAPP Plan shows that the whole SADC region has a supply deficit of 608 MW and the SAPP interconnection grid has a deficit of 204 MW. The supply deficit however varies by country and is most significant in Zimbabwe (-994 MW) and Zambia (-548 MW) while only South Africa (625 MW) and Mozambique (1 632 MW) had excess capacity. In 2010, nearly 1 300 MW could not be commissioned as was targeted.

Transmission interconnectors are required to strengthen in-country power evacuation, cross-border links within SADC and also the interconnectors linking SAPP with other Regional pools such as the East Africa Power Pool (EAPP). The transmission systems are currently weak and in most cases inadequate. This state of affairs is adversely affecting cross-border power trading. Under the SAPP Day Ahead Market (DAM) trading platform, transmission constraints have been limiting trading by between 40-50% of what could have been traded on a daily basis if there was sufficient transmission

capacity. There is a need, therefore, to ensure that the planned generation capacity is matched with adequate transmission capacity in order to evacuate power to demand centres via efficient high voltage transmission lines.

The access to electricity is still limited in the region as seen by the low access to electricity in rural areas of the SADC Member States. Access in these areas is below 30% for eight of the 12 SADC States on the mainland. In comparison to other Regional Economic Communities (RECS), SAPP's access to electricity at 24% lags behind that of EAPP (36%) and the West Africa Power Pool (WAPP) (44%)[4].

These circumstances dictate the electricity infrastructure that is needed for the region. There are a number of projects already planned for the SADC region to increase generation capacity, improve interconnection and thereby trade, but there are some implementation challenges. Major challenges have resulted in delays in commissioning projects, largely due to failure to prepare bankable projects and to secure funding for both project preparation and implementation. The failure is also linked to a lack of legal and regulatory frameworks in some countries and non-cost reflective tariffs which do not attract investors. As a result, the SAPP remains largely unimplemented and therefore, though generation and transmission projects have been identified and prioritised, completion dates continue to be moved forward. The resultant situation is that there has been virtually no significant new project implementation in the last 10-20 years in the region due to financial constraints.

A number of challenges have been identified in the electricity sector and these are elaborated on in Box 1 below.

Box 1: Challenges in the electricity sector

Challenge	Elaboration
National interests overriding the regional planning	There is a tendency by utilities to plan independently, disregarding regionally co-ordinated planning. There is also no clear endorsement of regional projects by SADC governments and of the implementation of the SAPP Plan in general. Lessons can be learnt from ECOWAS where governments sign-off projects for the WAPP before implementation.
Tariff gap (non-cost reflective tariffs)	Currently tariffs for most utilities do not reflect costs of supply[5]. SADC Member States have agreed on a five-year plan to introduce cost reflective tariffs in the region, but that has not been achieved. Member States would also require that utilities operate efficiently (e.g. ensuring collection of revenue, servicing of equipment and avoiding power theft) prior to introduction of cost reflective tariffs.
Lack of project preparation capacity	Project preparation capacity is limited, resulting in most projects being technically feasible but not being structured or documented in such a way to attract investment.
Lack of credible off takers/PPAs to underpin projects	The region has been banking on Eskom to purchase power, as most projects are too big for a single country except for South Africa. On the other hand Eskom also has its Integrated Resource Plan (IRP) to implement and has thus not been able to sign PPAs for most projects floated in the region. An option is to assess the potential of large electricity users, such as mines and large industries, to underwrite projects for implementation. PPA negotiations take long and currently there are no guidelines for PPA agreements precipitating some form of standardisation.
Too many levels of planning (at utility, national and regional levels)	Planning for projects occurs at utility, Member States and SAPP levels which often lack co-ordination to give priority to regional projects of importance. National IRPs take precedence over SAPP in terms of the focus of Member States.

[4] PIDA Phase III Report Energy
[5] Including costs that cater for replacement of assets at end of useful life

Lack of competitive industry/market structures at national level (single buyer model)	There is no regulatory framework that encourages competition especially for off-takers. Although Electricity Acts have been revised to allow for Independent Power Producers (IPPs), the single buyer model whereby the utility is the buyer is still prevalent. If the utility is not able to absorb the generated power, then often the project has no market to sell the power and hence no financing
Weak regulatory framework(s)	Member States have different regulatory environments therefore presenting a challenge for cross-border projects and electricity trading. There is also no clarity on cost pass through. The Regional Electricity Regulator Association (RERA) now has cross-border regulatory guidelines that can support development of the regulatory frameworks.
Lack of policies including policy implementation mechanisms	Certain policies necessary to effectively support electricity infrastructure development do not exist e.g. on tariff setting and where policies exist some are not fully being implemented e.g. commercialisation of utilities.
Weak project sponsors/developers balance sheet	Utilities themselves are not credit worthy and would not qualify to borrow as their balance sheets are weak. An exercise to rate utilities in the region indicated that three out of the nine utilities can be considered credit worthy. Utilities and IPPs are also not able to finance their equity, partly due to poor revenue inflow or inability to raise equity.
Uncoordinated fund raising	There is no standing plan for raising funds for projects in the region. A few investors' conferences have been organised but these are organised on an irregular basis. SADC mobilises funding as part of its mandate but Member States also raise funding to implement their own IRPs. The projects being developed at Member States level will have a regional impact hence qualifying for co-ordinated fund raising.
Electricity markets in some countries are small relative to sizes of projects to be developed in those countries	Projects being promoted in most SADC countries produce power that cannot be absorbed in the originating country due to small demand. In that case those projects can only go ahead if there is a guaranteed market in the other SADC countries - thereby creating a large market and justifying investment in the region.
Risk allocation	Preparation of projects demands a substantial allocation of financial resources to reach a point of financial closure and often this is not planned for and hence projects experience significant delays in reaching implementation.
Currency indexing	The major off-taker, Eskom, pegs its currency in Rands but other Member States use the US$ for sourcing and pegging charges. This presents risks to generators, transmitters and off-takers.
Weak capacity of the regional institutions relative to challenges and mandates	The demands on the SADC Energy Division, SAPP and RERA are high in comparison to what their limited staff compliments can manage and this also affects the pace at which projects can be driven and co-ordinated.

Some of these challenges have guided the crafting of the projects and interventions of this strategic framework.

2.1.2 Petroleum and Gas

2.1.2.1 Status

The SADC region is a net importer of petroleum products and this has an impact on the import bill and subsequent budgetary implications for most Member States. However, reserves of crude oil and natural gas are found in some Member States, the bulk of which are in Angola. The petroleum products are either imported or produced by refineries in the region that are only found in Angola, South Africa and Zambia.

Although the region is endowed with large reserves of oil (in excess of 5.5 billion barrels, 96% in Angola) and is producing crude oil e.g. Angola (1.25 million bbl/day), South Africa (215 bbl/day) and DRC (20 bbl/day); Member States still have to import most of the refined products due to limited refinery capacity in the region. Currently the largest oil refineries in the region are in South Africa (SA), which has four refineries with a combined distillation capacity of 504 547 bbl/day. The other refineries are found in few other SADC countries and are either small, old or have been mothballed. Member States with refineries are Angola (39 000 bbl/day), Madagascar (15 000 bbl/day) and

Zambia (23 750 bbl/day). The refineries in Tanzania (14 900 bbl/day[6]) and the one in Zimbabwe were mothballed. Small refineries are uneconomical and since economies of scale are required for refineries to be viable, a regional refinery hub would be desirable. The Lobito refinery (200 000 bbl/day) in Angola, proposed for joint investment in the SADC region was expected to start operating in 2009 but is not yet operational.

In relation to issues on gas, the SADC region is known to contain 9.1 trillion cubic feet (Tcf) of proven natural gas reserves constituting 1.9% of Africa's natural gas reserves. The natural gas resource has been realised in Angola (1.6 Tcf as associated gas), Mozambique (4.5 Tcf), Namibia (2.2 Tcf), Tanzania (0.8 Tcf) and DRC (0.035 Tcf). Botswana is exploring for coal bed methane and is estimated to contain in excess[7] of 12.8 Tcf of coal bed methane (Energy Information Administration[8], June 2006).

There is also limited cross-border pipeline for transporting oil products from ports. Most of the refined petroleum products are carried by road and rail to demand centres in the hinterland of the SADC region. Only a few cross-border pipelines are in operation in the region among them, the Tazama pipeline that transports crude oil from Dar-es-Salaam to the Indeni Refinery in Zambia. This is an example of government to government joint investment by Zambia (67%) and Tanzania (33%). The Mozambique-Zimbabwe Petrozim Petroleum Products Pipeline runs from the port of Beira in Mozambique through Feruka (Zimbabwe) to Msasa located near Harare. Zimbabwe imports 80% of its petroleum through the pipeline. Zimbabwe is planning to construct an additional oil-product pipeline from Beira to Msasa to help meet its oil demand.

For natural gas, there is a Mozambique-South Africa gas pipeline along the Maputo Corridor which is a PPP between the governments of South Africa and Mozambique and Sasol of South Africa and was built under a cross-border agreement.

A number of key challenges and opportunities have been mapped for the petroleum and gas sub-sector as part of this study, as summarised in Box 2.

Box 2: Challenges identified in the petroleum and gas (P&G) sub-sector

Challenge	Elaboration
Inadequacy of the refining capacity	Size of refineries cannot meet the demand for white petroleum products in the region hence Member States resort to importing white petroleum products at exorbitant prices.
Inability to refine crude oil from within the SADC region	Crude oil from Angola would require more specialised refinery technology than what is available in the region and yet that is the source of 96% of the crude oil produced in the SADC region.
Old refineries	Countries have tried small refinery plants but they are uneconomical and now old, with low quality specifications for products produced. Some of these old refineries have been mothballed.

[6] Tiper Refinery is mothballed
[7] The total resource estimate is put at 196Tcf with about 40Tcf recoverable
[8] www.eia.doe.gov

Need for pipeline network infrastructure connecting SADC countries	There are only a few pipelines and some were dictated by politics e.g. the Tazama but no comprehensive planning has been done to cater for the needs of the region. Transportation of petroleum by road and rail costs more than by pipeline.
Unascertained suppressed demand	Planning data is largely in the hands of the private sector, although governments collect levels of supply and consumption data. Without comprehensive data analysis it may not be clear whether supply is only meeting limited demand and not being able to assess the unsuppressed demand for petroleum and gas products.
Lack of a study to analyse the costs and benefits of importing refined oil products against refining regional crude oil	While it would make sense to refine crude oil produced in the region and create employment within the region, it needs to be established whether this is more cost-effective than importing white petroleum products.
Lack of readily available and reliable data on P&G	Similar to 5 above, but also that there is no clear co-ordinated collection of P&G data for use for planning. Some P&G associations, such as SAPIA keep data, but that data may also not be easily accessible for planning purposes at a regional level.
Long-term export commitments of some of the crude oil produced in the SADC region	Since the P&G sub-sector is largely driven by the private sector, often the countries that produce oil have surrendered the rights to produce and export to the private companies that explore and produce the oil. These countries have long-term export commitments and if SADC would like to refine and sell oil in the region crude oil may not be available.
Synergising gas and electricity	There is huge potential for electricity generation from gas but the limitation is making the gas available where electricity is being produced. Co-ordinated planning is required to ensure that gas projects also target the electricity industry. Globally gas is increasingly being considered for power production as it is less polluting in terms of greenhouse gas emissions than coal. Other challenges are the pricing of gas in the region, which tends to be pegged in foreign currency.
Lack of gas dispatching infrastructure	While a number of prolific discoveries have been made in the region, there is limited pipeline and storage infrastructure to bring the gas to market.
Lack of a gas regional plan in light of regional gas discoveries	A comprehensive plan for gas exploitation, supply and distribution similar to SAPP is lacking and that plan would be useful in guiding how the gas resources in the region could be deployed to meet the energy needs of the region in a cost-effective manner.
Weak P&G institutional framework	Institutions similar to SAPP and RERA for the P&G sub-sector are lacking at SADC level although national institutions may exist in the form of national oil companies. The Regional Petroleum and Gas Association (REPGA) that was to be created to cater for the P&G sub-sector could not be funded and in the interim was substituted by a Committee but it has no budget and has not functioned effectively to date.
Lack of well-established P&G utilities along the lines of power utilities	National oil companies are facing the challenges of maintaining efficient supply of petroleum products and that also constrains co-ordinated regional planning of the sector.
Weak regulatory framework (regulated in some countries by governments and in others by regulators)	Formulation of energy regulators will address this challenge but at the moment emphasis of regulators has been on electricity although the situation is changing to encompass all energy sub-sectors and sometimes water.
P&G sector largely driven by private sector	In some countries, for example the majority of SACU countries, the private sector dominates exploration, production, supply and distribution of P&G products. This hampers co-ordinated regional planning for the sector by Member States and SADC institutions

2.1.3 Coal

2.1.3.1 Status

There are large coal reserves in South Africa, Botswana, Zimbabwe and Swaziland and more recently also Mozambique in the order of billions. The proven coal reserves are about 32 billion proven reserves and the estimated resources are even more than ten times that figure.

Current production and consumption is below 1% of those reserves. SADC coal production levels in 2009 amounted to 253 million tonnes, compared to consumption of 186 million tonnes and exports 67 million tonnes are such that coal will still be available for the next 100 years basing on proven reserves and 1 000 years basing on estimated resources. The challenge is to continue using the coal e.g. for electricity generation in the face of global pressure to reduce global warming and climate change.

Coal production in the region has been dominated by South Africa (247 million tonnes/year), Zimbabwe (3.75 million tonnes/year) and Botswana (1.035 million tonnes /year), largely for electricity generation. Other coal producing countries, albeit at much lower rates (<0.5 million tonnes), are Swaziland, Zambia, DRC, Malawi, Tanzania and Mozambique. Mozambique is becoming a large coal producer for supplying its own coal power stations in the Tete region and also for exporting.

The coal produced in coal producing countries, apart from export, is largely used for electricity generation, 61% in South Africa and close to 100% in Botswana and Zimbabwe. In South Africa about 24% is used in synthetic fuels (Sasol), 12% in industry, 3% in the domestic sector and a negligible 0.03% in the mining sector.

Coal in the region is also offering opportunities for foreign earnings through export, e.g. to fast growing economies like China and India. For countries in the hinterland such as Botswana and Zimbabwe the limitation is the infrastructure to transport the coal to the coast and also having adequate facilities for stockpiling. Even for Mozambique that has recently started exploiting coal in its Tete region, there is demand for infrastructure for the coal to reach other demand centres in the south of the country and also ports for export. New ports are needed to accommodate coal export and there are plans to develop the Techobanine Port 70 km south of Maputo to accommodate Mozambique and Botswana coal exports. Botswana is also exploring the installation of a dry port at Walvis Bay to handle its commodities including coal. Rail transport is the cost-effective inland mode of transport that would make coal export competitive, for example the rail service for coal to Richards Bay is as low as US$0.01/t/km. In comparison, road transport can be five to 15 times this cost.

To a large extent the physical infrastructure required for coal is either cross-sectoral with mining or transport and hence demand that planning be co-ordinated with those sectors. The challenges for the coal sector are summarised in Box 3 below.

Box 3: Challenges identified in the coal sub-sector

Challenge	Elaboration
High dependence on rail transportation systems with old infrastructure and limited capacity	The opportunity to export part of abundant coal resources has always been there but for countries in the hinterland that is limited by lack of cheap transport such as rail. If transport costs are high then exporting coal is not competitive. So far the rail system is plagued with old equipment and poor management and thus coal cannot be competitively exported. Transport costs also affect even coal trade within the region- as there are times when some countries may not be able to mine their own coal. Zimbabwe is an example when its dragline was not functioning. The

	opportunity would have been there to import coal from nearby Botswana.
High costs of transportation, especially for road transportation	Similar to the above, except that road transport seems to be more reliable even for the transportation of petroleum products. The costs are, however, much higher when compared to rail and the prevailing coal prices received. Using road transport would not be competitive (5 to 15 times that of rail per t-km).
Some coal is exported as opposed to being utilised in the region due to transport constraints	This applies to those countries that may be closer to the sea than their counterparts in the hinterland e.g. Swaziland and South Africa.
Environmental challenges for utilisation of coal in electricity sector	Dominance of coal combustion in electricity generation and industries means the region will remain a significant emitter of greenhouse gas emissions (GHGs) even though there is a global effort to limit global warming. This means that, in the event that the region continues using coal, it must be able to identify and apply clean coal technologies to limit the GHG emissions.
Carbon tax impact on tariffs and access on poor populations	South Africa, in particular, being the major electricity producer in the region, is planning on introduce carbon tax. While that policy would encourage management and efficient consumption of coal, it will also increase the cost of electricity to consumers.
Weak institutional framework, largely private sector	Coal mining in most SADC countries is in the hands of the private sector and that means collective planning at SADC level may be constrained.
Multiplicity of players (Ministries responsible for Energy, Mines, Survey, among others) with no clear champions to mobilise explorations funds for coal development	Coal infrastructure development is influenced by other sectors and that may also limit an energy planning alone.

2.1.4 Renewable Energy

2.1.4.1 Status

The dominant renewable energy in use in the SADC region is biomass and it contributes 36.66% to the regional energy mix, while hydro contributes 1.95% and modern biomass 0.39%. The rest of the renewable energy sources namely, solar, geothermal, wind and biofuels are still negligible (<<1%). Use of bagasse to generate electricity is already widely used in the SADC Member States which include Mauritius, South Africa and Zimbabwe, and is gaining momentum on the SADC mainland[9].

The SADC region has a huge potential for renewable energy due to an abundance of solar[10] and wind resources, but exploitation of these energy resources on a large scale will require new investments in the form of generation plants and the evacuation of power to demand centres.

At off-grid level there are few windmills for water pumping and solar PV systems for households and institutions in use. The installed capacity is insignificant to register in the energy balance of Member States.

[9] Estimated in 2005 to be 400 MW – 245 Mw for South Africa; 61 MW for Zimbabwe and >70 MW for Mauritius and 44 MW for Swaziland.

[10] PV installed capacity was 13 MW in 2005.

The following challenges were identified in the renewable energy and energy efficiency sub-sector:

Box 4: Challenges identified for renewable energy

Challenge	Elaboration
High technology/upfront costs	Costs of RE (solar in particular) have been prohibitive and for the intended market can be prohibitive to invest in the required infrastructure.
Lack of manufacturing (establish market)	The fact that most RE equipment is imported, exacerbates the landed costs of the RE equipment/infrastructure. The expectations are that local manufacturing of RE products would lower costs to consumers.
Grid assessment to connect to RE projects	For large-scale RE projects to be connected to the SAPP or National grids, the capacity to do so should exist and that exercise to assess capacity availability needs to be established before RE plants are hooked to the grid. Only a few countries such as South Africa and Mauritius have undertaken some of that exercise. SAPP has now commissioned a project to study the impact of renewable energy integration on the SAPP grid.
Product quality and lack of proper testing facilities	RE has been plagued by poor quality of equipment and hence lost some credibility. For RE infrastructure to take root, good quality products should be ensured, which can be assisted by testing equipment that is to be distributed in the SADC region. Some Member States have their own testing facilities, but a harmonised standard is required as the equipment is traded across countries.
Lack of innovation and localisation strategies	RE equipment is produced outside the SADC region in developed countries and lately in the developing economies of China, India, and Brazil. R&D for RE is also entrenched in those countries. Localisation of R&D, and eventually manufacturing of equipment in the region, is expected to lower costs of the needed equipment and infrastructure.
High donor dependence	RE has largely been promoted through short-term (<5 years) projects/programmes, supported by the donor and after the donor support stops, the RE uptake also stops, so there is need to ensure RE is embraced in regional planning.
Lack of guidelines and models to analyse the potential impacts and benefits of RE incentives e.g. feed in tariffs	RE Feed in Tariffs (REFIT) have been seen as a panacea of introducing RE into the tariff structure of the national electrical system. While a number of countries have introduced REFIT, no success story has been presented as yet. South Africa in particular has abolished its REFIT before it was operational. It would therefore be important to establish whether REFIT is the route for RE investment. or there are other alternatives.
Lack of defined renewable energy projects	There is overlap of RE projects in the electricity sub-sector and RE sub-sectors, e.g. for hydropower and the large wind and solar projects being proposed in the SAPP and national IRPs, e.g. that of South Africa. Rationalisation is needed to track progress on RE infrastructure development.
Data constraints on biomass energy	Biomass is the widely used RE resource and there is fear that deforestation is occurring, but not enough data exist to demonstrate that. Data will be essential to establish whether traditional biomass is renewable or not, and how the resource could be used on a sustainable basis.

2.1.5 Nuclear Power

2.1.5.1 Status

Apart from the nuclear share of 1.6% in the SADC generation mix (only found in South Africa), there is occasional talk about deploying nuclear power to address demand for electricity in South Africa and the SADC region. However, this is not backed by concrete plans in the immediate future. According to the South Africa IRP (policy adjusted scenario), the next generation plant will be implemented in 2023. Development of nuclear plants faces strong NGO opposition in the country, in favour of advancing renewable energy and even continuation of coal.

South Africa perfected the Pebble Bed Modular Reactor Technology more than a decade ago, but no plant has been built yet with this technology in the region. The existing nuclear plant is based on the older technology.

Box 5: Pebble Bed Modular Reactor Technology

Pebble Bed Modular Reactor (Pty) Limited (PBMR) was established in 1999 with the intention to develop and market small-scale, high temperature nuclear reactors both locally and internationally. The 800 member PBMR project team is based in Centurion near Pretoria, South Africa. Pebble Bed Modular Reactor (Pty) Limited is a public-private partnership comprising the South African government, nuclear industry players and utilities.

The PBMR is a helium-cooled, High Temperature Reactor (HTR). Although it is not the only HTR currently being developed in the world, the South African project is on schedule to be the first commercial scale HTR in the power generation field. Very high efficiency and attractive economics are possible, without compromising the high levels of passive safety expected of advanced nuclear designs. The PBMR has a steel pressure vessel, which holds the enriched uranium dioxide fuel encapsulated in graphite spheres. The system is cooled with helium and heat is converted into electricity through a turbine. The PBMR plant comprises a module building with the reactor pressure vessel (RPV) and the power conversion unit (PCU).

