PATHWAYS TO URBAN TRANSFORMATION IN SOUTH AFRICA

THE CASE OF THE CITY OF JOHANNESBURG AND POLOKWANE















A research report from the ESRC-NRF URBATRANS project:

PATHWAYS TO URBAN TRANSFORMATION IN SOUTH AFRICA

THE CASE OF THE CITY OF JOHANNESBURG AND POLOKWANE

March 2018

Authors:

Yachika Reddy (Sustainable Energy Africa) Peta Wolpe (Sustainable Energy Africa)

The URBATRANS project (Urban Transformation in South Africa Through Co-Designing Energy Service Pathways) is a collaborative research project jointly led by the University of Cape Town and the University of Exeter, with partners Sustainable Energy Africa, University of Manchester; University of Plymouth and University of Sussex. The research is funded by the Newton Fund through the Economic and Social Research Council (ESRC) in the UK and the National Research Foundation (NRF) in South Africa. Project number ES/N014138/2.

ISBN: 978-0-6399269-1-9

List of Figures:

Figure 1: Map of South Africa highlighting the two cities, Google Maps	7
Figure 2: Map of the City of Johannesburg, Wikipedia	16
Figure 3: Average population growth rate in South Africa from 1996-2011, Stats SA 2011	18
Figure 4: The use of the hotbox technology, SEA	21
Figure 5: Map of Polokwane, municipalities.co.za	26
Figure 6: Community workshops in Ga-Dikgale, SEA 2016	30
Figure 7: Serapeng Agricultural Cooperative - making hotboxes, SEA 2016	31
Figure 8: Solar kits distribution in Polokwane, SEA 2017	32

Funders:



Research Partners:



CONTENTS

Acronyms	
Acknowledg	gements
Abstract	
1 Introduct	ion
2 Local go	vernment: an overview/scene sett
2.1 2.2 2.3 2.4	The economy South African urban context The role of local government The challenges
3 City of Jo 3.1 3.2 3.2.1 3.2.2 3.2.2 3.2.3	Introduction Implementation Project one: Low-income sustainable energy s Project two: Hotbox study Project three: Solar Water Heater Rollout Prog
	Acronyms Acknowledg Abstract 1 Introduct 2 Local gov 2.1 2.2 2.3 2.4 3 City of Jo 3.1 3.2 3.2.1 3.2.2 3.2.3 3.2.3 3.2.4

- City Power off-grid solutions for informal settlements
- 3.3 Analysis

26 4 City of Polokwane

- 4.1 Introduction
- 4.1.1 Project one: Green Goal Energy Strategy 2016
- 4.1.3 Project three: Solar lights roll-out
- 4.2 Analysis
- **34** 5 Key issues
- 37 6 Conclusion
- **38** 7 References

na

strategy development

ramme (2011-2014)

4.1.2 Project two: Alternative energy solutions for low-income households in Ga-Dikgale

ACRONYMS

CBD	CENTRAL BUSINESS DISTRICT
DEA	DEPARTMENT OF ENVIRONMENTAL AFFAIRS
DOE	DEPARTMENT OF ENERGY
	(FORMERLY KNOWN AS THE DEPARTMENT OF MINERALS AND ENERGY)
DSM	DEMAND-SIDE MANAGEMENT
FBE	FREE BASIC ELECTRICITY
GDP	GROSS DOMESTIC PRODUCT
GHG	GREENHOUSE GAS
IDP	INTEGRATED DEVELOPMENT PLAN
MW	MEGAWATT
NDP	NATIONAL DEVELOPMENT PLAN
NMT	NON-MOTORISED TRANSPORT
INEP	INTEGRATED NATIONAL ELECTRIFICATION PROGRAMME
IRP	INTEGRATED RESOURCE PLAN
KWH	KILOWATT-HOUR
LPG	LIQUEFIED PETROLEUM GAS
NDP	NATIONAL DEVELOPMENT PLAN
NGO	NON-GOVERNMENTAL ORGANISATION
PPD	PEAK-PLATEAU-DECLINE CARBON EMISSIONS TRAJECTORY
PV	PHOTOVOLTAIC
RDP	RECONSTRUCTION AND DEVELOPMENT PROGRAMME
SACN	SOUTH AFRICAN CITIES NETWORK
SALGA	SOUTH AFRICAN LOCAL GOVERNMENT ASSOCIATION
SANS	SOUTH AFRICAN NATIONAL STANDARDS
SEA	SUSTAINABLE ENERGY AFRICA
SSEG	SMALL-SCALE EMBEDDED GENERATION
STATSSA	STATISTICS SOUTH AFRICA
SWH	SOLAR WATER HEATER

ACKNOWLEDGEMENTS

THE AUTHORS WISH TO ACKNOWLEDGE THAT THE CONTENTS OF THIS REPORT WERE IN LARGE PART INFORMED BY THE SIGNIFICANT BODY OF WORK AND EXPERIENCE IN URBAN ENERGY DEVELOPMENT ACCOMPLISHED BY **SUSTAINABLE ENERGY AFRICA (SEA)** IN WORKING WITH LOCAL GOVERNMENT OVER THE LAST 18 YEARS.

SPECIAL MENTION AND THANKS GO TO:

Jon Phillips (University of Exeter) and Jiska de Groot (University of Cape Town), our research partners on this project, for their invaluable feedback on the draft versions of the report.

All research participants and workshop participants (many of whom are long-term city and national partners of SEA in the urban energy development work that SEA pursues) from various local and national government institutions and related non-governmental developmental organisations that have shared their time, expertise and insights so generously during the project.

The funders of the URBATRANS project under which this report was developed: the Newton Fund through the Economic and Social Research Council (ESRC) and South Africa's National Research Foundation (NRF)

SOLAR WATER HEATERS IN JOHANNESBURG SUSTAINABLE ENERGY AFRICA



ABSTRACT

South Africa is 64% urbanised and growing more so, with cities growing at approximately 2% per annum, largely due to international migration and people moving from rural areas in search of employment and better standards of living.

This paper, by looking through the lens of selected projects in the Cities of Johannesburg and Polokwane, examines the extent to which urban transformation has taken place, and where the challenges and opportunities lie in taking a sustainable and equitable energy transition to new levels. This would create a new future that is equitable and provides sustainable livelihoods for all, while taking into account a healthy environment.

Considerable work and change is taking place within the two case study cities and impacting the green economy, albeit at a small scale. Both cities are addressing the issues of livelihood opportunities, providing access to modern energy services for the poor and building equity and participation in energy transitions.

Moreover, there is evidence of substantial change across the municipal landscape beyond the two study cities, with many projects are being implemented, including those with strategies and frameworks in place and with remarkable champions advancing the cause. The challenge lies in the cities being able to adopt a more holistic or sustainable transformation approach to take these innovations to scale.



PHOTOGRAPH BY MARK LEWIS FROM THE PHOTO ARCHIVES OF SUSTAINABLE ENERGY AFRICA

1. INTRODUCTION

We are constantly becoming, constantly coming into being. We ought to step out of our old, hard casing. We think that we are one kind of people, when in fact we are always creating ourselves. We are not fixed.

The purpose of this paper is to provide an in-depth case study of niche innovations in two South African cities one metropolitan area and one secondary city. Through the case study the paper will broadly examine and assess to what degree urban transformation has taken place and where the challenges and opportunities lie in taking a sustainable and equitable energy transition to new levels.

The paper draws on many years of Sustainable Energy Africa's extensive urban energy development work with cities in Sub-Saharan Africa, in particular the two selected for this study. To this end the analysis and discussion is based on practice rather than being a formal academic review.



MAP OF SOUTH AFRICA HIGHLIGHTING THE TWO STUDY CITIES SOURCE GOOGLE MAPS

The paper will therefore explore in detail the ways in which the two cities have contributed to transformative energy pathways in the South African context and examines what would help in creating a new future that is equitable, provides sustainable livelihoods for all and at the same time considers a healthy environment.

The paper begins with an overview of the local government picture within the South African context, including their role and challenges to implement climate change action plans. This is followed by a detailed outline and analysis of the City of Johannesburg Metro followed by the Polokwane Municipality. The final section provides a summary of the key issues facing the country in relation to access to energy and the emergence of a green economy.



Ben Okri, 2011 🧦

The paper is part of a larger project called 'Urban Transformation in South Africa Through Co-Designing Energy Services Provision Pathways' (URBATRANS). The project aims to contribute to the transformation of South African cities towards a more sustainable and inclusive energy profile that support national goals of improving welfare, encouraging economic activity, creating employment, and reducing carbon emissions.

The project will investigate how the diverse challenges of energy provision in the South African context are interrelated with broader, on-going transitions to inclusive, secure and sustainable urban energy systems globally and nationally.

POLOKWANE

JOHANNESBURG

Through the in-depth case study analysis this paper will examine the city's contribution to:

- creating urban livelihood opportunities;
- providing access to modern energy services for the poor;
- equity and participation in energy transitions; and
- the potential to reduce carbon emissions, as part of the green urban economy.

2. LOCAL GOVERNMENT AN OVERVIEW/SCENE SETTING

You cannot take away someone's story without giving them a new one. It is not enough to challenge an old narrative, however outdated and discredited it may be. **Change happens only when you replace it with another.** When we develop the right story, and learn how to tell it, it will infect the minds of people across the political spectrum.

