

**A ROADMAP FOR NAVIGATING THE INSTITUTIONAL  
COMPLEXITIES OF IMPLEMENTING SMALL-SCALE HYDROPOWER  
PROJECTS FOR RURAL ELECTRIFICATION IN SOUTH AFRICA**

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## DISSERTATION SUMMARY

### A ROADMAP FOR NAVIGATING THE INSTITUTIONAL COMPLEXITIES OF IMPLEMENTING SMALL-SCALE HYDROPOWER PROJECTS FOR RURAL ELECTRIFICATION IN SOUTH AFRICA

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The Reconstruction and Development Programme (RDP) White Paper of 1994 laid the foundation for South Africa's developmental trajectory, focussing inter alia on providing basic water-, **electricity**-, health care- and education infrastructure and services, to **all** the people of South Africa. In South Africa, the Government has over the last 20 years been able to provide at least a basic level of electricity service to 86% of the people, with the remaining backlog mainly lying in the rural areas of the country, where topography, location and available technology pose challenges to being able to extend the distribution grid. The Department of Energy (DoE) estimates that the total number of non-grid household connections to be connected between 2014 and 2025 amounts to approximately 300 000. Taking into consideration that between 2002 and 2013, approximately 68 000 non-grid household connections, mainly through stand-alone solar home systems were made, the non-grid electrification programme will need to scale-up considerably; to approximately 25 000 per annum for the period between 2013 and 2025.

The DoE's "New Household Electrification Strategy" allows for any **appropriate and affordable technology** option to be applied towards achieving the non-grid electrification target.

An appropriate energy solution could entail **the application of small-scale hydropower (SHP) technology**, either on its own or in hybrid formation, in conjunction with a **mini-grid distribution system**.

Based on personal experience, risk management on any project is paramount to ensure the success of a project; with risks commonly being identified within specific project work-streams. Risks associated with technical and financial work-streams can traditionally be clearly quantified and mitigated, whereas risks associated with institutional work-streams are often more challenging to identify, quantify and mitigate due to subjective and often political influences.

The necessity therefore of understanding the institutional environment within which small-scale hydropower projects would be implemented, in order to navigate through the complex maze of South Africa's vertically- and horizontally co-ordinated Government architecture, is important.



It was hypothesised that South Africa's robust legislative-, policy- and planning architecture would allow socially driven stand-alone, small-scale hydropower projects with mini-grids, to provide electricity to those sparsely populated areas with low demand potential where it is not economically feasible to provide grid connected electricity.

The primary objective of the research was to develop an institutional roadmap illustrating potential approaches for the implementation of small-scale hydropower electricity generation and distribution projects within the ambit of South Africa's complex legislative-, policy- and planning environment; towards achieving an accelerated rate of delivery of non-grid electrification connections in the deep rural areas of South Africa.

The Study considered National Government planning- and legislation across sectors that have an influence on rural electrification projects, as well as the point where all the national planning, legislation, policies and strategies are to be implemented and operationalised at Local Government level.

This institutional setting within which rural electrification projects in South Africa would need to be implemented, is applied to analyse ownership and operator model options, specifically focussed on small-scale hydropower projects with a mini-grid distribution system.

The outcome of the Study showed that within the ambit of South Africa's current legislative-, policy- and planning environment in South Africa, potential approaches to opportunities exist to implement socially driven, small-scale hydropower projects, as part of the "New Household Electrification Strategy".



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## LIST OF ABBREVIATIONS

AC	Alternating Current
Ah	Ampere hours
ADAM	Approach to Distribution Infrastructure Asset Management
ADMD	After Diversity Maximum Demand
AEEP	Africa-EU Energy Partnership
AEPC	Alternative Energy Promotion Centre (Nepal)
AfDB	African Development Bank
AMEU	Association of Municipal Electricity Utilities (Southern Africa)
Amp	Ampere
ASGISA	Accelerated and Shared Growth Initiative
AU	African Union
AUC	African Union Commission
BA	Basic Assessment
CBO	Community Based Organisation
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CLRA	Communal Land Rights Act
CLTP	Communal Land Tenure Policy
CMA	Catchment Management Agency
CMS	Catchment Management Strategy
COGTA	Department of Cooperative Governance and Traditional Affairs
COP	Conference of the Parties
CPA	Communal Property Association
CPI	Consumer Price Index
CRDP	Comprehensive Rural Development Programme
CSIR	Council for Scientific and Industrial Research
DC	Direct Current
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DM	District Municipality
DoE	Department of Energy
DoRA	Division of Revenue Act
dplg	Department of Provincial and Local Government
DRD&LR	Department of Rural Development and Land Reform
DST	Department of Science and Technology
DWS	Department of Water and Sanitation
EC	Eastern Cape Province OR European Commission (to be read in context)
EDI	Electricity Distribution Industry



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EE	Energy Efficiency
EEDSM	Energy Efficiency and Demand Side Management
EEP	Energy and Environment Partnership
EIA	Environmental Impact Assessment
ENE	Estimates of National Expenditure
ERA	Electricity Regulation Act
es (or LGES)	equitable share or Local Government Equitable Share
ESA	Electricity Services Authority
ERA	Electricity Regulation Act, Act 4 of 2006, as amended
ESP	Electricity Services Provider
EU	European Union
EUEI PDF	European Union Energy Initiative Partnership Dialogue Facility
fbe alt e	free basic alternative energy
fbe	free basic electricity
fbs	free basic services
LCoE	Levelised cost of energy
LPG	Liquid Petroleum Gas
GCAP	Global Climate Adaption Partnership
GCM	Global Climate Model
GEAR	Growth, Employment and Redistribution Strategy
GN	General Notice
IA	Implementing Agent
IAR	Integrated Assessment Report
IDA	International Development Association
IDP	Integrated Development Plan
IEP	Integrated Energy Plan
IEA	International Energy Agency
INEP	Integrated National Electrification Programme
IPAP	Industrial Policy Action Plan
IPP	Independent Power Producer
IRR	Internal Rate of Return
IRP	Integrated Resource Plan
ISMO	Independent System and Market Operator Establishment Bill
ISRDP	Integrated Sustainable Rural Development Programme
IWRM	Integrated Water Resource Management
JAES	Joint Africa-EU Strategy
kW	kilo Watt
kVA	kilo Volt Ampere
kWh	kilo Watt hour
KZN	Kwa-Zulu Natal



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LG	Local Government
LGTAS	Local Government Turnaround Strategy
LM	Local Municipality
LTAS	Long Term Adaptation Scenarios
LTMS	Long Term Mitigation Strategies
MAP	Mean Annual Precipitation
MDG	Millennium Development Goals
MEC	Member of the Executive Council
MFMA	Municipal Finance Management Act
MHVP	Micro-Hydro Village Programme (Nepal)
MIG	Municipal Infrastructure Grant
MIIF	Municipal Infrastructure Investment Framework
MTEF	Medium Term Expenditure Framework
MTSF	Medium Term Strategic Framework
MW	Mega Watt
NCCRP	National Climate Change Response White Paper
NDP	National Development Plan
NEA	Nepal Electricity Authority
NEMA	National Environmental Management Act
NEP	National Electrification Programme
NEPAD	New Partnership for Africa's Development
NER	National Energy Regulator
NERSA	National Energy Regulator of South Africa
NGP	National Growth Path
NIP	National Infrastructure Plan
NPV	Net Present Value
NRREP	National Rural Renewable Energy Programme (Nepal)
NSDP	National Spatial Development Plan
NT	National Treasury
NWA	National Water Act
NWRS	National Water Resource Strategy
O&M	Operation and Maintenance
ODA	Official Development Assistance
ORTDM	O.R. Tambo District Municipality
PDF	Power Development Fund (Nepal)
PDP	Power Development Project (Nepal)
PGDS	Provincial Growth and Development Strategy
PICC	Presidential Infrastructure Coordinating Committee
PIDA	Programme for Infrastructure Development in Africa
PoA	Plan of Action



PPA	Power Purchase Agreement
PPP	Public Private Partnership
PV	Photovoltaic
RECP	Renewable Energy Cooperation Programme
REDs	Regional Electricity Distributors
REDP	Rural Energy Development Programme (Nepal)
REEEP	Renewable Energy and Efficiency Partnership
REFSO	Renewable Energy Finance Subsidy Office
RERL	Renewable Energy for Rural Livelihoods (Nepal)
RESCO	Renewable Energy Service Company
RDP	Reconstruction and Development Programme
REI4P	Renewable Energy Independent Power Producer Procurement Programme
SA	South Africa(n)
SABS	South African Bureau of Standards
SALGA	South African Local Government Association
sanedi	South African National Energy Development Institute
SDA	Service Delivery Agreement
SDBIP	Service Delivery and Budget Implementation Plan
SDG	Sustainable Development Goals
SDP	Spatial Development Plan
SHP	Small-scale hydropower
SHS	Solar Home Systems
SIP	Strategic Infrastructure Projects
SPD	Small Power Distributor
SPP	Small Power Producer
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN SE4ALL	United Nations Sustainable Energy for All
UP	University of Pretoria
V	Volt
W	Watt
Wp	Watt peak
WRC	Water Research Commission
WSA	Water Services Authority
WSP	Water Services Provider



## GLOSSARY OF TERMS

<b>CLIMATE CHANGE TERMS AND CONCEPTS</b> (Field, et al., 2012)	
<b>Adaptive Capacity:</b>	The whole of capabilities, resources and institutions of a country or region to implement effective adaptation measures.
<b>Climate Change:</b>	Any change in climate over time, whether due to natural variability or as a result of human activity.
<b>Climate Change adaptation:</b>	In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate.
<b>Climate Change mitigation:</b>	Technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce GHG emissions and enhance sinks.
<b>Resilience:</b>	The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.
<b>Vulnerability:</b>	Is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. (Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, the sensitivity and adaptive capacity of that system.)
<b>ELECTRICITY TERMS AND CONCEPTS</b>	
<b>Alternating Current:</b>	Electric current that reverses direction many times per second.
<b>Ampere</b>	A unit of electrical current consisting of an electric charge per unit time, in coulombs per second.
<b>Direct Current:</b>	Electric current which flows in one direction.
<b>Electricity Distribution:</b>	Means the conveyance of electricity through a distribution power system, excluding trading.
<b>Electricity Distributor:</b>	Means a person who distributes electricity.
<b>Electricity Distribution power system:</b>	Means a network for the conveyance of electricity which operates at or below a nominal voltage of 132 kV.
<b>Independent Power Producer</b>	IPP means any person in which the Government or any organ of state does not hold a controlling ownership interest (whether direct or indirect), which undertakes, or intends to undertake the development of New Generation Capacity pursuant to a determination made by the Minister in terms of section 34(1) of the Electricity Regulation Act (ERA) (Department of Energy 2011).





<b>Interconnected distribution power system:</b>	Means a distribution power system that is interconnected to a transmission power system either directly or through interconnection to a transmission power system where the latter system is interconnected to a transmission power system.
<b>Kilowatt (kW)</b>	1 kilowatt equals 1 000 watts. (power)
<b>Kilowatt hours (KWh)</b>	This is the basic unit of electric energy equal to 1 kW of power supplied to or taken from an electric circuit steadily for 1 hour. 1 kWh equals 1 000 watt hours. (A television rated at 100 watts operating for 10 hours continuously uses one kilowatt-hour. A 40-watt light bulb operating continuously for 25 hours uses one kilowatt-hour.)
<b>Non-grid electrification: (islanded use)</b>	For the purposes of this Study, “non-grid” electrification is interpreted to mean not connected to an “ <i>interconnected power distribution system</i> ”; and would therefore include the utilisation of mini-grids as a stand-alone application for electrification purposes.
<b>Reticulation:</b>	Means the trading or distribution of electricity and includes services associated therewith.
<b>Service Delivery Agreement:</b>	Means an agreement between a municipality and an institution or person providing electricity reticulation, either for its own account or on behalf of the municipality.
<b>Service Provider:</b>	Means a person or institution or any combination of persons and institutions which provide a municipal reticulation service in terms of a service delivery agreement.
<b>Small Power Producers and Distributors</b>	SPPs are independently operated electricity providers that sell electricity to retail customers on a mini-grid or to the national utility on the main grid or on an isolated mini-grid, or to both. SPPs are usually defined by their size, the fuel that they use or their technology.
	SPDs do not generate electricity. Their primary business is distribution. They buy power at wholesale, typically from a national utility and resell it to households and businesses.
<b>Tariff</b>	A schedule of prices or fees.
<b>Trading:</b>	Means the wholesale or retail buying and selling of electricity.
<b>HYDROPOWER PLANT TERMS AND CONCEPTS</b>	
<b>Generator</b>	A rotating machine that converts mechanical energy to electrical energy.
<b>Head</b>	Vertical change in elevation, expressed in meters, between the head water level and the tail water level.
<b>Mini-grid</b>	A mini-grid is typically defined to be a distribution grid that can operate in isolation from the national transmission grid, supplying a limited number of consumers from an electricity generation source of capacity between 10 kW and 10 MW (Franz, Peterschmidt et al. 2014).
<b>Penstock</b>	A closed conduit or pipe for conducting water to the powerhouse.
<b>Reaction Turbine</b>	A machine which converts the energy of water under pressure to motion. A pressurized case contains the water, which must turn the runner in order to reduce down to atmospheric pressure at the tailrace. The action of a reaction turbine is analogous to a pump running in reverse. Types include the propeller, Francis and Kaplan.
<b>Runner</b>	The rotating part of the turbine that converts the energy of falling water into mechanical energy. The part of Turbine, consisting of blades or buckets on a wheel or hub, which is turned by the action of pressurized water, either by a jet of water (impulse turbine) or by reducing the pressure of the water (Reaction turbine)
<b>Tailrace</b>	The channel that carries water away from a dam.
<b>Tailwater</b>	The water downstream of the powerhouse.



<b>Turbine</b>	A machine in which the pressure of kinetic energy of flowing water is converted to mechanical energy which in turn can be converted to electrical energy by a generator.
<b>GENERAL TERMS AND CONCEPTS</b>	
<b>Capital Cost</b>	The total cost of a project from the conceptual- to the completion stage, including initial studies, management, equipment cost, construction and materials costs, start-up fees, supervision and interest during construction.
<b>Municipality</b> (in context of the ERA):	Means a category of municipality that has executive authority over and the right to reticulate electricity within its area of jurisdiction in terms of the Municipal Structures Act.
<b>TERMS AND CONCEPTS RELATING TO LANDHOLDING</b>	
<b>Communal Property Associations</b>	CPAs are landholding institutions that were established so that groups of people could come together to form a legal entity to acquire, hold and manage property received through the restitution, redistribution and land reform programmes (Weinberg, 2015).
<b>Freehold</b>	Permanent and absolute tenure of land or property with freedom to dispose of it at will.
<b>Leasehold</b>	The right to hold or use property for a fixed period of time at a given price, without transfer of ownership, on the basis of a lease contract. A leasehold is a fixed asset.



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## SECTION 1: INTRODUCTION

### 1 INTRODUCTION

#### 1.1 Background

The electricity supply crisis that South Africans faced during the first months of 2015 has been superseded by a water supply crisis, which, as a result of drought conditions and extreme temperatures, has led to water restrictions being implemented in the City of Tshwane and the City of Johannesburg, taps running dry in many areas of Kwa-Zulu Natal, and the agricultural sector in the provinces of the Free State, North West, Limpopo and Mpumalanga being declared disaster areas.

The portion of the populace impacted most severely by events such as droughts, water restrictions and electricity interruptions are the rural poor, whose ability to adapt and respond to such events are low. Adapting the approach adopted by Downing (Downing, 2011), one can surmise that adaptation to external events fundamentally entails “Good Development”, as well as building the adaptive capacity of all stakeholders involved. Downing’s approach recognizes a continuum of strategies, from good development through to targeting actions to reduce future impacts of external events. “Good Development” in a South African context would entail providing all members of society with at least a basic level of service for water-, sanitation and **electricity** as well as access to basic social services such as health and education.

The Reconstruction and Development Programme (RDP) White Paper of 1994 laid the foundation for South Africa’s developmental trajectory, focussing inter alia on providing basic water-, **electricity**-, health care- and education infrastructure and services, to all the people of South Africa (South Africa, 1994). In South Africa, the Government has over the last 20 years or so been able to provide at least a basic level of electricity service to 86% of the people, with the remaining backlog mainly lying in the rural areas of the country, where topography, location and available technology pose challenges to being able to extend the distribution grid, resulting in increased electricity connection costs. Alternative technological means are required to provide electricity to those sparsely populated areas with low demand potential where it is not economically feasible to provide grid connected electricity.

A lack of access to basic municipal services such as water, sanitation and electricity as well as basic social services, including education and health, compound the prevailing challenges of unemployment and poverty within rural communities. *Rural municipal councils*, by providing basic services, can play an important role in alleviating fundamental poverty and promoting local economic development (National Treasury, 2012).



Rural municipal councils though on their own cannot address the massive challenge that is rural development; rural development must occur within the ambit of national rural development policies, and with the capacity support of both the provincial and national government spheres.

With one of the fundamental objectives of Government being poverty alleviation, and with social development lagging most behind in the rural areas, the Rural Development and Land Reform Ministry was established in 2009.

The Ministry has a dual service delivery mandate, continuing with the implementation of land reform on the one hand, **whilst also being responsible for the coordination of the various services delivery streams which constitute rural development.** The Comprehensive Rural Development Programme (CRDP) was launched in order to realise this dual mandate (DRD&LR, 2014).

The **CRDP** is aimed at creating vibrant, equitable and sustainable rural communities (DRD&LR, 2013a). The three key components that have been developed in order to deliver the objectives of the CRDP, are:

- sustainable land and agrarian transformation;
- **Rural Development, i.e. providing both economic and social infrastructure,** and
- Land reform based on restitution, redistribution and land tenure reform.

It is within this context of rural development, and specifically the provision of basic social infrastructure (including **electricity** services) to rural communities, that the development of small-scale hydropower projects in the O.R. Tambo District Municipality<sup>1</sup> in the Eastern Cape Province, and the uMzinyathi District Municipality in Kwa-Zulu Natal, have been initiated by the Department of Science and Technology (DST). The research undertaken for this Study, contributes directly towards facilitating a conducive implementation environment for these projects by mapping the regulatory-, and legislative requirements necessary to effect project implementation.

## 1.2 Problem Statement

In 2011, 85% of households, or 12.24 million of 14.45 million households in South Africa had been provided with access to at least a basic level of electricity supply, defined as households having access to electricity for lighting purposes (Statistics South Africa, 2012b).

The backlog<sup>2</sup>, i.e. those households<sup>3</sup> without access to at least a basic level of electricity service, was quantified to be approximately 2.2 million households.

<sup>1</sup> The O.R. Tambo- and uMzinyathi DMs are two of the 23 priority districts identified in 2011 by the DRDLR for the implementation of the CRDP.

<sup>2</sup> Backlog is defined to be the number of dwellings (premises in which the consumers are living, regardless of whether these dwellings are formal or informal) which do not have access to a basic service level (DBSA, 2011).

<sup>3</sup> A household is a group of persons who live together and provide themselves jointly with food or other essentials for living, or a single person who lives alone. Note that a household is not necessarily the same as a family (DBSA, 2011).



In comparison to the rest of Africa, this backlog is relatively small; the International Energy Agency (IEA) indicates that South Africa is the only country in sub-Saharan Africa<sup>4</sup> with a basic electricity services backlog of less than 25% (International Energy Agency, 2014).

Backyard dwellings, which are built on the same stand or erf as the main residential dwelling and which are not necessarily metered separately to the formal household, are included in the household figures determined by Statistics SA (Statistics South Africa, 2012a). Due to the fact that network designs were done without taking these approximate 1.1 million unmetered backyard dwellings and households into consideration, the distribution networks will require updating. Further, these households currently do not qualify for inclining block tariffs and neither for Government's free basic electricity grant.

The Department of Energy (DoE) therefore is defining their backlog to be **3.3 million** households, of which approximately 75% fall in the Eskom supply area, and 25% in municipal supply areas (DoE, 2013c). Nearly 45% of the backlog lies in the provinces of the Eastern Cape and Kwa-Zulu Natal (DoE, 2013c).

The census data measures access to electricity in 3 categories, namely: households using electricity for lighting (*can be considered to be the most basic level of service*), households using electricity for cooking, and households using electricity for heating. The 2011 census data shows that households using electricity for lighting reached 84.7%, up from 69.7% in 2001. In comparison to this, in 2011, the number of households using electricity for cooking was 73.9%, and for heating was 58.8% (Statistics South Africa, 2012b).

In June 2013, the South African Cabinet approved the Department of Energy's (DoE) "New Household Electrification Strategy". This strategy revises the target date to achieve universal access to a basic electricity service from 2014 to **2025**, implying that universal access to electricity is to be achieved by the end of the 2024/2025 national financial year (DoE, 2013c).

The universal access target itself has also been revised, from 100% by 2014, to 97% by 2025, with 90% of households to be connected through grid connections, and the remainder through high-quality and cost effective non-grid technologies (DoE, 2013c).

The Sustainable Energy for All (SE4All) Initiative launched by the United Nations (UN) in 2011, and to which South Africa is a partner, aims to achieve universal access to "modern energy services" by 2030 (SE4All Africa Hub, 2015). Importantly, the SE4All initiative emphasises that access to sustainable energy is not an end in itself, but that it is the first step in the development ladder towards access to modern energy services.

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<sup>4</sup> Sub-Saharan Africa includes all countries in Africa except for Morocco, Algeria, Tunisia, Libya and Egypt; collectively grouped as North Africa.



There is no single internationally accepted and adopted definition for “modern energy access”, but it is generally understood to mean household access to a minimum level of electricity (inferred to mean for lighting purposes), **and** access to safe and sustainable cooking and heating facilities (International Energy Agency, 2014). The 2030 SE4All goals are:

- To achieve 100% access to electricity; qualified to mean that 100% of urban households should have access to at least a basic grid-tied electricity service, and that between 65% and 80% of rural households are provided with electricity through an electricity distribution grid. As with the South African “New Household Electrification Strategy”, it is accepted that a portion of the rural population, between 20% and 35%, will require access to electricity through appropriate non-grid electricity technologies.
- To achieve 100% access to clean cooking facilities<sup>5</sup>.

Further, the SE4All initiative aims to achieve improvements in energy efficiency as well as doubling the share of renewable energy in the global energy mix (SE4All Africa Hub, 2015).

South Africa’s “New Household Electrification Strategy”, the free basic electricity policy and the free basic alternative electricity policy, the National Energy Efficiency Strategy, as well as the National Climate Change Response White Paper and the White Paper on Renewable Energy, are aligned to the objectives and goals of the SE4All Programme.

### **Box 1.1: Basic Electricity Service Levels**

The 2011 Local Government Expenditure Review summarises the acceptable minimum levels of access to basic electricity services as; Level 1 Basic (5-8 Amp or non-grid), Level 2 Intermediate (20 Amps) and Level 3 Full (60 Amps) (National Treasury, 2012).

#### **Level 1 – non-grid**

In the case of non-grid (solar home system) connections, a basic electricity service is defined to mean a 50 W, direct current (DC) limited supply to cater for 4 lights for 4 hours per day, a small monochrome television for 2 hours per day, a small radio for 10 hours per day (DoE, 2015d). A 50W solar panel equates to approximately 250 Wh/day (i.e. power for 5hours/day, and equating to 91.25 kWh/year) (DoE, 2012a). Thermal energy needs, such as cooking, heating and refrigeration are typically not catered for (DoE, 2012a) under this basic service definition.

#### **Level 2 - grid**

The DoE considers a 20 Amp limited supply to be the basic service for the poorest sector where grid extension is feasible, able to cater for typical appliances such as a radio, lights, television, fridge, and one of the following at any one time: (iron & double hotplate) or (kettle & single bar heater) or (iron & two bar heater) or small geyser (DoE, 2015d).

<sup>5</sup> Solid fuels such as biomass, coal and animal waste used for cooking purposes are considered harmful. LPG is typically considered as a “clean” fuel to be used for cooking (Sustainable Energy for All, 2015).



**fbe**

The Electricity Basic Services Support Tariff document sets the free basic **grid** electricity allocation at 50 kWh/month (or 600 kWh/year) per household. In addition, the Tariff document allocates free non-grid electricity to all INEP connected non-grid electrified households funded from the energy component of the equitable share to a maximum of 80% of the monthly service fee per indigent household (DME, 2003).

The intention of the free basic services policy was to provide a basic level of service to poor, or indigent<sup>6</sup>, households.

For the purpose of this Study, any reference to “non-grid” technology options, refers to all stand-alone systems which are not interconnected to an electricity transmission or distribution grid, and could therefore include both solar home systems and mini-grid systems.

It is assumed that the electricity services provision through a stand-alone mini-grid system could provide a Level 2 service.

This is reflected diagrammatically in Figure 1.1, in the context of South Africa’s Universal Access Strategy.

The DoE estimates that the total number of non-grid household connections to be connected between 2014 and 2025 amounts to approximately **300 000**, (DoE, 2013c), with the highest potential for non-grid electrification initiatives lying in the Eastern Cape- and Kwa-Zulu Natal provinces. Refer Figure 1.2.

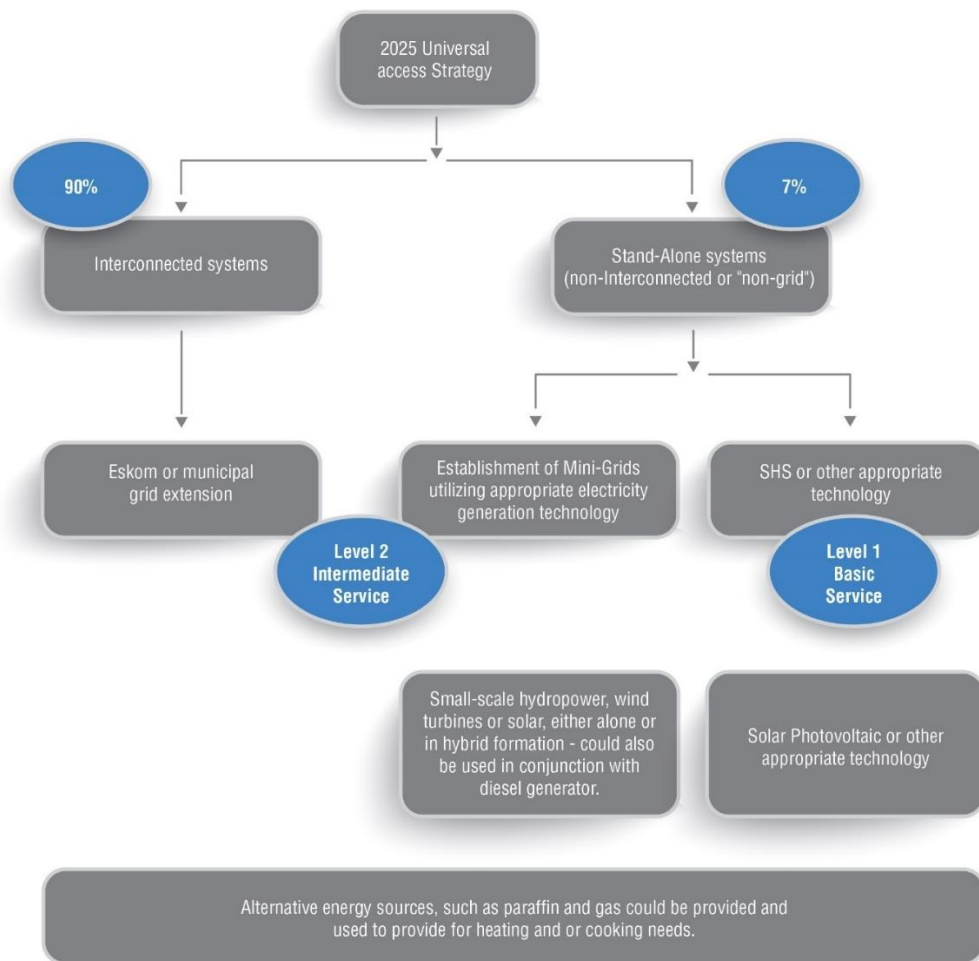
Taking into consideration that between 2002 and 2013, approximately 68 000 non-grid household connections, mainly through stand-alone solar home systems were made, (DoE, 2013c), **the non-grid electrification programme will need to scale-up considerably; from an average of 6 200<sup>7</sup> households provided with non-grid electrification per year over that 11 year period, to approximately 25 000<sup>8</sup> per annum for the period from 2013 to 2025.**

The operational mechanism through which both the non-grid-, and the grid programme is being rolled-out is the DoE’s “Integrated National Electrification Programme”, or INEP. The INEP was established during the 2001/02 financial year to address the backlog of households without electricity. At that time, it was planned that new household developments would be electrified through the restructured Electricity Distribution Industry (EDI). Since the restructuring of the EDI did not occur over time, the INEP not only has to address the electrification backlogs, but also the electrification of new household developments and informal households (DoE, 2013b).

<sup>6</sup>Households and citizens who are unable to access or afford basic services, are generally referred to as indigents. Individual municipal indigent by-laws are developed, which results in different definitions being applied throughout the country, also impacting the determination of the equitable share allocation to that municipality (dplg, 2005).

<sup>7</sup> Prior to FY12/13 this was not an indicator measured for reporting by the DoE to the National Treasury. 9 343 non-grid connections were made during FY12/13, and 14 059 connections made during FY13/14 (National Treasury, 2015b).

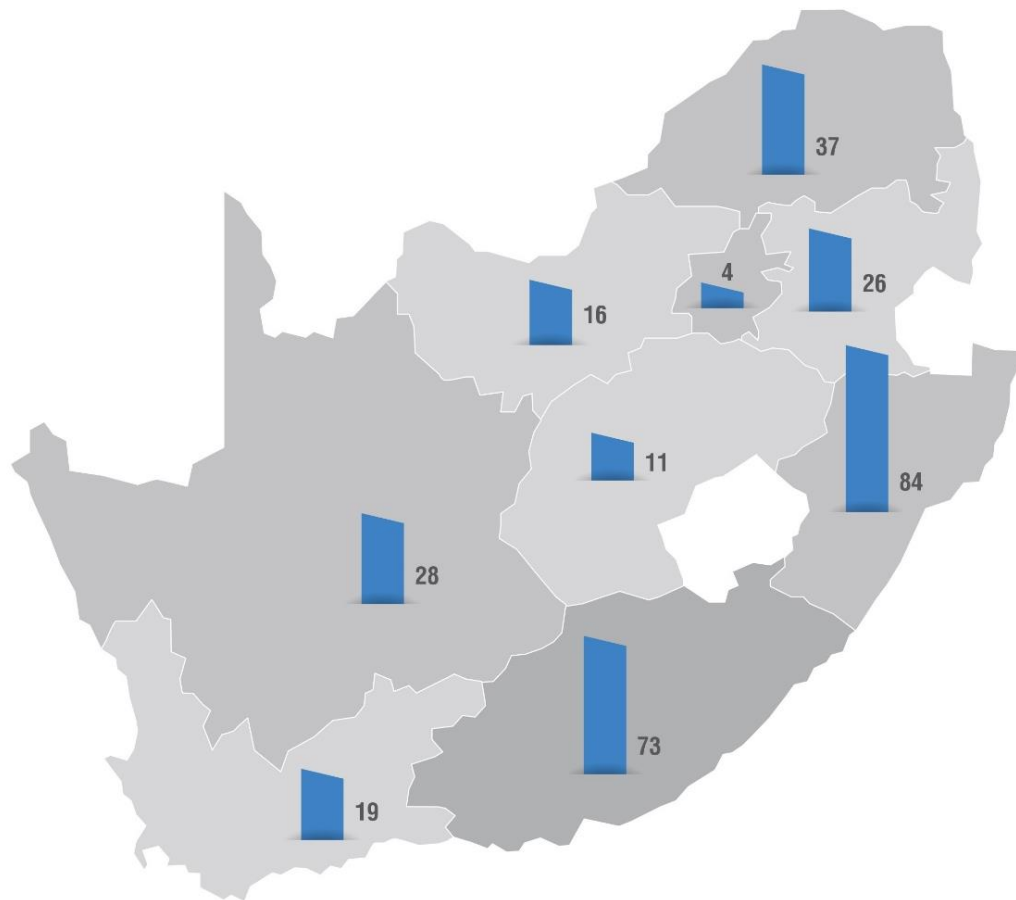
<sup>8</sup> The annual non-grid connection target was 15 000 for FY14/15, and 20 000 for FY15/16 and FY16/17, increasing to 25 000 by FY17/18 (National Treasury, 2015b).



**Figure 1.1: Diagrammatic representation of the Universal Access Strategy, indicating potential technology options**

The DoE makes use of Eskom and municipalities as implementing agents for the grid connecting portion of the programme, and transfers funds to these entities to implement the objectives of the INEP. The funds need to address the development of various elements of electricity distribution, including the building and upgrading of sub-stations and distribution networks, as well as the electrification of households (DoE, 2013b).





**Figure 1.2: Anticipated number of households ('000) per province that potentially could benefit from non-grid electrification projects**  
(DoE, 2013c)

Prior to the 2013 “New Household Electrification Strategy”, the non-grid portion of the programme was to be implemented only by private concessionaires appointed by the DoE to provide solar home systems (SHS) specifically, and within specific geographic areas.

The 2013 strategy makes provision for the implementation of not only solar home systems **but any other possible cost-effective technology.**

Further, it is extending the roll-out of the non-grid programme country wide, particularly to those rural areas with low consumption, as well as to high density urban households where it is not possible to provide grid connections (DoE, 2013c).

The challenge therefore can be summarised to be to find appropriate energy solutions for the deep rural areas of South Africa, that will be able to deliver non-grid basic electricity services to households at a rate of approximately 25 000 connections per year.



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**Box 1.2: Energy options for rural electrification**

Electrifying rural areas can be effected either through expanding an electricity distribution system, or providing stand-alone systems. Stand-alone systems in turn can be either home systems, or mini-grid systems. Solar technology is traditionally applied for the electrification of individual homes; and solar-, wind-, and **small-scale hydro** technology options are used either independently or in hybrid formation (depending on cost and appropriateness) for mini-grid systems. **Mini-grid systems** could also be used in conjunction with a diesel generator.

In South Africa, due to the fact that a basic non-grid electrification level of services does not provide for heating and cooking needs, alternative energy sources such as paraffin and gas are considered as options to complement rural electrification initiatives.

An appropriate energy solution could entail **the application of small-scale hydropower (SHP) technology**, either on its own or in hybrid formation, in conjunction with a **mini-grid distribution system**. In South Africa, typical hybrid formations would include small-scale hydropower technology applied in conjunction with diesel generators and solar PV systems.

The application of **small-scale hydropower** is deemed an appropriate technology for rural electrification due to (ARE, 2014), (BHA, 2005), (Paish, 2002):

- SHP has been shown to be the cheapest technology for rural electrification over the lifetime of the system. The initial capital costs of such a project are high, but with low operating costs. This is diametrically opposite to, for example, the application of a diesel generator, for which the initial capital cost is low, but the operating costs are high.
- SHP technology is mature, robust and reliable, with proven track-records of longevity (50 years or more), and efficiency<sup>9</sup> (70%-90%).
- It is a local energy source that makes use of small rivers. Stream flows are generally consistent, especially in comparison to the variability of solar- and or wind technologies, and therefore output can be calculated with a higher degree of reliability.
- Operation and maintenance of a SHP system is relatively simple and can be undertaken by appropriately trained local community members.
- It is an environmentally friendly, and sustainable solution, that does not consume water.
- SHP technology can be retrofitted to existing infrastructure, establishing a multi-purpose scheme. For example, SHP plants could be retrofitted to existing dams, integrated into a water reticulation network or within irrigation canals.
- Opportunities for the implementation of SHP exist in South Africa, in particular in the EC- and KZN provinces (Jonker Klunne, 2013).

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<sup>9</sup> Efficiency is described as the percentage obtained by dividing the actual power or energy by the theoretical power or energy. It represents how well the hydropower plant converts the energy of the water into electrical energy (van Vuuren, et al., 2013).



**Box 1.3 Hydropower Classification**

Hydropower is generated when energy from falling and or flowing water is converted into rotating shaft power by hydro-turbines, which can be used to drive an electricity generator, or other machinery (Paish, 2002). Stated differently, *“the energy of flowing water is harnessed by turbines, which are placed in the path of the water flow. The force exerted by the water moving over turbine blades rotates the turbine runner; the turbine runner rotates the generator, which produces electricity”* (Fichtner Management Consulting AG, 2015, p. 11).

The power available is proportional to the product of *pressure head* and *volume flow rate*.

The general formula for any hydro system’s power output is:

$$P = \eta \times \rho \times g \times Q \times H \dots \dots \dots (1)$$

Where:

- P** is the mechanical power produced at the turbine shaft (Watts),
- η** is the hydraulic efficiency of the turbine,
- ρ** is the density of water (kg/m<sup>3</sup>),
- g** is the acceleration due to gravity (m/s<sup>2</sup>),
- Q** is the volume flow rate passing through the turbine (m<sup>3</sup>/s), and
- H** is the effective pressure head of water across the turbine (m).

Topography and geography, as well as the hydrological flow regimes of a specific site will dictate a unique hydropower plant design.

Typical components of a hydropower plant are the civil works (e.g. weir, penstock, powerhouse and tailrace), the electro-mechanical works (e.g. generators and turbines), hydraulic steel structures (e.g. valves) and the grid connection infrastructure (e.g. transformers and distribution grid) (Fichtner Management Consulting AG, 2015).

Hydropower plants are generally classified by size, by head and by operation. Although there is no internationally accepted standard for the classification of hydropower plants by size or by head, the following parameters are generally followed (Fichtner Management Consulting AG, 2015) (van Vuuren, et al., 2013) (Jonker Klunne, 2009):

<b>Classification by size</b>		<b>Classification by Head</b>	
- pico:	P < 20 kW	- low:	2m < H < 30m
- micro:	20 kW < P < 100 kW	- medium:	30m < H < 100m
- mini:	100 kW < P < 1 MW	- high:	H > 100m
- small:	1 MW < P < 10 MW		
- medium:	10 MW < P < 100 MW		
- large:	P > 100 MW		

Pico- and micro sized plants are typically used in developing countries for energy provision to isolated communities, and has the potential to be developed utilising local labour and local materials. Mini sized plants are viable to be grid-connected, and usually require appropriate access roads to ensure that the electro-mechanical equipment can be delivered to site (Jonker Klunne, 2009).



### **Classification by operation**

*Run-of-river schemes* generate electricity by immediate use of the inflow, by diverting either a portion or all of the river flow through a turbine. Most of these types of schemes have no, or very little storage capacity and are subject to weather and seasonal variations.

*Storage schemes* are the stereotypical hydropower plant; water is released from a reservoir as and when electricity generation is needed. This allows this type of scheme to be less affected by weather and seasonal fluctuations. The construction of dams, and the subsequent impoundment of water though, have significant environmental impacts.