The PBMR is a strategic national project due to its significance to South Africa and its potential in international markets as a prospective provider of safe, clean energy.[11]

2.1.5.2 Challenges

The challenges listed in Box 6 have been identified for the nuclear energy sub-sector.

Box 6: Nuclear challenges and elaboration

Challenge	Elaboration
Potential plant accidents	The prevalence of nuclear plant accidents in recent years, e.g. the Fukushima plant in Japan, have hindered progress in deploying nuclear electricity generation plants with leading country such as Germany and France not committing to expand their nuclear power plants.
Problem of nuclear waste	Nuclear waste has always required specially designed disposal sites, and the risk posed by such waste disposal still prevents wide acceptance of nuclear electricity generation.
Lack of commitment to R&D and development of the technology	The development of a demonstration plant that was scheduled for 2004 by Eskom was stopped indefinitely in 2009. The following year the South African government stopped funding for the PBMR, resulting in the subsequent closure of the project. Hence the future of PBMR in the region is now very uncertain.
NGO objection in favour of renewable energy	Without a demonstration project to confirm that the Pebble Bed Technology is a better option with respect to nuclear waste generation and management, it will be difficult to convince civil society that no harm will come from the future nuclear plants.

2.1.6 Energy Efficiency and Conservation

2.1.6.1 Status

Apart from considering energy efficiency for improved cooking stoves, the same is important for electricity generation from both supply and end use. A number of SADC countries have initiated energy efficiency initiatives that include demand-side management measures such as the use of compact fluorescent lambs (CFLs), solar water heaters (SWHs), smart meters, grid code, as well as energy efficiency campaigns and targets.

[11] http://www.pbmr.co.za/

2.1.6.2 Challenges

The challenges related to energy efficiency are summarised in Box 7.

Box 7: Energy efficiency challenges and elaboration

Challenge	Elaboration
Lack of regulatory/legal framework	While countries have reached milestones to promote energy efficiency, the legal/regulatory frameworks are too weak to ensure the continuity and sustainability of efforts.
Lack of incentives	There are no clear incentives in most Member States to encourage consumers to implement energy efficiency measures, apart from the fact that they can save costs.
Lack of energy management systems	There are no systematic schemes that can enable countries to undertake energy efficiency programmes and meeting targets.

2.1.7 Climate Change

2.1.7.1 Status

Climate Change (Low Carbon) and Adaptation

Climate change is a cross-sectoral issue. Energy affects climate change through emission of greenhouse gas emissions. Electricity generation in SADC is 74% coal based, which means that for every kWh generated, 1 kg of CO_2 is emitted into the atmosphere. Although the majority of SADC Member States emit below 1t CO_2/cap, South Africa emits above 8.5t CO_2/capita, which is comparable to developed countries such as Germany, which had 9.6t CO_2/capita in 2008. In future, the use of coal will be constrained due to its contribution to global warming, and the electricity generation mix will need to be planned with that threat in mind.

On the other hand, the power sector is vulnerable to extreme weather conditions, which can result from climate change. Therefore infrastructure designs, location and robustness, as well as the management of assets, have to take the possible impact of climate change into consideration. Studies already conducted[12] in the region show that although insufficient data was collected to assess the impact of climate change, indications are there that both frequency and intensity of recent weather events show some increases. Climate change will also impact on RE resources such as hydropower, wind regimes, solar availability and biomass feedstock production in both positive and negative ways, and needs to be assessed and planned for.

2.1.7.2 Challenges

The challenges related to climate change are shown in Box 8.

Box 8: Climate change challenges and elaboration

Challenge	Elaboration
No evident planning to address the impact of climate change on the energy sector	Climate change is often debated as a topic that is not part of development and often is not reflected in national budgets and development plans.
No clear targeting to benefit from carbon revenue for the projects under development	Many projects that under development could benefit from carbon revenue, but there is no concerted effort to ensure that this is taken into consideration when designing clean energy projects

[12] Assessment and documentation of historical extreme weather impacts on the power sector in Southern Africa conducted by EECG Consultants with Eskom financing.

No clear planning for dealing with the adverse impacts of climate change	The severe impact of weather-related events are already being registered, and affect energy resources and cause infrastructure damage, but SADC Member States have not yet made adequate effort to monitor these impacts and determine what can be done to alleviate the loss of energy infrastructure.

2.2 Enabling Environment and Institutional Arrangements

2.2.1 International

The environment painted here refers to those aspects that will direct the development of the energy sector globally and affect the SADC energy infrastructure paradigm. Global electricity generation is dominated by fossil fuels (coal, natural gas and petroleum), followed by renewable energy (mainly hydropower and then nuclear power).

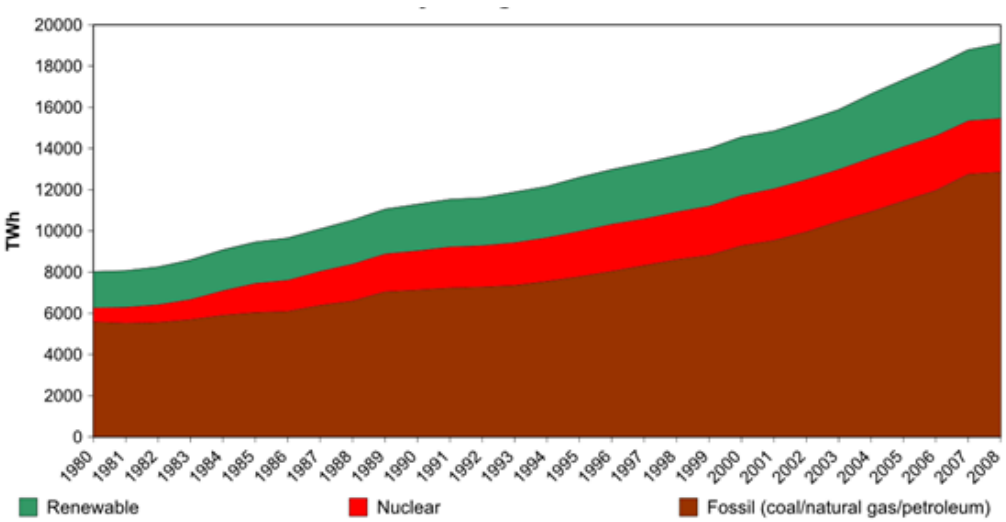

Figure 2-1: Annual global electricity generation

Coal

The dominant increases in coal use since 2000 can be seen in China and other Asian countries, particularly India, presenting an opportunity for exporting coal to those regions. In Africa there is a light increase in coal use, probably due to slow growth in economies (Table 2.1).

Table 2-1: Regional coal supply (TWh), share 2010 (%) and share of change 2000 – 2010 [26] [27]

	2000	2008	2009*	2010*	%*	Change 2000 – 2009*
North America	6 654	6 740	6 375	6 470	16%	-1.2 %
Asia, excl. China	5 013	7 485	7 370	7 806	19%	18.9 %
China	7 318	16 437	18 449	19 928	48%	85.5 %
EU	3 700	3 499	3 135	3 137	8%	-3.8 %
Africa	1 049	1 213	1 288	1 109	3%	0.4 %
Russia	1 387	1 359	994	1 091	3%	-2.0 %
Others	1 485	1 763	1 727	1 812	4%	2.2 %
Total	**26 607**	**38 497**	**39 340**	**41 354**	**100%**	**100 %**

*Source: IEA, *in 2009, 2010 BP*

**Region's share of the world changed +12 733 TWh from 2000 to 2009*

Natural gas

Despite the growth in coal demand, there is a general shift from coal to gas creating the need to align gas infrastructure with that for electricity. All regions registered an increase in gas use for

electricity generation, and in Africa a 3% increase was registered between 2000 and 2010[13] (Table 2.2). In the US and EU, the shift is partly driven by the desire to shift to carbon benign fuels.

Table 2.2 Regional gas supply (TWh) and share 2010 (%)[29] [30]

	2000	2008	2009*	2010*	%*
North America	7 621	7 779	8 839	8 925	27%
Asia, excl. China	2 744	4 074	4 348	4 799	14 %
China	270	825	1 015	1 141	3 %
EU	4 574	5 107	4 967	5 155	16 %
Africa	612	974	1 455	1 099	3 %
Russia	3 709	4 259	4 209	4 335	13 %
Others	1 008	1 357	958	nd	nd
Total	**3 774**	**5 745**	**6 047**	**7 785**	**23 %**

Source: IEA, in 2009/2010 BP

Nuclear Power

Nuclear power is considered an important fuel in the global electricity generation mix. It is viewed as a solution for climate change, but recent disasters and the constant fear of managing nuclear waste prevents it from being a popular solution. In the SADC region, the share of nuclear, which is only found in South Africa, is 1.6%. South Africa has been reluctant to implement further nuclear power stations using its Pebble Bed Technology. There is strong opposition from the NGO community, and proliferation of nuclear energy is not likely to happen as government stopped funding the project due to financial constraints. However, South Africa only plans to add nuclear capacity in 2023, perhaps hoping that the option will be more acceptable then. Globally, the annual generation of nuclear power has been on a slight downward trend since 2007, decreasing by 1.8% in 2009 to 2 558 TWh[14]. The contribution of nuclear energy is expected to decrease further following the Fukushima disaster in Japan in 2011. Germany, for example, has abandoned all plans to install nuclear in future and other European countries are following suit.

There is, however, an outcry from the NGO community for up-scaling the deployment of renewable energy. For instance, the World Wildlife Fund (WWF) now has a vision for 100% renewable energy by 2050. Donor funding also provided huge resources for up-scaling RE in the energy mix, for example the Global Environmental Facility (GEF), DFID/WB and all the clean technology funds. The climate change dialogue is encouraging a focus towards GHG benign energy systems, among them RE/EE. Furthermore a global climate fund is being formulated to support both climate change mitigation and adaptation projects, and will provide US$100 billion per year from 2020. SADC will have to align itself with such funding mechanisms to be able to implement some of its infrastructure in the future.

The share of renewables in global electricity generation is around 19%, with 16% of global electricity coming from hydro-electricity and 3% from new renewables. With regards to non-hydro renewables, wind power is growing at the rate of 30% annually and can be quickly adopted in the region, depending on resource potential.

Most of the petroleum products imported into the region are from the Middle East and other regions that have long suffered from instability and civil unrest, and that have driven oil prices up.

[13] World energy consumption. http://en.wikipedia.org/wiki/World_energy_consumption#Fossil_fuels
[14] ibid

The supply is threatened by social and political developments in these unpredictable and often unfriendly production regions.

An interesting development is that oil companies are broadening their view on their investments in renewable energy, fuels cells, hydrogen technologies, coal and natural gas conversion into synfuels as substitutes for petroleum. These are options that the SADC region should be exploring so as to benefit from the technology changes in energy supply in the international market.

World production of bio-ethanol increased by 8% in 2005 to reach 33 billion litres, with most of the increase in the United States, bringing it level to the consumption in Brazil. Biodiesel increased by 85% to 3.9 billion litres, making it the fastest growing renewable energy source in 2005. Over 50% is produced in Germany. The guidelines for the production and use of biofuels prepared by SADC will be in line with global trends, and a ready market exists that can absorb any excess biofuels. The ever-increasing fuel prices and uncertainty of supply partly drives the biofuels industry.

Although the recession of 2008 created sluggish growth for most economies, the developing countries have regained from that crisis. Growth in developed countries is still sluggish at 2.4%, while the developing countries are growing at 6%. Most of the growth will be realised in China and India, hence the expected high energy demands in those countries.

2.2.2 Regional Enabling Environment

This section presents the SADC efforts in creating an enabling environment for infrastructure development presented by sub-sector.

2.2.2.1 Policies, strategies and Plans

Electricity

Strategies

In 2010, SADC completed the Regional Energy Access Strategy and Action Plan (REASAP) that aims to harness regional energy resources to ensure, through national and regional action, that all the people of the SADC region have access to adequate, reliable, least-cost, environmentally sustainable energy services. The REASAP also aims to halve the proportion of people without such access within ten years for each end use, and halve it again in successive five-year periods, until there is universal access for all end users. In the context of the RIDMP for electricity, where access is currently 24%, this means that the number of people without access will result in 62% access by 2022 and 81% access by 2027[15].

Member States are to develop national energy access roadmaps based on REASAP, taking into consideration best practices in the region for rural electrification, including pro-poor tariffs issues. The roadmaps will be consolidated into a regional roadmap to be used for resource mobilisation as well as implementation, monitoring and evaluation of the programme. Although the deadline for submission of national roadmaps was October 2010, Member States have not completed their roadmaps, which slowed the pace for achieving the goals.

[15] The PIDA study made the assumption that African countries can reach access rates of 69% by 2040.

Regulatory Framework

In May 2011, 11 out of the 15 countries in the SADC region have introduced some kind of regulatory oversight in the form of energy or electricity regulatory authorities. Nine countries have regulatory agencies that are members of the Regional Electricity Regulators Association (RERA). Four countries (Botswana, DRC, Mauritius and Seychelles) were in the process of establishing regulators.

During the same period, the seven countries still only had electricity regulators, while three had energy regulators and one a multi-sector regulator (energy and water). The trend is however that most countries are transforming the electricity regulators into energy or multi-sector regulators.

Energy policies and acts of most Member States in the region provide for Electricity Supply Industry (ESI) reforms, which include the establishment of independent regulators for the ESI.

At regional level, RERA is supporting the harmonisation of the regulatory and national electricity policy frameworks and is working towards the standardisation of PPAs. RERA has championed the development of the Guidelines for Regulating Cross-Border Power Trading, which provides an enabling framework for cross-border trade and investment in infrastructure that would reduce some of the current uncertainties that are deterring investment and undermining efforts to improve security of supply through cross-border trade. The Guidelines for Regulating Cross-Border Power Trading have been adopted by SADC and are now in operation.

SADC has also produced electricity tariffs and selected performance indicators to bridge some of the information gaps and serve as an essential information aid on regional trends pertaining to the electricity supply industry tariffs and performance. According to the study, the SADC Member States' tariffs varied in 2008. The results of the study (Figure 2.2) show that Angola and Tanzania had the highest tariffs in the region at 12.5 US cent/kWh and 12 US cent /kWh respectively. Zambia had the lowest electricity tariff at 2.7 US cent/kWh, followed by the Seychelles and South Africa. The high tariffs in Tanzania, and probably Angola, may be due to use of emergency generators. A comparison with other parts of the world shows a similar variance. The USA and Canada are below 12 US cent/kWh, but EU countries generally are above 20 US cent /kWh.

Figure 2-2: Three-year electricity tariffs of SAPP member states
Source: RERA 2009[16]

[16] Reference: RERA tariffs and performance indicators 2009.

The SADC tariffs study is intended to benefit various stakeholders, including all interested parties such as governments, regulators, utilities, non-governmental organisations, academics and investors.

SAPP Plan

The SAPP Plan of 2009 reflects the Infrastructure Development Programme relating to power generating plants and key inter-connectors, with emphasis on the provision of inter-connectors to ensure that all the SADC Member States are well connected to the SAPP grid network. The basic idea of the SAPP Plan was to derive savings, which could be achieved by co-ordinated planning and avoiding over-investment. The SAPP Plan was to be an integrated regional plan that takes full advantage of the opportunities to capture the benefits of improved efficiency, wider choice of power plants and improved planning, however projects are not only prioritised according to cost-effectiveness.

The SAPP Plan has not yet received adequate support from governments, and is not binding. On-going discussions aim to ensure more Member State buy-in and commitment to the plan, which should catalyse resource mobilisation. In 2011, the SAPP Executive Committee used the SAPP Plan to select and prioritise projects that could be implemented and supported at regional level.

Petroleum and Gas

The REASAP would particularly apply to harnessing the large gas resources and access to LPG for cooking.

At present, there is no regional regulatory framework for the petroleum and gas sectors, but this would be realised as Member States move from electricity regulation to energy regulators.

The P&G sub-sector lacks a comprehensive regional plan such as the SAPP Plan and that is needed to guide infrastructure investments in the region. This is mainly due to the lack of a regional body to co-ordinate activities in the sector. The committee which is in place is under-resourced and therefore unable to fully achieve its mandate.

Coal

Strategies/regulations and Plans

There are currently no regional strategies, regulatory frameworks or plans catering for coal.

Renewable Energy

Strategies/regulations and Plans

SADC developed RESAP to contribute to energy supply security, stimulate economic growth and improve access to modern energy services, taking into consideration new developments in the sub-sector such as the entry of biofuels into the market, funding mechanisms in place for RE and considerations for climate change.

Although still needs to approve RESAP, it has set some ambitious targets for the deployment of least cost RE options (Table 2.3). It has also stipulated the necessary planning to boost RE/EE deployment and the necessary policy/strategy options needed.

Table 2-2: Targets for least cost options

Least cost option	2015 (%)	2020 (%)	2030 (%)
RE mix in the grid	21	33	39
Off-grid share of renewable energy	2.5	5	7.5
Energy efficiency savings achieved of grid use	5	10	15
Biofuels Ethanol share of total fuels Biodiesel fuels share		 10 5	 20 10
Cooking/heating efficient devices penetration	5	10	15
Efficient charcoal production share		5	5

Source: RESAP Draft February 2012

The identified and promising technology options were filtered through cost and benefit (e.g. through levelled costs of producing an energy unit), environmental, social impact and risk analyses. A proposal was made for the technology deployment in the considered timeframe of 2011 to 2030.

Planning interventions that have been proposed relate to:

- RE resource potential verification;
- Grid assessment for connecting RE projects, both for SAPP grid and national grids;
- Strategic environmental assessment required for RE projects;
- RE/EE device manufacturing in the SADC region;
- R&D for RE/EE; and
- Impact assessment for RE/EE.

The policy/strategy interventions that have been included in RESAP are for Member States to:

- Prepare their roadmaps from this RESAP;
- Develop and agree on RE pricing in the region;
- Develop PPA standardisation;
- Agree on grid use code;
- Establish a RE/EE institutional framework;
- Develop an RE/EE financing plan; and
- Agree on RE/EE targets for the region going toward 2030.

There are currently no regional regulatory frameworks for RE. Of the SADC Member States, only South Africa had a legislative and regulatory framework for renewable energy during the preparation of RESAP.

Although SADC does not have a separate comprehensive pool plan for RE, most of the RE projects that can be connected to the grid are included in the SAPP Plan. The SAPP Plan projects that by 2016, about 3% of the generation mix will be from RE, based on the current plans by Member States.

2.2.3 SADC Institutional and Organisational Arrangements

2.2.3.1 Energy Institutional framework

Electricity

The key SADC institutions that are mandated to drive infrastructure development in the SADC region are the SADC Secretariat (policy harmonisation and resource mobilisation), SAPP (operation, largely

co-ordination, and electricity trading) and RERA (regulatory harmonisation). The actual implementation of energy infrastructure projects is being done at Member State level by utilities and IPPs with support from governments. Currently SADC institutions cannot implement infrastructure projects, because they do not have the mandate to do so. Unlike WAPP that is mandated by governments to raise funding and implement projects, SAPP is a co-ordinating and planning body also tasked with running a competitive electricity market in the form of a Day Ahead Market (DAM). However, in the last few years, the SAPP Co-ordination Centre (SAPP-CC) was appointed as project co-ordinator for selected projects such the ZIZABONA and the CTC project in Zimbabwe.

RERA is an association of regulators and has no regional regulatory authority over its members. ECOWAS also provides good lessons, as they have a Regional Electricity Regulatory Authority that can regulate cross-border exchanges between Member States.

The low staffing levels in the Energy Division of the SADC Secretariat renders it incapable of adequately performing its full complement of duties. Additional positions supported by Member States have not yet been approved by Council owing to budgetary constraints.

SADC also interacts with the Energy Thematic Group (ETG) that comprises the SADC Secretariat Energy Unit, major ICPs in the energy sector, SAPP and RERA, and meets biannually to review the energy programme and identify areas for support. The ETG provides a platform for an efficient SADC/ICP dialogue, and gives an opportunity for pooling resources and implementing specific programmes in areas of common interest.

The Tripartite Task Force, headed by the Secretaries General of COMESA and the EAC, and the Executive Secretary of SADC is also an important institution that strives to harmonise RECs programmes in the areas of trade and infrastructure development.

The overarching objective of the Tripartite is to contribute to the broader objectives of the African Union (AU), namely accelerating economic integration of the continent and achieving sustainable economic development[17].

Other important collaborations to be recognised in the context of developing this RIDMP are with organisations such as AUC, Nepad, World Bank, AfDB and the Africa-EU Energy Partnership that can fund RIDMP energy projects.

The AUC/Nepad sets the All Africa Agenda to which SADC subscribes, it is therefore necessary to be consistent with the All Africa Infrastructure Development.

NEPAD was structured as the resource mobilisation framework for programmes implemented by RECs, and has been instrumental in sourcing funding through DBSA, AfDB and other sources for infrastructure projects in the SADC and EAC regions.

[17] http://www.comesa-eac-sadc-tripartite.org/intervention/focal_areas/infrastructure

2.2.3.2 Petroleum and Gas, Coal and Renewable Energy

SADC completed a study towards the formation of a Regional Petroleum and Gas Association (REPGA) in 2009, but to date only an interim committee has been formed to oversee the co-ordination of the sub-sector. An institution similar to SAPP and RERA that caters for the P&G sector does not exist in the current institutional structure. Once established, REPGA will facilitate the harmonisation of the P&G sector, develop a master plan to guide investments in the regional P&G sector and keep information management systems for sub-sector planning.

2.2.3.3 Member States

The status of energy policies, strategies and master plans in the SADC Member States is summarised in Table 2.4, the completeness of which was derived in June 2011 through stakeholder consultations in Member States. At Member State level, eight countries have an energy policy and nine have an energy master plan.

