



Green Urbanism in Contemporary Cities: A Socio-technical Transition Analysis

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Abbreviations

AMA	Accra Metropolitan Assembly
AMUP	Architecture Morphologie Urbaine et Projet
BRT	Bus rapid transit
CBD	Central business district
CHP	Combined heat and power
CIC	Cidade Industrial de Curitiba
CU	Corporative Union
EIU	Economic Intelligence Unit
FCUBE	Free Compulsory Universal Basic Education
FDI	Foreign direct investment
GAMA	Greater Accra Metropolitan Area
GAPTE	Greater Accra Passenger Transport Executive
GCIC	Ghana Climate Innovation Centre
GDP	Gross domestic product
GGBC	Ghana Green Building Council
GREDA	Ghana Real Estate Development Association
GHG	Greenhouse gas
GIS	Geographic Information System
GOG	Government of Ghana
GPRTU	Ghana Private Road Transport Union
GSS	Ghana Statistical Service
HIPC	Heavily Indebted Poor Country
HREC	Human Research Ethics Committee
IBGE	Brazilian Institute of Geography and Statistics
IMF	International Monetary Fund
IPPUC	Instituto de Pesquisa e Planejamento Urbano de Curitiba
LCD	Less developed countries
MDG	Millennium Development Goals
MLP	Multi-level Perspective
MMT	Metro mass transit

MPC	Multi-phase concept
NBR	National Building Regulation
NSDF	National Spatial Development Framework
NTP	National Transport Policy
NUP	National Urban Policy
NWP	National Water Policy
OECD	Organization of Economic Co-operation and Development
PPP	Public Private Partnership
PRISE	Projektgruppe für integrierte Stadtentwicklung
PROTOA	Progressive Transport Owners' Association
PURC	Public Utilities Regulatory Commission
RCC	Regional Co-ordinating Councils
SAP	Structural Adjustment Program
SDG	Sustainable Development Goals
SET	Socio-ecological Transition
SNM	Strategic niche management
TCPD	Town and Country Planning Department
TIS	Technological innovation system
TM	Transition Management
UGSG	United State Geological Survey
URBS	Urban Development Authority of Curitiba

Abstract

Green Urbanism evokes a wide range of ideas, images, and perceptions about how cities should be planned, developed, and/or governed to create a balance between human activities and the natural environment. In recent decades, Green Urbanism has attracted considerable research interest; however, these studies are mostly focused on defining a set of criteria for its application to cities based on the experiences of Western countries. Thus, there is a lack of adequate understanding of how Green Urbanism applies to the developing world. In addition, although the *whats* (criteria) of Green Urbanism are extensively discussed, the *hows* (transition processes) have received little treatment. Therefore, this study makes two major contributions to the existing literature on Green Urbanism. Firstly, it examines how different socio-economic contexts and local dynamics influence how Green Urbanism is conceived and applied. Secondly, it assesses the drivers of and barriers to green urban transitions, and what factors in cities provide potential sources of leverage for a transition towards Green Urbanism. It will be shown that these processes are not in general linear or predictable pathways of progress, but are complex and multifactorial.

The cases of Freiburg (developed country context) and Curitiba (developing country) are analysed. Lessons from this analysis are applied to Accra-Ghana (developing country) to identify potential levers for stimulating transitions towards Green Urbanism in a developing world city. The study is based on a review of literature, questionnaire surveys, key informant interviews, GIS mapping, site observations, and a review of government policies. The factors that present opportunities and/or barriers to green urban transitions are analysed through the lens of relevant transition theory, in this case the Multi-level Perspective.

Findings from the study show that Green Urbanism is not only about the physical greening of cities, but also about urban sustainability. Moreover, through the theoretical lens of the MLP, it was found that contextual socio-economic factors, known as landscape pressures, are important for creating windows of opportunity for green urban transitions to unfold. However, they must be effectively articulated to generate the needed responses from social actors, and also coalesce with developments at the niche level. The study notes two potential governance models for transition, namely top down and bottom up and debates the strengths and weaknesses of both. Given that cities are different in their social, economic, political,

technological, and physical characteristics etc., the study recommends that Green Urbanism needs to be responsive to the specific requirements of its application domain.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint award of this degree.

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1.1 Preamble

The growing phenomena of environmental pollution, natural resource depletion, carbon emissions and the resultant impact of climate change necessitate a development paradigm that respects planetary boundaries while promoting the wellbeing of people. Green Urbanism promises to deliver such outcomes. The term Green Urbanism was coined in the early 1990s by urban theorists who sought to define comprehensive parameters for transforming existing cities towards sustainable trajectories (Beatley 2000; Lehmann 2010a). However, precisely what constitutes Green Urbanism in theory and practice is still evolving. In this study, the theoretical underpinnings of Green Urbanism, and the dynamics involved in its application to contemporary cities are examined. To begin with, this chapter delineates the rationale of the study. Firstly, it expounds the statement of the research problem in Section 1.2. Building on this narrative, the research questions and objectives underlying this study are presented in Sections 1.3 and 1.4 respectively. The next section (Section 1.5) highlights the significance of the study. This is followed by definitions of some key terminologies in Section 1.6. The chapter concludes (in Section 1.7) with a brief structure of the thesis.

1.2 Statement of the problem

Cities are identified as the epicenter of a wide range of global challenges. It is long argued that global efforts towards sustainable future will be won or lost in cities (Ahern 2011; Fitzgerald 2010; Wackernagel et al. 2006). In the last century, cities have grown tremendously in population and size across the globe. For the first time in human history, more than half of the world's population lived in cities by 2007, with a projected increase to 70 percent by 2050 (Seto & Shepherd 2009). This growth trend has serious implications for our consumption of

natural resources, and production of waste. Already, cities consume 75 percent of the world's natural resources, produce 80 percent of greenhouse gas (GHG) emissions, and are responsible for more than half of global waste; although they occupy less than 3 percent of global terrestrial surface (UNEP 2012). A corollary of these developments is the rapid depletion of natural resources, inability of the ecosystem to assimilate anthropogenic wastes and emissions, and changes in global climate systems etc. (Global Footprint Network).

Although cities are the main drivers and results of these global phenomena, they also serve as the locus of innovation for technological, social, and economic development (Bettencourt et al. 2007; Shearmur 2012). Cities account for more than 80 percent of global gross domestic product (UNEP 2012). In addition, they provide opportunities for commerce, employment, education, healthcare, art and cultural expressions, and recreation among others. As pointed out by McLaren and Agyeman (2015, p. vii), the idea *“that you can't fix the planet without fixing our cities is obvious, but less obvious is that cities can fix the planet”*. The daunting question, however, is how cities can minimise their negative environmental and social impacts while promoting the quality of urban life, and the sustainability of the natural environment.

In the last decades, several concepts have been proposed to promote urban development paradigms that are beneficial to both humans and the natural environment. These concepts include: Ecological Urbanism, Bioregionalism, Landscape Urbanism, Eco-city theory, New Urbanism, Smart Urbanism, and Urban Resilience etc. (Grant 2009; Gray 2007; Hodson & Marvin 2010; Luque-Ayala & Marvin 2015a; Roseland 1997; Steiner 2014; Thompson 2012). An analysis of the literature reveals that although these concepts provide useful guidelines on how existing cities could be reframed to minimize their impact on the ecosystem, they tend to be trapped in their disciplinary silos. Thus, they are less effective in addressing the complex and dynamically changing realities that confront contemporary cities.

Green Urbanism offers a multi-disciplinary approach to urban development. It integrates the many components of urbanism to address the complex challenges or wicked problems confronting cities (Lehmann 2010a; Newman 2010). In the last two decades, Green Urbanism has gained considerable traction in academic discourses, with extensive discussions on the criteria for its application to cities. This scholarly literature largely builds on the works of

pioneer urban thinkers (e.g. Frederick Olmsted, Ebenezer Howard, Patrick Geddes, Louis Mumford, Jane Jacobs, and Ian McHarg etc.), and the experiences of cities, mostly, in the Western world. Therefore, how Green Urbanism is conceived in the existing literature is largely flavoured by insights from the Western contexts in which they are conceived. These insights might be less relevant to other contexts, given that cities differ in many basic characteristics (e.g. social, technological, political, cultural, economic, and physical etc.). Besides, there is a lack of adequate understanding of the dynamics and processes involved in transitioning existing cities towards Green Urbanism. These limitations in the literature raise critical questions that merit further exploration.

Firstly, they call for an empirical analysis of how different contexts and local dynamics influence how Green Urbanism is conceived and applied. This analysis will help to add some definitional nuance to the concept. Also, there is a need for deeper exploration of factors that present opportunities for and barriers to green urban transitions in different contexts. The current study aims to address these research gaps through an analysis of three empirical case studies (i.e. Freiburg, Curitiba, and Accra). The first two cases constitute a post hoc analysis of cities that claim to be 'green' in both developed (Freiburg, Germany), and developing (Curitiba, Brazil) country contexts. The third case (Accra, Ghana) is an application case study that builds on lessons from the post hoc analysis. The underlying argument of this thesis is that although cities can learn from one another's successes and/or mistakes, such lessons should be tailored to meet the specific requirements of the local context.

1.3 Research questions

To address the gaps observed in the literature, the following research questions are investigated:

1. How does Green Urbanism define its tools and principles in theory?
2. How may green urban transitions be assessed and influenced? What are the potential drivers, opportunities, and barriers to green urban transitions?
3. How have the principles of Green Urbanism been applied to reframe existing cities? How do the characteristics of the local context influence the application of these principles?
4. How can Green Urbanism be applied to cities in developing countries? What strategies are appropriate for transitioning cities in the developing world towards Green Urbanism?

1.4 Research objectives

Through an analysis of these research questions, the study aims to provide a more nuanced understanding of Green Urbanism, and identify key factors that are likely to influence the application of its criteria to contemporary cities. Three specific objectives guide this research:

1. To examine and synthesize the underlying principles of Green Urbanism.
2. To understand how the local dynamics in different contexts influence how Green Urbanism is conceived and applied to contemporary cities.
3. To systematically assess the processes and potential sources of leverage for transitioning cities towards Green Urbanism.

1.5 Significance of study

This study is relevant to sustainable urban development theories and practices in multiple ways. At the theoretical level, the study makes two major contributions to the existing literature on Green Urbanism. Firstly, it brings to light how the local dynamics in different contexts influence how Green Urbanism is conceived and applied. Central to this discussion are the strategies applied by different cities in a transition process, and how these strategies impact transition outcomes. As noted earlier, much of the existing knowledge about Green Urbanism is narrow and biased towards cities in Western countries. Thus, there is limited understanding of how Green Urbanism applies to cities in developing countries which tend to have different social, economic, political, and institutional arrangements to those of the developed world. As pointed out by Lehmann (2010a, p. 17), cities in the developing world cannot have the “same strategies and debates” on Green Urbanism as those in the developed world because of the peculiarity of their potential and challenges. Therefore, this study draws on the cases of Curitiba and Accra to provide insights into strategies that are appropriate for transitioning cities in developing countries towards Green Urbanism. This analysis will help to broaden and/or enhance an operational understanding of Green Urbanism.

Secondly, whilst calls for a transition to more sustainable, greener cities abound, there are limited examples of successful transitions; and few studies examine the processes of green urban transitions. The few existing studies examining these processes (e.g. Horne 2017; Moss & Marvin 2016; Newton 2008; Yamaguchi et al. 2007) are mostly partial, in that they tend to

focus on particular sectors (e.g. transport, housing, energy or waste) and context (developed countries). Hence, these studies fail to provide a holistic and integrated package. The current study makes progress by adapting relevant transition theory to undertake a systematic analysis of the processes of green urban transitions in the empirical case studies identified in Section 1.2. This analysis draws on the Multi-level Perspective (MLP) framework to examine factors that present opportunities for and barriers to green urban transitions. These factors are analysed through three analytical concepts i.e.: socio-technical landscape, regime, and niche. Findings from this analysis provide important reference for policy making, as it unravels potential levers for stimulating a transition towards Green Urbanism.

1.6 Definition of key concepts

This section provides an operational definition of key concepts and terminologies that underpin this study. As pointed out by some scholars, many of the concepts used in social and applied science discourses are fluid constructs which can be adapted to serve the interest of particular disciplines (Colander 2016; Gallie 1955; Schwartz 1992). For example, the ‘green concept’ has become a buzzword in many professions (e.g. commerce, architecture, engineering, and planning etc.) which sometimes breeds confusion and/or results in an abuse of the concept. Hence, the need for clarity to avoid ambiguity. The next sections provide a brief definition of some of the key concepts that are used in this study: Green Urbanism, Multi-level Perspective, landscape, regime, niche, and transition.

1.6.1 Green Urbanism

There is no consensus among researchers regarding the definition of Green Urbanism in the existing literature. The term has been variously defined by different researchers, but with common foundational assumptions. Beatley (2000), who is credited with coining the term fails to provide a concise definition of Green Urbanism. However, he proposes some fundamental criteria that exemplify Green Urbanism: reducing ecological footprint, connection with nature, carbon neutrality, circular metabolism, and dependence on renewable resources etc. In Lehmann’s view, Green Urbanism is:

...a conceptual model for zero-emission and zero-waste urban design, which arose in the 1990s, promoting compact energy-efficient urban development, seeking to transform and re-engineer existing city districts and regenerate the post-industrial

city centre. It promotes the development of socially and environmentally sustainable city districts. (Lehmann 2010a, p. 1)

Like Beatley, Newman (2010), proposes no precise definition of Green Urbanism, but suggests three key factors that characterize the latter. He argues that Green Urbanism is about promoting “smart, secure, and sustainable cities” (Newman 2010, p. 149). Adding to this discussion, the director of the Green Urbanism Program for Global Green USA defines Green Urbanism as “*the practice of creating communities mutually beneficial to humans and the environment*” (Wells 2010, para. 2). These representative definitions accentuate sustainability as the underlying goal of Green Urbanism. As emphasized by Beatley (2000, 2012), this goal should be coupled with a conscious care for and preservation of nature in the urban landscape. Hence, ‘green’ in this context implies literal greening of urban spaces to promote human wellbeing and ecological processes, as well as ensuring the sustainable development of cities. Building on this understanding, this study aims to unpack a more nuanced interpretation of Green Urbanism through the lens of the empirical case studies.

1.6.2 Multi-level Perspective

The Multi-level Perspective (MLP) is an emerging theory that delineates the processes of long-term transformative change in socio-technical systems (Svensson & Nikoleris 2018; Geels 2005). It proposes a heuristic framework for understanding how society changes and develops over time through the interaction of three analytical concepts i.e. socio-technical: landscape, regime, and niche. Thus far, the MLP has been applied to examine transitions in transport, energy, and sanitation technologies etc. (Geel 2005; Kern 2012; Rohracher & Späth 2014; Whitmarsh 2012). It has yet to be applied to assess the dynamics of broader sustainability transitions in cities. This study aims to address this knowledge gap by exploring how the MLP can be applied to enhance understanding of the dynamics of urban transitions.

1.6.2.1 Socio-technical landscape

Socio-technical landscape development is a metaphor for trends and changes in society and globally. It includes changes in global climate systems, shift in cultural preferences, macro-economic trends, globalization, natural and man-made disasters, public awareness of environmental issues, worldviews, changes in political processes, and peak oil and among others (Grin et al. 2010; Kemp et al. 1998; Sorrell 2018). These factors are slow to change, and

they are mostly beyond the direct influence of individual actors (Geels 2005). It is worth mentioning that landscape (as used in the context of the MLP) should not be misconstrued as implying physical land forms, but framework conditions that influence development trends in society. Landscape factors bring pressure to bear on socio-technical regimes to create windows of opportunity for emergent innovations to become mainstream (Kemp et al. 1998; Schot & Geels 2008).

1.6.2.2 Socio-technical regime

Socio-technical regimes are the locus of established practices and technical structures in mainstream society (Nelson & Winter 1982; Rip & Kemp 1998). In other words, regimes are the “primary source of stability” in societal functions (Sorrell 2018, p. 1268). They include consumer lifestyle, sunk cost, rules of thumb, established regulations and practices, existing scientific knowledge, and dominant technologies etc. (Grin et al. 2010). Regimes are dynamically stable, and they are modulated by various actors (e.g. policy makers, users, and corporate entities etc.) who influence their (re)production, maintenance, and transformation (Geels 2012). For the most part, regimes present significant barriers to radical innovations because of lock-in mechanisms and/or path dependence. The latter arise due to previous commitment to prevalent technologies and systems, historical preference, and past knowledge trajectory etc.

1.6.2.3 Socio-technical niche

Niche is where the seed for systemic change in socio-technical systems is developed (Kemp et al. 1998). In other words, it is an incubation space where radical innovations are given opportunities to develop and mature under temporal protection. The latter could take the form of tax exemptions, government investment in research and development, and subsidies etc. (Caniëls & Romijn 2006). Niche protection is important for the sustenance of emergent innovations because of the lukewarm political support for such innovations during their nascent phase of development. Niche has two main impacts on regime: to reconfigure regimes or replace them. To a great degree, the impact of niche on regime determines the direction of a transition process (i.e. introduction of a radically new system or reorganization of existing system).

1.6.3 Transition

Transition is commonly defined as a shift from one condition to another. In technological innovation system's (TIS) literature, it is identified as a shift from one entrenched technology to an emergent technology (Elzen et al. 2004; Markard & Truffer 2008). Following Svensson and Nikoleris (2018, p. 466) observation, this shift is underpinned by changes in "regulative and cognitive rules" that modulate actors' behaviour. Geels and Schot (2007), propose a more differentiated characterization of transitions. They identify four main typologies of transition pathways: transformation, reconfiguration, de-alignment and re-alignment, and substitution. These pathways depend on the relationship between regime and niche. In the transformation pathway, regimes adopt niche as add-ons. Over time, niche causes significant changes in the basic architecture of the regime. A reconfiguration path unfolds when the relationship between regime and niche is symbiotic. De-alignment and re-alignment explain a process where destabilized regimes are replaced by multiple niches. Eventually, one niche emerges and dominates. Finally, substitution occurs when a matured niche competes with an existing regime and replaces the latter. This study draws on these typologies to identify potential pathways for green urban transitions in different sectors and contexts.

1.7 Structure of thesis

This thesis is organized into ten chapters. **Chapter 01** provides the background to the study, and expounds the research problems, questions, and objectives underlying the study. **Chapter 02** comprises a review of scholarly literature on Green Urbanism. It provides a historical background to Green Urbanism, and discusses how the concept has evolved over time. Essentially, Chapter 02 addresses the first research question by identifying and synthesizing the underlying principles of Green Urbanism proposed in the literature. **Chapter 03** explicates the methodological approach used to investigate the research questions. It highlights the ontological assumptions and theoretical framework of the study, methods for data collection and data management, ethical procedures, and limitations of the data. **Chapter 04** presents a detailed analysis of the theoretical framework of this research. It begins with a critical analysis of various transition theories. This analysis is followed by justification of the choice of the Multi-level Perspective as the theoretical lens for the study. It explains how the MLP is applied in the empirical analysis to address the second research question.

Chapter 05 provides a brief profile and background to the application case study in Accra (Ghana). **Chapters 06 and 07** are post hoc analysis of cities the claim to be 'green' in both developed (Freiburg-Chapter 06) and developing (Curitiba- Chapter 07) country contexts. They provide insights into how the local dynamics in different contexts influence how Green Urbanism is conceived and applied. Both chapters address the third research question. **Chapter 08** is an analysis of findings from Chapters 06 and 07 through the theoretical lens of the MLP. It addresses both research questions 2 and 3 by examining factors that modulate the processes and outcomes of green urban transitions in different contexts. Building on this narrative, **Chapter 09** addresses the fourth research question. It draws on lessons from Chapters 06, 07, and 08 to examine appropriate strategies for stimulating a transition towards Green Urbanism in Accra. Finally, **Chapter 10** concludes with some key contributions of the study and recommendation for policy. It highlights areas that need further investigation in this field of research.

Literature Review

2.1 Introduction

Since the 1970s, humanity has consumed more ecological resources and generated more waste per annum than the ecosystem can regenerate and assimilate in one year (Global Footprint Network). This deficit places the ecosystem at the rim of an ecological apocalypse. Hence, in the last decades, the concept of Green Urbanism has received considerable attention in both academic and policy discourses to promote a development paradigm that respect planetary boundaries. Green Urbanism evokes a wide range of ideas, imagery, and perceptions about how cities should be planned, developed, and governed to create a balance between human activities and the natural environment (Beatley & Newman, 2008; Lehmann, 2010b). It builds on concepts that have attempted to address the fallouts from the Industrial Revolution at the turn of the 19th century. How Green Urbanism is conceived in theory and what criteria inform its application to cities form the fulcrum of this chapter.

Through an extensive review of literature and archival documents, this chapter presents chronological accounts of factors and/or developments that have led to the concept of Green Urbanism. The chapter is structured as follows: Section 2.2 provides a historical overview of the phases of urban civilization and their implications for the structure and function of cities. It highlights some of the major challenges that confronted cities during these phases, the solutions proposed to address them, and how these solutions have inspired the emergence of the concept of Green Urbanism. Building on this narrative, the questions of how Green Urbanism is defined, and what methods or principles it proposes to reframe existing cities are analysed in Section 2.3. This analysis informs the development of an operational framework for Green Urbanism. Finally, Section 2.4 highlights the gaps in this field of research, and how the current study seeks to address these gaps.

2.2 Evolution of the green city concept: a historical analysis

2.2.1 Phases of urban civilization

2.2.1.1 Pre-industrial society

The pre-industrial era was dominated by traditional agrarian lifestyle. Although the genesis of pre-industrial society remains debatable, it is generally associated with the era just before the Industrial Revolution (Cipolla 1976). It is a time before the widespread use of machineries and tools to enhance human productivity. Major attributes of pre-industrial societies included: dependence on natural elements such as seasons and the fertility of the soil; higher rural population relative to urban population; subsistence living; dependence on animate energy sources for the production of goods and services; non-standardization of goods, and low productivity among others (Sjoberg 1955). Social life was defined in units of extended families, and large numbers of children were regarded as an essential economic asset to support agricultural production among other services that required animate energy (Bell 1976).

According to Sjoberg (1960), pre-industrial societies displayed substantial similarities in their basic forms and functions due to their common technological limitations. People depended on human and animal power for production and transportation purposes. These technological constraints did not only determine the nature of work and modes of transport of people, but also influenced the size and forms of these societies. Hence, pre-industrial societies were generally small and dense (Morris 1979). Settlement patterns were commonly segregated by status and wealth, with highly placed people living close to the center and the poor on the periphery (Langton 1975).

Preindustrial man was attuned to natural order, with less human induced environmental degradation. Mumford (1956), identified this era as “eco-technic civilization” where humans lived in harmony with nature. Nonetheless, pre-industrial societies grappled with poor living conditions due to health problems and low productivity levels in the face of a steady rise in human population (Hall 1975; Morris 1979). In the late 18th century, great strides were made in mechanizing the means of production which ultimately ushered in a new era of

industrialization. This development brought about significant rise in technological inventions in many spheres of social life.

2.2.1.2 The Industrial Revolution: implication for urban development

The Industrial Revolution brought about a dramatic change to every aspect of human lifestyle, and its relationship with the environment (Gimpel 1977). It marked a period of change from a predominantly agrarian and rural society in Western Europe and other parts of the world, to an industrial and urban society. Beginning from the late 1700s, Great Britain (the birthplace of the Industrial Revolution) saw a remarkable transition from dependence on human and animal power to reliance on inanimate energy sources for the production of goods and services. This transition brought sweeping improvements in the production of basic human needs such as food, clothing, medication, shelter, and transportation among others.

Following McLamb's (2011) lead, one of the most striking evidences of the impacts of the Industrial Revolution on modern society was the tremendous growth in human population. There were significant improvements in life expectancy and the material living standards of people (Ashton 1997). Urban population growth was largely driven by the movement of people from the countryside to cities for jobs (Hays 1995). The population of London, for example, is said to have doubled from 1 million people in the early 19th century to 2 million by mid-19th century (Hall & Tewdwr-Jones 2010; Williamson 2002). Similar trends of population growth were also observed in major cities in the United States and other industrializing Western European countries (Ashton 1997). Thus, the quest for economic opportunities took center stage in most societies at the advent of industrialization.

According to Hays (1995), the value systems of people were significantly influenced by the dramatic socio-economic changes that ensued from the Industrial Revolution. Issues of environmental preservation, for example, paled in comparison to the motivation for economic development and wealth creation. This phenomenon led to serious environmental degradation in most industrializing cities. In the United States, for example, materialism became the predominant measure of success with religion and communal living losing their prominence in mainstream society (Hays 1995). The influx of people to cities immensely increased demand for public services which most city authorities were not prepared to provide (Hall & Tewdwr-Jones 2010).

As population grew, so did the demand for space and natural resources to meet increasing consumption patterns. The spatial growth of most industrial cities was facilitated by technological advancements, particularly, in the transport and the communication industries. Hall (1975), notes that before industrialization intensified in London, people lived within a radius of 3 miles from the center of the city which made walking to work reasonably short. Hence, the city center was relatively dense with mixed working and residential urban spaces. However, as technological inventions intensified, and the development of efficient public transport systems emerged, London expanded tremendously by the late 1900s (Hall 1975).

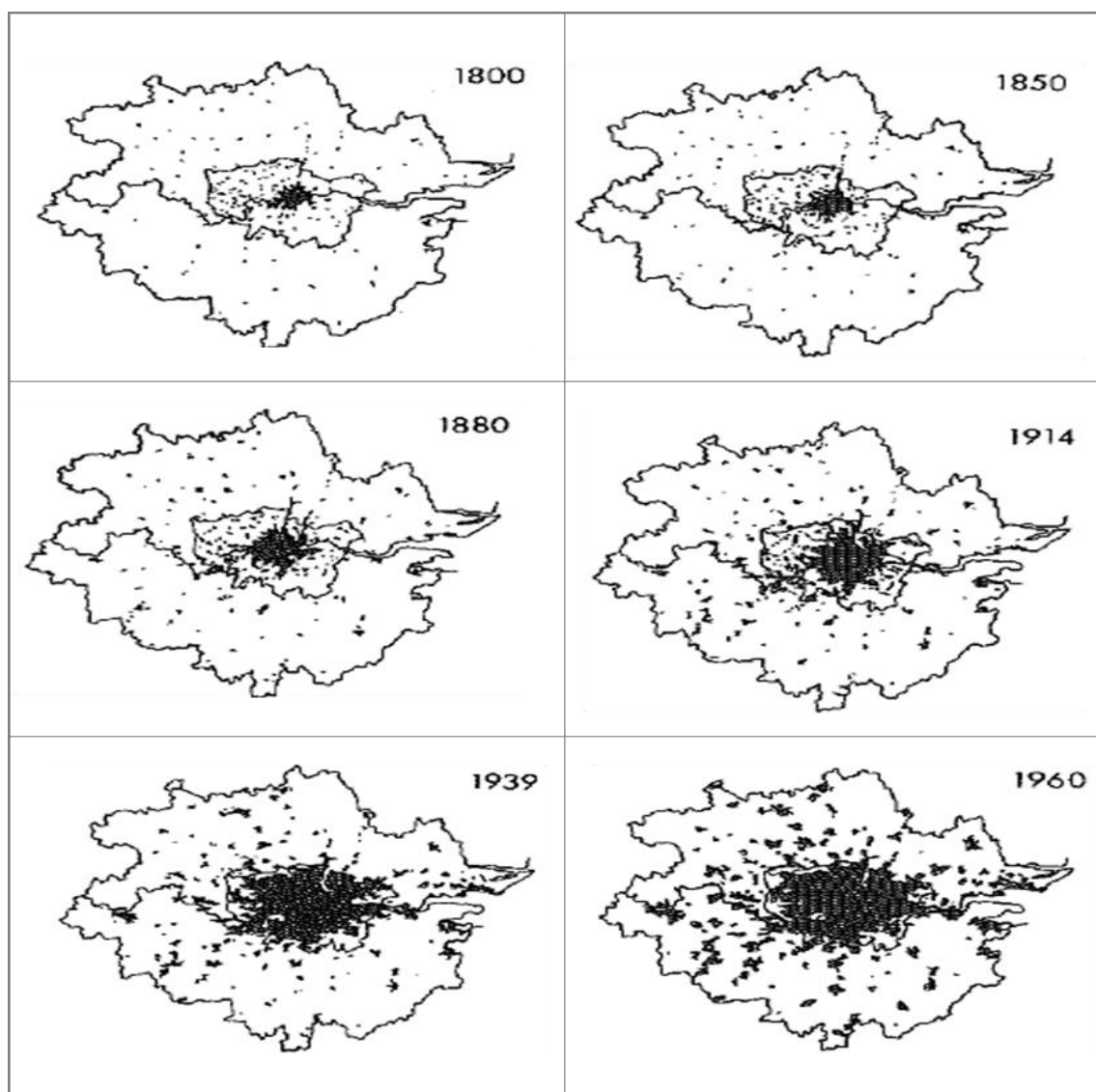


Figure 2.1: Population growth of London between 1800-1960 (Source: developed from Hall 1975)

Mieszkowski and Mills (1993), identify two theoretical perspectives that explain the drivers of urban growth in industrialized cities. These perspectives comprise the natural evolution

theory, and the “flight from blight” theory. The natural evolution theory argues that the process of suburban growth is a function of household demographic, income, and lifecycle changes (Bayoh et al. 2002). It postulates that as households’ income increased, people resorted to living in the periphery of cities for better housing conditions. Factors such as the intra-urban transport systems developed in the late 19th century made it possible for people to commute longer distances to work. Consistent with this viewpoint, Mumford (1961) notes that, at the outset, the possibility of suburban living was limited to the bourgeoisie; however, with the introduction and expansion of affordable public transport systems in the early 1900s, the lower class could also afford to move to the outskirts of the city.

The second notion of suburb growth (i.e. “flight from blight”) emphasizes the declining quality of urban centers and the fiscal stress (high property tax etc.) on urban residents as the underlying motivation for urban sprawl (Mieszkowski & Mills 1993). As more and more people moved to urban centers for economic opportunities, cities became vulnerable to crime, racial tensions, overcrowding, and environmental pollution among others. Thus, people moved to suburban areas for freedom from the deleterious conditions in the city (Bayoh et al. 2002). In fact, to escape from the city was seen as a “mark of success” (Mumford 1961, p. 549). Put together, these theoretical perspectives provide useful insights into the underlying causes of suburban growth in industrial cities. However, they do not exclusively account for the driving forces underpinning this growth pattern. They seem to be complementary propositions rather than distinct theoretical constructs.

To summarize, although the Industrial Revolution propelled development to extraordinary levels, it came at a serious cost to the environment and the general wellbeing of people. The manufacturing sector which generated tremendous wealth in cities was also the villain of the piece. To resolve these negative environmental and social consequences, a transition from a manufacturing-based economy to a service-based economy has been pursued by most industrialized societies since the turn of the 19th century (Bell 1976).

2.2.1.3 Urbanism in post-industrial society

Post-industrial society is marked by value for knowledge with less emphasis on the production of material goods (Masuda 1980). According to Bell (1976), “life was a game against nature” in pre-industrial societies. However, with the advent of industrialization, “life became a game against fabricated nature”; and with a steady transition towards post-industrial society, “life has become a game between persons” (Bell 1976, p. 576). Thus, the economic structure of post-industrial societies is largely underpinned by the exchange of ideas and immaterial goods or services. Generally, these (service-based) economies are considered to be inherently more environmentally benign than industrial economies (Dinda 2004; Newman & Matan 2013).

They are seen to provide clean or less polluting jobs. However, they do not guarantee a reduction in the ecological footprint of cities (Herring 2006). In fact, a recent report by the Global Footprint Network shows a higher ecological footprint per capita in predominantly service-based economies such as Australia, United States, and Belgium etc. than say China or Indonesia which have a significant share of their nominal gross domestic product (GDP) from the manufacturing sector (see figure 2.2). This phenomenon is largely associated with high consumption rates in the former (Herring 2006; Jorgenson 2003). Hence, the sustainability gains in most post-industrial economies are partly offset by high consumption and waste generation (especially carbon emission) patterns.

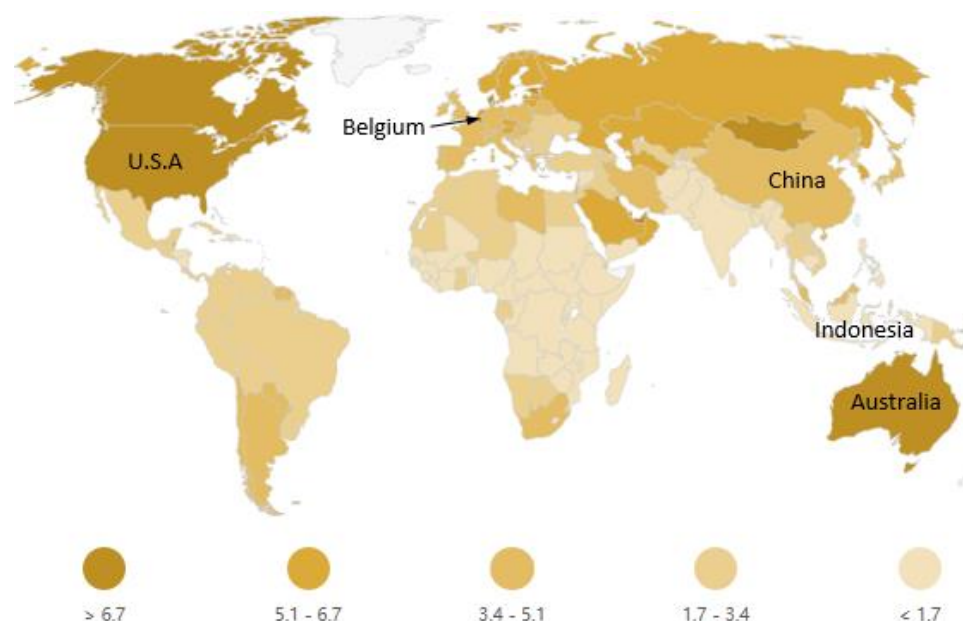


Figure 2.2: Ecological footprint per capita by countries (Source: modified from Global Footprint Network 2018: <http://data.footprintnetwork.org/#/>)

From the analysis above, it can be observed that the forms and functions of cities have been largely influenced by the various phases of urban civilization. As human society and the technologies used in everyday activities evolved and transposed from one phase of civilization to another, the environmental and social challenges confronting cities also metamorphosed in line with these structural changes. A major turning point in this transition process was the advent of the Industrial Revolution. The latter brought about major improvements in wealth, but not without its downsides: pollution, overcrowding, spread of diseases, and suburban growth etc. In response to these social and environmental challenges, several solutions were proposed (or applied) by various pioneer thinkers in urban planning to redirect the development of cities along desired trajectories. The next section examines the influences of these urban planners and theorists, and how they contributed to defining a new paradigm for urban planning that is responsive to the needs of people and the environment in general.

2.2.2 Responding to the challenges of the industrial city: perspectives of pioneer thinkers in urban planning

The ideas of ‘pioneer’ urban thinkers such as Howard, Geddes, Wright, Le Corbusier, Mumford, Jacobs, and McHarg among others have had significant influence on urban planning profession since the mid-19th century. Hall (1975, p. 19), identifies this group of thinkers as the “Seers”. According to Fishman (1982), the quest for a better world during the peak of industrialization (due to the environmental pollution and social tensions in cities) remained a dream to many; however, these “seers” took a step further and planned one. They deployed a sophisticated synthesis of metaphors, imageries, and theories to convey their ideologies with pertinacity.

It is interesting to note, though, that most of these influential thinkers did not have formal training in urban planning. They brought diverse careers and different (or novel) ways of thinking about cities to the planning profession. Their lack of professional training in urban planning, more or less, relieved them of what Alexander (1987), identified as a “reductionist” classical planning practice of the time. Hence, they had the liberty to think outside the box. Their ideological stance was underpinned by the magnitude and character of the urban problems they attempted to address, and their interpretation of these problems.

Ebenezer Howard (1850-1928): Howard remains one of the most influential thinkers in urban theory and practice. According to Hall (1975), Howard is the “least utopian in the sense of impractical” because he tempered his ideas with pragmatism. Echoing this point, Jacobs (1961, p. 17), acknowledged that the most “important thread of influence starts...with Howard”. His Garden City concept (proposed in the late 1800s) emerged as one of the maiden attempts to address the environmental and social challenges confronting British cities as a result of industrialization (Freestone 1993). The Garden City movement had major influence not only in Britain but also in North America, Australia and other parts of the world; although its application in other contexts is largely regarded as selective borrowing (Christensen 1986; Freestone 1993; Ward 2005). Studies by Stern et al. (2013), for instance, documented about 700 garden cities in 34 countries around the world. This widespread application of the Garden City concept accentuates Howard’s influence on planning doctrines across the globe.

A three-magnet metaphor was deployed by Howard to demonstrate the underlying goals of the Garden City concept (see figure 2.3). The top two magnets identify the merits and demerits of town and country life, while the bottom magnet attempts to integrate the advantages of the town and the country to communicate Howard’s conceptual model of Town-Country. Some observers argue that it is the most popular diagram in the field of urban planning which attempts to provide an equilibrium of the “fundamental variables” of sustainable urbanism (Duany 2013, p. 4). In the words of Hall (1975, p.48), “it is an extremely compressed and brilliant statement of planning objectives” that could be readily comprehended by laypersons who might not have any clue about urban planning.

The second diagram (figure 2.4) is an illustration of how the Garden City would be structured and connected to one another in relation to an existing central city. Howard’s idea was to promote a development that is self-sufficient and fairly small (about 32,000 people) surrounded by a large green belt. The aim was to afford people the opportunities of the town while not depriving them of the serenity and natural beauty of the country. Howard envisaged the Garden City not only as a community but also an economic unit where residents could invest in its development and receive returns on their investment. He also proposed a process of democratic planning that allowed for the reconciliation of the interests and autonomy of individuals with the collective interest of the community (Howard & Osborn 1965; March 2004). With this proposition, Howard advocated for a bottom-up planning approach. This

approach was inconsistent with the classical planning practice of the time which was predominantly top-down.

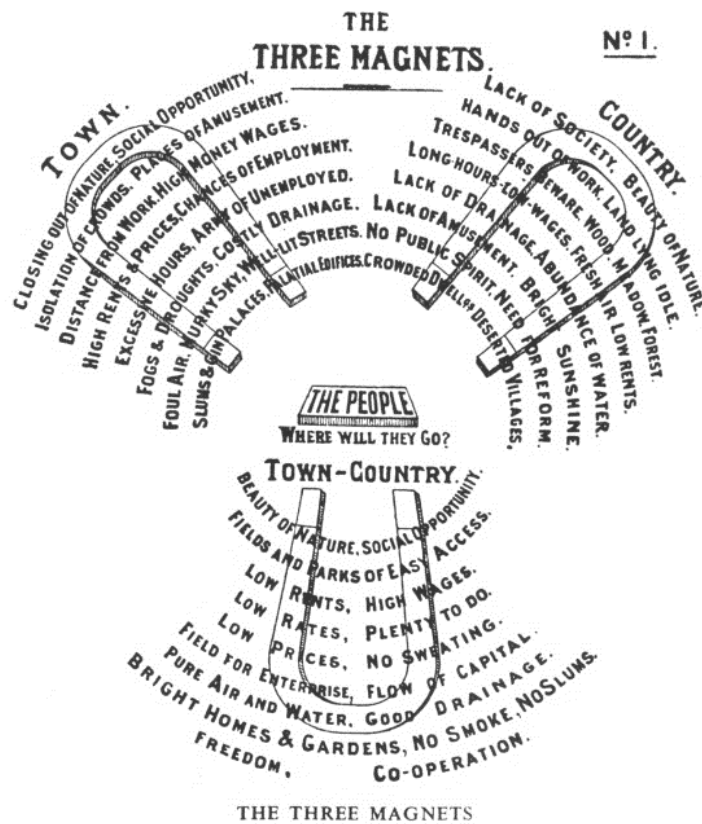


Figure 2.3: The Three Magnet (Howard & Osborn 1965)

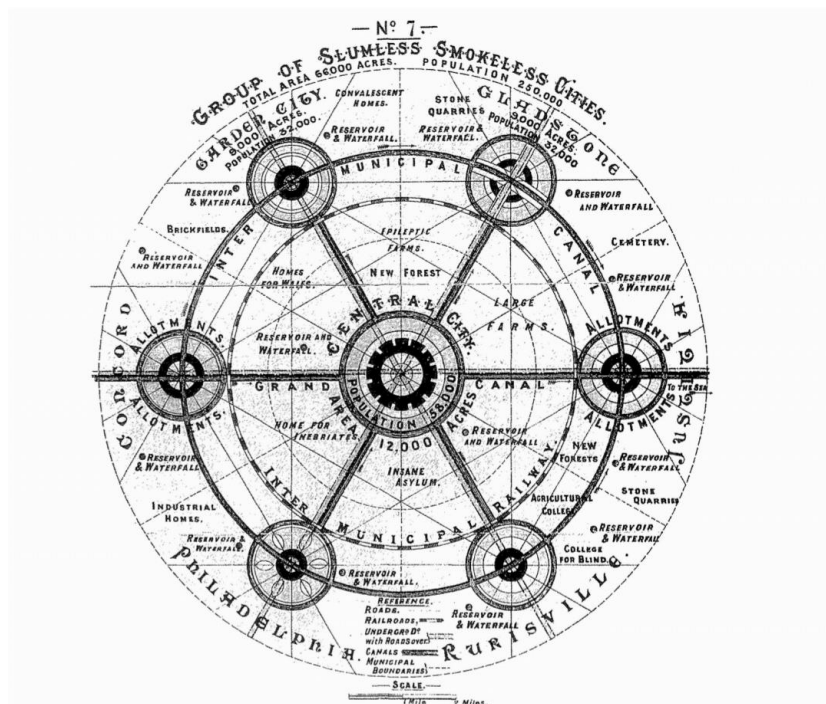


Figure 2.4: The Garden City (Howard & Osborn 1965)

Ultimately, Letchworth and Welwyn Garden Cities were built in the early 1900s as exemplars of Howard's thinking. These projects were accomplished with the support of Raymond Unwin who is credited with translating Howard's ideas into architecturally meaningful designs. Howard (1902), aimed to limit growth and create adjunct Garden Cities when the existing Garden City reached a threshold of 32,000 people to avoid the development of the green belts. However, little details were provided by Howard with regards to how the population overspill from an existing Garden City might be transferred to a new Garden City, and how this transition process might be managed.

It is, therefore, not surprising that the population limits set by Howard for his two Garden Cities (Letchworth and Welwyn) have been compromised with both cities exceeding the 32,000-population threshold. In fact, some observers argue that Howard's reference to the development of North Adelaide as a means to cater for the growth of South Adelaide (Howard & Osborn 1965, p. 140) is erroneous because the plans of both cities were laid out around the same time by Colonel William Light in the mid-19th century (Anderson 2013). Notwithstanding, the Garden City concept has had huge influence around the world, and it is largely regarded as a standard model for urban planning (Duany, Andrés 2013), and the harbinger of Green Urbanism (Lehmann 2010b).

Patrick Geddes (1854-1932): Building a career in biology, sociology, and geography etc., Geddes can be described as a polymath. He emerged as a pioneering urban theorist in the early 1900s with particular interest in investigating factors that underpinned the growth and transformation of cities (Hall 1975). His studies culminated in his book: *The Evolution of Cities*. In the preface to his book, Geddes proffered the concept "eutopia" in lieu of "utopia" to emphasize the importance of understanding and building on the best potentials of a place rather than drawing on imaginary concepts nowhere. Thus, Geddes decried utopian thinking as a way of "imposing a priori" ideal concepts on human society with little or no understanding of the inherent characteristics of the latter which have defined and shaped its development over time (Cordua 2010, p. 158).

Geddes was largely influenced by Darwin's evolutionary ideologies. He analogized the city to a living organism which develops and/or evolves over time in relation to its environment. His reading of the interaction between cities and their natural environment highlighted how cities

transform the environment and how these changes in the environment shape cities over time through a positive or negative feedback loop. This feedback mechanism could be understood as a chain of continuous cause-and-effect relationship between human activities and natural processes. Geddes' Master Plans for Tel Aviv and Bombay, for example, aimed to encourage the: integration of nature with the built environment; preservation of heritage buildings; design of pedestrian friendly and liveable communities; and development of communities that promote civic pride etc. (Makhzoumi & Pungetti 2003; Meller 2005).

He identified technological innovations as fundamental determinants of the evolution of cities. Building on this understanding, Geddes categorized urban civilization into two main eras: Palaeotechnic and Neotechnic (Cordua 2010). He associated the Paleotechnic era with the creation of overcrowded, polluted, and chaotic cities as a result of industrialization. According to Geddes, the Paleotechnic man sought after short-term gains, and prioritized monetary wealth at the expense of what he terms the 'real wealth' that lay in a healthy environment (Leonard 2007). On the other hand, Geddes describes the Neotechnic era as a period of optimistic development that brings nature back to cities with cleaner energy sources, efficient use of resources, and better conditions for people and their natural environment (Braham & Hale 2013). His Neotechnic theory resonates strongly with the ideals of proponents of Green Urbanism. Notwithstanding his contribution to urban planning, Geddes is criticised by some observers as a poor communicator. Hollis (2011), for example, finds his ideas to be anaemic and short of clarity. Most of his ideas were further distilled and expanded by Lewis Mumford who is identified as a true intellectual ally of Geddes.

Lewis Mumford (1895-1990): Drawing much of his inspiration from Geddes, Lewis Mumford emerged as one of the most influential architecture critics of his generation. He is credited with refining and synthesizing Geddes' ill-articulated ideas into coherent theories (Marshall & Batty 2009). Expatiating on Geddes' phases of urban civilization, Mumford identifies Ecotechnic civilization as predating the Paleotechnic and Neotechnic eras. According to Mumford (1963), the Ecotechnic era is a period when man lived in harmony with nature using wood, water, and wind as the main sources of energy. This era can be associated with pre-industrial societies and the periods preceding this generation. There was less human induced ecological degradation compared with the Paleotechnic era where dependence on coal and fossil fuel caused huge environmental pollution in most industrializing cities.

Like Geddes, Mumford (1963), blamed growing impacts of human society on the environment on the rise of materialism and industrial capitalism. Responding to the mass exodus from cities to the country at the peak of the Industrial Revolution, Mumford (1973), advocated for the reinvention of existing cities through a fruitful integration of ecological, social, and economic factors to enhance their liveability. He strongly opposed proponents of greater urban decentralization such as Wright's Broadacre City which he criticised as a way of disintegrating the city (Hill 1985). In his book: *City Development*, Mumford (1949, pp. 94), emphasized that *"if the existing city is not to go downhill in population, ...there must be systematic improvement of housing, ...and the provision of gardens and parks that will give the city all the advantages of the suburbs"*. For example, he identified the works of Frederick Law Olmsted as constructive efforts towards improving conditions in existing cities by developing gardens and open green spaces to serve as the lungs and breathing spaces of cities. Earlier works by Georges-Eugène Haussmann (Paris) and Ildefons Cerdà (Barcelona) could also be seen in the same light (see Table 2.1).

Mumford's core values hinged on his support for the creation of human community in lieu of a mechanistic approach to urban design (Mumford 1928). In the mid-1900s, his major criticism of urban planning in the United States lay in: the conception of the city as a machine; the prioritization of highways and monumental architecture with little or no recourse to the human scale; and the segregation of urban land uses which brought about major changes in human agglomeration and the proliferation of the automobile (Koritz 2004). This pattern of development in the United States had much influence from the creative art of Frank Lloyd Wright, the works of Swiss-French architect Le Corbusier, and the modernist approach of Robert Moses among others (Bacon 2001; Ballon & Jackson 2007; Novak 2014).

Frank Lloyd Wright (1867- 1959): Wright proposed the Broadacre City which is regarded as a complete desertion of the city for suburban development (Novak 2014). He placed much priority on the automobile with less consideration for spontaneous pedestrian life. He saw emergent technological developments in communication and transportation as invaluable discoveries that would make people regain their freedom from the overcrowded cities (Wright 1935). Wright's ideological position was anti-urban, and he sought to encourage an exodus from the industrial city rather than fix its immanent problems. With his Broadacre City, Wright envisioned a political milieu where American people would enjoy much liberty of

owning their properties (about one acre per household) in the country where the automobile would reign (Grabow 1977; Wright 1935). To some critics, his utopian plan is nothing more than an exurban development designed for the automobile with conspicuously wasteful spaces (Hill 1985). Although the Broadacre City never saw the day of light, the environmental impacts of the automobile in contemporary cities “offer enough proxy evidence for a negative verdict” on Wright’s car dependent plan (Leon 2014, para 3).

Charles-Édouard Jeanneret -Le Corbusier (1887-1965): Le Corbusier is widely acknowledged as one of the pioneers of modern architecture. He saw architecture as a socio-political and economic tool for improving the world through efficient design of buildings and the built environment (Corbusier 1987). Like Wright and Howard, Le Corbusier explored the prospects of addressing the environmental and social challenges of industrial cities through extensive rebuilding of adjunct settlements (Fishman 1982). However, unlike Wright and Howards, he is regarded as a centrist with particular interest in promoting vertical construction of cities in lieu of horizontal development (Breheny 1996). His proposed Ville Contemporaine and the Ville Radieuse allowed for high density development and the separation of urban land uses into residential, recreational, commercial, and industrial zones etc., connected by freeways. Le Corbusier, like other 20th century urban designers such as Wright and Robert Moses, is noted for his celebration of the automobile in the urban landscape.

In the English translation of his book: *The City of To-morrow and its Planning*, Le Corbusier (1987, p. 79) advocated for the creation of what he referred to as a “proportional mean” between man and nature via “covering with verdure the urban landscape and setting Nature in the mist of our labour”. He reckoned that nature in city planning is essential for promoting the physical and spiritual wellbeing of people. His regard for nature in the urban landscape informed the design of his *pilotis* (supports that lift buildings above ground level) to leave panoramas of continuous greenery at the ground level of skyscrapers in the city center. He was particularly influential in promoting buildings of exceptional heights to promote high density living, and enhance the internal efficiency of cities (Breheny 1996; Marmot 1981). Nonetheless, Le Corbusier’s planning theories has been criticised on many grounds. In the view of Ghirardo (1984), his modernist approach gives prominence to formal and technical issues but fails to efficiently address the social and political realities that underlie human society. To Jacobs (1961, p. 352), Le Corbusier’s ideologies were: extraneous to the aspirations

of the average citizen; had little regard for the context of its production; and his celebration of the automobile was an “insistent instrument of city destruction”.

Jane Jacobs (1916- 2006): Jacobs took exception to the anti-city approach, and advocated for what she referred to as vital streets and neighbourhoods. Her work was largely criticized on the grounds of lacking scientific validity and theoretical impetus (Hirt & Zahm 2012). Some critics also dismissed her work as oversimplification of complex socio-spatial issues, and mere narrative from someone with little knowledge of the planning profession (Alexiou 2006). Notwithstanding, Jacobs rose above these adversities and became one of the most influential urban theorists in the last century (Page & Mennel 2011). According to Hirt and Zahm (2012, p. 217), her works provide a new way of viewing cities through “the lens of empirical observation and community intuition” rather than utopian concepts.

She emphasized a humanistic understanding of cities which is grounded in the concepts of placemaking and bottom-up planning (Jacobs 1961). Her ideological commitment was antithetical to planning approaches that tend to impose order on urban life with little or no recourse to grassroots level participation (Hirt & Zahm 2012). In her book, *The Death and Rise of Great American Cities*, Jacobs underscored the significance of: promoting ecological, social, and economic diversity in cities; mixed-use and location efficient development; pedestrian friendly streets and neighbourhoods; efficient public transport systems; and decent quality of life in high urban density (Jacobs 1961). Her relentless effort in promoting people-oriented development has been a major inspiration for placemaking and community-centered approach to urban planning.

Ian McHarg (1920- 2001): McHarg was a prominent landscape architect and one of the key proponents of ecological approach to urban design. In his seminal book: *Design with Nature*, McHarg (1971), underscored the essence of nature to human wellbeing, and the need to plan cities in ways that do not set them against ecological processes but accommodate and nurture the natural environment. He believed that the daunting challenges facing the world all “have profound environmental content”; therefore, the way forward in urban design should be a shift from “orthodox city planning to human ecological planning” that accommodates and enhances natural processes (McHarg 1988, p. 35).

McHarg advocated for an interdisciplinary approach to urban planning that engages the physical, biological, and the social sciences to enhance understanding of human interactions with both biotic and abiotic elements of the ecosystem (McHarg 1981). Thus, he believed that the ‘wicked challenges’ confronting cities could only be unravelled by engaging various sciences and breaking down disciplinary silos. To some observers, his ideas helped to bridge the divide between landscape architecture, planning, and environmental activism (Thompson 2012). Like Mumford and Jacobs, McHarg’s influence on urban planning and design has been more theoretical than a physical manifestation of concrete projects.

2.2.3 Summary

From the review above, it can be observed that cities have undergone tremendous changes throughout the various phases of urban civilization. A critical milestone was the advent of the Industrial Revolution. Paradoxically, some of the greatest strengths of industrialization were also a major source of weakness. For example, the industrial city promised higher quality of life and wealth creation through technological advancement; however, these positive attributes also precipitated a cascade of unintended consequences (e.g. overcrowding, pollution, materialism, and environmental degradation etc.). The fallout from the Industrial Revolution instigated the emergence of new concepts or approaches to urban planning. These strategies shared a common goal of enhancing the quality of life of people in the urban space, but differed in how these goals might be achieved.

Essentially, the concepts proposed by the various pioneer urban theorists and planners can be seen as either supportive or dismissive of the city. In other words, some initiatives and/or concepts aimed to fix the immanent challenges of the industrial city while others were largely decentralist utopias against the industrial city. The Garden City and the Broadacre City are typical examples of the latter. They could be seen as precursors of new eco-city developments in China and other parts of the world that aim to provide a model for sustainable urban living. However, what this approach fails to address is how existing cities, which still accommodate the greater share of people and resources, might be ameliorated to enhance their performance. As pointed out by Mumford (1949), existing cities “will have an even more significant role to play in the future than [they have] played in the past”. Therefore, cities

should be the primary site for action if global climate and social challenges are to be resolved (Jacobs 1961; Johnson et al. 2015).

That said, the concepts proposed by the various pioneer urban thinkers (see Table 2.1) have been a source of inspiration for planning decisions in cities across the globe in the last century. They underpin contemporary urban theories that seek to promote both socio-economic and eco-efficient development in cities. According to Lehmann (2010a), they are important harbinger of the concept of Green Urbanism. Besides, they could be seen as precursors to recent global initiatives (e.g. Brundtland Commission, Local Agenda 21, Aalborg Charter and Commitment, Kyoto Protocol, and United Nations Sustainable Development Goals etc.) that aim to promote development paradigms that respect planetary boundaries while fostering the wellbeing of people. How these concepts have been applied and/or re-imagined by generations of urban planners and theorists to direct the developmental trajectory of contemporary cities towards more sustainable future form the fulcrum of the next section.

Table 2.1: Summary of concepts and principles espoused by pioneer urban thinkers

Year	Urban theorists	Projects/ theories	Objectives of projects/ theories	Underlying principles
1809-1891	Georges-Eugène Haussmann	Renovation of Paris	<ul style="list-style-type: none"> • Improve the poor housing and environmental conditions in Paris. • Tree planting along public streets. 	<ul style="list-style-type: none"> • Promoting nature in cities through the development of parks and the mass planting of trees.
1815-1876	Ildefons Cerdà	Expansion of Barcelona through the development of the <i>Eixample</i>	<ul style="list-style-type: none"> • Address the problem of overcrowding in Barcelona. • Improve housing, environmental and health conditions in cities. • Compact and walkable neighbourhoods 	<ul style="list-style-type: none"> • People oriented development. • Mixed-use development. • High residential density. • Designing with nature through proper orientation for efficient daylighting and ventilation. • Integrating nature into buildings via

				creating courtyard gardens.
1822-1903	Frederick Law Olmsted	Landscape architecture	<ul style="list-style-type: none"> Integrating nature into urban design for social and aesthetic purposes. 	<ul style="list-style-type: none"> Biophilic urbanism Designing with the natural setting of a given space.
1850-1928	Ebenezer Howard	Garden City concept	<ul style="list-style-type: none"> Integrating the economic and social benefits presented by the town with the natural and clean environment offered by the country. 	<ul style="list-style-type: none"> Self-contained development Top-down management and bottom-up democracy. Biophilic urbanism Mixed-use development
1854-1932	Patrick Geddes	<p>Proposed:</p> <ul style="list-style-type: none"> The concept of City as living organism. Integration of sociological concepts with town planning A theory for understanding the evolution and growth of cities which led to his concept of conurbation. 	<ul style="list-style-type: none"> Enhance the interaction between people and their natural environment. Provide a framework for understanding the process of urbanisation. 	<ul style="list-style-type: none"> Biophilic urbanism Sense of place Pedestrian friendly community development. Participatory planning process. Preservation of historical buildings.
1867-1959	Frank Lloyd Wright	Broadacre City	<ul style="list-style-type: none"> Avoid overcrowding in central cities. Provide alternative settlement where people can enjoy the quality of country life. 	<ul style="list-style-type: none"> Bottom-up democracy Local food production. Contact with nature
1887-1965	Charles-Édouard Jeanneret (Le Corbusier)	<ul style="list-style-type: none"> Ville Contemporaine Ville Radieuse 	<ul style="list-style-type: none"> Provide better living conditions for crowded cities through demolition of 	<ul style="list-style-type: none"> High density development. Integration of parks with residential and

			existing settlement and/or development of adjunct settlement.	commercial development
			<ul style="list-style-type: none"> • Separation of urban land uses through zoning. 	
1895-1990	Lewis Mumford	Human and ecologically oriented urban development.	<ul style="list-style-type: none"> • Improve living conditions in cities. • Reduce automobile dependence in cities. • Create a balance between social and natural processes. 	<ul style="list-style-type: none"> • Retrofitting of existing districts. • People oriented development. • Mixed-use development. • Integration of nature with the built environment.
1916-2006	Jane Jacobs	<ul style="list-style-type: none"> • Placemaking • Vital streets and neighbourhood 	<ul style="list-style-type: none"> • Revitalizing existing communities and streets. • Avoid the dominance of the automobile in urban space. • Promote vibrant social and economic activities in cities. 	<ul style="list-style-type: none"> • Retrofitting existing districts. • Sense of place • Bottom-up planning. • Mixed-use development. • People oriented development.
1920-2001	Ian McHarg	Ecological urban planning	<ul style="list-style-type: none"> • Improve the harsh conditions of industrial cities by incorporating the natural beauty of the country. • Brownfield regeneration. 	<ul style="list-style-type: none"> • Biophilic urbanism • Designing with the natural setting of a given space. • Integrated approach to urban planning.

2.3 A review of contemporary urban transformation theories: towards a framework for Green Urbanism

Consistent with Mumford's (1949) prediction, cities have assumed "an even more significant" role in contemporary society than they did throughout the various phases of urban civilization. For the first time in history, more than half of the world's population lived in cities by 2007 (Seto & Shepherd 2009). This tremendous growth in urban population has had serious implications for the consumption of natural resources and the production of waste. Already, cities consume 75 percent of the world's natural resources, produce 80 percent of global greenhouse gas (GHG) emissions, and are responsible for more than half of global waste (UNEP 2012). Consequently, it takes the earth one and a half years to regenerate the resources we consume, and absorb the waste we produce in one year (Global Footprint Network). Therefore, as argued by some observers, global efforts towards a sustainable future will be won or lost in cities (Ahern 2011; Fitzgerald 2010).

Against this backdrop, a plethora of theories have entered the policy and academic discourses with the aim to minimize the impact of cities on the ecosystem, and enable them live within their ecological boundaries. These theories largely build on the works of pioneer urban thinkers discussed in previous sections (Church 2014; Lehmann 2010c; Roseland 1997; Spirn et al. 2005). They include: Ecological Urbanism, Landscape Ecology, Landscape Urbanism, Bioregionalism, Eco-city theory, New Urbanism, Smart Urbanism, and Urban Resilience etc. It is beyond the scope of this study to provide a detailed review of the vast literature on these theories; however, a summary of the underlying principles of the theories is presented (in Table 2.2) for analytical purpose. As shown in Table 2.2, these theories are presented as distinct conceptual perspectives; however, they contain considerably overlapping principles. Consistent with this observation, a study by De Jong et al. (2015), shows that most of these theories are used interchangeably in practice. Although some level of conceptual resemblance cannot be avoided, since these theories all attempt to address one object (i.e. cities), some clarity should be brought to the focus of each theoretical domain to avoid conceptual fuzziness. Thus, a clearly defined toolkit upon which the principles and application criteria of these theories can be developed is necessary.

Table 2.2: Representative definitions and criteria of contemporary urban theories

No.	Theories	Definition	Principles	Sources
1	Ecological Urbanism	A framework to incorporate and accommodate the inherent conflictual conditions between ecology and urbanism to improve urban life (Mostafavi 2010)	<ul style="list-style-type: none"> • Promotion of ecological processes in cities (e.g. the flow and cycle of water, nutrient, energy, materials and organisms in an ecosystem) • Biodiversity conservation • Promoting urban resilience • Designing cities as part of the natural world • Cities as habitats for human and nonhuman species. 	<ul style="list-style-type: none"> • Mostafavi (2010) • Adams (2014) • Spirn and Say (2012) • Hagan (2014)
2	Landscape Ecology	A study of the patterns and interactions between ecosystems within a region of interest, and the way the interactions affect ecological processes, especially the unique effects of spatial heterogeneity on these interactions (Clark 2010)	<ul style="list-style-type: none"> • Preservation of natural habitats or biodiversity in the urban landscape • Integration of spatial patterns and ecological processes. • Environmental stewardship • Promoting a mix of ecosystems and habitats in the urban landscape 	<ul style="list-style-type: none"> • Jongman et al. (1987) • Turner, MG and Gardner (1991) • Wu and Hobbs (2002) • Wu (2008) • Kirchhoff et al. (2013) • Spirn (2014)
3	Landscape Urbanism	An approach to the design of cities, and their components, which aims to make good places through a creative integration of natural, human and cultural process layers (Turner, T 2015)	<ul style="list-style-type: none"> • Creative integration of nature in the design of cities • Placing landscape design as the first step in urban development • Promoting ecosystem processes and preserving urban biodiversity 	<ul style="list-style-type: none"> • Waldheim (2002) • Corner (2003) • Weller (2008) • Thompson (2012) • Turner, T (2015)
4	Bioregionalism	Promoting the ecological health of local life-places and with sustainable ways of living that	<ul style="list-style-type: none"> • Place-based development with due regard for the ecological boundaries of a place. 	<ul style="list-style-type: none"> • Van Newkirk (1975) • (Alexander, D 1990) • Berg (1991)

		are adapted to those places (Booth 2012)	<ul style="list-style-type: none"> • Promoting a sense of place and human connection to the local ecology • Designing with context (local climate, geography, vegetation, and culture etc.) 	<ul style="list-style-type: none"> • Booth (2012) • Church (2014)
5	Eco-city theory	An urban development paradigm that enables people to live a good quality of life while using minimal natural resources (Register 1987)	<ul style="list-style-type: none"> • Integration of nature in the design of cities • Active transport • Compact and mixed-use development along transit corridors (TOD) • Waste recycling • Local agriculture • Environmental awareness • Renewable energy • Designing with the local context 	<ul style="list-style-type: none"> • Register (1987) • Roseland (1997) • Joss (2010b) • Rapoport and Vernay (2011)
6	New Urbanism	A planning and development approach that aim to create sustainable, human-scaled places where people can live healthily in harmony with the natural environment (Congress for the New Urbanism)	<ul style="list-style-type: none"> • Walkability- high quality pedestrian network and public realm • Mixed-use development and urban diversity • Conservation of green spaces and biodiversity • Sustainable transportation • Local agriculture • Eco-friendly technologies • Eco-efficiency 	<ul style="list-style-type: none"> • Duany, Andres and Plater-Zyberk (1994) • Katz et al. (1994) • Leccese and McCormick (2000)
7	Smart Urbanism	Urban development approach that invests in human capital, infrastructure, and technological innovation to drive growth and manage resources more efficiently (Kim & Steenkamp 2014)	<ul style="list-style-type: none"> • Use of appropriate technology • Participatory action and engagement using information communication technologies • Eco-efficiency • Artificial intelligence to promote efficient use of resources and physical infrastructure 	<ul style="list-style-type: none"> • Kim and Steenkamp (2014) • Kitchin (2014) • Albino et al. (2015) • Luque-Ayala and Marvin (2015b)

8	Urban Resilience	Building the capacity of cities to undergo threats and maintain their basic functions (Gunderson 2001)	<ul style="list-style-type: none"> • Safe failure • Facilitating continuous learning and knowledge sharing • Flexibility • Redundancy • Modularity • Diversity 	<ul style="list-style-type: none"> • Gunderson (2001) • Tyler and Moench (2012) • Rodin (2014) • Meerow et al. (2016)
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In addition, most of these theories tend to be trapped in their disciplinary silos, with the tendency of inducing interventions or solutions that are less responsive to the complex and dynamically changing realities in cities. For example, Ecological Urbanism, Bioregionalism, Eco-city theory, and Landscape ecology largely draw from the scientific discipline of ecology; therefore, they tend to place more emphasis on ecological aspects of urban development than other elements such as social equity and governance etc. An empirical study of the application of the Eco-city concept in China, for example, revealed that although the projects performed well on ecological dimensions, they had little regard for social considerations (Ghiglione & Larbi 2015). Similarly, Smart Urbanism is largely criticized for its strong bias towards technological innovation and limited social and environmental foci (Albino et al. 2015; Kitchin 2016). Moreover, according to Harvey (2000), New Urbanism has a narrow focus on urban forms, with limited understanding of the methods or processes that influence the latter. These limitations call for a comprehensive approach to addressing the “wicked problems” confronting contemporary cities.

Green Urbanism offers itself as a nexus between environmental, social, physical, political, and economic objectives in urban development. It proposes a set of principles that aim to integrate the many components of urbanism to reconfigure and direct the development of cities towards more sustainable trajectories. It could be seen as an umbrella term that embodies various categories of urban transformation theories (Beatley 2000, Lehmann 2010a). It gives legitimacy to collaborative and interdisciplinary approach to urban planning that enables urban planners, policy makers, governments, ecologists, urban researchers, sociologists, civil society and all relevant stakeholders to work together and define an integrated approach to reframing the developmental trajectory of cities towards more sustainable future (Beatley 2012; Nassar 2013; Newman 2010). In the following sections, the

questions of how Green Urbanism is defined and what principles it proposes to reframe existing cities are analysed. Areas where Green Urbanism may benefit from insights from other theoretical constructs are highlighted. Finally, knowledge gaps in this field of research are identified and discussed.

2.3.1 Representative definition of Green Urbanism

The concept Green Urbanism emerged in the early 1990s; however, it builds on the seminal works of pioneer urban thinkers discussed in previous sections. Thus far, there is no one-size-fit-all definition of Green Urbanism in the existing literature. The terminology has variously been defined by different theorists but with a common set of beliefs and ontological assumptions. Lehmann, for example, defines Green Urbanism as:

...a conceptual model for zero-emission and zero-waste urban design... promoting compact energy-efficient urban development, seeking to transform and re-engineer existing city districts and regenerate the post-industrial city centre;...[and] promotes the development of socially and environmentally sustainable city districts. (Lehmann 2010a, p. 1)

To Beatley (2000, p. 5-6), “precisely what Green Urbanism implies is evolving”; nonetheless, it portrays “cities that strive to live within their ecological limits, fundamentally reduce their ecological footprint, and acknowledge their connections with and impacts on other cities... and the larger planet”. In his seminal book: *Green Urbanism—Learning from European Cities*, Beatley (2012), notes that cities exemplify Green Urbanism if they are designed to function in ways that make them liveable and sustainable. Applying this concept to Asian cities, Newman (2010, p. 149), argues that Green Urbanism aims to promote “smart, secure, and sustainable cities”. He defines smart, secure, and sustainable cities as those: that adapt to new technologies; build resilience to urban shocks and stresses; and respond to their social, economic and environmental needs respectively. Providing a simple explanation for this seemingly evocative concept, Walker Wells (director of the Green Urbanism Program for Global Green USA) defines Green Urbanism as “creating communities mutually beneficial to humans and the environment” (Wells 2010, para 2).

The extensional definitions presented above provide a concise account of how Green Urbanism is conceived and expounded by its key proponents. A common thread to the various interpretations is the fundamental goal of promoting urban sustainability. This observation

raises the question whether Green Urbanism is synonymous with the concept of sustainable urban development, and if so, why multiple theories are needed to explain the same concept. From the existing theoretical literature, no clear distinction has been made between the concept of Green Urbanism and sustainable urban development. In fact, the latter is cited as a key goal of the former in most of this literature. However, empirical studies assessing the application of Green Urbanism to cities gives nuances to the latter (Beatley & Newman 2012; Hoffman 2011; Low 2005; Neema et al. 2013). In this body of literature, Green Urbanism is defined by many common elements of sustainability, but none more so than the literal adoption of greenery-based development strategies upon which other aspects of urban sustainability (e.g. social, cultural, economic, political etc.) are addressed.

These greenery strategies place particular emphasis on how cities may promote intimate contact with nature (i.e. biophilic development) in ways that are more profound than the environmental objectives of sustainability (Newman et al. 2017; Reeve et al. 2015). As Beatley (2009) puts it, greening is not only about the efficient use of resources and/or strategies to mitigate climate change, but also about the extent to which we seek to care for, understand, engage with, and celebrate nature around us. This notion sets Green Urbanism apart as ensuring a balance between economic, social, and environmental objectives while fostering the ubiquity of nature in cities.

