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Reconfiguring electricity infrastructures in Accra and Cape Town:

Understanding the political ecologies of networked urbanism

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March 2013

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Abstract

This thesis explores the relationships between emerging intersections of climate and energy agendas in cities and how these responses are being materialised across networked systems through processes of network reconfiguration. The study is focused on how these dynamics are shaping socio-environmental conditions across the energy infrastructures of low income, networked neighbourhoods in Accra and Cape Town and the geometries of power relationships between different urban actors in these dynamics. It examines current approaches to infrastructure studies and how they can be utilised to reveal the political nature of networked systems. The thesis argues that such issues can be approached through a African situated urban political ecology that frames the city through the notion of cyborg urbanisation to reveal the metabolic processes that mediate networked urbanism, network reconfiguration across multi-scalar geographies and multiple social relations. A series of comparative sites in low income, networked communities across Accra and Cape Town are selected alongside research with a wide range of urban actors across both cities. The thesis draws on a range of data collected during fieldwork in both cities generated through a range of methods including community workshops, interviewing and household surveys. The methodology aims to generate a range of data encompassing both political economic and the everyday dynamics mediating urban energy networks. The thesis finds that these networked systems are shaped by historical processes of urbanisation that produce inequalities through a splintered urbanism, with urban dwellers experiencing these unequal geographies through the metabolisms of capital, climate and crisis. Examining a series of network reconfigurations the thesis argues that multiple urban actors are involved in these processes, shaped by a series of competing logics, rationalities and imperatives and revealing the contested and political nature of urban infrastructure. As cities become increasingly important sites in response to climate change and energy imperatives the question of who has the power to reconfigure becomes vital to addressing questions of future urban uncertainties. The thesis suggest these contestations over the power to reconfigure take place across a series of different terrains incorporating the everyday geographies of the urban energy network, global metabolic processes and policymaking domains.

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Abbreviations

A/C	Air Conditioning
AAC	African Centre for Cities
AMA	Accra Metropolitan Assembly
ANC	African National Congress
ANT	Actor network theory
CDM	Clean Development Mechanism
CCT	City of Cape Town
CPP	Convention People's Party
DA	Democratic Alliance
ERM	Environmental Resource Management
DANIDA	Danish International Development Agency
ECG	Electric Company of Ghana
ESKOM	Electric Supply Commission of South Africa
GAMA	Greater Accra Metropolitan Area
GAMADA	Ga Mashie Development Agency
GDP	Gross Domestic Product
GEAR	Growth, Employment and Redistribution framework
GHG	Greenhouse gases
HIV	Human Immunodeficiency Virus
IMF	International Monetary Fund
ICLEI	Local Governments for Sustainability
ICT	Information, Communication and Technology
IPCC	International Panel on Climate Change
KVA	Kilovolt-ampere
LTS	Large Technical Systems
NGO	Non-Government Organization
PN Energy	Phambile Nombane Energy
PPM	Pre-paid meter
PWD	Public Works Department
RCEER	Resource Centre for Energy Economics and Regulation
RDP	Reconstruction and Development Program
SAP	Structural Adjustment Programs
STT	Socio-Technical Transitions
STS	Science and Technology Studies
SWH	Solar water heater
TB	Tuberculosis
UN	United Nations
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UPE	Urban political ecology
VALCO	Volta Aluminum Company

Chapter 1: Introduction

Definition of **reconfigure**: Configure something differently (Oxford Dictionaries Online).

Emerging urban climate change and energy agendas are increasingly intersecting with the geographies of networked systems across African cities. This thesis examines these issues to explore how they reshape the social relations mediated through infrastructures across Accra and Cape Town.

1.1 Setting the scene: Climate change, energy and networked systems

The next section sets the scene for the thesis, exploring the emerging energy and climate change agendas, how these are becoming increasingly urbanised and the important role of infrastructures in materialising these imperatives.

1.1.1 Energy

“Africa is the most under-supplied region in the world when it comes to electricity, but its economies are utterly dependent on it” (McDonald, 2009: xv).

2012 was the United Nations (UN) International Year for Sustainable Energy showing the global concern for achieving a series of energy policy initiatives and placing energy at the centre of debates about the delivery of the Millennium Development Goals (UN-Energy, 2005), illustrating how energy mediates all manner of development indicators from poverty, through to women’s health and educational participation¹. As the UN Secretary-General Ban Ki-moon commented at the launch of the program in Abu Dhabi:

“This is the right time for this Initiative. Across the world we see momentum building for concrete action that reduces energy poverty, catalyzes sustainable economic growth, and mitigates the risks of climate change. Achieving sustainable energy for all is both feasible and necessary. My initiative will help us meet these objectives simultaneously. It can be a triple win for all” (Sustainable Energy of All, 2012).

The three objectives of the programme to be achieved by 2030 are: firstly, to ensure universal access to modern energy services; secondly, to double the global rate of improvement in energy efficiency; and thirdly, to double the share of renewable energy in the global energy mix (Sustainable Energy of All, 2012). These global goals around energy are being reframed at multiple scales and across geographical stretched networks as African regions and cities become increasingly important sites for global environmental governance (Simon, 2007, 2010). This global agenda is being transferred, interpreted and linking with range of initiatives across Africa. For instance, the ambitious ‘Electrification Roadmap For South Africa, Africa and Developing Countries’ aims to connect 500 million people to energy services in over 50 countries in Africa. Eskom, the South African utility company are facilitating the development of this partnership, providing technical

¹ See McDonald (2009) for a detailed breakdown of the relationship between electricity and achieving the Millennium Development Goals

knowledges and showing the geo-political aspirations of the electricity sector in South Africa to play a central role in the energy arena of the continent. At a national level countries such as Ghana are broadening their ambitions from electrification² to engage with wider issues of carbon reduction, climate change mitigation and renewable energy with ambitious targets of 10 percent renewables by 2020 being set (Ghana Energy Commission, 2011). What these and the plethora of initiatives, projects, financing and emerging institutional arrangements show is that energy is a vital and central concern to multi-scalar governance actors and the development aspirations of the continent and increasingly intersecting with ongoing development paradigms across cities.

1.1.2 Climate change

Intricately linked to the rise of this energy agenda in global environmental governance is climate change³ (Bulkeley and Betsill, 2003, Bulkeley and Newell, 2010) and the multiple intersections between these imperatives. As Stern (2007:2) in his assessment for the UK government argues, “An overwhelming body of scientific evidence now clearly indicates that climate change is a serious and urgent issue”. This recognition of the sheer scale of change taking place in the earth’s climate was further amplified by the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report of 2007. These two reports can be viewed as a continuation of a huge body of research and policy, first brought together in the United Nations Framework Agreement on Climate Change of 1992 that have centered the urgency of responding to these issues. Like the growing recognition of the importance of energy in achieving the Millennium Development Goals Davidson et al (2003:98) argue that, “it is becoming increasingly clear that realization of the development goals can be seriously hampered by climate change” as these dynamics converge with urbanisation, poverty, food security, health and flooding (UN-Habitat, 2007a). This will pose considerable adaptation and mitigation challenges in the face of the uncertainty of climate change impacts and their potential to cause extensive damage beyond the current environmental hazards, which continue to entrench socio-environmental inequalities across Africa’s cities (Simon, 2007, 2010). Over the coming decades trillions of dollars of financing will have to be invested into the global South to fund climate change adaptation and mitigation across energy, housing and transport systems. These flows of capital into the global South are estimated at up to \$175 billion per annum in mitigation spending and up to \$100 billion per annum (World Bank, 2010) in adaptation spending suggesting both the critical status of these issues and the transformative potential of this financing in relation to the development agenda.

1.1.3 Urbanising the global energy and climate change agendas

Energy and climate change dynamics as global environment change issues are increasingly being considered at a city scale and in relation to existing environmental hazards, issues of poverty and development agendas

² Up from 25% in 1989 to 67% currently (Sustainable Energy of All, 2012)

³ The basic premise of climate change is predicated on the changing of the earth’s climate through the growth of greenhouse gases through human activity, such as carbon dioxide, in the atmosphere. These greenhouse gasses are overwhelming the atmosphere’s capacity to absorb the earth’s radiation, trapping heat, changing the planet’s temperature, by an estimated 6 degrees celsius and creating new weather systems (Solomon et al, 2007). These processes will have a range of impacts directly attributed to climate change and include rising sea levels through droughts, floods and heat waves threatening human populations, ecosystems and the wider natural environment.

(Bulkeley and Betsill, 2003, 2005, Hodson and Marvin, 2010, Parnell et al, 2007). The changing economies in Ghana and South Africa over the last 20 years have brought energy concerns to the city with the growth of ‘producer services’ (McDonald, 2009) and the need to develop a plethora of infrastructures to support these urban economies alongside the parallel dynamics of electrification and energy poverty across urban poor communities. As McDonald (2009:9) comments, “Electricity is critical to this urban services growth...the rapid growth of the sector has meant increasing urban demands for electric power – in terms of both quantity and reliability”.

As a result of the growing recognition of the vulnerabilities of cities to climate change and the role such spaces play in contributing to greenhouse gases (GHG) emissions⁴ the global energy and climate change agendas are increasingly converging and being urbanised with responses to these imperatives intersecting with existing urban policy objectives (Bulkeley and Moser, 2007, Bulkeley 2010, Bulkeley et al, 2011), prompting the need to approach climate and energy governance at a range of scales (Okereke, 2009) including the urban. How cities, such as Accra and Cape Town respond to mitigation and adaptation imperatives in light of the challenges faced through climate change (and energy) dynamics is arguably one of the most important issues facing global environmental governance (Simon, 2010). This important agenda reveals a range of difficult issues for city governments, international institutions and other governance actors. Yet, simultaneously there is growing recognition that, “addressing climate change is an opportunity to meet the energy needs and particular issues of access in Africa” (Policy maker, United Nations Development Programme) and it is these twin dynamics of adaptation and mitigation, threat and opportunity that begin to place urban energy networks as a key site for climate change action. Bulkeley et al, (forthcoming) argue that:

“As responding to climate change takes root across multiple urban contexts, urban infrastructure networks – particularly those concerning the provision and consumption of energy services – are becoming critical to the workings of climate politics”.

This is an important insight in seeking to consider the relationships between climate change, energy and infrastructures. Adaptation and mitigation responses are incorporating the development of new (formal) infrastructure technologies by international actors all the way through to (informal) community responses and providing a mosaic of emerging urban responses and actions that are reconfiguring networked systems and socio-environmental conditions across African cities (Simon, 2007, 2010). Relatively little is known about these emerging responses to climate change and energy imperatives and particularly how they relate to existing infrastructure investment, policies and politics. The need to widen our understanding of these issues is important as increasing flows of infrastructure investment (in the form of climate change finance), alongside development and economic investment are being directed into energy infrastructures and particularly low carbon technologies. These dynamics raise questions about how such circulations will serve to reinforce or counter the existing geographies of infrastructure and how these imperatives sit alongside significant levels of poverty and socio-environmental inequality (While et al. 2010, Hodson and Marvin 2010). Studies have tended to neglect these dynamics and the ways that urban infrastructure networks are

⁴ Estimates from the International Energy Agency (2008) suggest that urban areas account for upwards of 70 percent of global carbon emissions. This central role of cities as producers of climate change is rooted in the industrialization of society and the polluting effects of industry, the sustaining of urban infrastructures and the consumption patterns of urban dwellers.

being reconfigured around these imperatives, logics and agendas and the resulting state and political economic restructuring of such processes (Bulkeley et al, forthcoming). These dynamics generate the need for detailed study of urban energy infrastructures in Africa cities as they become increasingly visible on policy landscapes and across everyday urbanism.

1.2 Centering the importance of urban infrastructure in African cities

This thesis proceeds by situating the research across the infrastructures of African cities. It begins with a view from the low income, networked neighbourhoods of Accra and Cape Town before reflecting on wider urbanisation processes in Africa, how infrastructure is central to how we view cities, the political nature of the urban energy network and the dialectical urbanism of these processes and dynamics.

1.2.1 A view from the low income, networked neighbourhoods of Accra and Cape Town

It is a bitterly cold day in the Western Cape and the rain is hammering down on the corrugated iron roof of an RDP house in Cape Town. Inside its damp, the condensation drops down the walls and the moisture combined with the cold make a rather unpleasant experience as I stand there wrapped up in my coat. In what must be the bedroom I can hear a child coughing and crying and one of the family tell me about the illnesses and sickness they have experienced this winter: colds, pneumonia and flu have made it a difficult time of year but they are thankful that tuberculosis hasn't visited this winter season. Before I leave one of the members of the household catches me staring at a heater that looks like it could make some inroads into the icy chill that pervades the house and says, "but of course we can't afford such luxuries as electricity at this time of the month" (Field notes, 13.06.11, Cape Town).

Another research day in Ga Mashie and the taxi pulls over after a short ride across town, paying him off I start to walk over to the spot where I have been meeting my research assistant but today's scene seems different. There's a large crowd gathering and at the front of the melee many voices arguing with men in uniform. It looks like our planned workshop might have to be cancelled as the research assistant has got bigger issues on his mind today, the authorities have come to demolish his home and those of his neighbours (Field notes, 07.11.10, Accra).

Across the low income, networked communities of Accra and Cape Town the urban dwellers live in neighbourhoods that have networked services provided by infrastructure systems. Electricity flows into and circulates across these urban spaces through government financed infrastructure, often in contrast to the sprawling non-networked informal settlements in both cities and in which tens of thousands of people experience urban life. Even in neighbourhoods where investment in networked systems has taken place, where formal urban services at least partly exist, conditions of poverty are vividly present, exposing residents to urban natures that reinforce these inequalities. As the above examples show, life remains precarious in the low income, networked neighbourhoods of both cities. Whether through the inability to access the circuits of energy that might extend to their homes but be stopped by a pre-paid meter (PPM)

without credit, or through attempts by authorities to seize land, these residents struggle to get by and get on in cities that offer everything or nothing depending on your socio-economic status. This thesis engages with these neighbourhoods in Accra and Cape Town and their networked electricity systems to explore how ongoing issues of energy poverty and wider inequalities, produced through the metabolisms of capital, climate and crisis will intersect with climate change and energy agendas. As McDonald (2009:16) argues:

“Millions of low-income households simply do not have enough regular income to buy (enough of) the electricity they may now have access to, forcing many to make tragic choices between buying electricity, water, food or clothing”.

Such urban conditions are prompting residents themselves, municipalities, civil society and a bewildering plethora of other intermediaries to recognize that the struggle for a better life does not stop because the electricity network has been installed. As such these urban actors sometimes seek to improve conditions through processes of network reconfiguration, intervening in the configurations of these infrastructure in the present to make a better tomorrow. At other moments actors may seek to reconfigure the networks to assert particular visions of the city that may make conditions worse for some and better for others. Configuring the electricity network differently can involve a simple clandestine connection to the grid to access free flows of energy to respond to household crisis or involve the large scale transformation of the neighbourhood involving a multitude of actors and international financing around a vision of the city. What all these processes of network reconfiguration, from the grandest scheme to the smallest everyday act share is the potential not just to change the electricity network but central to the thesis, the wider socio-environmental conditions of residents, showing the importance of these systems in mediating urban life and the dialectical nature of urban infrastructures.

1.2.2 Urbanisation processes in African cities

Over the next 20 years the global urban population will rise to around three-quarters of the total world population (UN-Habitat, 2007b) suggesting the importance of cities in debates about sustainability (Bulkeley and Betsill, 2003, Simon, 2010) and in relation to this thesis the energy and climate change nexus. Population predictions expected around 37 percent of sub-Saharan Africans to be urban dwellers in 2010 (UN-Habitat 2008), rising to 61 percent in South Africa and 51 percent in Ghana (UN-Habitat, 2007b). Many of these new urban dwellers live in conditions of poverty and socio-environmental marginalisation as Toulmin (2009: 92) comments, “in most African urban centres, 40 to 60 percent of inhabitants live below the poverty line”. In response to these dynamics commentators have characterised such processes as the “urbanization of poverty” (Ravallion, 2005) This rapid urbanization (of poverty) will account for nearly all population growth in Africa and generates a series of competing demands that include the delivery of basic services in urban spaces visibly lacking such infrastructure systems. One of these demands is to provide energy services to power the growing cities of the continent and the basic needs, economic development, health and other requirements of the urban population. Urban energy networks, consisting of vast conglomerations of lines, wires and cables are vitally important to sustaining and supporting the urban life of African cities through a series of flows, circulations and systems that provide electricity to homes, businesses

and public organisations. These networked systems encompass a complex and interconnected entanglement providing basic human rights such as heating for poor households, through to the fibre optic cables needed for instantaneous international trade (Graham and Marvin, 2001). They encompass a variety of geographical scales operating and connecting the home, neighbourhood, city, region and beyond yet often, “giving no hint to the average user of the huge and geographically stretched infrastructural complexes that invisibly sustains them” (Graham, 2009: 6). Thus, infrastructures are important not just as the, “fundamental background to modern everyday life” (Graham, 2009:1) but, “can be conceptualised as a series of interconnecting life-support systems” (Gandy 2005: 28) for cities through the urban services that they sustain. The energy (and wider) infrastructures and networks of African cities are considered to be in a state of ongoing crisis (Gandy, 2006, Davis, 2006, Pieterse, 2008, Simon, 1997, Tostensen et al, 2001) that has left many urban dwellers, particularly the urban poor with limited, disrupted or no access to energy services, reinforcing conditions of poverty and inequality. As Simone, (1999: 71) argues:

“It is important to amplify the deepening crisis of African cities - the fragmentation, conflicts, overextended informal arrangements and the increasingly fragile economic underpinning of urban life and infrastructure (or the lack of it) lays at the centre of these problematics”.

Paradoxically, this multi-faceted, connected and growing sense of urban crisis exists alongside ever increasing investment into the infrastructures of Africa’s growing economies such as South Africa and Ghana. For instance, investment in energy across Africa, rose from \$1 billion per annum in 2005 to \$2.3 billion per annum in 2007 (Infrastructure Consortium for Africa, 2009). These dynamics and processes are creating a complicated geography of ongoing crisis and increasing investment that shows African cities to be both peripheral to the world economic system whilst intrinsically connected to processes of globalisation, flows of investment and global networks (Simon, 1992). If this is the case, that African cities can be at once globalised and ‘underdeveloped’, then it prompts the question of where these circulations of investment manifest across urban space, how these flows are shaping the cities and accompanying infrastructure systems, particularly in light of the needs of the urban poor and in the context of climate change and energy agendas. Simone (2010b:30) outlines the geography of this investment suggesting that:

“much of the composition and location of this investment will either remain tangential to the operation of urban systems or build up highly truncated, circumscribed capacity within them - i.e. premium areas of operation dedicated to the management of resource evacuation and the financial domains associated with it”.

This prioritisation of particular infrastructure systems in specific urban spaces can be seen across African cities, with the urban poor forced to get by with(out) basic electricity services sometimes in close proximity to information, communication and technology (ICT) hubs that connect to global circuits of financial and knowledge exchange through fibre optic cabling. These geographies of infrastructure present a vision of African cities that shows the stark differences between the infrastructure systems of different urban dwellers with super fast ICT networks, emerging high-tech renewable energy systems and upgraded airports for the middle class/elite sitting alongside absent or decaying basic infrastructures for the poor. The urban dynamics,

which shape urban space for the demands of international business and capital accumulation and the desires of the middle class/elite over the basic needs of the poor, are often characterised as a splintered urbanism (Graham and Marvin, 2001). The concept of splintered urbanism has acted as a provocation across infrastructure studies (Jaglin, 2008 Coutard, 2008, Zerah, 2008, Fernández-Maldonado, 2008, Kooy and Bakker, 2008) providing a useful way in which to begin to consider how networked systems are (re) configured in African cities and importantly the political nature of these dynamics.

1.2.3 Politicalising urban energy networks

“The revolution will not be televised, Advo, Do you realise there’s no water or electricity in most of Chi, including at our house?” said Zero.

“What?” I said, pinching the bridge of my nose.

I recalled that the switches were dead when I had come back from Naturena that morning. At the time I had thought it was about the usual problem with the old power station in Orlando East.

“Siriyasi, Advo, these capitalists have removed the cables. Ever since we voted for them they don’t give a fuck about us any more” Said Zero, anger registering in his face. “They claim that we are stealing electricity. To get reconnected we need to pay one thousand five hundred bucks. That’s why there’s an urgent meeting today. The residents are angry, Advo. I’ve never seen people as angry with the government”.

“Where’s the meeting?”

“At the Star Soccer Fields. We have to go there right now. The revolution will not be televised, kuzonyiwa vandag. I-government isijwayela amasimba! The government is taking us for shit! This is Msawawa, our matchbox city, and we’ll show them like we showed the apartheid government before them”.

The above passage from Mhlongo’s (2011:156) South African novel ‘After Tears’ provides a literary articulation of the highly political nature of the delivery of urban services. The passage focuses on the anger of two of the main protagonists about the disconnection of electricity in their neighbourhood and the mobilisation of the community to challenge the utility company. The disconnection of electricity provides an example of a network reconfiguration undertaken by the state and shows how these processes can negatively effect urban dwellers, suggesting that decisions about configurations of infrastructure are political, contested and often controversial. As such network reconfiguration becomes the site both of the expression and contestation of power over networked systems. This framing of infrastructures as political is in contrast to much of the literature of African cities which instead focuses on technological responses to sustainability issues within normative frameworks, around the notion of developmentalism and under growing critique (Myers, 2008, Pieterse, 2008, Lawhon et al, forthcoming). The thesis is concerned with politicising urban infrastructures to interrogate how they embody the contested politics of cities in the context of climate change and energy. As Swyngedouw (2003:130) argues:

“Urban process and conditions are wrought from, and refashioned through, new networked technological systems, on the one hand, while, on the other, these systems embody myriad social processes that signal the changing parameters of contemporary urban practices and characteristics, both materially and socio culturally”.

The deeply political nature of infrastructures are explored across a growing number of infrastructure studies exploring different urban systems including water (Gandy, 2004, Truelove, 2011, Kooy and Bakker, 2008,

Swyngedouw, 2004), sanitation (McFarlane, 2008b, Botton and de Gouvello, 2008, Chaplin, 1999) and electricity (Jaglin, 2008, Ruiters, 2009). These studies show how infrastructures reflect and reinforce wider social relations across cities and are particularly present in the urban political ecology (UPE) literatures, which provide the entry point for the thesis in approaching research on urban energy networks.

1.2.4 Approaching dialectical infrastructures

“We reach out dialectically (rather than inward deductively) to probe uncharted seas from a few seemingly secure islands of concepts” (Harvey, 1985: xvi).

A series of often paradoxical, conflictual and political dynamics shape and are shaped by infrastructure systems, that on the surface may be invisible, mundane and the background to urban life in African cities prompting the need to consider how these relationships and dynamics can be approached. One way to investigate these processes is through a dialectical approach that has been mobilised across a number of Marxist studies of the city (Davis, 1998, Harvey, 2003, Merrifield, 2002) and particularly across the field of UPE (Gandy, 2002, Kaika, 2005, Swyngedouw, 2004). As Engels (1996[1847]:27) argues:

“For dialectical philosophy nothing is final, absolute, sacred, it reveals the transitory character of everything and in everything; nothing can endure before it except the uninterrupted process of becoming and passing away”.

Dialectical philosophy is to understand the world as multiple, unfolding processes that are reshaped and co-constituted through their contradictions and relationalities. It is this perspective that provides the foundation to how the thesis is approached, generating a way to think, consider and explore infrastructure systems, to develop theoretical responses and empirical knowledge, to trace, analyse and reflect on historical-geographical processes of networked systems. As Merrifield (1993:517) argues, “dialectics is both a statement about how the world is and a method of organizing the world for the purposes of study and research” and as the thesis will show this way of approaching the study of infrastructures provides a number of important points of guidance that shape and steer the study. At heart the dialectic of urban infrastructures reveals a city of flows, contradictions and relationships that remain transient, temporary, contradictory and infused with power and the logics of capital. This is a dialectical city that creates both hope and despair, improvement and crisis and shows the contradictions that lay at the centre of urban life. Positioning cities in such a manner is a dialectical way of reasoning, of thinking about the urban and infrastructure and of undertaking a geographical study that informs the theoretical framework, the methodology, fieldwork and analysis.

1.3 Situating the research and its aims

Much of the literature on African and global South cities remains focused on technological, managerial and developmental orientations and is increasingly critiqued (Pieterse, 2005, 2010) for being, “poorly informed theoretically” (Mbembe and Nuttall, 2004: 349) and for being shaped by urban theory and concerns from the North (Robinson, 2002, 2006, Roy, 2009, McFarlane, 2008). Responding to these challenges, a range of studies, grounded within actual existing conditions of African urbanism and focused on political ecological processes analyse a range of dynamics that attempt to bring together UPE with new ways to conceive of cities in the South (Graham and Ernstson, 2012, Gandy, 2006, Lawhon, 2012a, 2012b, in press, Loftus, 2006, 2012, Myers, 2003, 2005, 2008, 2011, Njeru, 2006). These studies have explored urban infrastructures in the widest sense and contribute to a growing critical body of research on African urban environments, revealing the politicised nature of the urban. This African focused UPE literature has emphasized the importance of developing responses to the postcolonial critiques of much of the urban knowledges being produced across and through African cities whilst seeking to uncover the wider dynamics shaping these urban environments. The thesis engages with these literature and the wider UPE field to propose a conceptual framework predicated on a dialectical approach that is situated within the African context and across the urban energy network. The conceptual framework reflects four interlinked ways of conceiving electricity systems in Accra and Cape Town. Firstly, that these energyscapes are historically produced both materially and discursively (Section 2.7.1). Secondly, that these energyscapes are mediated through metabolisms of capital, climate and crisis (Section 2.5.2). Thirdly, that energyscapes are negotiated by urban dwellers, mediating a dialectical, everyday urbanism (Section 2.6.4). Fourthly, that these energyscapes are infused with power relationships across the multiple social relations that incorporate urban governance (Section 2.5.3).

Drawing on the conceptual framework the thesis aims to interrogate the conditions in which the global aspirations for centering energy concerns and the emerging climate change agenda are being translated across cities networked systems. Through doing this it seeks to contribute to critical studies of infrastructure and wider debates about African cities through politicizing African urban environments and particularly energy systems in Accra and Cape Town. The thesis approaches this research aim through empirical investigation in Accra and Cape Town that has two objectives. Firstly, to critically explore the contested processes of network reconfiguration that are taking place in relation to climate change and energy issues; and secondly, to develop a African situated UPE approach for undertaking research on urban energy networks. Whilst UPE has tended to focus on water infrastructures in the city (Bakker, 2003, Gandy, 2004, Kooy and Bakker, 2008, Loftus, 2004, 2006, Swyngedouw, 2004) the growing agendas around climate change, energy and infrastructures generates the need to develop critical approaches to these dynamics. As such the research questions are shaped toward seeking to explore this aim within the specificity of urban energy networks in low income neighbourhoods of Accra and Cape Town. The research questions are aimed at developing both conceptual and empirical responses to these objectives. These are:

How have urban energy networks historically been configured in Accra and Cape Town, and with what consequence?

How, why and with what implications are energy systems in low income, networked neighbourhoods being reconfigured in Accra and Cape Town?

What do processes of reconfiguration reveal about wider social relations in Accra and Cape Town in relation to the emerging energy and climate change agenda?

The first research question has been developed to generate information and data that contributes towards a historically informed, contextualised study, one that would be situated within the wider political ecological histories of both cities and that could illuminate historic processes of investment, politics, splintered urbanism and more and is addressed in chapter four. The second research question seeks to identify the various ways in which network reconfiguration processes unfold in the low income, networked neighbourhoods from everyday practices through to larger scale investment and are explored in chapters five and six. The third question generates the focus of the study on seeking to understand how processes of network reconfiguration are reshaping wider social relations across both cities and is explored in chapter seven, whilst also influencing the unfolding analysis in the other analytical chapters.

1.3.1 Contributions

The thesis aims to contribute to emerging approaches and empirical studies concerned with interrogating the translation of climate change and energy agendas across the networked systems of cities. This contribution is predicated on the politicized nature of urban infrastructures across African cities and will focus on two main areas. Firstly, the thesis will provide a range of case studies and data predicated on an empirically grounded study of processes of reconfiguration in low income, networked systems of both cities. The need to generate knowledge about actual existing conditions in African cities in relation to the climate change and energy agenda is important, with these urban spaces being under represented compared to cities in other global regions. This is particularly the case with energy systems, where there has been a lack of focus on the urban scale compared to growing critical attention to water infrastructures. As climate change, energy security issues and poverty become ever more urbanized and entwined the need to generate research becomes pressing, both in identifying the political ecological processes but also in analysing these dynamics to support wider debates about African cities. Secondly, the thesis will contribute to ongoing debates about theoretical approaches for undertaking research concerned with the political nature of urban infrastructure in African cities particularly in relation to the debates taking place across the field of UPE.

1.4 Thesis Structure

The aim of *Chapter two* is to establish the conceptual framework upon which to build a critical analysis of the reconfiguration of urban infrastructure in Africa. First, it examines the different means through which questions of infrastructure and the city have been addressed in the existing literature, exploring the development of approaches including Large Technical Systems (LTS), Science and Technology Studies (STS) and Splintered Urbanism. The chapter argues that the critical insights into the relationship between urban politics, inequality and infrastructure offered by UPE provide the most promising means through which to build an approach. This is a way of viewing the urban which is sensitive to the dialectical approach adopted in this study, and which can also make space for thinking the city through the importance of infrastructures in mediating urban life. Second, the chapter engages UPE with recent developments in urban theory that are centered on global South and African urbanism by excavating the history of African cities in traditions of knowledge production, arguing that these spaces remain peripheral to urban theory and approached through developmental orientated research. The chapter engages with emerging theorizations of global South cities to suggest that a number of concepts can challenge these traditions and provide a further conceptual underpinning to the thesis. Proposing a conceptual framework that aims to articulate a African situated UPE the chapter argues that such an approach can critically interrogate the reconfiguration of networked systems in Accra and Cape Town, bringing together a concern both with political ecological processes and the everyday urbanism of these spaces.

In *Chapter three* the methodological approach of the thesis and the wider issues pertaining to methodology involved are outlined. The aim of the chapter is to provide not only an overview of how the sites of research were selected and the types of data collection undertaken but a reflection on the nature of such research in the context of the postcolonial aspirations of the study, both in the field and throughout the research. The chapter begins by firstly, outlining the research framework for the study that structured the fieldwork and guided the methodology. Secondly, the chapter explores the potentialities and limitations of a comparative urbanism using the methodological approach to explore, justify but also question the process from which the selection of comparative cities (Accra and Cape Town) and comparative sites (networked, low income communities) was undertaken. Thirdly, the chapter reflects on the range of data collection methods mobilized, illustrating how the varied tools of research were employed within specific contexts and the applicability of these methods in relation to the African situated UPE approach. Fourthly, the chapter explores analytical approaches of narrative analysis. This illustrates how diverse and seemingly problematic data has been brought together to draw out emerging themes, issues and knowledges from the research participants. Fifth, the chapter seeks to reflect on the postcolonial and ethical considerations that guided the data collection, research methodology design and fieldwork practice.

Chapter four provides the response to the first part of the conceptual framework. This chapter explores the dialectical histories of infrastructure systems across Accra and Cape Town in order to develop a historical perspective of the legacies of colonialism and apartheid and the multiple, differentiated ways in which they have shaped and mediated networked systems across both cities. The chapter undertakes this through two

main components to the chapter. Firstly, through a critical commentary on the history of urban energy infrastructures at a city scale. This involves charting the ways in which colonial, apartheid and post-colonial, post-apartheid periods of history have intersected with these networks with the thesis arguing that a splintered urbanism has characterised these eras of urban governance, creating a historical legacy of a divided or splintered infrastructure. Secondly, by exploring the histories of infrastructure within the particular neighbourhood spaces that constitute the focus of the research the thesis argues that such histories have shaped particular configurations of infrastructure, attendant social relations and the terrain from which reconfiguration emerges. This is undertaken through developing a history of each neighbourhood, considering this within the context of the energy network, identifying and analysing network reconfiguration and finally reflecting on the current condition of networked services in these areas. The chapter argues this is a post-colonial or post-apartheid condition in which the infrastructures of the cities are deeply divided providing the energyscape from which various urban actors and intermediaries seek to reconfigure networked systems and the context in which emerging logics, rationalities and imperatives around climate change and energy are embedded.

Chapter five provides the response to the second part of the conceptual framework and relates to the ways in which networked systems are (re)configured through multi-scalar metabolic processes. The chapter is predicated on examining the metabolism of capital, climate and crisis in relation to the networked systems of Accra and Cape Town. It focuses on how network reconfiguration connects to wider processes of the urbanization of nature, infrastructure investment and market or state-led interventions, together with the consequences of these urban metabolisms across the low income case study neighbourhoods. Using the concept of urban metabolism indicates a concern to not only trace and make visible but importantly centre the multifold ways in which capital intersects with climate and mediates the electricity networks in both cities. The chapter develops two linked analysis. Firstly, by exploring the ongoing sense of crisis in Accra, when the lights go out and the flow of electricity is interrupted, arguing such moments provide a window in which to explore a series of dialectical metabolic processes that produce, mediate and shape the energy network via the urbanization of nature. Secondly, the analysis explores the metabolic processes that constitute crisis for the urban poor in Cape Town incorporating the cold and damp winters in the Western Cape and the links to health, disease, poverty and flows of (under) investment into low income neighbourhoods. The chapter shows how the production of crisis across networked systems is a crisis for the urban poor, who are left vulnerable to the metabolisms of capital and climate, instigating a range of responses from multiple urban actors including municipalities, utility companies and residents themselves.

Chapter six provides the response to the third part of the conceptual framework and relates to the everyday ways in which networked systems are (re)configured. The chapter considers how an expanded notion of urban metabolism, that frames the dialectical responses across low income networked neighbourhoods to the flows of capital, climate and crisis outlined in the previous chapter as part of these circulations and flows. By extending urban metabolism into the everyday spaces of the network the analysis can respond to the conceptual framework that argues for the need to incorporate these processes in order to examine the reconfiguration of networks in both cities. The chapter argues that in cities characterised by widespread

inequality, splintered urban infrastructure and an increasingly market orientated and post-networked investment trajectory a series of dialectical responses to these conditions can be identified across urban energy networks. By mobilizing a number of concepts developed across urban studies to approach global South urbanism the chapter explores clandestine connections to the network, material improvisation, urban learning, and the mobilization of people as infrastructure to examine the dialectical urbanism of the everyday. To consider the electricity networks in low income communities in Accra and Cape Town is to recognise across the energyscapes of both cities that vast numbers of urban dwellers who are left to get by, generate opportunity and find new ways to navigate urban life on the periphery of networked systems and the formal city.

Chapter seven provides the response to the fourth part of the conceptual framework and relates to the social relations of network reconfiguration. The chapter seeks to take forward the analysis of network conditions outlined in the previous chapters to specifically examine the relationships between various urban actors involved in network reconfiguration and the power relations between these different actors. This is developed through a focus on the urban governance of networked systems, that is the institutional arrangements that shape particular pathways of network reconfiguration and how these are influenced by wider logics, policy imperatives and rationalities across Accra and Cape Town. This is undertaken firstly, by comparatively analysing the power relationships across the urban governance of networked systems in the case study neighbourhoods through examining how different forms of reconfiguration produce, reflect and reinforce social relations between the state, wider urban intermediaries and residents in low income areas. Secondly, the chapter reflects on the urban governance of networked systems to argue that they reveal a series of important considerations about the diverse institutional arrangements, circulating policy knowledges, logics and imperatives involved in shaping such governance, arguing that these dynamics link into a series of multi-scalar power relationships. The chapter argues that this provides an analytical position in which to develop a critique of the city scale (and beyond) governance in both cities and the power relationships and implications of such arrangements. Fourthly, the chapter seeks to reflect on the strategies by low income communities to shift power relations across networked systems and through processes of network reconfiguration suggesting that these struggles take place across the terrains of both civil and political society.

Chapter eight provides the conclusion to the thesis and it considers the research questions in relation to the findings (Chapters 4-7) and conceptual framework. The chapter begins firstly, with a brief introduction that provides an overview of the focus of the thesis. Secondly, it then reflects on the conceptual approach, seeking to consider how a African situated UPE provides an approach to research and analyse African cities and some of the strengths and limitations of such a framework. Thirdly, the chapter examines each of the research questions, bringing together the findings developed throughout each of the chapters to suggest important considerations between the intersections of climate, energy and infrastructures across Accra and Cape Town. Fourthly, the chapter examines the research implications of the thesis looking at the issues of who has the right to reconfigure and how the findings provide policy and practice considerations around energy, climate change and incremental urbanism. Fifth, the development of the thesis has been designed to

address the major issues within which it is situated and provides a number of important findings in relation to networked systems in low income neighbourhoods. As such the chapter considers some of the future areas of research generated from the thesis that outline ways for low income residents and other urban actors to address current current socio-environmental inequalities in the context of the logics, rationalities and imperatives of urban climate change and energy agendas.

Chapter 2: Infrastructures of Theory

The aim of this chapter is to establish the theoretical basis upon which to build a critical analysis of the reconfiguration of urban infrastructure in Africa. Firstly, it examines the different means through which questions of infrastructure and the city have been addressed in the existing literature. The critical insights into the political nature of infrastructure offered by UPE provide the most promising means through which to build an approach. This is a way of viewing the urban which is sensitive to the dialectical approach adopted in this study and which can also make space for thinking the city through the importance of infrastructures in mediating urban life. Secondly, the chapter engages UPE with recent developments in urban theory that are centered on global South and African urbanism. Through this encounter, it becomes possible to develop a conceptual framework that is informed by the critical insights from both of these sets of work and the chapter shows that this critical intervention can offer a contribution to a vibrant emerging field focused on urban infrastructures of the South.

The review of existing literature begins firstly, with a brief overview of earlier infrastructure studies that illustrate that critical approaches to these systems are relatively recent. Secondly, with an overview of STS from the early work on LTS and historical studies of infrastructure that begin to consider networks as socio-technical and to link them to the city. The chapter examines the intersections with Actor Network Theory (ANT) which contribute a series of important re-imaginings of networked systems that influence infrastructure studies particularly in relation to viewing these systems as in flux, yet in the context of the thesis also has a number of limitations. Thirdly, the Socio-Technical Transition (STT) literature is then explored in order to examine another pathway from which STS work on infrastructures travels. The thesis argues STT conceptual approaches are unable to offer the study the necessary tools to conduct the research because of a focus on elites, innovation rather than existing conditions and a tendency to ignore the city as a site of technological change. Fourthly, the review then goes on to argue for the importance of ‘Splintered Urbanism’ (Graham and Marvin, 2001) and the ways in which it centre’s urban infrastructures, provides a series of important insights and opens a number of empirical and conceptual challenges. Whilst the thesis suggests that this does not provide the conceptual framework it argues that the notion of splintered urbanism is a key way to approach networked systems and shows how this is incorporated into the concerns of the study. Fifth, the chapter reviews the field of UPE arguing that this field of work on infrastructures provides an approach from which to dialectically investigate the histories, flows of capital and relationships between infrastructures and social relations, within the context of global South cities. This is done through a particular configuration of UPE literatures that bring together historical materialism with notions of cyborg urbanisation. The second part of the chapter is focused on critically reflecting on the UPE conceptual framework to address postcolonial critiques of urban theory and the need to produce a thesis grounded in the actual existing conditions of urbanism in African cities. The thesis argues that by considering the dialectical production of cyborg urbanisation a theoretical space is opened up to expand urban metabolism into the everyday circulations and flows that constitute urban life in African cities. Finally, the chapter outlines the conceptual framework for the thesis, arguing it provides a African situated UPE approach to examining network reconfiguration in Accra and Cape Town and is reflected in each of the four analytical chapters. This

conceptual framework incorporates firstly, a focus on the historical patterns of urbanization that produce infrastructures. Secondly, the structural and thirdly, the everyday processes and dynamics that reconfigure networked systems. Fourthly, a focus on the urban governance and power relationships of these urban networks. This chapter and subsequent chapters argue and illustrate why these concerns are important to examining network reconfiguration in Accra and Cape Town specifically and wider infrastructure dynamics generally.

2.1 Early history of infrastructure studies

Critical urban studies have traditionally ignored the infrastructural nature of the urban. As Hodson and Marvin, (2010: 477) comment, “Until recent decades the provision and organisation of these critical infrastructures was largely perceived unproblematically, and taken for granted as largely engineering challenges and administrative issues”. This is not to suggest a history of engagement with urban infrastructures had not existed previously. Chadwick’s (1842), conceptualisation of the Victorian city and its sanitary conditions draws on ideas of circulation to (incorrectly) understand the terrifying spread of cholera and prompted John Snow’s (1854) ‘Ghost Map’ tracing cholera cases to the water system. Lewis Mumford’s (1961) study, ‘The City in History: Its Origins, Its Transformations, and Its Prospects’ promotes an organic city in which technological and natural systems provide a balanced infrastructure beyond the mechanised systems of the industrial revolution, exploring the relationship between technologies and the city. In the 1970s Marxist political economists explore the role of the state in providing infrastructures to facilitate the accelerating capitalist nature of the urban economy (Harvey, 1973, Lojkine, 1976) in which, “the materiality of urban infrastructures was one of the entry points into excavating the nature of capitalist urbanization and the role of the state therein” (Swyngedouw, 2003a:130). A paucity of theorisation and empirical work focused on urban infrastructures characterised much of the 20th century whilst other concerns, such as the role and structuring nature of urban policy or urban growth and decline, dominated disciplines such as geography, planning or technology studies. Over the last 25 years this lack of research on urban infrastructure has given way to new critical, social scientific explorations of urban systems. These often disparate, sometimes conflicting and relational bodies of literature provide a number of different conceptual pathways, debates and directions that position infrastructure at the heart of theorizations of the urban and are explicitly concerned with the materialities of these networks.

2.2 Science and Technology Studies (STS)

STS involve examining the ways in which initially science and later on technology innovation shapes and is shaped by society and are an important part of the development of studies of urban infrastructure. These STS are focused not simply on the technical configurations of networks but how they need to be considered as socio-technical and examined within the urban context. This section looks at different parts of the STS literature. Firstly, at the LTS and historical studies of infrastructure literatures that offer a significant contribution to examining networked systems and secondly how these concerns have been taken forward by

engaging more explicitly with the urban and through ANT approaches to the city. Finally, the section reflects on the contributions of these literatures to the thesis and some of the limitations of such work in relation to the aims and objectives of the thesis.

2.2.1 Large Technical Systems (LTS) and historical studies of infrastructure

STS are focused not simply on the technical configurations of networks but how they need to be considered as socio-technical. Within STS infrastructure systems has become an important area of research that helps to support the emergence of this field of study across academic disciplines and can be traced to the work concerned with LTS. Hughes's (1983) work is an examination of the historical development of the electricity network within the national contexts of the USA, UK and Germany and the study opens an emerging field within the STS community that focuses on the concept of LTS and technological innovation. By conceptualising technologies as systems that consist of, "coherent structures comprising of interacting, interconnected components" (Hughes, 1983:xi) infrastructure systems begin to be considered in greater detail. Here, cities form a key, if understated part of Hughes's (1983) exploration of the electricity network, implicitly foregrounding the infrastructural nature of the urban. The LTS approach focuses on the innovation of the invention to the technology transfer, its subsequent system growth and the momentum that Hughes's (1983) views as the resistance to change that characterises these systems. The conceptual underpinning of the LTS approach is predicated on a focus on how technology innovation, institutional environments and social practices can (de) stabilise and embed infrastructural systems. This insight becomes an analytical tool that can be taken up by those interested in infrastructure systems as socio-technical. Hughes's (1983, 1987) work opens up new avenues of enquiry around understanding LTS across a range of scales, including the urban and provides a series of considerations around how these systems change. As Graham and Marvin (2001:180) suggest studies of LTS, "help demonstrate how systematic changes appear in the technological fabric of society, as interrelated clusters of innovations sometimes cohere into large technical systems through processes of social, political and institutional agency and entrepreneurship". As Coutard (1996:47) argues, "apart from some specific studies the territorial dimension of LTS has been ignored" showing a lack of spatial understanding of technology systems (Graham and Marvin, 2001). Alongside the work by Hughes (1983, 1987), another important field within STS begins to spatialize LTS at the urban scale through historical studies of cities that explicitly foregrounded the importance of technology systems to the development of cities (Tarr, 1984, Tarr and Duputy, 1988). This historical approach to infrastructures examines the dialectical relationships between the development of modern cities and the huge networked systems that became part of urban landscapes. The work of Tarr (1984) on infrastructure begins an engagement between critical social sciences and urban infrastructure that move beyond normative accounts of system development, taking these issues outside of the realms of engineering and applied research to develop analysis that considers wider social, political and economic processes. These literatures provide an important contribution to infrastructure studies as Monstadt (2009:1927) argues, "it is one of the contributions of historical studies of technology to have described networked infrastructure as socio-technical systems and to have brought an explicitly urban perspective to the study of infrastructure". For instance, Nye's (1992) history of electrifying America explores the multiple ways in which electricity

entered everyday life within the context of the links between technology, culture and social life. These early literatures concerned with innovation, technology systems and historical development have become a departure point for wide ranging infrastructure studies, with much of the work being taken forward specifically focused on the urban scale and expanding in multiple different directions within and beyond STS.

2.2.2 Urban infrastructure and Actor Network Theory (ANT)

Following work on LTS and historical studies of infrastructure it was not until the late 1990s that STS scholars started to engage in earnest with questions of the urban (Coutard, 1999, Coutard and Guy, 2007, Summerton, 1999) that are firmly focused on, “the present, reconstructing and innovation governance of socio-technical systems” (Monstadt, 2009:1929). This scholarship drew not only on LTS and historical studies of infrastructure but also increasingly on the work and debates centered on ANT (Callon, 1991, 2007, Latour, 1993, 1997, 2005). Latour (1997: 2) contends that, “modern societies cannot be described without recognising them as having fibrous, threadlike, wiry, stringy, ropy, capillary character that is never captured by the notions of levels, layers, territories, sphere...structures, systems”. This ANT position is predicated on the abandoning of a priori distinctions between the social and technological, the city and its infrastructure, humans and non humans, to re-imagine the world as complex assemblages that favors interconnection over categorization. ANT provides a number of important contributions to how infrastructures are conceived. Firstly, Latour (1997, 2005) seeks to locate agency in the ‘more than human’ and in the interrelation between humans and non-human agents in networks. ANT helps to shift the terrain of urban infrastructure studies, with these networked systems being seen in this field as diverse assemblages of networks, spaces and practices that encompass both human and non-human actants (such as electricity, pylons and so forth). ANT brings together nature and technologies, as a method of analysis that has sought to re-imagine the city beyond the notion of a bounded entity (Farias and Bender, 2009). As Thrift (2000:5) comments ANT views the world and thus urban infrastructures as:

“diverse series of acts of heterogenous engineering by which is meant that the world is made up of diverse networks of association which are constituted by networks of associations, by the links rather than the nodes of the network and more than this by the traffic through the links”.

Such an approach provides a widening field of enquiry and a range of important approaches that can be applied to urban infrastructures as Graham and Marvin (2001:185) comment, “the development of networked infrastructures within and between cities boils down to the linkage of massive, heterogeneous arrays of technological elements and actors, configured across multiple spaces and times”. Secondly, ANT challenges the idea of urban infrastructure as a ‘thing’, rather that we frame these urban systems as a multitude of flows, circulations and dynamics across heterogeneous networks. Latour (1993:117) describes technology networks as, “thrown over spaces, and they retain only a few scattered elements of those spaces. They are connected lines, not surfaces”. Thirdly, Latour’s (1997) work to dissolve dualities such as structure and agency, human and non-human also reaches out to scale, arguing that it is, “a mistake to develop a binary opposition of local and global infrastructure networks” (Graham and Marvin, 2001:189) and illustrating the need to examine the

multi-scalar connectivity that reaches out from neighbourhoods out across urban, regional and global dynamics, to view infrastructures as dispersed and in flow, both hyper-local and grounded and global and stretched. Fourthly, the influence of ANT on wider STS engagements with urban systems is to examine these networks or assemblages as a source of agency in themselves and to seek to comprehend the mutual shaping and reshaping between and across urban infrastructures and society. This is, “because STS concepts pay attention to both the social shaping of technology (or, here, spatial artifacts) and the technological shaping of society” (Hommels 2005, 329). Latour’s (2005) work produces new understandings of the urban that enable us to conceptualise the role of nature and technology, allowing us to view urban space as relational, abstract and configured around network assemblages in continual circulation and brought to life vividly through Latour and Hermant’s (2006) account of ‘Paris, the Invisible City’.

STS accounts of the urban, predicated on ANT, focus on a distributed and extended notion of agency within flows and networks, prioritising movement, circulation and mobility across the city. This provides an important way of conceptualising networked systems, contributing to understandings of urban infrastructures that have influenced both STS of networked systems and wider literatures, including the growing and related field of assemblage urbanism (Farias, 2009, Farias and Bender, 2009, McFarlane, 2011a) and UPE (Section 2.5). As Swyngedouw (2006:110) comments these insights have, “provided a new grammatical apparatus that has profoundly revitalized empirical studies of human–nature–technology relations” and no where more so that in infrastructure studies. These STS approaches whilst making significant contributions to the study of urban infrastructures and the conceptual approach also have a number of limitations in relation to this thesis that are subsequently explored.

2.2.3 The limitations of ANT in relation to urban infrastructure

Whilst the contributions to urban infrastructure studies by ANT based work have been substantial and help to influence and shape multiple approaches to urban networks, including across the field of UPE, the thesis contends there are a number of limitations in relation to developing a dialectical approach to network reconfiguration. Firstly, STS approaches to networked systems are based on the construction of a dispersed model of movement, networks and flows. Whilst the thesis draws on this important reconceptualisation of networked systems this brings the model of the city into tension with the structural aspects that shape the urban and as Gandy (2005:31) contends mask a fundamental constituent of the processes of urbanisation:

“the emphasis on the fluid characteristics of urban space risks overlooking the particular combinations of fixed capital and human expertise that enable specific nodes within the global system to play enhanced roles in the arena of cultural and economic production”.

Although the thesis positions the city as a series of flows and networks it also recognizes Gandy’s (2005) caution and need to consider how urbanisation is structured. One way to consider this tension is through the work of Harvey (1996) who suggests the potential to (partly) reconcile these perspectives through the concept of permanences that can and must exist within and across these movements and circulations. Harvey (1996:81) terms this ‘relative fixity’ and draws away from Latour’s (1997, 2005) concentration on flow:

”flows often crystalize into things, elements, and isolable domains or systems which assume relative permanence within the social process. Reifications of free flowing processes are always occurring to create actual permanences in the social and material world around us”.

The argument put forward by Harvey (1996) for ‘relative fixity’ becomes an important juncture for this thesis as it simultaneously encompasses a certain level of structure [or crystallisation] that affects other processes, whilst acknowledging that these are dialectically produced through flows and circulations and remain part of an ongoing process of becoming that can link to ANT perspectives of the urban. This tension is explored further in an examination of the concept of cyborg urbanisation (Section 2.5.2) which the thesis argues helps to resolve the need to approach urban infrastructures as both structurally shaped and dispersed, circulatory and in flow. Secondly and related to the first problematic of ANT in relation to the thesis is the perceived failure to critically position the role of technology and networked systems in processes of capital accumulation and the inequalities that these processes create and reinforce (Swyngedouw, 2006). STS, predicated on ANT notions of urban infrastructure tends to view an:

“ambivalence inherent in all technologies...Within an STS framework of analysis, therefore, a more plausible prediction might be that while in *some* instances both network and urban inequalities grow in a mutually-supporting process, in *other* instances this is not the case”
(Coutard and Guy 2007:781).

Coutard and Guy’s (2007) work, emerging from an engagement with ‘Splintered Urbanism’ (Graham and Marvin, 2001) (Section 2.4) criticises the ‘bleak world view’ of urban scholars that position urban infrastructures and technologies as a central part of the capital accumulation process. They reject the economic, institutional and technological determinism inherent in some urban theories, particularly those emanating from Marxist thinking and seek to break down the ‘dystopian alarmism’ of urban research (Davis, 2006) focused on uncovering inequalities in the city. Their position, shared by other STS scholars working on the city and those engaged with ANT, rejects the notion that capital accumulation processes will always create, through deployment of new technologies on markets, new inequalities. The position of Coutard and Guy (2007) is eminently contestable, within the context of this thesis, which requires a conceptual approach that can interrogate network reconfiguration to consider how unequal social relations are produced across and through these urban systems (Section 1.3). Cities are understood, within the context of the thesis as places of exclusion, inequality and power relations that are dialectically mediated by, and mediate urban infrastructures (Section 2.5.4). The requirement to uncover, trace, analyse and reflect on these processes requires a conceptual framework that foregrounds these concerns. Whilst the thesis acknowledges cities are also places of life, learning, hope and excitement as argued by Coutard and Guy (2007) a failure to centre the dialectical relationships between capital, infrastructures and socio-environmental conditions suggests that the thesis needs to engage with literatures more explicitly focused on these connections.

STS approaches, particularly those that have emerged from work on LTS and the theoretical insights of ANT, have provided important contributions to the urban infrastructure literatures and provided a series of conceptual imperatives, partly taken up within the literatures of UPE (Section 2.5) and influencing the

conceptual underpinnings of the thesis. These contributions include, firstly, the early work to show the socio-technical nature of infrastructure systems that are not simply technological systems but embody, reflect and reinforce wider societal relationships. Secondly, the notion of the city of flows and dispersed multi-scalar networks and thirdly, the rejection of a priori categorizations such as urban and nature. All of these STS anchored perspectives have influenced the development of the approach in the thesis but fail to provide a conceptual framework that can dialectically examine the social relations of networked systems and address the tensions around structure and distributed agency examined above.

2.3 Socio-Technical Transitions (STT)

The STT literature provides another field of study focused on technological innovation drawing on LTS and historical studies of infrastructure (Monstadt, 2009) to consider specific innovation paths of technologies and how these relate to institutional contexts, suggesting the potential to contribute to understandings of the politics of network reconfiguration. Whilst an important field of literature concerning urban infrastructures the thesis argues that a number of limitations including the focus on elites, innovation and the national scale, suggest that this conceptual approach is not suited to the requirements of the thesis.

2.3.1 Overview of STT framework

STT literature seeks to analyse how LTS undergo change through technological innovation. A STT can be defined as a series of, “major technological transformations in the way societal functions such as transportation, communication, housing, feeding are fulfilled” (Geels, 2002:1257) and can be understood through a multi-level framework that consists of the regime, niches and socio-technical landscapes that mediate these transformations. The socio-technical regime, can be understood as the, “shared cognitive routines” (Geels and Schot, 2007:399) of engineers, policy makers and so forth which takes place at the macro level. Technological niches, can be understood as, “the micro level where radical novelties emerge (Geels and Schot, 2007:400) and involves competing technologies seeking to take advantage of, for example a low carbon market. This level is characterised as unstable and acts as a series of ‘incubation rooms’ in small networks, only some of which will be successful. Thirdly, Geels and Schot, (2007:400) refer to the socio-technical landscape, which “forms an exogenous environment beyond the direct influence of niche and regime actors (macroeconomics, deep cultural patterns and so forth). For scholars the STT framework can offer, “a relatively straight forward way of ordering and simplifying the analysis of complex, large-scale structural transformations in production and consumption” (Smith et al, 2010:441-2). By seeking to identify, trace and analyse these processes, actors and institutional environments STT provides a potentially interesting conceptual underpinning for the study of infrastructure. And it is not just the realm of academic research in which STT analysis is being used. This framework is increasingly mobilised to inform and guide transition management, a separate but related branch of STT work with urban managers developing policy, interventions and positions, based on particular visions of urban sustainability derived from similar theoretical perspectives. It can be argued that STT analysis has an important place in the landscapes of debate concerning infrastructures, but also in the planning and management of these systems.

2.3.2 The limits of STT in critical studies of urban infrastructure

Whilst the STT framework has offered interesting accounts of technological and infrastructural change (Geels, 2006, Jacobsson and Bergek, 2004) the thesis argues against mobilising such a conceptual approach to examine Accra and Cape Town's networked systems. This is because of firstly, the failure of STT to address actors outside of elites involved with technological innovation. Secondly, the political dimensions of infrastructure that require a conceptual approach beyond an institutional understanding of innovation and change. Thirdly, the need to understand these processes at an urban level that can connect to a range of multi-scalar governance dynamics.

STT frameworks tend to place an analytical emphasis on elite actors and the role experts, innovators and policymakers play in shaping, mediating and reconfiguring urban infrastructures. As Seyfang and Smith (2007: 584) argue this ignores the influence actors outside of this techno-managerial nexus play in shaping innovation trajectories:

“Innovation and community action are two important strands for sustainable development. Yet they have not hitherto been linked. Community action is a neglected, but potentially important, site of innovative activity”.

The need to explore the range of actors involved in reconfiguring the energy networks in Accra and Cape Town suggests the focus on elite actors across STT work is problematic. With much of the research of the thesis situated in low income communities and explicitly concerned with how residents and other local actors are transforming the network beyond the state and private sector, the need to move beyond elite actors involved in reconfiguring the energy system is pressing and limits the potential of using an STT framework in such as context. A number of scholars have taken forward work on grassroots innovations (Seyfang and Smith, 2007) and these perspectives are interested in socio-technical change and the insertion within networks of different forms of innovation. By focusing on such innovation they miss what it is that keeps networks obdurate and the power relationships that shape such dynamics. The second limitation of STT concerns its focus on institutions rather than politics as its notion of socio-technical, underplaying the political and contested nature of network reconfiguration. The STT focus on elite actors, already outlined, creates an emphasis on processes of technological and infrastructural innovation amongst global IT companies, government agencies and financial institutions. Whilst this is an important area of focus in understanding how technological niches can develop into infrastructural norms it also constitutes an inherent limitation in the STT literature by shaping an institutional understanding of these processes at the expense of wider considerations around the political. If the STT framework can illuminate the processes of innovation and change it remains limited in reflecting on the politics of these dynamics, the winners, losers and social relations reflected and reinforced across these processes. This failure to address the role of the political and how power relations shape urban system outcomes means that STT can be utilised within 'transition management' that is interested only in a narrow articulation sustainability and the socio-environmental. This thesis is concerned with the contested processes and politics of energy networks in African cities and the

failure of STT literature to offer a means to critically approach these issues would seriously limit the analytical scope of the research. The third tenet of critique is concerned with the relationship between geographic scale and the STT literature. A limited, although growing number of scholars explore an STT analysis at an urban level (Bulkeley et al, 2011, Hodson and Marvin, 2010, Monaghan et al, 2009) suggesting promising intersections with other bodies of literature (Lawhon and Murphy, 2012). Yet much of the existing work takes place at a national scale, reflecting a lack of engagement with space and geography generally and places, such as cities and regions, specifically:

“The MLP is interested in the socio-technical transformation of ‘societal functions’. The role of places and spatial scales in these transition processes has not been an explicit issue of concern. The tendency has been to presume regimes operating at a national scale, perhaps for reasons to do with nation-state policy audiences” (Smith et al, 2010: 443).

This focus toward STT analysis at the national scale is problematic in seeking to explore urban infrastructures with, “the role of cities in transitions approaches consequently uncertain, fragmented and often implicit” (Hodson and Marvin, 2010:480). Firstly, it presumes that societal transformations are occurring at the national scale, ignoring the role of cities in seeking to explore new pathways in infrastructural investment, experimentation and upscaling. As globally connected risks, hazards and security paradigms emerge (and converge), ranging from climate change through to financial meltdown, cities are increasingly involved in exploring governance and technological responses to these challenges (Section 1.1.3). They challenge the focus of STT researchers to move beyond the national scale and to direct attention to the urban, regional and metropolitan scales as sites for innovation and technological change. Secondly, this STT focus on the national scale diminishes the connected multi-scalar processes of governance that are involved in infrastructure and technological change (Bulkeley, 2005, Monstadt, 2009, Hodson and Marvin, 2010). Innovation and transitions are often embedded, shaped and influenced across a multitude of local, citywide, regional, national and international networks of actors, governance, policies, technologies and financing and infrastructure represents this conflux of various geographic scales:

“With (the variable) privatisation and the liberalisation of many infrastructures and the opening up to competition of infrastructure provision – a wide range of distributed stakeholders and social interests are now involved in the functioning of sociotechnical infrastructure systems” (Hodson and Marvin, 2010: 278).

Work has taken place to acknowledge and explore how to open STT analysis to connect these multi-scalar processes rooted within an explicit analysis of the urban (Monaghan et al, 2009, Hodson and Marvin, 2010), although rarely in global South cities. However, this has been a limited engagement and the role of multi-scalar processes in mediating urban infrastructures remains underdeveloped in the STT literature, forming a problematic tension for developing a geographically rich analysis. Whilst the STT literature provides a growing body of empirical and theoretical knowledge around technological change and innovation the need to develop critical perspectives that engage beyond the limitations of this work remain salient. Shove and Walker (2008: 768) suggest such perspectives can be developed by:

“loosening the intellectual grip of ‘innovation studies’, for backing off from the nested, hierarchical multilevel model as the only model in town, and for exploring other social scientific...theories of change” (Shove and Walker, 2008: 768).

An STT framework may provide fruitful avenues to uncover processes that are shaping urban systems but the limits of this conceptual approach are unable to support a critical examination that centres the political nature of infrastructure.

2.4 Splintered Urbanism

The publication of Graham and Marvin’s (2001) ‘Splintered Urbanism’ provides an important intervention in the emerging literatures around urban infrastructure and a departure point for scholars seeking to theorise the changing nature of urban systems, drawing on the LTS literatures and the ANT theorisations of the urban whilst centering the importance of capital accumulation processes that unlike STT focus both on the urban and the production of inequality across the city, via networked systems.

2.4.1 Overview of splintered urbanism

Emerging from STS approaches to infrastructures and technologies, Graham and Marvin’s (2001) work draws on and develops both LTS and ANT concerns with urban systems. Yet ‘Splintered Urbanism’ also goes beyond these fields of infrastructure studies by incorporating a political economy of capital accumulation processes and networked systems, alongside relational theories of the urban (Graham and Marvin, 2001). ‘Splintered Urbanism’ can be considered as offering a critical history of infrastructure that seeks to provide a narrative of the city that places urban systems at the centre of our understanding, explicitly ‘urbanising’ the work of Hughes (1983) and Latour (1997). Arguing that these networks have remained hidden and taken for granted within urban studies ‘Splintered Urbanism’ provides an analysis and pressing call for engaging with networked systems as the key mediators of urban life. Graham and Marvin (2001) develop a critical history of infrastructure that explores the importance of (urban) networked infrastructures and the ways these systems are used to connect and exclude populations. By examining the history of urban infrastructures, Graham and Marvin (2001) provide a narrative concerned with the rise of modernist urban thought and planning and its promises to provide integrated urban systems, technologies and infrastructures for all of society, in what the authors term the ‘infrastructural ideal’. From this high point in modernist urban planning the ‘Splintered Urbanism’ narrative traces the movements away from the promise of an integrated networked infrastructure toward a series of ‘unbundled’ infrastructures. The narrative explores the relationship between the fall of the Keynesian welfare state, the emergence of neoliberal practices of infrastructural privatisation and how these global shifts in political economy came to dramatically transform the governance, form and operation of urban infrastructure. These shifts in global political economy, supported the splintering of the networks service provision model, that unbundled the integrated and coherent systems of Keynesian state planning, focusing only on low risk, high profit elements:

“Given the long term and risky nature of infrastructural investment, investors from financial markets are likely to be reluctant to invest in large scale, comprehensive and bundled networks” (Graham and Marvin, 2001:97).

‘Splintered Urbanism’ provides a broad commentary of the processes of fragmentation that characterise many infrastructural systems during the neoliberal era, but perhaps more importantly widen the focus of change or evolution in which the earlier, STS research of networked systems, has broadened, to engage with wider issues of capitalist urbanization and political economy and therefore becomes important to this thesis by explicitly centering these processes. Graham and Marvin’s work (2001) provides the basis for a growing field of empirical and conceptual investigation into infrastructure seeking to understand the cause, course and consequences of these processes, what they reveal about the contemporary city and how they are shaping urban futures (Botton and de Gouvello, 2008, Jaglin, 2008 Coutard, 2008, Zerah, 2008, Fernández-Maldonado, 2008, Kooy and Bakker, 2008). These studies span a range of different theoretical and empirical concerns in an array of different contexts including seeking to examine splintering dynamics in global South cities (Section 2.4.2). The importance of this wider body of work that draws on and seeks to take forward ‘Splintered Urbanism’ (Graham and Marvin, 2001) for the thesis has been to reinforce the conceptual focus that foregrounds urban infrastructures as mediating urbanism and urban social relations as political issues. To examine the research foci with which this thesis is concerned requires a point of departure to engage with urban infrastructures that ‘Splintered Urbanism’ establishes through its assertion that such systems are divided, reflecting the wider social and political conditions of urbanization. However ‘Splintered Urbanism’ (Graham and Marvin, 2001) does not offer a conceptual lens as such in which to take forward these infrastructural studies partly because the focus on integration and coherence is regarded as something to aspire to, rather than one of many political projects for the city and partly because of its applicability to global South cities. Rather, it instead opens pathways for further detailed study that converges around critically exploring urban networks and the role of different urban theories in seeking to approach the splintered nature of cities. The prodigious number of themes, narratives and processes identified, but often not fully explored within ‘Splintered Urbanism’ means, “it often raises more questions than it can possibly answer” (Swyngedouw, 2003a:130), generating a basis for a vibrant field of critical infrastructure studies but not a conceptual framework in which to examine these issues. Each of the subsequent chapters in the thesis interrogates Accra and Cape Town through the notion of a splintered, rather than splintering infrastructure, reflecting the influence of Graham and Marvin’s (2001) work in approaching networked systems.

2.4.2 Splintered urbanism beyond the North

Although wider STS of networked urban infrastructures in the global South remain limited the ‘Splintered Urbanism’ thesis has explored infrastructural processes in cities of the South and been considered in a number of empirical studies over the last decade. Graham and Marvin (2001) acknowledge the different infrastructure histories of the colonial city in which, “During the period of formal and direct control of core countries over their colonial dependencies infrastructure was developed along a highly selected trajectory” (Graham and Marvin, 2001:92). The authors also explore the factors that shaped infrastructure investment pathways in global South cities:

“It was increasingly obvious that infrastructure networks in developing cities were outcomes not of smooth, natural processes of innovation and diffusion but of political and economic battles” (Graham and Marvin, 2001:129).

The ‘Splintered Urbanism’ thesis is one based on the modern networked city of the North and has been constructed in reference to these cities, not the cities of the South. Kooy and Bakker (2008) consider the application of the ‘Splintered Urbanism’ (Graham and Marvin, 2001) narrative within the context of a historical study of public services in Jakarta. Their study suggests fragmentation of the urban systems has existed as part of the legacy of colonial administration claiming, “Jakarta’s water supply system was not substantially characterised by the rise (or fall) of the modern infrastructural ideal” (Kooy and Bakker, 2008:1689) and like many cities in the global South has been historically highly fragmented. Research from Mumbai (Zerah, 2008) has also sought to explore how the ‘Splintered Urbanism’ (Graham and Marvin, 2001) argument fails to account for the long history of divided infrastructures within the city, questioning the notion of the ‘infrastructural ideal’ within the Indian context. Furthermore, Zerah (2008:1931) suggests that different sectors (water, energy, sanitation) have experienced different histories, influences and pathways and puts forward a need to explore these issues from the platform of the home, “The underplaying of the sectoral differences also results in the SU thesis’ silence on the question of shelter, while a careful examination of the water sector brings back in the housing question”. Jaglin (2008), taking ‘Splintered Urbanism’ as a basis to construct a detailed narrative of South African urban infrastructures, explores the differentiating networked energy services in Cape Town. She suggests that in South Africa the post-Apartheid era of public investment supports low income communities in connecting to urban systems, whilst simultaneously excluding the most marginalized and poorest:

“The focus on new investments and free basic services has essentially benefited the working class and the lower middle class while the poorest ‘miss out on benefits designed to protect them because their unregulated and informal urban conditions do not allow them to benefit from subsidies” (Jaglin, 2008:1897).

Jaglin (2008) illustrates that requirement for detailed empirical work at a city scale exploring the notion of ‘Splintered Urbanism’. This is a task which needs to uncover the specific contexts and pathways of splintered networked systems and that moves beyond the global narrative that Graham and Marvin (2001) establish. In another example from South Africa, the spatial distribution of ICT networks across Durban is explored and clearly demonstrates how the deployment of new technologies across these systems is reinforcing and perpetuating a splintered infrastructure in new ways and forms, “the spatial manifestation of this is clear; ICT access correlates with higher incomes and clustered private investment, thereby perpetuating inequalities” (Odendaal, 2011:2394).

Three main limitations arise from the research exploring ‘Splintered Urbanism’ (Graham and Marvin, 2001) in the global South that suggest whilst the notion of splintered infrastructure systems can offer an important contribution to the thesis it cannot act as a conceptual framework. Firstly, this critique focuses on the coherence of the infrastructural ideal in the context of post-colonial and post-apartheid cities that have

traditionally sustained splintered urban systems from earlier eras. Whilst ‘Splintered Urbanism’ (Graham and Marvin, 2001) at least partly resonates across the divided networks that constitute African cities and the post-colonial moments of modernisation⁵ that characterise many newly independent countries (Section 4.1) these networked systems have rarely been integrated, rather being characterized by racial and class divisions from the colonial era onwards. As such these urban spaces can be understood as ‘historically splintered’ rather than exhibiting a ‘splintering’. Secondly, whilst the ‘Splintered Urbanism’ (Graham and Marvin, 2001) provides a global narrative to processes of fragmentation this is not able to account for the differentiated geographically situated urban systems that all have complicated, contradictory and contestable histories of investment, fragmentation and trajectory. Thirdly, as Jaglin (2008) argues, the narrative of ever more fragmenting infrastructures does not account for networks that are simultaneously including and excluding different parts of the urban population and requiring detailed examination of the infrastructure systems of cities to reveal the specific ways in which inequalities are mediated through infrastructures. ‘Splintered Urbanism’ (Graham and Marvin, 2001) arguably plays an important role in developing a widening field of infrastructure studies and provides a basis for varied and informative work from a variety of geographical contexts and theoretical insights. Whilst it provides a broad commentary of processes that mediate and are mediated by urban networked systems, the critiques developed suggest it is not sufficiently robust to examine the infrastructures of Accra and Cape Town and construct analysis of these diverse dynamics illustrated by cases from cities of the global South. Instead, its central premise is reconfigured from the notion of networks becoming splintered through certain processes towards the historical splintered nature of infrastructure (Kooy and Bakker, 2008). This splintered urbanism is positioned as an important theme in which to examine urban energy networks in African cities and the wider global South. It is a provocation in which to guide the research, to approach the infrastructure systems of Accra and Cape Town and to be utilised by the conceptual framework to view cities as spaces of splintered urbanism and inequality.