Table 2-3: Summary of status of the policy framework of the SADC Member States

Country	Energy policy/strategies	Energy master plan	Energy/electricity regulator
Angola			√
Botswana	Draft	√	In progress
DRC			
Lesotho			√
Malawi			√
Mauritius	√	√	
Mozambique	√	√	√
Namibia	√		√
Seychelles			
South Africa	√	√	√
Swaziland	√		
Tanzania	√		√
Zambia	√	√	√
Zimbabwe	√	√	√
SADC	√	Under development	√

When regional strategies and master plans such as this ESP are developed, Member States benefit by developing their roadmaps from the regional plans/strategies. It is envisaged that the ESP will impact on the development of future energy master plans of Member States, particularly those that have not yet developed their own plans.

2.3 Projections and Trends for 2027 Requirements

2.3.1 Electricity

The energy demand outlook up to 2027 is based on the likely growth rates of 3% and 5% for the SADC economy, which is based on historical GDP growth rates in the SADC countries that varied

from 2.5% to 6% in recent years[18]. Ministers of Energy urged that the SAPP Plan take into account rural electrification and suppressed demand when considering future load forecasts and a target growth rate of 8% was included as the growth rate that will enable SADC countries to eradicate poverty and meet its MDGs[19].

Data available from SAPP shows that the electricity sent out from the SAPP grid grew at an average rate of 2.89% over a nine-year period, from 240 000 GWh in 2000 to 276 000 GWh in 2009. Figure 2.3 shows that at the current growth rate (i.e. about 3%) the electricity sent out would grow to as much as 500 000 GWh by 2027. However, projected electricity sent out at the higher growth rates of 5% and 8% show a potential increase of as much as 650 000 GWh and above 1 million GWh respectively. By considering the current regional supply situation, characterised by supply deficits and the drive to increase the region's electricity access, it is likely that the electricity sent out will grow at a rate of 5% to 8% if all the regional plans are implemented successfully.

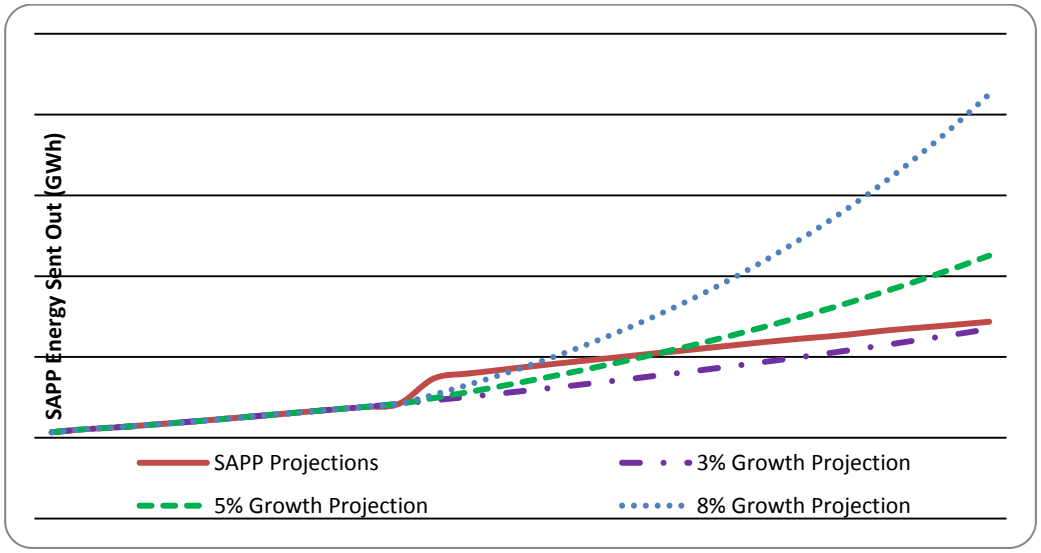

Figure 2-3: SAPP electricity energy sent out projection (Source: SAPP)

The supply scenario adopted here takes into account the South African IRP Priority Scenario (which was officially adopted by the country) and SAPP supply options as presented in the SAPP Plan of 2009[20] (Annexure 1). This supply scenario provides the highest generation capacity of the region so far. In Figure 2.4 this generation capacity is compared with the projected system maximum demand of 3%, 5% and 8% growth after taking into consideration the 10% reserve margin.

Between 2000 and 2009, the region's generation capacity grew in tandem with increasing demand, affording it to maintain a 10% reserve margin. However, as the infrastructure grew old with time and some plants were decommissioned, the available capacity reduced and led to a regional supply deficit between 2007 and 2012/13. There are also indications that there has been no significant investment in new generation capacity over the same period.

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18 PIDA assumed demand growth at 6.3% for all of Africa, which is rather too high for SADC countries outside the many oil producing countries.

19 Friedrich Ebert Foundation. 2007. *Deepening Integration in SADC*. ISBN 99912-564-8-2

20 In this study, the SAPP Plan was updated with the various project lists that have been circulated up to December 2011.

The planned generation capacity beyond 2011/12 will be adequate if the maximum demand grows at a rate of 3% up to 2027, in line with the SAPP scenario. However, this requires planning for suppressed demand if the region is to meet its energy access and economic development objectives. The Ministers of Energy[21] and stakeholders at the first RIDMP workshop made a call to think about a plan that can take into consideration an aggressive growth path that can eradicate poverty and accelerate economic growth, leading to the scenarios of 5% and 8% growth rates as determined above.

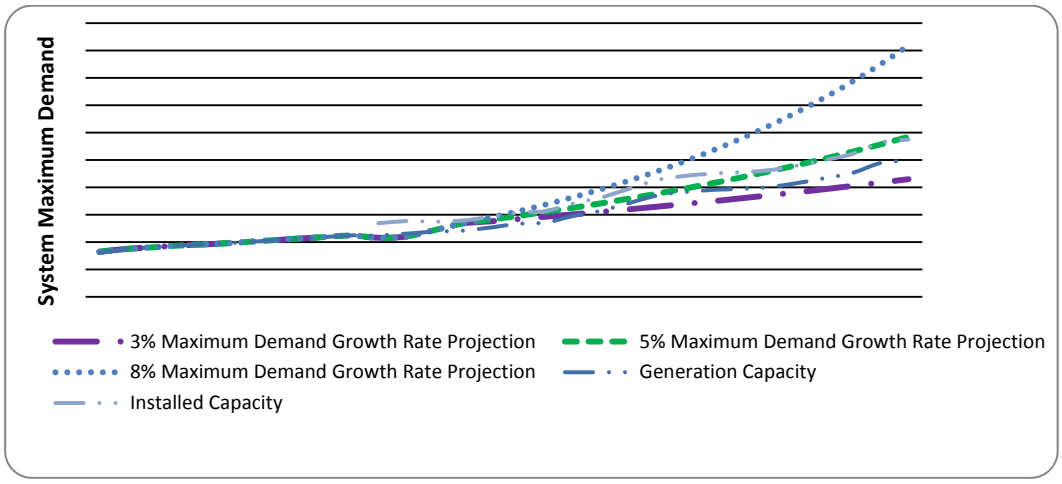


Figure 2-4: SAPP grid electricity demand versus electricity generation capacity projection (Source: SAPP)

If the SADC economy and electricity demand grows at 5% and 8%, the planned generation capacity will never meet the maximum demand, inclusive of the 10% reserve margin, in 2017, 2022 and 2027. The installed capacity will be slightly higher for the 5% growth rate in 2017 and 2022. In 2027, the installed capacity will also be lower than the maximum demand for the 5% growth rate (Figure 2.5).

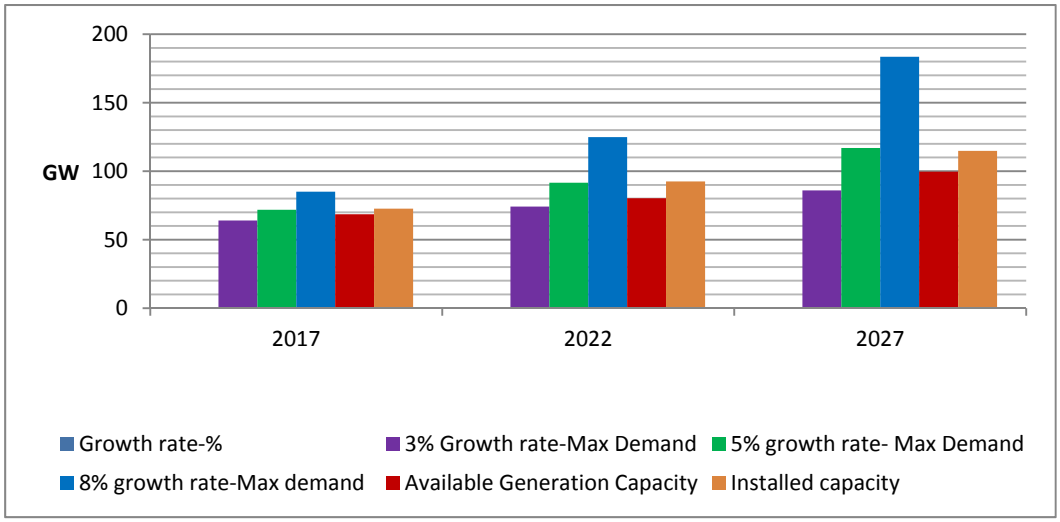


Figure 2-5: Supply-Demand situation for the electricity sub-sector

Figure 2.6 shows that beyond 2022, the supply scenario will be such that fossil fuels will be reaching a plateau and renewable energy (hydro, wind, solar and co-generation), and to some extent nuclear,

[21] Energy Ministers Meeting Report, May 2011. Gaborone, Botswana

will be increasing. Any shortfall at that stage should then be looking at additional renewable generation to meet the deficit that is in line with the global trend, without over-depending on one type of energy source.

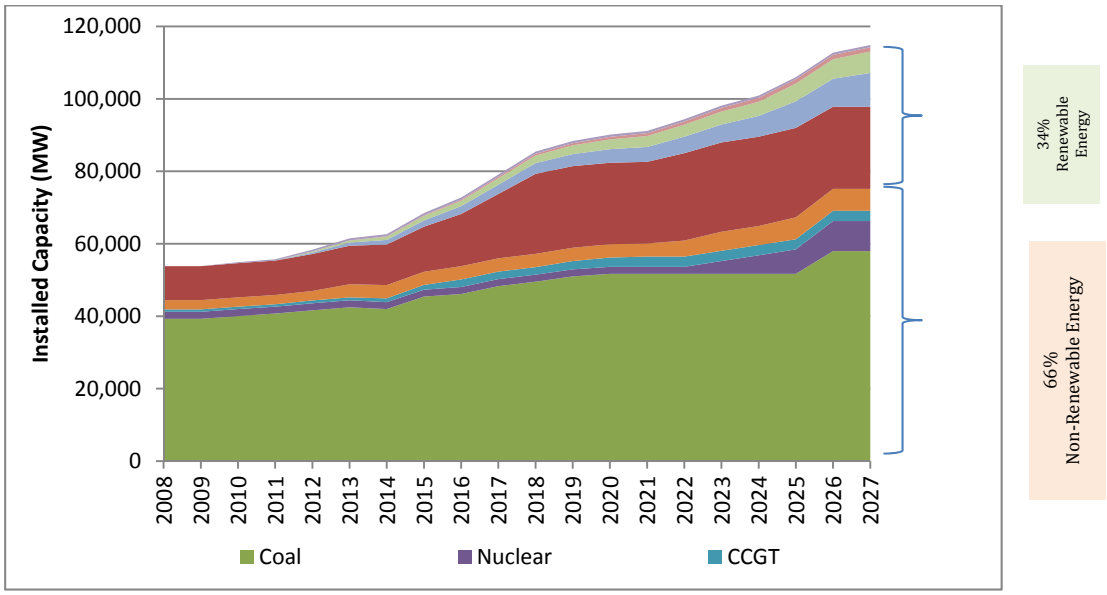


Figure 2-6: SAPP Grid Electricity Generation Energy Mix (Source: SAPP)

2.3.2 Petroleum and gas

Figure 2.7 shows the region's historical crude oil production from 1980 to 2008. It is evident from the graph that between 1980 and 1987 the region's crude oil consumption was less than the production. Over the time period depicted in the graph, crude oil production has grown at an average rate of 9% per annum compared to about 2.1% for crude oil consumption. Therefore the production has surpassed the consumption since 1987. However, most of the crude oil produced in the region is exported and most of that consumed in the region is imported, even though the demand is far less than the supply. This is due to the fact that most of the region's refineries are not designed to refine the crude oil produced by Angola. As of 2008, crude oil production was 116 million kilolitres compared to a modest 63 million kilolitres consumed in the same period.

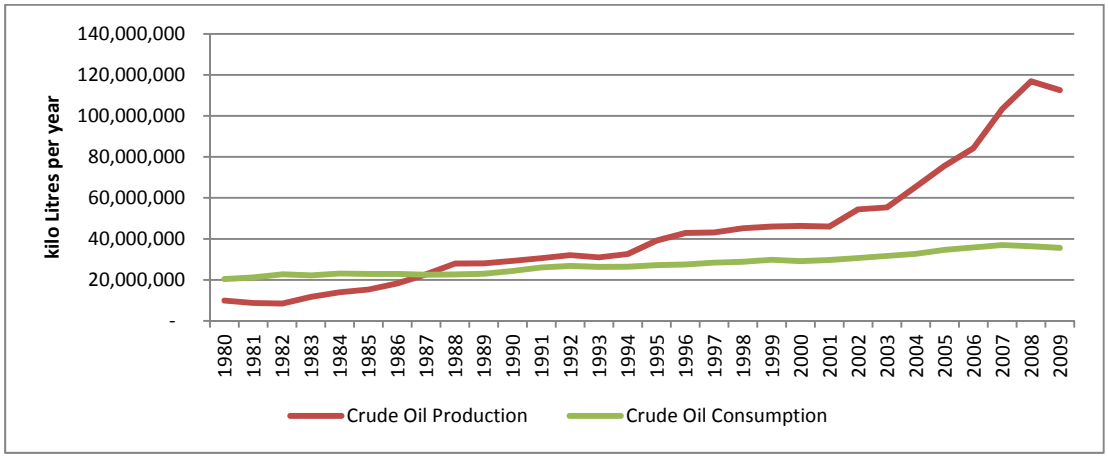


Figure 2-7: Historical crude oil production and consumption
Source: US DOE Energy Information Administration

In terms of petroleum products (i.e. petrol, diesel, paraffin and jet A1), Figure 2.8 shows that the region's total production in 2008 of 36 million kilolitres in 2009 falls short of the total demand, estimated at 41 million kilolitres. The growth in petroleum products consumption from 1986 has

been slow and consistent, averaging 3.1% compared to 3.4% growth in production, which has been less consistent. The figure further shows that the region has a production deficit and that the growth rate in production has not been sufficient to cover this supply/demand deficit.

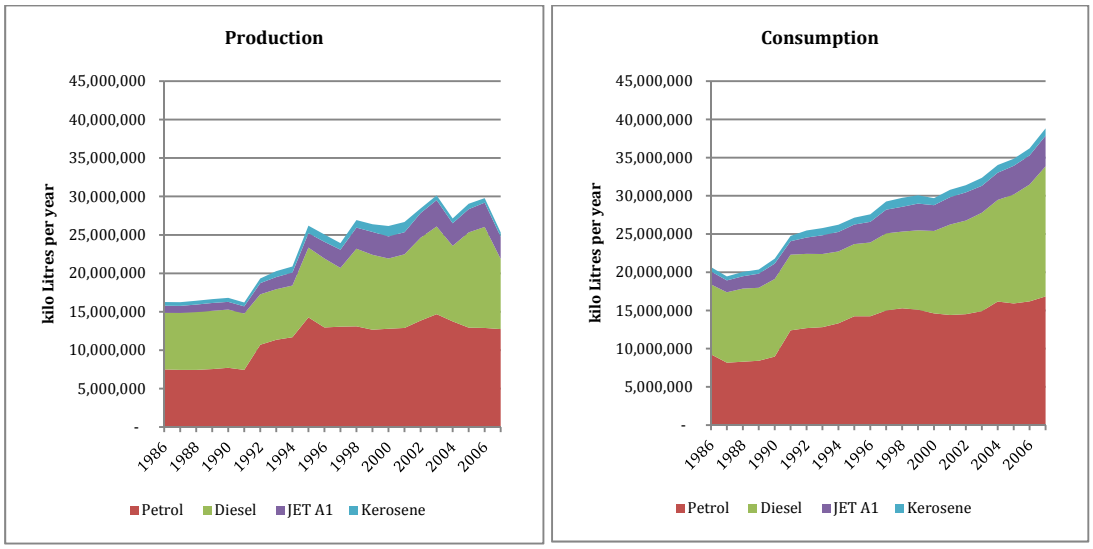


Figure 2-8: Comparison of SADC Petroleum Products production versus demand

The projected demand for petroleum products in the SADC region up to 2027 is shown in Figure 2.9. The graph shows that the demand for petrol and diesel was almost equal in 2007 and projections show an equal growth for these products going forward. The annual demand for either petrol or diesel is projected to be more than double the 2008 demand at 30 million kilolitres, 45 million kilolitres and almost 80 million kilolitres at 3%, 5% and 8% growth rates respectively by 2027. Demand for Jet A1 is projected to be below 10 million litres at 3% and 5% growth rates and below 20 million litres per year at an 8% growth rate by 2027.

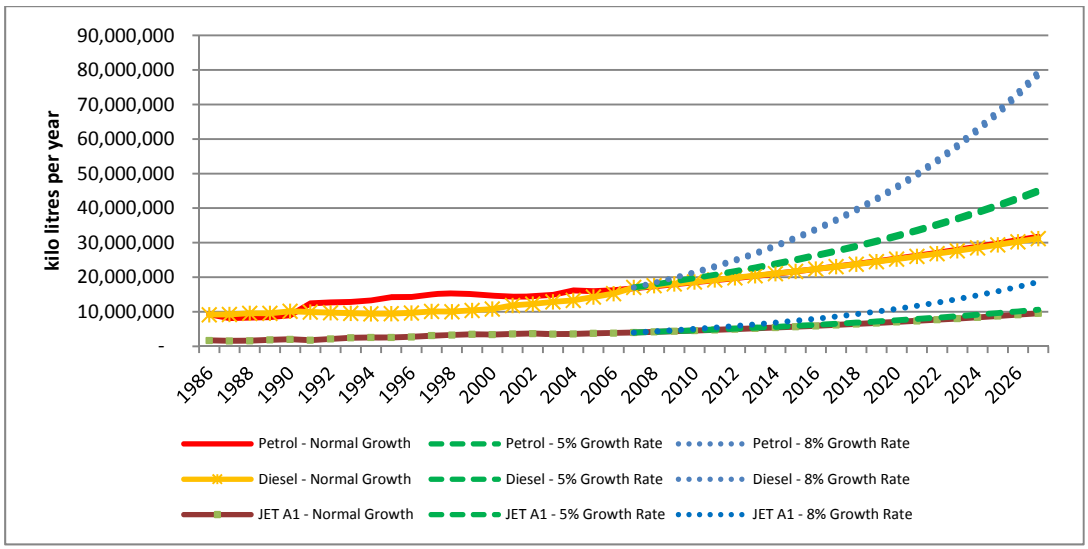


Figure 2-9: Projected demand for petroleum products

2.3.2.1 Liquid Petroleum Gas (LPG)

In the case of LPG, the data summarised in Figure 2.10 shows the historical consumption and production of LPG in the region. The graph shows that the region traditionally has a production shortfall of about 100 000 tonnes per annum. Though demand and production have grown in tandem between 1986 and 2002, the graph shows evidence of a demand/production plateau between 2002 and 2007.

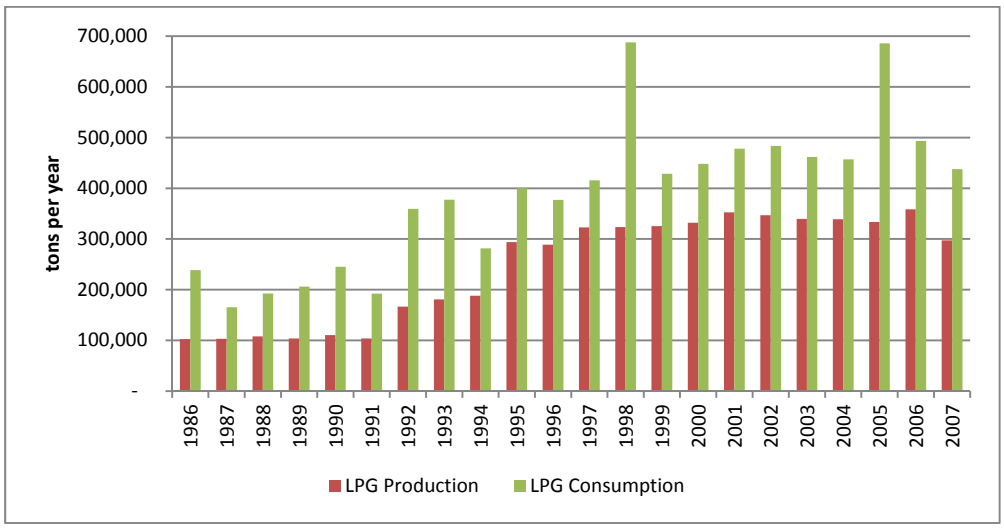


Figure 2-10: LPG demand and production

The 3%, 5% and 8% projection for LPG (Figure 2.11) shows that the demand could be as much as 1 million tonnes, 1.7 million tonnes and 2 million tonnes respectively by 2027. However, given the slow average growth of about 3% in the latter years of the historical data, the most likely growth is between 3% and 5% in the absence of the more aggressive promotion of LPG in the region.