George Monbiot, 2017

South Africa has many national and local level policies and plans focused on redressing the legacy of apartheid, poverty alleviation, reducing inequality, growing the economy and in turn boosting job creation. At the same time there has been increasing pressure at a global level, filtering down to the national and local levels in terms of climate change, sustainable energy and developing a green economy. In many respects this is about creating a new narrative, a new story, one that on the surface, in a developing context, might appear to be contradictory. argues that there is a new way of conceptualising our world, as Monbiot has suggested, a new narrative that brings about a more coherent, equal and environment-friendly order (Monbiot, 2017). South African cities are pushing boundaries and bringing about change, but in order to further this new story they need to build their projects and innovation from a new perspective, one that is all-encompassing – poverty alleviation, employment, opportunity and a low carbon sustainable energy bias – and that results in holistic and sustainable transformation.

and carbon emissions. This

could be perceived as a tall order

in a country dealing with high

levels of inequality, poverty and

unemployment. But the paper



In this context, the question often revolves around how to grow the economy and allow more people access to the fruits of a growing economy whilst at the same time lowering energy consumption In this context, the question often which is considered a prerequisite for developing countries. Since the onset of democracy in 1994 and despite the ANC's manifesto, growth has been underpinned by neo-liberal economic policies rooted in a capitalist market system that have to some extent

countries. Since the onset of democracy in 1994 and despite the ANC's manifesto, growth has been underpinned by neo-liberal economic policies rooted in a capitalist market system that have to some extent contradicted the developmental agenda set up in the 1996 Constitution (Van Niekerk & Fine, 2016; Habib, 2015). The Constitution sought to rectify the injustices of the apartheid system in a developmental manner premised on an equal and free South Africa. For instance, the Reconstruction and Development Programme (RDP) White Paper of 1994 (government's overarching socioeconomic policy at that time) promoted development by providing for poor communities through the delivery of basic services which previously had not been accessible to the poor, namely, water, electricity, sewage and waste services (Office of the Presidency, 1994).

2.1 THE ECONOMY

Coal accounts for approximately **72%** of the country's primary energy production and **93%** of its electricity generation.

The energy sector is responsible for **82%** of total GHG emissions.

DEA, 2013

SOLAR KITS DISTRIBUTION IN POLOKWANE, 2017 PHOTOGRAPH BY JON PHILLIPS FROM THE PHOTO ARCHIVES OF SUSTAINABLE ENERGY AFRICA The country has witnessed a fast-growing financial sector, which contributes 20% of GDP (Ashman et al, 2011) and is intrinsically linked to the minerals-energy sector (Fine et al, 2013).

The country's macro-economic policies have, however, put pressure on that developmental agenda by fostering competitive growth and a market-driven economy. The systemic social and economic divisions that existed under apartheid remain intact, as evidenced in the significant rise in inequality since 1994 (Habib, 2013). It is argued that many economic policies supported deregulation of financial and labour markets, endorsed competition and private sector investment and the privatisation of stateowned enterprises (Habib, 2014; Ashman et al, 2011). Whilst certain policies have focussed on the poor, there has not been significant systemic transformation, thus maintaining the neo-liberal economic status quo.

South Africa's economy and power sector have developed out of what is termed the mineral-energy complex, which is born out of an abundance of cheap coal and cheap black labour going back more than 100 years (Pakenham, 1991), the mining of minerals, associated smelting production, generation of electricity and a synthetic fuel industry (coal to oil) (Fine and Rustomjee; Wolpe, Reddy, 2016; Eberhard, 2011; 2016). Coal accounts for approximately 72% of the country's primary energy production and 93% of its electricity generation. The energy sector is responsible for 82% of total GHG emissions (DEA, 2013). In addition, the country has witnessed a fast-growing financial sector, which contributes 20% of GDP (Ashman et al, 2011) and is intrinsically linked to the minerals-energy sector (Fine et al, 2013).

2.2 SOUTH AFRICAN URBAN CONTEXT

South Africa is currently 64% urbanised and this figure is likely to reach 70% by 2030, with the metropolitan cities growing at approximately 2% per annum (NDP, 2011; SACN, 2011; Stats SA, 2011). This is due to international migration, and people migrating from rural areas to cities in the hope of employment and better standards of living. South Africa is experiencing a growth in secondary cities as towns expand through migration from rural areas. These cities are generally smaller than metros in population size and their contribution to the economy. However, because they are at the onset of a period of rapid growth they provide an opportunity for doing things differently.

Most South African cities and towns are characterised by their sprawling nature, giving rise to some inefficiencies with respect to energy. This was a product of inequitable apartheid land distribution policies, which generally resulted in the poor living in segregated townships. However, housing policies since then have entrenched this low-density picture, with the poor living on the margins of cities far from economic opportunities, jobs and services.

The Reconstruction and Development Programme (RDP, 1994) promoted development through the expansion of infrastructure in poor communities, including two highly successful programmes; the housing and electrification programmes. In 1994, only 36% of the population had access to electricity. Today the figure is approximately 87%, including informal and illegal

South Africa is currently 64% urbanised. This figure is likely to reach 70% by 2030, with the metropolitan cities growing at approximately

2% per annum.

connections. The goal was to have reached 100% electrification by now, but growing populations and a lack of funding have led to this goal being extended to 2025. The housing programme has resulted in the building of close to three million homes, known as RDP houses. However, government has not been able to keep pace with the housing demand, and as more people move to the cities, so informal settlements have grown. Informal dwellings are typically shacks built on land that is not suitable for formal housing or the delivery of formal basic services. More than 13% of the population reside in informal dwellings, mostly in urban areas. The incidence of backvard shacks built onto formal houses is also growing. These dwellings share the electricity and water of the formal house, resulting in one of the two households not being eligible for government's free basic services (discussed further in the next section).



SUSTAINABLE ENERGY AFRICA



Based on a broad definition using an income level of less than R3200 per month, more than 63% of South Africans live below the poverty line (SEA, 2014; Leibbrandt et al, 2010). Whilst it is recognised that the introduction of social grants have led to an overall decline in poverty levels, the absolute level remains high. Households that do not have sufficient access to reliable and safe energy services are deemed energy-poor (UNDP, 2000). This includes those without access to electricity or equivalent safe fuels and that cannot afford the purchase of these energy sources. Energy poverty also prevails in households that have access to grid electricity but continue to use unsafe fuels largely for reasons of affordability. Of the South African population, 47% are considered energy-poor (DoE, 2013), based on the proportion of household expenditure on energy and the practice of multiple fuel use to meet household energy needs.

63% of South Africans live below the poverty line 47% are energypoor

10

PHOTOGRAPH BY MARK LEWIS FROM THE PHOTO ARCHIVES OF SUSTAINABLE ENERGY AFRICA

Cooking is a primary household activity and an energyintensive thermal application. Among low-income households there are a number of health and safety issues associated with cooking such as fires, dangerous levels of indoor air pollution, and the risk of fires and burns as a result of the inefficient use of traditional biomass, paraffin and coal.

This overview points to the reason why poverty alleviation has been so high on all government policies since 1994. This raises the question, however, of how local government fits into this narrative, one dealt with in the next section.

In 1994 **36%** had access to electricity Today the figure is approx **87%**

The goal of **100%** extended to **2025**

2.3 THE ROLE OF LOCAL GOVERNMENT

The role of local government in the three-tier system (national, provincial and local government) was to be developmental in nature and bring at least one tier of government closer to the communities it serves. National government develops laws and policies and thus has both legislative and financial powers; provincial government has parallel powers to national government but relies on national government for financial transfers which ultimately limits its powers. There are nine provinces, and 282 municipalities divided into three categories: large cities or metropolitan municipalities, smaller cities or towns, and district municipalities. The Constitution refers to coordination and collaboration, but the boundaries between the spheres of government are not clear and there is a lack of alignment often resulting in their functioning inefficiently.

The objectives for local government as determined by the Constitution (Constitution of SA, 1996, Section 152 & 153) are to:

- provide democratic and accountable government for local communities;
- ensure the provision of services to communities in a sustainable manner;
- promote social and economic development;
- promote a safe and healthy environment; and
- encourage the involvement of communities in matters of local government.

Local government is assigned powers and functions to deliver on its mandate and, interestingly, the right to exercise powers that support the listed functions, which ultimately paves the way for municipalities to push the boundaries (Wolpe, Reddy, 2016). Of specific importance is the fact that local government is expected to prioritise the needs of the poor and to this end support developmental programmes.

Local government is strongly regulated and legislated. The Municipal Systems Act details municipal constitutional responsibilities and defines the manner in which local government should function to achieve their developmental objectives. Meanwhile, the Municipal Finance Management Act relates to sound financial planning and performance management and aims at ensuring that expenditure is developmental, effective and efficient and that municipalities are held accountable. The Division of Revenue Act determines division of revenue between levels of government for each financial year.

From a revenue perspective, local government receives grants from National Treasury through intergovernmental transfers for the delivery of basic services and infrastructure. Some of these grants are conditional or ring-fenced, whilst others are unconditional, meaning that municipalities have discretion on how to spend the funds. Many of the grants are formula-based and in reality are only able to finance 60-80% of municipal infrastructure needs. Many of the grants are not aligned with each other, so there is poor coordination in grant spending, and most grants are targeted for the poor. Thus, for a municipality to fund renewable energy



SUSTAINABLE ENERGY AFRICA



Many of the grants are only able to finance **60-80%** of municipal infrastructure needs.

Thus municipalities must generate their own revenue to supplement the grants.

or energy-efficiency projects through their municipal infrastructure grant, they have to ensure the benefits are directly targeted at the poor. Local government also receives funds from the private sector in terms of donor funds and loans, but these also have conditions and most funders require that funds are only spent on bankable projects.¹

These funds are not sufficient to cover municipal operating expenses or budgets and thus municipalities must generate their own revenue to supplement the grants, largely through property rates and the sale of electricity and water, as well as generating business and economic investment within their areas of jurisdiction. There is a substantial gap between the services municipalities must provide and the funding streams available for them. Further, the municipal revenue model creates a conflict of interests, given that the bulk of their revenue arises from electricity sales, thus creating a disincentive for emission reductions.

Stakeholder engagement with local government, national government, civil society, donor organisations on financing climate change at the local level, November 2017.