Although the current study does not seek to provide a one-size-fits all definition of Green Urbanism, it aims to identify an operational understanding of the concept (through an analysis of three case studies) in order to bring clarity to its parameters. To achieve this goal, it is argued herein that the definition of Green Urbanism should not be imposed dogmatically, but needs to adhere to definitional nuance and be more responsive to the specific requirements of its application domain. In this regard, the context of cities should be given due consideration given that cities differ markedly in their social, economic, cultural, demographic, infrastructural, technological, geographical, climatic, and political structures. Hence, an operational definition of Green Urbanism should not only emerge from theoretical knowledge but also practice. Against this backdrop, the following section examines the principles of Green Urbanism proposed in the existing literature, and how they have been applied to cities. It aims to develop a framework for understanding and assessing the criteria of Green Urbanism.

2.3.2 Principles of Green Urbanism: a theoretical and empirical analysis

Beyond the definition conundrum lies the question of what practical tools or principles Green Urbanism proposes to reframe urban development. Recent studies by Timothy Beatley, Steffen Lehmann, and Peter Newman etc. provide a starting point for deciphering the methods and/or underlying criteria of Green Urbanism. Following his studies on green initiatives in European cities, Beatley (2000, 2012), identifies several principles that are critical for reducing the ecological footprint of cities and enhancing the quality of urban life. He identifies these principles as fundamental requirements of Green Urbanism: compact development; sustainable mobility; public private partnership in green initiative; transit-oriented development; preservation of biodiversity; promoting ecological processes; incorporating greenness into the urban landscape; circular urban metabolism; renewable energy; and mixed-use development. Drawing on European case studies (e.g. Copenhagen, Freiburg, Venice, Stockholm, Helsinki, and Vienna etc.), Beatley concludes that the principles outlined above provide practical guidelines for cities to think globally and act locally by reducing their impacts on global ecosystems, and promoting sustainable, healthy, and vibrant local economies.

Lehmann (2010a, 2010b) adds to this list of principles by proposing what he identifies as “systematic and holistic” criteria for assessing Green Urbanism. Unlike Beatley (2000, 2012), whose checklist emerged from extensive empirical studies, Lehmann’s (2010b) set of principles largely draw on early writings and works of pioneer urban thinkers such as Baron Haussmann, Ildefons Cerdà, Frederick Olmsted, Ebenezer Howard, Reyner Banham, Lewis Mumford, and Ian McHarg among others. He lays out 15 core principles of Green Urbanism most of which are consistent with Beatley’s criteria. These principles include: designing with climate and context; renewable energy for zero CO₂ emissions; zero-waste; water efficiency; landscape, gardens and urban biodiversity; sustainable transport and good public space; local and sustainable materials with less embodied energy; density and retrofitting of existing districts; green buildings and districts, using passive design principles; liveability, healthy communities and mixed-use programs; local food and short supply chains; cultural heritages, identity and sense of place; urban governance, leadership and best practice; education, research and knowledge; and strategies for cities in developing countries. According to

Lehmann (2016), these principles are interconnected; therefore, they cannot be applied in isolation. His emphasis on urban governance and leadership as essential elements of Green Urbanism brings to the fore the notion that Green Urbanism should not only be about the physical character or performance of cities, but also about how decisions are taken to ensure collective responsibility and action.

Furthermore, Newman (2010), proposes seven characteristics of Green Urbanism based on lessons drawn from empirical studies around the world. He classifies these characteristics into seven “archetypal cities” namely: Renewable energy city, Carbon neutral city, Distributed city, Biophilic city, Eco-efficient city, Place-based city, and Sustainable transport city. The underlying goals of these city categories show a significant overlap with the ideas of Beatley and Lehmann except for the Distributed and Place-based city types which appear to have less resonance with the latter. With regards to the Distributed city type, Newman argues for the decentralization of key services such as power, water, and sewage treatment plants etc. to promote the resilience of urban systems, and enable cities to reduce their ecological footprint. This approach is emphasized in the resilience literature as a means of building redundancy, modularity, and independence into urban systems so that the failure of a part of the system does not result in the failure of the overall system (Tyler et al. 2010). On Place-based city, Newman (2010, p. 158) notes that “the more place-oriented and locally self-sufficient a city’s economy is, the more it will reduce its ecological footprint”. Therefore, the creation of jobs and the supply of basic needs such as food, healthcare, and education etc. should be promoted locally to reduce the need for people to travel. This principle lies at the heart of Howard’s quest for a self-contained city where residents would have access to all the basic human needs locally to support a healthy livelihood.

The analysis above shows that not only are the principles proposed by the various proponents of Green Urbanism considerably overlapping, but they also encapsulate the ideas of pioneer urban thinkers, as well as the underlying criteria of other contemporary urban transformation theories discussed in Section 2.3. This observation supports Lehmann (2010b) and Beatley’s (2012) argument that Green Urbanism offers a comprehensive and multidisciplinary approach to addressing the dynamically changing and complex challenges in cities, for which there cannot be a unilateral solution. The observed similarities between the various theories offer an opportunity for identifying a common ground where the various theoretical constructs

could be synthesized. As argued by McHarg (1988), an interdisciplinary approach, or better still a constellation of relevant theories, is necessary to understand and identify systemic solutions to the complex problems confronting contemporary cities.

That said, it is worth noting that the literature of Green Urbanism has so far failed to engage sufficiently with the human and social ramifications of its criteria. These considerations are not only about the intended benefits of Green Urbanism to people, but also the implications of the concept for social justice and equity. These social and/or human dimensions are worth careful consideration as they may complicate how transitions towards Green Urbanism might be achieved (Newton 2008). Following Ajzen's (2011) argument, people's attitudes and subjective norms can present significant barriers to and/or opportunities for the application of concepts such as Green Urbanism that demand certain behavioural outcomes. Therefore, it is important to consider the implications of these concepts for people, and how the latter might be effectively engaged to achieve desired outcomes. Fundamental to this argument is the question of how we might create 'green citizens' in a 'green city' to ensure voluntary compliance with the underlying principles of Green Urbanism.

In addition, the green concept comes across as a selling proposition for attracting high income populations which sometimes leads to the marginalization and/or neglect of the needs of the broader society (Anguelovski et al. 2018; Walker 2013). Indeed, it would be unjust if the application of Green Urbanism leaves some people worse off than they were previously. Therefore, an understanding of how human and social factors interface with the criteria of Green Urbanism to deliver just and inclusive development is critical. A just and equitable approach towards Green Urbanism will help to forestall some of the unintended social consequences of well-intentioned policies that are less holistic in scope (Bosch et al. 2013; Nguyen & Bosch 2013).

Table 2.3: Summary of the principles of Green Urbanism and related theories

No	Principles of Green Urbanism	Related theories								
		Pioneer urban thinkers	Ecological Urbanism	Landscape Ecology	Bioregionalism	Landscape Urbanism	New Urbanism	Eco-city Theory	Smart Urbanism	Urban Resilience
1	Renewable energy and energy efficiency	Patrick Geddes Lewis Mumford								
2	Carbon neutral development	Mumford, Jacobs								
3	Decentralized Services	Ildefons Cerdà Ebenezer Howard								
4	Zero waste (avoid, reduce, recycle, recover)									
5	Biophilic urban design/ preservation of biodiversity	Hausmann, Olmsted Howard, Geddes, Mumford, Le Corbusier, McHarg								
6	Place-based development	Cerdà, Howard, Jacobs								
7	Sustainable mobility (public and active transport)	Cerda, Mumford, Jacobs								
8	Transit-oriented development	Cerda, Mumford, Jacobs								
9	Placemaking	Jacobs								

10	Public Private Partnership in green initiatives	Howard, Jacobs								
11	Participatory governance	Howard, Jacobs, Mumford								
12	Resilient urban systems									
13	Designing with climate and context	Geddes, McHarg								
14	Compact development	Cerda, Le Corbusier, Mumford, Jacobs								
15	Mixed-use development	Cerda, Mumford, Jacobs								
16	Passive design									
17	Green education (environmental awareness)	Geddes, Mumford, Jacobs								
18	Shared learning									
19	Social equity	Cerda, Howard, Jacobs, Mumford								
20	Local and sustainable materials	Mumford, McHarg								

Significant overlap
 Moderate overlap
 Insignificant overlap

This list of principles is developed from content analysis of the existing literature on Green Urbanism. It provides a graphical representation of the overlaps between the latter and the various principles put out by the pioneer urban thinkers discussed in Section 2.2; as well as the underlying criteria of the various urban theories identified in Section 2.3.

Following the analysis in Section 2.3, It can be observed that the proposed principles of Green Urbanism offer practical guidelines for maximizing the potentials of cities, and ensuring their efficient management for sustainability outcomes. A synthesis of the principles reveals two fundamental categories into which the latter might be classified i.e.: (1) methods, and (2) application mechanism. Firstly, the methods provide ways for modulating key sectors in cities towards desired trajectories. These sectors include the: transport sector, energy sector, water sector, waste sector, building sector, and land-use planning. Figure 2.5 below provides a summary of the underlying principles Green Urbanism proposes to transition these sectors towards more sustainable trajectories. Secondly, the application mechanism can be viewed as the governance approach used to implement the methods and monitor their outcomes. As argued by Scharpf (1999) and Irazábal (2017), governance is fundamental to all public decision-making process; therefore, the particular mode of governance (i.e. top-down or bottom-up) applied by cities in policy implementation will have significant implications for the outcomes of such policies.

Howard was one of the earliest urban theorists who added a governance structure to his proposed model of urbanism. The Garden Cities of Letchworth and Welwyn were designed to be run under a quasi-public body which owned and managed the distribution of properties (Howard & Osborn 1965). Howard's approach aimed to foster grassroots engagement and ownership of place to promote a sense of community. Previously, Ildefons Cerdà had applied this approach as part of his goal of developing people-oriented cities that promoted dialogue and shared responsibilities between government and the people (Neuman 2011). In Jacobs' view, the judgement of so-called experts (planners, engineers, architects etc.) and city authorities are mostly inconsistent with the real-life functioning of cities and communities. Therefore, she advocated for bottom-up and community-centered approach to urban planning (Jacobs 1961).

Consistent with these views, Rollo and Winters (2000), opine that bottom-up processes offer a more "efficient and legitimate" approach to public policy implementation than policies that are imposed from the top-down. This claim has received much support in academic discourses. However, it is important to note that cities differ markedly in their political and institutional structures; therefore, it may be counterproductive to impose a governance model on these entrenched systems. The very idea of imposition, in the first instance, defeats

the fundamental goal of bottom-up processes (i.e. avoiding imposition). Therefore, this study aligns with suggestions by Smith et al. (2005, p. 1492) that the “associated modes of governance” in the implementation of the principles of Green Urbanism should be determined by prevalent factors in a given context.



Figure 2.5: A framework for Green Urbanism -Developed from principles proposed by Beatley (2000, 2012), Lehmann (2010a, 2010b), and Newman (2010, 2013)

Green Urbanism promises interdisciplinary dialogue, and provides useful guidelines on how planners, policy makers, governments, and all relevant stakeholders could work together to direct the development of cities towards desired trajectories. Notwithstanding, Green Urbanism should be judged by its accomplishment, not promise. In the last decades, an emergent challenge with the green concept is what is commonly known as greenwashing or ‘green myopia’. Munshi and Kurian (2005, p. 513), identify greenwashing as a deliberate attempt by institutions or corporate entities to portray a false image of “environmental, social, and cultural responsiveness”. To Bowen (2014, p. X), it embodies “positive green communication by companies without positive environmental performance”. Beder (1997), puts it bluntly as “corporate assault on environmentalism”. These observations call for the need to evaluate ‘green’ by its performance, not rhetoric.

Greenwashing is not peculiar to companies or marketing industries. Cities are also exposed to this 'temptation' in their quest to reinvent themselves to become a global destination for investments, tourism, and talents etc. Echoing this point, Hoffman (2011, p. 57), notes that the motivation underlying most urban transformation initiatives is "about place-making and place-marketing in the global competition for capital". Some flamboyant "Eco-city" initiatives in Asia and elsewhere have been shown to portray 'green myopia' by giving priority to economic interest, and little regard for socio-ecological considerations (Ghiglione & Larbi 2015; Hoffman 2011).

Expounding on this observation, urban political ecologists (UPE) and environmental justice (EJ) scholars have argued that issues of equity, justice, and social cohesion are often ignored or at best implicit in the rhetoric of Green Urbanism and related concepts (Agyeman et al. 2002; Cook & Swyngedouw 2012; Heynen 2014; Swyngedouw 2015). This claim is supported by a study by Ghiglione & Larbi (2015) who find that some Chinese green city initiatives led to social exclusion, community displacement, and economic exploitation. Adding to this point, Anguelovski (2016, p. 30) argues that green urban initiatives may be perceived as green locally unwanted land use i.e. "green LULU" if these initiatives undermine the local residents' right to place, and engender distributional inequality.

Against this backdrop, urban environmental justice scholars have argued for an "egalitarian conception" of sustainability or "just sustainability": an approach that advocates that green urban initiatives should be undertaken in a manner that is just and equitable to all (Agyeman et al. 2016; Agyeman & Evans 2004; Jacobs 1999; May & Perry 2017). According to Schlosberg (2007), the notion of environmental justice should embody four key interconnected dimensions i.e.: equal distribution of environmental bads (distributional justice); participative decision making (procedural justice); respect for deprived communities (recognitional justice); and empowerment of local communities (justice of capabilities). Although environmental justice and equity are not the focus of this research, this study recognizes that these issues should be duly considered in the rhetoric of Green Urbanism in order to promote a balanced and more inclusive development.

2.4 Gaps in the research

Green Urbanism is a relatively new concept although much of its core assumptions and principles are derived from theories and practices that have existed for more than a century. Early writings on the subject was undertaken by Beatley who is credited with coining the term. Studies by Beatley (2000, 2012) largely focused on green initiatives in Europe, and how that might contribute to both a theoretical and practical understanding of the concept of Green Urbanism. Subsequently, Lehmann (2007, 2010a, 2010b), Newman (2009, 2013), and Pow and Neo (2015) have attempted to further operationalize the concept by testing it in Australia and few Asian countries, particularly, Singapore. Thus, much of the understanding of Green Urbanism has been based on experiences of cities in the developed world. Therefore, there is a need for an understanding of Green Urbanism from a developing country perspective. Lehmann (2010b), highlighted the essence of such an investigation in his fifteenth principle of Green Urbanism; however, he provided superficial details in his commentary. Indeed, cities in the developing world have their unique challenges and opportunities; therefore, they cannot have the same strategies as those in the developed world (Lehmann 2010a). This study aims to address this knowledge gap by bringing to light the experiences of cities in developing countries. It examines what developing countries can learn from this concept based on the experiences of Western countries, as well as what they can contribute to enhancing an operational understanding of Green Urbanism. The cases selected for this analysis and the criteria for selection are further discussed in Chapter 3.

Furthermore, much of the existing literature on Green Urbanism has almost exclusively focused on defining the parameters of Green Urbanism through both theoretical and empirical analysis, with limited understanding of the processes of green urban transitions. For the most part, the question of what factors exemplify Green Urbanism has been extensively discussed. However, it is far from clear how these factors might be applied to transform entrenched social and technical systems in cities towards desired trajectories. The latter borders on the issue of transitions. Cities are embedded in particular social, cultural, institutional, political, infrastructural, and physical structures etc. that present significant barriers to change (Hodson & Marvin 2010). Kemp et al. (1998), identify these entrenched systems as socio-technical regimes. Following Geels (2005), regimes engender lock-in mechanisms and path dependency. Therefore, for radical change to unfold, new paths must

be created. Since the underlying objective of Green Urbanism is to create new paths for urban sustainability, an understanding of how old (unsustainable) paths might be broken and new (sustainable) paths created is critical. Thus, this study draws on relevant transition theories to examine how green urban transitions (may) unfold in cities. It assesses the factors that present opportunities for and/or barriers to this transition process, and how these factors might be modulated. A more detailed discussion on which transition approach is applied in the current study is presented in Chapters 3 and 4.

Research Methodology

3.1 Introduction

This Chapter elaborates on the research techniques considered to be suitable for answering the research questions investigated in this study. Firstly, it presents the theoretical underpinnings of the study, and explains how the theoretical framework adapted for the current study informs the research questions and data analysis. Following this discussion, an overview of the research paradigm and research strategies applied in this study is presented. The selection of the latter follows Naoum's (2007) suggestion that the choice of research paradigm and strategies should be informed by the underlying objectives of a study, and the type of information required to undertake the study. In addition, the criteria applied to select the multiple cases investigated in the current study are explained. This narrative includes the processes of data collection, documentation, data management, data analysis, and reliability and validity of measurements. Finally, the ethical considerations pertaining to this research, and limitations of the data are presented.

3.2 Theoretical framework

A theoretical framework is identified as a fundamental component of a research study that aims to enhance understanding of observed phenomena or provide a lens through which the latter might be examined. According to Ravitch and Riggan (2016), theoretical framework helps researchers to delineate the purpose of a study and its contribution to the body of knowledge. Other scholars also suggest a theoretical framework provides logical assumptions that guide the research, assist in determining the critical research questions to be investigated to unravel a research problem, inform the data collection process, and serve as a basis for analysing and interpreting the data within the context of existing literature (LeCompte & Preissle 2000; Miller 2007; Smyth 2004). Consistent with these observations, the theoretical framework applied in the current study serves several purposes: to clarify and limit the scope of the research; confirm the gap in existing literature and highlight the significance of the study; determine what variables to investigate and what relationships to examine; and guide the analysis and interpretation of the research findings.

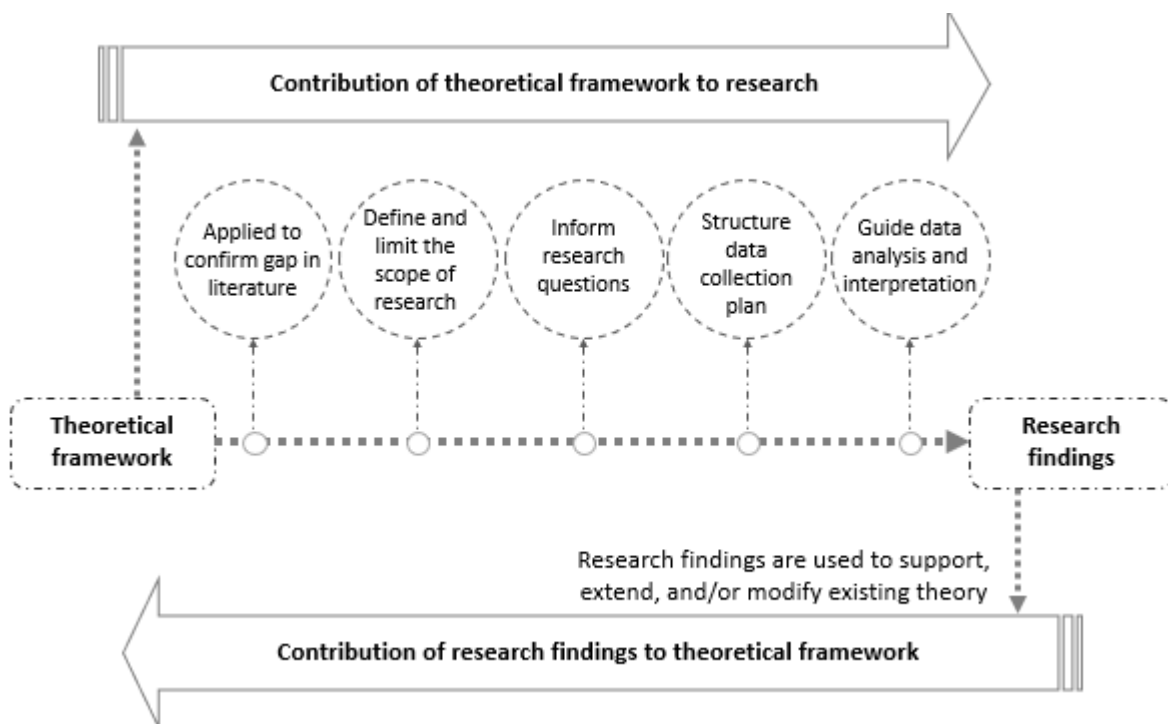


Figure 3.1: Application of theoretical framework to the current study (Author's construct)

Following a critical review of existing literature in the previous chapter (Chapter 2), it was observed that the concept of Green Urbanism has been extensively discussed by various scholars from both historical and contemporary viewpoints. However, previous studies have mostly focused on formulating principles for the application of Green Urbanism (Beatley 2009; Newman 2010), and assessing how these principles might be evaluated (Beatley & Newman 2012; Newman & Matan 2013; Pow & Neo 2015); with limited understanding of the processes of green urban transitions. Therefore, the current study contributes to this body of knowledge by systematically assessing how green urban transitions may be assessed and influenced towards desired trajectories. Thus, this study is at the nexus of urban sustainability studies and transition studies.

Drawing on socio-technical transition theories, the current study examines the barriers, opportunities, and potential drivers of green urban transitions using the Multi-level perspective (MLP) framework. Several other theoretical constructs have been developed to examine socio-technical transitions. Some of the widely applied theories include: Technological Innovation System (Bergek et al. 2008; Suurs & Hekkert 2009); Strategic Niche Management-SNM (Kemp et al. 2000; Raven et al. 2010); Transition Management-TM (Loorbach & Rotmans 2010; Rotmans et al. 2007); Multi-phase Concept-MPC (Loorbach & Rotmans 2006; Rotmans et al. 2001); and Socio-ecological Transition-SEC (Fischer-Kowalski et al. 2012; Laurent & Pochet 2015). Other theoretical traditions such as Political Economy Analysis (PEA) proposes a framework to enhance understanding of the social, economic, and political processes that underline transitions (Levy 1997; Scott 2007).

These theories have proven useful in elucidating transitions across systems; however, they are criticised for failure to fully account for the wider environment that influence transition processes and outcomes (Angeler et al. 2015; Caniels & Romijn 2008; Copestake & Williams 2014; Lachman 2013; Witkamp et al. 2011). For instance, the SNM is criticised for its emphasis on the product of innovation (what), and limited focus on how innovations come about and how they might be modulated to become mainstream (Ashford & Hall 2015; Witkamp et al. 2011). TM proposes a framework for managing transitions, but it is limited in explaining factors that underlie these processes (Lachman 2013). In addition, the MPC has been proven useful in explaining the patterns of change in socio-technical systems; however, the drivers of these patterns and how these processes might be influenced remain unclear (Loorbach &

Rotmans 2006b). The SET and PEA focus primarily on the approaches to transitions (what), with limited insights into the processes (or how) of transitions (Copestake & Williams 2014; Labaeye and Sauer 2013).

The MLP makes progress by presenting a systematic approach to examining the processes and dynamics of socio-technical transitions, with a clear distinction between the internal and external factors that influence these processes. Compared with the theories identified above, the MLP offers the potential to systematically analyse the drivers of and/or barriers to change by distinguishing three analytical concepts that interact to influence transition outcomes (i.e. landscape, regime, and niche). Given that this study aims to unravel how transitions towards Green Urbanism has (or might be) achieved, and unpack the underlying drivers of and/or barriers to these processes, the MLP is co-opted as the theoretical lens for this research. The study does not aim to apply this theory dogmatically, but seeks to explore the strengths of the MLP in analysing urban transitions and also highlight its limitations.

According to proponents of the MLP, socio-technical transitions are a function of the interface between these three analytical concepts (Grin et al. 2010). Hence, the alignments and quality of interaction between landscape, regime, and niche may engender or derail transition processes. The current study does not take these assumptions for granted, but critically examines their veracity and applicability to transitions in the urban context. Like the aforementioned transition theories, the MLP has several limitations which in the words of its main proponent may be addressed by “mobilizing insights from other theories”, and lessons from its empirical application (Geels 2011, p. 30). This study aims to contribute to an operational understanding of the MLP by empirically testing its core assumptions. A more extensive explanation of the MLP and how it is applied in the current study is presented in the next chapter (Chapter 4).

3.3 Research design

This study draws on multiple case study approach to examine and cross-analyse the nature and dynamics involved in transitioning cities towards Green Urbanism. The cases are not intended to be viewed in a comparative light, but they present different situations and contexts, the common element being an examination of the processes by which Green Urbanism has, or might be, achieved. Multiple case study approach has been shown to afford

more robustness to the results of a study than single case research (Bengtsson 1999; Yin 2003). It also helps to establish reliable and compelling findings, especially, when the conclusions of a study are buttressed by several empirical evidence (Baxter & Jack 2008; Gustafsson 2017; Yin 2017).

The study is conducted in four main phases (see figure 3.2). The first phase comprises a critical review of historical and contemporary literature on Green Urbanism, and synthesizes the tools and principles it proposes to reframe urban development. This review also highlights the gaps in existing literature to help define the research problem and objectives. The second phase embodies an analysis of the theoretical lens through which the research problems, research objectives, and research questions are evaluated. Thirdly, a post hoc analysis of how the criteria of Green Urbanism have been applied to cities that claim to be green is undertaken. This analysis is based on country-specific case studies. Building on the theoretical analysis and empirical studies, the last phase of the study examines how the criteria of Green Urbanism might be applied to a developing country context. The rationale for and methodological approach to this study follow the framework of research process (i.e. system of inquiry, research strategy, and research tactics) proposed by Groat and Wang (2002).

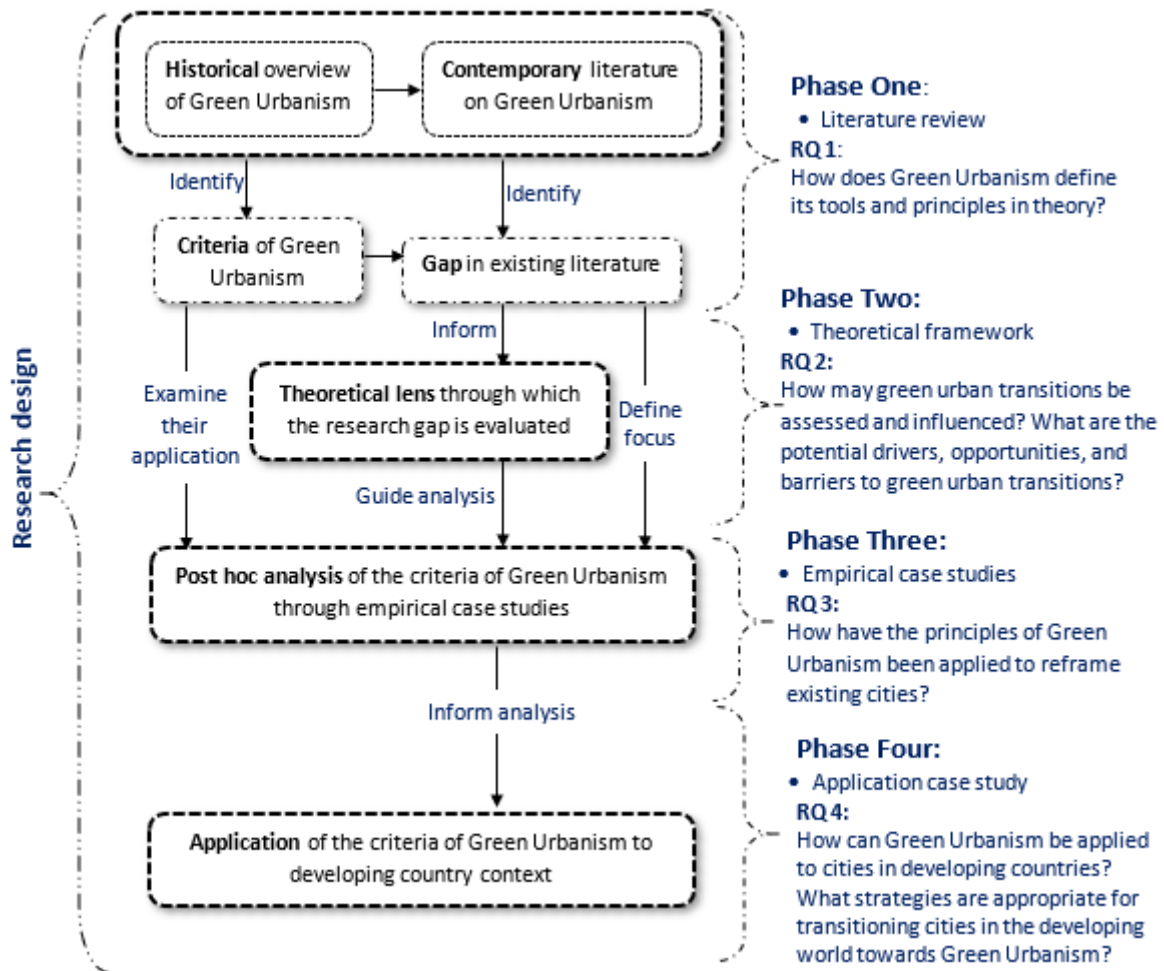


Figure 3.2: Research design for the current study (Author's construct)

3.3.1 System of inquiry

According to Groat and Wang (2002) system of inquiry encapsulates assumptions about how reality is constructed (ontology), and the nature of relationship that exists between the researcher and that being researched (epistemology). In the first place, ontology is associated with a fundamental question of whether social reality should be viewed as objective (positivism) or subjective (interpretivism or constructionism). On one hand, positivism is a strong realist worldview that believes in objective reality to research phenomena, independent of social actors. Thus, factual knowledge can be established if they “can be put to the test of empirical experience” (Gray 2013, p. 21). On the other hand, interpretivism asserts that reality is socially constructed and transmitted through discourses and experiences (Bryman 2016). Its proponents identify research context as critical to the interpretation and understanding of social phenomena (Thanh & Thanh 2015).

The current study holds that social realities vary from city to city. Therefore, the ontological assumption of this research largely aligns with the interpretivist paradigm. This paradigm is particularly useful to the current study because of its interest in the principle of contextualization to unpick the nuances and experiences in different research context. As pointed out by Batty (2009), cities are complex systems that vary in their social, cultural, political, and physical configurations. Thus, discussions about the performance of cities and/or how they might be influenced towards desired trajectories must be defined in terms of their local context (Neirotti et al. 2014). The interpretivist paradigm lends itself to heuristic methodologies that help to unpick the intricacies of experiences in different social context.

Similarly, the epistemological rationale for this study follows the interpretivist belief that knowledge is constructed through the perceptions and interpretations of the world by social actors who are part of and interact with that world (Schwandt 1994). Pickard (2013, p. 11), suggests two approaches to interpretive research: (1) empirical interpretivism- investigation in natural setting of social phenomena; and (2) critical theory-ideologically oriented investigation. This study draws on both approaches to empirically examine the application of the criteria of Green Urbanism to cities; and theoretically assess the dynamics of green urban transition in different social and geographical contexts. Altogether, the system of inquiry (research paradigm) adopted in this study helped to determine the research strategy and tactics.

3.3.2 Research strategy

According to Groat and Wang (2002), research strategy highlights the overall research plan of a study, and identifies the most appropriate approach for the study i.e.: qualitative, quantitative, or mixed method approach. On one hand, a qualitative approach is primarily exploratory with the intent of providing insights into the underlying drivers of a social phenomenon based on constructivist perspectives (Creswell 2003). A quantitative approach, on the other hand, lends itself to less in-depth but objective analysis of observed phenomena through the use of various metrics. It follows deductive and less biased processes that help to produce more reliable and generalizable results (Black 1999). Both approaches have inherent advantages and disadvantages with different analytical objectives, degree of flexibility, and data collection instruments. To maximize the best of both approaches and

offset their inherent weaknesses, a mixed method approach is proffered to enable methodological triangulation (Thomas 2003).

The current study adopts a mixed method approach to collect and analyse both qualitative and quantitative data. Although the interpretivist paradigm (which is the philosophical underpinning of this study) is largely associated with qualitative research, some studies have shown its usefulness in quantitative analysis (Babones 2016; Mackenzie & Knipe 2006; Sale et al. 2002). Thus, the study draws on case studies, questionnaire surveys, focus group, interviews, field observations, and secondary data (e.g. academic literature, policies, and government reports etc.) to analyse the research problem under investigation. As illustrated in figure 3.2, the initial phase of the study involves a review of literature to position the research in the existing body of knowledge, and also identify the research gap this study aims to address. The literature review also serves as a basis for formulating and refining the theoretical framework and methodological approach to this research. Following this review is an analysis of how the criteria of Green Urbanism have been applied to contemporary urban development in different contexts. Lessons drawn from these theoretical reviews and empirical analysis inform the formulation of an operational framework to examine how Green Urbanism can be applied to cities in a developing country context. The research strategy applied in this study was underpinned by various research tactics.

3.3.3 Research tactics

The research tactics outline specific techniques and guidelines for sampling, data collection, data management, data editing and coding, as well as procedures for analysing and reporting the research findings (Groat & Wang 2002; Sapsford & Jupp 2006). Several research tactics are deployed to collect data at the various phases of the study. The following sub-sections elaborate on these data collection techniques and how they are applied at different phases of the current study.

3.3.3.1 Literature review: phases one and two

The early stages of this research involved a review of relevant literature on Green Urbanism (from both historical and contemporary viewpoints) and socio-technical transition theories. A narrative literature review approach was used to undertake a comprehensive and critical analysis of the existing knowledge in the subject area. As illustrated in figure 3.3, there were

three main steps in the literature review process across the study: exploratory review; focused review; and continuous review of current literature relevant to the topic. These steps draw on Creswell (2009) and Machi and McEvoy (2016) recommendations for conducting effective literature review. The first step in the review process aimed to interrogate the academic literature regarding the conceptualization and application of the green concept to cities. Using alternative keywords searches and/or short phrases, a large quantity of scholarly articles (about 300) were retrieved from electronic databases such as Scopus, Web of Science, and Google Scholar. Books and archival materials from academic libraries were also used. These scholarly resources were categorized based on their comprehensiveness and relevance to the subject matter. Relevant literature was critically analysed to uncover gaps in knowledge.

The second stage of the literature review process was narrower. Firstly, it focused on an analysis and synthesis of literature which were identified to be central to the research topic in order to refine the research problem and questions (Creswell 2009). Secondly, an analysis of socio-technical transition theories was also undertaken to identify an appropriate theoretical lens through which the research problem (or gap) might be examined. In addition, empirical literature review was conducted to identify potential cases to investigate. The second stage of the review process drew on various secondary sources such as peer-reviewed journal articles, conference papers, dissertations, unpublished online articles, newspaper databases, reports, blogs, and social media outlets etc. Finally, the last stage of literature review involves a continuous review of academic literature, among other secondary data sources, to keep abreast of current body of knowledge in the subject area. This continuous review process aims to update the current study with ongoing dialogue on Green Urbanism, and provided a benchmark for comparing and contrasting findings of the study with the existing literature (Creswell 2009; Ridley 2012). Put together, the first and second phases of this research address the first and second research questions of the study: ***(1) How does Green Urbanism define its tools and principles in theory? (2) How may green urban transitions be assessed and influenced? What are the potential drivers, opportunities, and barriers to green urban transitions?***

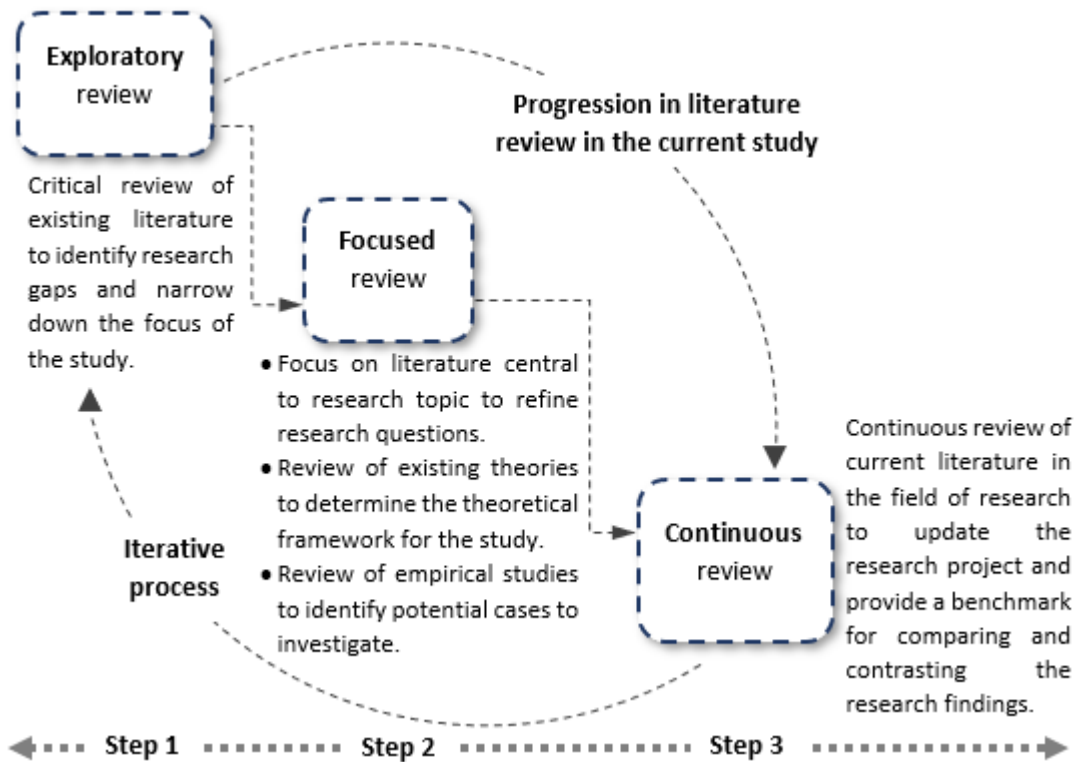


Figure 3.3: Steps involved in the review of literature and other secondary data (Author's construct)

3.3.3.2 Post hoc analysis: phases three

The third phase of the current study involves empirical analysis of how Green Urbanism is translated into practice, and what factors modulate the outcomes of its application to cities. It addresses the third research question of the study: **how have the principles of Green Urbanism been applied to reframe existing cities? How do the characteristics of the local context influence the application of these principles?** Specifically, this phase of the study investigates how cities define Green Urbanism in the local context. It assesses: what aspects of the concept are prioritized by different cities; what factors drive these initiatives; barriers to the initiatives; outcomes (successes and failures) of these initiatives; and factors that determined these outcomes. As noted earlier, a comprehensive review of the existing literature was conducted to determine which cases were appropriate for this empirical analysis.

Several cities in different geographical contexts are identified in the existing literature (e.g. Singapore, New York, Stockholm, Freiburg, Melbourne, Curitiba, Nantes, Copenhagen, Tianjin Eco-city, Masdar city, and Vancouver etc.). These cities are acknowledged, in the academic literature among other sources, for their commitment to the application of the criteria of

Green Urbanism at multiple levels. However, particular attention is paid to frequently discussed and most referenced cities in this category. Other filters are also applied to determine the appropriate cases to investigate in this study: (1) international awards and recognition as a green city; (2) approach to the application of the principles of Green Urbanism i.e. top-down and/or bottom-up governance; (3) socio-economic context i.e. developed or developing country context; and (4) the time frame for the application of these green principles since transitions are mostly projected to take several decades to unfold (Flyvbjerg 2006; Geels 2005; Yin 2013). Following these criteria, two cases are selected (i.e. Freiburg and Curitiba). Time and resource limitations also make this downscaling necessary.

The applied criteria help to establish the replication logic for the empirical analysis. According to Yin (2013), multiple case studies may follow one of two replication logics: literal replication (cases investigated corroborate each other); or theoretical replication (cases investigated cover different conditions). The study largely draws on the theoretical replication logic to understand how the criteria of Green Urbanism is applied to cities in different contexts, and how the location specific characteristics of cities influence the outcomes of these interventions. As shown in subsequent chapters (Chapters 6 and 7), Freiburg's (developed country context) transition towards Green Urbanism was largely motivated from the bottom-up, whereas Curitiba (developing country context) deployed a predominantly top-down approach.

Both secondary and primary data are collected to analyse these empirical case studies. With regards to secondary data, reports from national and/or city authorities, (local) government policies, geographical maps, journal articles, periodicals, magazines, newspaper databases, documentaries from social media outlets (e.g. YouTube), and blogs etc. are the main sources of data used in both cases. Due to lack of funding to travel to the study areas, interviews (via skype) were determined to be the main medium for collecting primary data. Following the requirements of the Human Research Ethics Committee of the University of Adelaide, it was also determined that potential interview participants would be contacted through their publicly available email addresses. In addition, interviews would be audiotaped with the consent of interview participants for transcription purpose only. Details of other ethical issues considered in the study are provided below (in Section 3.4).

In the case of Curitiba, three persons agreed to be interviewed (former deputy director of the Institute for Research and Urban Planning of Curitiba, an urbanist from Curitiba, and a PhD student from the region). These persons were identified using passive snowball sampling. However, in the case of Freiburg, a more extensive study was carried out due to an opportunity that came along to travel to Europe for an academic exchange program with Architecture Morphologie Urbaine et Projet (AMUP) in Strasbourg- France. With the support of officials of AMUP and some staff at Strasbourg, École d'Architecture, key contacts were made in Freiburg for site visits and interviews. In all, fifteen interviews were conducted with city officials, academics, civil society, students, foreign residents, and research institutions, notably, Oeko-Institut. One focus group discussion was also organized with local residents in Freiburg. In addition, a guided tour with Innovation Academy was undertaken to ascertain the sustainability initiatives in Freiburg and its two eco districts (Rieselfeld and Vauban). Following De Certeau's (1984) reflections on "Walking in the City" as a mode of appropriating a space and drawing meaning from it, most of the site observations were done on foot. This firsthand experience allowed for a deeper understanding of the day-to-day practices in this so-called model green city.

3.3.3.3 Application case: phases four

The fourth phase of the study involves an analysis of how the criteria of Green Urbanism might be applied to cities in the developing world to reframe their developments towards desired trajectories. It addresses the fourth research question: ***how can Green Urbanism be applied to cities in developing countries? What strategies are appropriate for transitioning cities in the developing world towards Green Urbanism?*** The study focuses on the case of Accra in Ghana. Detailed discussion on the profile of Accra and why the latter was selected is provided in Chapter 8 of this thesis. Essentially, this application case draws on lessons from the theoretical literature reviews (in Chapters 2 and 4), and empirical analysis (in Chapters 6 and 7). It contributes to an understanding of the 15th principle of Green Urbanism proposed by Lehmann (2007): what are the appropriate solutions for transitioning cities in the developing world towards Green Urbanism?

Both secondary and primary data are used in this analysis. On one hand, secondary data were derived from national and local government policies, reports from government institutions,

electronic media, official websites of local government institutions, census data from the Ghana Statistical Service, journal articles, dissertations, periodicals, and social media platforms etc. On the other hand, primary data were collected through semi-structured interviews, questionnaire surveys, site observations, and GIS mapping. In all, 25 interviews were conducted with local government officials, civil society groups, urban planners, policy makers, private sector, academics, professionals, local residents, and opinion leaders among others. The interviews aimed to collect in-depth information about factors that present potential opportunities and/or barriers to green urban transition in Accra from both policy and practice perspectives. A full list of the interview participants is provided in the appendices. The ethical procedures applied in the interviews are explained in Section 3.4 below.

In addition to the interviews, 240 questionnaires were administered across the 10 Sub-metropolitan District Councils in Accra. The survey aimed to examine day-to-day (or common) practices in Accra, and how these practices conform to, add to, or deviate from the basic tenets of sustainable living identified in the literature. As shown in figure 3.4, 24 participants were selected at random from each Sub-metro district. The questionnaires were administered by two research assistants identified by the researcher. Firstly, 20 pilot surveys were conducted. This pre-testing exercise helped to ascertain the feasibility, logical problems, and inadequacies in the survey instrument. Some necessary changes were made to the questionnaires after the pilot survey. The final survey instrument used for data collection is included in the appendices. Moreover, site observations were used to gather firsthand information (i.e. photographs, video recordings, and sketches etc.). Although the researcher lived and worked in Accra for several years, these site visits gave the researcher a 'third eye' to uncover many interesting activities that were inconspicuous or taken for granted.

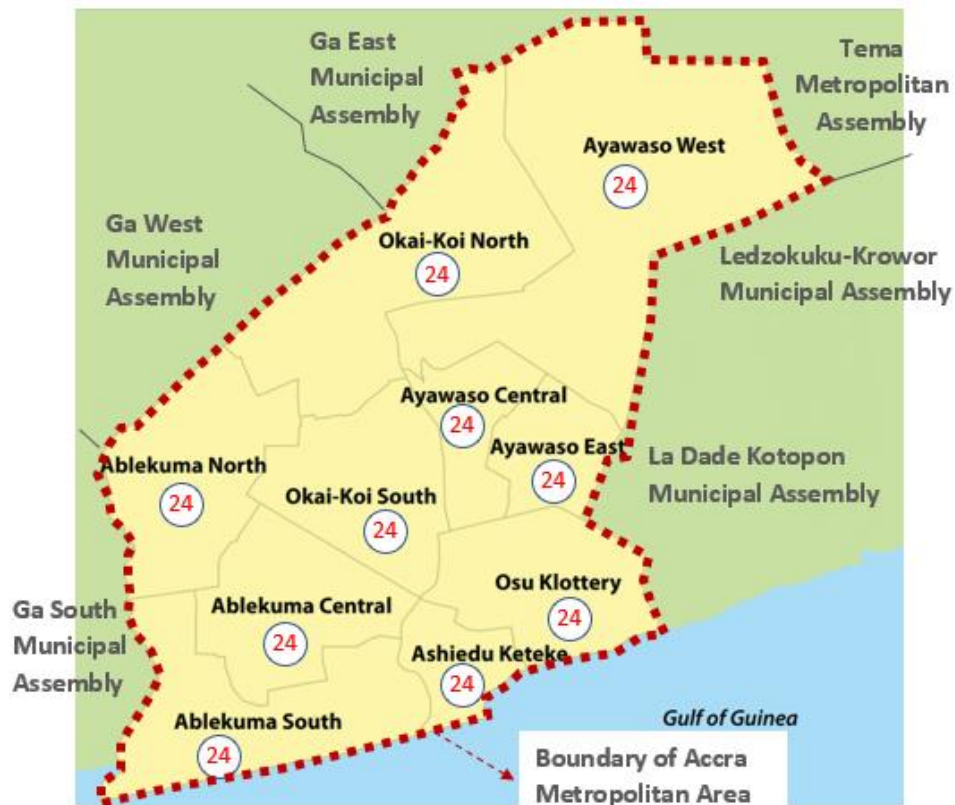


Figure 3.4: Map of surveyed areas in Accra (Source: modified from AMA map)

Finally, GIS mapping was used to assess the spatial growth of Accra over a period of three decades. Since the preservation of nature and biodiversity is central to the concept of Green Urbanism, this analysis aimed to uncover changes in land-use patterns in Accra, particularly, with regards to the built environment vis-à-vis the natural vegetation. To monitor changes in land cover, 30m resolution satellite images from LANDSAT5, 7 ETM+, and 8 sensors were obtained for the periods 1986, 2000, and 2016. These satellite data were obtained from the United State Geological Survey (UGSG) for row 53 and path 193. ArcGIS and ERDAS Imagine software were used for the analysis. Some of these datasets were geometrically and radiometrically inaccurate and were therefore corrected by orthorectification and atmospheric correction techniques. The resulting layers were clipped to the extent of the study area. Three land-use or land cover classes were identified namely water, vegetation, and bare/built-up areas. Descriptions of these classes are presented in Table 3.1 below. The land cover maps were composed using ArcGIS map, making capabilities with uniform legend and appropriate mapping scale.

Table 3.1: Classification of land cover categories in Accra

Land Use Category	Description
Built-up/Bare	Bare lands/built areas (residential, commercial, industrial, transportation) and all other impervious surfaces
Vegetation	Grassland/pasture, forest, cropland and shrubland
Water	All water bodies both natural and man-made

3.3.3.4 Data management and analysis

A data management plan was determined at the early stages of this research project to ensure efficient organization and preservation of data collected and used in this study. The researcher participated in seminars organized by the University of Adelaide on Data Management Planning to keep abreast of the University's data storage policies. As stipulated in the University's data retention policy, the records and materials gathered for this research need to be retained by the University for a minimum period of five years. Secondary data (e.g. literature, policy documents, maps etc.) were stored on the researcher's personal computer provided by the University of Adelaide with proper labelling. Backup files were created on the researcher's external drive. With regards to primary data, field interviews were transcribed and stored in Word format. In addition, the 240 questionnaire survey data were entered into SPSS for statistical analysis. The data was cleaned through screening and re-examination to detect, modify, and/or remove errors in the dataset. This process helped to create reliable data for analysis.

Qualitative content analysis was used to analyse secondary data (literature, policies, reports etc.). As pointed out by Bryman (2016), qualitative content analysis enables an investigator to construct understanding of the underlying themes and contextual meaning of a text beyond its manifest content. It is also identified as 'theory-guided approach to text analysis' that helps to uncover the latent content of materials being analysed (Mayring 2000). However, as cautioned by some proponents, observations in qualitative content analysis may not necessarily be an accurate reflection of reality; therefore, verification and validation of the sources and content of materials are necessary (Elo & Kyngäs 2008). Keeping in mind the above caveat, qualitative content analysis of secondary data is used in the current study to examine the drivers, barriers, and opportunity structures for green urban transitions; and

how various government policies etc. respond to these factors. The sources of materials used in this analysis were verified (e.g. whether from official or unofficial source) to ensure their credibility.

Qualitative primary data (i.e. interviews) were firstly transcribed manually for analysis. As acknowledged by many observers, manual transcription allows for a more accurate rendering of interview recordings than automated transcription techniques (Bazillon et al. 2008; Davidson 2009). It also enables the researcher to mull over the content of the interviews and how this might fit into the discussion. Thematic content analysis approach was used to analyse the interview transcripts. This approach involved: in-depth and inductive reading of the transcripts to ensure intimate familiarity with its content; coding and identification of patterned meanings (themes) in the transcripts that might be relevant to addressing the research objectives; refining themes to ensure they tell a logical and convincing story about the data; and creating a coherent narrative that adequately answers the research questions (Braun & Clarke 2006; Nowell et al. 2017). Themes emerging from this analysis are framed around the drivers, barriers, and opportunities for green urban transitions, particularly, in the application case study (i.e. Accra).

Quantitative data were collected during the field survey in Accra (Ghana). As noted earlier, 240 questionnaires were administered across the 10 sub-metropolitan areas in Accra. The aim of the survey is to examine how common practices in Accra conform to or deviate from the underlying principles of Green Urbanism. The survey data was entered into SPSS and analysed using descriptive procedures. Observed variables were clearly defined (as string or numeric) to ensure accurate and reliable measurement. Missing data (due to participants' failure to answer some items in the questionnaire) were given alternative codes to avoid spurious results. Descriptive statistical analysis (in SPSS) was used to determine measures of central tendency (mean) in observed variables, and generate charts (histograms, bar charts, and pie charts) to show data trends and/or compare multiple quantitative variables. Where necessary, survey data were exported to Excel to generate line charts or radar charts to create visual images that simplify complex data. Results of the quantitative data analysis are reported in the application case study in Chapter 9.

Both quantitative and qualitative data were checked for reliability (consistency of results) and validity (accuracy of results). The following protocols were observed to check the reliability and validity of data collected from the field studies: the use of triangulation techniques to cross-check information gathered from multiple sources of evidence using a combination of different methods (e.g. literature, theories, observations, survey, and interviews etc.); member checking or respondent validation to establish the credibility of data; pilot testing of research instruments (e.g. questionnaires and semi-structured interviews) to assess their comprehensiveness and/or effectiveness in measuring what they are intended to measure; seeking feedback from supervisors and peers on the ease to which the questions posed in the questionnaire and semi-structured interviews might be read and understood; and researcher's self-monitoring to avoid bias and ensure dependability of (qualitative) data etc. (Birt et al. 2016; Bolarinwa 2015).

3.4 Ethical consideration

The current study is undertaken in accordance with the Australian Code for the Responsible Conduct of Research and the National Statement on Ethical Conduct in Human Research (2007). A low risk human ethics application was submitted to the Human Research Ethics Committee (HREC) of the University of Adelaide in June 2016. It was approved in August 2016 (ethics approval number: H-2016-170). Several protocols were followed based on the ethical requirements. With regards to the field interviews, participants were contacted through their publicly available contact details (emails and telephones). Those who agreed to participate in the study were given participant information sheet (providing an overview of the study), a consent form, and a draft of the semi-structured interview questions via email or in person. Interviews were audiotaped with participants' consent for transcription and reporting purposes only. No reference was made to participants' identity (name) in the reporting of the interview findings. Similarly, the field surveys were conducted anonymously. Only aggregated data is used in the reporting of survey findings. Essentially, no risks were encountered by the researcher nor the research assistants during the data collection process.

3.5 Limitations of data

There are a range of limitations observed in the current study which largely border on access to data, and the appraisal and interpretation of data. Major limitations regarding access to both secondary and primary data were encountered in phases 3 and 4 of this study. As mentioned earlier, phase 3 embodies a post hoc analysis of the application of the criteria of Green Urbanism through two empirical case studies (i.e. Curitiba and Freiburg). In the case of Curitiba, lack of funding necessitated the use secondary data and online interviews. Due to language barrier, only three interviews were conducted (via skype). Besides, most of the official government reports and policies, which were relevant to this study, were written in Portuguese. These shortcomings were also encountered in the case of Freiburg, though, to a less degree. The time spent in Freiburg, for example, was limited to three weeks due to visa issues. Hence, the researcher had limited time to collect data. Nonetheless, language translation applications and other sources of secondary data such as documentaries on YouTube, proved useful in interpreting some of the non-English language text and providing supplementary information for the post hoc analysis respectively.

A different set of challenges with data collection was encountered in phase four (application case study in Accra, Ghana) of this study. Prominent among them is the paucity of data. Similar to the experiences of Adams and Page (2005), among many others, the researcher observed that Ghana's (developing country) commitment to collecting, storing, and providing data for public use is very poor. For example, basic information about Accra such as land cover changes, modal share, energy and water consumption patterns, and waste generation and recycling trends etc. were non-existent. Besides, most government sector policies were not available on the official websites of the institutions in charge of such sectors. It was also an uphill struggle to request for data from most of these institutions due to lack of proper data management structures in the latter. Therefore, the researcher had to generate much of this information (through surveys and GIS maps) or rely on interviews with relevant stakeholders.

Finally, the criticism of case study research as containing subjective bias, and lacking the ability to generalize from its findings, also raises concerns in this study (Adelman et al. 1980; Hammersley et al. 2000). Firstly, bias towards verification was minimized through triangulation of data sources and methods (Carter et al. 2014; Jick 1979; Taylor et al. 2015).

Secondly, the goal of the current study is not to generalize but to provide in-depth context dependent knowledge from the three empirical cases. That said, as argued by Flyvbjerg (2006), the criticism of case study research for lack of generalizability of its findings is a misconception. Echoing this point, Yin (2013), distinguishes between statistical generalization and analytic generalization, and argues that case study research provides a basis for the latter. According to Yin (2017), analytic generalization helps an investigator to examine how her case study findings bear upon an established theory, and how that theory might be applied to implicate other cases. The current study draws on this understanding to examine how lessons from the empirical cases and the theoretical analysis can inform green urban transitions in another context.

Theoretical framework

Towards a framework for assessing green urban transitions: an analysis of transition theories

4.1 Introduction

Whilst calls for a transition to more sustainable, greener cities abound, there are few examples of successful transitions; and limited insights into how cities may shift from embedded unsustainable practices to more sustainable lifestyle. Through a review and synthesis of transition theories, this chapter proposes an analytical framework to aid a systematic analysis of factors that present opportunities and/or barriers to green urban transitions. Specifically, the chapter draws on the Multi-level Perspective (MLP) to examine: the dynamics of socio-technical transitions; how social actors exercise agency in transition processes; and how transition processes might be influenced into desired trajectories.

The chapter is organized into five main sections. The following section (Section 4.1) provides a critical review of theories on transitions in socio-technical and ecological systems. Five major transition theories are presented: Strategic Niche Management; Transition Management; Multi-phase concept; Socio-ecological transition; and the Multi-level perspective. The underlying assumptions, strengths, and weaknesses of these theories are discussed. The rationale behind the adoption of the MLP as the theoretical lens for the current study is also explained. Building on the MLP, Section 4.3 presents an analytical framework for assessing green urban transitions. As pointed out by Geels, (2012, p. 474), the MLP is not a tool that automatically generates answers when data is fed into it; however, it is a “heuristic framework that guides the analyst’s attention to relevant questions and issues”. Thus, the proposed framework outlines salient questions at the various analytical levels of the MLP to enable a systematic analysis of transition processes. The next section (Section 4.4) explains

how the MLP is applied in the current study. The chapter concludes (in Section 4.5) with some thoughts about the utility of the MLP and how it can be further improved.

4.2 A review of transition theories in socio-technical and ecological systems

4.2.1 Strategic Niche Management

Strategic Niche Management (SNM) emphasizes the agency of social actors in niche development. Following Kemp et al. (1998), SNM is a transitional tool that enables experimentation of radical innovations among various stakeholder in a protected space (niche). It aims to facilitate the development and continuous improvement of new technologies; stimulate collaborative learning; and enhance understanding and social acceptance of these technologies (Raven et al. 2010). Rooted in evolutionary innovation theory, SNM draws on the knowledge, expectations, and expertise of stakeholders to ensure emergent innovations are responsive to the social and economic dynamics of their application domains (Caniëls, MC & Romijn 2008).

The SNM holds that promising innovations are stalled by dominant technologies (technological regime) which are underpinned by entrenched user practices, prevalent regulatory and institutional frameworks, established production processes, and sunk investments in infrastructure among others (Raven et al. 2010). Therefore, scholars of SNM posits that the development and mainstreaming of niche-innovation are social processes that require overcoming innovation inertia engendered by dominant technological, social, institutional, and market selection pressures etc. (Schot & Geels 2008).

Proponents of SNM distinguish three interactive processes of managing niche development i.e.: coupling and articulation of expectations, actors' networking, and shared learning (Caniëls & Romijn 2008; Verbong et al. 2010). Firstly, the coupling and articulation of expectations of all relevant stakeholders are identified as essential requirements in niche development to ensure that the outcomes of innovation experiments are desirable. Secondly, the building of actors' network (including those who directly or indirectly affect or are affected by niche-innovations), and the promotion of active interactions among actors in the network (e.g. firms, users, policy makers, and researchers etc.) also contribute to streamlining

niche experimentation to avoid “directionality failure”. Weber and Rohracher (2012), define the latter as innovations without well-defined priorities and collective coordination. A third requirement identified in these processes is knowledge and experience sharing among actors to benchmark best practices.

According to Grin and Van de Graaf (1996), a good learning process enables the articulation of the technical, social, environmental, and economic challenges of niche development through first order learning (accumulation and assessment of facts), and second order learning (i.e. changes in cognitive frames and assumptions). Expounding on these three niche-management processes, Kemp et al. (1998), identify five steps for undertaking niche experimentation which are underpinned by the latter. These steps include: (1) choice of technology- which is largely informed by the convergence of actors’ expectations and learning processes; (2) selection of a setting for experimentation- especially in a place where there is high cooperation among actors with aligned expectations; (3) setting up of experiment; (4) scaling up the experiment- through incremental learning and proactive actors’ involvement; and (5) breakdown of protection for unsuccessful experiments.

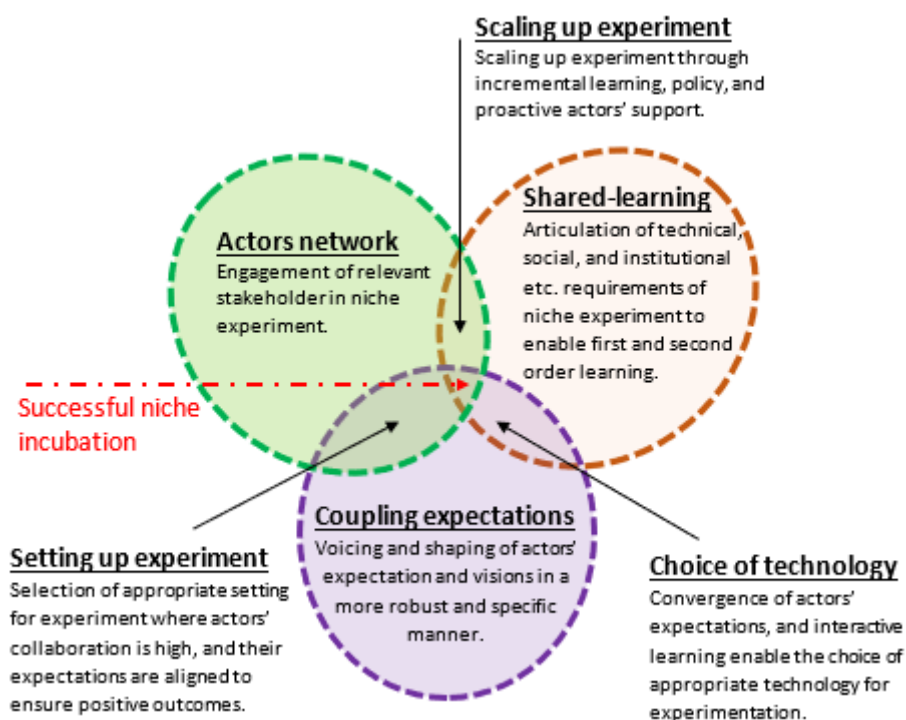


Figure 4.1: Niche development processes in SNM (Source: developed from Grin & Van de Graaf 1996; Kemp et al. 1998)

The SNM concept has been shown to be a useful tool for conceptualizing the outcomes of transition experiments in many fields of socio-technical innovations. For example, by applying

Social Network Theory to the SNM framework, Caniel and Romijn (2008), find that not only is the integration of the niche experimentation processes (networking, learning, and convergence of expectation) essential for successful niche incubation, but also the quality of the interactions between actors in the network. In addition, Ieromonachou et al. (2004) adapt the SNM concept to transport policies in Durham, and observe that dominant technologies are mostly embedded in prevalent policy regimes which reinforce these established technologies and create strong resistance to emergent innovations. Therefore, niche developments should be coupled with favourable policies to engender regime shift.

Furthermore, studies by Sushandoyo and Magnusson (2014), on the application of SNM to the upscaling of cleaner vehicle technologies, find that although the protection of niche-developments is necessary for successful incubation of emergent innovation, exposure to mainstream market selection pressure is equally important at certain stage of the development. Echoing this point, Kemp et al. (1998, p. 188), argue that too much protection may lead to “expensive failures”, especially, when it gives room for niche-developers to compromise on essential social and environmental requirements.

The SNM framework has been particularly useful in retrospective studies to examine and illuminate the dynamics of niche incubation, and the agency of niche-actors in innovation experimentation (Grin et al. 2010; Ruggiero et al. 2018). Nevertheless, it is inherently biased towards technological innovations, with limited attention to the cultural and social construction of these technologies. Besides, it is criticised for its narrow focus on product innovation, and little to no recourse to process innovation which embraces broader visioning towards sustainability transitions (Ashford & Hall 2015). Some scholars also note that SNM has limited practical application, and it is less explicit on how transitions towards emergent innovations might be managed (Raven et al. 2010; Witkamp et al. 2011).

4.2.2 Transition Management

Both SNM and Transition Management (TM) concepts underscore the importance of niche experimentation and collaborative networking among various actors. However, TM promises a more systemic instrument for the governance of socio-technical transitions (Raven et al. 2010). Built on insights from governance and complex system theory, TM offers a prescriptive governance model for socio-technical transitions (Loorbach 2010). It recognizes interactions

between external pressures, existing regimes, and emergent innovations as fundamental conditions for socio-technical transitions (Rotmans et al. 2007). Therefore, it proposes a governance framework that aims to influence these interactions towards more desired trajectories (Raven et al. 2010).

Conceptually, TM is underpinned by an iterative process model that distinguishes four guidelines for the governance of transition processes. These guiding principles include: problem structuring and the establishment of transition arenas; transition agenda and/or vision setting; actors' mobilization and the implementation of transition experiments; and monitoring, evaluation, and experiential learning (Foxon et al. 2009; Loorbach & Rotmans 2010). The first stage of the TM process is a strategic phase where the perceptions of stakeholders about a given problem and potential solutions are deliberated. This phase is followed by the identification of transition scenarios based on an understanding of the structural problems presented by entrenched socio-technical regimes. The third phase represents the operational level of TM where transition experiments are undertaken and scaled up to mainstream application. Following this phase is continuous monitoring and evaluation of outcomes to inform future developments.

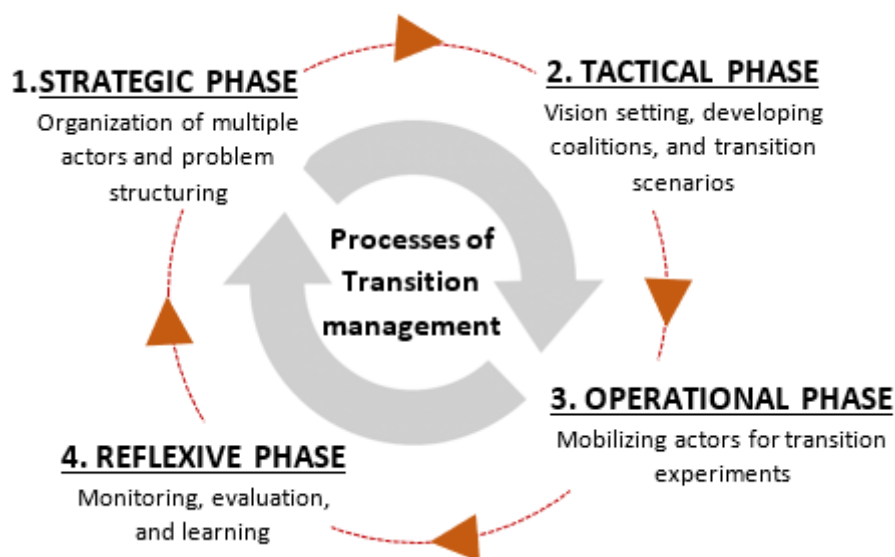


Figure 4.2: Transition Management Cycle (Source: Developed from Loorbach 2010)

TM is a relatively new governance framework with limited practical application to test its propositions. It emerged in the early 2000s following the outcomes of the fourth National Environmental Policy Plan (NMP4, VROM, 2001) in the Netherlands (Lachman 2013; Rotmans

et al. 2007). Therefore, TM requires broader practical experimentations in different domains in order to refine and enhance its relevance to transition governance. That said, the application of TM (mostly in the Netherlands) have been shown to offer valuable insights into the processes of managing transitions in an “operational sense” (Loorbach 2010, p. 172).

For example, Rotmans et al. (2007), observe that the application of TM to mobility, energy, agriculture, and healthcare studies etc. in the Netherlands accentuated the potentials of systemic interventions towards sustainable development. They note that TM enables both bottom-up processes (experimentation and learning in niche development), as well as top-down interventions (vision and agenda setting); which collectively provide a broader perspective on niche management as opposed to SNM’s bottom-up approach. However, TM (like SNM) tends to pay more attention to the supply side of socio-technical innovations (producers, policy makers, and institutional networks etc.), with limited focus on demand side factors (e.g. behaviours, norms, and values etc.) which underlie user practices (Lachman 2013). Besides, it fails to sufficiently account for the wider environment that mould and/or constrain transition processes. The TM is also limited in addressing critical issues of how transitions come about and evolve over time, and what factors underlie these processes.

4.2.3 Multi-phase concept

The multi-phase concept (MPC) underscores the notion that transition is a non-linear and gradual process of change, with multiple phases of transformation leading to moderate or radical changes in the basic architecture of existing socio-technical systems. It distinguishes four key phases for conceptualizing transitional change (Rotmans et al. 2001). These phases involve a wide range of possible scenarios, with no predetermined directionality (Frantzeskaki & de Haan 2009). Rotmans et al. (2001), identify the four phases as: (1) predevelopment phase; (2) take-off phase; (3) acceleration phase; and (4) stabilization phase. In the predevelopment phase, existing systems are dynamically stable with no fundamental changes in the status quo. Momentum for change is built up in the take-off phase. The acceleration phase is where structural changes begin to unfold, causing a shift in entrenched regimes. Finally, in the stabilization phase, new regimes are formed leading to new dynamic equilibrium. Essentially, the MPC is useful in elucidating the patterns of change in socio-technical systems (Loorbach & Rotmans 2006b; Van der Brugge et al. 2005). However, it is

limited in explaining the underlying drivers of these patterns, and how the latter might be influenced.