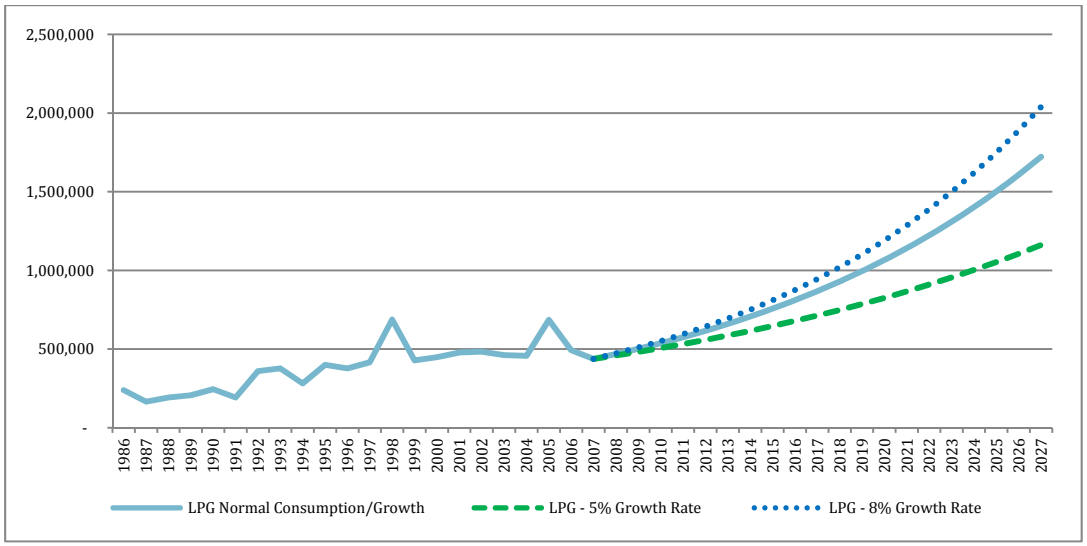


Figure 2-11: Projected LPG demand

The projected growth in demand for petroleum and gas products discussed above will have to be matched by the expansion of the necessary infrastructure (for production, refinery, storage and pipeline/transport) that goes with ensuring uninterrupted supply to the region.

2.3.3 Coal

Figure 2.12 shows the region's historical coal production, consumption and exports from 1980 to 2009 and projections up to 2027 (refer to Annexure 3 for raw data). The graph shows that 74% of the regional production is for local consumption, while the balance (26%) is for exports.

Historically, the region's coal production, consumption and exports have grown at a rate of 2.5%, 2.1% and 3.1% respectively. The growth in local consumption is mostly due to the coal to liquids production in South Africa, electricity production and partly from industrial consumption. The projections indicate that at the current growth rate, the regional production will grow to as much as 400 million tonnes per annum by the year 2027.

Given the current developments in the electricity sector, demand in local coal consumption is likely to be driven by demand in the electricity sector in the short to medium term. The global appetite for energy, which is mostly driven by rising demand in developing economies such as India and China, points to great potential for much higher growth in exports. This is likely to result in growth in regional infrastructure such as the Trans-Kalahari Railway in Botswana, the dry ports in Namibia and Mozambique for access to the American and Asian markets.

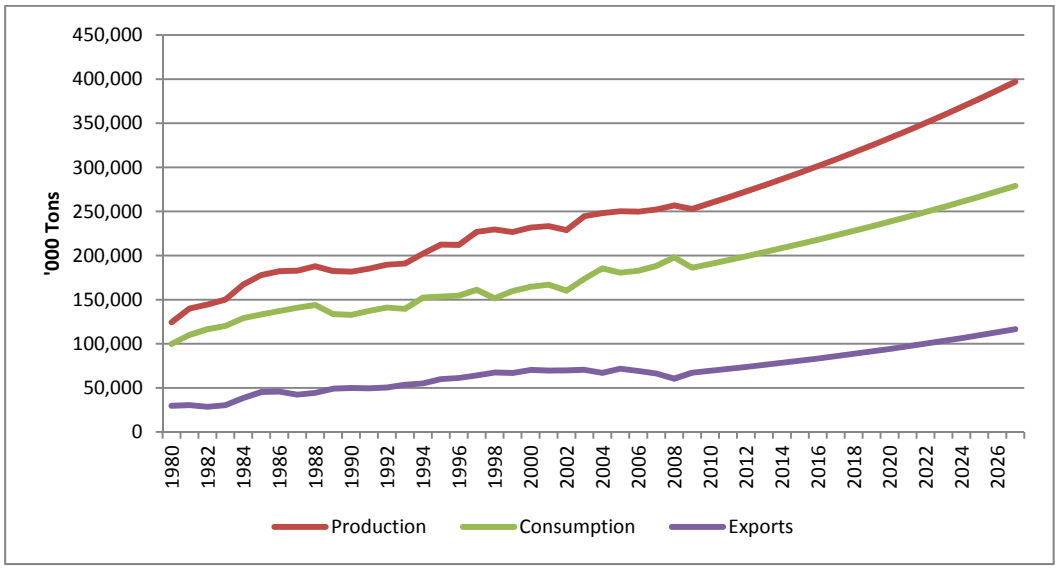


Figure 2-12: SADC Region coal production, consumption and exports and projections at current growth rates
Source: US Department of Energy – Energy Information Administration (http://www.indexmundi.com/)

Figure 2.13 shows the coal consumption projections up to 2027 at the current growth rates of 3%, 5% and 8% respectively. Since growth in regional demand is expected to be driven mostly by demand in the electricity production sector, which is expected to grow by rates of 3%, 5% and 8%, consumption has been projected at these rates. Growth rates for exports will be affected by demand in other economies where SADC would not have much influence, so the current growth rate has been adopted.

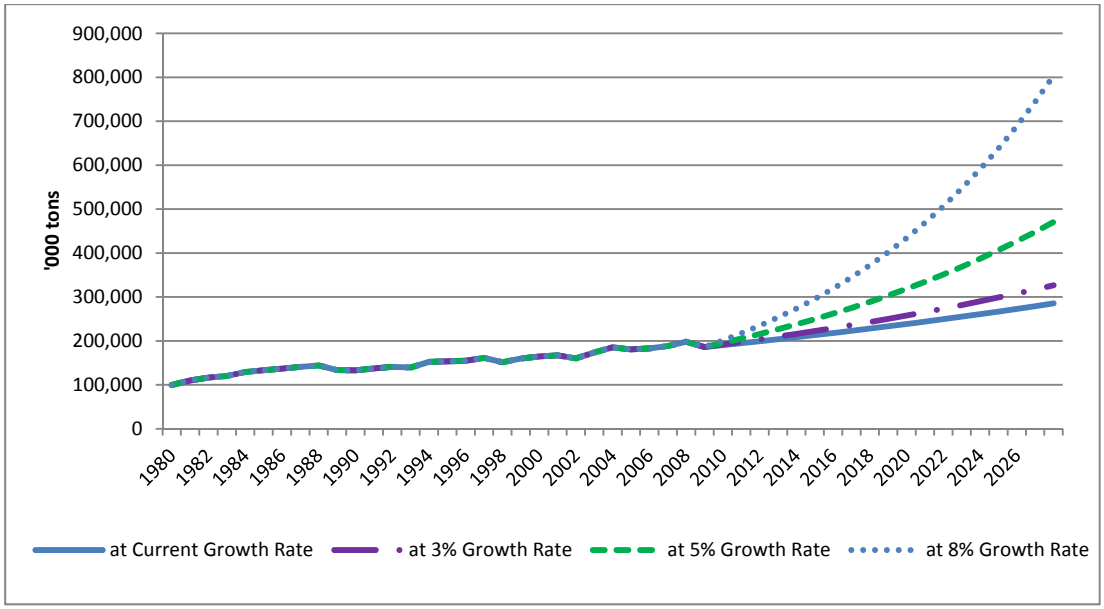


Figure 2-13: SADC region coal consumption projections

Comparisons are also made using the current production rate and projected demand at 3%, 5% and 8%, as may be dictated by demand in electricity and SADC economic growth (Figure 2.14).

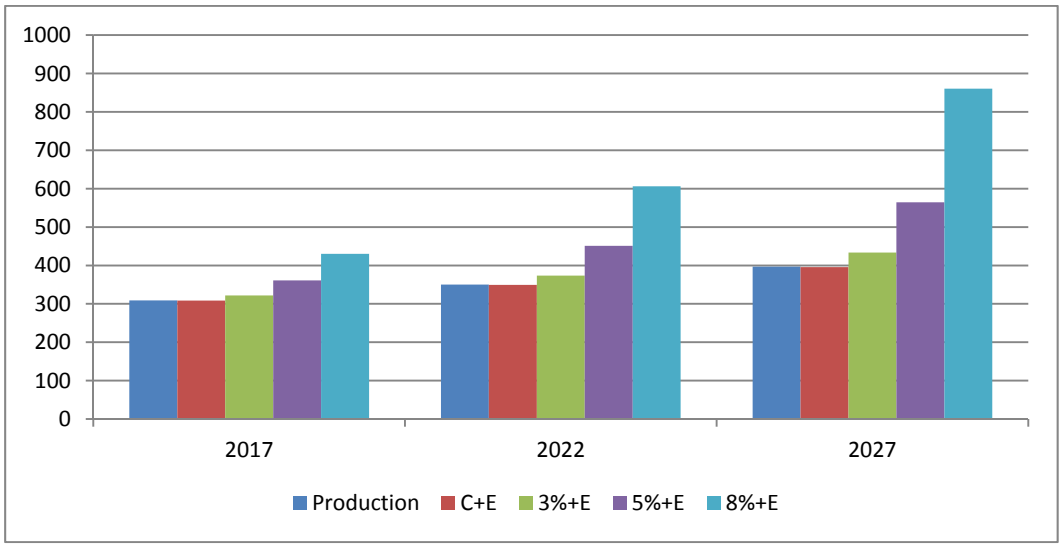


Figure 2-14: Coal supply and projected demand scenario

The indications are that if consumption and exports grow at the current rates, current production will be sufficient to meet future demand in 2017, 2022 and 2027, with even a small surplus in 2027. However additional production will be required if the SADC economy grows at 3%, 5% and 8%, which will affect consumption for the region. This will dictate the additional infrastructure that is needed to increase coal production and distribution. Increasing coal production is dependent on the mining sector. The energy sector, however, can ensure that coal demand in electricity production and industry is met should the economies grow at the rates projected in this Master Plan. Both transport and stockpiling infrastructure will be required, apart from the production infrastructure.

Unlike regional consumption, growth in exports is driven by the appetite for resources by other economies. However, it may also be constrained by the availability of the necessary infrastructure to effectively exploit these export opportunities, e.g. availability of transport systems such as rail and ports. For instance, Botswana and Mozambique will require such infrastructure at competitive prices

to be able to export their abundant coal resources to global markets. They will, however, need railway and new port infrastructure to achieve that, which can only be guaranteed if the transport sector provides the needed infrastructure. The transport plan is addressing the link to mineral production and distribution.

2.3.4 Renewable Energy

In terms of actual energy projects, based on the SAPP Plan and national IRPs, SADC is planning to increase the RE capacity by 13 719 MW, 10 345 MW and 8 243 MW in 2017, 2022 and 2027 respectively. Most of the additional capacity will be from hydropower and these projects are already captured in the electricity sector.

Apart from hydropower, the major capacity addition will be from wind energy, followed by solar PV, solar CSP and biomass. Geothermal energy is not expected to make any significant contribution to the RE capacity up to 2027.

The largest growth is expected from tapping the existing hydropower projects, particularly along the Zambezi and Congo River Basins.

2.4 Assessment of the Gap between the Current Situation and 2027 Requirements

The gaps analysis took the shortfalls of both “hard” and “soft” infrastructure into consideration in order to meet energy demand up to 2027. The “hard” aspects relate to the physical infrastructure that will be required, while “soft” gaps relate to the necessary policies/strategies, institutional capacity and financial issues that will need to be addressed to ensure the development of physical infrastructure. These “soft” issues also emanate from the identified challenges under each sub-sector outlined in section 2.1.

2.4.1 Electricity

2.4.1.1 “Hard” Infrastructure Gaps

In the case of electricity, the “hard” infrastructure gaps relate to additional generation capacity (and related electricity evacuation capacity) required to meet demand up to 2027.

Considering the planned and available capacity considered under the various growth projections, the planned capacity will only be adequate for a maximum demand (inclusive of the 10% reserve margin) in the 3% growth scenario. The planned generation capacity will exceed the maximum demand by nearly 5 GW in 2017, 6 GW in 2022 and 14 GW in 2027 (Table 2.5).

Table 2-4: Surplus/deficit of planned supply and maximum demand (+10% reserve margin) for various growth rates

Max demand growth rate	Surplus/deficit GW	Surplus/deficit GW	Surplus/deficit GW
3%	4.611	6.044	13.632
5%	-3.213	-11.427	-17.345
8%	-16.435	-44.714	-83.942

For a maximum growth rate of 5%, the planned supply will fall short by 3.2 GW in 2017, 11.5G W in 2022 and 17.35 GW in 2027. Similarly, a shortfall of 16.44 GW, 44.72 GW and 83.95 GW for 2017, 2022 and 2027 respectively will result from a maximum demand growth rate of 8%.

Depending on which RIDMP scenario is adopted, additional capacity may be needed to meet demand. It is, however, not easy to know what additional transmission lines would be required at this time. This will require a study to determine additional transmission capacity should SADC economies grow at 5% or 8%, after which a study will be required to assess where the additional generation capacity would come from and the related transmission capacity required.

2.4.1.2 "Soft" Infrastructure Gaps

Policies/regulations

As a matter of policy, Member States have fallen short by not being able to:

- Sign off regional projects that should gain priority for implementation;
- Establish a binding policy on setting cost reflective tariffs. Although it was agreed that such a policy would be put in place in the next five years, the pace is slow. This policy also needs to be supported by a standardised tariff- setting formula. This requires Member States to underwrite the tariff gap between future tariffs and long-run marginal cost;
- Develop a centralised project preparation fund, as there are many scattered sources of such financing. The planned SADC Project Preparation Development Fund (PPDF) could serve that purpose;
- Establish a policy to create a risk guarantee fund to allow utilities to borrow funds for capital expenditure. This is currently a problem for national power projects;
- Harmonise a regulatory framework for cross-border electricity trade, e.g. currency setting, wheeling charges, grid code etc.;
- Standardise regulatory frameworks and licensing, which are causing delays in the conclusion of PPAs due to a lack of standard PPA agreements;
- Have a legal framework that would allow large electricity users to sign PPAs directly, if required, to spread the off-takers.

Plans/strategies

- Lack of cross sectoral planning for electricity/water/ICT to take advantage of synergies in developing infrastructure that can serve all the sectors more cost effectively than if sectors were to plan separately.
- Slow implementation of the SAPP Plan, which is not being prioritised as alluded to earlier on.
- The recently developed REASAP is still to be implemented, but Member States have not yet produced their REASAP roadmaps that will guide improvement in energy access.

Institutions

- SADC institutions have limited authority and capacity to implement electricity infrastructure projects. RERA would need to be an authority to dictate the pace of regulation in the region. Similarly, SAPP would need authority to raise funds and implement projects together with the involved Member States, but this is not yet happening.
- There is lack of support teams, such as special purpose vehicles or project management task teams, which could support the development of projects and their implementation.
- The region needs champions to lead the development of projects, as it is not clear who is leading regional projects implementation.
- It is also not clear who is accountable for project implementation.

Capacity

- The SADC Energy Division and the two subsidiary bodies, RERA and SAPP, have serious staff shortages and cannot adequately co-ordinate the implementation of projects.
- The regional and Member States' institutions lack project preparation capacity, as projects are not sufficiently prepared and packaged before being presented to funders.
- Policy implementation capacity also needs enhancement.
- Utility capacity to eliminate inefficiencies in tariff setting and collection and to manage assets is weak.

Financing

- There is no clear regional financial framework through which to raise funds in order to implement projects, leading to the uncoordinated fund raising at regional, national and utility levels. On the other hand, financiers need coordination on what they can support and that needs to be redirected.
- The "regional project" concept needs to be clarified, and there is a need for the development of a framework for the coordination, implementation; championing and financing of such projects.
- There are limited alternatives to achieve financial closure, as most utilities and IPPs are expecting Eskom to sign PPAs for their regional projects.
- Utilities' inability to raise equity for projects, as the regional projects are owned by utilities.
- Lack of credit rating of all the utilities to be able to borrow for their project equity share.

2.4.2 Petroleum and Gas

2.4.2.1 "Hard" Infrastructure Gaps

In terms of projected supply/demand trends for 2017, 2022 and 2027, the region will require the largest capacity additions for petrol and diesel, amounting to 10 billion, 18 billion and 41 billion litres every five years at a 3%, 5% and 8% growth rate respectively. Smaller capacity additions will be required for paraffin and Jet A1, amounting to as much as 2 billion, 3 billion and 6 billion litres per year for the two fuels every five years up to 2027 at a 3%, 5% and 8% growth rate respectively. Ultimately petroleum products will require a minimum of 12 billion litres p.a. in production, storage and transportation infrastructure expansion every five years up to 2027. The summarised table is presented in Annexure 1.

For LPG, the current growth rate would require minimal additional capacity of 400 000 tonnes every five years up to 2027. The highest required capacity expansion would be 500 000 tonnes every five years at an 8% growth rate.

2.4.2.2 "Soft" infrastructure Gaps

Policies/regulation

Currently there is no harmonised regulatory framework or utilities for distribution. For instance, price variability and uncertainty is a challenge in the P&G sub-sector.

There is potential for the region to strengthen self-sufficiency in petroleum and gas resources by undertaking joint regional exploration and development projects. cooperation in this area must include the harmonisation of policies, regulations and legislation to facilitate cross-border trade and improve capacity utilisation and liaison in the joint procurement of petroleum products in the world market.

SADC is limited in its support of this sub-sector's development, as it is largely driven by foreign-owned companies and Member States no longer have the authority on where the crude oil is sold. The region needs a gas pricing policy for cross-border trading, which can determine the currency of trade in the SADC region.

Plans/strategies
The SADC region requires a comprehensive demand forecast for petroleum and gas, similar to that being developed under the SAPP Plan, as this will provide better guidance for the development of the sub-sector. Currently this is hindered by a lack of co-ordinated data, as data are largely in the hands of the private and public oil companies and national associations. This limits long-term planning for regional infrastructure development.

In the light of gas discoveries, there is need for a plan for a gas pipeline network to serve the electricity sector and industries. The development of both oil and gas pipelines ought to be preceded by a study of a regional gas and petroleum pipeline network. A cost study is also needed on the implications of using refined products versus refining regional oil.

Institutions
Institutionally, a committee was formed to address petroleum and gas issues in the place of REPGA, but it has no budget and has not delivered on its mandate.

Capacity
A lack of adequate capacity at the SADC Secretariat has meant that regional co-ordination to carry this sector forward is neglected. Capacity for regional project development and other necessary policies and regulatory frameworks for effective cooperation in infrastructure development and utilisation is also limited.

2.4.3 Coal

2.4.3.1 "Hard" Infrastructure Gaps

The critical infrastructure for coal lies with the mining sector in terms of increasing production, and with the transport sector for the development of infrastructure that would allow for the export of coal, namely rail systems and port facilities. For some of the landlocked coal-producing countries such as Botswana and Zimbabwe, the ports are far away and competitive transport is needed to make the export of coal worthwhile.

2.4.3.2 Soft infrastructure Gaps

Similar to the situation of the power sector, Member States are currently not focussing on the coal in terms of plans and regional institutions.

2.4.4 Renewable Energy

2.4.4.1 "Hard" Infrastructure Gaps

The "hard" infrastructure for RE has been stipulated in the RESAP and various potential projects requiring infrastructure have been identified, including hydropower (large and small), wind, solar (PV and CSP) biomass (bagasse and gasification), geothermal and biofuels.

2.4.2.2 "Soft" infrastructure Gaps

Policies/regulation

- Standardised rules, regulations and guidelines concerning renewable energy.
- Standard specifications for biofuel products, and set timeframes for the achievement of similar specifications by all Member States.

Plans/strategies

- Priorities for resource assessment and development.
- Grid capacity assessment for connecting RE plants and grid codes.
- Strategic environmental assessment for various forms of RE projects.

Institutions

The SADC renewable energy sub-sector has not made much progress in establishing institutions similar to SAPP and RERA. A RESAP proposal calls for the establishment of a RE centre of excellence, similar to ECREEE of ECOWAS.

2.4.5 Nuclear Energy

2.4.5.1 "Hard" Infrastructure Gaps

The "hard" infrastructure gap for nuclear energy relates to a lack of many planned projects for electricity generation and the uncertain future of the technology. The deficits reflected in the electricity sub-sector also include the nuclear plants that will be introduced by 2023. If there is justification that nuclear power can be deployed safely using the newly-developed Pebble Bed Modular Technology, it could also be considered for deployment earlier than 2023. A demonstration Pebble Bed Modular plant is thus required to test this new technology before full-scale deployment, which may require the resumption of finance for the PBMR project in South Africa.

2.4.5.2 "Soft" Infrastructure Gaps

The "soft" infrastructure issues relate to the need for awareness building to ensure that civil society, currently opposed to nuclear development, can be convinced of the safety of the new technology. Such a campaign should be accompanied by a demonstration of safety nuclear waste disposal mechanisms and the assurance that a nuclear disaster management plan is in place. None of these measures currently exist.

2.4.6 Energy efficiency

Energy efficiency has shown great energy savings potential, particularly in the electricity sector. A manufacturing plant for compact fluorescent lamps was established through a SAPP initiative in the region. In 2010, the SAPP region saved 750 MW through the deployment of CFLs.

Adequate regulatory and legal frameworks for the sustainable use of CFLs, as well as mandatory energy audits are required. Governments lack comprehensive energy management schemes and target for savings from energy efficiency initiatives. There are also no clear incentives to consumers to adopt energy efficiency and energy conservation, apart from costs saving.

2.4.7 Climate Change

Climate change as a potential threat to development, is widely talked about in the region, but no concrete actions are in place to deal with it. For instance, clean energy projects can benefit from

carbon revenue, and often projects that qualify for carbon registration, e.g. CDM, have a high chance of getting investment financing as well.