PHOTOGRAPH BY JON PHILLIPS FROM THE PHOTO ARCHIVES OF SUSTAINABLE ENERGY AFRICA

There are also various policies available such as the Free Basic Electricity Policy (DoE, 2004) which enables municipalities to use part of the Equitable Share grant to provide 50 kW of free electricity to poor households per month. The problem arises with the leakage of the subsidy, in that households that can afford electricity receive the subsidy because it is allocated on the basis of consumption rather than a register of indigent (low-income) households. Further, municipalities rely on cross-subsidising services: residents who can pay for electricity cross-subsidise the poor. As people use electricity more sparingly, due to rising electricity costs and installations of rooftop PV, municipalities receive less revenue from electricity sales and are consequently faced with constant and increasing tensions over managing their financial accounting while still delivering on their principle mandates. This tension is exacerbated for smaller municipalities with a smaller proportion of high-consumption electricity users.

This problem results in part from the way in which local government was established, which was in itself contradictory. The very fact that the intention is to promote local economic development, support growth, provide for the poor through the delivery of basic services, and yet at the same time achieve financial viability through cost recovery over the provision of those services, created this dichotomy. Habib (2013) argues that the economic policies and focus on fiscal gains have resulted in an undermining of local government's developmental agenda and led to an increase in inequality and poverty. In other words, the triple challenges of the new democracy



- poverty, inequality and unemployment - cannot be achieved unless the underlying structures change. This was set out by Wolpe (1995) in his analysis of the RDP, which, he argued, would lead to superficial changes and was not directed towards substantive transformation.

In recent years the country has furthered another global and national agenda, namely climate change and sustainable energy. To this end policies and frameworks have been developed on climate change in line with international requirements at the national and local levels (DEA, 2011; NDP, 2012; IPAP, 2017). Many of these frameworks and plans are laudable and progressive, but once again substantial change is not taking place. Below we examine some of the reasons for this.

Functions of local government include building regulations, electricity and gas reticulation, municipal planning, public works, roads, street lighting, water, waste removal and dealing with air pollution. The scope of these activities enables them to deal with energy efficiency and climate change generally and more specifically within their own operations and service delivery functions.

Apart from the cost recovery challenge, municipalities are also hamstrung by the regulations, legislative laws and policy direction that govern them, resulting in an impact on implementation of the good plans in place (SEA, 2017). In addition, there are no specific local government grants to fund climate response action and sustainable energy other than the Department of Energy's Energy Efficiency Demand Side Management Grant, which allocates money to municipalities for energy efficiency interventions. Most grants are targeted for the poor. Thus, for a municipality to fund renewable energy or energyefficiency projects through their municipal infrastructure grant, they have to ensure the benefits are directly targeted at the poor.

Meeting basic service delivery is a constitutional first priority, while tackling climate change and driving sustainable energy agenda such as energy efficiency and renewable energy development where it provides an obvious economic opportunity for the municipality, will follow. In recent years there have been many basic service delivery protests and this intensifies the pressure on municipalities to provide for their citizens. It is clear that municipalities vary in their resource capacities to both develop the appropriate climate and energy policies and then to implement them.

In addition, the governance and institutional structures are not always in place to support a low carbon future. The metros are generally advanced institutionally with respect to energy and climate change departments, but many municipalities do not have the resources and institutional structures in place. Climate change and sustainable energy are often not integrated into municipal planning processes and they lack the finances and other resource capacities to implement. A recent survey undertaken by the National Department of Environmental Affairs identifies three categories of municipalities in terms of climate change response capacity, namely front runners, those constrained by lack of adequate capacity, and those with very little in place for climate mitigation and adaptation. Furthermore, the survey highlighted that climate change concepts need to be simplified and lowhanging fruits need to be identified to start making an impact (DEA, 2016). Whilst municipalities are carrying out a number of projects, there was an appreciation that there is still an opportunity to further raise awareness on 'easy to do projects' that municipalities can implement without substantial cost implications.

2.4 THE CHALLENGES

It is clear that the issues are highly complex. The country has three tiers of government; how they interact or don't, their mandates, and a lack of alignment and coordination in their functions are critical to a sustainable future. The state apparatus and economy have an impact on local government, thus further adding to the complexity of the problems. The country sits with an energy-intensive industry sector, namely mining and related industries, a strong commercial sector and extreme poverty, inequality and a high rate of unemployment. South Africa is one of the most unequal countries in the world, with levels of youth unemployment sitting at close to 60% (NPC, 2011) – having never worked and with little prospect for the future. Amid these key developmental challenges and complexity is climate change and the environment. Much is written on trying to understand and analyse both the state and economy and climate change. In this paper, it is shown through case examples that for a country like South Africa – albeit classed as middle-income – the imperative for all policies and implementation efforts is to address the triple challenge of employment, poverty and inequality. All of this must be undertaken within a sustainable and environmentally benign manner. Climate change should not be perceived as separate from economic growth; it is not separate from building the economy nor creating jobs but fundamental to addressing the triple challenges facing South Africa. This paper will indicate through the case study analysis that a holistic approach is required to bring about sustainable transformation.

Tackling the urban profile in terms of sprawl, transport, access to basic services including energy and the reduction to poverty, and at the same time paying attention to climate change, a low-carbon trajectory and sustainable development are major challenges for cities. Whilst change needs to take place from the top down (in other words from the state, national government and the energy-intensive industries), it also has to occur from the bottom up and happen in a sustainable manner and not as a separate arm. This is happening at the local level of government and the case studies in this paper will illustrate the extent to which climate change and the triple challenges are addressed through mainstreaming into the planning mechanisms of local government processes.

3. CITY OF JOHANNESBURG

The City of Johannesburg won the Metro Category of the 2017 South African Greenest Municipality Competition Award. The focus was on sustainable development including efficient waste management practices, efficient energy use, sustainable water use, public participation and best practice of municipal leadership. This was a huge achievement for the Metro. The question this paper examines is the extent to which these interventions have been integrated and mainstreamed into the city's planning processes and how far they have created livelihood opportunities, improved energy access and led to a green urban economy. Four examples of projects underway are explored in such a way as to, hopefully, answer some of the questions.

The City of Johannesburg is the economic and financial hub of South Africa, generating 17% of the country's GDP. Whilst its economy was dominated by mining in the past, financial services is now the major economic sector, including finance, insurance, property and business services. Gauteng is the smallest but most densely populated province, with Johannesburg highly concentrated. It is expected that the population could double by 2040 to approximately seven million (Johannesburg, 2011). Urbanisation in Johannesburg is the highest in the country (99.8%) meaning that there are almost no peri-urban areas.

The City of Johannesburg is characterised by people living in extreme wealth and poverty juxtaposed to each other. Approximately 50% of the population survives on less than R3200 per month, the definition of poverty used here (Stats SA, 2011). There are 181 informal settlements, comprising approximately 180 000 households.



In 2011 this amounted to 17% of all households in the metro, similar to the national average. According to the Quarterly Labour Force Survey of 2017 (2nd Quarter), the official unemployment rate stood at 30.1%.

THE CITY OF JOHANNESBURG

Generates

of the country's GDP **50%** below the poverty line

Unemployment **30.1%**

91% had access to electricity

In 2011

In unelectrified households:

76%

use candles

18% use paraffin According to Stats SA 2011 data, 91% of the city's population had access to electricity, based on those using electricity for lighting and the 87% using electricity for cooking. This statistic does include the informal or illegal electricity connections, but it is clear that there remain unelectrified households in the city and this links with the growth in informal housing. In these households, 76% use candles and 18% use paraffin for lighting. Energy poverty is particularly widespread in the informal settlements, with households using a range of harmful and unhealthy fuels, such as paraffin, candles and coal, to meet their primary household energy needs (Reddy & Wolpe, 2014). Gauteng has very high levels of indoor air pollution, caused largely by the use of these inferior fuels (GDARD, 2015).

The City of Johannesburg has progressive climate, energy and development policies and strategies in place, all of which talk to the need to address the high levels of poverty described above. These are in line with global, national and Gauteng provincial directives. Johannesburg is ranked as a leading global city in terms of being strongly networked and having major economic links within the world economy (Turok & Borel-Saladin, 2013). It is a key player on international programmes, platforms and alliances, giving it a significant voice within international geo-political arenas. At the heart of all plans is the intention to promote a smart, equitable, economic and environmentally sustainable future that has a focus on innovation and bridging the inequality gap. There are



a number of laudable plans and strategies on the table some of which include those given below.

The **Growth and Development Strategy 2040** (GDS 2040, 2011), is a vital document that underpins all other plans within the city. The intention is to provide a set of defined strategic directives, a living document that frames all other plans including the Integrated Development Plan (IDP). The strategy pioneered new ways of doing things by bringing people together to build a collective vision through social cohesion and a strong engagement process with all role players including the community. It acknowledges that we live in uncertain and volatile times and is therefore 'an open ended holistic strategy that provides a 'rough consensus' of strategic choices, to guide future development':

A World Class African City of the Future – a vibrant, equitable African city, strengthened through its diversity; a city that provides real quality of life; a city that provides sustainability for all its citizens; a resilient and adaptive society.

Thus, in line with its **vision**, the strategy talks to a paradigm shift which includes resilience, liveability, access, equality and the growth of a sustainable green economy.

SOLAR WATER HEATERS IN JOHANNESBURG SUSTAINABLE ENERGY AFRICA

The City recently developed a **Climate Change Strategic Framework**. This builds on the current Energy and Climate Change Strategy and Action Plan (ECCSAP, 2012) and is the basis for the development of an updated comprehensive integrated climate change strategy and implementation plan as well as a guide on how to institutionalise and further mainstream the implementation of such strategies. The framework focuses on organisational elements of climate change action and sets up a roadmap of how to get there.

The metro has identified a 2050 mitigation target of **43%** below 2010 emission levels.

The Environment and Infrastructure Services Department developed a **Proposed Energy Framework** for the metro in 2016, which was taken to the mayoral committee. The proposed framework focuses engagement with industry, business and the community to address energy security of supply as well as an acceptable energy mix that is in line with the metro's low carbon economy for the future in alignment and the Growth and Development Strategy 2040. The framework also suggests a review of City Power's business model to support a sustainable future.