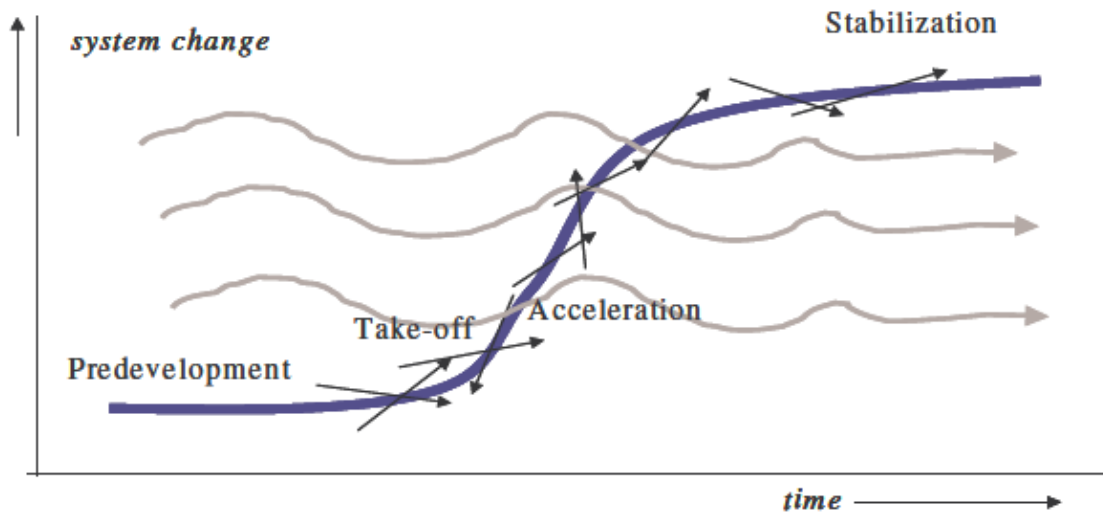


Figure 4.3: Phases of socio-technical transitions in the MPC (Rotmans et al. 2000)

4.2.4 Socio-ecological transition

The various transition theories discussed above (SNM, TM, MPC) are rooted in social theory and technological innovation systems literature, with no particular interest in the interface between socio-technical transitions and changes in the natural environment. Socio-ecological Transition (SET) theory proposes a framework to enhance understanding of this relationship on a long-term scale (Fischer-Kowalski et al. 2012). It poses the question of how the dynamics of socio-technical systems influence changes in natural systems. According to Laurent and Pochet (2015), the SET underscores the notion that environmental change is a function of social and economic progress. A key determinant of this change process is the “sources and dominant conversion technologies of energy” (Fischer-Kowalski et al. 2012, p. 5).

A typical case in point is the transition from agrarian society to industrial society at the turn of the nineteenth century. As briefly discussed in Chapter 2, the mode of livelihood in agrarian society was dependent on resources that were readily available in nature. Therefore, the major sources of energy were plant biomass and natural solar energy. A transition from this nature-based energy regime to coal and fossil fuel regimes brought about significant improvements in the social and economic well-being of people, but with serious consequences for the environment. Thus, proponents of SET argue for a new kind of growth

that downplays traditional measures of development (e.g. Gross Domestic Product) in favour of measures that ensure environmental preservation, social welfare, and inclusive development among others (Fischer-Kowalski et al. 2012; González de Molina 2010; Labaeye & Sauer 2013).

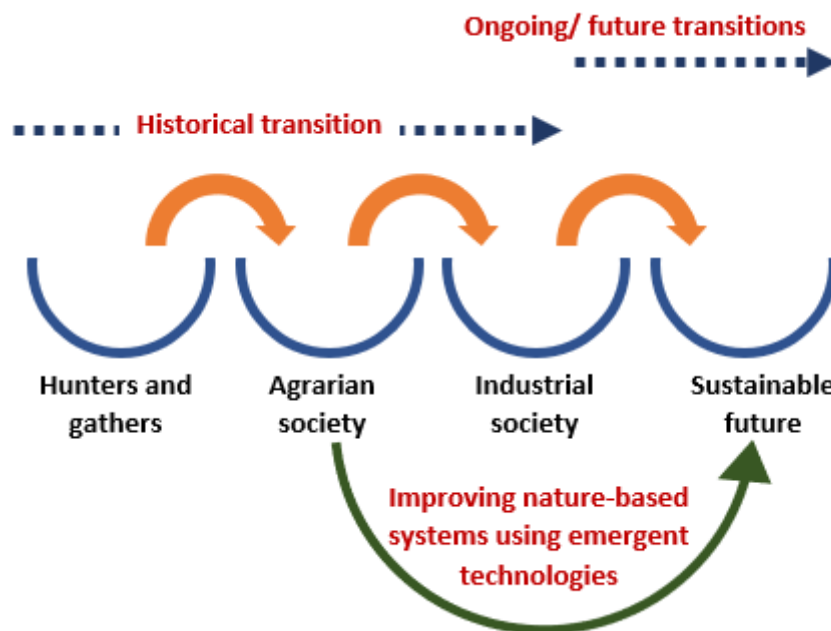


Figure 4.4: Historical and ongoing transitions in socio-ecological regimes (Source: modified from Fischer-Kowalski 2007)

Labaye and Sauer (2013), argue that such growth strategies may not make any significant impact if efforts are directed at resolving local problems without due consideration of their broader regional and global impacts. Therefore, they emphasize that collaborative initiatives and experience sharing on sustainability among cities should be key instruments in the SET to ensure that transboundary issues (e.g. climate change, global resource depletion, and social instability etc.) are addressed effectively. Generally, the SET advocates for a transition to new development paths that are responsive to social and ecological concerns based on a proper understanding of past and ongoing transitions within the context of global interdependency (Fischer-Kowalski 2007). The propositions of the SET are no different from the underlying goals of sustainability. It provides useful guidelines for deciphering what regimes in mainstream society must be changed to enable a transition to more sustainable trajectories. However, how this transition might be conceptualized and/or instigated remains unclear. The

SET adds little to the transition debate as it focuses primarily on the approaches to and outcomes of transitions (what?) rather than the processes of transitions (how?).

4.2.5 Multi-level Perspective

The Multi-level Perspective (MLP) is a middle-range theory that provides a framework to examine how society changes and develops over time (Geels 2005). It presents a heuristic model to analyse the processes of long-term transformative change in socio-technical systems (Weber & Rohracher 2012). Accordingly, the MLP deploys a multi-dimensional approach to understanding the complex interactions between social systems, the environment, and innovations at multiple levels i.e.: technology, market, policy, infrastructure, normative rules, and user practices among others (Lachman 2013; Smith, A et al. 2010). Following Grin et al. (2010), the MLP is rooted in a combination of various theoretical traditions with insight from Science and Technology Studies (STS), evolutionary economics, and social theory etc. It proposes a framework for assessing the drivers and barriers to the diffusion of radical innovations into mainstream society (Geels 2002).

Since the early 2000s, the MLP has received considerable attention from academics, with growing number of scholarly publications on its application to both historical and contemporary transitions. An underlying assumption of the MLP is that transition processes are non-linear, and they are underpinned by fundamental changes in the social and technical structures of society (Geels 2012). It distinguishes three analytical concepts in landscape factors, socio-technical regime, and niche-innovations that interact to engender radical changes in specific areas of societal functioning.

4.2.5.1 Landscape factors

Firstly, landscape factors represent trends and changes in society and globally. They are identified as macro-level phenomena, with autonomous functioning, which emerge from the broader external environment (Kemp et al. 1998; Raven et al. 2010). Following, landscape factors are slow to change, and they are predominantly beyond the direct influence of individual actors within a given social context. They include climate change, globalization, urbanization, worldviews, immigration, peak oil, political coalitions, environmental awareness, natural disasters, wars, and macro-economic trends, among others. These macro-

level developments bring pressure to bear on prevalent social and technical systems in society (regime) to create a sense of urgency for change (Jørgensen 2012).

4.2.5.2 Socio-technical regime

Socio-technical regimes refer to dominant social and technical structures that modulate people's behavioural outcomes (Kemp et al. 1998). They include entrenched institutional frameworks, standardised practices, cognitive routines, culture, normative preferences, existing technologies, sunk investment in infrastructure, and established scientific knowledge etc. (Geels 2002). Essentially, regimes are the locus of established practices. They provide stability for prevalent socio-technical systems (i.e. create path dependence and lock-in mechanisms), and are resistant to radical changes in societal functioning (Kemp et al. 1998). However, they are dynamically stable, and adapt to changing circumstances through incremental improvements and self-organization along predictable trajectories (Frantzeskaki & de Haan 2009; Lachman 2013). In socio-technical transition discourses, regimes are identified as the objects that require fundamental changes in a desired direction.

4.2.5.3 Niche-innovation

Niche is where the seed for fundamental change in socio-technical systems emerge (Kemp et al. 1998). A niche could be analogized to an incubation space where radical innovations are given opportunities to develop and mature under temporal protection (e.g. tax exemptions, funding for research and development, and subsidies etc.) against selection pressures (Caniëls & Romijn 2006; Geels 2005). These protection measures are important for the sustenance of niche innovations because of the lukewarm support they receive from the public at their early stages of development. Efforts to morph such innovations into mainstream application tend to face an uphill struggle against market uncertainties and entrenched user practices among others. (Geels 2012). These barriers are underpinned by existing socio-technical regimes which exert high constraining influence on emergent innovations (Geels 2014).

4.2.5.4 Conditions for transitions in the MLP

The MLP posits that socio-technical transition is a function of the interactions between niche developments, regimes, and macro-level landscape phenomena (Geels 2010; Markard & Truffer 2008; Smith et al. 2010). Following Geels' (2005, 2010) lead, transitions unfold when

ongoing processes at the landscape and regime levels create ‘windows of opportunity’ for niche developments to breakthrough and become mainstream. Changes at the landscape level such as climate change, macro-economic trends, and changes in societal values and worldviews etc., bring pressure to bear on existing regimes to create room for the diffusion of niche-innovations. Concurrently, these emergent innovations should have developed enough internal momentum to serve as viable alternatives to the existing regimes. Hence, the absence of one element in this constellation (i.e. landscape pressure, regime destabilization, competitive niche) may forestall or delay transition processes (Geels 2005; Grin et al. 2010).

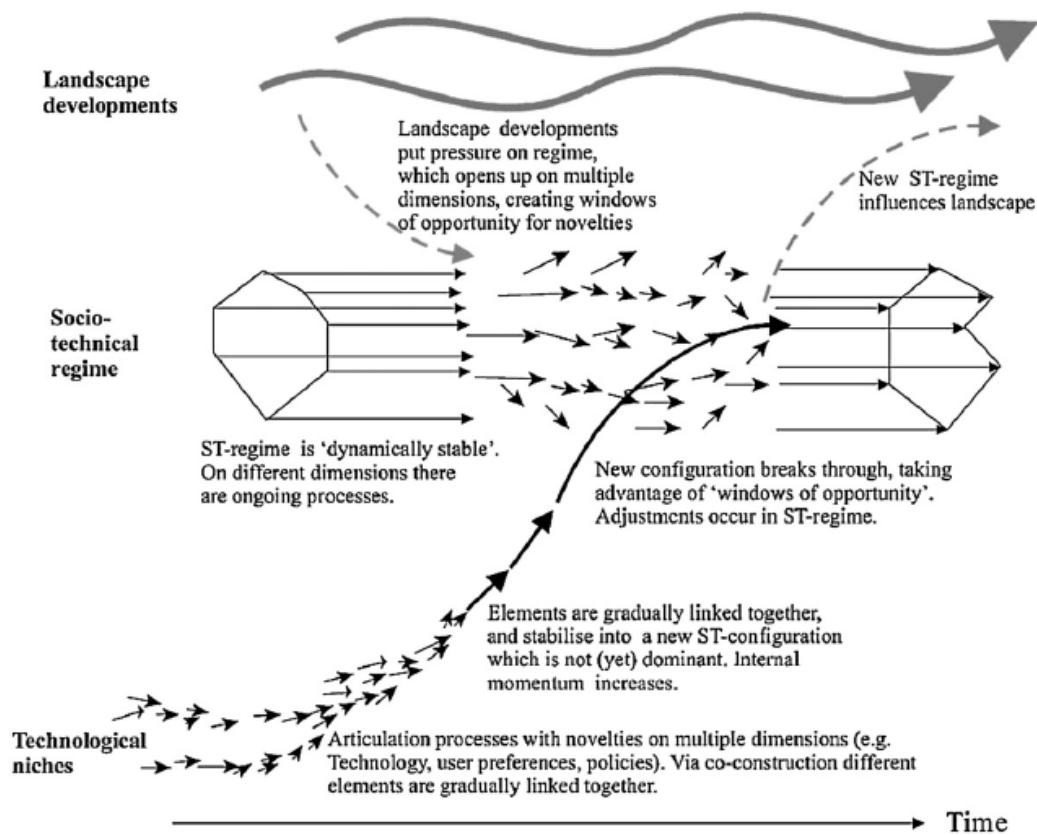


Figure 4.5: Multi-level Perspective on Socio-technical transitions (Source: Geels 2002)

The MLP identifies the creation of ‘windows of opportunity’ through landscape, regime, and niche interactions as the opening wedge in socio-technical transitions. Nevertheless, the existence of these opportunities does not guarantee that transition may occur or may be successful. In this regard, Weber and Rohracher (2012), point out several factors that may contribute to transitional failure in socio-technical systems even when ‘windows of opportunity’ do exist. Expounding on the works of Arrow (1962) and Woolthuis et al. (2005),

Weber and Rohracher (2012) conceptualize four “transformational system failures” in socio-technical transitions.

They identify “directionality failure” (innovations without well-defined priorities, and collective coordination); “demand articulation failure” (failure of innovations to adequately respond to user expectations and practices); “policy coordination failure” (lack of coherence between policies at different levels of government); and “reflexive failure” (poor monitoring of innovation-related policy outcomes) as potential setbacks to the mainstream application of niche-innovations. An underlying assumption of these concepts is that for niche development to successfully break through the boundaries of entrenched socio-technical regimes, it must be framed to sufficiently respond to the dynamics of its social context.

4.2.5.5 Application of the MLP

Since its inception in the early 2000s, the MLP has been used to undertake retrospective analysis of socio-technical transitions. It is identified to provide useful insights into the patterns and processes of socio-technical transitions towards greater sustainability (Jørgensen 2012; Lachman 2013). Thus far, the MLP has been applied in a wide range of historical and contemporary studies including: low-carbon transition in transport systems (Geels 2012; Whitmarsh 2012); introduction of electricity and hydrogen powered vehicles (Van Bree et al. 2010); transition in water supply and personal hygiene (Geels 2005); assessment of innovation policies (Kern 2012); sustainability transition in agri-food chain (Belz 2004); and transitions to low carbon electricity (Foxon et al. 2010; Rohracher & Späth 2014) among others.

Altogether, these strands of research highlight the descriptive usefulness of the MLP in illuminating the mechanisms through which radical changes in entrenched socio-technical systems (regimes) occur. For example, Geels and Kemp (2007), applied the MLP to analyse transition from cesspools to integrated sewer systems in the Netherlands and found that developments at the three analytical levels of the MLP (landscape pressure, regime destabilization, matured niche) have to coalesce for transitions to unfold. They argue that pressures from landscape factors do not “automatically lead to” a regime shift, but they must be complemented with pressures from emergent innovations which provide the seed for change (Geels & Kemp 2007, pp. 453). Consistent with this observation, Acheampong et al.

(2016), applied the MLP to assess sustainable urban water system reforms in Ghana and identified that landscape pressures do not only create favourable conditions for niche to emerge, but they also lead to policies that facilitate regime transformation. Other empirical studies have also accentuated the importance of landscape pressure to create a sense of urgency for change, and the need for matured niche to provide viable alternatives to unsustainable regimes (Markard & Truffer 2008; Smith 2007; Van Bree et al. 2010).

4.2.5.6 Criticisms of the MLP

Unlike the various transition theories discussed above (i.e. SNM, TM, MPC, and SET), the MLP proffers a more comprehensive approach to analysing the wider environment that influence transition processes. It provides a better understanding of how transitions come about, and what factors underlie these processes. Nevertheless, the MLP is not without its challenges. In the first instance, most of the studies in this field of research are less diverse in their geographical context. They are mostly based on European case studies, especially, in the Netherlands. Therefore, how different location-specific characteristics modulate transition processes have been given less treatment in these strands of research (Lachman 2013). Similarly, these studies have yet to address the broader socio-spatial dynamics of sustainability transitions (Coenen et al. 2012; Genus & Coles 2008). Specifically, the question of how context specificity influence transition processes and outcomes has not been dealt with in depth (Lachman 2013).

Moreover, the MLP is criticized for lack of empirical operationalization of its analytical levels (Genus & Coles 2008; Markard & Truffer 2008). Jørgensen (2012, p. 999), argues that the MLP does not “provide rigorous guidelines” for ascertaining the boundaries of regimes and landscape factors which, according to Lachman (2013), breeds ambiguity in the categorization of the concept. Expounding on this observation, Raven et al. (2010), point out that the interpretation of the analytical concepts of the MLP (i.e. landscape, regime, and niche) may have different meanings to different actors; especially, when dealing with different scopes, contexts, and power relations. Therefore, what might be conceived as a landscape change in one context might turn out to mean a regime change in another context. For example, they argue that changes in market regulations at the regional level by the European Parliament may qualify as a regime change to the latter, and at the same time a landscape change to

firms in the region (Raven et al. 2010). Therefore, the scope of transition contexts, and the power relations of the actor's involved must be clearly defined.

Another common criticism of the MLP is a lack of agency in its analytical framework. Lachman (2013), argues that the dynamics and relationships between actors in the various structural levels of the MLP are less articulated. In line with this argument, Jørgensen (2012) and Markard et al. (2012), observe that actors in a given socio-technical system may have multiple identities, and their activities may overlap several levels (e.g. regime and niche) at the same time. Therefore, the confinement of actors to one analytical level (e.g. regime actors or niche actors) as implied in some MLP studies could be misleading. Adding to this point, Avelino and Wittmayer (2016, p. 633), argue that “shifting power relations” between actors, and the notion of “(dis)empowerment of actors in transition processes are at best implicit in most transition analysis. These issues border on the motivation and/or capacity of actors to act to influence transitions toward desired trajectories. Furthermore, although the descriptive usefulness of the MLP is acknowledged by many scholars, its prescriptive utility in terms of how transition processes might be managed or governed remains underdeveloped (Genus & Coles 2008). This shortcoming hinges on the lack of a proper framing of agency in the MLP (Jørgensen 2012; Sorrell 2018).

Responding to criticisms of a lack of clarity on the role of actors in the MLP, Geels (2011, p. 29), argues that the “different structural levels [of the MLP] are continuously reproduced and enacted by actors”; therefore, the MLP is “shot through with agency”. However, he acknowledges that the stylized representation of the MLP (shown in figure 4.5) fails to explicitly accommodate agency. Indeed, transitions are “mediated by actors’ perception, negotiations, and agenda setting” (Grin et al. 2010, p. 26). Therefore, as argued by Jørgensen (2012), agency should be at the “core of discussions in transition theory”.

The criticisms discussed above highlight key areas for improvement in the MLP. Since the MLP is a mid-range and fairly new theory, a more extensive application and testing of the theory in different strands of disciplines and contexts might help build some rigour into the theory. As acknowledged by its main proponent, the MLP could benefit from insights from other theoretical constructs to address inherent shortcomings (Geels 2011). For example, Chadwick's (1978), resolution concept for deciphering the boundaries of complex systems provides a useful guide for clarifying the boundaries of the analytical levels of the MLP.

Chadwick (1978), (drawing on the work of Klir and Valach, 1967) suggests that the identification of “resolution level” of a system, based on one’s requirements, is an effective way of demarcating the boundaries of complex systems. For example, he argues that at a high-resolution level, the human body may be viewed (to the minutest detail) as a system comprising complex combinations of oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus etc. However, at a decreased level of resolution, the body is a structural system with several parts (e.g. head, neck, hands, and legs etc). Thus, the resolution level applied in complex system analysis determines what elements of the system should be investigated.

In socio-technical system analysis, “resolution level” may be viewed as the scope of the system under investigation. An analysis with a broad scope such as regional and/or international studies may have, for example, different landscape factors compared with a narrow scope analysis (e.g. organizational or sectoral studies etc.) when, say, the level of influence of actors is applied as a filter. In line with this observation, Geels (2011, p. 31), argues that “the scope of the empirical topic will have implications for the operationalization of the regime [and landscape] concepts”. Therefore, a clear definition of the unit of analysis in MLP studies is essential to determining the boundaries of its analytical concepts.

Moreover, Smith et al. (2005), introducing a quasi-evolutionary model for socio-technical transitions, propose two approaches to conceptualising agency in transition processes. These approaches offer useful insights into how the roles of actors in the MLP might be clarified. Smith et al. (2005), identify the articulation of pressures bearing on regime and the adaptive capacity of actors as two fundamental approaches to governing regime transformation. In the first place, the articulation of landscape pressures creates a sense of urgency for change in regimes. According to Smith et al. (2005, p. 1495), “effective articulation lies in the processes that render these pressures explicit and translate them into a form that prompts and enables a response by the regime”. Thus, the more explicitly landscape pressures are articulated, the more exposed are the weaknesses in incumbent regimes, and the higher the sense of urgency for change (Grin et al. 2010). That said, there is a need to clarify what form and direction the process of articulation should take, and which actors should be spearheading this process in a given transition context. Besides, as pointed out by Smith et al. (2005), effective articulation of pressures per se does not guarantee regime shift, but it should be coupled with the adaptive capacity of actors to respond to these pressures.

Smith et al. (2005), define adaptive capacity as the extent to which actors are able to mobilize resources and exercise power to influence the direction of regime change. A regime with greater adaptive capacity is likely to undergo ‘endogenous renewal’ or ‘re-organization’ under perceived threats without fundamental changes in its basic architecture (Berkhout et al. 2004). However, when the adaptive capacity of incumbent regime is weak, ‘it can be outside groups [niche actors] that generate alternative’ solutions to replace existing regime (Smith et al. 2005, p. 1496). Drawing on these two approaches to conceptualizing agency in socio-technical transitions, it could be argued that the role of actors mediates the interface between landscape pressures and regimes on one hand, and niche developments and regimes on the other (figure 4.6). In the first instance, how social actors articulate landscape pressures will determine the extent to which the latter might impact regimes. Similarly, the adaptive capacity (i.e. resources, knowledge, and power) of niche will determine how emergent innovations may break through entrenched regimes and become mainstream. It is also acknowledged that the capacity of actors at the regime level to respond to pressures from landscape and niche developments will influence the direction of regime change (Grin et al. 2010; Smith et al. 2005).

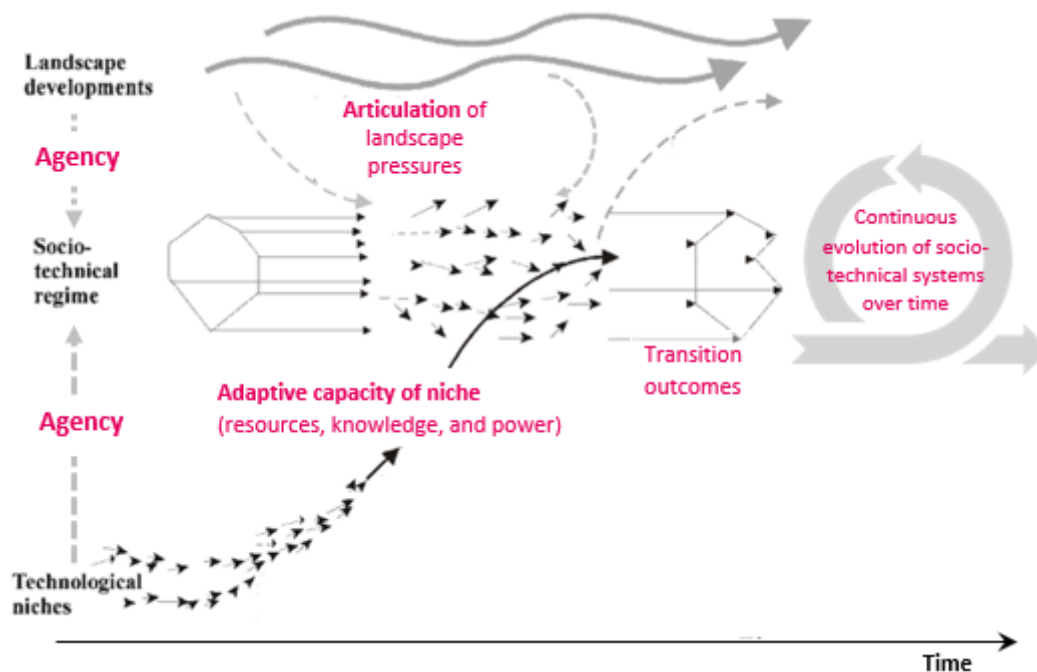


Figure 4.6: Role of actors in the Multi-level Perspective (Source: Modified from Geels 2002)

Essentially, the influence of actors on the various analytical levels of the MLP is a major determinant of the outcomes of socio-technical transitions (Geels, F & Schot, J 2007; Smith et

al. 2005). Successful transitions may emerge where selection pressures bearing on regime are effectively articulated to create a need for change, and niche has developed sufficient adaptive capacity to compete with and replace incumbent regimes (Grin et al. 2010; Loorbach 2010). However, the notion of successful transition should not be misconstrued as a dead-end, but a partially complete process given that socio-technical systems continue to evolve over time (Rotmans et al. 2007; Trist 1981). This continuous process of change in socio-technical transitions remains unaddressed in the MLP (see figure 4.5). Therefore, as shown in figure 4.6 above, the outcomes of transition processes in the MLP framework are likely to undergo further transformation over time at the instance of 'new' landscape pressures and/or niche-innovations. This pattern of change in socio-technical systems can also be observed in the cycle of adaptive change in ecological systems (See Gunderson 2001).

4.3 A framework for assessing green urban transitions: application of the Multi-level Perspective

Despite inherent shortcomings, the MLP provides a useful framework for assessing the processes of socio-technical transitions. Essentially, it elaborates on the drivers and barriers to transitions, and how these factors might be modulated to achieve desired outcomes. Thus, through the theoretical lens of the MLP, the current study aims to examine how green urban transitions unfold, and what factors influence these processes. Specifically, the study examines how the MLP may help enhance understanding of the drivers, opportunities, and barriers to green urban transitions; what factors influence the outcomes of these processes; and how these outcomes differ in time and space? These enquiries address the third research question of this thesis. They make two significant contributions to the existing literature. Firstly, they address the issue of urban transition and how it applies to the concept of Green Urbanism. As mentioned in Chapter 2, an analysis of Green Urbanism in respect of urban transitions remains briefly addressed in the existing literature. Secondly, they provide insights into how the MLP might be applied to explain broader spatial perspectives of sustainability transitions which has received less treatment in MLP studies (Coenen et al. 2012; Genus & Coles 2008).

4.3.1 How may the MLP be applied to examine the drivers, opportunities, and barriers to green urban transitions?

As discussed in previous sections, the MLP proposes three analytical concepts for examining the dynamics of socio-technical transitions (i.e. landscape, regime, and niche). The interface between these concepts are largely influenced by the agency which social actors bring to transition processes. Informed by this understanding, figure 4.6 proposes a modified MLP framework that highlights both the mechanisms and agency in transition processes. The adapted framework can be classified into five analytical sections. This classification allows for a systematic analysis of the dynamics of transition processes. As illustrated in figure 4.7 below, the first section addresses how landscape pressures initiate transition processes. Section two highlights the role of social actors in articulating these pressures to create a sense of urgency for change in existing regimes. The third section addresses how incumbent regimes respond to landscape pressures, and how they adjust to or are destabilized by the latter. Section four examines the adaptive capacity of niche, and the extent to which actors at the niche level can influence a regime shift. Finally, section five assesses the processes of niche development, and how successful emergence of niche is possible. Building on this framework, Table 4.1 raises fundamental questions at the various analytical sections to provide a systematic guideline for assessing the drivers, opportunities, and barriers to green urban transitions.

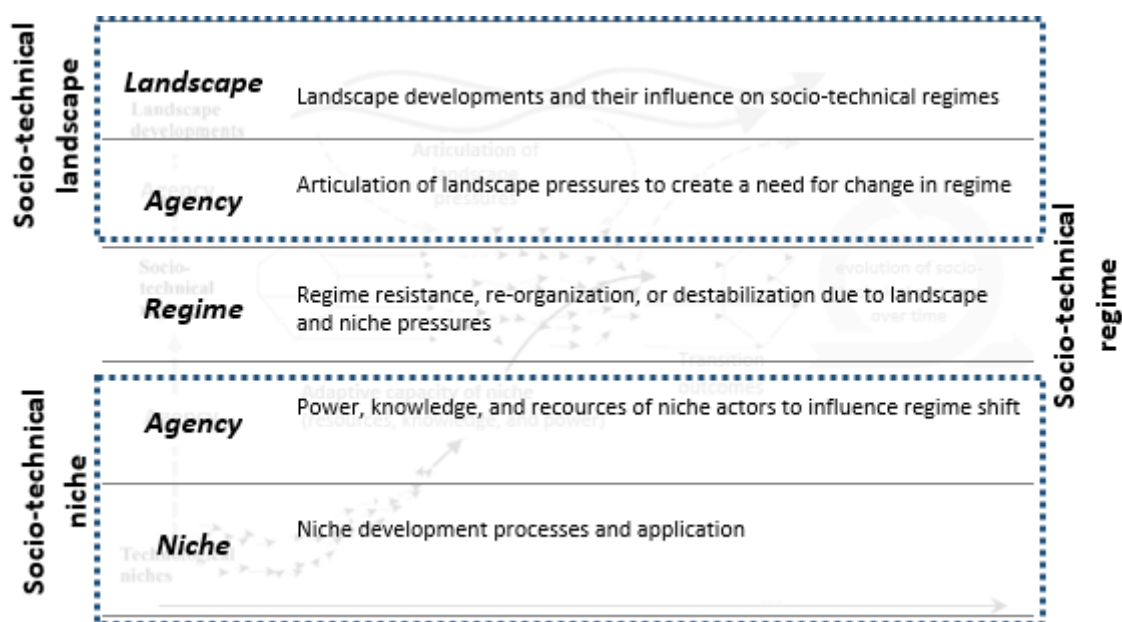


Figure 4.7: Proposed framework for analysing the mechanisms and agency in transitions (Adapted from Geels 2002)

Table 4.1: Analytical framework for assessing the dynamics of green urban transitions

Analytical levels	Proposed areas of enquiry
Landscape	<ul style="list-style-type: none"> • What landscape factors are prevalent in a given urban context? • What are the (potential) impacts of these landscape factors on existing socio-technical regimes (e.g. infrastructure, social norms, lifestyle, and institutions etc.) • How do landscape initiated transitions unfold in cities?
Agency	<ul style="list-style-type: none"> • How do social actors interpret and act upon these landscape d factors? • How can landscape factors be stimulated to generate the needed momentum for change?
Regime	<ul style="list-style-type: none"> • How do existing socio-technical regimes support or undermine the principles of Green Urbanism? • What factors underpin the stability of entrenched regimes? • How do actors at the regime level contribute to regime stability? • How does regime stability contribute to (or explain) persistent or wicked problems in cities? • How do existing regimes respond to landscape pressure and niche-innovations? And how do social actors modulate these responses? • What should be good indicators of regime destabilization?
Agency	<ul style="list-style-type: none"> • Who are the main actors at the niche level, and what are their interests, challenges, and opportunities? • How may actors at the niche level mobilize resources and exercise power to influence regime shift? • What is the capacity of these actors to influence policy and the market to facilitate the emergence of niche innovation?
Niche	<ul style="list-style-type: none"> • What processes are appropriate for niche development in a given social context? • How do niche-innovations support or defy the principles of Green Urbanism? • How is successful emergence of niche-innovation possible? • How may the technical, social, environmental, and economic aspects of niche-innovations be articulated to promote their socially shared legitimacy?

4.3.2 What are the potential pathways for green urban transitions, and what factors may influence these outcomes?

In addition to understanding the drivers and/or barriers to green urban transitions, it is also important to understand the potential direction and/or outcomes of these transitions, the factors that may underlie these outcomes, and how these factors might be influenced into desired trajectories. Geels and Schot (2007), propose four typologies of transition pathways i.e.: transformation, reconfiguration, de-alignment and re-alignment, and technological substitution. They define transformation path as the re-organization of a regime (without changing its basic architecture) due to moderate landscape pressure at a time when niche-innovations are still nascent. Reconfiguration path unfolds when the influence of landscape pressure on a regime leads to the adoption of 'symbiotic innovations'. De-alignment and re-alignment result from the destabilization of a regime by disruptive landscape pressure (de-alignment), and the experimentation of multiple niche-innovations in the absence of a dominant niche. Over time, one niche-innovation dominates and becomes mainstream (re-alignment). Finally, technological substitution describes a scenario where matured niche-developments replace incumbent regimes when landscape pressure on the latter is disruptive. A potential fifth scenario is a combination of these typologies which can result in 'a sequence of transition pathways' (Schot & Geels 2008, p. 413).

Building on these typologies, Schot and Geels (2008), identify two major factors that may underlie transition pathways i.e.: (1) the timing of multi-level interaction between regime, landscape development, and niche-innovation; and (2) the nature of interaction between these conceptual levels. They argue that 'if landscape pressure occurs at a time when niche-innovations are...[immature], the transition path will be different than when they are fully developed' (Geels & Schot 2007, p. 405). Besides, the nature of interaction (disruptive, moderate, or reinforcing) between landscape development/niche-innovations and regimes may engender different transition outcomes (Schot & Geels 2008). For example, landscape changes that disrupt regimes and/or niche-innovations that compete with the latter may result in a transition trajectory that is different from landscape changes and/or niche-innovations that reinforce or complement incumbent regimes. Hence, the dynamics between the three analytical concepts may lead to multiple transition possibilities (see figure 4.9).

Table 4.2: Typologies of transition pathways

Transition pathways	State of landscape development	State of niche-innovation	Impact on regime
Transformation	Moderate but disruptive landscape pressure	Immature niche-innovation	Reorganization of regime without fundamental change in its basic configuration.
Reconfiguration	Avalanche/disruptive landscape pressure	Symbiotic niche-innovation	Re-orientation of regime with significant changes in its basic architecture over time.
De-alignment & Re-alignment	Avalanche/disruptive landscape pressure	Competing but multiple niche-innovations	Destabilization of regime
	Avalanche/disruptive landscape pressure	Emergence of a dominant niche-innovation	Displacement of regime by a dominant niche-innovation
Technological substitution	Avalanche/disruptive landscape pressure	Matured niche-innovation	Destabilization and replacement of regime

Developed from Geels and Schot (2007)

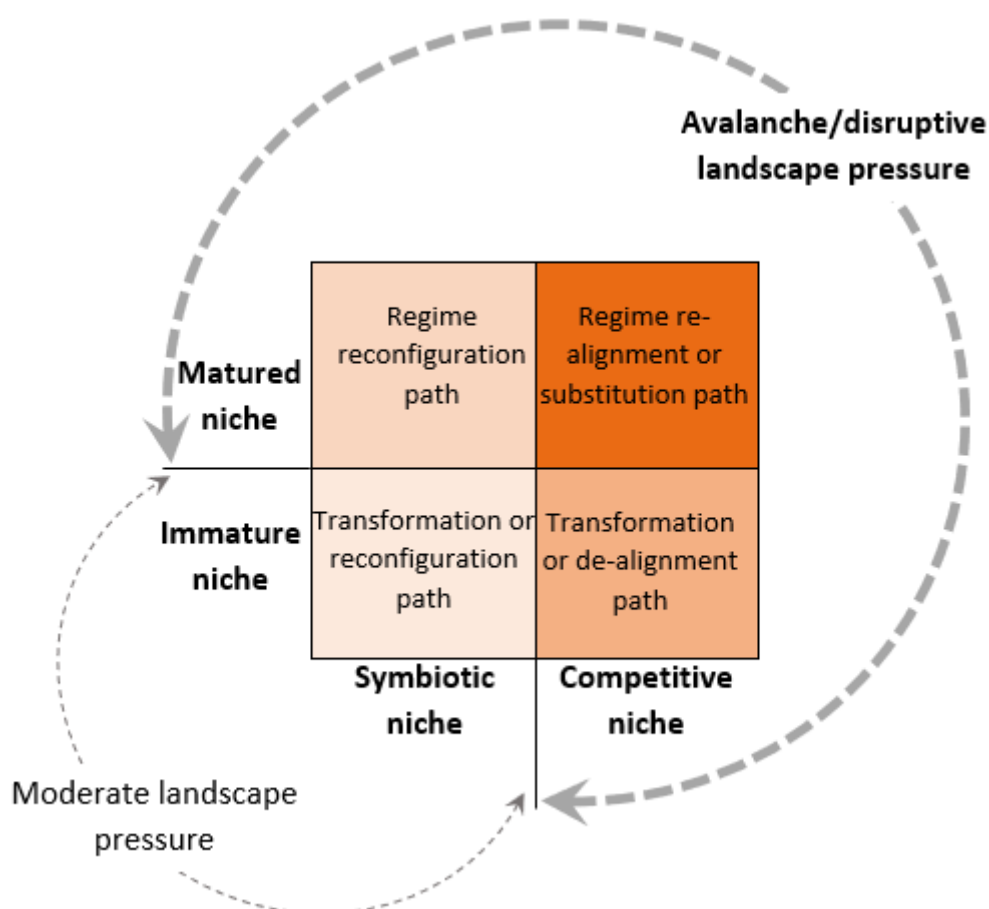


Figure 4.8: Transition pathways and underlying drivers (Developed from Schot and Geels 2008)

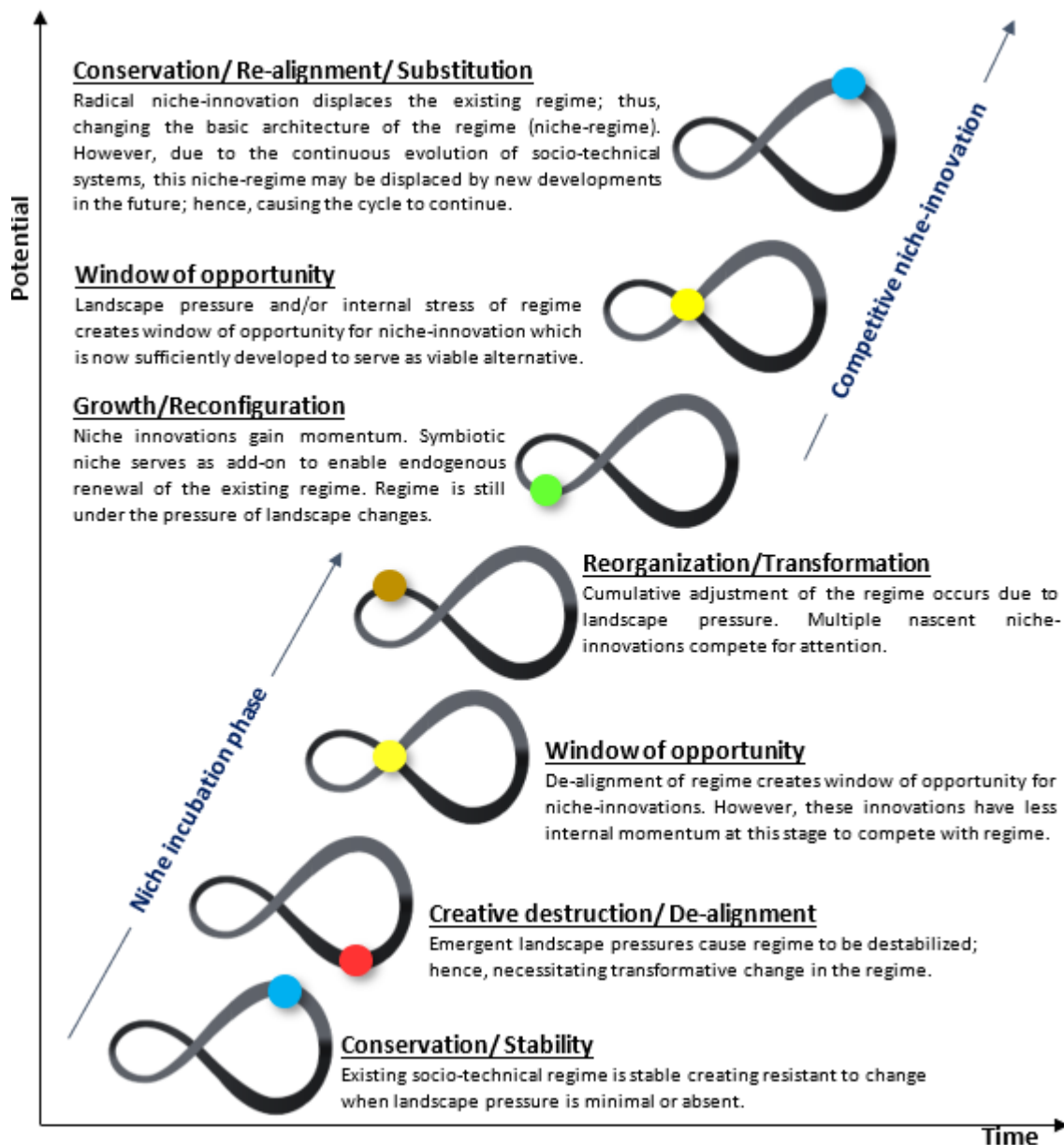


Figure 4.9: Potential phases of socio-technical transitions based on the dynamics between landscape, regime, and niche (Adapted from Gunderson 2001)

An understanding of the potential transition pathways discussed above, and their underlying drivers can help to inform public policies on appropriate strategies cities can adopt to reframe their developmental trajectories. Firstly, they can help to identify which pathways are feasible or necessary to achieve set goals within a given transition context. For example, policies that aim to reduce transport emissions may aim for a reconfiguration pathway by promoting green fuel technologies that could be used by existing vehicles to reduce dependence on fossil fuel. Moreover, a substitution pathway may be necessary for policies that aim to promote a shift from, for example, non-renewable energy (e.g. coal, nuclear power, and fossil fuel) to

renewable energies. Secondly, an understanding of the drivers of these pathways can help to identify potential sources of leverage for policy intervention. Typical leverage points could be promoting awareness about landscape changes to create a sense of urgency for change, and/or promoting policies that would enhance the mainstream application of niche. Essentially, the identification of leverage point is dependent on prevalent conditions in the local context.

4.4 Application of the MLP to the current study

Drawing on the analysis above, the MLP is applied in the current study to achieve three main objectives. Firstly, to help enhance understanding of the drivers, opportunities, and barriers to green urban transitions, and how social actors exercise agency in these processes. Secondly, to understand the outcomes (pathways) of transitions in different context, and what factors influence these outcomes. Finally, to examine how the MLP can help identify potential levers (triggers) of transitions towards Green Urbanism. The MLP is applied in Chapters 8 and 9 of this thesis to analyse the empirical cases discussed in this study. In Chapter 8, it is applied *a posteriori* to examine the processes of green urban transitions in existing cities that claim to be green. As explained in Chapter 3, the cases of Freiburg and Curitiba will be analysed in this regard. The analysis will highlight: (1) the key drivers of transitions in these cities; (2) factors that presented opportunities or barriers to the transition processes; (3) the role of government, civil society, private sector, and other relevant actors in the transition process; and (4) the outcomes of these transitions, and how these outcomes differ in time and space.

In Chapter 9, the MLP is applied *a priori* to examine the potential opportunities and barriers to green urban transitions in a city that aims to be green. The case of Accra (Ghana) will be analysed. This analysis will highlight how existing practices, institutions, governance systems, and technical structures etc. support or undermine the principles of Green Urbanism discussed in Chapter 2. Also, it will seek to identify potential sources of leverage for a transition towards Green Urbanism in Accra. Lessons from these empirical analyses will help to further operationalize the MLP, and verify its core assumptions.

4.5 Conclusion

This Chapter has elaborated on the theoretical framework underpinning the current study. It has shown that despite inherent shortcomings, the Multi-level Perspective presents a comprehensive approach to examining the wider environment that influence socio-technical transition processes. Drawing on insights from other theoretical constructs, a number of recommendations have been made to enhance the operational application of the MLP. Critical among these suggestions is the need for an explicit treatment of agency in the MLP framework. Clarification of agency in the MLP is particularly important because of the mediating role social actors play in the interactions between the various analytical concepts (landscape, regime, and niche) of the MLP. Building on this understanding, this Chapter proposes an analytical framework to aid a systematic analysis of the dynamics of green urban transitions, and how the latter might be influenced into desired trajectories. The framework is applied in subsequent Chapters (8 and 9) to highlight factors that present opportunities and/or challenges to cities in their effort to transition towards Green Urbanism; and how conditions in the local context influence transition processes.

Context of application case study-Accra

5.1 Introduction

This chapter provides the background information and context of the application case study of this research. It begins with a brief profile of Ghana (in Section 5.2) in terms of its geographical location, climatic conditions, demographic composition, economy, and political administration. This narrative is followed by a discussion on the selection of the study area (i.e. Accra) for the current research in Section 5.3. A profile of Accra (i.e. physical features, demography, education, economy, and governance) is then provided in Section 5.4. In Section 5.5, an overview of the historical development of Accra is presented. Following this historical analysis, key drivers of urban change in Accra are identified and discussed in Section 5.6. Section 5.7 highlights some key policies that have been introduced to modulate development trends in Accra. The potentials and weaknesses of these policies are discussed. The chapter ends (in Section 5.8) with some important observations that require further investigation.

5.2 Profile of Ghana

Previously known as the Gold Coast, the Republic of Ghana is a former British colony located in the west coast of Africa along the Gulf of Guinea and the Atlantic Ocean (see figure 5.1). It is situated above the equator in the northern hemisphere between longitude 1.20 E and 3.25 W and latitude 4.50 N and 11.18 N. Ghana spans a land mass of 238,535 km² with diverse ecological features ranging from the Sudan and Guinea Savannah in the northern regions to the Forest Savannah Transition, Semi-deciduous Rainforest, High Rainforest zone, and the Coastal Savannah. The climate is tropical and humid with two dominant seasons (i.e. rain and dry seasons). The rainiest (2100mm average annual rainfall) and driest (1100mm average precipitation per year) areas are in the southern and northern regions respectively (Logah et al. 2013). Average daily temperature ranges between 25°C (77°F) and 35°C (95°F).



Figure 5.1: Location of Ghana in global context (modified by author)

In the last two decades, Ghana's economy has transitioned from Heavily Indebted Poor Country (HIPC) to a Lower Middle-Income status. The economic base is underpinned by the extraction of natural resources (e.g. oil, gold, bauxite, and manganese etc.), the service sector, and the agricultural sector which employs 41.5 percent of the population (Ghana Statistical Service 2010). Presently, Ghana has an estimated population of 29 million people which ranks 13th in Africa and 48th in the world. It is predominantly a multi-ethnic, multi-religious, and multi-linguistic society. Hence, no region in the country is entirely homogeneous. Although English is the official language of Ghana, there are about 10 government sponsored local dialects which are taught in basic schools (e.g. Akan, Dagaare, Ga, Dagbane, Ewe, Dangbe, Nzema, Kasem, Gonja, and Nzema); and more than 30 non-government sponsored dialects spoken by different ethnic groups. This diversity in ethnic composition and dialects underpins the country's rich cultural heterogeneity. Nonetheless, ethnic diversity has also been a key driver of political polarization in the country.

Administratively, Ghana is divided into 10 regions (i.e. Ashanti, Greater Accra, Northern, Volta, Western, Eastern, Brong Ahafo, Upper East, Upper West, and Central Region) which are further divided into metropolitan, municipal, and district assemblies. Altogether, there are 6 Metropolitan Assemblies (> 250,000 inhabitants), 49 Municipal Assemblies (250,000 < x > 95,000 inhabitants), and 161 District Assemblies (95,000 < x > 75,000 inhabitants) across the country. One of the primary goals for the creation of these administrative units is to enable the decentralization of governance processes in the country (Antwi-Boasiako 2010). However, there is still room for improvement in Ghana's decentralization program since most government activities are still concentrated at the center (Nyendu 2012).

Like most developing countries, Ghana has experienced rapid urbanization in the last few decades. With only 15.44 percent of urban population in the 1950s, Ghana is now about 51 percent urbanized (Cobbinah & Erdiaw-Kwasie 2016). This growth pattern is uneven across the ten regions. As shown in figure 5.2, the most urbanizing regions are concentrated in southern Ghana with major cities such as Accra (Greater Accra Region), Kumasi (Ashanti Region), and Sekondi-Takoradi (Western Region) accounting for the greatest share of this urban population growth. According to the World Bank, urbanization in Ghana has contributed substantially to the country's structural transformation and socio-economic development. For example, between 1984 and 2013, tremendous growth in urban population

in Ghana (about three and half times) led to an average of 5.7 percent growth in annual Gross Domestic Product (GDP), and a significant expansion of the service sector (World Bank 2014). Nevertheless, this growth pattern has also engendered suburban sprawl, the proliferation of informal settlements, congestion, over-stretched infrastructure, and environmental pollution etc. in major cities across the country (Aryeetey & Kanbur 2017).

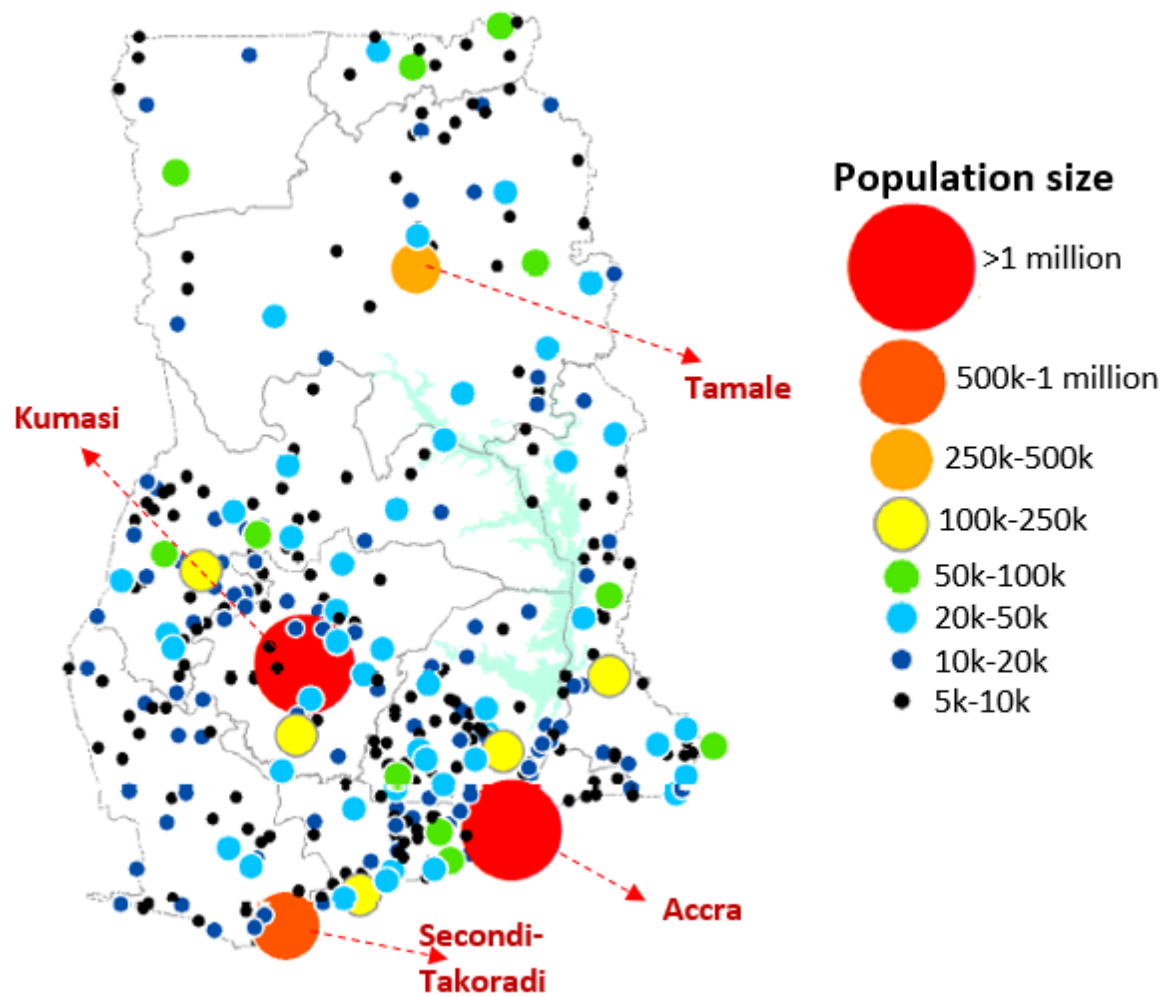


Figure 5.2: Urban settlement distribution in Ghana (Source: Adapted from Ghana National Spatial Development Framework 2015-2035)

5.3 Selection of study Area

The current study focuses on the Accra Metropolitan Area (in the Greater Accra Region) which forms the core of the governmental and commercial capital of Ghana. The Accra Metropolis serves as the administrative hub for the three arms of government i.e.: Executive, Legislature, and Judiciary. Accra was chosen as the study area for this research because of the following factors i.e.: (1) the city’s political and economic significance in Ghana and Africa in general;

(2) it is the largest cosmopolitan area in Ghana, and one of the fastest growing cities in Africa; (3) it has been a testing ground for various sustainability initiatives; and (4) the researcher’s working knowledge of the city.

Accra has received several recognitions at both the local and international levels in recent years. To mention but a few, Accra was ranked highest among 74 African cities for holding the ‘greatest promise of inclusive growth and a better material life for its population’ in the 2014 MasterCard African Cities Growth Index (Hendrick-Wong & Angelopulo 2014, p. 17). It was also named by the Rockefeller Foundation in 2014 as one of 35 global cities (out of 350 applications) that met the requirements to join the network of 100 Resilient Cities in the world. At the local level, Accra was earmarked for an urban regeneration program in the early 2000s, under the Ministry of Tourism and Modernization of the Capital City, to make it a model for urban sustainability in Ghana. In addition, it is the first and only city in Ghana where a bus rapid transit (BRT) system is being piloted. Other initiatives in waste management, housing, energy, and climate mitigation and adaptation etc. are also underway to direct the development of Accra towards greater sustainability (GOG 2012). Against the backdrop of these initiatives, the current study aims to interrogate how a transition towards Green Urbanism might be achieved in Accra.

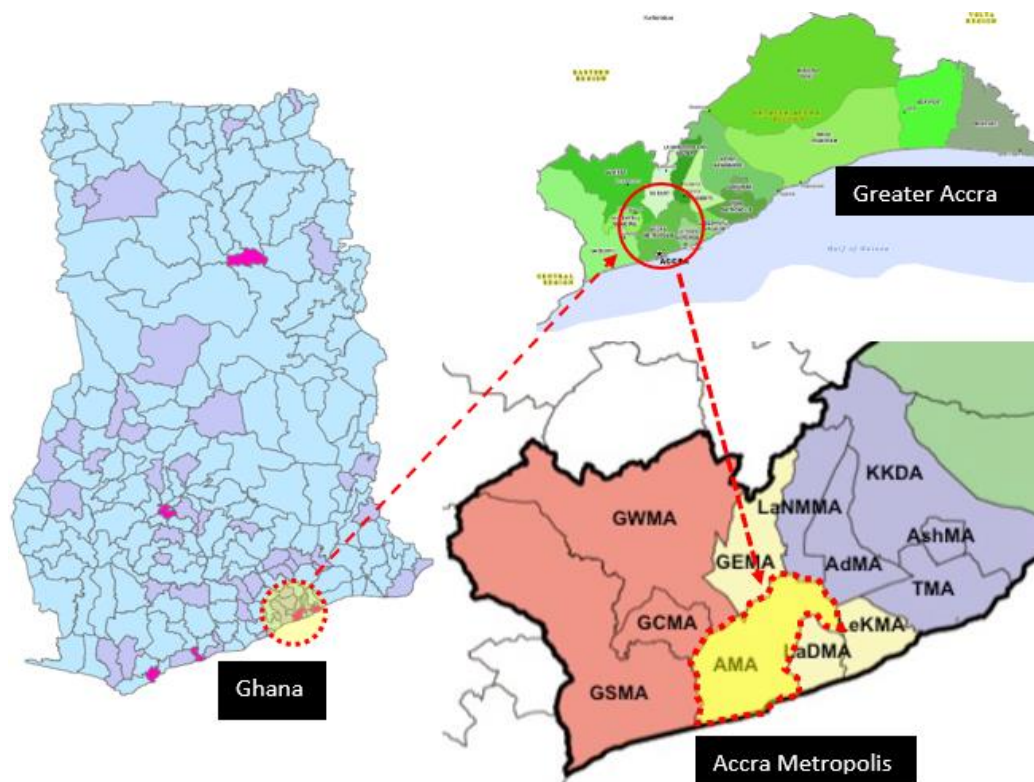


Figure 5.3: Geographical location of Accra Metropolitan Area (Modified by author)

5.4 Profile of Accra Metropolitan Area

5.4.1 Physical features

The Accra Metropolis serves as both the national capital of Ghana, as well as the capital of the Greater Accra Region. It consists of 10 Sub-metropolitan District Councils (figure 5.4) which are made up of 72 communities (figure 5.5) and 76 Electoral Area. The Accra Metropolitan Area covers a total land area of about 144.0207 Km². It has a tropical savanna climate with an annual average temperature of 27°C. Relative humidity varies from 65 percent at midday to 95 percent at night. Accra has one of the lowest average annual rainfall in Ghana (about 730mm). However, in the last decades, the metropolitan area has experienced perennial flooding and coastal erosions etc. which are largely attributed to poor planning and climate change impacts (Douglas et al. 2008; Larbi 1996; Owusu & Kofi Teye 2015).



Figure 5.4: Sub-metropolitan areas in Accra (Source: Accra Metropolitan Assembly)

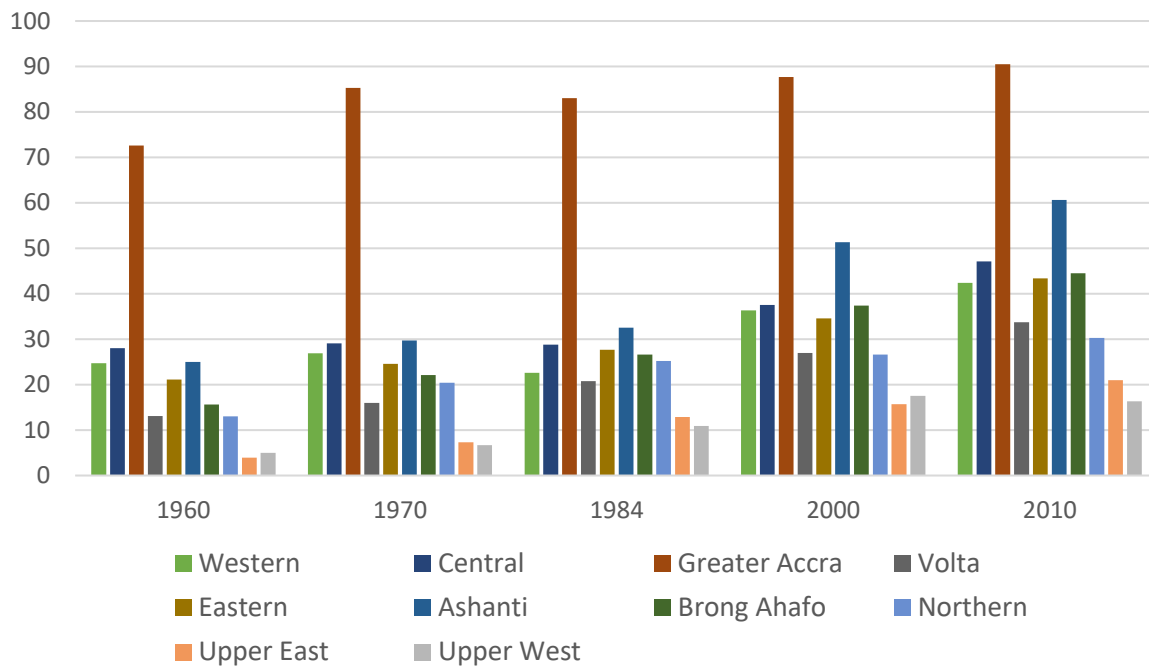


Figure 5.6: Urbanization trends in the 10 Regions of Ghana (Developed from National data- Ghana Statistical Service 2010)

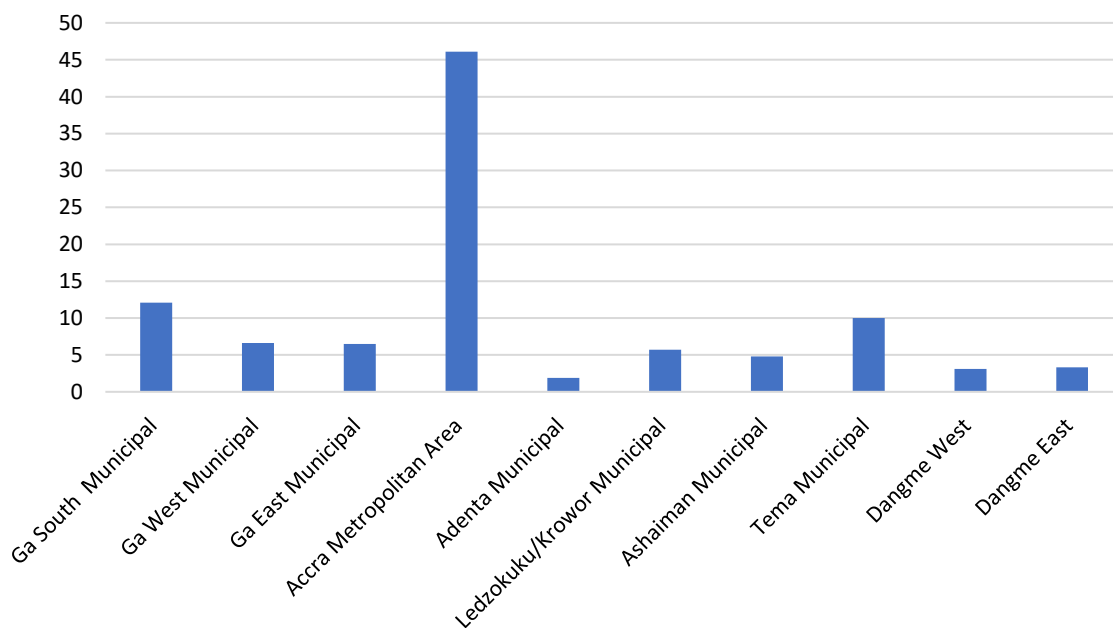


Figure 5.7: Population by District in Greater Accra (Developed from National data- Ghana Statistical Service 2010)

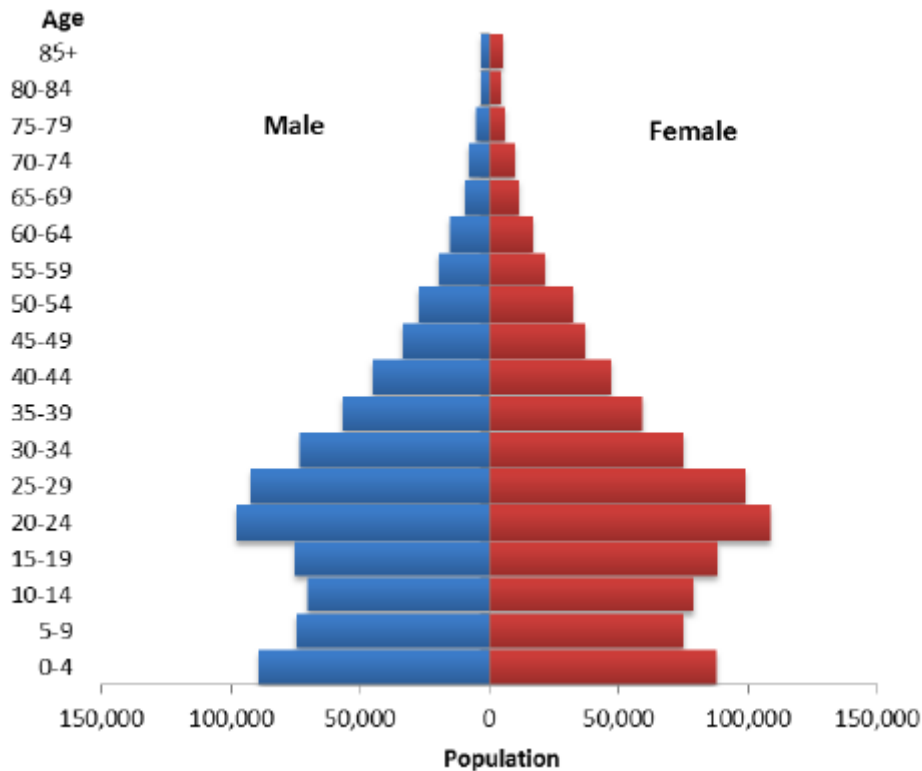


Figure 5.8: Population structure in the Accra Metropolitan Area (Ghana Statistical Service 2010)

5.4.3 Education and literacy

Education in Ghana is classified into three main stages i.e.: basic (11 years), secondary (3 years), and tertiary (2-6 years) education. Through the introduction of a Free Compulsory Universal Basic Education (FCUBE) program in 1996, education at the basic level is free for all Ghanaians. The incumbent government has also launched a Free High School Education Program since September 2017. It is expected that these initiatives will make formal education accessible to all Ghanaians, enhance literacy levels, and develop the human resource base of the country. Between 2000 and 2015, for example, adult literacy rate increased from 57.9 percent to 76.6 percent with majority of the people being literate in both English and a Ghanaian Language (GSS 2010). A Regional distribution of literacy levels across the country shows higher adult literacy rates in southern Ghana than the Northern Regions (figure 5.13). The Greater Accra Region has the highest adult literacy rate among the 10 Regions in Ghana, with the Accra Metropolitan area recording 89 percent of adult literacy.

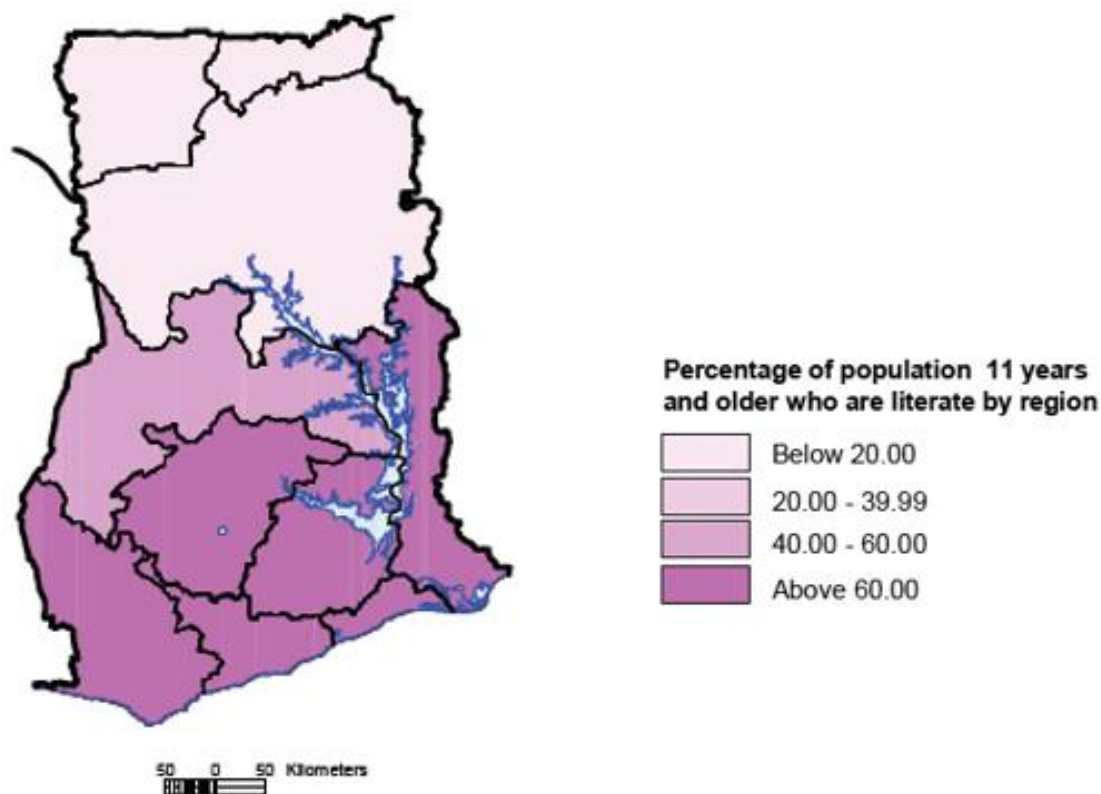


Figure 5.9: Literacy rate by Region in Ghana (Ghana Statistical Service 2010)

5.4.4 Economy

The Ghanaian economy has seen a steady move from the agriculture sector to the service sector in the last three decades. For example, the contribution of the agriculture sector to GDP dropped from 41.4 percent (in 1993) to 22 percent (in 2013), compared with the service sector which saw a significant increase from 30.8 percent to 49.4 percent within the same time frame (Aryeetey & Baah-Boateng 2015). This shift in GDP distribution across sectors at the national level reflects economic trends in Accra and other metropolitan and municipal areas in Ghana. According to Ghana Statistical Service’s most recent population census (2010), only 1.7 percent of the economically active population in the Accra Metropolis were employed in the agriculture sector (figure 5.10). The service sector is the main source of employment, and it is largely driven by the informal sector. There is less gender disparity in the employment rates of active population in Accra. However, to some degree, there are differences in the types of occupation common to both genders. Traditionally, women are discouraged from engaging in economic activities that are labour intensive or perceived to be risky such as driving, construction, and labour-intensive industrial jobs among others (Overå 2007).