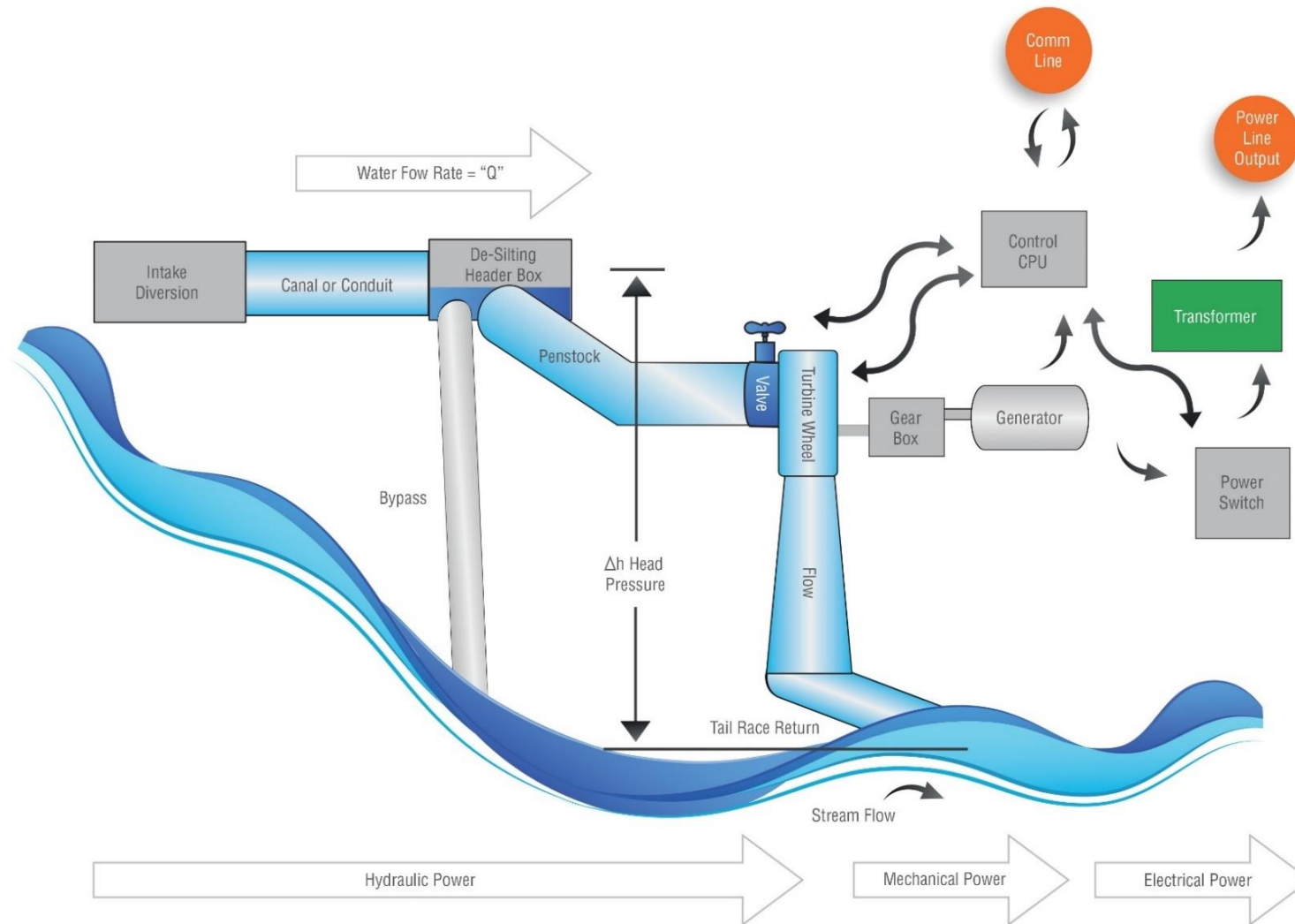
*Pumped Storage schemes* are hydropower schemes whereby water is pumped from a low level water source during off-peak periods to a higher level reservoir. Water from the high level reservoir is released through turbines when peak-time electricity is needed.

Unconventional opportunities for hydropower generation exist within existing water distribution infrastructure, at for example, water treatment works, reservoirs, pressure reducing stations and irrigation channels (van Vuuren, et al., 2013).

For the purposes of this Study, towards applying small-scale hydropower technology for rural electrification, hydropower plants of size less than 1 MW are considered, at any head and which are predominantly run-of-river type schemes.

Current perceptions in South Africa regarding the feasibility of mini-grids as an appropriate technology option towards achieving universal electricity access to the rural poor in South Africa, are predominantly based on studies towards the application of mini-grids for *commercial purposes*. In the context of South Africa's electrification achievements of the past, the relatively small number of dispersed, and mostly indigent, households in South Africa that are still to be electrified through appropriate non-grid solutions, and the current social subsidy schemes, it is understood that a commercial opportunity for a private entity wishing to establish a profitable non-grid electricity generation and distribution business, is not likely to exist.

This commercial perspective on the viability of mini-grids in South Africa though should not be applied to a *needs* perspective, driven by social and humanitarian prerogatives.



**Figure 1.3:** Diagrammatic illustration of a typical “Run-of-River” hydropower system (ARE, 2014)



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### 1.3 Hypothesis

In order to meet the non-grid electrification target in South Africa over the next 11 years, the methods and means used to provide non-grid rural electrification need to be scaled-up. Implementing the non-grid electrification programme only through stand-alone solar home systems, will in all likelihood not achieve the necessary scale. Consideration to other appropriate energy technologies, such as **small-scale hydropower**, must be given, as well as to the application of **mini-grid systems** to serve more than one household from a single but communal point of electricity generation.

In lieu of the 2014 publication by the Africa-EU Renewable Energy Cooperation Programme's (RECP) *"Mini-Grid Policy Toolkit: policy and business frameworks for successful mini-grid roll-outs"*, specifically for the implementation of non-grid rural electrification projects using renewable energy sources and mini-grid distribution infrastructure, it is hypothesised that the institutional framework within which the provision of (social) non-grid rural electrification is to occur in South Africa, is conducive for implementing stand-alone small-scale hydropower projects with mini-grid distribution infrastructure.

### 1.4 Objectives of the Research

The **primary objective** of the research is to develop an institutional roadmap illustrating potential approaches for the implementation of small-scale hydropower electricity generation and distribution projects within the ambit of South Africa's complex legislative-, policy- and planning environment; towards achieving an accelerated rate of delivery of non-grid electrification connections in the deep rural areas of South Africa.

In order to reach the objective of the study, the following **research questions** have been formulated:

- What is the current legislative-, regulatory- and institutional framework in South Africa within which the implementation of small-scale hydropower projects for non-grid rural electrification in South Africa, needs to occur?
- What is international good-practice with regards to the governance arrangements of non-grid rural electrification projects or programmes; and specifically with regards to using small-scale hydropower and the construction of stand-alone and or grid-tied mini-grid systems?
- Within the context of both South Africa's governance framework and international best practice, what potential institutional steps could be followed in order to implement small-scale hydropower projects towards sustainable rural electrification in South Africa?

This research contributes to, and forms part of, a Department of Science and Technology (DST) funded research project, implemented via the Water Research Commission (WRC), to initiate, plan, design and implement small-scale hydropower projects for non-grid rural electrification in two District Municipalities (DMs) in South Africa, namely the O.R. Tambo District Municipality in the Eastern Cape Province and



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the Umzinyathi District Municipality in the Kwa-Zulu Natal Province. **A secondary objective** of this research therefore is to develop an appropriate institutional approach to realise the implementation of small-scale hydropower projects at locations within the two identified DMs.

### 1.5 Scope of the Research

The scope of this research is based on a municipal perspective to infrastructure development, mainly due to the fact that Local Government is the sphere of Government in South Africa responsible for services provision to the people in their jurisdiction, and is therefore also the major confluence of Government grant funding, for example the municipal infrastructure grant (MIG)-, the equitable share (es) and the INEP grant.

For the provision of electricity services to rural communities in South Africa through renewable energy non-grid rural electrification projects, the following scope parameters for this study were chosen:

- Studying the *institutional* project implementation environment within which such a project would need to be implemented.
- Analysing and determining the most appropriate *ownership and operator models* in the context of international best practices for small-scale hydropower projects in South Africa.
- Researching the possible avenues of Government Grant *funding* for the implementation of rural electrification projects through the application of small-scale hydropower technology and distribution infrastructure. This is presented against a background of international donor funds as well as other South African funding sources.

The research of the *institutional environment* within which rural non-grid electrification projects would be implemented firstly addresses national government planning- and legislation across sectors that have an influence on rural electrification projects, and secondly, addresses the point where all the national planning, legislation, policies and strategies are to be implemented and operationalised at Local Government level.

This component of the research is holistic in nature, and would be applicable to any renewable energy technology applied to rural non-grid electrification projects.

It **excludes** analyses of any potential political institutional risks (for example the impact of the 2016 Local Government elections on project implementation), the role of provincial government and the *interplay* between Government and Traditional Councils with regards to issues pertaining to Communal Land Tenure, on the implementation of small-scale hydropower projects.

From experience in practice, the risks associated with institutional elements of a project cause the greatest project delays, and have the potential to derail a project completely.



This section of the Study was therefore undertaken to provide broad insight into the implementation environment of renewable energy rural electrification projects, so as to minimize as far as possible the institutional risks for the DST funded projects in the Umzinyathi DM and O.R. Tambo DM, as well as any future projects of this nature.

This complex institutional setting within which rural electrification projects in South Africa would need to be implemented, is applied to analyse *ownership and operator model options*, specifically focussed on small-scale hydropower projects with a mini-grid distribution system.

This component of the research is further complimented by the preliminary design work undertaken by other project team members working on the DST funded projects.

Finally, the current *grant funding options* for non-grid renewable energy projects in general are analysed and discussed.

The following elements are excluded from this component of the Study:

- Any detail electrical engineering elements;
- Descriptions of the design elements of a hydropower scheme, in general and specifically to the DST funded projects. Information pertaining to this can be attained from a 2015 Study undertaken by Gideon Bonthuys (Bonthuys, 2015).
- Neither a cost-benefit analysis of different small-scale hydropower options, nor a comparative analysis between appropriate renewable and non-renewable energy technologies, is provided;
- Carbon tax implications on rural electrification projects.

## **1.6 Approach and Methodology**

The research was undertaken, as far as practically possible, through a **transdisciplinary** approach. This implies that, inter alia:

- Research findings could be applied in practice, and re-integrated into the academic and research community;
- Stakeholders from both the academia and practice were consulted and engaged with.

The research was undertaken **qualitatively** through **desk-top studies** and **stakeholder engagements**. Public sector stakeholders engaged with included representatives of the National Energy Regulator of South Africa (NERSA), Eskom, the South African Local Government Association (SALGA), the Department of Energy, the Department of Water and Sanitation (DWS), City Power, the City of Tshwane and the eThekweni Municipality.





Private sector stakeholders included electrical engineers and consultants, and Environmental Practitioners specialising in implementing the requirements of the National Environmental Management Act (NEMA) and the National Water Act (NWA).

Due to the fact that the DST funded projects are being implemented in practice, the desk-top research findings will be verified in practice, although this process will only be realised after the finalisation of this Study. The engagements with the specific Local Municipalities and community beneficiaries will occur predominantly after the conclusion of this Study, but will continue as part of the DST funded project implementation process.

## 1.7 Organisation of the Report

This research report consists of the following sections, chapters and appendices:

- **SECTION 1: INTRODUCTION**
  - In **Chapter 1**, an introduction to the report is presented. It contains the background to the research, the problem statement, the study objectives, the scope of research and the methodology followed during the research.
  
- **SECTION 2: INSTITUTIONAL CONTEXT**
  - In **Chapters 2, 3, 4 and 5** descriptions of the legislative- and regulatory requirements, as well as the institutional-, and planning context, to and within which non-grid rural electrification projects utilising small-scale hydropower technologies, would need to comply with and operate in, is given.
  - A **key output** of this section is the legislative and policy map, showing the vertical and horizontal governance architecture within which rural electrification projects occur in South Africa.
  
- **SECTION 3: OPERATIONAL CONTEXT**
  - In **Chapter 6**, the literature review undertaken on *rural electrification* options, is presented, and an interpretation of the “*Mini-grid policy toolkit: Policy and Business Frameworks for successful mini-grid roll-outs*” for South African, small-scale hydropower rural electrification projects, is given. This is the **key output** of this section.
  - In **Chapter 7**, a high-level summary of the technical design of the DST funded small-scale hydropower projects is presented.



- **SECTION 4: FUNDING CONTEXT**

- In **Chapter 8**, the study on the grant funding available to municipalities for non-grid rural electrification projects is discussed. **A process roadmap** for the potential implementation of small-scale hydropower projects under the “New Household Electrification Strategy” is included at this stage of the Study – bringing together the research of all the Sections of this Study.

- **SECTION 5: CONCLUSION**

- **Chapter 9** summarises the research undertaken, and identifies areas for further research.
- **Chapter 10** lists the references consulted during the research.



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## SECTION 2: INSTITUTIONAL CONTEXT

### 2 INSTITUTIONAL PLANNING ENVIRONMENT IN SOUTH AFRICA

#### 2.1 Brief Introduction

Implementing rural electrification projects in South Africa occurs within an intricate vertical- and horizontal governmental structure. Vertically, South Africa's government is divided into National-, Provincial- and Local Government spheres, each with allocated roles and responsibilities and constitutional mandates, as defined primarily by the Constitution of South Africa. Both vertical- and horizontal coordination across government spheres and inter-departmentally is necessary to achieve integrated planning and effective service delivery (LinkD, 2013) (Giordano, et al., 2011). In the electricity sector for example, the responsibility for electricity *generation* is allocated in the Constitution as a national government function, and the responsibility for the *distribution* of electricity as a Local Government function.

Further, the co-ordinating function for *rural development* lies with the Department of Rural Development and Land Reform (DRD&LR); but the responsibility for ensuring a conducive environment for the implementation of rural *electrification* at *Local Government level*, lies with the Department of Energy (DoE).

The implementation therefore of any rural electrification programme or project, must be developed in the context of both these national departments' mandates, as well as be aligned with relevant policies and planning processes across the three spheres of Government, and across other government sectors (LinkD, 2013).

In the context of rural electrification through small-scale hydropower technologies, the Department of Water and Sanitation (DWS) would also be required to play an active role, specifically relating to their mandate of protecting and managing South Africa's water resources. In addition, the principles of South Africa's Climate Change Response White Paper (CCRWP), and the Long Term Mitigation Strategy (LTMS) developed by the Department of Environmental Affairs (DEA) need to be recognized and considered. Both the policy- and strategy document stress the importance of curbing anthropogenic green-house gas emissions by committing sector departments to specific targets and objectives towards climate change mitigation and adaptation.

The implementation therefore of rural electrification projects utilising small-scale hydropower technologies needs to occur within the complex policy and strategy environment of at least four national government departments, not considering the roles of the National Treasury, the Planning Commission and the Department of Local Government and Traditional Affairs, and implemented in an integrated and co-ordinated manner at Local Government level.



Numerous regulatory and legislative requirements govern the implementation of small-scale hydropower schemes in South Africa. Pertinent legislation that needs to be adhered to includes the Constitution of the Republic of South Africa, the Electricity Regulation Act (ERA), the National Water Act (NWA) and the National Environmental Management Act (NEMA).

These are discussed in context in the following chapters.

## 2.2 A national planning perspective for rural electrification

In February 2013, South African Cabinet Ministers Trevor Manuel and the late Collins Chabane briefed the media on the implementation of the *National Development Plan (NDP)* – South Africa's long-term strategic plan that aims to ensure that all South Africans attain a decent standard of living through the elimination of poverty and the reduction of inequality. A core element of what constitutes a “decent standard of living” was defined therein to be access to housing, water, *electricity* and sanitation (GCIS, 2013).

*“The NDP has been adopted as a National Plan for the whole country. It is our roadmap for the next 20 years. All the work we do in government is now part of the comprehensive National Development Plan, including all operational plans, be they social, economic or political.”* (South Africa, 2014)

The 2014-2019 Medium Term Strategic Framework (MTSF) constitutes the first of a series of five-year planning cycles that would operationalize the objectives of the NDP, by allocating key *outcome based activities* from, inter alia, the NDP, the New Growth Path<sup>10</sup> (NGP), the National Infrastructure Plan<sup>11</sup> (NIP), and the Industrial Policy Action Plan<sup>12</sup> or IPAP, to individual Government Departments through Departmental *Delivery Agreements* (GCIS, 2013) (South Africa, 2014).

Currently, the delivery agreements constitute an important input to the planning and budgeting processes of Government, (DEA, 2010) but are not legally binding (Giordano, et al., 2011).

Fourteen priority outcomes were identified for the 2014-2019 MTSF period (South Africa, 2014), with outcomes 7 and 9 having specific relevance to this Study:

1. Quality Basic Education;
2. A long and healthy life for all South Africans;
3. All people in South Africa are, and feel safe;
4. Decent employment through inclusive growth;
5. A skilled and capable workforce to support an inclusive growth path;
6. An efficient, competitive and responsive economic infrastructure network;

<sup>10</sup> NGP: sets the trajectory of economic development

<sup>11</sup> NIP: guides the roll-out of infrastructure to improve people's lives and enable economic growth

<sup>12</sup> IPAP: focusses on promoting investment and competitiveness in leading sectors and industries



- 
7. **Vibrant, equitable, sustainable rural communities contributing towards food security for all;**
    - a. **Including, inter alia, increasing access to quality basic infrastructure and services.**
  8. Sustainable human settlements and improved quality of household life;
  9. **Responsive, accountable, effective and efficient Local Government;**
    - a. **Including inter alia, connecting 1.4 million additional households to the grid in the 5-year MTSF period, as well as 105 000 additional non-grid connections.**
  10. Protect and enhance our environmental assets and natural resources;
  11. Create a better South Africa and contribute to a better Africa and a better world;
  12. An efficient, effective and development-oriented public service;
  13. A comprehensive, responsive and sustainable social protection system;
  14. A diverse, socially cohesive society with a common national identity.

National and provincial sectoral strategic plans for the period 2015-2019, aligned with the 2014-2019 MTSF, would have been submitted to Parliament and provincial legislatures during February 2015. Annual performance plans will reflect progress on key actions based on these strategic macro plans (South Africa, 2014).

Government is addressing infrastructure constraints through the work of the Presidential Infrastructure Coordinating Committee (PICC), (South Africa, 2014) which published the National Infrastructure Plan in 2012, which inter alia, details 18 Strategic Integrated Projects, or SIPs.

These 18 SIPs were developed to support economic development and address service delivery in the poorest provinces (PICC, 2012). Of particular relevance to rural electrification are the following SIPs:

- SIP 6: Integrated municipal infrastructure project
  - *“develop national capacity to assist the 23<sup>13</sup> least resourced districts to address all the maintenance backlogs and upgrades required in water, electricity and sanitation bulk infrastructure”* (PICC, 2012)
- SIP 8: Green Energy in support of the South African economy;
- SIP 10: Electricity transmission and distribution for all;
- SIP 11: Agri-logistics and rural infrastructure.

SIP 6 appears to be aligned with Action Plan 6 of 2011, stemming from the Cabinet Lekgotla of July 2011. Action Plan 6 called for *“scaling up rural development programmes including investment in rural areas and the revitalisation of smaller towns”*: (DRD&LR, 2013b)

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<sup>13</sup> 23 DMs were originally identified. This number increased to 27 over time.



It must be noted that planning at Local, Provincial and National level is further guided by long term development strategies such as the National Spatial Development Perspective (NSDP) and the Provincial Growth and Development Strategies (PGDS) (dplg, 2006).

Theoretically, projects at local level should only be implemented if they appear in a municipality's Integrated Development Plan (IDP) (dplg, 2006), which is a consolidation of the local sector plans, including the local electricity plan. The Department of Co-Operative Governance and Traditional Affairs (CoGTA) clearly allocates responsibility to sector departments to ensure that local sector plans are aligned with national policies, legislation and strategies to ensure sustainable delivery of projects (dplg, 2006). Rural electrification projects at local level should therefore be based on, inter alia, the Department of Rural Development and Land Reform's (DRD&LR) Agrarian Transformation Strategy, taking cognisance of the Communal Land Tenure Policy, and the Department of Energy's "New Household Electrification Strategy".

Via the provincial sector plans, if applicable, the key priorities for municipal projects are used to inform the Sectoral Macro-Plans, including the DoEs multi-year strategic plans, and their annual revisions.

The macro sector plans therefore can be considered to be the point of interaction of all three perspectives: this is where the input from the municipalities come through, how the objectives from the Delivery Agreements are captured into departmental plans, and where policy, legislation and strategy are operationalized.

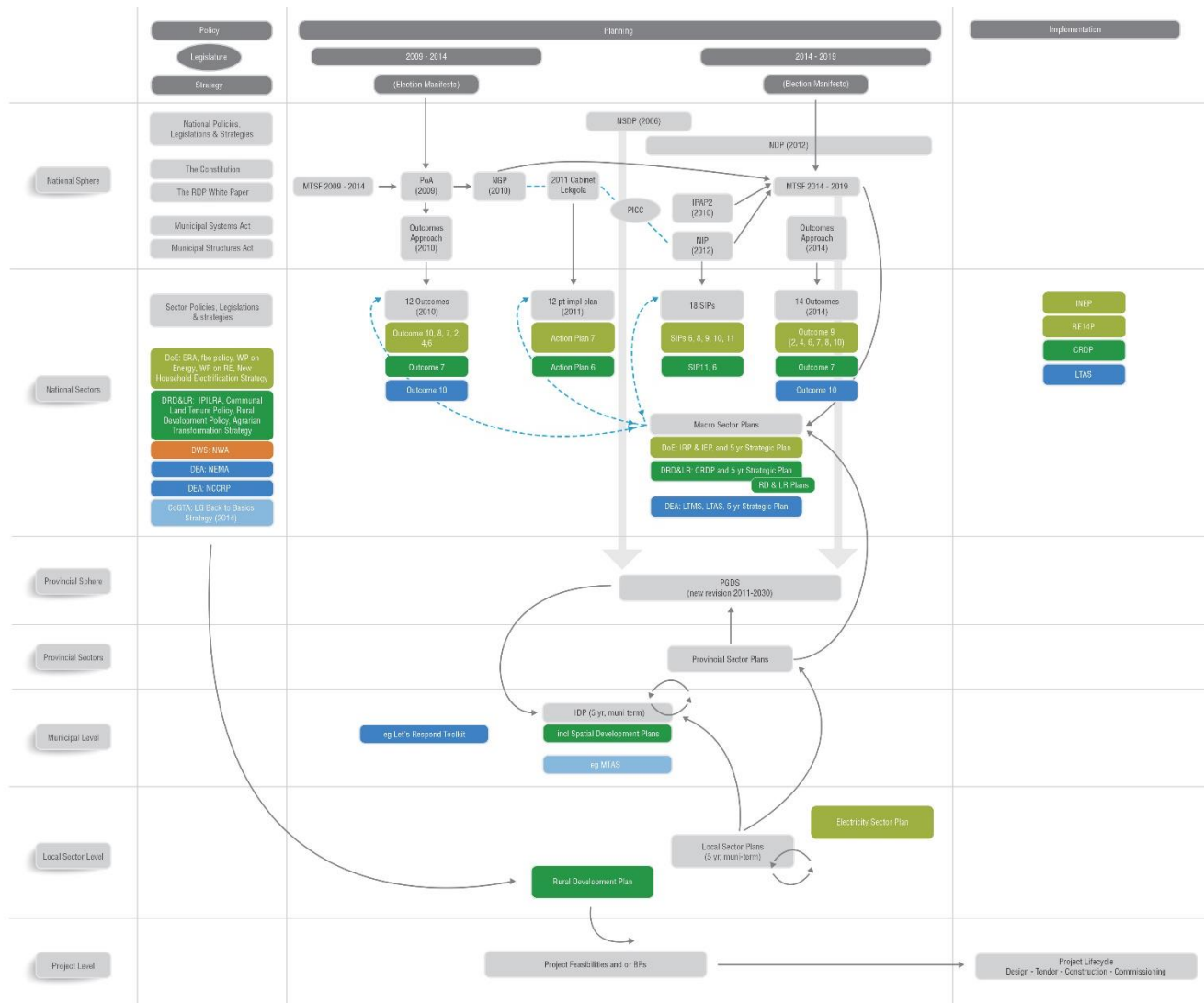
This is diagrammatically represented in Figure 2.1.

The architectural framework to ensure service delivery at local government level, is well established, but challenging to implement in practice. This mainly due to the capacity constraints experienced by local government. The 2014 COGTA released "Back-to-Basics" report, found that one third of South African municipalities were dysfunctional; another third were executing their functions at a barely acceptable level – and only one third of municipalities were executing their constitutional mandate satisfactorily (COGTA, 2014).

Challenges faced by municipalities include:

- Infrastructure backlogs;
- O&M, refurbishment and asset management needs;
- Lack of capacity to address institutional, technical and financial aspects to address the infrastructure challenges;
- Lack of cost recovery initiatives;
- Substantial lack of funding to address the infrastructure challenges;
- Lack of integration at municipal level towards services delivery;
- Complex institutional environment, including challenges relating to both horizontal and vertical co-ordination requirements.

A roadmap for navigating the institutional complexities of implementing small-scale hydropower projects for rural electrification in South Africa  
**SECTION 2: INSTITUTIONAL CONTEXT**



**Figure 2.1: Horizontal and Vertical Policy Architecture influencing the Electricity Sector**



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### 3 ELECTRICITY: A SECTORAL PERSPECTIVE FOR RURAL ELECTRIFICATION

Social and economic development in South Africa is highly dependent on the generation and effective transmission and distribution of energy for, inter alia, industry and household use, and as such, energy policy has been strongly influenced by economic and political drivers (Winkler, et al., 2006).

Winkler, et al. studied South Africa's energy policy evolution over time, and identified three periods which are distinguishable from one another due to their different policy directives and objectives. These periods being:

- **1948-1994:** The Apartheid period. The energy policies developed during this period mainly centred on *energy security*. (for the purposes of this Study, this period is not discussed.)
- **1994-2000:** The period immediately after South Africa's first democratic elections. The energy policies of this period were based on the ideologies of the Reconstruction and Development Programme White Paper (RDP) and the Constitution, and focussed on addressing providing at least basic services to *all* the people of the country.
- **Post 2000:** During this time, the energy policies were not only influenced by national political and economic drivers, but also by environmental drivers, and specifically, by the international agenda to reduce greenhouse gas emissions from mainly coal fired electricity generation stations towards mitigating the potential impacts of climate change.

#### 3.1 Energy policies and programmes from 1994 relevant to rural electrification

The first phase of the predecessor to the INEP, the **National Electrification Programme (NEP)**, was implemented between 1994 and 1999. The main objective of this programme was to address the immense electrification backlogs of South Africa's rural- and urban poor populations. The aim of this phase of the programme was to provide basic electricity to 2.5million households, to be funded by both the Government and Eskom.

Due to the fact that the majority of the electrification backlog was located in rural areas, Eskom undertook the task to provide nearly 300 000 new connections per year over 5 years, or 66% of the total programme target (Bekker, et al., 2008).

Even though the NEP achieved a high number of rural connections during its initial period between 1994 and 2002, the rural electrification component of the programme became a key focus only after 2002 (Bekker, et al., 2008). This shift brought about an associated increase in connection costs, a decline in connection rates and the necessity to provide additional transmission infrastructure.





### Box 3.1: South Africa's Development Context

The 2<sup>nd</sup> period as identified by Winkler, et al., aligns with the first 6 years of democracy, and the national development agenda implemented through the RDP and the Growth, Employment and Redistribution Strategy (GEAR).

The Reconstruction and Development Programme White Paper of 1994 laid the foundation for South Africa's developmental trajectory, focussing inter alia on providing basic water-, electricity-, health care- and education infrastructure and services, to **all** people of South Africa (South Africa, 1994). The objectives therefore of the RDP can be summarised to be (National Planning Commission, 2013):

- To meet basic needs;
- To develop human resources;
- To build the economy;
- To democratising the state and society

GEAR was launched in 1996 as a macro-economic strategy, and had as its objectives the following (National Planning Commission, 2013):

- To restructure the economy;
- To create plentiful jobs;
- To create environment for attracting foreign investment; and
- To create and implement policies to counter high inflation.

The energy policies developed during the post 2000 period identified by Winkler, et al., were and are informed and influenced by the 2001 Integrated Sustainable Rural Development Programme (ISRDP), the 2006 Accelerated and Shared Growth Initiative (ASGISA) which was introduced to speed up employment creation and reduce unemployment, the 2009 NGP and the 2012 NDP. The ISRDP was initiated to accelerate rural development, create economic opportunities in rural areas, decrease levels of poverty and unemployment and implement access to free basic services (National Planning Commission, 2013).

The fundamental changes taking place in Government during 2000-2001, including the decentralisation of service delivery functions from National Government to Local Government, and the resultant role and responsibility that the then Department of Provincial and Local Government (dplg) was allocated with regards to basic services provision to low income households, caused uncertainty within Government as to where the INEP should be positioned. The decision to finally establish the INEP within the DME was only finalised in 2005. The introduction of the Integrated Development Planning (IDP) process at Local Government level as a result of the decentralisation drive of Government also resulted in a change in the approach to electrification; whereas previously the focus was simply on ensuring connections, through the IDP process an *integrated development* approach was required (Bekker, et al., 2008).

Challenges with regards to the *funding* of the INEP also arose during this period. Though the NEP was funded jointly between Government and Eskom, the conversion of Eskom into a corporation in 2001 resulted in a decision being made that Eskom would not provide capital funding for the INEP. The INEP would therefore receive funding directly and only from the Fiscus (Bekker, et al., 2008).



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As mentioned in Chapter 1, the INEP is the main programme through which Government is implementing its aim of achieving universal electrification, and therefore has a direct bearing on any rural electrification initiative.

The **White Paper on Energy**, promulgated in 1998, states that: *“Government recognises that household access to adequate energy services for cooking, heating, lighting and communication is a basic need. Whilst these needs can be met by various fuel-appliance combinations, government recognises that without access to electricity, a clean, convenient and desirable fuel, human development potential is ultimately constrained.”* (DME, 1998)

From a demand perspective, this White Paper inter alia, emphasised household connections for the low-income, rural population.

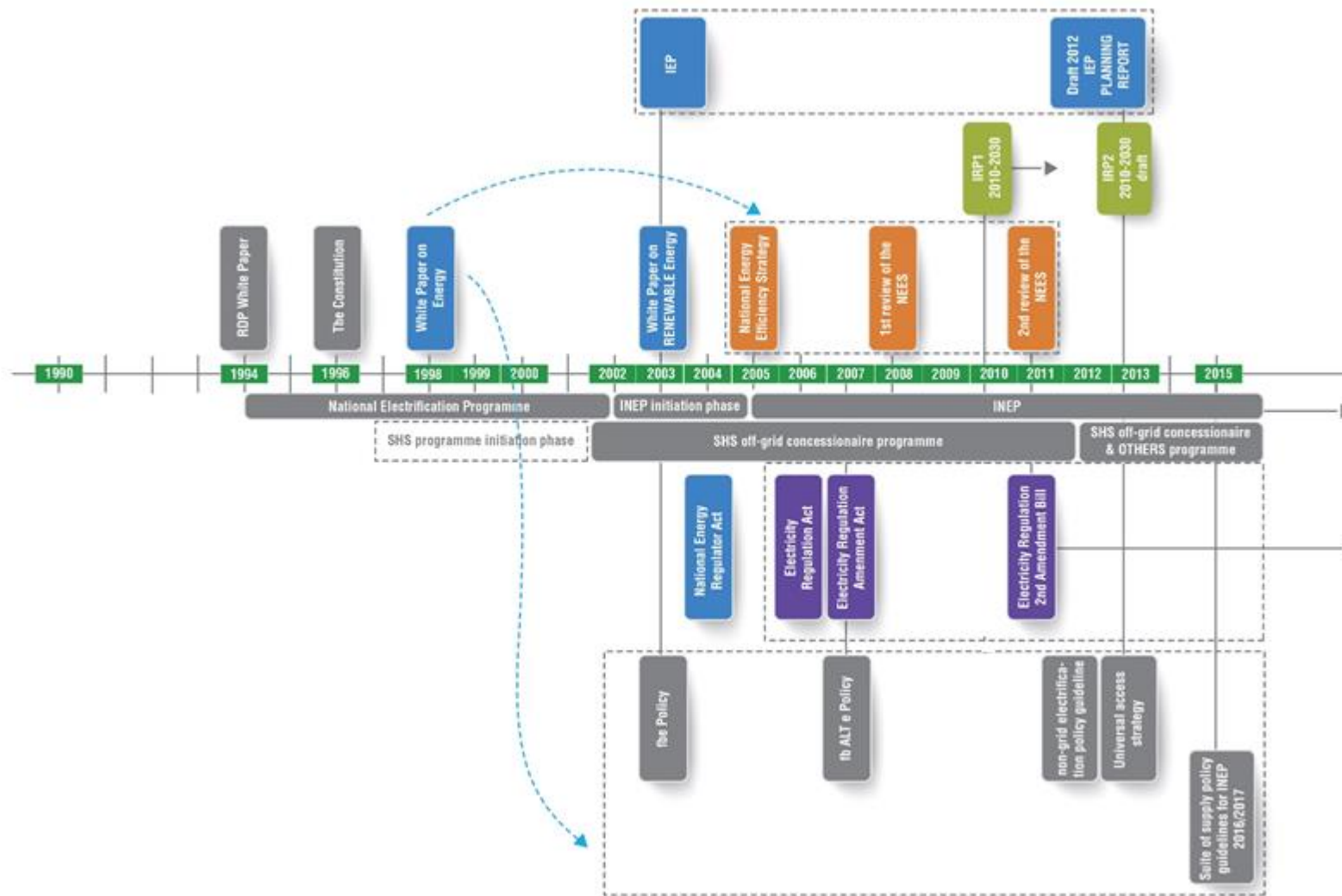
In this regard, the White Paper *proposed* that non-grid solar photovoltaic systems be provided to those rural communities too remote to be connected to the grid, (Bekker, et al., 2008) contributing to Government’s commitment to universal household access to electricity (Winkler, et al., 2006). Further, the White Paper encouraged energy efficiency initiatives, particularly to industry, commerce and mining.

Figure 3.1 is a diagrammatic representation of a timeline of these guiding documents.

From a supply perspective, the White Paper proposed restructuring the electricity distribution industry (EDI) into independent regional distributors or REDs, and unbundling Eskom into separate generation and transmission companies. Neither of these two proposals succeeded in practice; the proposed Independent System and Market Operator Establishment Bill, ISMO, published for public comment in 2011, was not approved by Parliament during 2015 (le Cordeur, 2015), and the restructuring of the energy industry was abandoned by Government in 2010 (Eberhard, 2013).

Importantly, the 1998 White Paper shifted the responsibility for Energy Planning from Eskom, to the DoE (DoE, 2015).

In 2003, the White Paper on Renewable Energy, the Integrated Energy Plan (IEP) and the free basic electricity (fbc) policy came into effect, providing inter alia, some institutional guidance towards the implementation of the renewable energy driven off-grid SHS programme launched by Government in 1999 in response to the proposals of the White Paper on Energy.



**Figure 3.1: Timeline of key policies impacting rural electrification in South Africa**



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The fbe policy was developed as a result of Government's 2000 policy directive for the provision of free basic water, sanitation and energy to poor households in South Africa.

The aim of the policy is poverty alleviation, with anticipated associated positive spin offs on community health and the empowerment of women. The provision for free basic services is therefore a means to an end – a tool to alleviate poverty and improve the lives of the poorest.

Government's Free Basic Services (FBS) commitment was borne out of numerous debates on ways to address the needs of the masses of impoverished citizens of South Africa. The provision of FBS plays an important role in addressing asset and capability poverty, and in improving the ability of the poor to participate in society and the economy.

The fbe policy allocates 50 kWh per month of free electricity for grid connected consumers, and further makes provision for fbe to non-grid energy consumers through (partial) subsidisation of both the once-off capital cost of the INEP SHS programme, as well as the monthly service fee.<sup>14</sup>

The White Paper on RE also proposed that Government include private energy producers into the electricity generation mix, and that the electricity generation mix should include renewable energy technologies.

Due to the fact that this Study is focussed on rural electrification, and specifically non-grid electrification, Government's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) developed in response to the White Paper on Renewable Energy, is not described and or discussed herein.

To support the South African Government's objective to achieve universal access by 2025, the DoE initiated the "New Household Electrification Strategy" in June 2013, which has inter alia:

- extended the roll-out of the INEP non-grid electrification programme to other areas that fall *outside of the concession areas*.  
This roll-out can be initiated and facilitated by *Municipalities* making application for non-grid electrification in their respective areas to the DoE (DoE, 2012a) (DoE, 2013c); and
- explicitly included "*other possible technologies based on cost-effective options in order to address current and future backlogs*" (DoE, 2013c)

This option would be applicable where:

- there is no electricity network connection and if it is not financially feasible to supply grid connections;

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<sup>14</sup> The free basic alternative energy policy of 2007 provides a subsidy of R55/month/indigent household (in 2007 terms) for alternative fuel sources such as paraffin, coal, bio-ethanol gel and LPG, to be paid from the equitable share, and only to those households to which neither an INEP grid connection, nor an INEP off-grid electricity solution, is available currently or in the near future (Keller, 2012).



- “the proposed non-grid system’s area of supply is not within 2km from a grid line, falls outside the 3-year grid plans of an electricity distribution utility and is included in the Municipal IDP.” (DoE, 2012a)
- Either Eskom or the licenced electricity distributor must confirm that those areas will not receive grid electrification in the foreseeable future, and give permission for the installation of a non-grid electrification system (DoE, 2012a).

DoE’s 2015 State of Renewable Energy Report (DoE, 2015) refers to the establishment of an “off-grid electrification authority”, which would aim to reinvigorate the off-grid electrification programme, by promoting off-grid energy access more generally, as well as promote the use of mini-grids.

**Box 3.2: Solar Home System (SHS) Concessionaire Programme**

This programme was *launched* in 1999 as part of the NEP and aimed to install more than 300 000 SHS. Due to institutional delays, specifically regarding which Government entity would contract with the private concessionaires for a renewable energy project, a pilot programme under NERSA was only started in 2002 (Lemaire, 2011).

These concessionaires were allocated exclusive rights (in terms of access to the capital subsidy) to provide non-grid electrification to particular geographic areas for a 5-year period, although the service contract remains binding for 20 years (DoE, 2012a). Under the scheme, the concessionaires OWN the SHS that they install, and service them for a monthly fee (Winkler, et al., 2006).

After the initial pilot contracts were concluded in 2004, the DME and later the DoE were the contracting party to the concessionaires.

Customers pay the concessionaire a once-off connection fee, as well as a monthly service fee.

Non-grid SHS projects initiated through the INEP:

- receive a capital subsidy of 80% from National Government (to the concessionaire). The concessionaire is responsible for the balance (DoE, 2012a); and
- through the fbe policy, and if the Local Municipality (LM) has an indigent policy in place, then the municipality will pay 80% of the monthly service fee on behalf of the beneficiary. The LM would receive budget for this via the equitable share allocation from the National Fiscus.

Lemaire notes that the concessionaire programme has generally not been successful with only three concessions being operational in 2011. Challenges faced by the Concessionaires included administrative delays between programme phases and lack of commitment by Government to provide subsidies over a 20 year period.



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### 3.2 Legislation governing the implementation of non-grid renewable energy projects as part of Government's "new household's electrification strategy"

In order to effect this, cognisance needs to be taken of the content and intent of the Constitution, the Electricity Regulation Act, the Municipal Systems Act, the Municipal Finance Management Act (MFMA) and the Municipal Structures Act<sup>15</sup>.