2.5 Urban Political Ecology (UPE)

If ‘Splintered Urbanism’ (Graham and Marvin, 2001) applied to cities of the South fails to account for the historically splintered nature of these cities then it poses questions about the ways to approach these divided infrastructures that are taken up in the field of UPE. Whilst STS, STT and ‘Splintered Urbanism’ all owe some heritage to the study of infrastructure embarked by Hughes; UPE’s origins lie elsewhere, within Marxist approaches to the city that have centered the importance of the inequalities perpetuated across and through networked systems through the socio-natural production of the city.

⁵ For instance, in Ghana, during the immediate post independence era, President Nkrumah sought to modernize the country, predicated on the construction of the Akosombo Hydroelectric Dam as a source of energy, to power urban modernization and rising living standards.

2.5.1 Overview of UPE

The thesis argues that the field of UPE studies of infrastructure provides a series of conceptual debates from which to develop a dialectical approach to interrogate the contested and splintered nature of networked systems across African cities. This is a broad field subject to ongoing debates and opening up a series of theoretical approaches (Keil, 2003, 2005, Zimmer, 2010) to infrastructures that explicitly focus on power, politics and the role of networked systems in the reproduction of social relations and urban life. Effectively UPE begins from a different starting point than the other literatures so far reviewed through a concern with not just technological change and innovation but how infrastructures are obdurate, the power relations that maintain these configurations and the inequalities that such systems produce, moving the focus towards the role of urban politics in mediating these socio-technical systems. Evolving from a long history of Marxist interventions in urban studies (Harvey, 1973, 1982, 1996, Smith, 1984), political ecology studies (Blaikie, 1985, Blaikie and Brookfield, 1987, Peet and Watts, 1993) and a series of encounters with post-structuralist ideas (Gandy, 2006, Holifield, 2009, Kooy and Bakker, 2008, Swyngedouw, 2004). UPE has developed into a field of infrastructure studies that offers a number of potential conceptual approaches through which to take forward the thesis. UPE is concerned with the processes of the urbanisation of nature, that is the political, environmental and social conditions in which nature becomes urbanised and the unequal power relations these conditions produce and reinforce (Keil, 2003, 2005, Lawhon et al, forthcoming). The thesis argues that UPE draws on three explicit concerns that offer the outlines of a conceptual framework. Firstly, UPE suggests that cities are dialectically produced through metabolic and hybrid processes that position nature as central to the urban (Keil, 2003, 2005, Zimmer, 2010), and in some UPE accounts can be characterised as a cyborg urbanisation (Gandy, 2005, Swyngedouw, 2006). Secondly, that these metabolic flows are made possible by, whilst also constituting, the infrastructures (which are also conceived of as metabolic) of the city and thus positions networked systems as central to understanding the urban (Gandy, 2005, Kaika, 2005, Loftus, 2007). Thirdly, the literature asserts that the metabolic flows that produce a hybrid or cyborg urbanization dialectically reflect and reinforce configurations of power that shape the city and mediate social relations (Keil, 2003, 2005, Swyngedouw, 2004, Zimmer, 2010) suggesting infrastructures embody these dynamics. Whilst the field of UPE is characterised by a series of debates the thesis argues that the main tenants of an approach can be brought together in a conceptual framework to guide the research and analysis.

2.5.2 The metabolic city and cyborg urbanisation

Harvey's (1996:186) claim that, "there is nothing unnatural about New York City" articulates the growing critiques of modernist urban thought and planning, which ontologically separates nature from the city. UPE studies are interested in the relationship between nature and the city, arguing that this separation is a false dichotomy which masked the hybridity of the urban and natural through drawing on the work of ANT (see section 2.2.2) to expand these insights to incorporate the capitalization of nature developed in (rural) based political ecology studies (Blaikie, 1985, Blaikie and Brookfield, 1987, Peet and Watts, 1993, Schmink and Wood, 1987). The social production of nature to meet the requirements of capitalism is understood as a historical process of capital accumulation that produces distinct socio-natural landscapes, i.e. cities (Smith,

1984, Castree, 2001, Braun, 2006). Thus, in the field of UPE urbanisation is conceptualised as the transformation of nature through processes of capital accumulation (Swyngedouw, 2004). These ongoing transformations can be understood through the concept of metabolism, which has a longer tradition in urban studies (Wolman, 1965), but is mobilized in UPE through a historical materialist perspective and mobilized as:

“a series of interconnected heterogeneous (human and non human) and dynamic but contested and contestable processes of continuous quantitative and qualitative transformations that re-arranges humans and non humans in new and often unexpected ways” (Swyngedouw, 2006:106).

Metabolic processes constitute the material (re)production of the city, combining the social relations of production with the ecological conquest of nature and linked to capital flows from the local to transnational (Gandy, 2004, Keil, 2005, Swyngedouw, 2004). Nothing lies outside of these transformations and the city is a part of these huge networks that span across the local through to the global, incorporating human and non human actants, everything from capital, to sewage to communication to policy discourses. This is a notion of metabolism in which the production of the city, that is hybrid urbanisation, can be understood as a process of the transformation of nature through capital accumulation (Bakker, 2003, Gandy, 2004, 2006, Heynen et al, 2006, Swyngedouw and Heynen, 2003, Kaika, 2005). As Bulkeley et al (forthcoming) suggest:

“Particular forms of metabolic circulation are regarded as historically produced in relation to different logics of capital, and while one regime may be dominant at any one time, urban metabolisms co-exist, compete and conflict in shaping particular urban conditions”.

Such a perspective positions the city, firstly as primarily structured through capital accumulation and; secondly, as constituting a series of ongoing metabolic flows and circulations, shaped in various ways and configuring and reconfiguring the networked systems of cities. This perspective generates a way to link a series of socio-natural dynamics mediating infrastructures in Accra and Cape Town. As such the debt to ANT (Latour, 1997, 2005) is evident in the way that UPE has conceived the urban (Swyngedouw, 2004). This is a city of flows and dispersed model of movements, dissolving of categories such as man and nature and providing an important conceptual underpinning across the field of UPE that links into the work of Latour (1997, 2005). These ideas of movement, hybridity and metabolism provide an articulation of the nature of networked systems that generates an important conceptual framing of urban infrastructures. Whilst UPE accounts of the city focus on the structuring role of capital in these processes Lawhon et al (forthcoming) argue that by:

“using a dialectical and “process-based episteme” (Swyngedouw, 2005: 387), UPE scholars do not believe in fixed ‘structures’, but physical landscape patterns of streets, industries, trees and water pipes, including social identities of class, gender, race, and cultural discourses of the ‘good city’ are outcomes of generative processes. The structuralist component of Marxist reasoning lies in the notion that it is capital accumulation—as a basic but multifaceted generative process of how flows of (use and exchange) value is accrued—which drives spatiohistorical processes to form ‘structures’ more recently referred to as quasi-objects, hybrids, cyborgs, assemblages or socio-nature (Swyngedouw, 2004, 2009), or ‘permanences’ (Harvey 1996)”.

As such whilst most UPE studies remain focused on capital centered accounts of the urban they incorporate ANT to approach the city as a place of movement, flow and circulation and analyse the ways in which capital mobilizes socio-natures into hybrids that mediate infrastructures (Castree 2001, Demeritt 2001, Keil, 2005, Zimmer, 2010). The relationship between a focus on capital and mobilisation of ANT creates a tension (Holifield, 2009) that could have implications for the conceptual framework of the thesis. Whilst UPE seeks to conceive of infrastructures as both constituting and acting as conduits for the city of flows and linked to the logics and structuring dynamics of capital this is in opposition to ANT theorisations, which for Harvey (1996:7) prompts the assertion that, "the reduction of everything to fluxes and flows, and the consequent emphasis upon the transitoriness of all forms and positions has its limits". The thesis suggests that these tensions in UPE can be overcome through the concept of the cyborg and through framing the city as a place of cyborg, rather than ANT's hybrid, urbanization as, "the work on metabolism bleeds into the emerging debate on cyborg urbanization" (Keil, 2005:644).

Haraway (1991:150) describes the cyborg as a, "cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction" and for Gandy (2005:35), "the cyborg metaphor goes further than the neo-Marxian tradition in its engagement with the inherent messiness and indeterminacy of urban space" and able to incorporate many of the insights offered by ANT whilst retaining a focus on the role of capital (Gandy, 2005). A number of UPE studies (Gandy, 2005, Swyngedouw, 2004) use the work of Haraway (1991) to approach this metabolic city through the concept of the cyborg, that draws on Latour's (2005) ANT but offers some important differences as Zitouni, (2004, in Swyngedouw 2006:114) suggests:

"Haraway views any entity as an embodiment of relations, an implosion, the threads of which should be teased apart in order to understand it. Whereas Latour views any entity as a piece of matter that is continuously affected and that contracts links with a larger network that allows it to live, to be. On the one hand, the entity crystallizes the network; on the other hand the entity is supported by the network. Haraway studies the network in order to define the entity; Latour studies that same network in order to define the entity's consistency and persistence"

Approaching the city through the notion of cyborg urbanisation generates the ability to dialectically examine capital (Gandy, 2005) through the concept of urban metabolism, retaining a position that frames the city as a place of movement, flux and circulation. Whilst ANT would approach metabolic flows and circulations through the notion of hybridity there are important differences between these terms, with metabolic processes being understood as traveling in particular ways (via the logics of capital) whereas hybridity would position these metabolic flows as assemblages without direction. As such the thesis draws on Swyngedouw's (2006:106) approach to UPE:

"that permits drawing together the insights of historical geographical materialism with the work of Haraway (1991) to view the modern city as a process of fusing the social and the natural together to produce a distinct 'hybrid' or 'cyborg' urbanization".

In viewing the city in this way, produced through metabolic flows that shape a cyborg urbanization a UPE framework generates a number of conceptual imperatives for the thesis. Firstly, by identifying the dialectical

relationships between social, political, economic and environmental conditions that constitute the metabolism of the cyborg cities of Accra and Cape Town, particularly the processes of capital accumulation that mediate and reconfigure the urban energy network. Secondly, tracing, uncovering and examining these (metabolic) flows (through which nature is urbanized) in order to analyse how they shape and reconfigure the networked systems of both cities. Thirdly, embracing the notion of cyborg urbanisation and metabolism as a conceptual vehicle to dialectically examine the conditions, dynamics and politics that shape urban infrastructures in Accra and Cape Town.

2.5.3 Urban infrastructures and power relations

The third explicit concern of UPE, identified as seeking to examine how urban infrastructures reflect and reinforce configurations of power (Keil, 2004, Zimmer, 2010) suggests that a conceptual framework drawn from this field provides a pathway in which to dialectically examine networked systems in Accra and Cape Town. The need to analyse the multi-scalar governance of networked systems (Chapter 7) and metabolic processes (Chapter 5) is predicated on seeking to reflect on the social relations that are dialectically produced and reproduced by these dynamics. Across the UPE literatures the focus on uncovering the contestation and conflict across urban networks and the power relationships of these urban politics has been undertaken in a number of different ways, reflecting the diverse theoretical traditions and directions encompassed within this broad field of study (Keil, 2004, Zimmer, 2010). These range from using historical materialism (Swyngedouw, 2004), to Gramscian (Loftus, 2008) and governmentality (Gandy, 2006, Kooy and Bakker, 2008) inspired analysis of the conditions urban infrastructure. Whilst this variety of, often very different theories of power may be considered a limitation in seeking to develop a conceptual framework for the thesis this provides a vibrant and diverse tradition of theoretical debate across UPE.

To understand the relationship between power and urban infrastructures across UPE studies that have mobilized the concept of the cyborg is to focus on metabolic processes and the cyborg urbanization which is produced through these processes, “Haraway asks penetrating questions as to why ‘cyborgs’ are produced the way they are and the relations of power inscribed in these imbroglios, this question remains silent in Latour’s work” (Swyngedouw, 2006: 113). By framing urban infrastructure through these concepts the importance of network reconfiguration becomes visible as an important focus in the mediation of power across cities. UPE has thus taken urban infrastructures as the point of departure in seeking to dialectically explore how capital shapes the city and the social relations that are created, reflected and reinforced during these ongoing metabolic processes. In this way, UPE provides a pathway in which to begin to develop detailed studies about the nature of splintered infrastructures across different contexts. Much of the UPE literature draws on a tradition of historical materialism from Marx (1990 [1867]) and Engels (1996 [1845]), through to Castells (1977) and Harvey (1982) that suggests:

“Under capitalist social relations then the metabolic production of use values operates in and through specific control and ownership relations and in the context of the mobilisation of both nature and labour to produce commodities with an eye towards the realization of the embodied exchange value” (Swyngedouw, 2004:16).

Like the other infrastructure literatures reviewed UPE frames these systems as socio-technical but importantly is not simply interested in tracing and describing the nature of infrastructures and how they might stabilise or evolve like STT or STS. From a historical materialist perspective the focus lays in considering how the metabolic production of urban infrastructures reflect and reinforce relations of power. The focus on uncovering the relationships of power within and across these metabolic processes suggests a UPE framework that draws together historical materialism with the cyborg (Swyngedouw, 2006) is positioned to examine how these socio-technical systems produce and reinforce inequalities and are deeply implicated in issues of power and control in the city. Whilst this provides a particular geometry of power across cities it generates an important way to consider processes of network reconfiguration by seeking to show how power over urban infrastructure is the ability (via reconfiguration) to secure outcomes and reshape the city. Allen (2004) would refer to this notion of power as a form of inscribed capacity, that can be held without being exercised and formed out of social relations, drawing on Isaac's (1987 in Allen, 2004:22) view that:

“To attribute a power to any one thing is to say something about its constitution; that is, what it is capable of doing by virtue of its intrinsic nature. On this view power is a casual property bestowed by the very structure of relations”.

As a number of studies make clear (Brenner, 2004, Swyngedouw, 1997) with a focus on linking a range of scalar dynamics these social relations are both simultaneously local, regional and global and the exercising of power across urban infrastructures is fluid and multi-scalar and is:

“no longer seen to operate in either a top down or a centre out fashion but rather upwards and downwards, through the different scales of economic and political activity, both transnational and subnational” (Allen, 2004: 35).

This framing can examine a range of different relationships concerning urban infrastructures, governance and social relations that illuminate a notion of power over infrastructure as the inscribed capacity to reconfigure these networked systems to secure the desired outcomes of various urban actors (Chapter 7).

2.5.4 UPE in global South cities

A growing body of UPE research is situated in global South cities, encountering a range of diverse urban systems in Africa, Latin America and Asia, that have added to the field and offering a range of different conceptual and empirical foci from which to draw from and including a growing number of studies of African cities, (Gandy, 2006, Lawhon, 2012a, 2012b, in press, Loftus, 2004, 2006, 2012, Myers, 2003, 2005, 2008, 2011). Whilst the literature mobilises intellectual traditions from the North it is simultaneously constructing analysis that builds detailed examinations of the specific (post-colonial) geographical-historical conditions of infrastructure in cities such as Guayaquil (Swyngedouw, 2004), Lagos (Gandy, 2006), Jakarta (Kooy and Bakker, 2008) and Lusaka (Myers, 2006) and providing an important part of the conceptual framework (Chapter 4). These studies provide a range of different considerations in seeking to develop the

conceptual framework for this thesis. They open dialogue with global South theorisations of cities and urban infrastructures, situate the empirical work in the specific postcolonial conditions of these urban spaces, and signpost conceptual strategies to help construct a African situated UPE of electricity systems in Accra and Cape Town. These encounters are evident in a series of UPE studies exploring urban infrastructures in the global South.

Swyngedouw, (2004:29) provides analysis of urban water infrastructure in Guayaquil, Ecuador and shows how the metabolisms of water are implicated in the social relations of the city across its infrastructure, “the multiple metabolisms of water are structured and organised through socio natural power relations – relations of domination and subordination of access and exclusion of emancipation, repression”. Swyngedouw, (2004) uncovers the multi-scalar social relations that structure water in the city, identifying those that control and those that are excluded, from the ‘Tanqueros’ at a neighbourhood level to giant private water companies in the global North. The study reinforces the need for the thesis to dialectically uncover, trace and reflect upon the (multi-scalar) metabolic flows that shape the geographies of the urban energy network. Gandy (2006) offers an analysis of the urban politics of Lagos arguing to understand the exercising of power in cities such as Lagos is not just to contend with the modern. That is, the apparatus of post-colonial independence, the state institutions that developmentalism seeks to improve and the political economies of global capital that mediate the power relations of the urban. It is also the ‘networks of subjugation’ that reconfigure from the past showing how this urban past exists alongside and interacts and mutates with, the modern. The study reinforces the need for the thesis to develop a historical excavation of the urban energy networks in Accra and Cape Town. Furthermore, Gandy (2005) contributes to the widening field of UPE by engaging in a dialectical examination of Lagos that engages with African urbanism, grounded in the lived, informal and diverse experiences of African cities. It is these intersections between an engagement with the postcolonial and the (urban) political ecological that show the potential of a UPE conceptual framework to engage with the urbanism of Accra and Cape Town. This dual focus, on the specific manifestations of capital accumulation in cities such as Accra and Cape Town, coupled with a sensitivity toward the actual conditions of urbanism in these diverse cities provides a theoretical rich seam of analysis and the central focus and key orientation of the conceptual approach of the thesis. Loftus (2007, 2012), illustrates how UPE is engaging with these issues through exploring networked water systems in Durban and the fragmented infrastructure, in the light of the post-Apartheid period of privatisation, that characterized South Africa during the late 1990s. Through a UPE analysis Loftus (2007, 2012) illustrates the conflict and contestation that these neoliberal reforms sparked and reveals how the free basic water allowance has left many township dwellers under increased household stress. Loftus (2007) identifies the role of politics and conflict in shaping the infrastructure of Durban, the role of metabolic flows of capital in mediating infrastructure and the unequal relations of power these produce. Importantly, the focus of the everyday in these struggles is elaborated through ‘Everyday Environmentalism: Creating an Urban Political Ecology’ (Loftus, 2012) which centres the role of the everyday in transforming urban conditions and forms an important influence on seeking to extend the conceptual framework to engage with the actual existing conditions of urbanism in both cities (Section 2.6.4).

Myers has based his work in Lusaka (2006) and Zanzibar (2002) and across African cities more generally (2005, 2008, 2011) to construct analysis that engage with patterns of historical urbanization and infrastructure development showing the importance of situating research within the specific post-colonial (and post-apartheid) histories of African cities (Chapter 4). Myers (2006) shows the need to bring together specific post-colonial/post-apartheid dynamics with the role of capitalist accumulation in structuring relations of power across urban infrastructures. Myers (2011), like Loftus (2012) argues for the importance of the everyday in seeking to explore the dynamics that shape African cities, mobilizing the work of artists, filmmakers and novelists as ways in which researchers can explore the everyday experiences of urban dwellers and suggesting that these strategies complement, inform and shape the political economic analysis of such urban spaces.

As these UPE studies suggest an African situated UPE approach must engage with the actual existing conditions in Accra and Cape Town, something the thesis argues can be undertaken by engaging with new conceptual directions emerging from the literatures on African and global South urbanism (Section 2.6.4). The detailed examination of global South cities across UPE studies, together with the concern to uncover the metabolic processes that shape urban infrastructures, the power relations that are reflected and reinforced across networked systems and the unfolding engagement with the postcolonial provides a field of infrastructure studies that is appropriate to the aims, research focus and questions of the thesis.

2.5.5 Mobilising a UPE framework

While a number of different ways to approach urban infrastructure exist, the review suggests that STS and STT offer only a limited terrain on which to proceed. Whilst STT provides a straight forward multi-level framework this suffers from failing to acknowledge the role of non-elite actants in innovation, the political nature of networked systems, and the urban scale as a key arena for technological study. Furthermore, STT inspired studies have rarely engaged with global South cities and can also be implicated in the criticisms associated with applied urban research. STS approaches to urban infrastructures are perhaps more useful and detailed in examining urban systems, engaging with both LTS and ANT ways of approaching these infrastructures and contributing to the dispersed notion of the city of flows and circulations. Yet as the review has suggested this potentially fails to address the role of capital in structuring urban infrastructures and linked to this problematic the political, contested and unequal nature of these networked systems. ‘Splintered Urbanism’ (Graham and Marvin, 2001) offers a compelling narrative that positions urban infrastructure as a key concern in urban studies, a focus on capitalist processes of urbanisation and a range of emerging questions, issues and agendas, it does not provide a conceptual approach to proceed due to the lack of coherence of the infrastructural ideal in the global South and the failure to account for the differentiated geographically situated urban systems and the complicated histories of these networks. Although the notion of a historically splintered infrastructure provides a key focus for examining Accra and Cape Town the theoretical approach of the study emerges from the UPE literatures. This field of study positions urban infrastructures and relations of power at the centre of understandings about the city and generating an explicit series of theoretical considerations to apply to the research. Thus, the thesis establishes UPE as the

theoretical approach on which to develop a conceptual framework to conduct the analysis of network reconfiguration in Accra and Cape Town.

The thesis is aware of Northern traditions of knowledge construction concerned with the city that (re) produce theoretical foci, approaches and shared understandings across urban studies that preclude a comprehensive analysis of networked systems in African cities. For the most part, African urbanism has been either ignored in debates on urban theory, or constructed on the terms and conditions of global North processes of urbanism. This is problematic for the analysis of contemporary processes of network reconfiguration in relation to the UPE conceptual framework and suggests the need to situate such an approach within the actual existing conditions of urbanism across Accra and Cape Town and subsequently explored in the next section.

2.6 Infrastructures of the Postcolonial

A series of intellectual trajectories shape constructions of Africa generally, and African urbanism particularly, as a historic process of mirroring the modernity and civilisation of the North. The ‘othering’ (Said, 1978) of African urbanism is predicated on a tradition of urban theory that either ignores or problematizes and relegates these processes within the field of urban studies. Furthermore, the construction of African urbanism as problematic and as ‘not yet’ modern generates a focus on developmentalism across literatures engaged with African cities. The developmental nature of much of the work of African urbanism suggests that a need to move beyond particular theoretical (and often normative) constructions of urban infrastructure in Africa is perhaps the most significant undertaking for those researching the contested nature of networked systems. Constructing an alternative pathway that seeks to ‘provincialise urban infrastructures’ in order to generate a African situated UPE, by acting upon the call by Chakrabarty (2000), to challenge, decentre and thus revitalise, Northern intellectual traditions, provides one such way forward. This endeavor of ‘provincialising urban infrastructures’ is being addressed by urban scholars articulating multiple new ways in which the theoretical terrain of African urbanism is being remapped and revitalised, with UPE one such field from which this can be produced.

This section outlines how the African city has been constructed in relation to wider intellectual traditions and relationships between the global North and the global South, arguing that these cities are positioned in urban knowledges in opposition to the Northern cities of modernity and as spaces of despair, failing to appear on the registers of urban theory as anything other than the poorer cousins of the cities of the North and producing what Bayart, (1993) terms the ‘politics of the mirror’. Constructions of the African city therefore shape a terrain in which these urban spaces are approached as requiring development and such perspectives have framed much of the urban research in cities such as Accra. The section argues that by beginning an analysis of African cities from the everyday urbanism that a more textured and grounded picture of these cities emerges that can counter some of these intellectual traditions. The section suggests that this can be undertaken by expanding the notion of urban metabolism to incorporate the everyday circulations that mediate urban life in Accra and Cape Town. This conceptual strategy is undertaken through approaching the

city as a dialectical cyborg that is metabolically produced through the relationship between wider political ecological processes and the everyday.

2.6.1 Constructing the African city

To undertake the ‘provincialising of urban infrastructures’ requires a historical contextualization of the constructed imaginary of urban Africa. Wider constructions and metaphors of the African continent, that served to justify colonialism, also influenced how cities in Africa were built, governed, mediated and understood. The assembling of these geographical imaginaries can be articulated through the work of Said (1978). Drawing on the ideas of Fanon (1967) and Foucault (1972), Said (1978) explores western knowledge relations with the Orient by conveying the concept of ‘the Other’ and the discursive construction and representation of Orientalism in which European culture was, “able to manage and even produce the Orient, politically, sociologically, militarily, ideologically, scientifically, and imaginatively” (Said, 1978:3). The construction of Africa, as the ‘Dark Continent’ (Figure 2.1) can be contextualised within Said’s articulation to show how an entire continent becomes ‘the other’, as a negative reflection of the North, historically frozen in a web of dualities with the ‘Enlightened West’ in what Bayart (1993:117) refers to as “the politics of the mirror”. These metaphors, developed by (Imperial) explorers such as Stanley, geographers such as MacKinder (1900), writers including Conrad (1902) and waves of missionaries, articulated the notion of a dark and impenetrable place requiring science, technology and capitalism to develop and civilize. As Said’s (1978) work helps to illustrate these Western discourses and imaginaries have continued to confirm, legitimise and perpetuate structures of superiority, domination and power, as Jarosz (1992:106) argues, “the metaphor of the Dark Continent has shown remarkable tenacity in a variety of Western idioms spanning the last hundred years of human geography in the Western tradition”.

The metaphorical construction of a dark, impenetrable and dangerous Africa needs to be considered within a specific urban context in relation to the development of a conceptual

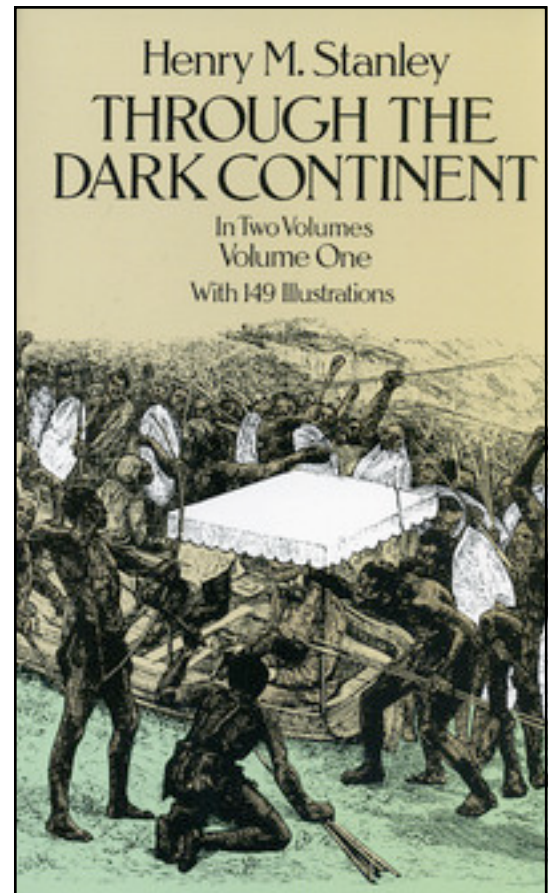


Figure 2.1: Book cover: Stanley, Through the Dark Continent

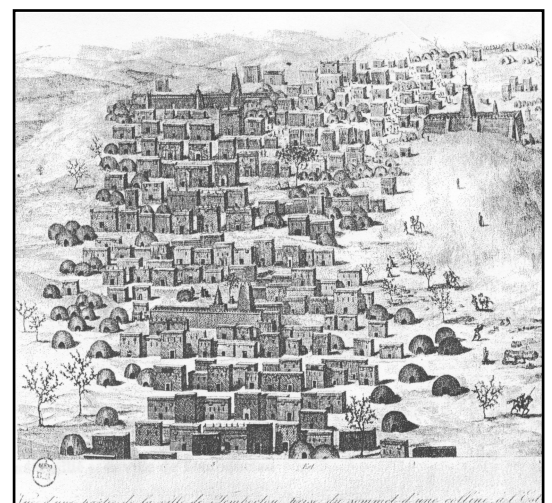


Figure 2.2: Image of Timbuktu

framework for the thesis. This urban African imaginary influences how colonial cities are conceived, built and administered. Legislation, segregation and planning all reflect a hierarchy of control across these urban spaces, predicated on wider discourses of subjugation. This is an urban history of colonial governance ignoring African populations and the infrastructural needs of these areas. Myers (2006:294) shows how this infrastructure governance occurs in Lusaka, “for the most part urban authorities and European residents simply ignored developments in the African part of town”. Other forms of urban colonial governance show a more active culture of control, around issues such as segregation, health ordinances and such forth, illustrating the infrastructure manifestations of colonial discourses across African cities. Whilst pre-colonial cities, such as Timbuktu (Figure 2.2), have been centres of learning, trade, and political life for hundreds of years, the rich histories of these urban spaces is ignored. Becoming instead part of wider discourses, that mediate constructions of African cities, requiring Enlightenment principles seemingly (and paradoxically) embodied in (post) colonial subjugation and development. A range of consequences travel outwards, across time and space, from these colonial discourses and resulting practices that structure how African cities are thought about, researched and analysed. Urban imaginaries, narratives and discourses thus historically construct the African city as a place of hopelessness and despair, influencing how (urban) knowledges are constructed about these cities and the very terrain upon which these urban spaces are mediated from.

2.6.2 A postcolonial critique of urban studies

The historical construction of the African continent and its cities shapes the relationship between African urbanism and urban theory, perpetuating and reinforcing the myth of the ‘Dark Continent’ within and across knowledges of urban Africa. This occurs either through a disregard for the diversity of urbanism across Africa, as a distinct series of urbanisation processes, or by positioning African cities as problematic, and requiring development. McFarlane (2008a:341) describes one consequence of this intellectual tradition as resulting in ‘urban shadows’ which are, “those cast by the particular preoccupations of Euro-American urban theory; these are spaces that often to not register as agents on the maps of urban theory”. These ‘urban shadows’ have meant that the urbanism of the global South is thought of in terms of the concerns of scholars engaged, in the very different context, of global North cities, ignoring the diverse multitude of urbanization processes that shape and mediate postcolonial cities:

“Thus urbanism is largely equated with complex, social, natural and material interactions that unfold in Western cities, whereas non-Western cities are only good for describing absences and wanting” (Pieterse, 2010a: 207).

These ‘urban shadows’ can be understood, in one way, through the work of Robinson (2002, 2006) who articulates a critique of urban theory that draws upon the North focused nature of world or global city narratives (e.g Sassen, 1991,1994):

“my contention is that urban theory is based primarily on the experiences and histories of western cities - much as Chakrabarty suggests that the theories and categories of historical scholarship have been rooted in western experiences and their intellectual traditions” (Robinson, 2002:583).

Whilst some cities of the global South are now deemed by urban theorists to be global cities, such as Johannesburg, Robinson (2002) argues that the world or global city theories of the urban still ignore the mass of cities that are not vying to join the global elite. This rapidly growing number of cities operate at various levels in the world economic system, intrinsically involved in globalization, shape and are shaped by flows of capital, resources, ideas and cultures and thus, supports Robinson (2002) in challenging the idea that they are somehow irrelevant or should be at the bottom of such hierarchies. The implication of such insight is to accuse urban theory of avoiding and obscuring the dynamism of global South cities, and particularly African cities, and the ways in which they are viewed through their construction in opposition to the globally connected city of the North. As both Robinson (2002, 2006) and McFarlane (2008) show, in different but complimentary ways, the heterogeneous geographies of African cities simply do not fit into urban theory constructed from the global North, beyond the status of the 'not yet' modern city, the binary construction of the globally connected cities of New York, Paris and Tokyo, and the mirror of modernity.

2.6.3 Discourses of urban developmentalism

If African cities have been positioned as 'not yet' modern then the significance of this intellectual tradition is its role in comprehending urban spaces as requiring development. To overcome dysfunctionality and to become modern has become the objective of these cities and the urban research that they situate. By focusing on urban spaces through a developmental lens, the cities of Africa are constructed as a 'problem', in need of progress and often on the edge of catastrophe. Much of the urban research in African cities has been orientated around the need to find responses or solutions to the problems of rapidly urbanising cities, resulting in a paradigm in which "the bulk of urban research remains seemingly fixated on issues broadly in the domain of urban developmentalism" (Pieterse, 2010a: 206). The consequence of this often localised empirical work, predicated on a developmental agenda, has meant that African urban studies can be, "poorly informed theoretically" (Mbembe and Nuttall, 2004:349). Pieterse (2005) suggests that this developmental and applied approach to urban research in Africa results in the ascendancy of technocentric rationality in understanding African urbanism and guiding research and practice. This is perhaps best exemplified by the hundreds of reports, plans and designs, concerned with improving African cities, that are produced each year by multilateral, bilateral and NGO agencies working on, in and with these urban spaces. Pieterse's (2005) critical position resonates across wider assumptions within urban theory, toward the central role of technology, policy outcomes and externally generated solutions in modernist urban thought and practice, and specifically how these technocratic orientated visions dominate urban knowledges across Africa. Studies orientated around normative, applied research have further consequences for constructing knowledges and imaginaries of urban Africa. The reliance on technological or rational 'fixes' to what are deeply political issues, in contexts in which the challenge of creating networked services may not be possible under current socio-environmental conditions provides one such example. The consequence of these discourses has been to orientate urban research in Africa to focus on generating solutions rather than producing detailed and theoretically robust analysis. Gandy (2006:372) reiterates this criticism:

“Much academic discourse about Africa has taken on the normative role of ‘social engineering’ rather than the need to provide critically and politically aware insights into actually existing conditions”.

The series of manifestations of deeply historical and political articulations of developmentalism, outlined above, can be considered within the specific context of urban infrastructures. For instance, this developmental approach can be implicated in processes, that prioritise particular networked services, such as international ICT, and arguably reinforce a splintering urbanism, as well as constructing notions of what infrastructures are that fail to account for, the very different nature of infrastructures in the global South. In the urban slum spaces of the South infrastructures can often mean something beyond the networked systems of the North, with the work of Grieco, (2008) providing one amongst many such articulations, through showing how children in Accra are part of a ‘living infrastructure’, operating sanitation services in place of any sewerage system. The mapping of these historical intellectual currents reveals the processes that have structured urban research in Africa, providing the historical narrative, and the consequences of particular conceptualizations of African cities orientated around a technocentric or developmental perspective, rooted in urban theory from the North. These series of factors, which have mediated the relationship between urban theory and African urbanism, provide a challenge for the UPE conceptual framework that is predicated on analysing urban infrastructures in African cities. A requirement to engage with the specificity of African cities, the historical patterns of urbanizations and wider postcolonial understandings of the urban forms a pivotal task in articulating a African situated UPE. The need to produce research that does not seek to provide a normative or technocentric analysis, in order to generate solutions, but instead provides a detailed, critical account of actual existing conditions, is central to the objective of the thesis. It is upon this conceptual terrain that a platform in which to articulate a African situated UPE is generated in the thesis, one that is focused on both a critical exploration of the structural and everyday dynamics in which network reconfiguration is taking place across Accra and Cape Town.

2.6.4 Approaching African urbanism through the everyday: expanding urban metabolism

Whilst the review of UPE studies (Section 2.5) outlines the ways in which a UPE framework can analyse the metabolic flows of capital that shape and reconfigure urban infrastructure the need to develop critical accounts of actual existing conditions in African cities means engaging with the everyday urbanism of these urban spaces and how this can be approached through the conceptual framework. Pieterse (2008) suggests that the failure to recognize actual existing conditions in African cities is predicated on conceptual models of the urban that continue to inform theoretical encounters with the city and the thesis seeks to mobilise an extended notion of urban metabolism to respond to such provocations.

An examination of network reconfiguration in Accra and Cape Town would remain only partially elaborated through a focus on the metabolic flows that configure and reconfigure the energyscapes of both cities and open itself up to a series of criticisms explored in the preceding section (2.6.3). Lefebvre (1991: 87) suggests that the everyday, “has a secret life and richness of its own” and the thesis is concerned with examining the infrastructure geographies in Accra and Cape Town to reveal the multiple ways in which the everyday

experiences of urban dwellers intersect and interact with wider metabolic processes. The thesis suggests that by bringing together these concerns with the UPE conceptual framework (Section 2.5) it is able to respond to the postcolonial imperatives outlined above (Section 2.6.3). This everyday urbanism can be framed within the cyborg city as dialectical responses to the metabolisms of capital, climate and crisis (Chapter 5), seeking to reshape the conditions of cyborg urbanisation in Accra and Cape Town. This African situated UPE framework suggests that a focus just on structural examinations of networked systems are unable to fully account for the multiple ways in which infrastructures are being reconfigured. In the urban spaces, and simultaneously alongside and in response to multi-scalar metabolisms, the electricity systems in Accra and Cape Town are also shaped, mediated and reproduced through the everyday interactions and intersections of urban dwellers. It is these dialectical processes which can be considered as revealing the actual existing conditions of Accra and Cape Town. Whilst political ecological dynamics remain central to any analysis focused on networked systems such work must simultaneously be expanded to incorporate, encounter and engage with the everyday, something that a number of African based UPE studies have undertaken (Loftus, 2012, Myers, 2011, Lawhon, in press). This task of widening the scope of the conceptual framework to engage with the everyday can be incorporated into the analysis of urban metabolic processes that produce, mediate and reconfigure networked systems.

An expanded notion of urban metabolism allows for the analysis to engage with urban dwellers that operate across and beyond the limited formal infrastructures of Accra and Cape Town and on the periphery and shadow zones of circulations of capital, infrastructure investment and planning visions yet need to be framed as part of the circulatory, metabolic dynamics mediating infrastructure. As Simone, (2005:519) describes, “Not only do individual residents circulate amongst each other, but the very meanings of their various points of anchorage — household, networks and livelihoods — must perform a kind of circulation as well”, helping to articulate how the circulation of everyday urbanism in African cities can link into the notion of an expanded form of metabolism. By engaging with the everyday circulations of the spaces of Accra and Cape Town a ‘conceptual inversion’ (that is beginning from the everyday) occurs (Pieterse, 2008, Lawhon et al, in review) that challenges the focus of UPE to trace a particular vision of urban metabolic circulations. Through exploring the city ‘from the bottom-up’ and from a beginning on a street, a corner or a busy junction it may be possible to begin to make visible the metabolic processes of network reconfiguration, “through the eyes of the majority of poor denizens who appropriate the city for their own ends” (Pieterse 2008:209). This focus on the everyday urbanism of such spaces means to trace how people interact and intersect with networked systems to see how relations dialectically emerge, stabilize and reformulate. It is from these encounters that a UPE, anchored in the streets of the South can reorient towards a more productive engagement with African cities. Such a conceptual undertaking generates another expression of how to situate UPE within the African context, building on existing studies (Loftus, 2012, Myers, 2011, Lawhon, in press) and providing a way to approach these urban spaces and the multiple surfaces, intersections and infrastructure configurations that shape Accra and Cape Town

Detailed empirical and theoretical work is undertaking the task of expanding and articulating the everyday dynamics and circulations that constitute the urbanism of African and global South cities (de Boeck and

Plissart, 2004, Njeru, 2006, Simone, 2004a, 2004b, 2010). These accounts are showing how urban life is a collaborative endeavor that exists not only as part of but also beyond spaces of formal urban systems (Diouf, 2003, Edjabe and Pierterse, 2010, 2011, Harts-Broekhuis, 1997, McFarlane, 2008b). These everyday activities and creation of new urban spaces can be considered as spatial and temporal constellations that are dependent on processes of incrementalism. As Simone (forthcoming) suggests, “Inhabitation in urban postcolonial worlds has depended on practices of incrementalism, where residents seem to add-on to built environments, livelihoods, and social networks a little bit at a time”. Here, the thesis, drawing on Simone’s (2004b, 2011, forthcoming) work positions incrementalism as understood as a *process or strategy* by urban dwellers to make gradual low or no cost improvements to daily life often through reconfiguring networked systems including the electricity network, the materialities of houses and in a dialectical response to socio-environmental conditions. This is an urban incrementalism in which residents engage in everyday improvisation that reshapes the city in small, often unnoticed ways at a household or neighbourhood level. Here improvisation can be understood as *practice* through which to undertake incremental improvements to the energy network that illustrates, “a daily life in urban Africa that has been frequently characterized as a rather tedious routine of incessant improvisation required to make ends meet in contexts offering little formal employment, economic production or political stability” (Simone, 2005:518). Thus, multiple practices of improvisation may work together as part of an incremental strategy of reconfiguring the electricity network to dialectically respond to existing metabolic flows of energy, investment and so forth. These incremental infrastructures suggest that everyday network reconfiguration is ongoing, often temporary and aimed at making small differences to the interactions between urban dwellers and infrastructure networks and illustrating how urban metabolic processes unfold at the household or neighbourhood scale. These infrastructure dynamics, flows and processes, including the role of ‘people as infrastructure’ (Simone, 2004b) and encompass diverse processes that point to a dialectical urbanism shaped. This presents a series of theoretical and empirical challenges to a capital centered approach to understanding urban infrastructure that is explored through a series of examples emerging from the research.

2.6.5 Between the structure of UPE and the everyday of African urbanism

If examining the everyday urbanism of the networks in Accra and Cape Town through the circulations and metabolic processes involved in network reconfiguration forms an important response to addressing the postcolonial imperatives outlined then it creates a potential tension in the UPE conceptual framework. There are ongoing, longstanding debates across the social sciences concerned with the relationship between structure and agency and ways to move beyond these dualities (Bourdieu, 1977, 1990, Giddens 1976, 1984, Choulnard, 1997). To resolve this tension this section returns to the figure of the cyborg, for if the city and its infrastructure is conceived as a dialectical cyborg, as the thesis argues (Section 2.5.2) it suggests this is metabolically produced both structurally and through the everyday (Figure 2.3). As Swyngedouw (2006: 118) comments:

“The production of the city as a cyborg, excavated through the analysis of the circulation of hybridized water, opens up a new arena for thinking and acting in the city; an arena that is

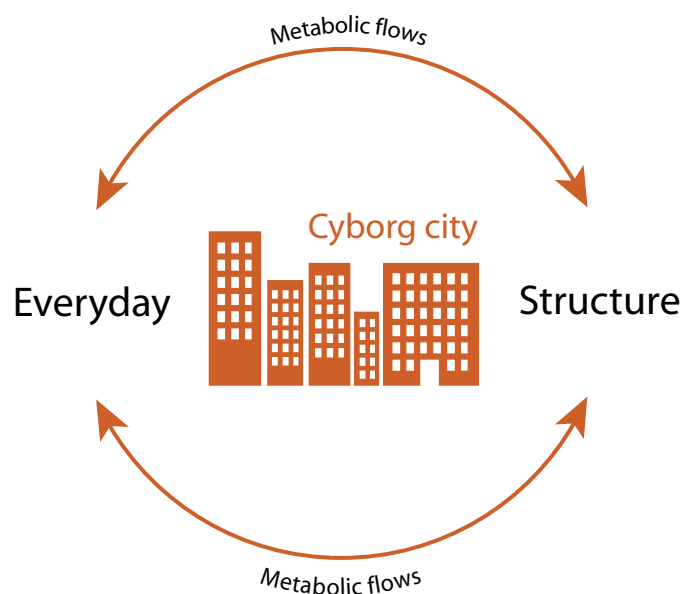
neither local nor global, but that weaves a network that is always simultaneously deeply localized and extends its reach over a certain scale, a certain spatial surface”.

This is an important conceptual juncture for the thesis as, “the cyborg city is, in other words, closer to an interpretative analytical framework that can connect analysis with the cultural and ideological realm of everyday life” (Gandy, 2004: 36). This is undertaken through the framework by widening the analytical lens of metabolism into the everyday ways in which infrastructures are being reconfigured, to trace the dialectical urbanism produced through and across these multiple circulations of urban transformation (see Figure 2.3). The thesis argues that by using dialectic analysis to extend the focus on metabolism into the everyday three important considerations emerge that incorporate the everyday geographies of the electricity network and address the need for the UPE framework to approach the everyday urbanism of Accra and Cape Town. Firstly, it provides the scope to examine how the everyday experiences of the electricity network are imbued with the wider power relations of the cities. Secondly, it shows the importance of the dialectical relationship between the everyday and structure and the way these interact and shape each other across Accra and Cape Town’s energyscapes. Thirdly, it positions the everyday as a site for political struggle (Lefebvre, 1991, Loftus, 2012) as if, “emancipatory urban politics reside in acquiring the power to produce urban environments in line with the aspirations, needs and desires of those inhabiting these space” (Swyngedouw, 2006:116) then this struggle often takes place on the terrain of the everyday (see section 7.4). As Lawhon et al (forthcoming) argue:

“a better understanding of the possible arises when everyday practices are taken as focus to understand how the city is thought and acted upon in new, creative ways, as this brings situated, and ‘sensuous’ ways of knowing to the centre of attention and theorization”.

Figure 2.3: The dialectic of the everyday and structure in the cyborg city

The mobilization of the cyborg to bring together a focus on both the structural processes that mediate and reconfigure networked infrastructures and the dialectical urbanism produced through such metabolic processes suggests that a conceptual framework can be developed that brings together a UPE approach with a detailed examination of the everyday geographies of African urbanism.



2.7 Provincialising urban infrastructure through an African situated UPE

In this section the conceptual framework for the thesis is presented that seeks to outline a African situated UPE approach, bringing together a number of concerns, imperatives and foci developed across the review of infrastructure literatures and examination of postcolonial approaches to the city.

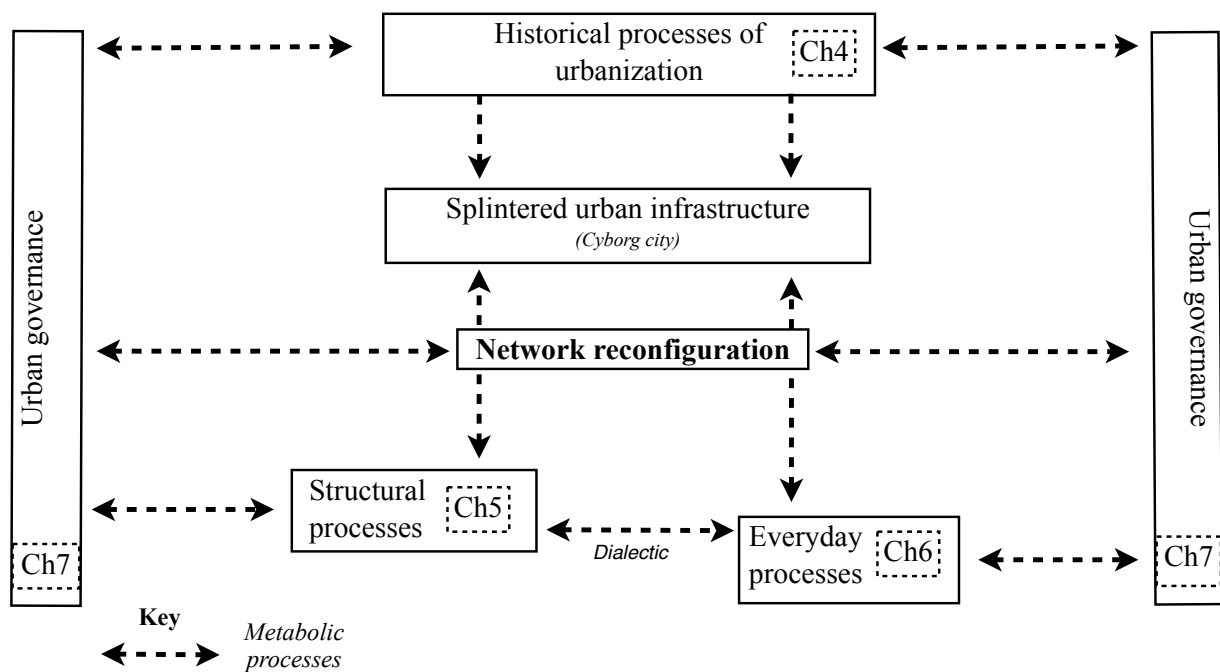
2.7.1 The conceptual framework

The chapter outlined a review of existing literature that provides the means through which questions of infrastructure and the city have been addressed. The review shows that the field of infrastructure studies has become increasingly vibrant since the work by Hughes (1983) and Tarr (1984) began to develop critical studies of these networks and the wider literature provides a series of conceptual approaches to the study of network reconfiguration of which the thesis is concerned with. The review has argued that a UPE conceptual framework, predicated on bringing together historical materialism with the notion of cyborg urbanization, (produced through metabolic flows and circulations) provides a way to dialectically examine network reconfiguration that can respond to the aims, objectives and research questions of the thesis. Addressing postcolonial critiques of urban studies and the requirement to engage with actual existing conditions of urbanism in Accra and Cape Town has meant that the thesis expands the notion of urban metabolism to engage with the everyday circulations and flows of African cities. These circulations are framed as dialectical responses from urban dwellers to the multi-scalar, capital infused metabolisms which frame their interactions with networked systems.

A conceptual framework is proposed that emerges from these concerns that provides a African situated UPE approach (see Figure 2.4) and is reflected in each of the four analytical chapters. The first constituent of the conceptual framework is focused on an analysis of **historical infrastructures (Chapter 4)** to provide a detailed examination of the historic and contemporary conditions in which Accra and Cape Town have developed and are situated that responds to both UPE (Section 2.5.6) and postcolonial explorations (Section 2.6.3) of networked systems. To understand the specificity of these cities the study engages with the, “historical and contemporary legacies of colonialism [and apartheid] through an urban theory that can aim at articulating and contextualizing the poisonous hangover of colonialism in both conceptual and practical ways” (Myers, 2006:290). This is undertaken through specifically focusing on the splintered nature (Section 2.4) of infrastructures in both cities and how these have been produced and mediate the contemporary context, seeking to show how the historic urbanization of nature (Section 2.5.2) has produced particular configurations of infrastructure. The second part of the conceptual framework is focused on **structural processes (Chapter 5)** and seeks to examine the metabolic production (Section 2.5.2) of urban energy networks and the ongoing crisis in low income neighbourhoods of Accra and Cape Town. The importance of this part of the framework is to identify and scrutinise the ways in which flows of capital, intersect with bio-physical processes to metabolically structure networked systems, mediate reconfiguration and produce unequal urban environments. The third part of the conceptual framework is focused on **everyday infrastructures (Chapter 6)** and seeks to examine the dialectical urbanism that exists across actual existing

conditions in low income neighbourhoods as urban dwellers seek to reconfigure networked systems in response to the socio-environmental conditions produced through urban metabolisms. This is undertaken by expanding the focus on urban metabolism to incorporate these ongoing, daily circulations of urban African life (Section 2.6.4). The final part of the conceptual framework is focused on analysing the **urban governance and power relationships (Chapter 7)** of network reconfiguration that examines the ways in which various institutional arrangements shape and guide the metabolic processes that (re)configure networked systems in Accra and Cape Town in order to explore the importance of various urban actors, circulating policy knowledges and politics in mediating infrastructure. This is undertaken to reflect on how processes of network reconfiguration link into wider relationships of power (Section 2.5.3) across networked systems and the ways in which low income communities seek to alter the balance of these relations.

Figure 2.4: Conceptual framework: An African situated urban political ecology



Chapter 3. Researching infrastructures

This chapter examines the methodological approach of the study, and the wider issues, pertaining to methodology, involved in the research. The aim is to provide not only an overview of how the sites of research were selected and the types of data collection undertaken, but an analysis of the nature of such research in the context of the postcolonial aspirations of the study, both in the field and throughout the research. The chapter begins firstly by outlining how the research was approached. Secondly, the chapter then goes on to examine the potential and limitations of comparative urbanism using the methodological approach to explore, justify but also question the process from which the selection of comparative cities (Accra and Cape Town) and comparative sites (networked, low income communities) was undertaken. Thirdly, the range of data collection methods is then examined, illustrating how the varied tools of research were employed within specific contexts and the applicability of these methods in contributing to the aims of the thesis. Fourthly, the analytical approach of narrative analysis is then explored. This illustrates how diverse and seemingly problematic data has been brought together to draw out emerging themes, issues and knowledges. Fifth, the chapter reflects on the postcolonial and ethical considerations that guided the data collection, research methodology design and fieldwork practice examining the appropriateness of the research, the role of the voices of the marginalised, the place of the researcher in urban Africa and other concerns.

3.1 Approaching the thesis

This section explores how the thesis was approached, outlining firstly the inception of the research and secondly the thesis approach.

3.1.1 Research inception

The research originated from an Economic and Social Research Council (ESRC) funded PhD studentship as part of a wider project led by Professor Bulkeley at the Department of Geography, Durham University. The project 'Urban Transitions: Climate Change, Global Cities and the Transformation of Socio-Technical Systems' was an ESRC funded leadership research fellowship that included 2 PhD studentships. The role was advertised in early 2009 and included a two page summary setting out the initial project outline developed by Professor Bulkeley and fellow supervisor Professor McEwan. This remained open but focused on work in two African cities around exploring how they are responding to climate change and the importance of examining urban infrastructures in response to the limited research undertaken on these issues in Africa. Before the interview a plan was sketched out to use Accra (due to a personal contact) and Cape Town (due to its status as a well resourced municipality). The shared use of English also provided another good reason for selecting the cities as it would make the research process more straight forward (thus discounting Kinshasa from my plans). After a successful interview and the beginning of the studentship in which agreement was reached that these would be interesting cities to work with, attention turned to creating

a research framework that would compliment and add to the existing, wider research project. Both Professor Bulkeley and Professor McEwan were interested in exploring an urban political ecology (UPE) approach to African urban environments. The content, direction and geography focus (within Africa) remained open and allowed for substantive discussions about the direction of the research and the potential sites for fieldwork. The research inception was also guided by work with the Durham Energy Institute's 'Centre for Doctoral Training' with a programme of activities working alongside the research to widen understandings of energy and providing an excellent resource in linking into multi-disciplinary group of scholars and an additional six months funding for the thesis.

3.1.2 Developing the thesis

The introduction (Chapter 1) stated the overall research aim of the study as interrogating the conditions in which the global aspirations for centering energy concerns and the emerging climate change agenda are being materialised across cities networked systems with two specific research goals. These were; firstly, to critically explore the contested processes of network reconfiguration that are taking place; and secondly, to develop a critical African situated UPE approach for undertaking this and further research. The research questions were aimed at developing both conceptual and empirical responses to this overall aim. These are:

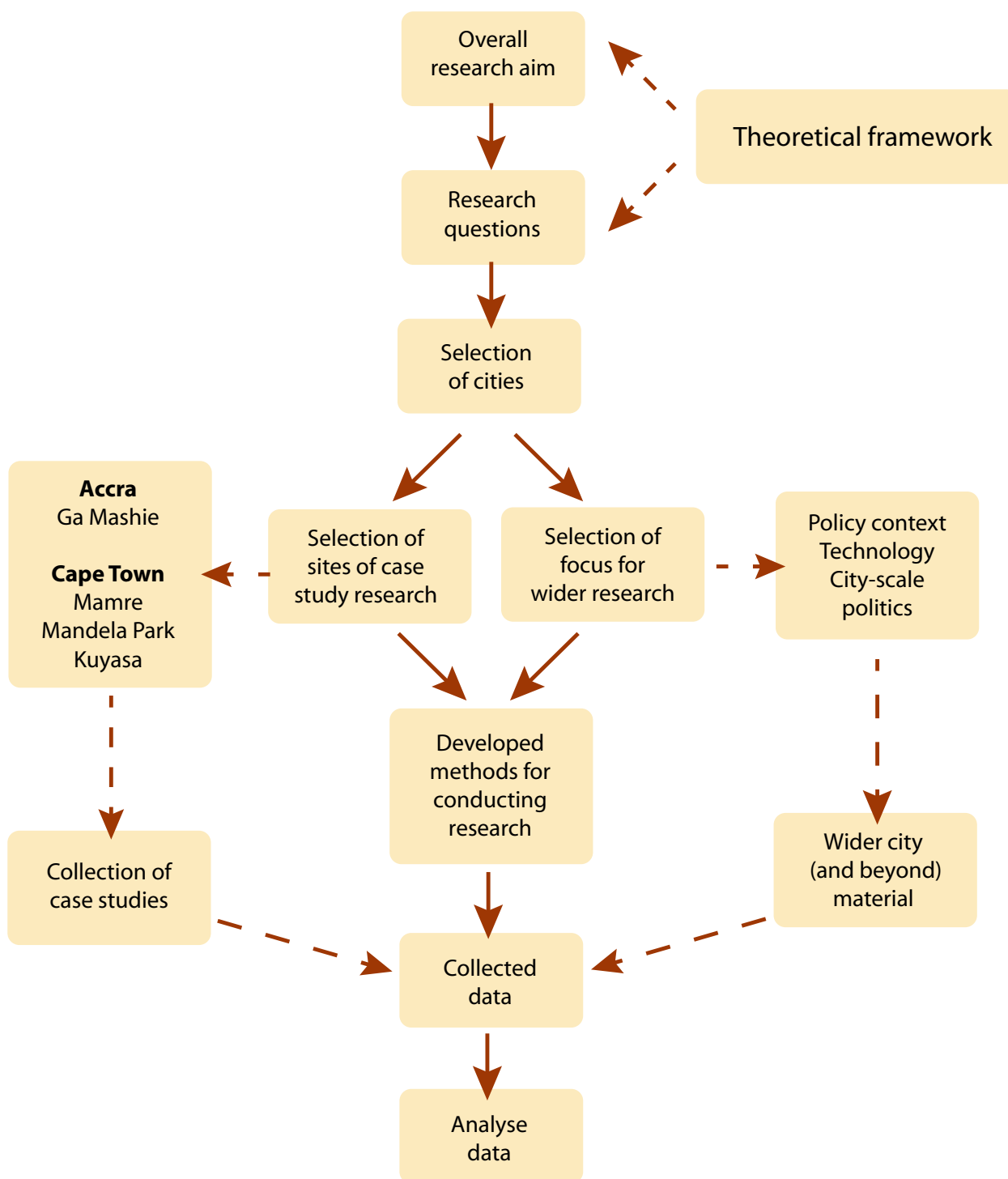
How have urban energy networks historically been configured in Accra and Cape Town, and with what consequence?

How, why and with what implications are energy systems in low income, networked neighbourhoods being reconfigured in Accra and Cape Town?

What do processes of reconfiguration reveal about wider social relations in Accra and Cape Town in relation to the emerging energy and climate change agenda?

The thesis was developed (Figure 3.1) to situate the study in Accra and Cape Town and to explore the research questions through a range of case studies, in low income communities, whilst developing wider research with other urban actors to provide a contextual overview. The main part of the fieldwork took place between October 2010 and January 2011 in Ghana (with a one month exploratory trip in April 2010) and February to July 2011 in South Africa meaning that fieldwork was undertaken for 11 months. During the fieldwork a series of case study sites were selected and researched in order to generate a range of data through multiple different methods, linked to and guided by the research framework. The selection of the sites of fieldwork, the data collected methods and a range of issues pertaining to the methodology are subsequently explored in this chapter.

Figure 3.1: Diagram showing how the thesis was developed



3.2 Comparative urbanism: Between and across sites of network reconfiguration

The next section establishes the ways in which the comparative nature of the thesis has been considered from the selection of Accra and Cape Town through to the case study sites via an ongoing reflection on debates across comparative urbanism, seeking to contribute to emerging postcolonial ways of comparing in and across cities. This is undertaken firstly, by examining wider critiques of comparative urbanism and showing how such debates help to shape the comparative terrain of the fieldwork and subsequent analysis, both theoretically and methodologically. Secondly, the section shows how these considerations influenced the approach to the notion of ‘African cities’. Thirdly, the section then goes on to briefly describe the comparative case study sites (further elaborated in Chapter 4), before fourthly outlining the role of the wider, contextual research and academic links in supporting the comparative research process.

3.2.1 Developing dialectical strategies for comparative analysis

The comparative strategy of the research and subsequent analysis was predicated on and shaped by two main requirements. Firstly, developing a comparative research process that begins on the street and is able to dialectically generate insights between and across the low income neighbourhoods and cities encompassing the multiple and multi-scalar dynamics operating across and beyond such urban spaces. Secondly, the research was concerned with exploring ways to reorder the traditional methodology of comparative urbanism, implicated in postcolonial critiques of urban studies, by considering multiple ways for undertaking comparison between and across the networked systems in Accra and Cape Town. Responding to calls by a number of scholars (Robinson, 2011, MacFarlane, 2010, Nijman, 2007, Ward, 2008) to reflect and rework the notion of comparative urbanism the thesis sought to use the comparative nature of the research to contribute to ongoing deliberations about how to postcolonise knowledge production (Connell, 2007). The selection of a comparative approach to the study was guided through a number of different considerations that are mediated by the research questions and theoretical perspective of the study and by what McFarlane (2010:738) suggests is the need for:

” a constant process of criticism and self-criticism that reflects on how a particular object of comparison is arrived at, and a commitment to develop new objects, methodologies and typologies of comparison through consideration of different theory cultures and perhaps also through new forms of collaboration”.

The history of comparative urbanism provides a wider commentary on the directions in which urban studies have travelled and the limitations that such pathways have generated in analysing cities. Walton and Masotti (1976) identify the reluctance of many urban scholars to undertake comparative studies, predicated on “a widespread belief that the explanation of local urban phenomena had to be unique, and that comparative research was therefore of no value” (McFarlane, 2010:727). Comparative urban studies became particularly visible from the 1960s and 1970s (Meadows and Mizruchi, 1969, Tilly, 1974) focused on the city as a bounded territory and exploring the commonalities and differences across these North America and European

spaces and the national economic context in which the cities were situated (McFarlane, 2010). Alongside this work was what Ward (2008:406) characterises as urban political economic research, taking place in the 1980s in which, “the work during this time emphasized patterns and regularities (Walton, 1975)”, using a “cross-national comparative perspective (Harloe, 1981, in Ward, 2008:406) and is similarly focused on global North cities. Yet, comparison has also long been associated, both explicitly and implicitly with urban studies and the global circulation of ideas, knowledges and models of cities being applied to local contexts that prompt a series of considerations in the thesis (McFarlane, 2010, Robinson, 2002).

The thesis suggests there are two main critiques of these traditions of comparing cities that have guided the comparative direction of the thesis. Firstly and related to urban theory, growing (postcolonial) critiques of urban studies, explored in the previous chapter and brought together in the work of Robinson (2002) argue against hierarchical and fixed ways of knowing cities based on particular indicators, such as economic activity or development in which, “these conceptual fields continue to ascribe innovation and dynamism, modernity to cities in rich countries, while imposing a catch-up fiction of modernisation on the poorest” (Robinson, 2002:2). This has resulted in what McFarlane (2010:728) suggests is a, “is a tendency in urban studies to attempt to compare with and learn from the usual suspects”. The outcome of such orientations in research has been to seek to find the paradigmatic cities of urban studies (New York, Los Angeles and so forth) as the starting point for developing a comparative analysis and making wider theoretical claims about ‘the city’ (McFarlane, 2010) whilst failing to examine and mobilise the relational, multi-scalar geographies of ‘ordinary cities’ (Robinson, 2006a). Such critiques imply comparative urbanism studies remain fixed and methodological in nature with models that categorized cities in particular configurations, acting as the framework from which cities were compared (Robinson, 2002, McFarlane, 2010). These models were the standard from which other cities were measured, taught for decade after decade in classrooms and lecture halls the world over, serving as the standardised ideal of a city that mediated comparative research and focused on particular global North cities as the way to construct urban theory at the expense of the multiple urban worlds of global South cities (McFarlane, 2010). The development of a comparative urbanism based on two African cities in this thesis thus contributes to the growing field of comparison which addresses global South cities exploring connections between and within and beyond these cities (Huchzermeyer, 2007, Lees, 2011, Harris, 2008, Myers, forthcoming, Oliveira, 1996 Waley, 2012, Simone, 2004a, Zerah, 2008) and seeks to utilise these spaces in which to generate theorizations of the urban beyond the paradigmatic cities of the North.

The second critique is predicated on methodological traditions of comparative urbanism that, “retain understandings of place, scale and space that are rooted in the past...understanding cities as bounded and discrete units and geographical scales as fixed and pre-given” (Ward, 2008:406). This comparative work has often taken the form of ‘encompassing’ strategies of comparison (Tilly, 1984, Robinson, 2011) that links different cities to wider systematic dynamics, particularly capitalism yet, “this approach therefore re-inscribes a priori divisions and hierarchies into the world of cities, which can militate against broader comparative ambitions” (Robinson, 2011:7). The thesis takes on these concerns by seeking to respond to Robinson’s (2011:8) call to explore:

“the prolific and uncertain associations created by various kinds of connections or flows and their diverse territorializations and assemblages mean that we also need to hold open the possibility of more fragmentary and limited relationships”.

Such provocations to the tradition of categorization, prioritisation and ‘encompassing’ provided a tentative step towards seeking to outline a postcolonial anchored comparative urbanism that seeks to move beyond the notion of Accra and Cape Town as flattened, uncountoured urban African spaces, linking into wider metabolic processes or fragments of reconfiguration from the everyday. Thus, a postcolonial approach to comparison in this thesis is focused on the notion of the multiplicity of the city and the importance of comparing fragments, instances and particular dynamics which can be focused both on similarity and difference rather than simply ‘the city’ as a whole. Yet, whilst a comparative strategy focused on the notion of the multiplicity of the city provides a pathway for the thesis this created a tension with the need to consider the political ecological/ economic dynamics shaping these cities. As the thesis is partly focused on seeking to analyse and compare how metabolisms of capital, climate and crisis are territorialised across Accra and Cape Town it has been important to consider how to retain a certain focus on ‘encompassing’ comparison whilst simultaneously responding to Robinson’s (2011) call to explore particular fragments, instances and processes. A strategy to overcome such issues has been mapped by McMichael (1990) who, “very usefully proposes the pursuit of a comparative strategy he terms ‘incorporating comparison’, in which both the individual instances (‘parts’) and the ‘whole’ are historically and mutually constituted” (Robinson, 2011:8). This has influenced the comparative direction of the research by supporting the need to undertake comparison not simply across the wider cities themselves (‘whole’) but across more fragmentary spaces and processes within the cities (‘parts’). Such a comparative strategy provided a central methodological and conceptual orientation for the thesis as it illustrated the importance of detailed comparative analysis of networked systems in low income neighbourhoods within and between both cities, alongside thinking through such issues at a city scale and the dialectical relationship between these dynamics.

Together these outlined critiques of comparative urbanism and subsequent responses helped to generate and shape a comparative study of Accra, Cape Town and particularly the low income neighbourhoods that seeks to uncover the diverse urban worlds of these cities and their networked systems. The fieldwork responded to this imperative and provided a series of different methodologies to undertake comparison work that has been able to consider multiple urban contexts. Thus, when considering historical infrastructures (Chapter 4) the analysis undertook a city-to-city comparison to consider the histories of both cities in shaping networked systems working through both similarity and difference. Yet it also sought to develop an inter and intra neighbourhood comparative analysis to consider how such insights might challenge and decentre the city scale (or ‘whole’) analysis through a more fragmentary approach focus on the ‘parts’. The exploration of power across (Chapter 7) took the process of network reconfiguration as the unit of comparison, providing a way in which to connect these dynamics across both cities that is at least partially deterritorilised. When considering incremental infrastructures (Chapter 6) the study argues that processes of improvisation, incrementalism and people as infrastructure can be viewed across all the low income neighbourhoods of the study as fragmentary moments or instances in both Accra and Cape Town and the comparative analysis is

predicated on the commonality of experience across these processes. Together these multiple methodologies of comparative urbanism are thus linked to McMichael (1990) 'incorporating comparison' and provide a way to; firstly, undertake comparative analysis that can chart the multiple and shifting flows and circulations of networked systems. These concerns are particularly relevant within the African situated UPE, as the metabolic nature of the urban dialectically operates across, through and within an array of connections, networks, scales and imaginaries that mediate urban infrastructures. Secondly, by mobilising a 'incorporating comparison' (McMichael, 1990) approach the thesis has responded to postcolonial critiques of existing urban theories, methodologies and ways of researching cities and position global South cities as important urban spaces for theorisation.

3.2.2 Commonality and difference across African cities

The research undertaken in the cities of Accra and Cape Town (Figure 3.2) was predicated on the rationale of seeking to develop a comparative study between and across two selected urban spaces in Africa and was partly driven by the requirements of the ESRC-funded PhD and partly by the potential insights that could be generated by basing the research in two African cities. The first consideration when approaching this comparative task was to consider the dangers of generalizing about the 'African city', linking into wider discursive productions of urban spaces across Africa explored in the previous chapter. This caution is emphasized in a paper (Silver et al, forthcoming) that explores such concerns within the context of urban responses to climate change in the West African cities of Bobo-Dioulasso in Burkina Faso and Saint-Louis, Senegal, arguing that:

"is important for policy-makers and practitioners not to attempt to generalize about 'the West African city', but to compile geographically and place-specific evidence so that knowledge and good practice might be disseminated in appropriate ways".

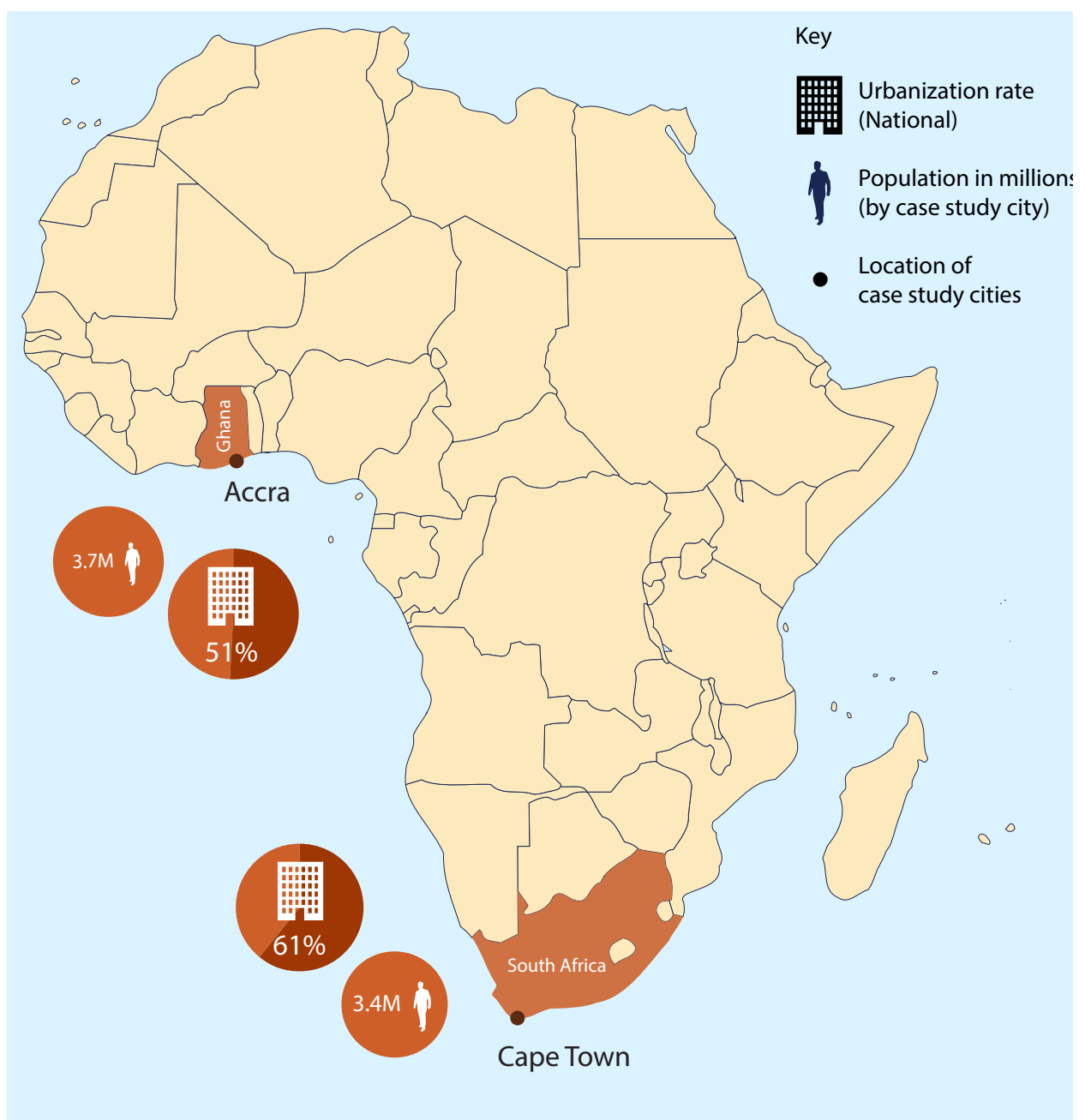
This caution can equally be carried over to academic research and perhaps becomes particularly pressing when considering the differences in histories, cultures, economy, politics and so forth that differentiate Accra and Cape Town. These specificities of place that constitute both cities suggest caution in thinking about the way in which comparative analysis proceeds between these African cities, one that does not seek to assume a commonality across these urban spaces because they share a geographical region.