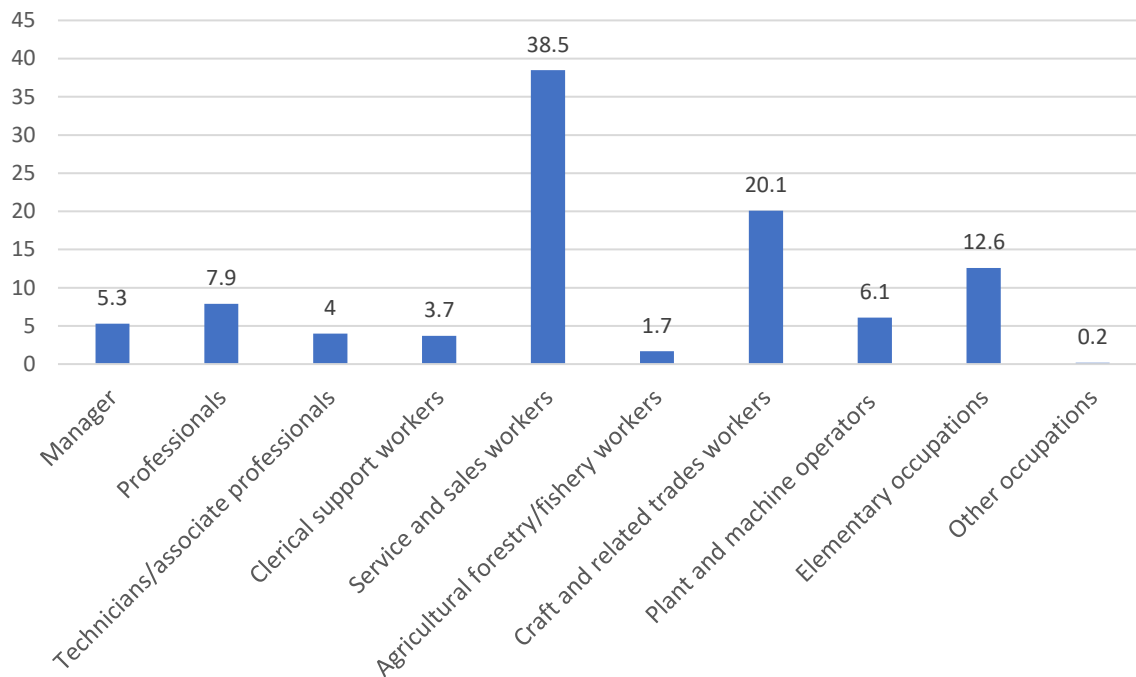


Figure 5.10: Employment by occupation in Accra (Developed from national data - Ghana Statistical Service 2010)

Generally, there has been a strong growth performance in Ghana’s economy over the last two decades (Adjasi & Osei 2007). The sixth *Ghana Living Standard Survey* shows that Ghana has experienced a stable growth of about 7 percent per annum on average since the early 2000s (GLSS6 2014). This growth pattern has helped the country to transition from a Lower-income status to a Middle-income economy status. Consequently, Ghana has reduced its national poverty rate from 56.5 percent to 24.2 percent between 1992 and 2013 (Cooke et al. 2016). However, reduction in poverty has been disproportionate across the country. Urban poverty has reduced at a much faster rate than rural poverty (37.9% vis-à-vis 10.6%); thus, widening the inequality gap between urban and rural dwellers (Cooke et al. 2016). At the regional level, the rate of poverty reduction is largely accounted for by Accra, with some regions (especially in Northern Ghana) experiencing steady rise in poverty levels (McKay et al. 2015). Thus, regional inequality and rural-urban inequality remain a major challenge to Ghana’s progress in poverty reduction.

5.4.5 Governance

The Accra Metropolitan Area is run under the political and administrative authority of the Accra Metropolitan Assembly (AMA). The Assembly administers development programs,

policies, regulations, and services etc. within the metropolis. It is the first of the six metropolitan areas founded in Ghana. Under the British colonial rule, the AMA was established as a Town Council represented by chiefs from various traditional societies. Before the arrival of the British, the chiefs served as the administrative heads of their people. They were largely responsible for adjudicating disputes, facilitating local developments, and enforcing customary laws etc. (Abotchie 2006). Thus, the British rulers engaged these traditional authorities through various legislative and institutional arrangements to achieve their goal of indirect rule in the Gold Coast. However, for political expediency, the role of chieftaincy was brought under the auspices of local governments through the Local Government Ordinance of 1951, and the Chieftaincy Act of 1961 after independence from colonial rule (Mahama 2009).

The Town Council established by the British was eventually dissolved and re-established as the Accra City Council in 1961, the Accra Tema City Council in 1964, and eventually elevated to a metropolitan district status in 1989 under PNDC Law 207 (AMA 2017). These changes came with a revision of the administrative system and jurisdictional boundaries of Accra. Presently, the AMA is headed by a Metro Chief Executive (Mayor) who is appointed by the President of the Republic of Ghana, and approved by the general assembly of the AMA. The latter (i.e. general assembly) is composed of elected representatives from the 76 Electoral Areas in the Accra Metropolis and government appointees. As shown in figure 5.11, the AMA has 16 Departments (with different heads) who report to the Metropolitan Coordinating Director (MCD), and ultimately to the Mayor.

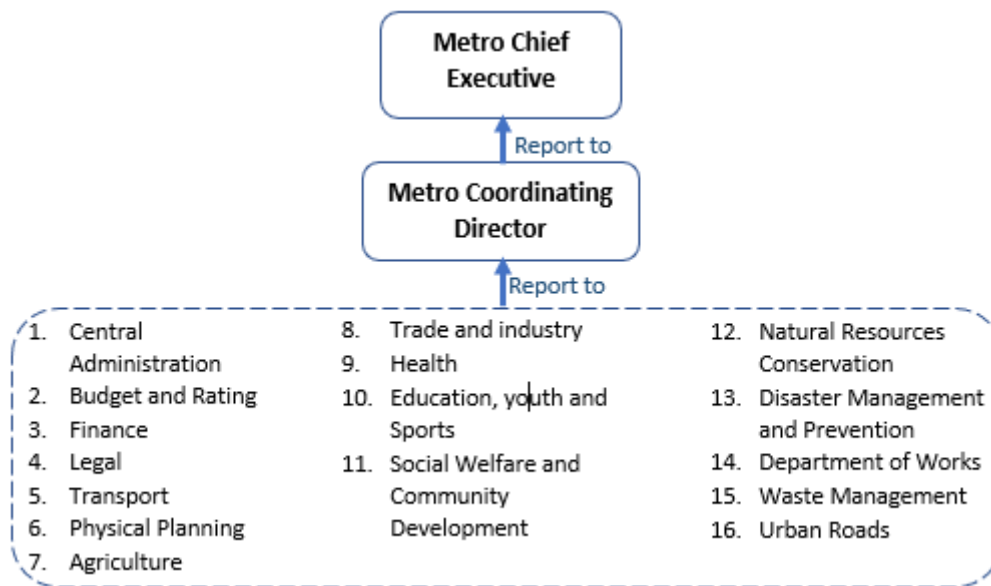


Figure 5.11: Organizational Structure of AMA (Developed from AMA 2017)

Notwithstanding the reformation of the local government system in Ghana since independence, traditional chieftaincies still play an important role in contemporary politics in Ghana. At the national level, the Ministry of Chieftaincy and Traditional Affairs was established in 1993 (under the 1992 Constitution) to create an enabling condition for effective interface between government and traditional institutions. Besides, the President of the National House of Chiefs is customarily appointed as a member of the Council of State which serves as the highest advisory board to the President.

At the Regional level, two representatives of the Regional House of Chiefs are appointed to the Regional Co-ordinating Councils (RCC). The RCC was established under the Local Government Act, 1993 (Act 462) to, among others, effect institutional coordination and harmonize development policies at the national and regional levels. The Council also exercises oversight responsibilities over the performance of local government institutions in the regions. Metropolitan and District Assemblies also have about 30 percent of their appointed council members from traditional (chieftaincy) institutions. In fact, traditional leaders (i.e. chiefs and family heads) are still the custodians of a significant percentage (about 80 percent) of land in Ghana (Kasanga 2001). They exercise significant influence over land tenure practices, land-use changes, and urban growth patterns which makes their role as agents of development paramount (Mahama 2009). However, the extent and limits of their authority

in the local government system has yet to be sufficiently clarified; hence, creating conflicts between traditional institutions and modern state structures (Asamoah 2012; Ubink 2016).

5.5 Historical overview of planning and development trends in Accra

Much of Africa's spatial development has been influenced by colonialization which was formalized during the Berlin Conference of 1884-1885. Major outcomes of this development include the delineation of national borders with little or no recourse to ethnic, religious, and linguistic disparities, as well as the imposition of colonial spatial policies on Africa (Njoh 2009; Silva 2015). In Ghana, for example, urban planning was an instrument of power the British used to exercise control. It was also used to restructure existing settlements to promote trade, and protect the safety and wellbeing of their citizens in the country (Grant & Yankson 2003). The legacies of the British planning and administrative systems in Ghana still form the basis of most government regulatory and institutional arrangements. For instance, Ghana's Town and Country Planning Ordinance is underpinned by the British Town and Country Planning Act 1932. This Act provides guidelines for the development of cities, towns, and villages across the country (Njoh 2007).

5.5.1 Accra under colonial rule

The name Accra is a coinage of European settlers in Ghana during the colonial period. It was formally spelt *Akra*, coined from the local word *Nkran* (i.e. ants) which referred to the numerous anthills in this part of the country. During the pre-colonial period, Accra was largely unplanned and little more than a cluster of trade and fishing villages. By 1874, the Gold Coast (now known as Ghana) was declared a British colony leading to the establishment of the British administrative capital in Cape Coast in the southern region of the country. Three years later (i.e. 1877), the administrative capital was moved from Cape Coast to Accra. According to Grant, R and Yankson (2003), this decision was largely influenced by 'health-related issues' rather than 'pre-existing economic advantages' which mostly determined the selection of capital cities in most European colonies.

The emergence of Accra as the administrative headquarters of the Gold Coast brought about significant improvements in economic activities and population growth in the city. The British

imposed a racially segregated planning scheme which ensured the separation of native towns from European towns. Unlike the European neighbourhoods which were laid out in a regular grid pattern, native communities were largely left unplanned (Grant & Yankson 2003). Traces of the co-existence of these planned and unplanned neighbourhoods can still be observed in some parts of present-day Accra. Notwithstanding, the British introduced a system of formal planning in Ghana through the British Town and Country Planning Act. The first master plan for Accra was developed in 1944 by Maxwell Fry with subsequent revision by BDW Treavallion and Alan Flood in 1958. The plan proposed a grid iron pattern with broad open spaces, public squares, nature reserves, and recreational preserves etc. However, the plan never became statutory (Travallion & Hood 1968). One of the key reasons for the latter is Ghana's independence from British rule.

5.5.2 Accra in post-independence era

The destabilization of most European countries after the Second World War gave way to Africa's decolonization in the mid-1900s. On March 6, 1957, Ghana (then known as the Gold Coast) emerged as the first Sub-Saharan African country to benefit from this wave of freedom and self-governance. The transfer of power from colonial rulers to native Ghanaians had far-reaching implications for the political, social, economic, and physical development of Accra and Ghana in general. This development brought an end to racial residential segregation in Accra. However, income levels and connection with political elites became major determinants of where one could live (Grant & Yankson 2003; Njoh 2009).

Unlike the Fry and Treavallion plan that sought to create a grand and hierarchically ordered urban setting, Kwame Nkrumah (first Prime Minister of Ghana) espoused a new plan for Accra that aimed to inspire national and African pride (Hess 2000). Thus, he invested in the construction of public edifices that were emblematic of nationalism and Pan Africanism. For instance, the construction of the State House, Independence Square, and the Organisation of African Unity building, among others, only accentuated Nkrumah's commitment to promoting a sense of national and African identity. However, Nkrumah's aspirations gave no order to Accra. Hence, much of the growth of Accra in the mid-1900s (figure 5.12) unfolded with little planning (Grant & Yankson 2003).

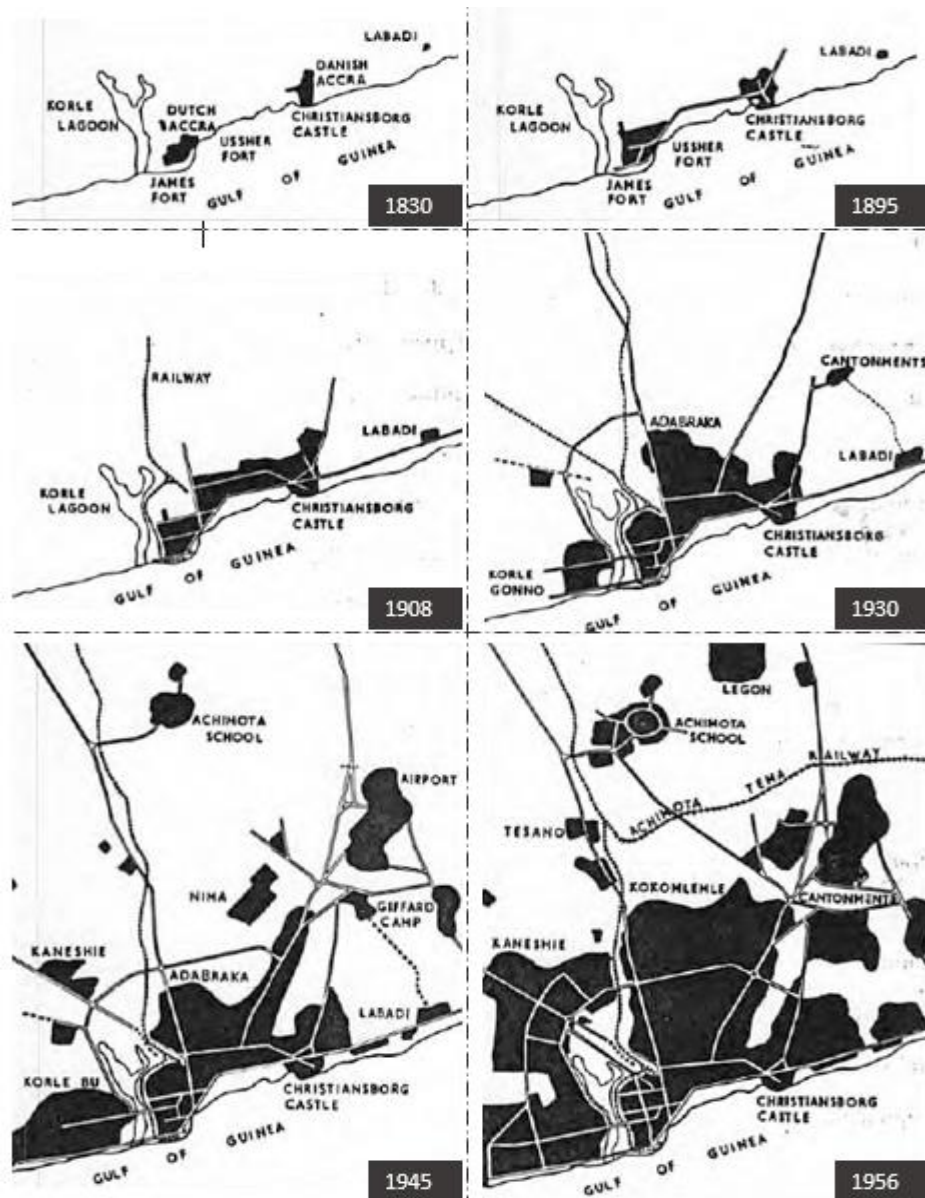


Figure 5.12: Growth of Accra from mid-1800s to 1900s (Travillion & Hood 1968)

Nkrumah's government embarked on a radical socialist ideological vision that advocated for economic self-sufficiency and the 'Ghanaianization' of most local industries. Therefore, public services such as housing development, transportation, education, waste management, water, and electricity supply etc. were (for the most part) delivered by state enterprises. Foreign involvement in most sectors of the economy was limited (Grant 1999). Through the expansion of State-Owned Enterprises (SOEs), the contribution of the public sector to total formal employment, for example, increased from 55.3 percent in the 1960s to 70.2 percent by 1965 (Boateng 1997).

Nevertheless, the consequences of corruption and poor management caused most of these SOEs to go down the drain. Coupled with this development was a series of coup d'état that ousted Nkrumah's regime in 1966. Hence, a political vacuum was created leading to political instability in Ghana until the late 1970s. By the early 1980s, Ghana's economy was in serious crises. The government had no option than to accept the International Monetary Fund (IMF) and World Bank's Structural Adjustment Programs (SAP) which involved major liberalization and deregulation of the State's economy. The SAP did not only transform the Ghanaian economy, but also affected the spatial growth of major cities in Ghana, especially, Accra which was the epicenter of the country's economic reformation.

5.6 The Structural Adjustment Program (SAP) in Ghana: implications for development trends in Accra

5.6.1 Background

A Structural Adjustment Program is a set of economic policies proposed by the IMF and the World Bank to improve the economies of less developed countries (LDC), and reduce relative poverty. It involves the supply of loans to LDCs by the two Bretton Woods with conditionality clauses such as the liberalization of market, privatization of state-owned enterprises, wage cuts, promotion of business-friendly environment for foreign investors, and good governance among others (Kraus 1991; Schydrowsky 1995). The SAP was launched in Ghana in 1983 following a protracted economic crisis in the late 1960s to 1980s (Konadu-Agyemang 2000).

The thrust of this initiative was to minimise the government's intervention in the economy (especially state ownership of the means of production and the centralization of capital) which was regarded by its proponents as inimical to economic growth (Konadu-Agyemang 2000). Hence, several SOEs in the transport, communication, housing, insurance, and manufacturing sectors etc. were divested under the program. Appiah-Kubi (2001), finds that this privatization exercise generated revenues of about 14 percent of GDP for the government between 1987 and 1999. Gross national investment also increased from 3.7 percent in the early 1980s to 16 percent by the 1990s (Hutchful 2002). In addition, the liberalization policies that ensued from the SAP lifted restrictions on imports, encouraged foreign direct investments (FDIs), and facilitated the emergence of the foreign exchange market in Ghana

etc. These policies had significant implications for the growth of Accra as more businesses (both local and foreign) settled in the city, and more people migrated to Accra for jobs.

5.6.2 Implications of SAP for Accra's growth and development

The SAP did not only revolutionize Ghana's economy but also stimulated significant transformation of key sectors in the country. Central to this transformation process was the emergence of new agents of development (i.e. the private sector). Through the liberalization policies of the 1980s, the private sector gained greater influence over economic outcomes in Ghana, and they became more directly involved in different spheres of the economy. Their active engagement in housing, transport, waste management, communication, health, education, and the foreign exchange market etc. have been fundamental to Accra's rapid economic, demographic, and spatial growth since the late 1980s (Grant & Yankson 2003).

The liberalization of the housing sector, for example, increased private participation in the housing market which was dominated by SOEs (e.g. State Housing Corporation, Ghana National Housing Corporation, and the Tema Development Corporation). This policy and subsequent housing reforms encouraged the growth of real estate companies in major cities like Accra and Kumasi which were undergoing tremendous population growth (Arku 2009). A combination of high demand for housing and speculative development gave rise to rapid expansion of peri-urban Accra (Yeboah 2000).

Grant, R and Yankson (2003), also observe that the legitimization of foreign currency transaction (as part of the economic reform program) enabled Ghanaians abroad to send monies back home; much of which went into housing development. In fact, residential developments by individuals in Ghana and overseas is identified as the major driver of Accra's spatial growth (Yeboah 2000). As illustrated in figure 5.13, much of this growth occurred after the introduction of the SAP; and they were mostly market-driven without proper planning. This unplanned and/or uncontrolled growth of Accra is also underpinned by entrenched informal land tenure practices. The latter involves a situation whereby traditional leaders (i.e. chiefs) lease out land to individuals/developers even when the land is not approved and/or properly planned by the appropriate government institutions (Yeboah & Shaw 2013). A corollary of this development is poor configuration of the urban space, and inadequate supply

of urban infrastructure and social amenities (e.g. green spaces, portable water, sewage systems, and proper road networks etc.) in most communities in Accra (Amoako & Frimpong Boamah 2015; Larbi 1996).

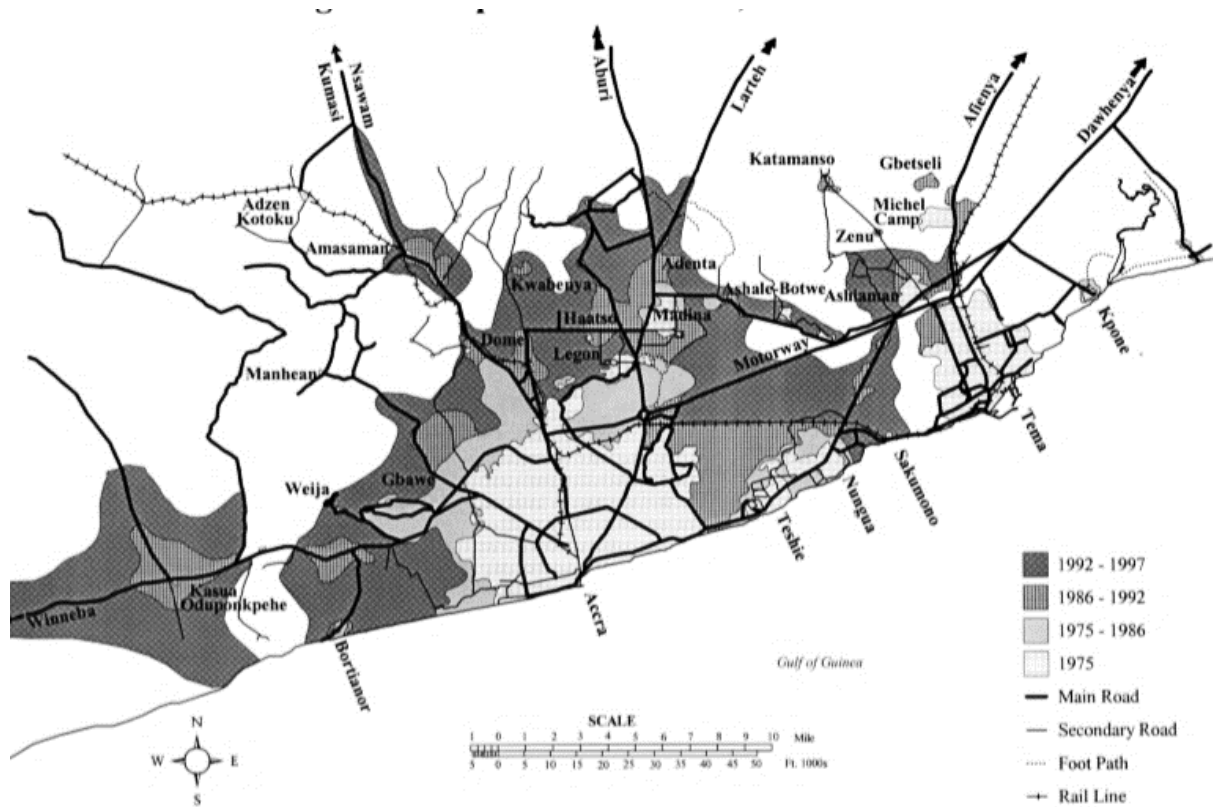


Figure 5.13: Spatial growth of Accra from 1975 to 1997 (Source: Yeboah, IE 2000)

The transport sector (especially road transport) in Ghana has also seen significant changes under the SAP. Before the introduction of the SAP, public transport was provided by agencies which were subsidized by the government (Quaye & Badoe 1996). However, following the deregulation of the transport sector, new (private) actors emerged displacing the existing public transport system. The former introduced mini-buses (known locally as trotro) and taxis which were more flexible in space and time, but less convenient. These private commercial vehicles operate under the umbrella of three main transport unions i.e.: Ghana Private Road Transport Union (GPRTU), Corporative Union (CU), and the Progressive Transport Owners' Association (PROTOA). The unions determine transport schedules and routes, and they also play an important role in determining public transport fares.

In addition to the housing and transport sectors, the telecommunication industry, waste management, education, banking, and the health sectors etc. have also seen tremendous

private sector participation since the late 1980s. Provision of public utility services such as water and electricity are some of the few sectors which are still dominated by SOEs (i.e. Ghana Water Company and the Electricity Company of Ghana). However, there have been increasing private sector engagement in urban water supply (especially deep well drilling), and solar energy in recent years (Agyeman 2007; Gyamfi et al. 2015). Most of these private organizations tend to start off from Accra for convenient and easy administration (i.e. easy access to central government institutions). The benefits of economic agglomeration have also been a major motivation for private businesses to locate in Accra (Grant 2009).

According to Ghana's most recent population census (2010 Census), the Greater Accra Region has the highest percentage of population in private formal employment. A spatial distribution of businesses established in the region shows that the Accra Metropolis has the highest number of business establishments in the Greater Accra Region (figure 5.14). Similarly, the distribution of persons engaged by establishments in the region is also highest in Accra (figure 5.15). Indeed, the economic benefits that accrue from the concentration of these establishments in Accra accentuate the positive impacts of the SAP in promoting Accra as the growth pole for the national economy.

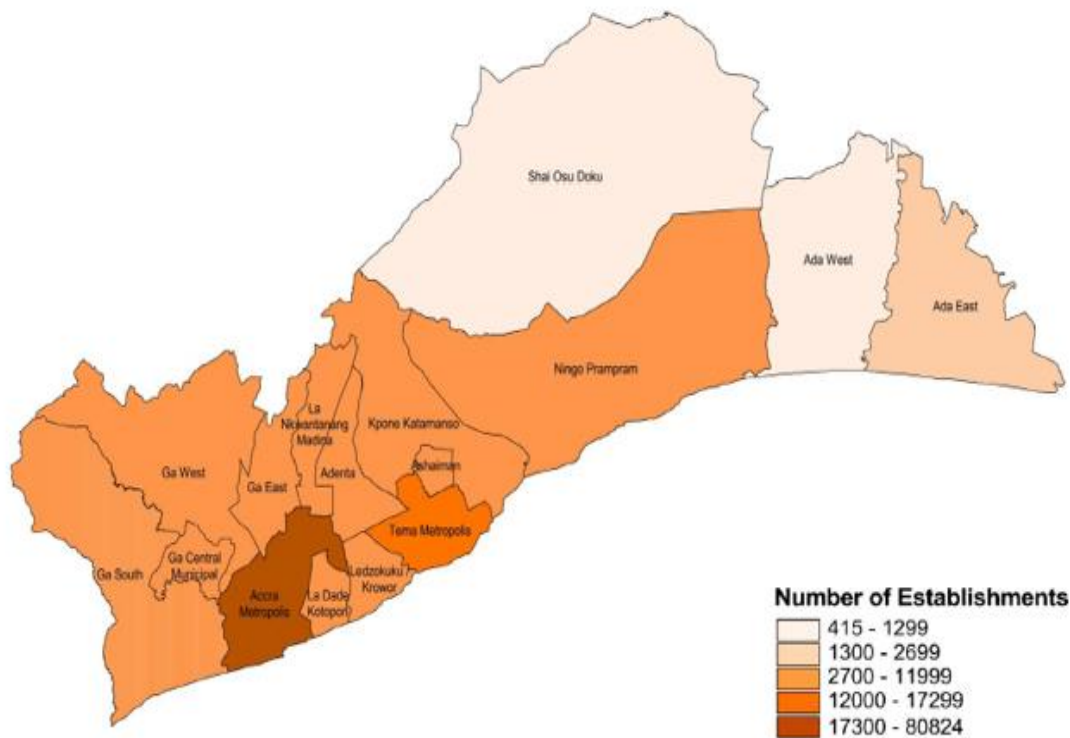


Figure 5.14: Spatial distribution of business establishments in Greater Accra Region (Source: Ghana Statistical Service 2010)

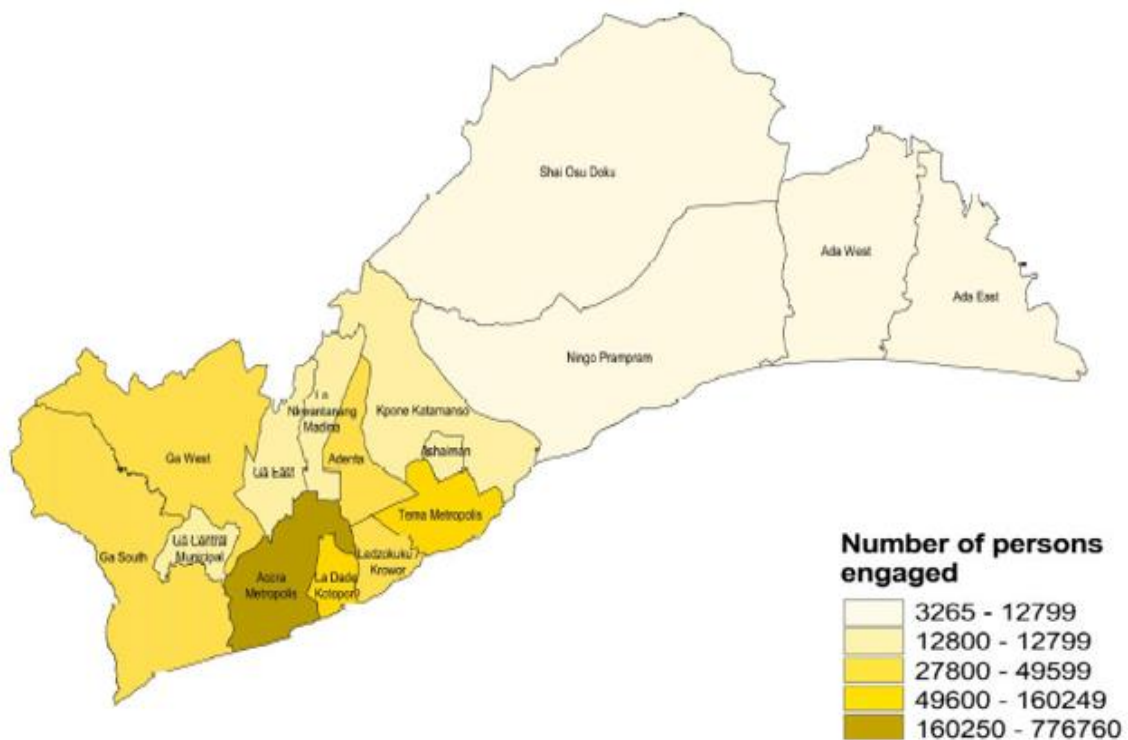


Figure 5.15: Spatial distribution of persons engaged by establishments in Greater Accra Region (Source: Ghana Statistical Service 2010)

Nevertheless, these economic achievements are only a partial reflection of the far-reaching implications of the SAP. Concerns about the long-term socio-spatial and environmental outcomes of the SAP in Ghana have been underemphasized in both academic and policy discourses (Anyinam 1994). This shortfall, as argued by Zattler (1989), is a consequence of the failure of the two Bretton Woods (i.e. World Bank and IMF) and beneficiary countries to effectively integrate social and ecological principles into the economic goals of the SAP. Accra is a victim of this shortcoming. Much of the urban growth that has occurred since the late 1980s has been incoherent and dispersed with little or no recourse to environmental sustainability issues. Uncontrolled sprawl, encroachment on water bodies, and loss of urban green spaces and biodiversity, etc. are only a snapshot of the direct and/or indirect consequences of the SAP.

To modulate and bring some order to the growth of Accra, several urban policies have been introduced in the last decades. Key among these policies are the Strategic Plan for the Greater Accra Metropolitan Area (1993); Ghana's first National Urban Policy Framework (2012); and the National Spatial Development Framework (2015-2035). The following sections provide a review of these policies, as well as their prospects, impacts, and limitations.

5.7 A review of urban policies in Ghana

5.7.1 Strategic Plan for the Greater Accra Metropolitan Area

The Strategic Plan for the Greater Accra Metropolitan Area (GAMA) incorporated not only the Accra Metropolis, but also other metropolitan areas and districts (Tema Metropolis and Ga district). It was the first comprehensive plan for Accra after independence. The Strategic Plan was more than conventional master plans which are mostly concerned with land-use planning and development control. It gave due recognition to local economic and social development, as well as efficient management of resources to build sustainability into local development approaches. The plan was designed based on a three-year systematic study with support from international agencies such as the United Nations Development Program (UNDP), and the United Nations Human Settlements Programme (UN-HABITAT). As shown in Table 8.1 below, the Strategic Plan outlined several development strategies for various sectors in the GAMA

with an underlying goal to promote sustainable development. However, the implementation of the strategies has been piecemeal, making the plan non-effective.

Table 5.1: Strategic Plan for the GAMA (1993)

No.	Key sectors	Strategies
1	Economic development	<ul style="list-style-type: none"> • Promoting the informal sector, and making them part of local government planning and management processes. • Improving existing hard/soft infrastructure to create favourable conditions for investment. • Increasing capacity utilization of local industries. • Supporting private sector development by creating a business-friendly macro-economic environment. • Effective coordination of public and private investment.
2	Urban development	<ul style="list-style-type: none"> • Consolidating developments within the existing urban areas, and promoting orderly expansion of new urban areas • Designation of green belt to constrain long-term urban expansion and to ensure the preservation of biodiversity. • Comprehensive upgrading of inner urban areas • Development of metropolitan open spaces for recreational activities consistent with the landscape and environmental objectives
3	Housing	<ul style="list-style-type: none"> • Promote mixed-use development at local communities. • Promotion of local building materials and construction technologies. • Incremental improvement of depressed residential areas.
4	Transport	<ul style="list-style-type: none"> • Promote an integrated land-use and transport system. • Improving access to existing public transit services by rationalizing existing road network, and providing terminals at vantage points etc. • Provide park and ride centers on the periphery of the central business districts to reduce traffic congestion. • Provide for safe and convenient bicycle and pedestrian movement.
5	Social services	<ul style="list-style-type: none"> • Protection of water catchments • Decentralization of water supply to enhance access and ensure effective management. • Development of local treatment plants for solid wastes. • Provide efficient waste collection services, and support waste recycling.

-
- Reduce electricity losses within the distribution system and at the point of consumption.
 - Encourage community participation in decision-making processes.
-

5.7.2 National Urban Policy and Action Plan

Although Africa is experiencing an unprecedented rate of urban population growth in recent decades, development policies across the continent have mostly had a bias towards rural development as a means to alleviate rural poverty and discourage internal migration from the countryside to urban areas (Fox 2014; Turok & Parnell 2009). Policy interventions in the urban sector are often piecemeal and disjointed (Turok 2016). Following a regional survey by the United Cities and Local Governments of Africa (UCLG) and Cities Alliance, Turok (2015, p. 351), finds that out of 50 African countries, only 34 percent have a clearly defined National Urban Policy (NUP) framework. Ghana is one of the few African countries with an NUP. On March 28, 2013, the President of Ghana announced the first National Urban Policy and Action Plan in the country.

The development of the NUP started from 2009 to 2012 through a series of consultations with traditional leaders, civil society groups, academics, urban planners, private industry, local government agencies, and international development partners (e.g. the World Bank and the Deutsche Gesellschaft für Internationale Zusammenarbeit) etc. (see policy formation process in figure 5.16). Among others, the NUP aims to address some of the fundamental challenges of rapid urbanization in Ghana. Specifically, it proposes a policy toolkit for dealing with issues of: uncontrolled sprawl; environmental degradation; urban governance; lack of institutional coordination in the implementation of urban policies; transport and traffic management; waste management; and the promotion of local economic development opportunities among others (GOG 2012).

To address these issues, the NUP outlines 12 main objectives with several initiatives or action plans (see Table 5.2). These objectives and action areas are meant to serve as guiding principles for the development of more nuanced and strategic local policy interventions at the regional, metropolitan, and municipal levels. The Urban Development Unit, under the auspices of the Ministry of Local Government and Rural Development, is responsible for coordinating the implementation of the NUP (Turok 2015).

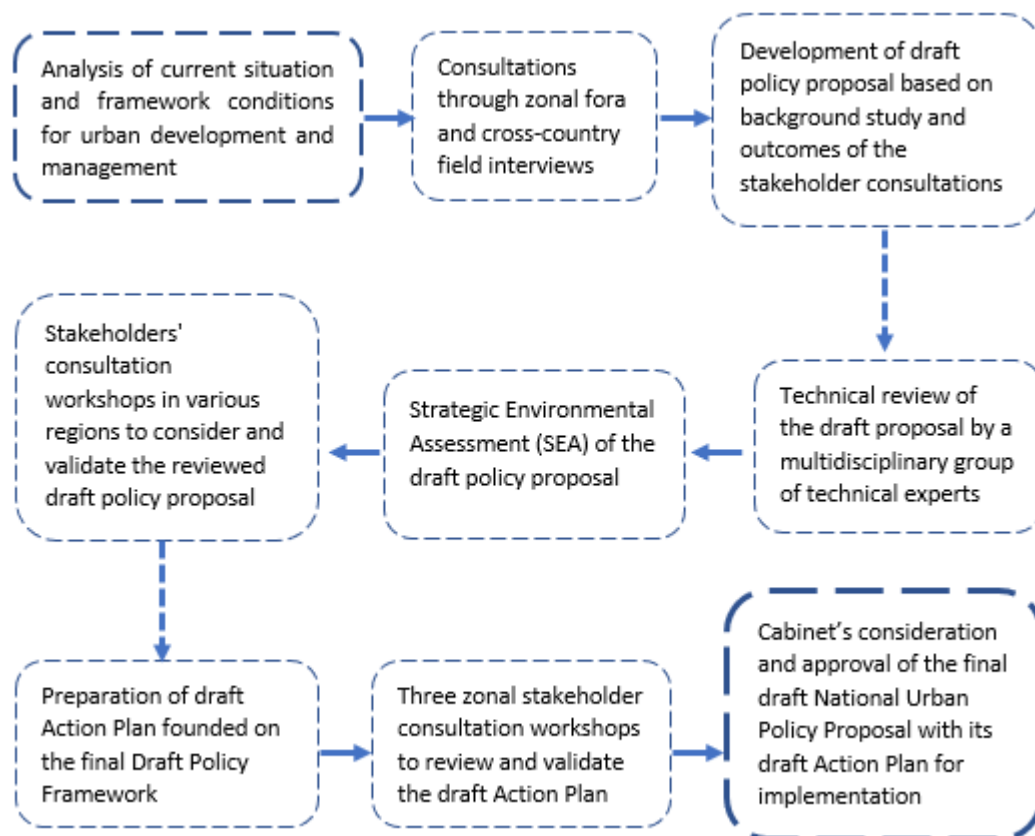


Figure 5.16: NUP formation process (Source: developed from GOG 2012)

Table 5.2: NUP policy objectives and action plans

No.	Policy objectives	Initiatives/ action plans
1	Facilitate balanced re-distribution of urban population	<ul style="list-style-type: none"> • Create new growth points as counter-magnets to fast growing cities such as Accra and Kumasi. • Promote accelerated growth of small and medium-sized towns, including district and regional capitals. • Ensure that existing and newly created centres adhere to best environmental and land management practices.
2	Promote a spatially integrated hierarchy of urban centres	<ul style="list-style-type: none"> • Undertake a study and establish a hierarchy of urban centres for defined functions and levels of services. • Spatially integrate regional and district capitals by transportation and communications facilities and other relevant services within the context of the guidelines provided in national and regional spatial development frameworks as recommended in the outputs of the Land Use Planning and Management Project (LUPMP). • Minimize the travel time between service centres of all sizes and their hinterlands. • Establish rural service centres and strengthen rural-urban linkages to promote agriculture and development of agro-based industries.

3	Promote urban economic development	<ul style="list-style-type: none"> • Promote local economic development (LED). • Improve urban services and infrastructure to support economic development and advance industrial investments and production. • Target infrastructural investments in growth centres as the choice destination for investments and other economic activities. • Enhance the competitiveness of Ghanaian cities in regional and international context. • Change official attitude towards the informal enterprises from neglect to recognition and policy support. • Ensure that urban planning provides for the activities of the informal economy. • Build up and upgrade the operational capacities of the informal enterprises. • Improve funding support for the informal economy.
4	Improve environmental quality of urban life	<ul style="list-style-type: none"> • Develop and manage infrastructure systems with the appropriate technology needed to provide basic hygienic conditions in towns and cities. • Prepare and implement sanitation action plans for all leading urban centres, including related statutory regulations and bylaws for ensuring effective collection, disposal and treatment of solid, liquid and toxic waste. • Generate environmental awareness by increasing mass media public education programmes on sanitation in schools and public places. • Provide adequate equipment and operational funds to support waste management activities. • Protect open spaces, green belts, forest reserves, water bodies, wetlands, water catchment areas and other ecologically sensitive areas from physical development and urban encroachment. • Develop and implement a systematic programme of flood control measures in urban communities. • Pursue rigorous public education and law enforcement against reprehensive public attitudes and conduct that induce environmental degradation. • Establish adequate measures against natural hazards in urban areas. • Prepare and implement coastal management plans to effect coastal re-vegetation and erosion control of denuded and neglected coastal towns. • Protect the environmental quality of mining towns and their hinterlands. • Educate the general public and communities to utilize marine, coastal and wetlands resources with negligible or minimal environmental hazards to coastal towns and cities. • Attend to the hygiene and quality of food for the urban public.

5	Ensure effective planning and management of urban growth and sprawl, especially of the primate cities and other large urban centres	<ul style="list-style-type: none"> • Ensure that investments and development will consistently and increasingly be directed towards targeted counter-magnet growth areas. • Probe and establish an effective integrated planning system for contiguous greater metropolitan areas, such as Accra/Kumasi/ Sekondi-Takoradi. • Ensure adoption and implementation/enforcement of relevant recommendations from the Land Use Planning and Management Project regarding legislation, development guidelines, planning standards, spatial development frameworks, structure plans, local plans and land use controls. • Strengthen the use of remote sensing (such as aerial photographs and satellite imageries) and a Geographic Information System (GIS) to enhance urban development and management.
6	Ensure efficient urban infrastructure and service delivery	<ul style="list-style-type: none"> • Assess infrastructure needs of urban areas and mobilize resources to support infrastructural development. • Improve delivery and management of urban services and infrastructure (including education, health, water, sanitation, energy). • Guide and manage investments in all relevant transport modes for an efficient and effective intra and inter-city transport development. • Promote efficient and effective public transport systems. • Develop and manage infrastructure systems with appropriate technology and standards to suit the peculiarities of urban communities. • Provide adequate technical capacity, equipment and operational funds to support waste management activities. • Provide infrastructure and services on the basis of national/regional/ district spatial development framework and urban structure plans. • Strengthen the capacity and institutional coordination of utility companies and other service and infrastructure providers.
7	Improve access to adequate and affordable low-income housing	<ul style="list-style-type: none"> • Provide a congenial environment for private sector delivery of affordable housing. • Implement recommendations on the promotion of indigenous building materials and appropriate construction technologies. • Promote the provision of social or low-income rental housing through public and public-private partnership arrangements. • Upgrade slums and dilapidated housing stock, especially in urban areas selected as growth poles. • Explore the introduction of non-conventional housing finance and strategies that benefit low-income groups.
8	Promote urban safety and security	<ul style="list-style-type: none"> • Incorporate specific security and disaster prevention and management mechanisms in urban planning and management.

		<ul style="list-style-type: none"> • Intensify education on individual and community responsibility and initiative in urban safety and security. • Introduce a more effective property addressing system (house numbering and street naming) to enhance security and safety in communities. • Enforce standards and regulations on the provision of fire hydrants. • Strengthen emergency rapid response to disaster and emergency situations. • Promote the use of Urban Surveillance Systems to assist in identifying illegal conduct. • Promote the use of remote sensing (such as aerial photographs and satellite imageries) and a Geographic Information System (GIS) to enhance urban security.
9	Strengthen urban governance	<ul style="list-style-type: none"> • Review, strengthen and resource the decentralized structures and substructures to make them effective in local governance in line with the policy recommendations contained in the new Decentralization Policy Framework and its Action Plan (April 2010). • Involve relevant state and non-state agencies and institutions in the governance of cities and towns. • Improve and enforce legislation and standards on urban development including the validation and adoption of those developed and recommended by the Land-Use Planning and Management Project of LAP. • Ensure effective coordination, monitoring and review of the NUP. • Probe and strengthen the institutional framework at the local level for effective coordination of urban development in the light of the provisions of Act 462 and its subsidiary legislation. • Strengthen institutional arrangements and measures to ensure efficient implementation of the NUP at the local level. • Institute practical measures to continually enrich the capacities and outlook of key actors in urban development and management. • Establish special courts to handle issues pertaining to urban development.
10	Promote climate change adaptation and mitigation mechanisms	<ul style="list-style-type: none"> • Intensify public information and awareness campaigns on energy conservation, climate change and mitigation strategies. • Encourage progressive reduction of hazardous substances by industry. • Promote settlement structure plans designed to achieve a high level of amenity as well as the prevention of effluent and refuse pollution. • Promote and strengthen cooperation of adjoining MMDAs in collaboration with traditional authorities and other relevant stakeholders in management of water bodies and other natural resources.

		<ul style="list-style-type: none"> • Avoid coastal zone development which affects ecologically-sensitive areas. • Impose and enforce more effective coastal zone and wetlands management regulations. • Strengthen the capacities of agencies that are charged with promoting environmental standards. • Generate public awareness on climate change and litigation strategies through mass media educational campaigns.
11	Strengthen applied research in urban and regional development	<ul style="list-style-type: none"> • Strengthen the capacity of research institutions and other bodies concerned with urban and regional development. • Develop an extended urban and regional information system to reinforce the land use planning and information system that is being developed by the LUPMP. • Promote public-private partnerships to fund research on urban development. • Encourage urban research that has immediate bearing on development problems and needs.
12	Expand sources of funding for urban development and strengthen urban financial management	<ul style="list-style-type: none"> • Find new ways of mobilizing finance for investments and urban development. • Promote public-private partnerships as alternative source of funding for urban infrastructure and services. • Adopt best practices in municipal finance and non-conventional and innovative ways of revenue mobilization. • Support customary landowners in prime urban areas to negotiate and collaborate with the banking institutions to develop site and services projects to enhance industrial and residential development. • Undertake the servicing of land for private development and recover the cost by a levy of service charges from beneficiary land owners and development charges from beneficiary developers. • Promote the use of pension and other investment funds as investments in specified urban development.

Developed from the Ghana National Urban Policy and Action Plan (GOG 2012)

As shown in the table above, the NUP aims to address some of the fundamental urban challenges in Ghana such as the uneven distribution of urban population which has brought significant pressure to bear on primate cities such as Accra, Kumasi, Secondi-Takoradi, and Tamale. Therefore, it proposes strategies for enhancing the competitiveness of secondary urban areas to serve as counter-magnets to the primary cities (figure 5.17). Moreover, the twelve objectives and their underlying initiatives aim to direct development trends in these primary and secondary cities along sustainable trajectories. These twelve action areas can be clustered around four urban sustainability dimensions i.e.: environmental, social, political, and economic sustainability (figure 5.18). Altogether, they aim to support a broader system

of urban transformation in which the different criteria of urban sustainability are integrated into a coherent policy framework.

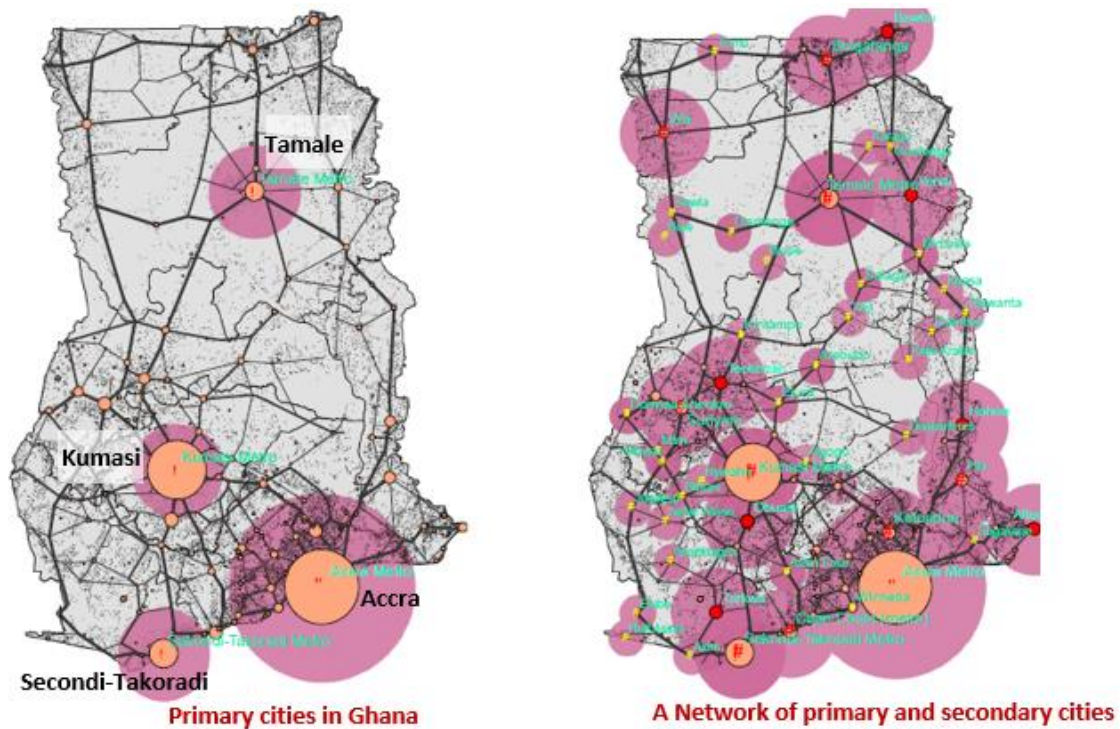


Figure 5.17: Primary and secondary cities in Ghana (GOG 2015)



Figure 5.18: Sustainability dimensions of the NUP (developed from GOG 2012)

The adoption of the NUP in Ghana is a positive indication of the government's awareness and growing interest in urban development issues which have played second fiddle to rural development for several decades (Awortwi 2015; Fox 2014). However, there are significant shortcomings that raise questions about its feasibility and/or applicability to mainstream society. In the first place, although the NUP outlines several policy initiatives and actions needed to achieve its twelve objectives, these policies/plans are mostly generic and less explicit on how they might be applied, monitored, and evaluated at sub-national levels. Hence, as argued by Awortwi (2015), the NUP at its present state is little more than 'typical textbook urban issues'. Besides, there is no clear financial plan and statutory backing for the implementation of the NUP (Awortwi 2015; Turok 2015). The latter is especially important within the context of Ghana's polarized political environment which has resulted in bureaucratic rivalries, and lack of consistency in the pursuit of national development goals.

The NUP also provides a long list of the challenges associated with current urban situation in Ghana but pays little attention to the potentials of urbanization in national development. In fact, urbanization is presented as a problem rather than an opportunity in this policy framework. A more positive view of urbanization may help to uncover its latent potentials for national development. The NUP may also benefit from effective private sector engagement in the implementation of its action plans, given the limited financial capabilities of the implementing government bodies. So far, it is dominated by state bureaucracies with only four of the seventy-seven policy initiatives making reference to public-private partnership. Effective and more proactive marketing of this policy to both the private sector and the general public, as well as a clearer definition of its goals (measurable), priority areas, implementation time schedule, and funding mechanisms may add rigour to the NUP and facilitate its mainstream application.

5.7.3 National Spatial Development Framework (NSDF)

The National Spatial Development Framework (NSDF) follows several previous development policies such as the National Physical Development Plan (1963-1970), Ghana Shared Growth and Development Agenda (2010-2013), and more recently the National Urban Policy (2013) etc. It presents a framework for defining the spatial implications of social, environmental, and economic policies at both the national and sub-national levels (GOG 2015). Like the National

Urban Policy, the NSDF was formulated through a multi-sectoral participatory process. It proposes five pillars of spatial development strategy. These pillars include: (1) emphasis on balanced polycentric development; (2) improve regional, national and international connectivity; (3) strengthen the metropolitan city regions of Accra and Kumasi; (4) promote development in networks and secondary cities; and (5) ensure sustainable development and protect ecological assets (Table 5.3).

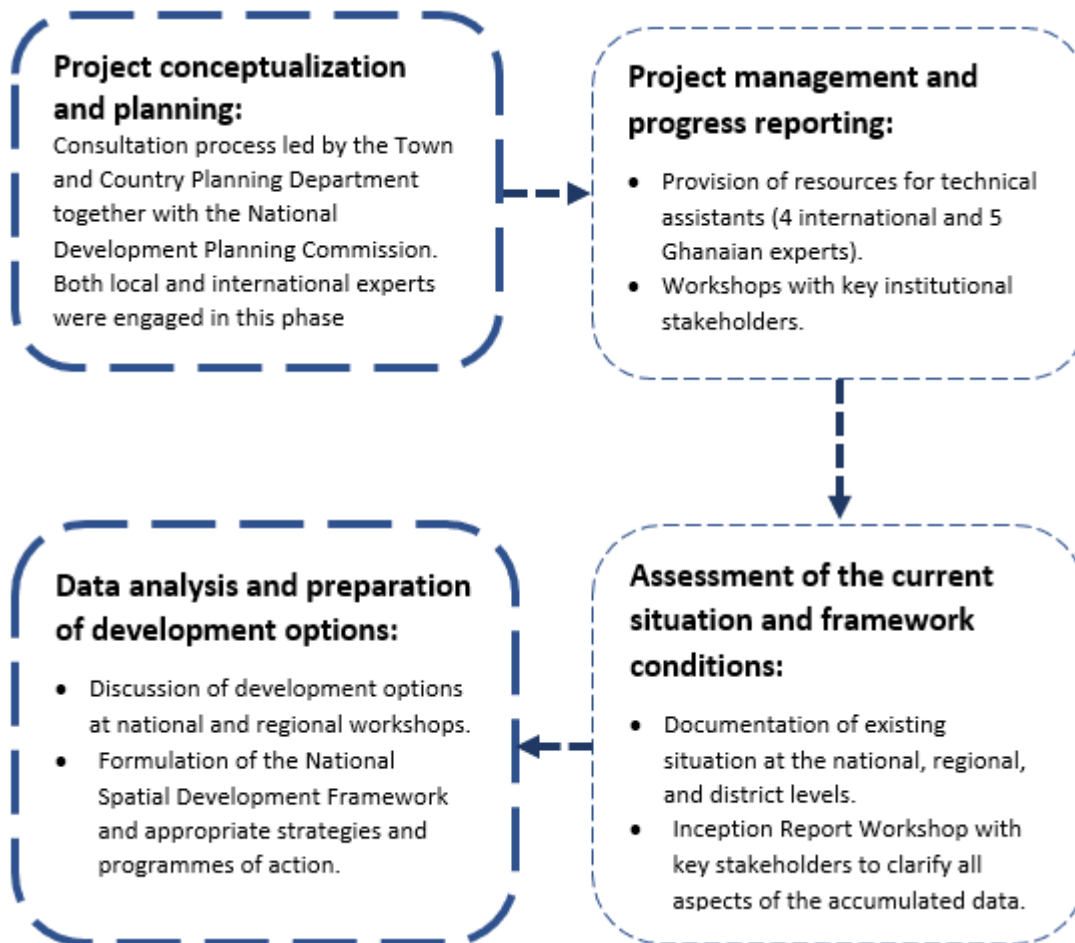


Figure 5.19: NSDF formation process (developed from GOG 2015)

Table 5.3: Pillars of the NSDF

No.	Pillars of the spatial strategy	Objectives
1	Balanced polycentric development	<ul style="list-style-type: none"> Promote balanced growth through the development of many connected and complementary settlements. Establishment of a new urban settlement hierarchy based on the distance between settlements and the area of influence, or service coverage, of individual settlements.
2	Improve regional, national and international connectivity	<ul style="list-style-type: none"> Facilitate linkages across the national territory in order to support the mobility of people, goods and ideas, and access to markets and resources. Ensure the integration of leading and lagging areas, more spatially balanced development and a reduction in regional disparities. Create an efficient multimodal national transport system.
3	Strengthen the metropolitan city regions of Accra and Kumasi	<ul style="list-style-type: none"> Discourage fragmented developments which tend to increase the distances between destinations, increases vehicle distance travelled, and lowers the overall population density. Establish an urban growth containment boundary to prevent encroachment on green belts. Provide ring roads where applicable with dedicated lanes for mass public transport and facilities for non-motorised transport. Promote high density and mixed-use development along transit corridors. Promote digital connectivity that enables virtual transactions and eliminates or at least reduces the need to travel.
4	Promote development in secondary cities	<ul style="list-style-type: none"> Incentivize secondary cities as nodal points that facilitate the flow of goods, services and people across national space. Promote more diverse job and housing opportunities, stronger attractiveness for investment, and improve capacity to solve urban problems.
5	Ensure sustainable development and protect ecological assets	<ul style="list-style-type: none"> Protect the natural environment and ensure that future generations can benefit from ecosystem services to meet their own development needs. Protect and restore natural systems and open spaces that serve as an environmental life support system for urban settlements

Developed from the National Spatial Development Framework (GOG 2015)

The underlying objectives of the NSDF put forward the need to redefine development trends in primary cities (especially Accra and Kumasi) which have undergone tremendous growth with little planning in the last three decades. It also reinforces the NUP’s goal of enhancing

the competitiveness of secondary urban centers to serve as counter magnet cities. Like the NUP, the NSDF underscores the need to promote the core values of urban sustainability. However, it suffers from lack of precision in its policy objectives and application mechanism. Besides, although the authors of the NSDF (i.e. Town and Country Planning Department and the National Development Planning Commission) recommended the formation of a Regional Spatial Development Committee (RSDC) to oversee the implementation of the NSDF at the sub-national levels, this committee has yet to be formed after five years since the NSDF was introduced. Thus far, the NSDF only adds to existing well-intentioned policies that are not implemented.

5.8 Conclusion

Ghana's development has been significantly influenced by its colonial history, traditional practices, and evolving socio-political system. A critical milestone in the nation's development was the introduction of the Structural Adjustment Program (SAP) in the mid-1980s. The application of this economic reform program unleashed the development potentials of major cities across the country but not without its downsides. Both the positive and negative outcomes of the SAP can be seen to co-exist in Accra. In some regard, the positive outcomes created unintended negative consequences due to failure of the state and local government institutions to effectively manage the former. For example, some observers believe that poor regulatory policies to modulate the economic and population growth that ensued from the SAP are largely to blame for the environmental and socio-spatial challenges confronting Accra (Grant & Yankson 2003; Yeboah 2000).

The introduction of the first urban policy framework in Ghana (i.e. National Urban Policy) and the National Spatial Development Framework are positive steps by the government to redirect the growth of Accra and other cities across the country on sustainable trajectories. Although these policies have some intrinsic weaknesses that need to be addressed, a critical part of the challenge is how they might be applied to mainstream society given the inertia of social and political processes which tend to provide stability for the unsustainable growth patterns observed in Accra in the last decades. Chapter 9 aims to address this concern through the theoretical lens of the Multi-level perspective.

Post hoc analysis-Freiburg

An analysis of the processes of green urban transitions: the case of Freiburg im Breisgau (Germany)

6.1 Introduction

In the past four decades, Freiburg has made significant progress in promoting what has emerged as a green city model in Germany and around the world. Several novel sustainability ideas have been tested in the areas of efficient land-use planning, sustainable public transportation, energy efficient housing, renewable energy, ecological waste management, comprehensive stormwater management, and participatory urban governance among others. The successful implementation of these ideas has put Freiburg into the limelight as a best practice model for Green Urbanism. How these processes began, and the factors that influenced the outcomes of Freiburg's sustainability approach form the fulcrum of this chapter.

Through a review of literature and policy documents, field interviews, focus group, and site observations this chapter discusses the milestones of Freiburg's green urban transitions. It examines the drivers, and location specific characteristics that presented opportunities and/or barriers to Freiburg's transition. An in-depth analysis of the various policies and/or initiatives that have been applied to transition Freiburg towards Green Urbanism is also undertaken. This analysis is carried out in the context of the broader literature on Green Urbanism to identify the successes, failures, and limitations of Freiburg's approach.

The following section (Section 6.2) provides a brief profile of Freiburg. Section 6.3 presents the milestones of Freiburg's green urban transition to provide important background context to the case study. This narrative highlights the various international and local factors that have

shaped Freiburg's sustainability policies in the last four decades. Building on this narrative, Section 6.4 examines the real-life applications of Freiburg's sustainability policies. It draws on the model districts of Rieselfeld and Vauban to understand how Freiburg's green rhetoric has been interpreted and applied in practice. This analysis brings to light some key principles and practices that will inform discussions on the transferability of the Freiburg model to other contexts. Nonetheless, this study recognizes that cities are unique in their physical and socio-cultural configurations; therefore, an imposition of a utopian concept without due consideration to the local context may be counterproductive.

6.2 Profile of Freiburg

Freiburg (im Breisgau) is one of the medium-sized cities in Germany located in the Federal State of Baden-Württemberg in the southwest of the country. It covers an area of 153.07 km² in the Rhine valley. Freiburg is nestled along the edge of the Black Forest Region close to both the French and the Swiss borders. It has a reputation as one of the classic German university cities. With a population of about 230,000, Freiburg has a relatively young demographic, especially, students who constitute more than 10 percent (about 30,000 university students) of the total population (Heller 2009). Freiburg has a lot to offer to both local residents and visitors alike. The historical old town, and the dense evergreen Black Forest are major sources of attraction to the city. Perhaps, what makes Freiburg most prominent among German and European cities is its label as a "Green City".

6.3 Milestones of Freiburg's green urban transition

Freiburg has made tremendous progress in innovative environmental policies, and sustainable urban development initiatives that position it as an exemplar of Green Urbanism. In the last four decades, Freiburg has received several plaudits as a best-practice model for ecological urban innovations both locally and internationally. Among others, Freiburg was named the German Environmental Capital in 1992; the European City of the Year in 2010 by the Academy of Urbanism; and the Federal Capital for Climate Protection in 2010 (Kronsell 2013; Scheurer & Newman 2009). These achievements have been possible due to proactive environmental citizenship, and political will and commitment to environmentally responsible urban development (Freytag et al. 2014; Rohracher & Späth 2013). In hindsight, several

phases of development can be observed in Freiburg's "green" achievements with different actors and factors coming into play at various stages of the transition process.

6.3.1 Resistance to the Wyhl nuclear plant

In the early 1970s, the government of Baden-Württemberg commissioned a nuclear utility company (i.e., *Badenwerk AG*) to build a nuclear power plant in Wyhl (a municipality in the district of *Emmendingen in Baden-Württemberg* -Southwestern Germany). According to Schils (2011), this initiative was motivated by the OPEC energy crises in the 1970s, and the growing demand for electricity in the state of Baden-Württemberg. However, the nuclear project was resisted by the local people, with the hotspot in Freiburg. Residents in Freiburg were, particularly, engaged in this anti-nuclear movement for two main reasons: firstly, the proximity of the nuclear plant to Freiburg (about 25km); and secondly the potential risks of radioactive waste materials to the environment and people. The protest is said to be the "symbolic birthplace" of anti-nuclear movements in Germany and across Europe (Meyer 2014, p. 212). It is also noted as the starting point for what would emerge as an energy transition ("*Energiewende*") in Freiburg (Rohracher & Späth 2013; Schils 2011).

In the mid-1970s, the protest gained momentum and sympathy across Germany and Europe when some protestors were violently forced out of the nuclear plant construction site by the police force (Milder 2013). About 30,000 people (including local farmers, University of Freiburg lecturers and students, citizens, and environmental activists etc.) occupied the site again in February 1975 as direct civil disobedience against the government (Barkan 1979, p. 23). With enormous number of people to deal with, the state government was forced into a compromise agreement to suspend the project for a final decision by the court. Eventually, the project was called-off on the grounds of technical deficiencies by the State's Administrative Court (Schils 2011).

The Wyhl anti-nuclear movement inspired new forms of citizen activism in Germany and across Europe; and provided impetus for the emergence of the Green Party (*Die Grünen*) in Germany (Achilles & Elzey 2013; Hager & Haddad 2015). It is also said to have motivated discussions on alternative energy sources to nuclear power. In an interview, a researcher at the University of Freiburg recounted his childhood experience of participating in a series of

lectures organized by scientific experts (at the demonstration site) on the impacts of nuclear power, and the opportunities for generating energy from renewable sources (e.g. sun, wind, and geothermal etc.).

This dialogue gained traction among several stakeholder groups (e.g. researchers, civil society, energy experts, and local government officials etc.). Although renewable energy technologies were still underdeveloped during this period, the deliberations culminated in the formation of key research and development (R&D) institutions such as the Oeko-Institut (in the late 1970s), and the Fraunhofer Institute for Solar Energy Systems (in the early 1980s). These institutions, among others, played key roles in developing and mainstreaming renewable energy technologies (particularly solar energy) in Freiburg through research and experimentations.

6.3.2 Institutional innovations for renewable energy transition in Freiburg

The fierce protest against nuclear power in Freiburg did not guarantee a shift from the latter. Nuclear power still accounted for about 90 percent of electricity supply in Freiburg in the 1980s (Parkinson 2013, para.6). As explained by Geels (2005), a window of opportunity for change can only be utilized when alternative solutions are fully developed. Thus, due to the immaturity of alternative (renewable) energy sources, nuclear power still dominated the energy market in Freiburg after the anti-nuclear protest in the mid-1970s. Thus, the need for research and development of renewable energy technologies in Freiburg became critical.

6.3.2.1 Oeko-Institut (*Institute for Applied Ecology*)

The Oeko-Institut was founded as an independent scientific research and advisory center in Freiburg. The Institute was founded by a group of people who lived in Freiburg and neighbouring towns with the primary goal of undertaking independent research on alternative energy sources to nuclear power and fossil fuel. This group was actively involved in the Wyhl anti-nuclear protest. Following the protest, a meeting was convened in Heidelberg (a medium size university town in Germany) where further discussions on the future of Germany's energy system were held. According to an official of the Oeko-Institut, this dialogue led to the formation of the Institut in 1977.

In the early 1980s, the Oeko-Institut published the book: *Energiewende – Wachstum und Wohlstand ohne Erdöl und Uran* (Energy Transition: Growth and Prosperity Without Oil and Uranium). It envisioned a change in German's energy system from nuclear power towards more renewable energy sources. With this publication, the Institut proposed an alternative energy future that emphasized end-user energy efficiency in addition to the replacement of nuclear power with renewable energy sources. In the 1980s, for example, the Institut initiated an energy saving scheme, in collaboration with Freiburg's local energy supply company- FEW, to distribute low-energy light bulbs with projected savings of about three million deutschmarks per annum (Seifried 2015, p. 3).

Beyond this initiative, the Oeko-Institut has also played a significant role in defining a sustainability pathway for Freiburg's urban development. In an interview, an official of the Institut pointed out that the Oeko-Institut played an instrumental role in Freiburg's green transition by developing principles and strategies for realising sustainable transformation in energy, transport, resource management, and sustainable governance among others. The institute was at the vanguard of efforts aimed at replacing undemocratic governance structures with citizen-led decision-making processes which have become a hallmark of Freiburg's urban governance system.

Presently, the Oeko-Institut is a leading independent European research center providing consultancy services on sustainable future in energy and climate, environmental law, transport, and urban governance among others. The Institut's approach is based on value-oriented research. It has its headquarter located in Vauban with a total number of 165 staff which includes 115 researchers at three locations in Germany i.e.: Freiburg, Darmstadt, and Berlin. The Institut is financed through multiple funding streams such as third-party project-based funding, donations, and membership fees (about 3,000 members), with an annual revenue of €8.5 million (Öko-Institut 2017).

6.3.2.2 Fraunhofer Institute for Solar Energy Systems (ISE)

Fraunhofer Institute for Solar Energy Systems (ISE) was founded in Freiburg by German physicist Prof. Adolf Goetzberger in 1981; as the first non-university institution for research and development in solar energy. With the first oil crises (see Akins 1973), and the Chernobyl nuclear reactor accident (see Christodouleas 2013) still lingering, Goetzberger and his team

of researchers found that one of the few inexhaustible, safe, and widely available energy sources around the world was energy from the sun. Building on his experiences from the Fraunhofer-Gesellschaft (an applied research institution in Germany), Goetzberger led his team to develop one of the world's most efficient flat plate collectors. The latter was the first entirely electronic inverter for autonomous photovoltaic systems (Goetzberger 1994; Magoun 2015). In addition, in the early 1990s, the Fraunhofer ISE developed the first worldwide "Energy Self-Sufficient Solar House" (Goetzberger 1994).

With the support of the Fraunhofer ISE, the first residential high-rise building to reach passive house standards was developed in *Weingarten*, a district in Freiburg. This 16-storey apartment (constructed in the 1960s) was renovated through cutting-edge insulation methods, efficient exterior sun protection strategies, and triple-glazed windows etc. It was also upgraded with sustainable energy technologies (e.g., photovoltaic systems), and a heat recovery ventilation system recommended by experts from the Fraunhofer ISE. Consequently, the primary energy demand for heating, lighting, ventilation, and hot water was reduced by 40 percent (Schneider 2011, p. 1). Thus, the rather deplorable social housing apartment has now become a model for sustainable construction and renovation both in Freiburg and around the world (Ibarra 2017).

These renovation standards, supported by the Fraunhofer ISE, were applied to other multi-story apartment buildings in the district of Weingarten under the aegis of the German Federal Ministry for Finance and Technology (Schneider 2011, p. 4). After more than three decades of operation, the Fraunhofer ISE has emerged as the largest institute for applied solar energy research in Germany, and across Europe. As part of its mission, the institute investigates scientific and technological fundamentals for solar energy production and application through the development of prototypes and demonstration systems.

6.3.2.3 Solar Info Center

Another innovative institutional setup that emerged in Freiburg as part of the city's efforts to transition towards renewable energies is the Solar Info Center. It was founded in 1999 as a Center of competence for renewable energies. The Solar Info Center offers approximately 14,000m² of office space for 45 independent organizations. It accommodates about 400 employees from diverse disciplines all working together under one roof (*see: green-city-*

cluster.de). The office complex is designed to high energy efficiency standards with an energy requirement which is 30 percent lower than the threshold determined by the German Energy Saving Ordinance (EnOB 2016). As part of its mission, the Center provides a platform for cross-industry networking for institutions from a wide range of sectors. Several stakeholders from the energy, construction, information technology, planning, engineering, and financial sectors etc., get the opportunity to learn from the experiences and expertise of others on innovative renewable energy products and services. Through these engagements, the Solar Info Center is able to provide the necessary support for small-scale and family-based renewable energy companies to build their competencies, and establish mutually-beneficial relationships with renowned organizations such as the Fraunhofer ISE.

Beyond the emergence of these institutions (i.e. Oeko-Institut, Fraunhofer ISE, and Solar Info Center), which have helped to develop the necessary technologies and policies needed to facilitate a renewable energy transition in Freiburg, some international commitments by the City Council have also shaped Freiburg's sustainability agenda. The following sections highlight these international treaties and how they have contributed to Freiburg's sustainability transition.