These Acts set out the roles and responsibilities inter alia, of National- and Local Government in the electricity sector, as well as distinguishing between the powers and functions of District- and Local Municipalities, and services authorities and services providers.

In the context of implementing non-grid electrification projects in the rural areas of South Africa, understanding the legislative roles of the various institutional role-players, and their responsibilities – as well as being aware of the inherent policy gaps, is important to mitigate project implementation risks and contribute to the sustainability of the projects in the long-term.

The Constitution, Act No. 108 of 1996, laid down that *generation of electricity* is a *national government function* and, as per Schedule 4B, the *reticulation (distribution) of electricity* to consumers in their area of jurisdiction is a *municipal* function (South Africa, 1996). As electricity generation is not a local government function, municipalities have no "*original competence*" to generate electricity, except where electricity generation is incidental to a local government function (De Visser, 2012, p. 136). Further, due to the fact that electricity generation is not listed in either Schedule 4B or 5B of the Constitution, electricity generation is deemed to be an *exclusive* national competence (De Visser, 2012).

A municipality though can derive competence for the electricity generation function through either a parliamentary executive delegation or a legislative assignment as per the Constitution (De Visser, 2012).

Even though rural electrification projects through small-scale hydropower technology will entail, in effect, Local Municipalities generating and distributing electricity, these projects will be stand-alone systems, operating completely independently of the national transmission grid, and could therefore be considered to be similar in context to the SHS programme. In addition, the provision of basic energy services to the rural communities in South Africa, fulfil Local Government's constitutional mandate of providing services to communities in a sustainable manner, the promotion of social and economic development and a safe and healthy environment (South Africa, 1996) (City of Cape Town, 2015, p. 35).

In the context therefore of the "New Household Electrification Strategy", non-grid small scale hydropower projects implemented by Local Municipalities is interpreted to fall within the ambit of the powers and functions allocated to Local Government by the Constitution.

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<sup>15</sup> Other Acts that need to be considered, though not explicitly described in this Study include the Intergovernmental Relations Framework Act (IGRA) and the Government Immovable Asset Management Act (GIAMA)



The functional responsibilities listed in schedules 4B and 5B of the Constitution, are shared between District- and Local Municipalities. The allocation of responsibilities between DMs and LMs is governed by the **Local Government: Municipal Structures Act, Act 117 of 1998, as amended**.

**Box 3.3: Municipal Structures Act**

Municipal Structures Act, clause 83: (South Africa, 1998)

1. A municipality has the **functions and powers**<sup>16</sup> assigned to it in terms of sections 156 and 229 of the Constitution.
2. The **functions and powers** referred to in subsection (1) must be divided in the case of a DM and the LMs within the area of the DM.
3. A DM must seek to achieve the integrated, sustainable and equitable social and economic development of its areas as a whole by:
  - (a) ensuring integrated development planning for the district as a whole,
  - (b) promoting bulk infrastructural development and services for the district as a whole,
  - (c) building the capacity of LMs in its area to perform their functions and exercise their powers where such capacity is lacking and
  - (d) promoting the equitable distribution of resources between the LMs to ensure appropriate levels of municipal services within the area.

Municipal Structures Act, clause 84, as amended: (South Africa, 1998)

1. **A District Municipality has the following functions and powers:**
  - (a) Integrated development planning for the DM as a whole, including a framework for IDPs of all municipalities within the area of the DM.
  - (c) Bulk supply of electricity which includes for the purposes of such supply, the transmission, distribution and, where applicable, the generation of electricity.
  - (o) The receipt, allocation and if applicable the distribution of grants made to the DM.
2. **A Local Municipality has the functions and powers referred to in section 83(1) excluding those functions and powers vested in terms of subsection (1) of this section in the DM in whose area it falls.**
3. Subsection (2) does not prevent a Local Municipality from performing functions in its area and exercising powers in its area of the nature described in subsection (1).

The Structures Act allocates the functions of (bulk) water, (bulk) sanitation, municipal health and (bulk) electricity to the DM; but also makes provision for the National Minister of Local Government to authorise a LM to exercise these powers and functions in its areas of jurisdiction instead of the DM (DWAF, 2007).

<sup>16</sup> "Functions" means the Local Government functions as set out in Part B of schedule 4 and Part B of schedule 5 of the Constitution. "Powers" means the legislative and executive **authority** associated with each of the functions. Legislative authority refers to the powers to make by-laws. Executive authority refers to the power to make decisions in relation to the functions (DWAF, 2007).



For the implementation of rural electrification projects at local government level, it is important to take cognisance of how the powers and functions for electricity service provision is divided between the DM and the LMs, and whether or not municipalities have the capacity to fulfil their designated powers and functions.

The constitutional classification of municipalities (category A, B and C municipalities) does not distinguish between municipalities in urban and *rural areas*, and therefore Government has adopted an approach that considers the number of poor households, the proportion of households with access to basic services and information on capital and operating budgets to classify municipalities (National Treasury, 2012).

**Table 3.1: Classification of municipalities**  
(National Treasury, 2012) (DBSA, 2011)

Class	Category	Characteristics	Number
Metros	A	Category A municipality	6
Secondary Cities	B1	The 21 LMs with the largest budgets	21
Large Towns	B2	All Local Municipalities with a large urban core. There is huge variation in population sizes amongst these municipalities and they do have large urban dwelling population.	29
Small Towns	B3	Municipalities with relatively small populations and a significant proportion of urban population, but with no large town as core. Rural areas in this category are characterised by the presence of commercial farms, as these local economies are largely agriculturally based. The existence of such important rural areas and agriculture sector explains its inclusion in the analysis of rural municipalities.	111
Mostly rural	B4	These are characterised by the presence of at most one or two small towns in their areas, communal land tenure and villages or scattered groups of dwellings and typically located in former homelands	70
Districts	C1	District municipalities that are not water services <b>providers</b> .	25
Districts	C2	District municipalities that are water services <b>providers</b> .	21





Rural municipalities, in whose areas of jurisdiction rural electrification projects would mainly be initiated, therefore can be considered as those municipalities classified as B3 and B4, sharing municipal executive and legislative authority with a category C municipality. They are geographically concentrated in the provinces of KwaZulu-Natal, the Eastern Cape, the Northern Cape and Limpopo.

**The Local Government: Municipal Systems Act, Act 32 of 2000** establishes municipalities as services authorities, and introduces an option for the municipality to either provide municipal services themselves, or to appoint appropriate service providers to undertake those municipal services on their behalf, through a service delivery agreement between the municipality and the service provider. This Act therefore, inter alia, introduces the concepts of **services authority** and **services provider** (South Africa, 2000).

The *legislative and executive authority* function of a municipality is defined by section 12 of the Municipal Systems Act, which includes the development of policies and by-laws (e.g. tariff, rates & taxes, and debt collection policies), deciding on the appropriate means of providing municipal services, preparing and managing budgets and arranging suitable financing for services. (SALGA, 2014) (South Africa, 2000)

It is important to note that only a municipality can be allocated the powers and functions for the *authority* role. Any legal entity though can be contracted by the municipality which has the powers and functions for services provision, to provide the services provision *function* (DWAf, 2007). Further, no person may act as a Services Provider without the approval of the Services Authority.

In the case of water, electricity and health, the default position was that the services authority would be the District Municipality, unless a LM was authorised to perform the function by the Minister of Provincial and Local Government.

*In the water sector* a process was initiated in 2003 that clearly defined each municipalities' role, whether DM or LM, as either Water Services Authority (WSA) or Water Services Provider (WSP). In the KZN- and EC provinces for example, the DMs were allocated WSA status, and the LMs WSP status. The Municipalities designated as Authorities can enter into a service delivery agreement with a WSP after a Section 78 (S78) process is undertaken as per the Municipal Systems Act, to undertake the provision function on their behalf.



**Box 3.4: Municipal Systems Act**

Municipal Systems Act, Chapter 8, Municipal Services, Clause 73: (South Africa, 2000)

*(1) A municipality must give effect to the provisions of the Constitution and-*

- (a) give priority to the basic needs of the local community*
- (b) promote the development of the local community and*
- (c) ensure that all members of the local community have access to at least the minimum level of basic municipal services.*

Municipal Systems Act, Chapter 8, Municipal Services, Clause 76: (South Africa, 2000)

*A municipality may provide a municipal service in its area or a part of its area through:*

- (a) an internal mechanism*
- (b) an external mechanism by entering into a **service delivery agreement** with-*
  - a municipal entity*
  - another municipality*
  - an organ of state including a licenced service provider registered or recognised in terms of national legislation and a traditional authority*
  - a community based organisation or other non-governmental organisation legally competent to enter into such an agreement*
  - any other institution, entity or person legally competent to operate a business activity.*

*In the electricity sector, such a process was never initiated after 2000 due to the fact that the electricity sector was anticipated to be restructured into REDs. As a result, confusion exists in the electricity sector as to which municipalities have electricity services authority status (SALGA, 2014).*

The DBSA states in the MIIF7 that the division of responsibilities between District- and Local Municipalities is an institutional challenge, specifically in the electricity sector. For electricity, for example, the MIIF7 report states that the DM's services authority role is not recognised and that Eskom acts as a services provider with "*little reference to Local Government*" (DBSA, 2011).

The Association of Municipal Electricity Utilities (AMEU), together with the South African Local Government Association (SALGA) has commenced engagements with Eskom to address the matter.

Eskom's position is premised on the fact that Eskom is licenced by NERSA to distribute electricity to specific areas as per the Electricity Regulation Act, and that this agreement overrides the requirements of the Municipal Systems Act (SALGA, 2014). This implies that NERSA issued Eskom's distribution licence(s) without a S78 decision regarding service delivery in a municipality or municipalities, and negating municipalities' constitutional right to electricity reticulation (distribution).

For rural, non-grid electrification projects, it is important to know where Eskom is distributing electricity, irrespective of the institutional mechanism through which it is undertaken due to the fact that non-grid projects need to fall outside of any current or future electrification programme.



The uncertainty regarding the allocation of services authority responsibilities could potentially create uncertainties when deciding on an appropriate operating mechanism for a small-scale hydropower plant, specifically around contracting mandates. Cognisance must also be kept of the fact that the DoE makes use of Eskom and municipalities as *implementing agents* for the grid connecting portion of the INEP, and transfers funds to these entities to implement the objectives of the INEP. The implication therefore is that Local Municipalities, even though not being allocated the responsibility as an electricity services provider, are providing electricity services through the INEP, and could therefore be considered to be de-facto ESPs.

**The Local Government: Municipal Finance Management Act, Act No.56 of 2003**, (MFMA) regulates the financial affairs of the municipalities and municipal entities and establishes treasury norms and standards for budgets, reporting and financial controls. It focuses on ensuring the management of revenues, assets, liabilities and the handling of financial dealings. This Act places the obligations on municipalities to practice supply chain management. This is a holistic approach to procuring goods and services by Local Government (DWAf, 2007).

**The Electricity Regulation Act, Act 4 of 2006** as amended, describes, inter alia, the responsibilities and powers of the National Energy Regulator of South Africa, NERSA, specifically in regards to the processing and issuing of electricity generation-, transmission- and distribution licences. The Act establishes a national framework for the electricity sector, from generation to distribution (City of Cape Town, 2015).

The ERA specifies that NERSA must consider applications for licences, and may issue licences for, inter alia, the construction and operation of generation facilities and the construction and operation of a distribution power system (DoE, 2011b).

Further, the ERA is very clear in its description of activities that require licencing; it states that no person, may, without the appropriate licence issued by NERSA construct or operate any generation facility and construct or operate any distribution power system (DoE, 2011b).

The 2<sup>nd</sup> Amendment Bill includes a new exception to this requirement:

*“...a person who operates a distribution power system **located solely on private property**:*

- *Need not apply for or hold a trading licence, provided that such person does not sell electricity to its customers at a price higher than the price at which the electricity would be sold to those customers by the person from whom that operator purchases the electricity and*
- ***Need not apply for or hold a distribution licence.***”

As is discussed in Section 5.3, the Department of Rural Development and Land Reform (DRD&LR) has begun a process to audit South Africa's land ownership status.



For small-scale hydropower projects for rural electrification, where land ownership is in flux, it will be important to know the status of the land ownership for distribution licencing requirements.

Even though the Bill has not been enacted yet, the intent of the DoE and NERSA in this regard is noted, and NERSA should be engaged with on a case by case basis to confirm whether or not a distribution licence will be required or not.

For the purposes of this Study, it is assumed that an *electricity distribution licence* will be required for a mini-grid system, unless the system is to be implemented on privately owned land. Associated with the attainment of the electricity distribution licence, **is tariff approval**.

The Act further requires that *electricity generation licence* applications must include evidence of compliance with the **Integrated Resource Plan (IRP)** of the time or provide reasons for any deviation for the approval of the Minister (DME, 2006). The IRP in the South African context is not the Energy Plan - it is a National Electricity Plan. It is a subset of the Integrated Energy Plan. The IRP is also not a short or medium-term operational plan but a plan that directs the expansion of the electricity supply over the given period, emphasizing the objectives for the development of renewable energy technologies.

The current version of the IRP, promulgated in 2011, emphasises security of electricity supply, and is therefore focussed on sources and extent of electricity generated that is to be transmitted and distributed via grid infrastructure. Under section 7 of the 2011 IRP, which highlights the research agenda for the next IRP, it states that “*Off-grid activities should be considered especially as there is an impact on the potential future demand (through “suppressed demand” which has occurred as a result of lack of grid access for a number of potential consumers).*” (DoE, 2011c)

The “New Household Electrification Strategy” was launched in 2013, and specifies that potentially 300 000 households will be provided with off-grid electricity services.

The 2013 non-promulgated IRP update version, was silent on both the recommendation given in the 2011 IRP regarding the impact of off-grid electrification on supply demand, and the “New Household Electrification Strategy”.

It is inferred that the ERA specifications regarding the conditions under which NERSA may issue generation licences, namely only for projects that are identified in the IRP, and or are subject to a Section 34 determination as per the Act, were written for projects that will contribute to the country’s generation mix, and which projects’ electricity will be transmitted and distributed through an interconnected distribution system.

NERSA could consider the “New Household Electrification Strategy” as a Ministerial Directive for non-grid electrification projects.



Conditions governing the issuing of generation licences are linked to the intended use of the electricity. Electricity generated from renewable energy sources, including small-scale hydropower schemes can be used for either:

- **Islanded use;**
- Synchronised to the grid without feed in (commonly referred to as “own use”);
- Connecting to a municipal electricity distribution network or,
- Connecting to the Eskom electricity distribution network.

Combinations and or variation of the above mentioned categories are also possible.

Rural electrification typically would be classified as “islanded use”. Electricity generated for “**islanded use**” is completely independent of municipal- or Eskom distribution networks and can be applied for commercial- or non-commercial purposes. Electricity generated for islanded use, and used for non-commercial purposes does not require a NERSA electricity generation licence. Electricity generated for commercial purposes, requires a NERSA electricity generation licence (DME, 2006).

No definition of “commercial” use is given, but for the purposes of this Study it is inferred that rural electrification through mini-grids is a “commercial” activity and would therefore require a NERSA generation licence. This assumption is made due to the fact that there is a flow of grant funds, and the potential exists for electricity utilisation greater than 50 kWh/m per household can occur, which would necessitate payment.

**Box 3.5: Definitions from the ERA**  
(DME, 2006) (DoE, 2011b)

<p><b>Distribution</b> - Means the conveyance of electricity through a distribution power system, excluding trading.</p> <p><b>Reticulation</b> - Means the trading or distribution of electricity and includes services associated therewith.</p> <p><b>Distribution power system</b> - Means a network for the conveyance of electricity which operates at or below a nominal voltage of 132 kV.</p> <p><b>Interconnected distribution power system</b> - Means a distribution power system that is interconnected to a transmission power system either directly or through interconnection to a transmission power system where the latter system is interconnected to a transmission power system.</p> <p><b>Service Delivery Agreement</b> - Means an agreement between a municipality and an institution or person providing electricity reticulation, either for its own account or on behalf of the municipality.</p> <p><b>Service Provider</b> - Means a person or institution or any combination of persons and institutions which provide a municipal reticulation service in terms of a service delivery agreement.</p> <p><b>Trading</b> - Means the wholesale or retail buying and selling of electricity.</p> <p><b>Distributor</b> - Means a person who distributes electricity.</p> <p><b>Municipality</b> - Means a category of municipality that has <b>executive authority</b><sup>17</sup> over and the right to reticulate electricity within its area of jurisdiction in terms of the Municipal Structures Act.</p>
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<sup>17</sup> The implication of this for the electricity sector is that the DM is assumed to be the de-facto municipality with the powers and functions for, inter alia, electricity services.

**SECTION 2: INSTITUTIONAL CONTEXT**

Table 3.2 and Table 3.3 summarise the current legislative and regulatory requirements to implement non-grid electrification schemes in South Africa.

**Table 3.2: Electricity generated for Islanded Use (commercial)**

Islanded Use – commercial use					
NERSA Generation Licence	Local electricity utility involvement	Proof of land ownership / permission to use land (refer section 5.3)	Environmental Authorisation (refer section 5.1)	Water Use Authorisation (refer section 5.2)	Water allocation confirmation
Yes  (a <b>distribution licence</b> might also be required)	If a municipality would like to act as implementer of non-grid electrification through the INEP in areas outside of concessionaire areas, then applications to the DoE are to be done by the Local Municipality	Needed for NERSA licencing requirements	Needs to be addressed for NERSA licencing requirements  Yes, if required by NEMA  Notice by Environmental practitioner if none is required	Needs to be addressed for NERSA licencing requirements	Needs to be addressed for NERSA licencing requirements  If conduit hydropower, WSP must confirm that water is available and hydropower generation will not affect security of supply.  If conventional hydropower, this will be addressed through the water use authorisation process.

**Table 3.3: Electricity generated for Islanded Use (non-commercial)**

Islanded Use – non-commercial use					
NERSA Generation Licence	Local electricity utility involvement	Proof of land ownership / permission to use land (refer section 5.3)	Environmental Authorisation (refer section 5.1)	Water Use Authorisation (refer section 5.2)	Water allocation confirmation
No	Good practice to inform	Good practice to have	Yes, if required by NEMA	Yes, if required by National Water Act (if water resource is directly impacted)	If conduit hydropower, WSP must confirm that water is available and hydropower generation will not affect security of water supply & services.  If conventional hydropower, this will be addressed through the water use authorisation process.



It is recommended therefore that NERSA be approached on a project by project basis, assuming that both an electricity generation and distribution licence will be required. The right to exempt the applicant from the need to hold such licences rests with NERSA. Further, NERSA and the DoE are in the process of reviewing the licencing regulations for all generation facilities, which review is expected to be completed during 2016 (Creamer, 2015), re-emphasising the need to engage with NERSA re licencing requirements on a project-by-project basis.

In addition to the requirements of the Electricity Regulation Act, the electricity sector's fundamental compliance standards such as the SA Distribution Code, the SA Grid code, the SA renewable power plants grid code and all other applicable SANS specifications, must be adhered to.

### 3.3 Summary of the implications of existing policies and laws of the electricity sector on the implementation of small-scale hydropower projects for rural electrification

In South Africa, the electricity sector is governed by robust legislation such as the National Electricity Regulation Act; by policies such as the White Paper on Renewable Energy and the Free Basic Electricity Support Tariff Policy and by strategies such as the “New Household Electrification Strategy”.

The “New Household Electrification Strategy”, has, inter alia:

- extended the roll-out of the INEP non-grid electrification programme to other areas that fall *outside of the SHS concession areas*.  
This roll-out can be initiated and facilitated by *Municipalities* making application for non-grid electrification in their respective areas to the DoE (DoE, 2012a) (DoE, 2013c); and
- explicitly included “*other possible technologies based on cost-effective options in order to address current and future backlogs*” (DoE, 2013c)

This option would be applicable where:

- there is no electricity network connection and if it is not financially feasible to supply grid connections;
- “*the proposed non-grid system's area of supply is not within 2km from a grid line, falls outside the 3-year grid plans of an electricity distribution utility and is included in the Municipal IDP.*” (DoE, 2012a)
- Either Eskom or the licenced electricity distributor must confirm that those areas will not receive grid electrification in the foreseeable future, and give permission for the installation of a non-grid electrification system (DoE, 2012a).

Even though the Constitution deemed that electricity **generation** is exclusively a national government function, rural, non-grid electrification at such small scales as would be implemented through the “New



Household Electrification Strategy” and as islanded systems, is not considered contrary to the principles of the Constitution.

Electricity generated for islanded use, and used for non-commercial purposes does not require a NERSA electricity generation licence. Electricity generated for islanded, commercial purposes, requires a NERSA electricity generation licence (DME, 2006).

No definition of “commercial” use is given, but for the purposes of this Study it is inferred that rural electrification through mini-grids is a “commercial” activity and would therefore require a NERSA generation licence. This assumption is made due to the fact that there is a flow of grant funds, and the potential exists for electricity utilisation greater than 50 kWh/m per household can occur, which would necessitate payment.

Stand-alone small-scale hydropower projects will be implemented within the boundaries of a local municipality, and should therefore comply with the planning prerogatives of that municipality. It is important to understand the allocation of roles and responsibilities for electricity distribution, operation and maintenance and revenue management when developing SHPs for rural electrification.

In this regard the Municipal Structures Act divides the powers and functions allocated to local government in the Constitution, between Local- and District Municipalities.

The Municipal Systems Act establishes municipalities as service authorities, and introduces an option for the municipality to either provide municipal services or functions themselves, or to appoint appropriate service providers to undertake those services on their behalf.

In the electricity sector a process to define which municipalities are Electricity Services Authorities, did not take place.

In order to reticulate or distribute electricity, a NERSA electricity distribution licence is required, and based on this, annual tariff approvals are issued by NERSA for various categories.

In many cases, municipalities and Eskom, as implementing agents of the DoE for the INEP programme, rather than as service providers, have been granted electricity distribution licences by NERSA.

In the context of developing and implementing a stand-alone SHP, that is reliant on the funding of the fbe grant, the municipality must be involved in the project, either

- as services authority, appointing a services provider, with or without INEP funding; or
- as stakeholder, entering into a service level agreement with the service provider appointed by the DoE or another Department.

Depending on the agreed to ownership and operation model for a specific project, the applicable party will apply for a NERSA distribution licence.

(Licence application forms can be downloaded from the NERSA website)





## 4 A LOCAL GOVERNMENT PERSPECTIVE

### 4.1 Integrated Development Planning

Theoretically, projects at local level should only be implemented if they appear in a municipalities Integrated Development Plan (IDP) (dplg, 2006), which is a consolidation of the local sector plans, including the local electricity plan. The Department of Co-Operative Governance and Traditional Affairs (CoGTA) clearly allocates responsibility to sector departments to ensure that local sector plans are aligned with national policies, legislation and strategies to ensure sustainable delivery of projects (dplg, 2006).

#### Box 4.1: Integrated Development Planning (dplg, 2000)

Integrated development planning is a **process** through which municipalities prepare a strategic development plan which extends over a five-year period. The Integrated Development Plan (IDP) is a **product** of the IDP process. The IDP is the principal strategic planning instrument which guides and informs all planning, budgeting, management and decision-making processes in a municipality.

Through integrated development planning, which necessitates the involvement of all relevant stakeholders, a municipality can:

- Identify its key development priorities;
- Formulate a clear vision, mission and values;
- Formulate appropriate strategies;
- Develop the appropriate organisational structure and systems to realise the vision and mission; and
- Align resources with the development priorities.

In terms of the Municipal Systems Act all municipalities have to undertake an IDP process, and as such it has legal status and supersedes all other plans that guide development at Local Government level.

Bekker et al. note that the introduction of integrated development planning changed the way the South African electrification programme was implemented. Prior to the IDP process, electrification projects occurred without reference to other Local Government development. The IDP process facilitates/ed the inclusion of electrification projects in the multi-sectoral Local Government context (Bekker, et al., 2008).

The programme therefore shifted *“from a focus on connection targets, to a broader set of development criteria.”* (Bekker, et al., 2008)

Rural electrification projects at local level therefore should be encapsulated into the local electricity plan, and aligned with national sectoral strategies that have a direct bearing on the project. Sectoral strategies, policies and programmes impacting rural electrification include:

- The DoE’s “New Household Electrification Strategy” implemented through the INEP;
- The DRD&LRs Agrarian Transformation Strategy implemented through the CRDP;



- The DRD&LR's Communal Land Tenure Policy;
- The DEA's National Climate Change Response White Paper and the findings from the LTMS and LTAS.

Refer Figure 2.1.

It should be noted that *“uncertainty still remains in many rural communities as to the manner in which local governance and land administration takes place in relation to the role of traditional authorities. In many rural communities the traditional authority forms a second layer of Local Government.”* (LinkD, 2013)

**Box 4.2: Current status of the role of Traditional Authorities**  
(Weinberg, 2015)

The Government of South Africa enacted the Communal Land Rights Act (CLRA) in 2004; an Act which would have empowered tribal leaders to make decisions on behalf of “their” people, including powers to decide over the occupation, use and administration of communal land. The CLRA, though enacted, was never implemented, and was struck down by the Constitutional Court in 2010. It is argued that the CLRA, as well as the Traditional Leadership and Governance Framework Act and the Traditional Courts Bill, vest power in traditional leaders, threatening tenure security of rural people.

During 2013 and 2014, the DRD&LR introduced a number of new policies and new legislation, including the Spatial Planning and Land Use Management Act and the Communal Land Tenure Policy (CLTP), colloquially referred to as the “Wagon Wheel” Policy. The CLTP suggests that title deeds be transferred to CPAs, or other similar entities, only in communal areas where traditional councils do not exist; implying that the CLTP, as did the CLRA, proposes to empower the traditional leaders and councils to make decisions on behalf of “their” people regarding land, and thereby curtailing rural peoples’ opportunities (and rights?) to secure land tenure through a landholding mechanism of their choosing. The Policy states that traditional councils will receive the title deeds to property, while individuals and families will receive institutional land rights to parts of the communal land.

Small-scale rural electrification projects aim to serve households and communities first and foremost. Cognisance must be taken of the fact that these projects will be implemented in areas where traditional councils have a deciding voice on land use and therefore also to service provision – even though the Constitutional mandate for services delivery is clearly vested with Local Municipalities.

#### **4.2 Status of institutional arrangements for electricity services provision in the IDPs of the municipalities under consideration**

The Department of Science and Technology invited interested parties to provide information on innovative technologies that could improve service delivery to communities in the 27 most distressed District Municipalities under the auspices of the Innovation Partnership for Rural Development programme.



The University of Pretoria, through the Water Research Commission (WRC), tabled an innovative small-scale hydropower technology solution for rural electrification which was then subsequently requested and accepted by the O.R. Tambo-, and Umzinyathi DMs.

The initiation phase was completed, with planning phase activities in process. Potential project sites were identified, and preliminary designs having been completed. Due to the fact that these projects were initiated by the District Municipalities, and the specific site identification process has only just been concluded, these projects are not listed in the specific Local Municipality’s IDP. The intent and necessity though for electrification specifically in the rural areas is clearly stated in each of the IDPs of the LMs located within the O.R. Tambo-, and Umzinyathi DMs.

4.2.1 Umzinyathi District Municipality

The Umzinyathi District Municipality is one of ten districts in KwaZulu-Natal. The Municipality is bordered in the north by the aMajuba Municipality, in the west by the uThukela Municipality, in the south west by the uMgungundlovu Municipality, in the south east by the iLembe Municipality and in the east by uThungulu District Municipality. The district consists of four Local Municipalities, namely: Endumeni, Nquthu, Msinga and Umvoti (Umzinyathi District Municipality, 2014).

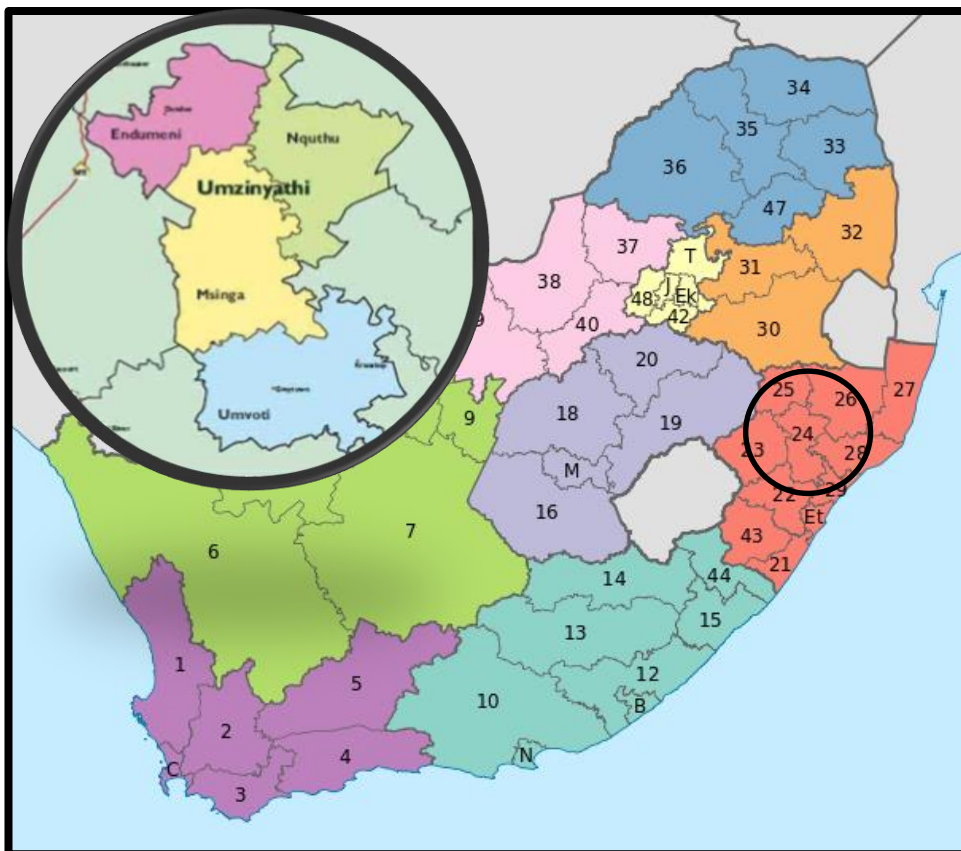


Figure 4.1: The DMs of South Africa, highlighting DC24, Umzinyathi DM



The municipal area is 8079 km<sup>2</sup> and has extensive grasslands in the north supporting the primary agricultural sector based on cattle ranching for beef, small scale sheep and mixed farming and maize cultivation. In the southern areas substantial forestry is prevalent. Sugar cane and smaller scale fruit farming such as avocado and kiwi fruit cultivation also occur.

The topography of the district is characterised by extensive variation with deep river gorges, rolling grasslands, extensive wetlands, hills and valley bush-veld. These characteristics make the development of infrastructure difficult and costly particularly in the steep terrain. The general slope of the land is between 1:5 and 1:6 and it is susceptible to soil erosion where it is not carefully managed (Umzinyathi District Municipality, 2014).

**Table 4.1: Selection of Institutional Information from the IDPs of the LMs in the Umzinyathi DM**

Municipality	Municipal Category	D	Electricity services identified as a need? Extent of backlog?	NERSA Distribution Licence <sup>4</sup> (NERSA, 2015a)	Is the LM an INEP Implementing Agent? <sup>1</sup>	Eskom also an IA in munic? <sup>2</sup>	SHS Concessionaire appointed? <sup>3</sup>	Traditional/Tribal Authorities?	Communal Property Associations?	Electricity services provision power and function as per IDP or SDBIP?	Assumed ESA?	Electricity Services Department? (also implies revenue generated from electricity sales)	Assumed ESP?	SLA with Eskom?	SHS non-grid projects?	SLA with SHS concessionaire?	Indigent policy/register & fbe / fb alt e?
Umzinyathi DM	C	DC24	Yes High	No	No	No	Yes (Kukhanya Energy Services previously, KwaZulu Energy Services)	As below		No	?	No	No	n.a.	n.a.	n.a.	n.a.
Endumeni LM	B	KZ241	Yes Low	Yes	Yes	No		No	Yes	Yes	Yes	Yes	Eskom & LM	Silent	Yes	Silent	Yes Silent on fbe
Msinga LM	B	KZ244	Yes High	No	Yes	Yes		Yes, 6 (Ingonyama Trust)	No	No	No	No	Eskom	Silent	Yes 2 640	Yes	Yes fbe
Nquthu LM	B	KZ242	Yes High	Yes	Yes	Yes		Yes, 9 (Ingonyama Trust)	No	No	No	Yes	Eskom & LM	Silent	Yes	Silent	Yes fbe
Umvoti LM	B	KZ245	Yes High	Yes	Yes	Yes		Yes, 8 (Ingonyama Trust)	No	No	No	Yes	Eskom & LM	Silent	Yes	Silent	Yes fbe



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**Notes:**

1. It is assumed that if the municipality receives an INEP grant allocation according to the DoRA (National Treasury, 2015c), then that municipality is an Implementing Agent of the DoE for the INEP. *(a condition of the INEP grant is that applicants, i.e. municipalities, need to be “licensed municipal distributors”. The Msinga LM though is receiving a Municipal INEP grant allocation, but does not hold a NERSA electricity distribution licence. Explaining this anomaly falls outside the scope of this Study)*
2. It is assumed that the Eskom INEP grant allocation is for the extension of the distribution grid, and grid connections.
3. A report by Wlokas in 2011 states that KES only operates in the Msinga area of the Umzinyathi DM (Wlokas 2011). Based on the information attained from the municipal IDPs, it is assumed that KES is the SHS concessionaire providing services in the areas of the other 3 Local Municipalities of the Umzinyathi DM as well.
4. NERSA Distribution licences are issued for specific areas within a Municipality, implying that even if a LM has a distribution licence, that licence might be for a specific area only, and not for the entire municipal area.

Interpreting the information presented in Table 4.1<sup>18</sup>, the following can be inferred:

- It appears that all the Local Municipalities in this DM have indigent registers in place. The equitable share allocation received through the National Fiscus for the provision of free basic services, including free basic electricity, is dependent on the indigent register.  
The provision of rural electrification through the DST funded study is anticipated to provide at least a basic level of service to the indigent communities of the DM, and the equitable share allocation will contribute to the long term sustainability of such a project.
- In the Umzinyathi DM, all LMs (except Msinga LM) operate a distribution grid, in addition to Eskom operating their distribution grid, and a non-grid SHS concessionaire. It is inferred from the IDPs that the distribution grids are operated in the context of the LM and Eskom being IAs of the DoE for the INEP, rather than ESPs for the municipality.  
Implementing small-scale hydropower projects within this DM therefore would require engagements with Eskom and the SHS concessionaire, in addition to facilitating engagements with the beneficiary community.

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<sup>18</sup> Source information for Table 4.1: (Endumeni Municipality, 2014) (Msinga Municipality, 2014) (Nquthu Local Municipality, 2013) (Umvoti Municipality, 2015)



- A need for non-grid electrification in the Umzinyathi DM is identified in all IDPs. It is acknowledged that grid connection, though perceived to be the ideal and “better” solution by consumers, will not be cost effective and viable in the sparsely populated and topographical hilly rural areas of the DM.

The Umvoti IDP refers to the development of a *provincial* alternative energy strategy with specific focus on hydro, solar and wind electricity potential, as well as a programme of alternative energy demonstration projects, in the context of climate change mitigation measures.

**Table 4.2: Electricity backlogs in the Umzinyathi DM**  
(Umzinyathi District Municipality, 2014)

Municipality	Access to basic and better service provision (hh)		Access to a less than basic service (hh) (or no connection)		Total
	Total	%	Total	%	
Endumeni	11 203	78.8%	2 827	20.2%	<b>14 030</b>
Nquthu	12 887	37.7%	21 278	62.4%	<b>34 165</b>
Msinga	7 462	21.6%	27 040	78.4%	<b>34 503</b>
Umvoti	13 298	48.9%	13 882	51.1%	<b>27 180</b>
<b>Umzinyathi</b>	<b>44 851</b>	<b>40.8%</b>	<b>65 028</b>	<b>59.2%</b>	<b>109 879</b>

- The allocation of powers and functions between the DM and the LMs with regards to electricity services provision is ambiguous.

The Umzinyathi DM’s 2014/15 final IDP review document states that “*the provision of electricity within the district lies with Eskom and the Local Municipalities...*”

This is corroborated by the Umzinyathi DM’s 2012 SDP, which states that the DM is responsible for water-, sanitation- and solid waste services and the LMs are responsible for electricity services provision (Umzinyathi District Municipality, 2014). Of the four LMs, only the Endumeni LM IDP specifically allocates the power and function for electricity services provision to itself.

The implication of this is that theoretically, only the Endumeni LM could be considered an ESA (as all municipalities with the power and function for electricity services provision should be) with the option of outsourcing the electricity services function.

In lieu of the institutional vacuum around electricity services powers and functions between the DM and the LMs, and therefore between ESPs and ESAs, it is assumed that the LMs are providing the electricity services in their capacity as IA of the DoE for the INEP.

(Due to the fact though that they are providing electricity services they could be considered as de-facto ESPs, as could be Eskom.)



This highlights the two sets of legislation that both have the same objective, namely the provision of electricity services provision to all the people, but follow different approaches to attaining that objective. The one set of legislation is founded on the premise that an IA of the INEP appointed by the DoE requires an Electricity Distribution Licence to be issued by NERSA according to the prescripts of the ERA, and therefore also requires tariffs to be approved.

The second set of legislation is founded on the Constitution, the Municipal Structures Act and the Municipal Systems Act, which allocates the responsibility of services provision to Local Government, and allows Local Government to make decisions pertaining to the means of providing that service.

As described previously, Eskom's role as IA for the INEP, undermines Local Government's powers and functions for electricity services distribution, and therefore also their ability to raise revenue.

For the purposes of this Study, it is assumed that due to the fact that the IDPs are silent on whether or not the Municipality has a SLA with Eskom, that no SLA exists between the Municipality and Eskom, and that Eskom is operating in those areas as IA of the INEP.

Should rural electrification through small-scale hydropower projects in future be initiated through a tender process for private companies by the DoE as part of the INEP's non-grid electrification programme, similar to the process followed currently for the SHS concessionaire programme, this institutional vacuum will not be an issue, due to the fact that an IPP will be contracted directly with the DoE as an IA for the non-grid component of the INEP. As will be discussed further on in this Study, the feasibility of an IPP driven small-scale hydropower project is doubtful though.

If a municipality engages with the DoE directly as per the "New Household Electrification Strategy" and requests funding for non-grid electrification through the INEP, the institutional vacuum will also not be an issue, due to the fact that the municipality will be acting as an IA for the INEP.

Should rural electrification through small-scale hydropower projects in future be initiated by or for a municipality *outside of the INEP*, this institutional vacuum must be addressed, specifically in the context of ownership of the generation- and distribution infrastructure, as well as future operation and maintenance obligations.

The *means* through which the municipality undertakes this will be dependent on a Municipal System's Act Section 78 process in lieu of that municipalities' allocation and acceptance of the power and function of electricity services provision.