A number of renewable energy resources such as hydropower, wind and solar power can be affected by climate change and planning should take such impacts into consideration. Climate change through extreme events such as floods, strong winds and storms have increasingly damaged energy infrastructure. Planning is therefore required to monitor such impacts and develop adaptation measures.

Both low carbon development paths with targeted carbon revenue incorporated in clean energy projects, and climate change impact analysis and adaptation measures, are not part of current energy planning in the region. These two issues need to be incorporated in the national development plans of Member States and promoted at SADC level to receive adequate financial support.

3. Strategic Framework

3.1 Strategy for Addressing Gaps and Expected Results by 2027

3.1.1 Significance of Sector and Prioritised Goals

3.1.1.1 Significance of the Sector

The energy sector, although not directly a development sector, is an engine of growth, both in terms of driving economic growth and poverty eradication. Significant economic and social development in SADC region will not be possible without a corresponding increase in access to energy for industries, social services and households. It is no longer debatable that there is a direct link between increased access to modern energy and progress on the MDGs.

The correlation of adequate energy consumption and economic development is well illustrated in Figure 3.1, which shows that GDP/capita increases as per capita energy consumption increases.

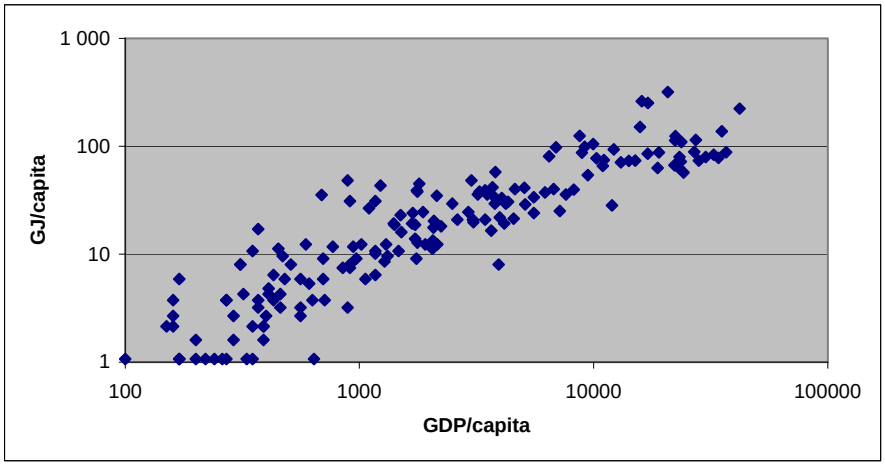


Figure 3-1: Correlation of modern energy consumption per capita and GDP per capita for developing and developed countries
Source of Data FAO and World Bank

The SADC per capita energy consumption is only 0.6 MWh, compared to the world average of 2.6 MWh[22]. It is therefore imperative that adequate energy be available, accessible and affordable for the SADC development objectives of economic development and poverty eradication to be met.

3.1.1.2 Strategic and Priority Goals

The Energy Sector Strategic Plan is based on the framework illustrated in Figure 3.2. The strategic framework for the ESP stems from the Energy Vision of Energising SADC towards adequate, reliable, least cost and environmentally sustainable energy service.

[22] 1 MWh = 3.6 GJ

Figure 3-2: ESP Conceptual framework

The ESP strategic goals are derive from the key energy sector issues that need to be addressed, namely energy security, low cost, modern energy access, tapping additional energy resources and sustainability. Table 3.1 elaborates on some specific issues that need to be addressed as part of the ESP.

Table 3-1: Energy issues being addressed in the ESP

Strategic goal	Issues being addressed
Energy security	Inadequate electricity supply High oil cost and volatile prices
Low access to modern energy	High dependence on traditional biomass Low electrification rates Inadequate transmission capacity
Tapping large energy resources	Untapped, rich renewable energy resources in the form of hydro, wind, solar, geothermal, etc. How to continue the use abundant coal resources
Sustainability	Financial and investment sustainability Environmental sustainability e.g. climate change

The priority goals for each of the sub-sectors are aimed at facilitating the attainment of the strategic goals. These priority goals are presented for each sub-sector indicating general expected outcomes, and will be supported by necessary policy/regulations, plans/strategies, institutional frameworks, capacity building and financing.

3.1.1.3 Electricity

The priority goals envisaged through this Strategic Framework for Electricity is to enable:

- The installation of adequate generation and transmission capacity to meet the forecasted electricity demand. This infrastructure entails the ability to trade in electricity among Member

States. The forecast demand is intended to address SADC's energy needs, catering for current and suppressed demand; and

- Increased access to electricity based on least cost project options. This goes beyond putting in place the large infrastructure to the level of urban/peri-urban and rural electrification.

In addition to these key goals, there are soft goals that include SADC having:

- Harmonised cross-border policy and regulatory frameworks;
- Capacitated SADC institutions with a stronger mandate;
- Centralised project/programme planning; and
- Investment and financing plans.

The expected outcomes from a regional ESP implementation approach are as follows:

- Delivery of electricity at a lower cost to the region. The implementation of the current SAPP Plan (2009) is expected to save the region US$8 billion;
- Sharing of investment costs and risks by Member States that share the same prospects for regional infrastructure development;
- The potentially large market infrastructural services can be attractive investments for global financing institutions and the private sector. Currently the electricity that will be produced by the projects being promoted cannot be fully utilised by most of the SADC countries;
- The liberalisation of the electricity sector creates opportunities for new private players to enter the energy market, particularly if large energy users can directly underwrite some of the projects awaiting PPAs with utilities. IPPs have been accommodated in the current reform, but more needs to be done on the buyers' side;
- Enhanced integration of Member States through cooperation in such infrastructural projects as some of the regional projects being implemented;
- Potential for countries to share their competitive edge and experiences in electricity generation technologies, e.g. Mauritius with bagasse technology, South Africa with coal etc.; and
- Paying more attention to a multi-sectoral/multi-criteria approach to address socio-economic and environmental needs that are of prime importance under other initiatives such as the UN MDGs and climate change.

3.1.1.4 Petroleum and Gas

The priority goals for the P&G sub-sector are:

- Joint exploration and development of trans-boundary petroleum infrastructure (refineries, pipelines, storage facilities), ensuring the efficient supply of P&G products to SADC demand centres. Apart from the "hard" infrastructure, the exploration aspects require the following policy/regulation:

    - Rules of engagement with oil and gas exploration companies to ensure transparency and regulation of benefits
    - Priorities for resource exploration and development
    - Synergy with the African Petroleum Producers Association (APPA)
    - Dispute resolution and joint agreement on development of common P&G fields;

On refinery infrastructure development the following policy/regulatory issues need to be addressed:

- Defined and formalised SADC market to support refinery investment
- Refinery product specifications
- Opportunities to use crude oil from SADC countries and aligning the designs of refineries to match the crude types produced in the SADC region
- Standardised rules, regulations and guidelines concerning access to regional refinery capacity
- Synergy with the objectives and activities of the Africa Refiners Association (ARA);

For pipeline development the following issues need to be addressed:

- Cross-border pipeline agreements and standards
- Ownership: third party access to established P&G infrastructure
- Standardised rules for pricing of P&G products and pipeline usage/levy;

- Joint procurement of petroleum products:
  - Joint procurement of fuel products by Member States in order to benefit from economies of scale by sourcing fuel products in bulk and redistributing to involved countries. This may be more feasible where procurement is done by national oil companies
  - Maintenance of strategic stock/reserves for a standard period, e.g. 30 days for a commercial buffer and 45 days for government reserves
  - Standard specifications for fuel products and set timeframes for when all Member States can achieve similar specifications
  - Developed a regional P&G master plan to inform demand situation and supply options including required storage facilities; and security of supply
  - Standardised rules, regulations and guidelines concerning utilisation and operation of regional storage and distribution capacity & associated infrastructure such as service station depots;

- Harmonised policies, regulations and legislation to facilitate cross border trade, improve capacity utilisation With regard to harmonisation of policies and legislation, the aspect that require attention in addition to the above ones is standard cross-border tariffs for petroleum and gas products;
- Co-ordinated planning of trans-boundary oil and gas pipelines and strategic storage facilities ensuring least cost and uninterrupted supply of oil and gas in the Region. The aspects that should be developed as part of this intervention are:
  - Developed regional petroleum and gas master plan to inform demand situation and supply options including required storage facilities; and security of supply
  - Regional operational database for the P&G sector
  - Standardised system of data collection
  - Obligations to provide information by members and stakeholders in the P&G sector; and

- Dedicated institution for petroleum and gas planning. This is an institution that will co-ordinate the regional aspects of the sub-sector with regard to:
  - The whole supply chain from upstream to downstream
  - Policy formulation and planning;
  - Regulating the market including tariff design and consumer protection;

- Contracts development and negotiations
- Maintaining information management system of the sub-sector.

The expected outcomes are:

- Delivery of P&G at lower cost to the region and improving access through the joint development of strategic refineries, storage facilities and/or pipelines to transport P&G products from Member States with a coastline to landlocked Member States;
- Joint procurement of stocks from oil producing countries and reducing supply costs to individual countries;
- The potential large oil and gas market presented by the SADC countries combined can attract investments for infrastructure development from global financing institutions and the private sector. The sub-sector is amenable to PPP and if the market is attractive, the private sector will participate;
- The liberalisation of the energy sector creates opportunities for new private players to enter the P&G market. The sector is already dominated by the private sector, but not in regional infrastructural development;
- The integration of Member States and the private sector is enhanced through cooperation in such infrastructural projects; and
- The potential for countries to share their competitive edge and experiences, e.g. South Africa's refining and coal to liquids technology and Angola's crude oil production and handling.

3.1.1.5 Coal

The following priority goals are presented for the coal sub-sector:

- Adequate coal production, distribution network and well-designed stock facilities;[23]
- Planning and application of clean coal technologies;
- Co-ordinated planning with mining and transport sector, since the production and delivery of coal depends on these sectors,
- Regional coal development and export strategy,
- Regional co-ordinating institutional framework.

The expected outcomes of these goals are:

- Coal is readily available for power generation and other region-wide economic activities such as industry;
- Coal is exported, as appropriate, to benefit the region economically;
- Coal continues to be used, even under global pressure to reduce global warming and climate change; and
- Cost-effective infrastructure is provided by cooperative planning with other sectors.

[23] Wet coal is increasingly becoming a problem to power stations due to poor design and management of stockpiles. This will be critical for large stockpiles, e.g. at central depots or at ports for export/imports within the region.

3.1.1.6 Renewable Energy

Some of the priority goals in this sub-sector are also common to the electricity sub-sector:

- Exploited abundant renewable energy resources increasing clean energy in the generation mix and also contributing to clean energy access;
- Regional manufacturing of RE products;
- Adequate grid capacity for connection of RE plants;
- Dedicated institutional framework for RE/EE;
- R&D and testing facilities for RE;
- Co-ordinated planning and guidelines for biomass resource/biofuels use;
- Harmonised policy on RE tariff setting and PPA standardisation; and
- Investment and Financial plan (similar to electricity).

The outcomes that are expected by achieving these priority goals are:

- Cleaner energy is provided to the region, meeting the global obligation of limiting greenhouse gas emissions and as a result global warming and climate change;
- Industry and the well-established markets in the region provide renewable energy at a lower cost to the region;
- Reliable RE equipment can be made availed; and
- Biomass stocks and required management are established.

The priority goals for nuclear energy, energy efficiency and climate change are summarised below.

3.1.1.7 Nuclear Energy

The priority goals for nuclear energy relate to building confidence in the fact that nuclear plants can operate in the region, without adverse environmental and safety impacts. This will be achieved through:

- A demonstration plant of the Pebble Bed Modular Plant;
- Documentation on safe nuclear waste disposal;
- Development of a disaster management scheme for nuclear plant disasters; and
- Creating an awareness campaign to educate civil society on the feasibility and plausibility of deploying nuclear energy in the region.

The expected outcome is to ensure that nuclear is acceptable as part of electricity generation option.

3.1.1.8 Energy Efficiency

The priority goals are aimed at ensuring the sustainability of energy efficiency, and are as follows:

- Putting appropriate laws in place for the adoption of energy efficiency principles, e.g. making energy audits mandatory, banning production and retailing of incandescent lamps;
- Reward policies for energy efficiency and energy conservation; and
- Developing energy management schemes in Member States.

The expected outcome is to ensure that there is continued energy saving, thereby avoiding investments in new energy infrastructure such as electricity generation plants.

3.1.1.9 Climate Change

The priority goal for climate change is to ensure that climate change is incorporated in overall energy planning through:

- The inclusion of climate change in national development plans in the form of a low carbon development path, and the development of adaptation measures to climate change impacts;
- Ensuring that clean energy infrastructure projects have a carbon revenue element; and
- Developing an impact assessment framework for energy infrastructure projects and related adaptation measures.
- The expected outcome is that climate change will be planned and budgeted for, the energy sector will benefit from climate change financial resources and countries can be well protected from the impacts of climate change.

3.1.2 Policy and Regulatory Framework

The cornerstones of SADC policies and regulatory frameworks are the current SADC instruments. These instruments are, however, outdated and require revision. The gaps analysis also points out areas/issues that will require additional attention. The sub-sectors share common policies and regulatory frameworks that ensure cooperation of the Member States on:

- The cross-border trading of electricity. The regulatory framework that needs to be harmonised for electricity is based on the principles and guidelines on the aspects presented in Box 5;
- Joint investment arrangements;
- The creation of financial mechanisms to support project development and implementation, as well as the liberalisation of the sectors to allow private sector participation, e.g. large electricity users becoming direct buyers from producers;
- Making an attractive market environment for investments, e.g. on tariff setting;
- Cross-sectoral planning; and
- Balancing self-sufficiency and energy security.

Box 5: Electricity regulatory principles and guidelines required

1. Regulatory powers and duties for cross-border trading.
2. Ensuring compatible regulatory decisions.
3. Timing of regulatory interactions in cross-border trading.
4. Licensing cross-border trading activities, imports and exports.
5. Approving cross-border agreements in importing countries (includes a review of security of supply impacts, tendering requirement, pass-through of power purchase costs to franchise customers).
6. Approving cross-border agreements in exporting countries.
7. Approving cross-border agreements in transit (wheeling) countries.
8. Approving transmission access, investment and pricing.
9. Promoting transparency in the regulation of cross-border trading.

3.1.3 Institutional Arrangements

Although SAPPP, RERA and even the SADC Secretariat lends strong support to the electricity sub-sector, these institutions require strengthening in terms of their staffing, as well as the mandate and authority, particularly SAPP and RERA, to support the implementation of regional energy infrastructure projects.

There are no similar regional coordination and support institutions for planning, project development and implementation for the other sub-sectors. These will need to be established. The proposed institutional arrangements for a comprehensive SADC energy sector are presented in Figure 3.3.

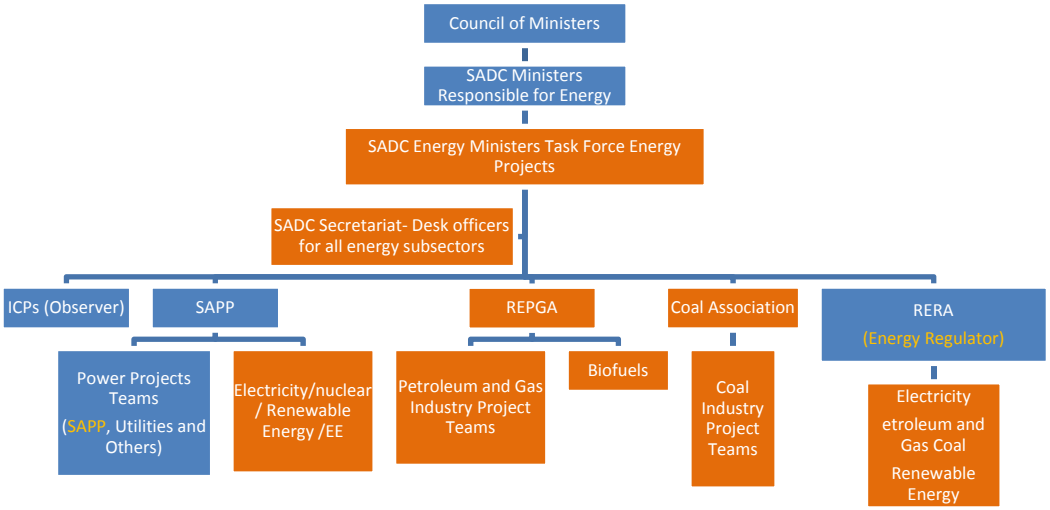


Figure 3-3: Proposed institutional arrangements for SADC energy sector

The proposal is that the SADC Energy Ministers Task Force be encompassing and cover all projects, not just power projects. The SADC Energy Division needs to be adequately staffed to cater for all the energy sub-sectors – electricity, P&G, coal, RE (inclusive of biomass), nuclear and energy efficiency. Aspects of climate change are cross-cutting and can be dealt with at the SADC Secretariat level.

SAPP may require additional staffing to support project co-ordination, implementation and resource mobilisation for the electricity sub-sector. Special Purpose Vehicles (SPVs) (e.g. similar to that for the disbanded WESTCOR project) are required, but in an expanded form to include representatives of SAPP in their project teams and steering committees. SPVs will be created as needed, to facilitate the collective implementation of power projects by promoting comparative advantages for the Member States concerned. The electricity institutional framework can also take care of nuclear and energy efficiency, in the absence of a dedicated RE/EE institution.

However, in RESAP, the proposed RE institution is a standalone institution similar to the ECOWAS Renewable Energy and Energy Efficient Centre (ECREEE) in Cape Verde. This also ensures that the off-grid systems can be accommodated.

Whether an RE institution should fall under SAPP or be independent can be debated further. The rationale for putting it under SAPP would be that most RE projects being considered for the RIDMP are grid connected, so the planning could be coordinated by SAPP.

Since Member States are moving towards energy regulator status, RERA can be transform to be an energy regulator, with adequate staffing to cater for the various energy sub-sectors. RERA should also be given the authority to ensure the enforcement of agreed regulatory decisions.

It was decided that the institution for P&G will be an association (REPGA), but this association is not yet functional. This association may also need to be upgraded to an authority to ensure compliance by Member States and other players in the sub-sector. For instance, demanding data for planning purposes may not be met by a good response, but if there is a standing regulation for stakeholders to provide certain data, it may work better. It is proposed that a transformed REPGA would cater for

petroleum, gas and biofuels coordination, planning, fundraising and support for implementation. The regulatory role of the sub-sector would however be under RERA.

Similarly for coal, there is a weak institutional link to regional energy planning. The institutional arrangement could start as an association to accommodate the participation of other sectors such as mining and transport. The danger of such an arrangement though is the lack of commitment by Member States, leading to the weak implementation of decisions. The institutional arrangement can be monitored, leading to an upgrade to a more binding arrangement.

3.1.4 Projects and Interventions

This section is based on the priority goals and aims to add the targets and strategic interventions that are to be undertaken and the intended outputs from those activities.

The various "hard" projects for the sub-sectors, particularly electricity, are already known, but what is lacking is the implementation. The projects are, however, at different levels of development, even in the electricity sector. The projects and interventions that have been provided in this Strategic Framework relate to how implementation can be achieved. In essence, this is a SADC Energy Sector Plan, and Member States will have to distil what they can and implement it at the Member State level. The emphasis here has been to provide strategic interventions in order for "hard" infrastructure to eventually be implemented.

For instance, only a few "hard" projects have been mentioned in the P&G sub-sector and no further information have been provided on their development. In this case, the Strategic Framework presents the interventions that need to be effected in order to select and prioritise projects for implementation.

Similarly, no initial work has been done in the coal sub-sector and more planning and policy/regulatory/strategy formulation is needed before real "hard" projects can be identified for implementation.

Under RE, least cost projects for the various types of renewable energy sources have been identified under RESAP, but projects are still to be provided by Member States, except those that are already listed in the SAPP Plan and RSA IRP. Under these circumstances, further preparation is required to ensure that "hard" projects are implemented.

The proposed projects and interventions have been presented below for each of the sub-sectors, based on the identified priority goals and in the following categories:

- Investments in regional energy infrastructure for projects that have been prepared, identified, or which still need to be identified;
- Interventions that establish policy, regulatory and institutional frameworks to create a conducive environment for investment in "hard" projects;
- Capacity building projects to empower institutions to coordinate and develop projects, including the creation of data management systems for planning; and
- Pre-investment studies that can guide future infrastructure investments, e.g. studies for pipeline network or guide policy, e.g. a REFIT analysis.

These types of projects and interventions have been put in each sub-sector as strategic interventions. Tables 3.2 to 3.8 presents the strategic interventions that are proposed to meet the priority goals for electricity, P&G, coal, RE, nuclear, energy efficiency and climate change.

Table 3-2: Electricity Strategic Interventions

Priority goal	Current status	Targets	Strategic interventions	Outputs	Outcome	Strategic goal met
Adequate generation and transmission capacity	Planning for a 3% growth rate, which is considered to be for suppressed demand	A better target would be at least 5% to cater beyond suppressed demand	• Revise SAPP Plan to include most recent changes in country IRPs[24] • Study on generation and transmission capacity additions for 5% and 8% growth rates • Prioritise the SAPP Plan projects for regional implementation[25] • Source project development fund for projects • Develop projects to bankable stage • SAPP raise funding for implementation	• Updated and prioritised SAPP Plan, endorsed by Member States • Study on generation and transmission capacity for 5% and 8% growth rates • Bankable projects for raising funds • Funds for project development and implementation	Adequate electricity supply and avoided power deficit up to 2027	Energy security
Improved energy access	24% (SADC overall)[26]	Meet REASAP target of 62% access by 2022 and 81% by 2027[27]	• Finalise the exercise on national energy access roadmap • Member States map additional infrastructure (backbone) for enabling connections • Map most cost-effective technologies for connection to various consumers • Estimate budget for achieving access rates	• Budget for additional backbone infrastructure • Best practice electrification models and infrastructure	Reduced dependence on traditional biomass	Improved access to modern energy service

[24] The current projects have included the most recent information available on country projects as filed with SAPP, but has adopted South Africa's recently adopted priority-adjusted scenario.
[25] Prioritise transmission projects for front ended investments.
[26] Source: PIDA Phase III Report – Energy.
[27] This is higher than the target of PIDA of about 69% for each country by 2040.