6.3.3 International and Regional initiatives for promoting sustainable development

6.3.3.1 Local Agenda 21

The Brundtland Commission was one of the maiden attempts to unite countries to deliberate on potential strategies for promoting global sustainability. The work of the commission, under the aegis of the United Nations, led to the publication of the Brundtland Report in 1987. One of the major outcomes of the report is the definition of the term sustainable development: *“development that meets the needs of the present without compromising the ability of future generations to meet their own needs”*. To further develop the sustainability concept into pragmatic solutions that are sensitive to local conditions, the Brundtland Commission's subsequent international summit in Rio de Janeiro (i.e. Earth Summit-1992) led to the development of Agenda 21. The latter is a non-binding action plan of the United Nations aimed to guide policies at regional, national, and city levels towards sustainable development. Following this development, a number of Local Agenda 21 (LA 21) have been initiated around

the world to address location-specific problems while contributing to global sustainability (Lafferty & Eckerberg 2013).

Agenda 21 broadly covers areas such as sustainable social and economic development, conservation and efficient management of natural resources, and the promotion of participatory governance (United Nations 1992). These objectives were developed to provide guidelines for local governments to work out comprehensive action plans towards environmental protection, social wellbeing, and economic prosperity. In Germany, for example, a total of 2610 local authorities had initiated an LA 21 process by mid-2006 (Kern et al. 2007, pp. 608-610). According to Voisey et al. (1996), the formulation of the LA 21 in Germany was largely underpinned by the principle of subsidiarity. The latter points out that social issues are best handled by the most immediate, and least centralized competent authority (Toth 1992). Therefore, the LA 21 process in Germany was characterized by independent and voluntary actions from cities with little or no interference from the federal government (Geissel 2009). Kern et al. (2007), observe that the pioneering cities in German LA 21 were largely university towns which include Heidelberg, Munster, and Freiburg.

Freiburg's LA 21 sought to create a balance between ecological, social, and economic development goals through a consensus-oriented dialogue with the local people. This participatory approach necessitated the creation of stakeholder organizations to galvanize local support for the implementation of the LA 21. Thus, the Freiburg Forum 21 was formed in 1997 to coordinate civic discussions on key policy issues regarding the LA 21 (Stadt Freiburg 2012). It was mainly composed of the *Bürgervereinen*. The latter is a voluntary and neighbourhood-based association that organizes local residents to deliberate on issues of common concern (Kronsell 2013). The effective engagement of citizen groups in the LA 21 process earned Freiburg several recognitions and awards both locally and internationally (Stadt Freiburg 2012a).

Moreover, an Agenda 21 office was established to serve as a bridge between local residents and the city administration on projects regarding sustainable development. The office facilitated the development of guiding principles for the LA 21. The contributions of the Agenda 21 Office were fundamental to major urban development policies in Freiburg such as the revision of the city's land-use plan (Stadt Freiburg 2012b). In addition, intermediary

institutions such as a Sustainability Council was established to work out goals and indicators for the development of sustainability strategies in Freiburg. Under the chairmanship of the Lord Mayor of Freiburg, the Sustainability Council provides expert advice to the Municipal Council and federal government on the city's sustainability policies.

The Council also helped to define and ratify 60 sustainability objectives (in accordance with the LA 21) aimed at guiding urban development policies in Freiburg. These objectives are broadly organized into 12 policy areas: (1) participatory governance; (2) local management for future sustainability; (3) Conservation of biodiversity and ecosystems; (4) responsible consumption; (5) sustainable urban planning; (6) improved mobility and less traffic; (7) public health; (8) dynamic local economy; (9) social justice; (10) education; (11) climate protection and energy efficiency; and (12) culture (Stadt Freiburg 2015). In an interview with an official of the Sustainability Council, it was noted that the 60 sustainability goals are currently being revised in line with the United Nations' Sustainable Development Goals (SDGs). This revision is meant to scale up the environmental commitment and contribution of Freiburg to contemporary global effort towards sustainable development.

6.3.3.2 Aalborg Charter

The City Council of Freiburg also signed the Aalborg Charter in 1996, and subsequently the Aalborg Commitment in 2006 as part of its commitment to the global sustainability agenda. Aalborg Charter is a campaign for building common understanding and strategies for sustainable cities and towns in Europe (Devuyst et al. 2001). Approved by participants at the first European Conference on Sustainable Cities and Towns in Aalborg (Denmark), the Charter aimed to elaborate on the requirements of the LA 21 initiated at the Earth Summit in Rio. The Charter is organized into three related parts i.e.: (1) a consensus declaration of European cities and towns towards sustainable development; (2) European Sustainable Cities and Town Campaign to create a network of local authorities working together towards global sustainability; and (3) local action plans towards the development and implementation of the LA 21 processes (Van Begin 2004).

The Aalborg Charter emphasizes that global sustainability goals cannot be achieved without sustainable local communities (Zilans & Abolina 2009). Therefore, local governments have a central role to play in developing sustainable local action plans due to their understanding

and closeness to the local setting where environmental, social, and economic problems are perceived (Evans & Theobald 2003). In this regard, the Charter recognizes that cities are unique in their social, cultural, economic, and physical characteristics etc.; hence, sustainability interventions should be context specific. Since its inception, more than 2500 local authorities from 46 countries in Europe have signed up for the Aalborg Charter. Some of the key policy issues addressed in the Charter include: location driven climate protection initiatives, participatory governance, sustainable land-use planning, social equity, responsible consumption, sustainable mobility, urban economy towards sustainability, and the prevention of ecosystem toxication among others (Szambelan 2013; Zilans & Abolina 2009).

6.3.3.3 Aalborg Commitment

Following the approval of the Aalborg Charter in 1994, the Aalborg Commitment was signed by participants at the Aalborg +10 conference in 2004. The Commitment reaffirms the Charter, and provides practical and flexible tools for applying sustainability principles across municipal sectors in ten thematic areas i.e.: (1) urban governance; (2) responsible consumption; (3) mobility; (4) urban management; (5) natural common goods; (6) planning and design; (7) local action for health; (8) social equity; (9) vibrant and sustainable local economy; and (10) local and global sustainability (Zilans & Abolina 2009). These thematic fields of action were designed to add new impetus to the Aalborg Charter, and build on the LA 21 processes being implemented by cities across Europe. By signing the Aalborg Commitment, municipal authorities committed themselves to developing short and long-term visions for local sustainability through effective engagement of all sectors of society in their decision-making processes. Freiburg has made tremendous progress in this regard by making policy development processes open, comprehensible, and transparent (Kronsell 2013). This approach is viewed as a way of building socially shared legitimacy in public policies, and promoting voluntary adherence while putting less burden on local authorities to enforce compliance (Scharpf 2009).

The Aalborg Commitment also emphasizes effective local management cycle from policy formulation through to implementation and evaluation of outcomes. In this regard, cities are required to define their sustainability policies in measurable objectives to enable them to monitor their progress. The Commitment offers a framework (i.e. sustainability cycle) to assist

local governments to develop a process for target setting and evaluation. As shown in figure 6.1, the sustainability cycle provides a multi-step model for conceptualizing, refining, implementing, and assessing sustainability policies through five iterative processes (Garzillo & Kuhn 2007). Freiburg’s approach to its green development policies is consistent with most parts of the sustainability cycle; except for the evaluation and reporting stages where much more transparency is being demanded by civil society and academics alike. According to an official of the Sustainability Council, indicators for evaluating the city’s sustainability targets are still in the process of development with support from the Council, the *Bertelsmann Stiftung* (non-profit organization in Germany), and the Fraunhofer EMI (technology research institute in Freiburg).



Figure 6.1: Sustainability Cycle (Source: Garzillo & Kuhn 2007)

Moreover, the Aalborg Commitment stresses the need for cities to protect natural common goods, preserve biodiversity, promote sustainable planning and design, reducing energy consumption, and increase the share of renewable energies. It also proffers local commitment to responsible consumption lifestyle through the efficient use of natural resources. Freiburg’s land-use planning, energy, and waste management policies etc. have been framed in line with these guidelines. The following sections discuss these key

sustainability policies in Freiburg, and how they have shaped the city's developmental trajectory over the years.

6.3.4 An analysis of sustainability policies in Freiburg

6.3.4.1 Energy policy

On energy policy, Freiburg has espoused three basic principles: renewable energy use, energy efficient technologies, and energy saving (Gregory 2011). As noted earlier, the founding myth of Freiburg's green urban transition was an environmental movement that inspired a quest for alternative energy sources to nuclear power. Therefore, much of Freiburg's initiatives at the early stages of its transition to Green Urbanism were predominantly energy centered. It, therefore, comes as no surprise that Freiburg was previously called the "Solar City" in the 1990s before the label was changed to "Green City" when the Green Party was voted into power in the early 2000s (Joss 2010).

Over the years, several renewable energies (e.g. solar, biomass, hydro, wind, and geothermal etc.) have been exploited to ensure a rapid phase-out of nuclear energy. Solar energy is the most ubiquitous renewable energy technology in Freiburg because of the abundance of sunlight in the region. In fact, personal communications with some researchers at the University of Freiburg revealed that Freiburg has the highest concentration of sunlight in Germany; hence, the substantial rise in the uptake of solar energy (figure 6.2). Other renewable sources, particularly, wind energy have yet to gain momentum due to restrictive State policies on the construction of wind turbines (Stadt Freiburg 2011). In addition to solar, Freiburg has made significant progress in the development of energy efficient technologies such as cogeneration plant (i.e. combined heat and power-CHP). The latter is identified to supply about 50 percent of the city's electricity needs (Gregory 2011). Freiburg's CHP produces both electricity and heat from renewable sources such as wood chips, geothermal, and biogas etc.

Installed PV capacity in Freiburg since 1989 in Megawatt

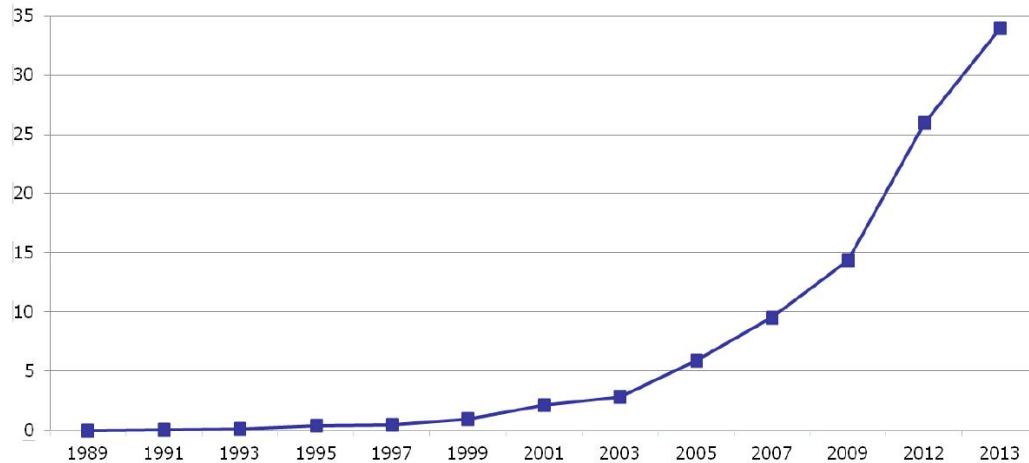


Figure 6.2: Trend of PV installation in Freiburg in three decades (Source: Innovation Academy)

Freiburg aims to transition to 100 percent renewable energy by 2050 as part of its vision to become a carbon neutral city by the same time (Stadt Freiburg 2017). Such ambitious targets are not uncommon in strategic plans of cities; however, they are often met with little success. For example, an earlier target set by the City Council to reduce carbon emissions by 25 percent by 2010 only resulted in a marginal 5 percent reduction in CO₂ emissions (Stadt Freiburg 2011). Despite this poor performance, in 2014 the City Council set a new target of reducing CO₂ emissions by 50 percent by 2030, and by 100 percent by 2050. Certainly, the solution to these ambitious targets does not lie in the declaration of intent, but requires real commitment that goes beyond mere rhetoric. Freiburg has made considerable progress in this regard compared with most cities in Germany and elsewhere. However, there is still much to be accomplished not only with mainstreaming renewable energies, but also ensuring the efficient use of the latter. One way the City Council has attempted to address issues of end-user energy efficiency is by enforcing low energy construction standards for all new buildings constructed within the city (Stadt Freiburg 2015a).

6.3.4.2 Building policy

Apart from promoting renewable energies, energy saving is another important area of Freiburg's energy policy. The latter feeds into the city's building and construction standards. Since 1992, Freiburg's City Council demands new buildings to be constructed to low energy standards. This requirement implies that all newly constructed buildings in Freiburg should not consume more than 65 kWh/m²/yr, compared with the national standard of 75 kWh/m²/yr (Gregory 2011). This standard was strictly applied to the development of Freiburg's model districts of Rieselfeld and Vauban in the late 1990s (Freytag et al. 2014; Medearis & Daseking 2012). To remain in the vanguard of low energy development, Freiburg also introduced passive housing standards in the early 2000s to further reduce the energy consumption of buildings to 15 kWh/m²/yr. The latter is not mandatory, but promises significant reduction in energy use in buildings.

In the last decades, several demonstration experiments have been undertaken in Freiburg to promote passive housing standards in new developments. For example, the construction of the Heliotrope in 1994 (see figure 6.3) as the world's first energy-plus house (by Architect Ralph Disch) became a major source of inspiration for high performance buildings in Freiburg and across Germany (Michler 2013). Subsequently, the development of the solar settlement in Vauban (Solarsiedlung) as PlusEnergy housing community in the early 2000s, and the renovation of high-rise residential apartments in *Weingarten* to passive standards in 2011 also gave further impetus to passive buildings in Freiburg. Although passive houses cost 10 percent more to build, they promise to deliver energy savings and CO₂ emission savings between 50-80 percent (Moran et al. 2014; Sadineni et al. 2011).



Figure 6.3: Freiburg Heliotrope: World's first energy-plus house (Source: Michler 2013)

6.3.4.3 Waste policy

In accordance with the Aalborg Commitment, Freiburg has also adopted an ecological waste management concept that aims to avoid and/or reduce waste, recycle unavoidable waste, and generate energy from unrecyclable waste. Hence, the goal is to ensure that there is no waste in the long-run. Freiburg has one of the most efficient waste management systems in Germany and across Europe with a recycling rate of 69 percent (Stadt Freiburg 2011, p. 50). This rate of recycling is above the German and European averages of 45.6 percent and 25.3 percent respectively (da Cruz et al. 2014). The success of Freiburg's waste management approach is largely attributed to the environmental consciousness of its citizens, and the application of efficient waste management technologies.

Since the late 1980s, Freiburg has embarked on a campaign on sustainable consumer behaviour to avoid or reduce waste in the first place. Thus, Freiburg's waste management company (Abfallwirtschaft und Stadtreinigung Freiburg GmbH -ASF), works together with academic institutions and civil society groups to create awareness on waste avoidance through information brochures, annual waste calendar, waste avoidance competitions, press releases, and educational campaigns among others. By instilling a more responsible consumption behaviour in its citizens, Freiburg has progressively reduced its waste from private households (see figure 6.4), and achieved a lower per capita waste production (i.e. 124kg) compared with the German average of 143kg (Stadt Freiburg 2011, p.30).

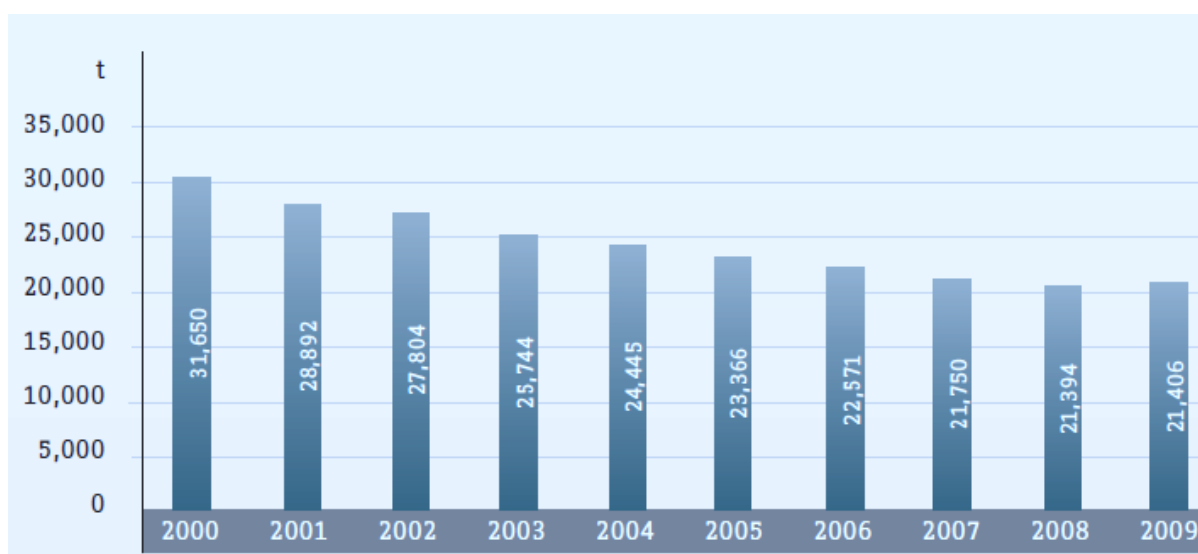


Figure 6.4: Waste from private households- 2000 - 2009 (Source: Stadt Freiburg 2011, pp.51)

In addition to behaviour change, Freiburg has adopted an eco-friendly waste recycling system to convert waste into reusable products, secondary raw materials, and/or energy. The share of recycled waste in Freiburg has increased tremendously from 17,000 tons in 1992 to 60,000 tons in 2009 (Stadt Freiburg 2011, p.50). This progress has been possible because of the introduction of an efficient waste separation systems in Freiburg. Households are required to separate their waste into different bins designated for papers, plastics, compostable wastes, glass containers, and unrecyclable wastes in order to facilitate waste sorting and recycling.

During a field visit, some households pointed out that Freiburg’s waste management company (i.e. *Abfallwirtschaft und Stadtreinigung Freiburg GmbH* -ASF) issues a caution to fine or refuse to pick the waste if they are not sorted properly. In an interview, an international student at the University of Freiburg recounted his experience of receiving an email from ASF, cautioning residents in his apartment for poor sorting; and explaining how they should separate their waste appropriately. According to some interview respondents, the efficiency of the waste separation process has been a major contributor to the improvements in the share of waste recycling in Freiburg over the years. The unrecyclable waste materials undergo environmentally friendly incineration process to generate electricity for about 25,000 households (Stadt Freiburg 2011, p.52).

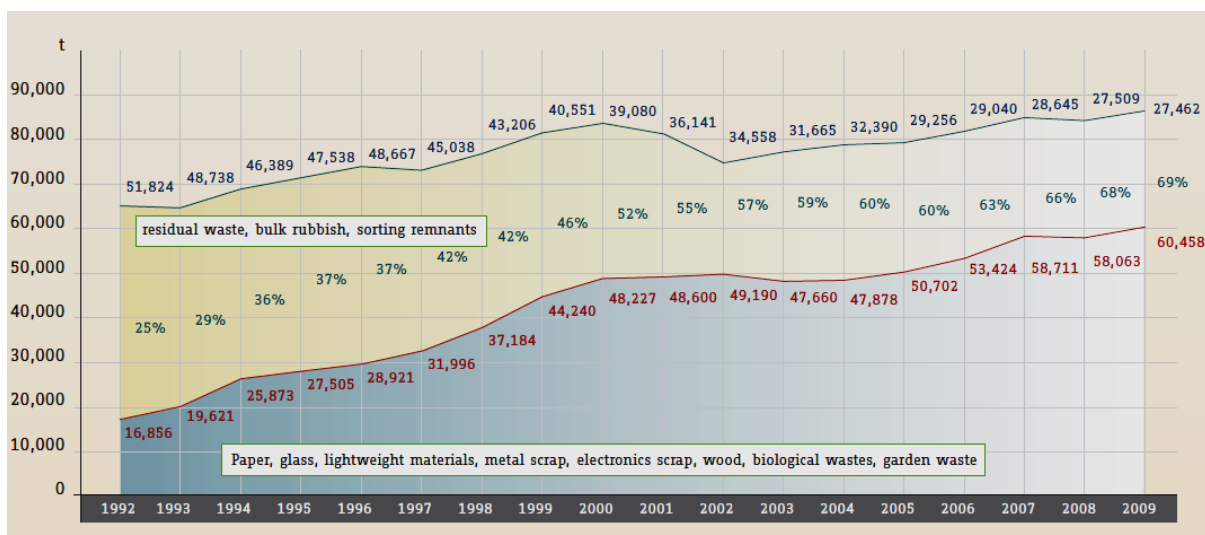


Figure 6.5: Recycling share: 1992 - 2009 -Freiburg’s households (Stadt Freiburg 2011, pp.50)

6.3.4.4 Land-use planning

Land-use planning is an important determinant of the physical character of cities, and how they perform. In this regard, the Aalborg Commitment recognizes efficient land-use planning as one of the key sustainability strategies European cities can apply to reduce their environmental impacts. The Commitment requires member cities to: (1) avoid sprawl and promote infill development; (2) give preference to brownfield redevelopment to greenfield development; (3) promote mixed-uses of spaces by creating a balance between housing, services, and jobs among others; and (4) ensure the conservation of urban cultural heritage (Stadt Freiburg 2012a).

Over the years, Freiburg has portrayed itself as a city of short distances, with a land-use policy that supports the functional integration of urban spaces, infill development, brownfield regeneration, and forest conservation in lieu of greenfield development (Ryan & Throgmorton 2003). The concept of “five fingers” (see figure 6.6) was adopted by the city to create transit-oriented development along five transport routes, interspersed with green wedges for agricultural and recreational purposes. Freiburg places much importance on the preservation of its green spaces (especially the rich Black Forest and Rhine River valley etc.) which has been a major source of attraction to the city (Beatley 2012). Consequently, about two-thirds of the city’s total land area (about 102.05 km² out of 153.07 km²) is devoted to green uses (Daseking 2013).

As part of the City Council’s policy of reviewing its land-use plan every two decades, the Freiburg 2020 land-use plan was launched in 2002 with active citizen participation to replace the city’s Master Plan of the 1980s (Stadt Freiburg 2016). The process went through three stages of dialogue i.e.: (1) the development of planning guidelines based on LA 21; (2) information events and identification of three scenarios for future development; and (3) extended civil participation in scenario discussions. These processes were carried out between city authorities, citizen groups, and planning experts under the aegis of a cross-departmental steering committee for integrated urban development (i.e. *Projektgruppe für integrierte Stadtentwicklung- PRISE*). The latter was set up in the city Mayor’s office to coordinate the planning process, and engage all relevant stakeholders in a constructive discussion (I.C.L.E.I 2006).

The dialogue resulted in the development of three possible scenarios for the future development of the city. All three alternatives emphasized green space conservation and mixed-use development. In the end, majority of the citizens decided on the scenario with the least amount of land for development to ensure the conservation of natural resources (e.g. Forest, water bodies, biodiversity etc.). By this decision, majority of the participants wanted a reduction of about 50 percent in the proposed area for outward development in the 1980/99 land-use plan (Stadt Freiburg 2016). Alternatively, participants emphasized infill development to optimize the existing water, energy, and transport infrastructure among others. In 2005, the plan was introduced to the public and presented to the mayor as a “vote of Freiburg’s citizens” (I.C.L.E.I 2006, p. 4). This proposal was further discussed with the various stakeholders (city authority, planners, and citizens etc.) and approved to serve as a blueprint for Freiburg’s medium to long-term development.

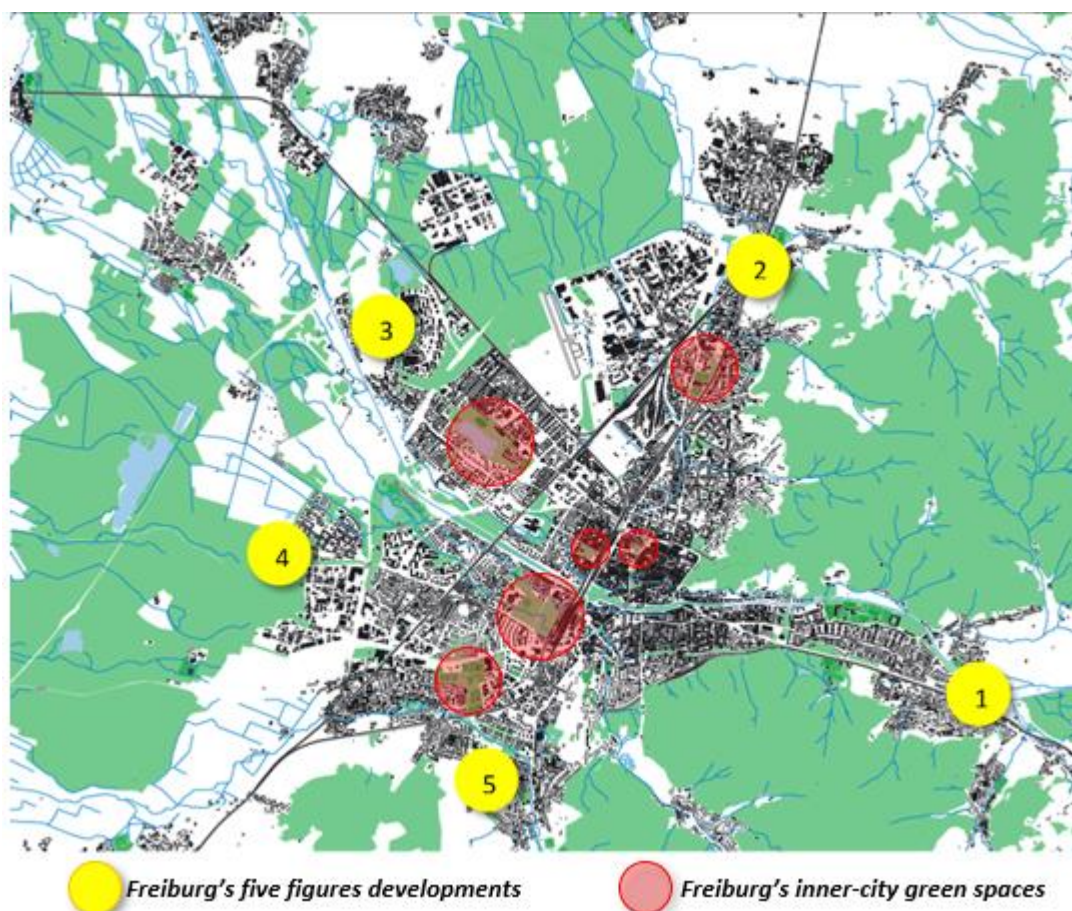


Figure 6.6: Freiburg’s City map with surrounding green wedge (Modified from Academy of Urbanism 2013)

6.3.4.5 Transport policy

Sustainable mobility is another key policy area endorsed by member cities in the Aalborg Charter and Commitment. The transportation sector is identified as a major contributor to global CO₂ emissions and climate change (Chapman 2007; Davis et al. 2010). Therefore, the Aalborg Commitment emphasizes the need for a reduction in the dependence on private motorized transport through an increase in the share of public transport, low-emission cars, biking, and walking. To achieve these objectives, it is important for cities to consider the modal split (varying proportions of different modes of transport used at any given time) of their transport system, and support policies that promote less polluting and more active modes of transport (Litman & Burwell 2006).

Freiburg is renowned for its commitment to environmentally friendly modes of transportation (trams, biking, and walking). By integrating land-use and transportation policies, Freiburg is reputed to be a bicycling city and a city of short distances (Beatley 2012). In the first place, the land-use plan of the city is designed to promote mixed-use development that ensures the integration of residential, commercial, recreational, educational, and health facilities among others. This development approach has been shown to reduce travel distances and dependence on cars, while encouraging active transport e.g.: biking and walking (Grant 2002; Newman 2016; Renne 2016; Vale 2015).

The City Council's decision to reduce cars in the city, and work towards more sustainable modes of transport dates back to the late 1970s. This decision informed several dramatic policies such as the: conversion of the city center into a pedestrian zone (see figures 6.8-6.9); conversion of the Wiwili bridge (connects the square of the church "Herz-Jesu-Kirch" to the city center) from a vehicular route to a bicycling route (see figure 6.7); expansion of the tram lines; introduction of German first transferable flat rate monthly transport ticket; redevelopment of existing roads to accommodate pedestrian and bicycling routes; introduction of regulations to calm traffic in all neighbourhood streets to 30km per hour; and the provision of bike parking spots in the city among others (Buehler & Pucher 2011). The underlying objectives of these policies were to expand public transport networks, promote bicycling, encourage walking, create liveable streets, and restrict private motorized traffic as

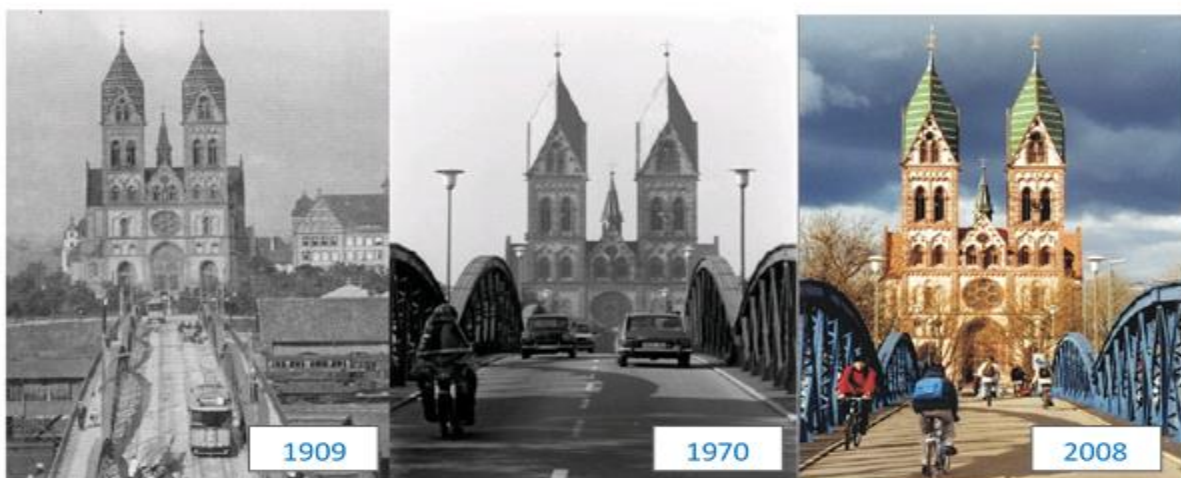
much as possible (Stadt Freiburg 2011). The successful implementation of these policies has enabled the co-existence of different modes of transport in Freiburg.



Conversion of city center into pedestrian zone (Source: Innovation Academy)



Freiburg City Center in 1950 and now (Source: SEE-Change)



Restriction of car use in the city center- Wilwili bridge (Source: Innovation Academy)

Figure 6.7: Transformations in Freiburg city center (Modified by author)

Freiburg’s modal split (see figure 6.8) shows an increase in bicycling and the share of public transport over the years. In the early 1970s, Freiburg was one of the few cities that maintained its tram network; although the tram system was being abandoned in most cities in Germany. This decision was complemented by the introduction of a financial incentive (i.e., affordable travel pass) to encourage public transport patronage (FitzRoy & Smith 1998). To make public transport more efficient and attractive, the City Council also made significant investment in the expansion of its tram lines (from 14.2 km in the 1980s to 30.4 km in 2011). This development has made tram services accessible to 80 percent of the population in less than 500m (Stadt Freiburg 2011, p.22). Hence, more people can walk or bike to a tram station in reasonable distance (see isochrones map in figure 6.9). Furthermore, the City Council has instituted measures to discourage private transport by, for example, charging high parking fees (about 2.20 Euros per hour) in the city. They also support car sharing enterprises through the provision of free parking lots at some vantage points within the city. By 2020, Freiburg aims to achieve a modal share that is predominated by cycling, walking, public transport, and car-sharing while reducing private car dependence to the barest minimum.

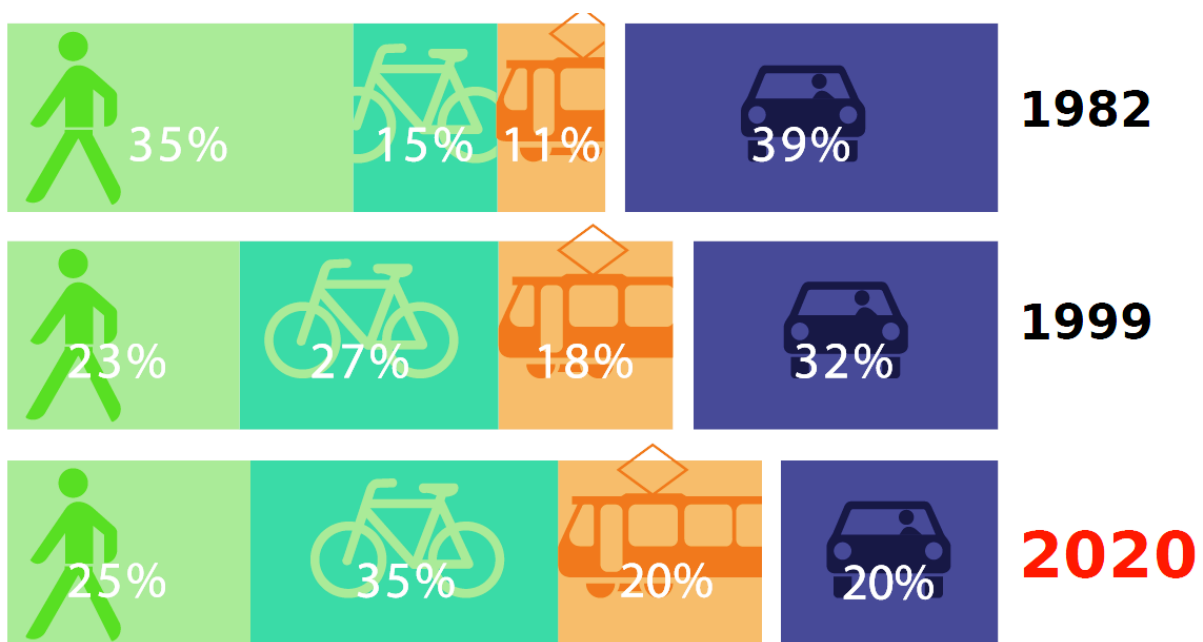


Figure 6.8: Modal Split in Freiburg's Transportation (Source: Innovation Academy)

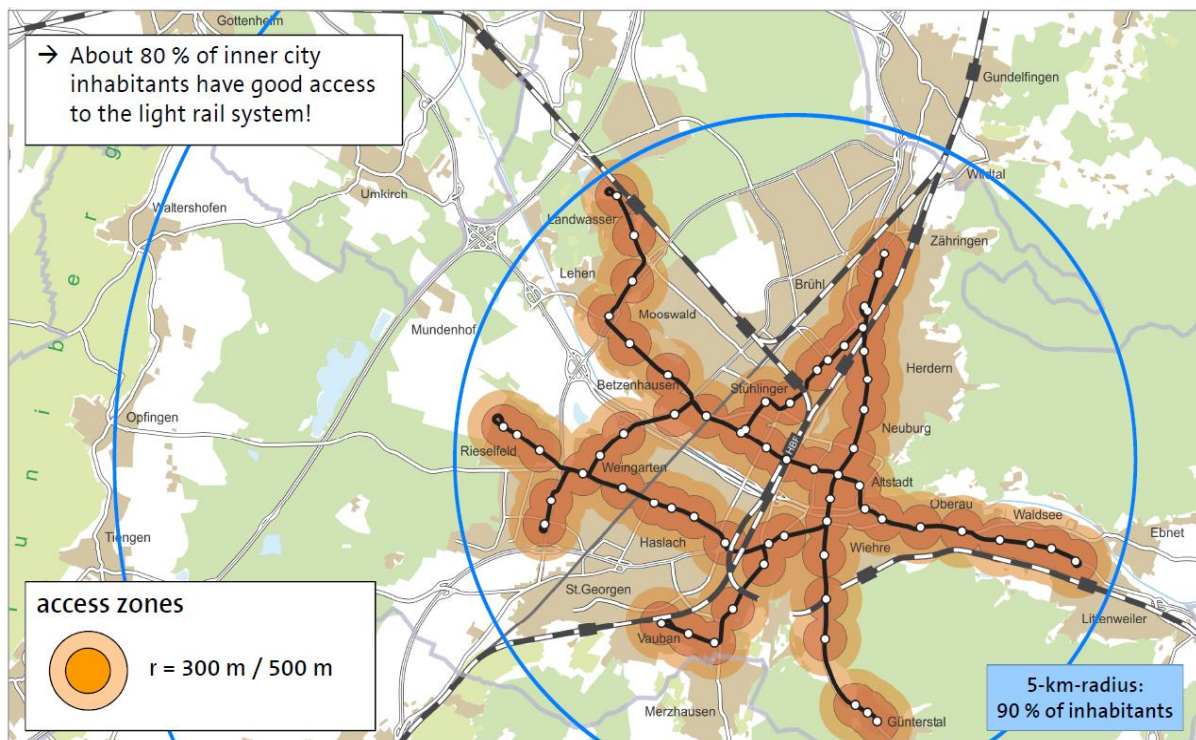


Figure 6.9: Extension of public transport network (Source: Stadt Freiburg)

6.3.4.6 Water policy

As Fagan et al. (2015) put it, water is life. The Aalborg Commitment categorizes water under natural common goods that needs to be protected, preserved, and distributed equitably. Freiburg’s water policy aims to achieve these goals by promoting the efficient management and (re)use of both natural water resources and stormwater. One of the most famous landmarks in the city is the Freiburg Bächle (i.e. clear water running through narrow gutters along streets and alleyways in the old city). As a foreigner, I was intrigued by the cleanness of the water (although the gutters are open), and how this system has been kept running for several decades. Some residents claimed that the water cooled the city in extreme hot weather. In fact, it is believed that any foreigner who accidentally steps into the Bächle will inevitably marry a Freiburg citizen. The care given to these narrow streams only accentuate how the local people in Freiburg value water. At the policy level, the City Council has introduced a split-rate water billing system that determines the amount of stormwater fees to be paid by private or commercial property owners based on the total area of impermeable surface of their sites (Keeley 2007). This policy aims to encourage in-situ treatment of stormwater to reduce pressure on the city’s flood and rain retention basins.

6.3.4.7 Urban governance approach

As noted earlier, participatory urban governance forms one of the fundamental requirements of the Aalborg Commitment. According to the latter, member cities are to: (1) promote commonly shared long-term vision for a sustainable city; (2) build participation and sustainable development capacity in the local community; (3) invite all sectors of local society to participate effectively in decision-making; (4) make our decisions open, accountable and transparent; and (5) cooperate effectively and in partnership with adjoining municipalities and towns. Freiburg's commitment to these principles is evident in its approach to policy formation and implementation processes. As mentioned in previous sections, most of the key sector policies were developed with strong public participation. The 2020 land-use plan, for example, was revised based on public consensus (I.C.L.E.I 2006). In addition to effective civic engagement, Freiburg also uses environmental education and fiscal incentives to promote key sustainability policies in, for example, the waste, transport, housing, and energy sectors. These 'soft' governance tools are also complemented with negative incentives to enforce existing regulations where voluntary compliance fails.

6.3.5 Summary

In the past four decades, Freiburg has adopted an integrated sustainability approach that is expressed in a holistic urban development concept. The focus has not only been about environmental and climate protection but also about the people, and their socio-economic wellbeing. A good number of Freiburg's sustainability initiatives predate the LA 21, Aalborg Charter, and the Aalborg Commitment. However, the City Council's endorsement of these global and regional non-binding action plans has reinforced and streamlined Freiburg's sustainability policies. It has also provided guidelines for Freiburg to think globally and act locally. The successes achieved in the implementation of some of these policies have earned Freiburg several national and international recognitions. Some of these awards include: German Green Capital (1992); European Local Public Transport Award (1995); Region of the Future (2000); 1st prize for sustainable ecological building in Vauban (2005); European OSMOSE Award (2007); and Cycle-friendliest city in Baden-Württemberg (2013) among others (Stadt Freiburg 2015a, p.23).

The success stories of Freiburg have made the city attractive to policy-makers, corporate institutions, local governments around the world, researchers, and tourists alike. A stream of over 25,000 tourists are said to visit the city every year (Stadt Freiburg 2011, p.57). In a personal conversation with a staff of Innovation Academy, it was found out that most of these visitors express particular interest in Freiburg’s model districts of Rieselfeld and Vauban where much of Freiburg’s green initiatives have been experimented. The following sections take an in-depth look at how the various policies discussed above have been applied in real life situation drawing on the cases of Rieselfeld and Vauban.

Table 6.1: Milestones of Freiburg’s green urban development initiatives

Time	Policies/Activities/ Achievements
1973	Conversion of Freiburg city center to pedestrian zone.
1975	Anti-nuclear protest in Wyhl
1977	Formation of the Oeko-Institut as a scientific research and advisory center.
1979	Refined transport plan (Generalverkehrsplan) with a focus on the integration of transportation and land-use plan to create a city of short distances.
1981	Establishment of the Fraunhofer Institute for Solar Energy Systems ISE.
1984	Introduction of Germany’s first environmental ticket i.e.: transferable flat-rate monthly transport ticket.
1986	Formation of Environmental Protection Office
1987	City Council’s decision to calm all neighbourhood streets to 30km/h.
1987	Introduction of 2,200 bike parking spots in the city.
1991	Implementation of ecological waste management concept.
1992	Adoption of low energy construction standard for urban buildings.
1992	Awarded as German Green Capital
1994	Construction of the Heliotrope as the world’s first energy plus house.
1994	Formation of Regional Transport Authority to synchronize activities of less formal public transport planning agencies and operators since the 1980s.
1995	Commencement of Rieselfeld’s planning and development processes.
1995	European Local Public Transport Award.
1996	Endorsement of Aalborg Charter.

1998	Vauban planning and construction.
1999	Revision of land-use plan with broader citizen participation resulting in the demand for more mixed-use and infill development.
2000	First German passive apartment building realized in Freiburg.
2002	Award of Vauban-Freiburg as Sustainable Model District in Dubai.
2003	First place in the Solar Federal League.
2004	Establishment of the Solar Info center.
2005	Presentation of revised land-use plan (2020 land-use plan) to the mayor as a “vote of Freiburg’s citizens”.
2005	<ul style="list-style-type: none"> • First prize for sustainable ecological building in Vauban. • First place in the Solar Federal League.
2006	Signed Aalborg Commitment
2006	First place in the Solar Federal League.
2007	Adoption of climate protection plan aiming for 40% reduction on CO2 emissions by 2030.
2007	European OSMOSE Award.
2008	Introduction of Transport Policy aimed at reducing private car trips; promoting public transport, bicycling, and walking; and enhancing short distance travels.
2009	<ul style="list-style-type: none"> • Establishment of Freiburg’s sustainability targets. • Introduction of 6040 more bike parking spots in the city.
2010	<ul style="list-style-type: none"> • Federal Climate Protection Capital. • European City of the year.
2011	First renovated residential high-rise worldwide to reach passive house standard.
2012	Recipient of first German Sustainability Award for cities and towns.
2013	Cycling plan to ensure one-third of all trips are undertaken by cycling by 2020.
2013	Cycle-friendliest city in the State of Baden-Wuttemberg.
2014	Climate protection target of 50% less CO2 by 2030, and carbon-neutral by 2050.

6.4 Green initiatives in Freiburg: an analysis of the model districts of Rieselfeld and Vauban

Freiburg is widely recognized as a pacemaker in sustainable urban development. In the late 1990s, Freiburg crowned this accolade with the construction of two model districts i.e.: Rieselfeld and Vauban. Both districts were developed in response to the huge housing deficit that confronted the city in the 1990s. The projects were conceived at a time when Freiburg had already rolled out most of its green initiatives in e.g.: renewable energy, sustainable transport, ecological waste management, and low-energy construction and passive house standards among others (Stadt Freiburg 2015a, p.2). Hence, both districts became testing grounds for these initiatives. To reinforce their commitment to sustainable approach to urban development, the City Council aimed for the redevelopment of brownfield sites in both projects. This criterion qualifies as one of the key principles of ecologically sensitive urban development (Register 1987; Roseland 1997).

Therefore, an erstwhile sewage farm (Rieselfeld), and a former French military base (Vauban) were chosen for the development of what would emerge as one of the most sustainable suburban developments in the world. Both districts were planned under the concept of transit-oriented development (Broaddus 2010; Cervero & Sullivan 2011); with energy efficient buildings, renewable energy technologies, and ecologically resilient urban infrastructure etc. which were all facilitated by active citizen participation (Coates 2013; Hamiduddin 2015; Medearis & Daseking 2012).

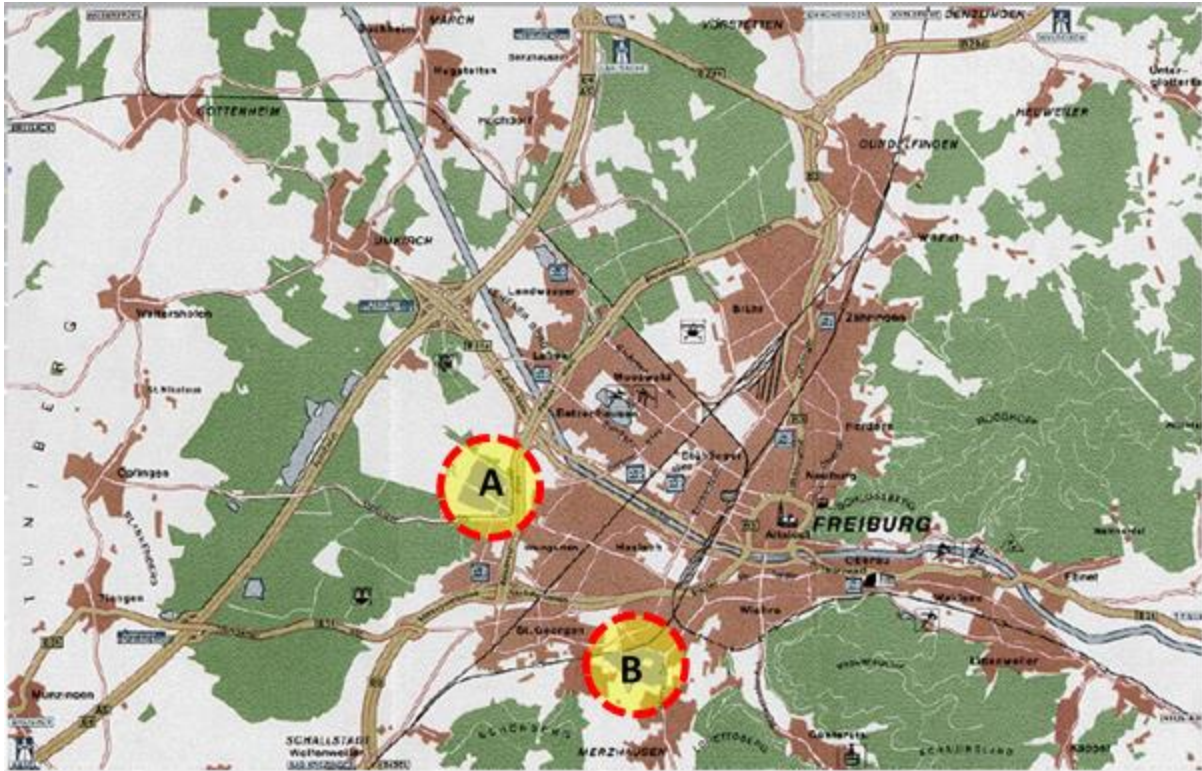


Figure 6.10: Location of Rieselfeld (A) and Vauban (B) in Freiburg im Breisgau (Source: modified from Stadt Freiburg 2012)

6.4.1 Rieselfeld: from a sewage farm to a “Green District”

The ‘green district’ Rieselfeld is situated in the western part of Freiburg. It covers an area of 3.2Km² (320 hectares). The name Rieselfeld means sewage field. This explains how the site was used for more than a century before its redevelopment (Stadt Freiburg 2012c). The housing deficit in the 1990s, coupled with soaring rental prices in Freiburg, is identified as the primary motivation for the development of Rieselfeld. Following resistance to the development of a satellite community in a forested area outside the city boundaries by some citizen groups, Rieselfeld was discovered as a compromise site, and an opportunity to redevelop a derelict site. The site had two main potentials: (1) it was the closest undeveloped land in Freiburg (about 7.9 km from the city center); and (2) it did not require the destruction of Freiburg’s greenfields (Drilling 2013). Accordingly, an extensive soil investigation was undertaken to remediate the soil to ensure its suitability for physical development. Out of a total of 320 hectares of land identified, only 22 percent (70 hectares) was approved for redevelopment with the remaining 78 percent (250 hectares) designated as nature reserve (Stadt Freiburg 2012c, p. 1).

The planning process began with an open urban development competition (*Städtebaulicher Wettbewerb Rieselfeld*) commissioned by the City Council in 1992 (Drilling 2013). The main planning and design criteria included: functional integration of spaces with high residential density; ecological urban infrastructure; diversity in housing typologies; transit oriented development; urban planning scheme that incorporates the concerns of families, children, women, elderly and handicapped people; low-energy construction; promotion of biodiversity and high quality of green spaces; and the application of adaptive urban planning approach among others (Stadt Freiburg 2012c, p. 1-3). The latter (adaptive planning) is identified as a way of creating a self-learning environment where urban development processes evolve with emergent dynamics in cities (Rauws & De Roo 2016). Therefore, the development of Rieselfeld was undertaken in four stages of construction to build on previous experiences, and improve project outcomes (see figure 6.11). The development process started with the construction of service infrastructure in 1994. This phase was financed via a trust fund outside the City Council's budget. The Council covered an initial cost of Euro 155 million for planning and public infrastructural development which was recouped through the sale of plots (with a share of infrastructure cost) to prospective residents and investors (Stadt Freiburg 2012c).

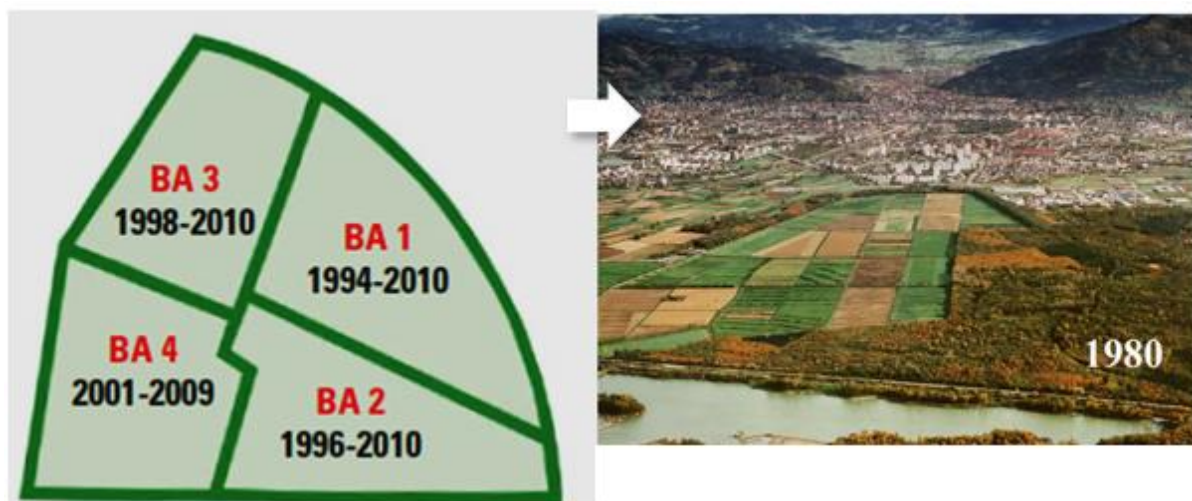


Figure 6.11: Four phases of Rieselfeld development (Source: Stadt Freiburg 2012)

An estimated number of 4200 residential units for about 11,000 people were proposed for development on the site. The residential buildings were developed in tandem with infrastructure services and public facilities such as schools, gymnasium, churches, shopping facilities, station for fire brigade, private services (e.g. health, banking, retail, and law etc.), and a sports center for children and young adults (see figure 6.12). The mix of both residential

and commercial facilities, as well as private and public services enabled the creation of local employment opportunities (about 1000 new jobs). It also promoted the efficient use of public infrastructure, enhanced neighbourhood vitality, and encouraged pedestrian and bicycle travel (see: Cervero & Sullivan 2011; Jacobs 1961). Hence, Rieselfeld has less private vehicles per 1000 people than in Freiburg i.e.: 408 per 1000 people in Freiburg, and 292 per 1000 people in Rieselfeld (Broaddus 2010). Major highlights of Rieselfeld’s development are its planning processes and sustainability initiatives. The next sections discuss how these factors unfolded in Rieselfeld.



Figure 6.12: Spatial configuration of Rieselfeld district (Source: Stadt Freiburg 2012c)

6.4.1.1 Planning processes in Rieselfeld

The outcome of the “Urban Development Competition Rieselfeld” (*Städtebaulicher Wettbewerb Rieselfeld*) organized by Freiburg’s City Council formed the basis for the design and development of Rieselfeld. The underlying objective of the district’s planning concept was to promote sustainable urban lifestyles and practices e.g.: mobility, energy consumption, waste, and water management etc. (Stadt Freiburg 2012b). In line with the Aalborg Commitment, the City Council set up the Project Group Rieselfeld which provided a forum for specialist from the city planning department to engage with outside actors (e.g. investors, potential residents, and churches etc.). This dialogue helped to accommodate the concerns of all relevant stakeholders in the planning process, and solicited for grassroots support for the sustainability targets set for the district.

Apart from social housing which was funded (or subsidized) by the City Council, the development of Rieselfeld was open to commercial developers, individuals, and self-organized groups -*Baugruppen* (Ryan & Throgmorton 2003). The latter (*Baugruppen*) was formed from existing social networks or professional associations (Coates 2013; Hamiduddin & Daseking 2014). The buildings were organized into series of blocks surrounding a central courtyard which served as a ‘green lung’ for recreational and ecological purposes. Each block had a mix of commercial developers, private residents, and self-organized groups. The integration of different stakeholders in one block ensured diversity in both the social and architectural elements of the buildings in order to break the social and/or architectural homogeneity commonly associated with real estate development (see figure 6.13).

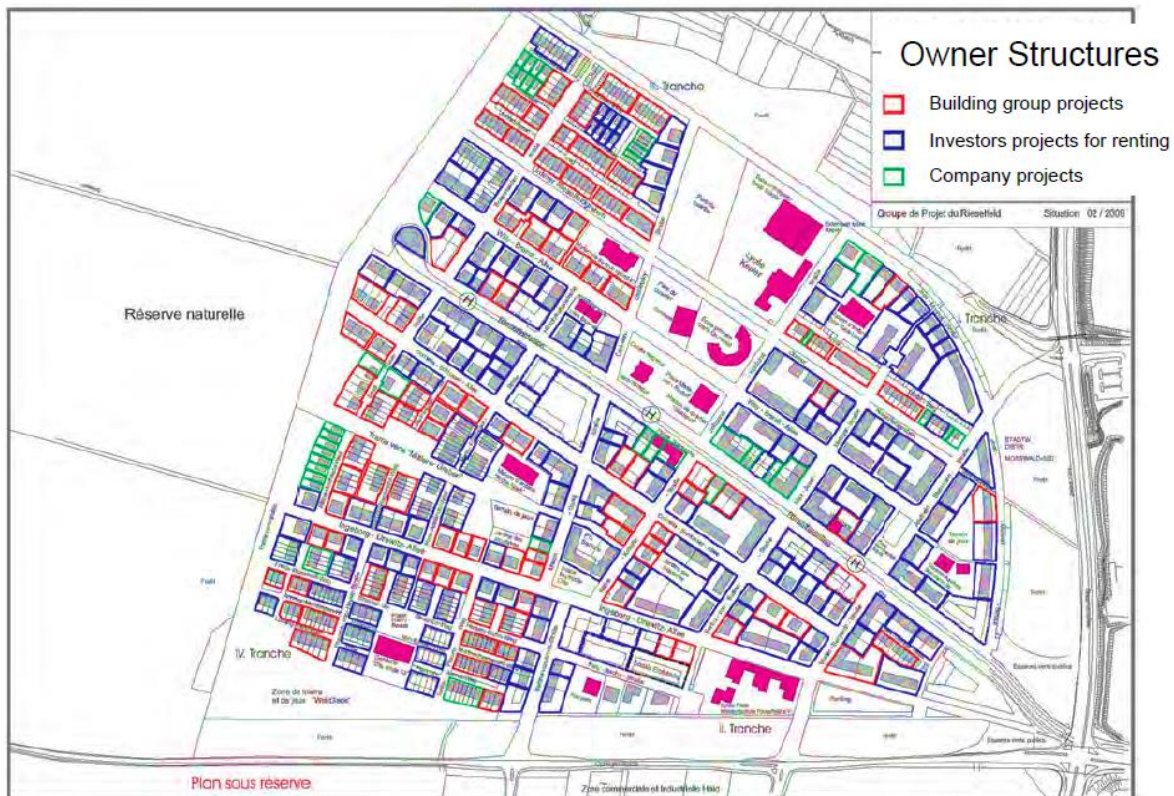


Figure 6.13: Ownership structure in Rieselsheld (Source: Freiburg Future Lab)

The idea of self-organized or co-housing groups (*Baugruppen*) was introduced to enable prospective neighbours to engage with each other, and share ideas on how they want their building blocks and immediate neighbourhoods to be designed. This process generally begins with identifying an affinity group of about 5 to 10 persons who come together to develop ideas on the design and financing of their building units. Once a group is satisfied with the outcomes of their deliberations, they apply to the City Council for a building lot. After acquiring the lot from the Council, the group then engages the services of an architect and other allied consultants to develop their collective design concept.

This approach is identified to have economic, social, and environmental benefits to society (Krokfors 2012). For example, in the field interviews, it was found that co-housing reduces building cost by 30 percent due, in part, to the distribution of consultancy cost (e.g. architectural design fees etc.) among group members. Besides, it builds social trust and creates a sense of place among residents (Ache & Fedrowitz 2012). Other studies have also shown that co-housing is more energy and resource efficient as more people conglomerate and share common spaces or facilities together (Gram-Hanssen et al. 2009; Williams 2007). According to Krokfors (2012), unlike individually owned housing communities, co-housing

communities are better able to support and implement sustainability principles through collective actions and social control. Indeed, Rieselfeld owes much of its community commitment to sustainability initiatives to the participatory environment created by its self-organized construction groups (Stadt Freiburg 2012d).

6.4.1.2 Sustainability initiatives and practices in Rieselfeld

Urban sustainability is a function of both the physical characteristics of cities, and the lifestyle of its people (Jenks et al. 2003; Spence & Pidgeon 2009). Sustainable land-use planning (e.g. high density mixed-use and transit-oriented development etc.), for example, has the potential of inducing more sustainable behaviour (e.g. biking, walking etc.) among citizens (Saelens et al. 2003). Besides people with sustainability-oriented values are also more likely to plan their communities to foster a sustainable lifestyle. Hence, both the physical and the social components of cities are mutually reinforcing in the development of sustainable cities. Therefore, a sustainability deficit may arise when one component is overlooked.

This phenomenon holds true for Freiburg in general, and Rieselfeld in particular. As noted earlier, the fallouts from the anti-nuclear protest in Freiburg inspired a new approach to urban development that gave due regard to both social and ecological processes. This commitment informed the City Council's sustainability concepts for the planning and development of Rieselfeld. With more than 85 percent of residents in Rieselfeld coming from Freiburg (Stadt Freiburg 2012d), the new district was naturally absorbed into Freiburg's thinking (i.e. environmental consciousness). This socially shared legitimacy belief helped to create grassroots support for the sustainability policies implemented by the City Council in Rieselfeld. These policies can be seen in the land-use planning of the district, as well as the transport, housing, energy, water, and waste sectors.

6.4.1.2.1 Land-use planning in Rieselfeld

Rieselfeld's land-use planning was undertaken with due consideration to both ecological and social concerns. The district was planned to nurture nature, and support the everyday life of its people while minimizing their dependence on the central city of Freiburg for both social and commercial services. This idea resonates with Howard's Garden City concept (see: Howard 1902) although there are no traces of replication. With about 320 hectares available for the planning and design of the district, only 70 hectares were approved for residential

development with the remaining 250 hectares designated as nature reserve. The residential enclave was also designed with both public green space and private green courtyards to bring nature closer to the people.

The layout of the residential units (building blocks with a green courtyard) is reminiscent of Cerda's *Eixample* in Barcelona (see: Cordua 2010) which is considered to be a precursor of green urban development (Neuman 2011; Pallares-Barbera et al. 2011). In addition, both public and private developments in Rieselfeld portray what Beatley and Newman (2013) refer to as biophilic urbanism (celebrating and nurturing nature around us). The biophilic concept influenced the design of the residential blocks, most of which were built to accommodate nature on the building facades. As mentioned in Chapter 2, this design approach has been shown to deliver positive physiological and psychological outcomes, as well as promote ecosystem functions (Beatley 2009; Maller et al. 2006)

Another important area of emphasis in Rieselfeld's planning concept is the functional integration of spaces. The project aimed for a mix of residential, commercial, educational, ecclesiastical, cultural, and recreational facilities among others in a high residential density (see figure 6.12 above). The shopping facilities were mostly located at the ground floor of buildings developed along the tram line which serves as the central axis of the district. These buildings were mostly five stories high (with a mix of residential and commercial uses), and the density reduced to four or three stories towards the outer edge of the district.

By avoiding the separation of living and working spaces, a total of about 100 private and public businesses were created locally which offered about 1000 jobs to the local people (Stadt Freiburg 2012d). As pointed out by Newman (2010), the more people work close to their living spaces, the more cities reduce their ecological footprint, minimize their dependence on the automobile, and mitigate carbon emissions. It is, therefore, not surprising that Rieselfeld has a relatively lower car dependency ratio than the city of Freiburg as a whole (Broaddus 2010). Moreover, the integration of different functional spaces has helped to create a district of short distances which has had significant impact on the modal split of Rieselfeld.

6.4.1.2.2 Transportation concept in Rieselfeld

Rieselfeld was planned as a transit-oriented development, with high residential density organized around a public transport system (tram line). The tram was introduced in 1997 (three years after construction begun) to connect the district to the city center of Freiburg. The underlying principles for Rieselfeld's transport system include: easy access to public transport by all residents in the district; prioritization of walking and cycling; general speed limit of 30 km/hour; and play streets where children have priority over cars. The tram line has three stops which makes public transport accessible to more than 90 percent of the resident in less than 500m radius. Hence, almost everyone in Rieselfeld can access the public transport in a reasonably short distance.

As shown in figure 6.14, in terms of accessing services within Rieselfeld such as shops, restaurants, community center, schools, churches, sports center, offices, and nature reserves, residents are more likely to walk or use their bicycles due to the efficient integration of these services in the residential areas. This ease of accessibility accentuates the benefits of integrating land-use planning and transport in the design of city neighbourhoods. In terms of accessing services in the city center of Freiburg, the options available to residents from their homes include: walking to the tram station, bicycling, or using private cars. Another option is to commute via car-sharing. The bicycling option was found to be the most efficient mode of transport in terms of saving time, money, and transport emissions.



Figure 6.14: Mobility options in Rieselfeld- Developed from Google Earth and Freiburg's online Public Transport routes and schedule system (Author's construct)

6.4.1.2.3 Energy and building concepts in Rieselfeld

The underlying principles of Rieselfeld's energy policy are to reduce energy consumption, use energy more efficiently, and generate energy through renewable sources as close as possible to where the energy is used. By constructing all buildings to low energy consumption standards (65kWh/m²/annum), Rieselfeld uses less heating energy (about 50 percent) than conventional districts in Freiburg. On average, buildings in Germany use an estimated heating energy of 220kWh/m²/annum which is more than three times the consumption rate in Rieselfeld (field interview). Some of the residential blocks were also designed to passive house standards to further reduce the energy required for heating to 15 kWh/m²/annum; and total primary energy consumption to 120kWh/m²/annum (Stadt Freiburg 2011; Williams 2013). These energy standards are complemented by the positive attitudes of residents towards

energy efficient practices. In general, energy literacy in Freiburg is relatively high which contributes to the efficient use of energy among its citizens on a daily basis.

The generation of renewable energies close to the point of usage is another important principle of Rieselfeld's energy policy. A substantial amount of electricity is lost in transmission (Wirfs-Brock 2015). Hence, electricity generated locally has the potential of avoiding transmission losses to minimize waste, and contribute to the overall efficiency and resilience of energy systems (Newman & Matan 2013). Thus, a combined heat and power (CHP) plant was installed at Weingarten (3.2 km from Rieselfeld) to supply the energy and heating needs of Rieselfeld. The CHP increases energy efficiency by capturing heat that is normally wasted or lost in energy production (Kanoglu & Dincer 2009). In addition, the City Council supports the use of solar energy in Rieselfeld and other districts in Freiburg by providing fiscal incentives to households. For example, a solar roof programme has been introduced to provide capital subsidy to residents in order to reduce the cost burden of procuring solar panels. Besides, a feed-in tariff scheme has been implemented to provide operational subsidy to local residents (Williams 2013). Nevertheless, the uptake of solar energy in Rieselfeld and Freiburg in general is still low (about 35 percent) given Freiburg's global reputation as an international center of excellence in solar energies.

6.4.1.2.4 Waste and water management concepts in Rieselfeld

Rieselfeld's waste management approach is consistent with Freiburg's ecological waste management concept which has become mainstream in Germany and across Europe. It emphasizes avoidance, reduction, and recycling of inevitable waste into primary or secondary products. The waste separation system which was introduced in the early 1990s forms the backbone of Freiburg's success as one of the highest waste recycling cities in Europe (about 69 percent recycling rate). This system underpins Rieselfeld's waste management practices. Every household in Rieselfeld has a minimum of three bins to sort and separate their waste before disposal. The segregation is done as follows: green bins for papers and cardboards; brown bins for organic kitchen and garden waste; and black bins for residual waste such as sweepings, textiles, broken glass, and hygiene products etc. Residents are also given yellow bags to sort plastic and metal wastes. As noted earlier, Freiburg's waste management company (i.e. ASF) imposes fines to discourage improper sorting. Besides, social control has

been another key instrument for enforcing compliance. Neighbours are each other's watchdog to ensure people conduct themselves appropriately. This voluntary cross-monitoring practice is identified as one of the important ways of building a sense of community, and promoting collective action towards sustainable development (Chavis & Wandersman 1990; Janowitz 1975; Lindblad et al. 2013).

In addition to the efficient management of waste, stormwater management has also been considered carefully in the design of houses and neighbourhood infrastructure in Rieselfeld. Stormwater management in Rieselfeld is addressed through a decentralised (in-situ) and centralised (wetland) infiltration process. In the first instance, buildings are required to have roof gutters to collect rainwater for reuse. Besides, every private or commercial property is required to reduce ground surface sealing to minimize stormwater runoff. In an interview, a City Council member noted that new developments that fail to comply with these requirements are not granted the permit to build. Existing developments are charged stormwater fees commensurate with the total area of impermeable surface of their properties (Keeley 2007). In addition to these decentralized stormwater management strategies, excess rainwater from houses and roads etc. is collected in permeable gutters and then directed to wetlands designed to serve both ecological and recreational purposes. To avoid excessive runoff of stormwater and the risk of flooding, pavements for pedestrians and parking lots are also designed to be permeable to enhance rainwater infiltration.

6.4.1.3 Summary

From planning to construction and daily practices, Rieselfeld can be seen to exemplify the underlying principles of Green Urbanism. The emphasis on citizen participation in most of the decision-making processes contributed markedly to the output legitimacy of the project outcomes (Kronsell 2013). Accordingly, a survey conducted in 2010 on residents' satisfaction in Rieselfeld showed that about 85 percent of the residents were generally satisfied with the living conditions in the district in terms of the diversity in social and cultural lifestyles, efficient public and private infrastructure, child-friendliness of the neighbourhood, proximity to nature, and easy access to the city center etc. (Stadt Freiburg 2012e). A grassroots organization namely *KIOSK im Rieselfeld* played an important role in communicating the concerns of prospective residents to the Project Group Rieselfeld during the planning process.

This bottom-up engagement helped to enhance the neighbourhood character (or place identity) of Rieselfeld.

In addition, the ecological standards applied to the design of buildings and the development of neighbourhood infrastructure etc. have given Rieselfeld a reputation as a best practice model for urban sustainability (Muhs & Clifton 2016). It is, however, disappointing to note that after almost two decades of its development, there has not been any comprehensive assessment of the sustainability performance of Rieselfeld to test the veracity of its claims. One of the major reasons attributed to this shortfall is a lack of sustainability performance indicators in Freiburg. As mentioned earlier, the Sustainability Council of Freiburg has yet to ratify Freiburg's sustainability indicators.

6.4.2 Vauban- a “Green District” from a military site

Like Rieselfeld, Vauban emerged out of growing demand for housing in Freiburg in the 1990s. It occupies a total area of 41 hectares out of which 16.4 hectares was designated as residential area; 1.6 as light industrial area; 2.6 hectares as green spaces; 12.4 hectares as traffic area; 2 hectares as public spaces; and 3 hectares as mixed-use area. The site (see figure 6.15) for this development was previously occupied by French troops after the Second World War (WWII). The original name of the district was Schlageter Army Barrack. This name was later changed to “Quartier Vauban” in memory of a French master fortification builder Sebastien le Prestre de Vauban (1663-1707) who served as a military architect to King Louis XIV (Vauban District Association 2009).