For the DST funded small-scale hydropower projects, those municipalities acting as IAs for the DoE in implementing the grid component of the INEP, and therefore by default require a NERSA electricity distribution licence, and that have an electricity services department, could be engaged with to consider accepting ownership of the generating, transmission and distribution system(s) and to consider appropriate operating models. The project site identified as being the most appropriate for the provision of small scale hydropower lies within the **Nquthu LM**. This LM has a NERSA distribution licence for an area, and therefore also approved tariffs, and is an INEP IA and therefore should have the capacity and capability of owning and operating a stand-alone mini-grid system.

#### 4.2.2 *O.R. Tambo District Municipality*

The O.R. Tambo District Municipality (ORTDM) is one of the six District Municipalities in the Eastern Cape Province. It is located in the eastern half of the Province, with as its eastern border the Indian Ocean coastline of South Africa (O.R. Tambo District Municipality, 2014).

To the north, it is bordered by the Alfred Nzo District Municipality, to the northwest, by the Joe Gqabi District Municipality, to the west, by the Chris Hani District Municipality, and to the southwest, by the Amathole District Municipality.

The District includes within its borders five Local Municipalities (see Map 2 below), namely Ingquza Hill Local Municipality; Port St Johns Local Municipality; Nyandeni Local Municipality; Mhlontlo Local Municipality; and King Sabata Dalindyebo Local Municipality.

The O.R. Tambo area has one large river system (the Umzimvubu) two medium-sized rivers (the Mthatha and Umtamvuna), and a number of smaller coastal rivers with limited catchments that stretch no more than 60 km inland (O.R. Tambo District Municipality, 2014).

The ORTDM is classified as a Category C2-Municipality, which means an area with a largely rural character. At least, 80% of the district was part of the former Transkei, and approximately 93% of the population resides in widely dispersed homesteads and small villages.



SECTION 2: INSTITUTIONAL CONTEXT

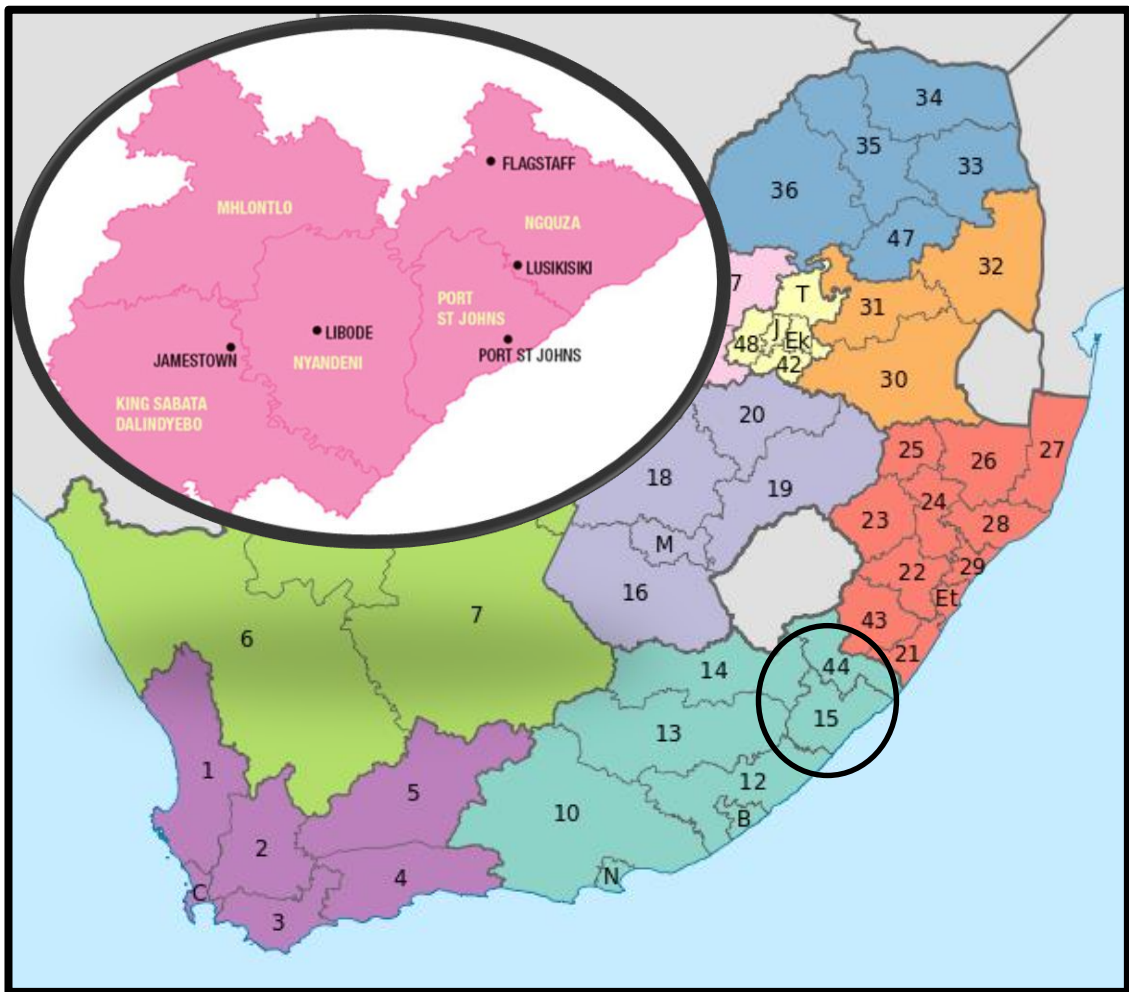


Figure 4.2: The DMs of South Africa, highlighting DC15, O.R.Tambo DM

**Table 4.3: Selection of Institutional Information from the IDPs of the LMs in the O.R. Tambo District Municipality**

Municipality	Municipal Category	ID	Electricity services identified as a need? Extent of backlog?	NERSA Distribution Licence <sup>4</sup> (NERSA, 2015b)	Is the LM an INEP Implementing Agent? <sup>1</sup>	Is Eskom also an INEP IA in munic? <sup>2</sup>	SHS Concessionaire appointed? <sup>3</sup>	Traditional/Tribal Authority?	Communal Property Associations?	Electricity services provision power and function as per IDP or SDBIP?	Assumed ESA?	Electricity Services Department? (also implies revenue generated from electricity sales)	Assumed ESP?	SLA with Eskom?	SHS non-grid projects?	SLA with SHS concessionaire?	Indigent policy/register & fbe / fb alt e?		
O.R. Tambo DM	C2	DC15	Yes High	No	No	No	No(Shine the Way was appointed but has stopped working)	As below	Silent (IDPs note land claims)	No (implied)	?	No	No	n.a.	n.a.	n.a.	n.a.		
KSD LM	B2	EC157	Yes High	Yes	Yes	Yes		Yes		Yes (implied)	Yes	Yes	Eskom & LM	Silent	No	n.a.	n.a.	Yes fbe & fbe alt e	
Mhlontlo LM	B4	EC156	Yes High	No	Yes	Yes		Yes		Yes	No (authority acknowledged, but unable to perform function due to capacity constraints)	No	No	Eskom	Silent	No	n.a.	n.a.	Yes fbe & fbe alt e
Ngquza Hill LM	B4	EC153	Yes High	No	Yes	Yes		Yes		Yes	No	No	Planned	Eskom	Silent	Yes	Silent	Silent	Yes silent
Nyandeni LM	B4	EC155	Yes High	No	Yes	Yes		Yes		Yes	No	No	Planned	Eskom	Silent	No	n.a.	n.a.	Yes fbe & fbe alt e
Port St Johns LM	B4	EC154	Yes High	No	No	Yes		Yes		Yes	No	No	Planned	Eskom	Silent	No	n.a.	n.a.	Yes fbe



**Notes:**

1. It is assumed that if the municipality receives an INEP grant allocation according to the DoRA, then that municipality is an Implementing Agent of the DoE for the INEP (National Treasury, 2015c). *(a condition of the INEP grant is that applicants, i.e. municipalities, need to be “licensed municipal distributors”. The Ngquza Hill-, and Nyandeni LMs though are receiving Municipal INEP grant allocations, but do not hold NERSA electricity distribution licences. Explaining this anomaly falls outside the scope of this Study*
2. It is assumed that the Eskom INEP grant allocation is for the extension of the distribution grid, and grid connections.
3. Information attained by Wlokas in a 2011 report indicates that “Shine the Way” seized operations due to financial problems (Wlokas 2011).
4. NERSA Distribution licences are issued for specific areas within a Municipality, implying that even if a LM has a distribution licence, that licence might be for a specific area only, and not for the entire municipal area.

Interpreting the information in Table 4.3<sup>19</sup>, the following can be inferred:

- A need for electrification in the O.R. Tambo DM is identified in all IDPs. The LM IDPs also refer to the municipalities’ provision of free basic *alternative* energy<sup>20</sup>.  
The IDP mentions that the hydro-electric potential of the uMzimvubu Dam be studied, and that other potential sources of renewable energy be considered where possible to alleviate the poor energy access situation in the DM.

**Table 4.4: Electricity backlogs in the O.R. Tambo DM**  
(O.R. Tambo District Municipality, 2014)

2011	Ngquza Hill LM	Port St Johns LM	Nyandeni LM	Mhlontlo LM	KSD LM	O.R. Tambo DM
Lighting	62.8%	67.8%	71.0%	72.6%	73.3%	70.2%
Cooking	36.2%	31.2%	40.0%	44.8%	57.5%	45.2%
Heating	19%	17.0%	15.5%	15.0%	19.8%	17.8%

- It appears that all the Local Municipalities in this DM have indigent registers in place. The equitable share allocation received through the National Fiscus for the provision of free basic services, including free basic electricity, is dependent on the indigent register.  
The provision of rural electrification through the DST funded study is anticipated to provide a basic level of service to the indigent communities of the DM, and the equitable share allocation will contribute to the long term sustainability of such a project.

<sup>19</sup> Source information for Table 4.3: (King Sabata Dalindyebo Local Municipality, 2014) (Port St John's Municipality, 2014) (Ngquza Hill Local Municipality, 2015) (Nyandeni Local Municipality, 2015) (Mhlontlo Local Municipality, 2015)

<sup>20</sup> The free basic alternative energy policy of 2007 provides a subsidy of R55/month/indigent household (in 2007 terms) for alternative fuel sources such as paraffin, coal, bio-ethanol gel and LPG, to be paid from the equitable share, and only to those households to which neither an INEP grid connection, nor an INEP off-grid electricity solution, is available currently or in the near future (Keller, 2012).



- The allocation of powers and functions between the DM and the LMs with regards to electricity services provision appears to be understood, but not implemented due to lack of capacity. The O.R. Tambo DM IDP states that the provision of electricity is the sole responsibility of Eskom, with the DM only involved in the planning thereof. Municipal capacity constraints could potentially influence the municipalities' decision to accept ownership of a small-scale hydropower plant and to consider appropriate operating models. The apparent *will* though to establish own electricity departments in three of the LMs, and the recognition of the authority role, potentially bodes well for discussions surrounding the various projects.
- In the O.R. Tambo DM, Eskom is the sole electricity services provider. Only the King Sabatha Dalindyebo LM also operates a distribution grid. The Port St. Johns-, Ngquza Hill-, and Nyandeni LMs have initiated processes to attain NERSA distribution licences and establish a municipal services department with the main aim of being able to generate revenue. Implementing small-scale hydropower projects therefore would require engagements with these stakeholders, in addition to facilitating engagements with the beneficiary community.

Should rural electrification through small-scale hydropower projects in future be initiated through a tender process for private companies by the DoE as part of the INEP's non-grid electrification programme, similar to the process followed currently for the SHS concessionaire programme, this institutional vacuum will not be an issue, due to the fact that an IPP will be contracted directly with the DoE as an IA for the non-grid component of the INEP. As will be discussed further on in this Study, the feasibility of an IPP driven small-scale hydropower project is doubtful though.

If a municipality engages with the DoE directly as per the "New Household Electrification Strategy" and requests funding for non-grid electrification through the INEP, the institutional vacuum will also not be an issue, due to the fact that the municipality will be acting as an IA for the INEP.

Should rural electrification through small-scale hydropower projects in future be initiated by or for a municipality *outside of the INEP*, this institutional vacuum must be addressed, specifically in the context of ownership of the generation- and distribution infrastructure, as well as future operation and maintenance obligations.

The *means* through which the municipality undertakes this will be dependent on a Municipal System's Act Section 78 process in lieu of that municipalities' acceptance of the power and function of electricity services provision.



For the DST funded small-scale hydropower projects, those municipalities acting as IAs for the DoE in implementing the grid component of the INEP, and therefore by default require a NERSA electricity distribution licence, and that have an electricity services department, could be engaged with to consider accepting ownership of the generating, transmission and distribution system(s) and to consider appropriate operating models.

In this DM, only the KSD LM is an IA for the INEP, **and therefore only the KSD LM has NERSA approved tariffs.**

The project site identified as being the most appropriate for the provision of small scale hydropower lies within the **Mhlontlo LM**. From Table 4.3, it can be read that Eskom is the sole supplier of (grid) electricity in the Mhlontlo LM, and most likely is doing this in its capacity as IA of the DoE for the INEP, rather than as the appointed ESP for the LM. Further, neither the DM nor the Mhlontlo LM have the capacity to fulfil the obligations of the powers and functions pertaining to electricity services provision; implying that neither municipality is the Electricity Services Authority, and that therefore neither municipality can enter into a Service Level Agreement with an external legal entity to provide electricity services on their behalf.

This will inform the decision pertaining to deciding an appropriate ownership and operating model for this project.

Further, due to the fact that the Mhlontlo LM does not have an electricity distribution licence, it also does not have approved NERSA tariffs.



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## 5 OTHER PERTINENT NATIONAL GOVERNMENT PERSPECTIVES FOR RURAL ELECTRIFICATION

### 5.1 An Environmental Perspective

#### 5.1.1 *Environmental Authorisations*

The National Environmental Management Act 107 of 1998 (NEMA), as amended, (Amendment of section 1 of Act 107 of 1998, as amended by section 1 of Act 56 of 2002, section 1 of Act 46 of 2003, section 1 of Act 8 of 2004, section 1 of Act 62 of 2008, section 4 of Act 14 of 2009 and section 1 of Act 30 of 2013 (DEA, 2014d)) promotes the application of environmental assessment and management tools to ensure integrated environmental management of activities. It aims to improve the quality of environmental decision-making by setting out principles for environmental management that apply to all government departments and organisations that may affect the environment (Beeslaar, 2012).

Section 23 of the NEMA provides the general objectives of integrated environmental management, and section 24 outlines the procedures to be implemented in order to achieve these objectives (DEAT, 2004).

An implementation tool of integrated environmental management is the Environmental Impact Assessment, or EIA. An EIA is a procedure which ensures that environmental consequences of projects are identified and assessed before an Environmental Authorisation (previously referred to as “Record of Decision”) by a competent authority is given (DEA, 2013a). A competent authority is either the Minister of Environmental Affairs through the Department of Environmental Affairs, or a Member of the Executive Council (MEC) of a Province with assigned responsibility for the environmental portfolio (DEA, 2014f). In other words, an EIA serves to identify, predict, evaluate and mitigate any environmental impacts of a proposed development (Beeslaar, 2012).

Regulations in terms of Chapter 5 of the NEMA were published in April 2006, and revised in both June 2010 and December 2014. These regulations, published as General Notices (GN) GN983, GN984 and GN985 in the Government Gazette, provide guiding procedures for the submission and evaluation of applications for environmental authorisations, including identifying the relevant competent authority.

At the initiation phase of any project or development, the extent of the potential environmental impact is anticipated through an initial screening process which consists of checking the proposed development activities against current legislation.

GN983 contains listed activities, which when triggered by a development, would initiate a Basic Assessment (BA). A Basic Assessment is applied to the activities of a development that are considered less likely to have significant environmental impacts.



A full public participation, or stakeholder engagement, process is still required. A stakeholder engagement process is commonly defined as “*the process of engagement between stakeholders during the planning, assessment, implementation and/or management of proposals or activities. The level of stakeholder engagement varies depending on the nature of the proposal or activity as well as the level of commitment by stakeholders to the process. Stakeholder engagement can therefore be described by a spectrum or continuum of increasing levels of engagement in the decision making process.*” (DEAT, 2004)

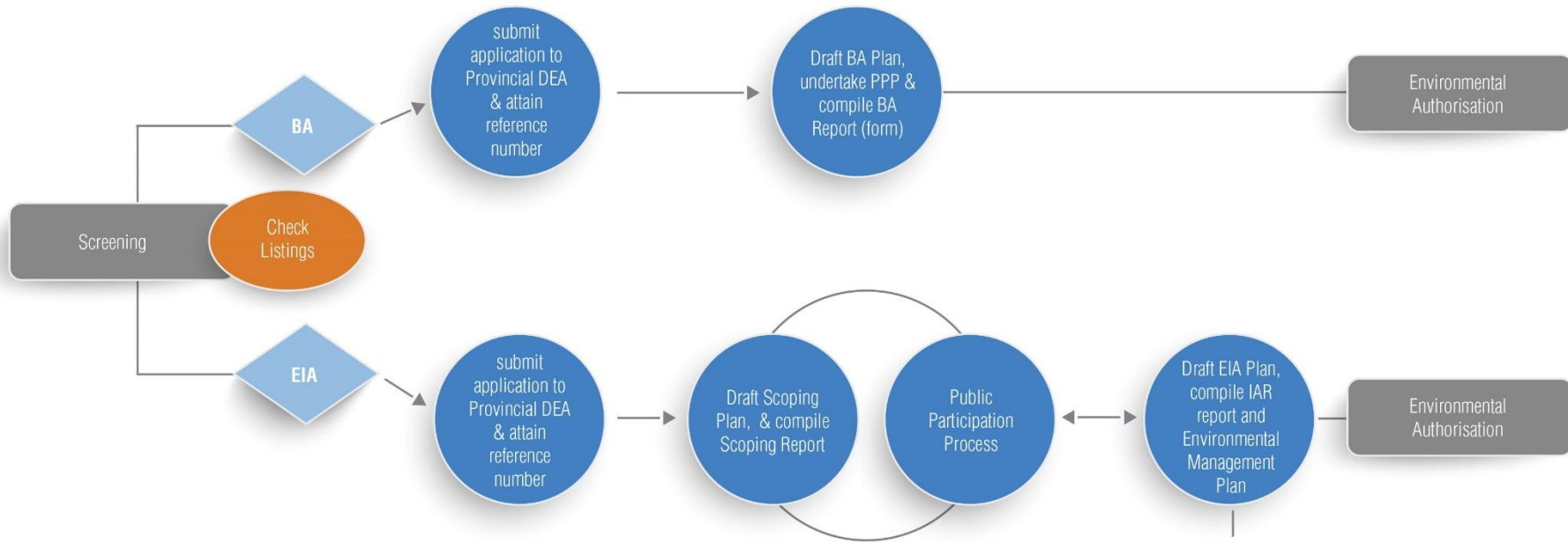
GN984 contains listed activities, which when triggered, would initiate a full EIA. The activities presented in this list would result in significant environmental impacts.

GN985 contains listed geographic activities, i.e. activities that stretch across borders and or provincial boundaries. Environmental authorisation applications for BAs are made to the National Department of Environmental Affairs.

Figure 5.1 illustrates the typical processes associated with undertaking either a BA or an EIA. The appointment of an Environmental Management Practitioner is advised to ensure that the processes are correctly undertaken.

The two key phases of an EIA are the scoping- and impact assessment phases. The scoping phase focusses the environmental assessment on the key issues to be investigated in the EIA. During the impact assessment phase, issues raised during the scoping phase are investigated; potential impacts are assessed and mitigation actions recommended, and presented in an Impact Assessment Report, or IAR (Beeslaar, 2012).





**Figure 5.1: Typical processes associated with a BA and an EIA**



### 5.1.2 *Environmental Authorisations for small-scale hydropower projects applied towards rural electrification*

An environmental authorisation based on either a full Environmental Impact Assessment (EIA) or a Basic Assessment (BA) **could be required when initiating and constructing a small hydropower scheme.**

Schedule GN983 requires a BA to be undertaken if any one of the following 2 activities related to electricity generation and distribution are applicable (DEA, 2014a):

- Listing Notice 1, activity 1: *“the development of facilities or infrastructure for the generation of electricity from a renewable resource where- the electricity output is more than 10 MW but less than 20 MW; or the output is less than 10 MW but the total extent of the facility covers an area in excess of 1 hectare. Excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs within an urban area.”*
- Listing Notice 1, activity 2: *“The development and related operation of facilities or infrastructure for the generation of electricity from a non-renewable resource where- the electricity output is more than 10 MW but less than 20 MW; or the output is less than 10 MW but the total extent of the facility covers an area in excess of 1 hectare.*
- Listing Notice 1, activity 11: *“The development of facilities or infrastructure for the transmission and distribution of electricity- outside urban areas or industrial complexes with a capacity greater than 33 kV but less than 275 kV; or inside urban areas or industrial complexes with a capacity of 275 kV or more.”*

Schedule GN984 states that an EIA will need to be undertaken when either one of the following two electricity generation and distribution activities are applicable (DEA, 2014b):

- Listing Notice 2, activity 1: *“the development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 MW or more, excluding where such facilities of infrastructure is for photovoltaic installations and occurs within an urban area.”*



- Listing Notice 2, activity 2: *“The development and related operation of facilities or infrastructure for the generation of electricity from a non-renewable resource where the electricity output is than 20 MW or more.”*
- Listing Notice 2, activity 9: *“The development of facilities or infrastructure for the transmission and distribution of electricity with a capacity of 275 kV or more, outside an urban area or industrial complex.”*

Based on the *electricity generation and distribution activity listings* of GN983 and GN984, neither an EIA nor a BA environmental authorisation will be required for the initiation and construction of the *electricity* components of small-scale hydropower schemes, due to the fact that:

- by the definition of “small-scale hydropower”, such projects will have installed capacity of less than 10 MW,
- would be constructed over an area most likely covering less than 1ha, and
- rural electrification will most likely require electricity distribution at 22 kV.

**Listed activities pertaining to the construction or alteration of water infrastructure must also be considered.**

Schedule GN983 states that a BA will need to be undertaken when any one of the following bulk water transportation and construction activities are applicable: (DEA, 2014a):

- Listing Notice 1, activity 9 *“The development of infrastructure exceeding 1000m in length for the bulk transportation of water or storm water- with an internal diameter of 0.36 m or more; or with a peak throughput of 120 l/s or more. Excluding where such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve; or where such development will occur within an urban area.”*
- Listing Notice 1, activity 12: *“The development of- Canals exceeding 100 m<sup>2</sup> in size; Channels exceeding 100 m<sup>2</sup> in size; Bridges exceeding 100 m<sup>2</sup> in size; Dams, where the dam, including infrastructure and water surface area, exceeds 100 m<sup>2</sup> in size; Weirs, where the weir, including infrastructure and water surface area, exceeds 100 m<sup>2</sup> in size; Bulk storm water outlet structures exceeding 100 m<sup>2</sup> in size;*



*Marinas exceeding 100 m<sup>2</sup> in size;*  
*Jetties exceeding 100 m<sup>2</sup> in size;*  
*Slipways exceeding 100 m<sup>2</sup> in size,*  
*Buildings exceeding 100 m<sup>2</sup> in size*  
*Boardwalks exceeding 100 m<sup>2</sup> in size; or*  
*infrastructure or structures with a physical footprint of 100 m<sup>2</sup> or more;*

*where such development occurs-*  
*within a watercourse;*  
*in front of a development setback or*  
*if no development setback exists, within 32 m of a watercourse measured from the*  
*edge of a watercourse,*

*Excluding*

*....where such development occurs within an urban area or within existing roads or*  
*road reserves.”*

- Listing Notice 1, activity 19: *“The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from (i) a watercourse...”*

Schedule GN984 states that an EIA will need to be undertaken when the following water development activities are applicable (DEA, 2014b):

- Listing Notice 2, activity 11 *“The development of facilities or infrastructure for the transfer of 50 000 m<sup>3</sup> or more of water per day, from and to or between any combination of the following; water catchments, water treatment works or impoundments excluding treatment works where water is to be treated for drinking purposes”*

Based on the *water activity listings* of GN983 and GN984, and depending on the actual scope of works of a particular small-scale hydropower rural electrification project, **a BA could possibly be required.**

Activities listed in GN985 are defined per geographic area, but none of the listed activities would be applicable to a rural electrification project applying small-scale hydropower technology.

### 5.1.3 *EIA Guideline for renewable energy projects*

The “EIA Guideline for Renewable Energy Projects” published by the DEA in 2013, indicates that the following environmental impacts could be associated with a hydropower development (DEA 2013a):



- Visual impact;
- Land use transformation;
- Impacts on cultural heritage;
- Displacement of communities;
- Impacts on water resources;
- Impacts on upstream/downstream watercourse;
- Impacts of biodiversity; and
- Electromagnetic interference.

It is interpreted that these potential impacts are focussed on the construction and development of a large-scale hydropower scheme.

In the context of developing small-scale hydropower projects for rural electrification, the main potential impacts will be on the water resource, in addition to some negligible visual impacts.

#### 5.1.4 Authorisations

It should be noted that should a NERSA electricity generation licence be required for a rural electrification project, either an Environmental Authorisation from a competent authority is required, or a motivation from an Environmental Management Practitioner that none is required, is needed. **If no electricity generation licence is required, it would not imply that an environmental process should not be undertaken.**

Attaining a water use authorisation, either through a Water Use Licence Application (WULA) process or a Water Use Registration process, can form part of the environmental authorisation process. Should no environmental authorisation process be required for the development, it would not negate the responsibility of the developer to apply for a water use authorisation.

## 5.2 A Water Sector perspective

The National Water Act (NWA) of 1998 as amended fundamentally changed the way water resources in South Africa are to be managed and used – the NWA is founded on the Constitutional principal that water belongs to all the people of South Africa.

The NWA aims to protect, conserve, manage and **control** water resources as a whole (de la Harpe & Ramsden, n.d.). The only *right* to water encapsulated in the Act is for basic human needs and the environment, and ensures that water for these needs are “reserved”, before water is allocated for other uses.



Integrated water resource management (IWRM) is described in the Act as the means to effect the aim of the NWA, and is operationalised through the National Water Resource Strategy (NWRS), which, inter alia:

- determines how much water is- to be “reserved”, allocated for international commitments, and available in each water management area;
- provides for the establishment of water resource management institutions such as Catchment Management Agencies (CMAs);
- sets principles for water conservation, **water use** and water quality.

South Africa is now divided into 9 CMAs, with the Department of Water and Sanitation’s regional offices acting as defacto CMAs, or proto-CMAs, where CMAs have not yet been established. It is the responsibility of a CMA to develop a Catchment Management Strategy (CMS) for its water management area. Importantly, the CMS should contain a *water allocation plan*, which should guide its water allocation decisions.

Water use is **controlled** through regulating the way water can be **used**. The NWA regulates water use through the *registration* of existing lawful water use, and through *different types of authorisations* (de la Harpe & Ramsden, n.d.).

Water use registration- or authorisation applications are to be submitted to the applicable CMA or proto-CMA.

After the promulgation of the NWA in 1998, *existing lawful water users were requested to register* their water use with the (then) Department of Water Affairs’ and Forestry’s (now Department of Water and Sanitation) regional offices to determine how much water is being used from different water resources (de la Harpe & Ramsden, n.d.).

This process allowed water use that was lawfully used before the NWA came into effect to continue until it can be converted into a licence using compulsory licensing.

Even though three different types *water use authorisation* categories exist, only two are of relevance for the development of small-scale hydropower projects.

(The first category requires no licencing and no registration for water uses as defined in Schedule 1 of the NWA. Schedule 1 water uses are mainly domestic in nature, with minimal risk and impact on the water resource)

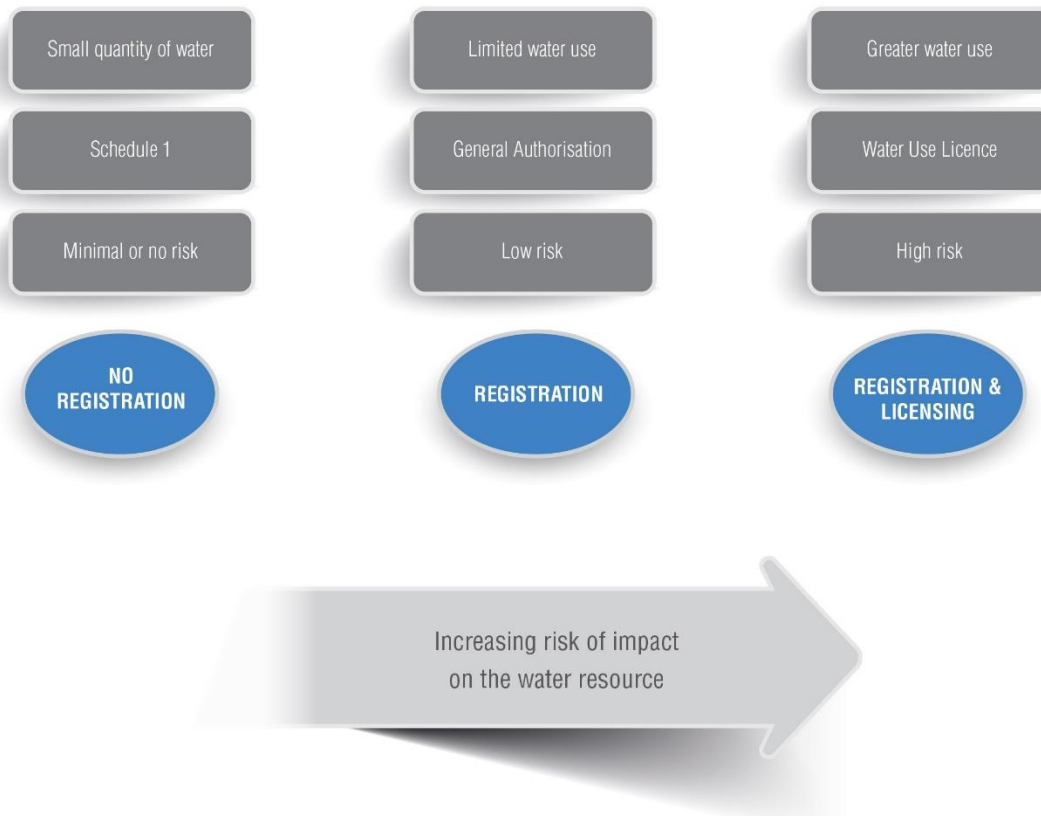


Figure 5.2: Three types of water use authorisations

A set of 11 consumptive and non-consumptive water uses are defined in Section 21 of the NWA, any one of which would necessitate the attainment of a **water use authorisation**:

- 21(a) taking water from a water resource;
- 21(b) storing water;
- 21(c) impeding or diverting the flow of water in a watercourse;**
- 21(d) engaging in a stream flow reduction activity contemplated in section 36;
- 21(e) engaging in a controlled activity identified as such...;
- 21(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
- 21(g) disposing of waste in a manner which may detrimentally impact on a water resource;
- 21(h) disposing in any manner of water which contains waste from or which has been heated in any industrial or power generation process;
- 21(i) altering the bed, banks course or characteristics of a watercourse;**
- 21(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
- 21(k) using water for recreational purposes.

21(c) and 21(i) are of particular relevance to small-scale hydropower projects.



### 5.2.1 *Water Use Authorisation: Registration in terms of a General Authorisation*

General Authorisations allow the DWS to authorise large numbers of people to take up water without the need for a licence. A general authorisation can be limited to a specific group of people, and/or specific water resources, and has several advantages, including (DWS, n.d.):

- *“Smaller scale emerging users would not need to be ready to apply for a licence;*
- *General authorisations can be adapted for specific regional and social needs;*
- *General authorisations can promote the uptake of smaller amounts of water by many people - and hence can have a greater impact on poverty;*
- *They can reduce the administrative burden;*
- *They can allow for the gradual uptake of water by the poor, paralleled with the gradual reduction of use by existing lawful water users.”*

If the intended water use activity is covered under a General Authorisation published in the Government Gazette in terms of section 39 of the NWA from time to time (normally every 5 years), then a *registration* process is to be followed. Importantly, a General Authorisation is only applicable to specific rivers or catchments and is not applicable to the whole country.

The current applicable General Authorisation, GA1199 published in December 2009 for Section 21(c) and 21(i) water uses, is currently under review. It is also these two water uses that are specifically applicable to small-scale hydropower projects. In lieu of this, as well as the potential cost associated with specialist studies required to attain water use *licences* for small rural electrification projects which would potentially make these types of projects financially unviable, the Department of Water and Sanitation has been approached with the request to include the construction of small-scale hydropower projects towards non-grid electrification in the rural areas of South Africa into the new General Authorisation (GA) as an activity.

The proposed amended GA was published in Government Gazette 39458 on 27 November 2015 to invite public comments, and included the requested aspects for rural electrification.

If this GA is passed, it would imply that small-scale hydropower projects initiated for islanded, non-grid electrification purposes would need to follow a registration process to attain the required water use authorisation, and not a full water use licence application process.

The registration process for an activity listed in a GA would entail compiling a document pack that would include the following information:

- Part 1: Form detailing the applicant type;
- Part 2: Forms detailing the intended water uses; a form per water use is to be completed;
- Substantiating documentation as per the GA and the published risk matrix.





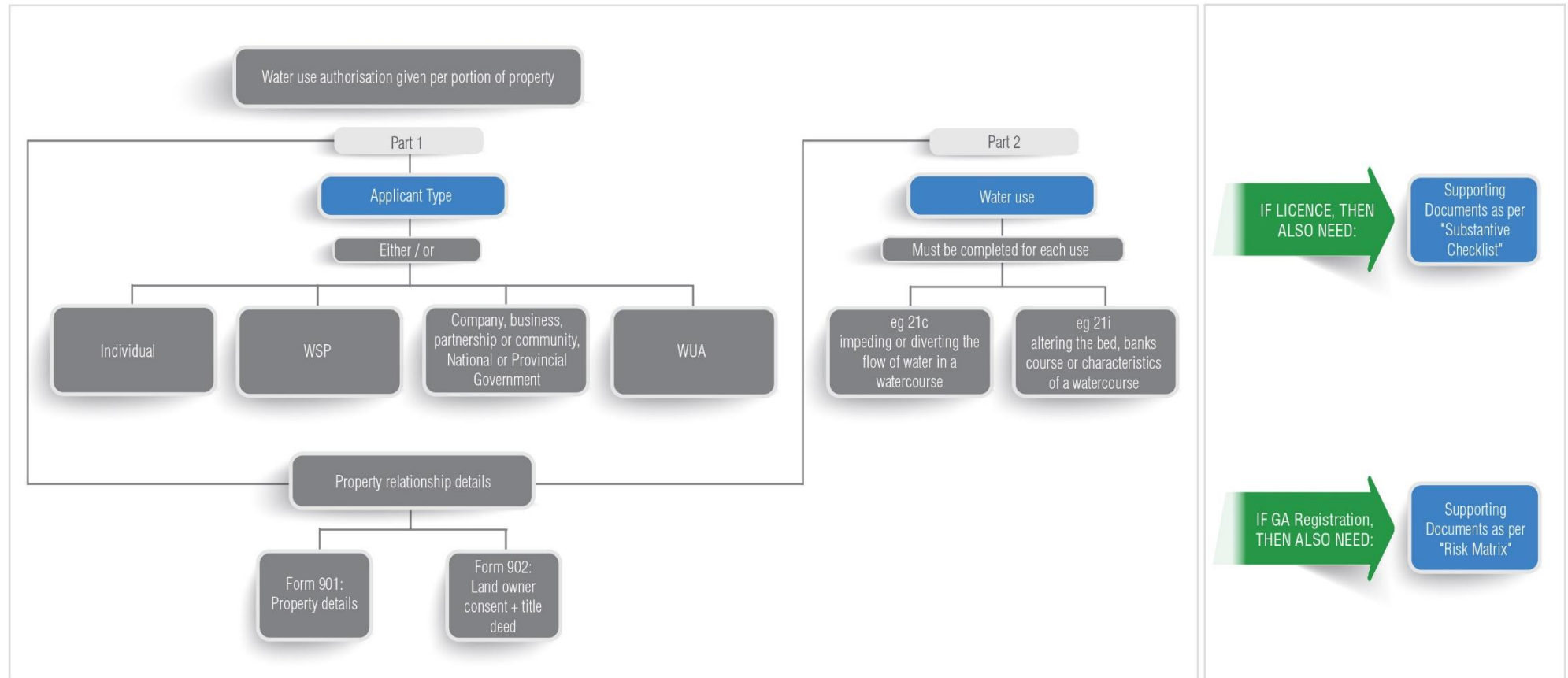
All forms are available from the DWS web-site.

The regional office to whom the submission was made will issue a registration number to the applicant after the application was reviewed, with the understanding that the applicant will honour the conditions of the authorisation.

#### 5.2.2 *Water Use Authorisation: Water Use licencing*

If the intended use is not covered in a General Authorisation, then a *licencing* process is required to be followed. The DWS has published a substantive checklist which aids users in ensuring that all the required information is submitted. This checklist is available from the DWS web-site.

A water use licence (WUL) application can be a complex submission, and it is recommended that an Environmental Management Practitioner be involved in the process.



**Figure 5.3: Submission documentation required for both a Water Use Licence and the General Authorisation Registration**



### 5.3 A rural development perspective

#### 5.3.1 Basic Services

The challenges continually being faced by South Africa's rural population include limited economic activity, inadequate infrastructure, widespread poverty, dependence on social grants, social and community challenges, under-utilisation and or unsustainable use of natural resources, high unemployment and unmarketable skills levels (DRD&LR 2011). With one of the fundamental objectives of Government being poverty alleviation, and with social development lagging most behind in the rural areas, the Rural Development and Land Reform Ministry (DRD&LR) was established in 2009.

The DRD&LR has a dual service delivery mandate, continuing with the implementation of land reform on the one hand, **whilst also being responsible for the coordination of the various services delivery streams which constitute rural development**. The Comprehensive Rural Development Programme (CRDP) was launched in 2009 in order to realise this dual mandate, (DRD&LR, 2014) with the vision to create “vibrant, equitable and sustainable rural communities.” The CRDP took into consideration the experiences of pre 2009 policy implementation initiatives, the outcomes-based approach adopted by Government, and emphasised a “**bottom-up**” approach to rural development.

#### **Box 5.1: Lessons learnt from previous rural development strategies**

The implementation of the aims and objectives of rural development policy as encapsulated in the 1994 Reconstruction and Development Programme (RDP), the 1995 National Rural Development Strategy (NRDS), the 1997 drafted but unconfirmed Rural Development Framework (RDF), the 2001 Integrated Sustainable Rural Development Programme (ISRDP), the 2008 War on Poverty Programme, is considered by some to have been unfocussed and ineffective (DRD&LR, 2011). Key reasons for the ineffective implementation of the rural development policy in South Africa pre 2009 are described to be, inter alia, the fact that the policy(ies):

- consisted of elements of sectoral policies, without regard to inter-sectoral effects;
- were construed from urban policies poorly adapted for rural application;
- assumed that there were public institutions that served the unique needs of rural areas.

In other words, the CRDP proposed an approach that addresses **the needs of the person, the household, community and space** (DRD&LR, 2011). The CRDP differs from previous rural development strategies, in that it follows a participatory approach, rather than an interventionist approach (LinkD, 2013).