The Metro's **Integrated Development Plan** includes flagship programmes such as the Corridors of Freedom, Green and Blue Economy and Smart City Development.

Johannesburg has clear climate change and mitigation strategies encapsulated in the above documents and clearly defined in the GDS and informed by both national and Gauteng provincial strategies. The metro has identified a 2050 mitigation target of 43% below 2010 emission levels. It realises that reaching these targets requires a mix of mitigation measures covering all the main emitting sectors (waste, water, energy, transport, spatial and human settlement development, buildings) and a comprehensive and aligned plan and verification cycle including measurement and collection of data. To date only the Environment and Infrastructure Services Department has specific climate change responsibilities which result in actions, and has limited impacts in other departments. Thus integration and mainstreaming climate planning is seen as key. This department is, however, engaged and cooperative in partnering on projects. From an institutional perspective, the city has a mayoral subcommittee on climate change, which facilitates high level political decision making.

POPULATION GROWTH



FIGURE 3: AVERAGE POPULATION GROWTH RATE IN SOUTH AFRICA FROM 1996-2011 SOURCE STATS SA 2011

3.2 IMPLEMENTATION

The metro has many policies and frameworks in place, of which only a few have been outlined for the purposes of this paper. The critical question is the extent to which they are managing to implement change – bring about a green economy, reduce inequality, create jobs – all within a sustainable and environment-friendly manner. To answer this question, four projects have been identified to determine the scale, extent and process of implementation taking place as well the degree to which they are implementing the strategies and frameworks that they operate out of.

3.2.1 PROJECT ONE: LOW-INCOME SUSTAINABLE ENERGY STRATEGY DEVELOPMENT

Given the substantial levels of poverty within the city, in particular energy poverty, the metro has embarked on developing a sustainable energy solutions strategy and action plan for low-income households, with the intention of changing the low-income energy profile. The decision to develop a strategy in part emerged from Sustainable Energy Africa's support to the Environment and Infrastructure Services Department (EISD) as well as their long standing energy poverty research work (Reddy & Wolpe, 2014; SEA 2015; SEA 2016). From the outset it was clear that the EISD is driving a number of projects to address some of the challenges of persisting energy poverty, some in collaboration with City Power (the electricity department). These have included low pressure solar water-heater rollouts in low-income housing areas, solar home systems, and hot box roll out, all of which are examined below. The department is well aware that there are various levels of challenges, namely, unelectrified households, affordability even for households with electricity, multiple fuel use and electricity theft. At the national level the Department of Energy has been advocating a national household energy strategy for several years, but as yet this has not come to fruition. It became clear that establishing an energy

Stakeholder engagements with City officials, NGOs, community organisations and workers, 2016.

poverty framework for the city would be beneficial in terms of unifying projects taking place and assisting with alignment and taking implementation to scale.

A process was embarked on which included stakeholder engagement² with relevant city departments, NGOs, community workers and community organisations as well as businesses engaged in sustainable solutions. The EISD was clear that the strategy should promote self-help, guide the local authority in terms of addressing energy poverty, and advise on technical and funding options and longer-term energy infrastructure maintenance issues.³

There were a number of interactive engagements, as well as a household energy survey and establishment of a reference group made up of metro, provincial and a community representatives. The process took a year and the following draft strategy is in place.

The proposed sustainable energy solutions vision for informal households in Johannesburg is 'A City of Johannesburg that facilitates Energisation by providing affordable, gender sensitive and sustainable energy solutions to formal and informal settlements.'

³ Personal communication, senior manager, City of Johannesburg, 2016.

The implementation plan consists of four pillars or enablers, which are fundamental to transforming the vision into action.

Stakeholder engagement is crucial for transforming vision into action, and therefore relevant stakeholders should continue to be engaged in each pillar to build consensus and partnership.

Each one is important in its own right, but implementation of all elements is key to successfully transforming the vision

into action which ultimately puts the metro Johannesburg in line with national goals of providing for its citizens, reducing poverty and moving towards a cleaner and lowcarbon economy. The four pillars are as follows:

LEADERSHIP

An institutional, governance and leadership pillar which underpins and enables the plan to function through institutional holding, alignment, coordination, the building of effective partnerships and ensuring the development of an integrated energy policy based on the principle of energisation, namely a holistic approach to energy solutions which does not focus on one form of energy but instead tries to improve the supply, availability and affordability of a range of different, safe energy options and services. It is an approach that involves service delivery through consultation and engagement. It is a holistic solution that promotes self-help and clear roles for local government, civil society and business.

TECHNOLOGY 3

The third pillar involves promoting technologies and fuels that are clean, safe, affordable and accessible to the low income settlements. This will be achieved through building relationships and partnerships.

Whilst consensus was reached in terms of the strategy and action plan, the next phase is to take the strategy to Council, in order to obtain political buy-in and a budget. Without this level of approval the danger is that the plan will not be implemented. City of Joburg highlighted the need for institutional change in order to enable implementation. In a roundtable meeting of municipal employees and NGO stakeholders, participants also stressed the importance of building independence and self-help at the community level and strengthening awareness around alternative energy sources.

FINANCE

2

The second pillar relates to financing, in order to support implementation of the plan. This will include a funding framework to rollout alternative energy technologies, encourage business development and grow jobs. This is critical in terms of enabling implementation and the achievement of targets. It is also important that such an investment is not seen as contrary to the economic growth and development of the city. Many city documents have focused on or included economic growth and the alleviation of poverty as a priority.

EDUCATION 4

A final pillar will involve the awareness and education of the community in terms of cost, gender equity and safety and will involve key NGOs and CBOs. A key element of the strategy is supporting consumers to move towards the vision, which will be done through building awareness and education which includes a gender-sensitive perspective. It is clear that the nature of change being advocated requires a change in behaviour, a paradigm shift. Knowledge of the impact of one's actions on the environment, on energy consumption, on personal budgets and on one's health, will empower people to make choices that will ultimately uphold the vision and objectives of the implementation plan.

3.2.2 PROJECT TWO: HOTBOX STUDY

As part of the process of developing the low-income energy services strategy, the reference group agreed to undertake a short study to broadly examine the impact of introducing alternative energy technology for clean cooking, namely the hotbox or Wonderbag. A hotbox is an insulated cooker made up of heat resistant material filled with an insulator such as polystyrene discards, into which a pot of food brought to the boil is removed from the stove and placed between inside the bags. The thermal insulation results in the cooking process continuing without requiring additional heat. Tests have shown that it can save approximately 50% of cooking energy.

Initially a survey was conducted on the energy-use patterns of low-income households in two settlements in Johannesburg, one being a formal low-income community (48 households), the other an informal settlement (50 households). The surveys indicated that energy poverty is a long-term problem, because of affordability, all households irrespective of accessibility to grid electricity



FIGURE 4:

THE USE OF THE HOTBOX TECHNOLOGY SOURCE SUSTAINABLE ENERGY AFRICA

use a range of unsafe fuels. In addition, not all of those with access to grid electricity were accessing the Free Basic Electricity grant provided by the city. This is a problem identified by the city itself. The surveys highlighted how little awareness there is of alternative energy technologies or of electricity-saving measures. It was for this reason that the hotbox study was decided upon and initiated in the formal community. Ten households were selected to participate in the study. A resident from the community was identified as an energy champion to work with the households and given training from a local NGO. She selected the households, introduced the hotboxes, and assisted households in monitoring their electricity use before and after receiving the hotboxes.

The intention of the study was to raise awareness and understanding around household energy choices and decision-making, through 'testing' and understanding the impact of the hotbox technology on the energy-use patterns of low-income households.

> A hotbox can save approx of energy

The results indicated that recipients learnt a considerable amount from the monitoring of their electricity use and the versatility of the hotbox in being not only suitable for continuing cooking but also for keeping things cool. The analysis of quantitative data showed savings in electricity consumption and cooking time. A further finding was that multiple fuel-use was prevalent in all households, with some recipients reporting chronic headaches and coughs perceived to arise from the toxic fumes of inferior fuels on which they rely for their household cooking needs

The study participants attended a hotbox training workshop on how to manufacture and use hotboxes, providing a potential income-generating skill and supporting the inclusion of the poor within the energy economy.

THE ENERGY STORY OF MAMA ROSSIE MACHABA

Mama Rossie Machaba lives with her son in River Park. She spends much of her personal time commuting to work and doing chores like cooking and cleaning. Mama Rossie and her son learned about saving electricity from this project. She reported that the hotbox substantially reduced her cooking time. She now wakes up in the morning and par-cooks her meat meal and then leaves it in the hotbox until she returns home from work to find the meat well cooked and warm. All that remains for her to do to complete the preparation of her evening meal is to cook ('pap') porridge for less than 30 minutes.

Mama Rossie's son is not a good cook and she doesn't really enjoy his food. The hotbox has made it easy for her to cook what she enjoys eating and it has saved her time, allowing her to relax when she returns home in the evenings. Mama Rossie used the hotbox for multiple purposes: to cook, to keep food warm, and to store cool drinks to keep them cool. (SEA, 2017) Although this was a very small study, it emerged from the overall work being done with the City of Johannesburg in relation to energy poverty. What transpired from the strategy development and work was the concept of energisation. This refers to an an approach to provide better energy solutions which does not focus on one form of energy (electrification), but instead tries to improve the supply, availability and affordability of a range of different energy options and services. This links strongly to what is advocated in this paper: that transformation and work on the ground needs to be guided by a holistic approach that considers all aspects of development (Caprotti, 2018). The hotbox training has been taken to another municipality, where a number of community members were trained. The use of hotboxes talks to safe alternative energy options, affordability, potential liveability through entrepreneurship, and saving time.