The 'comparability' of Accra and Cape Town and particularly processes of network reconfiguration in low income areas was therefore approached through the potential of a partial commonality that may exist across the urban conditions, experience and governance that situates these cities within the African context:

"African cities have also historically found themselves in the same boat when it comes to piecing together a functional sense of coherence and visibility from a most haphazard collection of aspirations and livelihoods. Many non-African cities may also be in the same boat. However, African cities do share a region and are, thus the objects of specific policy and program initiatives and administrative functions that are organised along regional lines. These initiatives and functions have a major impact on how cities are governed and developed. What distinct African cities make of this 'commonality' is, then, important for what happens to them in the future" (Simone, 2004:18).

Whilst this commonality can (and is) challenged (for example, in debates around the exceptionism of South African cities, postcolonial knowledge critiques and so forth), Simone (2004) suggests its also important to reflect on the ways in which processes of urbanism are taking place across the diverse cities of the continent, the ways in which these might produce some level of common urban conditions and how these (partial) commonalities can be considered in relation to mediating urban infrastructures. Thus, whilst comparative work across networked systems might be considered problematic (if focused only on seeking commonality), echoing particular discursive productions of homogenous African cities and the wider continent the study sought to investigate Simone's (2004) contention of a partial commonality alongside the differences in networked systems that are visible across both cities.

Figure 3.2: Map showing location of Accra and Cape Town and urbanization trends



Accra and Cape Town constitute cities of similar population size⁶ (Figure 3.2) that like other African cities are experiencing urban growth⁷ (Figure 3.2) and have witnessed large increases in rural to urban migration. They are located in two countries in Africa (Ghana and South Africa) considered to be important emerging diplomatic and economic leaders. Whilst Cape Town has been situated within a middle income national context for a number of years, Accra is part of a nation that has recently declared itself middle income and as such the partial commonality of economic position within the world economic system may be a shared position. This middle income status may also provide some commonality around issues of technology development. For example, in both countries solar industries are dominated by Chinese technologies. The shared (British) colonial history is another important potential commonality, with early infrastructure development mediated within the particular governance configuration of British Imperial rule. Whilst independence for Ghana was not mirrored in South Africa, where the system of colonialism morphed and intensified into totalitarian system of control these shared (early) colonial histories may perhaps provide another space to consider relations between the two cities. The splintered nature of urban infrastructures in the two cities whilst exhibiting different trajectories and forms of governance (Chapter 4) have also displayed some commonality, with the poor often being unable to access networked services, within the context of promises by governments to develop infrastructure for all (either in the post-independence period of President Nkrumah in Ghana or the post-apartheid period of African National Congress (ANC) government in South Africa). As in the case in cities across Africa the widespread nature of poverty and socio-environmental inequality characterise both cities with the focus of urban governance partly centered around, often internationally funded, programs of poverty alleviation and development, basic infrastructural investments and political pressures relating to the urban poor. Yet simultaneously Accra and Cape Town share many differences that suggest the need to analyse such differentiated urban spaces must acknowledge and explore how the unique experiences of both cities have created particular political ecological configurations.

The political economic context in Cape Town is very different to that of Accra with its limited resources. The city is part of a developmental state that has invested significant capital in creating new housing and network spaces across the city for the urban poor and situated in a national economy with a Gross Domestic Product (GDP) more than ten times that of Ghana⁸ illustrating the financial gap between the two cities in terms of infrastructure investment potential. Thus, in Accra the resources available to the City of Cape Town do not

⁶ Greater Accra had a population of 2,905,726 in the 2000 National population census and a growth rate of 4.4% suggesting a population for 2006 of 3,762,336 (Source: Ghana Health Service, 2002)
The City of Cape Town has a population estimated at around 3.4 million but could be as high as 4 million
(Source: City of Cape Town, 2008)

⁷ Although African countries have traditionally experienced lower levels of urbanization than other parts of the world this does not mean that cities across the continent are not experiencing urban rapid growth. By 2010 population predictions expect around 37 percent of sub-Saharan Africans to be urban dwellers, rising to nearly 60 percent in Southern Africa, 44 percent in Western Africa and over 50 percent in Northern Africa
(Source: UN Habitat, 2008)

⁸ In 2011 the GDP of South Africa was \$408 billion and the GDP of Ghana was \$39.2 billion
(Source: Trading Economics, (2012a))

currently exist, despite the country's booming economy⁹ and perhaps can only be found in the historical echoes of President Nkrumah and his calls of infrastructure for all, whilst a neoliberal climate mediates financial flows into urban networks. These cities struggle for resources, in the face of neoliberal macro constraints, lack of investment, unfair global trade agreements and urban populations characterised by widespread poverty there are some important comparative differences. Cape Town has managed to create a space in which to invest significantly in urban infrastructure and create some balance between the market and the significant needs of the urban poor (Section 7.3.2). Whereas the city of Accra can be seen as a urban space of neoliberalism, dominated by the interests of private capital (Section 7.3.1) and with little regulation as the sprawling city has grown dramatically over the last 20 years and at the same time as the Structural Adjustment Program (SAP), which sapped investment from public infrastructures whilst creating conditions for private investment. Although reconfiguration undertaken by the municipality is beginning to take place in Cape Town, of already existing network spaces, alongside the much more significant investment in creating such spaces via a plethora of interventions since this has failed to stem the network crisis experienced by the urban poor, who living in very different conditions, share a vulnerability with the networked, urban poor in Accra. This exploration of difference is undertaken through the UPE framework by tracing the metabolic processes that produce crisis across the low income, networked neighbourhoods of both cities (Chapter 5). Such commonality and difference across Accra and Cape Town prompted the need to reflect on the way in which comparative urbanism is undertaken in this study as both a methodological and theoretical strategy.

3.2.3 Identifying comparative urban spaces

A series of comparative sites of network reconfiguration were chosen across Accra and Cape Town to act as the urban spaces from which the research was constructed. As Merrifield (2002:14) suggests, “truth claims about cities must be conceived from the bottom upward, must be located and grounded in the street, in urban public space, in everyday life”. The research methodology was shaped around an approach that begins on the streets of Accra and Cape Town and dialectically pieces together the dynamics and processes that produce the infrastructure landscapes of both cities. The site selection was guided by seeking to develop research in networked, low income communities in which energy poverty is prevalent, reflecting wider socio-environmental conditions in these neighborhoods and the spaces in which reconfiguration were taking place. The aim of the research was to explore the ways in which energy networks are reconfigured in particular spaces across Cape Town and Accra. Such a focus meant the need to work in neighbourhoods characterized by poverty and wider conditions of inequality, yet also formally connected to the electricity network. This is in contrast to the often poorer, informal neighbourhoods that also constitute low income spaces across both cities. Case study neighbourhoods were selected as providing representations of other similar urban spaces across the cities. Hesse-Biber and Dunleavy (2011:256) suggest that using case studies, “provides the researcher with a holistic understanding of a problem, issue of phenomena because the case is investigated from many different angles and paying attention to many different dimensions of the issue”.

⁹ From 2000 until 2012, Ghana GDP annual growth rate averaged 7.5 Percent reaching an all time high of 20.6 Percent in June of 2011 (Source: Trading Economics, (2012b))

Through drawing on the knowledge of informants and organizations (see Appendix 1) working in each city opportunities to link up to neighbourhoods emerged. These site selections came about through a series of different encounters with actors across the network including urban intermediaries and the requirement of working in low income, networked communities. Urban intermediaries can be understood as individuals and organizations that act in-between production and consumption (Guy et al, 2011) and as Hodson and Marvin, 2010:482) suggest, “are set-up to intervene in a variety of ways in existing systems of producing and consuming resources” these intermediaries encompass a wide range of organisations including NGOs, utility companies, government energy agencies and so forth. These urban intermediaries mediate across various agendas, funding sources, policy orientations and so forth to reconfigure existing socio-technical systems (Guy et al, 2001, Hodson and Marvin, 2010). Work with urban intermediaries included a placement with the NGO, ICLEI, as part of their ongoing climate change work. This enabled an opportunity to work with the Mamre community, via the City of Cape Town (CCT), in undertaking research that was required around the network reconfiguration and involved a series of agreed and shared workplans for undertaking the necessary research. This partnership provided a relatively straight forward way to work with the community on a new network reconfiguration. In another instance, a public meeting was called in Mandela Park concerning the forthcoming municipal elections and contact was made with the organisers to establish permission to attend. Information about this meeting had been announced at another political meeting in the city and showed the utility of attending such events and networking. After attending the initial meeting and explaining the research further discussion was agreed upon. The very visible Kuyasa project made site selection relatively straightforward with visits facilitated by an NGO and hosted by a community leader. In Accra site selection of Ga Mashie was undertaken during a scoping trip in April 2010 with a local existing contact (an architect friend from Manchester) providing an introduction to the neighbourhood and a local guide who would go on to become a research assistant during the fieldwork period. The work and energy of the research assistant was a key part of the success of the research in the neighbourhood showing the importance of careful site selection based not simply on the area but the potential collaborations that are able to be formed.

3.2.4 *The comparative sites of network reconfiguration*

In Accra one site was selected to address the research questions providing an in-depth case study for the thesis:

Ga Mashie (or James Town¹⁰) is the old centre of Accra, and one of its most impoverished, networked neighborhoods in the city. An extended period of research explored how various urban actors are reconfiguring the energy network from the utility company installing electricity meters through to the community using reconfiguration as part of incremental responses to poverty and urban inequality. The case study explored the ways in which urban politics and the splintered nature of infrastructure are reflected in the energy network of Ga Mashie and provides an example of various forms of historical urban governance that have shaped and mediated the networked systems and at a moment when the promise of a NGO funded re-development of the neighbourhood draws closer



Figure 3.3: Overhead image showing central Accra and neighbourhood boundaries of Ga Mashie. © 2011 Google

In Cape Town three sites of network reconfiguration in low income, networked communities were selected, through a number of opportunities that opened out during the initial phase of research. The research sought to explore how these processes are taking place and the different forms of governance and emergent technology that they represent:

¹⁰ James Town is the name given to it during the colonial rule of Great Britain but the neighbourhood has always been called Ga Mashie in the local language, Ga, reflecting its centrality to the Ga people. As such the thesis uses the name Ga Mashie throughout.

Figure 3.4: Map showing location of case study neighbourhoods in Cape Town



Mamre, is a small, mainly Coloured (93.5 percent), low income (28.35 percent unemployment rate compared to 20 percent across the city) neighbourhood situated in the north of the city (CCT, 2013a). In 2010 through climate change financing 250 households were retrofitted with insulated ceilings. The project was led by the CCT's 'Sustainable Livelihoods' section and financed through the Danish International Development Agency (DANIDA). The intervention has provided an experiment to measure the impact of the ceilings and is being explored as a model for the local state to upscale the program, providing an early example of how climate change financing is intersecting with urban infrastructures. Alongside this extensive network reconfiguration a series of everyday, incremental ways of reconfiguring the energy network were visible.

Mandela Park, in Khayelitsha, Cape Town's largest township is a mainly Black (98.3 percent) low income neighbourhood (38.97 percent unemployment rate) (CCT, 2013c). It provides a case study in which the community itself is incrementally reconfiguring the energy network of the area through self build housing and other interventions including starting up a brick making project. This case study explores the conflict between the state, private sector and the community that has been ongoing for a number of years around housing and the implications this has for how energy networks are reconfigured, who undertakes this work and the incremental nature of the urban.

Kuyasa, opposite Mandela Park in Khayelitsha and sharing a similar predominance of Black residents (98.8 percent) and high rates of unemployment (38.54 percent) (CCT, 2013b) has seen large scale network reconfiguration with government funded installation of solar water heaters (SWH), insulated ceilings and other energy saving measures in 2500 households. The reconfiguration has been developed over a number of years by an NGO and with close involvement of the community and is generating income via the Clean Development Mechanism (CDM) and showing how climate change financing is an emerging logic across urban infrastructures

Across these case study neighbourhoods in Accra and Cape Town a range of network reconfiguration processes were identified and investigated (Figure 3.5).

Figure 3.5 Table showing types of network reconfiguration in each neighbourhood

Neighbourhood	Reconfiguration	Purpose
Ga Mashie	a. Installation of Pre-Paid Meters (PPM)	To increase revenues for Electric Company of Ghana (Electricity distributor)
	b. Series of everyday changes to the network by residents	In response to socio-environmental conditions
	c. Proposed re-development of Ga Mashie including demolition/new housing and potential for new/upgraded energy systems	Improving living conditions Strengthening capacity of slum dwellers (CHF International)
Mamre	a. Installation of 250 insulated ceilings	Housing energy upgrade project Pilot for climate change funding (DANIDA)
	b. Series of everyday changes to the network by residents	In response to socio-environmental conditions
	c. Installation of Pre-Paid Meters (PPM)	To increase revenues for City of Cape Town (Electricity distributor)
Mandela Park	a. Construction/demolition of new housing	In response to socio-environmental conditions In response to construction without permission (CCT)
	b. Series of everyday changes to the network by residents	In response to socio-environmental conditions
	c. Installation of Pre-Paid Meters (PPM)	To increase revenues for PN Energy(Electricity distributor)
Kuyasa	a. Installation of 2,500 solar water heaters (SWH)	Housing energy upgrade project Pilot for Clean Development Mechanism
	b. Series of everyday changes to the network by residents	In response to socio-environmental conditions
	c. Installation of Pre-Paid Meters (PPM)	To increase revenues for PN Energy(Electricity distributor)

3.2.5 Contextual research in Accra and Cape Town

Alongside the research emerging from the experiences on the streets of the case study neighbourhoods, wider contextual research was undertaken in both cities that linked what was happening in these everyday spaces with the political ecological processes shaping these dynamics. This was taken in order to develop a more comprehensive perspective of processes of network reconfiguration and develop another way to draw together a comparative analysis. The wider work included thorough and detailed research across a series of different points of interest that relate to the study and specifically the need to develop a UPE analysis that could draw together the multi-scalar processes that shaped networked systems beyond the case study neighbourhoods. This meant engaging with a series of multi-scalar intermediaries both across the cities and beyond and involved in networked systems, able to offer different perspectives on the issues. In Ghana this included work with a number of architects and developers working on eco-innovations and sustainable masterplans. This aim of this research was to seek to consider the urban spaces in which emergent technologies were becoming visible in contrast to the invisibility in Ga Mashie and the dialectical relationships such dynamics had with wider urban inequalities. Further work was undertaken to explore the development of planning frameworks in selected urban areas of Ghana, with Kasoa City, on the edge of

Accra's boundaries providing an excellent site in which to consider the rapid urbanisation of the city. Visits to a range of other points of interest were also undertaken including research at Akosombo Dam, as part of a process of tracing the energy supply of Ga Mashie beyond the neighbourhood geographies. In Cape Town, contextual work included spending time working with ICLEI on a series of climate change related projects, providing advisory input around research. This included supporting the developing '5 City Network to Pioneer Climate Adaptation through Participatory Research and Local Action' and facilitation at the Local Climate Solutions 2011 Congress¹¹, allowing for interactions with municipal actors from across the continent. Whilst not all of this work and research was directly relevant to the fieldwork it provided an opportunity to network with urban intermediaries involved in similar issues and develop wider understandings of the political ecologies of both cities.

Academic linkages

Building links with academic institutions in Accra and Cape Town formed a key strategy during the fieldwork, providing an excellent opportunity to build research networks, debate and discuss research issues, learn more about the cities and situate the research within circulations of urban knowledge of African cities. In Accra links were made with the Geography Department at Legon University through a visit during my scoping trip. Whilst a staff strike that lasted most of the fieldwork interrupted the process (particularly the hope of taking some classes) being able to spend time with a number of urban scholars challenged the research, helped to understand the local context and provided a chance, via the Ghana National Social Science Conference to present the work to an academic audience¹². In Cape Town the African Centre for Cities (ACC) provided a desk space and a vibrant culture of debate. This had been organised via prior links between my supervisors and staff. The ACC is one of the key centre's of

INVITATION

Jonathan Silver: Climate change, energy networks and the urban poor in Accra: a neighborhood perspective
BROWNBAG SESSION

Speaker: Jonathan Silver
Date: June 30, 2011
Time: 13:00 -14:00pm
Venue: Rm 2.27, Davies Room, Engeo Building, Upper Campus, UCT, Cape Town

In this brownbag session, Jonathan Silver will focus on the James Town/Ga Mashie neighborhood in Accra and explore the political ecologies of climate change and energy networks at a community level. This fieldwork is taking place in the context of emerging legislation around renewable energy and climate change adaption and the work seeks to link the everyday geographies of energy usage to this evolving policy formulation.

Figure 3.6: Image showing advert for workshop at African Centre for Cities

¹¹ Blog entry providing further information on the congress is available www.energygeographies.com

¹² Towards an Urban Climate Change Agenda, in the 'Climate Change and Ghana' session at the University of Ghana, Faculty of Social Sciences (4th Annual Colloquium on 'Interdisciplinary Research Amongst the Academia' 9th December 2010

learning for scholars interested in African cities and an opportunity to present emergent findings from the research in Accra (Figure 3.6), together with running a workshop on the research in Mamre was undertaken. Furthermore, the ACC provided an opportunity to link up with other researchers with similar interests with a reading group around African cities and UPE established and leading to a series of ongoing collaborations. Durham University and particularly the research links connected to the Urban Transitions project have also provide a series of opportunities to develop research links, expand networks and knowledges and contribute to wider debates that have helped to shape the research process and wider PhD.

3.3 Data collection methods

The next section outlines and examines the main data collection methods undertaken during the research process including interviewing, workshops, survey work, policy analysis, photography and other methods.

3.3.1 Outline

A range of data collection methods were used during the fieldwork in order to capture the multiple perspectives emanating from urban actors linked to energy networks in Accra and Cape Town. Whilst interviewing and focus workshops formed the core element of the research, a range of other methods were also used in order to capture the complexity of the issues, allow for participants to express perspectives beyond the potentially narrow form of interviewing and workshops, and to develop a more in-depth overview that tried to widen participation in the research process (for example with young people). Together these data collection methods have contributed to a research methodology that has been open to new ideas expressed by participants, allowed for a degree of flexibility in the field and helped to uncover a range of processes, issues and perspectives that contributed to a UPE in the making. Figure 3.7 shows a summary of these data collection methods and the different sites in which they were enacted, the participants involved and the rationale for selecting such approaches. The methodology relates to the conceptual framework in a number of ways that sought to generate data for analysis. Firstly, it focuses on seeking to examine the perspectives of residents in low income neighbourhoods and how the energy network and other processes relate to ongoing issues of poverty and socio-environmental inequality that links structural dynamics to everyday experiences. Secondly, it provides a series of often conflicting perspectives from multi-scalar urban actors involved in network reconfiguration. Thirdly, it provides a strategy to trace the metabolic processes that mediate urban energy networks and processes of network reconfiguration through various city scale and beyond dynamics.

Figure 3.7: Table showing outline of data collection methods

Activity	Rationale	Description	Location	Date	Participants	Number of participants
Interviewing	To explore in-depth issues through semi-structured interviewing. To allow for full exploration of issues	Community interviews in Mamre	Mamre, Cape Town	May to June 2011	Community members	25
		Stakeholder interviews in Cape Town	Cape Town	Feb to July 2011	Wider stakeholders	15
		Stakeholder interviews in Accra	Accra	Oct 2010 to Feb 2011	Wider stakeholders	20
Community workshops	To meet with residents and understand energy issues in area	Working with research assistant to develop a series of weekly workshops in the area with different households	Ga Mashie, Accra	Oct 2010 to Feb 2011	Community members	42 (6 per group x 7 sessions)
		Working with Mandela Park Backyarder's organisations with discussions around energy, housing, politics	Mandela Park, Cape Town	May to June 2011	Community members	15 (5 per group x 3 sessions)
		As part of evaluation work with City of Cape Town organised two day workshops	Mamre, Cape Town	May to June 2011	Community members	10 (5 per group x 2 sessions)
Survey Work	To develop a better understanding of the wider area	Household survey	Ga Mashie, Accra	Jan 2011	Community members	35 households
	To develop a robust data set for evaluation	Household survey	Mamre, Cape Town	May to June 2011	Community members	140 households
Photographic Sessions	To better understand the energy network and to involve young people in research.	Working with research assistant to organise workshops	Ga Mashie, Accra	December 2010	Community members	12
		Organised school activity around areas.	Mamre, Cape Town	May 2011	School children	35
Policy analysis	To develop a better understanding of policy context and build research contacts	Analysis of range of local, regional, national and international policy around urban, climate change and energy	Accra and Cape Town	At start of each fieldwork visit	N/a	N/a

3.3.2 Interviews

Interviews are used extensively as a form of collecting data across the social sciences (Noy, 2009).

Extended semi structured interviews have formed a key part of the methodological approach during the fieldwork. These interviews form:

“a verbal interchange where one person, the interviewer, attempts to elicit information from another person by asking questions. Although the interview prepares a list of predetermined questions, semi

structured interviews unfold in a conversational manner offering participants the chance to explore the issues they feel are important” (Longhurst, in Clifford and Valentine, 2003:118).

Around 65 interviews were conducted as part of the fieldwork. They were useful in that they gave the opportunity for individuals to situate themselves within an unfolding and expanding analysis of network reconfiguration in Accra and Cape Town and provided excellent data for consideration. Narrative plays a key part in our understanding of self and the world around us. It is, as Wiles et al (2005:90) comment, “both a mode of representation and a mode of reasoning, shaping our perceptions of ourselves and impacting our lives, culture and society in general” and thus forms a key tool for the researcher by helping to deconstruct the multiple and contested meanings of network reconfiguration offered by urban intermediaries and other urban actors such as communities. By viewing power and knowledge as socially constructed the researcher is able to develop understanding via the interview process because:

“the qualitative research interview is a construction site of knowledge. An interview is literally an inter view, an inter change of views between two persons conversing about a theme of mutual interest” (Kvale, 2004:2).

The semi-structured interviews were held with a range of participants during the research and can be grouped in two main categories: Firstly, elite interviews (Appendix 1) which involved engaging with stakeholders across Accra and Cape Town to provide a series of perspectives that included:

- National actors
- Municipal actors
- Utility company and technology actors
- NGO and research institution actors
- Activists
- Architects and developers
- Other stakeholders

The aim of these 15 interviews in Cape Town and 25 in Accra was to widen the research beyond the selected neighbourhood sites. Providing commentaries on the processes (e.g. policies, politics, financing) that were shaping both the city and the neighbourhood energy networks, through governance and emergent technologies, meant that the research has been able to link the network reconfiguration at the neighbourhood scale with the wider governing of networked systems and social relations (see Appendix 2 for prompt sheets). A series of interviews were also conducted with residents in low income communities (including stakeholders such as local agencies, teachers and so forth) that provided a complimentary set of data to that collected during the workshops (Section 3.3.3). It also allowed for individuals to ‘speak out’ without having to worry that their views would be heard by other members of the community. These included five in Ga Mashie and 25 in Mamre.

The interviews were shaped around the research goals and questions with an interview guide being prepared before the meeting to ensure that it covered the key areas of focus, whilst allowing the interviewee to bring forth new issues. Interviewees were either known to the researcher or recruited through a snowball sampling strata, being identified by fellow interviewees (Browne, 2005) which provided some limitations in terms of accessing different networks. The research was able to draw upon a wide network of potential interviewees for the research through various networks that were formed during the fieldwork (including those from working in low income communities, at universities, attending policy events). In some cases research was required before an approach was made to some of the key targets. This was especially the case with national policy actors for example with more success in Accra than Cape Town partly explained by the concentration of government departments in Ghana's capital. In the case of elite and stakeholder participants the interviews were digitally recorded and subsequently transcribed. However in the case of the community interviews, conversations were written down in note form and recording equipment was not used with the aim to make participants feel at ease. In Ga Mashie interviews were conducted in Ga and English with the research assistant being used to help translate. In Mamre interviews were conducted mainly in English but with some in Afrikaans, with the CCT providing the resources to help translation. All other interviews were conducted in English.

3.3.3 Workshops (or focus groups)

Workshops or focus groups¹³ were held with residents in low income communities as the key method of data collection for bringing together the views, opinions and perspectives surrounding energy network and reconfiguration in the case study sites. A workshop is defined by Powell et al (1996: 499) as a, "group of individuals selected and assembled by researchers to discuss and comment on, from personal experience the topic that is the subject of the research". As Kreuger and Casley, (2002; 75) suggest, "several strategies are used to identify participants for focus groups" and this was the case during the fieldwork. For instance in Ga Mashie, Accra, the research assistant, was asked to identify and organise these workshops with different households, explaining the nature of the research and the rationale for seeking their participation and using his personal contacts in the area to access these potential attendees (Figure 3.8). In Mandela Park, Cape Town, the focus group was discussed during a community meeting with an open invitation to participation for the following weekend. Goss and Leinback (1996) have suggested up to fifteen participants can take part in focus groups but MacIntosh (1993) suggests between six and ten. The latter was deemed to be a more manageable number of participants and the research was guided by this as an appropriate size.

The facilitation in Ga Mashie was straight forward due to the excellent work of the research assistant, this is important as, "A good assistant can make or break one's research and one's relations with the local community, even for local researchers" (Apentiik and Parpart, 2006: 34). The research assistant was important in translating when this was required. Translation in the workshops and other research activities presented a number of challenges, particularly around terminology prompting the need to explore the meaning of words and phrases in greater detail. Facilitation was used to guide the ebb and flow of the

¹³ the terms are used interchangeably

discussion rather than dictating the pace based on Kreuger and Casley's (2002;100) guidance that, "moderating requires the ability to listen and the self discipline to control your personal views".

Figure 3.8: Map showing location of workshops in Ga Mashie



The facilitation ensured that all members of the focus group were allowed the opportunity to make their point, although in many cases particular individuals would contribute to a higher degree than others. Power relationships were evident in group dynamics. For instance, the head of the household in the Ga Mashie workshops often spoke more often than more junior members of the household. The workshops were recorded through note-taking rather than a digital recording to make the participants feel more comfortable in expressing their views, except in cases where all participants were happy to be recorded using a dictaphone. Focus groups are sometimes suggested as limited in reflecting wider opinion (Kitchen and Tate, 2002) with a tendency towards consensus and conformity by research participants who may be reluctant to speak out within existing power dynamics operating across households or wider neighbourhoods. Whilst this was recognised the workshops were used to maximise the number of participants involved in the research (as opposed to interviewing) and although the thesis acknowledges the limitation in applying the views of workshop participants across the wider community at the same time they do offer a wider (qualitative) perspective than many other research methods.

A number of workshops were also organised with other stakeholders, particularly academics as a way to test out emerging ideas on the research process in Mamre and working with the CCT. These workshops involved selected participants, chosen because of their knowledge of particular issues that could contribute to improving the research. Alongside organising workshops multiple events were attended, organised by other urban intermediaries.

3.3.4 Survey work

The study is built around a qualitative research focus, in order to consider network reconfiguration by different urban actors. Additionally some survey work was also undertaken during the fieldwork due to a number of opportunities that arose during the process and providing a quantitative contribution that provides detailed data to provide a more robust picture of opinions by urban dwellers in low income neighbourhoods. A survey is defined by Kitchen and Tate (2000:47-48) as;

“A study which seeks to generate and analyse data on a specific subject from a particular sample population...In general, surveys use questionnaires to generate quantitative data from which they can calculate statistical information”.

Two surveys were completed during the fieldwork that provided supporting data to the research and a number of important ways to consider the opinions and perspectives of larger proportions of case study communities that would have been possible through interviewing or focus groups. Whilst both surveys were not planned before the research period began, the undertaking of the surveys would improve the wider research through generating further data for examination, whilst contributing to the knowledges of communities and urban intermediaries. The use of surveys whilst ‘in the field’ showed that the methodology was developed with a degree of flexibility that could respond to the conditions and context of the research.

In Ga Mashie, a short qualitative survey was undertaken with 33 households to provide an extra layer of data (Appendix 3). This was undertaken in January 2011 to respond to the need to try and incorporate a wider number of community voices in the research and test out some emerging findings from the workshops. The fifteen questions were derived from some specific and recurring issues the workshops and sought to widen the collected data on a number of specific issues (such as energy poverty). The role of the research assistant meant that this survey was relatively straight forward to plan, with the collection taking place within the same area of the neighbourhood as the workshops. The survey was small in relation to the size of the population of the neighbourhood or sub-area and the data is used alongside the interviews, workshops and other qualitative methods to compliment the identification of viewpoints and perspectives.

The research conducted in Mamre involved an extensive survey (Appendix 4) with 140 out of 250 households that had an insulated ceiling installed. This provided a response rate of 62.5 percent and a robust set of data. The survey work in Mamre was undertaken both as part of the research for the thesis and as part of the evaluation of the project by the CCT and ICLEI. These organisations had already conducted a pre-intervention survey and wanted to continue to generate data from the evaluation project. The survey was

designed in collaboration with a range of partners and reflects the need to understand how the intervention has interacted with a number of areas including;

- Energy
- Climate resilience
- Health
- Livelihoods
- Project delivery

The survey was conducted by community members, who had previously been trained in research by the partner agencies and were fully briefed on undertaking the task. It was felt that this would provide a training opportunity to the community researchers and that respondents would feel more comfortable. The survey was translated into Afrikaans by a researcher at the CCT as this was the main language of the community. A further session was organised in order to explain the scope and purpose of the survey, to go through the questions to make sure they were appropriate and comprehensible. A CCT official translated the survey into Afrikaans as this was the main language used by the community and it was felt would make both the community researchers and those participating better able to respond. The results of the survey, together with the wider evaluation report (Silver et al, 2011) were intended to contribute to ongoing debates in the CCT about retrofitting, climate change financing and energy issues.

3.3.5 Photographic work

During the fieldwork photography constituted a key supporting data collection method that provided an alternative way to gather information and engage the infrastructure systems of Accra and Cape Town:

“Photography is an abstracting process of observation but very different from the fieldworker’s inscribed notebook where information is preserved in literate code. Photography also gathers selective information, but the information is specific, with qualifying and contextual relationships that are usually missing from codified and written notes. Photographs are precise records of material reality” (Collier and Collier, 1986:10).

The photographic work provided a resource in widening the researcher’s perspective, developing a narrative beyond the written word, involving young people in the research and providing a record of the network reconfigurations taking place across the energy systems in Accra and Cape Town. The photographic work consisted of two different types of data collection. Firstly, photographic recording of the materialities of network reconfiguration and the urban infrastructures of the fieldwork sites by myself. This photography acted as another way to record information, data and observations whilst in the field, provided a visual resource to support the other data collected, and helped to inform the analysis and writing up of the study by providing a different way to consider the geographies of the network. Not everyone likes to be photographed and this can cause considerable disturbance to people’s lives meaning that when considering the ethics of taking photos to remain careful about taking pictures and not take any of people without asking permission.

Figure 3.9: Photograph showing photographic workshop in Ga Mashie



The second element of the photographic data collection was working with young people in the low income communities to capture their views, perspectives and ideas surrounding the energy networks in their local neighbourhood. Workshops were conducted in Ga Mashie, Accra with an extended household of young people and in Mamre, Cape Town with a class of young people from the local school. The aim of the photographic work was to involve young people in the research through a method that engaged them in the wider research and to provide another way of ‘speaking with’ residents from low income communities;

“In essence, by placing cameras in the hands of people, a facilitator or researcher can gain insights into people’s lived experiences, which were previously overlooked, rejected, or silenced. The photograph’s narrative becomes a participatory site for wider storytelling, community discussion, and action” (Singhal, 2004:8).

This is certainly the case for young people in poorer African communities who are quite often marginalized because of age related customary systems. In effect their voices are often not heard during research processes yet their needs can be most acute and they can offer unique opinions and perspectives on a range of issues. A series of outcomes (Appendix 5) followed from the photographic workshops that supported the wider research and helped to develop the analysis of energy network reconfiguration by capturing the everyday geographies of the network from the perspective of young people. This method helped to open up dialogue

around the research with participants actively involved in investigation and a way to articulate a narrative through a means beyond interviewing or involvement in workshops:

“The process of taking a photograph provides an opportunity to develop a story that was previously rejected, silenced, or overlooked. Further, the photograph’s narrative becomes a participatory site for wider storytelling, spurring community members to further reflect, discuss, and analyze the issues that confront them” (Singhal, 2004:7).

By being out in the neighbourhood and investigating the energy network through the photographic work ideas, observations and questions that could be explored all came together to create an interesting dialogue between the researcher and the researched and prompted new ways of considering the research questions and the way in which to structure the ongoing data collection process. The photographs were returned to participants. A collection of the images were subsequently collated into a short film that has been shown in a number of spaces¹⁴.

3.3.6 Policy analysis

A range of relevant national, regional and municipal policies were collected and analysed for the research. Whilst accessing policy documents was relatively straight forward in the context of Cape Town (and South Africa generally) with many of these being available on-line, the lack of policy documents in the public realm in Accra (and Ghana generally) meant having to spend more time seeking these documents and often involving contacting various policy actors (usually in conjunction with an interview request). The search for relevant policy documents could be extremely frustrating with the revelation after months of searching for one particular policy that it existed only in the draw of one man’s desk. The policy analysis was predicated on seeking to respond to the imperatives of the research that required information and data on the histories, politics, the policies and plans concerned with networked systems and wider urban governance. Without such background documents it would have been difficult to develop the research and would have made for some embarrassing interviews due to the annoyance of time constrained policy makers who are forced to answer questions when easily obtainable information could achieve the same purpose. Furthermore, policy is an alternative form of narrative and its analysis can be useful in the same way that analysing individual narratives is useful. As such the policy analysis was predicated on linking up the narratives of policy to data emerging from interviews and workshops.

3.3.7 Other methods

A number of other methods of data collection were used to supplement the main activities including site visits to a range of places that provided information for the study and participant observation in recording thoughts and views whilst attending events and meetings with a range of stakeholders. For example, a trip to Akosombo Dam in Ghana was used to gain data on electricity generation for the last twenty years and also

¹⁴ Available online: http://www.youtube.com/watch?feature=player_embedded&v=ZecuWvN1SIc#at=78

Shown at After Hours event for We Face Forward, Whitworth Art Gallery, Manchester, 18th August, 2012 and Durham Energy Film Festival, Tyneside Cinema, 24th September 2012

appreciate the national energy network in the country and the role that hydro-power plays in the energy landscape. Another example was attending the ICLEI Local Climate Solutions, a week long gathering of municipal climate change actors from across Africa, which provided an opportunity to network, listen to and record a series of important debates and talks as well as gain a wider understanding of the intersections between urban energy networks and climate change from across the continent.

Neighbourhood walkabouts were often arranged when visiting a low income community to gain a better understanding of the area, meet residents and begin to understand the materialities of the energy networks. In Ga Mashie, this neighbourhood walking formed an important part of the methodology in getting to grips with the complex electrical network, understanding the wider socio-environmental context and meeting interesting individuals and potential research participants. This method took place weekly with the research assistant, involving a two to three hour observational walk without any specific route being planned. This was another way in which to ‘unlearn’ the city (Section 3.5.3) and helped, not just methodologically, but also to develop better understandings of the city.

3.3.8 A note on data loss and robbery

A series of incidents over the course of a week in Ghana led to a significant loss of data (including film footage, interviews with national policy actors and detailed contextual work) collected during the first month of work and called into question the resilience of the research data storage. Starting the week with a malfunctioning back up system and ending with a robbery of laptop, camera and dictaphone from a hotel room in Kumasi, whilst sleeping, meant that the Monday morning back again in Accra felt very much like a hangover. This was a day of mixed emotions, reflecting on the lost data and what it meant for the study, a feeling of luck that no injury had occurred during the robbery and utter frustration that a series of misfortunes had meant having to start again with the research and spend time trying to organise replacement equipment. Alongside these series of considerations was a sense of anger felt toward the hotel which had failed to support me after the robbery and even accused me of fabricating the event, thus entailing a day spent trying to prove to police that the incident had occurred and that the hotel was in the wrong. Whilst advised to pursue the criminal case against the hotel by the Kumasi police, who at that stage were prepared to make, what could only be termed, ‘speculative arrests’, coupled with a desire for someone to answer for the crime the decision was made, in consultation with the supervisors to sort out my insurance and move on. Perhaps the most frustrating part of the incident was the way in which it supported narratives of the African city being a place of danger and criminality, that colleagues, friends and family had warned against. This was in direct contradiction to my experience in Accra and my subsequent fieldwork in the allegedly crime soaked streets of Cape Town, which felt safer than parts of many UK cities. Some of the data was recollected but much was lost due to being apprehensive about asking busy people for another interview. Ultimately the data loss may have helped the direction of research by forcing a focus on more specific themes and areas.

3.4 Reading narratives of infrastructure: Analysing the data

The next section provides an overview of how the analysis of the data was predicated on seeking to examine the multiple and contested narratives of infrastructure articulated by research participants.

3.4.1 Analytical overview

The analytical approach for interrogating the data provided the material from which to write the thesis and as such was structured to reflect a pathway to achieve this purpose. The research process had generated a body of data that provided a set of responses from across the cities around the research questions. The main analytical lens through which this data has been considered is the use of narrative analysis. The reason for using narrative analysis is to consider the various narratives emerging from urban actors around network systems and processes of reconfiguration. These research participants have provided a series of narratives around network reconfiguration and the analysis seeks to take these, often diverse and sometimes contesting narratives and draw out the emerging points of interest from these articulations.

3.4.2 Narrative analysis

Reisman (1993: 2) defines narrative analysis as, “taking as its objects of investigation the story itself”. Narrative analysis is based on the premise that we interpret and construct the world around us through language (Searle, 1995). Wiles et al (2005: 90) explain narrative as playing a key part in our understanding of self and the world around us, “Narrative is both a mode of representation and a mode of reasoning, shaping our perceptions of ourselves and impacting our lives, culture and society in general”. It is therefore useful to understand the data collected as a series of narratives concerned with urban infrastructures, network reconfiguration, urban politics and so forth with narrative analysis becoming the way to interrogate the collected data. There is no single approach or methodology for narrative analysis but a kaleidoscope of techniques from across the social sciences that can be mobilised by the researcher (Reissman, 1993). The thesis was concerned with how to use narrative analysis as part of a geographic approach to analyzing data that would link into the conceptual framework. The analysis has therefore been interested in how experiences, attitudes and views collected from research participants have reflected the broader shared and conflicting narratives of infrastructure in Accra and Cape Town. This has meant ‘reading’ the narratives that research participants offered to consider the social-environmental and spatial relations connected to networked systems. The geographical literature on narrative analysis is limited to a few studies relating to geographies of health (Garvin and Wilson, 1999) with only a few concerned with analysis of interviews (Wiles et al, 2005). As part of the analysis of the data in this thesis a developing method of narrative analysis linked to urban political ecology is signposted to show how this technique can be utilised to produce a series of analytical procedures in approaching data from the field. This narrative analysis is anchored in a Marxian perspective that is linked to Marxist literary theory and ways of considering text that reveal social relations (Eagleton and Milne, 1986). This links into the wider theoretical terrain of the thesis, as part of the analysis

(or reading) of the data and pointing toward a dialectical notion of narratives that can reveal hidden layers of meanings, relationships and processes that surround the contested processes of infrastructure reconfiguration.

Labov's approach to narrative analysis (1972) is a well-used tool within the social sciences that involves a formal structural analysis to uncover key characteristics and meanings of the narrative (Reissman, 1993). The first element of this analysis involved the production of an abstract or summary of the narrative (each interview or workshop). This provides a useful tool and a good first step in analysing the data and including key details. For example; who is the actor? how do they conceive infrastructure? what role do they play in reconfiguration?). Secondly, the narratives were then further analysed by focusing on orientation and a concern with the place, situation and the protagonists. For example; what are their views and politics on reconfiguration? how are they positioned compared to other urban actors and urban dynamics? what power do they have to reconfigure?). For the conceptual framework the importance of place and space may mean that the analysis will concentrate on this part of Labov's (1972) approach. Alternatively as undertaken in the analysis place and space can be excluded from this stage of the analysis and used to inform a developing perspective throughout the narrative. The third component of Labov's (1972) analysis involves the complicating action (Reissman, 1993) and is concerned with what actually happened during the narrative. For example; how did the actor reconfigure? did they link into wider networks to reconfigure?). This meant identifying and analysing the ways in which research participants were interacting with urban infrastructures and thinking through the social relations being reflected and reinforced. For example speaking to a local electricity worker may reveal, through narrative analysis of the interview text, wider social relations between the electricity company and the community. The final part of Labov's (1972) approach involves understanding the narrative's resolution, which meant seeking to consider the outcomes of network reconfiguration in terms of different urban actors and the way that such processes alter social relations. For example; practices of illegal connections to the network in Ga Mashie would often produce less financial stress in households but may criminalise those who participated in such action.

Labov's (1972) structural approach to narrative analysis provided a good basis from which to conduct the interrogating of the data and a foundation on which to develop an understanding of the multiple and often conflicting views of processes of network reconfiguration. Yet this approach is in some ways, limited in its potential to fully explore the collected data. The study thus develops these analytical procedures in relation to the UPE framework and the series of concerns that it produces. This meant developing the narrative analysis based on a position centered on the core concerns of the conceptual framework and seeking to reorient Labov's (1972) framework around the particular focus of the study.

3.5 A postcolonial sensibility? Ethical considerations in urban Africa

The thesis has taken seriously the ethical considerations of the research and the need to relate the fieldwork to a postcolonial sensibility. This is a central concern with the methodology focused on low income communities and calls into question the place of the researcher in such spaces and the implications of working with the urban poor and conducting an ethically informed study. Perhaps, most importantly, the

ethical considerations have attempted to shape the ‘how’ of working with these communities and the role of the research in ‘speaking with’ the marginalised.

3.5.1 An intermediary?

Throughout the fieldwork research was conducted both with marginalized communities and what are often termed ‘elites’, policy makers or wider stakeholders. This meant one day might involve a morning conducting a focus group outside a shack, followed by a change into a suit to sit in an air conditioned office awaiting a key policy maker. This research brought about a series of shifts in context that required a constant negotiation. Yet the role of working across these different urban spaces was more complex due to undertaking research ‘on behalf’ of particular governance actors, such as the NGO ICLEI and requiring me to be very clear about the work to be conducted, positionality in the process and the different research that was being undertaken for the thesis. One way to consider such a role between these different groups of people would be to use the term intermediary (Guy et al, 2011, Hodson and Marvin, 2010) to describe the movements between and across different urban worlds in Cape Town and Accra and the status of an academic within these processes. This is of course more difficult where there is the potential to be working with two conflicting parties. The best response to this was honesty, being open and clear about the research, its aim and objectives and how the wider research may be used and mobilised. Part of this commitment meant to be clear from the beginning that the work focused on research rather than generating solutions.

3.5.2 Researching elites

Parry (1998) outlines the multiple dynamics of power during processes of elite interviewing that are equally applicable to other data collection methods. Suggesting that these moments often foster an insider/outsider duality between the researcher and the interviewee that can make the experience uncomfortable for the researcher. Whilst this was noticeable in speaking to elites throughout the process, researchers need to be comfortable in such situations and be able to confidently assert the right to (respectfully) question and challenge. Certainly one way of overcoming these dynamics, particularly in Ghana, was to dress smartly to meet policymakers. This might involve donning a suit in 35 degree heat but it also had the affect of conveying respect to the interviewee and displaying some level of importance as a researcher. Many of the policy makers were experienced in interviewing and happy to discuss a range of issues. By offering individuals (although not their institutions) anonymity the hope was that this would allow the ‘elites’ more freedom and comfort to discuss certain topics in an open manner

3.5.3 Speaking with marginalised communities

“We should first remind ourselves that, as a general rule, the experience of the Other, or the problem of the “I” of others and of human beings we perceive as foreign to us, has almost always posed virtually insurmountable difficulties to the Western philosophical and political tradition. Whether dealing with Africa or with other non-European worlds, this tradition long denied the existence of any “self” but its own” (Mbembe, 2001:2).

The research methodology meant the need to work in a range of different urban spaces and particularly in areas characterised by poverty and wider socio-environmental hazards. This entailed working with low income communities that are often marginalised to develop an understanding of the ways in which network reconfiguration was taking place. This entailed conducting research that would inevitably involve a substantial range of ethical considerations about whether the research should be based in low income communities and the role of the research in articulating the voices of, or speaking on behalf of marginalized groups. George (1976: 289) cautions against research focused on the poor, suggesting the need to focus on those who hold power:

“Study the rich and powerful, not the poor and powerless..... Meanwhile, not nearly enough work is being done on those who hold the power and pull the strings. As their tactics become more subtle and their public pronouncements more guarded, the need for better spade-work becomes crucial.....They already know what is wrong with their lives and if you truly want to help them, the best you can do is to give them a clearer idea of how their oppressors are working now and can be expected to work in the future”.

Whilst George’s (1976) contention has acted as an important consideration for the thesis, the need to conduct research in urban poor areas, and to speak with the ‘poor and powerless’ forms a crucial methodological strategy for the thesis. Without exploring the actual conditions in which networked systems and the perspectives of marginalised groups then the danger exists that particular narratives are constructed by elite actors concerning these issues and the voice of the marginalised is ignored or subsumed into wider social relations that are guiding network reconfiguration. For instance, a focus on the role of various municipal intermediaries in network reconfiguration in Mamre is a clear requirement to understand this reconfiguration. Yet without understanding how this reconfiguration is understood and received by the neighbourhood it is not possible to reflect on the wider socio-environmental relations and other effects of the process.

Working with low income communities presents other problems, particularly around representation. Spivak (1988) cautions those attempting to give voice to the subaltern and the risk of speaking ‘on behalf’ of the dispossessed’ which suggests not only the replication of privileged, Northern discourses but also potentially closing down the space or platform from which the subaltern may speak. This has clearly been a central concern for the study, although the communities may not be considered subaltern Spivak’s (1988) insight is also applicable to marginalised and poor communities. This has involved periods of reflection in the field and the requirement to challenge and reappraise perspectives, and is explicitly linked to the wider theoretical commitment to shaping a postcolonial study. McEwan’s (2001) exploration of postcolonial feminism and the politics of speaking and writing about women in the South illustrates that incorporating the ‘voices of the dispossessed’ does not in itself offer a postcolonial pathway for scholars. Suggesting that simply acknowledging the situatedness of the research and to be aware of one’s positionality is not enough to constitute a postcolonial informed study but, drawing on Spivak (1988), requires a need to become part of a process of ‘unlearning’. During the study the task of ‘unlearning’ (which can be considered an ethical gesture and a starting point of ‘learning to learn anew’ that destabilizes old certainties) informed relationships with actors from urban poor spaces. This was, in part, an acknowledgment of the mutually constituting

subjectivities, of the researcher and those being researched, and how they were continually being mediated, reshaped and reformed, as well as the research process and the knowledges and voices it was producing, (McEwan, 2001, Spivak, 1988). This formed an important guiding principle, ethically, methodologically and theoretically and forms part of the task of ‘unlearning’ in the context of research in the global South. Here ‘unlearning the city’ has meant following McEwan’s (2003: 384) advice that:

“this involves working hard to gain knowledge of others who occupy those spaces most closed to our privileged view and attempting to speak to those other in a way that they might take us seriously and be able to answer back”.

Subsequently the study presents research on network reconfiguration, not ‘on behalf of the dispossessed’ but as part of a relational theoretical and methodological journey. This has involved working in and across marginalized and poor urban spaces and ‘unlearning the city’ through being challenged and confounded. Simultaneously, this process has generated ongoing and difficult ethical considerations at many junctures of the thesis from inception, through to first arrival in a new urban space to writing up. As such the thesis has focused on constructing the methodology and theory ‘in the field’ based on an approach outlined by McEwan (2001:102):

“speaking with’ people from other places and cultures involves openness to their influence and the possibility of them ‘speaking back’. It also links to broader notions of breaking with Eurocentric concepts of development and finding other ways of knowing and being”.

The research involved ‘speaking with’ the communities in the case study sites and been open to the voices of the marginalized, resulting in the changing of research foci, methodologies and perspectives in the course of the data collection phase. However, this does not mean that the thesis can claim to be successful in this task:

“Even when the subaltern does speak, her voice is relayed, filtered, reinterpreted, appropriated and even hijacked by intervening institutional structures.....The subaltern voice is always mediated, even within participatory approaches” (McEwan, 2009: 231).

Therefore it is right to acknowledge the potential role of the research in closing down spaces for the marginalised to speak and whilst every effort has been made to consider these processes and shape a methodology that addresses the issues it would be wrong to assume that this can happen in its entirety. Furthermore, this study acts to mediate these voices and such ‘interpreting’ or ‘translating’ should acknowledge these limitations and power relations.

3.5.4 Knowing the place of a researcher in urban African space

The research methodology has considered the ethical dimensions of the study in seeking to construct a postcolonial informed approach to the research predicated on a, “principled sensitivity to the rights of others...ethics say that while truth is good, respect for human dignity is better” (Bulmer in Gilbert, 2001: 45). Part of this task has been to consider the voices of the marginalised in the study and a further element was to reflect on the positionality of the researcher because, “the way we see things is affected by what we

know or what we believe” (Berger 1972: 9). It is not possible to divorce this positionality from the research as England (1994:84) suggests, “researchers remain human beings complete with all the usual assembly of feelings, failings and moods. Therefore, the need to consider the role and suitability of a researcher, from the global North, in researching low income communities in urban Africa formed a central concern not just during the conception of the study but throughout the fieldwork and writing up of the research; it also involved ‘speaking with’ the researched through a process of ongoing dialogue, debate and revision.

The task of interpreting urban life in Africa involves multiple perspectives. As long as particular constructions of the urban are not prioritised over others, then ‘outsiders’ can provide important insights about the nature of urban infrastructures. During the research in Accra, one particular interviewee explored this in a way that brought some considerations to the thesis:

“The bottom line is Africa has been conquered, it’s a colony, ideas, development, imagination are products of a big lie. Need an opportunity to re-imagine, dream, reflect and that’s not a period the continent has enjoyed for a long long time and its still not there”. (Architect/Educator, Accra)

Acknowledging the implication of this statement provided another way in which to situate the role of the research within a postcolonial context. The main way in which this challenged and thus helped structure the methodology was to consider the purpose and conduct of the research. Here the research, conducted as a collaboration through an approach of ‘speaking with’ people, is predicated on finding ways to support Africans in the task of re-imagining, dreaming and reflecting. It is supportive of opening up spaces for this processes to happen and to acknowledge that the research provides another fragmentary contribution to urban knowledges in the making, rather than a definite or privileged account or ‘solution’. One way to undertake this was to provide contributions from the research to the researched communities (Figure 3.10).

Figure 3.10: Contribution to Western Cape Anti-Eviction Campaign blog



Conducting research in low income communities was nearly always an uncomfortable experience. This is not to suggest that people were unhappy or angry about the research being conducted, that hostility was frequently experienced (although there were isolated incidents or throw away remarks) or that participants were not prepared to engage with the work or reveal often deeply personal experiences and feelings. What is being suggested is that to be in such spaces is inherently an uncomfortable experience for a researcher who has many of the privileges (race, gender, financial security, nationality, education and so forth) that low income communities in urban Africa simply do not share. To listen to experiences of poverty, struggle, inequality and oppression is difficult, not in the same way as the person recounting these experiences, but in a way that actively challenges how we think about ourselves as researchers specifically and also about the purpose of the research and ultimately our 'place in the world'. For example, to hear about the health difficulties of township dwellers living in sub-standard housing in Cape Town was challenging and kept the need to constantly reassess the purpose and nature of the research. Yet it was from these difficult experiences that the role of the researcher becomes stabilised, in the sense of not only 'speaking with' the poor communities, but also documenting these urban processes and working with inspiring people to reveal the role of networked systems in mediating social relations and urban inequality.

3.5.5 Is there a place for a white researcher in the South African township?

In South African the system of (white) oppression, in the form of apartheid, remains a complex, vivid and critical issue in considering the role of a researcher conducting a study in a township and the ethical considerations of such work. Whilst the infrastructure legacy of apartheid remains and the poverty of the majority black population exists in unequal relationships with the minority white population, there are clearly a range of implications about undertaking research that need to acknowledge these unequal power relations and a relatively recent history of explicit racial oppression. This should not preclude research with these communities but structure a methodological approach that is, not just aware of these relations of power but actively addresses new ways of work that seek to reorient these relationships. In Khayelitsha these issues were actively addressed with research participants in a process of 'speaking with' those involved with the research in order to reflect on the role of a white researcher in coming to a community. These discussions with and the contributions of the participants had a significant impact on locating the positionality of the research, researcher and researched;

"People never hated people for being white but associated it with oppression. But many white people understood this and fought with the black people. But the reality is that too many white people approach black people with a superiority complex. They think they can tell them what to do and they should listen and not all white people are like this, people need to be educated and understand there are white people with us and want to fight the struggle with us and see where it all went wrong. People like you have come here and talk to us...you have identified the problem and saying enough is enough...its not how people should live together...the failure of your brother and mine to live together is not our failure" (Mandela Park Backyarder #3).

A clear sense of solidarity between the researcher and researched during some (although certainly not all) parts of the research process clearly helped to locate a commonality across seemingly diverse people and a

legitimation of sorts of conducting the research. Part of this solidarity clearly comes from a commitment to sit and listen to what participants had to say, to show sympathy (real, not constructed), an openness to take onboard criticism or challenging ideas and not to be easily offended and also perhaps a shared sense of the need to challenge inequality and wider socio-environmental inequalities.

3.5.6 Informing research practice in the field

The series of postcolonial, ethical considerations outlined above helped to structure the research practice in the field. In terms of conducting interviews or workshops in low income communities a number of practices were developed. When approaching residents the purpose of the research was given as contributing to a thesis, with the aims and objectives explained and the rationale behind doing such work. A strong commitment to focusing on analysis rather than generating solutions was communicated whilst explaining that the research data could be used by the community or other urban actors in the future to help inform decision making. This focus on a research-only process, with the data and findings being made available to participants at the end of the work, was particularly important in urban areas that have witnessed a range of urban renewal, infrastructure upgrading and other interventions, some of which have had negative consequences for households or wider communities. As a researcher from the North encountering participants in urban poor spaces provoked a range of ethical considerations and reflections, in part predicated on the histories of the communities and wider social relations, which made the commitment to analysis and not solution-finding a core response to some of these considerations.

For the participants consent could be withdrawn at any point during the research process and no monetary benefits were gained by participating (although in some cases refreshments were provided for participants of the workshops). The initial engagement with low income communities also discussed confidentiality, structuring a position in which no names, addresses or positions of any of the participants of the research are used in the thesis. In most cases this has meant that the neighbourhood, if those being interviewed were part of the case study communities, or an institution, if those being interviewed were part of the wider stakeholder community are included to give enough information to understand and contextualize the comments.

The research began by using consent forms in Ga Mashie but these proved to be problematic, because of issues of language and use of technical phrases, the forms were often not properly understood or viewed with suspicion, as something that may get the respondents in trouble later on (for example if a certain opinion was expressed). As Muzvidziwa, (2004:304) suggests, “such attitudes date back to the advent of colonialism” and a suspicion of bureaucracy in communities. They have also been amplified by the extreme levels of oppression under apartheid. In response verbal consent was used instead as a form of agreement and to ensure that participants were comfortable in disclosing information. A review of the briefing for each participant was conducted and changed to ensure that the guidelines under which the research was operating were fully understood. These briefings would also change depending on the context of the research. For instance, in Mamre the work was undertaken with external partners, the CCT and ICLEI, and it was

important that the community members understood that the research would form part of an evaluation of the project and be read and considered by a range of municipal actors. All interviews are thus based on the notion of informed consent. This provides that “persons who are invited to participate in social research activities should be free to choose to take part or refuse, having given the fullest information concerning the nature and purpose of the research” (Bulmer in Gilbert, 2001: 45).

A commitment that the research would ultimately be responsible to the low income communities that were used as case study sites was decided in order to guide the work. The nature of the research meant that encountering conflict in urban space, either through experience (for example, witnessing attempted demolitions) or through testimony of participants, meant being involved, sometimes centrally and other times peripherally with the urban politics of these spaces. As Muzvidziwa, (2004:309) suggests, “It is important to take into account the political context of fieldwork at every stage of the research process”. During the fieldwork it was rarely possible to lose sight of the political context in which the research was being conducted, yet this did not necessarily translate into clear political positioning or a full knowledge of complex issues, rather a process of negotiation and the maintenance of a position as an independent academic scholar focused on analysis rather than generating ‘solutions’.

The relationship with the research assistant in Ga Mashie embodied many of the difficult considerations in conducting an ethical research practice in the field. S lives in the neighbourhood and he was introduced during the scoping trip to Accra before the fieldwork and through a shared friend. Before agreeing to the role of research assistant a full briefing about the research, its scope and goals and the type of research that was being planned was discussed and subsequently amended to take into consideration his views. A series of training sessions were also organised around taking notes, interview conduct and so forth and we also agreed to a paid wage for the work that was being conducted.

3.6 Reflecting on the limitations of the thesis

The thesis recognises a number of limitations to the study that are outlined below.

3.6.1 Limitations

A series of limitations in the thesis can be articulated that reflect some of the conceptual and methodological challenges that have been generated during the research and the limits to what can be undertaken during a PhD. Firstly, the scope of the research and the data collected was limited by the time spent on fieldwork. Whilst this amounted to around a year in Accra and Cape Town the need to develop a comparative study meant that this was split between both cities. As these both constituted new cities in terms of networks, connections and knowledges this meant that a considerable amount of time was consumed in developing a familiarity with both urban spaces, with developing networks and contacts and with identifying research sites and relevant urban actors to approach. This was particularly the case in the low income neighbourhoods, with time being spent developing relationships with potential collaborators, explaining the research and

allowing people time to consider whether they wanted to participate. The need to undertake these actions meant in some cases that time was expended on ‘dead ends’ in that they didn’t generate research opportunities. At other moments the time taken to identify and engage with participants meant that the time left to conduct research was not always as long as it could have been. A second limitation relates to the focus of study, whilst the research was concerned with low income, networked neighbourhoods a more comprehensive analysis would also have been able to explore the wider cities in more detail to provide better context, that is the ongoing metabolic processes across the city, the different geographies of these dynamics and the landscape of splintered urbanism (Graham and Marvin, 2001). Whilst a significant part of the research engaged with policy makers and related processes of network reconfiguration one particular research pathway that would have improved the study would have been engaging in more depth with residents from informal settlements. Although the case study neighborhoods all displayed various degrees of informality and a number of site visits were undertaken to informal areas the study would have benefitted from a deeper exploration of the relationship between formal and informal energy networks in both cities. A range of important themes, questions and considerations could have been generated that would have helped to better define what is meant by a networked, low income neighbourhood and the different ways in which such dynamics unfold in these different urban spaces. Thirdly, dynamics and issues around social relations, beyond the economic could have also been explored in more detail. Whilst the thesis has focused on socio-economic status as the key mediator in relation to ability to access energy and the power to reconfigure networked systems other forms of social identity also mediate such processes. These include gender, with little focus being spent on the gender dynamics within, across and beyond the low income, neighbourhoods and how these relations shape and in turn are shaped by networked systems and processes of network reconfiguration. Another important set of relations may have been age with the research seeking to interrogate the relationship between reconfiguration and age of residents involved questioning whether young people were more likely to transgress the legal boundaries of what could be undertaken. Whilst the study was focused on socio-economic relations these other relations thus remained at the margins of the analysis but could provide important considerations in seeking to unpack, analyse and critique processes of network reconfiguration. Fourthly, the scope of UPE analysis of infrastructures involves focusing on a range of multi-scalar processes and dynamics from the local through to the global in what can be considered a comprehensive approach that create a series of demands for researchers. The need to source and generate data to explore these dynamics and processes across two unfamiliar cities within a specific period of time meant that not all relevant avenues could be undertaken. Whilst the thesis can be considered to provide a robust analysis, based on detailed data from a variety of sources it is right to acknowledge the limitations of the thesis in being informed by every relevant policy or every relevant urban intermediary.

3.7 Conclusion

This chapter has outlined the way in which the research framework for the study was constructed from an initial two page summary written by Professor Bulkeley and Professor McEwan to a full 3.5 year PhD research processes across two African cities. During both the selection of the two cities and the comparative sites of investigation the aim has been to generate a series of different comparative directions that the

fieldwork could explore that whilst predicated on working across Accra and Cape Town could explore strategies and methodologies of comparison that could weave together different scales and processes. The methodologies to undertake such explorations have been driven both by the need to generate data and engage with 'elite' actors but also the desire to engage with postcolonial and wider ethical concerns. Thus this has been a series of data collection methods that seek to build a analysis from the streets of marginalised communities, linking the everyday and the structural ways in which networked systems are being reconfigured. This approach has provided a means to generate data to develop the African situated UPE that unfolds over the next four chapters.

Chapter 4. Historical infrastructures

This chapter explores the dialectical histories of infrastructure systems across Accra and Cape Town in order to develop a historical perspective of the legacies of colonialism and apartheid and the multiple, differentiated ways in which they have shaped and mediated networked systems across both cities. The chapter develops a detailed examination of these historical processes of urbanisation that have both been reflected in and in turn been influenced by the spatialities of urban infrastructures. Central to such considerations and an important part of the conceptual approach is to map and analyse the ways in which urban infrastructure across both cities have been used as systems of control through periods of colonialism and apartheid (Demissie, 2007, Yeoh, 2001). As Fanon (1967:39) vividly describes these are brutal histories of segregation, exclusion and racism across urban space:

“The zone where the natives live is not complementary to the zone inhabited by the settlers. The two zones are opposed, but not in the service of a higher unity....they both follow the principle of reciprocal exclusivity. No conciliation is possible”

The importance of excavating the histories of urban infrastructures is predicated on seeking to dialectically consider how these networks have shaped and been shaped by the particular geographical-historical condition of the cities, forming an important part of the conceptual framework. These histories illustrate the ways in which networked systems have both reflected and reinforced highly uneven metabolic landscapes in both cities and a historical splintered urbanism (Graham and Marvin, 2001) that mediates current network geographies and processes of reconfiguration. To understand the post-colonial and post-apartheid geographies of urban infrastructures across Accra and Cape Town is not just to historicise these spaces within the colonial and apartheid eras but to acknowledge the social, political and cultural dynamics in both cities as former colonial subjects gained independence from their European oppressors (McEwan, 2009) and South Africans broke free from the shackles of apartheid. Such perspectives suggest that economic and political relationships of domination over metabolic processes have arguably continued to legitimise exploitative relationships, shaping and mediating urban infrastructures. Mbembe (2001:102), considering how we research the post-colonial condition (and that could equally be applied to the post-apartheid context) argues for the need to reflect on the, “the political, cultural and economic realities of societies living with the legacies and in the aftermath of colonialism” as an important undertaking in any studies of contemporary societies, dynamics and relations and providing the conceptual underpinning to the historical focus of this chapter and the first part of the conceptual framework.

The chapter begins firstly, with a history of urban infrastructures focused on electricity systems at a city scale exploring the specific histories of Accra and Cape Town in relation to the development of infrastructures and the relationship between such networked systems and wider processes of control, exclusion and segregation. The purpose of this analysis is to situate the thesis within the wider urban historical context, seeking to consider how the electricity systems in the case study areas reflect wider histories of governing infrastructure in Accra and Cape Town and the historical urbanisation of nature that has transformed these cities (Gandy,

2002, Swyngedouw, 2004). This historical overview is predicated on identifying key era's in the urban governance of both cities and explores the key characteristics of these particular junctures of time, space and infrastructure development, together with current intersections with climate change and energy, drawn primarily from secondary sources with some relevant primary data. Secondly, the chapter provides a detailed history and contextual analysis of the case study neighbourhoods in both cities using some secondary sources alongside the more detailed primary data collected during fieldwork. This analysis is undertaken through exploring the history of each neighbourhood, the historical and current conditions of the energy network, and specifically the electricity system, before outlining the processes of network reconfiguration taking place across these urban spaces. Thirdly, the chapter mobilises the analysis to reflect on the post-colonial/post-apartheid condition of networked services in the case study areas that provides a series of issues, considerations and context to inform the forthcoming chapters. Fourthly, the chapter then draws on various methods of comparative reflection to examine different scales, considering the multiple processes of network reconfiguration across Accra and Cape Town and at both inter and intra neighbourhood scales. Finally, the chapter concludes by arguing for the importance of historical and contextual analysis in seeking to develop studies of networked systems and arguing that the excavating of infrastructure histories implicates the past in the current condition of infrastructure in both cities.

4.1 Urban infrastructure at a city scale

The first task of situating Accra and Cape Town within the post-colonial and post-apartheid condition involves exploring the wider history of infrastructures in Accra and Cape Town. This is undertaken firstly, by examining the histories of governing urban infrastructures in Accra, charting the early histories of the city, the colonial era and the post-colonial ways in which networked systems are reconfigured, finishing with a focus on climate change and energy. Secondly, by examining the histories of urban infrastructures in Cape Town, considering the early histories of the city, the colonial era and move to the apartheid system before considering forms of infrastructure in the post-apartheid era and the intersections with climate change and energy

4.1.1 A history of urban infrastructure in Accra

Early histories

The Ga people, the original inhabitants of Accra arrive from Chad creating a number of coastal towns along the coast of modern day Ghana. Although a date for this migration is not known its estimated that Ga settlements exist along the coast for hundreds of years before European exploration and exploitation. The Portuguese are the first European power to establish a settlement in present day Accra, building Fort Vincente in the 1560s. The growth of the slave trade along the West Africa coastline means that fortified settlements and deep harbors become a necessity for the slave trading nations of Europe. Thus, the British build a fortified James Fort in 1659 through which to link up with other settlements along the Gold Coast and rival other imperial powers as they construct similar structures along the coast. The end of the slave trade

brings new economic opportunities for the region beyond slavery. The growth of natural resource extraction such as cocoa and palm oil production attracts more traders and administrators to Accra. This prompts the building of a range of infrastructure systems to deal with the large scale extraction and movement of goods from the interior and accelerates the transformation of these natures into the built environment of Accra.

Colonial infrastructures

Figure 4.1: Image of historic harbor in Ga Mashie



Colonial era infrastructure systems in Accra closely mirror those of other urban areas across Africa. This is a history of the colonial authorities ignoring the African population and their infrastructure needs (Myers, 2006). Ghana is no exception. Indeed this exclusionary colonial mindset manifests in political under-representation and a lack of essential urban services, justified through various discourses of subjugation and imperial supremacy. This colonial logic concerning urban infrastructures is reflected in the words of the Colonial Governor in 1858, "the object of this Government was not to clean out dirty towns but to direct the people to that and other objects by controlling and modifying their own Government" (Hess, 2000:40). By 1877 the British move their capital of the Gold Coast to Christiansbourg Castle (present day Osu) with the Dutch departure in 1872 forming the last act of the wider European involvement in the city. Within a year of the British move from Cape Coast the city becomes a focus for colonial administrators seeking to create better living conditions and improved infrastructures for the European settlers. The 1878 'Gold Coast Towns Police and Health Ordinance' creates a new legislative tool for the authorities with the objective of empowering the Governor to deal with unsanitary conditions and impose punishments that includes fines and court appearances for those deemed to be creating unsanitary conditions (Hess, 2000). This is followed by further legislation in 1894, which is perhaps spurred by the outbreak of bubonic plague and the burning of parts of James Town by the British. Through the 'Town Council Ordinance' the colonial authorities seek to develop new urban services through the introduction of the first networked energy provision in the form of street lighting (paraffin lights) and the construction of an integrated water network, which begins in 1885 with the building of a reservoir. Colonial control over urban services continues through the establishment of committees set up to develop infrastructure systems across a range of urban issues including water supply, sanitation and lighting (Dickson, 1969). By 1885 an increasingly worried colonial authority concerned about the sanitary conditions of the city and the spread of disease leads to the planning and creation of a new town in Victoriaborg. Established well away from the cramped and unsanitary conditions of historic Accra this new settlement provides a safe and comfortable environment for the

colonisers providing urban services and from 1916 the limited provision of electricity (RCEER: 2005). This racially segregated neighbourhood attracts many of the traders, administrators and other settlers away from the hot and busy streets of historic Accra and so by the early 20th century spatial segregation mandated through law and predicated on a division not just of people but access to networked systems comes to characterise the spatial form of the city. The establishment of a networked electricity service is expanded by the Public Works Department (PWD) who operated electric supply systems and, “commenced limited direct current supply to Accra in 1922. On November 1, 1924, the PWD commenced Alternating Current supply to Accra”. (RCEER: 2005:16). The Devonshire White Paper of 1923 drafted by the colonial secretary in Kenya advocates for the ending of racial segregation in Britain’s African colonies. De facto segregation of Accra, between the urban spaces of networked provision for the coloniser, and the cramped and non networked spaces of the colonised, continues to be enforced through financial investment in particular areas of the city rather than colonial decree. By 1947 the colonisers establish the Electricity Department in the Ministry of Works and Housing, as a dedicated unit that oversees the growing but segregated emergence of an electricity network in Accra and across the country with, “this partial completion of modern infrastructure a very deliberate attempt to symbolise the superiority of colonial power holders over colonised civilizations” (Graham and Marvin, 2001:82). After World War II the British unveil the development of a master plan for Accra by architect Maxwell Fry which envisages a vast governmental complex supporting the ever increasing number of traders to Ghana. Along the coast from James Town to Osu the plan suggests a city with separated zones of activity for industry, the urban poor and the middle class all being confined to particular spaces and the particular configuration (or not) of networked services. Although many of these plans are rejected in the post independence era the vision of a segregated city between the rich and the poor, rather than the coloniser and the colonised is partly realised in the post independence era as a splintered infrastructure (Graham and Marvin, 2001) is sustained in spite of the bold rhetoric and actions of President Nkrumah.