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The strategy to achieve the CRDP vision is the “Agrarian Transformation Strategy”, which refers to the “*rapid and fundamental change in the relations of land, livestock, cropping and community.*” (DRD&LR, 2013a)

The CRDP is being implemented over three phases, (DRD&LR, 2011) (DRD&LR, 2015a):

- Phase 1: meeting basic human needs (shelter, water, sanitation, electricity, food etc)
- Phase 2: Infrastructure development and enterprise development
- Phase 3: small, medium and micro-industries (agri-processing, village markets, finance/credit facilities)

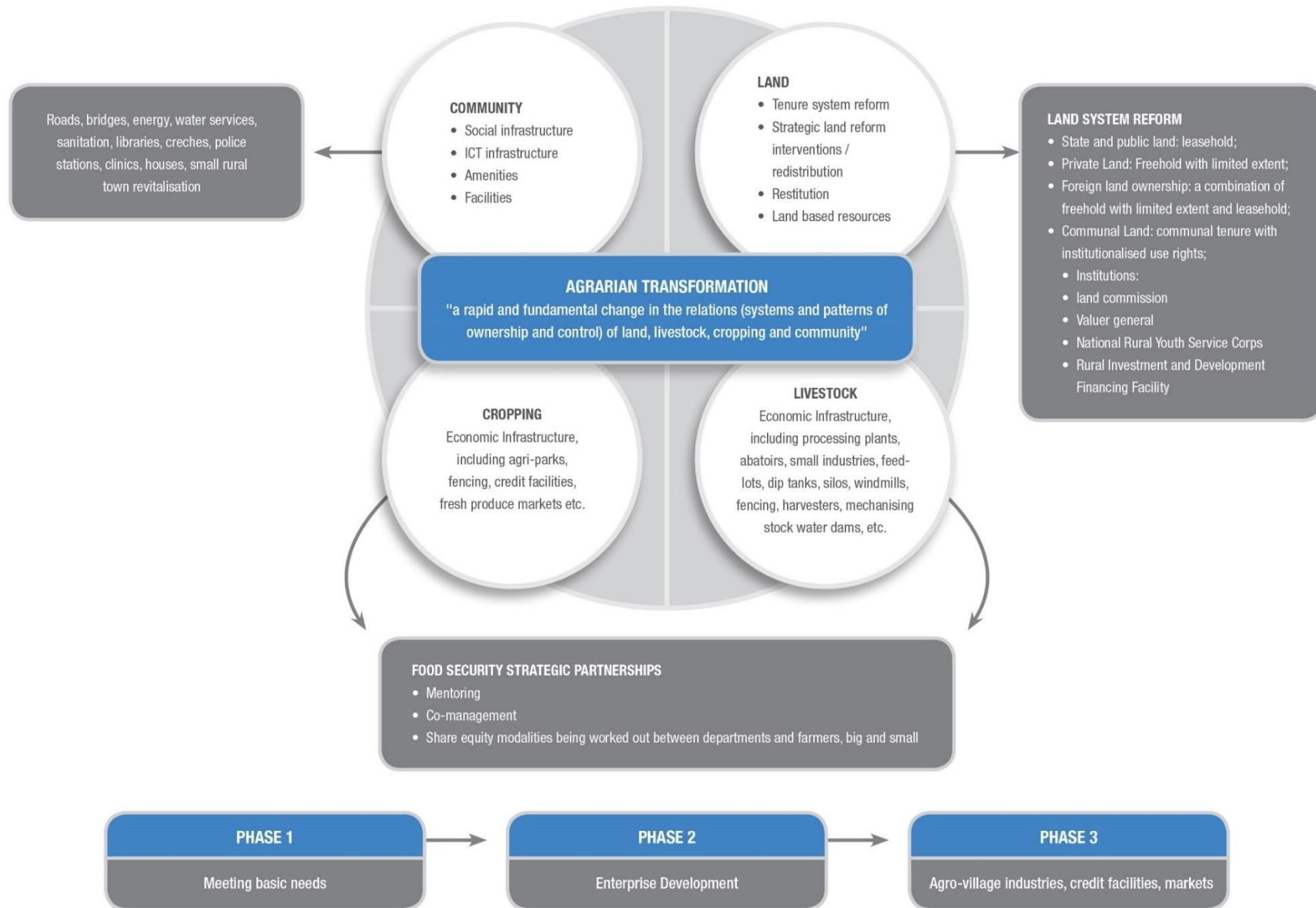
This is shown diagrammatically in Figure 5.4.

Phase 1 of the CRDP is focussed primarily on providing required social infrastructure to households, for improved access to water, sanitation, **energy**, housing, education and health (DRD&LR, 2013a).

It is interpreted that a final objective of the CRDP growth phases is the establishment of the so called Agri-Parks. The DRD&LR’s strategic plan for 2015-2020 states that Agri-Parks are to be established in each of the 27<sup>21</sup> poorest District Municipalities (DMs), effectively establishing a CRDP site in each of these DMs. “*The Agri-Parks are conceived as providing for the creation of sustainable rural enterprises and industries, agro-processing, trade development, production hubs for food security, local markets and financial services.*” (DRD&LR 2015)

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<sup>21</sup> Initially, 23 District Municipalities were identified as most distressed during 2013. This number subsequently changed to 27.



**Figure 5.4: Agrarian Transformation System/Strategy**  
(DRD&LR, 2015a)



**Box 5.2: What are Agri-Parks?**  
(DRD&LR, 2015b)

Agri-Parks are envisioned as smallholder farmer / cooperative-led rural development hubs which will be linked to the district gateways. They will be designed for multiple uses that accommodate small farms, public areas and natural habitats. These Parks would allow smallholder farmers access to secure land and local markets; provide fresh food to households and schools nearby, and would become an educational, environmental, and aesthetic amenity for nearby communities.

The implementation of small-scale hydropower rural electrification projects is aligned with, and contribute directly to, Phase 1 of the CRDP and the Agrarian Transformation Strategy – and should not be implemented only from the perspectives of the INEP, but in the context of the CRDP. Integration and alignment therefore of the local electricity plan and the local rural development plan, would be required.

The implementation of small-scale hydropower rural electrification projects is aligned with, and contribute directly to, Phase 1 of the CRDP and the Agrarian Transformation Strategy – and should not be implemented only from the perspectives of the INEP, but also in the context of the CRDP. Integration and alignment therefore of the local electricity plan and the local rural development plan, would be required.

5.3.2 *Land Tenure*

Correcting the injustices of the past with regards to land tenure, or land ownership, constituted a crucial component of both the 1994 RDP White Paper, as well as the 1996 Constitution of South Africa. More than 20 years into a democratic South Africa, the issues surrounding land reform in South Africa are complex and emotive, and difficult to resolve.

Land reform in South Africa is being effected through three main initiatives; Land Restitution, Land Redistribution and Land Tenure Reform. Land reform is an integral component of the CRDP – as is the provision of basic services to households. Refer also Figure 5.4.

In order to undertake a developmental project in rural South Africa, it is required, inter alia, to either purchase land for such development from the land owner, or attain the permission of the land owner to use the land.



**Box 5.3: The three sub-programmes of the Land Reform Programme (DLA, 1997)**

**Land Restitution** involves returning land, or compensating victims for land rights, lost because of racially discriminatory laws, passed since 19 June 1913.

**Land Redistribution** makes it possible for poor and disadvantaged people to buy land with the help of a Settlement/Land Acquisition Grant. Redistributive land reform will be largely based on willing-buyer-willing-seller arrangement. Communities are expected to pool their resources to negotiate, buy and jointly hold land under a formal title deed.

**Land Tenure** reform aims to bring all people occupying land under a unitary legally validated system of landholding. **It is a complex process and must address systems of land holding, land rights and forms of ownership.**

Operationally, the DRD&LR is managing Land Restitution as a separate programme to Land Redistribution and Tenure Reform.

In South Africa, as a consequence of the dispossession of the land and the subsequent attempts to address this dispossession, it is important to know **who owns the property**, and what **land use rights** have been vested to that property and to whom.

Land can be owned by the State or privately:

- Privately owned (or non-State owned), which includes:
  - land owned by a Community Property Association, or CPA. A CPA is a legal body that can be established by communities in order to submit land claims through the Restitution or Redistribution land reform programmes (DLA, 1997). The establishment of CPAs is legally governed by the Communal Property Associations Act, Act No.28 of 1996. The Act is aimed at enabling communities “to form juristic persons, to be known as CPAs, to acquire, hold and manage property on a basis agreed upon by members of a community in terms of a written constitution, and to provide for matters *connected therewith*.” (DLA, 1996)
  - Municipal owned land (Municipal Commonage) and
  - Land owned by Traditional Authorities and registered by the Deeds Office (PMG, 2013)
- State owned (i.e. owned by National and Provincial Government);
  - Which includes land owned by the State but administered by Trusts or other entities, for example the Ingonyama Trust in KZN (PMG, 2013). The land is owned by the State, but is administered on behalf of the community by the Trust.



The land is therefore held in Trust by the State, and the community or communities, does not own the land;

- The Department of Public Works (DPW) is usually the custodian of State Owned Land, (SANRAL, 2008), and in particular all state assets and developed state land (Umhlaba Consulting Group, 2013).
- The Minister of Rural Development and Land Reform is the custodian of State Owned Land on behalf of (inter alia) various Tribal Authorities (SANRAL, 2008).

In 2013, the DRD&LR published the findings of a comprehensive land audit undertaken in South Africa to determine, inter alia, land ownership status, as well as the status on land use rights, current land use, and current land users. Of particular interest to this Study are the findings for the EC and KZN Provinces.

**Table 5.1: Summary of the Land Audit finding for the EC and KZN Provinces (DRD&LR, 2013c)**

LAND USER	EC			KZN		
	State Land	Private Land	Unaccounted	State Land	Private Land	Unaccounted
	9%	67%	24%	50%	46%	4%
	100%			100%		
Traditional Authority	4.68%			58.88%		
Government Dept	14.98%			19.27%		
Unknown	51.65%			8.05%		
Municipality	6.67%			5.87%		
Organisation	3.70%			4.23%		
Private Person	5.06%			2.15%		
Public Entity	13.26%			1.55		

**Notes:**

- The definition of “State Land” in the Land Audit corresponds to the definition of “Public Land”. The 2013 DRD&LR Land Audit report defines “State Land” as being “*Land that is owned by the State (National, provincial, Local Municipalities and parastatals*” (DRD&LR, 2013c, p. 7) “Public Land” is defined “*as land that includes land held by provincial and national governments, as well as land owned by Local Authorities and land belonging to parastatals or other enterprises wholly owned by Government.*” (Polity.org, 1995)
- Another definition for “State Owned Land” is “*Land that refers to all properties that are registered in the name of, or under the control of, the Republic of South Africa or any State Department, including all un-surveyed and/or un-registered State Owned Land*” (SANRAL, 2008, p. 24) (Umhlaba Consulting Group, 2013). Municipal owned land is excluded from State Land (Umhlaba Consulting Group, 2013).





- Registered State Land implies that the land is registered in the name of the State, and certified by a title deed document that indicates which State Department or Division has been allocated ownership (DRD&LR, 2013c).
- Un-registered State Land implies that the land has been surveyed but has not yet been registered in the Deeds office. The 2013 Audit excluded un-registered state land (DRD&LR, 2013c).
- The Ingonyama Trust land in KZN is recorded as “State” land in the Table (PMG, 2013), although some privately owned land may exist within this land.
- Land owned by traditional authorities in the Eastern Cape, and registered by the Deeds Office was included in the data for privately-owned land (PMG, 2013).

For development purposes, land is either **acquired**, and the land use rights changed if necessary, or **permission to use the land is acquired from the land owner**, and a servitude<sup>22</sup> registered in the name of the land user for the portion of land subject to development. Importantly, the community or communities living on the land must pass a resolution to approve the servitude and land use; based on which the land owner (for example the State, and in particular the DRD&LR) would be able to grant the servitude.

A conveyancer will need to be appointed to effect this, and, as would most likely be the case for the DST funded projects, the Local Municipality will own the small-scale hydropower generation and distribution infrastructure, and the servitude therefore would be registered in the name of the respective Local Municipality.

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<sup>22</sup> A servitude is a limited real right in terms of which a burden is imposed on an immovable property restricting the rights, powers or liberties of its owner to a greater or lesser extent in favour of either another person or the owner of another property. It can either be a praedial-, or personal servitude. A praedial servitude is a real right entitling one piece of land from receiving the benefit of the right and the other piece of land being subject to the right (Meumann White Attorneys, 2011).



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## 5.4 A climate change perspective

### 5.4.1 Climate Change Projections for South Africa

Climate is the average pattern of weather. It is determined by measuring temperature, precipitation, atmospheric pressure and wind over a long period of time. The climate of a region also results from the interaction of other variables, including latitude, height above sea level, topography and proximity to oceans or large water bodies (Fry, et al., 2010).

#### Rainfall

The overall feature of the distribution of Mean Annual Precipitation (MAP) over South Africa is that it decreases uniformly westwards from the escarpments across the interior plateau (Schulze, 2011). Based on specific Global Climate Model simulations and downscaling methodologies applied in their analysis and research, Schulze et al. (2011) were able to generate data that indicates an overall wetting over the next 50 years – very slight in the west, and more pronounced in the east. This trend of increasing MAP over the interior and eastern parts of the country was found to become more pronounced when modelling up to the end of the century. The implications of increases in rainfall are:

- increase in the number of days of rain;
- increase of depth of rain;
- increase in waterlogging days;
- increased runoff generation is likely to occur (floods);
- increased groundwater recharge likely;
- decrease in drought events.
- decrease in irrigation needs.

A drying trend is being projected by the long-term model simulations for the western parts of the country. This implies that the number of days with  $\geq 25\text{mm}$  is projected to decrease into far future, as well as:

- less waterlogged days;
- runoff generation is likely to decline;
- groundwater recharge likely to decrease;
- increase in drought events in the long term;
- Irrigation needs are expected to increase.

#### Temperature

With regards to temperature, Schulze *et al* (2011) found trends in their model results indicating a gradual increase in temperature of between 1.5°C and 2.5 °C at the coasts, and between 3.0°C and 3.5 °C in the interior over the next 50 years.

Long term modelling indicated an increase of up to 6 °C in the interior. The implications of this are increased rates of evaporation from soil and water bodies.



**Box 5.4: Potential Projected Impacts of Climate Change on the Water Sector in South Africa**

(Schulze, 2011, pp. 282-283)

Climate change will affect not only water *supply*, but also the *demand* for water, with projected changes to availability, timing and assurance of water supply affecting all water user sectors, e.g. agriculture, **hydropower**, urban areas, water for sanitation, the poor and the environment. Changes will also affect the broader dynamics of the economy, including water scarcity, water related disasters, spatial patterns of development, and structural changes in economies.

The following changes are anticipated:

- Changes in irrigation water demand and practices;
- Effects of changed land use patterns on water availability and production;
- Effects of changed water availability on land use patterns;
- Changes in water demand and supply, including:
  - Urban, i.e. municipal, domestic (formal and informal residential), industrial, and
  - **Rural, including settlements, tourism, recreational or agricultural.**
- **Changes in water rights and allocation mechanisms;**
- Changes in dynamics of water quality responses and their consequences in regard to *water-borne diseases, water-washed diseases, water-based disease, water-related diseases, and water-dispersed diseases*;
- Impacts on terrestrial and aquatic ecosystems;
- A re-think on water storage, including natural, man-made and virtual storage;
- Impacts on infrastructure in regard to hydraulic design, dam safety, and infrastructure maintenance.
- Integrated Catchment Studies, with installed modelling systems (IMs) particularly on stressed and vulnerable catchments,
- Potential conflicts over shared rivers,
- Vulnerability of the poor, including
  - In urban areas, e.g. living in flood prone riparian areas,
  - **In rural areas, e.g. availability of potable water.**

Any hydropower project is dependent on the availability of water and therefore it is imperative to understand the implications of the potential impacts of climate change on the water cycle.

This Study focusses on the provision of basic electricity services to the rural communities of South Africa. Understanding the vulnerability of rural communities to potential climate change impacts is therefore important.



**Box 5.5: Impacts of climate change on rural communities**  
(DEA, 2014e)

Agriculture, herding and tourism are the primary economic drivers of rural economies; all of which are vulnerable to the potential impacts of climate change.

- Decrease in quantity and quality of water for consumption and use;
- Reduced viability of crops harvested from subsistence farming practices due to either floods or droughts;
- Aggravated health issues due to poor nutrition and temperature increases;
- Reduced ability to maintain and feed livestock;
- Overgrazing of communal land;
- Deterioration of road infrastructure to and from rural communities, potentially impacting the ability of police, fire and ambulance services to reach rural communities;
- Diminished biodiversity and environmental degradation impacts, for example ability of rural communities to access fuel for cooking and heating.

**5.4.2 Adaptation to Climate Change**

Households without access to basic services such as water, **electricity** and sanitation would be impacted more severely by potential climate impacts.

This also aligns with the approach adopted by the Global Climate Adaption Partnership (GCAP) to achieve effective climate adaptation. GCAP surmises that climate adaptation fundamentally entails “**Good Development**”, as well as building adaptive capacity in all stakeholders involved in a particular initiative. The approach recognizes a continuum of strategies, from good development through to targeting actions to reduce future impacts of climate change.

**Box 5.6: What does climate adaptation entail?**  
(Downing, 2011)

- The baseline for climate adaptation is Good Development that contributes to societal goals of economic and social welfare. This is generally seen as not part of a climate change regime per se, although mainstreaming integrates climate and development so that the two cannot be separated.
- Supporting responding to climate change is Adaptive Capacity and Planning, embedded in the development baseline but requiring additional effort as well.
- Reduced current vulnerability is an imperative at present, while also achieving benefits of reduced impacts in the future, hence also a mix between the baseline of development and future climate adaptation.
- The penultimate goals of climate adaption are Climate Resilience and Targeted Climate Change Actions: resilience is a broad strategy to ensure climate risk does not disrupt developmental pathways while targeted actions are aimed at specific future climate change impacts.



Rural electrification projects through small-scale hydropower projects would contribute directly towards providing at least a basic level of electricity services to the most vulnerable communities in rural South Africa, providing a first step towards building a communities' adaptive capacity.

Small-scale hydropower projects therefore not only contribute to mitigating the effects of climate change by promoting the use of renewable energy technologies, it also contributes directly to climate change adaptation initiatives.

The potential impacts of climate change on the flow regimes of rivers and streams pose an inherent risk to the long-term sustainability of small-scale rural hydropower projects. Appropriate response strategies should be developed for both extremes of changes in flow regimes; these being either floods or droughts. Historic flow records of proposed sites for, for example, run-of-river schemes, could mitigate the impact of floods and or droughts on the operation of the hydropower scheme.

#### 5.4.3 Policy prerogatives

Section 24 of the Constitution states that:

*“Everyone has the right*

- a. to an environment that is not harmful to their health or well-being; and*
- b. to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that*
  - i. prevent pollution and ecological degradation;*
  - ii. promote conservation; and*
  - iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.”*

In order to give effect to this constitutional mandate, the Department of Environmental Affairs, designated as the custodian for environmental matters, has, since 1994, passed numerous environmental Acts. Over time, as needs arise, new legislation is promulgated. So also is the case with climate change – an external, global change factor that the Government of South Africa has been cognisant of since 1993, when the Government signed the United Nations Framework Convention on Climate Change (UNFCCC).

The UNFCCC was adopted in 1992 at the Earth Summit in Rio de Janeiro and invites country leaders to become signatories to the Convention, and to thereby commit themselves to taking actions, *“dependent on their common but differentiated responsibilities, to limit or reduce their contribution to climate change, and to cooperate in adapting to the impacts of climate change.”* (DEA, 2010)



The government of South Africa ratified the UNFCCC as a developing country in August 1997; giving impetus to a variety of policy-making and legislative processes, as well as institutional arrangements in South Africa (DEA, 2010).

It is through the UNFCCC that the Kyoto Protocol was developed and implemented. Adopted in 1997 and enforced in 2005, the Protocol is an internationally and legally binding commitment from some UNFCCC member states on targets restricting greenhouse gas emissions (DAFF, 2012).

The UNFCCC *encourages* developed countries to stabilize GHG emissions, whereas the Kyoto Protocol *commits* them to do so (DAFF, 2012). The South African Government acceded to the Kyoto Protocol in 2002 (DAFF, 2012), but as a non-Annex 1 country under the Protocol, South Africa is not legally bound to reducing GHG emissions.

If South Africa as a non-Annex 1 country implements a GHG emission reduction project, such a project can receive carbon credits which can be sold to Annex 1 countries. The Kyoto Protocol binds Annex 1 countries to reduce GHG emissions, but allows these countries to buy emission reductions elsewhere. The carbon credits must be certified as “certified emission reductions” or CER by the UNFCCC’s Clean Development Mechanism before trading may commence. The cost of attaining a CER could be high, and should therefore be suitably large to warrant such an expenditure. In South Africa, “...*the proceeds on the disposal of CERs by South African residents will be exempt from tax in South Africa*”, as per section 12K of the Income Tax Act, Act No. 58 of 1962, as amended. “*The proceeds received on the sale of CERs will be zero-rated for VAT purposes on the basis that CERs will be disposed of by South African residents to non-residents.*” (Sonnenbergs, 2010)

It must be noted that the Kyoto Protocol’s first commitment period came to an end in 2012, where after the so-called “Doha Amendment” came into effect. South Africa ratified the Amendment, and is now classified as a non-Annex B party, without binding targets.

The Government of South Africa allocated the responsibility of co-ordinating and leading South Africa’s participation in all activities relating to the UNFCCC to the Department of Environmental Affairs (DEA, 2010). Over and above the international UNFCCC and Kyoto Protocol obligations of the South African Government, nationally focussed processes have been launched in South Africa to realise both the adaptation and mitigation commitments made internationally.

These processes are:

- The development of the South African National Climate Change Response White Paper,
- The compilation of the Long Term Mitigation Strategy (LTMS) and
- The drafting of the Long Term Adaptation Scenarios (LTAS).



Due to the fact that these processes directly impact the electricity sector in South Africa, they are described shortly below.

#### National Climate Change Response White Paper (NCCRP)

This White Paper committed key sectors, including **electricity**, water, health, bio-diversity and agriculture to compile climate change sector plans to identify and prioritise short- and medium term sectoral adaptation initiatives. These sectoral plans should be developed in the context of sectoral legislation and strategies; in the case of the electricity sector, this will be, inter alia, the National Electricity Regulation Act, the National Energy Efficiency Strategy, the IRP and the Integrated Energy Plan (IEP) (DEA, 2011).

Two of the 8 near-term priority flagship programmes, namely the “renewable energy flagship programme” and the “energy efficiency and energy demand management flagship programme” relate specifically to electricity sector specific objectives. It can be argued that the REIPPPP can be considered to be the DoE’s response to the energy objectives in the NCCRP, though originally initiated from the concepts of the Renewable Energy White Paper of 2003.

#### Long Term Mitigation Strategy (LTMS) (2006-2007)

In the mid-2000s a number of actions were taken by Government to begin to address carbon emissions. The 2003 White Paper on Renewable Energy, for example, targeted reaching 10 000 GWh of renewable energy generation by 2013, which target was not met (Eberhard, et al., 2014).

Other initiatives included the 2005 National Energy Efficiency Strategy (NEES) which set a long-term target for energy efficiency improvement of 12% by 2015 across various sectors, “*in relation to the forecasted national energy demand at that time, and based on the “business as usual” baseline scenario for South Africa modelled as part of the 2003 National Integrated Energy Plan.*” (DME, 2008a)

Of particular note, however, amongst these efforts was the Long-Term Mitigation Strategy (LTMS) that influenced Cabinet decisions on GHG emissions. The LTMS was initiated with a mandate from Cabinet in March 2006 and concluded with outcomes agreed by a Cabinet meeting in July 2008.

At this meeting the Cabinet agreed on a strategic direction – that the countrys GHG emissions must peak, at the latest by 2020-2025, stabilize for up to ten years and then decline in absolute terms (DEA, 2011).

The LTMS formed the foundation for South Africa’s 2009 UNFCCC meeting of the parties (COP9) pledge that “*South Africa would reduce its CO<sub>2</sub> emissions 34% below a business-as-*



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*usual scenario by 2020, and below 42% by 2025, provided the international community supported South Africa with financial aid and the transfer of appropriate technology”* (Eberhard, et al., 2014). These scenarios also contributed to the development of the IRP 2010-2030.

The electricity sector contributes between 40%-50% to GHG emissions (Eberhard, et al., 2014) (Winkler, 2007).

#### Long Term Adaptation Flagship Research Programme or Long Term Adaptation Scenarios (LTAS)

The LTAS is one of the flagship programmes identified in the NCRRP, and aims to undertake climate change adaptation research and scenario planning for South Africa.

Two phases of the LTAS have been initiated. Phase 1, completed during June 2013, *“developed a consensus view of climate change trends and projections, summarised key impacts and identified potential response options in primary sectors.”* (DEA, 2013b, p. 2)

Phase 2 of the LTAS, completed during July 2014, used the information from Phase 1 to develop adaptation scenarios for future climate conditions. These scenarios are described in 7 technical reports.

One of these reports describes the implications of climate change on urban-, **rural**- and coastal human settlements in South Africa. It is premised on determining the vulnerability of communities to potential climate impacts, and the ability of the community to respond or adapt to, and recover from, such impacts. Impacts could range from increased temperatures, increased occurrences of extreme weather events such as storms, droughts and floods, and changing rainfall patterns (DEA, 2014e).

### **5.5 Summary of the implications of National Government Perspectives for the implementation of stand-alone small-scale hydropower projects**

The development of stand-alone small-scale hydropower projects, would require the consideration of environmental impacts according to both the NWA and the NEMA. These legislative processes are inter-related, but mutually exclusive. Attaining a water use authorisation, either through a Water Use Licence Authorisation (WULA) process or a Water Use Registration process, can form part of the environmental authorisation process. Should no environmental authorisation process be required for the development, it would not negate the responsibility of the developer to apply for a water use authorisation.





Depending on the scope and extent of individual projects, it is most likely that either a BA-, or **no** environmental impact assessment process would be required for the development of small-scale hydropower projects with installed capacity of less than 1 MW.

Should the DWS GA be passed, a full water use licencing process will not be required for the development of run-of-river hydropower schemes for rural electrification of capacity of less than 300kW. A registration process would then need to be followed as defined in the GA.

For development purposes, land is either acquired, and the land use rights changed if necessary, or permission to use the land is acquired from the land owner, and a servitude registered in the name of the land user for the portion of land subject to development. Importantly, the community or communities living on the land must pass a resolution to approve the servitude and land use; based on which the land owner (for example the State, and in particular the DRD&LR) would be able to grant the servitude.

A conveyancer will need to be appointed to effect this, and, as would most likely be the case for the DST funded projects, the Local Municipality will own the small-scale hydropower generation and distribution infrastructure, and the servitude therefore would be registered in the name of the respective Local Municipality.

Small-scale hydropower projects for rural electrification inherently contribute to the objectives of rural development, and climate change mitigation and adaptation – and coordination and alignment with the prerogatives of the DRD&LR and DEA would be required.



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## SECTION 3: OPERATIONAL CONTEXT

### 6 RURAL ELECTRIFICATION

#### 6.1 What is rural electrification?

Rural electrification is described as the provision of long term, reliable and satisfactory electricity services to households in remote, rural communities via grid or non-grid means, from either renewable or non-renewable energy sources. It is commonly accepted that rural electrification in particular not only requires a technical solution, but also an institutional solution that takes into consideration the economic, political and cultural drivers of the communities being supported (Lahimer, et al., 2013).

#### 6.2 Rural Electrification in South Africa

South Africa's rural development framework of 1997 characterises rural areas as areas which are sparsely populated, in which the land is farmed, and people depend on natural resources. This characterisation of a rural area includes the villages and small towns located throughout these areas. In addition, the framework defines as rural the large settlements in the former homelands, "*which depend on migratory labour and remittances as well as government social grants for their survival, and typically have traditional land tenure systems.*" (Department of Land Affairs and Rural Development Task Team, 1997)

Inherent challenges of providing electricity services to rural areas include:

- Dispersed and sparsely populated areas of mostly indigent households;
- Lack of ability to pay for electricity services;
- Difficult topography and geography; it is not only challenging to provide cost effective appropriate technology in difficult terrain, it is also generally difficult to access these locations.

The benefits though of providing electrification services to rural communities include:

- A potential reduction in urban to rural migration;
- The ability to provide improved health and education services;
- Facilitates the access to communication means, such as cell phones, internet, television, radio. In this regard, the Policy and Operations Evaluation Department of the Dutch Ministry of Foreign Affairs is quoted as stating that "*the primary story to tell about the impact of electricity is not lighting, but communication: television, mobile phones and the internet*" (Franz, et al., 2014)
- Enabling rural industrial development;
- Less time spent on collecting, for example, fire wood.



Electrification of rural areas can be effected through extending the national distribution grid, the establishment of mini-grids in areas outside the reach of the distribution grid or providing stand-alone systems to sparsely populated areas with weak demand potential (Franz, et al., 2014).

Interpreting this for the South African context, and specifically for this Study, rural electrification can be effected through:

- Extending either the Eskom-, or the municipal distribution grids, which are defined as “interconnected distribution systems”, i.e. these distribution systems are connected to the national transmission power system.
- Establishing stand-alone mini-grids in those areas where the Eskom and or the municipal distribution grids will not reach in the foreseeable future, i.e. these mini-grids are not interconnected to any transmission power system and are therefore considered to be stand-alone systems.
- Continuing with the roll-out of the solar home system (SHS) concessionaire programme to individual households, which programme is also considered to be a stand-alone system.

**Box 6.1: South Africa’s rural electrification backlog in the context of Sub-Saharan Africa’s rural electrification backlog**

More than 620 million people in sub-Saharan Africa<sup>23</sup> live without access to electricity, with 80% of these people living in rural areas. An exasperating factor in eradicating the electricity backlog in sub-Saharan Africa is the fact that the backlog is increasing year-on-year due to rapid population growth (International Energy Agency, 2014). South Africa is the only country in sub-Saharan Africa that has achieved an electricity access rate in excess of 80%, with a large proportion of countries in this region having access rates of less than 50%.

South Africa’s high access rate is reflective of its vast electricity generation, transmission and distribution infrastructure asset base. Southern Africa<sup>24</sup> has more installed grid-based capacity than any of the other sub-regions with 58 GW, of which 46 GW is in South Africa. By far most of South Africa’s capacity is coal-fired at 85% with 6% oil-fired, 5% hydropower and 4% nuclear from the continent’s only nuclear power plants. Since 2000, oil and hydropower have provided the bulk of net capacity additions, while coal capacity remained stable. Excluding South Africa, the remaining three-quarters of the population of Southern Africa rely on some 12 GW, just 21% of the installed generation capacity. Their technology mix has a very different complexion, with hydropower accounting for more than half of capacity, oil for 22%, coal for 16% and gas for 8% (International Energy Agency, 2014).

By 2030, South Africa should have an installed capacity of 89 500 MW, of which 45.9% will be sourced from coal, 21% from renewable energy and 12.7% from nuclear, and the balance from other sources such as gas, pumped storage and hydropower (Barradas, et al., 2015).

<sup>23</sup> Sub-Saharan Africa includes all countries in Africa except for Morocco, Algeria, Tunisia, Libya and Egypt; collectively grouped as North Africa.

<sup>24</sup> The countries of South Africa, Namibia, Botswana, Swaziland, Zimbabwe, Mozambique, Angola, Zambia, Malawi, Tanzania, Madagascar, Mauritius, Comoros, Seychelles constitute Southern Africa.



South Africa's approach to rural electrification, and in particular non-grid rural electrification, is informed directly by the (relatively small) extent of the backlog in rural areas that could be served by non-grid solutions, and secondly by the fact that the population in the rural areas of South Africa are mostly indigent, and would therefore not necessarily be able to pay for electricity services.

### 6.3 Non-grid rural electrification in South Africa

It can be interpreted that the White Paper on Energy of 1998 initiated two distinct initiatives towards non-grid rural electrification in South Africa in the context of the post-1994 Government's objective to provide universal access to electricity to all the people of South Africa. The first being the Solar Home System programme (which is described in more detail in the context of South Africa's electrification programme in section 3.1, and specifically in Box 3.2); and the stand-alone mini-grid pilot projects initiated in the Eastern Cape Province.

#### 6.3.1 *The SHS Programme*

The DME initiated the non-grid electrification programme in South Africa in 1999 with a request for proposals for the provision of subsidized electricity and other energy services to specific rural areas (Afrane-Okese & Thom, 2001). Even though the programme initiated is commonly referred to as the "Solar Home System Concessionaire Programme", the programme's institutional architecture changed during its first two years, and by 2001, concessions were no longer awarded; instead "*the programme grants private companies the rights to establish off-grid energy service utilities...*" (Afrane-Okese & Thom, 2001, p. 1241)

Successful bidders would have exclusive rights to a partial *capital* subsidy from Government for a five-year period, and receive a 20-year fee-for-service contract, which would guarantee maintenance of the systems installed. In addition to providing households with a solar home system, the service providers were expected to improve access to fuel sources which are to be used for cooking, such as gas and paraffin (Afrane-Okese & Thom, 2001).

The programme's inception phase was plagued by numerous institutional challenges, including lack of capacity, poorly defined roles and responsibilities for stakeholders and unexpected legal wrangling (Afrane-Okese & Thom, 2001). The programme finally started in 2002.

Lemaire notes that the SHS programme has generally not been successful with only three of the original companies being operational in 2011 (Lemaire, 2011).

#### 6.3.2 *The Hluleka Nature Reserve- and Lucingweni Village hybrid-mini-grid systems*

In 2001, the DME appointed the National Energy Regulator (NER) (now NERSA) as Implementing Agent (IA) for a pilot mini-grid hybrid project at the Hluleka Nature Reserve in the Eastern Cape Province.

The scope of the project entailed the design and construction of an energy system, a water treatment plant and a telecommunications system.



Two villages adjacent to the Nature Reserve, Luncingweni 1 and 2, were also identified as pilot sites for a mini-grid hybrid energy system (DME, 2008b), which was installed in 2005 (Spake, 2010).

The **Hluleka energy system** comprised a wind-solar-diesel hybrid generating set, consisting of two 2.5 kW wind generators, a PV array of 56 x 100 W solar panels as well as a control system, batteries for electricity storage and a diesel generator (DME, 2008b). This electricity generation system was to serve the needs of 12 chalets, street lighting, the administration block, the staff quarters as well as the requirements for the water pumping station, and water treatment plant (Ortiz, et al., 2009). A 75 kVA back-up generator was also provided. The reticulation provided was three-phase 400 V AC (DME, 2008b). Hot water was provided mainly by solar water heaters, and liquid petroleum gas (LPG) was provided cooking purposes (Ortiz, et al., 2009).

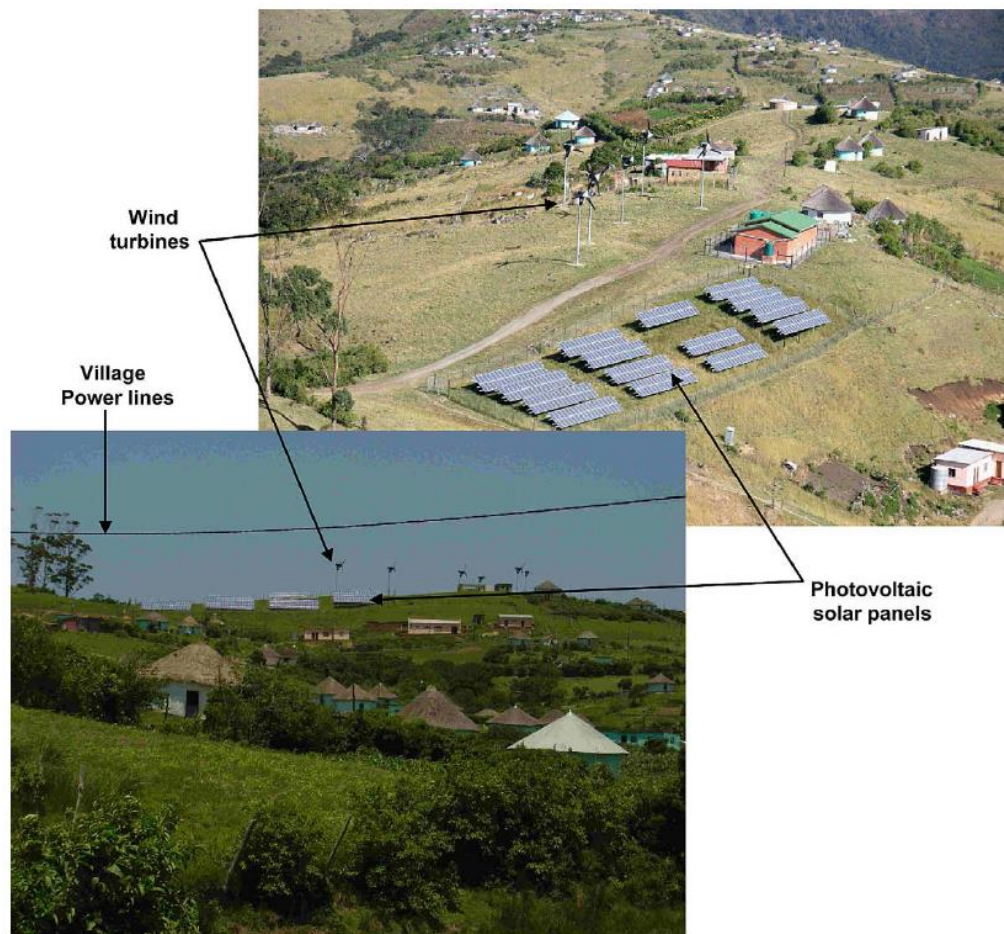


**Figure 6.1:** The Hluleka Nature Reserve mini-hybrid off-grid system (Ortiz, et al., 2009)

The **Luncingweni hybrid mini-grid energy system** consisted of six 6 kW wind turbines, five hundred and sixty (560) 100W solar panels, a battery bank, and a mini-grid distribution network. (Ortiz, et al., 2009).

Electricity was to have been provided to approximately 220 households, shops, a community centre, and streetlights (DME, 2008b).

To meet the needs of the rural poor, all basic services need to be provided, including energy, clean water, sanitation and healthcare. The project initiated at Lucingweni therefore focussed not only on providing energy services to the community, but also water services- solar power was used to pump water from a stream near the village and purified.



**Figure 6.2** The Lucingweni Village mini-hybrid off-grid system  
(Brent & Rogers, 2009)

During 2008, the DME commissioned an assessment to be undertaken on these projects to determine whether or not mini-grids at this scale could be rolled-out to other suitable project sites. The report concluded that the Hluleka project failed to achieve its objectives:

- neither the water component, nor the telecommunications system, was successfully installed,
- extensive delays were experienced;
- the costs per kWh were high. *(It was found in a 2009 study undertaken by the CSIR that the total system cost (in 2007 terms) of the Lucingweni system was R7.76/kWh for 119 000 kWh per annum; which in comparison to the 2007 Eskom tariff charge of R0.16/kWh, was therefore 50x higher (Brent & Rogers, 2009). Reasons for this disparity include 30% energy conversion losses between the point of generation and the consumer, capital costs of lead acid DC storage and DC to AC conversion, as well as low capacity factors of renewable energy generators);*
- the energy system provided was not sustainable, and electricity generation and distribution stopped.