3.2.3 PROJECT THREE: SOLAR WATER HEATER ROLLOUT PROGRAMME (2011-2014)

City Power, Johannesburg's Electricity Department, pioneered and implemented a rollout of solar waterheaters (SWHs) for low-income households. The project was largely funded by City Power charging a local demand-side management (DSM) levy of 1-2 c/kWh to customers consuming more than 500 kWh of electricity per month. One objective of the programme was to contribute to the goal of universal access to clean and affordable energy services for all. In addition, because of the national electricity supply crisis at the time, the intention was to reduce the load on peak electricity demand by displacing an estimated 500 kW per hour energy required for boiling water using a kettle or electric stove per household per year. City Power contracted students to undertake research into how much electricity is saved by installing a SWH. The findings illustrated that the electricity packages are not affordable for households and when they have no electricity they resort to paraffin, which is not safe. The subsidy allocated by government is only 50-100 kWh per month and this is not sufficient to



SOLAR WATER HEATERS IN JOHANNESBURG SUSTAINABLE ENERGY AFRICA

Interview with member of management, electricity utility, Johannesburg, June and November, 2017.

provide for basic energy needs such as lighting, cooking, cellphone-charging, internet access, etc. It is clear that people cannot live on only 50 kWh electricity, which means the problem becomes a vicious cycle.⁵

Through this programme the city installed close to 80 000 units with 200 litre capacity passive SWHs and also used some of the funds for smart meters.⁶ This project was innovative in terms of the pressure on cities to deliver basic services to its citizens within certain budgetary limits. As noted above there are very limited finances for cities to deliver on climate change or sustainable energy initiatives. By placing a levy on highend users, the city was able to implement a successful project. It is indicative of thinking outside of the box and pushing boundaries to achieve significant results. Despite this, there were challenges in terms of engaging with the community and obtaining their consensus. Issues of training of installers, high staff turnover, and management meant that some important skills development was lost.

The subsidy allocated by government is only **50-100 kWh** per month and this is not sufficient to provide for basic energy needs The city installed close to **80 000** units

⁶ Roundtable meeting with national and local government, NGOs, 2016, 2017; interview with member of management, electricity utility, Johannesburg, November, 2017.

3.2.4 PROJECT FOUR: CITY POWER OFF-GRID SOLUTIONS FOR INFORMAL SETTLEMENTS

Electrifying informal settlements is problematic for municipalities in terms of the cost of providing a grid connection and the fact that informal settlements are often located on land unsuitable for development, so that any installed infrastructure will not be permanent, leading to additional costs. Providing a grid connection costs an estimated R25 000 per household. In addition there are the ongoing monthly operational costs of about R900 per month.⁷ For an equivalent cost it is possible to provide these households with a PV solar home system that will provide lighting, cellphone-charging, internet access and TV services. However, most people desire grid access, which leads back to issues of awareness and education.

City Power and the EISD have explored the provision of a range of energy options, including alternative and renewable energy, in a manner that is sustainable and affordable for both the community and the metro. As has been observed, many households cannot afford to pay for electricity when they are connected to the grid, even if they are able to receive the government subsidy.

Providing a combination of energy solutions, which include grid electricity, solar energy and LPG gas, is a more sustainable approach to enabling low-income households to meet their energy needs. The project



PHOTOGRAPH BY MARK LEWIS FROM THE PHOTO ARCHIVES OF SUSTAINABLE ENERGY AFRICA forms part of Johannesburg's ongoing efforts to avoid dangerous and illegal power connections and electricity theft by households without access to the grid (CoJ, 2017). The rollout is currently piloted in two informal settlements, whereby households are supplied with grid electricity, a solar PV system with a battery, and gas stoves.⁸

The uptake of renewable energy technologies in informal settlements will provide communities with the opportunity to access cleaner, reliable and efficient energy. The challenge, however, lies in convincing lowincome communities that these technology options are a good way forward. An additional problem is that the technology is portable, making it liable to theft. As noted in an interview with a member of management of the electricity utility,⁹ a possible solution to this would be for the municipality to develop a roof structure with a built-in PV panel and then rent the roof, together with LPG, in order to meet household energy needs.

Individuals within Johannesburg's management are coming up with innovative and creative solutions that are definitely changing the energy patterns; the issue is whether these projects are sufficient to create a green economy and improve energy access. The next section continues this interrogation.

Providing a grid connection costs an estimated **R25 000** per household + operational costs of about **R900** per month

For an equivalent cost it is possible to provide these households with a PV solar home system

- ⁸ Interview with member of management, electricity utility, Johannesburg, August 2016.
- ⁹ Personal communication, member of management, electricity utility, Johannesburg, June and November, 2017.

3.3 ANALYSIS

The projects and programmes in place are innovative. It is clear that the City of Johannesburg is contributing to the energy experiment, in that it is creating urban livelihood opportunities and increasing access to modern energy.

What is argued is the need for a sustainable transformation based on the concept of energisation. That means that the projects and innovation need to be undertaken in a holistic manner and address the key municipal priorities - notably poverty alleviation, job creation, climate change and sustainable energy. The focus needs to be on a developmental and sustainable future driven by equity and a green economy and bringing in the concept of community (Monbiot 2017).

Whilst the City of Johannesburg's low-income strategy attempts to bring these elements together, it is not quite achieving success. Mainstreaming low-carbon energy provision is set out in its strategy, but climate change is discussed as a separate entity. The metro recognises the need for political buy-in and for a holistic approach,

The City is very aware that Johannesburg is not a static force and that, with its high levels of poverty, increased population and urbanisation, it needs to 'continue to evolve as technology and needs develop, but the principles of integration, participation, collaboration, efficiency and optimization are key'

Energy framework, 2016

and argues for the need to implement large-scale PV or contract independent power producers, to allow them to move to a new business model and to change the electricity tariff structures. In line with this they recognise the need to diversify their energy sources. Some of the difficulties with this diversification lie in the role and monopoly of Eskom and current electricity regulations. This is where further change needs to occur and the metro is attempting to tackle this.¹⁰ A major stumbling block is how the city generates revenue, revealed by some emerging difficulties. Services supplied to the poor do not generate revenue and, as mid-to-high-income households and commercial enterprises move to off-grid solutions there is a further loss in revenue. An example given by City Power regarding finances was a commercial company installing a large 1.5 MW PV system on its roof, which resulted in revenue loss for the municipality, while strategically retaining investment in the Metro rather than letting it be taken elsewhere.¹¹

The processes followed with the City of Johannesburg have led to a next step which is important in building energisation. A plan has been formulated by city officials that will require further institutionalisation and support from higher levels of power. This is to be followed by a workshop developing awareness and capacity around the feasibility and sustainability of grid electricity and alternative energy options for low-income households. Further training will be pursued, targeting community champions around household energy issues and promote awareness campaigns. The City is very aware that Johannesburg is not a static force and that, with its high levels of poverty, increased population and urbanisation, it needs to 'continue to evolve as technology and needs develop, but the principles of integration, participation, collaboration, efficiency and optimization are key' (Energy framework, 2016).

Despite the significant struggles of the City of Johannesburg in providing access to energy for its population whilst moving towards a low-carbon city, each example brings innovation and change to the Metro. These niche developments themselves are crucial to the push and pull taking place from the bottom up and ultimately influencing a holistic response from the top down. The next phase in the City's transformation will need to incorporate the political systems in the changes taking place. The city has not yet managed to fully integrate the triple challenges within a climate and energy discourse, and until it does so these projects will remain stand-alone to some extent. In order to provide an opportunity for these energy experiments and innovation to break through, a new dispensation needs to arise.

⁷ Interview with member of management, electricity utility, Johannesburg, November, 2017.

¹⁰ Personal communication, manager, City of Johannesburg, August, 2017.

¹¹ Personal communication, member of management, electricity utility, Johannesburg, June and November, 2017.

4.1 INTRODUCTION

Polokwane won the 2017 greenest secondary city award, assessed on areas that included waste management, energy efficiency, water management, and public participation and community empowerment. Polokwane will receive R3.5 million, which will be given through funding of infrastructure projects aimed at the protection of the environment. It is important to recognise that the municipality is nurturing small business enterprise and that the green economy is being promoted and pursued.

Polokwane Municipality is located in the central part of Limpopo province, in the Capricorn district. It is the administrative capital of the province, comprising 3% of its total surface area. Its spatial pattern is characterised by separate settlements. At the centre is the CBD, which houses the industrial area, community services, finance and manufacturing; this is the economic hub of Limpopo and accounts for 23% of the geographic area of the municipality. On the outskirts are rural/periurban settlements, the main clusters being Seshego, Mankweng, Molepo and Moletjie, which account for 71% of the geographic area of the city. Much of this land remains held in traditional land tenure systems, which presents particular challenges to the municipality in that it does not exercise authority over much of the land within its jurisdiction. This land is also effectively 'free' and not subject to rates and taxes, encouraging a dispersed settlement pattern that may challenge the densification needed for greater investment in public transport systems.

Polokwane Municipality has a population of 628 999, living in 178 001 households of which 45% are headed by females. Population growth between 2001 and 2011 was at a rate of 2.2% (Stats SA 2011). The unemployment rate in 2011 was 32.4%, and 55% of the population were living under the poverty line (earning less than R3200 per month).



Polokwane Municipality is the largest urban centre north of Gauteng. The economy is based on agricultural produce: tomatoes, citrus fruit, bananas and avocados. The municipality has several major industries, including Coca-Cola and SAB. It also has a large commercial sector, with the four largest banks in the country each having at least three branches in the city. It also has two industrial smelters, resulting in energy usage per capita being equal to that of the large metros. Industry is followed by transport as the largest energy consuming sectors (see Figure 6). The residential sector accounts for 10% of municipal energy consumption; although relatively small, this has an impact on peak demand for electricity.



Due to the semi-rural nature of the municipality, Eskom is responsible for a large proportion of its electricity distribution. Much of the backlog in electrification is in the rural areas, and plans are in place to address this. The municipality is 83% electrified, but although this has reduced the use of paraffin, poor households continue to use wood and candles for their energy needs, leading to environmental degradation and health risks (SEA, 2015; Polokwane, 2016).