Post-independence infrastructures: Modernization and the infrastructural ideal

Once Ghana has become independent in 1957 President Nkrumah sets about developing his own vision of Accra with a focus on creating an (Afro) united and modern(ist) culture that would bind together Africa’s first independent country and create a prosperous future for all. This optimistic era embodies a range of pan-African visions of the future of Ghana and the wider continent, predicated on a socialist vision of modernisation and economic growth, closely entwined with planning the city (Demissie, 2007).

This post-independence period which has vivid modernist architectural form (Figure 4.2) in Accra is an era of euphoria as the post-colonial moment finally arrives. Visionary nationalist leaders such as President Nkrumah view cities as the nodes for modernisation and national development, echoing the infrastructural ideal (Graham and Marvin, 2001, Kaika, 2005) of governments in the global North. This is the time for an Afro modernity, for a belief in the future, in technology, networked systems, infrastructures and the growth of a modern nation. This infrastructural ideal (Graham and Marvin, 2001 Kaika, 2005) is perhaps best embodied by the construction of the Akosombo Hydro Project which begins in 1962 and can be closely

linked to promises of networked services for all circulating through newly independent African states including Ghana. During this era many neighbourhoods in Accra are linked to the electricity network providing the city with expanding access to energy services. Yet as Otiso and Owusu (2008:150) explain about Ghana (and Kenya) such visions are impeded by a series of colonial legacies:



Figure 4.2: Photograph showing Independence Square in Accra

“The provision of housing, basic services, and urban infrastructure also suffered in both countries because of their continued reliance on colonial urban planning regulations, by-laws, architectural styles, and housing standards”.

The end of the Nkrumah regime through a military coup in 1966 brings about the end of grand socialist imaginaries for Accra and the infrastructure ideal becomes a symbol of the past replaced by a realist vision of networked service provision the country could afford and meaning the sustaining of a splintered urbanism across the city.

Post-independence infrastructures: Stagnation, structural adjustment and globalization

As Konadu-Agyemang (2002, in Davis, 2006:96) describe the splintered urbanism of the city continues through the post-independence era:

“the indigenous elite took over the European posts and all the benefits attached thereto, and have not only maintained the status quo, but have, through zoning and other planning mechanisms, created several other upper class residential areas, where income, position and clout determine access”.

During the era of alternating military and civilian rule (1966 to 1993) the infrastructures of Accra begin to experience the breakdown of services under the accelerating urbanisation that the country is experiencing, the ever increasing national debt burden and the underperforming economy. After the promises of the post-independence government of a modern future for Accra the weak macro-economic performance means public investment in urban infrastructures and the built environment decline markedly (Otiso and Owusu, 2008, Grant, 2009, Davis, 2006). The infrastructure that President Nkrumah has built, alongside the increasing urbanisation means that electricity demand continues to grow up to the 1980s with domestic consumption more than doubling between 1967 and 1976 (RCEER, 2005:19). The 1980s witness the introduction of SAPs into the Ghanaian economy brought about through IMF and World Bank macro

economic planning and further sapping government or municipal investment in urban infrastructure networks. This era becomes known as the ‘lost decade’ characterised by the increasing role of private and voluntary organisations in the provision and governance of services (Otiso and Owusu, 2008). By 1993, the financing of a new thermal power plant by the World Bank becomes contingent on wider comprehensive reform of the sector that seeks to unbundle the (partially) integrated electricity network whilst increasing tariffs and encouraging privatisation (Williams and Ghanadan, 2006). Whilst these reforms do not take place the 1990s continue to witness neoliberal visions of electricity sector reform that seek to reinforce fragmentation across the urban network and increase the cost of energy, a pattern that is arguably continued to the present, as Honkaniemi, (2010:4) suggests:

“Recent hikes in electricity prices are believed to be a direct consequence of the World Bank’s conditions to increase revenue in the electricity sector. Many analysts believe the proposed tariff increases, are the results of a push by the World Bank, said Abdullah Darimani, from the organisation Third World Network Africa” (Honkaniemi, 2010:4).

During the 1980s and 1990s the urban population of Accra begins to grow significantly with the rapid increase in informal housing settlements beyond the networks of water and electricity provision becoming an increasingly visible part of the urban landscape. At the same time the overcrowding of long established neighbourhoods put significant strains on the capacity of the existing electricity network whilst households struggle to afford the cost of electricity as the economic situation worsened. The increasing financialization of the land in Accra beyond traditional systems of ownership and through accelerating flows and circulations of global capital in to the city (Grant, 2009) during the 1990s forms another key moment in the neoliberalisation of Accra’s governing of infrastructures as multiple dynamics contribute to a fragmented and increasingly segregated city. This combination of dynamics and processes shape a booming city of economic growth, reflecting its position at the centre of the country’s rapidly growing economy in which, “Ghana has become a rising star and is one of the recent success stories in Africa” (Breisinger et al, 2009:3). Accra remains a city divided by socio-environmental inequality and networked services that continue to reinforce social relations and reflect wider conditions inequalities that are intrinsically linked to the city’s past.

Intersections of climate change, energy and infrastructure

At present there are few intersections between climate change and cities in Ghana, “One thing in future we need to integrate climate policy better at local level, there is much at global but nothing at for instance the Accra level” (Ghana national policymaker #3) with work focused on national level responses to energy and climate change issues. One example of an intersection between climate change, energy and urban infrastructures has been the development of a CDM financed waste to energy facility in the city that involves a number of organisations including Zoomlion, the South African, Standard Bank, alongside a plethora of advisors and consultants. This example remains isolated and shows how the resource constrained various scales of governance fail to bring climate change to the city even whilst developing a range of important national level responses that establish a series of adaptation and mitigation challenges for the country.

4.1.2 A history of urban infrastructure in Cape Town

Early histories

Estimates of human activity in the Western Cape date back over tens of thousands of years. Whilst little is known about these groups the KhokKhoi have been long established when they begin trading with passing ships on route to the Indies at the end of the 15th century. The Dutch East Indian Company, led by Jan van Riebeeck establish a settlement (now the Castle of Good Hope) which grows with the importation of slaves from the Indies (and who would later on be known as Coloreds and make up the largest racial group in the city) and becomes a productive space for agriculture. Control of Cape Town shifts between the Netherlands and Great Britain from 1795 until the Anglo-Dutch Treaty of 1815 when it becomes the legislative capital for the Cape Colony and as the city grows through the exploitation of natural resources in the interior and its position in global networks of trade.

Colonial infrastructures

Cape Town municipality establishes an electric power station before the turn of the 20th century (Eberhard, 2003) providing flows of electricity to the commercial and (white) residential spaces of the city. The network operates under similar conditions until the Electricity Act of 1922 which shifts control of the generation (although not distribution which remained with the municipality) of energy to the Electricity Supply Commission (ESCOM) a state owned utility company (Jaglin, 2009). The flows of electricity in Cape Town reflect wider urbanisation patterns in the city. This is a city in which the colonial authorities are keen to keep the Black African population away from Cape Town (and all South African cities) but the need to secure labour power means some investment is made in developing new urban spaces to host Black Africans in a deliberate policy of segregation that continues and intensifies across the decades of the 20th century. Such spaces reflect the splintered urbanism (Graham and Marvin, 2001) of the colonial city and are characterised by the absence of services that are common in European parts of the city. The colonial era is characterised by strict movement controls, such as the 1866 Pass Law which means arrest for any Black African caught outside designated residential areas. This legislation is undertaken to regulate urban migration and manifests in poor living conditions and a lack of infrastructure that makes the populations of these areas susceptible to a range of urban natures from climate through to disease. These conditions are further compounded by the absence of any type of political or land rights for the populations. Segregation of urban space by race becomes an increasingly central feature of South African urbanism. In Cape Town ordinances are passed to establish and administrate these peripheral African areas, such as Ndabeni and include some limited service provision and a range of accompanying levied charges. Supported by key legislation such as 1913 Black Land Act No 27 (prohibiting Africans from owning or renting land outside of reserves) and the 1920 Housing Act (to supervise the housing of Africans, Indians and Coloured populations) the municipality gradually takes greater control over the affairs of urban populations. The 1923 Black Native Administration Act provides a defining moment in considering the segregated nature of the city and the splintered (racial) urbanism of Cape Town. National legislation regulating segregation consolidates the ad hoc urban

governance practices and forms the central tenant to the emerging Apartheid system of urban segregation which, whilst being the responsibility of local government, remains driven by national government. Whilst local government begin to take more interest in the development of these urban spaces the sheer scale of urbanisation (fueled by ever growing labor needs) mean that conditions remain poor, residents have little access to networked services and construction of informal settlements emerge. By 1931 South Africa has become a fully independent country with continuing legislative focus on controlling the movement of the African and Coloured population and the control of urban space.

Apartheid infrastructures

“Under apartheid there was systematic under-investment in municipal infrastructure in black areas” (South African Department of Provisional and Local Government, 1998: para. 2.3).

In 1948 the National Party comes to power and with them an increased series of spatial controls are visible, particularly through the series of Groups Areas Act first enacted in 1950. This legislation shifts colonial forms of governing the city into an apartheid system of control and marks an intensification of a racially demarcated city and the emergence of a totalitarian system of apartheid urban governance (Guelke, 2005, Smith, 1992). Whilst Cape Town initially opposes the Groups Areas Act with continued informal, but not fully legislated segregation, the Group Areas Act is declared throughout 1957. This Group Areas Act dramatically reshapes the geographies of the city with Cape Town becoming one of the most segregated urban spaces in the country. At the same time and through a raft of new legislation, racial segregation of housing and infrastructures becomes fully institutionalised (Smith, 1992). The growth of townships increases through the forced removals from newly designated ‘white zones’ within the city. The most famous of these removals being the demolition of District Six after 1965 in which this previously racially mixed urban space witnesses the movement of over 60,000 residents. Many of these residents are moved to townships in a peripheral area 15km from the centre of Cape Town that is known as the Cape Flats or by many locals as ‘apartheid’s dumping ground’. Townships are organised through racial classification with African and particularly Coloured¹⁵ areas being established. The townships are now regulated via national government that control everything from the specification of the housing units through to the isolation from transport systems aimed at effective control of these urban spaces:

“The key focus of the specifications set out for Townships was to enable the government to asset control. Row upon row of identical dirt streets radiating from a central hub, line upon line of drab, cheap, uniform houses....through regimentation and uniformity the government sought to establish a firm control that could not be challenged” (Bonner and Segal, 1989 in Lester et al, 2009:41).

Township dwellers, spatially distanced from economic opportunities and urban service provision, become poorer and more isolated (Robinson, 1991) as the government develops its Homeland policy (beginning in 1960 and ending in 1970 with all Africans becoming ‘citizens’ of a homeland). Across civil society the

¹⁵ The Coloured population remaining much larger than the African population making the Western Cape demographically unique and meaning Cape Town remains the least African city in the country

increasingly strong resistance (from armed attacks to international sanctions) begins to create a series of pressures on apartheid governance. The 1976 Soweto student uprisings begin a campaign of mass resistance by South Africans to apartheid and signal the beginning of its eventual dismantling. These changes are reflected in the growing, reluctant acceptance of Black Africans in urban areas with the emergence of property rights and new funding for housing infrastructures within cities such as Cape Town. As the apartheid era draws to a close the urban legacy of this totalitarian system becomes clear as segregation and a splintered urbanism (Graham and Marvin, 2001) continue to characterise Cape Town and other cities across the country, leaving a legacy, described by Lester et al, (2009:13) in which:

“South Africa is left with cities structured by apartheid. Townships are characterised by small, poor quality houses, with a large number of informal settlements, poor service infrastructure and amenities and lack of affordable public transportation”.

It is during this era and especially in the 1980s that the growth of Cape Town’s largest township, Khayelitsha begins to expand rapidly after its establishment in 1985 and the scrapping of influx control in 1986 and the Pass Laws in 1987 making it impossible for the city authorities to control the increasing rural to urban migration of people from the Eastern Cape. As Malan (n.d., in Davis, 2006:61) describes, “it was if a distant dam had broken, allowing a mass of desperate and hopeful humanity to come flooding over the mountains and spread out across the Cape Flats”. The township infrastructure fails to keep up with this freedom of movement due to underfunded Administration Boards that act as the local authority and extensive payment boycotts over municipal services. Significant changes to the now renamed ESKOM through the Electricity Act of 1987 lead to its increasing neoliberalisation and profit orientated focus alongside its near monopoly in relation to the city’s electricity generation capacity (McDonald, 2009, Jaglin, 2009).

Post-apartheid infrastructures

In 1994 South Africa’s first democratic elections promise hope for the marginalised townships that have been established as part of a system of control that had segregated, splintered and divided the city, entrenching deep inequality across Cape Town’s infrastructures. ANC promises to transform the country are welcomed and the country begins the difficult task of transformation of its urban conditions. Huge investment in urban renewal, service delivery and infrastructural development are launched under the 1994 RDP which comprises a transformative plan to deliver housing, networked services and development to the millions of marginalized citizens of the country (Parnell et al, 2005) and including the ‘right to energy access’ (van Heusden, 2009). As part of the RDP a basic house is developed that provides the ubiquitous design template that would be replicated across hundreds of different urban spaces throughout the country. Whilst the RDP ended in the 1990s the house that it spawned continues to bear its name (and is subsequently referred to throughout the thesis). Other important legislation includes the 1998 White Paper on Local Government, the 1997 Urban Development Framework and the 2000 Housing Code, all focus on developing the initial aims of the RDP and providing the tools, finance and resources for municipalities to deliver on the promises of the ANC government (Parnell et al, 2005). These multiple programs of investment can be considered relatively unique globally with significant resources and outcomes delivering millions of new housing units and

networks spaces through a developmental orientated state. As this investment has continued townships such as Khayelitsha remain spaces of segregation, poverty and exclusion. The failure to uplift the urban poor in Cape Town can be understood through multiple different dynamics from the effects of retrenchment in the face of programs of mass privatisation and what Davis (2006:154) terms, “self imposed neoliberalism”, through to the limited capacity of local government to reshape the embedded racial segregation in the spatial form of the city. By 2001 the recognition of continuing poverty and network inequality leads to the government introducing the Access to Free Basic Services program that seeks to provide a minimum level of service for poor households but takes a number of years to be rolled out (Ruiters, 2009) and is criticised by a wider range of commentators and communities (Section 5.2.2) In 2004 the Municipal Infrastructure Grant is introduced which (Lester et al, 2009: 57) describes as:

“a multi billion rand municipal infrastructure grant - aimed at fast improved service delivery from municipalities. The grant focused on supporting the provision of improved water, sanitation, roads, solid waste and lighting”.

Today the city is faced with the spatial legacy of segregated networked systems that have arguably not been seriously challenged during the post-apartheid era, “Cape Town is a racist city...so lets get that set. the dynamics are worse than Johannesburg we still have our race issues to get over. Its entrenched in the city, geographically, socially, culturally, financially of course” (NGO worker). This leaves the city, which has made serious efforts at housing and service delivery over the last 18 years, with an almost unsurmountable challenge, with over 450,000 people (Western Cape News, 2009) remaining on the housing waiting list alone:

“Essentially people living in backyards what they want or what they would see as being heard is RDP houses and that is a problem, even in Western Cape where we are top in terms of delivering houses as its still not fast enough for the number of people coming into Cape Town compared to the number of houses we can build, the gap is big and is widening” (Policy maker #3, Cape Town).

Whilst tens of thousands of electric connections have been made since 1994 connecting most Cape Town residents to the electricity grid, the geography of distribution in the city remains caught in the legacy of apartheid visions of the city. In this context, the CCT is responsible for the distribution of electricity throughout most areas of the city, creating a significant stream of income for the city. This is not the case in Khayelitsha where Phambile Nombane Energy Services (PN Energy) a venture led by ESKOM (with Electricité de France and East Midlands Energy) controlling distribution since 1994 due to the unpopularity of the South African utility company and as van Heusden, (2009: 238) suggests is, “largely influenced by the desire to prevent non-payment and illegal connections”. Such dynamics produce a problematic and divided geography of electricity distribution, creating a situation described by Jaglin (2009) in which:

“Eskom’s services within city boundaries should be governed by a service level agreement between CoCT (as authority) and Eskom (as a provider). Such arrangements have not been put in place and the fragmentation of electricity distribution and the related disparities (e.g. in electricity tariffs and service levels) have persisted”.

Such a splintered distribution systems has a range of consequences for low income households. For instance, by 2003 ESKOM has not provided any of the promised Free Basic Electricity to areas, such as Khayelitsha, that it distributes electricity to and spending only R46 million in the following year (Ruiters, 2009). Such dynamics can be explained by ESKOM continuing to operate via a focus on facilitating capitalist growth (Gentle, 2009) and neoliberal reforms at both a micro (for example Pre-Paid Meters) and macro (for example conditionality's) scales showing the way the electricity sector in South Africa operates in a tension with the developmental state (McDonald, 2009). Clearly across the diverse spatialities of Cape Town, the segregated housing and the differentiated infrastructure systems the spectre of apartheid looms across the landscape, continuing to mediate a splintered urbanism in the city and an urban area defined by large scale inequalities across and beyond networked services.

Intersections of climate change, energy and infrastructure

The coal dominated electricity generation in South Africa makes it one of the leading greenhouse gas (GHG) producers in the world (Bond, 2002, Bond and Erion 2009) and characterizes its urbanization process as a carbon intensive dynamic (McDaid, 2009) and predicated attempts to decarbonise the country through developing low carbon technologies. Across Cape Town various urban intermediaries are responding to emerging climate change imperatives, reflecting the dynamic role of the city in the context of the wider country. These wider trends in pioneering city response to climate change are illustrated by the city being one of the first in Africa to develop a Energy and Climate Change Strategy, undertaken in 2006 and providing a series of ambitious aims around adaptation and mitigation. This is followed up with the Energy and Climate Change Action Plan in 2010 reflecting the growing importance and mainstreaming of climate change in municipal policy and the role of the municipality and civil society in moving forward debates about taking action. Initiatives such as the energy efficiency Smart Living campaign and the public transport MyCiti bus system provide a growing sense of low carbon momentum across the city and increasing intersections between urban infrastructure, climate change and energy.

4.2 Neighbourhood scale

The second task of developing the historical and contextual analysis of Accra and Cape Town involves exploring the histories of governing within the particular neighbourhoods that constitute the case studies for the thesis. This is important as the conceptual framework (Chapter 2) shows the need to link city scale and beyond dynamics to the case study neighbourhoods, examining how these wider processes manifest across particular low income urban space. This section considers how historical dynamics are mediated and manifested across the networked spaces of Ga Mashie, Mamre, Mandela Park and Kuyasa to shape particular infrastructure histories and the terrain from which reconfiguration emerges. This is undertaken through firstly, developing a history of each neighbourhood: secondly, examining this within the context of the energy network: thirdly, identifying and introducing processes of network reconfiguration and: fourthly, reflecting on the condition of networked services in these areas.

4.2.1 Ga Mashie

History

James Town or Ga Mashie as it is known locally is a long established neighborhood in central Accra often termed ‘Old Accra’ due to its place as the nexus of colonial activity in the city. Ga Mashie is a vibrant neighborhood at the centre of Ga culture and is divided into two main areas, James Town (or Ngleshie) and Ussher Town (or Kinka) reflecting the division of the area by the Dutch and British colonialists. These two areas are made up of seven Ga Towns which each have their own divisional chief and accompanying palace.



Figure 4.3: Overhead image of Ga Mashie © 2011 Google

The area's deep harbor means that the area is an early example of colonial urban space in which the colonisers seek to control the colonised through spatial and infrastructure practices. The area has been spatially organised with a de facto segregation with the run down thatched cottages of the Ga people based away from the brick buildings of the settlers near the harbor. This segregation is not just about interaction but was viewed as essential to prevent disease in the settler community through the development of its own urban infrastructural systems such as water systems. The creation of Victoriasborg means that a more formal segregation exists in Accra and the area becomes a space for Africans with the colonial authorities ignoring the infrastructure needs of the local population, whilst ensuring that the harbor facilities were connected to flows of electricity, “James Town is a historical point of interest for energy in Ghana. It was one of the first places to have electricity but not for the community until the Nkrumah era” (Local politician #2). For many years the neighbourhoods residents suffer from a lack of urban services in contrast to the emerging networked services in the residential and adjacent commercial spaces of the coloniser. From the 1930s Ga Mashie becomes a geographical focus for the burgeoning independence movement. Protests by war veterans at the harbor and the election in 1951 of Dr Kwame Nkrumah add to the historical importance of the neighbourhood in the wider life of the city and the nation. After independence President Nkrumah's modernization vision for the country includes the development of a central business district in Accra and Ga Mashie is repeatedly targeted for slum clearance to make way for these plans. Hess (2000: 54) explains that, “The administration repeatedly instigated slum clearance in James Town and Ussher Town, but relocation and demolition efforts..were consistently resisted by Ga leaders and members of the opposition”. The spectre of demolition continues to haunt residents of informal dwellings in Ga Mashie showing a continuity

throughout different eras of the city and the precarious nature of particular parts of the neighbourhood. Thus, although the neighbourhood is a vibrant centre, described by its residents as ‘cosmopolitan rural’ and reflecting the dichotomy of tradition and modernity in the area it is also classified as deprived (Songsore, 2009), suffering from complex socio-environmental hazards including, “inadequate potable water supply, unsanitary conditions, insect infestation, uncollected garbage, poor waste water disposal, smoky kitchens, crowding and shelter poverty” (Songsore, 2009:1) alongside issues of energy poverty.

Since 1999 a number of local, national and international projects are established in the area including the UNESCO Old Accra Programme and inclusion in the UNDP National Poverty Reduction Programme. These initiatives culminate in the 2006 launch of the Ga Mashie Development Agency (GAMADA) which seeks to develop Ga Mashie using its historical architecture¹⁶ and proximity to central Accra to bring financing into the area. Made up of a range of municipal and private partners, the structure of GAMADA is derived from a design by the City of Amsterdam represents a governance regime characteristic of a neoliberal growth coalition that focuses on attracting private investment (Harvey, 1989, Ward, 2003). This is an important new type of urban governance in Accra (although dating back to the 1980s in US and Europe) that illustrates the lack of capacity and resources the municipality has to improve Ga Mashie’s urban infrastructures and thus the embedding of a neoliberal logic around discourses of urban improvement and the requirement of private capital to shape and improve infrastructure. Whilst GAMADA is considered successful in working with the built environment heritage of the area it fails to significantly improve the networked systems of Ga Mashie. Yet developing work and partnerships by CHF International, an international NGO toward re-development of Ga Mashie are now emerging. This could be constructed to show the (neoliberal) success of work by GAMADA in attracting investment partners. CHF are looking at using land values to redevelop the area with a mix of commercial development and replacement residential for residents. Ga Mashie is acting as the test bed for new forms of urban governance as it has throughout its history this time the public-private partnership characteristic of neoliberal cities. Such an emerging partnership suggests a significant structural reconfiguration of the networked systems may be undertaken over the coming years.

Energy network

Older people in Ga Mashie remember the installation of the electricity network into the neighbourhood as the spearhead for a wider programme of modernization in Ghana during the early 1960s and feel proud to be at the centre of these efforts for the building of a modern and independent African country. As one participant of a workshop (#3) explained:

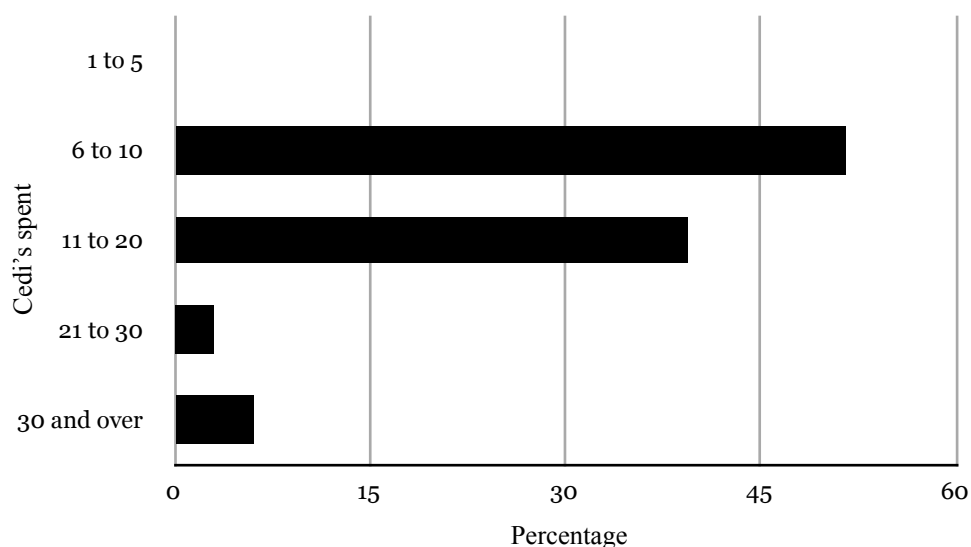
“When Nkrumah was President he made promises to the nation that we would have the electrical power and he constructed the dam. Because of the importance of the harbor for the country then electrical power came here from around 1965”.

¹⁶ As the historical centre of the capital, Ga Mashie has a series of significant, landmark buildings that currently serve a variety of uses or are not being used, these included a number of forts, lighthouse and series of historical houses such as Brazil House which makes the area one of the most interesting in the country.

Before electricity, people in the area use osunu (kerosene) lanterns. The arrival of electricity for residents implies that the modernization of the country was materializing and remains an important event in many older residents memories as one participant of a workshop (#2) suggested, "I felt the power of it", and a local politician (#2) remembers, "I was told that in infancy they used to use two stones to create light and then one day we could press a switch and receive light". The electricity is initially cheap to use as there is a much lower population across the neighborhood and the electricity was is mainly for light, which was the prime aim of the installation.

The area now has an aging electricity network that is managed by the state owned Electric Company of Ghana (ECG) and provides extensive electricity services across Ga Mashie. Whilst the infrastructure is facing considerable strain due to the increasing population of the area it is able to provide flows of electricity into many of the households of the area and is mainly located underground. The community itself uses a range of different energy sources at the household level. Most of the homes in the area are connected to the electricity network and use these flows for lights, appliances and other household uses. Charcoal and wood are also central to the energy mix of the households especially for cooking food and heating water. Households use a range of technologies which are explored through the photography workshops¹⁷. The issues surrounding electricity access in Ga Mashie are multifaceted and complex manifesting across the everyday lives of residents, affecting in many ways from mediating household finances to exacerbating environmental risks and hazards through to limiting economic development opportunities to impacts on community safety and health issues. The research identifies households spending small amounts on electricity (although these amounts may often be a significant proportion of the household income). The household survey work showed that households tended to spend between 6 and 20 Cedi's (£1-£4) per month (Figure 4.4) on electricity credit. The larger amounts spent maybe explained by households with bigger financial resources, the operation of economic activities or larger family size.

Figure 4.4: Graph showing household spend, in Cedi's on electricity per month? (In percentage)



¹⁷ See Appendix 5 in more detail and incorporating appliances such as; lights, fridges, freezers, televisions, sound systems, irons, kettles and fans

The research illustrates that many households struggle to afford a constant flow of electricity to meet the needs of its members with just under 80 percent of household respondents in the survey sometimes or often struggling to afford electricity credit for the home. This energy poverty was a key concern for participants in a workshop, “In James Town they must bring the bills down” (Participant, resident workshop #4). The costs of electricity constitutes a financial burden for most of Ga Mashie’s residents many of whom survive below the poverty line. Although a lifeline tariff of around \$1.50 per month is supposed to be provided by the government as an energy subsidy to the urban poor this payment to the utility companies is often unpaid. The cost of electricity means that appliances are not used all the time¹⁸. Many of these appliances are older, second hand models (often shipped from overseas¹⁹) and therefore offer low energy efficiencies for users.

Network reconfiguration

Network reconfiguration is visible across the neighbourhood including the state financed and delivered installation of pre-paid meters (PPM) brought in by ECG alongside a range of everyday and incremental changes to the network undertaken by residents and the potential for significant redevelopment of the neighbourhood through the partnership between GAMADA and CHF International.

Most households in Ga Mashie now have PPM installed that mediates connection to the electricity network and an example of a state-led network reconfiguration in the neighbourhood. These have been installed in households over the last few years by the ECG. Credit is available from the ECG payment office based in the neighbourhood. The PPM system begins in Accra as a pilot project for the country and installation begins in Ga Mashie from around 2008 with (contested) estimates²⁰ suggesting that over 90 percent of households now have this technology installed. Opinion is divided about the use of PPM technology. The household survey showed that 65 percent of respondent households preferred these PPM compared to the old credit meter system. During the workshops the issues surrounding the PPM are explored in more depth revealing a conflicting narrative about how this network reconfiguration is received across different households in Ga Mashie. Those who support the introduction of the PPM feel that it brings benefits to the area. One impact has been that unscrupulous landlords are not be able to present artificially high electricity bills thus providing a level of control over the cost of electricity for the household. This notion of control over the electricity supply emerges as a crucial platform for the formation of support for this network reconfiguration as it also allows the household to monitor the flows of electricity into the home (and thus management of money being spent), as one resident (Workshop #2) explained, “The pre-paid meter allows us to keep track of how much we are spending” . This ability to monitor and control the flows of electricity into the household is thus a tool for households with limited resources to ensure that the electricity component of domestic budgets are better understood and more reactive to the often strained financial resources of household members. Although the PPM supposedly provides households with more control over their electricity flows and the costs associated

¹⁸ For instance, in one household although they have a fridge this is expensive to run and is maybe only used at certain special times of the year when they have more food such as festival/celebrations

¹⁹ Until a ban on second hand imports completed its long journey through legislation in December 2012

²⁰ By the local ECG payments office although residents claim that the figure is much lower.

with this access the research also engages with individuals and households who prefer the old credit meter system. The discourse emerging from the research around a preference for the credit system revolves around access to electricity with a key response concerning the problem of a lack of financial resources to sustain electricity flows into the home. As one resident starkly suggests, “If you have money you can get a card. If you don’t you sit in the dark” (Workshop #2). For households with limited financial resources the need to pay upfront for electricity in the form of credit means interruptions in supply during periods when the household struggles to raise the required finances for the purchasing of more credit. In the past the sustaining of electricity flows into the household continues until billing at the end of the month or even longer. Furthermore, in the large households of Ga Mashie it is difficult to keep track of who is using the electricity and thus responsible for further purchasing of credit for the PPM. This has the potential to create conflict within households. There remains contestation of this network reconfiguration and anger among certain participants in the research process. These are orientated around a number of issues focused on anger about the process of installation. Households are offered free PPM and the clearing of any outstanding electricity charges which encourages take up in the technology. However ECG reverse this decision with the requirement for households to make these payments, some of which include six months of outstanding arrears and creating new financial burdens on households, “this old debt has brought chaos and confusion” (Accra politician #2). The process of installation of PPM are resisted by a number of households by refusing to let ECG into homes to introduce the technology. Police intervention is used to gain access and ensure that the PPM was fitted, creating a further level of resentment from some members of the community as the ECG neighbourhood representative explains:

“In some places they refuse and don’t want to get involved with pre-paid system so it is a case of constant negotiation. Government says it is compulsory and threatens disconnection but in reality people can continue with the old system especially if they don’t have deeds for their homes” (ECG neighbourhood worker).

Beyond the PPM the electricity network is being reconfigured in multiple different everyday ways by households in the Ga Mashie community in order to access electricity that they cannot or do not want to pay for. Many households in Ga Mashie use clandestine connections²¹ (Section 6.1.2) to the electrical system to create new network spaces and flows beyond the controlled network configurations of ECG. These forms of network reconfiguration counter the relative cost of electricity and its significant strain on the household. The research identifies a number of these strategies used to access electricity flows in Ga Mashie and explored in further detail in chapter six.

Reflecting on the post-colonial condition of networked services in Ga Mashie

Ga Mashie can be considered a low income neighbourhood in Accra, characterised by formal housing systems but with a significant presence of informal housing and widespread conditions of poverty and when compared to other parts of Accra unequal socio-environmental conditions (Songsore, 2009). Whilst the area

²¹ Clandestine means “kept secret or done secretly, especially because illicit” (Oxford Dictionaries Online). This adjective is used to describe such actions rather than illegal or unauthorised in order to - common across South America to describe such connections the word is used throughout the chapter and wider thesis.

has been an important urban space when considering energy networks (from the colonial to post-independence) and has a well established network service of electricity residents continue to struggle with energy poverty reflecting the condition of many poor communities across the city that may have access to electricity but exists in precarious relationships with such flows. This precariousness, which can be further illustrated by the history of demolition that has characterised parts of the neighbourhood reflects the wider post-colonial condition of insecurity many residents in poor neighbourhoods experience. Various network reconfiguration shapes and mediates the electricity system of Ga Mashie. The promise of change that CHF International brings is certain to have a significant affect on the network as the NGO seeks to reconfigure wider housing infrastructures in the area. Thus, the various typologies of reconfiguration which are occurring across the everyday geographies of Ga Mashie can be considered as reflecting the post-colonial condition of the networked, urban poor in Accra. This is a condition in which incremental change and daily practices shape and mediate the energy network within the wider context of a splintered and unbundling network, reflecting the divided nature of infrastructures in post-colonial cities, the range of urban governance eras that have shaped the urban form and the strategies of reconfiguration that residents and other urban actors mobilize to shape the network.

4.2.2 Mamre

History

Mamre is situated on the northern border of the CCT around two kilometers from the industrial town of Atlantis and over 45km from the central city thus constituting a peri-urban area within the metropolitan area of Cape Town. Its long history can be traced back to the seventeenth century as a military outpost for the Dutch East India Company when it is known as Groene Kloof and provides protection to settlers from the indigenous KhoiKhoi, who have lived in the area for hundreds of years. After the outpost was abandoned in 1791 the area is

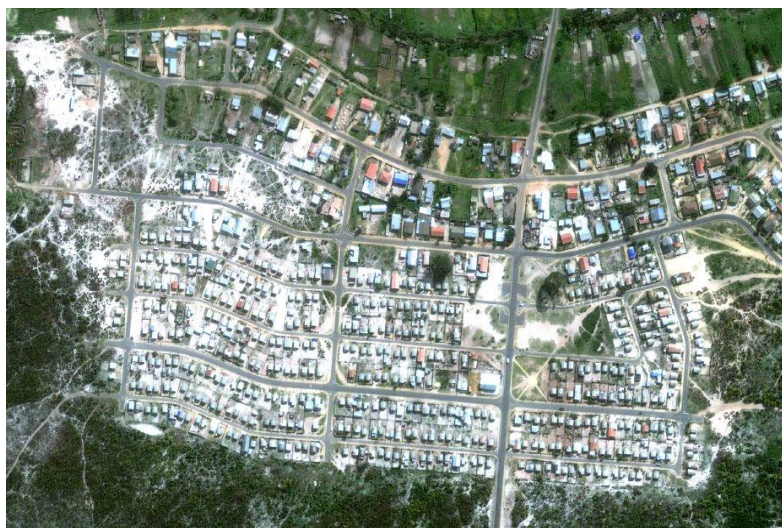


Figure 4.5: Overhead image of Mamre RDP housing area

transferred to British colonial control. From 1808 onwards it becomes a Moravian church mission with missionaries working with the local KhokKhoi to provide religious education, work and shelter (through permission to settle on the land). By 1854 the Monrovia's have renamed the settlement Mamre. The settlement with land held in a trust by the church becomes self-sufficient and develops a series of residential buildings, characterised by white washed lime walls and thatched roofs and alongside an integrated urban

form that provides a prototype garden suburb. This is not just orientated around the religious activities but also the allotments provided to each of the households, as St Claire, (2011:7) explains:

“Mamre once epitomized the original eco-village. The inhabitants livelihood was sustainable and people lived off the land; everyone used to have their own livestock and kitchen gardens. Unemployment was unknown - in a conventional sense. Nobody was employed, but everyone worked”.

A tradition of governance through the church continues to characterise the area with the KhokKhoi keen to remain outside the influence of colonial governance authorities and further reinforcing the self sufficient, semi-autonomous nature of the settlement from Cape Town, as Katzenellenbogen (1988: 366) explains:

“About a hundred Mamre citizens qualified to vote in the first Cape Parliament election in 1854, and participated in petitions against the subdivision of grant stations for freehold plots for individuals. They preferred to keep the land in joint property, for fear of ultimately being bought out by colonists”.

Over the next hundred and twenty years the self-sufficient nature of Mamre continues although much of the architecturally vivid and coherent historic building stock is slowly replaced by often unauthorised dwellings. The governance arrangements of the settlement made it an interesting comparison to Cape Town with the extensive provision of infrastructure in Mamre existing on the periphery of colonial infrastructures of control that characterise the era (although perhaps constituted in a different form through the paternalistic nature of the church). By the 1970s, the increasingly repressive urban governance of the apartheid local and national state is beginning to influence the character of Mamre with a significant extension of the area that leaves behind the garden orientated urban form of the settlement, toward a suburban style of town planning (St Claire, 2011). The forced removals and demolitions of District Six reverberate out to Mamre as the town of Atlantis is built in 1976 through the Group Areas Act to house tens of thousands removed from the inner city in a designated Coloured town in which residents are bussed back to the the city for work. As the area became increasingly urbanized, many of the problems associated with the city; poverty, crime, unemployment and environmental degradation become increasingly ingrained in the character of the area. In 1996 the process of building RDP homes for around 800 households on the housing waiting list begins with the Blaauwberg Municipality (one of the six municipalities that constitute the CCT metropolitan areas after post 1994 reforms). By 1998 the Executive Committee of the Western Cape Housing Development Board approves construction of 550 RDP houses to be built that accommodates beneficiaries classified as most in need. The land, previously held in the Mamre Trust by the community and church, is transferred to the municipality as part of the negotiations around delivery. During the process conflict is reported between the ANC and Democratic Alliance (DA) representatives (Davy, 2006) resulting in the dissolving of the Project Steering Committee by Blaauwberg Municipality and predicating further conflict between and amongst the municipality and the local community. Delivery of the RDP houses slows to halt by 2001 with less than 400 RDP units built. The project resumes in 2005 with further housing construction and the completion of the electricity network to serve the new residents who have waited patiently for over a decade after the promises of service delivery by the new ANC government. The relative isolation of Mamre means that many of the

residents face a struggle to access economic opportunities and the area of Mamre in which the RDP houses are located is characterised by continued poverty and economic exclusion.

Figure 4.6: Photograph of RDP housing in Mamre



Energy network

Since the construction of the RDP houses, completed in 2005, the energy infrastructure of Mamre includes provision for electricity for households. This networked service is not provided to all households, and the financial burden of connecting to the electricity network often falls on families who struggle to access finances to connect to such infrastructural services. As one resident explains, “When I moved into this RDP house, we had no electricity. I had to pay an additional R100²² for the electricity to be connected” (Mamre community member #4). Whilst the RDP housing in Mamre shows the progress made by the municipality in service delivery, the community continues to struggle with conditions of widespread poverty characteristic of low income formal housing areas in the city. Although the community has been connected to the electricity network energy poverty remains prevalent. Rising utility prices meant that even with subsidy support²³

²² Around £7.50

²³ Free basic electricity of 50kWh per household per month for a grid-energy system (connected through the national electrification programme) is provided (McDonald, 2009).

energy remains a central factor in the finances of households, “In my house, we cannot live without energy. The paying rates for the electricity are too high. Every time it increases we can barely afford our lifestyle. Life is not easy here in Mamre” (Mamre community member #2). The use of PPM is visible in Mamre with many respondents unhappy about the presence of such technology that was installed during the construction of the RDP housing. Many households in Mamre are reliant on heating sources that offer a cheaper alternative to electricity, reflecting the patterns of energy consumption that continue to mediate the limited role of networked infrastructures in poor communities, “The house is not warm enough. We make a fire outside if it is too cold, we use a fire a lot. The firewood is a cheaper way to keep warm than the electricity”. (Mamre community member #13). Households are thus at risk from a range of effects (such as ingestion by children of fuels, burns and fires that can destroy homes and so forth) caused by these alternative heating sources such as paraffin or outdoor fires. Although the formal housing and planned nature of the neighbourhood means this is not as significant a risk as in areas of informal housing across Cape Town in which fires destroy thousands of homes each year these issues remain.

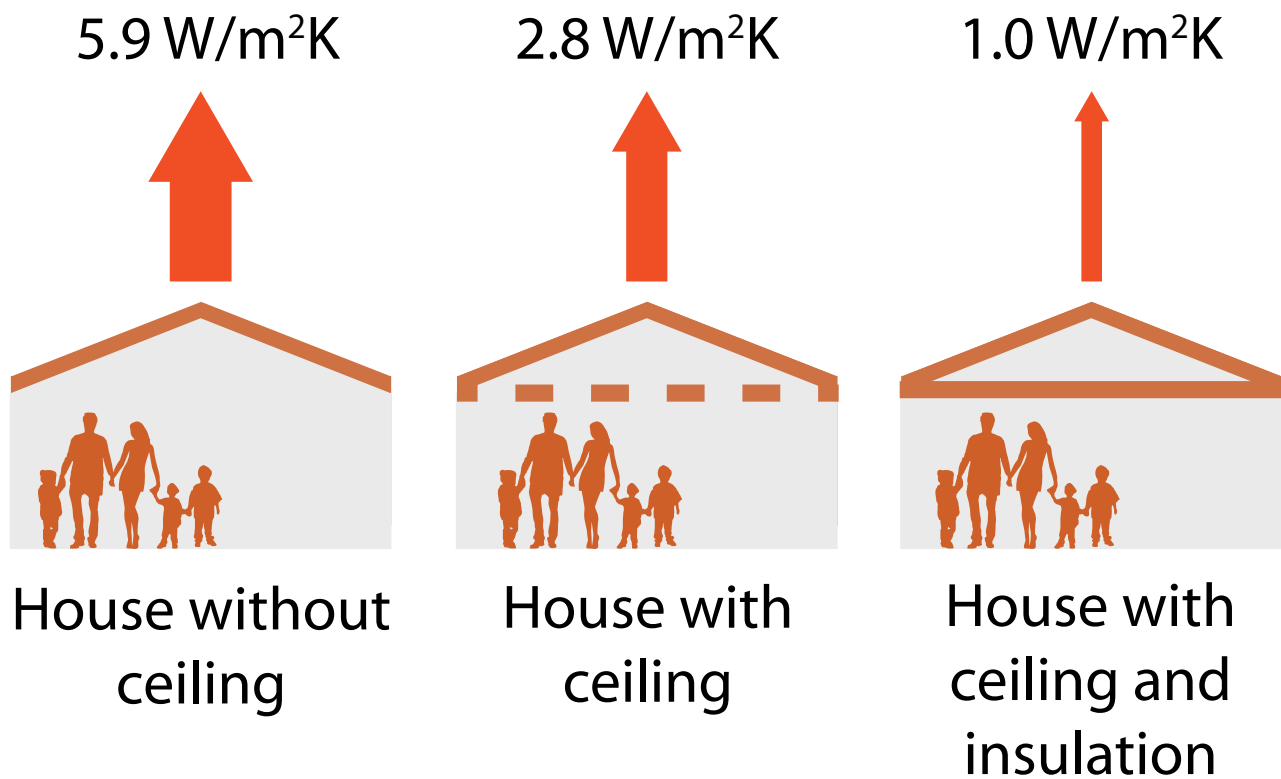
Network reconfiguration

The networked energy infrastructures of Mamre is continually reconfigured from the establishment of the first RDP houses and subsequent electricity services in the area. The need for households to connect to the electricity network is followed by ongoing household strategies in seeking to access electricity services. These include clandestine connections, as one resident explains, “I know that there are illegal connections within the community. We are poor and most households do not have any income besides social grants. That money is so little, but you have to make the most of it” (Mamre community member #3).

In 2009 around 250 RDP households in Mamre are selected by the CCT to be retrofitted with insulated ceilings in a municipality led, internationally funded project by the DANIDA that reconfigures the flows of energy within the household by retaining a larger proportion of the generated heat (Figure 4.9). The reconfiguration is financed from DANIDA’s Urban Fund through the program ‘Promoting Resilience of at Risk Communities in Climate Change. The rationale for this state-led reconfiguration relates to the history of RDP housing construction in the city. Over the last ten years, in recognition of the Southern Cape Condensation Problem Area the National Government provide a National Housing Subsidy for insulated ceilings in new RDP housing in the Western Cape. This recognises the need for increased thermal efficiency in the region, the low energy efficiencies of this type of housing and the significant impact that this low cost reconfiguration would have on low income households (Figure 4.7).

Figure 4.7: Analysis of thermal efficiencies in RDP housing

(Source: Sustainable Energy Africa, 2010)



However, no funding from government has been made available for the houses already built in places such as Mamre that lack ceilings. The private ownership²⁴ of the RDP houses makes it difficult to fund any retrofitting work owing to the Municipal Funding Act which means that the municipality is seeking financial mechanisms to deliver the work and experimenting with different forms of delivery models. Mamre becomes the site of experimentation for this network reconfiguration in which climate change is providing new financial opportunities for the municipality to undertake such experiments through increasing flows of climate finance that are aimed at a range of objectives including low carbon technology innovation. Although insulated ceilings are primarily considered as an energy efficiency intervention a wider understanding of their benefit to households is being developed around health, livelihoods and climate change. The municipality has been seeking investment in experiments/pilot projects, such as Mamre in order to consider how to upscale these experiments to approach the wider challenge of the 30,000 to 40,000 RDP houses in Cape Town lacking such thermal protection²⁵. A range of urban governance actors are involved including various departments and sections of the municipality²⁶ with the community participating in the process after selection of the area (and technology). This network reconfiguration can be positioned as part of the wider developmental nature of the post-apartheid state which, unlike the government in Ghana, is able to channel significant flows of capital into the urban infrastructures of cities such as Cape Town.

²⁴ The ownership of such RDP housing is transferred from the state to the household upon occupation.

²⁵ Estimate provided by policymaker at City of Cape Town

²⁶ Including the Environmental Resource Management Department, the Housing Department and the Expanded Public Works Programme

The reconfiguration itself can be considered a success in terms of its impact on improving the thermal efficiencies of the housing but conditions of poverty remain prevalent in the households reflecting the deep seated and multi-dimensional poverty experienced in communities such as Mamre. The household survey shows that the network reconfiguration reduces the amount of electrical energy required to heat the house in 64 percent of households and supports the research undertaken by Sustainable Energy Africa that ceilings increase thermal efficiency in low income housing. For a number of households (44 percent) this reduction in the amount of electricity required to heat the house also precipitates a reduction in overall fuel costs for energy to heat the house (Figure 4.8)²⁷.

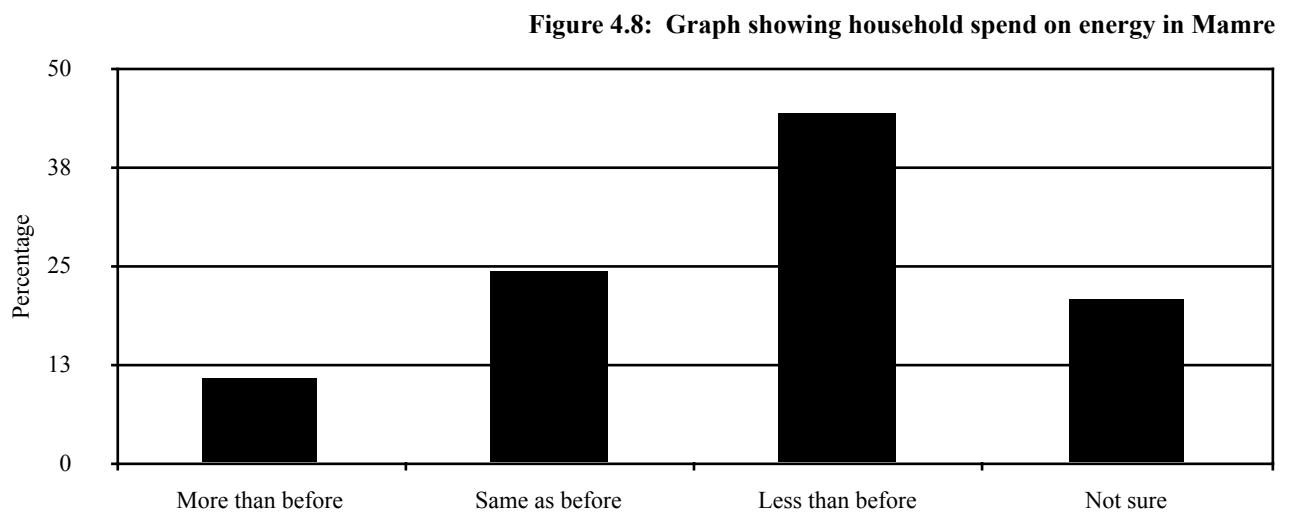


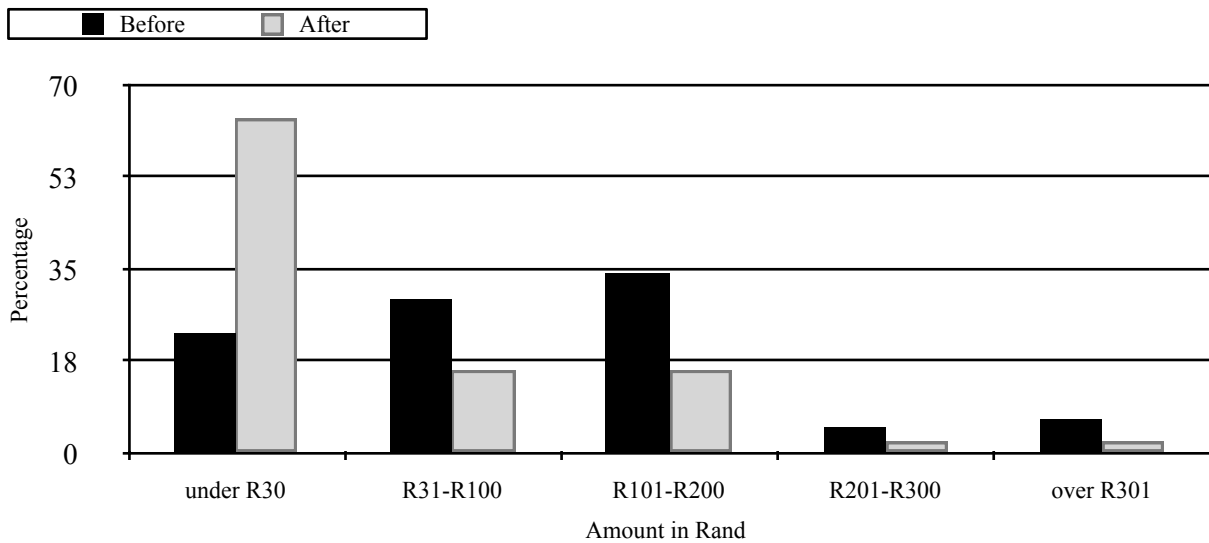
Figure 4.9 shows the overall amount of money spent during a (winter) month by households in Mamre on energy. The rise in households spending under R30²⁸ a month on energy is increasing significantly whilst those spending higher amounts (R31-R100, R101-R200 and R201)²⁹ also decreases. Although other factors may have influenced these patterns (such as climate, worsening household finances etc) this supports the contention that the reconfiguration helps households reduce both their heating and wider energy costs.

²⁷ It should be noted that this is not a uniform response with some households using the same amount of energy as before the intervention and a minority actually increasing how much they spend in heating homes.

²⁸ £3

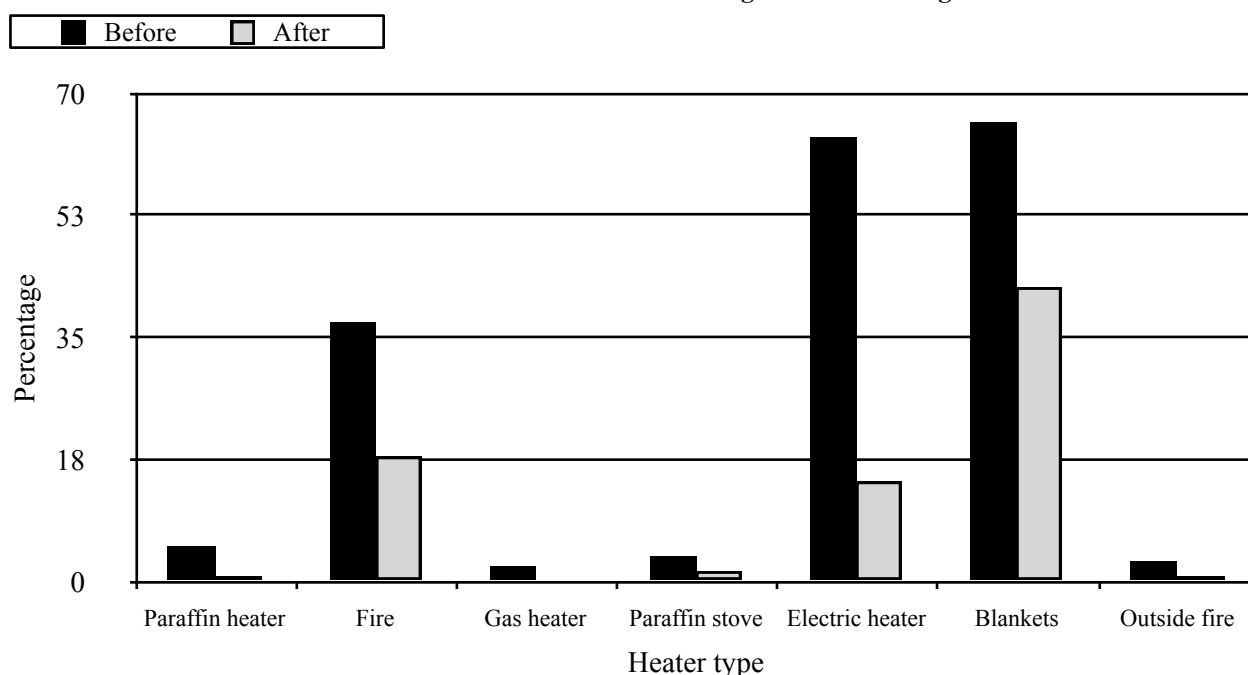
²⁹ £3 to £10, £10 to £20 and over £20

Figure 4.9: Overall spend on energy per month in rand in Mamre (winter)



For a significant number of households overall energy usage, energy used for heating the household or the amount of money spent on energy has not been reduced. This suggests that the Mamre households are also changing their energy practices beyond simply reducing energy usage/costs. One explanation is that energy usage for heating whilst remaining stable is termed the ‘rebound effect’ (Roy, 2000) and is allowing homes to keep warm for longer due to the increased thermal efficiency provided by the insulated ceilings, “Using the same amount of electricity as before but lasts longer so can help the house stay warm for longer” (Mamre community member #14). For those households that are using less energy for heating around 65 percent are re-directing flows of electricity into other appliances. Households are choosing the ‘take back’ effect in which the financial saving is reallocated within the energy budget to meet the repressed (energy) demand of the household. For the 35 percent of households who save money this is reallocated to various other areas of the households budget, “Don’t use as much electric now after ceiling has been installed so save money - maybe R10-R15 a month which is now spent on food for the children” (Mamre community member #17). Many residents in Mamre are reliant on heating sources that offer a cheaper alternative to electricity. The survey (Figure 4.10) findings point to a significant reduction in all types of non-electrical heating sources being used by Mamre households since the intervention. This suggests that households are generally staying warmer as alternatives are being used less often and thus implying an important reduction in energy practices that pose significant health risks for households.

Figure 4.10: Heating sources in Mamre households



The research shows the ways in which the network reconfiguration supports households but this should not hide the complex and interconnected issues of energy poverty that continue to effect households in Mamre. The survey shows that nearly a third of households (31 percent) continue to struggle with the costs of electricity in relation to current energy needs. Whilst the reconfiguration supports households in fulfilling some of their energy demands this is not necessarily enough for vulnerable households to move beyond issues of energy poverty. Energy poverty, despite the RDP house, despite the monthly free amount and despite the network reconfiguration remains a central issue in mediating the economic status and livelihood pathways of low income households in Mamre as a community member (#17) explains:

“I get my money once a month and it must last but sometimes don’t have and therefore no electricity so must borrow money. Can’t get through with this money. There are things we must have every time. Other members of the community will feel the same.... Energy is biggest problem in Mamre.”.

Reflecting on the post-apartheid condition of networked services in Mamre

Mamre provides an example of the importance of excavating the post-apartheid histories of neighbourhoods beyond the city scale. The relatively unique history of infrastructures in Mamre illustrates the need to consider the specificity of networked systems across different spaces within the city. The housing infrastructure of the area can be considered mainly formal but with a growing informality exemplified by the back yard dwellings, can be considered low income with significant conditions of poverty including intersections with energy poverty. Again, the daily practices of reconfiguration that take place across the network in Mamre illustrate the various ways in which low income neighborhoods intersect with the energy infrastructure and the incremental strategies that residents undertake to reconfigure networks. The ceiling insulation project can be considered a relatively successful reconfiguration of the energy network in which the state decide on the type of intervention and seek to find a community in which to implement the project.

Such action is predicated on mobilizing logics around climate change and energy to secure financing and rationalize the reconfiguration, linking into wider imperatives around poverty and so forth. This reflects the framework from which the local and national state practice service delivery over the last couple of decades. Yet whilst the reconfiguration can be quantified as a success, it has taken place in a context in which poverty remains part of the Mamre community and the insulated ceilings do little to transform the wider splintered urbanism that exists between low income spaces such as Mamre and other more affluent (and white) spaces of the city, instead offering a more incremental series of improvements.

4.2.3 Mandela Park

Figure 4.11: Overhead image of Mandela Park neighbourhood - © 2011 Google



History

The history of Mandela Park is a history of conflict between the state, the private sector and a low income neighbourhood both during and since the apartheid era. Located in the township of Khayelitsha in the 1980s the area is one of the first in the city and significantly also across South Africa in which Africans can purchase housing from banks, that purchase the land and begin construction from around 1986³⁰. The purchase of these bank-built houses is mired in controversy from the beginning with many of the homes failing to be adequately completed, doors and ceilings missing, lack of connections to the electricity and water infrastructures, cracked walls and damp and two houses being built on single plot allocations. This practice of bad construction of housing continues beyond apartheid and the private sector and government financed RDP houses provide a series of challenges for residents of the area, “I can take you around the

³⁰ When reforms detailed in the wider history of Cape Town began to significantly change the urban conditions in townships.

homes built in 2008 where at the back the plastering is off the whole wall and that was six months after the people moved in” (Mandela Park Backyarder #2).

Running up to the end of apartheid in 1990 the community undertake a general payment boycott refusing to pay the bank bonds and linking into wider rent and service boycotts emerging across the country as apartheid begins to disintegrate. The dawning of a new era in South Africa with the election of the ANC is meant to bring transformation to the poor urban communities of the country. In Mandela Park this brings optimism that the dispute with the banks regarding housing conditions in Mandela Park will be resolved. This optimism soon dissolves into an acrimonious dispute with a new body Servcon, a partnership between the new government and a host of banks that owned land in Mandela Park that suggests households will be evicted or ‘rightsized’³¹. As the 1990s progress the conflict between the community, banks and government escalates as the privatization of huge parts of the economy leads to a retrenchment of workers and the rising spectre of unemployment of residents in Mandela Park. This leads to a renewed attempt by the banks to evict families that are no longer able to make payments on their homes and Mandela Park enters into a period of conflict and tension:

“The first evictions took place around mid-day in September 1999. There were a lot of police, in Casspirs and in small vans, together with sheriffs, with dogs, teargas and rubber bullets....The police managed to evict only 13 families on the first day. Many people who were evicted were restored to their houses by the community” (Legget, 2003).

These evictions are disturbing to both the Mandela Park community and wider observers in South Africa and beyond. This is 1999 and these tactics, associated with the apartheid state are supposed to have been left in the past. Instead, chaotic scenes of police repression against families seeking to keep their homes resonates beyond Mandela Park and shows the increasingly reactive nature of the ruling ANC towards dissent.

Alongside these evictions the growing size of households (through the ability of people to move around the country unhindered by Pass Laws and other such legislation and resulting in mass migration from the Eastern Cape to Khayelitsha) is putting further significant strains on the ability of families to afford basic services such as electricity. The growth in the number of backyard shacks to house growing families creates a blurring of formal and informal housing across the neighbourhood, the need to deliver RDP housing for these burgeoning households and a complicated mosaic of networked service provision in the area. The almost daily evictions of families in Mandela Park leads to the organisation of an anti-eviction campaign in the early years of the millennium which has some success in mobilising the community against what it views as the illegitimate attempt to take people’s homes. This social movement is viewed by the ANC as a threat to the claims of the government to be delivering services and protecting the rights of the urban poor and thus the criminalisation of the group weakens the effectiveness of its anti-eviction work. The struggle for housing and networked services is reenergized in 2007 with the establishment of the Mandela Park Backyarders group, who campaign for RDP housing for the significant population of the area living in backyard dwellings who

³¹ Banks use the term to refer to the moving of residents to a smaller home that has reduced overheads and is seen as more suitable to the needs and resources of that person.

have waited, in many cases, longer than a decade for housing provision. The campaign also works with families still at risk of eviction and the conflict with the local state, now under the control of the Democratic Alliance (through being able to mobilise the majority Coloured population) continues.

Energy network

The energy infrastructure of Mandela Park reflects the wider conflict between the community and the authorities. Whilst a networked service exists in the area, many households, and particularly backyard dwellings, are unconnected to these services due to the need for title deeds and a municipality letter of authorisation. Such exclusion from the network reflects the practices in which the state enact control through regulating access to networked services:

“In fact with the houses we have built for ourselves its also going to be a big issue to get ESKOM to electrify these houses for now as currently they do not have electricity and we require them to install but before they can do it they need title deed or produce a municipality letter bearing your name you know” (Mandela Park Backyarder #4).

The cost of electricity services is high for households, even with the lifeline tariff (Section 5.3.2) reflecting wider issues of energy poverty in low income communities in Cape Town. For households the consumption of electricity can take up over 20 percent of income, a significant part of the household budget. For many residents in Mandela Park the costs of electricity are rising faster than wages or benefits meaning households are spending more and more on energy costs. Pensioners, who make up a large part of Mandela Park, are particularly vulnerable to these price rises:

“If you are pensioner I think they get R1,100 per month³² from the government so if you buy for R10 electricity that is two days if you are lucky so if you are buying for 2 days for R10, there are 30 days in a month then it comes to around R200 and thats only for electricity” (Mandela Park Backyarder #1).

Whilst free electricity is provided by ESKOM to the poorest households³³, the housing crisis in Mandela Park means that households often incorporate backyard dwellings and large families and resulting in the allocation of 50 free units of electricity being not nearly enough to cover the energy needs of these households:

“We hear that they are trying to overcome challenges by supplying some households with free electricity. But in the manner [the criteria] that they are doing this is surprising I think for some of us, its unrealistic as they look at how many times you buy electricity or how much you spend rather than the size of the household and conclude whether you deserve to get free electricity or not - how do they know you have not borrowed the money for the electricity but this is the methods they are using to measure and supply households” (Mandela Park Backyarder #5).

³² Around £110 with R10 being £1 and R200 being £20

³³ Free basic electricity of 50kWh per household per month for a grid-energy system (connected through the national electrification programme) is provided, and is used in all three case study neighbourhoods.

As in Mamre, a reliance on other, non-networked energy sources such as paraffin and the attendant problems that these bring, “Our main focus is to keep warm and we will only deal with health effects once we see coughing and even then the discussion will not be entertained but still you will never divorce from heater”. (Mandela Park Backyarder #7). The history of badly built RDP and bond housing in Mandela Park has a range of repercussions on the energy infrastructures and practices of the area. The bad quality of many of the houses built in Mandela Park mean that households do not have adequate protection from the cold and damp of the Western Cape and therefore, require significant financial resources in order to heat the home. The continued threat of eviction from bond houses or demolition of self-built housing systems means that households are not able to plan for the future or invest in the energy infrastructure of the house.

Network reconfiguration

Like the other case study communities, everyday network reconfiguration is part of the energy geographies of Mandela Park involving everything from clandestine connections to non-payment and tampering with PPM, “I think the most common one is the tampering with meters, I think one in five houses the meter is just not working so people are using electricity freely, you understand?” (Mandela Park Backyarder #2). Whilst the case studies of Mamre and subsequently Kuyasa provide examples of state or urban intermediary-led reconfiguration of networked systems in Mandela Park this is not the case. Here network reconfiguration is community-led and is closely related to the decades old housing struggle that the community has participated. This takes the form of self-built houses that are constructed, since 2007, in response to the lack of housing and service delivery by the municipality and the ongoing issues of energy poverty experienced by those living in backyard dwellings or substandard homes. As a response to this continued assault on the community and the associated problems in accessing networked services including flows of electricity a community activist group, the Mandela Park Backyarders begins a process of creating a community-built housing infrastructure that would also support the energy needs of households and backyarders:

“So, in 2011 the Backyarders decided to take their own initiative: families started to build their own houses on their own – without government help. We began our Siyawuthatha Ngenkani Campaign (We Are Taking It By Force Campaign). Through our campaign, hundreds of houses have already been built by backyarders on unused land in Mandela Park. While the Housing Department has come in and destroyed our self built homes, and while we suffer repression and false arrest from DA leaders, they have not destroyed our resolve. We are planning on building more homes until we no longer suffer the indignity of living in shacks in other people’s backyards. Forward to Land and Housing for the poor! Aluta Continua! The Struggle Continues” (Mandela Park Backyarders, 2010).

The self building of housing can be considered as a community-led reconfiguration of infrastructure in the neighbourhood that seeks to respond to the energy (alongside wider housing and socio-environmental conditions) imperatives facing residents in backyard dwellings. These new houses can be frames as a response by those who don’t have electricity connections or have structures with connections but low thermal efficiencies making them cold and damp, within the context of a large household surviving off a modest amount of provided electricity through the lifeline tariff (Section 5.32). The process continues to reinforce a conflict between the state and the community, which seeks to develop the infrastructure of the

area through their own actions, rather than waiting for the state to deliver on its promises of services and housing and providing an alternative framing of network reconfiguration in post-apartheid South Africa. Connected to the self built housing the Mandela Park Backyarders are exploring a brick making project that has two main aims around improving local infrastructures and stimulating economic development as one resident (#4) explained, “To improve existing households, and to create, the main purpose is to create employment and sell them beyond Mandela Park”. Conceived within the same spirit of self reliance, community empowerment, and reconfiguration as the house building, the brick project represents another example of how Mandela Park provides an alternative narrative of reconfiguration that challenges the South Africa state in how urban dwellers can improve their infrastructures outside of the state.

Reflecting on the post-apartheid condition of networked services in Mandela Park

Like the other low income neighbourhoods that have been historically contextualised in this chapter Mandela Park is a community that is characterised as a networked neighbourhood of formal housing on the surface but with conditions of informality throughout the area and reflecting wider conditions of poverty and unequal socio-environmental conditions. Such conditions show how the historic urbanisation of poverty in the area has been predicated on a splintered urbanism compared to middle class/elite areas of the city and is sustained through particular metabolic processes (Section 5.2). Energy poverty is one manifestation of this poverty and residents struggle with the series of dynamics that mediate such conditions. The community struggles reflect the wider manifestations of historical processes of splintered urbanism (Graham and Marvin, 2001) in Cape Town and the entrenched spatial legacy of apartheid. Residents employ various strategies of reconfiguration of the network, clearly illustrated by the continued conflict with the local state concerning housing and networked systems which has characterised the wider network reconfiguration in this neighbourhood. Furthermore, the conflict over reconfiguration provides a further example of the precarious nature of residents life’s in low income communities in Cape Town both through the everyday struggle around energy poverty but also the wider precarious position in which residents face the spectre of demolition of housing (and thus energy) infrastructure by the local state. Mandela Park acts to shatter the myth of the infrastructural ideal in post-apartheid South Africa. This is the post-apartheid condition in which communities have been promised housing and service delivery but have been let down by a resource constrained state and have contested this lack of reconfiguration by reconfiguring the networked spaces of the neighbourhood, in the form of housing.

4.2.4 Kuyasa

History

Kuyasa is located in Khayelitsha and close to Mandela Park. Yet this geographical proximity does not reflect the very different infrastructure trajectories of the two neighbourhoods, with Kuyasa coming to embody a optimistic vision of the post-apartheid era generally and network reconfiguration specifically. The residents have lived in Kuyasa for ten years moving from informal housing from other parts of the township that lacked services including electricity or water to the Government-built RDP housing. Thus, the neighbourhood of Kuyasa is an example of the success of the urban policies of the national and municipal governments in delivering housing and networked services to the urban poor. The neighbourhood was built on empty land in the Khayelitsha township and partly predicated on seeking to make the townships viable to stop the poor from migrating the 15km to 20 km into Cape Town proper. Kuyasa itself means ‘dawning’ in Xhosa and has come to represent a new dawn for the residents as they moved from their old challenging conditions without electricity, sanitation and water systems to this new housing and accompanying networked services. Over the last five years the neighbourhood has been increasingly home to a growing professional class (teachers, doctors etc) that choose to continue living in the township, illustrating the growing emergence of a black middle class in Cape Town’s township spaces.



Figure 4.12: Overhead image of Kuyasa neighbourhood - © 2011 Google

Energy network

The energy network in Kuyasa is developed to ensure the flow of electricity services to households through a single point of supply in the RDP houses and through a PPM which are built into the newly built housing, adding to the over 500,000 PPM's installed across Cape Town by 2006 (van Heusden, 2009). The energy infrastructures of the houses themselves are incomplete due to the limited financial investment of the state, with residents expected to install insulation, wiring and water heaters. This means that some of the poorer households continued to have only a limited access to the electricity network as they lack the financial means to retrofit the property. Energy poverty, like in the other low income communities remains a key issues for residents:

“I could see when we arrived that unemployment was a huge problem and often seasonal jobs, they did have electricity but it wasn't wired. People were affording mainly because the PPM system allowed people to put R5 in but those that struggle would not get electricity and had to use candles or get a loan from somewhere” (NGO worker, Cape Town #1).

The PPM system clearly causes difficulties in Kuyasa, as in the other neighbourhoods, for the poorest households. Whilst the amount of credit required is low the required electricity needed to heat the house in the winter remained unattainable to many households in the area and acts to stop flows of electricity into the home, instigating a series of connected problems for households. One of these problems associated with the energy poverty of the area and the mediating nature of the PPM technology is health problems with significant impacts on the health of the community from the poor quality of RDP homes, the cost of electricity and the need for further and significant reconfiguration of the energy network in the area. As an NGO worker (#1) explains, “Its freezing in the winter. By the time you go to sleep everything is wet and most of the sickness was Tuberculosis (TB), pneumonia,. Even two guys from the project died of TB”. Residents have to use a series of different energy sources beyond the networked service (such as wood and paraffin) in order to heat and cook.