Following the fall of the Berlin wall in the late 1980s, and the reunification of Eastern and Western Germany in 1990, the French Forces withdrew from the district in 1992 and reverted ownership of the district to the German Federal Government. A year after the exit of the French army, Freiburg's Municipal Council decided to purchase the site from the federal government for residential development to address its housing crises. This decision led to the acquisition of the site in 1994 (for about EUR 20 million). Subsequently, a design competition was organized to solicit plans for the redevelopment of the site. This competition was won by architects Kohlhoff & Kohlhoff from Stuttgart. Their proposed plan served as the basis for stakeholder deliberations. Parallel to this high-level discourse, several grassroots discussions (by civil society and student groups) were also underway. These grassroots deliberations led

to the formation of Forum Vauban in 1994. The latter played a key role in fostering a rich and constructive dialogue between city officials and the local people in the planning and development of Vauban.

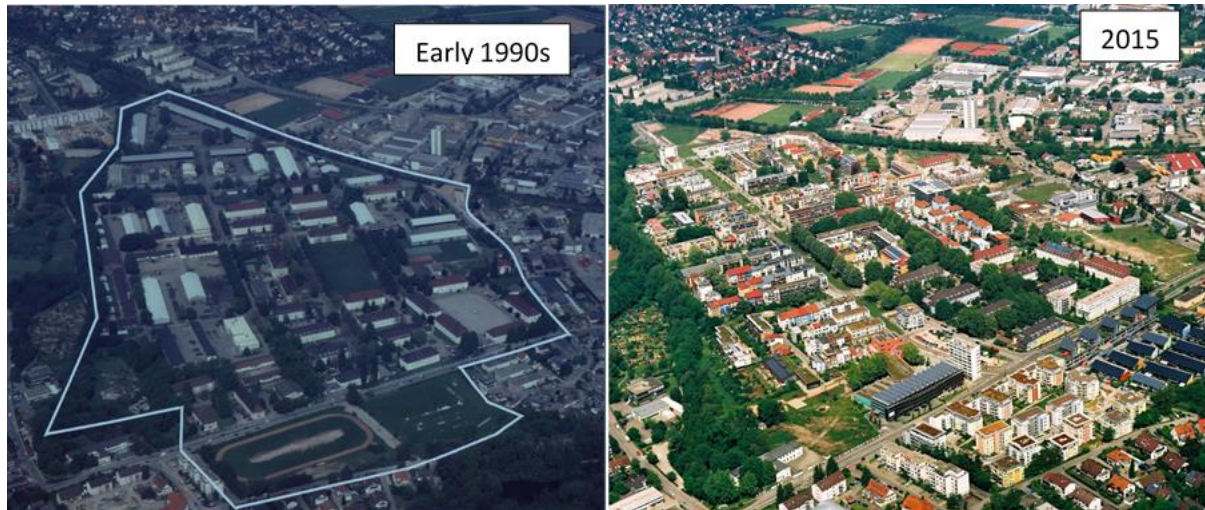


Figure 6.15: Vauban before (left) and after (right) its redevelopment (Source: Stadt Freiburg 2016)

6.4.2.1 Planning processes in Vauban

From the field interviews it was observed that although several citizen groups were actively engaged during the planning phase of Rieselfeld, the latter was largely viewed as a top-down initiative because of the leading role the City Council played during the conceptualization and implementation phases. Most decisions were determined by the Council based on the existing planning and development regulations e.g. parking space per household (Broaddus 2010). On the other hand, Vauban portrays a more bottom-up approach with most critical decisions receiving significant inputs from citizens. Some of the grassroots initiatives sometimes challenged and/or displaced the status quo. The success of this bottom-up process is largely attributed to the effectiveness of the Forum Vauban, and the political will of Freiburg's City Council to accommodate suggestions from the grassroots.

The City Council set up a quasi-public institution (i.e. Project Group Vauban- administrative body involving local authorities) to create a platform for effective dialogue between the local authorities and Forum Vauban (i.e. citizen groups). The latter emerged from a constellation of like-minded people who envisioned a sustainability model for the redevelopment of Vauban. It was a not-for-profit organization funded by public subscriptions, donations, and grants from both local and international organizations such as the German Federal

Foundation of Environment, Freiburg City Council, and the EU's environment program LIFE (Vauban District Association 2009). Through the work of Forum Vauban, a number of working groups were set up to develop a socio-ecological concept for the new district of Vauban. Important areas considered in this development included energy, transport, nature preservation, housing, and social equity among others.

6.4.2.2 Sustainability initiatives and practices in Vauban

Vauban could be seen as an urban laboratory for sustainability experimentation. Most of the novel ideas experimented in the district were initially viewed as ambitious and perhaps quixotic. Nevertheless, the development outcomes in Vauban have proven the utility of risk taking, educated guesses, and community spirit in achieving outstanding sustainability targets. Like Rieselfeld, the key policy areas were location efficient land-use planning, sustainable mobility, energy efficient buildings and renewable energy supply, efficient management of water and waste, as well as social and gender equality. On promoting gender equality, for example, the streets in the neighbourhood were named in commemoration of female scientists, women's right activist, and anti-fascists among others (Vauban District Association 2009). The following sub-sections discuss Vauban's approach to land-use planning, transportation, housing, and energy. The waste and water management concepts applied in Vauban are no different from that of Rieselfeld and Freiburg in general; therefore, they shall not be revisited.

6.4.2.2.1 Land-use planning in Vauban

The land-use planning of Vauban aimed for high residential densities of about 3 to 5 storeys, interspersed with open green spaces for both social and ecological purposes. As is the case in Rieselfeld, buildings in Vauban are relatively higher (about 5 storeys with commercial and social services at the ground floor) along the tram track which forms the district's main axis. They reduce to 4 and 3 storeys towards the outer edge of the district. The primary intent of this development approach was to ensure the integration of different functional spaces to enhance accessibility to local services and jobs within short distances.

Overall, Vauban has about 600 local jobs. This figure amounts to 0.12 jobs per capita which is higher than Rieselfeld's 0.09 local jobs per resident (Field 2011). These jobs are predominantly service providers, research institutions, and light industries. They include: restaurants, café,

bakeries, supermarkets, organic shops, bicycle shop, computer repair shop, florist, pharmacy shop, physiotherapist, and paediatrician among others. These facilities are effectively integrated with the residential development. For instance, the Sun Ship building which is identified as the first PlusEnergy commercial and residential building in the world accommodates retail shops, offices (for Oeko-Institut and the GLS-Bank), and apartments in penthouses on the top deck of the building.

Moreover, Vauban has both kindergarten and primary schools, a community center, a public square for social events, a local market for organic and locally produced agriculture products, and playgrounds for kids etc. The availability of these services in reasonable distances has created a somewhat self-contained community. Hence, the need to travel to Freiburg’s commercial and business district (CBD) is significantly reduced.

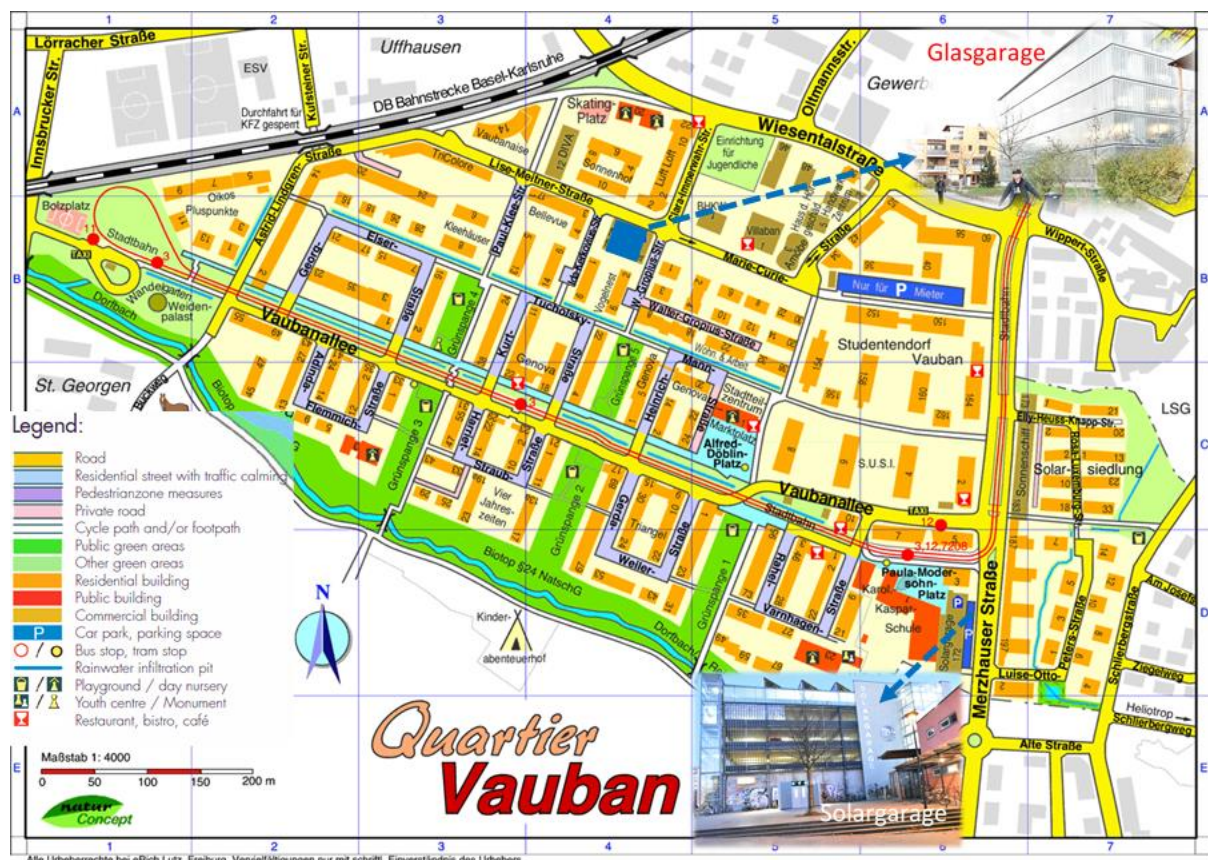


Figure 6.16: Vauban masterplan with U-shaped street design and two collective garages (Source: adapted from Stadt Freiburg)

6.4.2.2.2 Transportation policy in Vauban

The outcomes of the transportation policy (i.e. car-free concept) in Vauban is, perhaps, the linchpin of the district's sustainability concept. The idea of a car-free living is a bottom-up initiative that emerged from discussions between prospective residents and citizen experts in Forum Vauban (Frantzeskaki et al. 2016). Drawing on the proposed masterplan for the district, the City Council had already envisioned a sustainable transport plan for Vauban. The plan aimed to extend the city's tram lines to the district, and avoid through traffic by giving the neighbourhood streets a u-shape design (see figure 6.16 above). Nonetheless, the citizens group in Forum Vauban demanded stricter regulations to keep cars out of the district as much as possible.

The position taken by Forum Vauban was a contravention of the building regulation of the State of Baden-Wuerttemberg. This regulation required every housing unit to have at least one parking space. Thus, the idea of a car free living was initially rejected by Freiburg's City Council. Upon further deliberations between representatives of Forum Vauban and the City Council, a compromise decision was taken to decouple housing and parking cost, and develop collective garages for residents who wanted to own cars. Consequently, two garages (Solargarage and Glasgarage) were developed (see master plan in figure 6.16) at the cost of EUR 18,500 (Solargarage) and 22,500 (Glasgarage) to car-owning residents (Field 2011). On the other hand, car-free residents were obliged to sign a bond (renewable per annum) with the Association for Car-Free Living (i.e. citizen-based organization set-up by the car-free residents to administer their operations) to confirm their commitment to living car-free. They were, however, required to pay an amount of EUR 3,600 to the association which was used to purchase a site for the development of a garage if the members decided to own a car in the future. This site is presently used as a public green space.

By providing options for residents, a flexible system was created to avoid coercion and foster voluntary compliance. After all, there was enough financial incentive (a savings of between EUR 14900 and EUR 18900), as well as an efficient public transport system to encourage residents to opt for a car-free living. Out of 1000 households in Vauban's parking-free zones (figure 6.17), a total of about 420 households participate in the car free living initiative (Vauban District Association 2009). As shown in figure 6.18, Vauban has made significant

savings in land by forgoing the building regulations of the federal state, and avoiding on-site parking. These lands have been developed into public green spaces to promote contact with nature in the built environment. This observation brings to light how existing planning regulations could create lock-ins, and inhibit sustainable innovations that sit outside the mainstream.



Figure 6.17: Parking free zones in Vauban (Source: Stadt Freiburg)

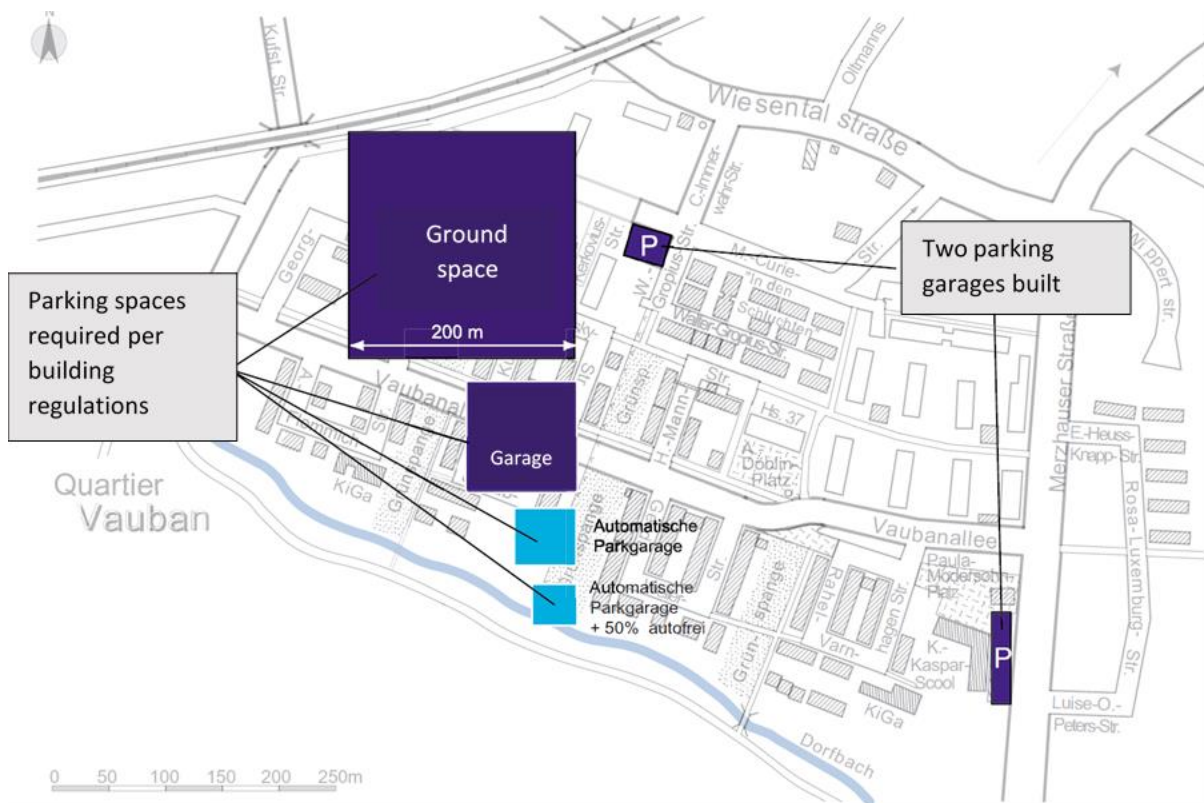


Figure 6.18: Parking concept in Vauban with significant land savings (Stadt Freiburg)

Vauban is not completely car free. In fact, cars are allowed into the district but only for loading and/or offloading purposes. There are also several public spaces designated as visitors’ parking. However, unlike Rieselfeld, streets in Vauban are designed with no side parking (see figure 6.19). Therefore, most neighbourhood streets are designated as play streets where cars are supposed to be driven at walking pace to allow children to use the space for recreational activities. The restrictions placed on cars coupled with the efficient integration of land-use planning and urban transportation have helped to enhance Vauban’s non-motorized modal share – about 64 percent (Field 2011; Scheurer 2001).

As illustrated in figure 6.20, unlike Rieselfeld, the first mobility options available to households in Vauban are walking and cycling. Even residents who own cars need to walk or bike to one of the collective garages. The next available and closest options are public transport (3 tram stops reachable within 300m radius), and twelve car-sharing vehicles with 30 dedicated parking spaces within the district (Vauban District Association 2009). This arrangement makes the private vehicle the last option in Vauban. Consequently, Vauban has one of the lowest car ownership per 1000 residents in Germany i.e.: Vauban 160; Rieselfeld 299; Freiburg 326; and Germany 411 (Field 2011; Frantzeskaki et al. 2016).



Figure 6.19: Typical residential streets in Vauban and Rieselfeld (Author's photograph)

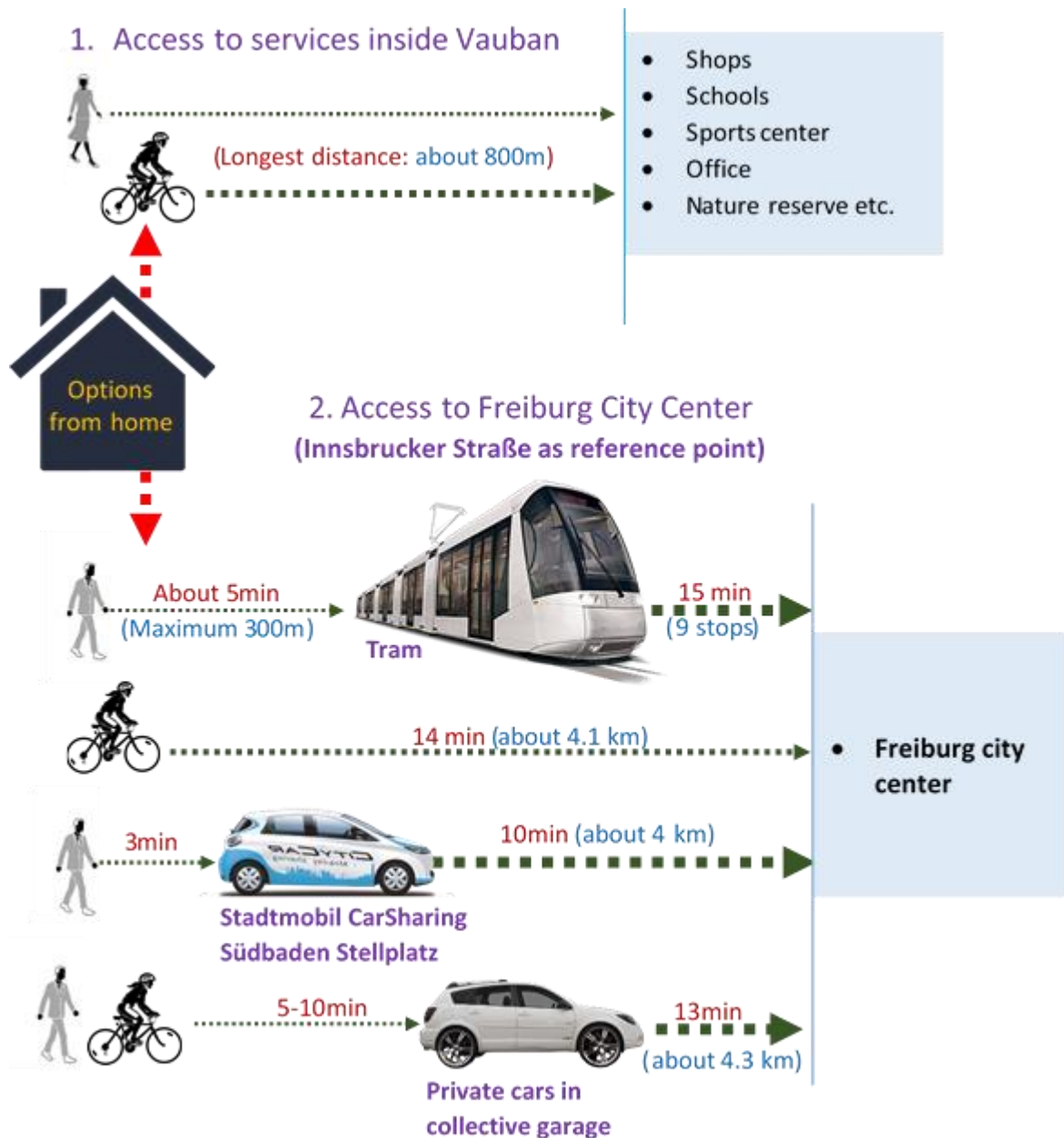


Figure 6.20: Mobility options in Vauban- Developed from Google Earth and Freiburg’s online Public Transport routes and schedule system (Author’s construct)

6.4.2.2.3 Housing and Energy concepts in Vauban

The housing concept in Vauban follows the classic cooperative principle of democratically self-organized construction groups (Baugruppen) which was earlier applied in Rieselfeld. Although this concept dates back to the early 1900s, Rieselfeld is identified as one of the first contemporary and large-scale applications of this collective housing approach (Reeve et al. 2013). Vauban has a mix of self-organized groups (*Baugruppen*), investors, and individuals to promote a socially diverse community. The highest priority was, however, given to the

Baugruppen due to the social and economic benefits accruing from this building collectives. For example, interviews with some residents in Vauban showed that the *Baugruppen* has helped to reduce the upfront and running cost of buildings as various spaces and facilities are shared among residents e.g.: guest rooms, utility areas, bicycle facilities, and common equipment such as washing machine and deep freezers.

A major shortcoming of the *Baugruppen* is the tendency to exclude citizens who do not have the financial resources to contribute to this collective development. This shortfall was partly addressed through the introduction of two social housing initiatives i.e.: SUSI, and affordable housing for students. The latter involved the conversion of former barrack buildings into affordable students' hostels by the City of Freiburg Student Union. The SUSI (Self-organized Independent Settlement Initiative) was founded as a non-profit organization in the early 1990s. It aimed to create affordable housing from the military bunkers in Vauban which had long stood empty after the exit of the French troops. The idea was to preserve the barracks and reuse available materials to create living spaces for low income people.

This initiative followed the principle of self-help development with contributions from residents (especially voluntary labour into the project). The project was largely financed through soft private loans and public subsidies. In sum, the SUSI raised EUR 5.37 million to convert four barrack buildings into 45 apartments for about 255 people at a rent of €5.20/m²/month (SUSI 2013). An interview with a resident in a SUSI apartment revealed that one had to show that he/she is on a low income to qualify to stay in one of these apartments. Like other building types in Vauban, the SUSI apartments were designed to be energy efficient with a higher proportion of renewable energies: about 50 percent renewables, and 50 percent from gas-operated cogeneration plant. The success of this affordable housing model in Vauban has resulted in the replication of the SUSI concept in about 37 cities across Germany.

Houses in Vauban are generally designed and built to high energy standards. Following the building regulations set by the City Council, all buildings were required to be built to a low energy consumption standard i.e. 65KWh/m²/annum. However, Vauban residents envisaged a higher energy standard (i.e. 15KWh/m²/ annum) by opting for passive and energy-plus houses, with support from experts from the Fraunhofer Institute for Solar Energy Systems, and Passive House Institute in Darmstadt (Thorpe 2014). Although these standards required

additional 10 percent investment, residents were motivated by the long-term energy savings they provided (Reeve et al. 2013).

With regards to energy, the major source of electricity in Vauban is a woodchip-powered combined heat and power plant (CHP) located within the district (see figure 6.21). In addition, the *Baugruppen* supported joint solar installations to reduce the cost burden involved in individual installations. These bottom-up initiatives together with federal government subsidies have made solar panels a lot more widespread in Vauban than other districts in Freiburg. This development has helped to lessen the burden on the public grid. In the Solar Settlement, for example, a surplus of about 9000 kWh per year is fed into the public grid (Vauban District Association 2009, p.23). To summarize, the successes of Vauban’s initiatives emphasize the utility of bottom-up democracy in driving sustainability policies in cities.

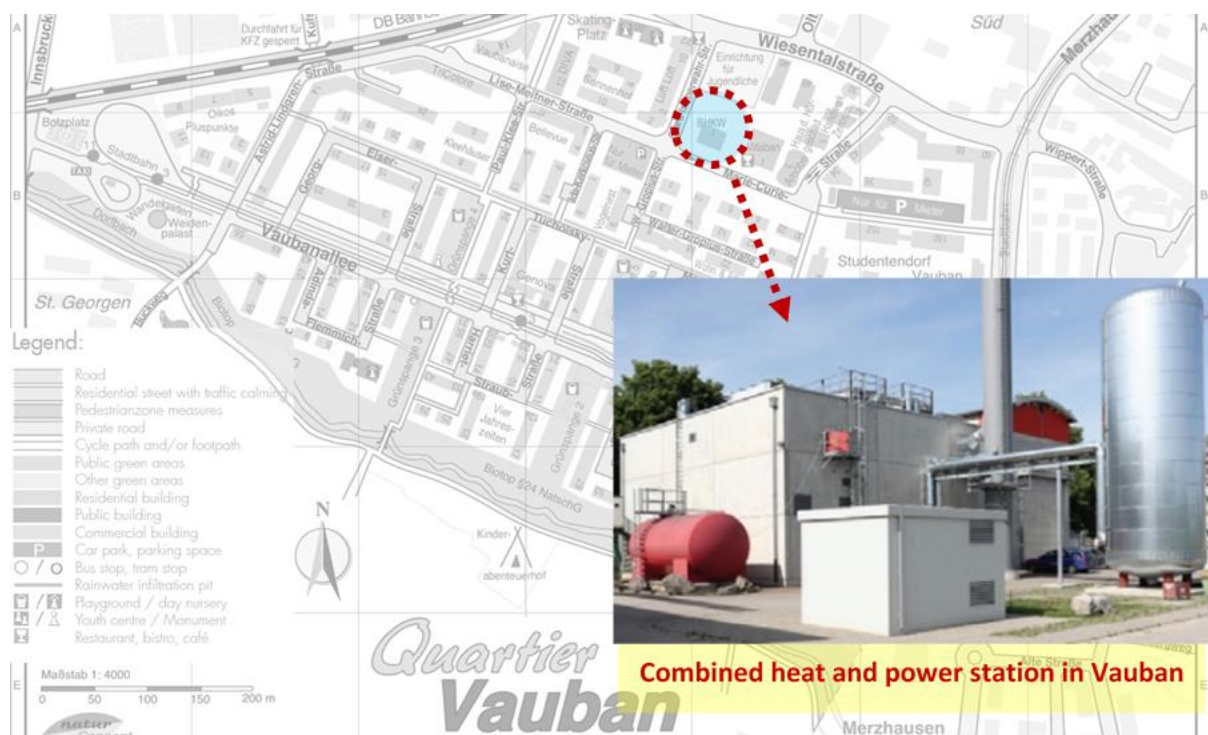


Figure 6.21: Woodchip-powered CHP plant in Vauban (Source: Stadt Freiburg)

6.4.3 Drivers and outcomes of the green concepts in Rieselfeld and Vauban

The successes of both Rieselfeld and Vauban districts are attributable to strong grassroots participation, and the consensus-oriented dialogue between the City Council and civil society. At first glance, both districts seem like normal residential developments with no iconic

architectural edifices that merit international awards. However, a closer observation reveals an ecologically pleasant living environment with specially designed buildings at higher energy performance standards etc. A curious mind may further discover: the location efficient land-use plan which fosters travelling at short distances; sustainable transport system; ecological waste management practices; comprehensive stormwater management system; as well as the ubiquity of renewable energies (particularly solar energy). But there is even more to these green initiatives than meets the eye: the support of socially shared expectations that engender voluntary compliance of citizens with the sustainability policies of the City Council.

A critical review of the development processes in both Rieselfeld and Vauban reveals that the latter was more grassroots driven than the former. This observation can be attributed to two fundamental reasons. In the first place, the City Council was in the vanguard of most decision-making processes in Rieselfeld more than in Vauban. Forum Vauban (citizen group) which was given a legal status by the Council played a prominent role in ensuring that the expectations of the people were given priority. Secondly, a greater share of the development in Rieselfeld was carried out by developers than the *Baugruppen*: about 80 percent for developers and 20 percent for building collectives (Loux 2009). The reverse is true in the case of Vauban. Since most developers are motivated by short-term profits, less attention was paid to architectural innovations (e.g. passive house standards) which may increase the cost of the building and deter potential buyers or renters. Besides, the developers strictly applied the building regulations of the federal government (e.g. parking standards) without taking risk with any innovations (e.g. car free concept) that might undermine the appeal of their projects to potential clients.

On the other hand, the greater share of the *Baugruppen* in Vauban enabled residents to experiment with novel ideas with long-term goals, and little or no apprehension about short-term cost. Consequently, Vauban was able to achieve a cutting-edge car free concept. In addition, the *Baugruppen* also created the opportunity for residents to design their immediate neighbourhoods, residential units, and private gardens among others. This engagement has created diversity in the physical environment and architectural character of Vauban more than in Rieselfeld.

Nevertheless, except for the SUSI and student hostel projects, Vauban has less social housing than Rieselfeld (Ryan & Throgmorton 2003). The City Council subsidized social housing projects undertaken by developers which was not the case for the *Baugruppen*. In fact, Vauban remains a special case because of the social status of majority of its residents (mostly middle and upper middle class). It remains to be seen how such a “rich society model” could be mainstreamed in traditional cities where different income groups co-exist. Perhaps a SUSI presents an answer.

Another shortcoming of Vauban is the question of how long-sighted grassroots driven cities are. In an interview undertaken to assess residents’ satisfaction of the district, some residents pointed out that there were limited facilities for young adults in the district (Kaiser, B 2012). This shortcoming can be traced back to the history of the district. During the planning and conceptualization phases, most of the members of the *Baugruppen* were young families (about 30 percent of the population were children under 18 as at 2009). Therefore, much attention was paid to creating a child-friendly community with little consideration of how that might translate into a young-adult-friendly neighbourhood. Rieselfeld adopted a better approach by providing sporting facilities and schools etc. that catered for the needs of both children and young adults. Some respondents attribute Rieselfeld’s success, in this regard, to the foresightedness of the city planners who played a more decisive role in the development of the district.

This reading is not to imply that the *Baugruppen* had no consideration of the future implications of their choices. However, it is to drive home the point that grassroots initiatives should be comprehensive, objective, and long-sighted to forestall the unintended consequences of subjective decisions, driven by self or collective interests. In fact, in the past few years, residents in Vauban have realized the need for more facilities for teenagers; hence, they have been engaging in a working group namely ‘Jugend’ (Youth) to create more spaces for young adults (Vauban District Association 2009).

6.5 Discussion

The sustainability achievements of Freiburg in general, and Rieselfeld and Vauban in particular bring to light the progress cities can make when sustainability policies coincide with

political will and unfaltering grassroots support. It is important to understand the drivers of these policy outcomes to inform the transferability of these initiatives to other contexts. According to the City Council, the enabling factors that supported Freiburg's sustainability achievements is the so-called "Freiburg mix": an interplay of historical, political, social, economic, and geographical factors (Stadt Freiburg 2015a). Specifically, the City Council identifies four key factors that underpin Freiburg's successes: (1) high level environmental awareness among its citizens; (2) political will and commitment to sustainability principle; (3) the geographical characteristics of Freiburg (i.e. green with abundant sunlight); and (4) the promotion of targeted businesses and institutions towards sustainable niche innovations.

In the first place, the citizens of Freiburg are identified as environmentally conscious people (a.k.a. the Freiburg Spirit) which dates back to the city's history of staging one of the few successful environmental movements in Europe in the early 1970s. The success of the anti-nuclear movement brought about the conglomeration of diverse interest groups who have, over the years, pursued an agenda that protects Freiburg's environment, and promote innovative ideas towards sustainable urban development.

Freiburg's political regime has also been supportive of these ideologies. With the election of German first Green Mayor (Dieter Salomon) in Freiburg in 2002, the City Council has further improved its sustainability plans, especially, with regards to climate protection policies towards reducing CO₂ emissions. In addition, the City Council together with Freiburg's School and Education Bureau (ASB) have pursued widespread environmental education on waste avoidance, energy and water savings, and organic food consumption among others. This initiative primarily focuses on kindergarten and elementary school children. The idea is to prepare the minds of the young generation to support and further enhance the city's sustainability goals.

The City Council also promotes social events that get students engaged in sustainability activities. For example, a personal communication with a group of high school students revealed that when students graduate to high school, they are required to undertake one voluntary project that supports Freiburg's sustainable development. From the discussions with the students, it became obvious how environmental education at a younger age can help mainstream environmental ethics, and foster voluntary compliance with sustainability

policies. In fact, education has been one of the essential governance tools for promoting Freiburg's sustainability policies. Other tools applied include fiscal incentives (e.g. subsidies for solar panels), and fines (e.g. stormwater fees) to deter environmentally harmful practices.

Freiburg also sees its climatic conditions (sunniest city in Germany), and green features (especially the Black Forest) as key elements of its green image. The abundant supply of sunlight has provided a solid foundation for the mainstream application of solar energy technologies in Freiburg. Besides, the Black Forest provides ecological benefits, and also serves as a source of attraction to tourists. A good number of residents were quick to point to the Black Forest as the beacon of Freiburg's green image. In fact, most of the residents engaged in this study identified 'green' to mean the nature reserve in Freiburg. Few residents associated 'green' with, for example, the transport, energy, and waste policies in Freiburg. This observation cannot be generalized to the entire population of Freiburg; however, it brings to light how the 'green concept' might be conceived and interpreted by ordinary citizens.

An interview with a City Council member brought forward a different perspective to Freiburg's green agenda. Green was interpreted to mean mitigation measures to reduce carbon emissions. This definition is consistent with the objectives set out in most of the City Council's published documents (e.g. Freiburg Environmental Policy document, and Freiburg GreenCity brochure etc.). In essence, Freiburg's City Council places more emphasis on reducing CO₂ emission (in transport, economic activities, waste, housing, and energy production/consumption etc.) when it talks about its 'green concept'. On the other hand, some members of society prioritize the preservation of the environment (especially the Black Forest) in their interpretation of the 'green concept'.

This imbalance in the prioritization of goals has been a major source of conflict between the City Council and local residents; although the expectations of both parties are consistent with the underlying criteria of the 'green concept'. For example, a proposal by the City Council to include a section of Freiburg's nature reserve in a proposed residential development (Dietenbach district) that aims to address the city's soaring housing deficit has been strongly opposed by the local people. According to a City Council official, the local residents noted in a consensus building meeting with the City Council that they will not allow even one tree to

fall. Consequently, the Dietenbach project is still in the process of dialogue for a more effective and amicable solution.

Beyond these conflicts, an important question that has yet to be fully addressed is how Freiburg (and its model districts) performs against its sustainability standards. Unfortunately, there is no comprehensive and consistent reporting of Freiburg's sustainability performance. As noted earlier, the Sustainability Council has yet to ratify indicators for Freiburg's 60 sustainability goals. Some civil society groups engaged in this study expressed disappointment about the lack of transparency in the City Council's evaluation of the performance of Freiburg. Some opined that the public were told what they wanted to hear for political capital. An objective analysis and consistent reporting of Freiburg's sustainability performance will not only help to allay these suspicions, but also enhance understanding of the outcomes of these initiatives, and how they might be improved and/or deployed to inform future applications.

That said, Freiburg presents a model through which the criteria of Green Urbanism and the processes of their application might be examined. The analysis above has highlighted how Freiburg exemplifies these criteria. Table 6.2 below provides a summary of these criteria (discussed in Chapter 2), their underlying objectives, and how Freiburg performs against them. As shown in Table 6.2, Freiburg fares well with respect to most of the criteria outlined below. Fundamental to this achievement is the city's respect and care for nature. However, urban agriculture, which is one of the means of promoting nature and biodiversity in the built environment, is rapidly declining due to the development of most urban farm lands into residential apartments. This development is necessitated by the perennial housing shortage in Freiburg, and the growing population of economic migrants and students in the city. It remains to be seen how much growth Freiburg can accommodate and still preserve its green character. This observation is symptomatic of some of the potential conflicts that might arise in the pursuance of environmental, social, and economic sustainability.

Table 6.2: Principles of Green Urbanism: A review of its application to Freiburg

General criteria	Principles of Green Urbanism	Description of principles	Application in Freiburg
1. Land-use planning	Transit-oriented development	Maximizing the amount of residential, commercial, and recreational spaces etc. within a reasonable walking distance of public transport	<ul style="list-style-type: none"> • Introduction of the five fingers in Freiburg to bring residential developments close to public transit routes. • More than 85% of residents in Freiburg live in 500m radius from a tram stop.
	Compact development	High density	<ul style="list-style-type: none"> • Promotion of high residential densities in both Rieselfeld (129/ha) and Vauban (122/ha).
	Mixed-use development	<ul style="list-style-type: none"> • Functional integration of spaces • Self-sustainable development 	<ul style="list-style-type: none"> • Integration of residential, commercial, social, and recreational facilities etc. in the layout of Freiburg’s model districts. • Creation of local jobs and services (e.g. 1000 local jobs in Rieselfeld and 600 in Vauban)
	Biophilic development	Promoting green open spaces, green roof, nature reserve, and urban agriculture etc.	<ul style="list-style-type: none"> • Preservation of the Black forest. • Green private and public spaces in both Rieselfeld and Vauban • Green roofs and walls in Rieselfeld and Vauban • Weekly local markets in Freiburg, Rieselfeld and Vauban where local food is sold.
	Climate and context	Enhancing opportunities offered by topography and natural setting.	<ul style="list-style-type: none"> • Freiburg takes advantage of the abundance of sun in the city to promote solar energy • Appropriate orientation of buildings in passive house designs in Vauban to optimize daylighting and natural cooling/heating.
	Passive design	Low energy consuming construction	Development of passive houses in Vauban with less than 15 kWh/m ² /annum energy consumption.

2. Transport	Sustainable mobility	Promotion of public transport, car-sharing, bicycling, walking.	<ul style="list-style-type: none"> • Prioritization of public transport over private cars in the city center. • Introduction of car-free concept in Vauban. • Provision of bicycling routes in all districts in Freiburg. • Establishment of car-sharing companies in Freiburg city center, Rieselfeld and Vauban. • Projection to achieve 25% walking; 35% bicycle; 20% tram, and 20% car-sharing and private cars by 2020
	Zero emission vehicles.	Vehicles that emit no harmful pollutants from the onboard source of power	<ul style="list-style-type: none"> • Introduction of electric car-sharing services in Vauban.
3. Energy	Renewable energy	Solar, wind, hydro, biomass, geothermal etc.	<ul style="list-style-type: none"> • Advancement in solar technology and combined heat and power (CHP) systems from renewable sources.
	Energy efficiency	<ul style="list-style-type: none"> • Minimizing waste or losses in the production and consumption of energy 	<ul style="list-style-type: none"> • Decentralized electricity provision to minimize losses in transmission. • Education on end-user energy efficiency by trained energy saving advisors. • Policies supporting the use of energy efficient appliances.
4. Buildings	Energy efficient buildings <ul style="list-style-type: none"> • Passive design • Designing with context 	<ul style="list-style-type: none"> • Reducing energy consumption and greenhouse gas emissions from buildings 	<ul style="list-style-type: none"> • Adoption of low energy construction standard in Freiburg (65kWh/m² /annum). • Promotion of passive house standard and PlusEnergy buildings in Vauban.
	Retrofitting/ Local materials	<ul style="list-style-type: none"> • Reuse of buildings to reduce waste. 	<ul style="list-style-type: none"> • Conversion of old barracks building in Vauban into low-income housing
5. Waste	Circular metabolism	<ul style="list-style-type: none"> • Waste reduction • Waste reuse • Waste recycling and recovery 	<ul style="list-style-type: none"> • Waste segregation and recycling system in Freiburg • About 69 percent recycling rate

6. Water	End-user water efficiency and water sensitive design	<ul style="list-style-type: none"> • Efficient use and management of water 	<ul style="list-style-type: none"> • Stormwater fees to encourage on-site stormwater management • Permeable pavement and gutters to increase stormwater infiltration. • Wetlands to accommodate excess rainwater runoff. • Promotion of water efficient appliances and fixtures in households. • The use of recycled water to irrigate public parks.
7. Urban governance	Participatory urban governance	Grassroots engagement in decision making processes.	<ul style="list-style-type: none"> • High grassroots participation in public policies in Freiburg. • Establishment of Rieselfeld Project Group and Forum Vauban.
	Green Public Private Partnership	Cooperation between the public and private sectors as well as civil society in promoting green urbanism.	<ul style="list-style-type: none"> • City Council liaise with civil society, and research institutions such as the Oeko-Institut, and Fraunhofer ISE etc. in public policies. • Collaboration between City Council and Forum Vauban in the planning process.
	Shared learning	Incremental learning from other cities and a city's own experiences	<ul style="list-style-type: none"> • Shared learning of experiences at Aalborg conferences. • Incremental construction in Rieselfeld and Vauban to "learn while planning"
	Green education	Environmental awareness creation	<ul style="list-style-type: none"> • Organization of environmental campaigns and competitions in schools.
	Placemaking	Creating sense of community and promoting local identity	<ul style="list-style-type: none"> • Establishment of community organization such as KIOSK and Forum Vauban in both Rieselfeld and Vauban respectively. • Creating opportunity for residents to design public gardens in Vauban.
	Social equity	Social inclusion of marginalized/low income people.	<ul style="list-style-type: none"> • Subsidized housing in Rieselfeld • SUSI projects in Vauban

6.6 Conclusion

Freiburg has long been acknowledged as an exemplar of Green Urbanism. This recognition is reinforced by the numerous national and international awards the city has received in the past four decades, especially, in sustainable environmental policies, and effective urban governance. The processes and outcomes of the city's sustainability innovations present a model for reframing existing cities towards more sustainable trajectories. Nonetheless, it is important to mention that the current study recognizes Freiburg's transition as a work in progress, but not an impeccable model of Green Urbanism. Indeed, as pointed out by Beatley (2012), the criteria of Green Urbanism are "overarching"; therefore, no one city can exhaustively address all its elements. Cities (like Freiburg) can strive towards these standards and provide practical examples for other cities to follow.

Essentially, the outcomes of Freiburg's sustainability initiatives reveal the benefits of leveraging different governance tools (education, incentives, regulations, tax, and fines etc.) to promote urban policies. The approach to Vauban's car free concept, for example, demonstrates the need to include both sticks and carrots in seemingly contentious urban policies. Vauban realized this goal by making car ownership and parking more expensive while providing other alternative modes of transport which are more environmentally friendly and economical. This approach provides a flexible space where people can make informed decisions, bearing in mind the implications of their choices. Hence, less burden (both cost and time) is placed on city authorities to enforce compliance (Hurrelmann & Schneider 2015).

Another important observation in this case study is the potential barriers entrenched planning standards can present to sustainability innovations that sit outside the mainstream. As shown in the case of the car free concept in Vauban, the City Council disapproved of this initiative for lack of compliance with the existing planning regulations. But for the persistence of some local actors, the idea would have been asphyxiated by the decision of the city authorities. Ironically, the City Council highlights the car free concept as one of its key sustainability achievements in most of its policy documents. Against this backdrop, efforts by cities to transition to a more sustainable future should not only focus on introducing new policies, but also assessing how old or existing policies support or impinge on these goals.

Furthermore, the case study accentuates the benefits of engaging people in the formation and implementation of public policies. The creation of the Project Group Rieselfeld and Forum Vauban as platforms for public engagement proved useful in galvanizing grassroots support for the City Council's sustainability targets for both districts. As argued by Scharpf (2009, p. 5), participative decision-making "creates a sense of normative obligation that helps ensure voluntary compliance with...[policies] of governing authorities". Although this bottom-up process (or negotiated development) may be costly in terms of time and money in the short-term, it has the potential of producing positive externality effects in the long-run. Having said that, it is worth noting that the success of the bottom-up approach in Freiburg was largely predicated on an informed citizenry who made constructive contributions to the city's development plan.

Historically, Freiburg is identified as one of the classical university towns in Germany with a large percentage of highly educated citizens. Therefore, a significant number of Freiburg's grassroots movements were composed of experts who had the know-how to make meaningful and informed judgements. A typical outcome of these elites' grassroots activities is the Oeko-Institut which was formed by like-minded citizens in Freiburg to undertake research on alternative energy sources to nuclear power. Besides, Germany has a history of engaging citizens in public decision-making processes which has created the enabling environment for bottom-up democracy. This process is not a common practice in many jurisdictions. Therefore, it might be misleading to generalize bottom-up approach as a precondition for effective policy application in cities without giving due consideration to the quality (level of education) of their human resources, the prevalent socio-cultural norms, and the governance system they are embedded in. Against this background, it is important for cities to look inward, and assess their unique characteristics in order to identify a governance model (i.e. top-down, bottom-up, or a combination of both approaches) that might be effective and socially acceptable.

Post hoc analysis-Curitiba

An analysis of green urban transitions in a developing country context: the case of Curitiba (Brazil)

7.1 Introduction

Green Urbanism is mostly conceived in the light of developed countries. As mentioned in Chapter 2, much of the existing literature has predominantly focused on cases in Western and Asia-Pacific countries. Hence, there is little treatment of how Green Urbanism might be applied to developing countries, and how experiences of the latter might contribute to further operationalizing the concept. Against this background, this Chapter makes a contribution to the existing literature by drawing on the case of Curitiba (Brazil) to interrogate the strategies that are appropriate for transitioning cities from the developing world towards Green Urbanism. Curitiba is widely acknowledged for pioneering ideas and development practices that would become essential benchmarks for green urban development (Carvalho et al. 2012; Macedo & Haddad 2016; Moore 2006).

Semi-structured interviews (conducted online), multimedia documentaries, and extensive review of literature, policy documents, and reports are deployed in this case study to examine the drivers, opportunities, and challenges to Curitiba's green urban transitions. It will be shown in the analysis that against common perceptions that the criteria of Green Urbanism are expensive to undertake with potential returns largely attainable in the long-term, cities can still achieve these goals in the short to medium-term within the limits of their fiscal capacity if they build on their existing potentials to address emergent challenges with strong internal locus of control.

The Chapter is structured as follows: Section 7.2 presents a brief profile of Curitiba. This is followed by an overview of historical events that have shaped Curitiba's development in

Section 7.3. Following this narrative, Section 7.4 presents a review of the various ‘green’ policies that have been applied in Curitiba, the processes of their application, and the factors that presented opportunities and/or barriers to their implementation. An assessment of the outcomes of these policies is also undertaken to identify the successes, failures, and limitations of the so-called ‘Curitiba model’. Informed by these understandings, Section 7.5 discusses how Curitiba’s approach and policies tick the boxes of the criteria of Green Urbanism. The Chapter concludes, in Section 7.6, with some theoretical and practical lessons from Curitiba’s experiences.

7.2 Curitiba city profile

Curitiba is the capital and largest city of the state of Parana in the southern part of Brazil. It covers a total land area of 430.90 km² on the First Plateau of Parana at an average altitude of 934 metres above sea level. The geographical location of Curitiba puts it in close proximity to prominent Brazilian cities such as Rio de Janeiro, Sao Paulo, and Santa Catarina (see figure 7.1). This strategic location made Curitiba an intermediary trading post for different kinds of minerals, livestock, agricultural goods, as well as a thoroughfare for cattle drivers in the 1700s (Macedo 2013, p. 335). Curitiba has a mid humid temperate climate (relative humidity varies from 50% to 100%) with temperature typically ranging between 8°C and 27°C. It is identified to have high incidence of solar irradiation with estimated value of horizontal solar irradiation ranging between 1,500 kWh/m²/annum and 2,500 kWh/m²/annum (Tiepolo et al. 2014). This abundant solar resource presents tremendous opportunities for solar energy generation in Curitiba. However, the solar energy potentials of Curitiba are less explored because of its reliance on hydroelectricity. In fact, hydropower is noted to supply about 80 percent of electricity in Brazil because of the abundance of water resources in the country (OECD 2005).

With a population of about 1.8 million people, Curitiba is identified as the seventh largest city in Brazil. The demographic profile of the city reflects a multicultural society: a phenomenon which is attributable to the city’s historical development. The 2010 population census by the Brazilian Institute of Geography and Statistics (IBGE), for example, identified only 0.2 percent of native Brazilians (Amerindian) in Curitiba, with more than 90 percent of the residents being people with European, Levantine, African, and Asian descents etc. The first European settlers facilitated the mechanization of agriculture, and the establishment of both commercial and

industrial activities which made Curitiba attractive to both people (foreign/local), and international corporations. These developments accelerated the rate of urbanization and population growth in the city (Macedo 2004; Rabinovitch 1996).

Today, Curitiba can still boast of vibrant economic activities with prominent international companies in the automotive, information technology, and manufacturing industries etc. in its designated industrial city. Thus, Curitiba remains a demographic magnet in Brazil (OECD 2011). To appreciate the processes of Curitiba’s sustainability transitions, it is important to understand the historical events that gave impetus to the social and technical innovations that have put Curitiba on the global map as a best practice urbanization model. The following sections examine these events and how they have impacted Curitiba’s developmental trajectory.

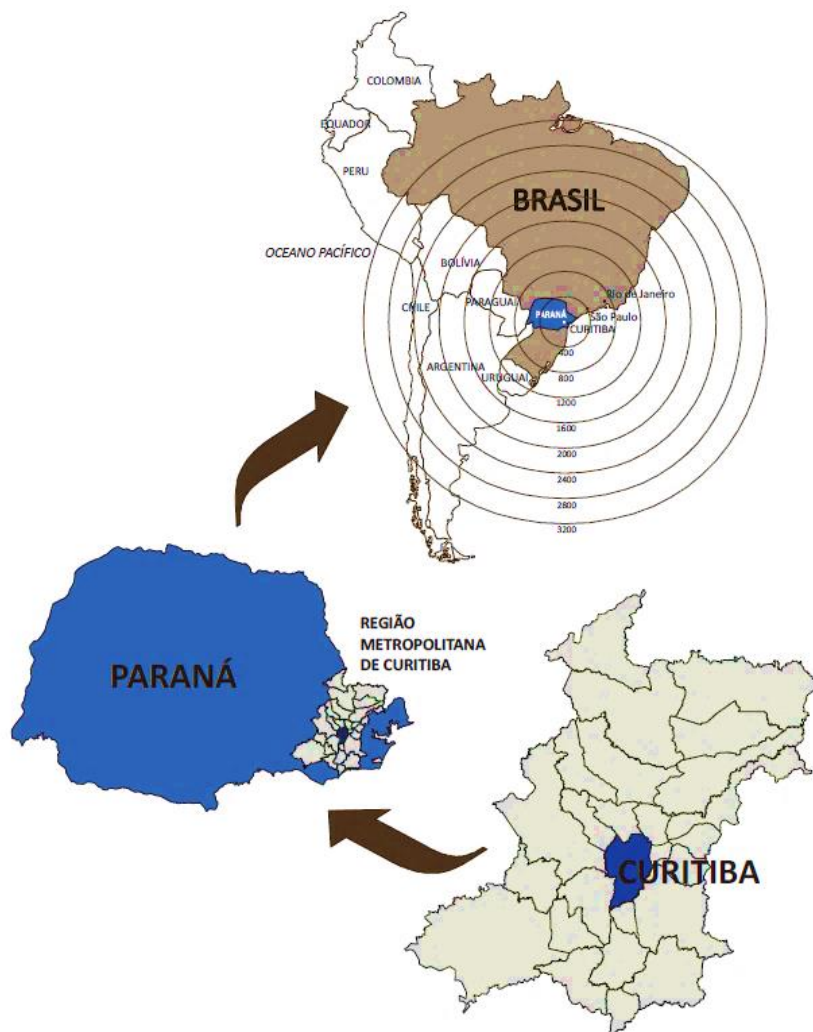


Figure 7.1: Location of Curitiba in Brazil (Source: IPPUC)

7.3 Historical development of Curitiba

The name Curitiba is derived from a constellation of two words in *Guarani* (native dialect of indigenous people in Brazil) i.e. *curiy* and *tiba* which mean “pine” and “abundance” respectively. It replaced the city’s original name of Vila Nossa Senhora da Luz dos Pinhais in 1721 (Macedo 2004; Moore 2006). The earliest settlers in Curitiba arrived in the 1500s. They were predominantly Portuguese and Spanish aside from the indigenous people. These groups of migrants were later joined by immigrants from Italy, Germany, Austria, Ukraine, and Poland among others in the 1800s (Moore 2006).

Curitiba was founded in 1693. It was eventually recognized as a city in 1842, the capital of Paraná in 1853, and the first city in Brazil to have a university (Universidade Federal do Paraná – Federal University of Paraná) in 1912 (Macedo 2013, p. 335). The urban planning and development of Curitiba since its foundation has been influenced largely by the prevalent political regimes in Brazil since the early 17th century (see BBC 2017).

For example, during the Portuguese colonial period in the 1800s, Curitiba had an organic urban form which was typical of Portuguese settlements (Macedo 2013). This layout was subsequently revised under different political regimes in 1943, and 1965 to give Curitiba its present urban form (Macedo 2004; Rabinovitch 1996). A critical milestone in Curitiba’s development is the appointment of Jaime Lerner as the mayor of the city by a military regime in 1971. To many observers, ‘Lerner is Curitiba, and Curitiba is Lerner’ because of the transformational leadership he brought on board to put Curitiba on the global map (Del Rio 1992; Margolin 2002; Rabinovitch 1992). Others attribute his success to the political regime (i.e. military dictatorship) that enabled the implementation of urban policies with little or no public resistance (Moore 2006). To Macedo (2013), the work of Lerner’s predecessors such as Mayor Ivo Arzua Pereira provided the stepping stone for Curitiba’s urban transition. The following sections review the processes of Curitiba’s urban transformation before and after Lerner’s emergence.

7.3.1 Pre- Lerner Curitiba: an analysis of urban planning policies in Curitiba from 1857-1970

Following the independence of Brazil from Portugal in 1822, influences of urban planning concepts from other countries such as Paris (Haussmann's plan), and the United States (L'Enfant's plan for Washington, DC) begun to creep in to replace the Portuguese organic layout (Macedo 2013). In Curitiba, a revision to the spatial configuration of the city became necessary following the city's rise to state capital. Consequently, a French engineer, Pierre Taulois, was hired in 1857 as chief surveyor of public lands to undertake what would become the first changes in Curitiba's urban space (Macedo 2004). A major observation made by Taulois and his team of surveyors in Curitiba was that only two roads intersected with each other at right angles, with all other roads spread out without any regular pattern. Therefore, Taulois proposed a series of interventions to regularize the road network to achieve an orthogonal grid pattern through the gradual expropriation of private lands for public use (Herbst 1992). However, Taulois' plan (see figure 7.2) had limited impact on Curitiba's spatial structure because it was limited in giving a clear direction for the city's development (Macedo 2013). Thus, a comprehensive plan was required to respond to the city's rapid growth, and associated urban challenges in the mid- 1900s.

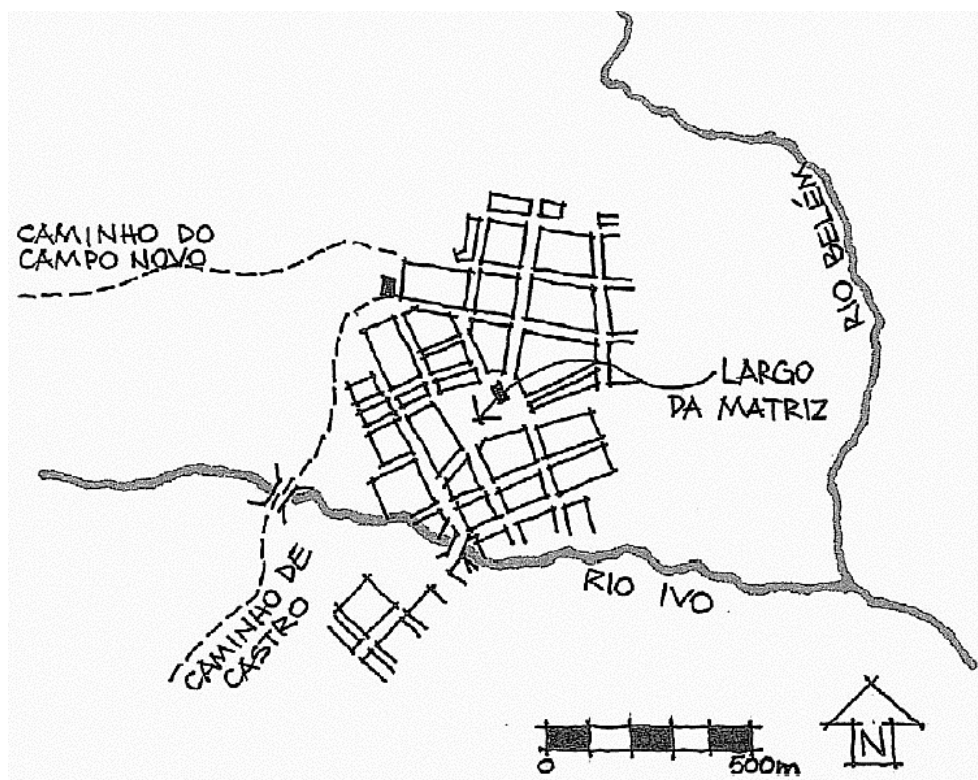


Figure 7.2: Pierre Taulois Plan in 1857 (Source: Macedo 2013)

In 1943, another French influence brought a new direction to Curitiba's urban form. French urbanist and architect Alfred Hubert Donat Agache was commissioned to develop the first comprehensive plan for Curitiba. The new plan aimed to improve Curitiba's infrastructure and sanitation systems, and cater for its population growth as well as industrial development. This urban plan was meant to follow an earlier project he had undertaken in Rio de Janeiro in the late 1920s (Lundqvist 2007; O'hare & Barke 2002). Agache was a member of the Garden City movement; thus, he was largely influenced by Howard's Garden City concept in his project in Rio de Janeiro, and proposed plan for Curitiba (Brandão 2006).

The Agache Plan in Rio de Janeiro followed a structural circulation system with green belts, and the zoning of urban spaces into business, administration, monumental, financial, and industrial centers etc. (Brandão, cited in Reis 1977). The plan was not completely realized because it turned out to be "over ambitious", and the Municipal authority in Rio had limited financial resources to implement it fully (Brandão 2006, p. 40). A similar fate of partial implementation emerged in Curitiba in the mid-1900s due to lack of funding (Lundqvist 2007). The Agache Plan of Curitiba was composed of a radial system of roads around the city center with rings of perimeter avenues to connect the rest of the city to the downtown (figure 7.3).

The plan was largely influenced by Haussmann and Howard's design concepts with common features such as the segregation of land uses, grand boulevards radiating from the city center, public parks, and peripheral greenbelts. Like Haussmann's audacious renovation plan for Paris, the Agache Plan called for the demolition of many historical buildings in Curitiba to make way for the construction of grand boulevards. However, this proposal was resisted by the local people which further delayed the full implementation of the plan (Karis et al. 2006). Although the Agache Plan was not completely executed, it defined the "city's internal linkage based on a radial road system" (Macedo 2013, p. 338). It is also credited with introducing, for the first time, the concept of comprehensive urban planning in Curitiba (Karis et al. 2006).

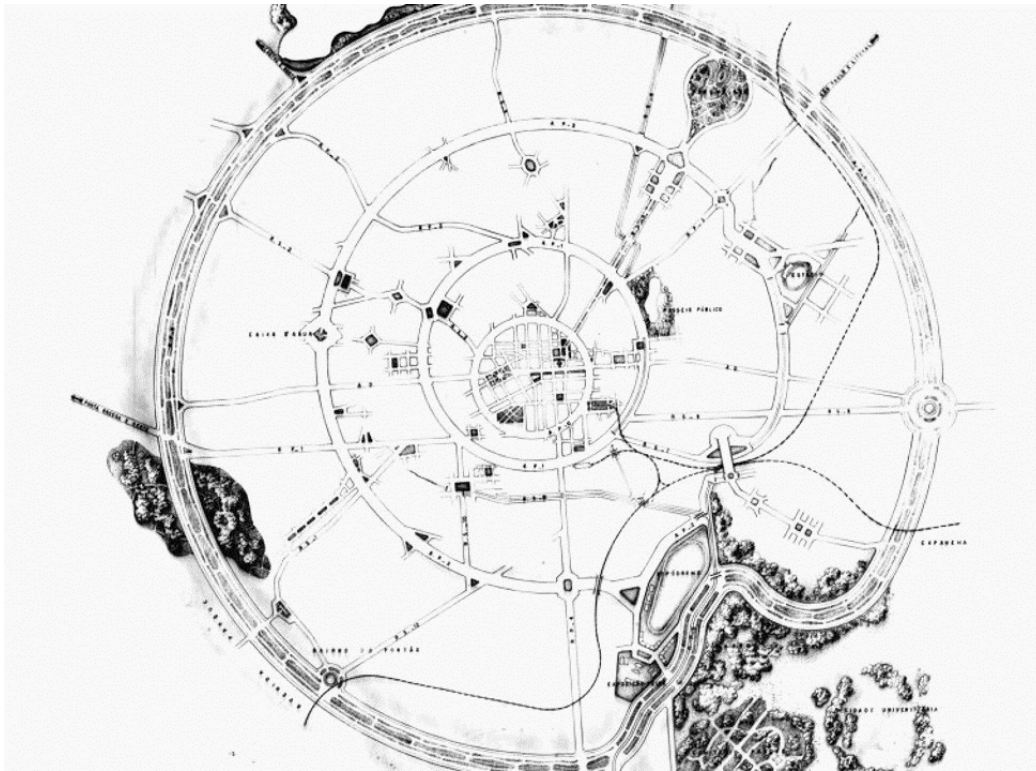


Figure 7.3: Agache Plan of Curitiba- 1943 (Source: Institute of Research and Urban Planning of Curitiba)

Between 1950 and 1960, Curitiba's population doubled as the city became more and more attractive to both locals and foreigners as a result of industrial growth (Mikesh n.d.; Rabinovitch 1996). During this period, the Agache Plan, which was the existing urban development plan of Curitiba, was deficient in accommodating this rapid population and economic growth (Brescia & Marshall 2016; Macedo 2004). Therefore, a new plan for Curitiba was required to direct the population, economic, and spatial growth of the city.

Upon his election as mayor of Curitiba from 1962 to 1966, Ivo Arzua Pereira issued a call for a preliminary urban plan for Curitiba in 1964. Six companies submitted entries for this competition with a proposal from a Sao Paulo firm, *Sociedade Serete de Estudos e Projetos Ltd.* winning the competition. The design of this preliminary plan was undertaken under the authorship of architect Jorge Wilhelm (Macedo 2013). The underlying principle of the Wilhelm Plan was to modulate the physical, social, economic, and cultural transformations that unfolded in the city (Rabinovitch 1992). Therefore, the Wilhelm Plan sought to preserve historical centers, improve upon existing infrastructure, and provide green open spaces for both environmental and social purposes. Moreover, the Wilhelm Plan adapted the Agache

radial plan into four linear axes (figure 7.4) to encourage Curitiba's spatial growth along transit corridors (Macedo 2013; Moore 2006).

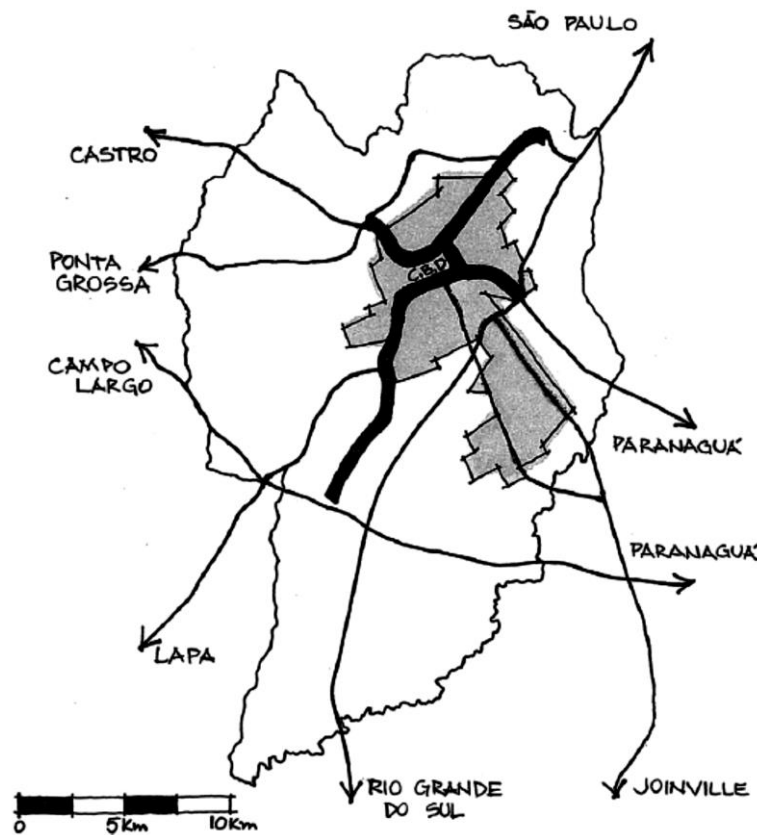


Figure 7.4: Wilhelm Plan for Curitiba approved in 1966 (Source: Macedo 2013)

To ensure the efficient implementation of the proposed Wilhelm Plan, the Arzua regime established a working group of architects and engineers etc. to further develop and adapt the plan to local needs, and the future development of Curitiba (Lundqvist 2007). Arzua, who was democratically elected just before a takeover by a military regime, is noted to have promoted a democratic process in the development of Curitiba's Master Plan. He encouraged grassroots participation through a series of public forums during "Urbanism Month" to receive comment and feedback from citizens on the city's proposed plan (Macedo 2013). The working group facilitated this discussion processes, and eventually became the Institute of Research and Urban Planning of Curitiba (Instituto de Pesquisa e Planejamento Urbano de Curitiba- IPPUC) in 1965 (Rabinovitch 1996).

The establishment of the IPPUC earned Arzua a national recognition, in 1975, from the Brazilian Institute of Municipal Administration for his contribution to institutionalizing the practice of urban planning in Brazil (Macedo 2013, p. 345). Nevertheless, less progress was

made in terms of the implementation of the plan under Arzua's administration. In an interview, Jonas Rabinovitch (a United Nations senior adviser and former planner at the IPPUC) noted that the IPPUC was more engaged in producing and/or examining plans than implementing them (Adler 2016). However, the tide was turned when a former director of the IPPUC (from 1960 to 1970), Jaime Lerner, was appointed the mayor of Curitiba by a military regime that ruled Brazil from 1964 to 1985. The new political environment engendered by the military dictatorship came with some opportunities (but not without its challenges) in forging a pathway for Curitiba's transformation in the early 1970s.

7.3.2 Curitiba under Lerner: a review of Curitiba's urban policies from 1971 to 1992

"I can't understand why people are frightened of new ideas. I'm frightened of the old ones." This quote by John Cage, an American philosopher, encapsulates the personality and beliefs of Jaime Lerner, a three-time mayor of Curitiba (1971-1975; 1979-1984; and 1989-1992). Lerner who was born of Polish immigrants in 1937 in Curitiba emerged as the mayor of the city at age 33 through an appointment by the then military regime. His training in architecture and urban planning as well as his experience as a member and former director of the IPPUC seem to have prepared him for the job at hand.

Upon his appointment, Lerner led an urban revolution that transformed a grimy, polluted, and congested city into a model for sustainable urbanization (Margolin 2007). In the light of these achievements, Lerner's Curitiba has received several local and global recognitions for innovative urban planning such as the: United Nations Environmental Awards (1990); UNICEF Child and Peace Award (1996); World technology Award for Transportation (2001); Sir Robert Mathew Prize for the Improvement of Quality of Human Settlements (2002); and granted the Leadership in Transport Award by the International Transport Forum at the Organization of Economic Co-operation and Development (OECD) in 2011 among others. Besides, Lerner was also included in the list of "The 100 most influential people in the world" in Time Magazine in 2010 (Macedo 2013).

In the preface to the English translation of his book: "*Urban Acupuncture*" (see Lerner 2014), Jaime Lerner is said to follow the traditions of Jane Jacobs and William H. Whyte who are identified as prominent proponents of placemaking and people-oriented cities. Lerner

believes that cities must be designed for people but not cars; and that the more “we mix [the use of urban spaces] the more human is the city” (Lerner 2012). The underlying principles that informed Lerner’s urban development policies are what he identifies as simplicity, speed, and doing more with little resources (Phillips 2008). In a TED talk in 2012, Lerner decried the conception of cities as the source of global environmental and socio-economic challenges; and he called for an optimistic view of cities as part of the solution to contemporary global challenges.

He believes that “every city can be transformed in less than three years” with small and pragmatic interventions (urban acupuncture) that unravel the potentials of a place and its people regardless of the scale and resources available (Lerner 2012; Rabinovitch 1996). Although this assertion may sound like a mere political rhetoric with little meaningful impact in practice, Lerner seems to have walked his talk with ground breaking initiatives that were completed in record time. A typical example is the conversion of Curitiba’s downtown automobile thoroughfare into a pedestrian mall in the early 1970s. The project was completed in 72 hours although the construction secretary to the project proposed to complete it within 6 months (Macedo 2013). His leadership brought tremendous improvements in Curitiba’s land-use plan, urban transportation, flood control mechanisms, and waste management among others. These achievements, as discussed below, form the linchpin of Curitiba’s sustainability model.

7.3.2.1 Land-use planning in Curitiba

Curitiba owes much of its urban morphology to the Wilhelm Plan of the mid-1960s. During this period, Lerner was a member of the working group that eventually became the IPPUC (Macedo 2004). The implementation of this plan was started in 1971 by Lerner’s administration which had just been inaugurated by the then military government (Rabinovitch 1996). In a Skype interview with a former Co-Director of the IPPUC, it was pointed out that this period was the exact right time to implement the plan because of the political environment that had little regard for democratic processes, and ensured public policies were implemented with little or no bureaucratic inertia. Echoing this point, Rabinovitch (former member of the IPPUC) notes that Curitiba may not have progressed thus

far if Lerner and his team had delayed any further in the implementation of the Wilhelm Plan (Adler 2016).