Limpopo has the highest levels of poverty in the country, with 78.9% of the population living below the national poverty line, with an overall increase in poverty of 1.4% between 2011 and 2016 (Stats SA 2016). In 2011, 9% of households in Polokwane were informal, and 47% of households in the municipality were earning less than R3200 per month and, using the broad definition, 40% of people were unemployed (SEA, 2015).

Polokwane Municipality developed its first State of Energy Report and an Energy Strategy in 2013, and in 2016 completed its Energy Strategy Update and Implementation Plan 2016. The strategy is premised on the following vision:

'The ultimate in energy innovation and leadership through the provision of sustainable energy that is reliable, safe and affordable for all.'



The strategy identifies five key goals, in line with addressing the challenges and opportunities for a sustainable energy future to 2020:			
efficiency			
renewable energy			
alleviating poverty			
public transport, non-motorised transport and the influence of spatial form			
and institutional capacity			
- all supported by a detailed action plan for implementation.			

A strong foundation of institutional capacity has been laid to take this work forward. The Energy Department, falling within the Engineering Services Directorate, continues to provide the institutional home for this work within Polokwane municipality. An interdepartmental committee drawn from the Green Goal Team has supported the development and implementation of the strategy. This includes representation from Energy, Water and Sanitation, Waste Management, Local Economic Development and Tourism, Facility Management. Transport and Spatial Planning have been consulted, but are not yet regular participants within the forum. This strategy is intended to become a more formal part of the Green Goal Team's mandate. The strategy document is in place, but is still to be formally approved by the Council and launched.

The newly developed Integrated Development Plan 2017/2018 (Polokwane Municipality IDP, 2017) is premised on its vision 2030, which promotes a long-term growth path to transform the municipality into a sustainable city based on the Smart City concept and the 20 year Economic, Growth and Development Plan adopted by Council. The Smart City concept focuses on the economy, citizens, good governance, mobility, the environment and spatial form. It is centred on four clusters, each of which promotes growth and development but must operate in harmony and is founded on holistic planning.

In this section, examples of four projects and innovation that are taking place in the city are examined. This section also attempts to explore some of the different qualities seen within a secondary city and to what extent they are achieving a sustainable transition.

4.1.1 PROJECT ONE: GREEN GOAL ENERGY STRATEGY 2016

The Polokwane Green Goal Energy Strategy and Implementation Plan 2016 is an update of the 2013 strategy and followed a process of stakeholder engagement, review of data and an energy futures modelling exercise in order to provide a strong database from which to update the original strategy. The municipality is committed to innovation and sustainable development (including carbon emissions reduction and economic development).

Polokwane's mission is to support a stronger economy and greater resilience amongst poor households. A 'business as usual' trajectory indicates that energy consumption in Polokwane (if one excludes the large smelting industries) is set to increase by 69% within the next 15 years, giving rise to a 38% increase in carbon emissions. The transport sector is a major contributor to this growth in energy consumption. Thus, to change this carbon-intensive trajectory the strategy identifies five key priority areas in an attempt to address the key challenges of energy security, economic competitiveness, climate change and poverty.

Energy efficiency:

Promote the efficient use of energy within all sectors in the Polokwane municipal area and, with a view to improving economic competitiveness, reduce the environmental impact of energy use and stimulate local enterprise.

Renewable energy development:

Ensure that renewable energy represents a significant portion of energy supply. By supporting this sector the municipality will also be a driver of local economic development.

Energy poverty:

Promote reliable and safe energy services and reduce energy poverty. A key challenge for the Polokwane Municipality going forward is to identify and provide access to alternative forms of energy for households that are affordable, safe and reliable, and at the same time introduce measures to reduce the energy requirements of residents so that they are not negatively affected by fuel price increases.

Public transport and non-motorised transport use: Establish a sustainable transport and spatial planning system.

Institutional capacity:

Build partnerships and ensure adequate capacity to implement the strategy.

Each of these priority areas works towards meeting Polokwane's energy vision and addressing the key challenges in the short-to-medium term. The strategy and implementation process will be reviewed every three years to ensure that the work is relevant and unfolding.

A workshop in 2017¹² that brought together the key stakeholders involved in implementation to review achievements to date was extremely revealing. It established that much has been achieved around energy efficiency, such as rolling out SWHs and efficient lighting in the residential sector, LED street lights have been installed through the DoE EEDSM programme, municipal buildings have been retrofitted, and watersaving implemented at the stadium. From a renewable energy perspective, the municipality has introduced a small-scale embedded generation policy for a feed-in tariff, explored the possibility of installing a solar PV plant through a public-private partnership, and is assessing the feasibility of biogas. From an energy poverty perspective, it has introduced a number of programmes such as a roll-out of solar lights and hotboxes and developing an indigent register for FBE provision. Regarding transport, the municipality is in the process of planning for non-motorised transport. In sum, the municipality has successfully promoted a green economy while at the same time considering issues of poverty and employment. It has managed to forge partnerships that have enabled the strategy to be partially implemented and is open to new ideas and new ways of doing things.

Energy consumption in Polokwane is set to increase by **69%** within the next 15 years, giving rise to a **38% increase in carbon emissions.**

¹² Review of strategy implementation workshop with City representatives, NGOs, community representatives, 2017.



Challenges remain in terms of vested interests, such as Eskom versus municipal jurisdictions given that the municipality distributes electricity in the urban areas and Eskom in the rural areas (about 60%). Further difficulties have been identified from municipal officials, such as information not being filtered through from the top down, not having sufficient involvement in decision-making processes and not getting access to the additional budget or finance required for 'new' lowcarbon development work. This is especially problematic because the municipal primary mandate is service delivery and not climate change mitigation. Given the municipality is largely rural, it also has to work with traditional authorities and communities in which relations are particularly complex. Whilst the indigent register is being established, many people are not aware of FBE and, particularly in the rural areas, continue to cook with cow dung or wood.

SEA has been working with the municipality over three years to assist in developing their State of Energy

PHOTOGRAPH BY MARK LEWIS FROM THE PHOTO ARCHIVES OF SUSTAINABLE ENERGY AFRICA

Report, Energy and Climate Change Strategy and building capacity. In a final workshop assessing where the municipality is with its energy development work, it became clear that many of the challenges experienced relate to regulations and legislation. For instance, officials stated that the municipal procurement system results in contradicting what they are trying to achieve. Communication between departments, and between officials and management structures, are such that information does not always filter through or decisionmaking processes themselves are too slow. Financing was highlighted as a major challenge in terms of how to get projects into budgets plans. Whilst the workshop illustrated the progress that has been made, it was clear that many officials feel that they are operating in silos and there is a lack of integration and holistic planning. Issues relating to poverty and service delivery are high on the Municipality's agenda, and climate change can seem far removed from day-to-day survival challenges.

4.1.2 PROJECT TWO: ALTERNATIVE ENERGY SOLUTIONS FOR LOW-INCOME HOUSEHOLDS IN GA-DIKGALE

Ga-Dikgale is a sub-district within the Polokwane area and encompasses 15 villages. The area has a mix of shacks, mud and brick houses and has an electrification rate of 93%. There are high unemployment rates within the area and service delivery is poor. Although electrification rates are high, residents are unable to afford using electricity half way through the month and then use wood and paraffin to meet their energy needs. Many residents are on social grants and yet only 22% receive the FBE subsidy.

A household energy survey undertaken in the area suggests that energy costs are relatively low, raising a question about percentage energy costs of more than 10% being taken as an indicative measure of energy poverty. The findings of the survey also lead to recommending increased awareness and education particularly in terms of alternative energy technologies, given the gaps identified.

Following the survey, members of a community youth project were engaged with and trained as energy ambassadors. Their role initially was to publicise and demonstrate alternative energy technologies in the community with the aim of raising awareness about the affordability and safety of alternative energy options which can be used in conjunction with electricity.

The alternative energy solutions demonstrated to communities comprised:

the solar cooker

hotbox

Tshisa box (a hot water box which heats 10 litres of water over 4-5 hours in the sun)

solar lights

and energy-efficient light bulbs.

While all the alternatives appealed to the community members, the hotbox emerged as the preferred technology. GA-DIKGALE

93% electrified **however** residents unable to afford using electricity

50% of the time

Only **22%** of residents on social grants receive **FBE subsidy**

Energy ambassadors received capacity building through a three-day entrepreneurial training on hotbox development which involved sewing and producing the hotbox, and business skills to establish small hotbox businesses. The young women were thus able to start a hotbox production business and they were contracted by the Municipality to make 500 hotboxes that will be distributed to vulnerable households of Ga Dikgale. In May of 2017, 325 hotboxes had been made and distributed to the vulnerable households, with the young women providing further demonstrations on how to use the hotbox before the households receive them.





FIGURE 6: COMMUNITY WORKSHOPS IN GA-DIKGALE SOURCE SUSTAINABLE ENERGY AFRICA 2016



MAY 2017 **325** hotboxes were made and distributed to vulnerable households FIGURE 7: SERAPENG AGRICULTURAL COOPERATIVE - MAKING HOTBOXES SOURCE SUSTAINABLE ENERGY AFRICA 2016

This project formed part of a larger support project to the City of Polokwane and to this end was able to draw on several years of building relationships and capacity within the city as well as through the qualitative research. The project involved the engagement of the community as well as the municipality. Both were important in recognising that policies alone and even the work of a municipal champion will not be sufficient to maintain and sustain a project into the future. Unless people understand the benefits of hotboxes in terms of energy provision and saving as well as the potential for job creation, the hotbox could land up sitting on a shelf or discarded. It would be useful to return and assess to what extent the hotboxes are still being used. The success so far of this project highlighted the definite benefits to a project being rolled out as part of a larger approach and programme that runs over time rather than a short-term consultancy.