Network reconfiguration

Whilst the everyday, incremental reconfigurations associated with low income neighbourhoods are visible in Kuyasa it is particularly well known for a large scale reconfiguration of the network. This reconfiguration of Kuyasa's energy network incorporates the installation of 2,300 solar water heaters (SWH), insulated ceilings and energy efficient lighting which helps the community become an urban Africa energy icon, a project that is continually cited as a success of the Clean Development Mechanism (CDM)³⁴ and a vision of the potentialities of reconfiguration within low income communities across Cape Town, South Africa and the wider continent. This is not an easy process. Over 10 years of work by a wide range of actors including the community, the government, the NGO, SouthSouthNorth and in an initial financing role the CCT is spent

³⁴ “The CDM allows GHG emission-reduction projects in developing countries to earn certified emission reduction (CER) credits equivalent to one ton of CO₂. CERs can be traded and sold and used by industrialised countries to meet a part of their targets under the Protocol. Projects qualify through a vigorous public process designed to ensure real, measurable and verifiable emission reductions to what would have occurred without the project” (Goldman, 2010:6)

developing the project, particularly negotiating the CDM verification process, locating financing and developing a research base. Although over 2,300 households received these reconfigurations (through the Department of Environment and Tourism's 'Social Responsibility Programme' and Provincial Government's Department of Housing) there are still many households in the community waiting for the next stage of the project. The impact of the ceilings and SWH has been evaluated by researchers at the Energy Research Centre at the University of Cape Town (Wlokas, 2011, Wlokas and Corbera, 2009). It is clear that with water heating accounting for a third to half of the average South African household's energy costs that the SWH system is a beneficial intervention across Kuyasa. Yet it seems that it is the ceiling insulation that has the bigger impact, "Kuyasa has changed but I think the real issue during the last 10 years has been not having a ceiling" (NGO worker, Cape Town #1). For energy poor households the need for hot water is greatest in the periods of coldest weather and thus the SWH can provide only a limited level of support for families during the cold Western Cape winters whereas the reconfiguration of the energy infrastructure through ceiling insulation, as explored in the Mamre case study, has a significant impact during the winter in controlling thermal efficiencies, reducing energy poverty and improving health.

This reconfiguration is cited in numerous reports, talks and other forms of urban learning as a model for future interventions in energy infrastructures in South Africa. It provides a case study that becomes mobilized across urban policy/energy debates not just in the city, but across the country and the wider continent, as an NGO worker (#4) explains:

"The project has helped to place energy poverty in low income housing firmly on the national agenda and the Government has shifted radically by targeting one million solar water heating installations in the next two years....the insulated ceiling is a revolution...it's a false economy not to have these ceilings in housing in South Africa".

While this reconfiguration provides an excellent example of the benefits of reconfiguring energy infrastructures for the urban poor the almost unique nature of the intervention and the resources (time and finances) involved in the delivery ask serious questions about whether this is replicable in other low income urban communities that are considered later in the thesis.

Figure 4.13: Photograph of Kuyasa CDM project



Like the other case study sites Kuyasa is a low income area characterised mainly by formal housing but situated within wider ecologies of poverty and reflecting the state of post-apartheid township spaces in South Africa as spaces of marginalization and economic inequality. Energy poverty characterises the households of the area which are also left with the need to connect to the network from their homes and meaning that the poorest are left with only the basic connection to the network, mediated through PPM technology. Whilst the reconfiguration improves households conditions of poverty remain for many of its residents and characterised by a state of precariousness in terms of accessing energy. This type of reconfiguration, a collaboration between community, non-state actors and also state actors offers a different way to consider network reconfiguration from both Mamre and Mandela Park in terms of how the infrastructure geographies of these urban spaces are being shaped and mediated. Like in Mamre, the Kuyasa reconfiguration is predicated on mobilizing logics around climate change and energy to secure financing and rationalize the reconfiguration, linking into wider imperatives around poverty, sustainability and such like.

4.3 Comparative histories of networked systems.

Various forms of comparative reflection can be drawn from the histories of infrastructure across Accra and Cape Town that show the commonalities and differences inherent at a city to city level, across different neighbourhoods in the same city and within a neighbourhood itself. The next section outlines some of these tentative comparative associations.

4.3.1 City to city comparison

A number of commonalities across the post-colonial and post-apartheid conditions of low income neighbourhoods in Accra and Cape Town can be considered that have shaped and mediated a historically rooted splintered urbanism (Graham and Marvin, 2001) and the metabolic processes that continue to entrench inequality (Chapter 5). Firstly, these areas are all characterised by poverty and compared to the wider cities of Accra and Cape Town can be considered as having unequal socio environmental conditions. Such inequality is produced through the (very different) patterns of historical urbanization in both cities, the metabolic processes that accompany the transformation of nature in Ghana and South Africa and the use of infrastructures to control urban populations. This is a history across both cities and in different ways which either prioritises networked services for the elite (be they colonial, apartheid, post-colonial or post-apartheid) or fails to provide enough investment to reshape conditions and leaving a legacy of a splintered infrastructure. Whilst the 'Splintered Urbanism' (Graham and Marvin, 2001) thesis suggests that networked systems have become more fractured after a period of integrated networks this is not the case in Accra and Cape Town. In both these cities splintered infrastructures characterise the spatial histories of the cities from early colonial times, echoing other studies in the global South that have found similar processes. (Kooy and Bakker, 2008, Zerah, 2008). As Demissie, (2007:1) argues:

“Like other colonial institutions such as the courts, police, prisons and schools that were crucial in establishing and maintaining political domination, colonial architecture and urbanism played pivotal roles in shaping the spatial and social structures of African cities during nineteenth and twentieth centuries”.

Secondly, the post-colonial and post-apartheid conditions of these low income communities can be understood as constituting a precariousness, in that through a range of different issues, dynamics and infrastructural processes, households lack security or stability showing that historical patterns of urbanization produce, reinforce and reflect ongoing socio-environmental inequalities across race and class in Accra and Cape Town. This socio-environmental inequality can be seen across the everyday geographies of the electricity network, with households often struggling to afford electricity or finance reconfigurations of the network that would improve their position. This energy precariousness can be linked to the wider precarious nature of low income households and the struggle to survive under contemporary conditions that remain shaped by the past. There are conditions in which the historical development of infrastructures leave communities with few assets or resources and vulnerable to crisis and changing financial circumstances. Furthermore, the precarious condition can also be considered beyond energy and wider poverties to incorporate the security of households in terms of tenure and housing with demolition and disruption by urban governance authorities having a long history across a number of the neighbourhoods. A third finding that emerges from seeking to consider the historically shaped conditions of these low income neighbourhoods is the various modes of reconfiguration which shape and mediate the energy networks of these places, showing that the infrastructure is not a static thing but a continually reshaping system. Although divergent reconfigurations are mapped, especially when considering larger scale reconfigurations and the actions of other urban actors, it's clear that residents in low income communities in Accra and Cape Town are involved in a series of incremental acts that seek to improve access to the network, reduce the financial cost of energy and so forth.

Whilst the cities and their low income communities share a series of commonalities there are also some important differences in the post-apartheid and post-colonial condition of infrastructures in Cape Town and Accra and relating to the historical trajectories of networked systems in the two cities. The move from colonial forms of urban governance provides the key diverging factor separating both cities with Accra moving to a post-independence period characterised by the infrastructural ideal and investment in infrastructure undertaken by President Nkrumah. In Cape Town the colonial control by the British is instead replaced by the apartheid system of urban governance that intensifies the infrastructure dynamics of the colonial authorities, turning them into a nightmarish totalitarian system of control. Another key difference is the role of the local state at present in relation to the sites of reconfiguration and how they intersect with climate change and energy logics. In Cape Town the municipality are perhaps the best resourced city in Africa and investing significant financial resources in delivering housing and networked services that are increasingly intersecting with climate change and energy logics and emerging flows of climate finance. Whilst this investment is not able to transform the lives of all of its population the city is making significant progress and is quick to see opportunity in these new urban logics. The context in Accra is different, where this investment is not available and the municipality finds itself under resourced, dealing with crisis

management rather than infrastructural upgrading and reconfiguration and yet to link to climate change and energy logics and financing. Such dynamics in Accra are partly predicated on the withdrawal of public investment that is brought about by the SAP and partly, alongside wider global inequalities in economy, trade and politics this produces a very different municipal context than Cape Town. Whilst Cape Town can be partly characterised by neoliberal conditions its substantial investment capacity and the widespread construction of housing and networked services offers a developmentalist vision of network reconfiguration compared to the more neoliberal anchored dynamics that shape and mediate network reconfiguration in Accra.

4.3.2 Inter neighbourhood comparison

Another comparative method is to consider network reconfiguration across different neighbourhoods within the same city, in this case Cape Town. This comparative work reveals the danger of over simplifying the infrastructure conditions of particular cities and the very different contexts and presents in which reconfiguration of energy networks is taking place across the urban (poor) spaces of one city. The network reconfiguration undertaken in these neighbourhoods illustrates the complex and diverse nature of post-apartheid urban governance across the city. Whilst similarities exist with daily practices of incremental reconfiguration these divulge when considering the larger and more prominent reconfigurations. In Mamre the reconfiguration is state-led, with the municipality selecting the nature of the intervention and the community receiving the insulated ceilings without much of a role in the conceiving of the project. This contrasts to the network reconfiguration of Kuyasa in which the community and an NGO develop a long term partnership that works to consider, plan and deliver the intervention. Both Mamre and Kuyasa are similar in being driven by climate change concerns (or using climate change to mobilize other concerns), but differently configured in both projects, (relating to the different partners and finance involved). Such interventions suggest that these strategic interventions are being grounded in low income, formal neighbourhoods rather than more challenging areas of the city which remain 'outside' the scope for such forms of reconfiguration. Finally, network reconfiguration in Mandela Park is characterised by ongoing conflict with the state and offers a very different vision of the city than either Mamre or Kuyasa. Clearly, these three neighbourhoods portray very different Cape Town's and the diverse patterns of reconfiguration taking place across the city.

4.3.3 Intra neighbourhood comparison

Ga Mashie provides an example of different typologies of reconfiguration within the same neighbourhood contributing to the emerging picture of multiple, often competing logics, rationalities and arrangements of urban actors that suggests the need for detailed community-based analysis of these processes. The PPM installation provides an example of a reconfiguration that can be considered as simultaneously welcomed and rejected. For some members of the community this was viewed as a welcome intervention in supporting their energy needs, whereas for others this was deeply conflictual, with police and force being used to deliver the reconfiguration. This same dichotomy between these reconfigurations emerges at another level with serious

investment in the historic building stock in parts of the neighbourhood from the municipality whilst at the same time the authorities seek to demolish other informal parts of the area. The promise of reconfiguration from CHF international provides an opportunity for collaborative reconfiguration of the housing and energy networks of Ga Mashie but it is not clear how this will unfold and whether it will be a participatory process or something resisted by members of the community. The daily incremental practices of reconfiguration, like across the other case study areas, provides a commonality of experience across the neighbourhood with residents involved in the constant and unmappable changes to the electricity network.

4.4 Conclusion

Drawing on the conceptual imperative articulated by Myers (2006) and Yeoh (2001) about seeking to examine the post-colonial condition as a fundamental component of any investigation of African cities the chapter illustrates the importance of such work in relation to a conceptual framework focused on investigating the political ecologies of network reconfiguration. This chapter excavates the infrastructure histories at both a city and neighbourhood scale responding to the overall aim and research questions of the thesis. This is undertaken by examining the historical configurations of urban energy networks in Accra and Cape Town and arguing, based on the evidence that historical processes of splintered urbanization have shaped current socio-environmental inequalities in low income neighbourhoods. This is a context in which the urban energy network can be implicated in mediating conditions of poverty, linking in the historical splintered nature of infrastructures in both cities that are predicated on race and class divisions and generating exclusionary circuits of energy. The chapter has revealed the post-colonial/post-apartheid conditions in which Accra and Cape Town are situated in which the colonial and apartheid eras can be considered not just as history but deeply implicated in the current state of networked systems in Accra and Cape Town and a key dynamic in shaping and mediating network reconfiguration in the cities. These are differentiated conditions emerging from different histories, yet they are both contexts in which the infrastructures of the cities are deeply divided and low income communities are struggling with energy poverty and wider unequal socio-environmental conditions and in which various urban actors seek to reconfigure the energy networks, with varying levels of finance and success. Whilst Cape Town invests significantly in networked systems over the last 20 years this is not the case in Accra and the emerging intersections of climate change investment and urban infrastructures may reflect the current capacity of the cities to develop reconfiguration responses to these agendas and the metabolic flows of energy that shape both cities. Chapter five examines these socio-natural flows through seeking to trace the metabolisms of capital, climate and crisis produced through both the historical and contemporary context.

Chapter 5: The metabolism of capital, climate and crisis across networked systems

This chapter is predicated on examining the ways in which intersections of capital and climate via metabolic processes mediate the network reconfiguration of electricity infrastructures in Accra and Cape Town. The chapter focuses on how network reconfiguration connects to wider processes of the urbanization of nature, infrastructure investment and market or state-led interventions, together with the consequences of these urban metabolisms across the low income case study neighbourhoods. Using the concept of urban metabolism indicates a concern to not only trace and make visible, but importantly centre the multifold ways in which capital intersects with climate and mediates and structurally (re)configures the electricity networks in both cities (Section 2.5). This is an imperative to consider how these circulations and flows dialectically shape the city and its networked systems and the important structuring role these processes play in connecting, composing, splintering, fragmenting, enlarging and renewing urban infrastructures. Swyngedouw (2004: 8) suggests that, “Urbanisation is primarily a particular socio-spatial process of metabolizing nature, of urbanizing the environment” and the analysis in this chapter is conducted through a detailed examination of these metabolic flows and circulations that constitute the electric networks in Accra and Cape Town. The analysis draws on the concept of metabolism from across the UPE literatures (Bakker, 2003, Gandy, 2004, 2006, Heynen et al, 2006, Swyngedouw and Heynen, 2003, Kaika, 2005) (Section 2.5.2) because, the urban energy network, akin to a waterscape, “should be understood as a produced socio-natural entity. It is produced directly through the urbanization of nature” (Loftus 2007:49). Thus, the thesis contends that energyscapes are not only a series of metabolic processes but also make possible other, connected metabolic flows, implicating such networked systems in shaping and mediating the urban. This dialectical role is particularly important in considering the splintered nature of infrastructure (Section 2.4), how such segregated, fragmented and fracturing networks reflect and reinforce configurations of power (Section 2.5.3) and how these dynamics produce a series of urban energy crisis across the low income, networked neighborhoods of Accra and Cape Town.

If crisis is understood as, “a time of intense difficulty, trouble, or danger” (Oxford Dictionaries Online) then the electricity systems and wider energy networks across Accra and Cape Town’s low income neighbourhoods can be considered through such a notion. Lack of networked provision, disrupted services, issues of affordability and fragmentation all constitute an ongoing crisis across the energy networks of the cities and for the municipalities, service users and urban dwellers who interact with such systems. The urban energy crisis and wider infrastructure crisis more generally is well documented (Graham, 2009), including across Africa (Eberhard, 2008, Gandy, 2006, McDonald and Pape, 2002, Pieterse, 2008, Davis, 2006, Simon, 1997). Through UPE crisis can be conceptualized as a series of metabolic processes which constitute, “a multifaceted phenomenon that links with political and economic factors operating in a global as well as a regional arena” (Gandy, 2006: 390). The mobilization of crisis as an analytical window is undertaken in order to consider how urban metabolic processes intersect with conditions of splintered urbanism (Graham and Marvin, 2001) and how such dynamics reflect and reinforce social relations across the cities because,

“the politics underpinning urban infrastructural transformation are rarely more evident or visible than in times of crisis or rupture” (McFarlane and Rutherford, 2008: 368). This is undertaken by firstly examining the urbanisation of nature that produces crisis across urban energy networks and secondly, through the dialectical responses to these urban energy crisis in which the state and/or market reconfigure networks in response to these socio-environmental conditions.

The chapter argues there are two main ways in which energy crisis are experienced in low income, networked neighbourhoods that guide the analysis. Firstly, through wider network disruption caused by lack of generation capacity and causing the ubiquitous rolling black out (or lights out in Ghana). Secondly, the conditions of poverty in low income households that generate difficulties in sustaining flows of electricity into the home, particularly in the context of the PPM, which can be considered as energy deprivation (Annecke, 2005). In Accra the chapter is mainly focused on the first notion of energy crisis, as failure or disruption of the flows of energy across Accra’s electricity network, predicated on a lack of generation capacity and caused through a number of metabolic processes. The chapter examines the metabolism of this crisis of disruption from the moment the lights go out in Ga Mashie, seeking to reveal the wider processes that produce these dynamics and the dialectical responses to these conditions. This is undertaken through firstly, examining the flows of water and processes of climate change in Northern Ghana in producing crisis. Secondly, these dynamics are linked to the sprawling urbanisation (and capitalisation) of the city. Thirdly, the growth of the middle class/elites is examined in amplifying urban energy crisis. Fourthly, the analysis considers emergent low carbon technologies in relation to fragmenting networks across the city, arguing that these processes reinforce a splintered urbanism (Graham and Marvin, 2001) through a growing post-networked urbanism (Coutard and Rutherford, 2011). In Cape Town the energy crisis is mainly focused on the second notion of crisis proposed around energy deprivation (Annecke, 2005) and is understood as constituted by winters in the Western Cape, revealing the conditions of low income households in relation to the ability to access and sustain flows of energy. Tracing the metabolic flows between firstly, the climate of the Western Cape, (particularly during the cold and damp winters); secondly, the affordability of energy for the urban poor in Cape Town; thirdly the histories and consequences of (under) investment in RDP housing and; fourthly how these metabolic processes create conditions in which poverty and health (particularly the spread of pathogenic diseases) intersect to produce an energy crisis for the poor. Fifth, the energy crisis is considered within the context of emergent technologies in low income neighbourhoods and the reconfiguration taking place through new circuits of global capital flows, in the form of climate change financing, examining how these circulations are producing new logics and rationalities across the city in relation to climate change and energy concerns.

The chapter concludes by reflecting and comparing metabolic processes in precipitating but also responding to infrastructure crisis in Accra and Cape Town to consider the ways in which capital investment (or the lack of it) is reshaping historically splintered infrastructures. Finally, the chapter reflects on the limitations of an analysis centered on uncovering how capital and the urbanization of nature mediate urban infrastructures. It concludes by suggesting that whilst revealing the central role of multi-scalar metabolic processes structured via logics of capital across urban infrastructures and the inequalities produced from such processes, it only

provides a partial understanding of such networked systems in Accra and Cape Town. This insight generates the need to further explore the responses across the everyday urbanism of both cities and the dialectic of crisis and socio-environmental conditions in low income neighbourhoods.

5.1 Producing energy crisis across Accra's energy network

The crisis of electricity provision in Accra, and Ga Mashie in particular, is neither natural or inevitable; it is produced through a series of metabolic processes (Figure 5.1) that bring together capital and climate. Within this ongoing sense of crisis particular moments such as when the lights go out and the flow of electricity is interrupted, provide a window in which to explore the metabolisms that produce such crisis. This section explores the disruption of flows of electricity into Ga Mashie through examining the metabolic production of this energy crisis, beginning in the low income neighbourhood before tracing this outward to climate change dynamics in the Sahel, the subsequent reduction in water levels that effect the Akosombo Dam and its electricity generation. Alongside these metabolic processes the rapid urbanisation of Accra is examined, arguing that the growth in the middle class/elites in the city can be directly implicated in the increased energy demands that increase network disruption and resulting in these sections of population investing in a series of low carbon technologies to counter the effects of disruption and in contrast to the urban poor. The section argues that such dynamics reinforce a splintered urbanism and show the increasingly post-networked urbanism (Courtard and Rutherford, 2011) of the city, revealing the energy crisis as a crisis of the poor and the need to examine how these urban dwellers respond to these network conditions.

5.1.1 When the lights go out, network disruption and failure in Accra

The disruption of electrical power supply across the city's network occurs regularly for residents across Accra, both through the inability to finance sustained flows of electricity (Section 4.2.1) and importantly through ongoing problems with generation that links low income neighbourhoods to global metabolic processes. These dynamics illustrate the fragility and vulnerability of the electricity network and the ongoing condition of infrastructure crisis. The household survey in Ga Mashie shows over 90 percent of respondent households recorded more than 20 interruptions per year and helps to articulate the sense of ongoing crisis for the urban poor, connected to such networked infrastructures:³⁵

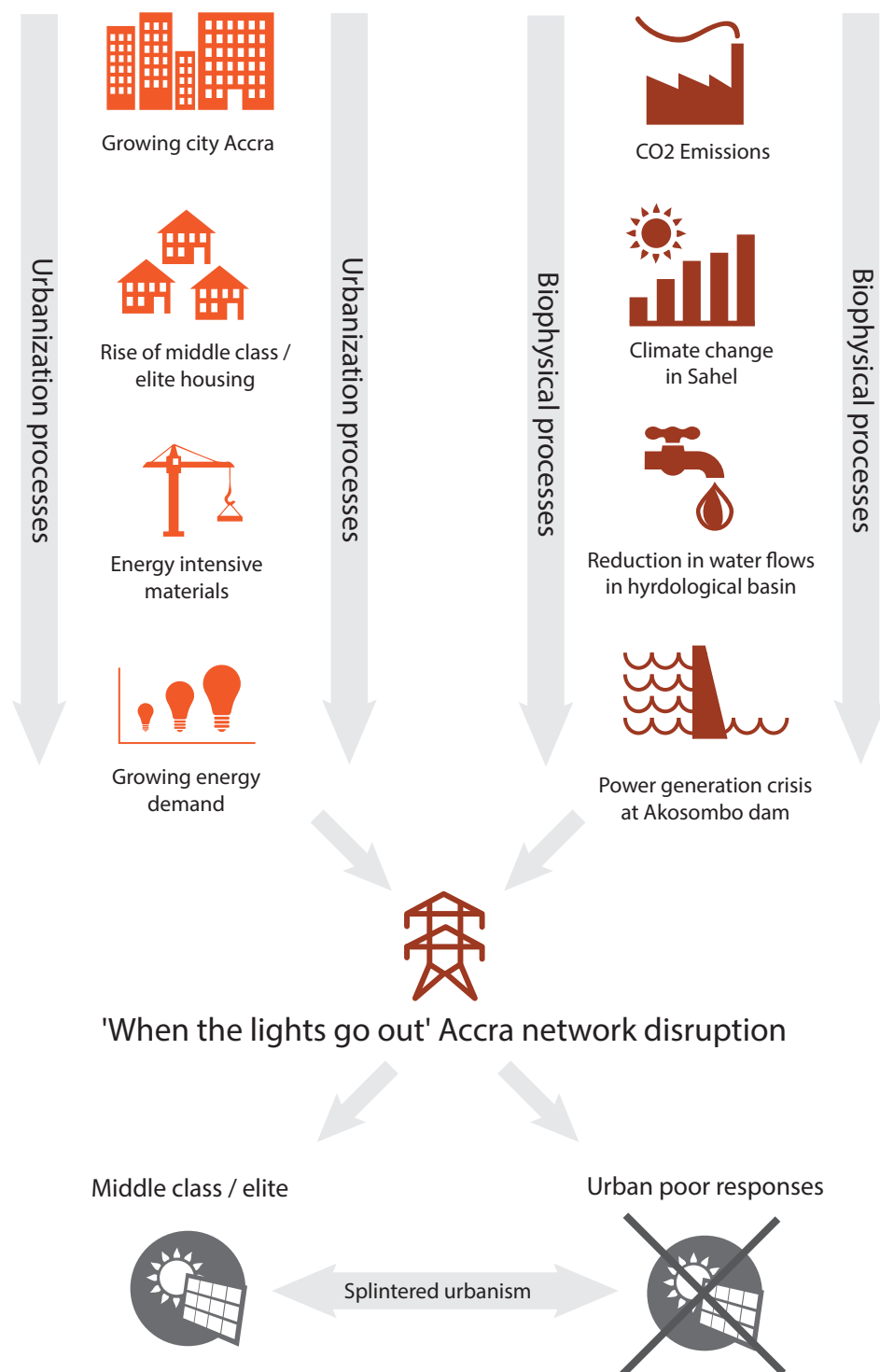
“We depend on light for our everyday activities, without the light or the energy there were many problems for people trying to make money or for people to get by in the family compound”
(Participant, resident workshop #5).

During 2007 electricity production drops dramatically in Ghana and the country is forced to introduce load shedding, meaning days without electricity in urban spaces such as Ga Mashie. As a municipal policy maker (#1) explains, “In 2007 we had to share the electricity and ration it and these things are not easy, even with planning you can't work at night”. Ga Mashie experiences a series of effects emanating from this extended

³⁵ Of course very different, but connected issues of electrical power supply exist for urban communities (such as Old Fadima, adjacent to Ga Mashie) that are not connected to the energy infrastructure of Accra.

crisis and intersecting with ongoing problems across households in sustaining flows of electricity due to conditions of poverty. These effects of crisis are experienced regularly in low income neighbourhoods but are particularly pronounced during 2007 and include disruption to already precarious economic activities, “The lights out affect a lot of people and business with much revenue lost during these episodes, disturbing people’s lives and ruining appliances and business” (ECG neighbourhood worker #1). The consequences of the extended energy crisis in 2007 provides a specific period of sustained crisis, and resulting effects, that are examined to consider the metabolic production of this network disruption.

Figure 5.1: Diagram showing the metabolism of crisis across Accra’s energy network



The costs to poor households in Ga Mashie goes beyond economic effects with residents describing having to adapt to nights without light, spoilt food, broken electrical appliances, increased crime and traffic incidents and a range of other effects of prolonged crisis, such as the potential for increased disease vectors³⁶ and other health effects. Furthermore, with the city's networked water system dependent on treatment plants, such as Weija, the disruption of electricity supply to these facilities precipitates further crisis across Accra's infrastructures (Adank et al, 2011). This state of network disruption and failure contributes to a paradoxical condition of ever expanding infrastructure breakdown in a city with increasing signs and symbols of wealth, typified through increasing investments in network spaces for the middle class/elite (Section 5.1.4). Thus, these dynamics contribute to the reinforcing of the socio-economic position of the urban poor and precipitate further waves of crisis in low income households. The ongoing power crisis in Ga Mashie that was especially prevalent and visible in 2007 is produced through a series of metabolic processes that mediate this infrastructural condition and prompts the need to travel outside the city to examine these dynamics.

5.1.2 The role of biophysical processes

“We have all been terrified by the fact that it [the water levels] gets to some points when its reported in the newspapers that it's at a low level and we all start getting load shedding and rationing” (Ghana national policymaker #3).

The amplification of ongoing energy crisis in 2007 is partly predicated on the dramatic reduction of water levels in northern Ghana and the subsequent effect this hydrological event has on electricity generation levels at the Akosombo Dam, showing the multi-scalar, metabolic nature of network crisis. Thus, to consider crisis in the electricity network of Ga Mashie necessitates the examination of the metabolism of energy appropriation, transformation, distribution and consumption taking place in Ghana.

The analysis begins at Akosombo Dam, a hydro-electric facility and the main power generator for the country, with its capacity of 1038MW and accounting for around 60 percent of installed electricity capacity in the country (RCEER, 2005). The facility is run by the Volta River Authority, a government owned utility who sell on electricity to ECG, that distribute these flows across southern Ghana. Akosombo Dam stands testament to the modernist infrastructural ideals (Graham and Marvin, 2001, Kaika, 2005) of the Nkrumah post-independence government which seeks to modernise and universalize Ghana's energy infrastructure through large scale hydro-electrical generation. Whilst plans for Akosombo Dam are first conceived by the colonial authorities it is not until post-independence era that the national government set about seeking to finance this significant infrastructure project. Akosombo Dam symbolises during Nkrumah's rule a bold vision of the nation's future and embodying the goal of universal networked services for citizens. Yet with limited access to capital the Ghanaian government has to work in partnership with the American owned Volta Aluminum Company (VALCO) and in conjunction with the World Bank to develop the project. The conditions of the financing arrangement, with the Ghanaian government contributing around 50 percent of required capital mean that the priority of this infrastructure mega-project is firstly to power the VALCO

³⁶ Without the ability to cool households it is likely that households will see an increase in disease carrying vectors such as mosquitos

aluminum smelter (shut down between 2007 and 2001 and now owned by the Government), accounting for 80 percent of capacity and only secondly the population of Ghana, accounting for 20 percent of capacity (Gyau-Boakye, 2001). Thus, the financing of Akosombo Dam is predicated on the continued practice of resource extraction by companies and governments of the global North, reflecting the difficulty of newly independent states in generating capital for infrastructure investment and the contradictions inherent in articulating an infrastructural ideal for the nation. The construction of the largest man made lake in the world³⁷, covering over 8,000 square kilometers (Fobil et al, 2003) and displacing over 80,000 people in the Volta River Basin (Gyau-Boakye, 2001) is a mega scale infrastructure investment, predicated on capital accumulation, via the production of aluminum, that bounds together Ghana's energy production with its hydrological dynamics. As a ECG employee at Akosombo Dam (#1) comments, "In Ghana water is life, not just for the thirsty but for those that need energy in their lives".

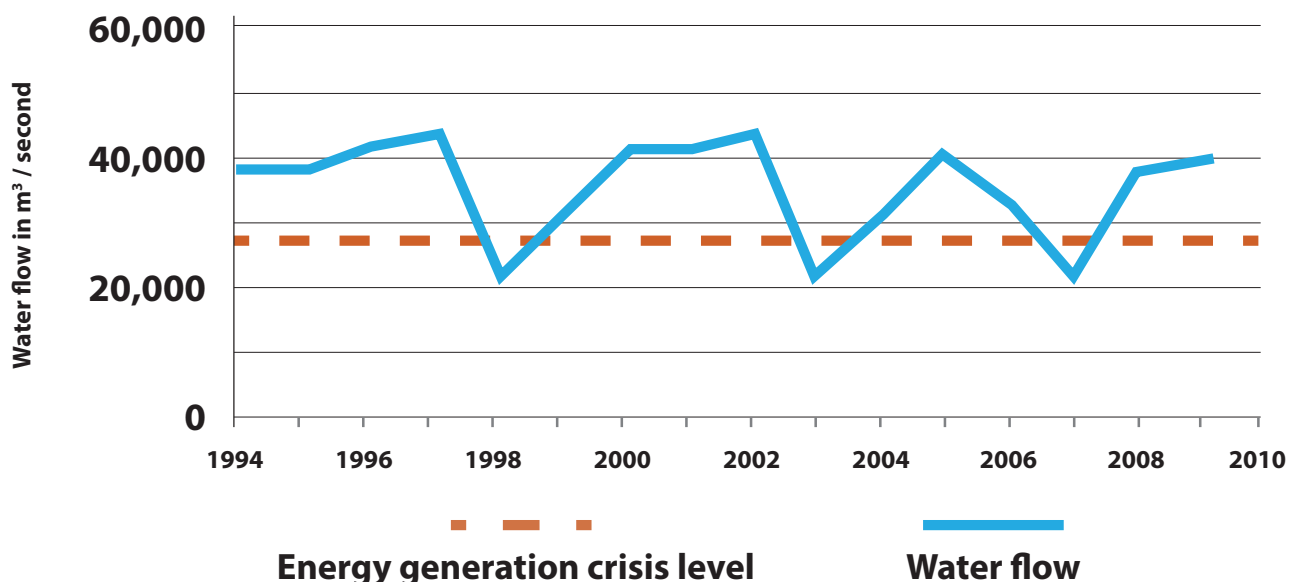
Figure 5.2: Photograph of Akosombo Dam



³⁷ Now surpassed by the Chinese construction of the Three Gorges Dam in Hubei Province

The hydrological zones that generate the flows of water necessary for energy production at Akosombo Dam stretch north toward the Sahel. These zones are becoming increasingly unstable, reflecting the growing implications of climate change in this fragile region³⁸ (Silver et al, forthcoming, Tacko Kandi et al, 2006). With the Sahel areas of northern Ghana and the other countries that make up the Volta Water Basin³⁹ predicted to become increasingly dry and arid (Gyau-Boakye, 2001) the hydrological zones that together constitute the water supply for Akosombo Dam are forecast to experience reductions in flow of between 30 and 40 percent (Ghana National Government, 2000:50). As Figure 5.3 illustrates there have been a number of periods in which these flows have been reduced dramatically, including during 2007, when water flow to Akosombo Dam drops below 30,000 square cubic meters a second, lowering generation capacity by up to 60 percent.

Figure 5.3: Total water flow Akosombo Dam (annual)
(Source: Ghana Energy Commission, 2011)



With over 55 percent of Ghana's electrical generation capacity coming from the Akosombo Dam (RCEER, 2005) emergent climate change processes, that are generating an increasingly dry and arid hydrological zone in the Sahel (Kandji et al, 2006, Toulmin, 2009), threaten to further destabilise energy flows through lowering the water flows into the Volta hydrological zone. This matters as these dynamics are predicated to intensify over the coming years (Kandji et al, 2006). This in turn translates into decreased generation capacity and thus effecting, via network disruption, low income households, precipitating further crisis for the urban poor.

As such the chapter argues that climate change and hydrological dynamics become key metabolic constituents through which energy crisis is produced in Ga Mashie, implicating historical economic development and capital accumulation in the North via GHG emissions and through the development of the

³⁸ This increasing lack of rainfall and aridity can be partly explained by processes of deforestation and desertification that have characterised northern Ghana over the last century and closely implicated to the energy needs of urban populations (via charcoal).

³⁹ These include Mali, Burkina Faso, Benin, Togo and Cote d'Ivoire

Akosombo Dam to power the aluminum industry. These metabolic processes link into networks of provision across Accra's low income neighbourhoods showing how the generation of electricity to serve accumulation needs has created a series of dependencies and vulnerabilities in these urban spaces.

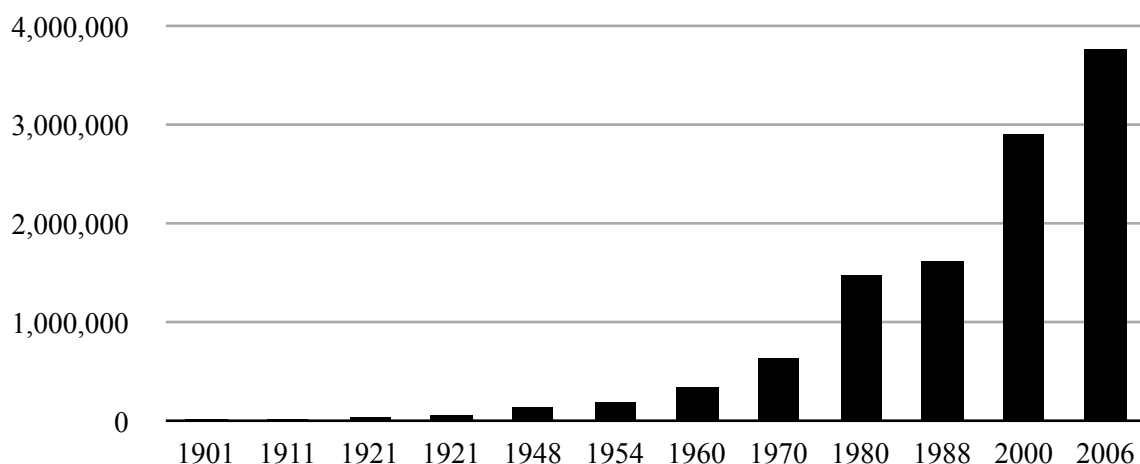
5.1.3 A sprawling city: Urbanizing energy demand

Tracing the metabolism of crisis across the urban energy network does not just lead out of the city toward Akosombo Dam, the wider hydrological zones that sustain flows of water to the hydro-electric facility and anthropogenic climate change. They are also produced through the process of urbanisation and the splintered urban electricity infrastructure (Graham and Marvin, 2001), reinforced by moves towards so-called sustainable technologies such as solar generation systems, building materials, architectural design and so forth.

The rapid urban growth of Accra mirrors urbanisation (Figure 5.4) patterns taking place across coastal West Africa and African and global South cities more widely, in an unprecedented era in which:

“the scale and velocity of Third World urbanization, moreover, utterly dwarfs that of Victorian Europe. London in 1910 was seven times larger than it had been in 1800, but Dhaka, Kinshasa and Lagos today are each approximately forty times larger than they were in 1950” (Davis, 2006:2).

Figure 5.4: Graph showing population growth of Accra 1901-2006
(Source: Brand, 1972 and Ghana Health Service, 2001)



Accra's population growth rate of 4.4 percent contributes to its status as one of the largest cities in West Africa⁴⁰ with the consequence of the rapid incorporation of surrounding rural areas into the city, predicated on the large scale metabolic transformation of natural resources from the rest of Ghana and beyond. This significant urban growth is exemplified by part of the emerging Accra urban conurbation, Kasoa City, which is on the edge of the Greater Accra Metropolitan Area (GAMA) (Figure 5.5). Since the late 1990s the area

⁴⁰ Greater Accra Metropolitan Area had a population of 2,905,726 in the 2000 National population census and a growth rate of 4.4% which gives an estimated mid year population for 2006 of 3,762,336. Source: (Ghana Health Service, 2001).

operates as a de facto commuter settlement for the ever expanding city and is one of the fastest growing urban areas in Ghana. The population of Kasoa City grows from around 34,000 (Ghana Health Service, 2001) in 2000 at a rate of around 13 percent per annum to a population projected at 117,000 in 2010 (LUMP, 2010). Planners have projected the Kasoa City population will continue to grow, up to 175,000 by 2015 and over 300,000 by 2025 (LUMP, 2010). The speed of urbanisation in this edge city, the urban sprawl characterising such growth and the middle class/elite housing systems that are being constructed together embody a series of metabolic urbanisation dynamics implicated in the energy crisis across low income neighbourhoods in the city. The growing middle class and their home owning aspirations, the capitalization of urban and formerly peri-urban land, the emergence of new financial products such as mortgages all mediate this urbanization of nature and the crisis it contributes toward.

Contrasting housing and infrastructure systems characterise this growth and sprawl. Firstly, the increasing number of middle class/elite housing systems across the city and secondly the increasing numbers of urban residents living in slums (UN-Habitat, 2009). The series of infrastructure systems that characterize the growth and sprawl of Accra are emerging from the city's sustained real estate boom and the financialization of the land, predicated on housing construction for the rapidly growing middle class (Grant, 2009, Karley, 2009). These housing and associated infrastructure systems reveal very different processes, dynamics and outcomes compared to the slum urbanism that is shaping other parts of Accra. As one architect suggests, "Trends in construction are more like suburban America as you can see when you visit East Legon. Gated communities that are very inward looking" (Accra architect #2). Accra's rapidly growing middle class housing landscapes are increasingly spaces of detached, expensive homes⁴¹ from European and North American suburban typologies, with row upon row emerging from the horizon in an incessant march across former peri-urban land. The increased visibility and availability of global capital is present in some of these new developments, with a range of financial actors, such as private equity groups, beginning to invest in real estate markets in West Africa. This suburbanisation dynamic, financed through the increasingly internationalised urban land market produces a series of important changes across Accra. These include the growth of gated communities and privatized urban space (Arku, 2009, Grant, 2009) that reinforce a splintered urbanism (Graham and Marvin, 2001) in the city. As Obeng-Odoom, (2010:396) comments, "the rapid rise of gated communities, inhabited by upper and middle class Ghanaians and the proliferation of low-income settlers around these communities provides further evidence of segregation". In relation to the crisis across the energy network of Accra this urbanisation of nature through housing construction is playing a significant role. The construction material used in many of these new middle class housing systems (Figure 5.6) is imported concrete or sandcrete blocks used in over 84 percent of (formal) houses across Accra (Accra Metropolitan Assembly (AMA, 2006). Estimated amounts of concrete used in Accra are at around 2.7 millions tons per annum and expected to increased by 11 percent each year (Antwi-Barfi, 2001) indicating a significant transformation of nature into urban form, with most of this being imported from outside Ghana (Antwi-Barfi, 2001). Used in part because of its relative cheapness and availability and in part to allow for architectural details that symbolise the emergence of an (imported) middle class aesthetic (classical columns,

⁴¹ For instance homes in Savannah Gardens in the desirable middle class enclave of East Legon and around 10km from the centre of Accra and close to the airport are being sold for \$300,000 upwards to a mix of the Ghanaian middle class and elite alongside foreign workers and ex-pats.

arches and so forth) concrete has become the defining material characterising the urban sprawl of Accra, transforming former peri-urban space into landscapes of concrete. The energy intensive nature of concrete is significant, not just in terms of production, but because these new houses require large air conditioning systems due to the thermal inefficiency of concrete. As an Accra-based architect (#1) explains:

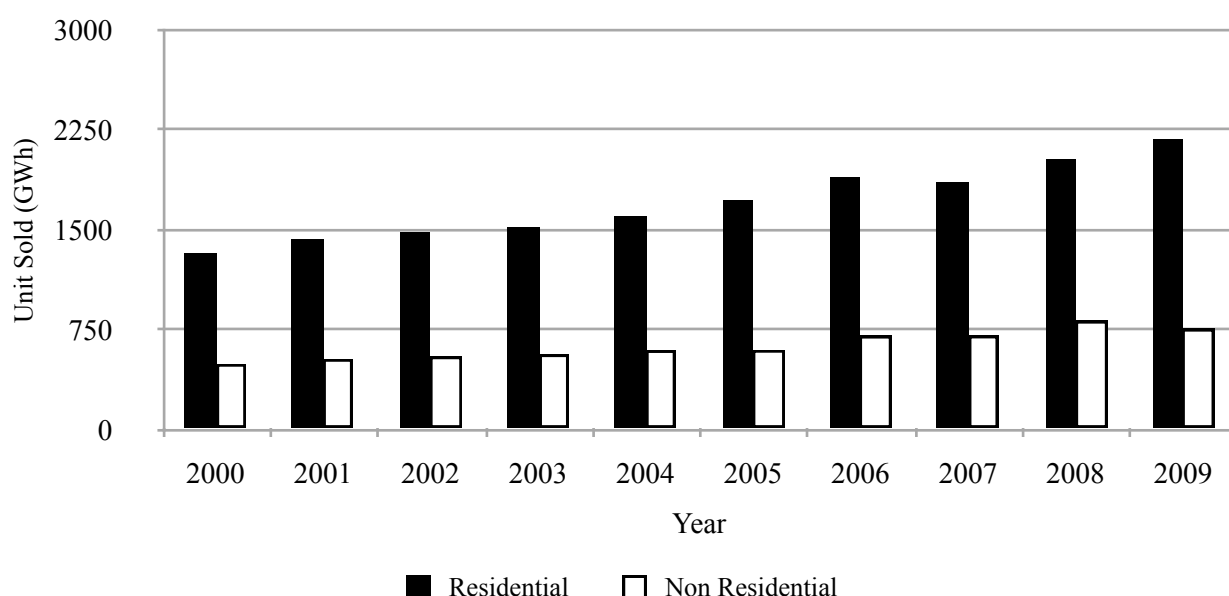
“Most of the new middle class housing has air conditioning (A/C) and this creates a growing demand on energy and the need to finance this at the household level and the national level. The cost of running A/C we discovered is nearly as much as the mortgage payments in the standard middle class housing. Some of the homes being built by individuals have up to seven bedrooms, how much will have to be spent on A/C? You could imagine how much energy this would take up in a two storey, glazed windowed house”.

Figure 5.5: Photograph of concrete shell housing in Accra



Urbanisation dynamics partly driven by the growth of a middle class, that themselves symbolize the growing economy of Ghana, are increasing the energy demands across the city. The design and materialities of these housing systems has further contributed to the urbanisation of energy demand and partly prompted a significant growth in total consumption of electricity (Figure 5.6) by domestic users. This has grown from 1319 GwH sold in 2000 rising 853 GwH to 2172 GwH by 2009 or a jump in demand by around 65 percent (Ghana Energy Commission, 2011).

Figure 5.6: Total units (Gigawatt Hours) sold by Electricity Company of Ghana 2000-2009
(Source: Ghana Energy Commission, 2011)



Alongside climate stress and the hydro-electricity complex, the production of energy crisis in Ga Mashie is also structured through global financial investment in real estate, the emerging middle class and urban sprawl. Such an analysis implicates processes of (sub)urbanisation and the growing prosperity of certain segments of the city's population in an unfolding energy crisis whose effects are centered on the urban poor. This is an energy crisis in which the energy intensive houses of the middle class/elites place increasing demand on the energy network and contribute to the disruption and failure that partly characterize this infrastructure. Furthermore, when disruption and failure in the energy network occurs, secondary infrastructures provide additional levels of energy security for middle class/elite urban dwellers with access to finance. For instance, a 4.5 Kilo Volt Ampere (KVA) diesel generator that could supply a low income household with limited power during network disruption remains prohibitively priced at 4,000 Ghanian Cedi (£1,300). A 15KVA diesel generator, (enough to power a three bedroom middle class home) costs over 21,000 Ghanian Cedi's (£6,800)⁴² illustrating that such secondary infrastructures remain out of the reach of many urban dwellers in Accra. The spluttering and humming of diesel generators has become a ubiquitous sound outside the city's middle class/elite homes as a response to a crisis predicated at least partly on the very design and construction of such new urban network spaces. These metabolic processes prompt questions about the metabolic production of crisis and its relationship with social relations across the city. Increasingly, emergent technologies such as solar photovoltaics are providing a new way for those with the financial ability to deal not just with disruption and failure across the energy network but to offer new premium network spaces away from the crisis prone infrastructure of the rest of the city.

⁴² Source for prices of generators from Ghana's leading comparison price site: <http://www.ghanabuys.com> (Accessed 12.08.2012)

5.1.4 Emergent technologies, premium network spaces and a post-networked urbanism?

Emerging responses to network disruption and failure reveal the metabolic processes mediating structural network configuration in which the ability to negotiate network crisis is mediated through urban dwellers economic status. Technologies and materialities that respond to the infrastructure crisis in Accra show that new premium network spaces (Courtard, 2002, Graham and Marvin, 2001) via market logics are being produced in the city outside of state-managed electricity systems.

A number of eco homes are beginning to emerge across the city providing niche, premium spaces for eco-innovation, emergent technologies and materialities yet so far remain limited to a handful of spaces that are often developed and owned by architects. One such example is the Addo house in East Legon (Figure 5.8). The house is designed to act as a signifier for the concerns of the architectural practice behind the design. In a short film made in conjunction with an architect from the practice⁴³ the rationale for the eco-home was explained:

“The philosophy of the practice is to develop a sustainable African architecture, to create an architecture that is rooted within its own specific environment using traditional indigenous African materials, passive design strategies and alternative technologies that respond to the climate and specific site and user requirements” (Accra architect #2).

Figure 5.8: Addo House, East Legon, Accra



⁴³ The short film on the Addo house can be viewed here: http://www.youtube.com/watch?v=dcYdizkAhCI&feature=player_embedded

The house presents a series of technological and material innovations responding to the ubiquitous, energy intensive, cement based buildings being produced for middle class/elite consumption across Accra's urban spaces. Passive design creates natural cooling and ventilation, with the timber floor set 1.2 metres above ground level allowing the circulation of air and working alongside a range of other design features, such as large roof overhangs, timber screens and a terrace, all of which counter the need to use air conditioning. Alternative technologies such as solar photovoltaic panels and rain-water collection are used with the solar running alongside the network supply and acting as a support infrastructure during shorter disruptions. Indigenous natural materials used for centuries across Ghana and the wider West African region in building practices are re-introduced in a contemporary way. Mud blocks are being used to keep the building cool and support the wider passive design system. By using mud in construction large financial and energy savings can be accrued, using locally sourced materials rather than energy intensive materials, dependent on being imported, such as concrete. Furthermore, the thermal efficiency of mud means that housing is naturally cooled, rather than requiring air conditioning. At present less than ten percent of (formal) houses in Accra currently contain mud in outside walls, compared to over 50 percent in other parts of the country (AMA, 2006), particularly the arid Sahelian north of Ghana. This illustrates what may be considered a cultural movement over the last few decades that urban dwellers are undertaking, moving away from traditional methods of building climate resilient buildings in the region. The aim of the Addo house is partly to dissociate materials such as mud, often linked to poverty and the past and to present a new architectural identity that seeks to converge with the aspirations and tastes of the growing middle class. The integration of such materials in construction would make a significant difference on the energy consumption landscapes of the city both in the construction sector and in domestic usage. Thus, the role of such eco-housing innovation is linked, not just to the task of articulating an Afro style of architecture that is responsive to its environment and counters current construction methods in the city, but the wider task of re-imagining what constitutes a modern African or Ghanaian identity in the context of a rapidly urbanising culture. Such concerns were elaborated by an Accra based architect/educator:

“There is no reason to copy Western building techniques except to show prosperity, no reason to build in concrete it's the antithesis of what should be getting built. I want to be clear about traditional building and traditional building techniques that can be appropriated for modern design building. I think its an important distinction, no one should live in the past I think what we grapple with is what was progressive in the past and what should be left behind and what we try to take forward is traditional technology and intelligence about the climate and turn it into something modern and relevant” (Architect/Educator, Accra #1).

These experiments in eco-innovation are articulating new Afro-centric architectural styles remain at a early stage of development, fragile, taking place in isolated locations across Accra and yet to significantly permeate the imaginations of the city's growing and aspirational middle class.

Interest in these eco-houses is linking up with new imported sensibilities around sustainability and energy efficiency from international developers. At the same time the increasing, although limited, visibilities and discourses emerging around low energy technologies and materialities in individual eco homes is also evident in the development of 'sustainable masterplans' for new middle class/elite housing that suggest a significant upscaling of such systems and precipitating further network reconfiguration across Accra. The construction of these housing systems and attendant premium network spaces being created, is mainly being driven by international developers who are backed by significant capital holdings and often having some level of sustainability embedded in their governance charters. As an Accra architect reiterated (#2):

"Its developer led, those from the West want to get involved in sustainability but as far as I can see the Ghanaian developers and contractors are not really considering these issues and see concrete as the most suitable building material".

These visions of a very different urbanism and urban natures are beginning to offer new ways of imagining housing systems in Accra beyond the ubiquitous concrete suburbias that have grown across the city's landscape. The delivery of these sustainability orientated projects is about to begin on a significant scale in Accra, as the city becomes an increasingly attractive urban space for flows and circulations of international capital. One such example is the aptly named Appolonia City of Light scheme. Financed by the global equity company the Renaissance Group⁴⁴ and delivered through its African land business Rendeavor Ltd, mobilizing \$100 million of initial investment to work on the master planning, land division, infrastructure systems and management framework for Appolonia (World Construction Network, 2012) (and a similar site in Takoradi), the development suggests an emerging reconfiguration in the housing and energy geographies of the city. The project is part of a series of real estate projects by Rendeavor Ltd across Africa, with an urban estate with similar vision on the outskirts of Nairobi beginning construction during 2012. These dynamics show the increasing convergence of global flows of capital, fast growing African cities and the emergence of apparent concerns with urban sustainability that emanate from a range of politicians, NGOs and civil society organizations.

Appolonia itself is planned as a new city on the outskirts of the GAMA with construction expected to take place over the next ten years on a 800 hectare site with ambitions to eventually accommodate over 85,000 residents. Its (self) described as promoting, "world class environmental integrity and sustainability"⁴⁵ with the potential to significantly reconfigure current flows and circulations of energy across middle class housing systems. Whilst the development remains is yet to be materialized it hints at the possibility of significant changes across the energyscape of Accra and the production of particular, premium (eco) network spaces in the city. As the developer hints, "We have a strong focus on being as sustainable as possible. Given the impact of what we do, I mean if we develop 200 hectares of land you can have a positive or negative impact" (Accra Developer #2). The potential delivery of these planned developments will integrate eco-

⁴⁴ The Renaissance group began in Russia in 1995, it was founded by a New Zealander who went to Russia in 1992 working with Credit Suisse on privatization work and over the years it has diversified as a company, Renaissance group is the merchant bank part of the business. They own and buy assets and sell them on including financial interests such as the African wide Eco Bank and some 600,000 acres of forestry in far east Russia.

⁴⁵ A short film by the developers illustrates the vision for Appolonia as a focus for sustainability http://www.youtube.com/watch?v=FDOGHwegw70&feature=player_embedded#!

innovations within a local context, building on the work of local architects and their early experiments and combining with international knowledges and narratives around sustainability, design and so forth⁴⁶. The construction of these middle class/elite homes in Accra may perhaps provide a way to counter the fast growing energy demands of Accra and change the ecological make up of building materials. It is thus being promoted as a solution to potential buyers seeking access to infrastructures and networks beyond the disruption and failure that characterise such systems (particularly around flows of energy and water) and as a solution to the wider city in terms of problems associated with Ghana's rapid urbanisation and infrastructure crisis. As Stephen Jennings, Chief Executive, Renaissance Group (Daily Graphic, 2012) comments, "Ghana's powerful combination of a dynamic economy and business-friendly environment will allow it to create solutions to rapid urbanisation and demographic growth faster than many countries in the world". This rhetoric offers at least a partial truth and potential urban future for Accra in which new middle class/elite housing development is predicated on sustainability and low energy criterion moving away from current energy intensive typologies. These network reconfigurations could help the city respond to the infrastructure crisis by decreasing demand on the urban energy system through creating new post-networked spaces and secondary infrastructures beyond the grid. This emergence of sustainable orientated houses and wider development, whether through envisioned, integrated neighbourhood scale, masterplanned networks or the dispersed and isolated eco homes currently existing, contributes to a post-networked urbanism (Coutard and Rutherford, 2011). This is an urbanisation in which these premium spaces become unbundled (Graham and Marvin, 2001) and privatised from the wider energy network. Coutard and Rutherford, (2011:107) describe such urbanism and its consequences as:

"The development of 'small-scale', 'decentralized', 'dispersed', or otherwise 'alternative' technologies clearly problematizes the inherently networked nature of the urban, on the environmental, spatial, social and political levels that technical infrastructure always implies and impinges on".

These urbanisation dynamics therefore generate a number of potential subsequent implications across Accra's networked systems that will produce differential outcomes for the urban population. This emerging network reconfiguration is producing premium network spaces (Courtard, 2002) through new experimental eco-homes and large masterplanned potential housing developments, reflecting an a new layer of such spaces on the energy and housing geographies of the middle class/elites. Here, the potential exists for a reduction in energy demand that may effect the frequency of disruption and failure across the network. Yet, increasing numbers of middle class/elite households opting out of large networked systems will reduce revenues for the ECG and effect investment in upgrading and maintenance, potentially precipitating further crisis. Furthermore, these dynamics will reinforce a splintered infrastructure (Graham and Marvin, 2001) between those able to afford to access such premium networked space and those who are not, whilst also contributing toward a post-networked urbanism (Coutard and Rutherford, 2011) meaning that crisis across the city is focused in low income neighbourhoods and reflecting and reinforcing inequality across Accra. For those able to afford such reconfiguration access to technologies, such as generators and photovoltaic panels, provides a

⁴⁶ For instance the design and planning teams are South African based during initial stages of the development.

premium network space, beyond the crisis space of the city's main fragmenting electricity network that creates additional layers of household energy security. Accra's unbundling and increasingly splintered infrastructure mediates access to diversifying circuits and flows of energy based on socio-economic status and the ability to pay for such premium network spaces within the context of a dwindling hope and aspiration in universal service provision for the city,

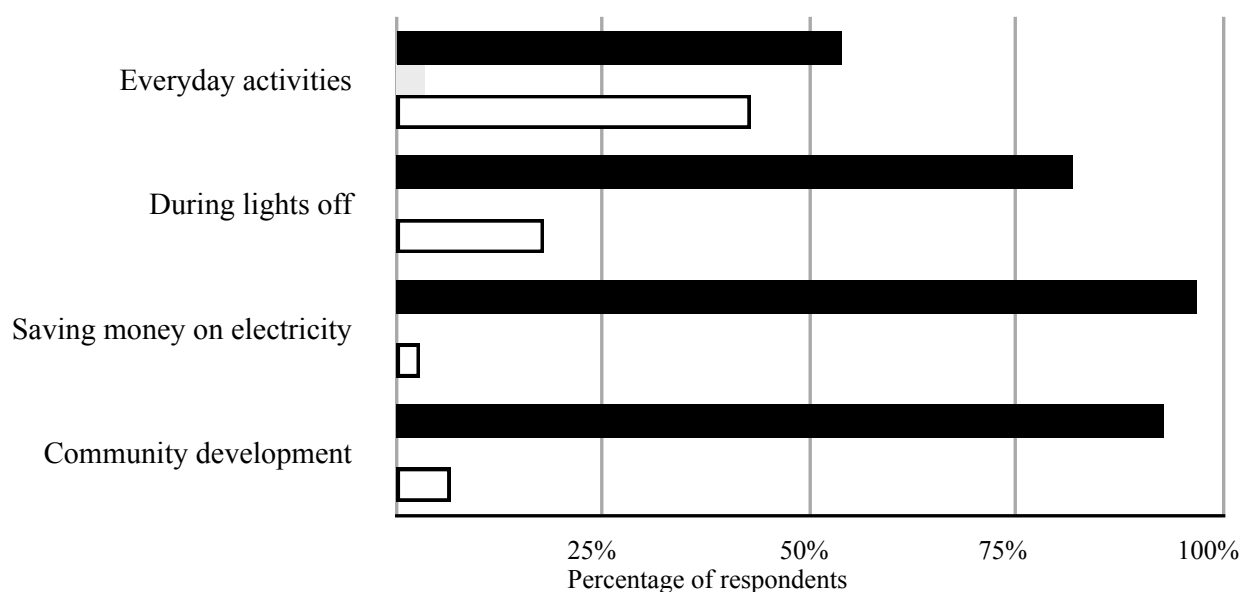
5.1.5 New energy networks in urban poor areas?

The growth of urban slums in Accra in which urban dwellers are forced to live in hazardous socio-environmental conditions is perhaps the city's greatest infrastructure challenge. As UN Habitat (2009:10) comments, "the sprawl or horizontal rapid growth of the city has hindered the provision of such service like water, solid waste disposal, refuse collection, good drainage, and electricity very difficult". Such urban conditions suggest the need for significant investment in networked systems with the urban poor of the city either having no access to electricity or being connected to networks experiencing disruption. This ongoing crisis can be explained through either the lack of finance to sustain flows, termed energy deprivation (Annecke, 2005) or the frequent episodes of disruption outlined above. In Ga Mashie as in other urban poor, networked communities, access to the emerging premium network spaces, technologies and eco innovations that the middle class/elites are engaging with remains low or non-existent. Whilst some larger businesses or organisations, possess access to secondary support infrastructures, mainly in the form of diesel generators, there is only a limited presence of emergent technologies that may act to support the area through both the ongoing, as well as concentrated periods, of energy crisis⁴⁷. Members of the Ga Mashie community are aware of emerging energy technologies, such as solar photovoltaic, with over 80 percent of survey participants suggesting some level of recognition. Furthermore, the respondents expressed interest and enthusiasm for the uptake of solar technologies in Ga Mashie with Figure 5.9 illustrating popular support for the development of solar technologies in the neighbourhood:

"If there was solar we could get it free or cheap, they don't use it here but they need to try. Community leaders need to bring solar lamps here and fix it as it will help a lot of people economically and during lights out" (Participant, resident workshop #4).

⁴⁷ For example the Usher Polyclinic did use a number of solar lanterns (12 volt, built in the UK and donated) for its back up system during moments of crisis, providing essential and emergency lighting for the staff and patients. However this technology has since been replaced by the recent installation of a diesel powered generator, which provides a more comprehensive support system for the medical clinic and thus the lanterns have become obsolete and are not really used anymore on site.

Figure 5.9: Attitudes to solar technology in Ga Mashie (in percent)



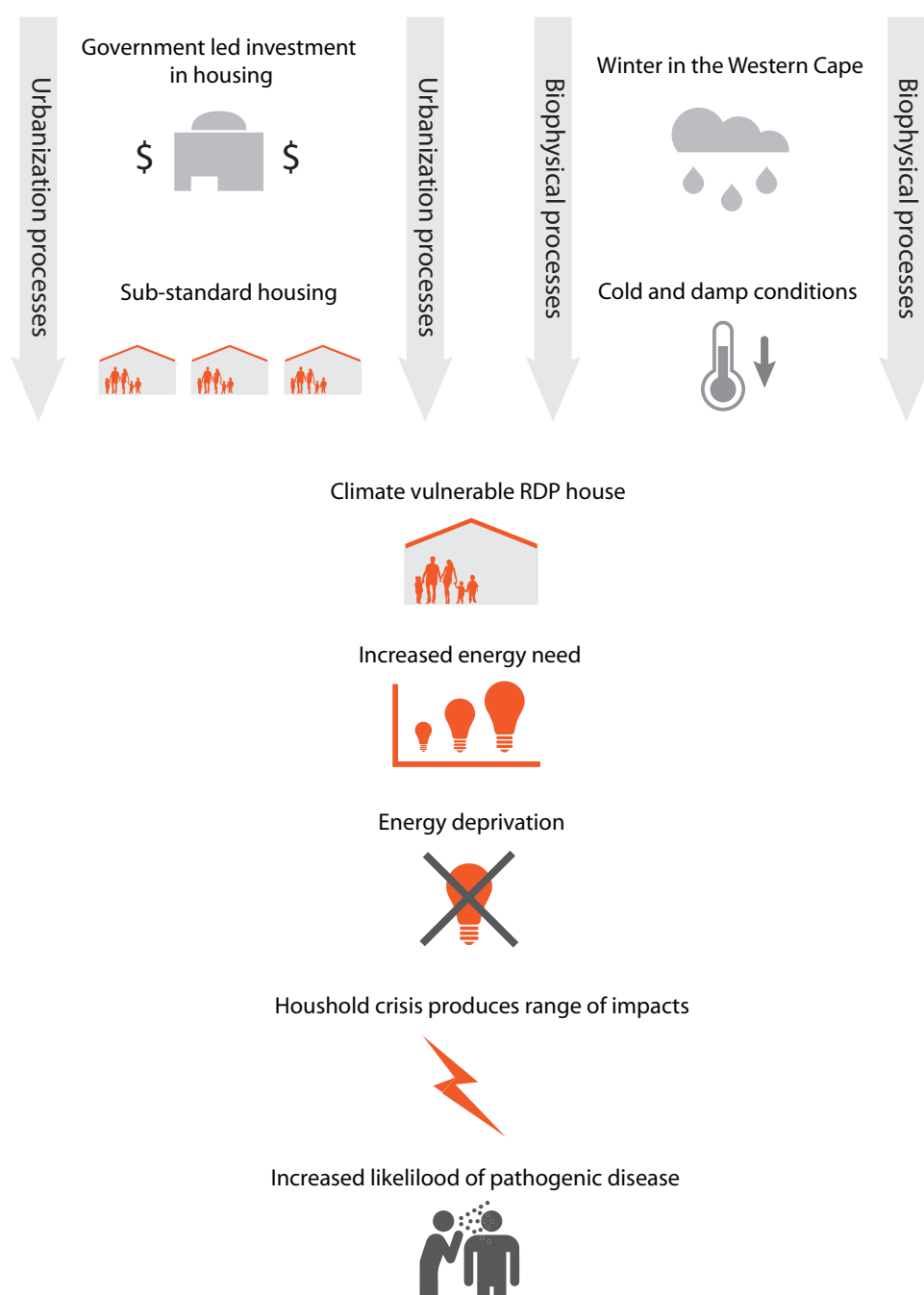
Residents are acutely aware that the costs of these emergent technologies remains prohibitive for low income communities under current economic conditions in which access is mediated by market logics. As one resident (Workshop #3) reflects, “It would be difficult to get money to afford and loans have high interest”. In this context technologies, eco-innovations and emerging network spaces that are operating as secondary energy infrastructure for the middle class/elites and beyond the main electricity network, are emerging in Ghana under market orientated conditions. This forestalls access to these premium networked spaces for the urban poor, “Solar became only for the rich but should be for the poor” (ECG neighbourhood worker #1). Instead of being able to access these premium network spaces the community relies on multiple and incremental strategies of crisis management. Such strategies lay at the periphery of circulations of capital investment and accumulation across the city’s electricity network but need to be considered as dialectical response to these metabolic dynamics (Section 2.6.4). These intersections with the networked system show the disjuncture between the network reconfiguration being undertaken in Accra, through market led approaches and requiring substantial financing and the everyday ways in which the urban poor seek to get by in contemporary Accra (Chapter 6). What these connected metabolisms suggest in relation to the electricity network of the city is the reflecting and reinforcing of a splintered urbanism with various intersections of climate and capital enrolled in metabolic processes and sustaining crisis for the urban poor.

5.2 Producing crisis across Cape Town’s energy network

Having examined the metabolisms of capital, climate and crisis across the energy networks in Accra, this section turns to examine these processes in the context of Cape Town (Figure 5.10). While related connections between capital, climate and crisis are identified these differ in important ways, particularly in terms of how the links between disease and energy poverty have been established and problematised. The section begins by examining the effects of winter on low income households in the city. This involves

exploring the difficulties experienced by low income households in keeping homes warm via sustaining flows of electricity into the house, producing a series of crisis including the amplification of pathogenic metabolisms. The chapter goes on to explore emergent responses to this ongoing crisis across the wider city, suggesting that new technologies are contributing to a historically produced (Chapter 4) splintered urbanism (Graham and Marvin, 2001). Whilst new circulations of climate and carbon capital are beginning to reconfigure low income networks at a household scale, showing the response of the development state to this crisis these remain fragile and experimental in nature and failing to significantly transform the energyscape of Cape Town.

Figure 5.10 Diagram showing the metabolism of crisis across Cape Town's energy network



5.2.1 The onset of winter

“Its freezing in the winter, by the time you go to sleep everything is wet and most of the sickness was TB, pneumonia, even two guys from the project died of TB” (NGO worker, Cape Town #1).

A range of health, livelihood and other consequences are experienced by the urban poor during the cold and damp winters in the Western Cape. These dynamics link socio-economic status, low quality housing, the energy network and the ongoing condition of crisis in such communities. This is a crisis that continues despite the over 200,000 network connections created in Cape Town (Jaglin, 2009). During winters in Cape Town, areas such as Mamre, Kuyasa and Mandela Park experience a series of effects emanating from a metabolism incorporating housing (under) investment, meteorological and climate dynamics, energy poverty, infectious pathogens and more. Together these dynamics produce an energy crisis in low income communities. These are urban spaces in which infrastructure inequalities are strikingly vivid compared to the middle class/elite spaces of the city. They illustrate the ongoing inequalities in Cape Town despite significant capital investment in infrastructures. This energy crisis is experienced regularly by households living in the RDP⁴⁸ or bond houses that characterise the case study neighbourhoods and together with the associated informal dwellings (such as backyard structures) suggest that connection to networked services does not necessarily provide a means to negotiate the cold, damp and wet winters. This energy crisis during the city’s winter is explained by a resident of an RDP house:

“In the winter it is cold, we can feel it coming inside, I worry my boy has TB or something wrong with his lungs. We use blankets to keep warm as the electricity costs a lot of money and we cannot afford it. I worry about the asbestos in the roof. I bought R20 of power for two days, thats R300 per month and then all the food, the schooling, clothes, so many costs. I would like to use electricity for more heating but can’t always do it. If I switch on the heater it costs R50 for two days” (Mamre community member #9).

The effects on low income communities living in RDP housing of being unable to heat such housing goes beyond health problems, with residents facing connected issues such as loss of income, livelihood impacts, the risk of fire hazards⁴⁹ and so forth. Furthermore, with many of the city’s RDP house dwellers living in substandard housing the exposure to the winters in the Cape illustrates the wider energy crisis facing the city. This is a crisis not just for the hundreds of thousands of urban poor requiring housing and service delivery as often characterised and part of the narrative of post-apartheid South Africa. This is also a crisis for the urban poor who are connected to such networked services, that have possession of an RDP house but remain living in conditions of poverty and sub-standard housing that together with meteorological dynamics combine to reinforce inequality. It is a crisis in which the need to upgrade and retrofit already existing government financed housing contributes to a ever expanding sense of urban crisis in the city. This crisis, visible in the case study neighbourhoods of Mamre, Kuyasa, and Mandela Park is produced through a series of metabolic

⁴⁸ Whilst the RDP as a programme finished in the 1990s the generic countrywide model/typology of house generated during the process have come to dominate the government financed housebuilding process.

⁴⁹ Often households are forced to use fires as a source of cheap heat in houses, this brings a range of fire hazards and smoke related health issues.

processes that mediate the relationship between such communities and networked services and is increasingly recognised across the municipality, resulting in new investment into these urban spaces.

5.2.2 Energy crisis in urban poor housing

Kuyasa, Mamre and Mandela Park are all low income, networked neighbourhoods characterized by significant RDP (and some bond housing) construction, but also with informal housing amongst such development (Sections 4.2.2 to 4.2.4). These areas show the significant capital investment by the national, provincial and local governments since 1994 under the various programs of urban improvement and the ways in which the state has sought to uplift the poor through housing (ownership) and service delivery (Swilling, 2006) in a metabolic process that has transformed the urban poor landscapes of the city. Yet much of this housing has been blighted by the bad quality of construction in the city and visible across the country as the pressures to deliver as many houses as possible drives down the amount spent on each unit. It has meant that seemingly fortunate urban poor households (that have gained receipt of a RDP house or bought a bond house) have been living in sub-standard structures with a range of defects, that create disruptions in flows of energy, low thermal efficiencies and cold and damp household space. For instance, the low thermal efficiency of the housing requires spending more of a households resources on electricity to keep the space warm or resort to dangerous alternatives such as fires. These metabolic processes thus produce low quality housing predicated on underinvestment by the state and reflected in the private sector, generating considerable anger in communities promised or investing in housing:

“The houses were built, two different types by different contractors/developers that did the construction and you will find that some of them were not with ceilings and such but the others were different. That is why the struggle started, many of the houses were not of good quality, structural defect, cracks in walls, so people started to boycott the bond as they were not good standard...direct result of the quality that we begin struggle” (Mandela Park Backyarder #5).