The final recommendation of the DME assessment report was that mini-grid projects, as piloted at the Hluleka Nature Reserve, should not be rolled-out to other potential sites.

The authors of the report were unable to draw conclusions on the viability of the Lucingweni project due to the fact that they had insufficient information and data at the time of writing the report.

Reasons given in the report as to why the Hluleka energy system was unsustainable, include (DME, 2008b):

- the generation plant was located too far from the reserve itself, making it difficult for staff members to access and supervise. The remoteness of the system resulted in the vandalism and theft of in particular the solar panels;
- the back-up generator was not integrated into the system, which necessitated staff members to have to manually switch the generator on or off, at any time;
- no first line operation and maintenance procedures were in place. In addition, no funding had been made available for this function, no staff had been trained to undertake this responsibility and integral components of the energy system were imported, necessitating spare parts for these components to also be imported.

The assessment report provided the following insights to the situation at Lucingweni, important in lieu of the fact that the Lucingweni system was also no longer operational by 2010 (Spake, 2010):

- insufficient or inappropriate stakeholder engagements were undertaken. For example, community members were not engaged regarding preferred ownership of the system, tariff structures, and level of service requirements. The level of service provided was a basic LoS, sufficient for lighting, cell phone charging and a black and white television – and did not cater for cooking or heating needs. The importance of providing alternative sources of energy for cooking purposes in conjunction with basic electricity, was clearly identified during the assessment. The 20A household trip switches were found to have by-passed (Brent & Rogers, 2009), in order to use electricity for cooking and heating purposes.
- energy and current limiting meters in the Lucingweni households were incorrectly installed.
- unclear allocation of ownership of the system, as well as lack of allocation of operation and maintenance responsibility resulted in poor community acceptance of the system, and systematic decline of the infrastructure due to lack of maintenance;
- the fact that community members contributed nothing financially to the capital costs of the system, further exasperated the lack of ownership of the system by the community members. Community engagements during the project assessment found that the



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community would prefer a pre-paid system, for a reliable energy supply, instead of a flat-rate system.

The 2009 study undertaken by the CSIR reiterates these findings; stating that the “*disregard at the design stage for almost all of the non-technical aspects has further resulted in an overall unsustainable system.*”

*The uncontrolled connections by the community resulted in system overload, disputes between all parties, and disconnections of power by the generator; the system stopped operating continually within one year of commissioning. Overall the management of the technological intervention did not improve the conditions of the social sub-system in the rural village or meet any of the performance aspects raised by the stakeholders. The result was the breakdown of trust between the traditional societal structures and the formal government structures, and the technology developers.”*

### 6.3.3 The application of mini-grids in South Africa

Small-scale hydropower projects applied towards rural electrification consist mostly of electricity generation infrastructure at a water source, and distribution infrastructure such as *mini-grids* to transmit the electricity to end-consumers.

In 2003, a study was undertaken by ScottishPower, one of the e7 group of electricity companies, titled “*Community Electricity in Rural South Africa: Renewable mini-grid assessment*”, which found that “*it is not feasible to deliver a sustainable mini-grid solution in South Africa*”, and “*...makes it clear that there is no significant prospects for the roll-out of a mini-grid programme in South Africa.*” (ScottishPower plc, 2003)

This report pre-empted the same conclusion of the 2008 DME assessment undertaken on the Hluleka and Luncingweni pilot mini-grid projects.

The purpose of the ScottishPower feasibility study was to develop an off-grid mini-hybrid energy demonstration project in South Africa.

After an extensive process, the villages of Mbandana and Dumsi in the Eastern Cape were selected as potential sites to demonstrate the key socio-economic and technical issues associated with a mini-grid renewables based project. ScottishPower acknowledged that these villages were within an existing SHS concessionaire area.

This preliminary engineering design made allowance for a basic level of service to households limited at a 5A supply, supplemented with LPG for cooking and heating needs, electricity for street lighting and water pumps, as well as higher levels of service (20A limited supply) for schools, clinics and business.





**Table 6.1: Description of the main technical and financial components of the ScottishPower feasibility study**

	<b>Scenario I Mbandana only</b>	<b>Scenario II Mbandana and Dumsi (Mostly domestic)</b>	<b>Scenario III Mbandana and Dumsi with an additional zone for an anchor customer</b>
<b>Number of households</b>	208	203+208	203+208
<b>Photovoltaic</b>	330 x 150 Wp panels with net output of 34.85 kW	720 x 150 Wp panels with net output of 76.03 kW	840 x 150 Wp panels with net output of 88.7 kW
<b>Wind turbines</b>	3 x 15 kW units	5 x 15 kW units	6 x 15 kW units
<b>Diesel Generators</b>	1 x 50 kW	2 x 50 kW	2 x 50 kW
<b>3 Phase inverter</b>	100 kW (80 kW min)	175 kW (150 kW min)	200 kW (175 kW min)
<b>Battery system</b>	180 x 2 V 2500 Ah cells Arranged 60 in series for the 120 V system with 3 parallel banks	300 x 2 V 2500 Ah cells Arranged 60 in series for the 120 V system with 5 parallel banks	360 x 2 V 2500 Ah cells Arranged 60 in series for the 120 V system with 6 parallel banks
Generating Station (R million)	6.94	13.20	15.49
Distribution System (R million)	1.86	3.87	4.11
<b>Total (R million)</b>	<b>8.80</b>	<b>17.08</b>	<b>19.60</b>

The reasons provided by ScottishPower for their conclusion were:

- The planned reach of the grid electrification programme was anticipated to be extensive, resulting in very few areas being available for mini-grid systems outside of the concessionaire areas;
- The absence of a policy framework to support the roll-out of, it is assumed, non-grid electrification to the rural areas of South Africa, possibly through the application of mini-grids;
- High cost in relation to the low Eskom tariff.

It is understood that the e7 study was undertaken from the perspective of determining whether or not it would be *commercially viable for a private operator* of a mini-grid system utilising mostly renewable energy generation options, to operate in South Africa over a period of time; and this would by default require economies-of-scale in terms of geographic area, consumer base, and government grant funding, to name a few.

The “...there is no significant prospects for the roll-out of a mini-grid programme in South Africa” statement made by the authors of the ScottishPower report, based on a single project’s feasibility study, should be interpreted as a generalised statement, and is not necessarily applicable to other types of mini-grid projects:



South Africa's "New Household Electrification" strategy was launched in 2013, and the universal electrification target revised from 100% to 97% of households which are to have access to at least a basic electricity supply service by 2025 – with 90% of households to be grid-tied and the remainder to be serviced by appropriate non-grid technologies.

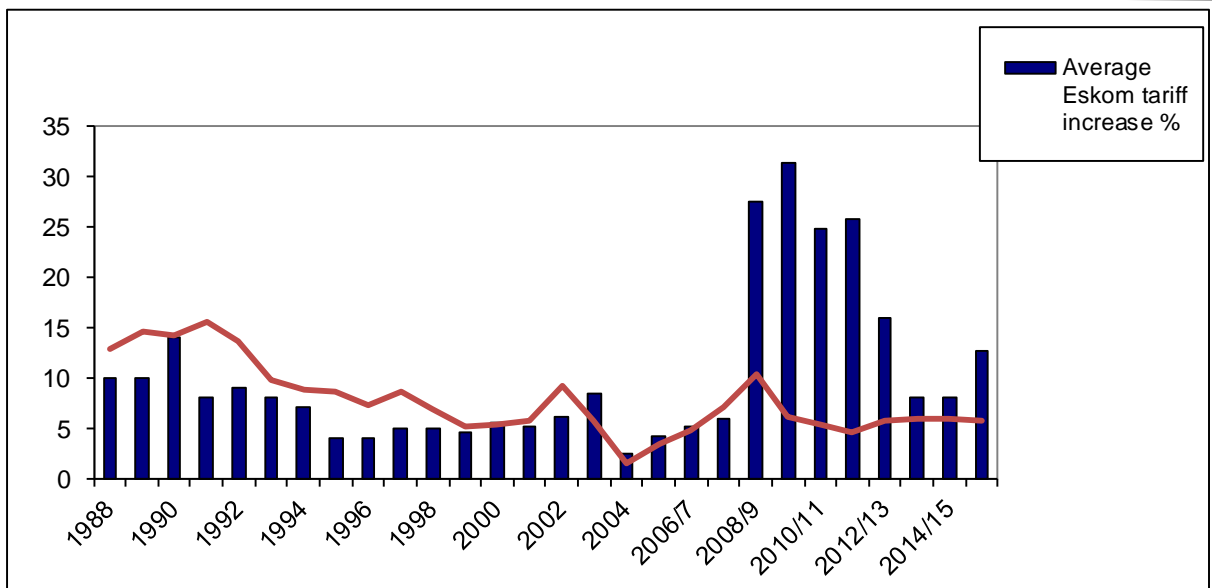
The extent therefore of the non-grid electrification programme is now clearly quantified. The geographic location of these areas has also been identified.

Further, the CRDP and the Agrarian Transformation Strategy was initiated by the DRD&LR focussing on, inter alia, the provision of basic services to rural communities, including basic electricity services. The Department of Cooperative Governance and Traditional Affairs' "Back to Basics" strategy of 2014 aims to support Local Government in the delivery of their constitutional responsibilities relating to services provision, focussing on basic services such as water, sanitation and electricity in especially the 27 most distressed District Municipalities (COGTA, 2014).

Even though South Africa does not have a rural electrification policy as such, rural electrification is entrenched in the priorities of National Government.

Further, the annual Eskom tariff increases, have, since 2008, exceeded annual consumer price inflation (Figure 6.3); whilst the general trend in large scale renewable energy technology tariffs are decreasing. The energy weighted average tariff at which power is sold to Eskom (as DoE's designated buyer) per bid window of South Africa's REIPPPP, expressed in 2013 terms, decreased from R2.15/kWh for bid window 1, to **R1.14/kWh** for bid window 3 (IPPPP Unit , 2015). The average tariff for the hydropower bids received under bid window 2 was R1.16/kWh. In comparison to this, Eskom's FY13/14 NERSA approved average tariff was **R0.66/kWh**, an 8% increase on the FY12/13 tariff (NERSA, 2013). Consideration though should be given to the fact that it is anticipated that the Medupi and Kusile coal fired generation plants' levelised cost of electricity will be significantly higher than this, at over R1/kWh (IPPPP Unit , 2015).

The trend therefore projects that renewable energy costs in South Africa are moving ever closer to the previously extremely cheap Eskom electricity costs.



**Figure 6.3** Average Eskom price increases over time in comparison to annual CPI (Eskom, 2015)

Determining whether or not a *commercial* opportunity exists in South Africa for the implementation of renewable energy mini-grid projects in the current policy, planning and pricing context lies outside the scope of this Study. Taking a *needs driven* perspective though over a commercial perspective, and based on the fact that over 25 000 households should be targeted annually over the next 11 years to receive appropriate non-grid electricity connections, consideration should, again, be given to the implementation of mini-grids in South Africa. The main reasons cited by ScottishPower to motivate their conclusion that mini-grids are unviable in South Africa, have over time, mostly been addressed, especially when distinguishing between commercial and social forces driving the implementation of such projects.

Further, the lessons learnt, and experiences gained from implementing the Hluleka and Lucingweni projects, in addition to the myriad of international research promoting the use of mini-grids towards rural electrification, will contribute to supporting a scaled-up non-grid electrification programme through mini-grids in South Africa.

#### 6.4 International trends towards rural electrification

A number of rural electrification research documents have been published in the last two years, including the World Bank's "*From the Bottom Up: How Small Power Producers and Mini-Grids Can Deliver Electrification and Renewable Energy in Africa*" (Tenenbaum, et al., 2014), the United Nation Foundation's "*Microgrids for Rural Electrification: A critical review of best practices based on seven case studies*" (Schnitzer, et al., 2014) and the European Union Energy Initiative Partnership Dialogue Facility's "*Mini-grid Policy Toolkit: Policy and Business Frameworks for Successful Mini-grid roll-outs*" (Franz, et al., 2014)



The “From the Bottom Up” guide focusses on the implementation of a decentralized track to electrification (i.e. electrification is carried out by non-governmental organisations), and specifically on the regulatory and policy approach to be followed to create commercially viable small power producers (SPPs) and mini-grids in rural areas. It was written from the perspective that a National Government has made a policy decision to promote SPPs and the decentralized track, and that the National Regulator must implement that decision.

In South Africa, the concepts of *centralisation* and *decentralisation* commonly refer to the process undertaken by Government in 2000, of shifting the services provision function from National Government to Local Government. Interpreting the concept therefore of *decentralisation* as referred to in the “From the Bottom Up” guide in the South African context, this would refer to the involvement of the private sector in both the electricity generation and the distribution sectors. In terms of involving the private sector in the electricity generation mix, the South African Government has initiated the REIPPPP on a national scale, and the SHS concessionaire programme on a local scale; both of which entail the DoE going through tendering processes to procure private service providers.

The “New Household Electrification Strategy” can be interpreted as being an initial step towards creating an enabling environment for the roll-out of private sector SPPs and Small Power Distributors (SPDs). The viability of such an initiative will depend largely on the availability of both capital and o&m subsidies.

The “Micro-grids for Rural Electrification” report analyses case studies to identify the factors that either made the micro-grid projects successful, or unsuccessful. The authors of the report define micro-grids as “*distributed systems of local energy generation, transmission and use*”, and indicate that due to the fact that new and innovative business and financing models for micro-grid development have emerged, in addition to technological advances, interest in micro-grid development is continually on the rise. The report provides a summary of an investigation undertaken to determine what works-, and what aspects need improvement, when implementing a micro-grid project. It based its conclusions on set indicators against which project performance was measured. These indicators for example included whether or not the system provided the amount of energy it is supposed to, when it is supposed to; referred to in the report as energy service reliability and schedule reliability. In addition to these two indicators, a third fundamental indicator, a financial viability indicator, which balances financial incentives / subsidies and revenue streams from tariffs, with debt, equity and operational expenses, was also applied.

Interestingly, the report details three types of business models, namely the:

- “For Profit” model, which is based on a return over capital invested plus complete coverage of operational and maintenance costs;
- “Partly subsidized Non-Profit” model where large portions, if not all, of the capital costs are subsidized, but o&m costs are covered through tariff-based revenue streams;
- “Fully Subsidized Non-Profit”, which is not designed to recover capital nor o&m expenses.



It could be argued that micro-grid projects in South Africa would be implemented by means of the “Fully Subsidized Non-Profit” business model, due to the fact that the o&m costs for a basic level of service are partly or completely subsidized by the fbe subsidy, and also the fact that the South African Government initiated its non-grid electrification programme by mostly subsidizing the capital costs associated with the SHS concessionaire programme. A precedent with regards to the provision of capital subsidies for the roll-out of the South African non-grid electrification programme has been set, and which, by extrapolation to other appropriate technological solutions as defined by the “New Household Electrification Strategy”, could be applied to the roll-out of micro-grids. It must be noted though that SHS consumers in South Africa, do pay a low monthly service fee.

Various performance factors, impact the success or failure of a micro-grid project differently. This is summarised in Table 6.2.

**Table 6.2: Relevance of factors determining sustainability for three micro-grid business models**  
(Schnitzer, et al., 2014)

	Factor	For Profit	Partly subsidized non-profit	Fully subsidised non-profit
Financial Viability	Tariff-based o&m cost recovery	High	High	Low
	Tariff-based capital cost recovery	High	Low	None
	Theft	High	Medium	Medium
Energy Service Reliability	Contractor performance	Medium	Medium	High
	Local training and institutionalization	Low	Medium	High
	Load Limits	High	High	High
	Unmet demand growth	High	High	Medium

The importance of local training and institutionalisation for the fully-subsidised business model is clear.

**Box 6.2: Case Study: Nepal Rural Energy Development Programme**

**Background**

Nepal is a land-locked country in South East Asia. It is bordered in the north by the People’s Republic of China and in the south by India. It has a population of under 30 million people, of which 82% live in rural areas (World Bank, 2016). Nepal’s difficult hilly topography, as well as prevalent poverty, makes it challenging to provide modern energy services. By 2008, approximately 40% of the total population had access to electricity, with rural electrification at 29% (UNDP, 2013). By 2010, the electrification rate was up to 53%, with wood the primary source of fuel for cooking needs of 76% of the population. The extent therefore of the electrification backlog in Nepal, quantified in 2010 terms, amounted to approximately 12.5 million, mostly rural people.

The Government of Nepal, has, since 2003 initiated a number of ambitious projects and programmes to address the backlog. These include the **Community Electrification Programme**, implemented by the Nepal Electricity Authority (NEA, the national electricity utility) with a focus on extending the national distribution grid, and the **Rural**



**Energy Development Programme**, which is focussed on providing off-grid micro-hydropower solutions to rural communities.

#### **Rural Energy Development Programme (REDP)**

The Alternative Energy Promotion Centre (AEPC) is a government institution, that acts as an intermediary between the Government of Nepal and project stakeholders at local level, specifically for off-grid rural electrification projects. It is in this capacity that the AEPC was appointed as Implementing Agent for the **Rural Energy Development Programme (REDP)**.

*“The REDP was launched in 1996 with the objectives of expanding energy access to remote rural communities, strengthening capacities of energy institutions and establishing a national rural energy policy framework. The programme operated at the community, district and national levels. It focused strongly on capacity development, community mobilization and livelihoods enhancement, using community-managed micro-hydropower plants as an entry point for holistic development of remote rural communities.”* (UNDP, 2013, p. v)

Through the REDP, micro-hydropower systems were built (<100 kW), and improved cooking stoves were provided, to facilitate decentralised renewable energy services to the rural areas of Nepal. The programme was launched in 1996 as a 5 project pilot initiative, before being scaled-up via the Nepal national Hydropower Development Policy in 2001.

At completion in April 2011, the REDP had:

- *“benefitted 550 000 people living in remote areas;*
- *Constructed 307 new micro-hydropower plants, with 5.8 MW of installed capacity and*
- *Installed nearly 14 255 improved cooking stoves, 3 099 solar home heating systems and 6 811 toilet-attached biogas plants.”* (UNDP, 2013, p. v)

In addition, the lessons learnt and experiences gained through the programme lifecycle, contributed to promulgating the 2006 national Rural Energy Policy. This pro-poor policy promotes private sector involvement in providing clean energy solutions, and community-managed energy service delivery.

The success of this programme was attributed to:

- **National ownership and commitment to the REDP**, for example the establishment of the AEPC to lead Nepal’s rural energy programme, and the creation of conducive policy and legislative frameworks (UNDP, 2012);
- **Central government support for decentralised service delivery**, in the context of facilitating local electricity generation and distribution. Central budget subsidies, and tax exemptions have, for example, enabled co-financing from donors, local government and communities (UNDP, 2012). The international donor funding (IDA<sup>25</sup> and UNDP) constituted a lesser portion of the total programme budget of US\$133.4 million, with the larger portion being sourced from local banks and local community members (GNESD, 2016).
- The IDA, for example, funded the Micro-Hydro Village Programme (MHVP). The aim of the MHVP was to establish off-grid, **community operated** micro-hydropower projects in the rural areas of Nepal, as part of Phase 2 of the Rural Energy Development Programme (REDP). The MHVP constituted one of the three projects initiated through the IDA funded Power Development Project (PDP) in 2003. The other two projects

<sup>25</sup> The International Development Association (IDA) is a funding institution of the World Bank, and specifically provides grants or loans at zero percent interest to the poorest countries of the World.



were for the establishment of a Power Development Fund (PDF) implemented by the Department of Electricity Development, and for improvements to the transmission and distribution grids, implemented by the NEA. The PDF aims to support private sector development of small and medium sized hydropower schemes, mostly for grid connection (GNESD, 2016).

- **Community mobilisation and local partnerships.** The UNDP Country Director in Nepal was quoted as saying that the UNDP placed “*the community people at the center of the project so that they are the driver to introduce this technology, and also maintain and then have full ownership.*” (UNDP, 2013) For example, communities donate land for the construction of the required infrastructure, as well as provide the labour force for the construction thereof.
- capacity development for all stakeholders.

The project aimed to contribute not only to providing lighting services to households, but to create the potential for local economic development, through enabling, inter alia, agro-processing, poultry farming, and bakeries, to be established. A second imperative of the project was to facilitate the empowerment of women and other marginalised groups to become involved in the decision-making processes of operating and maintain the micro-hydropower scheme.

Tariffs are set by the local community structure, and are based on loan repayments, operation and maintenance costs, depreciation and provision of a reserve fund (20% of revenues) for maintenance (GNESD, 2016), (Tenenbaum, et al., 2014). The installation of electricity meters and the development of appropriate and sustainable tariff structures have been noted as major issues of the Programme. Electricity consumption is generally low, making energy based tariff structures unviable – the operational costs generally exceed the revenue generated. Mitigating measures such as paying for the number of light bulbs installed, installing load limiters or paying according to social status have been used (GNESD, 2016). Further, higher tariffs are charged for commercial and high-use domestic users (Tenenbaum, et al., 2014).

The REDP, at the end of its 15-year implementation period in 2011, evolved into the Renewable Energy for Rural Livelihoods Programme (RERL), and became integrated into the Government's single umbrella programme, the National Rural Renewable Energy Programme (NRREP), initiated in 2012. The RERL is funded jointly by the UNDP, the Global Environment Facility and the Government of Nepal, and is supporting NRREP to develop 10 MW of mini-hydropower, 2.5 MW of solar PV systems and the establishment of mini grids.

### **Community Electrification Programme**

In Nepal, the NEA is extending the national distribution grid through an innovative and ambitious approach. Enabled by the 2003 Community Electrification bye-laws, communities are appointed as de-facto small power distributors (SPD).

The NEA provides 80% of the capital subsidy required to extend the distribution grid to a community, and the community pays 20%. The community is further responsible for all aspects of operation and maintenance of the distribution grid, as well as revenue collection.

The SPDs buy electricity in bulk at wholesale rates from the NEA, and sell the electricity at lower retail rates to consumers. It is a requirement that the SPD set-aside 10% of revenue for operation and maintenance. A low income margin can be financially viable in Nepal, due to the fact that the NEA has subsidised 80% of the capital costs associated with the distribution infrastructure (Tenenbaum, et al., 2014).

The infrastructure remains the property of the NEA, and is operated by a community cooperative.



This rapid grid expansion programme has had a negative impact on the micro-hydropower programme in Nepal. It has been reported that some micro-hydropower projects are being abandoned in favour of being grid-connected, even in lieu of the regular load-shedding implemented by the NEA (Mahato, 2010). Alternatives to abandonment could be to either convert the small power producer (SPP) to a SPD as part of the Community Electrification Programme, or to connect the micro-hydropower generators and the mini-grid, to the national grid. It has been interpreted that the NEA must pay for the capital costs of investments that are needed to connect a SPP to its system, after proving that such an action is economically feasible (Tenenbaum, et al., 2014).

#### **Lessons learnt from the micro-hydropower REDP that could be applied to South African circumstances**

- Importance of international donor funding for rural electrification, and the associated fiscal and financial frameworks necessary to attract these;
- Community owned and operated micro-hydropower schemes can work if a conducive institutional environment is established, for example promoting the use of stand-alone mini-grids for community rural electrification;
- Extensive capacity building and skills development of local operators.

Is South Africa's current institutional environment conducive for a programme such as the REDP to be implemented? Yes, especially if the proposed "off-grid electrification authority" is indeed established, and which could act in a similar role to the AEPC. The Authority could provide the capacity to the applicable implementing body to claim carbon credits such as CER, as well as benefit from SAs soon to be implemented carbon tax legislation. In addition to extensive capacity building, and local government co-ordination with CPAs, tribal authorities or communities, especially with regards to facilitating the flow of the fbe and es grant funding from the LM to the implementing body, vertical coordination between the implementing body and NERSA with regards to the allocation of a distribution licence and tariff structuring will be required. Further, the bundling or regionalisation of the non-grid backlog into a larger programme, utilising hybrid systems – could attract additional grant funding, and gear this to leverage private sector financing.

## **6.5 Planning for electricity supply systems**

### *6.5.1 Interconnected electrification of Human Settlements*

The Guidelines for Human Settlement Planning and Design, commonly referred to as the "Red Book", provides information to engineers and urban planners for the sustainable development of human settlements (CSIR, 2000).

In terms of the planning and designing of (interconnected) electricity supply systems for residential townships and developing communities, the "Red Book" promotes a phased approach to planning, commencing with an initial 7-year planning horizon, building up towards a 15-year masterplan period.





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Load estimation for urban or rural (interconnected) consumers has a direct bearing on the cost of the system; over-estimation will result in over capitalization, and under-estimation will result in poor quality of supply (SANS, 2007).

The After Diversity Maximum Demand (ADMD) approach is used in the design of electricity distribution networks where demand is aggregated over a large number of customers.

ADMD accounts for the coincident peak load a network is likely to experience over its lifetime and as such is an overestimation of typical demand (Barteczko-Hibbert, 2015). It is generally found that as the number of customers increases, the maximum time-coincident demand per dwelling falls and the uncertainty decreases (Barteczko-Hibbert, 2015).

A constraint of the ADMD approach is that it is less accurate for smaller load groups, resulting in potential overestimated peak power results, leading to over dimensioned and costly systems (Blennow & Bergman, 2004).

The ADMD in South Africa for different consumer classes for either a 7 or 15 year planning horizon, can be attained from Table 2 of NRS 034-4-1: Electricity distribution- Guidelines for the provision of electricity distribution networks in residential areas.

Electricity utilities might specify specific ADMD values to be used in development within their area of jurisdiction. For example, Eskom Eastern Cape specifies a minimum ADMD of 1.2 kVA for densely populated townships.

An ADMD of between 0.42 kVA and 0.84 kVA per household would be applicable for interconnected rural settlements or villages.

If a rural settlement consists of 50 households, the total residential load could be  $0.42 \times 50 = 21$  kVA, for a 7 year planning horizon, an amount that will in all likelihood be exceeded due to the fact that the uncertainty of the size of a combined load increases as the consumers forming the load decreases (SANS, 2007).

The ADMD is used to plan and design the placement and sizing of electrical equipment within an electricity distribution system, and should not be confused with the potential power available to each household.



**Table 6.3: Classification of domestic consumers – Description of consumer load classes (SANS, 2007, p. 18)**

<b>Consumer Load Class</b>	<b>Derivation of income</b>	<b>Description of dwelling</b>	<b>Type of road</b>	<b>Water reticulation</b>
Rural settlement	Mainly from pensions and subsistence farming. Some breadwinners work far away in cities.	Mainly based on traditional construction methods	Normally tracks with difficult access	Normally none
Rural village	From pensions and subsistence farming. Some breadwinners are employed in nearby industrialized areas and commute daily.	Mixture of modern and traditional construction Methods	Mainly gravel with main roads tarred	Some communal standpipes

These types of settlements would typically be provided with a 20 Amp limited supply, 220 V distribution systems, equating to a potential power output of 4.8 kW per household.



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Table 6.4 provides an indication of typical home appliance electricity consumption

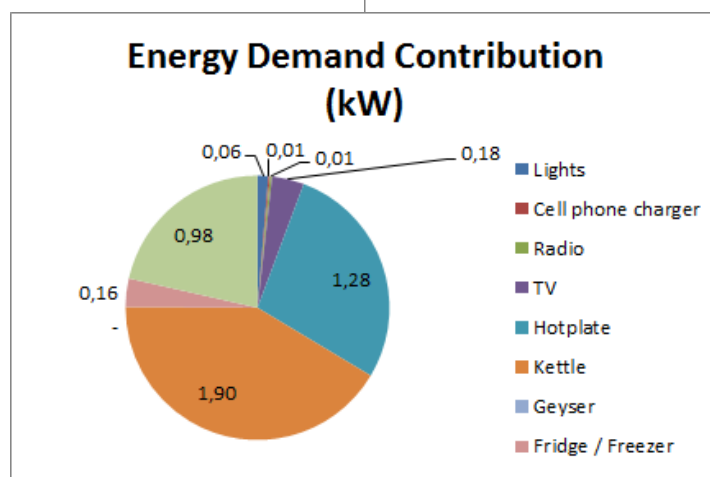
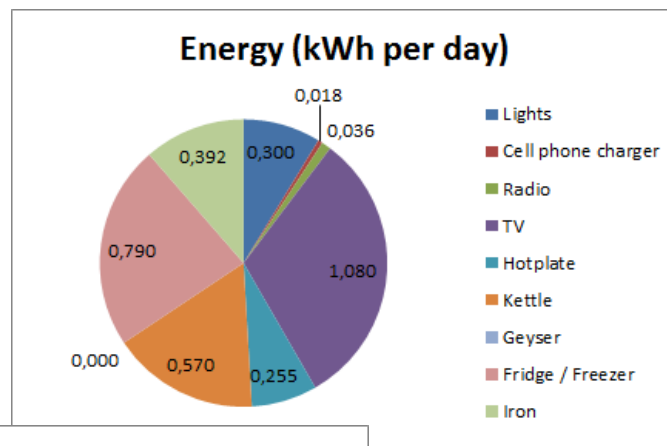
This approach can be classified as being “**demand**” driven, which assumes that a commensurate growth in supply will be provided to meet the interconnected electricity demand over a 7 to 15 year planning horizon. It further assumes a typical “S-curve” demand growth over time, as a result of new customers being connected to the grid, as well as increases in household electricity consumption. A third major assumption is that the consumers are able to afford increased electricity usage.



**SECTION 3: OPERATIONAL CONTEXT**

**Table 6.4: Typical home appliance electricity consumption (City of Cape Town, 2011)**

Description	Quantity	Demand (W) - No Diversity	Demand (kW) Sub Total	hrs/day	Energy (kWh) per day
Lights	5	12	0.06	5	0.300
Cell phone charger	1	9	0.01	2	0.018
Radio	1	12	0.01	3	0.036
TV	1	180	0.18	6	1.080
Hotplate	1	1 275	1.28	0.2	0.255
Kettle	1	1 900	1.9	0.3	0.570
Geyser <sup>26</sup>	0	2 600	0	404	0.000
Fridge / Freezer	1	158	0.16	5	0.790
Iron	1	980	0.98	0.4	0.392
			<b>4.574 kW</b>		<b>3.441 kWh/d</b>



<sup>26</sup> Rural settlements and or communities in all likelihood do not have access to a higher level of water service. At most they would have stand connections and or a community water access point. Geysers, and or Solar Water Heaters would therefore not be an applied appliance.



**6.5.2 Stand-alone electrification for Rural Development**

In recognition of the DoE’s New Household Electrification Strategy, and accepting that those rural areas that are projected to be provided with appropriate non-grid electrification technologies with at least a basic level of energy access, are populated by mostly indigent communities, on tribal land, in areas with little or no socio-economic drivers such as agriculture, mining, industry or tourism, it must be assumed that a “**supply**” driven approach needs to be followed. This type of approach should be applied in conjunction with strong demand management practices to prevent burn-outs and or blackouts due to over utilisation, and should be based on the ability of the State to provide adequate capital and operational grant funding for at least a basic level of energy access. This would imply providing generation capacity to a community to provide at least access to lighting through either SHS, or by the provision of electricity via a stand-alone mini-grid with 20 Amp circuit breakers, in conjunction with alternative energy sources such as LPG for cooking and heating.

**Table 6.5: Potential distribution of energy sources**

Description	Energy (kWh) per day	Alternative, i.e. LPG	Mini Grid
Lights	0.300		0.300
Cell phone charger	0.018		0.018
Radio	0.036		0.036
TV	1.080		1.080
Hotplate	0.255	0.255	
Kettle	0.570	0.570	
Geyser	0.000	0.000	
Fridge / Freezer	0.790	0.790	
Iron	0.392	0.392	
	<b>3.441 kWh/d</b>	<b>2.01 kWh/d</b>	<b>1.43 kWh/d<sup>27</sup></b>

Growth projections for rural areas have been projected to be very low (0.3%) to negative (-0.5%) by 2019, assuming ongoing depopulation of rural areas, and rapid low income urbanisation (DBSA, 2011).

The growth projections of rural settlements and rural villages over a 7 and 15 planning horizon, should take into consideration potential movement of residents from nearby communities which do not yet have any access to electricity, to newly electrified areas.

<sup>27</sup> On average, 1.667 kWh/day is subsidised through the fbe grant. Electricity utilities have the right to establish their own indigent- and free basic services by-laws. A minimum fbe subsidy of 50 kWh per month per indigent household is prescribed by National Government Policy. Whether or not the minimum subsidy amount of 50 kWh per household per month is not debated in this Study.



Unless the rural area has access to any one socio-economic driver, the probability exists that the residents of these rural settlements and or villages will remain indigent dependent on Government social grants, and therefore would not be able to pay for a higher level of electricity service in lieu of alternative energy sources.

If a rural settlement consists of 50 households and sufficient capital grant funding is provided to facilitate the construction of a 50kW generation- and distribution system, it would imply a 1 kVA ADMD. (assuming a power factor of 1, and implying that this system would be able to accommodate future growth if one compares this ADMD to the NRS 034-1 ADMD values of 0.42 kVA-0.84 kVA)

*“For customers with a limited potential demand, in the very low, low or moderate consumption range, an individual customer’s consumption is typically four to five times the ADMD for a group of similar customers”* (CSIR, 2000, p. 12.1:1).

## **6.6 Mini-grid operator models**

Mini-grid operator models describe the organisational structure of mini-grid implementation and operation (Franz, et al., 2014). The four main mini-grid operator models are the:

- Community model;
- Utility model;
- Private sector model; and
- Hybrid model.

These models differ based on who owns the power generation and distribution assets, who operates and maintains the system and how customers are engaged with. The choice of which model to apply will depend on each unique situation, and considers aspects such as the natural environment, the local socio-economic context as well as the policy and regulatory environment (Franz, et al., 2014).

Table 6.6 indicates generalised advantages and disadvantages of the various implementation models.

**Table 6.6: Advantages and disadvantages of different mini-grid operation models** (Tenenbaum, et al., 2014) (Franz, et al., 2014)

Model	Description	Advantages	Disadvantages
Community	<ul style="list-style-type: none"> <li>The community owns, operates and manages the system and provides all services for the benefit of its members;</li> <li>Planning, design, procurement and installation probably undertaken by third party;</li> <li>Funding is mainly grant based, supplemented potentially by some community contributions;</li> <li>Need working social and decision making structures in the village to prevent conflicts.</li> </ul>	<ul style="list-style-type: none"> <li>Self-managed public infrastructure;</li> <li>Less conflict potential with customers and officials;</li> <li>Can be more efficient than bureaucratic utilities.</li> </ul>	<ul style="list-style-type: none"> <li>Communities may lack technical and business skills (e.g. design and installation, tariff setting) leading to higher costs to bring these in;</li> <li>Governance and ownership of systems needs to be well managed;</li> <li>Highly grant dependent;</li> <li>Tariffs not covering the o&amp;m costs.</li> </ul>
Private (Regulated)	<ul style="list-style-type: none"> <li>A private entity plans, builds, manages and operates the mini-grid system;</li> <li>Funding depends on private equity and commercial loans, as well as Government subsidies;</li> <li>Opportunities exist when bundling a number of mini-grids to reduce management costs.</li> </ul>	<ul style="list-style-type: none"> <li>Scalability through private capital;</li> <li>Technical know-how;</li> <li>Legal security of regulated market attracts private finance;</li> <li>Greater efficiency;</li> <li>May have capacity to offer better o&amp;m services;</li> <li>May be better able to navigate political interference.</li> </ul>	<ul style="list-style-type: none"> <li>Lack upfront financial support in most cases;</li> <li>Vulnerable to changes in regulation, fixed tariffs and conflict with customers;</li> <li>High transaction costs;</li> <li>Grid interconnection a potential risk;</li> <li>Often difficult to find enough experienced companies, so often schemes are run by smaller companies with less capacity.</li> </ul>
Utility	<ul style="list-style-type: none"> <li>A utility is responsible for all mini-grid operations (generation and distribution);</li> <li>Funding is traditionally attained from Government;</li> <li>Mini-grid &amp; interconnected distribution grid operated and charged on same basis.</li> </ul>	<ul style="list-style-type: none"> <li>Responsibility lies with an experienced organisation;</li> <li>Often good links to policy so have better access to legal systems;</li> <li>Their scale means that they may have better access to spare parts and maintenance.</li> </ul>	<ul style="list-style-type: none"> <li>Mini-grids considered to be non-core business;</li> <li>Unsuited company structure for smaller projects</li> <li>Strain on limited budget;</li> <li>Often inefficient and bankrupt;</li> <li>Often driven by political agendas.</li> </ul>
Hybrid	<ul style="list-style-type: none"> <li>Investment, ownership and operation of mini-grids is potentially not carried out by the same party;</li> <li>Generation and distribution functions could be split;</li> <li>Important to clearly define roles and responsibilities.</li> </ul>	<ul style="list-style-type: none"> <li>Combine the advantages of the models above, such as the technical expertise of a utility and the financial expertise of the private sector.</li> </ul>	<ul style="list-style-type: none"> <li>Differences in the management systems of each entity can increase transaction costs;</li> <li>Potential for conflicts between partners leading to non-fulfilment of contracts;</li> <li>Complex arrangements.</li> </ul>



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Different contracting options are available in hybrid operator models, these being (Franz, et al., 2014):

- The **Public Private Partnership approach (PPP)**; broadly defined as any form of private sector involvement with a contract between a public and private party. A public partner can for example finance, own and manage the mini-grid while contracting a private partner to undertake the o&m function of the power generation system.
- In the **Power Purchase Agreement (PPA)** approach the generation and distribution assets are owned by separate entities. An example of this in South Africa is the REIPPPP contracts entered into between the DoE and private electricity generators.
- The **Concession model** approach entails a private company enjoying beneficial terms, such as monopoly supply, and preferential market access for a period of time in defined geographical areas, for providing electricity services to rural communities. The SA SHS concessionaire programme is an example of this type of contract.
- **Renewable Energy Service Companies (RESCOs)** work similarly to utilities but on a smaller scale; the government traditionally owns the infrastructure, while a RESCO undertakes the o&m- and cost recovery functions.

## 6.7 Mini-grid operator models contextualised for the South African regulatory environment

In 2014 the European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF) published the *“Mini-grid policy toolkit: Policy and business frameworks for successful mini-grid roll-outs”* (Franz, et al., 2014), which aims to orientate and guide policy-makers to effectively implement the utilisation of mini-grids. The publication of this guideline, as well as others relating to the promotion of mini-grids in Africa, seem to indicate a reversal in perception of the effectiveness of implementing mini-grids.

The guide defines a mini-grid to be a distribution grid that can operate in isolation from the national transmission grid, supplying a limited number of consumers from an electricity generation source of capacity between 10 kW and 10 MW (Franz, et al., 2014).

In the South African context, mini-grids should be considered in those areas where grid-tied infrastructure would not be feasible due to geographical-, topographical-, technological- and or demographical constraints; and an alternative solution to solar-home systems could potentially be implemented. Applying mini-grids as an intrinsic part of a small-scale hydropower rural electrification scheme focussed towards specific communities should be seen as **an** implementation tool for the Universal Household Electrification strategy.