The Wilhelm Plan transformed the Agache radial system into transit-oriented development based on four linear axes (see figure 7.5). These axes radiated from Curitiba's downtown towards the north, south, east, and western part of the city. An additional corridor towards the south-eastern part of Curitiba was created in the 1970s due to unanticipated demographic concentration (Rabinovitch 1996). Hence, Curitiba's urban growth has been directed along five structural axes (see figure 7.6) with high density, and mixed-use development (Smith, H & Raemaekers 1998). The densities along these transit corridors were planned to be high along the structural axes, and reduce gradually in concentration towards the outer neighbourhoods. As shown in figure 7.7, zone ZR4 has high density development with a mix of residential and commercial facilities to push new growth from the city center to the transit corridors. The densities begin to taper in proportion to distance from the transit corridors at zones ZR3, ZR2, and ZR1 which are predominantly designed for residential development.

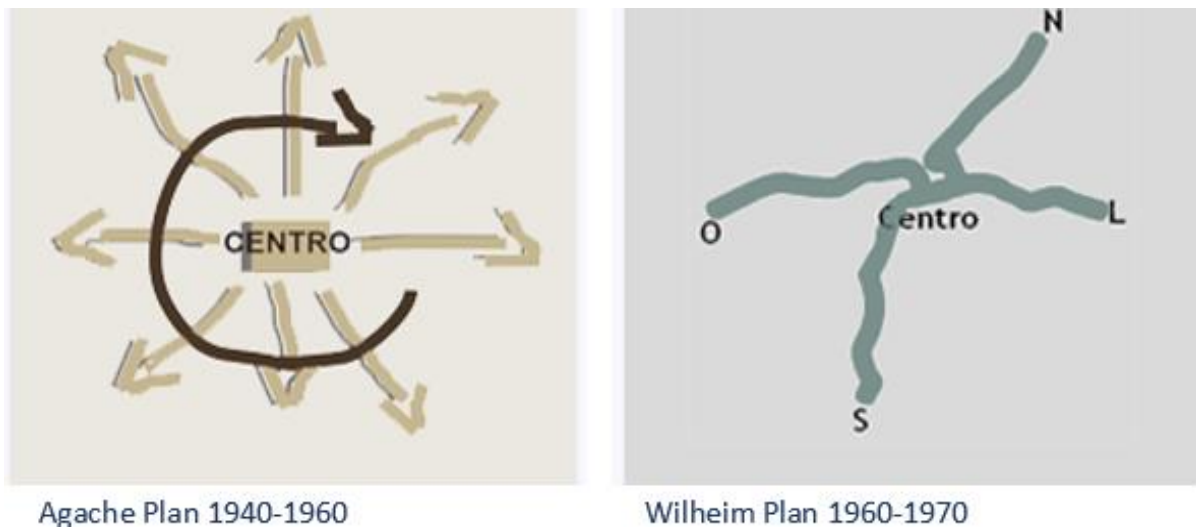


Figure 7.5: From Agache Plan to Wilhelm Plan (Source: IPPUC)

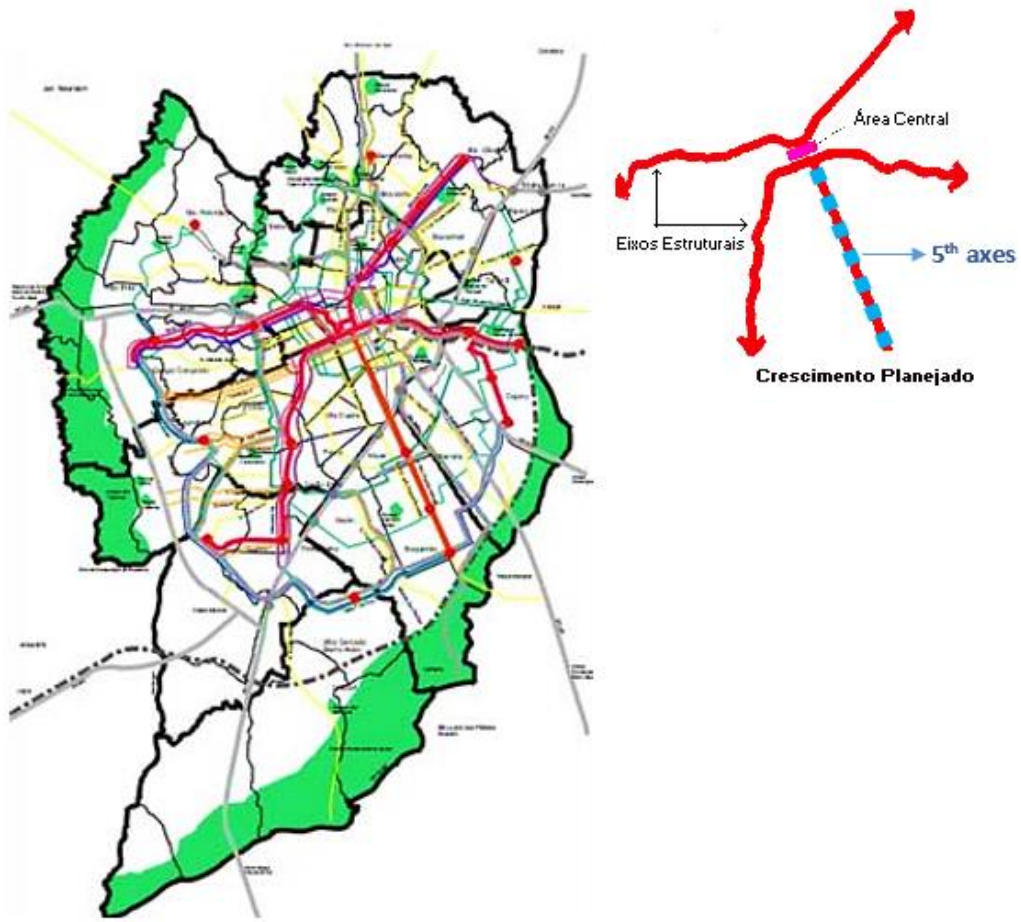


Figure 7.6: Curitiba's modified city map with 5 structural axes (Source: Parasram 2011)

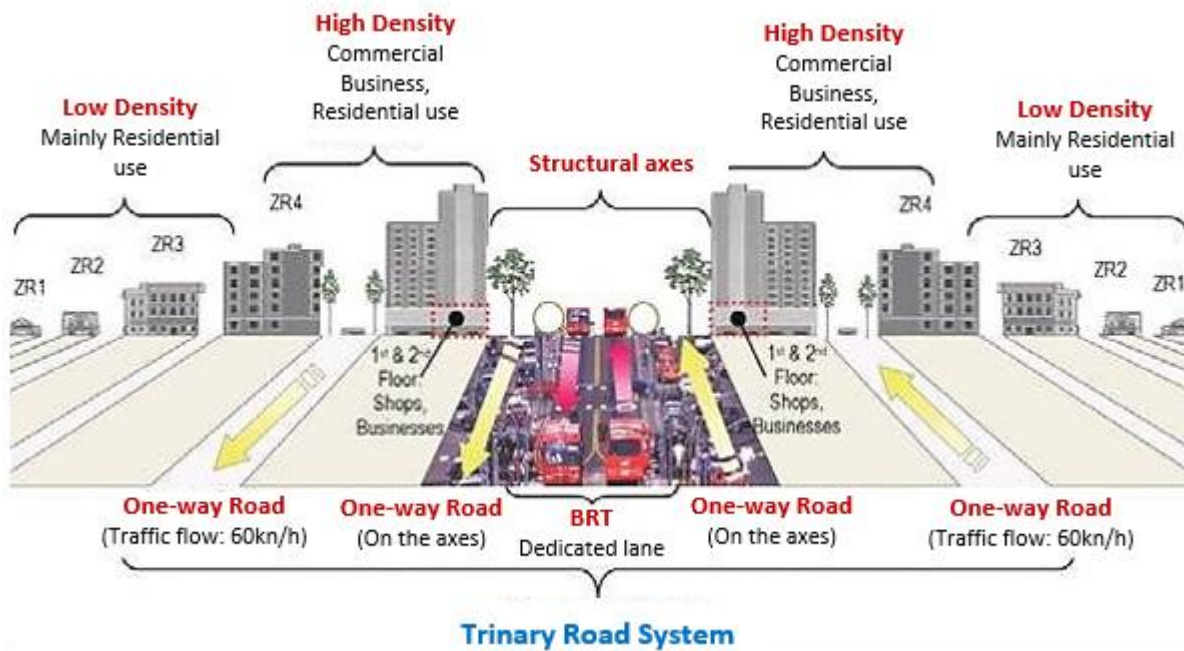


Figure 7.7: Densities and zoning along Curitiba's structural axes (Source: modified from IPPUC)

The Wilhelm Plan provided a framework for: (1) the integration of land use patterns; (2) decongestion of the city center, and the promotion of demographic and spatial growth along the transit corridors; (3) hierarchy of road systems and transit networks; (4) preservation and revitalization of Curitiba's historical district; and (5) the zoning of land use into four basic categories i.e.: residential, commercial, industrial, and mixed-use (Macedo 2004). The IPPUC, which is operationally linked to the mayor's office, ratified and directed the implementation of the plan. According to some observers, the relationship between the IPPUC and the political authorities helped to mitigate tensions or agonistic strife that sometimes arise between professionals and politicians (Campbell 1996; Pløger 2004). In fact, several mayors of Curitiba were former directors or senior staff of the IPPUC (Macedo 2013). This transformation from technocrats to politicians is identified as one of the key drivers of Curitiba's planning successes; as it enabled the transfer of skills from professional institutions to political offices, and ensured political continuity in Curitiba's development initiatives (Lindau et al. 2010; Smith & Raemaekers 1998).

The zoning of Curitiba has been guided by two main criteria i.e.: the type of use assigned to a given area, and the density of development required (Rabinovitch 1996). These criteria have been enforced through planning legislations (e.g. mandatory densities and mixes along structural axes and outer neighbourhoods); economic incentives (e.g. compensation to owners of historical buildings to ensure their preservation); physical instruments (e.g. separation of bicycle paths and bus lanes from other transport systems to enhance efficiency and safety); and transparent information system to avoid, for example, land speculation which may engender suburban sprawl (Joshua et al. 2016).

According to Rabinovitch and Hoehn (1995), one of Lerner's first steps to implementing the city's Master Plan was the conversion of the busy downtown streets into a pedestrian mall in 1972. This audacious decision bears a striking resemblance to Freiburg's pedestrianization of the city center in the early 1970s (Ryan & Throgmorton 2003). During this period, traffic congestion in Curitiba's downtown necessitated the demolition of buildings in the city center to broaden the streets and create room for more cars. This approach was a common phenomenon in most Brazilian cities that experienced economic and population growth in the early 1970s (Phillips 2008; Rabinovitch & Hoehn 1995). However, Lerner believed that the city should be designed for people but not for cars. Besides, he saw the demolition of

historical buildings as synonymous with the destruction of a family portrait which represents one's identity. Therefore, contrary to public expectations, Lerner preserved the family portrait (historical buildings). Besides, rather than expand the streets to accommodate more cars, he closed them to traffic and converted them into what would become the first downtown pedestrian mall in Brazil.

The project was initially resisted by merchants in the city center who threatened to file a court injunction to stop its implementation. Their decision was fuelled by the fear of losing customers who could no longer drive to their shops. To avoid this interruption, Lerner insisted on the completion of the project in 3 days -from Friday night after close of business to Sunday night before the start of business on Monday morning (O'Meara 1998). Before the courthouse opened on Monday morning, the project was too far advanced to be quashed. Nonetheless, the disgruntled merchants threatened to drive over it. In response, Lerner and his team unrolled long strip of paper on the pedestrian streets and organized kids to paint on them. This option was regarded by Lerner as a more peaceful way to avert the impending mayhem than set up police barricades to restrain public protest (Rabinovitch & Leitman 2004). Consequently, the presence of children painting murals on the pedestrian streets helped to prevent any violent protest from the public.

After several years, painting on the pedestrian streets has become a tradition in Curitiba. Children are organized every Saturday morning to undertake this activity not only for the fun of it but also to promote social cohesion among children from different socio-cultural backgrounds (Mang 2012). In fact, the pedestrianization of the streets encouraged more foot traffic and window shopping which promoted trading activities in the downtown. The disgruntled merchants who resisted the project at its inception subsequently lend their full support for the initiative after witnessing its positive outcomes (Macedo 2013). Other shopkeepers on other streets in the downtown are said to have requested a replication of the project on their streets (Meadows 1995). The project might not have seen the day of light if Lerner had embarked on a consultative process with the merchants who might reflexively oppose such 'contentious initiative' in order to protect their myopic interest. Thus, despite its advantages, public engagement can also be a barrier to sustainability innovations if the public lack foresight.

Another initiative Lerner undertook at the early stage of his mayorship was the development of Curitiba's industrial district (Cidade Industrial de Curitiba- CIC). According to Macedo (2013), this project was one of the main directives by the military government to industrialize the state capital of Parana to enhance its economic profile. The Wilhelm Plan did not make provision for this district; therefore, it became one of the major additions the IPPUC made to the plan. The industrial district is located 10 km from the main city. It occupies an area of 40 km² towards the western border of Curitiba. It is strategically located to ensure that the prevalent south-eastern wind does not blow pollution from the site to the city (Lundqvist 2007).

The CIC accounts for one-fifth of Curitiba's total employment, with about 700 factories, 20,000 housing units, and greenfields that cover about 15 percent of the total area of the district (Suzuki et al. 2010). The land-use plan of the CIC ensured the functional integration of spaces to promote working and living together in a conducive environment. The district is well connected to the city's public transport system through an integrated land-use and transportation policy that defined Curitiba's zoning regulation (Lundqvist 2007; Rabinovitch 1996).

Curitiba's land-use plan also promotes the integration of compatible urban functions to ensure that people work close to where they live. Hence, aside from the downtown and the Industrial City, a number of businesses have been integrated with the residential developments along the five structural axes (Macedo 2004). This principle is strongly supported by Lerner who believes that the city is an integrated structure of life, work, and movement; therefore, the more we "blend incomes, ages, and activities, the more human the city becomes" (Lerner 2014, p. 63). He analogizes a liveable city to a turtle that works and lives within its shell; and argues that "if you break the shell of a turtle [living here, working there], it will die" (Lerner 2012). Thus, cities will put themselves on the pathway of peril if they separate the use of urban spaces. Lerner identifies the consequences of disintegrated urban spaces as "urban cholesterol" i.e.: high automobile dependence, more energy consumption, more emissions, less walking and biking, and increased risk of cardiovascular diseases among others (Lerner 2014, p. 96).

Another important element of Curitiba's spatial plan is the efficient integration of the city's public transit system into the land-use plan. According to Rabinovitch (1996), Curitiba's transport system and land-use plan are the two most significant determinants of the city's current urban form. The following section takes an in-depth look at Curitiba's transportation initiatives, how they have influenced Curitiba's development, and the outcomes of these initiatives.

7.3.2.2 Curitiba transportation innovation

The transportation system in Curitiba has been complemented by a comprehensive land-use plan that emphasizes linear growth along major transit corridors. Before the Wilhelm Plan (which provided the framework for transit-oriented development in Curitiba), the city's growth was sporadic, and largely influenced by private interests (Macedo 2013). However, upon the approval, and gradual implementation of the Wilhelm Plan, Curitiba has managed to distribute its demographic concentration along five structural axes. These transit corridors terminate at bus terminals connecting the city to its neighbouring towns (O'Meara 1998). Each structural axis (see figure 7.7 and 7.12) is designed with two exclusive bus lanes at the center for express buses, and adjacent traffic lanes for other vehicles which flow in and out of the city (Rabinovitch & Hoehn 1995). The separation of bus lanes from other traffic has been shown to promote safety, and efficiency in terms of time and cost to both passengers and transport operators (de Palma et al. 2008; Deng & Nelson 2011). Streets in the outer neighbourhoods are designed to have low traffic volumes (two-way traffic). Curitiba identifies this development as the trinary road concept (see figure 7.7).

Since the mid-1970s, the structural axes have been developed in phases (see figure 7.8) together with concentric loops that have different functions and level of importance (hierarchy). The road network system in Curitiba can be grouped under four major categories: structural routes, feeder routes, inter-neighbourhood routes, and direct routes (see figure 7.9). As noted earlier, the structural routes extend out from the downtown; and they are composed of five main axes along which residential and commercial developments are undertaken at high densities (Macedo 2004). These routes are serviced by express buses (red) on dedicated lanes. The concentration of people and economic activities along these transit routes is part of Curitiba's strategies to promote public transit ridership.

The feeder routes (orange buses) bring people from the fringe settlements to the express routes which connects them to the city center. Moreover, the inter-neighbourhood routes (green buses) link suburbs outside the city center to the express routes at designated interchange terminals. These routes facilitate movements from one neighbourhood to another without going through the city center. Lastly, the direct routes (grey buses) link some suburbs directly to the city center and/or the fringe settlements. They make many more stops than the express buses (red). These four major routes collectively form the structural network of Curitiba's transport system (Rabinovitch 1996). There are additional buses for tourists, and night routines etc. that complement the major bus types (Sherlick & Vassoler-Froelich 2007).

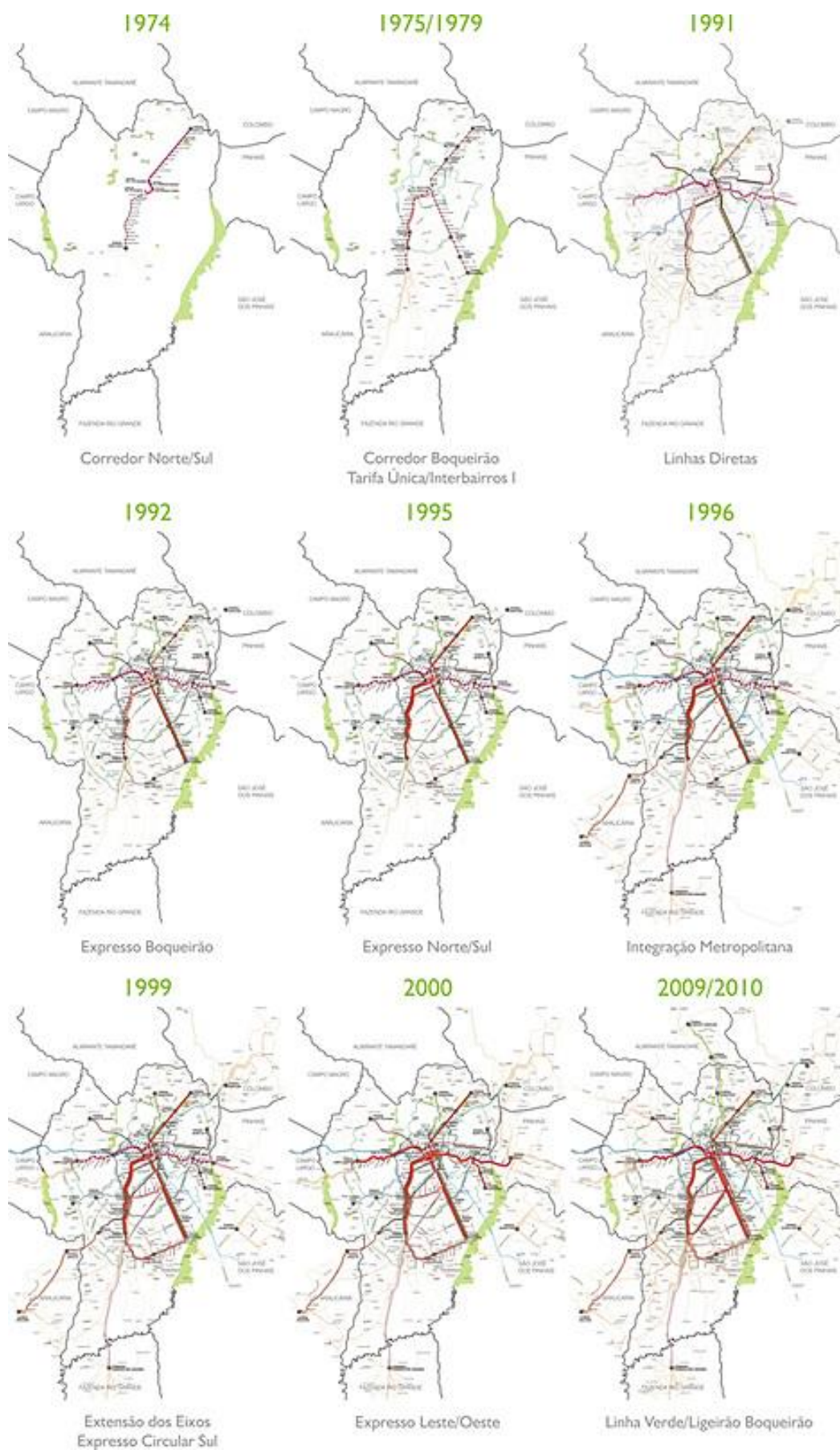


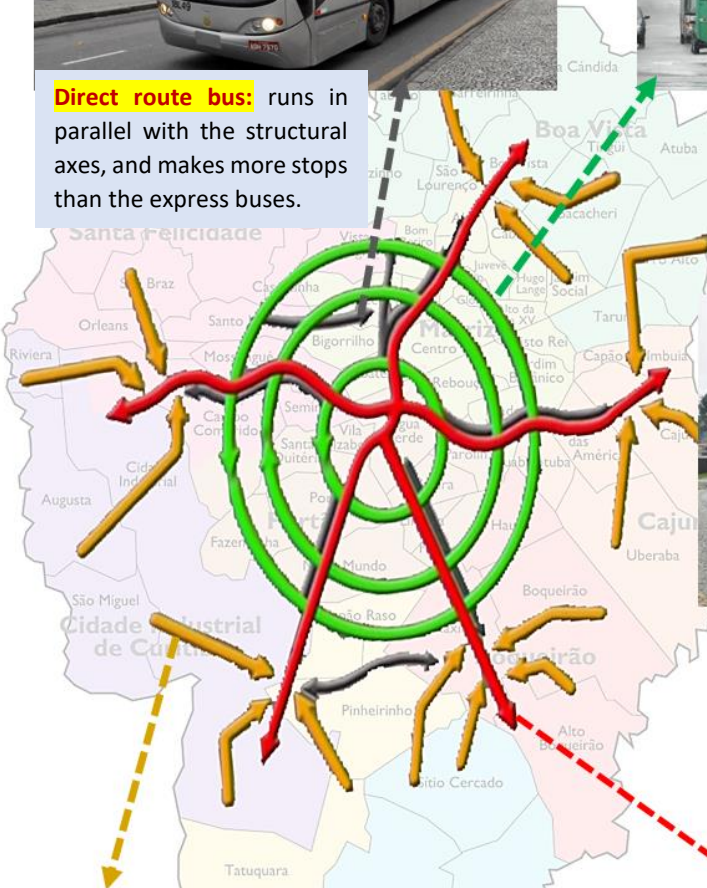
Figure 7.8: Phases of Curitiba transport network (Source: URBS)



Direct route bus: runs in parallel with the structural axes, and makes more stops than the express buses.



Inter-neighbourhood bus: makes orbit trips to link neighbourhoods, and the express routes without going to the city center.



Tourist bus: designated to tourists visiting Curitiba.



Feeder route bus: Circulates within fringe settlements and links them to the express buses at transfer terminals.



Express route bus: Circulates on the structural axes, and runs independent of car traffic to avoid traffic jams at peak hours.

Figure 7.9: Curitiba transport network system; (Source: Modified from Taylor Smith 2014; and pictures by Oren Hirsch 2010)

Curitiba's transport innovation can be traced back to the 1970s and 1980s when the city was confronted with the dilemma of determining which public transport system should be adopted to cater for its growing population. During this period, Curitiba had the highest growth and urbanization rate in Brazil, with its population growing from about 600,000 to more than 1 million people (Macedo 2004). There were calls for a subway line which were fuelled by the prevalent technological dogma that any city with more than 1 million population should have a subway system to function efficiently (Reed 2015). However, Curitiba did not have the financial wherewithal to support the development of a subway system; nevertheless, it had buses. Therefore, rather than jettison the existing transport system (buses), and grapple with a new and a more expensive system (subway); Lerner and his team decided to revolutionize the bus-based transportation system to deliver the same level of efficiency provided by the subway system at a substantially lower cost (Rabinovitch & Hoehn 1995). A major challenge, however, was how to integrate the transportation network which was then poorly coordinated to respond to public demands across the city. Besides, the city center became a thoroughfare for buses which exacerbated traffic conditions within the downtown (Sherlick & Vassoler-Froelich 2007).

To respond to these challenges, the revised Wilhelm Plan directed growth from the downtown along five structural axes with concentric loops to facilitate inter-district movements without going through the city center. This mass transit system has become officially known as Curitiba's Integrated Transport Network (RIT). The network has well-coordinated coded buses (red, ash, green, and orange etc.) that enable easy transfer from one bus route to another (see figure 7.12) with only one fair valid for all buses (Rabinovitch 1996). With these developments, Curitiba established the first non-subsidized bus rapid transit (BRT) system in Brazil and across the globe. The BRT is estimated to have cost \$200,000 per kilometre which is a lot cheaper than the cost of a subway line estimated at \$60-70 million per kilometre (O'Meara 1998, p. 12; Rabinovitch & Leitman 2004, p. 48-49). In addition, the BRT is said to offer high convenience and flexibility, speed, affordability, and accessibility - more than 80 percent of the inhabitants live within 400 metres radius from a bus stop (BBC 2014).

Consequently, Curitiba has one of the highest passenger journeys per capita, and fleet buses per 1000 inhabitants in Brazil (Rabinovitch & Hoehn 1995). About 70 percent of commuters

in Curitiba use public transport, out of which 28 percent previously travelled by private cars (Goodman et al. 2005). In addition, fuel lost and cost of time lost due to traffic congestion are said to be low in Curitiba compared with other Brazilian cities such as Porto Alegre, and Belo Horizonte which have similar population and geographical size as Curitiba (Sherlick & Vassoler-Froelich 2007). According to Goodman et al. (2005, p. 76), Curitiba consumes 30 percent less of fuel per capita compared with eight other Brazilian cities of comparable size. Furthermore, it is estimated that about 27 million litres of fuel is saved per annum in Curitiba (owing to the efficiency of the BRT) with substantial reduction in ambient air pollution (Rabinovitch 1995, p. 11).

These achievements have put Curitiba on the global map as an exemplar of sustainable urban transportation. They were largely attained through strong political will. Several ideas were experimented with continuous improvements and feedback mechanisms. Lerner believes that for cities to be transformed to become more sustainable, city authorities do not need to have all the answers before they begin. However, they should start with simple well thought out ideas and engage the public to contribute to their improvement (Lundahl 2011). Against this backdrop, Lerner and his team carried out significant changes in Curitiba's bus system with "simple" ideas such as the reorganization of the transport network, transformation of the bus-based system into bus rapid transit system, and the introduction of flat fares for all bus trips (Rabinovitch 1996).

Due to the introduction of the flat fares, residents in Curitiba are said to spend no more than 10 percent of their income on transportation compared with the national average of about 26 percent (Ferdman 2013; Goodman et al. 2005). In addition, Curitiba improved its buses to cater for growing demands by upgrading the conventional buses (80 passengers) to articulated buses (170 passengers). Through negotiations between the City Council and Volvo, Curitiba also introduced bi-articulated buses (270 passengers) in the mid-1990s (Lindau et al. 2010; Moore 2006; Rabinovitch 1995). Besides, to reduce boarding time and eliminate the inconvenience of queuing in buses to pay transport fares, Lerner designed an elevated tube station (at the same height as the bus). The tube station concept mimics a subway system: passengers pay fares before getting on the bus (figure 7.10). This design came with wheelchair lift to facilitate boarding by the elderly or disabled passengers (Rabinovitch & Leitman 2004). These innovations have contributed significantly to making the public transport system of

Curitiba attractive to its people. Hence, an estimated 70 percent of commuting in Curitiba is made by public transit (Pienaar et al. 2005).



Figure 7.10: Typical Curitiba tube station (Source: adapted from Lindau et al. 2010; Reed 2015)

Due to budget constraints, the local government of Curitiba engaged the private sector (about 16 private bus companies) in the provision of transport services for its BRT (Brescia & Marshall 2016). The Urban Development Authority of Curitiba (URBS) was established (in the 1990s) to coordinate this public private partnership (Lindau et al. 2010). The URBS helped to synchronize the operations of the private transport providers to forestall unnecessary competition that might undermine the BRT system (Sherlick & Vassoler-Froelich 2007). The private transport providers purchase a concession from the city government to operate particular routes under specific guidelines provided by the URBS.

The URBS manages the fares through a municipal bus fund. It pays the private operators based on the number of kilometres they cover, and their compliance with route timetable; but not how many passengers they are able to convey (Rabinovitch 1996). This arrangement mitigates competition for passengers among bus operators, ensures punctuality, and enables the even distribution of buses along all transit routes (Sherlick & Vassoler-Froelich 2007). Put together, Curitiba's flat fares, as well as improvements in transport infrastructure, transport services, and bus capacity have helped to increase patronage of its BRT system from 25,000 passengers per day (at the time of inception), to more than 2 million passengers a day in recent years (Brescia & Marshall 2016).

It is important to note that Curitiba's BRT system was not an instant success. It has undergone a cycle of trial and improvement over several decades. An interview with a former city official showed that this process is still ongoing. For example, since 2009, a sixth BRT corridor has been introduced namely the "Green Line" (in an industry dominated area). The latter operates 100 percent bio-diesel articulated buses with 30 percent less CO₂ emissions and 70 percent less smoke compared with conventional buses that run on traditional fuel. In addition, the transport system has been digitized to ensure efficient management of traffic by Curitiba's Traffic Control Center. In a video documentary, Lerner acknowledges that "everything that we do [in Curitiba] each time has a follow-up, an improvement, optimising, and as we progress in quality, we set some standards and then guarantee the standards" (Lundahl 2011). Indeed, Curitiba's BRT has been a standard model for many cities in Brazil, and around the world (Levinson et al. 2002).

Despite these successes, there are still some lingering challenges that require considerable attention to keep the system abreast of contemporary realities in Curitiba. One of such challenges is the inability of the glass tube station to protect passengers from extreme temperatures (Reed 2015). In addition, the continuous growth of Curitiba's population has brought some of the bus transit lines close to saturation point. This development has necessitated the city council's decision to dig a subway line along some of the dense routes, and replace the surface with a landscape garden (Brescia & Marshall 2016). This decision has been highly criticised by Lerner who believes that the BRT has all it takes to accommodate the city's transport needs but needs continuous innovation and improvement (Gaunt 2016).

Another area of concern is how Curitiba may optimize the BRT system's interface with other non-motorised modes of transport especially bicycling. Although some efforts have been made in this regard (e.g. the proposed 2012 bicycling Master Plan by the IPPRC which aims to create 400km of new bike lanes) the cycling modal share of Curitiba still remains low in most parts of the city (Brescia & Marshall 2016; Reed 2015). Therefore, much attention is required to promote the culture, safety, and patronage of bicycling in Curitiba. Notwithstanding, Curitiba has shown the utility of integrating public transport with land-use planning to create a balance between transport supply and demand, and limit the sporadic sprawl of the city to foster a more sustainable urban development.

7.3.2.3 Waste management in Curitiba

In addition to being recognized globally for its novel BRT system, Curitiba has made major strides in waste management and recycling. As Newman (2010, p. 157) puts it, Curitiba has avoided the traditional view of waste as “negative outputs”, and “re-envisioned [it] as productive inputs to satisfy other urban needs”. Consequently, Curitiba recycles about 70 percent of its waste; which is arguably the highest recycling rate in the world (Kennedy 2015; Soltani & Sharifi 2012). According to Rabinovitch (1992), Curitiba’s waste management achievements have been possible as a result of two major initiatives i.e.: the “Garbage that is not Garbage” (Lixo que não é Lixo) recycling program, and the “Green Exchange” (Câmbio Verde) program. These programs were spearheaded by Lerner in the late 1980s. The “Garbage that is not Garbage” initiative was introduced in 1989 to encourage residents in Curitiba to separate their garbage into organic and inorganic wastes for collection by garbage trucks at least once every week (Keuhn 2007).

Through constant public education about efficient waste management practices, 100 percent of households in Curitiba are said to participate in the city’s waste separation initiative (Gratz 2013; Rabinovitch 1992). Much of this campaign has focused on children in Curitiba. In a TED Talk, Lerner argued that the education of children about waste segregation offers the best lever for changing a society’s attitude towards waste as children easily grasp these tenets in less than 6 months, and pass them over to their parents and friends (Lerner 2012). Reiterating this point, a former Co-director of the IPPUC pointed out in a Skype interview that public (especially children) education was one of the key instruments Lerner and his team deployed to introduce a pervasive environmental mindset in Curitiba. According to him, this constant awareness creation got people on-board their transformational policies, although much of the policies were formulated with little or no public engagement.

Furthermore, the “Purchase of Garbage” or “Green Exchange” program (Cambio Verde) aimed to clean up the shanty-towns (favelas) in Curitiba by engaging residents to collect their waste in exchange for food, bus tickets, and in some cases stationeries for students (Kennedy 2015). Lerner refers to this approach as an “equation of co-responsibility” where both the city council and the people share responsibility in achieving a public goal that inures to the benefit of both parties. Through this initiative, the city government is able to collect wastes from

squatter settlements (which are mostly inaccessible by the garbage trucks) at a relatively lower cost to keep these settlements from the risk of diseases. On the other hand, the squatter settlers get food etc. in exchange for their household garbage. This system was introduced by Nicolau Kluppel (Civil Engineer) in the late 1980s. Being the first of its kind in the world, the United Nations Environmental program (UNEP) honoured Curitiba with its highest environmental award in 1990 (Lietaer & Belgin 2010).

Curitiba's waste management programs have had significant environmental, social, and economic impacts on the city and its people. The city's paper recycling alone is said to save an equivalent of 1200 trees a day. Besides, the "Green Exchange" program provides enough incentives for favela settlers to take responsibility of their environment by cleaning it up and trading 4kg of garbage for 1kg of food produce. This initiative has not only mitigated the problem of food security among poor people in the favelas, but has also provided a market for local farmers who sell their produce to the city council. Expounding on this point, Cássio Taniguchi (former mayor of Curitiba from 1997-2004) noted in a documentary that prior to the Green Exchange program, local farmers in Curitiba's agricultural belts suffered significant losses due to overproduction; therefore, the Green Exchange Program helped to avoid these losses by making this excess produce available to low income people (Smith 2014).

About 30,000 families are said to benefit from this program, with more than 300 tonnes of waste collected every month. Another positive outcome of Curitiba's waste management policy is the provision of employment in the garbage separation plant for people who struggle to find jobs in Curitiba such as the homeless, recent immigrants, and those recovering from alcoholism etc. (Rabinovitch 1992). Essentially, the numerous spin-off benefits of Curitiba's waste management initiatives (e.g. environmental cleanliness, disease prevention, job creation, food security for the poor, and the promotion of local farming etc.) were all achieved with low capital investment. Monies raised from the sale of recycled materials are channelled into social programs to support the less privileged (Suzuki et al. 2010). In essence, these initiatives "burdened no one, [but] everyone benefited" (Lietaer & Belgin 2010, para 8). These achievements point out that the cost of 'green initiatives' can be significantly reduced if an "equation of co-responsibility" is effectively applied.

7.3.2.4 Integrated approach to nature preservation and water management in Curitiba

Curitiba is widely recognized as the green capital of Brazil with abundance of green spaces and ecological reserves. (Macedo 2004; Soltani & Sharifi 2012). However, Curitiba did not start of as a green city. In the early 1970s, Curitiba had 0.5 square meters of green space per inhabitant compared with the World Health Organization's international standard of 16 square meters per capita (Macedo & Haddad 2016). Nonetheless, with comprehensive policies, Curitiba has increased its green space from 0.5 square meters per capita (in 1970s) to 51.5 square meters per capita despite a tremendous growth in its population from 600,000 (in 1970s) to more than 1.8 million people today (Macedo & Haddad 2016; Suzuki et al. 2010, p. 175). With this remarkable increase in green area per capita, Curitiba has emerged as one of the greenest cities in the world comparable with Freiburg, Stockholm, and Vienna etc. (Beatley 2000; Sehgal 2016). Curitiba's 'biophilic development' has been possible through an integrated urban development plan that promotes environmental preservation, sanitation, and flood control mechanisms based on the use of ecological infrastructure.

Built on the first plateau of the state of Parana, Curitiba was faced with serious challenges of redirecting surface runoff to avoid flooding. The abundance of waterbodies surrounding Curitiba, especially the Iguaçu River, posed major flooding risk to the city (Suzuki et al. 2010). In the early 1980s, a severe flooding incidence in Curitiba caused damages worth \$50.3 million together with other flooding occurrences of comparable impacts (Tucci 2004, p. 2). The risk of flooding increased as the city became more urbanized, and people invaded the flood plains and developed more infrastructure which further obstructed water flow (Rabinovitch & Leitman 2004). To reduce flooding and its attendant environmental, economic, and social impacts, Curitiba opted for a natural drainage system rather than constructing concrete culverts to direct water flow. According to Tucci (2004), the latter would have only decreased the frequency of flooding in the short to medium term, encouraged encroachment on the flood plains, and consequently increased the risk of more devastating flooding incidences in the long-term. Besides, the cost of constructing drainage canals is estimated to be five times higher than the ecological approach Curitiba adopted (Suzuki et al. 2010).

Curitiba allowed nature to take its course in its flood management strategy. As Spirn and Say (2012) point out, nature is too strong to resist; therefore, urban development approaches

that subdue rather than accommodate and/or adapt to natural processes have the tendency of engendering natural disasters. Therefore, cities must be designed with an understanding of their potential interactions with the natural environment. Against this backdrop, Curitiba developed an ecological corridor along the main riverbanks (Iguaçu River), and flood plains to accommodate precipitation runoff. This development was underpinned by the objectives of creating an ecological space that mitigated water overflow, and prevented encroachment on flood plains (Heinzeller & Nebelsick 2005). Accordingly, the city authorities begun with the expropriation of flood-prone lands, and the relocation of about 800 households to safer places in other parts of the city (Slebzak 2013).

This resettlement arrangement made way for the development of public parks and man-made lakes (to serve as retention basins) in the flood-prone areas (Macedo & Haddad 2016). The cost of constructing these parks and lakes together with the resettlement funds paid to occupants of the flood-prone areas are reported to be five times lower than the cost of constructing concrete canals which have high maintenance cost with little or no environmental and social dividends (Slebzak 2013; Suzuki et al. 2010). To reinforce this ecological approach to landscape planning, an Integrated Urban Drainage Master Plan was proposed to facilitate the development of urban parks along the tributaries of the Iguaçu River, and enforce regulations on the management of stormwater on-site in new developments (Heinzeller & Nebelsick 2005).

Presently, Curitiba has about 35 parks, 1004 conservation areas including woods and gardens, and a total of 78,000 square meters of natural forest which are well interconnected with bicycle routes (Brescia & Marshall 2016, p. 86; Macedo 2004). To further encourage patronage of these public parks, the city provides free bus services on weekends using retired city buses (branded green) to connect the downtown to major parks via its “pro-park” routes (Rabinovitch & Hoehn 1995). Some of these parks were created from brownfield sites such as garbage dumps and abandoned quarries in order to regenerate urban sites that offered little opportunities for redevelopment (Macedo & Haddad 2016).

To promote a sense of ownership, Curitiba’s parks were dedicated to various ethnic and immigrant groups who were engaged in the design of these parks according to their cultural, and historical nostalgia (Mikesh n.d.). These parks serve multiple purposes such as flood

control, recreation and leisure, preservation of biodiversity, improvement in sanitation and water quality, carbon sequestration, promotion of public health, and environmental education among others (Brescia & Marshall 2016; Rabinovitch & Leitman 2004). In addition, properties located in close proximity to the parks enjoy high real-estate value which implies an increase in property tax revenue for the city (Gustafsson & Kelly 2012).

Nevertheless, the extensive development of parks meant high maintenance cost to the city. Rather than employ lawn mowers which would put recurrent cost burden on the city with some environmental consequences (due to emissions from fuel combustion), the city authorities decided to mow the lawns the old-fashion way by using sheep and capybara. This strategy has helped to reduce maintenance cost by 80 percent, provides natural fertilizer from the animal excreta that enriches the soil, and enhances the uniqueness of attractions offered by the parks (Suzuki et al. 2010, p. 175).

Further development of green areas in Curitiba has been espoused through fiscal incentives to property developers, and the transfer of development rights to ensure the preservation of greenfields and historical properties (Macedo & Haddad 2016). For example, landowners are offered compensation or tax reduction if they planted trees on their properties, especially the Parana pine tree (Suzuki et al. 2010). On the other hand, fines are imposed for unauthorised felling of trees within the city. Property developers are also allowed additional storeys on their buildings on condition that they create more green spaces on their properties (Brescia & Marshall 2016; Gamesby n.d.). Besides, the right to develop greenfields or historical properties can be exchanged for the right to develop extra square meters in other locations within the city (Macedo 2013; Suzuki et al. 2010).

Put together, these policies have helped to increase contact with nature in Curitiba with its attendant social, economic, and environmental benefits. Iconic monuments in Curitiba's parks and gardens such as the Ópera de Arame, the Glass Greenhouse in the Jardim Botânico Fanchette Rischbiere (Botanical Garden of Curitiba), and the Open University of the Environment (UNILIVRE) etc., provide entertainment and educational facilities that attract both local people and tourists to these green areas. A major concern, however, is how Curitiba can ensure equitable distribution of its parks which are less developed in the southern part of the city where there is high concentration of low-income people (Macedo & Haddad 2016).

A potential solution to this anomaly might be how Curitiba extends its 'equation of co-responsibility' to the development of green areas in low income settlements by engaging the local people in this development as is the case with the Green Exchange Program. This approach may not only enhance the environmental quality of low-income settlements, but also ensure that the local people take responsibility for the sustenance of these green areas.

7.3.2.5 Creating green citizens: environmental education in Curitiba

Environmental education is one of the key drivers of Curitiba's sustainability successes. Although Lerner's regime applied fewer consultative and democratic processes in the implementation of their policies, they were proactive in enlightening the public about the environmental and social merits of these policies (e.g. garbage separation, public transit, preservation of green areas etc.) through both formal and informal campaigns. Children were a major focus of Curitiba's environmental campaigns. As noted by Wilson (1996), altering environmental attitudes in children is easier than in adults since the personality traits of children are more malleable.

Curitiba adopted several strategies to bring environmental ethics to the doorstep of children and young adults in the city. These strategies include the incorporation of environmental lessons in elementary school curriculum, and the introduction of an Infant and Adolescent Environmental Education Program for children and young adults in the favelas (Rabinovitch 1992). Teachers and students are also given guided tours through Curitiba's rich nature reserves and parks to provide them with firsthand experience of the ecosystem services derived from urban green spaces. Lerner, who has been in the vanguard of most of these campaigns, believes that teaching children about environmental ethics is a sine qua non for building a sustainable future as it builds stewardship values in the latter, and enables them to transfer these values and knowledge to future generations (Lerner 2012).

To formalize these environmental campaigns, an Open University of the Environment was founded in the early 1990s as a beacon of enlightenment to bring environmental awareness to Curitiba people (Moore 2006). The university was established as a non-governmental organization (the first of its kind in Brazil) on an abandoned quarry site to offer environmental lessons to people from all backgrounds e.g.: school children, commercial drivers, media personnel, workers, firms, and tourists etc. (Rabinovitch 1992). The university offers courses,

seminars, conferences, and exhibitions on urban sustainability, recycling, and environmental preservation among others (Crowley 2014).

These initiatives are complemented by Curitiba's mobile classrooms that reuse the city's retired buses to provide education to people in low-income communities (Karis et al. 2006). Besides, Curitiba has expanded the opportunities of access to knowledge by establishing several neighbourhood libraries (also known as Lighthouse of Knowledge). The latter provide free learning centers furnished with books, computers, and internet facilities for students and the general public (Irazabal 2009; Soltani & Sharifi 2012). Some of these educational facilities were developed from recycled properties (buildings, buses, brownfield sites etc.) which came at a minimal cost to the city. Essentially, Curitiba's sustainability initiatives under Lerner's administration have been undertaken with due regard for its local challenges and potential to ensure that the policy instruments are cost-effective, and that they are sensitive to local nuances.

7.4 Milestones of Curitiba's urban transition

As shown in Table 7.1, Curitiba has undergone various phases of urban transition starting with an integrated land-use plan that created the momentum for other innovative policies in public transportation among others. The application of these policies has been predominantly top-down with bottom-up engagements through education, and public hearings. In the view of Macedo (2013), Curitiba has been blessed with technocrats-turned-politicians who could anticipate the development trend of the city, and device strategies to direct its growth towards more sustainable trajectories. Most of these political leaders such as Ivo Arzua Pereira (1962-1966), Jaime Lerner (1971-1975; 1979-1984; and 1989-1992), Rafael Greca (1993-1996), and Cássio Taniguchi (1997-2004), among others, were professionals (e.g. architects, engineers, urban planners etc.), and former staff or directors of the IPPUC. The visionary and continuous political leadership provided by these technocrats helped to ensure continuity and consistency in Curitiba's urban policies.

Table 7.1: Summary of milestones of Curitiba's urban transition

Year	Description of events/projects	General category of events/projects
1693	Curitiba was founded under the name Vila Nossa Senhora da Luz dis Pinhais.	Historical events
1721	Renamed as Curitiba.	
1842	Recognized as a city.	
1853	Became the capital of the state of Parana.	
1857	Transformation of Curitiba's organic form into orthogonal grid patterns by Pierre Taulois.	Land use planning
1886	Construction of the first urban park- Passeio Público.	Green infrastructure
1912	Establishment of the Universidade Federal do Paraná – Federal University of Paraná as the first university in Brazil.	Education
1943	Development of Curitiba's first comprehensive Master plan by Alfred Hubert Donat Agache.	Land use planning
1964	Development of Curitiba's second Master Plan by Jorge Wilhelm. The plan defined four transit corridors (structural axes) along which Curitiba's growth should be directed.	Land use planning
1965	Formation of the IPPUC to supervise the implementation of the Wilhelm Plan.	Institutional innovation in urban planning
1971	Appointment of Jaime Lerner as mayor of Curitiba by a military dictatorship.	Political intervention
1972	Pedestrianization of Curitiba's downtown.	land-use planning
1973	Development of the Industrial City of Curitiba (CIC)	Land use planning
1979	Introduction of flat fares for public buses.	Mobility
1989	Introduction of "Garbage that is not garbage" and "Green Exchange" programs.	Waste management
1990	Granted United Nations Environmental Awards	Global recognition

1990	Introduction of Infant and Adolescent Environmental Education Program for children and young adults in Curitiba's favelas.	Green education
1990	Formation of the Urban Development Authority of Curitiba to coordinate the various modes of transport and manage fares in Curitiba.	Institutional innovation in transport management
1991	Introduction of the Bus Rapid Transit with boarding tubes.	Mobility
1992	Formation of the Open University of the Environment.	Green education
1996	Development of ecological corridor along Curitiba's river banks and flood plains.	Green infrastructure
1996	Granted UNICEF Child and Peace Award.	Global recognition
2001	World technology Award for Transportation.	Global recognition
2002	Winner of Sir Robert Mathew Prize for the Improvement of Quality of Human Settlements.	Global recognition
2009	Introduction of Curitiba "Green Line" which operates 100 percent bio-diesel articulated buses with 30 percent less CO2 emissions and 70 percent less smoke compared with conventional buses.	Land-use planning and mobility
2011	Granted the Leadership in Transport Award by the International Transport Forum at the Organisation for Economic Co-operation and Development (OECD).	Global recognition
2012	Introduction of bicycle master plan (400km).	Mobility
2016	Winner of C40 Award for Best Sustainable Communities Projects in Urban Agriculture.	Global recognition
2017	Honourable mention for implementing Sustainable Urban Transport Master Plan during the International Transport Award summit in New York on June 2016.	Global recognition

7.5 Discussion

Curitiba's urban development approaches exemplify what Lehmann (2010b) identifies as the 15th principle of Green Urbanism i.e.: strategies for basic low-cost green urban development solutions appropriate for cities in the developing world. To a great extent, Curitiba's approach has focussed on uncovering and exploiting the potential of the city to overwrite its challenges within the fiscal capacity of the local government. Fundamentally, problem solving

approaches tend to produce quick fixes which often have limited long-term impacts (Bosch et al. 2013). Therefore, as Curitiba has shown, building upon the existing potential and opportunities in cities not only produces a more creative and context sensitive solutions, but also ensures the efficiency and cost-effectiveness of such solutions (Nam & Pardo 2011). From land-use planning to urban transportation, waste management, flood control, and green space development etc., Curitiba has prioritized optimizing the potential of the city to provide solutions that are both responsive to the local context, and economically feasible.

In general, simplicity, political will to experiment with novel but inexpensive ideas within a cycle of speculation and criticism, continuous public education about environmental stewardship, and political continuity have been the cornerstones of Curitiba's sustainability innovations. Another key element of Curitiba's development approach is the integration of urban policies to foster synergies between different policy goals. As shown by Giddings et al. (2002) and Hahn et al. (2010) a lack of this synergy in seemingly sound or well-intentioned policies could be a recipe for frictions between different policy outlooks which may ultimately undermine their resultant outcomes. The coherence between the various policies in Curitiba could be explained by the central and continuous role of the IPPUC in defining and monitoring the city's developmental trajectory in close collaboration with the political leadership (mayor's office) of the city. Thus, although Curitiba's sustainability policies were applied at various times (see Table 7.1) under different political regimes (both military and democratic governments), they have been framed to complement one another in order to create a virtuous cycle in which environmental, social, and economic goals feed into each other to improve the quality of urban life.

For example, in lieu of developing concrete canals to direct water runoff, Curitiba used green and blue infrastructure (parks, trees, lakes, wetland etc.) to mitigate flood incidence along its riverbanks and flood plains. The parks and lakes have also promoted the preservation of biodiversity (environmental benefit), provided a site for leisure and recreation (social benefit), and enhanced the value of properties overlooking these green corridors (economic benefit). The latter benefits both property owners (increase in property value) and the local government (increase in tax revenues). Taxes collected are reinvested into social programs to support low-income communities (Suzuki et al. 2010). Besides, Curitiba's abundant nature

reserves and parks have been used as a health resource through, for instance, a “Zooterpia” initiative that provides horticultural therapy for sick people (Curitiba 2010, p. 122).

In addition, the “Green Exchange” program addresses its core objective of cleaning up Curitiba’s favelas to minimize health problems in the latter (environmental and social benefits), while also promoting food security in these deprived neighbourhoods to alleviate malnutrition (social benefit). The food supplied to these communities by the local government is bought from local farmers. Through this initiative, food losses are minimized, and local farmers are able to sell their (excess) produce; thus, promoting the local agriculture industry (economic benefit). Lerner also introduced the “fish for garbage” concept where he engaged local fishermen to collect garbage from Curitiba’s bays (at a fee) to prevent the contamination of these bays and make them conducive for fish production (Gratz 2013). Figure 7.11 below provides a summary of the relationships between the various policies and how they collectively address Curitiba’s sustainability objectives. Suffice to say that the interconnectedness and multiple outcomes of these policies are no mere coincidence, but deliberate efforts by Curitiba’s local government to promote policy integration, and achieve more with less resources.

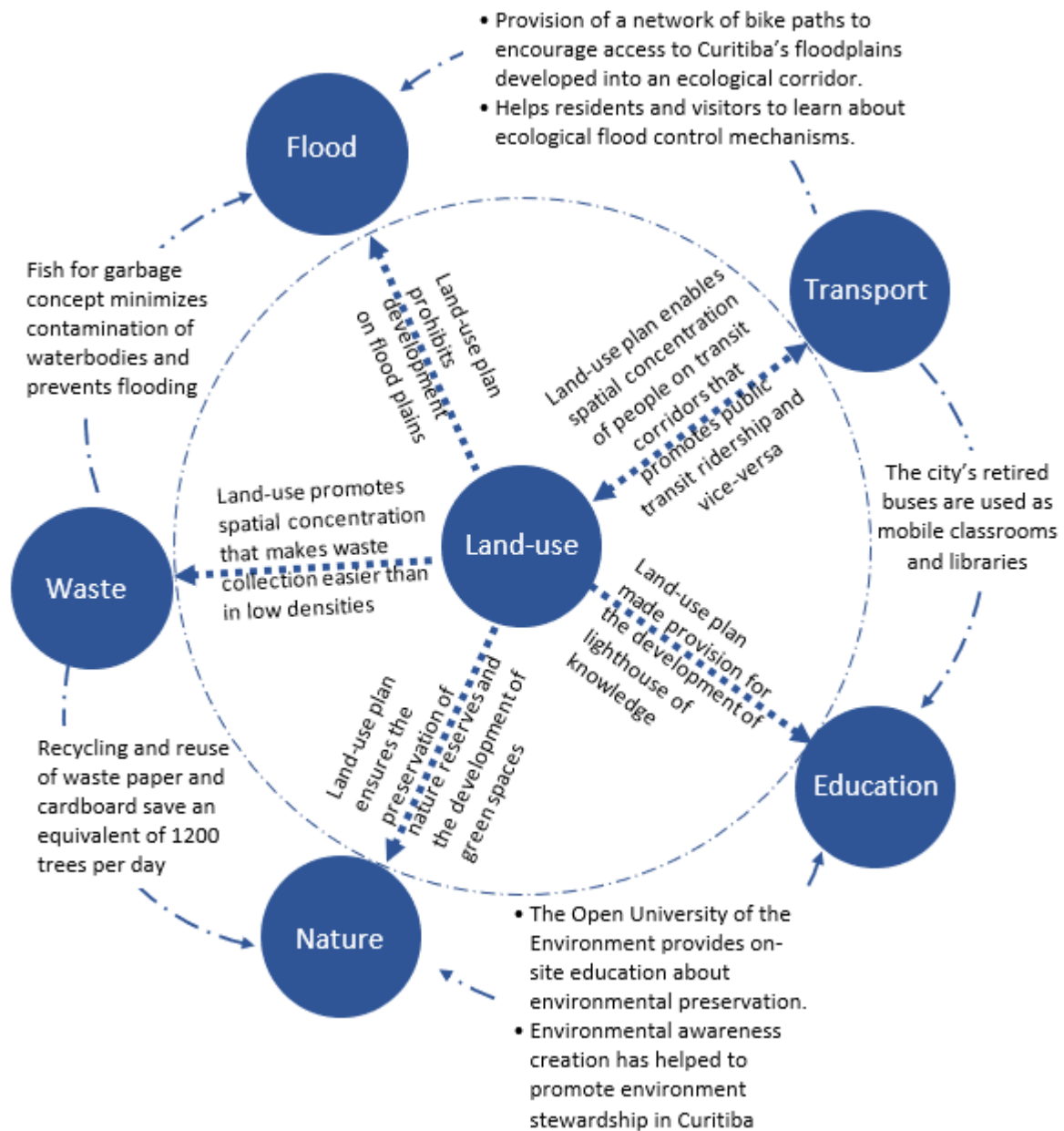


Figure 7.11: Examples of relationships and outcomes of Curitiba's integrated urban policies (Author's construct)

Notwithstanding these tremendous achievements, Curitiba cannot be said to be without lingering challenges. The city still grapples with high crime rates, inadequate affordable housing supply, energy problems, illegal settlements, poverty, and an increasing trend of automobile dependence due to rising middle-income class etc. (Halais 2012). Lerner admits that Curitiba is not a paradise, nor a perfect model of Green Urbanism; therefore, it will continue to experience some of the common challenges that confront cities. As Duany (2013) points out, the green city concept should be understood as a standard model for evaluating the performance of cities, and a protocol for correcting deviations from these standards.

Thus, the underlying principles of Green Urbanism should not only be viewed as performance criteria, but also a framework for modulating transitions towards these standards. Table 6 below provides a summary of the criteria of Green Urbanism and how Curitiba performs against these criteria. It highlights some of the key strengths and weaknesses in Curitiba's approach towards Green Urbanism.

Major strengths can be identified in transport, land-use planning, education, waste and stormwater management, and effective partnership between the local government and the private sector to promote Curitiba's sustainability goals etc. Institutions such as the IPPUC and the URBS have played significant roles in monitoring, evaluating, and reporting the outcomes of these policies for continual improvement. Nevertheless, little can be seen in Curitiba in terms of innovations in alternative renewable energies and energy efficient buildings. Curitiba is heavily dependent on hydropower (about 84% of electricity from hydropower) which is highly susceptible to climate change impact (Harrison & Whittington 2002; Kemp & Stephani 2013). For instance, the energy crisis in Brazil in the early 2000s was largely attributed to severe droughts that diminished the country's hydropower capacity (Lewis 2004). There is little development of other alternative renewable sources such as solar despite existing potentials (Tiepolo et al. 2014). Efforts by the local government to encourage solar energy use are quite recent and less widespread (Morais 2015).

Besides, the green building concept (low energy buildings) which has been shown to promote life cycle energy efficiency in buildings is less advanced in Curitiba. According to Kemp, RL and Stephani (2013, p. 93), Curitiba performs averagely in "*eco-buildings policies*" due to the absence of clearly defined standards for low energy construction, and the lack of incentives for households and businesses to invest in eco-efficient buildings. Consequently, the building sector in Curitiba emerged as the city's lowest placement in the *Siemen Latin American Green City Index* (EIU 2010). Nonetheless, Curitiba has shown remarkable commitment to improving access to housing for low-income people. For example, Curitiba City Council has embarked on the development of affordable housing schemes to support low-income households living in informal and/or flood prone areas (Kemp & Stephani 2013). This initiative aims to enhance the living standards of the poor, and protect Curitiba's floodplains.

Table 7.2: Principles of Green Urbanism in the context of Curitiba

General criteria	Principles of Green Urbanism	Description of principles	Application in Curitiba
1. Land-use planning	Transit-oriented development	Maximizing the amount of residential, commercial, and recreational spaces etc. within a reasonable walking distance of public transport	<ul style="list-style-type: none"> • The Wilhelm Master Plan directed Curitiba’s growth along four transit corridors. • The IPPUC has introduced two more corridors for both residential and commercial developments.
	Compact development	High density	<ul style="list-style-type: none"> • Curitiba land-use plan promotes high density development along six transit corridors.
	Mixed-use development	<ul style="list-style-type: none"> • Functional integration of spaces • Self-sustainable development 	<ul style="list-style-type: none"> • The six transit corridors are composed of both residential and commercial development. • Curitiba’s Industrial city accommodates both industrial and residential development to enable working and living together.
	Biophilic development	Promoting green open spaces, green roof, nature reserve, and urban agriculture etc.	<ul style="list-style-type: none"> • Curitiba has transformed its riverbanks and floodplains into a network of parks (ecological corridor). • Fiscal incentives are provided to property developers to include green spaces on their properties. • Transformation of brownfield sites into gardens (e.g. Curitiba Botanic Garden). • The ‘Green Exchange Program’ promotes local agriculture.
	Climate and context	Enhancing opportunities offered by topography and natural setting.	<ul style="list-style-type: none"> • Freiburg takes advantage of the abundance of water to generate hydropower. However, the city’s solar

			energy potential is less exploited.
	Passive design	Low energy consuming construction	<ul style="list-style-type: none"> • No clear policy on low energy construction
2. Transport	Sustainable mobility	Promotion of public transport, car-sharing, bicycling, walking.	<ul style="list-style-type: none"> • Development of the BRT along six transit corridors, and inter-district routes. • Provision of bicycle routes along Curitiba's ecological corridor. • Pedestrianization of the downtown to avoid traffic and encourage walking.
	Zero emission vehicles.	Vehicles that emit no harmful pollutants from the onboard source of power	<ul style="list-style-type: none"> • Introduction of 100 percent bio-diesel articulated buses on Curitiba's 'Green line'.
3. Energy	Renewable energy	Solar, wind, hydro, biomass, geothermal etc.	<ul style="list-style-type: none"> • 84% of electricity supply in Curitiba is generated from hydropower. • High potential for solar energy generation.
	Energy efficiency	<ul style="list-style-type: none"> • Minimizing waste or losses in the production and consumption of energy 	<ul style="list-style-type: none"> • There is no clear policy on end-user energy efficiency in Curitiba.
4. Buildings	Energy efficient buildings <ul style="list-style-type: none"> • Passive design • Designing with context 	<ul style="list-style-type: none"> • Reducing energy consumption and greenhouse gas emissions from buildings 	<ul style="list-style-type: none"> • There is no clear policy and incentives to support low energy construction in Curitiba.
	Retrofitting/ Local materials	<ul style="list-style-type: none"> • Reuse of buildings to reduce waste. 	<ul style="list-style-type: none"> • Curitiba's land-use policy proscribes the demolition and redevelopment of the city's historical centers. • Adaptive reuse of historical buildings and sites saves money, avoids demolition waste, and forestalls the cost of new construction.
5. Waste	Circular metabolism	<ul style="list-style-type: none"> • Waste reduction • Waste reuse 	<ul style="list-style-type: none"> • The 'Green Exchange' and the 'Garbage that is not Garbage'

		<ul style="list-style-type: none"> Waste recycling and recovery 	<p>programs have enabled efficient management of waste in Curitiba. Thus, about 70% of the city's waste is recycled.</p>
6. Water	End-user water efficiency and water sensitive design	<ul style="list-style-type: none"> Efficient use and management of water 	<ul style="list-style-type: none"> Curitiba adopts an ecological approach to stormwater managements which has helped to prevent flooding and promoted urban biodiversity.
7. Urban governance	Participatory urban governance	Grassroots engagement in decision making processes.	<ul style="list-style-type: none"> Mayor Cassio Tanigushi (1997-2004) introduced the "Modelo Colaborativo" to engage citizens in urban planning decision making process.
	Green Public Private Partnership	Cooperation between the public and private sectors as well as civil society in promoting green urbanism.	<ul style="list-style-type: none"> Partnership between the local government and 16 private companies in the provision of public transport services. Engagement of citizens in waste collection and recycling (i.e. equation of co-responsibility).
	Shared learning	Incremental learning from other cities and a city's own experiences	<ul style="list-style-type: none"> Curitiba is a member of the C40 Cities Climate Leadership Group where it learns from other cities, and also shares its experiences with them. Curitiba received a C40 Award for best sustainable community project in 2016.
	Green education	Environmental awareness creation	<ul style="list-style-type: none"> Education of children on waste recycling. Creation of the Open University of the Environment to provide education on urban development issues to all interested residents in Curitiba. Introduction of the Infant and Adolescent Environmental Education Programme in

		Curitiba's poor neighbourhoods.
Placemaking	Creating sense of community and promoting local identity	<ul style="list-style-type: none"> • Curitiba engages various ethnic and migrant groups in the design of the city's parks.
Social equity	Social inclusion of marginalized/low income people.	<ul style="list-style-type: none"> • Curitiba's Master Plan made provision for low-income housing development along the 5 transit corridors to make access to public transit easier for low-income people. • The introduction of social/flat fares has reduced the cost burden of public transport on low-income households. • The Green Exchange programme promotes food security and environmental cleanliness in poor neighbourhoods. • Retired city buses are used as mobile classrooms to provide skills training for residents in poor neighbourhoods. • A "Linhão de Emprezo" program introduced by Mayor Taniguchi provided technical skills to unemployed people in Curitiba.

7.6 Conclusion

Curitiba provides a model for assessing basic low-cost solutions appropriate for transitioning cities in developing countries towards Green Urbanism. The successes and limitations of Curitiba show that Green Urbanism is a continuous process of urban transition with diverse principles that could be selectively applied based on the needs, context, resources, and fiscal capacity of cities. In addition, the historical events leading to Curitiba's sustainability achievements illuminate the point that the identification and exploitation of windows of opportunity for change, and the optimization of local potentials are essential requirements

for successful urban transitions. Since the criteria of Green Urbanism are “overarching”, and no one city may perfectly match all of its principles (Beatley 2000), it is expected that different cities may excel in different aspects of these criteria with shortcomings in others. Therefore, there is a need for shared-learning among cities to benchmark best practices.

Curitiba’s development has evolved over time with the experimentation of novel ideas under technocratic leaderships who had the political will and skill to define a sustainable pathway for the city’s growth. The sustainability processes have been predominantly top-down, starting from Lerner (appointed by a military dictatorship) who is widely acknowledged for revolutionizing the city’s developmental trajectory. The prevalent political environment during Lerner’s first term in office allowed him to carry out dramatic changes with little recourse to democratic processes. However, with the benefit of hindsight, Lerner could be seen as a benevolent dictator due to the positive outcomes of most of his “wild ideas”. Lerner carried out intensive public campaigns to carry the citizens along with his dreams. It is, therefore, not surprising that urban planning vocabularies became a common parlance under Lerner’s regime (Zingoni 2017, personal communication, 2 March).

Aside from public education, Curitiba’s sustainability processes have also been enhanced by the imposition of a land-use plan that made it convenient for people to live in high densities along transit corridors. This development enabled high patronage of Curitiba’s public transport system (about 70% of residents), and a significant reduction in fuel consumption (27 million litres of fuel is saved per annum). In addition, fiscal incentives have been essential tools for promoting biophilic development, and waste recycling especially in poor neighbourhoods. The Green Exchange program, for instance, exemplifies how green urban policies may be applied equitably to respond to the needs of people with different income levels. A major challenge of this incentive-based approach, however, is its tendency to stimulate social norms that are driven by transactional exchange as opposed to particular values or belief systems. Over time, such an approach may lose its effectiveness when the incentive is misconstrued as an entitlement rather than a motivator for behaviour change (Gneezy et al. 2011). Therefore, a key source of leverage is influencing the worldviews that underlie people’s behavioural patterns (Du Plessis 2013).

In the last decade, the momentum of Curitiba's sustainability innovations is said to be experiencing social and political inertia after the exit of Lerner and his successors who shared his vision. For example, the city's famous Bus Rapid Transit system is said to have decreased by 14 million ridership in the last four years with a significant number of people (especially the middle class) turning to private cars (Halais 2012). This phenomenon is largely attributed to the growth in income levels in Curitiba, and the changes in attitudes and/or tastes that come with it. Therefore, Curitiba may need strong regulations to counter behavioural patterns that undermine its sustainability policies. A major challenge, however, is how Curitiba may restrict car usage as it is a major car producer (e.g. Volvo, Renault, and Audi-VW).

There are also doubts about the continuity of Curitiba's waste management and environmental education initiatives due to continuous changes in the city's political leadership in recent decades (Scruggs 2013). This observation reveals the weaknesses of predominantly top-down policies. Such policies will, inevitably, require a shared vision and strong leadership to carry the masses along. In events where leadership changes, and interests change, the probability that such policies may renege is high. However, in situations where the masses are the carriers of the vision, the likelihood that such visions may persist for a considerable period of time is high given that politicians come and go while society remains largely unchanged (Newig & Fritsch 2009). Therefore, promoting a sense of ownership of public policies among the grassroots, even in predominantly top-down political environment, is essential for the sustenance of such policies.

Notwithstanding these shortcomings, Curitiba's achievements offer key lessons that can inform sustainability transitions in other context. In the first place, Curitiba's experiences point to the need for cities to look inward to identify and build upon their existing potentials to address emergent challenges. This approach helps to identify solutions that are more context sensitive, and cost effective compared with the imposition of utopian concepts that might be extraneous to the nuances of the local context.

In addition, the integration of the various urban policies such as land-use planning and transportation; flood control and biophilic development; as well as waste management and food security in poor neighbourhoods etc., have helped to overcome segmentation between

policy goals, and fostered a mutually reinforcing policy framework that is self-perpetuating. These policies have been applied under what Lerner refers to as an “equation of co-responsibility” where the local government, private sector, civil society, and the general public all have shared responsibilities and rights in the realization of the policies.

Curitiba has also been proactive in marketing the successes of its urban initiatives to the world. Consequently, the BRT system, for example, has received several international awards which have inspired its adoption in other cities around the world. A corollary of this global recognition is the enhancement of the city’s image, and the promotion of public trust and confidence in Curitiba’s policies. Hence, 99 percent of Curitiba residents were reported to be satisfied with the city in a poll conducted to solicit public perception about living conditions in Curitiba (Mang 2012). To conclude, some fundamental questions this case study raises are how top-down policies might be sustained in dynamic political environments, and how public ownership of such policies might be strengthened. These questions lie at the essence of efficiency and longevity in public policy.

Application of the MLP

Dynamics and outcomes of green urban transitions in two forerunner cities: application of the Multi-level Perspective

8.1 Introduction

This chapter examines the nature and dynamics of socio-technical transitions in the urban context. Drawing on the Multi-level Perspective (MLP), the underlying drivers of green urban transitions, and how social actors influence these processes are discussed. The analysis draws on two case studies from both developed (Freiburg) and developing (Curitiba) country contexts. Findings from the empirical analysis illustrate two contrasting approaches to green urban transition: bottom-up niche-actors driven transition, and top-down regime-actors led transition. It is identified that both approaches may thrive in different transition contexts; however, the mechanisms for perpetuating the positive outcomes of such transition processes must be established. Besides, it will be shown that transitions take a considerable length of time (more than 4 decades), especially, when a regime shift is anticipated. Therefore, the choice of temporal scale in transition analysis is critical.