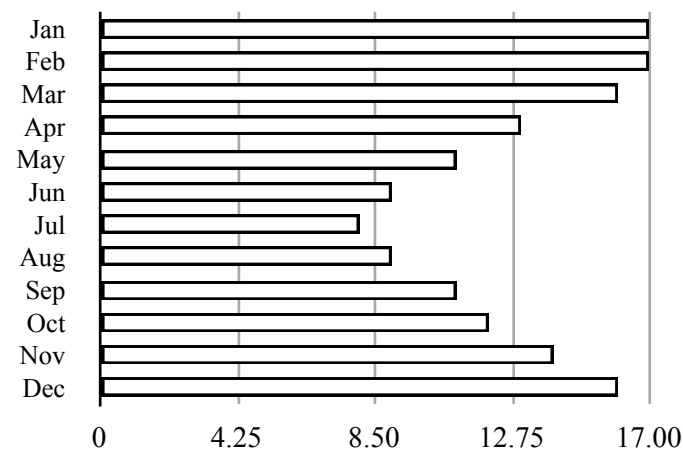
Around 30 percent of new RDP houses built in South Africa are failing to comply with building regulations, (Lodge, 2003) which themselves offer a questionable level of quality. As the RDP housing is transferred to the household as part of an arguably neoliberal strategy to uplift the urban poor through home ownership (Lemanski, 2011) there has been little state support available to retrofit them due the Municipal Financing Act⁵⁰ to a standard in which households can live a dignified and healthy life and afford to sustain flows of energy into the household. This quality deficit in RDP housing in South Africa is estimated at around R58 billion (around £450 million) (Human Settlements South Africa, 2011) to bring such housing to a decent standard. This is a requirement that cannot realistically expect to be fulfilled by municipalities whilst struggling to house those urban dwellers still living in informal settlements. The political ecological legacy of substandard building quality, vulnerable to the urban natures of the winter climate are significant, with an estimated 30,000 to 40,000 RDP homes built without insulated ceilings. This legacy leaves households vulnerable to the cold and damp conditions of winters in the Western Cape as low thermal efficiency means

⁵⁰ The private ownership of Cape Town's RDP housing stock makes it difficult to fund any retrofitting work from municipal funds, owing to the Municipal Funding Act, and the municipality is seeking alternative financial mechanisms to deliver improvements to existing housing

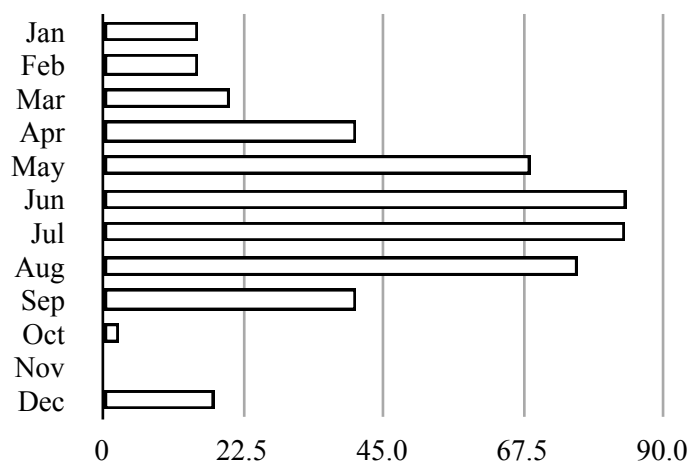
heating the house becomes too expensive for many of these residents. As the previous chapter (Section 4.2.2) shows under investment in new high quality housing for the urban poor translates into wider energy network inequality, with thermal efficiencies up to six times greater in good quality housing with insulated ceilings, compared to the many constructed houses without such protection, placing additional and unequal economic burdens on the urban poor in such housing rather than the state. The South African national government recognises the challenges these conditions are having on the RDP houses that were not designed for the climate of the Western Cape. Thus, from 2004 an additional subsidy for ceilings in new RDP homes is provided. Yet this is not retrospective meaning further retrofitting investment is required for the housing built before 2004 or other types of housing such as bond housing, visible across the case study neighbourhoods.

Figure 5.12: Monthly average temperature and precipitation in Cape Town

(Source: The Weather Channel, 2013)



□ Ave Temp (°C) Low



□ Precipitation (MM)

Meteorological dynamics create conditions which leave urban poor households without adequate thermal protection or efficiency vulnerable to conditions of damp and cold, wind and rain if disruption to the flows of energy occur through lack of household finance. Figure 5.12 illustrates the high level of precipitation and cool temperatures during winter months, that become particularly pronounced for urban dwellers in informal or sub-standard housing with the households requiring increasing flows of energy to keep the house warm. Energy poverty is experienced by households across low income communities in Cape Town struggling to sustain connections to networked services, as a Mamre community member (#16) explained:

“I get my money once a month and it must last but sometimes don’t have and therefore no electricity so must borrow money. Can’t get through with this money. There are things we must have every time. Other members of the community will feel the same.... Energy is biggest problem in Mamre”.

Whilst a lifeline tariff of 50 kWh is introduced from 2001 onwards (Ruiters, 2009), estimated to be sufficient for basic needs for households, shows a response by the South African state to recognize energy deprivation (Annecke, 2005) and support flows of electricity to the urban poor this remains problematic across communities in Cape Town. For instance Eberhard (2010 in in Adam, 2010:15) suggests:

“The 50 kWh amount is probably not suitable for urban areas with big households and multiple energy demands, not least because the FBE amount does not take into account the typically large sizes of low-income urban households”.

Estimates from the NGO Earthlife (Adam, 2010) suggest that around four times more electricity should be provided for urban poor households⁵¹ than currently supplied under the lifeline tariff to meet the energy needs of these households and begins to illustrate a stark difference between basic service delivery discourses, that dominate infrastructure investment directions in the city, and the actual costs and investments required for low income communities to move beyond these conditions of poverty whilst, “a developmental approach to the level of supply might take a different view of the minimalist understanding of needs” (Ruiters, 2009:251).

Furthermore, with annual increases in



Figure 5.13 PPM technology in Mamre

⁵¹ The 50 kWh is estimated at being sufficient to “run two 60-watt light bulbs for four hours a day” (McDonald, 2009: 27)

electricity tariffs by the CCT and ESKOM (who both profit from distributing this electricity), making energy an increasingly large proportion of households budgets the focus during the post apartheid era, of creating network connections has provided only a partial infrastructure success story. Despite significant flows of investment low income households remain vulnerable to winter conditions, suffering a climate-driven crisis. Whilst tariff rate increases are larger for the high consuming households across the city⁵² the above inflation rise for the lowest tariff rate shows the increasing difficulty of urban poor houses to afford adequate flows of electricity and the inequality in terms of household budgets spent on procuring energy. With these problems not existing in in and across middle class/elite households:

“The electricity rate is increasing too quickly in this country. The rich will always be in a position to afford buying electricity at the new tariff rates. We as a community really struggle with looking after our own immediate family” (Mamre community member #4).

These inequalities across the energy network suggest a splintered networked urbanism in Cape Town increasingly predicated on the ability to pay and mediated through PPM technology (Figure 5.12) rather than the issues of connection, with the tariff structure an example of these structural inequalities. As McDonald (2009:26) argues the result is that it, “is a pricing scheme that subsidizes industry and middle-class suburbanites, while charging low-income households higher absolute and relative prices for a service they more desperately need”. As a NGO worker in Cape Town (#3) points out:

“The person with the PPM pays the highest rates per month per Kwh its a simple equation its not secret knowledge and besides that which is already a bit of injustice people on PPM are subsidizing because they are paying upfront for as service they have not had whereas the wealthy get a bill after 30 days and another 30 days to pay it so effectively 60 days free credit if you think about it so if thats not subsidy I don't know what is”.

For low income households that are connected to networked systems this energy poverty means that they often lack the financial resources to ensure that there is enough energy to meet their basic needs, “In my house, we cannot live without energy. The paying rates for the electricity are too high. Every time it increases. We can barely afford our lifestyle. Life is not easy here in Mamre” (Mamre community member #2). The thesis shows that the struggle of the urban poor to sustain flows of energy into the household is a significant burden for many and one that is not always able to be achieved. This energy crisis for the urban poor is also framed by growing disruption caused by a lack of generation capacity in the carbon heavy⁵³ South African power industry. Dominated by EKSOM operating over 40,50 MW of electricity generation in 2008 the sector witnessed a sustained period of rolling black outs and disruption, largely predicated on (subsidized) industrial needs. As Bond and Ngwane (2010) make clear, “the increased electricity consumption of metals smelters is due to the 2002-08 speculative uptick in commodity prices”. Whilst billions of Rand have subsequently invested the future may be characterised by increased likelihoods of

⁵² E.g. for those purchasing 350kWh to 600kWh the tariff rises by 9.9% compared to the rise of 5.4% for those purchasing 0kWh to 150kWh . Yet the tariff rise for the lowest spending consumer is still above the inflation rate of 4.9% itself a problem for many households sensitive to any price rises in basic produce and services.

⁵³ Coal-fired power stations produce 92,6 percent of the power generated in South Africa (Serebro, 2010)

crisis across the network and intersecting with existing energy deprivation (Annecke, 2005) to amplify the crisis in low income neighbourhoods.

5.2.3 Pathogenic metabolism

Households residing in poor quality housing with low thermal efficiency and without the ability to finance sustained flows of energy into the home suffer a range of health burdens and vulnerabilities that create inter-related effects on the household and wider community. These vulnerabilities are the consequence of under investment in Cape Town's low income housing:

“Think about it this way, you are building an RDP house, so if you are building for someone who is poor and does not have anything, you do not plaster the walls, so it is brick, you do not put a ceiling in the house, then the person moves in and you know they are poor, they are not working most of them, you have a picture in your mind it has no ceiling, plastering so its grey, the person is not working, cannot afford carpet, mat so the house is grey. You just see a small table and stove and its hollow, there is no seats or sofas to keep the house warm. its empty. You have a 5 year old boy staying there, you have this boy he is obviously going to get asthma or a disease of his lungs. Its never warm, never hot unless it is outside. You have a lot of asthma patients here as they are staying in these horrific places in which moisture goes to the roof, clings and then later forms droplets and goes back down and nothing absorbing the heat, everything is happening in the house, who wouldn't get sick. People are living under these horrific circumstances” (Mandela Park Backyarder #5).

Premature mortality due to chronic disease or illness particularly TB, asthma and Human Immunodeficiency Virus (HIV) constitute a visible and tragic crisis for urban poor households in Cape Town and become particularly acute during winter (Groenewald et al, 2008). These geographies of disease suggest that urban inequalities are both reinforced and reflected across the energy network of the city and the current infrastructure investment dynamics, that produce low quality housing and unaffordable networked services. One example of these pathogenic circulations that are amplified through poverty and produced through the energy crisis, reinforcing urban inequality is tuberculosis (TB)⁵⁴. In Cape Town it is estimated that around 25,000 people at any one time suffer from TB with around 70 percent of these urban dwellers also living with HIV and Aids, complicating matters further⁵⁵. TB is the third biggest cause of premature death in the city, after homicide and HIV/Aids⁵⁶. Costs associated with TB include the direct treatment costs that rise from R400 to over R24,000 for drug resistant TB, secondary treatment costs (transport and so forth) and significantly the long term loss of economic activities and associated loss of livelihoods for households. There is a clear link between the current housing conditions, networked services and flows of energy relating to the urban poor and the pathogenic metabolism of TB across urban space:

“TB spreads easily in damp and crowded conditions, which are common among township households. Water incursion from internal (e.g. leaking pipes) or external (e.g. rainwater) sources

⁵⁴ TB an infectious airborne disease cause by Mycobacterium-tuberculosis, a bacteria that attacks primarily the lungs, causing severe illness, pneumonia and millions of deaths each year globally

⁵⁵ City of Cape Town (2013d)

⁵⁶ South African Medical Resource Council (2003)

causes dampness, which becomes problematic when a leaking roof causes structural materials (e.g. walls, ceiling) to become wet for extended periods of time” (Cramm, et al, 2011: 142).

In Cape Town, as across sub-Saharan Africa and historically in countries such as the UK, TB has long been considered an illness of the poor, with investment in treatment but also crucially, wider living conditions being able to contain such illness, “the problem of tuberculosis control is of course dominated by economic considerations” (Dubos, 1952 in Gandy and Zumla, 2003:7). In Cape Town this illness of the poor is thus also racialized through this poverty with TB rates 50 times higher for the Black population than across the white population (Stephens, 1996). For instance, Khayelitsha has the highest TB incidence in the city with 1,655 new cases for every 100,000 people per year in 2005 (Médecins Sans Frontières, 2005). This shows how poor quality formal and informal housing, poverty, climate and pathogens interact in a metabolism that reinforces socio-economic inequality in Cape Town. By tracing these intersections it has been possible to make visible the relationship between levels of infrastructure investment in Cape Town, that produce substandard housing and the ongoing health, and particularly TB crisis that can ultimately be described as a crisis of the urban poor. The energy crisis in Cape Town, predicated on poor quality housing and infrastructure investment for the (housed and networked) urban poor, in the context of significant capital investment in the post-apartheid era is ultimately a metabolic crisis of unequal social relations. It shows that the developmental state is failing to provide the necessary support for the city’s urban poor, even whilst at some level transforming the lives of many thousands. This perhaps challenges the widely held belief that such investment has benefited particular sections of the urban poor.

5.2.4 Emergent responses, technologies and discourses

A range of emergent technologies, energy network reconfigurations, architectural innovations and green building practices are visible across Cape Town, mediated via market and state logics and concentrated in middle class/elite housing and communities and starkly reflecting the country’s status as the most unequal⁵⁷ on the planet. These developments include the growth of solar photovoltaic and geyser systems across the city’s landscape, which are becoming increasingly ubiquitous as a roof situated technology. Spectacularly designed extravagant individual homes, conceived as sustainable and displaying features such as solar heated swimming pools and so forth are evident, both at an individual level and across masterplanned new estates for the growing middle class and the increasingly wealthy, segregated and aloft elite that suggest a reformulation of archipelagos of wealth (Kooy and Bakker, 2008) around sustainable technologies, green concerns and of course ever increasing securitisation of urban space (Dawson, 2006, Davis, 2006, Jurgen and Landman, 2006). These space are unlikely to have any effect on the surrounding urban spaces of poverty and network crisis although might, like in Accra provide the basis to remove pressure from electricity service provision elsewhere. Furthermore, alongside these emerging flows of new technology and forms of sustainable urbanism the low cost of electricity in South Africa, for middle class/elite homes and predicated on the cheap availability of coal, alongside the relative security of flows of energy to such urban spaces means that energy is often of little concern to such households and the vulnerability of urban poor

⁵⁷ South African Regional Poverty Network (2003)

households associated with winter is not a risk or consideration. As with Accra, these market mediated developments show that emergent technologies may produce premium network spaces (Courtard, 2002), contribute to ongoing fragmentation of infrastructure and suggest that a segregated, neoliberal and splintered urbanism is beginning sustained, despite the significant capital investment, promises and rhetoric of the state. This is an urbanism in which the municipality will continue to connect urban poor communities yet increasingly struggle to sustain such connections for the urban poor, whilst the middle class/elites opt out of such systems or continue to use large amounts of energy without consideration of the costs, reflecting an inequality of network connection, disruption and crisis.

Within the municipality, rhetoric focusing on low carbon technologies, developments and innovations are becoming increasingly important to the emerging climate change and energy agendas and the resulting flows of finance. Engaging with issues of sustainability, climate change, low carbon energy and new technologies, through a number of policies, such as the Climate Change and Energy Strategy (2006). These emerging agendas are bringing together new coalitions of urban intermediaries, including the state, non state actors, such as NGOs and the private sector, interested in multiple logics from economic development through to a greener Cape Town and coalescing around the notion of the sustainable (African) city. An emerging series of logics, articulated through various interventions into urban infrastructure and brought together through a brand is seeking to place the city on the radar of best practice and innovation through a vision of a, “a sustainable, world-class African city” and “a leading city in South Africa, as well as in the continent in this regard” (CCT, 2006: 6). Market orientated responses, such as SWH and solar generation technologies for middle class housing are becoming increasingly significant, able to link into economic opportunity and the wealth of many households in the city and creating an emerging energyscape that is comparable to the dynamics taking place in Accra.

Like Accra, residents respond to these metabolisms in multiple ways through everyday practices. From tampering with the PPM to ensure continued flows of electricity through to incremental changes to the structure of the house to improve thermal efficiency these responses are reshaping the circulation of these flows and generating the need to explore this dialectical urbanism in more detail (Chapter 6). Unlike Accra, some investment responses to energy crisis in low income, networked communities are taking place in Cape Town in Mamre and Kuyasa (Section 4.2.2 and 4.2.4) mobilizing investment to address the metabolism of capital, climate and crisis. These responses show the difference between each city in linking and generating capital investment in infrastructure and the resources available to the respective municipalities. These reconfigurations of the energy network, mainly concentrated in RDP housing, illustrate the developmental orientated nature of the CCT by showing how the municipality remains focused on housing and energy infrastructure investment, together with the flows and potential flows of capital it has available to invest in urban infrastructure beyond the systems being delivered. These reconfigurations offer the potential for technologies to improve the quality of housing and thus the energy condition of the household, through interventions that seek to improve the thermal efficiency and lower the financial burden of energy for the urban poor, allowing for continued flows of energy and less disruption. These emergent reconfigurations, in Mamre and Kuyasa, are predicated on new flows of climate change financing. They provide the CCT with

the opportunity to begin to improve low quality housing, and the energy burden of such construction, that also serves to meet other urban policy logics, such as the low carbon agenda, poverty alleviation and sustainable livelihoods and suggests:

“there is also a growing concern, both in policy documents and in the academic literature, that service delivery will not be able to address the needs of the poor if it relies on traditional technologies and systems that are seen to be inefficient and ecological unsustainable” (Jaglin, 2009: 19).

The case of Mamre illustrates substantial, although incremental improvements in households across a range of indicators including energy poverty, climate resilience, physical and mental health as well as household livelihoods (Section 4.2.2). These, currently limited in scale, reconfigurations, in Mamre and Kuyasa, provide early glimpses of the potential to improve the quality of housing delivery and respond to the energy crisis through emerging low carbon logics. Such logics offer connections to international circulations of climate change and carbon financing and suggest the potential for significant structural reconfiguration of networked systems in the future, yet remain fragile, small-scale and incremental at present. Thus these (re) configurations involving technologies such as SWH (Figure 5.14) and insulated ceilings, might provide the opportunity to address the wider issues of poverty, health and socio-environmental inequalities that persist, grow, fragment and mutate across Cape Town’s urban poor spaces and alter the metabolic processes that are currently producing crisis. Furthermore, these experiments in network reconfiguration perhaps show the beginning of a reformulation of housing and infrastructure policy in the city, to focus on quality alongside that of quantity (Bulkeley et al, in review). The neoliberal carbon financing, predicated on the commodification of the atmosphere (Bond and Erion, 2009) and materialising across the networked systems in Kuyasa, paradoxically provides opportunities to think about how to create additional financing for a developmental state, seemingly committed to service delivery and poverty alleviation, yet restrained within a neoliberal macro economic context.

Figure 5.13 Solar water heaters in Kuyasa



Although the reconfigurations in Mamre and Kuyasa are primarily constructed as pilots or experiments to improve and consider the energy efficiency of urban poor households, they have been mobilised through the logic of housing improvement as an extension of a developmental mode of governing in Cape Town. Firstly, and on the surface, the reconfigurations are aimed at both improving and monitoring these changes in the energy efficiency and climate resilience of poor households in the city, through retrofitting and as such are positioned as a solution to the metabolisms of capital, climate and crisis. Secondly, the infrastructure investment in Mamre and Kuyasa is positioned, by the local state, as a potential solution in terms of improving wider housing and infrastructure conditions in Cape Town. As a result, sustainable housing may be positioned as an emerging response to a range of different problematics and becomes the dominant logic and site of convergence in addressing the metabolic dynamics that become so visible during winters in places such as Mamre and Kuyasa.

5.3 Conclusion

This chapter has approached the metabolism of capital, climate and crisis to reveal the multi-scalar, socio-natural processes that mediate and shape networked systems in low income neighbourhoods and the responses to these dynamics from urban actors. The analytical task has been to identify such dynamics involved in the shaping of energy crisis to examine how inequality is produced, reflected and reinforced across and beyond the electricity systems of places such as Ga Mashie and Mamre. The chapter examines, in some ways, very different processes across both cities. In Accra crisis is framed as network disruption and failure linked to the generation and distribution of electricity, whereas in Cape Town the crisis is framed via the energy poverty of households and the inability to sustain flows of electricity mediated by PPM. The purpose of the chapter has not been to develop the urban comparative across the same particular crisis issues per se as both wider network disruption and energy deprivation (Annecke, 2005) are visible across both cities. Instead, the focus has been to develop a wider sense of how the metabolisms of capital and climate are implicated in producing crisis across networked energy systems and what this means in relation to network reconfiguration in the context of the growing momentum around the climate change and energy agendas at an urban level (Section 1.1.3). Whilst both cities are situated within different contexts across histories and current conditions (Chapter 4) there are some clear parallels that suggest the metabolisms of capital, climate and crisis reveal important considerations.

Firstly, the chapter shows that energy crisis in these urban spaces is produced through a multi-scalar ensemble of human and non human actors, mediated through the structuring logic of capital (Swyngedouw, 2004) and intersecting with historical patterns of splintered urbanism (Graham and Marvin, 2001). The chapter argues that these dynamics need to be analysed as metabolic processes that incorporate the urbanization of nature, whether through the interactions of water dynamics, GHG emissions and so forth in Ghana or pathogenic diseases, bad housing conditions and such like in South Africa and importantly infused with power relations. As Kaika (2005:75) comments, this focus on metabolism illustrates the socio-natural production of electricity networks:

“Exploring the uncanny materiality of “the other” in the form of the invisible metabolized nature or technology networks points at the social construction of the separation between the natural and the social, the private and the public. It reveals the individual, the social, and the natural, as a socio-natural continuum that disrupts the boundaries between the above socially constructed categories”.

This is important as it suggests that debates about urban climate change vulnerability, adaptation and mitigation need to move beyond the city scale to engage with the multi-scalar metabolisms that mediate these issues and importantly incorporate the structuring logic of capital in these flows and circulations. Secondly, the chapter argues, in considering the production of crisis across energy networks in both Accra and Cape Town that energy crisis is a crisis of the urban poor and links to wider urban inequalities and social relations produced and reshaped via these metabolic processes. The ability of urban dwellers to negotiate crisis, whether network failure and disruption in Accra or the health emergency in Cape Town is clearly

related to socio-economic position, revealing how urban inequality is reflected and reinforced in and across networked systems. In Accra, when disruption and failure occur middle class/elite houses are able to draw upon secondary support infrastructures and emerging new technologies to sustain the flows of energy. In Cape Town when cold winters arrive middle class/elite houses are able to sustain the flows of energy to heat the house, whereas network connected poor households may struggle, exposing them to illness and bad health. This is not crises which emerges only from outside the city, but is also produced through middle class/elites through higher energy demand and increasing consumption. Furthermore, this splintered urbanism is reinforced by capital flows into urban infrastructures which are orientated around market logics and neoliberal rationalities. Thirdly, these intersections between energy and climate (change) are multiple, creating and reinforcing vulnerability across low income neighbourhoods and showing that the electricity network plays a central role in reflecting and reinforcing socio-spatial relationships, via the flows and circulations, generated through metabolisms. Energy poverty, disruption of supply and other factors limiting the flow of electricity into poor households have a series of effects from amplifying health problems through to curtailing vital economic activities and supports the recognition (UN-Energy, 2005) that energy issues are vital to the achievement of the Millennium Development Goals and are seriously hampering efforts by urban dwellers, state agencies and urban intermediaries to develop successful poverty alleviation strategies. Fourthly, whilst the analysis presents a landscape of splintered urbanism, premium network spaces, archipelagos of new technology and emerging post networked cities the chapter suggests that these are often segregated not necessarily between the connected and unconnected, but between those with the ability to negotiate network crisis and those who are not. This is a key point, which suggests how the city, particularly in low income, networked neighbourhoods is splintered through urban metabolism and circulation of capital is not along the lines of the networks per se, but in terms of the (financial) capacity to engage with them through accessing the flows of energy or being able to mobilise secondary infrastructures in times of crisis. Fifth, early financing of reconfigurations of energy networks in Cape Town, via new international flows of climate change and carbon capital present the potential for reducing network crisis for low income communities by showing how metabolisms of capital, climate and crisis can be altered and intervened with. Yet these remain embryonic, incremental and small scale in their development and may present difficulties in being significantly upscaled, showing the importance of the role of urban governance (Chapter 7) in these dynamics. Sixth, the chapter suggests this analysis put forward also has some limitations in terms of approaching the network reconfiguration in African cities. Whilst it provides an excellent way to consider the relationship between capital, climate and crisis in the urban environment, enabling a tracing of how multi-scalar, socio-natural processes constitute the energy network and the reconfigurations taking place across Cape Town and Accra this ignores the dialectic of such processes within the low income, networked neighbourhoods of both cities (Sections 5.1.5 and 5.2.4). The everyday responses to these metabolisms are clearly important with urban dwellers seeking to reconfigure the socio-environmental conditions shaped by climate, capital and crisis and supports the focus of the conceptual framework (Section 2.7.1) in seeking to extend metabolic analysis to incorporate the circulations and flows across the everyday spaces of the network. It is this dialectical urbanism that the thesis turns to next.

Chapter 6: The dialectical urbanism of the everyday network

This chapter considers how an expanded notion of urban metabolism, that frames the dialectical responses across low income networked neighbourhoods to the flows of capital, climate and crisis outlined in the previous chapter as part of these circulations and flows. By extending urban metabolism into the everyday spaces of the network including the site of the home, the analysis can respond to the conceptual framework that argues for the need to incorporate these processes in order to examine the reconfiguration of networks in both cities. This focus on the everyday provides an important if understated part of UPE as Truelove, (2006:143) suggests these studies have tended to focus on analysis, “of class and distributional dimensions of inequality on a city-wide scale rather than illuminating how multiple social differences are (re)produced in and through everyday... practices”. This insight prompts the need to incorporate these everyday circulations within the conceptual framework of the thesis (Section 2.6.4). The chapter suggests a way forward to expand the structural and capital orientated focus of the previous chapter and respond to what Roy (2009: 823) suggests is the, “dizzying sense of the urban economy” in such spaces. Thus, the chapter provides a contribution to the growing work undertaken in destabilising privileged, traditional knowledges of the urban through seeking to provincialize (Chakrabarty, 2000) urban infrastructures and generate an African situated UPE, a task established and outlined in chapter two and visible in different ways in the work of a number of urban political ecologists engaged with African cities (Myers, 2011, Loftus, 2012, Lawhon, 2012a).

The chapter seeks to undertake such analysis to examine how urban dwellers in low income, networked neighbourhoods find ways to negotiate crisis and socio-environmental conditions in spite of not possessing the capacity to engage with large scale network reconfiguration, due to limited financial resources or political connections. As such the aim of the chapter is to respond to the actual existing conditions of urbanism across these cities, in which:

“the truncated process of economic modernization at work in African cities has never fully consolidated apparatuses of definition capable of enforcing specific and consistent territorial organizations of the city” (Simone, 2004b: 409).

Through this widened notion of metabolism, that incorporates the dialectical response to the structuring of urban energy networks through capital, climate and crisis, an analysis is developed that responds to the incremental, everyday and improvised intersections between and across urban dwellers and electricity networks.

The chapter begins by examining the incremental nature of energy infrastructures by engaging in an analysis of how the energy systems in networked, urban poor communities are reconfigured through clandestine connections suggesting such incremental acts are vital to reproduction of urban infrastructures in such splintered urban space and remain in flux, fragile and open to incessant reconfiguration. The second part of

the chapter seeks to consider how these incremental acts are constructed through material improvisation and processes of learning by urban dwellers in these spaces. It explores the improvised nature of housing to show how urban dwellers can reconfigure the network through the site of the home in response to the sometimes limited opportunities to engage with the wider electricity network. Furthermore, the chapter shows how such urbanism recasts African modernities away from the notion of not-quite-modern cities. These urban spaces that lay at the bottom of world city classifications and as ‘basket cases’ of the world economy to the ‘city yet to come’ (Simone, 2004a). Such considerations imply distinct and very different trajectories of urbanism that require imaginative ways to re-evaluate what constitutes the urban beyond the global North. Thirdly, the chapter mobilises the concept of ‘people as infrastructure’ (Simone, 2004b), suggesting the importance of people in understanding network reconfiguration through examining both the successful prevention of demolition in Ga Mashie and the everyday ways in which people are enrolled in and across networked systems. Fourthly, the chapter reflects on how these emerging insights are important to analysing urban infrastructure through UPE, what they do in relation to the research questions and how an expanded notion of urban metabolism can approach African cities as forms in circulation (Nuttall and Mbembe, 2005).

Comparing daily life in African cities and across networked systems

Throughout the chapter the comparative is explored beyond the territorial notion of comparison seeking to piece together across the urban poor communities of the study and in both cities fragments of network reconfiguration that can be generated around notions of the incremental, of improvisation and as ‘people as infrastructure’. Thus, there exists no city to city comparative work between and across Accra and Cape Town within this chapter and unlike the previous chapter which sought to trace the metabolisms of capital, climate and crisis in both cities and then comparatively reflect on these dynamics. Instead a series of generative associations are proposed that emerge from the networked urban poor spaces of Accra and Cape Town. These insights reveal circulations or an expanded urban metabolism between and across urban dwellers, networked systems and cities that operates through a dialectical relationship with capital, climate and crisis. The chapter seeks to build upon the divergent and experiential methods of comparison offered throughout the thesis that seeks to explore and respond to Robinson’s (2011:13) call to, “recast our assumptions about the appropriate units of comparative research”. The forms of network reconfiguration explored in this chapter offer a narrative that crosses the networked, urban poor communities of Accra and Cape Town as they seek to improvise, make incremental changes and become enrolled as infrastructure. Neighbourhoods such as Ga Mashie in Accra and Mamre in Cape Town offer a common experience for urban dwellers, predicated on people finding new ways to survive and incrementally improve their circumstances and in a way that offers a fruitful comparative pathway.

6.1 Exploring incremental urbanism through clandestine connections

This section focuses on the notion of incremental infrastructures to suggest a conceptual tool to show how urban metabolism is drawn into a dialectical relationship with the everyday. Mobilising the work of Simone (2004b, 2011, forthcoming) the incremental is then applied to the multiple strategies in which urban dwellers

clandestinely connect to energy networks across Accra and Cape Town in order to show how the metabolism of electricity is reconfigured across low income neighbourhoods through such acts.

6.1.1 Reconfiguring the energy network through incremental acts

Research undertaken across networked, low income communities in Accra and Cape Town reveals a series of incremental strategies relating to the energy network and linked issues of poverty and socio-environmental inequality that are prevalent in both cities. This notion of the incremental, of incremental strategies to improve household or neighbourhood conditions is described by Simone (forthcoming) as, “temporalities of remaking life through continuing adjustments, of adding on the calibration of expectations concerning what can work, what is viable, and when” and shows how cyborg urbanization is shaped both by structural dynamics and the everyday interactions of urban dwellers (Nye, 1992).

Across the electricity networks in the case study neighbourhoods and in contrast to the larger scale investment by either market or state mechanisms, through incremental reconfiguration residents are engaged in a continual relationship with the network. Such a relationship can be defined as a constant dialectic of adjustment and readjustment that is often unsanctioned and sometimes on the boundary of legality, in order to make possible flows of energy into households that exist beyond or in response to the state and private sector interventions. They lay on the periphery of the official, mapped and regulated circuits of energy and infrastructure plans of city planners. It is in these spaces and through these activities that the urban poor illustrate the possibilities and multiple potentialities they possess in creating new configurations of networked systems either within the home or the wider network, but also the often desperate stakes in which this dialectical urbanism unfolds. Through these incremental acts, residents in low income, networked neighbourhoods work hard to sustain not only survival in the city but also hope, aspiration and opportunity. As Simone (2004b:428) argues:

“With limited institutional anchorage and financial capital, the majority of African urban residents have to make what they can out of their bare lives. Although they bring little to the table of prospective collaboration and participate in few of the mediating structures that deter or determine how individuals interact with others, this seemingly minimalist offering—bare life—is somehow redeemed. It is allowed innumerable possibilities of combination and interchange that preclude any definitive judgment of efficacy or impossibility”.

In spite of the limitations of network inequalities produced through the metabolisms of capital, climate and crisis these everyday, incremental strategies for accessing, connecting and sustaining flows of energy show the ways in which provisional networks often temporary in nature, are informally produced through incremental reconfiguration and suggest a powerful incentive to explore further the ways in which networked systems are being mediated and shaped through a dialectic between structure and the everyday.

6.1.2 Clandestine connections in Accra and Cape Town

The examination of clandestine connections to energy networks begins in Ga Mashie where the reconfiguration of the electricity system is noticeably incremental and provisional. In Ga Mashie the workshop participants articulate the difficulty of sustaining flows of electricity into households, illustrated by the 80 percent of respondents to the household survey who sometimes or often cannot afford electricity credit and termed energy deprivation (Annecke, 2005). The lack of large scale investment into the energy network to respond to these issues by the state and/or market means that households have to use a range of strategies of incremental reconfiguration of the infrastructure in order to access flows of electricity. Thus, many households in Ga Mashie are involved in a series of incremental strategies to create new network spaces and flows beyond the geographies of the official system and the restrictive rates of the ECG. These incremental changes to the electricity network shape and mediate the circulations of energy into the neighbourhood in an endless shifting maze of reconfiguration and as a response to the relative cost of electricity and the requirements of urban poor households. The research identifies a range of incremental reconfigurations of the energy network in Ga Mashie including a series of clandestine connections, which are common across many urban poor areas throughout the city and beyond. As a local politician (#2) explains, “Electricity in James Town is a problem. They say it costs too much and they are not able to afford it, so most of us use the illegal connection”. There is no data on the neighbourhood to ascertain the proportion of households engaged in such incremental strategies of network reconfiguration⁵⁸. However, it was suggested by both residents and stakeholders such as at the local ECG payment office that many people are involved in clandestine connections to the electricity network. Such incremental strategies of reconfiguration are normally undertaken with the support of electricians who are sympathetic to the need of households to access the flows of electricity that remain unaffordable to many. A connection can cost up to 50 Cedi’s⁵⁹ and the payment to an electrician can seem like a large upfront investment for most families and is usually negotiated in advance with payments perhaps over a number of months. Another incremental reconfiguration of the energy network in Ga Mashie involves households or businesses, working again with electricians, to configure a ‘split’ electrical supply system. This involves residents registering and paying for a proportion of their electricity through the ECG network and then also using a clandestine connection to access further flows of energy. Thus, the appearance of paying for electricity is constructed through this incremental strategy and keeps investigation by the ECG limited. This incremental reconfiguration is popular amongst the residents of the neighbourhood, especially to aid economic activity with flows of electricity considered too expensive to sustain small locally based enterprises and the tight margins in which they operate. These actions provide a strategy to counter the increasing unaffordability of electricity generated to create revenues for the Volta River Authority as generators and the ECG as distributors.

Alongside such connections to the network that reconfigure the neighbourhoods electricity network on a daily basis other clandestine incremental strategies and tactics serve to support households in accessing flows

⁵⁸ It was also decided during the research process, after speaking to workshop participants, that it would be important to be careful around investigating clandestine connections, particularly if this involved any quantitative data.

⁵⁹ About £15

of electricity. The introduction of the PPM acts as a mediating technology or barrier to flows of energy for those households unable to afford the electricity credits from the ECG office (Chapter 4). Like the earlier meter system, PPMs have become a focus of incremental strategies by residents that seek to resist the effects of new technologies that aim to increase revenue for the utility companies and reduce the burden of such measures, providing a vivid illustration of how dialectical urbanism operates across these urban spaces. These incremental strategies involve two main activities. Firstly, households without PPM are working together by using the same meter as neighbours and seeking to confuse the ECG in relation to who has responsibility for the bill. Yet this strategy is being recognised by the ECG who are trying to stop joint usage of meters mainly through the introduction of PPM which has made such activity less likely to produce incremental gains and forces the residents to find new pathways of reconfiguration. Thus, another incremental strategy for accessing underpaid or free electricity is to ask an electrician to come and adjust the meter to stop it going up or measuring energy usage, something that can be done with both the PPM and the older meter. Residents of Ga Mashie may be charged from two to ten Cedi's⁶⁰ for this network reconfiguration from an electrician which like the previously described incremental changes can create a dramatic transformation in the ability of households to sustain flows of electricity.

Yet these incremental, clandestine reconfigurations that are taking place daily across Ga Mashie's energy network are not always successful for long and thus incremental improvements in accessing energy can be reversed, provide the requirement for a bribe to a public official, or even result in criminal proceedings against the household, showing the instability that exists in the space of the everyday. The ECG employs technicians to go house to house to find these clandestine connections to the network in a dialectical dance of connection, disconnection, reconfiguration and such like that plays out across the electricity network in a way that produces an unmappable infrastructure of movement and flux, becoming and unbecoming. The ECG undertake such activities as it suggests that such reconfiguration threatens its revenues, sustainability and future infrastructure investment plan. If evidence of these clandestine connections is found then the ECG may cut the connection, in some cases informally demand money from the family in order to sustain such configurations or even prosecute those without the finances to pay the bill (or bribe). Thus, those unable to make such payments i.e. the poorest in the community are most vulnerable to processes of criminalisation through such clandestine connections, something which is likely to further compound the poverty of the household. These strategies of incremental reconfiguration have create an ongoing, low intensity conflict between community members and ECG, a dialectical urbanism that plays out through everyday interactions of these different urban actors. Yet many residents in Ga Mashie suggest they are forced to engage in such incremental reconfiguration due to energy poverty, their position on the periphery of the urban economy and the introduction of PPM that mediates the flows of energy to the household. There was general agreement in the workshops that residents would prefer not to resort to clandestine connections and the associated risks of such reconfiguration but until the government recognise that the area is poor and on the margins of the formal economy and invests in both further infrastructure and lower tariffs then these many small acts to change and reshape the energy network would continue. A similar narrative of dialectical urbanism is present

⁶⁰ About 65p to £3

in networked, urban poor communities in Cape Town, showing how the metabolisms of capital, climate and crisis are reconfigured from everyday spaces:

“I know that there are illegal connections within the community. We are poor and most households do not have any income besides social grants. That money is so little, but you have to make the most of it. I am scared that we are busy breaking the plugs that connects the electricity to most of the house” (Mamre community member #3).

Estimates by a research participant in one of the Cape Town communities in which investigation was undertaken suggest that around one in five households in the neighbourhood tampers with the PPM to access free or lower cost flows of electricity. This is justified by the desperate need for sustained flows of energy in winters in Cape Town. Thus, a dialectic exists between the metabolic production of crisis in the city and the response by urban dwellers to these socio-environmental conditions that show the cyborg city to be a space of ongoing flow and circulation, reconfiguration and adjustment. A range of other strategies of reconfiguration of the energy network by urban poor communities are generated, explored, tested and often upscaled by residents in Cape Town as older methods become obsolete, service providers develop new technologies or the need for energy increases dramatically (such as during the winter). The CCT is estimated to have lost R121 million⁶¹ (ESKOM, 2010) in revenues in 2010 due to electricity theft with national losses for ESKOM at R1.2 billion⁶² (ESKOM, 2010) and municipalities at R3.2 billion⁶³ (ESKOM, 2010) placing clandestine connections, electricity theft and everyday reconfiguration at the centre of energy and finance debates in South Africa and brought together in Operation Khanyisa, ESKOM’s energy losses management programme. Whilst electricity theft is not a crime under South African law, people can be prosecuted for damaging municipal property and a range of utility companies, municipalities and private sector actors are seeking to create legislative change that addresses what the industry considers one of the most important energy issues in the country. The seemingly everyday and micro processes of network reconfiguration can have a wider impact on urban infrastructure and redirect metabolic processes of capital accumulation when collectively considered, illustrated by the substantial focus on electricity theft by service providers in South Africa. These relations illustrate the relationship between and across the incremental and the structural, that they are co-constituted through the relationality of one to the other.

Whilst the context in Cape Town is different to that of Accra and the difference between such communities in many ways remains vast, it is evidently important to draw out the commonality of experience for urban dwellers in both cities. It is across the networked, urban poor spaces of Accra and Cape Town that it is possible not only to draw out a comparative series of incremental reconfigurations, but a seemingly similar set of ways in which urban dwellers in such neighbourhoods seek to interact and intervene with the energy network and the metabolisms of capital, climate and crisis. In both cities these incremental strategies of reconfiguration show a remarkable tenacity despite the operations of service delivery providers and other urban governance actors in seeking to ensure that flows of electricity are accounted and paid for. New

⁶¹ £9 million

⁶² £90 million

⁶³ About £240 million

technologies such as PPM may limit the incremental gains made by a particular reconfiguration, such is the nature of the incremental acts in such urban spaces. Yet simultaneously new strategies emerge to counter such foreclosure and provide a different direction of incremental travel. This is a dialectical urbanism, a ceaseless, circulating and metabolic transformation of the urban energy network that moves between and across the everyday and the structural.

Another way to compare and consider across the incremental infrastructures of both cities is to focus on the specific spaces in which these clandestine connections seem most concentrated. It is in the informal areas of networked, urban poor communities, backyard dwellings in Cape Town and shacks in Accra, that these processes of incrementalism seem at its most intense. This is where the electricity network becomes entangled through the dense urbanism of these spaces impeding the ability of the authorities to unravel such material complexity. In these spaces the needs of the households are at the most intense, the lack of finance to invest in sustaining flows of energy most acute and the requirement to resort to the incremental most common. This network geography of the clandestine suggests that the poorer and more informal an urban space the more ways in which residents must resort to incremental actions in order to support resource poor households. These urban spaces exist on the periphery of city life where the incremental becomes as central as flows and circulations of investment in thinking through urban infrastructure. That these peripheral zones of incrementalism exist in the neighbourhoods of networked, urban poor communities shows, when considering the huge number of more concentrated informal spaces in Accra and Cape Town the vastness of urban life beyond the urban policies and infrastructure investment that shape and mediate networked systems.

6.1.3 The incremental as crisis management

Its worth further considering the reasons for such strategies of incrementalism across the electricity networks of both cities. What is evident from the research in both Accra and Cape Town is that such incremental reconfiguration is undertaken by networked, urban poor communities in response to the metabolisms of capital, climate and crisis outlined in the previous chapter. Urban poor communities in both cities are confronted with the need to reconfigure electricity systems to help themselves and their wider support networks through the complexities and inequalities of contemporary Accra and Cape Town, to not only get by each day but to open up new urban possibilities for economic opportunity. These processes occur within a context of a historically splintered urbanism, segregation, increasingly marketised, privatized and post networked infrastructures. Without the ability to generate large scale financing for network reconfiguration due to limited access to capital, resources or political connections urban dwellers need to find ways to intersect interests and generate the necessities of economic life. These economic necessities are partly orientated⁶⁴ around the need to sustain flows of electricity into the household to support health, economic activity, education and so forth. The incremental can be considered as a form of crisis (network) management by the urban poor in the context of a splintered urbanism and the metabolic production of the energyscape.

⁶⁴ Sustaining other incremental infrastructures such as water or waste systems are often equally important in terms of considering the interactions of urban poor households with networked systems.

Here the everyday becomes a site in which the urban poor are required to reconfigure infrastructure as a way to reproduce urban life in neighbourhoods that exist on the periphery of formal economies, political participation and networked systems.

These incremental acts show how urban infrastructure is reconfigured as part of the everyday urbanism of such networks and interactions with urban dwellers. These dynamics challenge knowledges about how urban systems operate and are reconfigured beyond the rationalities and certainties of urban planning, flows of capital and such like. Furthermore, the residents of networked, urban poor communities do not accept the current configurations of the energy system in their neighbourhoods that leaves them without sustained flows of energy into the household. They actively seek to reconfigure these networks through incremental strategies to reshape such infrastructure to the needs of the households. This incrementalism becomes a way forward for residents in Accra and Cape Town to inhabit the city and to negotiate the metabolisms of networked systems in order to find, consider, test, debate and withdraw from particular interactions with infrastructure and to empower themselves in the face of inequality and adversity. It is in these urban spaces across and through networks that a significant proportion of residents in both cities live, work and experience urban infrastructure. Always seeking to steer, direct and to open up (incrementally) new possibilities and opportunities.

6.2 Everyday reconfiguration as material improvisation

The next section explores the everyday reconfiguration of urban infrastructure that builds on the notion of incrementalism to suggest that material improvisation forms one particular practice to undertake incremental strategies. Improvisation takes the existing materialities of urban space and re-orders them into new arrangements into a new cyborg configuration of humans and non humans, in which materials such as corrugated iron, wood, sand, concrete and plastics are physically altered, reassembled and put to different usages to benefit the protagonists. Using examples from improvised housing in Mandela Park and Ga Mashie the thesis shows that these improvised practices create new forms of urban learning and knowledge that are shared across such urban spaces and suggest alternative developmental pathways.

6.2.1 The material improvisation of housing in Mandela Park and Ga Mashie

The everyday reconfiguration of the energy networks of connected, urban poor communities in Accra and Cape Town show the ways in which incremental change characterises networked systems in both cities as much as the structural reconfiguration and metabolic flows of capital outlined in the previous chapter, in a dialectical process of co-constitution. The chapter argues that infrastructures are mediated not simply by the rationalities of urban planning and the regulatory frameworks of energy providers but are co-constituted by urban dwellers interacting, often on a daily basis with the networks, through metabolisms grounded within local spaces but dialectically linked to the wider circulations within and beyond the city. Thus, the incremental becomes an increasingly important lens to consider electricity networks across Accra and Cape Town, one that is partly produced through practices of improvisation by urban dwellers. This improvisation,

incorporating ingenuity, accumulated knowledges and social collaboration is driven by the poverty as Gandy (2005:46) makes clear:

“With the high prices of imported food, clothing and other essential goods, and average earnings of less than a dollar a day, the day-to-day survival strategies of many households depend upon barter and improvisation”.

Improvisation therefore provides a way to consider how such incremental strategies are undertaken across peripheral urban spaces in both cities and an important emerging component of the wider conceptual framework, suggesting an alternative way to consider how urban space is reconfigured. This improvisation creates the conditions, knowledges, skills, confidence and resources for incremental reconfigurations of the energy network through ongoing processes of urban learning (Section 6.2.3). The focus now moves from the processes of incremental reconfigurations of the energy network, through clandestine connections, towards considering the improvised nature of dwellings and how the attendant processes of learning generate improved network conditions for households in the context of wider network inequality and an accelerating splintered urbanism. By focusing on the house, the chapter extends the urban energy network to incorporate dwellings because these are often the only sites in which residents can actively reconfigure the flows of energy. As McFarlane (2011a: 216) argues in the context of Mumbai:

“Housing within informal settlements is typically—though not exclusively—constructed individually and incrementally, using locally available materials, and often clustered in ways that depend on closely shared roofs, walls and infrastructures. Building materials might be gathered from local construction debris, riverbeds, manufacturing waste or patches of tree cover; the city is both mined and recycled. Kitchens might be supplied with portable gas burners and cooking items might be hung up to save space, while a lack of windows often necessitates creating space for fans”.

In Ga Mashie, amongst the colonial buildings that characterise the area and articulate its position as the old Accra and the heart of the city multiple informal structures have been constructed, generating a vast range of differentiated, improvised housing and evolving networks of family compounds that have developed as the area's population has grown (Figure 6.1). The historical conception of this type of dwelling can be traced to the earthquake of 1939 that destroyed many of the older colonial buildings and produced the need to build rapidly after this disaster, creating a legacy of improvised, informal housing. Over the last 50 years these structures have been gradually strengthened, expanded, decorated, reinforced and reconfigured, whilst newer structures are constructed as urban migration and population growth intensify demand for residential space. Materials used for house construction in Ga Mashie include a range of urban natures; timber planks, mud, scavenged wood, corrugated iron, and for those with financial resources, sandcrete, concrete and breeze block (Figures 6.2 to 6.5). The vast range of materials utilised illustrate the improvisation of residents from Ga Mashie in constructing new dwellings. These housing configurations remain in a permanent state of flux, not just spatially, in terms of new structures such as cooking areas or new sleeping spaces. This is also a material transformation as corrugated iron walls transform into concrete walls, connections to regularised energy supply provide a level of formality and architectural form shifts, morphs and evolves. Over time previously informal type dwellings have developed into more formal, robust structures that solidify not simply the building but the household's status in the community and the perceived right to tenure of the land.

Yet, improvised building does not simply characterise the visible, informal dwellings of the area as may be imagined by the first time visitor to the neighbourhood. The older, colonial buildings are also undergoing a process of incremental change through improvisation. These are buildings in which spaces are redefined from their old purpose to be re-imagined to the reality of the present and the needs of the future. Previously single family dwellings have become multiple occupancy, hosting ever expanding families and creating the need for improvised reconfigurations and additional spaces (Figure 6.6). These dwellings thus exist at the intersection between the formal and the informal, the planned and the improvised, mutating and reshaping to the needs but also constraints of the dwellers. The neighbourhood of Ga Mashie across both its older, more permanent and often colonial era buildings and newer, informal structures can be considered as a neighbourhood of improvisation. This is important because it shows how the network, via the reconfiguration of domestic spaces is in continual flux. These improvised actions mean that new wires are brought in, PPM's are bypassed through creating a new room, a new wall helps to cool the household meaning less need for expensive electricity or an official connection allows the dwellers to charge electricity to the business downstairs. Here the network as cyborg urbanisation is stripped bare, bringing together diverse metabolisms of knowledges, human activities, electrons, protons and materials, from wood, through to concrete, to payment cards used to access the PPM. The constituents of these metabolisms are not casually associated but structured by the logic of capital and the production of socio-environmental conditions across the neighbourhood.

Figure 6.1 Photograph illustrating the mix of formal and informal housing in Ga Mashie and the significant presence of improvisation



Figure 6.2 Photograph illustrating improvised housing on the beach at Ga Mashie.



Figure 6.3 Photography illustrating loose stone constructed dwelling in background and plastic coated dwelling in foreground



Figure 6.4 Photograph illustrating timber constructed improvised housing in Ga Mashie, alongside more formal infrastructure, in regards to a drainage system



Figure 6.5 Photograph illustrating range of materials used as part of improvisation in constructing dwellings in Ga Mashie including concrete, stone and timber



Figure 6.6 Photograph illustrating improvised reconfiguration of older, colonial building in Ga Mashie.



In Mandela Park incremental infrastructures are produced as a way to generate new ways to imagine the future for the neighbourhood. For many residents the reality of post-apartheid life has been living in backyard dwellings whilst waiting for inclusion in state-led infrastructure investment. These dwellings, themselves manifestations of improvisation, are often unconnected to the electricity or water networks, offer little thermal protection against the urban natures of Western Cape winters and offer a bleak future for dwellers who aspire to more. It is out of these conditions and alongside a wider community struggle against evictions of older bond housing that the Mandela Park Backyarders formed (Figure 6.7) as an:

“Unfunded community group made up entirely of affected residents and representing the most vulnerable individuals and families living in Mandela Park. We focus on providing legal support for residents, conducting workshops and democratic discussions about housing issues, as well as helping build the community’s negotiation power vis-a-vis housing and other government officials” (Mandela Park Backyarders, 2010).

The formation of the Mandela Park Backyarders is predicated on the crisis of infrastructure, be that housing, energy or water (Chapter 5), leaving the urban poor vulnerable to a series of socio-environmental hazards and in the context of deeply unequal infrastructures across the city. Yet this original purpose and focus has developed into a social movement focused on creating through improvisation new infrastructures of housing and associated networks of energy. The Mandela Park Backyarders show the need to improvise, to stop waiting for promises of government led construction and infrastructure development, and to take action on issues such as housing need and energy poverty:

“As backyarders we want to talk less and do more. We hear people talking and people are used to listening to high profile individuals making good speeches, but having no outputs then for those of us who are not speakers but can do. I think people are more into seeing the result than telling us how to run our affairs” (Mandela Park Backyarder #6).

This motivation to undertake improvised changes to the neighbourhood, outside the plans and regulations of the local state, are predicated on seeking to deploy the resources of the community. This is an imperative to take action that generates the impetus to construct new dwellings and to consider how such buildings can be developed at a fraction of the cost of the RDP housing built by government. to create new infrastructures from the community itself. But a series of problematics arise out of material improvisation across urban space in Cape Town. This is the clash between an urbanism that often originates from a certain level of informality and the ways it encounters the rigid frameworks, planning regulations and rules which govern urban space. In Mandela Park the practices of constructing new improvised dwellings create a tension with the formalities of urban infrastructure planning at the municipal and service provider level and shows the limitations of improvisation in relation to the specificity of electricity, through a dependence of the state to connect to wider flows of energy as a Mandela Park Backyarder (#6) explains:

“In fact with the houses we have built for ourselves its also going to be a big issue to get ESKOM to electrify these houses for now as currently they do not have electricity and we require them to install but before they can do it they need title deed or produce a municipality letter bearing your name, you know...”.

Figure 6.7: Photograph showing meeting of Mandela Park Backyarders at planning meeting (C.Guilloux)



What emerges from the conflict between the state and Mandela Park Backyarders is the resistance and rejection by the City of Cape Town toward improvisation in the neighbourhood. Using rules, regulations, laws and ultimately force authorities can thus delegitimise, destroy and disperse such improvisation by urban poor communities. In the context of Mandela Park and the history of struggle and conflict over infrastructures in the neighbourhood (Section 4.2.3) this suggests that improvisation can embody protest, a response not just to household needs but an articulation of the deep disaffection felt by urban dwellers in the context of splintered urbanism and infrastructure investment trajectories. The improvisation of incremental infrastructures in Mandela Park challenge the longstanding post-apartheid promises that the ANC and to a lesser extent the DA (as the current holder of local power) will deliver homes and services for all South Africans and thus retain a monopoly on the creation of housing, energy networks and so forth. Yet by challenging such government narratives via practices of improvisation the Mandela Park community is also challenging the legitimacy of state power over the the future direction of the neighbourhood and generating a reaction that has incorporated a long, documented history of state-led attempts to criminalise, demolish, evict and delegitimise such improvised infrastructures (Desai and Pointer, 2004). Yet, in many ways this improvised challenge is limited by the need to get the state to become involved in the neighbourhood, to provide the urban services that they hold a monopoly on.

Another example of this tension between the improvisation of low income communities and the planned, legal and regulatory processes of authorities in Cape Town can be considered that provides a very different but linked narrative to that of Mandela Park. Tensions between community members and the municipality related to improvisation surface in the selection process of the insulated ceilings in Mamre. Households that had reconfigured the house, improvised and incrementally alter the flows of electricity (through increased thermal efficiency) by plastering the walls, would not be considered for this reconfiguration led by the City of Cape Town. As a community member (#12) suggests, “I think we don’t get ceiling as we extended the house and added another two rooms. We also plaster the walls of all the rooms. Not aware of ceiling insulation at the time of the extension”. This creates resentment amongst those households engaged in incremental improvements to their homes. For by improvising and seeking to improve the thermal efficiency of the house they had missed out on a insulated ceiling provided by the municipality. The policy environment in Cape Town, at least across the networked, urban poor communities is an environment that does not fully recognise the role of the incremental, the need for residents to improvise and seek to make improvements by using these actions as justifications to select potential households for reconfiguration. In Mandela Park this is actively opposed, delegitimized and erased, illustrating the desire of the state to control housing and energy network reconfiguration. In Mamre, this improvisation, whilst not actively opposed becomes a rationale for non-selection during a state led reconfiguration of the energy network. Yet these responses from the City of Cape Town towards improvised infrastructures takes place in the context of growing agreement, from shack dwellers to policy makers that it is beyond the capacity of the state to deliver the post-apartheid promises of housing and wider service delivery to the poor communities of the city (Odendaal, forthcoming). Furthermore, discussing this problematic in Mamre a municipal policymaker reflects on the need to encourage improvisation:

“And then some households put ceilings up themselves so they go and see the difference and then the City comes and says they are putting ceilings in but you already have one so we won’t be putting one in yours. But you should actually be rewarding them for taking the initiative and putting the ceiling in” (Policy maker #1, Cape Town).

Whilst historically, in the post-apartheid era, improvisation has been either opposed or undervalued by the state, recognition of the value of such incremental acts by the urban poor may become increasingly important to the resource constrained municipality. For instance, a relatively recent partnership between the City of Cape Town and Slum Dwellers International, representing what Odendaal, (forthcoming) terms a, “hybrid institutional assemblage”. It suggests that the municipality are beginning to engage with such thinking around the role of urban poor communities in creating improvised infrastructures through supporting ongoing improvised work to improve housing and networked systems.

6.2.2 Improvised learning in urban poor spaces

New urban knowledges emerge from the practices of improvisation such as constructing houses, plastering walls, making network connections, collaborating on new economic opportunities around mobile phone charging points and such like arise. These are ways of understanding the city and the intricate ways in which

urban dwellers can operate across the marginal spaces of urban infrastructure. Firstly, contributing to an understanding of these urban spaces as in continual metabolic transformation through putting into practice learning about how to reconfigure the house or the wider network to improve conditions, suggesting that informality exists even in these neighbourhoods of perceived formality. Secondly, they challenge the focus simply to address large scale network reconfiguration, generating a need to explore how metabolisms are altered and reconfigured by low income residents. These processes of learning remain informal, outside, or at least on the boundaries of prioritised circulations of knowledge, shared by policy makers, engineers and so forth and they portray a different urban infrastructure, a different imaginary of the electricity network. For many residents, processes of learning through improvisation become an important tool for everyday survival but also wider community mobilization and empowerment. These are new conjunctures from which to generate economic activity and better, more productive ways to interact with networked systems. The everyday metabolism of network reconfiguration suggests the accumulated knowledges of urban dwellers provide a shared understanding of networked systems through exchange, collaboration and support and how they can be reconfigured to sustain households whilst opening up new possibilities and opportunities. Here it becomes important to consider McFarlane's (2011b:60) comment that:

“Urban learning in the context of improvisation involves acting within assemblages of multiple relations, between family and friends, sustained explicit infrastructural arrangements and systems of borrowing and lending, anticipating the rhythm of the city over day-night, week and season, the legal and illegal, the modern and the traditional, the new and the habitual”.

Here the city is understood as experienced, constructed and understood from below, generating new associations and configurations of urban learning that offer alternative visions, knowledges and practices of urban infrastructure across African urban spaces. In Mandela Park, the Backyarders create new networks of urban learning predicated on action, on intervening in the urban space and in using improvised practices of reconfiguring the materialities of the area:

“Once you start building and teach others than they understand when you tell them to do it. To me what matters is capability, not talking. We are about doing. Its all about doing. We may not be capable of talking but we can do. It does not matter how many of us talk today but if we can do these projects then the majority might also contribute because they are capable” (Mandela Park Backyarder #2).

Yet, this comment by a Mandela Park Backyarder also shows the difference between the ability to ‘learn the city’ through dwelling spaces (usually individually owned, built, or improvised, or done at the community level) and the ability to learn the city through networked infrastructure in which the state, utility companies and other urban intermediaries often need to be engaged in order to provide urban services, illustrating some of the limitations in the ability to learn the city at a network scale (rather than a household or neighbourhood scale). Yet, ‘learning the city’ can provide the potential for urban dwellers to, “secure for themselves the ongoing possibility to carve out a viable life” (Simone and Rao, 2012:316). It allows activists in Mandela Park to pass on, or circulate knowledge, ideas and new practices that stretch, shape and reconfigure the urban energy network to support the needs of the community. Through these circulations of knowledge and learning around improvisation, urban dwellers can and importantly do generate new urban possibilities

beyond the prospect of years on housing waiting lists, unaffordable flows of energy and the implications that come with such urban inequalities. Instead of the knowledges of reconfiguration remaining the preserve of policy makers and beholden to the ability to secure capital investment, the improvised infrastructures, predicated on processes of urban learning and practices of improvisation by residents provides another vision of the future. This is a vision that is a reality in the urban spaces across Accra and Cape Town in which urban dwellers are forced to work together to generate alternative urban knowledges about the city, about infrastructures and about economic opportunities.

6.2.3 The improvised city

Improvisation by urban dwellers in Cape Town and Accra across energy networks in poor spaces of both cities helps to articulate the analytical need to develop a focus beyond the structural, to engage with the actual conditions of urban life that are occurring through and across networked systems in both cities. This improvised urbanism needs to be considered as the norm, not the exception. Mbembe and Nuttal (2004: 369), considering Johannesburg suggest a useful way of thinking through the urban life of Accra and Cape Town:

“Like the continent itself, it is an amalgam of often disjointed circulatory processes. Turning its back on the rigid rationalities of planning and racial separation, it has become, in spite of itself, a place of intermingling and improvisation” (Mbembe and Nuttal, 2004: 369).

Here, Mbembe and Nuttal (2004) suggest that across neighbourhoods such as Ga Mashie and Mandela Park that simultaneously and alongside the ways in which urban infrastructure is mediated through structural processes there exists a related form of urbanism. This is predicated on a different but dialectically connected series of movements, flux and temporalities that emerge from disjunctures in flows of capital into the urban environment. From this perspective emergent forms of everyday network reconfiguration need to be considered alongside the multi-scalar metabolisms outlined in the previous chapter. Scholars (Rao, 2006, Pelling, 2011) have characterised this incremental, informal and improvised city as slum urbanism, as a way to show that global North-centered accounts of cities simply do not provide the theoretical coherence to address cities of the South unless they engage with actual existing conditions in these spaces. As such its important to conceptually and empirically engage with such concepts. As Pelling (2011: 85) argues:

“Slum urbanism is not a ‘passing phase’ as cities move along the linear trajectory from a primitive ‘pre-modern’ urban form to the ‘modern networked city’, as imagined by so much of the urban development literature and associated aid programs”.

This slum urbanism is, “located in the interstices of a whole range of mutations whose specificity is no longer locatable within a singular framework” (Rao, 2006: 232). Thus, whilst it is altogether unproductive to sideline structural, capital centered analysis its evident that slum urbanism, predicated on improvisation, incrementalism and other related concepts challenges the singularity of structural accounts of urban Africa and foregrounds, “the slum as a demographic and theoretical construct - straddles the conceptual and material forms of city making that are challenging the imaginary of the modern city” (Rao, 2006 231).

6.3 People as infrastructure, widening notions of urban networks

This section explores the notion of ‘people as infrastructure’ to introduce the third conceptual component of the analysis in this chapter that seeks to widen the notion of urban metabolism into the dialectical processes taking place across the everyday spaces of the network. These can be partly characterised by the role of people themselves in acting as the conduits for the metabolic flows of the city and illustrating the cyborgian nature of the urban

6.3.1 Considering ‘people as infrastructure’

The chapter now turns to people as infrastructure (Simone, 2004b) to show the importance of urban dwellers in enrolling themselves within the infrastructures of Accra and Cape Town and how these movements and circulations of people can be considered as part of the metabolism of networked systems. This is predicated on both theoretical explorations being undertaken across African urbanism by a range of scholars (Greico, 2008, Pieterse, 2010, Simone, 2004b) together with empirical findings suggesting that urban dwellers in these African cities become more than actors in the reconfiguration of networked systems in these urban spaces. In order to develop the third part of the analysis focused on the dialectical urbanism of the network it thus becomes an analytical imperative to consider ‘people as infrastructure’, linking into the cyborg notion of the city (Section 2.5.2) that positions networks as a vast arrangement of technology, practices, metabolisms and people. Simone (2004b:407-408) defines ‘people as infrastructure’ thus:

“I wish to extend the notion of infrastructure directly to people’s activities in the city. African cities are characterized by incessantly flexible, mobile, and provisional intersections of residents that operate without clearly delineated notions of how the city is to be inhabited and used. These intersections, particularly in the last two decades, have depended on the ability of residents to engage complex combinations of objects, spaces, persons, and practices. These conjunctions become an infrastructure a platform providing for and reproducing life in the city”.

If we return to the figure of the cyborg city in relation to ‘people as infrastructure’ (Simone, 2004b) then it becomes conceptually possible to imagine the energy network in Ga Mashie consists not simply of the materialities of hardware but the urban dwellers who undertake a variety of functions integral to the continued circulation of energy across the neighbourhood into households showing these networks as relational and socially produced. Such dynamics are vital to the reproduction of daily urban life and sustaining the neighbourhoods energy network. Hawkers sell fuel for lamps to use during network disruption. Boys carry fire wood and transform it into charcoal providing material for cooking and generating some Cedi’s for electricity credit. Electricians go around keeping meter readings low so households can sustain light in the evening for children’s homework and a woman sits around offering charging points for people’s MTN mobile phones. Somebody tinkers with a broken transistor radio that used to provide news of network disruption. Others come together to hook up a new shack to a light source. Elsewhere the ECG office closes because of some illness, meaning the rest of the day without electricity

credit for local residents. The next day the pattern, circulation and movement of people is similar, but perhaps a new charging node for mobile phones has been opened by an electrician using income derived from his work on clandestine connections. The ECG office re-opens allowing someone to buy credit and begin work on the sewing machine scheduled for the day before and the local spot (a shop or bar) constructs a street light to entice customers later in the evening. Whilst conflict can erupt between and across these shifting infrastructures (of people), collaboration is the norm. Temporary intersections of interests around sustaining and reconfiguring the energy infrastructures of the area combine. Thus, the work of constructing the new street light is financed by the local spot, anticipating increased revenues. The electrician with his newly opened charging point nearby undertakes the labor without cost, two young lads from the opposite compound are sent to fetch some wire that they remember from the last time they were given a few Cedi's to help out their mother, content in the knowledge the street light will provide the household with some no-cost evening light. Finally, the head of the local ECG office comes down and waves away any reservations about the status of the street light, knowing he'll be receiving a beer or two later in the week as he passes by and understands the importance of the light in generating income for the family. At these intersections of people and infrastructure, and through collaborative acts and ongoing processes of urban learning residents become part of the very network in which they are reconfiguring and reveal the wider flows and dynamics that produce cyborg urbanisation as a series of metabolisms, incorporating people, technologies, natures, flows of capital and knowledge. The peripheral nature of urban life for many residents in Ga Mashie, operating outside of the formal economy, often in conditions of poverty and on the margins of opportunity produce:

“a specific economy of perception and collaborative practice constituted through the capacity of individual actors to circulate across and become familiar with a broad range of spatial, residential, economic, and transactional positions” (Simone, 2004b: 408).

It therefore becomes an imperative not simply to consider ‘people as infrastructure’ but to re-ascribe meaning when considering the energy network in neighbourhoods such as Ga Mashie to incorporate such social collaboration as very much a part of (living) cyborg networked system. Furthermore, such a perspective suggest that infrastructures are not simply ‘networked’ through physical technical connections/flows, but through social relations and the relation between different objects.

6.3.2 People as an infrastructure of resistance in Ga Mashie

One way in which the research findings have supported Simone's (2004b) notion of ‘people as infrastructure’ is during moments of conflict in networked, urban poor communities when housing and wider infrastructure is under threat from demolition and eviction by municipal authorities. These moments bring together what Simone (2004b: 407) terms, “provisional intersections of residents” creating a series of people, practices, spaces, beliefs and so forth that becomes in itself an infrastructure. This infrastructure is temporary in nature and forms from multiple existing social, economic and community networks to resist the demolition or eviction attempt and becomes implicated in the consolidation and continued reproduction of daily life, households, assets and community relations. This was vividly brought to life during the research when one day, meeting the research assistant to go and conduct a workshop, the police arrived in pickup

Figure 6.8: Photograph showing AMA officer during attempted eviction



trucks alongside AMA officials (Figure 6.8). They had come to demolish the structures, used for economic activity (such as bars, mobile phone credit spots and so forth) along the main road and the homes behind (including the research assistant's compound) and housing around 80 people from a number of families. Within minutes the community had mobilised dozens of people beyond the immediate area who came to resist the demolition. Word of mouth and mobile phones had created what seemed like a spontaneous reaction to defend the dwellings targeted for demolition. The police were armed and pushing people out the way, but there was little violence during this occasion from either the authorities or the community. The land in question had been a park or open space up until the 1930s but was now housing a number of business and people's homes. A deal had apparently been signed with the bank to buy the land (from a man who claimed to have the land title) and to then demolish the homes and build a branch which would serve the adjacent central business district. The research assistant stepped forward and demanded to see the court order with the police and AMA were not able to provide one and the people began to place themselves between the structures and the authorities shouting, singing, moving objects to create a barrier. It seemed unclear at this time how the standoff would develop but as more people from across the neighbourhood joined the scene the police and AMA officials could see the difficulty in continuing with proceedings especially without a court order. The group meanwhile demanded to see the court order and climbed onto the police vehicles chanting Ga songs. At this point it was clear to many residents there was no court order and this was an opportunistic attempt to demolish the dwellings quickly and illegitimately. The police and AMA officials began their

retreat and people stood around for a while talking, discussing and generally looking happy before they moved back into the neighbourhood and continued with their everyday activities.

After weeks of trying to find out about community mobilisation at various workshops and failing to identify many formal groups suddenly a people-centered infrastructure had been utilised to generate a demonstration, an act of resistance and defend other community members living and livelihood spaces in a moment of collaboration, a collective network of resistance that dissipated as soon as it had emerged. Reflecting on the incident it became clear that the success of the moment was predicated on people as infrastructure that is not immediately evident. Thus, this mobilisation of community members can be considered as an infrastructure, as a temporary configuration of people that served to secure the fundamental need to shelter and the current network configurations of the compounds and in many regards is as important as the engineered hardware systems of cables, wires, meters and transformers in sustaining life, hope and opportunity in Ga Mashie. Moments such as this are evident during the installation of PPM into the neighbourhood as some households resisted and called upon such infrastructures to support actions to halt these reconfigurations.

6.3.3 The importance of considering ‘people as infrastructure’

The chapter argues it is important to consider the notion of ‘people as infrastructure’ as it provides a particular pathway to consider the ‘emergent forms of social collaboration’ in African cities (Simone, 2004b) that can be expanded to incorporate networked systems in Accra and Cape Town. It is through these ‘thickening fields of social relations’ (Simone, 2005) that new forms of infrastructure are constantly being reconfigured as social movements, households, neighbours, extended families, electricians, families and so forth all become involved in the incremental and improvised (re)production and reconfiguration of networks. Whilst this can sometimes result in conflict between these different urban actors or failure to achieve objectives, at other times these dynamics can improve socio-environmental conditions. This urbanism, common across the networked, urban poor communities of Accra and Cape Town suggests that, “‘infrastructure must be understood not as steel and concrete but rather as fields of action and social networks” (Roy, 2009: 826). Therefore to consider ‘people as infrastructure’ within the context of the energy network and through the conceptual framework is to embrace the notion that these networked systems are cyborgs, enrolling multiple human and non human actors in ongoing processes of metabolic circulation.

6.5 Conclusion

This chapter uses a series of concepts, predicated on how they intersect with a framing of the city as cyborg and produced through metabolic processes that extend to the everyday, to explore network reconfiguration. Using a range of emerging knowledges concerned with global South urbanism the chapter argues for the need to examine how metabolisms are dialectically re-ordered across everyday urban space.