Even though a national policy process specifically for the roll-out of mini-grids in South Africa will most probably not be initiated, due to the robust nature of the existing policy and strategy environment in South Africa, as well as the relatively limited scope for non-grid electrification in the country in comparison to the rest of Africa, the guidelines provided in the mini-grid policy tool-kit towards for example ownership-, and operation and maintenance arrangements or models are valuable and can





be applied in the South African context. The guideline could be interpreted and used for determining a most suitable operational model on a project by project basis.

The toolkit is an outcome of the Africa-EU Renewable Energy Cooperation Programme (RECP); which in turn is an outcome of the Africa-EU Energy Partnership (AEEP). The AEEP aims to improve access to *“reliable, secure, affordable, cost-effective, climate friendly and sustainable energy services”* for Africa and Europe, aligned with achieving the targets as set by the Millennium Development Goals (MDG) (Africa-EU Energy Partnership, n.d.).

This partnership agreement between the EU- and African leaders can be seen to be contributing directly to the United Nation’s Sustainable Energy for All (UN SE4All) initiative, which aims to provide sustainable energy for all by 2030. The UN SE4All targets in part informed the target year set for South Africa’s “New Household Electrification Strategy”.

The RECP can be considered as the companion programme to the Programme for Infrastructure Development in Africa (PIDA) – whereas the main objective of the PIDA is to facilitate continental integration through the provision of regional infrastructure, such as large-scale power generation, transmission and distribution infrastructure, the RECP supports the development of opportunities in the field of small- and medium sized renewable energy projects.

For the purposes of this Study, which focusses specifically on the provision of rural electrification services through the implementation of small-scale hydropower generation technology, either alone or in hybrid configuration with other technologies, the establishment of mini-grids is considered further in the context of the “mini-grid policy toolkit”.

The key aspects as described in the policy toolkit for the implementation of mini-grids towards rural electrification are listed in table format in the following paragraphs, and interpreted for the South African context.

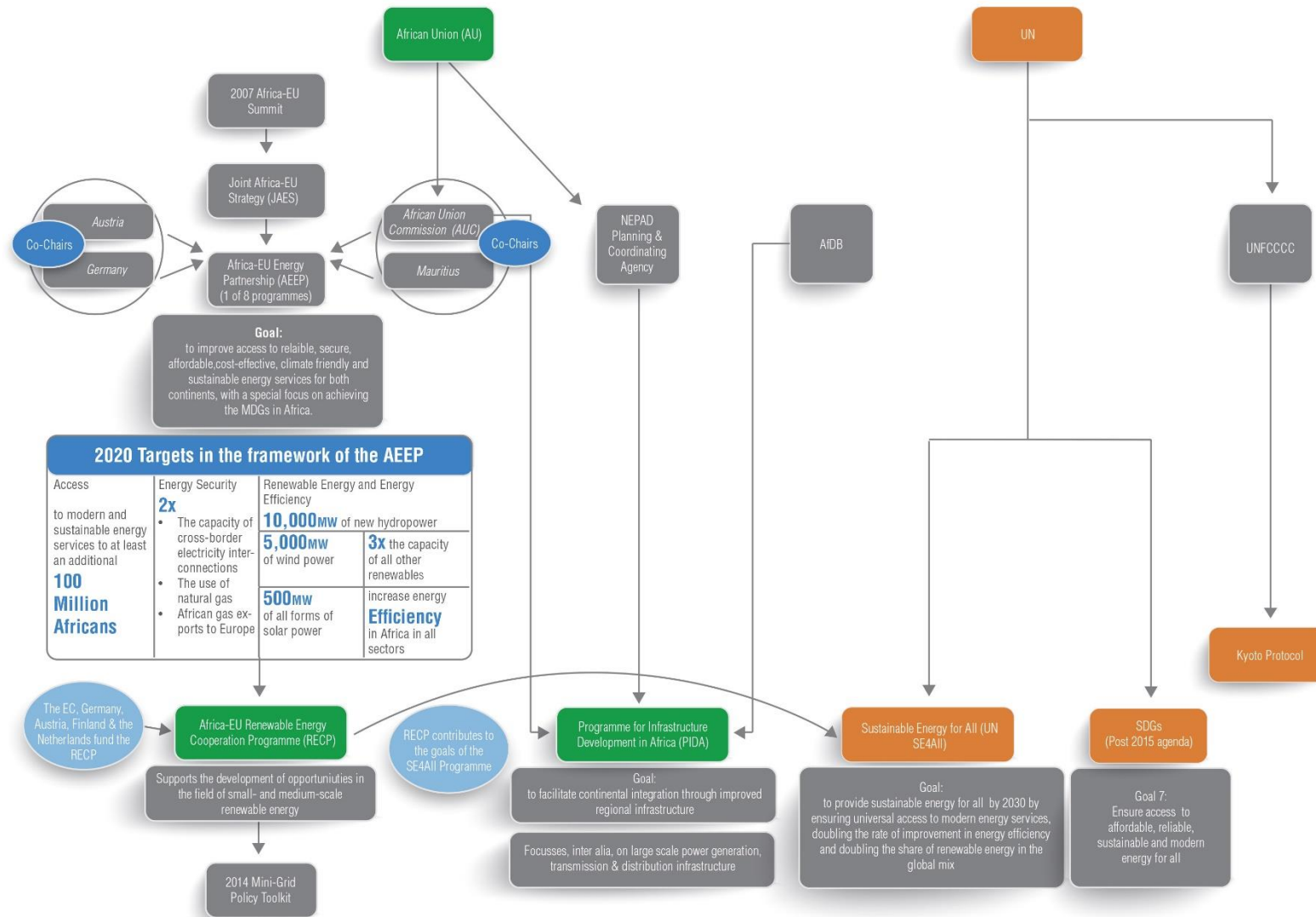


Figure 6.4: International context of the 2014 “mini-grid policy toolkit”

**Table 6.7: Interpretation of the Toolkit to South African circumstance**

Toolkit ref	Typical aspects to consider from the Toolkit	South African context	Cross-Reference in this Study
National Electricity and Electrification policy	Definitions for electricity access	<p>A basic electricity service is understood to be electricity for lighting, and is quantified as:</p> <p><b>Level 1 – non-grid</b> In the case of non-grid (solar home system) connections, a basic electricity service is defined to mean a 50W, direct current (DC) limited supply to cater for 4 lights for 4 hours per day, a small monochrome television for 2 hours per day, a small radio for 10 hours per day (DoE, 2015d). A 50W solar panel equates to approximately 250Wh/day (i.e. power for 5hours/day, and equating to 91.25kWh/year) (DoE, 2012a). Thermal energy needs, such as cooking, heating and refrigeration are typically not catered for (DoE, 2012a) under this basic service definition.</p> <p><b>Level 2 - grid</b> The DoE considers a 20 Amp limited supply to be the basic service for the poorest sector where grid extension is feasible, able to cater for typical appliances such as a radio, lights, television, fridge, and one of the following at any one time: (iron &amp; double hotplate) or (kettle &amp; single bar heater) or (iron &amp; two bar heater) or small geyser (DoE, 2015d).</p>	Paragraph 1.2
	Define targets for electricity access	The SA target for universal access (97%) by 2025 to a basic electricity service is defined in the “New Household Electrification Strategy” of 2013, and is to be achieved through extending grid connections to 90% of the SA population, and providing sustainable and appropriate non-grid solutions for the remainder of the population (DoE, 2013c). These solutions could be based on either renewable- or non-renewable energy sources. The definition of non-grid electrification is further interpreted to mean that the service provided is not connected to an “ <i>interconnected power distribution system</i> ”; which definition would therefore not exclude the utilisation of mini-grids as a stand-alone application for electrification purposes.	Paragraph 1.2
A1	Measure electricity access in rural areas	Access to electricity in rural areas in SA can be drawn from the 2011 Census data, specifically for those municipalities classified as rural municipalities; i.e. all B3 & B4 municipalities. The backlogs per LM and or per DM can also be drawn from the municipal IDPs.	Paragraph 1.2 Paragraph 3.2 Paragraph 4.2

Toolkit ref	Typical aspects to consider from the Toolkit	South African context		Cross-Reference in this Study
	Is the access rate lower than the target?	<p><b>LOWER.</b> The DoE estimates that the total number of non-grid household connections to be connected between 2014 and 2025 amounts to approximately 300 000, (DoE, 2013c), with the highest potential for non-grid electrification initiatives lying in the Eastern Cape- and Kwa-Zulu Natal provinces.</p> <p>Taking into consideration that between 2002 and 2013, approximately 68 000 non-grid household connections, mainly through stand-alone solar home systems were made, (DoE, 2013c), the non-grid electrification programme will need to scale-up considerably; from an average of 6 200 households provided with non-grid electrification per year over that 11 year period, to approximately 25 000 per annum for the period from 2013 to 2025.</p>		Paragraph 1.2
A1 National Electricity and Electrification policy	Are mini-grids integrated in the rural electrification approach where appropriate?	<p>NOT SPECIFICALLY included or excluded.</p> <p>The 2013 “New Household Electrification Strategy”, taking cognisance of the many challenges faced by the concessionaire programme, and the extent of the non-grid target requirement, makes provision for the implementation of not only solar home systems <b>but any other possible cost-effective technology.</b></p> <p>Hydropower is a possible cost-effective technology, and requires the establishment of a mini-grid to distribute electricity from point of generation to point of utilisation.</p> <p>The application of mini-grids was piloted in two rural villages in South Africa, utilising a wind-solar-diesel hybrid generation system. Valuable lessons were learnt from this experience, which could be applied to any other mini-grid type project.</p>		Paragraph 1.2 & Paragraph 6.3
	Should <u>only</u> the national electricity utility be responsible for mini-grids?	NO.	<p>Constitutionally in South Africa, <i>electricity generation</i> is a National Government function. The “New Household Electrification Strategy” though allows <i>municipalities</i> to initiate appropriate electrification projects towards achieving the universal access target through non-grid technologies – implying that due to the fact that the national electricity utility will not be able to extend its national grid to these areas, that within these areas, electricity generation will need to occur at local level.</p> <p>These types of generation activities would typically be considered as “islanded use”; i.e. electricity generated for “islanded use”.</p> <p>South Africa’s Constitution allocates the responsibility and authority for <i>electricity services provision</i> to municipalities. Further, the Municipal Systems Act allows for municipalities who have executive and legislative authority for services provision, to decide whether or not the services provision function is to be out-sourced to either (South Africa, 2000):</p>	Paragraph 3.2
	Should a local electricity utility be responsible for mini-grids?	YES.	<ul style="list-style-type: none"> <li>• a municipal entity,</li> <li>• another municipality,</li> <li>• an organ of state such as a licenced service provider in terms of national legislation or a traditional authority, a CBO or NGO.</li> </ul>	

**SECTION 3: OPERATIONAL CONTEXT**

Toolkit ref	Typical aspects to consider from the Toolkit	South African context		Cross-Reference in this Study
	<i>(option not in toolbox)</i>		<p><b>Only a municipality can be allocated the authority function</b> (DWAF, 2007).</p> <p>In addition to this process, South Africa's electrification programme is driven through the nationally funded INEP, by IAs – either Eskom or Local Government.</p>	
	Should <i>(could)</i> communities own and or operate mini-grids?	Possible	<p>Eskom, playing a dual role of being both the national electricity utility responsible for electricity generation and transmission in South Africa, and a local electricity utility responsible for electricity distribution in certain areas of the country, could also be a role-player in the ownership and operation of mini-grids.</p> <p>This implies that in SA, a decentralised<sup>28</sup> electrification strategy is being implemented (funded though through the National Fiscus). The following owner / operations options <i>could</i> be considered:</p> <ul style="list-style-type: none"> <li>Local Municipality owned, and operated &amp; maintained by either a private service provider, community, Eskom, or by the LM themselves.</li> <li>Community owned, and operated &amp; maintained by either a private service provider, <del>the LM<sup>29</sup>, Eskom,</del> or by the community themselves – IF the CPA and or TA owns the land, i.e. it is not public land, OR IF the municipality has entered into a SLA with the TA to provide the services according to the Municipal Systems Act;</li> <li>Eskom owned, and operated &amp; maintained by either a <del>private service provider, community, the LM,</del> or by Eskom themselves.</li> <li>Privately owned, and operated &amp; maintained by either the <del>LM, community, Eskom,</del> or by the IPP themselves, IF on private land OR IF initiated through a DoE tender.</li> </ul>	
	Should private business own and or operate mini-grids?	Possible	<p>If the project is located on land owned by a traditional authority, CPA or other private entity (i.e. considered private land), and the project is initiated by the land owners to provide non-grid services to communities residing on the land, these entities could be considered, as in the water sector, “services intermediaries”. Clause (2A) of the Electricity Regulation Second Amendment Bill relates to “a person who operates a distribution power system located solely on private property” and states: “that such a person need not apply for or hold a trading licence, provided that such person does not sell electricity to its customers at a price higher than the price at which the electricity would be sold to those customers by the person from whom that operator purchases the electricity” (DoE, 2011b, p. 11).</p> <p>Interpreting and applying this clause to islanded, non-grid electricity provision, it can be inferred that private land owners can own, operate and distribute electricity on their land provided that the tariffs charged are as per the tariffs of the local electricity utility.</p>	

<sup>28</sup> Decentralised in the context of the services provision function having been shifted from National Government to Local Government.

<sup>29</sup> Text with a “strike through” indicate options that are not likely to realise.

**SECTION 3: OPERATIONAL CONTEXT**

Toolkit ref	Typical aspects to consider from the Toolkit	South African context	Cross-Reference in this Study
		<p>If the project is located on either public or private land on which traditional authorities have land rights, the role of the traditional authority will be to accept the project and give permission for the project to continue, prior to the land owner (most probably the DRD&amp;LR) giving permission for the developer to continue. The land owner must give permission for the development to continue, and ideally agree to services servitudes being registered.</p> <p>Based on the fact that only municipalities can be allocated the authority function for services provision in South Africa as per the Municipal Structures Act, it is inferred that a traditional authority having land use rights on state land, will not be able to own, operate and distribute electricity, unless appointed to do so via a S78 process as per the Municipal Systems Act. (assuming further that the generation &amp; distribution of electricity constitutes the electricity services provision function)</p> <p>The Privately owned and operated option could follow a “concessionaire” approach, as per the SHS model implemented by the DoE. Due to the fact though that the communities and households that would require non-grid electrification are mostly indigent, and constitute a relatively limited number of households, this operating model would require an extensive feasibility study that would consider scale in terms of:</p> <ul style="list-style-type: none"> <li>• geography and <i>regionalisation</i>,</li> <li>• a spread of consumers within that area including industry and or mines and or agriculture and households;</li> <li>• Sufficient grant funding in order to leverage alternative sources of funding through, for example, project finance options.</li> </ul> <p>Regionalisation would be a critical factor in determining the feasibility for such a concession approach – if concessions are allocated through competitive bidding allowing the IPP to bundle or cluster a number of mini-grid projects, appropriate scale might be attained. This could also lead to efficiency gains in planning, financing, programme administration, equipment supply, o&amp;m and therefore potentially reduces the project cost and improves profitability (Franz, et al., 2014).</p> <p>The financial viability of each option would need to be considered, before deciding on the appropriate o&amp;m solution for a specific community, as well as the appropriate contracting mechanism.</p>	

**SECTION 3: OPERATIONAL CONTEXT**

Toolkit ref	Typical aspects to consider from the Toolkit	South African context	Cross-Reference in this Study
A2 Rural Electrification Strategy and Plan	Assess current electrification plans and activities and determine whether or not these are sufficient to effect rural electrification	<p>South Africa does not have a Ministry of Rural Electrification, nor a rural electrification strategy or masterplan per say. Rural electrification in South Africa is an intrinsic aspect of the CRDP of the DRD&amp;LR, as well as the DoE's INEP. The DoE's 2015 State of Renewable Energy Report (DoE, 2015) refers to the establishment of an "off-grid electrification authority", which would aim to reinvigorate the off-grid electrification programme, by promoting off-grid energy access more generally, as well as promote the use of mini-grids. It is assumed that this authority would not be a separate Government Department, but would rather be a Programme Management Unit within the DoE responsible for the scaled-up programme of non-grid rural electrification, and most importantly assisting with sourcing financing options.</p> <p>The INEP is a robust programme, though it has since inception focussed on delivering non-grid rural electrification through stand-alone SHS only. The INEP is the ideal implementation mechanism through which to implement small-scale hydropower projects with associated mini-grid distribution infrastructure. Local Municipalities and Eskom implement these projects as IAs of the INEP with funding from National Government, and detail electrification plans are made at local level and captured in a Municipalities' IDP.</p> <p>Zones for grid and non-grid electrification projects have been deduced by Government planners utilising information from the municipal IDPs, Eskom's distribution grid plans, and other documents referencing South Africa's SHS concessionaire programme.</p> <p>South Africa's plans for rural electrification can therefore be considered to be sufficient and robust.</p>	Paragraph 1.2, Paragraph 3.2 & Paragraph 5.3, Paragraph 1.2.
A3 Energy and Electricity Law (incl. implementing Institutions)	Assess existing laws and determine whether they create an enabling environment for mini-grid projects	<p>South Africa's existing laws that facilitate the implementation of non-grid rural electrification are (inter alia) the Constitution, the Municipal Structures Act, the Municipal Systems Act, the MFMA and the Electricity Regulation Act. In addition, the White Paper on Renewable Energy, as well as the National Climate Change Response White Paper encourages the utilisation of renewable energy technologies.</p> <p>The "New Household Electrification Strategy" could potentially open the door for mini-grid implementation in South Africa. The existing laws in South Africa are robust, and do not exclude the utilisation of mini-grids, but also do not explicitly promote the utilisation of mini-grids.</p> <p>No simplified regulatory procedures exist for mini-grids at this stage, although negotiations with NERSA have commenced.</p>	Paragraph, 3.2
A4 Tariff Policy and Regulation	Assess tariff policy	Tariffs are set by NERSA, and all electricity distributors need to abide by the set tariffs.	n.a.

**SECTION 3: OPERATIONAL CONTEXT**

Toolkit ref	Typical aspects to consider from the Toolkit	South African context	Cross-Reference in this Study
B1 Fiscal Policy and Regulation	Consider import tariffs, accelerated depreciation for mini-grid equipment, tax breaks etc.	Should be considered when a sufficient number of small-scale hydropower projects, or other mini-grid technology projects, are initiated in South Africa. This will be particularly relevant to hydropower projects due to the fact that appropriate turbine technologies are imported from other countries.	n.a.
C1 Technical Regulation	Assess existing <b>technical regulation</b> , minimum standards for appropriate mini-grid technology.	<p>Technical standards for mini-grid generation and distribution networks would be those applied to the electricity distribution network in South Africa. An extensive array of standards and specifications has been published by both Eskom and the South African Bureau of Standards (SABS). (Lists are available on the NERSA-, Eskom and AMEU webpages; which at the time of undertaken this Study were:</p> <ul style="list-style-type: none"> <li>• <a href="http://www.nersa.org.za">www.nersa.org.za</a>,</li> <li>• <a href="http://www.eskom.co.za/Whatwedoing/Pages/Technical_Specifications_And_Standards.aspx">www.eskom.co.za/Whatwedoing/Pages/Technical_Specifications_And_Standards.aspx</a> and</li> <li>• <a href="http://www.ameu.co.za/LibraryReports/IndustryDocuments.aspx">www.ameu.co.za/LibraryReports/IndustryDocuments.aspx</a>)</li> </ul>	n.a.
C2 Quality of Service Regulation	Assess <b>quality of service regulation</b> & operation and maintenance requirements	<p>Any mini-grid installed in South Africa should adhere to the same quality of service specification and standards as are applicable for municipal- or Eskom distribution grids, and electricity services provision.</p> <p>Operation and maintenance requirements of both the electricity generation and distribution components of the systems will need to be documented, allocated to responsible parties, and appropriate training thereon provided.</p> <p>An inherent risk of any hydropower project is that it is directly linked to the availability of flowing water, and should this be affected, for example through drought or upstream development, the security of electricity supply would be impacted.</p>	n.a.
C3 Environmental Policy & Regulation	Assess environmental regulations, standards and norms.	South Africa has robust Environmental Management legislation in place, including the NEMA. Further, South Africa's water resources are protected and managed through the NWA.	Paragraphs 5.1 & 5.2.



Toolkit ref	Typical aspects to consider from the Toolkit	South African context	Cross-Reference in this Study
D1 Per mits and Licences	Is a licence required for all mini-grid sizes?	In South Africa, the Electricity Regulation Act governs the electricity generation-, distribution- and trading licencing requirements. A NERSA electricity generation licence will be required if rural electrification projects are initiated and applied for commercial purposes. A NERSA electricity distribution licence will also be required, unless the development occurs on private land.	Paragraph 3.2
D2 Concessi on contract and schemes	Does the Energy Law allow for / foresee mini-grid concessions?	NO. A concession is a contract between a public and private entity granting the exclusive right to invest, operate and maintain the assets and sell electricity to end-users for a given number of years in specified geographic areas. In South Africa, a SHS “concessionaire” programme was launched, but was later changed to a service contract. This programme, in addition to a relatively small number of mainly indigent households that would need to receive non-grid electricity services spread over a wide geographic area, make it unlikely that SA would initiate a mini-grid concessionaire programme. Mini-grids in South Africa could be used towards achieving the non-grid electrification target set by Government as a technology option.	Paragraph 1.2 & Paragraphs 6.3, 6.4 & 6.5
D3 Power Purchase Agreements	Is a hybrid business model to be used with generation and distribution assets owned by two entities?	NO, probably not. A power purchase agreement (PPA) is a multi-year contract detailing the rights and obligations of two parties – a generator and a buyer of power (Tenenbaum, et al., 2014). For the REIPPPP in South Africa, IPPs sign a PPA with Eskom, as the designated buyer of the electricity produced. In the context of rural, non-grid electrification in South Africa, with the limited, dispersed and mainly indigent communities that would need to be served, the probability of small power producers operating independently from small power distributors, is slim. Mini –grids in this context are not expected to be connected to the national grid at any time in the foreseeable future. In the context of embedded generation, when a SPP (either private or public) owns and operates a generation facility in order to feed-into a local municipal grid, the SPP would enter into a PPA with the Local Municipality or other applicable entity for the supply of electricity. An example of a PPA in South Africa is the City of Cape Town’s PPA for embedded generators.	Paragraph 1.2, paragraph 3.2 and paragraphs 6.3, 6.4 and 6.5
E1 Grants and Subsidies	Are public and international donor subsidies well designed / sufficient for the scaling-up of mini-grids?	The National Fiscus funds the INEP, the Government programme initiated in South Africa to achieve the universal access target as defined in the “New Household Electrification Strategy.” In addition, a number of social grants are available to the Local Municipalities to provide indigent households with at least a basic level of service. In the case of electricity, this would be the fbe and the fb alt e subsidy, paid from the equitable share to that municipality. The SHS concessionaire programme has been allocated a 80% capital subsidy grant, which grant could potentially be adapted and rolled-out to accommodate other appropriate technologies.  This budget appears to be insufficient to fund the non-grid programme, through any technology, and consideration must be given to adapting the non-grid electrification budget, as well as source alternative grant funding.	Paragraph 8.4

**SECTION 3: OPERATIONAL CONTEXT**

Toolkit ref	Typical aspects to consider from the Toolkit	South African context	Cross-Reference in this Study
E2 Loan Support	Debt facilities, loan guarantees, risk insurance etc.	Should be considered when a sufficient number of small-scale hydropower projects, or other mini-grid technology projects, are initiated in South Africa.	n.a.



## **6.8 Mini-grid generation and distribution operator model**

The interpretation of the Toolkit for South African circumstances shows that South Africa is appropriately geared to implement mini-grid generation and distribution technologies on a small scale towards achieving Government's universal access to electricity target, and that the most appropriate owner – operator model will depend on site specific circumstances.

The probability of a concession type approach to the roll-out of a mini-grid stand-alone electrification initiative as part of the INEP non-grid programme, will in all likelihood prove to be unfeasible mainly due to the fact that the extent of the households to be served is relatively small, dispersed and mainly indigent. Consideration could be given to determining whether or not regionalisation, or clustering of a number of mini-grid projects, could become feasible. A non-profit, purely social driven IPP initiative could be an option for consideration.

It is anticipated that in all circumstances the ownership of the generation and distribution infrastructure will not be separated.

For the DST funded projects, it is inferred that the projects will be owned by the Local Municipality due to the fact that the funding was requested by the respective District Municipalities to specifically benefit their Local Municipalities. The project conditions therefore guide the ownership role in this instance.



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## 7 SMALL-SCALE HYDROPOWER

### 7.1 Small-scale hydropower as an appropriate technology for rural electrification in SA

The application of **small-scale hydropower** is deemed an appropriate technology for rural electrification due to (ARE, 2014), (BHA, 2005), (Paish, 2002):

- SHP has been shown to be the cheapest technology for rural electrification over the lifetime of the system. The initial capital costs of such a project are high, but with low operating costs. This is diametrically opposite to, for example, the application of a diesel generator, for which the initial capital cost is low, but the operating costs are high.
- SHP technology is mature, robust and reliable, with proven track-records of longevity (50 years or more), and efficiency<sup>30</sup> (70%-90%).
- It is a local energy source that makes use of small rivers. Stream flows are generally consistent, especially in comparison to the variability of solar- and or wind technologies, and therefore output can be calculated with a higher degree of reliability.
- Operation and maintenance of a SHP system is relatively simple and can be undertaken by appropriately trained local community members.
- It is an environmentally friendly, and sustainable solution, that does not consume water.
- SHP technology can be retrofitted to existing infrastructure, establishing a multi-purpose scheme. For example, SHP plants could be retrofitted to existing dams, integrated into a water reticulation network or within irrigation canals.
- Opportunities for the implementation of SHP exist in South Africa, and in particular in the EC and KZN (Jonker Klunne, 2013).

Challenges exist in implementing small-scale hydropower in South Africa, which include for example, insufficient grant funding, inability to gear grant funding to leverage private financing, poor promotion of small-scale hydropower technology as an appropriate solution at policy levels, and conflicting roles and responsibilities within the electricity sector.

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<sup>30</sup> Efficiency is described as the percentage obtained by dividing the actual power or energy by the theoretical power or energy. It represents how well the hydropower plant converts the energy of the water into electrical energy (van Vuuren, et al., 2013).



## 7.2 Experiences and lessons learnt internationally and locally on the implementation of small-scale hydropower for rural electrification

A vast quantity of journal articles is available on the topic of rural electrification utilising hydropower technology either independently or in hybrid formation.

A random selection of 30 papers was read, and even though they describe different elements of hydropower projects in various countries around the world, a number of common threads can be found. These common threads are summarised hereafter, in the context of drawing specific lessons learnt and experiences from these papers which could be relevant to implementing small-scale hydropower projects in South Africa.

### 7.2.1 *Common institutional lessons learnt and experiences gained*

The following institutional experiences were highlighted:

- **Community involvement and participation** is required in all aspects of implementing a rural electrification project, from the inception phase, through the planning- and construction phases, to the ongoing operation and maintenance of the system. Ensuring that local capacity is created to undertake the fundamental maintenance functions is deemed critically important. Capacity building in associated aspects such as basic financial management was found to complement the purely technical training provided on how to operate and maintain a hydropower system. Communities should be involved in a process to determine their required level of service, (including what the electricity provided should be used for) and their willingness to pay for the services provided.
- Clear definitions of **roles and responsibilities of all stakeholders** in the project are required, specifically with regards to ownership of the infrastructure and responsibility for the operation and maintenance thereof. Further, a common understanding regarding the funding streams is necessary, irrespective of whether the funding is received through billing initiatives, Government grants or donor funding.
- A **conducive institutional (regulatory and legislative) implementation environment** at national and local level is required to allow and or facilitate the implementation of rural electrification projects through renewable energy sources alone or in hybrid formation with for example, diesel generators.
- **Capacity constraints**, including technical capacity constraints with regards to the design, operation and maintenance of hydropower, and institutional capacity constraints of policy- and decision makers who are not aware of hydropower as an



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appropriate technical solution for rural electrification, need to be addressed to facilitate the utilisation of small-scale hydropower projects.

#### 7.2.2 *Common technical lessons learnt and experiences gained*

- The main common denominator mentioned in the papers reviewed regarding the technical design of the various systems, was the necessity for **appropriate** designs being undertaken, utilising locally manufactured materials (to facilitate ease of replacement), of robust quality.
- Aspects to be considered during the design phase include allowing and designing for siltation and seasonal flow variances in rivers, as well as considering the placement of the powerhouse in relation to the community being served.
- Consideration should be given to applying hydropower technology in hybrid formation with other possible technologies, such as diesel generators, solar photovoltaic systems with battery packs and possibly even wind turbines.

#### 7.2.3 *Common financial lessons learnt and experiences gained*

- The provision of rural electrification services is mostly dependent on Government grant funding.
- The costs associated with the initial capital investment, as well as the ongoing operation, management and maintenance costs need to be covered sustainably over the lifetime of a project. The high up-front capital cost, and low operation and maintenance costs associated with small-scale hydropower projects, makes the financing of hydropower projects unattractive for funding options other than government grant funding.
- Financial sustainability of small-scale hydropower projects can be boosted by ensuring that some small businesses or social services centres form part of the total distribution load.
- Preference should be given to sites with higher potential head difference, over sites with higher flows due to the associated increases in cost of conveying larger equipment for the latter.



### 7.3 The status of the DST funded projects

After an extensive technical design and financial feasibility process, 2 project sites were identified by Bonthuys (Bonthuys, 2015), namely **Kwa-Madiba** in the Eastern Cape, and **Ndodekhling-Shayiwe** in KZN.

Several site selection parameters, other than potential head and flow, were used to identify the most appropriate project sites. These parameters included:

- The location of the nearest rural settlement,
- The distance to the nearest rural settlement,
- The population of that rural settlement,
- Determining whether or not the rural settlement was grid-tied, or would be grid-tied in the near future;
- Whether or not the site was accessible by vehicle,
- Environmental Impact and Social Impact.

**Table 7.1: Project Locations**  
(University of Pretoria, 2015)

	<b>Kwa-Madiba</b>	<b>Ndodekhling-Shayiwe</b>
Site Co-Ordinates	31°11'38.62"S ; 29° 3'18.18"E	28°21'57.98"S ; 30°35'9.70"E
DM	O.R. Tambo DM	Umzinyathi DM
LM	Mhlontlo LM	Nquthu LM
Community	Kwa-Madiba	Ndodekhling-Shayiwe
No of households	39	32

Based on hydrological-, and hydraulic analyses, hydropower systems were designed.

**Table 7.2: System Design**  
(University of Pretoria, 2015)

	<b>Kwa-Madiba</b>	<b>Ndodekhling-Shayiwe</b>
Available flow 95% of the time	640l/s	466l/s
Available Head	50m	11m
Design flow rate	150l/s	200l/s
Design Head	48.8m	7.3m
Penstock length	116m	397m
Energy losses	1.2m	3.7m
Design power output	50.0kW	10.0kW
kW per household	1kW	0.3kW

The turbine rooms/powerhouses of both projects are designed as a containerised units.



The unit is assembled off-site and transported to site and connected once the penstock and turbine room foundation is completed. The containerised unit reduces overall construction time and eliminates construction restraints in confined and remote locations. The turbine room/powerhouse houses the turbine, generator, controls and regulators of the SSHP plants. At the connection of the penstock to the turbine room the pipeline is fitted with secondary screen to protect the impeller of the turbine against erosion by finer particles which passed the primary screen at the intake structure.

For both projects, a 20 Amp limited supply is provided, in conjunction with a pre-paid meter. If more than 50 kWh/month is used, then households will need to pay for it.



**Figure 7.1:** Nnodekhling-Shayiwe (Bonthuys, 2015)



**Figure 7.2:** Intake and penstock location and layout of Nnodekhling-Shayiwe (Bonthuys, 2015)





**Figure 7.3:** Kwa-Madiba  
(Bonthuys, 2015)



**Figure 7.4:** Kwa-Madiba Preliminary Site Layout  
(Bonthuys, 2015)



## SECTION 4: FUNDING OF NON-GRID RURAL ELECTRIFICATION

### 8 FUNDING FOR NON-GRID RURAL ELECTRIFICATION

#### 8.1 Funding of the grid component of the INEP

Funding for the provision of basic services, including water-, sanitation and electricity services, has increased substantially since the current Local Government system was established. Municipalities were allocated R141 billion between 2001 and 2011 via infrastructure grants (FFC, 2014).

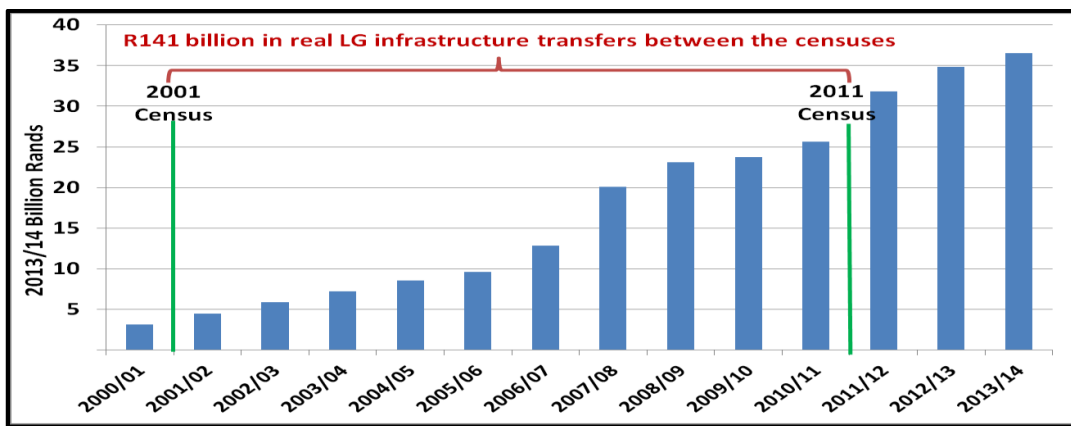


Figure 8.1: Infrastructure Grants to Local Government (FFC, 2014)

Despite progress in the roll-out of basic services, backlogs, particularly in the provision of water and sanitation services, remained high. Figure 8.2 shows that between the 2001 Census and the 2011 Census, electricity services provision backlogs, even of rural municipalities, *decreased* (FFC, 2014).

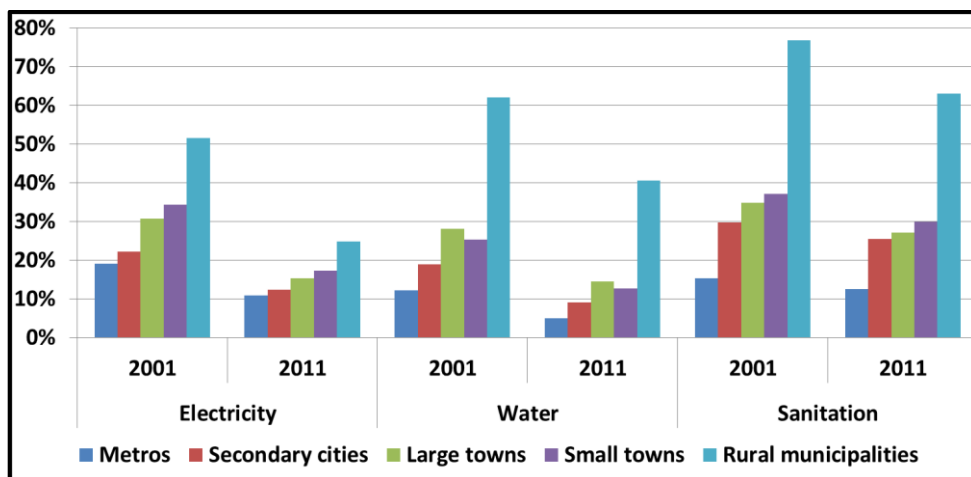


Figure 8.2: Percentage backlogs in access to basic services (FFC, 2014)



**SECTION 4: FUNDING FOR NON-GRID RURAL ELECTRIFICATION**

The infrastructure grant applicable to electricity services provision is the Integrated National Electrification Programme Grant, or the INEP grant. The INEP grant is a Schedule 5, conditional capital grant to Local Municipalities and Schedule 6 conditional grant to Eskom, being the designated Implementing Agents of the DoE for the INEP.

The purpose of the INEP LM grant is “to implement the INEP by providing capital subsidies to municipalities to address the backlog of occupied residential dwellings, and the installation of bulk infrastructure<sup>31</sup>” (National Treasury, 2015c, p. 183).

The purpose of the INEP Eskom grant is “to implement the INEP by providing capital subsidies to Eskom to address the backlog of occupied residential dwellings, the installation of bulk infrastructure and rehabilitation and refurbishment of electricity infrastructure in order to improve quality of supply in Eskom licenced areas” (National Treasury, 2015c, p. 184).

Conditions and allocation criteria are set according to the Grant Frameworks published in the annual Division of Revenue Act (DoRA), and for example specify, for the LM INEP grant, that applications from licenced municipal distributors will be considered, with priority given to those Local Municipalities within the 27 most distressed District Municipalities.

For the Eskom INEP grant, for example, allocations are made to Eskom on behalf of municipalities based on applications for non-licenced municipalities.

Table 8.1 indicates the INEP grant allocations that have been allocated to the Local Municipalities in the O.R. Tambo-, and Umzinyathi District Municipalities.

**Table 8.1: MTEF infrastructure grant allocations to municipalities**  
(National Treasury, 2015c)

DM	LM	INEP Eskom Grant (‘000)			INEP LM Grant (‘000)		
		2015/16	2016/17	2017/18	2015/16	2016/17	2017/18
O.R. Tambo	Ngquza Hill	175 143	175 146	177 731	18 000	25 000	25 000
	Port St Johns	29 592	29 599	20 079	0	0	0
	Nyandeni	27 322	27 322	28 688	25 000	20 000	20 000
	Mhlontlo	7 338	7 338	8 705	13 000	15 000	15 000
	King Sabata Dalindyebo	42 098	42 099	45 704	20 000	18 000	20 000
Umzinyathi	Endumeni	0	0	0	10 000	10 500	12 000
	Nquthu	46 780	29 186	32 145	20 000	21 000	23 000
	Msinga	86 742	79 853	83 851	20 000	21 000	23 000
	Umvoti	750	0	0	25 000	25 000	12 000

<sup>31</sup> Bulk infrastructure in this context is assumed to exclude generation- and transmission infrastructure, and to include all required infrastructure associated with ensuring effective distribution of electricity to consumers, such as substations and distribution networks.



**SECTION 4: FUNDING FOR NON-GRID RURAL ELECTRIFICATION**

The grants allocated to these municipalities indicate that grid extension initiatives by either the municipality or Eskom are planned to be implemented *within areas* of these municipalities over the next three years at least.

A stand-alone non-grid electrification project should take these plans into consideration, as well as the plans of a SHS concessionaire, to ensure alignment of communication with potential beneficiary communities regarding level of service, tariffs and billing if applicable, utilisation options and operation and maintenance requirements.

Though the INEP grant in the context of the other municipal infrastructure grants is small, the INEP constitutes nearly 80% of the DoE Programme budget. (shown in Figure 8.3.)