Harmonised cross-border policy and regulatory frameworks	Policies and regulations for trade not harmonised	Policies and regulations harmonised	• Assess aspects to be harmonised • Analyse Member State policies and regulations • Merger of harmonised framework to be considered by Member States	Agreed policies and regulations for cross-border trade	Facilitate electricity trade and deliver electricity at lower costs	Energy security
Strong SADC institutions with a stronger mandate	SAPP: no implementation RERA: an association SADC Secretariat (energy): no funding for additional sector desk officers	SAPP: implementation RERA: authority not association and cater for all energy sources SADC well-staffed	• SAPP mandated to raise funds and coordinate implementation in addition to planning and manning DAM • RERA raised to an authority to be effective in regulation • Provide budget for SADC energy staff	Capacitated SADC institutions	Capacity to implement all energy sector infrastructure projects	Sustainability
Coordinated planning	Uncoordinated planning	Planning centralised at SAPP	• Analysis of national IRPs • Amalgamating national IRPS • Agree on prioritisation	Single plan that region is able to follow for implementation	How to tap large resources cost-effectively	Energy security/ untapped resources/ sustainability
Investment and financing plan	Uncoordinated fund raising	Coordinated fund raising	• Compile project development financing facilities • Develop a centralised project development fund facility, e.g. at DBSA • Compile a list of debt and equity support funders and their requirements • Develop risk allocation fund facility to allow utilities to borrow equity, e.g. through AfDB	Sources of funding for project development and implementation	Financial sustainability	Sustainability

Table 3-3: Petroleum and gas strategic interventions

Priority goal	Current status	Targets	Strategic interventions	Outputs	Outcome	Strategic goal met
Joint exploration and development of trans-boundary P&G infrastructure (refineries, pipelines, storage facilities)	Inadequate refineries, pipelines and storage facilities	• Additional refinery capacity for local and imported crude • Network of pipelines • X-day storage facilities	• Asses infrastructure facilities and development stages • Study of cost benefits of additional refinery or importation of white products • Study on pipeline needs and capacity • Agreement on x-day (30/45/ 90 day) storage facilities for Member States	• Decision on expanding refinery capacity • Proposal for pipeline network and capacity • Decision on x-day storage facilities for countries	Guidance on additional refinery, pipeline and x-day storage facilities	Energy security Financial/investment sustainability
Joint procurement of petroleum products	Ad hoc groupings for procurement[28]	Official groupings for joint procurement of petroleum products	• Assess the existing procurement facilities and quantities • Needs assessment of Member States and their location in the region • Set product specifications across countries • Recommend procurement groupings and facilities needed	• Capacity needed for storage reserves • Agreed product specifications • Locations of storage facilities for joint supply	Adequate regional supply to avoid shortfalls	Security of supply
Harmonised policies, regulations and legislation to facilitate cross-border trade and improve capacity utilisation	Lack policies/regulatory framework on e.g. product specifications for cross-border trading	Develop harmonised policies/regulatory framework	• Assess various policies and regulations on P&G trading • Provide harmonised policies and regulatory frameworks • Member States agree on the harmonised policies and regulatory frameworks • RERA is mandated to implement these policies and frameworks	Harmonised policies and regulatory frameworks	Facilitate trade	Energy security

[28] Sometimes Zimbabwe and Malawi procure their fuel through Mozambique

Coordinated planning of trans-boundary oil and gas systems	No centralised planning system and data	Centralised planning for the region	• Develop system of capturing data for planning • Develop a P&G plan, similar to SAPP, and prioritised • Member States agree on priority projects	P&G plan and information management system	Coordinated investments in P&G projects Supply at lower costs	Energy security
Dedicated institution for P&G planning	No dedicated institution for P&G, only a non-functional committee	REPGA with authority status	• Mobilise public and private stakeholders to initiate REPGA • Upgrade REPGA's legal status to authority • Mobile resources from Member States for REPGA	P&G intuitional arrangement	Coordination of P&G projects	Sustainability/ investment/energy security/planning

Table 3-4: Coal strategic interventions

Priority goal	Current status	Targets	Strategic interventions	Outputs	Outcome	Strategic goal met
Adequate coal production and distribution network and well-designed stock facilities	Not well-planned for	Planned coal production and network and storage facilities designs	Undertake a comprehensive analysis of coal production and demand centres in the region, indicating demand patterns	Assessment report	Ensured coal availability	Energy security
Planning and application of clean coal technologies	Conventional coal technologies not popular anymore	Clean coal technologies in power generation and industry use	• Assess the various clean coal technologies and their application and merits • Recommend application for clean technologies for power generation and industry use	Best practice for clean technology	Continued use of tapping coal resources	Tapping abundant coal resources and environmental sustainability
Coordinated planning with mining and transport sector, since production and delivery depends on these sectors	Individual sector planning	Multi-sectoral planning	• Create sectoral planning teams • Assess demands for coal in the region and the location of demand centres • Develop a joint plan	Regional plan for coal production, transport systems and demand	Reliable supply of coal	Financial and investment sustainability
Regional coal development and export strategy	None	Strategy for coal production and exports	• Conduct a study to understand the implications of coal export vis-à-vis local coal demand to avoid a situation similar to the oil sector where all oil is now committed to outside contracts	Strategy document streamlining how much coal should be exported and how much is earmarked for the development of SADC countries	Informed allocation of coal resource utilisation	Energy security investment sustainability
Coordinating institutional arrangements	None in the hands of private sector	Dedicated institutional framework needed for coordinating coal activities	• Create a desk office position at the SADC Secretariat • Mobilise resources for filling the coal desk officer position • Formulate a coal association involving ministries of mining and transport • Develop functions, a constitution and all necessary legal documentation for the association to function	• Coal desk officer at SADC Secretariat • Coal Association co-ordinated through the SADC Secretariat	Co-ordinated coal activities and planning in the SADC region	Sustainability

Table 3-5: Renewable energy strategic Interventions

Priority goal	Current status	Targets	Strategic interventions	Outputs	Outcome	Strategic goal met
Exploit abundant renewable energy resources, increasing clean energy in the generation mix and contributing to clean energy access	More hydro potential to be exploited Very small proportion of other renewable in the energy mix (<1%)	Over 21% RE in grid by 2017, over 33% by 2022 and over 37% by 2027	• Prioritise hydro potential through wind and solar projects in the SAPP Plan for development and implementation, by synergising with RESAP • Support fund raising for project development and implementation • Develop appropriate tariff regimes for different RE energy sources	Targeted RE generation projects	Increased clean energy in the mix	Energy security/ environmental sustainability
Regional manufacturing of RE products	RE equipment mostly imported	Locally produced RE systems	• SADC study to identify demand for various RE technologies and comparative prices for locally manufactured and imported products • Market study for various technologies • Marketing of RE manufacturing opportunity in SADC	Market study report and potential investors	Affordable RE equipment	Energy security/ environmental sustainability
Adequate grid capacity for connection of RE plants	Very little done to assess grid availability for RE plant connection	Known grid capacity and locations in the region in relation to RE potential sites	• Assess grid capacity for connection of RE plants in the region • Evaluate additional capacity required and related costs • SADC mobilises resources for grid updates in Member States and for SAPP grid	Capacity requirements for RE connection	Grid stability and RE capacity additions	Energy supply security/ tapping energy resources

Dedicated institutional framework for RE/EE	Temporary desk officer and no dedicated RE institution	Permanent desk officer at SADC for RE and the formation of RE institutional arrangements	• Assess the most appropriate model that is agreed to by Member States under SAPP or as standalone institution	Agreed institutional arrangements	Coordination and planning of RE infrastructure development	Tapping large RE resources/sustainability
R&D and testing facilities for RE	Limited R&D activities and testing facilities	R&D budgeting and programmes and regionally recognised testing facilities	• Review R&D activities for RE and identify opportunities for further R&D • Assess RE testing centres in the region and harmonise testing required • Support the establishment of R&D and testing centres in the region	R&D programme defined. Testing facilities defined	Innovative and quality RE products	Tapping large RE resources/sustainability(financial and environmental)
Coordinated planning and guidelines for biomass resource/biofuels production and use	Do not know if biomass is renewable due to lack of data	Comprehensive forestry/woodlands data collected	• Undertake a comprehensive regional survey of forest/woodland resources • Set up a system for monitoring changes in forest/woodlands resources	Biomass information management system	Sustainable biomass planning	Environmental sustainability/tapping large biomass resources
Harmonised policy on RE tariff setting and PPA standardisation	REFITS have been started, but not implemented. Delays in PPAs	Recommending a working model for RE tariffs and PPA standardisation	• A study to assess the most appropriate tariff setting for renewable energy connected to the grid • Develop PPA standardisation	Recommended tariff structure for RE in SADC and develop PPA standards	Increased private (e.g. IPP) participation and project financing	Energy security/ tapping large biomass resources/investment sustainability
Investment and financial plan (similar to electricity)	RE is largely donor-supported. No sustainability	Need a sustainable RE financial and investment plan	• Assess the various financial mechanisms for project development and implementation • Form a funding facility for a project development fund • Define a clear framework for financing the implementation of renewable energy infrastructure	Framework for financing project development and implementation	Established RE infrastructure development financing	Investment sustainability

Table 3-6: Nuclear energy strategic interventions

Priority goal	Current status	Targets	Strategic interventions	Outputs	Outcome	Strategic goal met
Demonstration plant of Pebble Bed Modular Plant	1.6% share in SADC generation mix Funding for PBMR stopped by South African government	Additional nuclear capacity	Build a small modular PBMR plant to demonstrate safety and operation	Demonstration plant	Adequate electricity supply and avoided power deficit up to 2027	Energy security
Safe nuclear waste disposal	No regional guideline on nuclear waste disposal		Demonstrate safe nuclear disposal	Audited proof of safe deployment of nuclear	Facilitated investment in nuclear	Environmental sustainability
Development of a disaster management scheme for nuclear plant disaster	No scheme in place	Disaster management scheme for nuclear energy projects	Create a disaster management scheme that is audited by international auditors/accreditors	Disaster prevention and management teams and practices	Safe nuclear use	Sustainability
Creating an awareness campaign to educate civil society on the feasibility and plausibility of deploying nuclear energy in the region	Uncertain knowledge on safety of nuclear plants	Clear understanding of pros and cons of nuclear	Engage civil society in nuclear energy opportunities and constraints	Endorsement of civil society and governments for nuclear deployment	Society confidence in nuclear technology	Sustainability

Table 3-7: Energy efficiency strategic interventions

Priority goal	Current status	Targets	Strategic interventions	Outputs	Outcome	Strategic goal met
Putting appropriate laws in place for the adoption of energy efficiency	1.5% electricity saving	5 – 15% electricity savings	• Member States and SADC establish an EE regulatory framework by late 2013 • Member States make energy audits mandatory • Member States ban the production and retailing of incandescent lamps	Regulatory/legal framework	Sustainable deployment of EE	Energy security
Reward policies for energy efficiency and energy conservation			Member States review EE and DSM projects, funding and policies and create incentives and awards	Incentive policies	Investment in energy efficiency	Energy security
Developing energy management schemes in Member States			• Member States create national programmes for energy management implementation • Member States undertake capacity building for energy management	Programmes and capacity	Sustained EE deployment	Energy security

Table 3-8: Climate change strategic interventions

Priority goal	Current status	Targets	Strategic interventions	Outputs	Outcome	Strategic goal met
• Inclusion of climate change in national development plans • Adoption of low carbon development path • Development of adaptation measures	No climate change budgets	Budgets for climate change programmes	• Member States formulate a low development path strategy and budget for it • Member States assess the impact of climate change on the energy sector infrastructure and develop adaptation measures	Climate change programmes and budgets in NDPs	Implemented climate change programmes	Environmental sustainability
Ensuring that clean energy infrastructure projects have carbon revenue element	No low carbon programme/ targets	Low carbon programmes and carbon revenue targets	Member States identify their RE/EE carbon projects and create a project pipeline for carbon revenue	Low carbon projects implemented	Carbon revenue	Financial/investment sustainability
Developing an impact assessment framework for energy infrastructure projects and related adaptation measures	No climate change impact monitoring and adaptation	Monitored climate change impacts and adaptation measures	Member States assess climate change impacts on the energy infrastructure and develop adaptation measures	Climate change monitoring framework and set of adaptation measures for types of impacts	Avoided costs of energy infrastructure damages	Investment sustainability/energy security

3.2 Small Island States

The island states of Mauritius and the Seychelles may not be affected by the interventions that relate, for instance, to the SAPP grid, as they are not connected to that regional grid. They would also not be focusing on improving energy access, as they are either 100%, or nearly 100%, connected to electricity and have access to modern energy sources such as LPG for cooking.

The island states would, however, benefit from harmonised policies and regulatory frameworks to enable trade of energy equipment between the mainland and the island states. The island states could also benefit from coordinated financial resource mobilisation.

These states can participate in the exchange of experience, e.g. for renewable energy R&D, the manufacturing and trading of RE technologies, clean coal technologies and coal export arrangements. Lastly, the island states can benefit from harmonised tariff setting and standardised PPAs.

3.3 Linkages to Other Infrastructure Sectors

The following cross-sectoral issues and linkages have been identified:

- Electricity and water;
- Gas and electricity;
- Energy and mining (coal and gas);
- Coal and transport;
- Biomass and electricity;
- Electricity and ICT; and
- Energy, water and agriculture, e.g. biofuels production.

3.3.1 Electricity and Water

All the hydropower planning has to be done in conjunction with the water sector. This is relevant in Member States where electricity is largely generated from water, and both the energy and water sectors fall under the same ministries to facilitate joint planning. With the region generating 20% (and expected to reach 40% by 2030) of its electricity from hydropower, the combined planning with river basin institutions and ministries of water is imperative.

3.3.2 Gas and Electricity

There is an increasing link between gas and electricity, and power generation is also shifting from coal to gas as indicated by international trends.

Some Member States have already installed gas power plants. Angola and Tanzania installed 160 MW and 485 MW respectively in 2008. Tanzania plans to add another 240 MW in 2015, while Mozambique plans to install 100 MW and 265 MW in 2012 and 2014 respectively. South Africa is planning to install 237 MW in 2019, 2020 and 2021.

The SADC region has been planning the implementation of gas to electricity plants for a long time, starting with the planned supply of a 1 850 MW power plant in the Western Cape, South Africa through Kudu Gas of Namibia. Namibia is also planning to install a further 800 MW using Kudu Gas by 2016.

Gas turbines are cheaper to install than equivalent coal plants and have the shortest lead time of all plant types. With increasing gas and coal bed methane discoveries, cross-sectoral planning will be required to ensure that gas is availed for utilisation in power generation in the region.

3.3.3 Energy and Mining

Energy and mining also interact, particularly regarding coal and P&G. Coal production, as already discussed, falls in the domain of mining. Similarly, P&G exploration and extraction falls under mining. The allocation of prospecting licenses would therefore be issued in the mining sector. Similar to water, Member States that depend on coal tend to combine energy and mining in one ministry. This demands energy planning with the mining sector in the cases where these two energy commodities are involved.

3.3.4 Coal and Transport

The dependence of coal distribution and exports on transport has already been alluded to. For coal to reach demand centres, it is only cost effective to move it by rail. Where exports are involved, port facilities are also required to stockpile the coal before shipment. In that context it is therefore important to plan coal supply systems in conjunction with the transport sector.

3.3.5 Biomass and Electricity

Various forms of biomass are now used for electricity generation. Sugar cane waste in the form of bagasse is used widely and is influenced by agriculture and the demand for sugar on the international market. Any plant design involving agriculture-based biomass waste should be done with an understanding of where the agricultural and trade sectors are heading.

3.3.6 Electricity and ICT

Transmission lines, including optic fibre, are a priority, as the two sectors can be served by ICT. This is more evident in smart grids, where there is a close integration of electricity generation, transmission and distribution though ICT. This therefore warrants that the planning of transmission lines be synergised with ICT infrastructure, as both can use the same routes and lines.

3.3.7 Energy, Water and Agriculture, e.g. biofuel production

Biofuels, which can in the future be an intervention in the fuels sector (P&G), is largely influenced by both the availability of water and land for production. Land allocation and water rights are therefore allocated by the agriculture and water sectors respectively and any biofuels production would require multi-sectoral planning.

3.4 Risks and Assumptions

3.4.1 Risks

Some of the infrastructure development risks in the region are:

- Some of the regional infrastructure projects have not gone ahead due to national interest overriding regional interests. For instance, a lack of government support for the implementation of the SAPP Plan in favour of national integrated resource planning;
- Political constraints to reach agreement among Member States in implementing regional projects, e.g. for trans-boundary projects;
- The investment climate may not change for the better in some countries due to poor governance and political instability;

- The global financial framework may not improve any time soon in order to support the financing of infrastructure projects;
- Poor cooperation between energy sector players, e.g. for P&G, in not delivering adequate long-term planning information for decision making; and
- Limited capacity for project development and implementation management, particularly at the SADC Secretariat, SAPP and Member States.

3.4.2 Assumptions

The important assumptions related to the development of the RIDMP are as follows:

- Member States will cooperate to give priority to regional projects that can be implemented cost-effectively ;
- Financing shall be available on time to implement the prioritised projects as planned, e.g. in the SAPP Plan;
- There is adequate institutional and human capacity to develop, promote and implement RIDMP projects;
- A framework should be in place to attract funding and private sector participation; and
- The ESP shall be updated regularly to capture the ever-changing global and regional environment.

3.5 Preparing for Future Sector Trends (beyond 2027)

There are changes in the electricity sub-sector that can be expected beyond 2027. Obviously the large coal power plants being built over the next 15 years will still be running, but there will be stronger resistance to invest in coal power stations. The thrust to shift to renewable energy is expected to be stronger as the region moves towards the vision of 100% renewable energy by 2050. A stronger focus on hydropower projects would bring about a good balance, as long as the hydro-dams are not environmentally and socially damaging.

Considering the SAPP Plan and RSA-IRP priority scenario data, the share of coal-based generation added between 2012 and 2027 will be 31% compared to hydro 24%, wind 15%, solar (PV and CSP) 11%, nuclear 11%, gas 3% and distillate 5%. The consideration for additional capacity beyond 2027 should be based on a combination of hydro, wind and solar power. At that stage, geothermal potential may be better understood, making it a candidate for introduction to the generation mix. The SADC Secretariat, with its subsidiary bodies, therefore ought to keep track of developments in the electricity market.

The SAPP Plan of 2009 showed that by 2025, the SAPP region will have to double its generation capacity. The energy mix would also change significantly, with coal still dominating at 56% (down from 74% in 2009) and hydro (up to 34% from 20% in 2009).

The demand for petroleum is not expected to change much, unless the growth global economies slow down further. The politics driving oil prices may stabilise, but economies will continue to be sensitive to oil shocks. The planning for the production of biofuels may gain momentum and alleviate those uncertainties.

Gas exploitation is likely to increase with increasing discoveries of gas resources in the region. Increased demand will occur if the gas is planned for power generation, which will not make a significant impact on the power generation mix by 2027.

Clean coal technologies, e.g. coal to liquids, may increase the continued utilisation of large coal resources. Exports will be important, as the large coal power plants being built in China and India will still be operating for another 15 years or more.

As already indicated under electricity, renewable energy costs will have come down further and large plant options will be available, so there should be a better opportunity for both wind and solar power going forward.

The advancement of nuclear power will remain marred by the recent disasters in the sector and the lack of funding for R&D on nuclear energy in the region. With economies such as Germany preferring to advance renewable energy rather than nuclear, its future deployment is uncertain. In the SADC region, South Africa proposes to introduce addition nuclear capacity of 6 400 MW between 2023 and 2027, but it is unclear what the capacity additions would be beyond that period. .

4 Implementation

4.1 Action Plan

4.1.1 Prioritised Projects, Resource Requirements and Sequenced Timeline

SADC defined a number of projects that are being promoted for development and implementation, with the SAPP Plan as the basis for electricity projects. There are no similar plans for P&G, coal and RE regionally agreed projects. Member States have indicated that they are fowking on some P&G and coal projects. These projects are regional in the sense that they may involve more than one Member States or will affect energy supply at a regional level.

As part of this Action Plan "hard" or physical projects that have been selected for implementation originate from the same sources. These are complimented by "soft" projects that have been presented in the Strategic Framework.

For the electricity sub-sector, the projects that have been costed are from the SAPP Plan 2009, adjusted for changes up to December 2011, and national IRPs. The generation projects have been categorised according to generation type and costed using a range of investment costs for 2017, 2022 and 2027. Transmission costs that may be required to support the additional generation capacity have also been estimated[29]

Annexure 4 presents the estimated investment costs for known generation projects. The estimates for the related transmission projects to support additional generation capacity are presented in Annexure 5.

The estimated generation costs are presented in Table 4.1 and are dependent on the capacity additions in those periods. The total generation costs, as estimated by PIDA, for 2011 – 2030 is about US$289 billion, which is larger probably because it takes into account all power generation between 2011 and 2012 and 2027 – 2030. The maximum estimated generation cost of US$233 would be close to the PIDA estimates.

Table 4-1: Estimated investment costs of all planned electricity generation projects on the SAPP grid

Period	Min US$ billion	Max US$ billion	Average US$ billion
2012 – 2017	41	83	62
2018 – 2022	26	52	39
2023 – 2027	46	98	72
Total	114	233	174

The additional transmission investment costs to support new generation capacity were estimated to be US$540 million (see Annexure 5 for details). This will probably exclude the inter-connector costs that are already planned for. The estimated costs for the four transmission projects planned as inter-connectors and national backbones in SADC is US$3 billion. SADC/SAPP also prioritised generation and transmission projects using SAPP agreed criteria.