This chapter approached the analysis of reconfiguration through the notion of incremental infrastructures (Simone, 2004b, 2011, forthcoming). Exploring practices of improvisation (McFarlane 2011a, Gandy, 2005),

urban learning (McFarlane 2011b) and ‘people as infrastructure’ (Simone, 2004b) it shows how everyday urbanism shapes and reconfigures urban space in Accra and Cape Town. This generates a series of considerations about Africa urbanism generally and network reconfiguration specifically. Firstly, many urban spaces in Accra and Cape Town and the urban dwellers in such neighbourhoods exist on the periphery of these cities. The peripheral is both a spatial descriptor and metaphor for these networked, urban poor communities. Often circulations of capital investment in improving infrastructure are absent meaning residents become vulnerable to metabolisms of capital, climate and crisis, prompting a series of dialectical responses from the neighbourhood. This dialectic between the wider metabolic processes shaping urban spaces and the everyday responses from urban dwellers produces an additional analytical requirement not simply focused on the structural dynamics that mediate network reconfiguration but the need to explore how these metabolic processes travel and are reconfigured across and through low income, networked neighbourhoods. Secondly, in these peripheral urban spaces, conditions of poverty are severe and formal infrastructure either non-existent, costly for residents, or unable to support urban households fully. As a result a range of network reconfiguration is undertaken to support families and communities through everyday interactions with infrastructure. These processes are often incremental in nature creating small changes to the ability of households to survive, create opportunity or generate economic activity and are developed through practices of improvisation. Improvisation can’t be understood as the utilisation of resources and particular intersections of people to reconfigure such networks. Thirdly, these incremental reconfigurations take place on an everyday basis, creating new network spaces and a constantly shifting urban space that is at least partly predicated on responding to the fragile and often temporary gains made by such acts. Fourthly, these processes are constituted through urban learning (McFarlane 2011b) amongst urban dwellers in such spaces. This urban learning is an accumulation of knowledge of infrastructures that supports and informs the reconfiguration of the network by urban dwellers and provides an alternative vision of the urban, one based on the need to interact with networked systems through intersections of social collaboration. Fifth, these processes and dynamics of the incremental are dependent on people becoming enrolled as infrastructure and widening further the notion of such networks in Accra and Cape Town as the everyday urbanism of such places reveals energy systems to be not merely dependent on urban dwellers but part of wider networks of social collaboration. Sixth, in cities characterised by widespread inequality, splintered urban infrastructure and an increasingly market orientated and post-networked investment trajectory dialectical responses emerge across such networks. To consider the electricity networks in low income communities in Accra and Cape Town is to recognise the vast numbers of urban dwellers who are left to get by, generate opportunity and find new ways to navigate urban life beyond, outside and on the periphery of networked systems and the formal city. Thus incremental infrastructure can be at least partly explained by the actions of urban dwellers in seeking to bridge the spaces of absence between the flows of investment in the electricity network and the material manifestation of such disjunctures. Furthermore, this incremental urbanism whilst also a lived daily reality across both cities also becomes an important analytical imperative for scholars engaged in networked systems in such contexts. Such analytical pathways show a richer, more detailed picture of urban life in Accra and Cape Town beyond the stark socio-environmental inequalities of such spaces. Urban dwellers in networked, poor communities in Accra and Cape Town are not just getting by on the periphery. Emergent forms of social collaboration, generate ways of reconfiguring

networks, communities coming together in temporary infrastructures of resistance all counter a narrow narrative of urban life predicated on the development of modern cities in the global North and discourses of developmentalism. Therefore, to consider such processes and to centre their importance suggests a altogether different understanding of modernity and the ‘city yet to come’ (Simone, 2004b). This is a city beyond the linear narratives of much existing urban theory, one that mutates and emerges from the slum urbanism of places such as Ga Mashie and the urban future of vast swathes of our urbanized planet. McFarlane, (2011b: 40) suggests an important note of caution when considering such incremental, improvised infrastructures:

“Improvisation is not, of course, a process that should be necessarily be celebrated. It can, for instance in relation to water or sanitation provision, or in electricity or housing, represent as often desperate attempt to cope with severe hardship and poverty”.

This chapter has presented such processes as constituting the everyday urbanism of urban spaces suggesting the need to widen analysis of urban infrastructure and the terrain from which climate change and imperatives are approached. These dynamics and circulations at the periphery of flows of investment generate a series of considerations about the splintered nature of urbanism and urban inequalities in Accra and Cape Town, in the context of the intersections between energy and the delivery of the Millennium Development Goals (UN-Energy, 2005). This prompts the need to consider the relationship between the structural and the incremental within and across networked systems.

Seventh, conceptually the chapter has provided a important part of the African situated UPE framework. Focused on working through Roy’s, (2009: 829) critique and subsequent call for action that, “the world is not flat, and it is time to produce a more contoured knowledge of its cities” the thesis seeks to expand, through presenting the empirical findings a more nuanced analysis of network reconfiguration in Accra and Cape Town. Thus, “the city seen from the South provides the occasion to rethink the contours of modernity in a global age” (Rao: 2006: 227). The chapter argued that UPE focused on addressing African cities must respond to such imperatives and widen its analytical tools to engage with actual existing conditions of African and everyday urbanism and thus generate a more reflexive, relational theoretical underpinning. In the previous chapter the thesis established the how and what of a capital-centered analysis through presenting accounts from Accra and Cape Town that showed how metabolic circulations and dynamics shape networked systems and how they are reconfigured in urban poor communities. The dialectical analysis traced these circulations of capital, climate and crisis that condition the energy infrastructure of low income, networked communities in both cities. The chapter illustrates how such dynamics reflect and reinforce network inequality across such urban spaces. Yet, this analysis fails to account for the ways in which urban dwellers are reconfiguring urban infrastructures through strategies of incrementalism, practices of improvisation and at intersections of collaborative urban life. The chapter suggests a response to these conditions can be produced through an African situated UPE of these African cities that engages with these circulations, seeks to centre alongside capital the everyday urbanism of such peripheral spaces.

Finally, the chapter suggests that an analysis of both structural and everyday dynamics or the urban metabolisms of network reconfiguration needs to examine in further detail the social relations and power

relationships existing across these processes through seeking to interrogate the urban governance and wider logics and rationalities of these arrangements and is undertaken in the next chapter.

Chapter 7: The power of networked systems

As the review of UPE made clear (Section 2.5.3) the central concern of this field of urban studies is to reveal the power relationships that mediate the metabolisms of the city and shape the socio-environmental conditions of urban spaces (Keil, 2003, 2005, Lawhon et al, forthcoming, Swyngedouw and Heynen, 2003, Zimmer, 2010). The conceptual framework (Section 2.7.1) is presented to reflect this concern with power and social relations, the important role of infrastructures (as both metabolisms themselves and conduits for other metabolisms) in mediating these relationships and how network reconfiguration provides the terrain from which power is both expressed and contested. Chapter four examines how these relationships have been historically produced, showing that historic social relations through colonial, apartheid, post-colonial and post-apartheid eras create an infrastructure geography that is characterised as splintered urbanism (Graham and Marvin, 2001). Chapter five illustrates how current conditions of inequality across networked systems are produced through the metabolisms of capital, climate and crisis that shape socio-environmental conditions across the networked systems of Accra and Cape Town. Chapter six explores the dialectical urbanism of these metabolisms, examining how residents in low income neighbourhoods mobilise everyday interactions with networked systems to alter and shift the flows of metabolic processes. As such the thesis outlines the multiple dynamics that create and reconfigure the networked systems of Accra and Cape Town through a series of social relations and at a series of scales from the local to the global. This chapter seeks to take forward the analysis of network conditions outlined in the previous chapters to specifically examine the relationships between various urban actors involved in network reconfiguration and the power relations between these different actors. This is developed through a focus on the urban governance of networked systems, that is the institutional arrangements that shape particular pathways of network reconfiguration and how these are influenced by wider logics, policy imperatives and rationalities across Accra and Cape Town

The focus outlined above is undertaken by firstly expanding the conceptual underpinning to the chapter that builds on the perspective of power outlined in section 2.5.3. This is addressed through defining a particular, structural notion of power linked to historical materialist perspectives on the city (Harvey, 1996, Smith, 1984) and mobilised within a number of UPE studies (Swyngedouw, 2004). Here, the chapter argues that power across urban infrastructures can be considered as an inscribed capacity (Allen, 2004) to undertake network reconfiguration. Following on from this examination of power the chapter argues these issues need to be addressed through analysing the institutional arrangements, or urban governance of network reconfiguration. Such an approach reveals the various urban actors involved in network reconfiguration and the logics and rationalities that shape the ongoing metabolic production of socio-environmental conditions in the low income, networked neighbourhoods of Accra and Cape Town. Secondly, the chapter mobilises these concepts to comparatively analyse the power relationships across the urban governance of networked systems in the case study neighbourhoods by examining how different forms of reconfiguration produce, reflect and reinforce social relations between the state, wider urban intermediaries and residents in low income areas. Thirdly, the analysis reflects on the urban governance of networked systems to argue that they reveal a series of important considerations about the diverse institutional arrangements, circulating policy

knowledges, logics and imperatives involved in shaping such governance, arguing that these dynamics link into a series of multi-scalar power relationships. The chapter argues that this provides an analytical position in which to develop a critique of the city scale (and beyond) governance in both cities and the power relationships and implications of such arrangements. Fourthly, the chapter seeks to reflect on the strategies by low income communities to shift power relations across networked systems and through processes of network reconfiguration. This is predicated on seeking to outline an urban politics being undertaken in these spaces using Chatterjee's (2004) terrains of 'civil' and 'political' society to examine how low income communities gain power to reconfigure networks and alter socio-environmental conditions. Such considerations are an important part of a UPE conceptual framework as, "The political programme of urban political ecology, then, is to enhance the democratic content of socio-environmental construction by identifying the strategies through which a more equitable distribution of social power and a more inclusive mode of environmental production can be achieved" (Swyngedouw and Heynen, 2003: 914).

7.1 Conceptualising power and governance across networked systems

This section outlines a more detailed conceptual underpinning for the approach to power and governance across networked systems in Accra and Cape Town. This is undertaken firstly, by articulating the notion of power mobilised in the analysis and predicated on historical materialist approaches to the city and secondly by outlining the importance of examining urban governance in approaching power relationships across cities.

7.1.1 The dialectical relationship between infrastructure and power

As Lawhon, et al (forthcoming) argue, "one specific strategy for tracing the operation of power is through unpacking the many factors involved in controlling material flows of resources" and this notion of power has been central to the field of UPE studies (Lawhon et al, forthcoming, Zimmer, 2010). Such a perspective would position urban energy networks as central to the social relations of Accra and Cape Town, shaping the fortunes of urban dwellers through metabolisms that both constitute and are made possible through the overhead cables, transformers and substations of networked systems. These relationships are approached through a structural notion of power in which, "capital accumulation is understood as the primary underlying and therefore structural force for organizing the city" (Lawhon et al, forthcoming). This is, as Allen (2004:20) argues, "the notion that power may take the form of capacity or a capability which allows those who hold power to realise their aims". Whilst this approach only provides one geometry of power amongst the myriad forms and flows of power across urban space it is particularly suited to interrogating the role of urban infrastructures in mediating social relations. As Swyngedouw and Heynen (2003:911) comment, "It is this nexus of power and the social actors carrying it that ultimately decide who will have access to or control over and who will be excluded from access to or control over resources or other components of the environment". UPE studies undertake such analysis by examining how the flows and circulations or metabolic processes of and across networked systems mediate and shape the city (Swyngedouw and Heynen, 2003, Heynen et al. 2006) as, "not all actors can mobilize metabolisms in the same way (Zimmer, 2010:

350). As the previous chapters show, the urban poor do not have the resources, capacities or powers to undertake large scale reconfiguration and the power to transform is limited to incremental responses or mobilisations to appeal to the state or other urban intermediaries to secure investment in networked systems, urban services and so forth. As such to examine power in this way means to explore the often unequal social relations across the multitude of urban actors involved in the governance of networked systems (Section 7.1.2). This task forms a key analytical imperative for the approach to the chapter as it explores the shifting relations between communities, the state, civil society and the market because as Allen (2004:24) suggests, in the context of this notion of power, “Particular institutions or groups with their own respective powers will stand in a multitude of relations to other agencies who may also possess a specific combination of powers”. Furthermore, the chapter suggests that uncovering these social relations is an important task as, “power is at the heart of city development, because governance boils down to question of control over decision-making, how resources are used in a sea of competing and different interests” (Pieterse, 2008:5). Therefore the analysis is focused on seeking to understand how power, that is the ability or capacity to control metabolic flows and material resources shapes and is in turn shaped by the social relations of Accra and Cape Town across urban governance. The role of network reconfiguration becomes important in these processes and such interventions reorientate these metabolic flows, thus the power to reconfigure becomes the capacity to change socio-environmental conditions. Though this analysis the chapter argues it becomes possible to consider:

“the question of who gains and who pays and to ask serious questions about the multiple power relations—and the scalar geometry of these relations—through which deeply unjust socio-environmental conditions are produced and maintained” (Swyngedouw and Heynen, 2003: 901).

7.1.2 The urban governance of networked systems

When considering urban governance the chapter argues its important to consider that, “the conditions for infrastructure provision have altered due to the transition of urban processes” (Monstadt, 2009: 1927). Over the last few decades urban research has shifted from a focus on government to that of governance reflecting the changing institutional arrangements involved in the management of cities. As Brenner (2004:449) argues:

“In contrast to the earlier fetishization of the national scale of political power, scholars have begun to analyze a range of rescaling processes through which new, multi-scalar hierarchies of state institutional organization, political authority and regulatory conflict are being generated. Accordingly, the scalar organization of state power is no longer understood as a pre-given background structure, but is increasingly viewed as a constitutive, contested, and therefore potentially malleable dimension of political-economic processes”.

This is a shift from government, with the state at various scales controlling policy, regulation and such like toward governance, which describes the range of public, private and civil society actants involved in shaping the city, across various geographical scales. As Swyngedouw and Heynen (2003:912) argue, “these dynamics are embedded within networked or territorial scalar configurations that extend from the local milieu to global relations”. Thus, it is important to consider the urban governance of networked systems in Accra and Cape Town as an institutional arrangement incorporating a shifting and multi-scalar collection of actors and

institutions. Urban governance is shaped and influenced by a series of global, international and regional circulations of policy, finance and technologies across local contexts (MacLeod and Goodwin, 1999). Thus as Ernstson et al, (2010: 537) argue, “cities need to be viewed as loci in multiple networks of relationships at different scales, rather than as entities”. Such a perspective suggests that when examining urban governance it is important to consider the relationalities of these institutional arrangements and the directions of the various circulations of urban policy knowledges (such as neoliberalism and developmentalism) that continue to undergo transformations through, “urban changes in technologies, corporate organizations, political institutions, consumer sovereignty, cultural values and spaces of infrastructure provision” (Monstadt, 2009: 1927). A UPE analysis of urban governance must therefore interrogate the multiple relationships, dynamics and discourses that mediate the form and function of such arrangements to critically reflect on the power relationships across network reconfiguration. As Allen (2004:35) suggests, “In this more complex geography, power is largely about the reorganization of scale, in so far as it is redistributed to take account of the proliferating sites of authority and reordered boundaries”.

An analysis of urban governance using the African situated UPE framework is predicated on seeking to respond to the specific context, presents, social relations and conditions in and across networked systems in the case study neighbourhoods. The chapter undertakes this by comparatively exploring the urban governance involved in processes of network reconfiguration in Ga Mashie, Mamre, Mandela Park and Kuyasa and reflecting on how these institutional arrangements reveal the social relations between different urban actors and the power infused across these relationships. The thesis contends it is important to begin the analysis within these case study neighbourhood. As Merrifield (2002:14) argues, “urbanization unfolds vividly at the most local of scales, and it is paramount for any critical urbanist to know how to intimately map the city”. Once this analysis is undertaken within the low income neighbourhoods it provides the basis to explore how urban governance is shaped at a city level by various rationalities and logics and develop a critique of currently existing power relationships across Accra and Cape Town.

7.2 Examining power relationships and network reconfiguration

This section explores the three neighbourhoods in Cape Town and the neighborhood in Accra to analyse the various power relationships across the of processes of network reconfiguration in each of these urban spaces. It begins; firstly, with examining the urban governance of network reconfiguration in Mamre; secondly, by examining these relationships in Mandela Park; thirdly, by developing the analysis in Kuyasa. Fourthly, the section comparatively reflects on the low income, networked neighbourhoods in Cape Town to suggest that the relationships between various urban actors in these communities provide a number of different perspectives on the condition of power relationships across networked systems in the city. The section suggests these neighbourhoods reveal the developmental nature of the local state, the promises of co-production and the increasing conflict characterising urban poor spaces across the city. Fifth, the section analyses urban governance in Ga Mashie, suggesting the multiple social relations that are connected to the urban energy network can articulate a range of wider power relationships across the city.

7.2.1 Governance in Mamre

The installation of insulated ceilings in RDP housing in Mamre provides an example of the urban governance of network reconfiguration that is led by the local state and backed by international climate financing that seeks to change the conditions of energy poverty in the neighbourhood through a climate change financed intervention. The community are generally pleased to receive ceilings, illustrated by the nearly 90 percent of respondents in the household survey who feel their expectations were met, together with the wider good feeling associated with the project. The CCT develops incremental ways to experiment with network reconfiguration and develop knowledges about the best ways to engage with these infrastructures after providing basic services. The governance of this network reconfiguration is led by the municipality and particularly its Environmental Resource Management (ERM) Department but incorporating a multi-scalar ensemble of different organisations including the DANIDA. The network reconfiguration is framed by the logics and concerns of the financing DANIDA around climate change and translated into the local context by linking up to wider poverty alleviation rationalities (especially around energy poverty). It is characterised by the control of the local state deciding on the type, location and beneficiaries of the intervention:

“We first realized, and its not the way to go about it, but we were first told that we had the money and then tried to figure out what to do with that money and where we could apply it and where that could work. In an ideal world we would have identified the community, the intervention, how much it would cost and then look for that money. In the real world in this case it didn’t happen like that, we were told we had this much money do something with it along the theme of climate change and we workshopped and make informed decisions about the best intervention for green or energy efficient benefits for that money” (Policy maker #3, Cape Town).

Whilst the community is involved in the delivery of the insulated ceilings from conducting research, through to training and the actual retrofitting works the parameters of the project had already been defined by the CCT suggesting that the capacity or power of the community to actively shape the network reconfiguration or influence the process is relatively muted. The relationship between the state and the community during this process is characterised through the capacity held by the municipality to reconfigure the infrastructure. Such a relationship, dominated by the state, reflects the power relationships across urban governance in Cape Town and is characteristic of service delivery over the last couple of decades in the city (Swilling, 2006). It is worth thinking about this relationship in more detail. The developmental state in South Africa has invested significant amounts of capital into urban infrastructures that have helped to provide much needed housing and networked services for marginalised and poor communities (Turok and Parnell, 2009). This is precipitating a series of metabolic transformations across the landscapes of the city through a shift in the materialities of living conditions for the urban poor. Mamre is an example of the way in which service delivery has helped to support the urban poor in the city, with the initial investment in RDP housing and the subsequent investment in further network reconfiguration. Yet, throughout this process the CCT have kept a tight control of the resources, plans and resulting urbanism of these infrastructure investments, whilst also operating as the electricity distributor for the area. As Swilling comments, (2006:25), “building the developmental state is now official government policy, and with this comes an interventionism across the board that is premised on the assumption that greater state control means greater success”. The urban

governance of Mamre's network reconfiguration is dominated by the local state and to a lesser extent a bi-lateral development agency in the global North. This reconfiguration shows the power of DANIDA, through its ability to define the parameters of investment and by the CCT who hold and use the power, generated by the investment finance and current conditions of governance, to shape Mamre's infrastructure.

These institutional arrangements and attendant power relations generate a number of potential limitations in terms of seeking to transform the conditions of poverty in the neighbourhood and the wider democratic participation of the residents. The power relationships of this urban governance are characterised by the contradictions between the discourse emerging from the state and the actual process that marginalizes the community and fails to give them any power over the networked system and is echoed across the country (Odendaal, 2011). Whilst the insulated ceilings have a incrementally positive effect on a range of household indicators such as energy, health and livelihoods this reconfiguration in infrastructure does not dramatically redress the poverty in the community. Thus, whilst the insulated ceilings offer some welcome improvements to housing and the energy conditions the network reconfiguration shows how the state is not able to substantially improve the socio-economic status of the neighbourhood, something that would require a much larger scale reconfiguration. This limitation on the ability of the CCT reflects the wider failure of the developmental state to dramatically transform the fortunes of many of the city's residents via RDP housing (Parnell and Pieterse, 2010, Charlton and Kihato, 2006) and the limited power of the municipality to link into increased and needed financing. Furthermore, the community have limited power to participate in the process, (making decisions on the technologies to be used or the delivery framework in which such actions are undertaken). Alongside these limitations the chances of further state-led reconfiguration of local infrastructure remains low whilst the municipality struggles to provide housing and networked services to the city's population, many of whom are living in significantly poorer conditions than the residents of Mamre. As such the governance of this reconfiguration fails to offer further pathways for the community to develop non-state financed, managed and delivered responses to the multiple imperatives facing poor households by monopolizing effective power over who can reconfigure the network as both the municipality and the electricity distributor. This urban governance in Mamre prompts the need to question whether network reconfiguration that is state-led, often taking place over a short period of time and arguably failing to empower communities is necessarily able to counter the endemic splintered urbanism, lack of spatial integration and socio-environmental inequalities that continue to characterise the city. Commentators such as Odendall, (forthcoming) have described a tension within the South African state between the need and aspirations to develop long term empowerment of urban poor communities and the shorter term and politically driven need to deliver (and importantly be seen to deliver) basic services, housing and improvements in already existing infrastructures that leaves the power, curtailed by the wider political economic conditions, to reconfigure with the state.

7.2.2 Governance in Kuyasa

The network reconfiguration in the Kuyasa neighbourhood generates a very different series of outcomes compared to Mamre, revealing a different form of urban governance and power relationships. During the planning and delivery of the network reconfiguration the community are a key partner in the governance and subsequently involved in the formation, planning and delivery of the works:

“We involved community participation, allowing lots of community meetings, workshops etc. We spent time with community, gave them responsibility when we started to roll out. We employed 86 staff for two years full time, mix of different people including disabled people”
(NGO worker, Cape Town #1).

Over the course of the ten years in which the Kuyasa CDM project unfolds a range of different actors are involved in the governance including international, national and local agencies. Importantly these arrangements are centered on a community leader working in close partnership with the wider community and making important decisions about the direction of the project⁶⁵. Perhaps the most significant relationship across governance during the Kuyasa network reconfiguration is between the community and the NGO, SouthSouthNorth. The NGO provides, after little progress during the years after the pilot phase, additional skills and expertise to secure financing and significant upscaling of the project. Perhaps more importantly the NGO also operates as a mediator between the state and the Kuyasa community, supporting the neighbourhood in finding its voice, accessing state controlled financial resources and gaining power over local infrastructure. This process can be referred to as co-production and is defined by Joshi & Moore (2004: 40) as:

“the provision of public services (broadly defined, to include regulation) through regular, long-term relationships between state agencies and organised groups of citizens, where both make substantial resource contributions”.

Co-production suggests a different set of social relations with a series of different urban intermediaries involved, yet a community able to assert control and power over the neighbourhoods infrastructure beyond the municipality, other state institutions such as ESKOM and the market. This co-production means the community and the NGO are able to assert power in steering the network reconfiguration that suggests a level of success in changing the position of the community compared to Mamre. This is despite the myriad participating organisations,⁶⁶ including various tiers of the South African state and it generates what can be argued is an empowered community, particularly when compared to the dominating role of the state and lack of power across the Mamre community. Furthermore, this process provides the opportunity for the Kuyasa community to increase their power over infrastructure through urban learning (McFarlane, 2011b)

⁶⁵ An example of the central role of the community in the decision making process is during the initial pilot phase of the reconfiguration when 10 houses were needed for evaluation, testing etc. The community reached a collective decision that such reconfiguration should begin in the most vulnerable houses and as such the SWH, insulated ceilings and energy efficiency measures were targeted at households with elderly and/or disabled members.

⁶⁶ Which include a series of different actors within the City of Cape Town (Housing Department, Spatial Planning and Urban Design Department, Expanded Public Works Programme, Supply Chain Management, Ward Councillors and others.), as well as Agama Energies, the National Department of Environment and Tourism and the Housing Department of the Provincial Government

developing a range of knowledges about reconfiguration and how they can intervene in such processes to reshape the materialities of the electricity system. These accumulating knowledges incorporate multiple different forms from technical specifications through to negotiation, community decision making and awareness of potential financing pathways. Whilst these are perhaps different in form to the incremental, improvised learning suggested by McFarlane (2011b) such processes also provide an example of what Simone (2004:9) describes as a, “conjunction of seemingly endless possibilities of remaking”. These possibilities suggest that the accumulated learning and knowledges can provide a way for the community to incrementally gain power over the energy network and continue to hold a central role in the governance of the network in Kuyasa. The institutional arrangements of this process challenge the longstanding assumption concerning governance, by the various tiers of government in South Africa, that the developmental state is always the best vehicle in which to plan, respond and reconfigure networked systems. It opens up new institutional contexts from which infrastructure investment can emerge and low income communities gain some level of control and thus power over the material flows and circulations of networked systems. The emerging picture in Kuyasa suggests the possibility to move beyond the particular configurations of governance that characterise the city and shift relationships of power.

However, the governance in Kuyasa also has limitations. Chiefly, the time and finances involved in delivering this project requiring a prolonged investment by a series of urban intermediaries including supporters within the municipality, NGOs, technology companies and more. Whilst Kuyasa was able to draw upon empowered local residents and the resources of the NGO such institutional arrangements and attendant resources remain the exception rather than the norm in many low income, networked neighborhoods across the city. These current limitations suggest the governance in Kuyasa which the community lay at the heart of is not going to be expanded across all low income communities in Cape Town under the current, wider conditions of the city. This is due to lack of resources and the reluctance of the state to cede power over network reconfiguration. Whilst urban intermediaries, together with the community in Kuyasa have sought to use the success to challenge current processes of service delivery, “We try to get government heavyweights here to try and wake them up” (NGO worker and local resident, Kuyasa CDM project), it is not clear whether such success is likely to change the views of state actors. Furthermore, whilst the mobilisation of the Kuyasa CDM project within policy environments is widespread, its lessons in widening the actors involved in governance to centre the role of the community have not always been so. Such mobilisation of best practice, via conferences, reports, case studies and such like, has created a situation in which discourses of improvement, dynamism and action around upgrading and reconfiguring urban infrastructure across Cape Town, promoted by the CCT, masks a range of deep seated issues around the social relationships across networked systems. These included the failure to develop more democratic governance, the control and power exerted by the developmental state, the constraints of political economic conditions and the continued splintered nature of urban infrastructures in the city.

7.2.3 Governance in Mandela Park

Mandela Park provides a different way to consider the social relations and power relationships across the networked systems of Cape Town. These relations in Mandela Park can be understood through three key dynamics that have emerged from the governance of the area. Firstly, the imposition by the state and the market of what can be characterised as a neoliberal visions of urbanism in Mandela Park that leads to home repossessions, demolitions, criminalisation and a history of conflict between the state, (both the municipality and ESKOM), the market (in the guise of banks) and the community. Secondly, the resistance and conflict generated by the rejection of these policies by the community as an explicit challenge to the power of the developmental state and the markets to exert control over urban infrastructure in Cape Town. This conflict over the networked systems of the neighbourhood is emblematic of the wider relationships between many urban poor communities, the South African state and markets (Pithouse, 2009). Finally, the role of the community in seeking to shape the reconfiguration of infrastructure within the neighborhood provides a further way to consider governance in low income, networked communities that shows how particular configurations, and the policies and processes that emerge can be contested. Tension between the community, local political parties connected to the local state (controlled by the DA) and national state (controlled by the ANC) has been ongoing for a number of years. A range of disputes characterise the area (Section 4.2.3) and manifest across the urban infrastructures of the neighbourhood. Such disputes are very much concerned with the governance and the processes that such arrangements generate. These disputes include the lack of RDP housing for the backyard dwellers stranded on fifteen year housing waiting lists and originate from attempts by banks to repossess poor quality bond housing, which residents, caught up in the privatisations of the late 1990s, struggle to continue paying. Brutal bank-led evictions, protests, the criminalisation of the community, with hundreds spending time in prison (Desai and Pithouse, 2004) and ongoing demolition represent a response by the state and private sector that rejects the claims by the community to have power over infrastructure. Such contestations articulate the relationship between the state, market forces and communities in many networked communities in the city, one that is common for urban dwellers across the city and beyond (Bond, 2006) in which they remain relatively powerless in the face of global, national and local dynamics. Such an interpretation points to ongoing urban revolt and resistance to the continuing exclusion and marginalisation in the governance of networks and is concentrated on the fight for the power to control urban infrastructure, be that housing, electricity or water systems. This conflict over the power to reconfigure has become part and parcel of the experience of many low-income urban dwellers in South Africa.

Protests, community mobilisations and practical solidarity have played an important role in the ongoing struggle for residents in Mandela Park to be able to be assert power over urban space. These forms of resistance to the actions of the state, banks and other organisations have tended to characterise social movements in urban poor spaces of the city:

“The community movements respond to attempts to evict people from their homes or to exclude them from water, electricity and education with actions designed to prevent and reverse dispossession. Their actions are largely defensive and reactive” (Desai and Pithouse, 2004:260).

Yet importantly, when considering this conflict the Mandela Park community has not simply rejected the governance (dominated by the state and bank nexus) by resisting the way reconfiguring of the infrastructure unfolds. Members of the community actively seek to take control/power of local infrastructures through the ways in which such networks are reconfigured. This interpretation suggests a series of incremental responses from residents in Mandela Park can challenge particular arrangements of governance and the attendant power relations through everyday actions. Such community responses, recognising the impasse of any state-led development or investment and the desperate need to reconfigure the unequal forms of urbanism thus seek to assert the power of the community to use infrastructure and the ability to reconfigure the networks of the area. This is urban space characterised by the community themselves working on the construction of housing and the reconfiguring of energy networks outside the terrain of civil society (Chatterjee, 2004) in the form of the state (municipality and ESKOM, national departments and so forth) the ANC and other urban intermediaries such as NGOs. Through self-built housing and other improvised actions including a start-up brick making project, the community is reconfiguring the networked systems, through interventions into housing, as a response to current institutional arrangements and conditions that reinforce a state mediated, neoliberal influenced governance and have brought little improvement in socio-economic status for many households. Such actions produce processes of urban learning and knowledges through, “gradual manipulations of the urban environment” (McFarlane, 2011:36) and at least partly relate to those being developed in Kuyasa, the neighbourhood across the road from Mandela Park. These dynamics suggest a, “form of incremental learning that tweaks and alters existing urban arrangements” (McFarlane, 2011:176) with residents becoming skilled in understanding obscure banking regulations, building new housing or resisting militarized demolition processes. Yet this urban learning takes place in a very different context than in Kuyasa and produces infrastructure outcomes that are often temporary, disputed and contingent on being continually defended from a developmental state and the banks that seek to assert their power over this urban space. Simultaneously, these processes of urban learning and contestation of power emerging from the conflict over the area’s infrastructures, generates knowledges from Mandela Park that can help shift community struggles beyond the ‘militant particularism’ that has characterised much community resistance to repression (Desai and Pithouse, 2004). Yet, the power to transform the local infrastructure and change the context within which residents live their lives through these processes of learning are ultimately limited by how the state responds to such developments, revealing the central role of the municipality and wider state institutions in controlling the metabolic flow of resources, in this case energy into the neighbourhood.

7.2.4 Inter-neighbourhood comparisons of governance in Cape Town

By developing a linked analysis of Mamre, Kuyasa and Mandela Park the aim has been to comparatively reveal the multiple forms of social relations that exist across processes of network reconfiguration in these urban spaces and how these shape the power relationships between different urban actors. This inter-neighbourhood comparison in Cape Town suggests a series of findings that aim to reflect the wider condition of post-apartheid urban (infrastructure) governance in the city and the social relations such arrangements produce. These include how the power relationships between the state, urban intermediaries and local communities, which are configured from these urban spaces, showing that beneath the apparent

commonalities shared by the neighborhoods very different urban worlds exist. The divergent governance in these communities can be partly explained by the histories of the neighbourhoods with all of them being established in different eras of the city's history. Mamre during colonial times, Mandela Park during apartheid and Kuyasa during the post-apartheid era, resulting in very different network histories, subsequent trajectories and relationships between state actors, the private sector, urban intermediaries and communities. Yet this account cannot fully explain the social relations that characterise the neighbourhoods during processes of network reconfiguration. Secondly, the analysis has illustrated the very different processes by which networked systems are reconfigured in post-apartheid Cape Town. The purpose of this analysis is to suggest that the three neighbourhoods can act as a reflection on the wider conditions of networked systems across the city and help to illuminate the logics that shape urban governance and mediate power relationships. Here, the process in Mamre can be considered as partly embodying the promises of the post-apartheid era in that RDP housing and the subsequent ceiling insulation have been provided by the state as part of significant investment in urban infrastructure in the community. Yet many problems remain for residents in Mamre who, whilst not the poorest section of society, still remain in conditions of poverty through a marginalised socio-economic status. The network reconfiguration process in Mamre comes to represent the most common experience of service delivery in Cape Town which shows the potential limitations of a developmental state operating within neoliberal, macro-economic constraints and to an extent a powerlessness in the face of ongoing metabolisms of capital, climate and crisis. This is a state that is able to deliver networked services and reconfigure infrastructures to a significant number of urban dwellers, but leaving thousands without services, and even those who have services living in conditions of poverty and marginalised from exerting any form of control of infrastructure investment. In Kuyasa the process suggests a possibility of a different trajectory of network reconfiguration within the city based on the notion of co-production. Kuyasa illustrates the potential of Cape Town's low income communities to actively shape the flows and circulations of infrastructure investment that make significant impacts on households and importantly involves forms of learning that equip the residents to hold the power to make further network reconfiguration. The community of Kuyasa, increasingly middle class, can be mobilised in the analysis to suggest it embodies the hopes and dreams of the post-apartheid era, of the steady growth of (some of) the black population, of sustained investment in infrastructures, housing and urban spaces and the urban knowledges to continue to exert control over network reconfiguration. The analysis emerging from Mandela Park offers an alternative questioning of state and market power over processes of network reconfiguration, but from a very different angle to that of Kuyasa. Unlike the co-production and collaboration in Kuyasa, the social relations across Mandela Park are dominated by conflict and contestation between the various urban actors. Such conflict suggests the lost hope of many urban dwellers in post-apartheid Cape Town. The community has had little infrastructure investment and has articulated a challenge to the ANC (and DA) hold on power over reconfiguration. This takes place not just by resisting the actions of the state, but by seeking to articulate material responses to the crisis facing many poor households in the neighbourhood, to reshape the metabolic landscape of the area. These material responses are actions that illustrate the ways in which residents respond to the power relationships across urban governance. The comparative analysis undertaken across Mamre, Kuyasa and Mandela Park provides accounts of the different ways in which urban (infrastructure) governance is configured across the electricity systems of these low income neighbourhoods

and the resulting power relationships between those involved. These ongoing and shifting relationships provide a way to consider wider city scale governance and the ways in which networked systems both reflect and reinforce power relationships across Cape Town (Section 7.3).

7.2.5 Ga Mashie: One neighbourhood, many forms of governance?

Whilst the analysis of the social relations across governance in Cape Town's low income, networked neighbourhoods sought to develop a comparative analysis drawing out some of the key differences across each area, the analysis in Accra focuses on identifying comparative differences in power relationships within one neighbourhood. Significant network reconfiguration is rarely undertaken in Ga Mashie, beyond the daily, incremental practices of the residents in sustaining flows and circulations of electricity. This condition reflects the lack of infrastructure investment in the area and suggests the limited capacity in current governance to generate the resources required for reshaping the electricity system and showing how the state, whilst able to exert power over the urban poor is itself in a position of powerlessness in relation to wider political economic conditions. When network reconfiguration has taken place it reveals the central role of the state through the ECG and municipality in mediating the processes and the conflict that is sometimes generated. Emerging partnerships in the neighbourhood are beginning to shape new forms of urban governance that suggest a series of possible new arrangements, relationships and processes of network reconfiguration.

Instances of state controlled infrastructure investment include the construction of the electricity network in the years after independence, welcomed by the community that was not actively involved in the governance of these works. The introduction of PPM for electricity, described earlier in the thesis provides an example of a state led network reconfiguration that can provide insights about power relationships in the area. This was undertaken by the ECG, with the PPM welcomed by a number of households in the neighbourhood (around 65 percent in the household survey) yet little choice or debate took place before this intervention by the ECG. Furthermore, for the poorest in the community the reconfiguration potentially reinforces inequality by making payment up front a requisite of accessing circulations and flows of energy and shifting power back to the utility in its objective of increasing revenue. Recognising that such reconfiguration could potentially create conflict with the community, the ECG offered a number of inducements to manage the process (such as dropping unpaid bills) as part of a strategy to manage conflict during the process. For other residents the power of the state utility over the energy network in Ga Mashie and during the process of PPM installation has been contested with conflict occurring. During the installation of PPM, conflict between the community and the state (represented by the ECG) was generated at a number of different junctures that exposed the ways in which the state exerts its power over infrastructure. Firstly, the network reconfiguration was undertaken without consent in a number of households in Ga Mashie. The process of installing the PPM involves reconfiguration of the network within the homes of the residents. For those that did not agree to this network reconfiguration they were ultimately forced to allow the ECG to enter their homes and allow them to undertake the work, "Government then came and told us we had to comply and they would turn up at the house at the end of the day, we had no choice" (Participant, resident workshop #4). The process of

installation of PPM was resisted by a number of households by refusing to let ECG into homes to introduce the technology. Police intervention was used to gain access and ensure that the PPM was fitted, creating a further level of resentment, anger and conflict from affected households and showing how the power of the state to reconfigure is partly predicated on force and potential violence. The conflicting interests of the state and some residents during this process is further illustrated by the explicit threats by ECG toward those households who would not agree, “Government says it is compulsory and threatens disconnection” (Accra politician #2). A second area of conflict was predicated on a promise, ultimately retracted by ECG and generating further anger and conflict surrounding the process of installing the PPM. Households were offered free PPM and the clearance of any outstanding electricity charges which encouraged take up of the technology amongst many households, particularly the poorest who struggle with energy poverty and were in debt to the ECG and can be considered a strategy of conflict management during the process. However ECG has now reversed this decision with the requirement for households to make these payments, some of which include six months of outstanding charges, creating new financial burdens on households. As an Accra politician (#2) explains, “for now people are not happy as the ECG or the government had said when installing new meters that people would not have to pay bills and so people were happy”. Now, “this old debt has brought chaos and confusion” (GAMADA representative) and subsequent anger amongst many residents in the area. Such instances during network reconfiguration reveal the multiple ways in which the state seeks to manage networks and the range of ways it seeks to assert its power over these processes.

Further instances of conflict between the urban actors involved in network reconfiguration also take place in Ga Mashie. One such form has been the ongoing struggles around demolition, (Section 6.3.2), which show how rising land prices, the neoliberalisation of urban space in Accra and the focus of the state on attracting inward investment into central Accra has further marginalised the power of the Ga Mashie community over its built environment and networked systems. Such conflict has resulted in protest by the community as a way to voice concerns and articulate a challenge to the power held by the state, “Sometimes there is spontaneous anger that is not organized” (Accra politician #2). This illustrates the everyday challenges to the power held by particular institutions and intermediaries. As outlined earlier in the study such demolition attempts seek to undertake significant network reconfiguration. Moreover, the reshaping of the geographies of the neighbourhood generate uncertain futures for local households and creates a relationship of conflict, mistrust and antagonism between the state, private sector and the community. Demolition attempts and ongoing conflict around these issues are not new and suggest a history of power struggles in the area over control of infrastructures. These can be seen from the challenging of colonial edicts through to President Nkrumah seeking to radically alter the neighbourhood in the 1960s and disputed claims about land characterising the neighbourhood to the present day (Section 4.2.1). The conflict between various urban actors, particularly the state and the community, over power in Ga Mashie suggests a number of important considerations. Firstly, the community has been historically vulnerable to contestation of land by the state and markets due to its proximity to central Accra. Secondly, the community resists such demolition attempts through often unorganised mobilisations that in some cases can stop the municipality from carrying out network reconfiguration. Yet the power of the neighborhood’s residents to put themselves at the centre of governance is limited and partly rests in resistance to actions by the state and, like Mandela Park, the ability

to develop alternative, incremental responses that remain contested and fragile. The third insight suggests that Ga Mashie can act as a case study to represent wider relations between the state and other networked communities across Accra. Overall the lack of state led network reconfiguration in Ga Mashie, (beyond the PPM technology) over the last couple of decades can be characterised as limited, with few changes to the infrastructure of the neighbourhood even as its population and their needs have grown significantly. This lack of network reconfiguration shows the limits of what current urban governance can achieve in Ghana's cities due to the resource constraints of municipalities and national government, "Accra Metropolitan Assembly is basically a reactive institution whenever there are problems, if there isn't a problem they won't go to the area" (Accra NGO worker #2). Here the limits of a post-neoliberal shaped urban governance (Ong, 2006) are visible, suggesting conditions, "where (urban) state capacity has been decimated and disconnected from viable policy circuits, or where local states have not been effectively established and so cannot be rolled back, privatized, or decentralized (Parnell and Robinson, 2012:601). However, emerging institutional partnerships, arrangements and plans may reshape this post-neoliberal governance and the accompanying relationships between different urban actors.

The developing work and partnership by CHF International, the international NGO that is now operating in the neighbourhood, alongside GAMADA and the community is prompting changes to the urban governance of Ga Mashie that suggest a series of intersections between current governance and possible future configurations and how the social relations of the area are produced. Firstly, this emerging partnership has been made possible by the work of GAMADA in seeking and subsequently securing investment into the neighbourhood:

"Importantly there was an agency established by the AMA that is able to co-ordinate all development activities in Ga Mashie so that is more or less an element that we can build upon. So that is why we chose Ga Mashie" (Accra NGO worker #2).

These forms of partnership and the role of the municipality in establishing GAMADA to attract investment, point to different intersections with neoliberalism than the lack of state action predicated on conditions of post-neoliberalism (Ong, 2006) described above and in which this urban space has been partly excluded from, "neoliberal forms of rule" (Parnell and Robinson, 2012: 600). By considering these new governance arrangements a significant change in the social relations of the neighbourhood becomes visible. Here neoliberal strategies and policy circulations have been adopted by the state through the establishment of GAMADA as a vehicle to attract a wider partnership of actors in order to link into financial investment not available to the state. This is a new institutional arrangement in the neighbourhood that illustrates how the area is being used as a testbed for new forms of network reconfiguration and accompanying governance. Whilst it shows the lack of capacity and resources the municipality has to improve Ga Mashie's urban infrastructure it also suggests that GAMADA has acted to connect to circulating knowledges via the embedding of a neoliberal logic around discourses of urban improvement and the prioritisation of private capital to shape and improve infrastructure.

A second consideration emerging from this institutional arrangement is focused on the power of the community to shape networked systems. The redevelopment of Ga Mashie is predicated on seeking to address housing and wider poverty issues that may centre the involvement of the community through the co-production of a new development plan in improving socio-environmental conditions. These processes may hint at a similar long term programme of network reconfiguration to Kuyasa, led by the community and supported by various intermediaries, state actors and other institutions that may reorientate power relationships. What remains unclear at this juncture is how this emerging governance will reconfigure the power relations between these different urban actors involved in the process. The role of the community has yet to be fully defined and the danger exists that this could potentially fail to empower the residents in the process (by providing the ability to reconfigure). Whilst Ga Mashie has a relatively high number of households with land deeds, needed as part of the NGO's strategy to purchase, redevelop and rehouse it is unclear what will happen to those without deeds. As such it will be important over the coming years to consider whether such residents will lose their current land, be rehoused or simply displaced, mirroring wider urban dynamics in which, "Over the past decade we have seen the rapid and visceral emergence of state-led gentrification in the global South that is increasingly prevalent in global South cities" (Lees, 2011:156)⁶⁷. The rhetoric of CHF International in relation to working in low income communities, suggests the potential for a widening of current governance that gives power to the community, despite the many potential hurdles in the process, through a commitment to work closely and help empower the local community:

"We don't directly intervene in the community but we engage all the local NGOs, public institutions to deliver the various interventions that have been planned. So for SCALE UP we basically have about four objectives; the first one is engaging civil society, the second is working with local NGOs to see how we can strengthen their capacity so we can lever the type of interventions that we want to achieve and to bring them closer to institutions, basically the city authority, in this case the Accra Metropolitan Assembly; then delivering the type of development the community want; the third one is the direct intervention where we partner to build up the economic assets of the poor with their businesses or if their landlords and how we can help them to maximize their investments and how to improve the infrastructure that may help their living conditions in the slum" (Accra NGO worker #2).

These actions being undertaken by CHF suggest the potential for a similar co-production of reconfiguration (Joshi & Moore, 2004) in the redevelopment plans for the neighbourhood to that being undertaken in Kuyasa, Cape Town, which has taken a decade to develop and deliver but has reshaped power relationships in the area. Alongside the commonality of process are the accompanying institutional arrangements which suggest new and emerging directions in governance in Accra. Whilst it is still too early to view whether such dynamics will significantly change the power relationships between different urban actors, it clearly represents an important moment in the governance of Ga Mashie and the wider city.

⁶⁷ Such issues have recently come to the fore in Accra with Old Fadima, the informal slum in close proximity to Ga Mashie facing the end of a battle between the state and residents that has been ongoing over a number of years about displacing the current residents numbering 50,000 and undertaking a \$600 million project that aims to transform the lagoon into a transport and leisure hub.

7.2.6 Intra-neighbourhood comparisons of governance in Accra

Ga Mashie provides an example of how governance includes different urban actors in network reconfiguration within the same neighbourhood and contributing to the emerging picture of multiple and overlapping arrangements, imperatives, diverse urban worlds and myriad different processes across one particular urban space. The absence of significant reconfiguration (like for instance the SWH, ceilings and such like in Kuyasa) suggests that few financial resources exist for the state to invest in the neighbourhoods electricity network. Where it has, in the form of the PPM intervention, this has been to increase revenues from the electricity system and predicated on the increasingly neoliberal character of the state utility, ECG (Honkaniemi, 2010). The daily incremental practices of network reconfiguration as in the other case study areas provides one neighbourhood response to such current conditions with residents involved in the constant and unmappable changes to the electricity network that at different junctures intersect in different ways with the state, private sector and other urban intermediaries and the power relationships of these arrangements. When changes to the network take place, in the form of the PPM installation, such processes provide an example of how reconfiguration produces and mediates a series of different relations. For some members of the community this was viewed as a welcome reconfiguration of the network, showing the role of the state in supporting their energy needs. For others this was a deeply conflictual process, with police and force being used to compel reconfiguration of the network and assert the power of the state to intervene across the urban infrastructure of this urban space.

The promise of investment and large scale reconfiguration from CHF International suggests two emerging rationalities and logics that are intersecting with the governance of the neighbourhood. Firstly, the increasingly neoliberal make up of governance in the area after a period of what can be considered post-neoliberalism (Ong, 2006, Parnell and Robinson, 2012) making visible the wider circulations of neoliberal policy knowledges (in this case traced to the Amsterdam municipality). Secondly, these dynamics may provide an opportunity for governance that is more open, but it is not clear how this will unfold and alter power relations between the community, urban intermediaries and state institutions. Ga Mashie inspires a number of important reflections on processes of network reconfiguration in Accra through the multiple arrangements that exist across different processes in the neighbourhood. The next stage of analysis seeks to mobilize these considerations, alongside the assembled reflections from Cape Town to reflect on how governance at a neighbourhood scale and the social relations mediated through such arrangements creates a number of platforms of critique.

7.3 Framing social relations across Accra and Cape Town

The next section explores a number of important logics and rationalities that are intersecting with, reshaping and influencing the directions of urban actors involved in network reconfiguration and the social relations across networked systems in Accra and Cape Town. This is undertaken by seeking to develop analysis that is informed by the governance arrangements and power relations across the neighbourhoods and examining how such relations are constituted by wider logics, imperatives and circulating knowledges. The section

examines a number of issues. Firstly, the limitations of current processes of network reconfiguration in both cities in relation to the hybrid neoliberalisms (Ong, 2006) that intersect with other circulating urban policies and shape particular arrangements of governance and resulting policies. This analysis is focused on how such dynamics mediate the power relationships across networked systems. Secondly, following on from the insight that urban governance in Cape Town is shaped by the intersections of neoliberal discourses and a development agenda the section develops a critique that draws on the limitations of developmental logics and imperatives in Cape Town and the way the state is recognising and responding to such perceived failure through network reconfiguration. Thirdly, the thesis examines new configurations of governance based around emerging response to climate change (Bulkeley and Betsill, 2003, Bulkeley et al, 2011, Hodson and Marvin, 2010), which in Kuyasa and Mamre are beginning to link climate change responses to opportunities to reconfigure networked communities. The section argues these dynamics are becoming increasingly important in the social relations of the city as the climate change and energy agenda increasingly intersect with other urban imperatives (Section 1.1.3).

7.3.1 Intersections of hybrid neoliberalism and network governance

An analysis of processes of network reconfiguration in the case study neighbourhoods suggests that whilst various forms of neoliberalism are, “not the only relevant form of circulating urban policy knowledge” (Parnell and Robinson, 2012:594) they suggest an important dynamic in shaping the imperatives of urban governance in both cities and in mediating network reconfiguration. As such the role of neoliberal processes, knowledges and policies at a city scale needs to be unpacked from the neighbourhood analysis and focused on:

“Understanding the gyrations and mutations of actually existing neoliberalism, and positioning these projects within social fields and ideological landscapes that include a range of hybrid formations, orthogonal initiatives, and oppositional counter projects” (Peck et al, 2009: 105).

Various (mutated) forms or hybrids (Ong, 2006) of neoliberal urban knowledges, policies and processes have a central role in how urban governance in both cities is implicated in the structuring of networked systems in low income neighbourhoods. Whilst these urban spaces are different they also share an ongoing sense of crisis (see chapter 5) around the electricity systems that criss-cross the areas. Such crisis exists in contrast to the premium network spaces of the middle class and elites in both cities and reflects the wider socio-environmental inequalities characterising Accra and Cape Town. Thus, the emerging evidence from the case study neighbourhoods and in the context of the wider city suggests neoliberal discourses are shaping the imperatives and actions of actors involved in urban governance to produce an increasingly post-networked (Courtard and Rutherford, 2011) market orientated urbanism for Accra and Cape Town. In these urban spaces those able to finance reconfiguration are able to do so, and those who are not rely on hoped for investment from the state, other urban intermediaries or are forced to engage in incremental and improvised practices. Such simultaneously global and localised neoliberal dynamics show the inequalities in the ability to reconfigure networks, the multi-scalar power relationships beyond Accra and Cape Town and the way in which neoliberalism shapes institutional arrangements and priorities that marginalise low income

communities. These dynamics foster an accelerating splintered infrastructure whilst reinforcing the further unbundling of these systems (Graham and Marvin, 2001) because they seek to attract private sector investment that is mediated via market logics and aimed at middle class and elite urban dwellers. These dynamics show how networked systems are partly embodying (neoliberal) processes that signal changing material and socio-economic practices and conditions mediating urban infrastructures (Swyngedouw, 2003). Neoliberal processes have predicated what Ong (2006:3) has described as a, “reconfiguring [of] relationships between governing and the governed, power and knowledge, and sovereignty and territoriality” across the networked systems of Accra and Cape Town. When considering these processes across the case study neighbourhoods these neoliberal dynamics and intersections with governance have very different forms across both cities.

Accra

The hybrid forms of neoliberalism in Accra suggest the city’s governance can be partly characterised through the notion post-neoliberal (Ong, 2006) which provides an articulation of the lack of state intervention across networked systems due to the limited financial and resource capacity to intervene. Yet, the emerging governance in Ga Mashie, incorporating international NGOs, the community, municipality and other urban intermediaries points towards a more orthodox neoliberal governance arrangement. Parnell and Robinson, (2012: 145) discussing Ong’s (2006) exploration of a post-neoliberalism suggest the argument, “implies that there are places where neoliberalism has little impact, or at least a set of places with high levels of urban poverty, informality, or traditionalism where the impact of neoliberalism may be muted, if it is present at all”. This insight can be partly applied to Ga Mashie and other low income neighbourhoods in the city in which the state only partially operates. These post-neoliberal conditions can be explained by the Structural Adjustment Program (SAP), which has significant influence on the governance in the city since the introduction in 1982, under the guidance of the World Bank and International Monetary Fund (IMF). These dynamics implicate these institutions in uneven power relationships with both the state and low income, networked neighbourhoods. The SAP in Ghana, as in other global South countries, was predicated on reducing government expenditure, via mass privatisation of public goods, and the halting of subsidies to sectors of the economy, including for instance, and 80 percent decrease in spending on health and education (Davis, 2006). These dynamics were accompanied by seeking to create a pay as you use model for networked services (Peck and Tickell, 2002) with the aim to manage infrastructure like a business, and not like a bureaucracy. A range of consequences were, and still are being felt from the SAP across Ghana and Accra that share both commonalities and points of divergence with other African cities experiences of SAP, as Konadu-Agyemang (2000:481) describes these include, “Rising poverty levels, high rates of unemployment, reduced access to basic services and increasing levels of spatial inequalities”. These dynamics produced through SAP and the associated changes in urban and national governance of networked systems decimate state capacity (Parnell and Robinson, 2012) and suggest that Accra operates under a post-neoliberalised urban governance in which the state doesn’t have the power to develop large scale reconfiguration responses to conditions of socio-environmental poverty and inequality. The influence of these urban knowledges on governance is visible across Accra’s networked systems, acting to further splinter

the networks between those able to invest in technologies and post-networked systems (Courtard and Rutherford, 2011) and the urban poor who are unable to maintain and sustain such infrastructures, in what can be considered the marketisation of networked services across the city. This process is infused with power relationships that have marginalized low income communities at the expense of market dynamics, incorporating international property developers, banking institutions and consultancies, supported by the state and the (limited) power (in relation to the urban poor) it is able to mobilise.

Yet, alongside this intersection of post-neoliberalism and urban governance the emerging partnership in Ga Mashie suggests that urban governance in the city may become more characterized by traditional neoliberal governance arrangements as the state explores way to attract infrastructure investment. The establishment of GAMADA provides a tentative step in developing such arrangements. Its structure, derived from a design by the City of Amsterdam represents a configuration of urban governance characteristic of a European/North America 'neoliberal growth coalition or regime' that focuses on attracting non-state investment (Jessop, 1998, Peck and Ward, 2002, Ward, 2003). The success of GAMADA in attracting CHF International into the neighbourhood suggests that the municipality are keen to embrace this new logic of public-private partnership. The agreement from both GAMADA and CHF to mobilize the land values of the neighbourhood as a way of financing redevelopment and reconfiguration suggests that the financial considerations of these urban intermediaries remains focused on using the market to reconfigure infrastructures in urban poor areas. Ga Mashie may well act as a test bed to explore how the municipality can go about significant network reconfiguration through widening the scope for other urban intermediaries to participate in reconfiguring infrastructures suggesting an increasingly neoliberal orientated urban governance in the city. What remains unclear at this stage is how these processes will alter the power relationships between the different urban actors and creates tensions, fragilities and uncertain urban futures in relation to the hopes of empowering the community (Section 7.2.6).

Cape Town

Intersections between neoliberalism and other policy imperatives shape the governance of networks in Cape Town, reflecting the multiple and sometimes competing logics and rationalities that these circulating forms of knowledge produce and show the importance of neoliberal urban knowledges in the city. Post-1994 South Africa, in spite of wider neoliberal dynamics occurring in many other countries, invested heavily in developing networked systems for the urban poor, together with wider public investment pathways (Van der Berg et al, 2006). Such developmental imperatives, predicated on the post-apartheid consensus can be seen across Cape Town in the dozens of new networked settlements built across the city since 1994 with power relationships characterized by the state seeking to reshape historic metabolic flows into the urban environment and simultaneously retaining control over these processes. Yet this developmental agenda intersected with wider macro economic processes in the form of a series of neoliberal reforms, especially the Growth, Employment and Redistribution (GEAR) framework (Turok and Parnell, 2009). As Oldfield and Stokke, (2006:145) suggest these intersections instigate a change in governance that has to an extent, "moved from statist service delivery to neoliberal partnerships with private sector actors". What is clear from

the case study neighbourhoods is that the state, including in Khayelitsha the utility ESKOM through its metering technologies, continues to invest significant flows of capital into networked systems across the city but increasingly through the logic of the market, using such processes to justify its continued control over infrastructure. Simultaneously the state has been restricted from achieving universal provision of services or the wishes and wants of the urban poor forcing the municipality to explore wider partnerships to achieve such objectives. Processes of network reconfiguration in the city display multiple and competing logics as Lemanski, (2007:454) suggests, “Cape Town is promoting both pro-growth and pro-poor strategies” and showing a tension across various urban actors in the city between the neoliberal influenced ‘global city’ and the developmental influenced ‘just city’. As the subsequent section explains these intersections of policy have limited the developmental aspirations of the city and urban intermediaries forcing them to think about responses to such limitations, generating the potential for new configurations of power.

7.3.2 Responding to the limitations of developmental governance

“One cannot live a life one values if your shelter leaks when it rains, is vulnerable to structural collapse or is not safe or secure” (Helen Zille, Western Cape Premier, former mayor of Cape Town).

As Parnell and Robinson, (2012: 145) argue the, “South African state has grappled with means to institutionalize and deliver on its development imperatives locally, it has made particular choices at the macroeconomic scale”. The limitations of these intersections of neoliberal and developmental agendas across Cape Town are evident in the case study neighbourhoods. The network reconfiguration in Mamre and Kuyasa suggests important emerging dynamics across infrastructures in Cape Town. Whilst displaying different institutional arrangements they both show that urban actors, particularly the CCT are recognising the limitations of urban policy that incorporates both developmental and neoliberal logics, different institutional arrangements, policy knowledges and so forth. This (part) acknowledgement of failure in uplifting the urban poor can be seen by the further attempts, via reconfiguration, to improve the socio-environmental conditions that characterise low income, networked communities. The delivery of RDP housing and accompanying networked services provides the key means for the CCT to improve conditions for the urban poor and has become a mainstay of municipal policy. Thus, the provision of housing and creation of home ownership operates as the de facto, poverty alleviation strategy (Lemanski, 2011) influenced by an intersection of neoliberal and developmental rationalities. Yet for many of the urban poor the acquiring of a RDP house does not easily translate into improvements in livelihoods, health and other indicators of socio-economic status as they move from informal settlements to state financed housing. As chapter five explores the current housing being provided by the state is implicated in a series of metabolic processes that produce socio-environmental inequalities, imparting a vivid example of the limits to the development aspirations of the state. The growing recognition that having an RDP house and connection to networked services does not mean households can afford such services has instigated a growing challenge from urban dwellers concerning the power of the state to monopolise the governance of the city. These conditions have prompted a focus on the quality of the house as a key mediator in such dynamics. Such insights are mobilising the state (alongside others) to consider how it can reconfigure networks in already existing housing stock across the city’s low income landscapes and assert its power to continue to manage

infrastructure. The governance in Kuyasa and Mamre can thus be understood as predicated on an emerging institutional response and corrective to a housing at any cost as long as it's cheap policy that has shaped urban policy in the city and resulted in challenges to state power over networked systems.

Cape Town's sub-standard, publicly constructed housing, alongside accompanying energy networks, reveal the need for state actors and urban intermediaries to not just consider delivering basic housing and service infrastructures, but also providing the infrastructures, technologies and build quality for the urban poor to lead dignified lives, rather than face sustained network mediated crisis and resulting inequalities incorporating health, livelihoods and so forth. Dignified housing can be viewed in this context as a decent standard housing that moves away from the cheaply built housing in which key costs, such as energy flows and connection to the network are transferred from the state to poor households and are illustrative of the inequalities and splintered urbanism present in socio-spatial relations across Cape Town (Bulkeley et al, forthcoming). Network reconfiguration offers the potential to improve housing quality and the socio-economic status of households, and offers the opportunity to rectify the growing sense of the failure of the home ownership model, via the RDP, to generate dignified lives for the urban poor. The potential for these network reconfigurations to improve the dignity of families in RDP housing may perhaps fundamentally reshape urban governance imperatives and objectives in Cape Town in order to secure the ongoing power relationships involved in development. Such dynamics may shift the focus onto supporting not just the informal poor but also engage with households and communities that remain in conditions of poverty and socio-environmental inequality after government financed housing and services have been delivered. Equally such network reconfiguration may be used as a strategy to sustain the existing neoliberal rationality of home ownership in Cape Town that has characterised urban governance in the city (Bulkeley et al, forthcoming). What is clear is that these responses from both the state and civil society illustrate the wider limitations of urban governance predicated both on intersections of developmental and neoliberal visions of the city in acting upon historic urban inequality and splintered urbanism. Thus, the implications of Mamre and Kuyasa for debates about network governance in Cape Town are potentially significant. The raising of the quality of housing and wider networked infrastructures may provide a potential platform for social justice campaigners to coalesce around and further articulate the demand for dignified lives through infrastructure quality as well as quantity. It also illustrates the significant task facing the state in retaining the power to shape infrastructures, not just in the informal settlements, but in the low income, networked communities featured in this study, suggesting that new urban governance arrangements will be needed to sustain current power relationships across the city and the legitimacy of the state at the centre of these relations.

7.3.3 The emergence of climate change governance

Throughout the thesis the research on urban energy networks has intersected with climate change issues both within the neighborhoods and through the wider research undertaken. The institutional arrangements involved in the reconfiguration in Mamre and Kuyasa suggest the growing importance of climate governance in Cape Town (Cartwright et al, 2012) and the way these responses are beginning to unfold across infrastructure systems (Bulkeley et al, in review, While et al. 2010, Hodson and Marvin 2010). Such

dynamics suggest that infrastructure and particularly energy networks are becoming critical sites in the grounding or urbanization of climate change responses (Bulkeley, et al, 2013, Bulkeley et al, forthcoming). As both Kuyasa and Mamre show housing is at the centre of these responses, showing how the house is increasingly enrolled within the wider energy network through these emerging logics:

“As Lovell (2004) explains, ‘sustainable housing’ has become framed as a solution to the climate change problem both because of the flexibility of the concept and because of its apparently ‘ready to hand’ nature, available to be enrolled into discourses and programs for addressing a multiplicity of issues, from energy security and affordability to climate change” (Bulkeley et al, forthcoming).

Yet, in Accra, the entrenched neoliberal/post-neoliberal condition (Section 7.3.2) has meant limited resources across the municipality and various tiers of the state to negotiate the growing climate and carbon financing landscapes. Such limited capacity means that flows of finance remain absent and such governance intersections limited, suggesting that these new circulations of capital into infrastructure systems may reinforce current configurations of power and social relations both at a city level and at an international scale. A Ghana national policy maker (#3) comments about these relations at an international level:

“Unfortunately we wanted to tap into the international climate change Adaption Fund and Ministry of Finance was doing this, however there has been a set back, the Ministry has been refused the status of administrator of the Adaption Fund for Ghana by the fund on the grounds of capacity”.

Adaptation and mitigation in cities will form a significant proportion of climate change financing (Ayers, 2009) and open the possibilities of significant opportunities for network reconfiguration in low income communities, such as Kuyasa and Mamre. These dynamics suggest new forms of multi-scalar governance that will interact with existing configurations (Hodson and Marvin, 2010, Bulkeley and Newell, 2010) and include a range of urban intermediaries beyond the state (Biermann and Pattberg, 2008). This financing landscape creates the need for cities to negotiate convoluted pathways to access and secure these circulations of financing (Romero Lankao, 2007, Bulkeley and Newell, 2010) with the processes in Kuyasa and Mamre suggesting new configurations of urban governance are beginning to emerge to respond to these imperatives. With municipalities such as Cape Town required to work with a shifting series of guidelines, rules and assessments it remains challenging for cities to secure such investment. For cities such as Accra developing such responses is a challenge, with the lack of municipal resources to chart pathways through complicated regulations and requirements and suggests that carbon and climate finance remains difficult to access, reinforcing the status of cities able to devote resources and the organisations and institutions within these cities that control flows of infrastructure investment. Furthermore, like the global financial system, Africa exists very much on the periphery of these circulations of carbon capital, whilst simultaneously being one of the most vulnerable regions to the effects of climate change (Boko et al, 2007, Toumlin, 2009). This has meant that the continent has witnessed significantly less climate change financing than other regions of the global South, particularly in Asia⁶⁸. Whilst much of this investment has not been directed to cities, the clear

⁶⁸ For instance, the Clean Development Mechanism (CDM) provides the largest source of global mitigation funding and is enrolled in the network reconfiguration in Kuyasa. It has circulated significant flows of capital into over 4,000 carbon emission reduction programs, with a value up to 2012, of \$10,453 million. In Sub-Saharan Africa \$464 million has been invested, representing around 3 percent of total funding and a minuscule amount compared to the over \$3,000 million invested in South Asia, representing 17 percent of total funding or the over 75 percent that goes to Brazil, China and India (UNEP, 2008)

disparities between these regions suggest that such unequal circulations of finance are likely to be translated to an urban scale. Despite these inequalities within the wider climate and carbon financing system its evident that urban (infrastructure) governance will increasingly intersect with climate governance and climate change processes, dynamics and discourses (Bulkeley and Betsill, 2003, 2005, Meadowcroft, 2009, Bulkeley and Moser, 2007). It is at this juncture that the importance and potential of emerging climate change governance and network governance becomes visible. Whether such new governance will alter power relationships across low income neighbourhoods remains unclear, with the case studies showing how these new circulations have both reinforced current configurations of power (Mamre) whilst opening up new possibilities for residents to plan, control and manage infrastructures (Kuyasa).

7.4 Empowering low income neighbourhoods

The previous sections of the chapter explored the dynamics between ongoing governance and power relationships at both a neighbourhood scale and a city (and beyond) scale arguing communities in low income, networked neighbourhoods are often, although not always marginalised from processes of network reconfiguration. The power, that is the inscribed capacity (Allen, 2004) of these urban dwellers to shape and mediate processes of reconfiguration is often limited in contrast to the power of the state and other urban intermediaries, influenced by intersections with various circulating urban knowledges, such as neoliberalism and developmentalism that manifest in multiple ways across the electricity networks of both cities. The next section explores and reflects upon some of these strategies in which low income communities contest the power to reconfigure networks. This is an important constituent of a UPE analysis as:

“To the extent that an emancipatory urban politics resides in acquiring the power to produce urban environments in line with the aspirations, needs and desires of those inhabiting these spaces—the capacity to produce socially the physical and social environments in which one dwells—the question of whose nature is or becomes urbanized must be at the forefront of any radical political action” (Swyngedouw and Heynen, 2003:915).

The aim is to analyse the ways in which the communities mobilise to reconfigure infrastructure which suggests important insights about the power relationships that exist in both cities and the mechanisms used by the urban poor to shift these relations. This is important as, “Whether one is in favor of state-driven development or not, it is self-evident that a large part of the resolution of the African urban crisis will come from the efforts of the urban poor themselves” (Pieterse, 2010b:14). The section begins by situating the power struggles over networked systems before suggesting that the work of Chatterjee (2004) provides a useful tool to consider the post-colonial and post-apartheid urban worlds in which contestation over power to transform networks forms an everyday part of many urban dwellers lives. The section mobilises these insights to argue for the importance of contestation undertaken across the terrain of ‘political society’ in low income neighbourhoods as a way to reconfigure the power relationships mediating the networked systems through material practices. Finally, the thesis explores and reflects on how challenges to the power to reconfigure can also take place across the terrain of ‘civil society’ through processes of co-production.

7.4.1 Contesting power on the grid

“There’s a war in the ghetto, there’s a war in the streets and for to long we’ve been facing defeat”
(Lyrics from ‘War on the Streets’ by Soundz of the South collective)

The above lyrics from the Cape Town hip hop collective, Soundz of the South, provide a cultural expression of the ongoing power struggles taking place across the poor spaces of the city providing one way in which criticism and critique of existing power relationships is brought into the public realm. The thesis has argued that issues such as energy poverty and processes of reconfiguration are not simply predicated on the terrain of the technical but that, “technology itself is embedded in and is an expression of a wider political discourse and practice” (Swyngedouw, 2004:176). Whilst the state and other intermediaries mobilise around technological issues and discourses of developmentalism, improvement and managerial approaches to networked systems these urban governance actors are of course masking the deeply contested and political nature of infrastructure in the city. The political nature of infrastructure also centre’s the politics of network reconfiguration as the process through which urban actors reshape not simply the technologies but wider social relations of both cities. As such low income, networked communities are sometimes forced to contest and challenge the power of urban governance in both cities to reconfigure networks. The ongoing conflict in Mandela Park and, to a lesser extent, particular spaces in Ga Mashie illustrates the response of the state and urban intermediaries to such challenges. In Cape Town the asserting of power by the municipality in Mandela Park is sadly replicated in other networked and particularly non-networked, informal communities, generating an increasingly bleak picture of the relationship between the post-apartheid government, state agencies and the urban poor. This use of force, to assert the power of the state to control urban space and infrastructure adds to the serious concerns in South Africa that are emerging not just from high profile incidents, such as the murder of Andries Tatane⁶⁹ or the Marikana massacre⁷⁰, but the everyday ways in which the deteriorating relationship between the government and the poor occurs across networked systems. In Accra, similar scenarios exist for many low income residents, with the municipality and other urban actors, including the banking sector exerting power over urban spaces and networked services. This power to shape urban space and reconfigure networks is made visible through a range of different moments of conflict. During these moments of conflict the state and private sector are often prepared to use force and assert power over the urban poor in order to forcefully reconfigure the energy network and wider infrastructures. Both the conflict in Ga Mashie and Mandela Park together with the power relationships in other neighbourhoods suggest a divide between those institutions that hold power over urban space and processes of reconfiguration and low income communities that seek to shape their neighborhood’s networked systems, improve conditions of poverty and participate in decision making.

⁶⁹ Andries Tatane died during a service delivery protest in Ficksburg in April 2011 and six police officers are currently facing charges in connection with his death that was filmed and broadcast across South Africa, bringing shock and anger to many.

⁷⁰ The death of approximately 47 people during August 2012 was the largest lethal use of force by the South African state since the 1960s and was the culmination of a strike by miners working at mines owned by Lonmin in the Marikana region.

7.4.2 The domain of power politics

This divide or split between those that hold considerable power, as inscribed capacity (Allen, 2004) over reconfiguration and often marginalised low income communities who have less power can be considered through the work of Chatterjee (2004:39) who provides a way to consider and reflect on the, “split in the domain of politics between an organised elite domain and an unorganized subaltern domain”. Chatterjee (2004:40) does this by arguing that:

“Many of these groups, organised into associations, transgress the strict lines of legality in struggling to live and work...in dealing with them, the authorities cannot treat them on the same footing as other civic associations following more legitimate social pursuits. Yet state agencies and NGOs cannot ignore them either, since they are among thousands of similar associations representing groups of population whose very livelihood or habitation involve violation of the law”.