Polokwane's Electricity Department were offered 2 500 solar light kits for distribution to informal unelectrified households, with a focus on school-aged children. The lights were donated under SA Airlink's Corporate Social Responsibility Education Programme. The kits included a small solar panel, rechargeable torch and battery that could provide three LED lights and cellphone charge port.

With the assistance of the energy champions, SEA and the municipality identified a number of villages to be the beneficiaries of the solar lights. An important element of the roll-out included capacity-building and awarenessraising focussing on alternative household energy sources and the financial benefits of the technology. Thus, prior to the lights being distributed, each village received some basic training and education.

The Electricity Department approved of this project for two key reasons. Firstly, they experience considerable electricity theft in communities and were confident that supplying the solar lights would reduce theft, largely because what people want primarily are lights and cellphone-charging facilities. Secondly, financing sustainable energy projects is difficult and they appreciated the donation. However, there were difficulties in rolling out the lights, partly because Polokwane is semi-rural, making the villages less accessible and resulting in the distribution taking longer than planned. Some recipients did not turn up and others came who were not on the lists. Further there were challenges in terms of the municipal governance in relation to Eskom versus municipal distribution areas. As a result, the roll-out was temporarily halted.

Liaising between the donor, the municipal political bureaucracy and the communities themselves poses some complications, and all relationships need to be managed at a certain level. All role-players have their own agendas, and coordinating them all can be challenging.

The municipality was keen to keep a list of recipients in order to do a follow-up assessment at some time in the future. Further to this, political tensions that arose in the municipality during distribution also caused delays.









FIGURE 8: SOLAR KITS DISTRIBUTION IN POLOKWANE, 2017 SOURCE SUSTAINABLE ENERGY AFRICA

4.2 ANALYSIS

Polokwane municipality is already making enormous The long-term nature of support that the municipality developments to address the objectives and goals of the has received from various external support organisations strategy. A number of projects are currently in progress, has meant that, over time, relationships have been built, whilst others have been completed. They are concerned weaknesses identified and assistance offered in terms with the triple challenges facing both the country and of policy development, research and, in particular, their own municipality and to this end have been able building institutional capacity. It is clear that working with the municipal officials, the community and other to develop and implement sustainable energy projects driven by poverty alleviation and enterprise development. key roleplayers has made an impact. It is a small yet a complex municipality in terms of its urban/rural divide, the However, there are constraints at the political level which revolve around the way in which decisions are reached. fact that villages are spread out and there are traditional factions. However, the engagement of all has allowed for innovation and drive to take place and from a more holistic perspective.

Support from external organisations has meant that, over time, relationships have been built, weaknesses identified and assistance offered in terms of policy development, research and, in particular, building institutional capacity.

The municipality identified a need to evaluate projects Further the financing of projects, the procurement rules undertaken in order to assess where gaps lie and what and regulations and lack of alignment between various might be required to take the projects further. Evaluations departments and key role players such as Eskom can should be incorporated into their planning processes constrain change. Whilst they are dealing with energy going forward. A further challenge relates to financing poverty, it is not a diminishing problem as there has been a projects. The municipality is dealing with people, with growth in the number of backyard dwellers which has also changing contexts, changing technologies, changing resulting in overloading the network. Further, urban-rural politics - it is not a static unfolding machine but rather migration has resulted in an increase of new settlements a living and dynamic situation. This is fundamental to a and an increase in the electrification backlog. sustainable or holistic approach.

Personal communication, Assistant Energy Manager, Polokwane Municipality May, July, September 2017.

Communication and awareness have been identified as key challenges going forward, including shifting mindsets around sustainable energy use. The municipality would like to roll out public awareness campaigns going forward. Many mid-to-high-income households are installing rooftop PV, but their understanding of the processes involved is poor. The municipality would like to run a PV workshop for private owners on how to improve both grid and off-grid electricity services, with the key aim of informing users. The municipality would like to develop a public awareness campaign for poor households on how to access FBE and the impacts of a change climate on their lives. Whilst the municipality is working on a programme to register lowincome people for FBE, households who do not require it and for whom the policy was not intended are still accessing the subsidy while some households that are eligible for accessing it are not, sometimes because they simply not aware of its existence.13

5. KEY ISSUES

Polokwane (or Pietersburg as it was originally known) was founded in 1886 and only became a city in 1992. During the apartheid era it was a white-designated area and as it has grown has included a large black population, particularly in the outlying areas. Johannesburg by contrast is much larger, with a population of over four million. It was established in 1886, around the same time as Polokwane but it is the largest city in South Africa and one of the 50 largest urban areas in the world. It is far wealthier than Polokwane and a more established urban centre with more complex dynamics in place. It is the financial hub of the country and has a place in the global city picture, which means they are at the coalface, so to speak, in terms of all aspects of their municipal functions and how they present themselves nationally and globally. This places enormous pressure on the Johannesburg city officials and results in them tending to be overstretched in human resource capacity to execute operations. This is not to say that the Polokwane officials are not working to full capacity but the sense is they might have a bit more space to work holistically, given that the city is not on the international agenda and has additional international reporting and monitoring obligations.

Both the cities presented in this report have strong climate change and energy frameworks and strategies in place. Yet this is not sufficient to achieve the level of change required or indeed hoped for. It is a good starting point, but a huge challenge for municipalities relates to implementation. Many municipalities have innovative programmes and flagship projects underway, yet taking this to scale and institutionalising sustainable energy and climate change remains a challenge for almost all municipalities, as evidenced by the two case studies. In order to substantively move towards a low-carbon future, sustainable energy and climate change programmes need to be mainstreamed into municipal planning processes and institutionalised in their planning and operations. City officials, and in particular those taking a lead in championing climate change, talk about the need for political buy-in at the local level whereby municipal managers and mayoral committees actively support the work being undertaken. The City of Johannesburg is planning to take its energy poverty strategy to the mayoral committee, and the City of Polokwane plans to launch its Energy and Climate Change strategy with a view to bringing in political support.



PHOTOGRAPH BY CEDRIC NUNN FROM THE PHOTO ARCHIVES OF SUSTAINABLE ENERGY AFRICA

Having a standard item on the mayoral committee agenda, for instance, as is the case for some municipalities, or having an energy and climate change strategy approved and adopted by the municipality is key. This would also assist in building a holistic response to all the challenges a municipality faces. The work is also strengthened by the existence of a specific energy or climate change department or unit, as is the case in Johannesburg. However, even with this in place there is a lack of coordination and alignment across departments. The issues do not fit neatly within one municipal department, which requires some bold decision-making, partnering with civil society and business. It is not a case of one size fits all; the work is dynamic and challenging and in part the problem lies in the cross-cutting nature of energy and climate change, as noted above.

The processes in place do not always support low carbon transformation, such as regulations and procurement rules. In South Africa municipalities cannot generate their own electricity without a ministerial determination. This is not a straightforward process. The City of Cape Town is in the process of taking the Minister of Energy to court over this and Johannesburg is awaiting the results, as it would impact on them favourably if Cape Town were to win. The City of Joburg has stated that there is sufficient roof space to roll-out rooftop PV to scale; the question is how to get there and Johannesburg would welcome being able to implement its own renewable energy programme to offtake energy for the next 20 years. This would involve allowing the City to develop private public agreements with independent power producers but, again, approval for this would be required.

Implementation and taking innovation to scale is effected by the way in which municipalities are funded and how they generate income. They are expected to function in a developmental manner, ensuring the delivery of basic services to their communities and growing their economies and overall development of their areas of jurisdiction. To this end they do not provide one service but many services at the same time, with limited resources and limited capacity. All municipalities receive grants from national government and in addition they are expected to generate revenue from the sale of services such as electricity. They tend to be run on neo-liberal lines, given the need to balance their accounts. This places pressure on how innovative and sustainable projects are implemented. Larger metros are able to cross-subsidise services to the poor, which is more difficult in smaller and less well-resourced municipalities. The example projects cited in both cities illustrate innovative thinking and how they have been able to bridge the gap between funding available and the amount of revenue required to roll out the budgeted projects. The hotbox studies in both cities show how the community can create livelihood opportunities and provide no-cost energy for cooking. Johannesburg was able to fund the roll-out of solar water heaters by introducing a small levy. The work on solar

home systems is also an important step forward in how to make use of available funds.

What is emerging are growing demands and responsibilities in relation to sustainable energy and climate change without the accompanying policy and funding changes. How local governments access climate finance or develop bankable projects poses another challenge. In addition, many municipalities fear a lack of compliance with municipal financing regulations and at the same need to attract additional funds to finance the energy and climate change initiatives

In terms of equity and participation in energy transitions, both cities have made attempts to bring in the voices of its citizens. In the case of Polokwane the example of the solar light distribution illustrated the complexities in doing this but also the need for it. It was not simply a case of distributing solar lights and tick a box but also an opportunity to educate and engage with communities. This was seen as an opportunity of reducing electricity theft by providing the basic electricity needs of lighting and cell phone-charging. Although not included in the grant, Polokwane Municipality would have liked to undertake an evaluation of the adoption of the solar lights six months later. Similarly in Johannesburg, the lowincome energy work has highlighted the need for strong community participation. In fact, a key official has been pushing the concept of self-help from the low-income sectors, in other words moving away from a culture of entitlement.

A further challenge for municipalities is that they are obliged to protect the poor but feel that Eskom, the national electricity utility from which the Metro purchase electricity, is not helping in this, given that they have to pay peak rates to a single buyer. Eskom, they believe, is protected by national government and linked to a 100 year coal production and monopoly. This again relates to the neo-liberal policies in place. In relation to delivering and providing for poor communities, the municipalities portrayed in the case study have shown innovation in their projects and strategies. They have to find off-grid energy solutions for informal settlements to ensure access to energy services to citizens within its jurisdiction. If the settlement is on land not zoned for services they are hamstrung and yet the constitution makes clear they must provide basic services. They are clearly finding solutions and access to energy, as well as in some cases creating livelihoods.