The estimated investment costs for priority generation projects (>50% score, >1 000 MW) are US$4.8 billion – US$12.2 billion between 2015 and 2017, US$5.9 – US$17.8 billion between 2018 and

[29] Using the approach in Energy Information Administration. Annual Report Outlook 2011. DOE/EIA-0383 (2010)

2022 and US$24.7 billion – US$74.1 billion between 2023 and 2027.The total estimated investment cost for 2015 – 2027 is therefore a minimum of US$65 billion and a maximum of US$104 billion.

The estimated investment costs for priority generation projects (>50% and <1 000 MW) are US$5.1 billion – US$12.3 billion between 2015 and 2017, US$1.3 billion – US$ 3.9 billion between 2018 and 2022 and US$7.0 billion – US$ 17.8 billion between 2023 and 2027.The estimated total investment for 2015 – 2027 for this category of generation projects range between US$7 billion and US$18 billion.

The total cost of all the prioritised projects (>50% score) would range between US$42 billion and US$122 billion. The planned projects of various sizes that scored below 50% would cost a minimum of US$50 billion and a maximum of US$90 billion. The grand total of all these projects to be implemented between 2015 and 2027 would cost in the range of US$93 billion to US$212 billion, which is close to the budget for all the planned projects above (Table 4.2)[30].

Table 4-2: Estimated investment costs of SAPP-prioritised electricity generation projects 2015 – 2027

Generation projects	Min US$ million	Max US$ million	Period
>50% & capacity >1 000MW	4 845	12 155	2017
	5 920	17 760	2022
	24 735	74 140	2027
Sub-total	35 500	104 055	2015 – 2027
>50% score and <1 000MW	5 134	12 251	2017
	1 305	3 915	2022
	543	1 629	2027
Sub-total	6 982	17 795	2015 – 2027
Total >50%	**42 482**	**121 850**	**2015 – 2027**
<50% score	50 392	89 964	2015 – 2027
Grand total	**92 873**	**211 814**	**2015 – 2027**

SAPP earmarked 11 priority transmission projects, but only five have been costed, totalling about US$3 billion, There projects include the Zimbabwe/Zambia/Botswana/Namibia Project (ZIZABONA) (US$225 million), Zimbabwe Central Transmission Corridor (US$100 million), Zambia/Tanzania/Kenya Inter-connector (US$860 million) and the Mozambique Transmission Backbone Project (US$1 700 million) (Table 4.3). All these projects are expected to have been implemented by 2017 at the estimated cost.

[30] The annexures contain detailed list of prioritised projects and costs calculations.

Table 4-3: Investment costs for some SAPP transmission priority projects up to 2017

Country	Project	US$ million
SAPP priority list		
Transmission		
Zimbabwe/Zambia/Botswana/Namibia	ZIZABONA	225
Zimbabwe	Central Transmission Corridor	100
Zambia	Kafue-Livingstone Upgrade	
Zambia/Tanzania/Kenya	Zambia-Tanzania-Kenya(ZTK) Power Inter-connector	860
Mozambique/Malawi	Mozambique-Malawi 220 kV Inter-connector	94
Namibia/Angola	Namibia-Angola	Study underway
DRC/Angola	DRC-Angola	Study underway
Mozambique	Transmission (Backbone) Project (CESUL)	1 700
Mozambique/Zimbabwe	2nd Mozambique and Zimbabwe Inter-connector	
DRC/Zambia Inter-connector	2nd DRC-Zambia Interconnector	
Zimbabwe/South Africa	2nd Zimbabwe-South Africa Inter-connector	
Total		**2 979**

The PIDA Priority Action Plan 2020 projects that affect SADC countries amount to US$ 28.5 billion (Table 4.4). These projects include four power generation plants, namely the Mpanda-Nkuwa Hydropower Plant in Mozambique (1 500 MW), the INGA III Hydro in DRC (4 200 MW), the Batoka Hydro-electric Plant on the Zambezi River (1 600 MW) and the Lesotho HWP Phase II Hydropower Component (unspecified). The projects also include two transmission lines, the North-South Power Transmission Corridor (8 000 km) and the Central African Inter-connector (3 800 km). The transmission lines extend beyond the SADC region, therefore the countries involved will only participate in the transmission extention through their countries, probably bringing their investment costs down to below US$20 billion.

Table 4-4: PIDA Priority Action Plan for projects affecting SADC countries

Project type	Project name	Description	Stage	Cost US$ million	Countries/region/basin involved
Generation	Mpanda-Nkuwa	Hydro-electric power plant with a capacity of 1 500 MW for export to SAPP	Feasibility needs assessment	2 400	Mozambique-Zambezi Basin
	Lesotho HWP Phase II Hydropower Component	Hydropower programme for power supply to Lesotho and power export to South Africa	Feasibility needs assessment	800	Orange-Sengu River Basin
	Batoka	Hydropower plant with a capacity of 1 600 MW to enable the export of electricity	Project structuring to get financing	2 800	Zambia/Zimbabwe – Zambezi Basin
	Inga III Hydro	4 200 MW capacity of the hydropower station with eight turbines on the Congo River	Feasibility needs assessment	6 000	DRC-Congo River

Transmission	North-South Power Transmission Corridor	8 000 km line from Egypt through Sudan, South Sudan, Ethiopia, Kenya, Malawi, Mozambique, Zambia, Zimbabwe to South Africa	Feasibility needs assessment	6 000	Kenya, Ethiopia, Tanzania, Malawi, Mozambique, Zambia, Zimbabwe, South Africa
	Central African Inter-connector	3 800 km Central African line from the DRC to South Africa through Angola, Gabon and Namibia, and north to Equatorial Guinea, Cameroon and Chad	Early concept proposal	10 500	South Africa, Angola, Gabon, Namibia, Ethiopia
Total				**28 500**	

PIDA estimates transmission costs of US$5.4 billion per year for the whole of Africa. The PIDA study also estimates that if SAPP countries are to increase energy access by 69% by 2040, the investment cost would be about US$27.5 billion, while approximately US$20 billion would be spent by 2030. Member States would need to estimate the costs for improved access, as investments require national extensions of the grid and then connection to consumers of different sizes.

Similarly, the P&G projects that have been mentioned for refineries, pipelines and storage facilities are presented in Annexure 6 indicating the status and costs were estimated where capacities are known, e.g. for refineries. Annexure 6 also presents the calculated estimates of investments for refineries. The estimated investment costs for the planned refineries in South Africa, Mozambique and Angola are US$1 billion – US$5billion. More work is needed to develop the pipeline and storage facility projects in order to make estimations.

Theprojects that are being promoted for rail and ports in Mozambique (Techobanine) and Namibia (Trans-Kalahari Railway to Walvis Bay), and that are intended for coal exports as well, the estimates provided are US$7 billion and US$9 billion respectively (Annexure 7). These will probably be reflected better in the Transport Sector Plan.

The “soft” projects that are presented in Section 3.1.4 will need to be implemented in the short term (2017) to facilitate the implementation of the physical projects.

4.1.2 Implementation Modalities

4.1.2.1 Initial Agreement Between and Maintaining the Commitment of Member States

The initial agreement between and maintaining the commitment of Member States is the most important need to be addressed in order for any regional projects to go ahead. SADC is politically well-connected, but has not demonstrated its commitment to support collective economic development.

Indications that Member States cannot fund institutions such as REPGA, which requires about US$200 000 per year, and cannot support three to four additional staff members at the SADC Energy Division, does not show sufficient commitment.

Member States should already be interested in ensuring that collective development efforts reduce risks and costs, but they should start allocating budget to the implementation of some of the “soft” interventions that have been proposed. Furthermore, the implementation of projects related to coordinated planning and regional projects which have been given sign-off priority is imperative.

The upgrading of the roles of SAPP and RERA can drive more activities to fruitation, and is one of the key milestones that need to be achieved in order for infrastructure projects to be developed and completed.

The fact that funders comfirmed that money for projects is not a problem, despite the 2008 financial crises, shoud encourageMember States to pursue the proposed infrastructure projects and improve capacity to develop projects and seek investment.

4.1.2.2 Financing

Electricity

Financing should be categorised for the types of interventions. Project development has many sources that can support it, but these may be scattered and may need to be cordinated and centralised. The DBSA provides such funding and can be mandated to undertake this exercise.

The conventional source of infrastructure funding in the Member States is public funding in form of national budgets, and is important in delivering the needed both “hard” and “soft” electricity infrastructure.

The funding of “soft” interventions, e.g. policy and regulatory frameworks, the development of information systems, capacity building and the establishment of strategies and plans, can be provided by the various ICPs.

Investment financing need to be carefully looked at, since most utilities do not have the credibility to borrow funds. To add to this problem, tarrifs are not cost reflective in order to entice IPPs, and most utilities depend on Eskom to sign off on PPAs that are utilised for borrowing purposes. A possible solution is to create a risk fund so that utilities can be guaranteed for their borrowing. Such a fund could be located within an infrastructure funder such as the AfDB. Another option is to allow large energy users, such as mines and large industries, to sign PPAs directly with the utilities. This will allow utilities to borrow against the PPAs.

Private sector participation in BOT, BOOT, and PPP are feasible options for financing large infrastructure projects, as proven by the SADC transport sector. Similar modes of financing can be considered for energy infrastructure projects.

Petroleum and Gas

The financing of physical P&G infrastructure can easily be absorbed by the private sector, but markets, prices and regulatory frameworks should be favourable. Projects, such as large refineries in Mozambique that can take advantage of cheaper power and distribute products in the SADC or global markets, can be financed if they are properly developed. Cross-border pipelines will require Member States not to create bottlenecks with regards to charges and the maintenance of infrastructure. Large storage facilities will similarly require a sizeable market of about two to three countries to share procurement costs, maintenance and the consumption of petroleum products.

Similar to electricity, the soft interventions can be financed by governments, ICPs and the private sector.

Coal

Financing for coal infrastructure would probably be sourced through the transport sector where models of PPP, BOO, BOT, BOOT, etc. have been applied in the past.

The private sector has always been active in coal production in South Africa, Botswana and Zimbabwe, although governments would still have an interest in either obtaining shareholding or regulating the mines, e.g. in Zimbabwe. More regional and foreign private sector companies are showing interest in exploring power generation through coal, e.g. in Botswana.

Development in the coal sector is mostly propelled by development in the electricity sector, as financiers for power generation projects will also finance the development of coal mines to supply the raw materials to the power sector.

The interests that China, Brazil and India have in coal in the region may provide an opportunity for the funding of coal projects. Brazilian companies are already active in coal production, power production and exports in Mozambique.

Renewable Energy and Energy Efficiency

The deployment of renewable energy is costly and will require special and attractive tariffs. Due to the varied capacity sizes, the private sector can get involved should the tariffs be attractive. REFITs that have been proposed, e.g. for South Africa and Botswana, are better than for conventional fossil generation, but have not encouraged private sector participation yet. A tarrif negotiation approach, like that adopted by South Africa, will mean that larger tariffs may not be achieved if utilities still have options of conventional supply. A REFIT study has therefore been proposed so that Member States can be better guided on what tariff setting they can adopt for renewable energy projects.

Energy efficiency does not require high capital layouts and, with appropriate incentives to electricity consumers, could be funded by the consumers themselves.

The financing of nuclear projects could still depend on similar sources for electricity. There are various international financing mechanisms to support climate change projects, and some are targeted at building capacity for accessing these funds. The climate change funds being proposed are in the order of US$100 billion.

Some of the funds spent in 2009 – 2010 on climate change mitigation projects alone were in the order of US$92.5 billion, consisting of multilateral financial institutions, bilateral financial institutions, dedicated climate change, carbon offsets, philanthropy and private financing sources.

4.1.3 Milestones and Key Steps

Milestones relate to what will happen after submission of the ESP. This obviously goes through the approval process by SADC ministers and the SADC Summit, after which implementation of the proposed interventions ought to take place.

A timeline has been provided for each of the proposed interventions for each of the sub-sector, including the organisation that will be responsible for implementation and the potential funder (Table 4.5 – Table 4.8). The timeline also provides indication of when milestones should be achieved, as well as a sequencing of interventions, although some will be implemented in parallel.

All the interventions have been proposed for implementation in the next three to four years, as they will facilitate physical project implementation to meet energy demand in 2017, 2022 and 2027.

Table 4-5: Electricity strategic interventions

Priority goal	Strategic interventions	Responsibility	Funders	Timeframe
Adequate generation and transmission capacity	• Revise SAPP Plan to include most recent changes in country IRPs[31] • Study on generation and transmission capacity additions for 5% and 8% growth rates • Prioritise the SAPP Plan projects for regional implementation[32] • Source project development funds • Develop projects up to bankable stage • SAPP to raise funding for implementation	SAPP	ICP/Member States (MS)	2012 – 2013
Improved energy access	• Finalise the national energy access roadmaps • Member States to map additional infrastructure (backbone) for enabling connections • Map most cost-effective technologies for connection to various consumers • Estimate budget for achieving those access rates	MS with SAPP	MS	2012 – 2013
Harmonised cross-border policy and regulatory frameworks	• Assess aspects to be harmonised • Analyse Member State policies and regulations • Merger into a harmonised framework to be considered by Member States	RERA with MS	ICP	2012 – 2013
Strong SADC institutions with a stronger mandate	• SAPP mandated to raise funds and coordinate the implementation, planning and manning of DAM • RERA raised to an authority in order to be effective in regulation • Provide budget for SADC energy staff	MS/SADC	MS	2012
Centralised planning	• Analysis of national IRPs • Amalgamating national IRPS • Agree on prioritisation	SAPP	ICP	2012 – 2013
Investment and financing plan	• Compile project development financing facilities • Develop a centralised project development fund, e.g. at DBSA • Develop a risk allocation fund to allow utilities to borrow equity, e.g. AfDB • Compile a list of debt and equity support funders and their requirements	DBSA AfDB	ICP	2013

[31] The current projects have included the most recent available information on country projects filed with SAPP but has adopted the RSA's priority adjusted scenario which has recently been adopted by South Africa

[32] Prioritize transmission projects for front ended investments

Table 4-6: Petroleum and gas strategic interventions

Priority goal	Strategic interventions	Responsibility	Funder	Timeframe
Joint exploration, development of trans-boundary petroleum and gas infrastructure (refineries, pipelines, storage facilities)	• Asses infrastructure facilities and stages of development • Study of cost benefits of additional refinery or import white products • Study on pipeline needs and capacity • Agreement on x-day (30 or 45 or 90 day) storage facilities for Member States	SADC Secretariat	MS/ICP	2013
Joint procurement of petroleum products	• Assess the existing procurement facilities and quantities • Needs assessment of Member States and their location in the region • Set product specifications across countries • Recommend procurement groupings and facilities needed	SADC Secretariat/MS	ICP	2013 – 2014
Harmonised policies, regulations and legislation to facilitate cross-border trade, improve capacity utilisation	• Assess various policies and regulations on P&G trading • Provide harmonised policies and regulatory frameworks • Member States agree on the harmonised policies and regulatory frameworks • RERA is mandated to implement	SADC/RERA/MS	ICP	2012 – 2013
Coordinated planning of trans-boundary oil and gas systems	• Develop system of capturing data for planning • Develop a prioritised P&G plan similar to SAPP • Member States agree on priority projects	SADC in absence of REPGA	ICP	2013 – 2015
Dedicated institution for P&G planning	• Mobilise public and private stakeholders to initiate REPGA • Upgrade REPGA legal status to authority • Mobile resources for REPGA from Member States	SADC/MS	MS	2013

Table 4-7: Coal strategic interventions

Priority goal	Strategic interventions	Responsibility	Funder	Timeframe
Adequate coal production, distribution network and well-designed stock facilities	Undertake a comprehensive analysis of coal production and demand centres in the region, indicating demand patterns	SADC	ICP/MS	2013 – 2015
Planning and application of clean coal technologies	• Assess the various clean coal technologies and their application and merits • Recommend application for clean technology technologies for power generation and industry use	SAPP/utilities	MS/utilities	2013 – on-going
Coordinated planning with mining and transport sector, since production and delivery of coal depends on these sectors	• Create sectoral planning teams • Assess demands for coal in the region and location of demand centres • Develop a joint plan	SADC/MS	MS	2013

Regional coal development and export strategy	A study to understand the implications of coal export vis-à-vis local coal demand. This will avoid experience similar to the oil sector where all the oil is now committed to outside contracts.	SADC	ICP	2013 – 2014
Coordinating institutional arrangements	• Create a desk office position at the SADC Secretariat • Mobilise resources for filling coal desk officer post • Formulate a coal association involving ministries of mining and transport • Develop functions, constitution and all necessary legal documentation for the association to function	SADC/MS	MS	2012 – 2013

Table 4-8: Renewable energy strategic interventions

Priority goal	Strategic interventions	Responsibility	Funder	Timeframe
Exploiting abundant renewable energy resources, increasing clean energy in the generation mix and contributing to clean energy access	• Prioritise hydro potential through the development and implementation of wind and solar projects in the SAPP Plan and synergising with RESAP • Support in the raising of funding for project development and implementation • Develop appropriate tariff regime for different RE energy sources	SADC/SAPP	ICP	2012 – 2013
Regional manufacturing of RE products	• SADC study identify demand for the various RE technologies and comparative prices for locally manufactured and imported products • Market study for various technologies • Marketing of opportunity for RE manufacturing in SADC	SADC/SAPP	MS/ICP	2013 – 2015
Adequate grid capacity for connection of RE plants	• Assess grid capacity now for connection of RE plants in the region • Evaluate additional capacity required and related costs • SADC mobilises resources for grid updates in Member States and for SAPP grid	SAPP/MS	MS/utilities	2013 – 2014
Dedicated institutional framework for RE/EE	Assess the most appropriate model that is agreed to by Member States, either under SAPP or as standalone institution	SADC/MS	MS	2013 – 2014
R&D and testing facilities for RE	• Review R&D activities for RE and identify opportunities for further R&D • Assess testing centres for RE in the region and harmonise with	SADC/MS	MS	2013 – 2015

Priority goal	Strategic interventions	Responsibility	Funder	Timeframe
	testing required • Support establishment of R&D and testing centres in the region			

Table 4-9: Nuclear energy strategic interventions

Priority goal	Strategic interventions	Responsibility	Funder	Timeline
Demonstration plant of Pebble Bed Modular Plant	Build a small modular PBMR plant to demonstrate safety and operation	Eskom/South African government	Government of South Africa and industry	2017
Safe nuclear waste disposal	Demonstrate safe nuclear disposal	PBMR team/Eskom/ government of South Africa	Government of South Africa and industry	2015
Development of a disaster management scheme for nuclear plant disasters	Create a disaster management scheme that is audited by international auditors/accreditors	PBMR team/Eskom/ government of South Africa	Government of South Africa and industry	2016
Creating an awareness campaign to educate civil society on the feasibility and plausibility of deploying nuclear energy in the region	Engage civil society in nuclear energy opportunities and constraints	PBMR team/Eskom/ government of South Africa	Government of South Africa and industry	2014

Table 4-10: Energy efficiency strategic interventions

Priority goal	Strategic interventions	Responsibility	Funder	Timeline
Putting appropriate laws for the adoption of energy efficiency, e.g. making energy audits mandatory; banning production and retailing of incandescent lamps	Member States and SADC to have an EE regulatory framework established by late 2013	Member States, harmonised by SADC	Member States/ICP	2014
Reward policies for energy efficiency and energy conservation	Member States to review EE and DSM projects, funding and policies and create incentives and awards	Member States and harmonised by SADC	Member States/ICP	2013
Develop energy management schemes in Member States	• Member States to create national programmes for energy management implementation • Member States to undertake capacity building for energy management	Member States, harmonised by SADC	Member States/ICP	2015

Table 4-11: Climate change strategic interventions

Priority goal	Strategic interventions	Responsibility	Funder	Timeline
Inclusion of climate change in national development plans for low carbon development paths and adaptation measures	Member States to formulate a low development path strategy and a budget for it	Member States	Member States	2013
Ensuring that clean energy infrastructure projects have carbon revenue element	Member States to identify their RE/EE carbon projects and create a project pipeline for carbon revenue	Member States with SADC resource mobilisation	Utilities/climate change funds	2013 – on-going
Developing an impact assessment framework for energy infrastructure projects and related adaptation measures	Member States to assess climate change impacts on the energy infrastructure and develop adaptation measures	Utilities/Member States	Utilities	2013 – on-going

4.1.4 Monitoring Mechanism for Status of Implementation

The Monitoring Framework has been developed to indicate whether interventions have been implemented and to give some of the some results. The indicators that have been provided do not follow any of the conventional formats such as the Logical Framework Approach. The idea is to avoid the proliferation of indicators that may eventually not be measured.

The approach adopted here is to consider what aspects are critical to measure. Apart from what is lined up as necessary to energy delivery, other important that give a high level picture, e.g. for electricity, are also given.

The framework includes:

- Number of projects under preparation;
- Projects that secured project preparation funding;
- Number of projects with secured implementation funding;
- Number of electricity projects under implementation;
- Financing gap;
- Capacity additions;
- Share of generation mixes; and
- Access to electricity.

A combination of such high level and intervention indicators has been presented for consideration (Table 4.12).