These ideas of the ‘political society’ outside and beyond ‘civil society’ and the rules, regulations and processes that manage cities provide a (postcolonial) tool that is well suited to considering and thinking through relationships of power in both cities and the ways in which the urban poor challenge existing social relations. They suggest that in the urban worlds of Accra and Cape Town there is a, “constantly shifting compromise between the normative values of modernity and the moral assertion of popular demands” (Chatterjee, 2004: 41). This is a messy politics, one in which groups, associations and such like exist outside the domain of ‘civil society’ and use various tactics and strategies such as popular protest or unauthorised construction to assert claims over the power to shape urban space. It is such struggles over power that partly define processes of reconfiguration across networked systems and highlight the importance of infrastructure in mediating the social relations across cities. This ‘political society’ of conflict (Chatterjee, 2004) over urban infrastructure suggests the need to focus on the improvised and incremental urbanism in such neighbourhoods as a strategy of the urban poor in asserting power over infrastructure.

7.4.3 Contesting power on the terrain of political society: Incremental urbanism

Low income communities challenge the power to reconfigure networked systems, showing how popular protest and mobilised anger provide a strategy or tactic of ‘political society’ to challenge various ways in which the electricity system and wider infrastructures are being reconfigured. The next section seeks to explore strategies beyond what Desai and Pointer (2004) suggest is the ‘militant particularism’ of these actions through considering how material improvisation and incrementalism can shift the power relationships across the infrastructures of low income neighbourhoods.

Incrementalism (Simone, 2004b, 2011, forthcoming) become an important strategy for low income communities to contest power over urban infrastructures through mediating material flows and circulations by the reconfiguration of urban space and in what the thesis suggested in chapter six are dialectical responses to splintered urbanism and socio-environmental inequalities. These improvised practices suggest that in the urban worlds of Cape Town and Accra network reconfiguration generally, and urbanism more widely, is

partly shaped by urban dwellers developing responses to the conditions they find themselves in. As chapter six explores this can take many forms as part of what Simone and Rao (2012:316) argue is the need to “secure for themselves the ongoing possibility to carve out a viable life”. As the thesis shows these practices relate to minor everyday actions such as reinforcing a roof before a storm through to bigger scale reconfigurations such as creating a new street light system or constructing a home. These incremental responses to currently existing conditions of urbanism sometimes are undertaken within existing rules and regulations and sometimes transgress the boundaries of legality (Chatterjee, 2004). What they share is the power for low income communities to take control of urban space in a dialectical response to the processes, dynamics and relationships that shape conditions of poverty through their own actions rather than waiting for the day that a plan is announced by local government. If these incremental strategies are considered through the work of Chatterjee (2004) then the contours of urbanism in the low income neighbourhoods of Accra and Cape Town can be, at least partly characterised as an urbanism from below, in which ‘political society’ creates, reconfigures and shapes a different city, an infrastructure on the peripheries of the spatialities of ‘civil society’. This incremental urbanism which is often undertaken through practices of improvisation that generate new configurations of infrastructure provides an important way for low income neighbourhoods to control the flows and circulations of energy across urban space and as such reshape social and power relations. For residents in Mandela Park the incremental strategies and improvised practices of house construction and network reconfiguration may offer an alternative way to challenge the power of the state and banks beyond protest and community mobilization. Yet for these incremental strategies to be sustained in the long term would involve a recognition of the legitimacy of these actions and the support of wider governance in developing responses outside of current developmental policies, something recognised and demanded by the community in Mandela Park:

“We didn't ask government....you can just provide us with land, that is not a problem but the government does not want to co-operate and we have to wait till the government decide when they want to build the houses....we say wake up and do it ourselves...instead of supporting us they want to demolish the homes, instead of supporting people at the grass roots they want to demolish us” (Mandela Park Backyarder #1).

Pieterse (2008:87), reflecting on the need to widen the urban political terrain through understanding spatiality, provides an important call for urban actors such as the state to consider the demands emerging from Mandela Park:

“If the horizon is extremely limited, spatial configuration continues to produce segregation, fragmentation and exclusion. Alternatively, if the horizons are more open, we are more inclined to use the rich multiplicity of spatial practices to unleash new ways of interaction and engagements”.

These incremental strategies can thus be viewed as both a process by which to address conditions of poverty, a visible way in which the urban poor make clear their recognition that wider power relationships are intricately linked to the electricity system and wider infrastructures and a way for development to take place beyond the monopoly of the state and restraints of ‘civil society’.

7.4.4 Contesting power on the terrain of civil society: Co-production

Whilst the ‘political society’ (Chatterjee, 2004) provides a way to think about how low income communities challenge and contest power over infrastructure these struggles are also taking place in different ways on the terrain of ‘civil society’ that is the formal channels, processes and procedures that constitute the ways in which cities are managed by urban governance. One particularly strategy to shift power to low income communities within the frameworks of ‘civil society’ that has emerged from the research is the co-production of policy and network reconfiguration. The governance of Kuyasa’s infrastructure, together with the emerging institutional arrangements in Ga Mashie, suggest that co-production can become a pathway for poor communities to assert control and power over urban infrastructures through involvement in the conception, planning and delivery of network reconfiguration.

Joshi and Moore (2004) suggest that co-production is driven by two key processes. Firstly, the logistical constraints of the state in wider power relationships with national funding, international capital and the markets driving these partnerships. In Ga Mashie, GAMADA is explicitly established to foster such a partnership in order to secure investment and financing into the neighbourhood and its redevelopment that would otherwise be unachievable through existing governance arrangements and a reactive, resource constrained municipality. Such new configurations of governance may be considered as a strategy by the local state to keep control and thus power of processes of network reconfiguration via a neoliberal form of governance. Yet, equally such partnerships may become a strategy for the urban poor to gain power over the processes of network reconfiguration. The second driver identified by Joshi and Moore (2004) is the wider governance context in which municipal priorities are focused on a multiple of competing objectives, policy goals and strategic visions of the city. In the political arenas of municipal politics in Cape Town and Accra concern with networked systems, the reconfiguration of existing networked systems and the linked energy and climate change agenda is considered of secondary importance, compared to the ongoing and significant requirement to provide basic services for the urban poor living in informal settlements. For municipal policy makers in both cities the recognition that, “from the City side it is very difficult as we have very little resources to do anything” (CCT policymaker #3) is providing the need to consider new strategies in service delivery, particularly for the upgrading of already existing networked systems. These imperatives should and in a number of cases are providing the opportunity for control and power over networked systems to be shifted towards a focus on the residents of these neighbourhoods. Odendaal (forthcoming) shows that in Cape Town the emergence of institutional networks and partnerships between Slum/Shack Dwellers International, the municipality and national departments are being explored in the context of wider conflict and struggle between these groups. Such co-production is focused on delivering pragmatic responses to the local issues facing informal settlements and, alongside Kuyasa, suggests a wider possible change in the power relationships that mediate urban infrastructures of the city, foregrounding the urban poor to guide and control the pathways of reconfiguration. As such co-production points to the potential for these institutional arrangements to reconfigure power relations in and across networked systems and may become increasingly important as the climate change and energy agenda is driven forward at an urban level. Bovaird, (2007:855)

argues that such forms of governance, that brings low income communities into the decision making process have:

“major democratic implications because it locates users and communities more centrally in the decision making process...and demands that politicians and professionals find new ways to interface with service users and their communities”.

Yet it is unclear if co-production in neighbourhoods such as Kuyasa and Ga Mashie will always necessarily provide the space for the urban poor to reorder power relationships and take control of their networked systems. As Swyngedouw, (2005: 1992) suggests:

“the inclusion of civil society organisations (like NGOs) in systems of (urban) governance, combined with a greater political and economic role of ‘local’ political and economic arrangements, is customarily seen as potentially empowering and democratising”.

As such the outcomes of co-production generating increased power over infrastructures for low income communities should not be taken for granted. For instance, in Ga Mashie, it is unclear whether the involvement of CHF International and its promises of co-producing neighbourhood development and reconfiguration will result in increased power for the community or whether it becomes a discursive tool to manage and marginalise the voices of urban dwellers. Such considerations suggest the need to develop increased critical attention to processes of co-production and how they may shift and alter power relations. As Mitlin, (2008: 345) argues this needs to be concerned with the “more fundamental political issues such as the implications for the distribution of power between organised citizens and the state”.

7.5 Conclusion

This chapter has been particularly concerned with addressing the final research question of the thesis: What do processes of reconfiguration reveal about social relations across the cities? The chapter has undertaken this task by providing an analysis that seeks to connect the governance of networks, particularly during processes of reconfiguration and the social relations of these dynamics with wider, city scale infrastructure governance and intersections with existing power relationships across both cities. It has argued that by exploring these issues that the wider social relations are revealed across processes of reconfiguration. Using an analysis of each of the neighbourhoods in Accra and Cape Town the chapter has outlined the commonalities and differences across governance in these urban spaces showing the multiple institutional arrangements, urban policy knowledges and imperatives that shape processes of reconfiguration in Ga Mashie, Mandela Park, Mamre and Kuyasa. The chapter has argued that approaching urban governance can help to chart the relationships between different urban actors engaged in network reconfiguration, particularly the state and low income communities, the power relationships that exist between them and how processes of network reconfiguration are political in nature and often deeply contested.

A series of emerging considerations are generated from this chapter that contribute to the aims, objectives and research questions of the thesis. Firstly, the chapter argues that it is evident that historical relationships of

power between low income communities and other urban intermediaries are configured through urban infrastructures and mediate wider urban inequality through the ways in which urban dwellers access, use and afford material resource flows (in the form of electricity). Such flows of energy, as chapter five illustrates, are linked to wider metabolic processes of climate, capital and crisis that constitute these networked systems. Low income communities, state institutions and urban intermediaries, such as NGOs, seek to reconfigure the energy networks in urban spaces such as Ga Mashie in order to effect the metabolic flows of energy to restructure the social relations that are embedded across these networked systems. Sometimes this takes the form of incremental and improvised material manifestations to existing networked inequalities, at other times such claims over power are contested through conflict. Secondly, the chapter argues that a range of different dynamics including processes of collaboration and conflict are visible at a neighbourhood scale that provide a window to the shifting relationships between the urban poor and other urban actors at a city (and beyond) scale. Whilst these different institutional arrangements, circulating urban policies and imperatives are present across the low income neighbourhoods of the study they simultaneously show the wider power relationships between those with the ability, resources and power to undertake network reconfiguration and the struggles of the urban poor to position and place themselves in the governance of such infrastructures. The implication of such a consideration is the importance of identifying which urban actors have the power to reconfigure, how the urban poor challenge this power and importantly who in the city has the right to reconfigure (Section 8.4.1). These questions become important beyond the electricity system and wider infrastructures to considering the type of cities that Accra and Cape Town are and the urban futures that a being travelled, showing that such considerations are intricately tied to the type of social relations that exist across both urban spaces and the power relationships that exist across networked systems. Part of the purpose of this chapter has been to show how these relationships can be revealed, the constant shifting negotiations, conflicts and collaborations that characterise them and the power relationships that constitute and are constituted by such dynamics suggesting the nature of urban governance is determined by both the structural conditions and the agency of urban actors. Thirdly, the chapter has argued that low income communities can develop a series of ways to challenge existing power relationships and their marginalisation from how networked systems are reconfigured. Various strategies exist across both Chatterjee's (2004) terrain of civil and political society. On the terrain of political society this can take the form of direct conflict through protest and community mobilization. Whilst this is often important to stop particular courses of network reconfiguration (e.g. demolition) it remains reactive and fails to chart different urban futures for the communities involved. More productive to low income communities is the incremental forms of urbanism developed through improvised actions by residents that creates new and reconfigured networks and materialities across the neighbourhoods, explicitly challenging the power of the state, the private sector and other urban intermediaries over control of infrastructures. Yet these incremental configurations remain fragile and open to challenge suggesting the state, which in Cape Town has delivered hundreds of thousands of houses and connections yet still struggles to deliver on the promises of the post-apartheid era, needs to fundamentally shift how it manages network reconfiguration. Thus, alongside the ongoing transformative programs of investment being undertaken the state needs to provide the space for communities to experiment with new forms of improvised infrastructure and developing incremental responses to conditions of poverty as a strategy to build upon the significant gains already made. On the terrain of civil society the chapter

shows the possibilities that exist through processes of co-production, particularly in relation to the emerging climate change and energy agenda. These are new forms of governance that instead of marginalising communities in the governance of network reconfiguration seek to centre the role of urban dwellers and the chapter suggests potentially and significantly alter the social relations and power balance across these urban spaces. Whilst emerging partnerships orientated around co-production are visible in both Accra and Cape Town these remain experimental in nature rather than the norm across these cities suggesting that municipalities and other urban intermediaries such as utility companies like ESKOM and ECG are hesitant about the empowerment of low income communities. Furthermore, it's unclear if wider urban governance, involving the urban poor necessarily produces a difference in the power relationships or whether it simply ticks a participation box on evaluation forms of those who hold power. Fourthly, the chapter has provided the final part of the African situated UPE framework (Section 2.7.1) which is proposed to approach the political nature of energy infrastructures in African cities. UPE is explicitly concerned with seeking to uncover the power relationships across and through urban infrastructures and the chapter shows how a focus on the structural nature of this power (across urban infrastructures) can be expanded through considerations of the everyday, incrementalism and Chatterjee's (2004) concept of the split between 'political' and 'civil' society. In the analysis the chapter builds on these concerns, conceptual imperatives and tools to chart a pathway through the assembled data and generate a focus on the social relations that are reflected and reinforced through processes of network reconfiguration. The need to consider the postcolonial critiques of existing urban theory (Robinson, 2006) have played an important role in this development with the analysis beginning with actual existing conditions in the low income neighbourhoods and seeking to consider the governance, power relationships and social relations from these urban spaces.

The next chapter will bring together the findings from this chapter to consider them within an assembled critical framework, addressing the research questions and reflecting on the African situated UPE that has been developed.

8. Conclusion

This chapter considers the research questions in relation to the findings (Chapters 4-7) and conceptual framework (Section 2.7.1). The chapter begins with a brief introduction that provides an overview of the focus of the thesis. Secondly, the chapter reflects on the conceptual approach, seeking to consider how an African focused or situated UPE generates a particular approach to researching and analysing African cities and some of the strengths and limitations of such a framework. Thirdly, the chapter examines each of the research questions bringing together the findings developed throughout each of the chapters. Fourthly, the chapter examines the research implications of the thesis including across debates in climate change and energy, incremental and comparative urbanism. Fifth, the chapter considers some of the future areas of research generated from the thesis

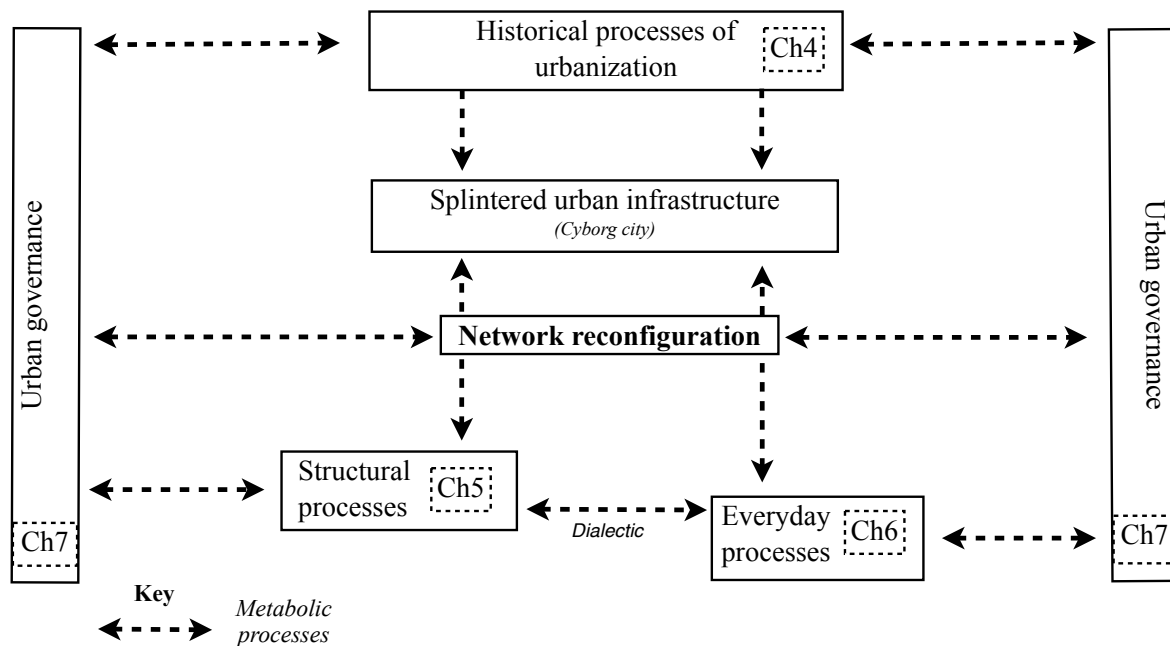
8.1 Reflecting on the aim of thesis

The overall aim of the thesis is to interrogate the conditions in which the global aspirations for centering energy concerns and the emerging climate change agenda are being translated across urban networked systems, particularly in low income neighbourhoods. In doing so the thesis seeks to contribute to critical studies of infrastructure and wider debates about African cities through politicizing these urban environments and particularly energy systems in Accra and Cape Town. This is important as climate change and energy concerns at an urban level cannot be considered as techno-managerial issues, laying in the domain of planners and policy makers but as the thesis shows are deeply political and contested. If the lofty goals of the UN, governments and others around energy (UN-Energy, 2005) and the imperatives associated with the climate change agenda are to be addressed then the need to critically explore these issues at an urban level becomes important. Part of this task entails revealing the power relationships guiding the transformation of these policy imperatives into the networked materialities of the city. As the thesis has argued access to flows and circulations of electricity forms a key mediator in wider social relations across both cities, including the households in the case study neighbourhoods. The principle role of socio-material flows of electricity in shaping social relations across cities has informed the focus of the thesis which shows the multiple urban actors seeking to control, reconfigure and shape these metabolic processes. The thesis argues that network reconfiguration is predicated on a range of competing motivations, strategies and visions of the socio-materialities of the city, suggesting reconfiguration becomes the site through which power is both articulated and contested across networked systems. As such the thesis has made an important contribution in these debates by focusing on how climate change and energy issues are being materialised across cities as part of contested processes of urban change. As increased investment into energy infrastructures is promised from a plethora of multi and bi-lateral institutions the question of which urban actors (and their associated motivations, logics and rationalities) are shaping network reconfiguration becomes increasingly important to the uncertain urban futures of cities such as Accra and Cape Town and the socio-material landscapes of inequality which characterise them.

8.2 An African situated, urban political ecology

The next section reflects on the conceptual framework developed in order to address the thesis aims, objectives and research questions and reflects on the contributions the thesis makes to UPE particularly and urban studies more generally

Figure 8.1: Conceptual framework: An African situated urban political ecology



8.2.1 A useful conceptual framework?

The thesis provides a critical review of the burgeoning conceptual approaches to urban infrastructures (Chapter 2) arguing concerns across UPE, together with a postcolonial anchored focus on African urbanism provide an emerging theoretical intersection to interrogate urban infrastructures in these spaces. In undertaking this task the thesis seeks to make claim to a particular approach to the city which provides a number of contributions and implications in how these urban spaces are conceptualised and how ways of knowing the urban are advanced.

An African urbanism?

The thesis contributes to ongoing debates across urban studies that are predicated on claims about a distinctive 'African urbanism'. These claims are partly based on the particular geographic-historical experience of countries in sub-Saharan Africa and which the thesis makes clear in a number of areas (for instance in the experience of colonialism/apartheid in shaping the infrastructure geographies in chapter 4). The thesis shows, supports and expands on work by Myers (2011), Simone (2010) and Roy (2009) that there

remains utility in considering African cities as loosely bounded theoretical constructs based on these shared, if diverse experiences. Although the thesis has been careful to seek to show the diverse nature of urban worlds in Accra and Cape Town such findings can support wider claims to an Africa urbanism. By interrogating the validity and utility of this claim the thesis has prompted two important conclusions that contribute to these ongoing debates in urban studies. Firstly, that African urbanism is best understood as a 'epistemological location' rather than a geographic container (Lawhon et al, forthcoming). This is a notion constructed in the thesis as a conceptual space from which urban theory generally, and UPE more specifically can be provincialized as a response to the call by postcolonial studies to re-examine the production of knowledge. Such a perspective contributes to the wider task of unpacking what a postcolonial influenced theory can be within the city. The notion of an African urbanism used in the thesis is about making sense of these debates within the context of UPE. Such a position has meant that the conceptual framework has been able to tease out particular strands of postcolonial studies of the urban that provide a more nuanced and detailed landscape of urban environments in Africa, bringing to ongoing debates a particular configuration of postcoloniality within urban studies. The implication of such work is that the mobilisation of the notion of African urbanism in the thesis contributes to the politicising of African urban environments both within traditions of knowledge production and more generally in seeking to challenge current relationships of power over these urban spaces.

A situated UPE

The need to develop critical responses to urbanisation processes in African cities demands a kaleidoscope of theoretical strategies to critically uncover the socio-materialities of these urban spaces. The thesis provides a contribution to this emerging field of studies through the intersection of UPE and African urbanism or as a situated UPE. This focus on developing critical ways to undertake African situated UPE analysis is being taken forward in multiple directions (Graham and Ernstson, 2012, Gandy, 2006, Lawhon, 2012a, 2012b, in press, Loftus, 2006, 2012, Myers, 2003, 2005, 2008, 2011, Njeru, 2006). The thesis contributes to these growing currents and debates by generating one particular research strategy in which to examine urban infrastructure in African cities.

The framework is centered on four key concerns that allow the research to critically examine network reconfiguration and provides a way for the work to be mobilised by other researchers. This is undertaken by firstly, conceiving of the urban energy network as historically produced, both materially and discursively, secondly, as mediated via the metabolisms of capital, climate and crisis, thirdly as infused with social power relations across urban governance and finally as reshaped through an everyday dialectical urbanism. The first three of these concerns are drawn from UPE studies and have generated the examination of the historical shaping of urban energy networks (Chapter 4), the metabolic production of the urban energy network (Chapter 5) and an interrogation of the governance and power of these urbanisation dynamics (Chapter 7). These three conceptual concerns can be considered the core features to a UPE approach. By undertaking this UPE analysis, through understanding the city as a cyborg and produced through the metabolism of nature (Section 2.5.2) the conceptual framework provides the analytical underpinning to show how a:

“political-ecological examination of the urbanization process reveals the inherently contradictory nature of the process of metabolic circulatory change and teases out the inevitable conflicts (or the displacements there-of) that infuse socio-environmental change” (Swyngedouw, 2006:118).

The thesis challenges UPE by seeking to bring this field of study into conversation with the literatures concerned with African urbanism through the notion of a situated UPE. In Section 2.6 the thesis argues that increasing attention to how global South and particularly African cities are conceptualised, researched and analysed have contributed to wider growing criticisms about urban knowledge construction and postcolonial critiques of urban studies (Robinson, 2002, Pieterse, 2010a, McFarlane, 2008, Roy, 2009). Importantly, a fourth part of the conceptual framework is predicated on the everyday processes of reconfiguration (Chapter 6), framed as a dialectical urbanism and responding to the metabolisms of capital, climate and crisis faced by low income neighbourhoods. This has expanded the structural centered, historical materialism of UPE through approaching the city as a series of metabolisms that produce a cyborg urbanisation (Section 2.7.1) both through structural and importantly, for wider debates across the field, everyday processes. As Lawhon et al (forthcoming) argue this, “requires concentration on particular, situated explanations as these ground us in contextual, experiential knowledge from which to begin articulating general concepts”. Whilst a number of UPE studies (Myers, 2011, Lawhon, 2012a, Graham and Ernstson, 2012, Loftus, 2012) have made important contributions to the place of the everyday within the context of African cities and the contributions that literatures concerning African urbanism can make these examples remain relatively recent. As such the thesis has provided another example of and contribution to the utility of charting the intersections between African and global South literature on urbanism, actual existing urban conditions in African cities and UPE analysis.

When considering the contribution of this situated UPE to studies concerning urban energy infrastructures and the ways it can be utilised within the wider field a number of implications are generated that illustrate how UPE can be progressed and the demands that the thesis makes in seeking a more productive understanding of African urban environments. The ways in which energy networks are being incrementally reconfigured through improvisation are framed as a dialectical urbanism that unfolds in response to and subsequently can be incorporated within the metabolisms of capital, climate and crisis. This conceptual framing can inform the wider field of UPE by showing the importance of the need to extend metabolic analysis into the everyday spaces and socio-material flows of cities. Utilising a range of different concepts that are able to articulate these urban dynamics, including incremental infrastructures (Simone, 2004b, 2011, forthcoming) improvisation (McFarlane, 2011a) and people as infrastructure (Simone, 2004b) the thesis argues that UPE should engage with circulations and flows across urban spaces that are both generated by and lead to the territories, landscapes and spatialities of the everyday as an expanded metabolism.

The thesis has advanced and challenged UPE through the research by showing that it is possible to bring diverse strands of urban theory (in this case based on the African urbanism literature) into a dialogue that expands the focus of UPE beyond its Northern, historical materialist tradition. The thesis contributes to UPE by bringing it into dialogue with work on African urbanism as an attempt to develop a situated UPE in what can be considered as one strategy (amongst a growing number) for epistemological re-orientation of the

tradition. This is important as it reflects the increasing need for postcolonial interventions across UPE that seek to create spaces in which a broader range of urban experience can inform theory and show how they are produced, politicised and contested. The contribution of the thesis is to argue that by adding the work based around African urbanism the core elements of UPE (capital, metabolism and so forth) are expanded to shift UPE towards a more pronounced engagement with the everyday, showing that these framings open up new ways of understanding power by focusing on more situated explanations of the role of capital in urban environments. This contributes to UPE studies not simply through this shift in analytical attention but also as a way to open up conditions of possibility around political action. As UPE is clearly concerned with supporting political struggles this forms a key implication of the thesis and provides lessons to consider the political utility of this theoretical intersection. The thesis makes clear through revealing and critiquing both the structural level inequalities in the system and the everyday ways in which these dialectically manifest that both incremental change and large scale transformation have to be accounted for in a program of political change that seeks to reconfigure socio-material conditions in Accra and Cape Town.

The contribution to wider debates in and across urban studies, geography and environmental governance is not simply about thinking about UPE in urban Africa but how notions of cities of the North are challenged through these interventions. One way in which these lessons can take thought through is to consider the particular concepts that are important to UPE and consider how the thesis contributes to debates on these specific terms that are utilised within this theoretical tradition.

Firstly, the focus on metabolic inequalities, how they are multi-scalar, socio-materialities makes explicit the metabolic experience of the urban poor in these cities and follows on from longstanding work within UPE. The thesis has sought to expand how metabolism is often used in UPE by examining how these socio-materialities are circulating, being dialectically reshaped and contested at a neighbourhood and household level and bringing to the fore the importance of micro-scale sites for tracing these metabolic flows. By expanding metabolism to incorporate the everyday the thesis prompts questions about the metabolic commons (McFarlane, 2013) that connect the everyday urbanism of these spaces to anthropogenic climate change, the logics of capital, hydrological dynamics and a vast, ever changing array of urban natures. This is important as it alters the metabolic focus of UPE studies to incorporate not just the city scale and beyond dynamics but also sites in which urban dwellers have the ability, power and space in which to contest these socio-natural inequalities, suggesting a range of strategies in which metabolic commons are claimed by the urban poor. Secondly, the examination and mobilisation of the notion of cyborg urbanisation provides an important contribution to UPE and wider urban studies as a conceptual tool to dialectically frame the tensions between the everyday and structure. The contribution the thesis makes to the utility of cyborg urbanisation is in its role in addressing the at times strained relationships between the various strands within UPE (particularly the influence of ANT and how this links with historical materialism). This is important contribution to ongoing debates in UPE about how such diverse intellectual projects can be brought not just into conversation but mobilised in a consistent, productive manner. By framing the city as cyborg a number of implications for approaching infrastructures, climate change and energy are identified by the thesis including the need to examine the the dialectical relationships between social, political, economic and

environmental conditions that constitute the metabolism of the networked systems and the processes of capital accumulation that mediate and reconfigure the urban energy network. Secondly, such a conceptual framing foregrounds the importance in tracing, uncovering and examining these (metabolic) flows (through which nature is urbanised) in order to analyse how they shape and reconfigure the networked systems of both cities, widening the framing of the city, its urban natures and the struggles that take place across these terrains. Thirdly, the thesis contributes to ongoing debates within and beyond UPE concerned with the notion of splintered urbanism (Graham and Marvin, 2001). The contributions to these debates are based on showing how such urbanism is historically produced in post-colonial/post-apartheid urban worlds that didn't witness the same infrastructure histories as the North, but instead histories based on racialised landscapes of control. A second contribution to these debates focuses on the findings that a splintered urbanism in Accra and Cape Town may be increasingly less about physical infrastructure and more about issues of access for many urban dwellers as these cities connect growing proportions of urban populations yet who often struggle to finance sustained flows of electricity. The contribution of the thesis, by focusing on networked neighbourhoods makes this increasingly visible division across both cities foregrounded in debates about infrastructures and inequalities and challenges the ideas in *Splintered Urbanism* (Graham and Marvin, 2001) that the lack or presence of physical infrastructure and its materialities are the prime mediators of social conditions.

8.3 Addressing the research questions

This section addresses the research questions by considering the main findings from each of the chapters (representing the African situated UPE framework) and showing the ways in which each of these conceptual imperatives intersect and the purpose of developing the analysis in this particular way.

8.3.1 How have urban energy networks historically been configured in Accra and Cape Town, and with what consequence?

Researching networked systems the thesis argues (Chapter 4) must begin with seeking to uncover not simply their current configurations but the historical development of these technological systems and how these processes need to be considered as socio-technical, wrapped up in the wider histories of colonialism, apartheid, independence and the post-colonial, post-apartheid conditions from which they emerge. The thesis argues for the importance of excavating the histories of infrastructures at both a city and neighbourhood scale. This in part is a need to understand how legacies of urban control (either colonial or apartheid) create an urbanism of subjugation and a spatial legacy of segregated or splintered urban infrastructures and how these historical patterns of urbanisation shape current socio-environmental conditions. The contemporary legacies of different eras in the cities histories (colonial, apartheid, post-colonial and post-apartheid) and the, "historical political ecological processes" (Swyngedouw, 2004:80) produce and shape particular socio-materialities and resulting network geographies across both cities and within the case study neighbourhoods.

The thesis finds in Accra these historical dynamics produce a network geography that is predicated on the establishment of the city as a colonial node in initially the slave trade and later on natural resource extraction

from the interior. The early segregation of the city between colonisers and colonised is mediated through colonial visions of the urban before witnessing the post-independence rise of Nkrumah's 'infrastructural ideal' (Graham and Marvin, 2001, Kaika, 2005) that predicates large scale, although only partial electrification across the city. This aspiration for networked services disintegrates and dissolves in a long period of stagnation in which the influence of the market rises and mediates segregation less on race and more on income (Section 4.1.1). The neighbourhood of Ga Mashie acts to reflect these different eras of Accra's history through its position as the old centre of the city, experiencing segregated infrastructures during the colonial phase and the rapid electrification of the neighbourhood post-independence. These eras are followed by the gradual and ongoing disintegration of the energy network as conditions of poverty in the area increase in the context of ongoing urbanisation and capitalisation of the wider city (Section 4.2.1). These dynamics leave the neighbourhood vulnerable to the metabolisms of capital, climate and crisis (Section 5.1) predicated on historic carbon emissions, capital investments in Akosombo Dam and the rapid urbanisation and growing middle class of Accra. The thesis finds in Cape Town, similar historical dynamics to Accra are witnessed, of the establishment of the city as a node in wider metabolic geographies of imperial natural resource extraction, fostering a racial segregation across urban space. Unlike Accra, these systems of control are intensified through the imposition of apartheid and the totalitarian urban management that produces a deeply segregated energyscapes (Section 4.1.2) with whites enjoying subsidised electricity and many Black and Coloured areas lacking any connection to the grid. Whilst the post-apartheid promises to transform the city are undertaken with significant investment, resulting in hundreds of thousands of new connections and homes, the city remains one characterised by a racial segregation across infrastructures and struggling to provide dignified lives for the urban poor. These dynamics leave low income neighbourhoods vulnerable to the metabolisms of capital, climate and crisis (Section 5.2) that intersect with climate vulnerability, energy poverty and pathogenic circulations to effect households in multiple ways. At a neighbourhood scale, Mamre, Mandela Park and Kuyasa reflect these wider city scale dynamics but in different ways that prompt the need to undertake detailed examination of the multiple urban worlds within one city. In Mamre, the construction of RDP housing and later the investment in insulated ceilings shows the important role of the local state in providing urban services (Section 4.2.2). In Mandela Park, the history of conflict shows the ongoing struggles of the urban poor in relation to housing and networked services (Section 4.2.3). In Kuyasa the role of the community in developing a programme of network reconfiguration shows how once marginalised communities are becoming increasingly important in urban governance of network reconfiguration (Section 4.2.4).

The thesis finds the consequences of these historical processes are significant in approaching network reconfiguration. Firstly, whilst the analysis reveals differentiated contemporary conditions in Accra and Cape Town both cities can be characterised by historically splintered infrastructures that can be traced back to colonialism and apartheid, with these systems of control producing deeply divided cities. Such findings support insights from studies based in the global South (Kooy and Bakker, 2008, Zerah, 2008) that argue against processes of splintering urbanism (Graham and Marvin, 2001), showing the history of segregated networks is predicated on historically produced colonial (and apartheid) logics as much as market logics over the last 50 years. Secondly, the thesis finds that the history of urban infrastructures in both cities has been a

history of marginalisation for low income communities, sometimes predicated on racism and at other times, or in combination, on economic marginalisation. This has produced in Accra a post-colonial and in Cape Town a post-apartheid condition in which urban infrastructures come to dialectically produce, reflect and reinforce historically constructed social relations. These histories matter in terms of approaching network reconfiguration because any investigation into changing infrastructure landscapes must engage with the historical production of both networked systems and importantly the attendant colonial and apartheid power relationships that in different ways characterise Accra and Cape Town. The implication of this insight is the need to conceive of energy networks as expressions of wider historical political, economic, cultural and environmental processes from a local to global level. Thirdly, in the historical examination of energy networks in both cities the thesis seeks to expand the analysis beyond the city scale to consider how such processes manifest within particular low income, networked neighbourhoods. This focus highlights the limitations of simply relying on a city scale historical examination of infrastructure rather than undertaking such analysis across particular sites (in this case the low income, networked neighbourhoods). The multiple histories of networked systems across the different neighbourhoods in Cape Town and within the same neighbourhood of Accra show the need to recognise the multiple and diverse urban worlds across cities and the very different histories, presents and contexts that seemingly similar urban spaces may contain.

8.3.2 How, why and with what implications are energy systems in low income, networked neighbourhoods being reconfigured in Accra and Cape Town?

The thesis finds that energy networks in Accra and Cape Town are being reconfigured through responses to historical conditions, outlined above and the metabolisms of capital, climate and crisis (Sections 5.1 and 5.2) that shape and structure the geographies of networked systems. The metabolisms of capital, climate and crisis produce a number of conditions that create the context for and the ways through which network reconfiguration takes place. The thesis shows that energy crisis in low income, networked neighbourhoods is produced through a multi-scalar ensemble of human and non human actors, mediated through the structuring logic of capital. That energy crisis is a crisis of the urban poor and links to wider urban inequalities and historically splintered urbanism. That intersections between energy and climate (change) are multiple, creating and reinforcing vulnerability across low income neighbourhoods and showing that the ability to access flows of electricity plays a central role in reflecting and reinforcing social relations. The thesis shows that crisis, that is when the flow of electricity is interrupted, is occurring both through energy deprivation (Annecke, 2005) in low income neighbourhoods and wider generation/disruption problems that expose the multi-scalar networked geographies of energy. The responses to these metabolic conditions via network reconfigurations are predicated on a series of multiple logics in relation to these conditions across various urban actors that show how the metabolisms of capital, climate and crisis are problematised by these different groups.

Firstly, the thesis finds that for residents in low income neighbourhoods the conditions of poverty produced through historical dynamics (Section 8.3.3) and metabolisms of capital, climate and crisis (Chapter 5) generates the need to intervene in the energy network to reconfigure the flows of energy (whether through

intervening directly in the network or through the site of the house) to address these socio-environmental inequalities. The thesis finds a number of everyday ways in which electricity networks are being reconfigured. These include; the clandestine connections to the network that take place continuously in low income neighbourhoods (Section 6.1.2), material improvisation across housing that responds to the energy poverty of residents (Section 6.2.3) and the ways that urban dwellers become enrolled as infrastructure (Section 6.3). These incremental infrastructures (Simone, 2004b, 2011, forthcoming) express the ingenuity of the urban poor in finding ways to get by and get on, linked to processes of urban learning (Section 6.2.2) but also illustrate the desperation of many residents in low income neighbourhoods and the precarious lives they lead. Furthermore, these reconfigurations remain provisional, fragile and open to contestation from other urban actors and show how the network is reconfigured through ongoing, everyday and contested practices. This suggests the need to conceive of the urban energy network as a series of ongoing flows and circulations (or urban metabolisms) of a range of socio-materialities (people, capital, materials and so forth) that frames a dialectical urbanism in these spaces.

Secondly, the thesis finds that across Accra and Cape Town network reconfiguration is also predicated on market logics. In Accra, energy networks are being reconfigured in middle class/elite areas reflecting the absence of investment into the low income neighbourhoods of the city. Innovations in technologies, building design and construction are predicated on the growing capitalisation of urban land (Grant, 2009) and the rapid growth in new residential markets in the city is creating a post-networked urbanism (Coutard and Rutherford, 2011) and reinforcing a history of splintered urbanism (Graham and Marvin, 2001). Simultaneously, the limited resources of the state mean that any reconfiguration is market-led and leads to the partnership between CHF International and GAMADA, that is predicated on mobilising land values to transform Ga Mashie. In Cape Town similar processes are evident to those in Accra in relation to the growth of renewable technologies, architecture and so forth. Yet the thesis identifies an important difference with the market logics being embedded in a number of different intersections with the developmental agenda of the city. These include the project of retrofitting RDP housing in order to sustain the neoliberal rationality of home ownership as a poverty alleviation strategy. With the metabolisms of capital, climate and crisis effecting RDP houses, the network reconfiguration in Mamre can be framed as a response to improve housing quality in order to legitimise the current policy, predicated on both developmental and neoliberal logics (Section 7.3.2). They also include the connection of carbon finance to the CDM project in Kuyasa showing that market logics are being mobilised to generate capital investment and fund reconfiguration. These dynamics illustrate the increasingly entrepreneurial nature of various urban intermediaries in the city in negotiating pathways between and across the developmental and market logics in the city and in relation to wider marketised climate rationalities.

Thirdly, the thesis finds that the state, often in the form of the utility companies (ESKOM and ECG) are involved in reconfiguration through PPM technology, predicated on increasing flows of revenue through necessitating urban dwellers to pay up front to access flows of electricity and in many cases causing difficulties in households facing energy deprivation (Annecke, 2005). For municipal actors and urban intermediaries in Mamre (Section 4.2.2) and Kuyasa (Section 4.2.4) logics shaping network reconfiguration

are predicated on experimenting with new forms of climate change and carbon financing that remain limited in scale, provisional and experimental. This is an important implication in that these forms of network reconfiguration, emerging from municipalities and urban intermediaries, can be considered in to an extent incremental. Whilst the thesis has mobilised the notion of incremental infrastructures in relation to the everyday practices of urban residents across urban spaces the thesis finds that this can also be extended to incorporate the network reconfiguration in both Mamre and Kuyasa for a number of reasons. These include the small scale nature of these reconfigurations, intervening at a neighbourhood scale rather than across the city. That these network reconfigurations are predicated on exploring options in the context of uncertain urban futures, particular in relation to emerging climate change and energy imperatives (Section 7.3.2) across cities (Bulkeley, et al, in forthcoming). As such these reconfigurations may be considered as ‘climate change experiments’ (Bulkeley and Castán Broto, 2012), focused on finding new ways to reconfigure urban infrastructure in response to these agendas that have the potential to be upscaled across the networked systems of Cape Town. As such network reconfiguration can be conceived as incremental urbanism that has a range of policy, practice and conceptual implications (Section 8.4.2) about how urban energy networks are managed. The implication of these various logics and rationalities, the urban actors intersecting and mobilising them in response to metabolisms of capital, climate and crisis can be considered through the social relations revealed across these processes.

8.3.3 What do processes of reconfiguration reveal about wider social relations of Accra and Cape Town in relation to the emerging energy and climate change agenda?

An analysis of network reconfiguration reveals a series of considerations about wider social relations in Accra and Cape Town specifically and African cities more generally. The thesis begins from the perspective that networked systems are central in providing the services vital to sustaining urban life and mediating the socio-economic and environmental relations across Accra and Cape Town and as such has generated a number of findings about these relationships. The thesis finds that network reconfiguration can be framed as both an expression and contestation of power relationships across networks. This predicated on who has the ability, resources and power as forms of inscribed capacity (Allen, 2004) to change the socio-material conditions. As such network reconfiguration becomes the site through which these various urban actors assert and contest power across urban infrastructures. It is in these acts of reconfiguration, that reshape the conditions of the area that show how the capacity of power is translated into the exercise of power (Allen, 2004). The thesis shows that historical relationships of power (Chapter 4) between low income communities and other urban actors are configured through urban infrastructures and mediate wider urban inequality through the ways in which urban dwellers access, use and connect to material resource flows (in the form of electricity). The metabolisms of energy in Accra and Cape Town are imbued with power relationships at multiple different geographical scales. At a global level a series of metabolic processes mediate the conditions in which network reconfiguration takes place. This means that municipalities and especially residents in low income neighbourhoods have relatively limited power to transform networked systems, producing a series of disabling socio-environmental conditions (Heynen et al, 2006) in relation to the political ecological context in which reconfiguration unfolds. At an urban level municipalities do have a

level of control over these resource flows and in conjunction with state utility companies are able to impose visions of how the energy network is configured and are thus implicated in who is excluded or included. These processes are made visible at a neighbourhood scale with a range of different power relationships providing a window to the shifting relations between the urban poor and other urban actors. In Ga Mashie, the community are relatively powerless in instigating large scale transformation of the neighbourhood. They have been powerless to stop the installation of PPM by the utility company (Section 4.2.1). They are waiting to see if the arrival, via a municipal strategy of a neoliberal growth regime (Section 7.3.1), of an international NGO will help them to gain more power over their neighbourhood in the context of ongoing energy crisis. In Mamre, the state has provided further investment into the urban energy network through financing intervention in RDP houses (Section 4.2.2) to increase thermal efficiency, showing how the CCT is gaining more power via climate change financing to intervene in infrastructures across the city. However, during the process the community have little control over the type, nature or direction of the network reconfiguration which whilst improving conditions fails to empower the residents. In Mandela Park the power over reconfiguring the housing (and energy) infrastructure is contested by the community and the municipality, revealing the shifting negotiations, conflicts and struggles over who has the power to reconfigure (Section 7.2.3). Finally, in Kuyasa (Section 7.2.2) the community has gained power over the local infrastructure through a process of co-production (Joshi and Moore, 2004) with a local NGO, showing that low income urban dwellers can assert power and control over networked systems and reshape conditions of poverty. Across these low income neighbourhoods its clear that residents are often marginalized from the governance of network reconfiguration, translating into little power in which to reconfigure urban energy networks, with municipalities and other state agencies, alongside urban intermediaries often controlling the validity and legitimacy of these interventions and themselves exposed to geographically extended power relationships. Yet as Heynen et al, (2006:13) argue:

“Socio-ecological sustainability can only be achieved by means of democratically controlled and organized processes of socio-environmental (re)construction. The political programme, then, of political ecology is to enhance the democratic content of socio-environmental construction by means of identifying strategies through which a more equitable distribution of social power and more inclusive mode of the production of nature can be achieved”

Responding to these UPE imperatives the thesis shows that low income communities can develop a series of ways to challenge existing power relationships and their marginalisation from how networked systems are reconfigured. Various strategies exist across both Chatterjee’s (2004) terrain of civil and political society that provide vehicles for community empowerment across Accra and Cape Town’s networked systems. (Section 8.4.1).

Finally, the thesis finds a number of implications of these power relationships in relation to the emerging climate change and energy agenda. Firstly, that due to historic power relationships across Accra and Cape Town low income, networked neighbourhoods remain marginalised in city life, both spatially and politically leaving them vulnerable to climate change and energy dynamics (via the metabolisms of capital, climate and crisis). Secondly, that climate change and energy logics, processes and dynamics will intersect with existing socio-environmental conditions, sometime amplifying ongoing crisis and further marginalising low income

communities and at other times generating new pathways to support empowerment, such as in Kuyasa. Thus, the growing importance of climate change and energy agendas in mediating network reconfiguration and how these dynamics shape power relationships remain open, contestable and fragile. Thirdly, this insight suggests that addressing issues of vulnerability and the ongoing crisis across low income, networked neighbourhoods is explicitly linked to the re-ordering of power relationships and the need to put the urban poor at the heart of decision making processes concerning these uncertain urban futures.

8.4 Research implications and future avenues of research

This section begins firstly, by arguing for the importance of network reconfiguration in researching not just the infrastructure geographies of cities but the wider urban conditions, processes and dynamics that constitute the city. Secondly, the section then goes on to consider the implications of a focus on who holds the power to reconfigure networked systems within broader discourses of the right to the city agenda. Thirdly, the section then goes on to explore the policy implications of the research in climate change and energy debate and incremental urbanism. Fourthly, a reflection on the contribution of the thesis to debates across comparative urbanism are reflected upon before finally offering a series of considerations about future avenues of research generated by the study.

8.4.1 Whose power? The right to reconfigure

Explored throughout the thesis and particularly in chapter seven are the social relations that are reflected and reinforced across networked systems that generates a number of important questions about power relationships and electricity systems in Accra and Cape Town. The thesis finds that power, in reference to urban infrastructure can often take the form of the ability to reconfigure the energy network and these processes have been dominated by governance characterised by state control and shaped by circulating urban policy knowledges of neoliberalism and developmentalism (Sections 7.3.2 and 7.3.3). Much of the research for the thesis has shown that low income, networked communities remain marginalised in processes of network reconfiguration and have little power to improve the conditions of socio-environmental inequality and poverty that characterise these neighbourhoods. Swyngedouw (2004:184), thinking about urban water systems suggests it, “is part of a much wider consideration of the environmental basis of the city’s existence and change over time”. As such considerations over who has the power to reconfigure networked systems of energy become vitally important to thinking about about the socio-environmental relations of cities and questions of equality. One way to consider these issues is through the ‘right to the city’ agenda (Parnell and Pieterse, 2010, Saule Jr, 2008). As Harvey (2008: 23) eludes to, at its heart the ‘right to the city’ is the right to reconfigure, to change and transform the urban conditions:

“The question of what kind of city we want cannot be divorced from that of what kind of social ties, relationship to nature, life-styles, technologies and aesthetic values we desire. The right to the city is far more than the individual liberty to access urban resources: it is a right to change ourselves by changing the city. It is, moreover, a common rather than an individual right since this transformation inevitably depends upon the exercise of a collective power to reshape the processes of urbanization.

The freedom to make and remake our cities and ourselves is, I want to argue, one of the most precious yet most neglected of our human rights”.

Across Accra and Cape Town urban dwellers struggle to assert these rights to reconfigure as they are marginalised in formal planning processes or see improvised attempts to improve conditions rejected, destroyed or delegitimised. The thesis draws out the urban politics mobilised by low income communities, suggesting that strategies emerging from the terrain of both ‘civil’ and ‘political’ society (Chatterjee, 2004) can shift the power relationships across networked systems and place the urban poor at the centre of governance. As Loftus (2012, n. pag) argues, “those involved in making urban environments through their day-to-day interactions with one another are well positioned for grasping the mutability of the current condition and for generating a transformative politics”. Yet charting strategies for the urban poor to contest and secure power across networked systems and transform conditions cannot just be focused on the ‘bounded cities’ of Accra and Cape Town. The thesis has shown that socio-environmental conditions across networks, together with the power relationships that characterise these infrastructures incorporate how flows and circulations of energy in Accra and Cape Town are shaped and are in turn shaped by wider global dynamics. These dynamics are visible by the tracing of metabolic flows of infrastructure crisis in Accra, illustrating how global North carbon emissions predicate climate change, lowering water levels in the Volta River basin and subsequently limited electricity generation at Akosombo Dam, producing an ongoing energy crisis back in the city. Such globally connected processes suggest, “we need to emphasize questions about need and the politics of interdependencies rather than bounded security for some” (Hodson and Marvin, 2009:77). The implications of this in relation to the right to the city agenda show that it is intrinsically linked to wider questions of unequal power relations at a series of geographical scales and beyond, linking to global debates about climate justice, trade and debt relationships, natural resource extraction, energy securities, the capitalisation of urban land, neo-colonialism and so forth.

8.4.2 Debates on energy and climate change

The thesis has shown, particularly through the in-depth empirical work undertaken in Mamre, that reconfiguration of the energy network can make important improvements to the conditions of low income households. These dynamics suggest initial investment in creating networked systems and providing urban services cannot be the end of the development process in Cape Town or Accra. Sustained investment is needed in order to address and translate the global energy agenda set out in the Sustainable Energy of All (UN-Energy, 2005) program, that is so vital in supporting poverty alleviation strategies and transforming the socio-economic status of millions of urban dwellers. The thesis has argued that energy infrastructures provide a key mediator of socio-economic conditions and social relations and yet simultaneously, network reconfiguration has its limitations when it remains piecemeal and isolated, failing to create the transformational conditions needed to make serious inroads into the multi-dimensional poverty in urban poor spaces of both cities. The thesis contributes to wider debates across urban climate change and energy by considering how such issues may change the urban geographies of both cities. The thesis argues that despite new flows of energy infrastructure investment in terms of climate change finance, together with development and economic investment being increasingly directed to low carbon energy it remains to be seen whether

these forms of investment can escape the politics and geographies of infrastructure outlined in the thesis or will reinforce the splintered nature of networked services in Accra and Cape Town.

A series of policy implications can also be drawn from the study that contribute to these debates and show the growing importance of climate change as a means through which infrastructure reconfiguration is being made possible. As the Deputy Mayor of eThekweni Municipality (addressing the ICLEI Climate Solutions 2011 conference) argues:

“We as cities, are the centre’s of growth and development with energy usages projected to increase by 73 percent. We need to be leaders on the mitigative issues....We have contributed very little to these changes whilst our continent will certainly feel the effects”.

The thesis has shown that urban responses across networked systems to these imperatives remain embryonic, yet to gain significant momentum or absent illustrating the work need to be undertaken across urban governance. The network reconfiguration in Mamre and Kuyasa, predicated on different forms of climate and carbon financing show the ways in which urban actors align emerging climate change financing and concerns with current urban policy imperatives suggesting that these growing flows of investment can intersect with existing priorities for cities such as Accra and Cape Town. Climate change has become the means through which network reconfiguration is taking place because opportunities to secure financing are multifold and may provide the space to dramatically expand financing of network reconfiguration by connecting to new circulations of infrastructure investment. This pathway for future and more comprehensive climate change financing to align with wider urban policy objectives is, the thesis argues vitally important. As Satterthwaite et al (2007: 88) discuss in the context of adaptation, “unless adaptation to climate change is seen to support and enhance the achievement of development goals it will remain marginal within government plans and investments. Given that particular departments of the CCT have recognised this requirement the thesis suggests the city is well positioned in accessing both climate capital for adaptation or carbon capital from international markets and utilising such network reconfiguration to work alongside already existing municipal objectives, plans and strategies. The Mamre and Kuyasa network reconfiguration provides examples of such multiple imperatives and logics being addressed together with a municipality with considerable institutional capacity, important in the maintaining of such interventions and perhaps providing an early indication to policymakers and practitioners of the potentials that exist across responses to climate change. As such the thesis has contributed to debates about urban change by showing how climate change imperatives are enabling the reconfiguration of infrastructures in ways that other discourses such as sustainability have not been able to and generating the need to develop further research that explores these materialisations of plans and objectives. Yet as the thesis shows in Accra these dynamics are often highly problematic and illustrate the highly uneven landscape of climate change action. Thus, the failure to urbanise the climate change agenda, together with ongoing struggles with international institutions over the power to administer climate change funds means that responses at an urban level remain absent and reflect the limited capacity of the municipality to respond to emerging agendas and imperatives. As such the thesis points to the limitations across African cities such as Accra in addressing these challenges within the current financial and institutional configurations. Furthermore, the thesis contributes to these debates by arguing that these

challenges are not just institutionally shaped but are clearly linked to the glocal politics of such dynamics and processes, implicating the role of the global North in how these pathways unfold. Finally, whilst climate change remains considered as a policy issue the thesis has shown that these issues need to be further addressed both conceptually and methodologically to approach the political nature of urban responses to climate change as they begin to reshape the infrastructure geographies of cities. Firstly, the thesis has examined how the materialisation of climate change and energy policy developments across urban infrastructure systems are unfolding and contributes to a limited literature that is critically examining these processes, particularly in the African context in which work has focused either on policy landscapes or more normative descriptions of changing infrastructures. Secondly, the thesis has contributed to debates about how to research climate change and energy by showing how a UPE approach provides a critical framing for understanding this issues. Whilst urban climate change issues are often approached from governance perspective these can fail to account for the wider global and local micro dynamics of climate change processes.

8.4.3 Incremental urbanism

An important implication for policy and practice emerging from the study is the ways in which municipalities and other centres of policymaking and control over networked systems can begin to re-imagine how urban development is undertaken through experiments with incremental urbanism. The thesis finds that alongside the incremental reconfiguration taking place across the everyday spaces of the network that interventions such as in Mamre and Kuyasa can also be considered as incremental. This suggests that incrementalism should be embraced by policymakers, encouraged not just across the municipality but linking up with ongoing attempts by communities to refashion their socio-environmental conditions. As the thesis has argued the incremental strategies undertaken by residents across the low income, networked neighborhoods of Accra and Cape Town provide experiments in new ways to reconfigure, improve neighbourhood conditions and support low income households. These accounts centre the importance of everyday actions by urban dwellers, showing that such practices can be considered as political acts, and as a materialisation of a pre-figurative politics (Gordon, 2007). Whilst this does not always produce desired outcomes or results in conflict between different urban actors the thesis has shown that the terrain of the everyday forms an important arena for political action and responding to socio-environmental conditions. Such perspectives should influence the decisions and directions of travel taken by policy makers who practice in cities that are characterised by resource constrained municipalities and simply do not have the finances to deliver not just basic services but a dignified life for urban dwellers. There are a number of ways to support these dynamics (Pieterse, 2008) that can engage with emerging climate change and energy logics across cities. These include; firstly, providing physical asset bases for the community, particularly land and materials, together with the policy, legal and institutional space to undertake experiments; secondly, providing institutional support (be that academic, municipal or NGO) to encourage community self-management and can be undertaken through processes of co-production (Joshi and Moore, 2004). Simultaneously, these forms of incremental urbanism need to be given space to grow, ensuring that communities are not punished for experimenting outside mainstream development paradigms. Thirdly,

providing (what would be limited) financing to instigate these multiple experiments, predicated on the hope that some of these processes may be upscaled and generate low cost ways for the city to reconfigure networks to improve socio-environmental conditions. Pieterse (2008) approaches these ways of developing empowerment through the notion of ‘radical incrementalism’, predicated on governance structures opening to allow marginalised communities to assert control over urban space. He goes on to suggest that:

“Radical incrementalism is a disposition and sensibility that believes in deliberate actions of social transformation but through a multiplicity of processes and imaginations, none of which assumes or asserts a primary significance over other struggles. This position may not resolve the existential struggle of urbanism, but it provides a means to confront the struggle and perpetually work one’s way through it, stumbling across what works and what does not” (Pieterse, 2008: 6-7).

As such radical incrementalism cannot be undertaken just by residents in low income neighbourhoods. As the thesis has shown, municipalities such as the CCT are engaging in similar strategies of incremental urbanism, testing, piloting and reconfiguring to develop pathways across uncertain futures and showing how climate change governance across infrastructures can be characterised through notions of experimentation (Bulkeley and Castán Broto, 2012). These processes should be embraced across municipalities and other urban intermediaries whilst at the same time ensuring that at the heart of these climate change experiments lays a commitment to empower low income communities as part of the process. The thesis suggests that these two forms of incremental urbanism, one legitimised by the state and one often operating on the boundaries of legalities can be brought together through the notion of radical incrementalism (Pieterse, 2008). That this urbanism should be embraced in relation to the cyborg city, to network reconfiguration, to the challenges of climate change and energy insecurities and to the conditions of poverty and inequality. As Okri, (1997:32) comments:

“Without transgression, without the red boundary, there is no danger, no risk, no fission, no experiment, no discovery and no creativity. Without extending some hidden or visible frontier of the possible, without disturbing something of the incomplete order of things there is no challenge, no pleasure and certainly no joy”.

8.4.4 Comparative urbanism

The comparative nature of the thesis both across and within the cities links into wider debates concerning comparative urbanism. The ambitious nature of the comparative work provides a number of useful reflections about what is gained and lost in seeking to develop these comparisons and the implications of such a comparative strategy.

By developing a comparative across countries the thesis has been able to show that at a city level diversity and plurality is important and provides a contribution to urban studies by countering narratives and discourses concerning the ‘African city’ as a constructed and often ‘flat’ notion. The work suggests the need to develop studies that are able to explore this diversity across African cities and pay greater attention to the comparative differences as well as similarities that these urban spaces share. Therefore, as Silver et al (forthcoming) argue, “there is a need for context-specific knowledge, which takes account of geography,

different climate change challenges, urban governance, and economic and cultural issues” of these cities to show the multiple trajectories and urban futures that are emerging around climate change and energy issues. Yet at the same time its clear that by focusing on two separate cities in two different countries that the study is not able to develop as detailed research or analysis as would have been possible by examining one of these cities. The nature of the PhD meant that the focus on two cities was fixed and whilst these weaknesses are acknowledged other insights have been gained by undertaking a comparative across Accra and Cape Town.

Another implication for comparative urbanism that the thesis contributes is to refute the idea that cross-country comparisons are necessary to understand the diversity and plurality of urban worlds. As the thesis makes clear these can also be found both across a city and across a neighbourhood, as well as particular ‘fragments’ that can be extrapolated and reflected upon. These multiple comparative strategies challenge the practices within comparative urbanism to often select case studies from a range of cities that are then characterised in particular ways rather than problematising these dynamics within cities themselves. The compilation of this detailed geographically and place-specific evidence is vital so that knowledge might be disseminated in appropriate ways. As such the thesis contributes to debates about comparative urbanism through its use of both inter and intra comparisons by showing how this work does not need to always focus across cities but rather demands that more detailed understandings of diversity also need to be captured within cities.

8.4.5 Future avenues of research

The thesis explores a range of issues relating to networked systems and how such infrastructures interact with wider urban conditions, generating a series of potential future avenues of research. Firstly, the thesis illustrates the importance of network reconfiguration as the process by which urban intermediaries intervene to reshape urban infrastructures and the site from which power is both expressed and contested. Network reconfiguration thus becomes central to how cities are mediated and the ways in which urban conditions can be transformed suggesting that infrastructure studies can benefit from thinking not just about the current conditions of networked systems but the ways in which they are being reconfigured and how this intersects with changing social relations across cities. Secondly, the thesis shows and subsequently addresses the need to develop both conceptual strategies and empirical accounts that bring together structural and everyday dynamics and processes across and through networked systems to reveal the cyborgian nature of the city (Gandy, 2005, Swyngedouw, 2006). Infrastructure studies specifically and urban studies more widely have tended to focus on either one or the other, the structural or the everyday, reflecting the focus of particular literatures to how research is undertaken. Thirdly, the thesis argues for the importance of flows of energy across infrastructure systems in mediating social relations across both cities. Much of the UPE literature has taken water as the lens through which to explore urban infrastructures and social relations and whilst these studies have provided a series of important conceptual and empirical explorations the need to study the socio-materialities of urban energy networks could make unique contributions to ongoing debates and dialogues across UPE. This is particularly pertinent in African cities such as Accra and Cape Town in which the difficulties of delivery and the struggles over basic services such as electricity form an important part of

the urban landscape and are becoming increasingly central to debates about energy and climate change. As cities such as these are reimagining, deploying and reconfiguring energy networks in response to resource constraints, climate change, the search for efficiency, the advent of new technologies and ongoing poverty alleviation agendas the need to develop empirical and conceptual responses to these processes becomes ever more pressing. Questions about the politics and practices and how they reconfigure urban energy networks and reflect the contested nature of processes of transformation across networked systems require multiple response with UPE providing an important tool in approaching these issues through critical perspectives. The politics of energy networks should be an important agenda for infrastructure and urban studies more widely as a way to consider processes of urbanization, forms of urbanism and power relationships.

Fourthly, the importance of developing data, case studies and detailed examination of African cities and the dynamics and processes that constitute urbanisation forms a key future avenue of research in infrastructure studies, UPE and beyond. As Pieterse (2005: 139) argues, “South African cities are being remade and reimagined at a ferocious pace and with worrying consequences from a radical democratic and redistributive perception”. Thus, the thesis argues for the need to chart, trace, track, analyse, reflect and explore these dynamics forms a research imperative for urban scholars involved in these urban spaces in order to generate more in depth knowledges. Related to this need to develop more detailed empirical material is the fifth potential avenue of future research, the need to develop critical frameworks for analysing African cities. The need to respond to the current technocentric, managerial accounts that dominate literatures on infrastructures in African cities is increasingly recognised, generating conceptual approaches that can, “completely rethink and recast the pragmatic considerations of development policy on the back of a more textured appreciation of the urban and its probable and possible futures” (Pieterse, 2010a: 208). Again, like the need to develop conceptual ways to explore relations to structure and the everyday these critical frameworks can travel in many different directions and generate multiple different ways to conceptualise the urban. Sixth, during the research links with various urban intermediaries from activist groups through to municipalities and departments in national government have been developed with data and emerging considerations being generated and shared and suggesting some important considerations and future avenues of research. This research process suggests that the role of the academic research in wider circulations of knowledge production of infrastructure is important with the researcher acting as an urban intermediary in how data, knowledge and policies are being produced. Seventh, throughout the thesis and particularly in chapter seven a focus on exploring the social relations across process of network reconfiguration and urban governance reflect and reinforce power relations was undertaken. The chapter argues power, in the context of the thesis, was the ability to reconfigure, thus shaping the analysis to identify these arrangements, the actors involved and the circulating knowledges guiding these forms of governance. Yet the field of UPE provides scope for considering more diffuse forms of power or the important task of tracing how power operates. Governmentality studies have explored the how of urban governing that have illuminated important dynamics (Gandy, 2006, Kooy and Bakker, 2008, Legg, 2008, Roy 2009). Whilst the scope of thesis was not focused on these concerns the research has helped to inform the development of a co-written paper (Bulkeley, et al in forthcoming) that does engage with such a perspective, arguing that:

“Such a governmentality perspective is productive for it moves the focus of inquiry beyond the actors and institutions formally associated with the wielding of political power, to an understanding of the dispersed nature of rule and the ways in which this is achieved through the social body”.

These considerations in relation to the outlined conceptual framework show that emerging framework remains tentative and open to different theoretical debates that may orientate research around different but complimentary themes.

Considering these future research avenues as a collective agenda brings the focus of the thesis back into view, that is the inherently political nature of urban energy networks and the role of network reconfiguration in mobilising political visions of networked systems. In the face of uncertain climate and energy urban futures across the low income, networked neighbourhoods of Accra and Cape Town the politics of network reconfiguration are not just peripheral but lay at the heart of attempts to transform the unequal energyscapes that pervade both cities.

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Appendix One: Interviews (Organisations)

Climate Change Unit, Environmental Protection Agency (Ghana)

The Landuse Planning and Management Project, Town and Country Planning Department (Ghana)

African Adaptation Programme on Climate Change (Ghana)

Accra Metropolitan Assembly, (Ghana)

Ministry of Energy (Ghana)

City of Cape Town, (South Africa)

Ghana Electric Company, (Ghana)

Ga Mashie Development Agency, (Ghana)

Institute of Economic Affairs, (Ghana)

Kokobite Institute, (Ghana)

Laurus Development Partners, (Ghana)

New World Renaissance, (Ghana)

Mamre community, (South Africa)

Mandela Park community, (South Africa)

Ga Mashie community, (Ghana)

Kuyasa Community, (South Africa)

Kuyasa CDM project, (South Africa)

Energy Centre, KNUST, (Ghana)

Constructs Architects, (Ghana)

Trashy Bags, (Ghana)

Habitat for Humanity, (Ghana and South Africa)

5 North Architects, (Ghana)

Convention People's Party (Ghana)

Ghana Energy Commission, (Ghana)

NorthNorthSouth, (South Africa)

CHF International, Ghana)

Earthscan, NGO, (South Africa)

Architecture for Humanity, (Ghana and South Africa)

Institute for Infrastructure Development, (Ghana)

Volta River Authority (Ghana)

Western Cape Anti-Eviction Campaign (South Africa)

UN-Habitat (Africa)

United Nations Development Programme, (Africa)

Sustainable Energy Africa (South Africa)

Energy Research Centre, University of Cape Town (South Africa)

ICLEI NGO, (South Africa)

Appendix Two: Interview prompt sheet for policy makers in Cape Town

What difficulties does CCT recognise around issues of energy poverty and how does the City go about addressing these?

How do you think City is progressing with these challenges around service delivery?

Could you describe how the communities cope with energy poverty?

Could you describe some of the climate change challenges facing the city?

What policy responses have you developed around these issues? How do they link to infrastructure?

What are the opportunities and challenges you face around these issues?

How do you think the city compares to other cities across South Africa?

Over the next ten years or so what are the implications of these trends around climate change, energy and livelihood issues?

How do these issues link into the climate change agenda?

Could you tell me about the work in Kuyasa?

How does this into the CDM verification process?

What do you think the City of Cape Town could learn from this process?

How do you create sustainable financial models for programs such as Mamre?

How does retrofitting in general fit into wider priorities for the climate change and energy program?

What about community participation?

How does the City speak to communities that have waited for services and how do you build a relationship for the future when you are financially constrained?

Do you think ceilings have a bigger impact than solar water heaters?

How important are insulated ceilings for communities in Cape Town?

Were you able to capture the impacts?

What about communities that are not receiving interventions, how can the city support these areas in terms of supporting themselves?

How important are pilots or experiments in new energy interventions?

How important are experiments in the energy infrastructure and how we take it to the wider level?

What are these factors?

How can the City deliver these ceilings and how can research support this process?

How do you think retrofit links into wider issues of service delivery and poverty?

What scope there is for wider retrofitting finance at an international level?

What would make your life easier?

Appendix Three: Household survey for Ga Mashie

Appendix Four: Survey for Ga Mashie

Survey Number:

Area:

1. How many people live in your household? (People)

1-5

6-10

11-15

16-20

20+

2. How much does your household spend on electricity each month? (Cedis)

0-5

6-10

11-20

21-30

30+

3. Do you consider the cost of your electricity....

Cheap

Fair

Expensive

4. Does your household ever have difficulty buying electricity credit?

Never

Sometimes

Often

5. Which type of electricity meter do you prefer?

Credit

Pre-paid

6. Do you use more electricity when it is hot weather?

No

Yes

Not sure

7. What is the impact in your household when there is lights out?

8. How often over the last year have you experienced lights out?

0

1-5

6-10

11-20

20+

9. What impact would increased incidents of lights out have on your household?

10. Would you support the establishment of James Town as a low tariff neighbourhood for all households and small business?

☐

No

☐

Yes

☐

Not sure

11. Are you aware of solar power devices?

☐

No

☐

Yes

☐

Not sure

11. Do you think solar power devices would be useful for:

	No	Maybe	Yes
Reason?	☐	☐	☐
Everyday activities	☐	☐	☐
During lights off	☐	☐	☐
Saving money on electricity	☐	☐	☐
Community development	☐	☐	☐

12. Would you consider buying a solar lantern?

☐

No

☐

Yes

☐

Not sure

13. If so how much would you spend? (Cedis)

☐

1-5

☐

6-10

☐

11-15

☐

16-20

☐

21+

14. Do you think Ga Mashie should develop a community energy generation scheme?

☐

No

☐

Yes

☐

Not sure

Appendix Four: Household survey for Mamre

Appendix 5: Mamre survey

MAMRE FINAL EVALUATION SURVEY

Survey Number _____

THIS SURVEY IS CONFIDENTIAL PLEASE DO NOT PROVIDE NAME OR ADDRESS

You can speak to -----, City of Cape Town if you have any questions about this survey on -----

Thank you for your time

Section 1: Household

1.1 Number of household members	1.2 Number of elderly people in household	1.3 Number of children in household

1.4 Total monthly income for household

Under R1,000	R1,001 to R2,000	R2,001 to R4,000	R4,001+

1.5 Do climate conditions adversely affect your household?

	Before ceiling	After ceiling
Wind		
Rain		
Damp		
Heat		

1.6 Are you satisfied with your ceiling?

Very satisfied	Satisfied	Dissatisfied	Very dissatisfied

Section 2: Energy

2.1 Do you use anything to heat the household?

	Before ceiling	After ceiling
Yes		
No		

2.2. If yes, what?

	Before ceiling	After ceiling
Paraffin heater		
Wood burner		
Paraffin stove		
Gas heater		
Electric heater		

2.3 Other than electricity how much does the household spend on heating the household? (Per winter month)

	Before ceiling	After ceiling
Under R30		
R31 to R100		
R101 to R200		
R201 to R300		
Over R301		

2.4 Would you say this is more, less or the same than you used to spend in FUEL for HEATING before you got the ceiling?

More than before	
The same as before	
Less than before	
Not sure	

2.5 How much do you spend on electricity? (Average monthly in winter)

Before ceiling	After ceiling

2.6 Is this enough for your current energy needs?

Yes	
No	

If not please explain why?

2.7 Since the ceiling installation do you need less electricity to make the house warm?

Yes	
No	

2.8 If you use less electricity to make the house warm, do you....

Keep the house warm for longer by using more electricity	
Save money on electricity	
Use electricity for other appliances	

2.9 If you save money on electricity how much do you save per month? (Average winter month)
R

Section 3: Health

3.1 Have you noticed any difference in the family health since the ceiling installation?

Yes, my household is generally healthier	
No, there is no difference	

3.2 If yes, what difference has this made to the household?

Miss less time from work		days
Miss less time from school		days
Spend less on medical costs		R per month
Happier household		
Other (Please describe)		

3.3 BEFORE the installation could you describe the frequency of illnesses in the household?

	Very often	Often	Sometimes	Never
TB				
Pneumonia				
Cold/Flu				
Asthma/breathing difficulties				
Headaches				
Heat stress				
Dizziness				

3.4 AFTER the installation could you describe the frequency of illnesses in the household?

	Very often	Often	Sometimes	Never
TB				
Pneumonia				
Cold/Flu				
Asthma/breathing difficulties				
Headaches				
Heat stress				
Dizziness				

3.5 In the last 5 years has anyone in your house suffered from burns caused by heating sources?

Yes	
No	

Section 4: Any other comments

Any other comments on any aspect of the process that you would like to share?