Both cities have revealed their potential to reduce carbon emissions through the projects they are implementing, but the extent to which they are producing a green urban economy is debatable. Some of the projects, such as the hotbox rollout and solar water heater roll-out, do illustrate the potential around livelihood development, but these are small though positive steps.



PHOTOGRAPH BY MARK LEWIS FROM THE PHOTO ARCHIVES OF SUSTAINABLE ENERGY AFRICA

6. CONCLUSION

It is apparent that considerable work and change is taking place within the two cities highlighted in this report. They are definitely beginning to impact on the green economy, even if at a small scale and even if these are small initial steps. In addition they are both addressing the issues of livelihood opportunities, providing access to modern energy services for the poor and building equity and participation in energy transitions. There have been substantial changes: across the municipal landscape - not just the two cities presented here - many projects are being implemented (Reddy, Wolpe, 2018). Many have strategies and frameworks in place and many have remarkable champions furthering the cause.

Where further work is identified and what could influence the scale of change is the concept of sustainable transformation including energisation (an approach to provide better energy solutions which does not focus on one form of energy (such as electrification), but instead tries to improve the supply, availability and affordability of a range of different energy options and services), which in turn would in due course impact on the national and bigger economic picture. This takes the discourse to a different level, the focus becoming multi-faceted rather than emphasising one element of the equation. Only by doing this and including the community, the key stakeholders as well as government, can substantive change take place.

It is clear that innovation needs to continue and needs to be pushed from the bottom up. In doing so, this may create potential for cities to leverage change from the national position as well.



7. REFERENCES

Ashman, S & Fine, B, 2013. Neo-liberalism, varieties of capitalism, and the shifting contours of South Africa's financial system. Transformation 81/82, 144-178.

Ashman, S; Fine, B & Newman, S, 2011. The crisis in South Africa: Neoliberalism, financialization and uneven and combined development. Socialist Register 2011, 174-195.

Baker, L, 2015. The evolving role of finance in South Africa's renewable energy sector. Geoforum 64: 146-156

Baker, L, Burton, J, Godinho, C, Trollip, H, 2015. The Political economy of decarbonisation: exploring the dynamics of South Africa's electricity sector, University of Cape Town - Energy Research Centre (ERC) Research report series, November 2015. South Africa.

Biermann, S & Van Ryneveld, M, 2007. Improving the location of low-income housing delivery in South African urban areas. 10th International Conference on Computers in Urban Planning and Urban Management (CUPUM).11-13 July 2007. Iguassu Falls, Parana, Brazil.

Caprotti, F, 2018. Future cities: moving from technical to human needs. Forthcoming in Palgrave Communications.

City of Johannesburg, 2011. 2040: Growth and Development Strategy. Johannesburg, South Africa.

City of Johannesburg, 2016. Energy Framework 2016. Johannesburg, South Africa.

Constitution of South Africa, 1996. Section 152 & 153. Pretoria, South Africa.

Csutora M, 2012. The ecological footprint of green and brown consumers. Introducing the behaviour-impact-gap (BIG) problem. European Roundtable on Sustainable Consumption and Production (15th ERSCP), Bregenz, Austria.

De Visser, J, 2009. Developmental local government in South Africa: institutional fault lines. Commonwealth Journal of Local Governance 2, January 2009.

DEA [Department of Environmental Affairs], 2011. The National Climate Change Response White Paper. Pretoria, South Africa.

DEA [Department of Environmental Affairs], 2014. South Africa's greenhouse gas emission mitigation potential analysis Report. Pretoria, South Africa

DEA [Department of Environmental Affairs], 2016. Local government climate change mitigation assessment report. Pretoria, South Africa.

DME [Department of Minerals and Energy]. 2005. Energy efficiency strategy of the Republic of South Africa. Pretoria, South Africa.

DoE [Department of Energy], 2012. A survey of energy-related behaviour and perceptions in South Africa, The Residential Sector, Pretoria. Available at: http://www.energy.gov.za/files/media/Pub/Survey%20of%20Energy%20 related%20behaviour%20and%20perception%20in%20SA%20-%20Residential%20Sector%20-%202012.pdf [Accessed October 2017]

DoE [Department of Energy]. 2003. Free Basic Electricity Policy. Pretoria, South Africa.

DTI [Department of Trade and Industry]. 2017. Industrial Policy Action Plan (IPAP) 2017/2018.

Eberhard A, 2011. The future of South African coal: market, investment and policy challenges' Working Paper #100. Program of Energy and Sustainable Development. Freeman Spogli Institute for International Studies, Stanford University, USA.

Eberhard, A, Kolker, J, Leigland, J, 2014. South Africa's renewable energy independent power producer procurement programme (IPPPP): success factors and lessons. Public Private Infrastructure Advisory Facility (PPIAF). Washington, DC.

Eberhard, R, 2016. Understanding electricity demand patterns in South Africa's cities: Briefing Paper 1 for National Treasury. Draft 4, Dec 2016. National Treasury, Pretoria, South Africa.

Fine B, & Rustomjee, Z, 1997. South Africa's political economy: from minerals-energy complex to industrialisation Wits University Press, Johannesburg, South Africa.

GDARD [Gauteng Department of Agriculture and Rural Development], 2015. A feasibility study and an implementation plan of alternative energy technology options for unelectrified informal settlements in Gauteng Province. A report produced by Sustainable Energy Africa, the University of Cape Town and Safe Energy Depot. South Africa.

Habib, A, 2013. South Africa's suspended revolution, hopes and prospects, Wits University Press.

Leibbrandt, M., Woolard, I., Finn, A. and Argent, J. 2010. Trends in South African income distribution and poverty since the fall of Apartheid. OECD Social, Employment and Migration Working Papers, No. 101, OECD Publishing.

Metcalf, S. 2017, Neo Liberalism: The idea that swallowed the world. The Guardian Newspaper. https://www. theguardian.com/news/2017/aug/18/neoliberalism-the-idea-that-changed-the-world [Accessed November 2017]

Monbiot, G, 2017. Out of the Wreckage: A new politics for an age of crisis. Verso Books, United Kingdom.

NPC [National Planning Commission - The Presidency Republic of South Africa], 2012. National Development Plan -Vision for 2030. Pretoria, South Africa.

NPC [National Planning Commission - The Presidency Republic of South Africa], 2011. Diagnostic Overview. Pretoria, South Africa.

NT [National Treasury of Republic of South Africa], 2017. Medium Term Budget Policy Statement. Pretoria, South Africa.

Office of the Presidency, 1994. Reconstruction and Development Programme. Pretoria, South Africa.

Okri, B, 2011. A Time for New Dreams. Penguin Publishers.

Pakenham, T, 1991. The Boer War. Abacus Publishers.

Polokwane Municipality, 2016. State of Energy Report for Polokwane. Report produced by Sustainable Energy Africa for Polokwane Municipality. South Africa.

Polokwane Municipality, 2016. State of Energy Report for Polokwane. Report produced by Sustainable Energy Africa for Polokwane Municipality. South Africa.

Polokwane Municipality, 2017/2018. Integrated Development Plan. South Africa.

Reddy, Y, Wolpe, P, 2014. Tackling urban energy poverty in South Africa. SEA, Cape Town, South Africa.

analysis of 7 cities. Unpublished paper, Cape Town, South Africa.

SACN [South African Cities Network], 2011. Towards resilient cities: a reflection on the first decade of a democratic and transformed local government in South Africa 2001-2011. South African Cities Network, Johannesburg, South Africa.

SACN [South African Cities Network], 2012. Secondary cities in South Africa: the start of a conversation. Background Report. South African Cities Network, Johannesburg, South Africa.

SEA [Sustainable Energy Africa], 2006. State of energy in South Africa's cities - setting a baseline SEA, Cape Town, South Africa.

SEA [Sustainable Energy Africa], 2015. State of energy in South Africa's cities. Cape Town, South Africa.

SEA [Sustainable Energy Africa], 2015a. Citywide mitigation potential for South Africa. Cape Town, South Africa.

SEA [Sustainable Energy Africa], 2016. An exploration in the household energy use patterns of low-income households in the City of Joburg. A report produced by Sustainable Energy Africa for the City of Joburg, as part of the HBS funded 'Africa's Energy Future' 3- year project. Cape Town, South Africa.

SEA [Sustainable Energy Africa], 2017. A short study exploring the impact of household energy awareness raising and the introduction of the Wonderbag/Hotbox - a clean alternative energy technology - on the energy use patterns of low income households in an electrified community in Johannesburg. A report produced by Sustainable Energy Africa for the City of Joburg, as part of the HBS funded 'Africa's Energy Future' 3- year project. Cape Town, South Africa.

Stats SA [Statistics South Africa], 2011. South African census 2011. Pretoria, South Africa.

Stats SA, 2016, Limpopo community survey results, http://www.statssa.gov.za/?p=7988

Stats SA, 2017, Quarterly Labour Force Survey, third quarter 2017.

Turok, I, & Borel-Saladin, J, 2013. The spatial economy. Background Research Report for the Integrated Urban Development Framework Draft. Human Sciences Research Council, South Africa.

Wolpe, H. 1995. The uneven transition from Apartheid in South Africa. Transformation 27: 88-101.

Wolpe, P & Reddy, Y, 2016. South African Cities of the Future: A low-carbon urban development path: the challenges and opportunities. Unpublished paper. Sustainable Energy Africa, Cape Town, South Africa.

- Reddy, Y, Wolpe, P, 2018. An overview of niche innovations in energy service delivery in urban South Africa: case-study

Sustainable Energy Africa (SEA)

The Green Building, 9B Bell Crescent Close Westlake Business Park, Tokai Cape Town 7945, South Africa

e info@sustainable.org.za

t 021 702 3622

ESRC-NRF Urban Energy Transformations Project www.urbanenergytransformations.co.za