Table 4-12: Monitoring framework for the ESAP

Sub-sector	Level	What to measure	Indicator	Comments
Electricity	Interventions	Regional priority projects	List of priority projects	Signed off by Member States (MS)
		Harmonisation of cross-border policy/regulation	Agreed policies and regulatory framework	Validated by MS
		SAPP/RERA/SADC mandated and staffed	New status of SAPP, RERA and staff compliment at all three SADC institutions	
		Financial plan	Plan document	Stipulating both project development and implementation risk funding
	High level	Infrastructure financial gap	US$	Investment and access
		Projects being prepared	Number of projects and types	Generation/transmission
		Projects with secured preparation funding	Number of projects and types	Generation/transmission
		Projects with secured implementation funding	Number of projects and types	Generation/transmission
		Electricity projects under implementation	Number of projects and types	Generation/transmission
		Capacity additions	MW and generation source	Coal, hydro, etc.
		Share of generation mixes	%	Coal, hydro, etc.
		Inter-connection added	Km and capacities (KV)	
		Access to electricity	%	
P&G	Interventions	Studies (pipeline networks and storage facilities)	Reports of studies	Validated by MS
		Harmonised cross-border trade regulatory frameworks	Harmonised policies and regulatory framework	Report validated by MS

		Information system	Data base system of Petroleum and gas	data and analysis and reports
		Institution formed	Desk officer at SADC and REPGA in place	With funding provided by MS
	High level			
		P&G projects under development	Number of refineries and capacity Pipeline km and size Storage facilities and size	
		Financing gap	US$	By project type: refineries, pipeline, storage facilities
Coal	Interventions	Studies on demand	Reports	Validated by MS
		Best practice technologies in use	Types	Considered or installed
		Planning team	Team membership	Representing the three sectors
		Strategy	Report	Validated by MS
		Regional coal institution	Institution in place	
	High level			
		Quantities of coal produced	Tonnes	
		Quantities of coal consumed in SADC	Tonnes	
		Quantities of coal exports	Tonnes	
		Infrastructure costs related to coal	US$	
		Financing gap	US$	
		Financing	Type and model	E.g. Private sector, e.g. BOOT, PPP
RE	Interventions	Priority projects	List of projects	Signed off by MS
		Studies (market, REFIT, grid capacity, biomass)	Reports	Validated by MS
		Regional RE Institution	Name and location	
		R&D and testing programme	Programme and facilities in place	Centres for R&D and facilities for testing
		Financial plan	Plan in place	Project financing support
	High level	RE mix in grid	%	
		Capacity additions	MW	
		Tariffs in place	Tariff rates	
		Financing gap	US$	
		Projects status		As in electricity
Nuclear	Interventions	Demonstration plant	MWh produced	In modular form
		Safety of PBMR technology	Audited/certified reporting on plant performance	
		Disaster management scheme	Trained disaster management team	
		Awareness campaign	Tools for communication strategy	
	High level	Capacity of nuclear in SAPP generation mix	MW	
		Safety levels	Number of plant disasters and nuclear related illnesses	Perceptions on safety also important
Energy efficiency	Intervention	Legal/regulatory framework	Acts	
		Incentives	Policy	
		Energy management schemes	EMS programmes and targets	
	High level	Saved electricity	MW	
		Saved plant investment	US$	
Climate change		NDPs with climate change	Number of countries	

		Low carbon development	Number of countries with low carbon development agenda	
		Climate change monitoring and adaptation	Number of countries with frameworks	
	High level	Carbon revenue to countries	US$	
		Avoided costs of weather related damages	US$	

4.2 Critical Factors for Successful Implementation

The following factors are considered critical for the successful implementation of the ESP.

- **Member States commitment:** Member States must show their commitment to cooperate in regional projects and put funding towards improving the functioning of the SADC institutions. Member States should commit to signing off regional priority projects for SAPP to implement;
- **Capacity for project development:** Capacity for the development and implementation of bankable projects will be critical and is needed at SADC, Member State, or utility level;
- **Demand for energy services:** The demand for energy services will depend on whether the SADC economies perform well as predicted. A critical factor is whether the economic growth can be sustained over up to 2027. This will also enable Member States to afford support for and the implementation of projects;
- **Financing availability:** Financial availability will depend on a number of factors, including whether the region is conducive to FDI and private sector investment, hence a framework for attracting private sector participation is critical. Global factors, such as a financial crisis similar to that of 2008, might limit the availability of financing for infrastructure projects and donor support;
- **Strength of SADC institutions:** The SADC institutions are important to drive the regional agenda, and need to be strengthened to fulfil their mandate, both in terms of their staff compliment and skills development; and
- **Updating of plans:** It will be important for the ESP to be periodically updated to capture possible changes in the sector to remain relevant. Updating the ESP and the rest of the RIDMP can be done every five years in line with the suggested timeframe for PIDA revision.

4.3 Way Forward and Specific Actions in Order to Address Challenges

This section spells out the specific actions needed to address the challenges identified for each sub-sector as presented in Table 4.13 – Table 4.20. These were recommendations made by the stakeholders that attended the workshop of 22-23 May 2012.

Table 4-13: Electricity

Challenge	Recommended Actions/Strategies	Responsibility	Timeframe
National interests overriding regional planning	• Heads of state to commit to the SADC RIDMP	SADC	2012
	• Energy ministers to make a commitment through an MoU for the identified SAPP priority projects	SADC	2012
	• Members where projects identified should take the lead in the project marketing and should include these in their national development plans	Member States	2013

Tariff gap (non-cost reflective tariffs)	• Member States should report annually during SADC energy ministers meetings • Their strategies for capital recovery for future investments • Their strategies to move towards cost reflective tariffs, taking into account future investment requirements	Member States	2012
Lack of project preparation capacity	• Member States to form project preparatory units within the ministries of energy. Another option is to implement the national project teams to deal with project preparation and tracking • SADC Secretariat, in liaison with DBSA, to organise training on project packaging	Member States SADC	2013 2013
Lack of credible off takers/PPAs to underpin projects	• Member states should commit to underpin investments or invest in projects within their respective countries • Governments should commit to off-take power on behalf of utilities • Market should be deregulated to allow large customers to assist in underpinning investments in the electricity sector • Member States should work towards making their utilities balance sheets more credible to underpin investments • SAPP, in conjunction with RERA, should develop a PPA template to be adopted by energy ministers	Member States Member States Member States Member States SAPP and RERA	2013 2013 2015 2013 2013
Too many levels of planning (utility, national and regional)	• Member States to liaise with their utilities on project plans • SADC Secretariat to ensure the Electricity Sub-committee discuss Member States' project plans on a regular basis • National project teams to be operational	Member States SADC Member States	2013 Annually 2013
Lack of competitive industry/market structures at national level (single buyer model)	Member States to consider reviewing the single buyer model market structure to allow other off-takers to underpin investments	Member States and SAPP	2015
Weak regulatory framework(s)	RERA to look at individual Member States' regulatory frameworks and assist in making them conducive for investment	RERA	2014
Lack of policies, including policy implementation mechanisms	• Member States are encouraged to put the necessary commercially viable policies in place and implement them • Where policies are not commercially viable, e.g. RE policies, these need to be highlighted	Member States and RERA	2017
Weak project sponsors/developers in terms of balance sheet	Projects should be properly packaged and proper project structures must be put in place in order to attract project finance as opposed to relying on utilities' balance sheets	Member States and SAPP	2013
Uncoordinated fundraising	• SADC to organise an investors conferences every two years • Public-private partnerships need to be encouraged	SADC Member States	2013 2013
Electricity markets in some countries are relative to the sizes of projects to be developed in those countries	There is need to promote projects in other SADC Member States if the host country is unable to absorb all the power to be generated from a project	SADC/SAPP	2013

Risk allocation	• Member States to allocate some funds for their projects for project preparatory works as a sign of commitment to the project • Grant funding to be used to compliment Member States' contributions to project preparatory funds	Member States DBSA and SAPP	2013 2013
Currency indexing	• SADC to speed up the proposed SADC common currency initiative	SADC	2018
Weak capacity of the regional institutions relative to challenges and mandates	• SAPP mandate needs to be revised to include the mandate to do project preparation and development coordination • Human resources ofSAPP, RERA and SADC Secretariat to be beefed up in order to carry out their mandates effectively • SADC Secretariat Energy Division need more staff to effectively cover other sectors such as P&G, coal and RE	SADC SAPP,RERA,SADC SADC	2013 2013 2013

Table 4-14: Petroleum and gas

Challenge	Recommended actions/strategies	Responsibility	Timeframe
Inadequacy of the refining capacity	• Angola (Lobito), SA (Mthombo-400) and Mozambique(Nacala and Maputo) are planning to build refineries • Need to check the adequacy of these refineries to meet regional needs • SADC Secretariat to facilitate regional engagement on these projects, to the benefit of the whole SADC region	Respective Member States SADC SADC	2015-2018 2014 2014
Inability to refine crude oil from within the SADC region	• SA indicated willingness to share refining and crude storage facilities • SADC Secretariat to facilitate regional engagement on these projects, to the benefit of the whole SADC region • Private players need to be engaged, since they are the key players in this sector –SADC and Member States to spearhead this • Member States should provide funding for the recruitment of a P&G expert to spearhead the establishment of a P&G regional coordinating body	SA SADC SADC and Member States Member States	2018 2013 2013 2013
Old refineries	For noting only		
Need for pipeline network infrastructure connecting SADC countries	• A regulatory and investment environment/framework to facilitate cross-border pipeline networks, e.g. inter-country IG-MoUs, need ot eb created • The SADC Secretariat should follow up on implementation of IG-MoUs signed by Members States • A regional body is critical to spearhead all these initiatives	SADC SADC SADC	2013 2013 2014
Unascertained suppressed demand	For noting		

Lack of a study to analyse the costs and benefits of importing refined oil products against refining regional crude oil	For noting		
Lack of readily available and reliable data on P&G	There is no clear co-ordinated collection of P&G data for planning purposes. Some P&G associations, such as SAPIA, keep data, which may not be easily accessible for planning purposes at regional level		
Long-term export commitments of some of the crude oil produced in the SADC region	Covered above		
Synergising gas and electricity	Enhance coordinated planning	SADC	2014
Lack of gas dispatching infrastructure	Noted		
Lack of a gas regional plan in light of regional gas discoveries	Noted		
Weak P&G institutional framework	• A regional body to coordinate these activities need to be established • SADC Secretariat should organise a sector workshop involving all stakeholders to determine a strategy for going forward	SADC SADC	2014 2013
Lack of well-established P&G utilities along the lines of power utilities	A case of lack of coordination between the available players, not necessarily lack of established institutions	SADC	2014
Weak regulatory framework (regulated by governments in some countries and by regulators in others)	• Energy regulators are available in some countries, but the harmonisation of the regulatory framework is lacking • Need harmonisation of regulatory frameworks • Transform RERA to cover energy as opposed to electricity alone	 RERA SADC	 2016 2014
P&G sector largely driven by private sector	Covered above		

Table 4-15: Coal

Challenge	Recommended actions/strategies	Responsibility	Timeframe
High dependence on rail transportation systems with old infrastructure and limited capacity	• Need to conduct a sector study and come up with projects that can address issues • The transport sector is expected to deal with this		
High costs of transportation, especially using road transportation	As above		
Due to transport constraints, some coal is exported as opposed to being utilised in the region	As above		
Environmental challenges for utilisation of coal in electricity sector	Noted		
Carbon tax impacts on tariffs and access of the poor populations	Noted, but may be difficult to avoid		
Weak institutional framework, largely private sector	• Coal is playing a critical role in energy supply in the region • A regional body should be created to deal with coal issues • SADC Secretariat to have a dedicated person to deal with coal issues	 SADC SADC	 2015 2013

Multiplicity of players (ministries responsible for energy, mines, survey, among others), with no clear champions to mobilise explorations funds for coal development	There is need for coordination between the relevant departments	Member States	2013

Table 4-16: Renewable energy

Challenge	Recommended actions/strategies	Responsibility	Timeframe
High technology/upfront costs	• Lesotho has a regional plant for CFLs, SA has a wind plant, Mozambique is developing a solar plant • Guidelines for renewable energy technology need to be put in place • Manufacturing companies within the region should be enhanced to meet regional needs	SADC SADC	2014 2013
Lack of manufacturing (establish market)	As above		
Grid assessment to connect to RE projects	SAPP initiatives on this will resolve the issue	SAPP	2014
Quality of products and lack of proper testing facilities	Need to develop specifications and standards for the products	SAPP	2014
Lack of innovation and localisation strategies	Same as the case of high technology/upfront costs above		
High donor dependence	Noted		
Lack of guidelines and models to analyse the potential impacts and benefits of RE incentives, e.g. Feed in tariffs	Addressed above		
Lack of defined renewable energy projects	To be addressed by the RE Strategy study currently in progress	SADC	2013
Data constraints on biomass energy	• Biomass is playing a critical role in the energy mix • Need for appropriate analysis of technologies that will allow for efficient use of biomass as a renewable energy source and have a better mix with other technologies such as solar • SADC Secretariat to have an expert to look at biomass in detail	SADC SADC	2015 2014

Table 4-17: Nuclear energy

Challenge	Elaboration	Responsibility	Timeframe
Potential plant accidents	SA government, with PBMR team, to define their nuclear development path and when they can demonstrate the PBMR technology in the form of a plant	SA government with PBMR team	2012/13
Problem of nuclear waste	Make information on how safe PBMR technology is public	SA government with PBMR team	2013/14
NGO objection in favour of RE	Engage NGOs and other civil society in issues of safe nuclear electricity generation	SA government with PBMR team	2013 – 2017

Table 4-18: Energy efficiency

Challenge	Elaboration	Responsibility	Timeframe
Lack of regulatory/legal framework	Define the legal and regulatory frameworks needed through a needs assessment	Member States and SADC	2012/13
Lack of incentives	Define needed incentives through a stakeholder consultations	Member States and SADC	2013
Lack of energy management systems	Plan for development of EMS in the countries and required financing	Member States and SADC	2013 – 2014

Table 4-19: Climate change

Challenge	Elaboration	Responsibility	Timeframe
No evident planning to address climate change	Member States include climate change planning in their NDPs	Member States	2013
No clear targeting to benefit from carbon revenue for the projects that are being developed	Needs assessment for a low carbon development path and defining roadmaps	Member States	2013
No clear planning for dealing with the adverse impacts of climate change	Define impact assessment programme and resource requirements	Member States	2013

Annexure 1: Sadc Priority Projects

Priority Ranking Generation Projects Score >50% and Capacity >1 000 MW

SAPP PRIORITY GENERATION PROJECTS (CAPACITY >1 000 MW)					
Priority ranking	**Country**	**Project name**	**Capacity [MW]**	**Technology**	**Expected commissioning date**
1	Mozambique	HCB North Bank	1 245	Hydro	2015
2	Mozambique	Mphanda Nkuwa	1 500	Hydro	2017
3	Zambia/Zimbabwe	Batoka	1 600	Hydro	2022
4	DRC	Inga 3	4 320	Hydro	2018
5	Zimbabwe	Gokwe North	1 400	Coal	2017
6	South Africa	New PF + FBC	6 250	Coal	2026
7	South Africa	Nuclear	9 600	Nuclear	2023
Total			**25 915**		

Summary: Hydro – 8 665 MW
Coal – 7 650 MW
Nuclear – 9 600 MW

Annexure 4: Priority Ranking Generation Projects Score >50% And Capacity <1 000 Mw

SAPP PRIORITY GENERATION PROJECTS (CAPACITY <1 000 MW)					
Priority ranking	**Country**	**Project name**	**Capacity (MW)**	**Technology**	**Expected commissioning date**
1	Zimbabwe	Kariba South Extension	300	Hydro	2016
2	Namibia	Kudu	800	Gas	2016
3	Botswana	Morupule 5 and 6	300	Coal	2015
4	Namibia	Baynes	360	Hydro	2018
5	Mozambique	Benga	600	Coal	2015
6	Zimbabwe	Hwange 7 and 8	600	Coal	2015
7	Zambia	Lunsemfwa Lower	255	Hydro	2016
8	DRC	Busanga	240	Hydro	2016
9	Zambia	Kalungwishi	220	Hydro	2016
10	DRC	Zongo 2	120	Hydro	2016
11	Tanzania	Kiwira	200	Coal	2015
12	Tanzania	Kinyerezi	240	Gas	2015
13	Tanzania	Rumakali	520	Hydro	2018
14	Mozambique	Moatize	300	Coal	2015
15	Zambia	Mambilima Falls Site 1 and 2	425	Hydro	2019
16	Zambia	Mpata Gorge	543	Hydro	2023
17	Malawi	Lower Fufu	100	Hydro	2015
18	Tanzania	Ruhudji	358	Hydro	2017
Total			**6 481**		

Summary: Hydro – 3 441 MW
Coal – 2 000 MW
Gas – 1 040 MW

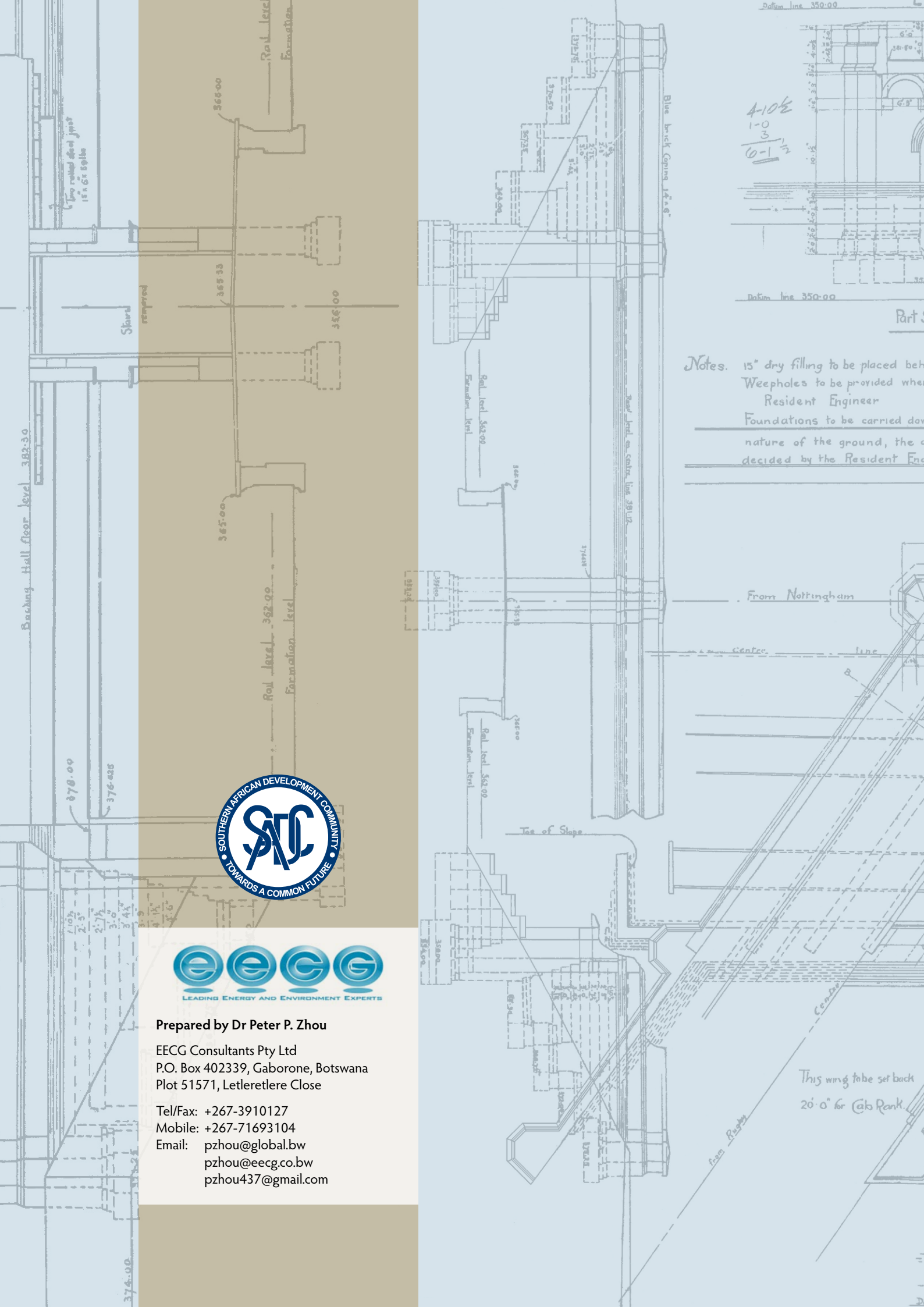
Annexure 5: Priority Ranking Generation Projects Score < 50%

SAPP UTILITY INTEGRATED RESOURCE PLAN GENERATION PROJECTS				
Priority ranking	**Country**	**Project name**	**Capacity [mw]**	**Technology**
1	Lesotho	Kobong Pumped Storage	1 200	Hydro
2	Zambia	Devils Gorge	500	Hydro
3	Malawi	Mpatamanga	260	Hydro
4	Malawi/Tanzania	Songwe	340	Hydro
5	Malawi	Kholombizo	240	Hydro
6	South Africa	OCGT	2 370	Gas
7	South Africa	CCGT Gas	3 910	Gas
8	South Africa	New Wind	7 200	Wind
9	South Africa	Solar PV	6 900	Solar
10	Zimbabwe	Lupane	300	Gas
Total			23 220	

TRANSMISSION PROJECTS TO RELIEVE CONGESTION				
No.	**Project Name**	**Countries**	**Capacity [MW]**	**Expected Date**
1	ZIZABONA	Zimbabwe, Zambia, Botswana, Namibia	600	2014
2	Central Transmission Corridor	Zimbabwe	300	2013
3	Kafue-Livingstone Upgrade	Zambia	600	2014
4	North West Upgrade	Botswana	600	2014

TRANSMISSION PROJECTS TO INTERCONNECT NON-OPERATING MEMBERS				
No.	**Project Name**	**Countries**	**Capacity [MW]**	**Expected Date**
1	Zambia-Tanzania	Zambia, Tanzania	400	2016
2	Mozambique-Malawi	Malawi, Mozambique	300	2015
3	Namibia-Angola	Angola, Namibia	400	2016
4	DRC-Angola	Angola, DRC	600	2016

TRANSMISSION PROJECTS ASSOCIATED WITH NEW GENERATION				
No.	**Project Name**	**Countries**	**Capacity [MW]**	**Expected Date**
1	Mozambique Backbone (CESUL)	Mozambique	3 100	2017
2	2nd Mozambique-Zimbabwe	Mozambique, Zimbabwe	500	2017
3	2nd Zimbabwe-RSA	South Africa, Zimbabwe	650	2017
4	2nd DRC-Zambia	DRC, Zambia	500	2017



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