**8.2 Funding of the non-grid component of the INEP**

*8.2.1 Capital subsidy of the non-grid component of the INEP*

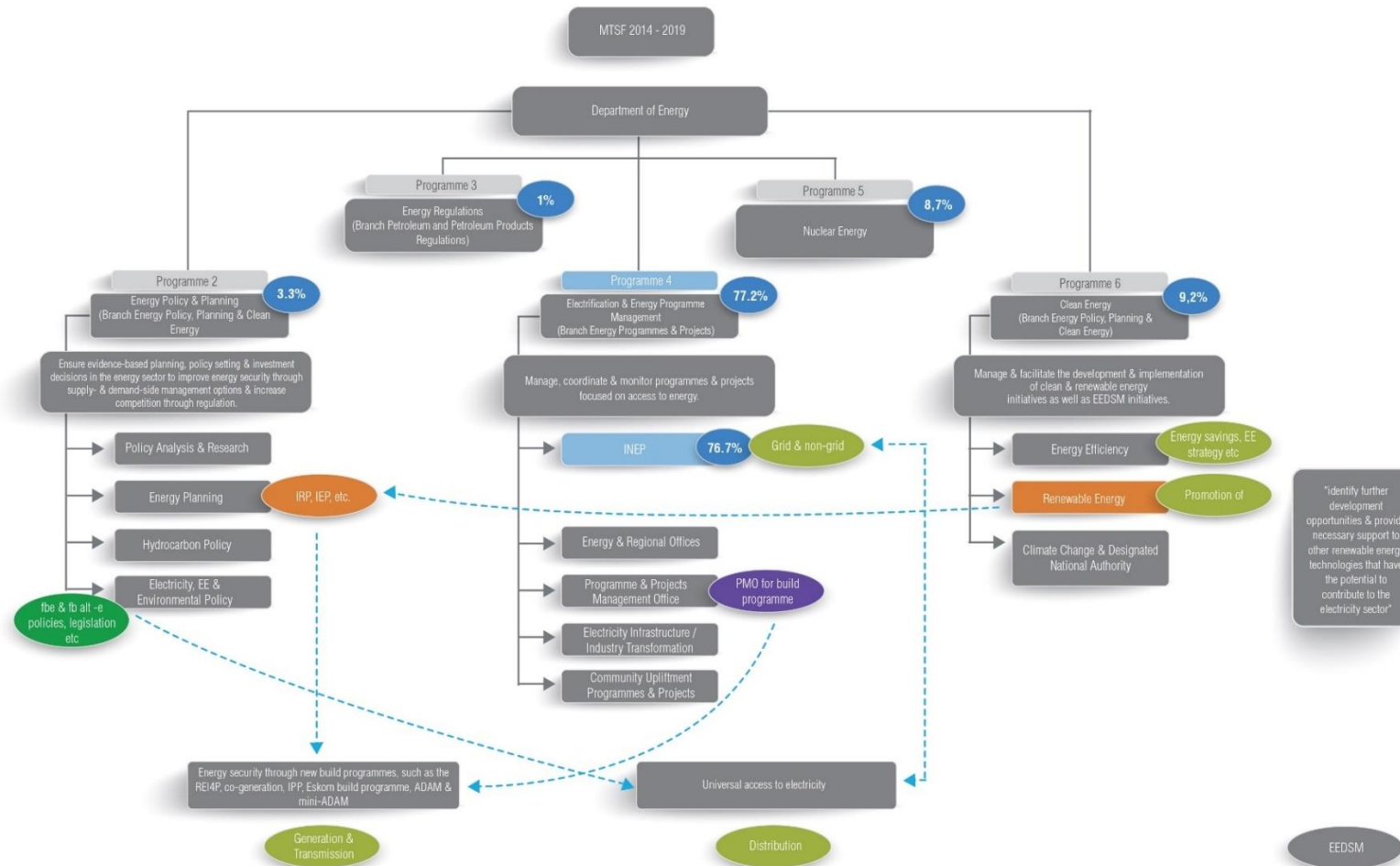
The non-grid component of the INEP is disbursed directly from the DoE to contracted service providers, appointed for specific geographic areas and through a tender basis.

The INEP non-grid budget for FY15/16 is approximately R130 million (National Treasury, 2015b, p. 16 of Vote 26), and is included in the total INEP budget amount reflected in Figure 8.3. The non-grid component of the FY15/16 INEP grant allocation constitutes but a fraction of the total INEP budget, 2.2%. The 2015 ENE further states that “*transfers for non-grid electrification are projected to increase from R105.5 million in 2014/2015 to R191.7 million in 2017/18*” and “*the non-grid electrification programmes will be implemented in any area where extending the grid would not be cost-effective, and not only in concessionary areas (low density and low consumption households where non-grid service providers have been appointed to provide SHS.*”

**Table 8.2: Indicative INEP subsidy amount per non-grid connection**  
(National Treasury, 2015b)

	<b>non-grid connections to be made</b>	<b>non-grid budget allocation</b>	<b>average cost per connection</b>
FY14/15	20 000	R 105 525 000	R 5 276
FY15/16	20 000	R 131 067 000	R 6 553
FY16/17	25 000	R 166 424 000	R 6 657
FY17/18	25 000	R 191 745 000	R 7 670

**SECTION 4: FUNDING FOR NON-GRID RURAL ELECTRIFICATION**



**Figure 8.3: DoE Implementation Programmes indicating proportional FY15/16 MTEF budget allocation**  
(diagram by Beate Scharfetter, and based on information attained from the DoE Strategic Plan 2015-2020, (DoE, 2015c))



**SECTION 4: FUNDING FOR NON-GRID RURAL ELECTRIFICATION**

Taking cognisance of the fact that the DoE's FY16/17 subsidy level for the grid connection part of the INEP is R19 500 for a rural connection (DoE, 2015d), (for a basic grid-tied level of supply), and it is generally accepted that the provision of non-grid, rural electrification services is more costly than extending the grid to geographically remote areas, a **disconnect** between the subsidies made available for the grid- and non-grid components of the INEP is apparent.

It appears therefore that the budget allocated for the non-grid component of the INEP will also need to be scaled-up in order to achieve the necessary targets.

**8.2.2** *The Local Government equitable share* (National Treasury, 2015c)

In terms of section 227 of the Constitution, Local Government is entitled to an equitable share of nationally raised revenue to enable it to provide basic services and perform its allocated functions. The Local Government equitable share is an unconditional transfer that supplements the revenue that municipalities can raise themselves (including property rates and service charges).

The equitable share provides funding for municipalities to deliver free basic services to poor households and subsidises the cost of administration and other core services for those municipalities that have the least potential to cover these costs from their own revenues.

$$LGES = BS + (I + CS)xRA \pm C \tag{2}$$

Where<sup>32</sup>

LGES Local Government equitable share.

BS Basic Services component.

This component helps municipalities provide free basic water, sanitation, electricity and refuse removal. For FY2015/16 the basic services subsidy amounts to R313.76 per month per indigent<sup>33</sup> household.

I Institutional component

CS Community services component

RA Revenue adjustment factor

C correction and stabilisation factor

The basic services component accounts for 75% of the value of the LGES.

<sup>32</sup> The I, CS, RA & C components enable municipalities with limited resources to afford basic administrative governance capacity & perform core municipal functions

<sup>33</sup> NT used a monthly household income of R2 300 per month as the affordability threshold.



**Table 8.3: Amounts per basic service allocated through the LGES for FY15/16 (National Treasury, 2015c)**

	Rand Allocation per household below affordability threshold per month		
	Operations	Maintenance	Total
Energy <sup>34</sup>	59.57	6.62	66.19
Water	89.77	9.97	99.75
Sanitation	72.37	8.04	80.41
Refuse	60.67	6.74	67.41
<b>Total Basic Services</b>	<b>282.38</b>	<b>31.38</b>	<b>313.76</b>

The fbe subsidy is an integral part of making a non-grid rural electrification project feasible, without which such a project would probably not be able to be implemented.

The basic services component allocation to each municipality is calculated by multiplying the monthly subsidy per household by the updated number of indigent households in each municipal area. Funding for each basic service is allocated to the municipality that is authorised to provide that service. If another municipality provides a service on behalf of the authorised municipality, it must transfer funds to the provider.

As discussed in previous sections of this Study, the acceptance of the electricity authority function by either a DM or a LM, is not always done, particularly in lieu of Local Government capacity constraints and the role of the INEP IAs in fulfilling the electricity services provision function.

As could be seen from the IDPs of the Umzinyathi-, and O.R. Tambo DMs, the local municipalities within these DMs do have indigent registers in place, and do provide fbe; therefore these LMs must claim and receive at least the energy component of the Basic Services allocation of the LGES.

### 8.2.3 Procurement options for the non-grid electrification programme in South Africa

The DoE Solar Home System concessionaire programme tender for FY2014/15 “invitation of bids to appoint non-grid service providers for the supply, installation and maintenance of SHS in KZN, Limpopo and Eastern Cape”, was awarded to Kukhanya Energy Services (Pty) Ltd, to Nura Energy (Pty) Ltd and to Xhahumba Sunlec JV (DoE, 2014).

The Terms of Reference of the tender indicated that the successful service providers will be required to supply and install 8 500 SHS units (3 000 in EC, 2 000 in KZN North, 2 000 in KZN South and 1 500 in LP), with a monthly minimum of 350 SHS units, over a 20 year maintenance period or until grid electricity becomes available in those specific geographic areas.

<sup>34</sup> The energy component is for the provision of 50 kWh per month per hh, and is updated regularly based on NERSA’s approved multi-year price determinations, any price increases awarded by NERSA to Eskom and NT’s inflation projections.



Based on the information provided by Wlokas in 2011 with regards to the operational areas of existing concessionaires, as well as the tender briefing presentation of the DoE, it is inferred that Kukhanya Energy Services was awarded the KZN South- (including Umzinyathi DM), and EC work (excluding the O.R Tambo DM), Nura Energy the KZN north work and the Xhahumba Sunlec JV therefore the work in LP (Wlokas, 2011) (DoE, 2014).

The SHS concessionaire programme is subsidised through two separate funding streams, firstly, a 80% capital subsidy per SHS unit installed complete, paid by the DoE to the concessionaire, with the remaining 20% to be covered by the concessionaire. The second subsidy is the free basic electricity (fbc) grant, transferred to Local Municipalities based on, inter alia, the number of indigents within their area of jurisdiction, of which 80% is then paid to the concessionaire according to the service level agreement entered into between a LM and concessionaire.

The concessionaire levies a monthly service fee to the beneficiary to cover the balance between actual monthly maintenance costs and the fbc subsidy received from the Local Government, as well as a once-off connection fee.

In the case of the DST funded small-scale hydropower projects, the capital costs of the generation and distribution infrastructure are 100% funded, and only the monthly operation and maintenance costs need to be carried.

Should small-scale hydropower projects be implemented at other project sites to address the need for rural electrification towards achieving universal access to electricity by 2025 as per the “New Household Electrification Strategy”, the DoE will need to be engaged to determine the extent of capital subsidies to be provided, if any, for technologies other than SHS.

In this regard, it is anticipated that **two potential procurement methodologies** could be followed:

- The DoE appoints an IPP for rural electrification through any appropriate and cost effective electricity generation technology (i.e. a similar tender process as is being applied currently by the DoE when procuring private service providers for the SHS programme) OR
- Local Municipalities apply to the DoE by 30 September of every year and request financial support to undertake non-grid electrification as part of the INEP in specific areas of their municipality (DoE, 2012a).

Municipalities would need to submit a formal request signed by the Municipal Manager to the DoE which should entail at least the following information:

- Name of the area/ward and or village;





#### SECTION 4: FUNDING FOR NON-GRID RURAL ELECTRIFICATION

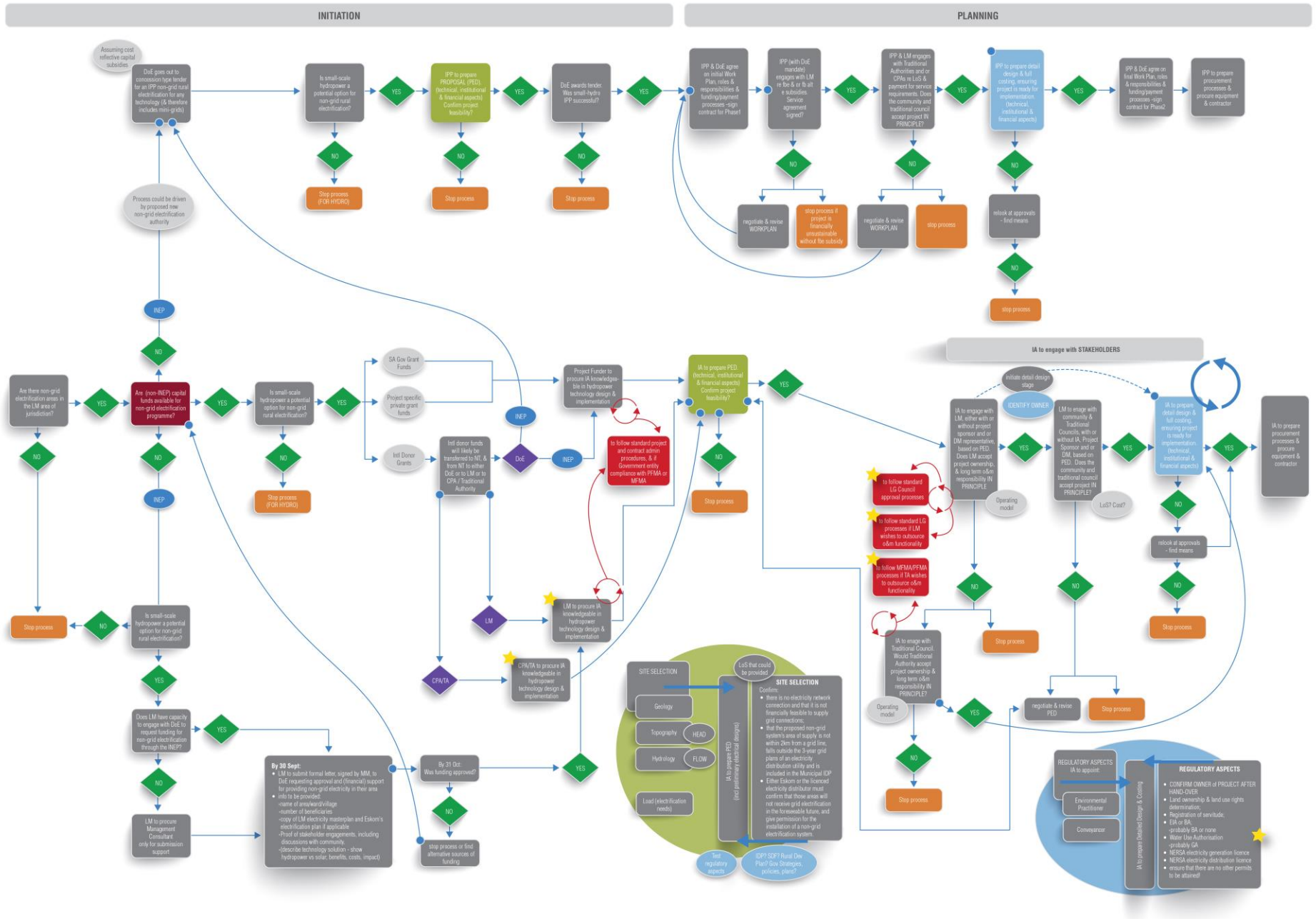
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- The number of beneficiaries;
- The LM's electrification master plan;
- Reference to Eskom's electrification plan in and around the proposed area to ensure that no duplication occurs;
- Reference to and or approval from, any SHS concessionaires operating in and around the area under consideration for electrification, and
- Confirmation that extensive stakeholder engagements have occurred with regards to the project.

Figure 8.4 is an illustrative roadmap that indicates the potential steps that would need to be followed for each of the three procurement / funding possibilities described in this section, in the context of the research presented in the previous sections, in order to undertake and implement the initiation and planning stages for a small-scale hydropower project.

The electronic version of this dissertation is available from the UP.

**Figure 8.4: Process roadmap for the potential implementation of small-scale hydropower projects under the “New Household Electrification Strategy”**





The initiating question of the roadmap is to confirm whether or not non-grid electrification areas are available within a particular LM areas of jurisdiction; where after it must be determined whether or not INEP funds are available, either through an IPP tender type process, or through a Municipality applying to the DoE to act as an IA for the non-grid component of the INEP through the “New Household Electrification Strategy”, or whether other sources of Grant funding are available, as would be the case with the DST funded projects.

The specific **regulatory** checkpoints are indicated, and depending on which funding and procurement approach is followed, can lie either in the initiation or in the planning stages of the project lifecycle.

**Box 8.1: Legend for Figure 8.4**

- High risk processes are highlighted by a yellow star;
- The blood red blocks indicate cumbersome Government compliance processes;
- The processes indicated in blue refer to detail design activities;
- The processes indicated in green refer to PED activities;
- The diamond shapes indicate decisions that were made which lead to the next process step;
- The grey rectangular shapes refer to activities, actions and or specific considerations.

The development of the roadmap highlighted a number of fundamental regulatory and funding aspects that will need to be taken into consideration during the initiation and planning stages of a rural electrification project:

- The provision of rural electrification to the remotest, most dispersed and mainly indigent areas of South Africa, is driven by social needs, rather than commercial needs.
- Grant funding will therefore be necessary to a large extent to cover the capital costs, and subsidies will be required to support the o&m costs.
- The capacity of Local Municipalities to administer the fbe policy, to develop tariff policies should higher levels of service be provided, to engage with NERSA to attain distribution licences and approval of tariffs, to manage billing and cost recovery for higher levels of service, and to engage with communities to attain their buy-in, must be taken into consideration.
- Adherence to the general tariff principles as prescribed by NERSA should be adhered to, irrespective of whether or not the provision of the electricity is costing the LM nothing due to grant funding. A dangerous precedent could be set by providing higher levels of service for “free” which could emphasise and or instil a culture of non-payment for higher levels of service, and could then also impact the payment culture for other services provided by the LM.



### 8.3 Potential additional grant funding sources

Municipalities, excluding possibly Metropolitan Municipalities, typically have limited borrowing capacity. In other words, Municipalities are typically not able to raise finance against their own balance sheets. Municipalities therefore can either make use of their own funds, donor funds or Government Grant funding to co-fund the capital expenditure of a small scale hydro-power project for rural electrification.

#### 8.3.1 South African Grant Funding

Table 8.4 lists current Government grants that indirectly might allow for applications by Municipalities requesting funds to cover the capital costs associated with small-scale hydropower installations.

A 2014 review of energy regulations in renewable energy (Montmasson-Clair, et al., 2014), refers to the DoE's Renewable Energy Finance Subsidy Office (REFSO), whose mandate includes managing renewable energy subsidies and offering advice to developers and other stakeholders on renewable energy finance and subsidies. This includes information on the size of awards, eligibility, procedural requirements, and opportunities for accessing finance from other sources. Financing options proposed by the REFSO include grants for feasibility studies, short- and long-term financing, export credits and soft loans, equity or loans, and the purchase of carbon emission reduction credits. The REFSO, if still operational, can be approached for additional co-funding for small-scale hydropower projects.

**Table 8.4: Description of possible co-funding grants**  
(National Treasury, 2015a)

Name of allocation	Purpose	Type of allocation	Controlling department / vote
<b>Schedule 5A: Specific Purpose Allocations to Provinces</b>			
Land Care Programme Grant: Poverty relief and infrastructure development	To promote sustainable use and management of natural resources by engaging in community based initiatives that support the pillars of sustainability (social, economic and environmental) leading to greater productivity, food security, job creation and better well-being for all.	Conditional allocation	Agriculture, Forestry and Fisheries (Vote 24)
Human Settlements Development Grant	To provide funding for the creation of sustainable human settlements.	Conditional allocation	Human Settlements (Vote 318)



**SECTION 4: FUNDING FOR NON-GRID RURAL ELECTRIFICATION**

Name of allocation	Purpose	Type of allocation	Controlling department / vote
<b>Schedule 5B: Specific Purpose Allocations to Municipalities</b>			
<b>Recurrent Grants</b>			
EPWP Grant for municipalities	To incentivise municipalities to expand work creation efforts through the use of labour intensive delivery methods in the following identified focus areas, in compliance with the Expanded Public Works Programme Guidelines: road maintenance and the maintenance of buildings, low traffic volume roads and rural roads, basic services infrastructure, including water and sewer reticulation, sanitation, pipelines (excluding bulk infrastructure), other economic and social infrastructure, tourism and cultural industries, waste management, parks and beautification, sustainable land-based livelihoods, social services programme, health service programme and community safety programme.		Public Works (Vote 11)
<b>Schedule 5B: Specific Purpose Allocations to Municipalities</b>			
<b>Infrastructure Grants</b>			
Neighbourhood Development Partnership Grant	To support and facilitate the planning and development of neighbourhood development programmes and projects that provide catalytic infrastructure to leverage third party and private sector development towards improving the quality of life of residents in targeted underserved neighbourhoods (generally townships)		National Treasury (Vote 7)
<b>Schedule 6A: Allocation-in-kind to provinces for designated special programmes</b>			
School Infrastructure Backlogs Grant	Eradication of entire inappropriate school infrastructure, provision of water, sanitation and electricity to schools		Basic Education (Vote 14)
<b>Schedule 6B: Allocation-in-kind to municipalities for designated special programmes</b>			
Neighbourhood Development Partnership Grant	To support and facilitate the planning and development of neighbourhood development programmes and projects that provide catalytic infrastructure to leverage third party and private sector development towards improving the quality of life of residents in targeted underserved neighbourhoods (generally townships)		National Treasury (Vote 7)
Municipal Water Infrastructure Grant	To facilitate the planning, acceleration and implementation of various projects that will ensure water supply to communities identified as not receiving a water supply service.		Water & Sanitation (Vote 36)

**8.3.2 International Grants**

The South African National Energy Development Institute (senedi) developed a web-based application which provides a broad overview of all financiers of sustainable energy projects (senedi, 2015).



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The total database consists of 59 different funding entities. For the purposes of this Study, the database was firstly filtered for those entities that provide Grant funding. Rural municipalities in South Africa will most probably not have the ability to attain loans nor then repay them.

This reduced the list to 22 possible options.

A secondary filter was applied, which provided a list of those financiers who would fund projects for non-grid electrification, renewable energy, rural electrification, clean energy and hydropower.

This indicated that for South African rural, non-grid electrification projects utilising hydropower technology, 2 potential funders can be approached:

- Energy and Environment Partnership  
The Energy and Environment Partnership (EEP) promotes renewable energy, energy efficiency, and clean technology investments. The EEP Programme supports projects which aim to provide sustainable energy services to the poor and combat climate change.

EEP provides seed financing to cover part of the project costs which are necessary to start and develop a business (such as pilot and demonstration activities) or which can create something in value so that it is worthy of investment (such as pre-feasibility and bankable feasibility studies) (sanedi, 2015).

- Renewable Energy and Efficiency Partnership (REEEP).  
The Renewable Energy and Energy Efficiency Partnership (REEEP) is operated by the REEEP International Secretariat and comprises 400 partners including 45 governments as well as a range of private companies and international organisations. Its objective is to assist governments to create favourable regulatory and policy frameworks and promoting innovative finance and business models to activate the private sector. Its current focus is on Brazil, China, India, Indonesia and **South Africa** (sanedi, 2015).

An alternative to procuring international donor funding at project level by the municipalities or local entities themselves, could be for National Government to procure official development assistance (ODA) from international donor agencies, which would then be allocated to either the Department of Energy, a local municipality or another local entity, for the implementation of the non-grid INEP, or an appropriate state owned enterprise which could act as Implementing Agent.

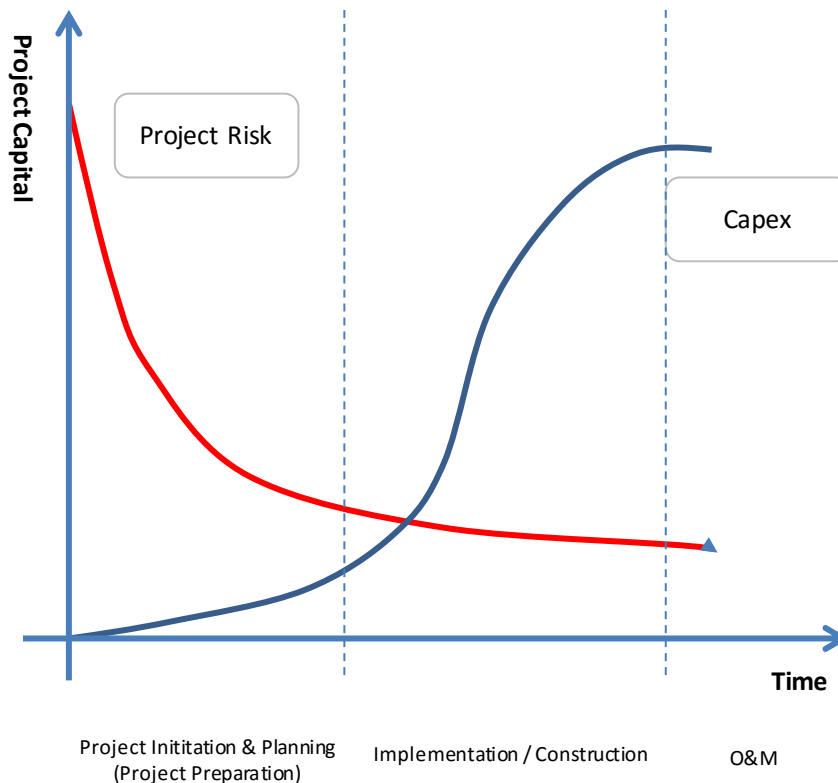


As described previously, if South Africa is to achieve its ambitious electrification targets, the INEP programme needs to be scaled-up considerably, in terms of both the programme financing and the programme delivery tempo. Procuring ODA towards this objective would be a means to address the funding shortfall.

#### 8.4 Indicative cost of small-scale hydropower

The inception and planning stages of an infrastructure project generally account for approximately 10% of the total programme budget; with the bulk of the expenditure (traditionally about 85%) occurring during the construction or implementation stage. The o&m cost usually accounts for 5% of the total programme budget.

As a project moves from the initiation and planning stage, and into the construction or implementation phase, the risk decreases proportionately. Figure 8.5 illustrates this diagrammatically, and shows that the risk profile of a project declines steadily as risks are mitigated until it reaches the point where the risk of the project is acceptable.



**Figure 8.5: Project Risk vs Capital cost over project lifecycle**  
(BIGEN AFRICA, 2008)



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As per the roadmap depicted in Figure 8.4, the initiation and planning processes associated with the implementation of a small-scale hydropower project with mini-grid, are quite extensive. Managing and mitigating the various risks over this phase, to ensure project feasibility, will require determination, an understanding of the broad range of institutional forces at play, robust stakeholder engagements and patience.

The capital cost components of a hydropower scheme are made up of the following components (Bonthuys, 2015):

- Initiation, planning & design;
- Construction / Implementation
  - Civil works,
  - Electro-mechanical works and the
  - Implementation cost.

The o&m costs are calculated as a percentage of the capital works.

The major cost components of a hydropower scheme are the electro-mechanical works, in particular the transmission and distribution system and the turbine, as well as the civil pipework (penstock length). The electromechanical works constitute between 35% and 50% of the capital cost, and the civil works between 30% and 45% (Bonthuys, 2015).

Cost/benefit<sup>35</sup> and the determination of the “levelised cost of energy”<sup>36</sup> over the project lifespan, inter alia, are therefore sensitive to the design parameters of the project, specifically the length of the penstock and the transmission and distribution distances of the electricity grid. It should therefore be strived to achieve a design based on high heads, and short transmission lines.

Determining the levelised cost of energy is important for comparative purposes; due to the fact that:

- hydropower plants have high initial capital outlay requirements, but low o&m costs (ARE, 2014), opposite to, for example, the purchase of a generator which has a low upfront capital outlay, but high running costs, and
- hydropower is a renewable energy technology that is not cyclically dependent on the availability of its driving natural resource (like the sun or wind).

<sup>35</sup> The cost benefit ratio is the ratio of the capital cost associated with providing grid-tied electricity to the capital cost of providing non-grid electricity via a mini-grid hydropower plant.

<sup>36</sup> The LCoE is defined as the total cost of the hydropower project over the full operational lifespan of the system (NPV), divided by the total energy generated over the lifespan of the system.





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In his 2015 Study, Bonthuys found that the LCoE for small scale hydropower plants with a constant generating capacity of 50 kW, a constant penstock diameter of 355mm, with penstock lengths of 100m and 200m, and transmission line lengths of 1 000m and 2 000m, ranges in the order of between R1/kWh and R1.30/kWh (Bonthuys, 2015, pp. 7-28); which is in the same order of magnitude as the REIPPPP average hydropower cost of R1.16/kWh (IPPPP Unit , 2015).

For the DST funded projects, the LCoE for the Kwa-Madiba project in the Eastern Cape was calculated to be approximately R1/kWh, and the LCoE for the Ndodekhling-Shayiwe project in KZN was calculated to be just under R2.45/kWh. Since the Kwa Madiba project has a designed energy generation capacity of 50 kW, and the Ndodekhling-Shayiwe project a designed energy generation capacity of 10 kW, Bonthuys inferred that a lower generation capacity leads to a higher LCoE.

The capital cost of the Kwa-Madiba project is anticipated to be approximately R5 million, and the capital cost for the Ndodekhling-Shayiwe project approximately R2.5 million. Even though the cost per household would seem high (R130 000/hh for Kwa-Madiba and R80 000/hh for Ndodekhling-Shayiwe), the residents have access to a 20 Amp limited supply, and if affordable to them, **more than 50 kWh/month** per household. The system allows for future growth, not only in terms of the number of households, (a trend that is common in rural areas is that once a community has been electrified, people from surrounding villages tend to migrate in) but also in terms of levels of service.



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## SECTION 5: CONCLUSION

### 9 CONCLUSIONS AND RECOMMENDATIONS

#### 9.1 Conclusions

The **primary objective** of this research was to develop an institutional roadmap illustrating potential approaches for the implementation of small-scale hydropower electricity generation and distribution projects within the ambit of South Africa's complex legislative-, policy- and planning environment; towards achieving an accelerated rate of delivery of non-grid electrification connections in the deep rural areas of South Africa.

The following **research questions** were formulated, and answered towards the development of the roadmap:

- *What is the current legislative-, regulatory- and institutional framework in South Africa within which the implementation of small-scale hydropower projects in South Africa needs to occur?*

Based on personal experience, risk management on any project is paramount to ensure the success of a project; with risks commonly being identified within specific project work-streams. Risks associated with technical and financial work-streams can traditionally be clearly quantified and mitigated, whereas risks associated with institutional work-streams are often more challenging to identify, quantify and mitigate due to subjective and often political influences. The necessity therefore of understanding the institutional environment within which small-scale hydropower projects would be implemented, is important.

The electricity sector has, and is, evolving with the driving socio-political policy directives of Government, as well as internationally driven priorities. Internationally, the South African Government has, inter alia, committed to reducing greenhouse gas emissions towards climate change mitigation via the UNFCCC and the Kyoto Protocol, as well providing universal electricity access to all citizens of South Africa by 2030 through the SE4All initiative.

These international commitments are supported and underpinned by existing and occasionally custom developed national policies and strategies. In South Africa, the electricity sector is governed by robust legislation such as the National Electricity Regulation Act; policies such as the White Paper on Renewable Energy and the Free Basic Electricity Support Tariff Policy and strategies such as the "New Household Electrification Strategy".

The implementation of small-scale hydropower projects for non-grid rural electrification in South Africa would need to be implemented by Local Government as it is their constitutional mandate



to ensure service delivery. Even though electricity generation is a constitutionally deemed exclusive National Government function, rural, non-grid electrification at such small scales as would be implemented in South Africa through the “New Household Electrification Strategy” and as an islanded system, is not considered contrary to the principles of the Constitution.

Rural electrification by its very nature contributes towards rural development; hydropower projects in turn by their very nature are directly dependent on water resources – the implementation therefore of small-scale hydropower projects for rural electrification cannot occur in isolation, and intergovernmental coordination both horizontally across sector Departments (across for example the DRD&LR, the DoE and the DWS) and vertically across the three spheres of Government, will be necessary.

Small-scale hydropower projects for non-grid rural electrification can be implemented within this robust and complex institutional framework.

- *What is international best-practice with regards to the governance arrangements of non-grid rural electrification projects or programmes; and specifically with regards to using small-scale hydropower and the construction of stand-alone and or grid-tied mini-grid systems?*

The “New Household Electrification Strategy” allows for any appropriate and affordable technology option to be applied towards achieving the non-grid electrification target, set to be in the order of 300 000 households that would need to be electrified between 2014 and 2025. In order to achieve this target, the delivery tempo of the non-grid programme would need to be substantially up-scaled, from approximately 6 200 connected households per year between 2002 and 2013, to over 25 000 per year for the period from 2013 to 2025.

An option for consideration would be to identify other appropriate energy technologies, such as small-scale hydropower, as well as to the application of mini-grid systems to serve more than one household from a single but communal point of electricity generation.

In 2011, 85% of South Africa’s population had access to basic electricity services for lighting purposes; the only country in sub-Saharan Africa to boast of such an achievement. The DoE, together with its sector partners (Eskom, NERSA, and Local Municipalities as well as the private sector) has an impressive track record of being able to provide grid-tied electricity services to households in South Africa, and after years of experience understand which areas would be able to be grid-tied and which areas not.

Specific geographical areas have been identified in South Africa which would need to be served by appropriate non-grid electrification technologies, which could be either renewable, non-renewable or a hybrid of the two. These areas being mainly in KZN and the Eastern Cape.



The extent of the scope of non-grid electrification in South Africa, in addition to the scattered distribution of the households, challenging topography in the identified areas, low energy consumption, the mainly indigent and rural nature of the households, all contribute to non-grid rural electrification through mini-grids being a financially unattractive option for private power producers seeking a commercially viable venture. Consideration could be given to grouping a number of individual projects, to potentially achieve economies of scale which could make such projects attractive to other funders.

The 2014 publication by the Africa-EU Renewable Energy Cooperation Programme's "*Mini-Grid Policy Toolkit: policy and business frameworks for successful mini-grid roll-outs*", specifically for the implementation of non-grid rural electrification projects using renewable energy sources and mini-grid distribution infrastructure, was used as a baseline against which South Africa's implementation context was applied.

The interpretive analysis shows that South Africa is appropriately geared to implement **socially driven** mini-grid generation and distribution technologies on a small scale towards achieving Government's universal access to electricity target, and that the most appropriate owner – operator model will depend on project specific circumstances.

It is anticipated that in all circumstances the ownership of the generation and distribution infrastructure will not be separated.

It was also found that in order to achieve the required increase in tempo, an increase in capital grant funding for alternative sources of energy and the implementation of mini-grids will be required.

- *Within the context of both South Africa's governance framework and international best practice, what potential institutional steps could be followed in order to implement small-scale hydropower projects towards sustainable rural electrification in South Africa?*

The final research question defined the output of this research. An illustrative roadmap was developed that indicates the potential steps that would need to be followed for each of the three potential procurement / funding possibilities, in order to undertake and implement the initiation and planning stages for a small-scale hydropower project towards rural electrification.

In the case of the DST funded small-scale hydropower projects, the capital costs of the generation and distribution infrastructure are 100% funded by other Government sources, and only the monthly operation and maintenance costs need to be carried.



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Should small-scale hydropower projects be implemented at other project sites to address the need for rural electrification towards achieving universal access to electricity by 2025 as per the “New Household Electrification Strategy”, the DoE will need to be engaged to determine the extent of capital subsidies to be provided, if any, for technologies other than SHS.

In this regard, it is anticipated that two potential procurement methodologies could be followed:

- The DoE appoints an IPP for rural electrification through any appropriate and cost effective electricity generation technology (i.e. a similar tender process as is being applied currently by the DoE when procuring private service providers for the SHS programme) OR
- Local Municipalities apply to the DoE by 30 September of every year and request financial support to undertake non-grid electrification as part of the INEP in specific areas of their municipality (DoE, 2012a).

Municipalities would need to submit a formal request signed by the Municipal Manager to the DoE which should entail at least the following information:

- Name of the area/ward and or village;
- The number of beneficiaries;
- The LM's electrification master plan;
- Reference to Eskom's electrification plan in and around the proposed area to ensure that no duplication occurs;
- Reference to and or approval from, any SHS concessionaires operating in and around the area under consideration for electrification, and
- Confirmation that extensive stakeholder engagements have occurred with regards to the project.

**A secondary objective** of this research was to develop an appropriate institutional approach to realise the implementation of small-scale hydropower projects at locations within the two identified DMs.

The outcomes of this Study, and the potential approach to rural electrification through the application of small-scale hydropower technology, will be tested in practice during 2016, when the DST projects are implemented.

## **9.2 Value-add elements of this Study**

The research work that was undertaken through this Study has added value to the strategy and policy developments currently underway in South Africa regarding the introduction of small-scale hydropower technology into the energy mix, at national-, regional-, and local levels. Specific contributions include:



- Developing a Policy Brief for the Department of Science and Technology on the current institutional architecture within which the application of small-scale hydropower technology towards rural electrification in South Africa would occur.
- Advising the Department of Water and Sanitation (DWS) on energy specific legislative and regulatory requirements towards the development of a DWS policy and guideline document that would facilitate the utilisation of nationally owned water resource infrastructure to be used also for the generation of hydropower.
- Contributing input to the content of the DWS' proposed "Revision of General Authorisation in terms of section 39 of the National Water Act, Act No.36 of 1998", to facilitate the inclusion herein of mini-hydropower projects for non-grid electrification. Should the GA be approved, the implications would be that developers of mini-hydropower projects that meet the conditions of the GA, would need to comply with the process requirements for water use authorisation as defined in the GA, and would not need to follow the full process of attaining a water use licence. A benefit for developers of mini-hydropower projects would include cost savings on the water authorisation process.
- Motivating for the inclusion of small-scale hydropower technology into the National Energy Regulator's (NERSA) discussion document on embedded generation.
- Applying these (adapted) research outcomes to small-scale hydropower project initiatives being considered by municipalities including the City of Tshwane, the City of Johannesburg, and iKheis Local Municipality, as well as advising private sector consultancy firms eager to enter the burgeoning renewable energy market in South Africa on the institutional protocols that are in place currently in South Africa.
- Sharing this research at small-scale hydropower workshops facilitated by the Water Research Commission (WRC) to a wide range of sector stakeholders.



### **9.3 Opportunities for future research**

Opportunities for future research include identifying and mapping all international rural electrification programmes and initiatives, and determining opportunities therein for the South African rural electrification drive, specifically with regards to accessing international donor funds to facilitate optimal gearing potential of grant funds to leverage South African private sector financing towards achieving the robust and ambitious non-grid electrification target in South Africa.

Aligning the programmes of the UN's post 2015 Sustainable Development Goals, and specifically SDG7, the energy goal, with the various SE4All initiatives, the Africa-EU Energy Partnership (AEEP), the Programme for Infrastructure Development in Africa (PIDA), energy programmes of the United National Development Programme (UNDP), the World Bank, the African Development Bank and the European Commission, to name but a few, would form the backbone of such a Study.

Maintaining the funding and financing trend, it could be valuable to determine whether or not the grouping together of a number of stand-alone mini-grid projects, could gain sufficient economies of scale in South Africa in order to effectively gear the available grant funding to leverage private funds – probably through a provincial or national government special purpose vehicle. As part of the project preparation phase, an update of the information pertaining to the potential for small-scale hydropower projects in South Africa would need to be undertaken.



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