The chapter is organized as follows: the following section (Section 8.2) recapitulates the underlying principles of the MLP, and how it is applied in this chapter. Section 8.3 discusses the processes and mechanisms of green urban transition in both Freiburg and Curitiba. Following this narrative, the dynamics between the various analytical levels of the MLP, and how social actors influenced this interaction to facilitate transitions towards Green Urbanism in the selected cases are discussed. Building on this understanding, the potential pathways for green urban transitions under different conditioning factors are analysed. The paper

concludes (in Section 8.4) with some theoretical contributions, and lessons for policy-making facing societal transitions.

8.2 Overview of the multi-level perspective

The MLP (see Section 4.2.5 for a detailed discussion) holds that transitions come about when regimes are destabilized by internal tensions and/or pressures from landscape factors, and niche-innovations build up internal momentum to serve as viable alternatives to incumbent regimes (Geel 2005; Kemp et al. 1998). Proponents of the MLP acknowledge that transitions are not unidirectional, but they may take different pathways (i.e. transformation, reconfiguration, de-alignment and re-alignment, and substitution) depending on the timing and nature of interactions between landscape changes, regimes, and niche-innovations (Geels & Schot, J 2007; Schot & Geels 2008). However, how social actors influence the interface between landscape changes, regimes, and niche remains only implicit in the MLP. Therefore, following Smith et al. (2005), “quasi-evolutionary model of socio-technical transitions”, this study proposes a modified MLP framework that explicitly addresses the mediating role of actors in transition processes.

The proposed framework (discussed in Chapter 4) distinguishes five analytical sections in the MLP to aid a systematic analysis of the nature and dynamics of green urban transitions. As illustrated in figure 8.1 below, the first section highlights what landscape factors are prevalent in a given social context, and how these developments bring pressure to bear on entrenched regimes. The second section examines how landscape factors are interpreted and acted upon by social actors, and to what extent developments at the landscape level create a sense of urgency for change. Section three elaborates on how regimes respond to landscape pressures and emergent innovations, and how actors at the regime level contribute to regime stability or destabilization. In section four, the capacity of actors at the niche level to influence regime shift is discussed. Finally, section five unpacks the processes of niche development, and what factors present opportunities and/or barriers to their mainstream application.

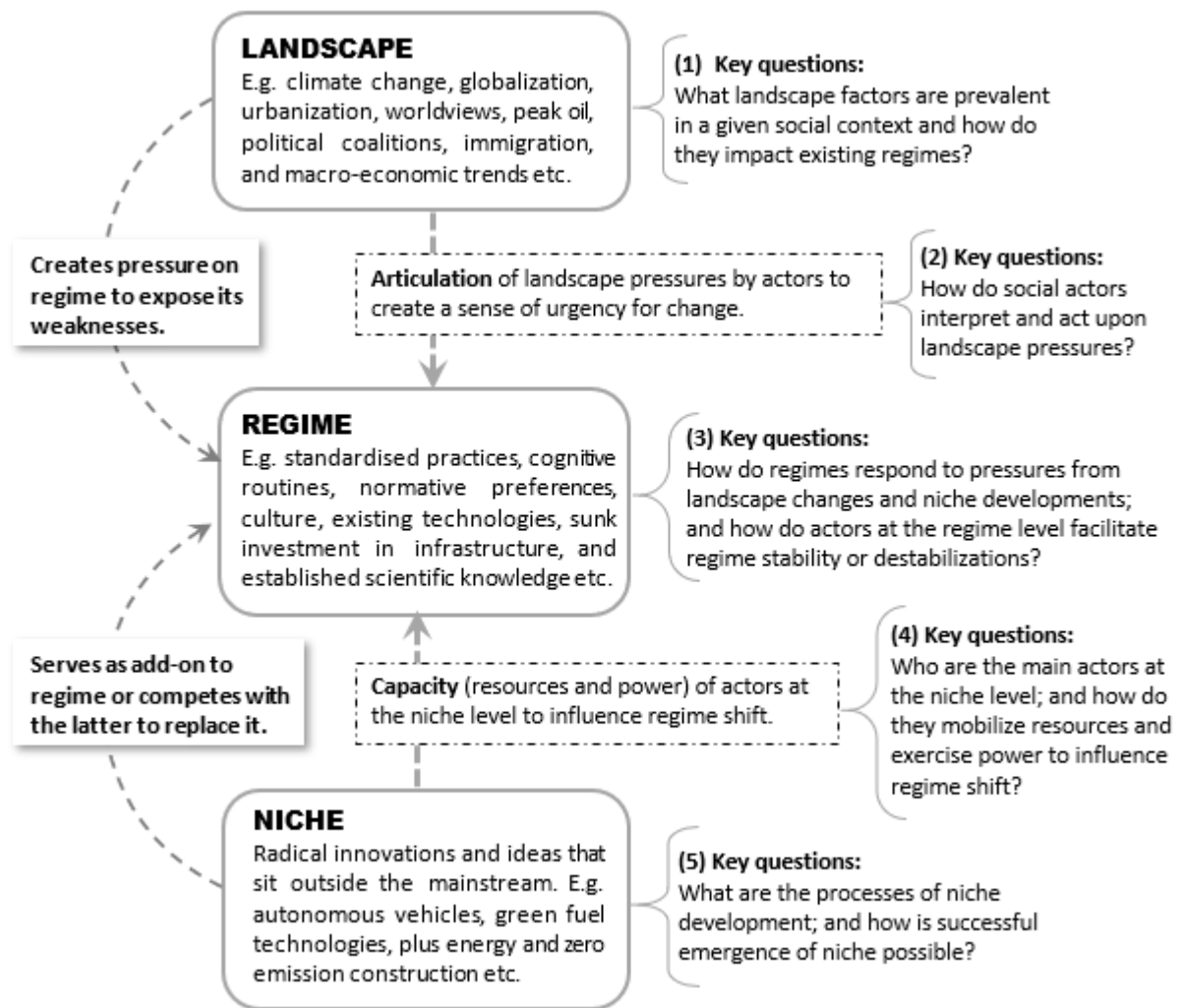


Figure 8.1: Analytical framework for assessing transitions in socio-technical systems (Developed from the MLP- Geels 2002)

Drawing on the analytical framework illustrated above, the following sections examine how the MLP might help enhance understanding of the dynamics of green urban transitions. Specifically, the cases of Freiburg and Curitiba will be discussed. The analysis will elaborate on: (1) factors that constitute landscape development in both contexts, and how these developments initiate transition processes; (2) the relationship between landscape and regime, and whether the former reinforces regime stability or provoke changes in its basic architecture; (3) how niche-innovations develop and become mainstream, and to what extent they complement or compete with incumbent regimes; (4) how social actors modulate these processes; and (5) the pathways or resultant outcomes of transitions in both contexts. To set the analysis in context, a chronological account of important events that unfolded to facilitate transitions in both cases will be first presented. Following this narrative, the two cases will be analysed based on the analytical framework discussed above.

8.3 An empirical analysis of the processes and outcomes of green urban transitions: application of the MLP

8.3.1 Case study 1: Freiburg im Breisgau (Germany)

Freiburg identifies itself as a 'Green City', and a pacesetter in urban sustainability in Germany and across Europe. For more than four decades, Freiburg has been at the cutting edge of innovative policies for sustainable land-use planning, urban transportation, housing, energy, and waste management etc. The successes of these policies have earned the city both national and international recognitions as a best practice model for Green Urbanism (refer to Chapter 6).

8.3.1.1 Drivers and mechanisms of Freiburg's transition process

Freiburg's 'Green City' accolade was set in motion by an environmental movement that seeded the experimentation of renewable energy technologies in the city and across Germany (Rohracher & Späth 2014). In the early 1970s, attempts by the German government to construct a nuclear power plant in Wyhl (25km from Freiburg) was met with strong public resistance. The government dismissed the protesters as 'backward-looking NIMBYs (Not In My Backyard)', and mobilized the forces to remove them forcibly from the site (Hager & Haddad 2015, p. 1). However, the persistent defiance of the protesters necessitated a court decision on the project. Eventually, the Wyhl nuclear project was called-off by a state administrative court, but with a lingering question of what alternative energy future should be pursued in the Freiburg region.

8.3.1.1.1 Landscape factors, articulation, and impacts on regime

As explained earlier, landscape factors refer to those macro-level phenomena that bring pressure to bear on existing socio-technical regimes, and create windows of opportunity for niche-innovations to emerge (Grin et al. 2010; Kemp et al. 1998). They include shifts in public perception, worldviews, environmental consciousness, climate change, changes in political processes, macro-economic trends, demographic change, urbanization, natural and/or man-made disasters, and wars among others (Geels 2005; Raven et al. 2010). Following Smith et al. (2005), how these developments are articulated will determine the extent to which they

influence incumbent regimes, and create a sense of urgency for change. In this case study, several landscape factors could be identified to underpin the Wyhl anti-nuclear movement.

In the first place, the nuclear apocalypse associated with World War II, and subsequent rise in global nuclear testing fuelled widespread concerns about the safety of nuclear power. These concerns were heightened by the Chernobyl nuclear disaster in the former Soviet Union in April 1986. Following these landscape factors (i.e. nuclear disaster and change in public perception), several anti-nuclear movements were organized in Europe and elsewhere in the mid to late 1900s. However, unlike the Wyhl anti-nuclear movement, most of these protests had limited impact on the nuclear power regime. The agency which social actors brought to the Wyhl protest made the latter stand out from the rest.

Firstly, the technical expertise brought on board by scientific experts (from the University of Freiburg and elsewhere) during the protest helped to articulate the problems with nuclear power more clearly and objectively beyond 'mere' social sentiments or paranoia. For example, Hager and Haddad (2015) note that during the legal proceedings, the state administrative court was keen on technical and scientific evidence; thus, the protesters were placed at a great disadvantage. The scientific experts and researchers who participated in the protest helped to provide counterarguments to the prevalent scientific and political opinions that tended to support the nuclear project. According to Hager and Haddad (2015), these objective criticisms and counterevidence were key to the state administrative court's decision to call off the project.

In a personal communication with a participant of the protest, it was noted that the experts involved in the anti-nuclear movement (especially scientists at the University of Freiburg) took advantage of the mass gatherings to hold public fora to educate the local people about the potential environmental and social consequences of nuclear power. These campaigns created further landscape changes (e.g. public awareness about the impacts of nuclear power, and environmental consciousness etc.), which engendered a sense of urgency for change. Hence, a significant part of the public lost faith in the nuclear power regime (Rohracher & Späth 2013; Schils 2011a).

In addition to creating awareness about nuclear power and the environment in general, Hager and Haddad (2015), argue that the protest challenged the prevalent governance system in Germany that entrusted more power and decision-making to few bureaucrats. Hence, it promoted a government-citizen relation that enabled citizens to contribute more actively to public decision-making processes. Eventually, this development inspired the founding of Forum 21 in Freiburg which coordinates civic dialogue on important public policy issues (Stadt Freiburg 2012a; Kronsell 2013). Similarly, Freiburg's endorsement of the Local Agenda 21 and Aalborg Charter also reinforced the city's commitment to consensus-oriented dialogue in the delivery of public policies (Stadt Freiburg 2015).

These landscape factors (i.e. nuclear disaster, change in public perception about nuclear energy, environmental consciousness, and change in government-citizen relation etc.) snowballed into widespread public disapproval of nuclear power, and strong grassroots support for more sustainable energy future. The alternative energy sources available at the time (mostly fossil fuel and coal) delivered no better environmental outcomes. Therefore, external actors (outside the large energy utilities) sought for more sustainable energy sources. This undertaking was largely driven by grassroots mobilization with less state interest. In fact, it is noted that some state officials withdrew support for these initiatives because of the material interest they had in the nuclear power regime (Hager & Stefes 2016). Besides, a push for an energy transition from nuclear to renewables was also met with strong resistance from established utilities (regime actors) through political lobbying and lawsuits. This observation reiterates how regimes provide stability and reinforcement to existing practices (Geels et al. 2016; Svensson & Nikoleris 2018). Notwithstanding, the window of opportunity created by the landscape changes (public disapprobation against nuclear power, and a quest for environmentally friendly alternatives) motivated the incubation and experimentation of renewable energy technologies (niche) in Freiburg.

8.3.1.1.2 Niche development processes and impact on regime

Although the nuclear project was cancelled, and public disapproval of the nuclear power regime became widespread, this window of opportunity did not automatically lead to a regime shift. Emergent niche-innovations (renewable energies) were underdeveloped, and the niche actors (scientific experts) had limited adaptive capacity (i.e. resources and power)

to influence the regime. Therefore, nuclear energy and other entrenched energy sources (fossil fuel and coal) continued to dominate the market. Niche development processes started off with the establishment of new institutions and social networks. In November 1977, the Oeko-Institut was founded by individuals from Freiburg and neighbouring communities (in the form of a voluntary association) to undertake independent research on alternative energy sources to nuclear power. One of their earliest studies i.e.: *Energiewende–Wachstum und Wohlstand ohne Erdöl und Uran* (Energy Transition: Growth and Prosperity Without Oil and Uranium), formed the basis of Freiburg's sustainable energy policy which aims to promote energy savings, renewable energies, and energy efficiency (Stadt Freiburg 2011).

The Oeko-institut did not develop renewable energy technologies per se but their research provided a road map for an energy revolution in Freiburg and Germany in general. Solar panels, for example, were experimented by individual groups at the subsistence level (Hager & Stefes 2016). However, the formation of the Fraunhofer Institute for Solar Energy Systems (ISE) in the early 1980s gave impetus to the development of solar technologies in Freiburg (Goetzberger 1994). After about three decades of operation, the Fraunhofer ISE has emerged as the largest institution for applied solar energy research in Europe (Rombach 2000). Earlier experiments by the institute and other emerging solar factories were articulated through exhibitions and demonstration projects such as the Heliotrope and the construction of the first German passive apartment building in Freiburg in the late 1990s among others (Stadt Freiburg 2015).

Alongside solar energy, other renewable energy technologies such as wind power, biomass, hydropower, and geothermal energy etc. also came to the limelight and competed for attention. In fact, although solar is the most visible renewable energy technology in Freiburg (due to the ubiquity of solar panels), biomass (cogeneration plant) accounts for the largest share of renewable electricity supply (Gregory 2011). At the early stages of development, there was little government support for these niche-innovations; therefore, “grassroots groups were key to embedding” these emergent technologies in mainstream society (Hager & Haddad 2015, p. 43).

Niche actors had limited power and resources to lobby for favourable government policies on renewable energies. However, the formation of the Green Party -Die Grünen (one of the

outcomes of the Wyhl protest) in the early 1980s, and their rise to power through a coalition government (Red/Green alliance) in the late 1990s marked the turn of the tide. Through the influence of the Greens, a feed-in law was passed in the early 1990s followed by a Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, EEG) in April 2000 (Bechberger & Reiche 2004). The implementation of these policies has been instrumental to the rapid deployment of renewable energies across Germany (Hager & Haddad 2015; Rohracher & Späth 2014). Other developments at the regional level such as the liberalization of the electricity market in Europe (further landscape change) in the 1990s also enabled the emergence of new (renewable energy) actors in the energy sector in Germany.

For more than four decades since the emergence of renewable energy technologies (especially solar energy) in Germany, a transition from nuclear energy remains partial. Nuclear power still accounts for a significant percentage of gross power production in Germany (see figure 8.2). In Freiburg where most of these innovations first gathered momentum, electricity supplied by the regional energy utility (*badenova*) to private households became ‘nuclear free’ only in 2008 (Stadt Freiburg 2011). According to Hager and Haddad (2015), the exit of the Red/Green government from office in 2005 resulted in a decline in political commitment to phasing out nuclear energy. Subsequent governments only committed to a complete withdrawal by 2022 after widespread public outrage following the Fukushima nuclear disaster in March 2011. The embeddedness of the nuclear power regime after more than four decades of persistent bottom-up pressure demonstrates how complex and protracting a shift in (or displacement of) entrenched regimes can be.

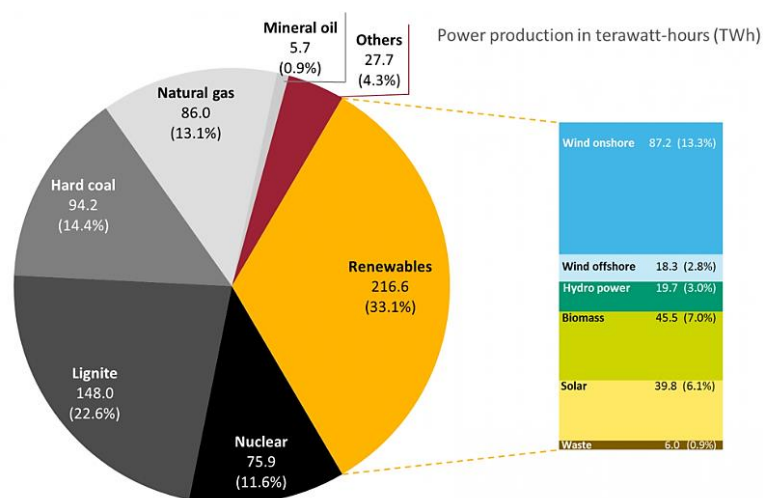


Figure 8.2: Share of Energy sources in German (Source: AG Energiebilanzen 2017)

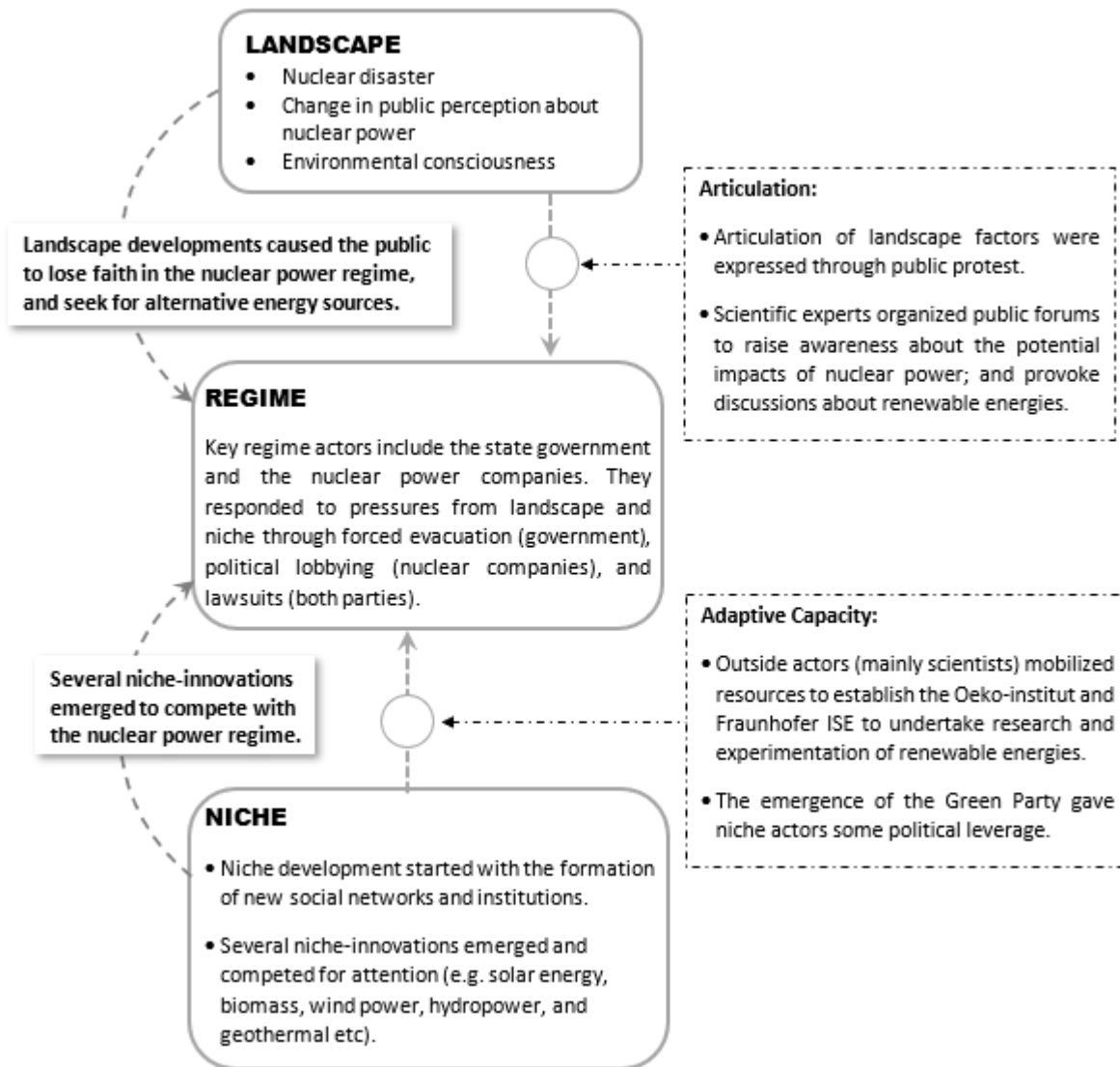


Figure 8.3: Nature and dynamics of Freiburg's energy transition (Author's construct)

8.3.1.2 Analysis of transition outcomes in key sectors in Freiburg

The history behind Freiburg's 'green revolution' is an energy transition which (directly or indirectly) gave impetus to radical innovations in other sectors. It was largely a landscape-initiated transition that created a window of opportunity for niche-innovations to emerge. Niche played a limited role in the transition process. In fact, the development of multiple niche (solar, biomass, wind etc.) created a situation where the various niche innovations had to compete for attention. Therefore, niche actors (with their limited adaptive capacity) had to compete with the entrenched regime (large utilities) and other niche actors for market share.

Freiburg's energy transition mimics the de-alignment and re-alignment pathway. According to Geels and Schot (2007), de-alignment arises when social actors 'lose faith' in existing regimes as a result of disruptive landscape pressure. In the absence of a dominant niche-innovation, multiple innovations emerge and compete for attention. One niche-innovation eventually dominates and form "the core for re-alignment of a new regime" (Geels & Schot, p. 408). Although the de-alignment phase could be observed in the energy sector in Freiburg, it is unclear whether one renewable energy will eventually dominate and form a new regime (re-alignment), or multiple renewables may mature concurrently and become mainstream. Given current trends of development in renewable energies in Germany, a 'parallel transition' is likely to unfold giving rise to multiple niche-regimes (Smith et al. 2005).

Apart from the energy sector, the transport, housing, and wastes sectors etc. have also undergone significant transformation. For example, the transport regime which was dominated by private motorised transport in the mid-1900s has been reframed to reduce automobile dependence as well as mitigate transport emissions due to the impacts of climate change (landscape). These changes were carried out through regulations and the imposition of a land-use plan that makes it convenient for people to use public transport and different modes of active transport (e.g. cycling and walking). In addition, transport innovations such as car-sharing and electric cars have been integrated to provide more sustainable modes of transport for private car users. Another compelling initiative is the introduction of the car free living concept in Vauban. This initiative challenged the status quo, and demonstrated the possibility and merits of avoiding private vehicles in the design of city neighbourhoods.

In addition to the transport sector, the introduction of low-energy construction and passive standards in the housing sector has also contributed to energy savings and efficiency of new buildings in Freiburg. Remarkable progress has also been made in the treatment of waste and stormwater. The conventional disposal of wastes (lumped together) at landfills has gradually been phased out since the late 1980s through an ecological waste management policy that conceives waste as a resource, and emphasizes waste avoidance, reuse, and separation for recycling. Consequently, Freiburg has one of the highest recycling rates in the world (69 percent). This eco-friendly waste management approach has been sustained and reinforced by the ecological consciousness of the people of Freiburg (landscape factors). Furthermore, stormwater is managed through a split-rate water billing system that imposes a fee on private

and commercial property owners based on the volume of impermeable surfaces of their properties (Keeley 2007). The main aim of this regulation is to mitigate flooding, and lessen the load on the city's stormwater drainage infrastructure.

Changes in the transport, housing, and waste sectors can be seen more as an 'endogenous renewal' than a regime shift (Smith et al. 2005). Pressures from landscape factors (i.e. environmental consciousness, climate change, and changes in national/regional regulations etc.) resulted in a "conscious and planned" effort by regime actors to re-organize existing regimes through regulations and policies (Geels & Schot, p. 401). Emergent innovations in the various sectors such as electric cars (transport), energy-efficient materials (housing), and recycling technologies (waste) etc. were adopted as add-ons to reconfigure the incumbent regimes. In this regard, both a transformation and reconfiguration path could be observed.

This case study shows that changes in normative rules, regulations, and policies etc. are important for regime transformation with or without interactions with niche-innovations. In addition, the study points out that radical changes in cities are not only driven by technologies but also ideas. These ideas can and may, eventually, translate into guiding principles, regulations, and policies that form the basis for transition experiments. Therefore, there is a need for a broader conceptualization of niche as 'socio-technical niche' to capture not only technological innovations but also 'radical innovative ideas' that sit outside the mainstream. A typical case in point is the car free living concept in Vauban. This idea did not only change the behaviour patterns of residents in Vauban, but also inspired fundamental changes in the design of the district (see Section 6.4.2 of Chapter 6).

8.3.2 Case study 2: Curitiba (Brazil)

Curitiba (refer to Chapter 7 for detailed discussion), the capital city of Parana state in Brazil, presents a model to assess how simple and low-cost but pragmatic ideas could be applied to transition cities in the developing world towards Green Urbanism. To enhance understanding of Curitiba's transition process, the following section discusses the drivers and mechanisms of Curitiba's urban transformation.

8.3.2.1 Drivers and mechanisms of Curitiba's transition process

Curitiba's sustainability transition was largely driven by top-down initiatives by political elites who were committed to simple ideas that delivered positive social and environmental outcomes. Some of the early radical changes that took place in Curitiba were criticised for lacking democratic legitimacy. However, Lerner (who led most of these initiatives) believes that democracy is not necessarily 'consensus' building but the ability to manage conflicting interests (Adler 2016). To a great extent, the political regime (military government) that brought Lerner to power in the early 1970s facilitated the implementation of some policies with little bureaucratic and social inertia (Moore 2006). However, Lerner's government carried out intensive education to carry the people of Curitiba along his visions for the city (Rabinovitch 1992). These ideas were in response to the social and environmental challenges (landscape factors) that confronted Curitiba at the time.

8.3.2.1.1 Landscape factors, articulation, and impacts on regime

Curitiba became attractive to migrants at the beginning of the 20th century following the introduction of light industries. As a result, the population of Curitiba doubled between 1950 and 1960 (Rabinovitch 1996); and continued to double every 10 years for three decades (Macedo 2004). Rapid economic growth and demographic change threatened to turn the city into a nightmare of environmental degradation, pollution, and congestion. Squatter settlements also emerged as the city got more urbanized. Some of these settlements encroached upon floodplains which aggravated the city's vulnerability to persistent flooding (Rabinovitch & Leitman 2004; Suzuki et al. 2010). These landscape factors (i.e. demographic change, urbanization, environmental pollution, and flood disasters etc.) necessitated the re-organization of Curitiba's deficient infrastructure to cater for the new realities that confronted the city.

Regime actors (especially Curitiba's local government) took a leading role in finding solutions to the city's emergent problems. According to Wilhelm, Curitiba officials found the answer in spatial planning (Wilhelm 1969 cited in Macedo 2004). The Wilhelm Plan was a political decision to replace the Agache Plan (which turned out to be overambitious and expensive) with a more comprehensive and feasible master plan that gave direction to the city's growth and responded to its social and environmental problems. Although the Wilhelm Plan held

much promise, its application was sluggish in the late 1960s until further landscape changes (transition from democratic to military government) created the momentum for the gradual implementation of the plan in the early 1970s.

Curitiba's land-use transition facilitated the transformation of the city's transport networks and services. The introduction of transit corridors in the Wilhelm Plan enabled the experimentation of the first BRT system in the world. This development helped to promote public transit ridership in Curitiba. Apart from the BRT, other revolutionary ideas in Curitiba worked with remarkable success during Lerner's regime. For example, the city's ecological waste management concepts received the highest environmental award of the United Nations Environmental Program (UNEP) in the early 1990s. Lerner and his political cohorts carried out intensive environmental campaigns to change the worldview of Curitiba residents about their environment to galvanize grassroots support for their sustainability initiatives.

Nevertheless, after the exit of Lerner and his successors who identified with his ideologies, most of the innovations Curitiba is widely acknowledged for are said to be on a downward spiral. For example, between 2008 and 2012, usage of the BRT is reported to have decreased by 14 million ridership. Two major changes at the landscape level are identified to contribute to this phenomenon. Firstly, the continuous growth of Curitiba's population (demographic change) has brought some of the BRT lines to saturation point. Hence, there are rising concerns about crowded buses which have become a major deterrent to the usage of the BRT (Reed 2015). Secondly, the rise of middle-income population in Curitiba has triggered changes in consumer mobility preferences; thus, resulting in the demand for more private vehicles. Lerner blames this defect on the failure of recent governments to adapt the BRT system to changing demographics and consumer needs (Gaunt 2016).

8.3.2.1.2 Niche development processes and impacts on regime

Niche played a less significant role in Curitiba's transitions. Much of the initiatives were propelled by regime actors (especially the local government) at the instance of landscape factors (e.g. demographic change, urbanization, flood disasters, and changes in political processes etc.). The introduction of radical ideas in the transport (BRT) and waste (Green Exchange) sectors, for example, depended more on the adaptive capacity of regime actors (city officials) than outside (or niche) actors. Innovations by outside actors such as the

introduction of bi-articulated buses, hybrid articulated buses (HibriPlus), and hybrid electric buses (HibriPlug) by Volvo were only adopted as add-ons to enhance the capacity and energy efficiency of the BRT. Therefore, Curitiba's transport transition can be said to be the outcome of an effective alignment between regime and niche actors.

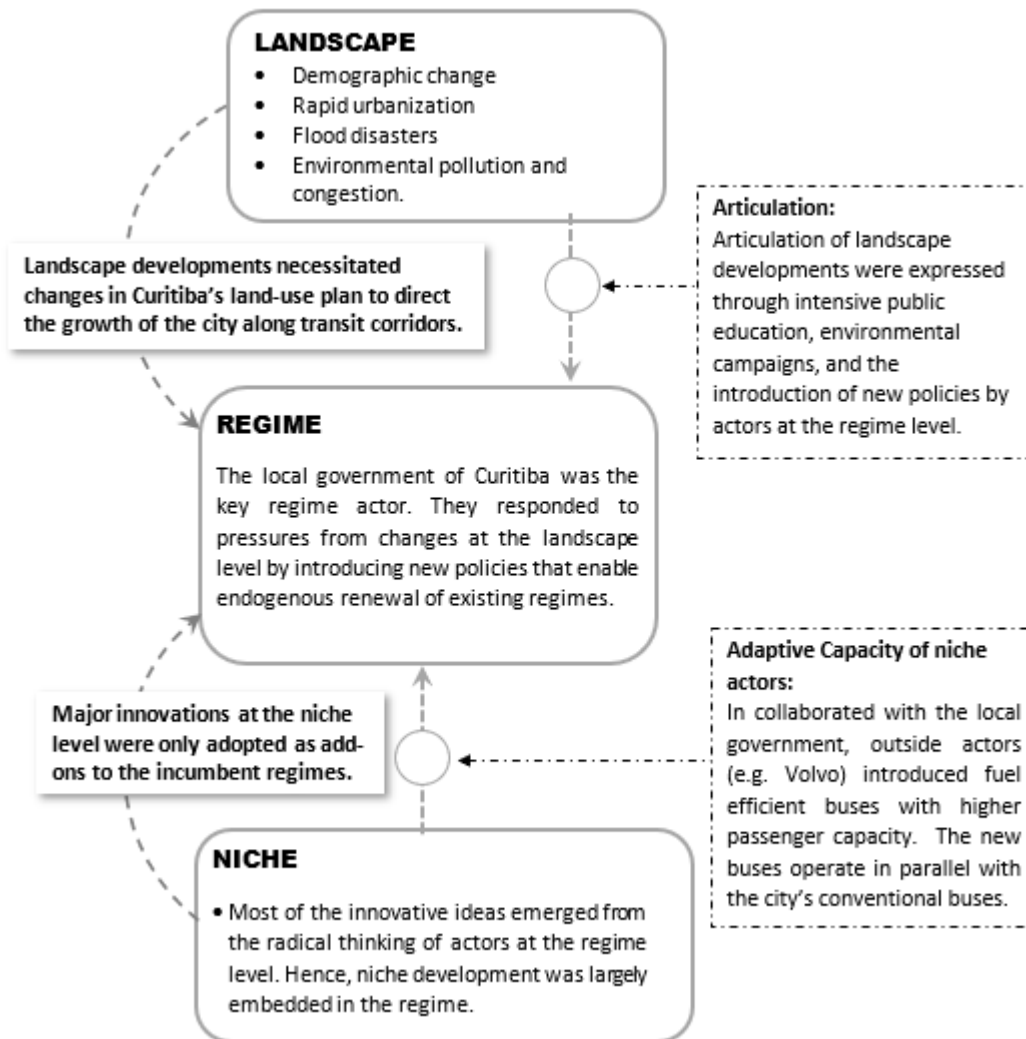


Figure 8.4: Nature and dynamics of key drivers of Curitiba's transition (Author's construct)

8.3.2.2 Analysis of transition outcomes in Curitiba

This case study represents a regime dominated transition. Changes at the landscape level, and responses from regime actors coalesced into 'endogenous renewal' of incumbent regimes (Smith et al. 2005). The problems articulated by landscape factors (i.e. rapid urbanization, environmental pollution, and flood disasters etc.) called for physical planning solutions. Therefore, Curitiba's transition started off with a revision of the basic form and functions of the city. Changes in the city's master plan gave impetus to significant changes in

transport networks and operations, as well as housing development among others. Outside (or niche) actors, for the most part, played a complementary role in the transition process. In the transport sector, for example, niche-innovations were only adopted as add-on by regime actors (Curitiba officials) to enhance the efficiency of the BRT. Therefore, Curitiba's transport system tends to follow the reconfiguration pathway.

Innovations in waste management, flood control, and the conservation of biodiversity etc. originated within the regime at the instance of landscape changes. The power and resources (adaptive capacity) to carry out these transformational changes largely rested with regime actors (especially the local government). Due to the dominant influence of Curitiba's local government in the city's developmental trajectory, niche-innovations which received limited government support hardly broke through to become mainstream. In the energy sector, for example, until recently alternative renewable energy sources such as solar power etc. was marginalised due to the city's dependence on hydropower despite the increasing vulnerability of the latter to climate change impacts (OECD 2005; Tiepolo et al. 2014). These outcomes point out that when transition processes are dominated by regime actors, landscape changes may only trigger the reorganization of existing regimes to address particular shortcomings.

The case study also shows that landscape factors may evolve in a given transition process which may derail or challenge a regime shift. For example, changes at the landscape level in the mid-1900s (e.g. congestion, pollution, and rapid urbanization etc.) necessitated changes in the city's land-use plan and public transportation system to reduce automobile dependence. However, in the last two decades, the marked growth of the middle-class population in Curitiba has brought about a resurgence of interest in personal vehicles which pose significant threat to the BRT system. This observation begs the question of how competing regimes might be modulated to sustain the momentum of a transition process on desired trajectory.

8.4 Conclusion

This Chapter makes two contributions to the literature on sustainability transitions. Firstly, it assesses the urban context of sustainability transitions, and the factors that drive these processes. This analysis elaborates on how the interaction between landscape factors,

incumbent regimes, and niche-innovations interface with the agency of social actors to determine the outcomes of transition processes. It suggests that transitions are not linear pathway of progress, but they are modulated by nuanced and inherently complex interactions that can result in outcomes that are hard to predict. Secondly, the paper examines how the location-specific characteristics of cities influence transition outcomes. In this regard, the study explores transitions in the context of both developed (Freiburg-Germany), and developing (Curitiba-Brazil) countries.

The case studies show that the articulation of pressures from landscape development is an important source of leverage for triggering regime change in desired trajectory. Essentially, developments at the landscape level create a sense of urgency for change in the first place. Besides, the cases point to a correlation between the nature of landscape factors, and the sectors where transitions are instigated. For example, Freiburg's sustainability transition started off with an energy revolution because of the type of landscape development (i.e. anti-nuclear movement) that triggered this change process.

In the case of Curitiba, pressures from landscape changes (rapid urbanization, congestion, flood disasters etc.) necessitated solutions that were oriented towards physical planning interventions. Hence, Curitiba's progressive planning initiatives in land-use and transport networks form the linchpin of its sustainability transition. Against this background, it is expected that different cities will prioritise different sectors in their quest to transition towards Green Urbanism depending on the nature of prevalent landscape factors, and the window of opportunity they create. Therefore, it is important for cities to identify which sectors offer the best lever for propelling change under given circumstances.

Another important source of leverage is the adaptive capacity of social actors to respond to selection pressures from landscape factors (Smith, A et al. 2005). From an analysis of the case studies, it can be observed that transitions may take different pathways depending on which group of social actors (regime or niche) have the capacity to initiate a change process. On one hand, Freiburg showed an energy transition initiated by outside (niche) actors. Niche actors formed new social networks (e.g. Oeko-Institut) and mobilized resources to challenge the incumbent nuclear power regime. This grassroots development led to the de-alignment of nuclear energy, and the emergence of alternative renewable energies. On the other hand,

Curitiba's transition was predominated by local government led initiatives. Since the resources and power to respond to landscape pressures largely rested with regime members, the transition process was mostly an endogenous renewal of existing regimes. Outside and/or niche actors played a less important role in this transition context. They were mostly engaged as partners or end-users.

In fact, both approaches in the two case studies (i.e. grassroots niche actor driven transition and local government led transition) are widely acknowledged as sustainability success stories. In one sense, this observation dismisses debates about which approach is better; and suggests that cities have to build on the approach that offers the best lever for advancing change given their local conditions. Nevertheless, a more critical analysis evokes provocative questions about the longevity of urban policies that thrive on either approach. In the case of Freiburg, the green or sustainability concept was largely driven by grassroots mobilization. Eventually, the people elected political leaders (the Greens) who shared in this ideology. The nexus between grassroots commitment and political will reinforced and perpetuated Freiburg's identity as a green city. Curitiba portrays a different historical development. The idea of building a sustainable city was largely conceived by Lerner and his political cohorts. These ideas were then transferred to the people in the form of policies, regulations, and incentive structures. However, in recent years, Curitiba is said to be losing its edge in advancing its past achievements due to changes in political priorities. This inertia raises the question of how cities might create a sustainability framework that is self-perpetuating regardless of which governance approach is applied.

Analysis of application case-Accra

Green Urbanism in Accra: analysis of the drivers, opportunities, and barriers to green urban transitions in a developing country context

9.1 Introduction

In this Chapter, the results of questionnaire surveys, site observation, GIS mapping, and interviews examining factors that present opportunities and/or barriers to green urban transition in Accra are presented. The analysis builds on the theoretical and empirical studies presented in previous chapters. Through a broader review of literature, Chapter 2 highlighted key principles of Green Urbanism that can be applied to cities to minimize their environmental impacts and improve the wellbeing of people. Applying these principles to both developed (Freiburg, Germany) and developing (Curitiba, Brazil) country contexts, Chapters 6 and 7 identified different governance approaches (top-down and bottom-up) to transitioning cities towards Green Urbanism. Both approaches were found to be effective in different socio-political contexts, but with inherent merits and limitations.

A deeper analysis of the dynamics of green urban transition in both contexts was presented in Chapter 8. This analysis highlighted a number of factors that create inertia and/or build momentum for change. Firstly, the applied theoretical framework in Chapter 8 (i.e. Multi-level perspective) identified the interface between landscape development, socio-technical regimes, and socio-technical niche-innovations as fundamental condition for green urban transitions. Secondly, it revealed that the nature of interaction (i.e. disruptive or reinforcing) between these three analytical concepts (i.e. landscape, regime, and niche), and the capacity of social actors to modulate these processes are important determinants of transition outcomes. The theoretical and empirical analyses pointed to a deeper exploration of the

location specific characteristics of cities (e.g. physical characteristics, common practices, and political context etc.) as the opening wedge to enabling a transition towards Green Urbanism.

Against this backdrop, this Chapter examines how current development trends, existing policies, and mainstream practices in Accra present opportunities or barriers to green urban transition. It addresses four sets of objectives: (1) to understand how existing policies and practices compare with the criteria of Green Urbanism; (2) to identify the strengths and gaps in these policies and common practices; (3) to examine the opportunities and barriers to green urban transition in Accra; and (4) to assess (through the theoretical lens of the MLP) the potential triggers and pathways towards Green Urbanism in Accra.

As illustrated in figure 9.1 below, this chapter is organized as follows: Section 9.2 recapitulates the principles of Green Urbanism discussed in Chapter 2. Drawing on a review of government policies and findings from the field study, Section 9.3 assesses the performance of Accra against these principles; and examines the strengths and shortcomings in existing policies and common practices. Following this discussion, Section 9.4 presents an analysis of the barriers, opportunities, and potential sources of leverage for green urban transition in Accra. It builds on findings from the field survey and interviews with insights from the Multi-level perspective. Finally, Section 9.5 highlights the significance and limitations of the findings and offers suggestions for policy and further research.

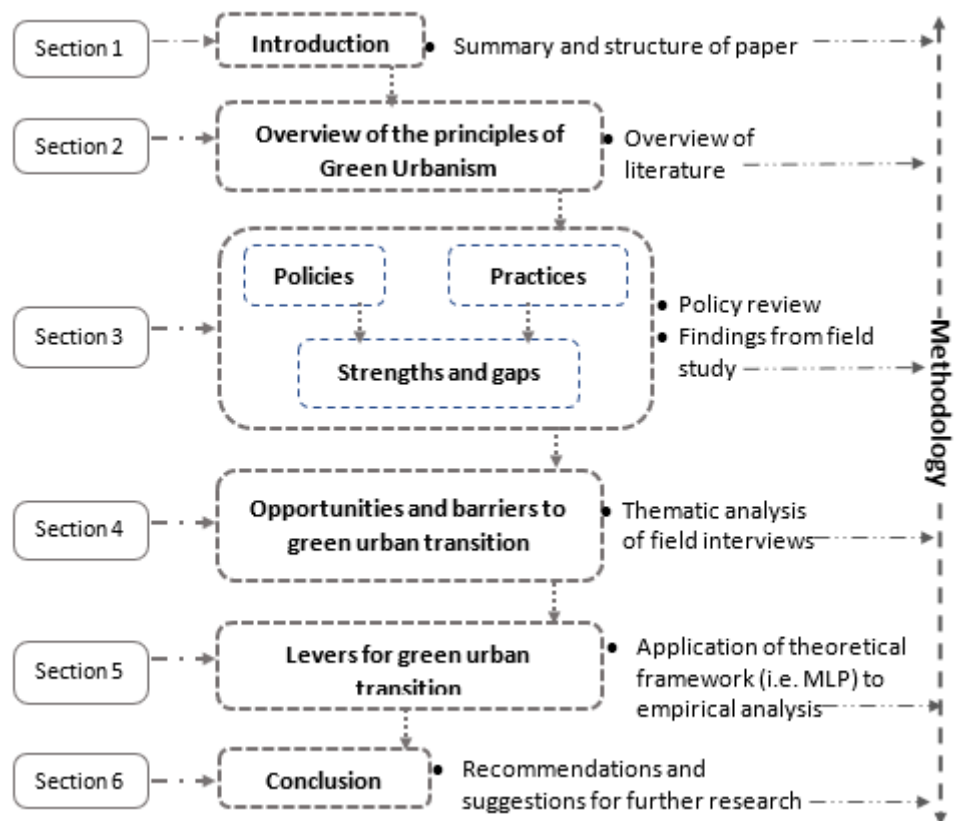


Figure 9.1: Schematic structure of Chapter 9 (Author's construct)

9.2 Overview of the principles of Green Urbanism

Green Urbanism evokes a wide range of ideas, images and theoretical interpretations among urban theorists, policy makers and academics alike. There is lack of a standard definition of this concept; however, the existing literature broadly agrees on some salient principles of Green Urbanism. This study examines these principles under six broad criteria i.e.: land-use planning, transport, energy, building, waste, and water. The illustration in figure 9.2 provides examples of local level practices and governance level interventions that can help facilitate the application of the underlining principles of Green Urbanism. Among others, the principles of Green Urbanism aim to minimize the ecological footprint of cities, mitigate carbon emissions, promote natural processes as part of urban infrastructure, and enhance the identity and economic competitiveness of cities (Beatley & Newman 2012). As shown in the empirical case studies in Chapters 6 and 7, these principles can be applied through different governance approaches (i.e. top-down, bottom-up, or a combination of both) depending on the social and political contexts of cities. The following sections examine how these principles

apply to Accra. They assess the strengths and shortcomings in existing policies and practices, and identify potential triggers for green urban transition in Accra.



Figure 9.2: Summary of the criteria of Green Urbanism (Author's construct)

9.3 Application of the criteria of Green Urbanism to Accra

9.3.1 Land-use planning

Land-use planning is an important tool for managing the interface between anthropogenic activities and the natural environment (Kaiser et al. 1995; Randolph 2004). This relationship is acknowledged by proponents of Green Urbanism as fundamental to the liveability and environmental performance of cities. Therefore, Green Urbanism proposes comprehensive land-use strategies that emphasize high density and mixed-use development along transit corridors (i.e. transit-oriented development). These development strategies have been shown to reduce automobile dependence, promote active transport, improve community health, stimulate local economies, and optimize the use of land and urban infrastructure etc. (Bartholomew & Ewing 2011). In addition, Green Urbanism emphasizes the promotion of nature in urban land-use planning. Beatley (2009), identifies this approach as 'biophilic urbanism': a conscious 'strive for more intensive and protracted exposure to nature' (Beatley

2009, p. 212). Several studies have established a positive relationship between biophilic urbanism and urban liveability, community health, and property value etc. (Lee & Maheswaran 2011).

9.3.1.1 How does Accra meet the criteria of TOD and biophilic urbanism?

9.3.1.1.1 Policy perspective

As mentioned in previous chapter, the Strategic Plan for the Greater Accra Metropolitan Area-GAMA (from 1991 to 2010) forms the first comprehensive development framework for Accra since independence. Subsequent planning policies such as the National Urban Policy-NUP (2012) and the National Spatial Development Framework-NSDF (2015-2035) are recent national developments which have yet to be adopted and operationalized at the local (i.e. metropolitan, municipal, and district) levels. The 1991 Strategic Plan was designed to serve as the basis for land-use planning and development control in Accra. Most of the strategic goals of this plan resonate with the ideals of transit-oriented development and the integration of nature in the design and development of the built environment.

For example, Chapters 2 and 3 of the Strategic Plan accentuates urban consolidation, functional integration of urban spaces, and the concentration of new developments along three transit corridors within the GAMA. The Plan also proposes a network of green spaces in and around the GAMA. For instance, an estimated 11,250 hectares is designated as metropolitan open green space together with peripheral green belts to constrain long-term urban expansion into the rural hinterlands. The NUP and the NSDF reinforce these policies in many respects. Both policies advocate for spatially integrated development as well as urban growth containment boundaries to protect green belts among other ecologically sensitive areas.

To a great extent, the strategic goals of the existing planning policies in Accra are in sync with the principles of Green Urbanism underlying urban land-use planning. Nevertheless, there is little evidence of the direct impact of these policies on the development of Accra. There appear to be many “*what and how*” questions hovering around these policy initiatives. For instance, although the Strategic Plan for GAMA accentuated high density and mixed-use development integrated with efficient multimodal transport system, it was less explicit on

how these goals might be applied at the sub-metropolitan district levels. Much of the underlying goals of the plan were too generic and less precise on what targets they aimed to achieve, how they translate into real spatial transformation, and how their implementation might be monitored and evaluated over time. These shortcomings can also be observed in the NUP and the NSDF. Thus, it remains questionable how these policies might positively influence current development trends in Accra.

9.3.1.1.2 Perspective from common practices

From the field study (i.e. interviews, surveys, mapping, and site observations), it was observed that Accra performs fairly well in the aspect of mixed-use development within walking distance of public transport. However, it performs very poorly in biophilic urbanism. The spatial characteristics of most communities in the Accra Metropolis portray fairly integrated residential, commercial, cultural, and recreational functions. According to findings from the field survey, a significant percentage of the respondents (across the 10 sub-metropolitan districts in Accra) have access to essential social and commercial services such as markets, hospitals or health post, drugstores, retail shops, schools, and eateries etc. within walking distances or via public transport (see figure 9.3).

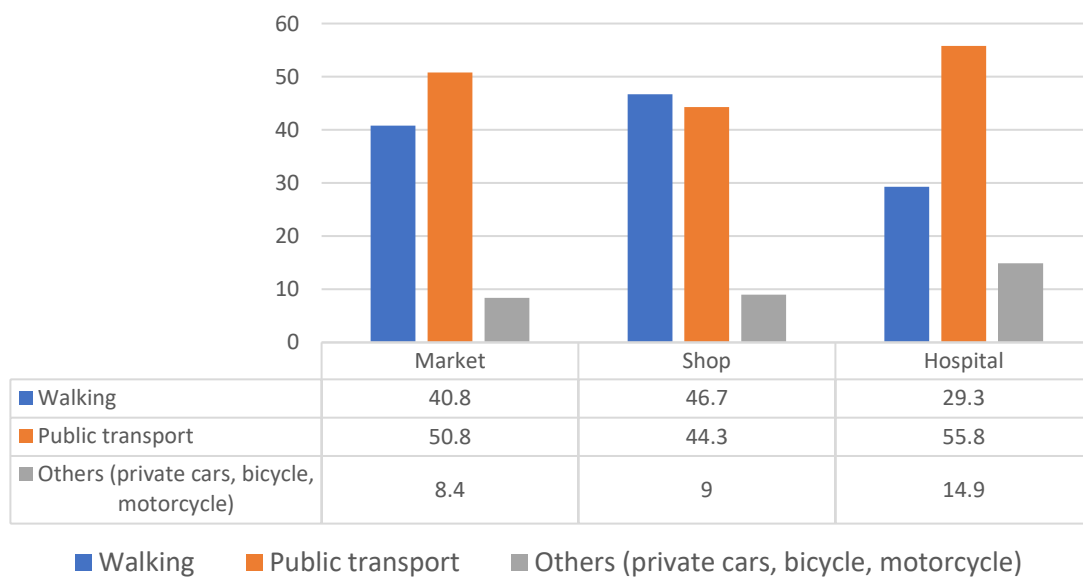


Figure 9.3: Modes of transport to commercial and social services within the Accra Metropolitan Area (Field survey)

This mixed-use transit-oriented development is largely driven by grassroots initiatives rather than government policies and/or land-use regulations. The field interviews and site observations reveal that most of the community retail shops, markets, and public transport services etc. are provided by the private informal sector. In fact, the informal sector is the main source of employment in most communities in Accra. The recent Population and Housing Census in Ghana shows that out of the economically active population in Accra, 92.2 percent are employed, and 73.3 percent of the employed population work in the private informal sector (GSS 2010). Like most developing cities in Africa, the informal sector is a key driver of growth in Accra. It provides a wide range of service; thus, creating economically vibrant communities.

Nevertheless, the influence of the informal sector on land-use patterns in Accra has been rather deleterious for the natural environment. Current development trends (largely propelled by the informal sector) are sporadic and uncontrolled. Hence, there is a significant mismatch between existing planning policies and common practices. Drawing on a Geographic Information System (GIS) map of Accra obtained for the periods 1986, 2000, and 2016 (see figure 9.4-9.6), it was observed that a greater share of the vegetation cover of Accra (i.e. grassland, pasture, shrubland, cropland, and forest) has been replaced by built-up artificial areas (e.g. residential, commercial, industrial, transportation) and bare lands due to poor adherence to planning regulations. In the last three decades, the Accra Metropolitan Area has seen a significant reduction in its natural vegetation cover from about 88km² to 7.3km² due to uncontrolled growth (see figure 9.7).

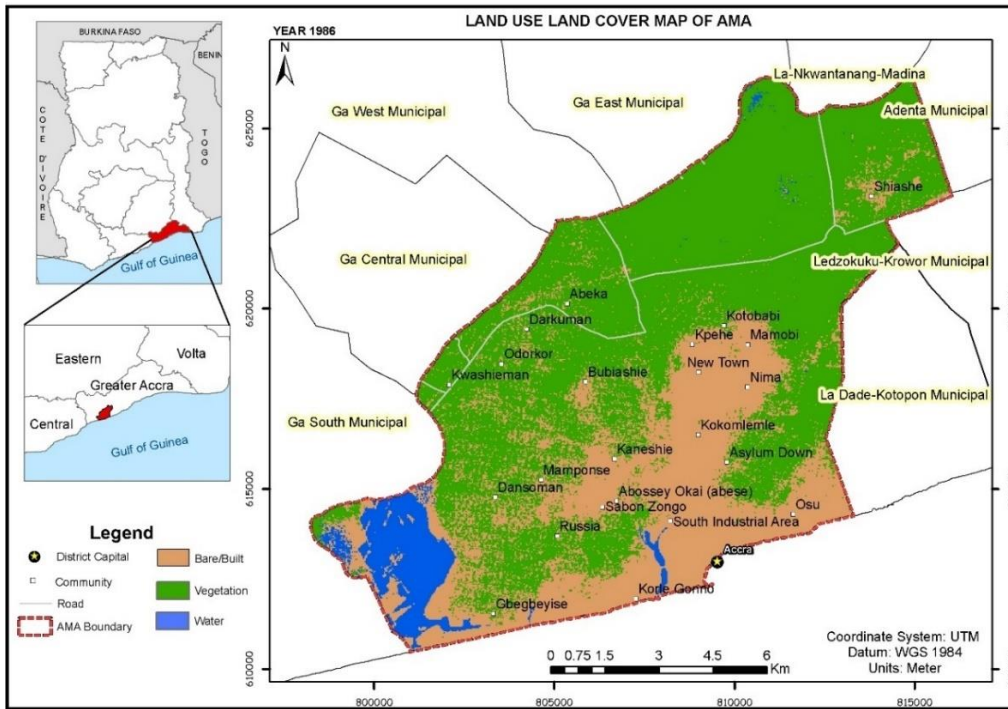


Figure 9.4: Land use and land cover map of the Accra Metropolitan Area - 1986 (Source: ArcGIS map- Source: Centre for Remote Sensing and Geographic Information Systems, University of Ghana)

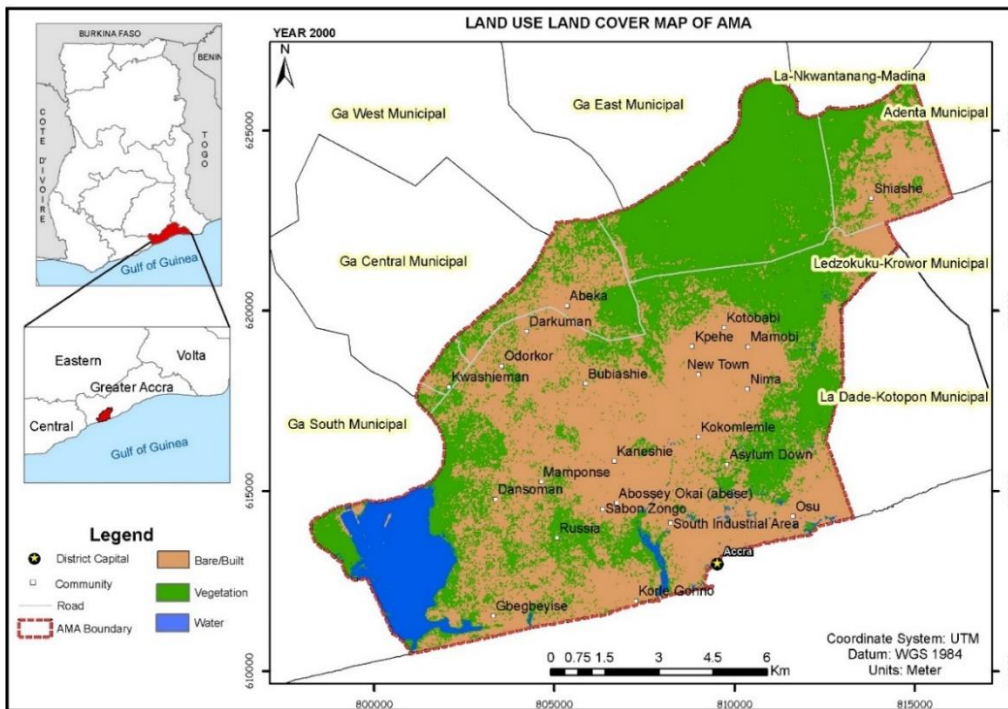


Figure 9.5: Land use and land cover map of the Accra Metropolitan Area - 2000 (ArcGIS map- Source: Centre for Remote Sensing and Geographic Information Systems, University of Ghana)

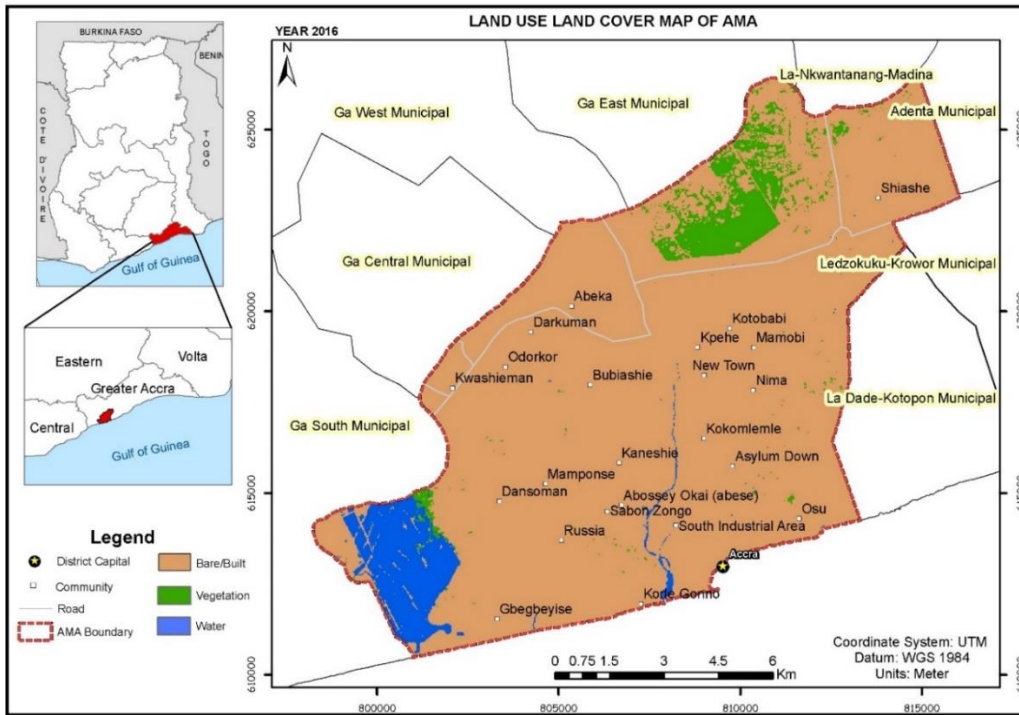


Figure 9.6: Land use and land cover map of the Accra Metropolitan Area - 2016 (ArcGIS map- Source: Centre for Remote Sensing and Geographic Information Systems, University of Ghana)

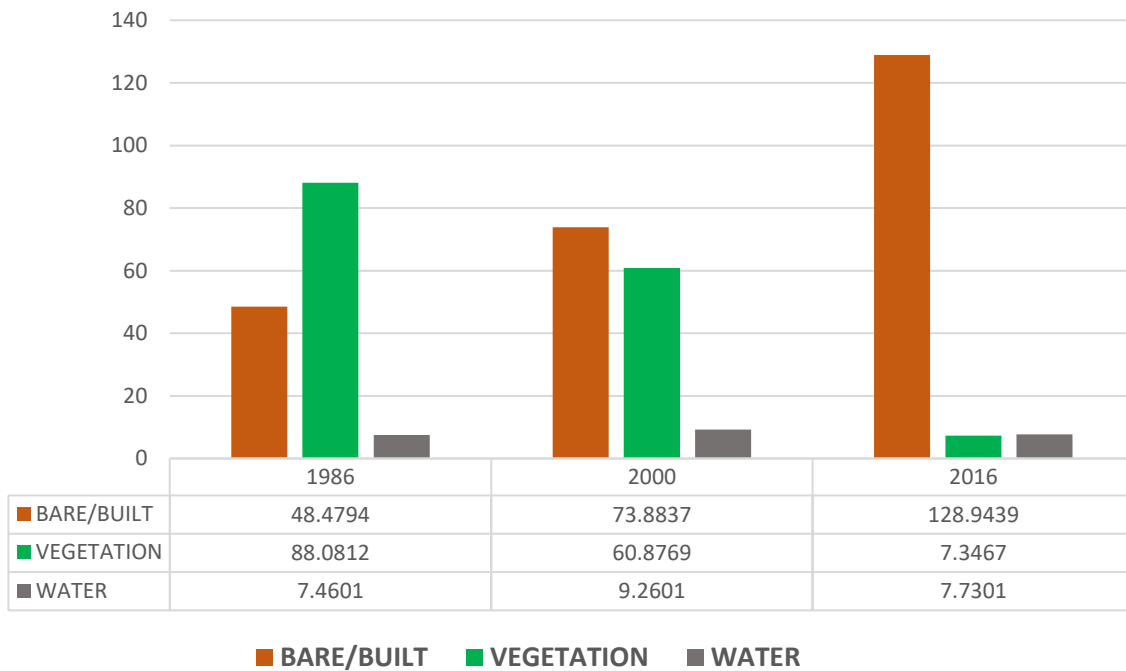


Figure 9.7: Land cover change (Km²) in the Accra Metropolitan Area from 1986 to 2016 (Source: developed from ArcGIS map -Centre for Remote Sensing and Geographic Information Systems)

Among others, land speculation was identified as a major driver of Accra’s sporadic growth. Being the economic growth pole of Ghana, the Accra Metropolitan Area attracts the greatest share of investments in property development across the country. About 80 percent of real

estate developers in Ghana operate in Accra (Participant 09). Hence, there is immense demand for land for development which has created a speculative bubble and a sense of scarcity. However, spatial analysis and site observations in Accra show that this sense of land scarcity (which is pushing developers to the green fields) is overexaggerated. According to a local planning practitioner, 'Accra is not congested but it is poorly planned' (Participant 06). Therefore, there are still opportunities for urban regeneration if land tenure practices are regularized and planning policies are enforced. A good number of the field interview respondents believed that the key sources of leverage for efficient land-use management in Accra lie in regularizing the informal sector to enhance its productivity and minimize its adverse impacts; and promoting an effective decentralization system that gives local governments the necessary resources and power to modulate local developments.

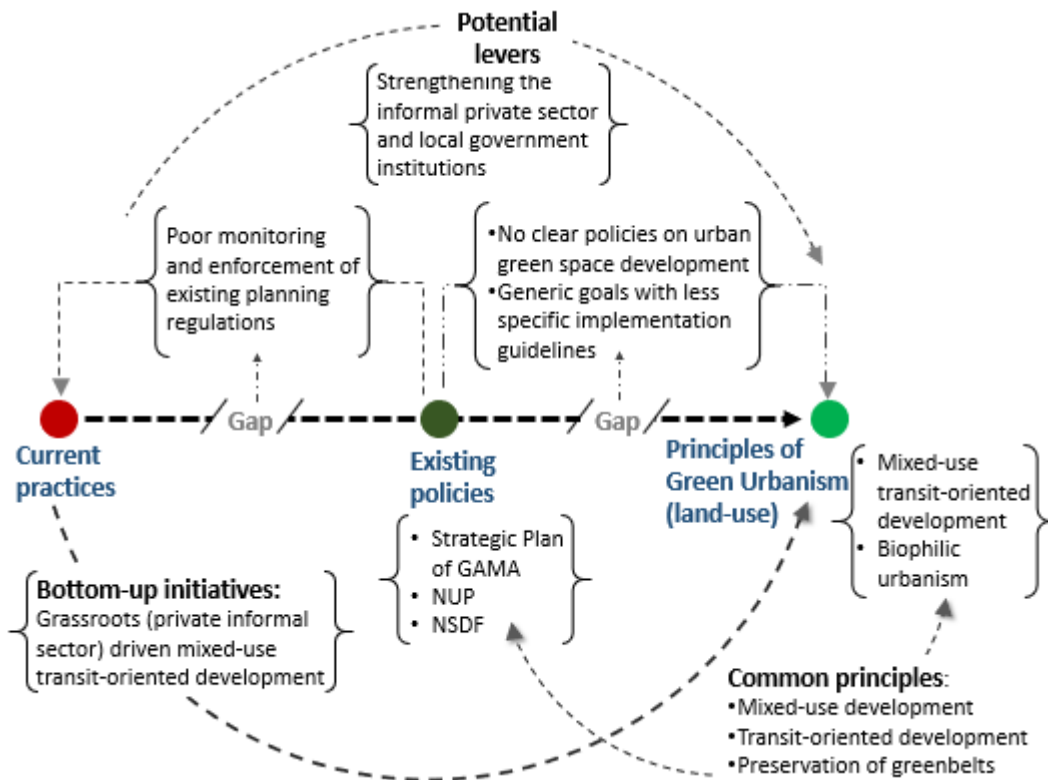


Figure 9.8: Performance gap analysis of land-use planning in Accra against the principles of Green Urbanism (Author's construct)

9.3.2 Urban transportation

Transportation is the mainstay and catalyst of socio-economic activities and information flow in cities. However, it also comes with potential downsides: congestion, impacts of emissions on air quality, noise pollution, and safety issues etc. Most scholars agree that efficient

transport planning is one of the key determinants of urban liveability (Joshi et al. 2018; Vuchic 2017). Therefore, urban transportation systems should be structured around eco-efficiency to minimize their social and environmental impacts. Green Urbanism advocates for efficient public transit system, non-motorized transport (e.g. cycling and walking), and alternative fuel (renewable) vehicles to promote clean urban transportation (Carvalho et al. 2012; Newman & Matan 2013). The existing literature has shown that cities can significantly mitigate transport related emissions, reduce demand for parking spaces, minimize the economic cost of traffic congestion, encourage social connectedness, and reduce health risks associated with sedentary lifestyle if public transit and active modes of transport are the rule rather than the exception (Pérez et al. 2017; Saunders et al. 2013).

9.3.2.1 How sustainable is the transportation system in Accra?

9.3.2.1.1 Policy perspective

The Strategic Plan for GAMA (1991) outlined several strategies to improve the public transit system in Accra and promote active commuting. These initiatives include: provision of park and ride centers on the periphery of the central business district (CBD); provision of dedicated lanes and laybys for buses on all arterial and collector roads; progressively restricting access and parking by private cars in the CBD; urban consolidation and mixed-use development to encourage walking and cycling; and separation of pedestrian accessways and bicycle lanes from motor vehicle traffic etc. In hindsight, these policy initiatives only add to existing well-thought-out ideas that have yet to be implemented.

Some of the ideas which were experimented in the late 1990s and early 2000s have hit the rocks due to poor monitoring and enforcement. For instance, the provision of dedicated bus lanes on some major roads in Accra have been taken over by private vehicles and paratransit services with impunity. Besides, the few bicycle lanes which were developed in the early 2000s remain highly underutilized due to poor cycling culture and road safety issues in Accra. At different site visits, it was observed that most of these bicycle routes are used by street vendors, pedestrians, and/or motorcyclists.

In December 2008, Ghana's first comprehensive National Transport Policy (NTP) was published with the aim of delivering "an integrated, efficient, cost-effective and sustainable

transport system responsive to the needs of society, and supporting growth and poverty reduction” (GOG 2008, p. 38). Reporting on the current situation of Ghana’s transport sector, the NTP found poor integration of land-use and transport development planning as one of the major weaknesses of Ghana’s road transport sector. Therefore, it proposes transit-oriented development as an entry point to the delivery of an efficient public transit system. It also proposes non-motorized transport (especially walking and bicycling), and the provision of intermodal passenger transport (i.e. mixed-mode commuting) as means to promote: eco-friendly transport options; reduce traffic congestion; cut travel time and fuel consumption; and mitigate transport related emissions.

The NTP identifies three key stakeholders as playing important roles in the development and implementation of these transport sector policies i.e.: government; private sector; and civil society. Following the market liberalization policy of the 1980s, the role of the government has changed from being a provider of transport services, to one of creating the regulatory environment to ensure that the operations of transport service providers do not undermine social and environmental concerns. The private sector is regarded as the main provider of public transport services in the NTP. Their responsibilities range from ensuring efficient transport service delivery within the purview of the law to contributing to practice-led research aimed at enhancing the delivery of public transit services. Lastly, civil society provides oversight over transport policies and operations to ensure consumer needs are adequately met. Thus far, the governments’ regulatory role has been ineffectual, creating many loopholes in the road transport sector in Accra.

9.3.2.1.2 Analysis of existing transport services in Accra

As mentioned earlier, the transport sector in Ghana has seen significant changes since the introduction of the Structural Adjustment Program (SAP). Prior to the SAP, public transport was provided by quasi- government transport agencies (e.g. Omnibus Services Authority and City Express Service). These agencies were heavily subsidized by the government to run scheduled bus services in Accra and other major cities across the country. However, due to the economic reform policy and subsequent deregulation of the public transport sector in Ghana, the government withdrew support for these state-subsidized transport services. This

withdrawal incapacitated the bus operators, resulting in a significant shortfall in public transport supply.

In response to this deficit, new (private) actors appeared and introduced an informal public transit system i.e.: mini-buses ('trotro') and taxis. This development resulted in some 'creative destruction' with the de-alignment of the existing public bus services, and the emergence of a new public transit system ('trotro' and taxis). These private commercial vehicles operate under the umbrella of three main transport unions i.e.: Ghana Private Road Transport Union (GPRTU), Corporative Union (CU), and the Progressive Transport Owners' Association (PROTOA). In the last decades, the unions have taken over the local government's responsibility of managing the various transport stations in Accra, and determining public transport routines in the urban space.

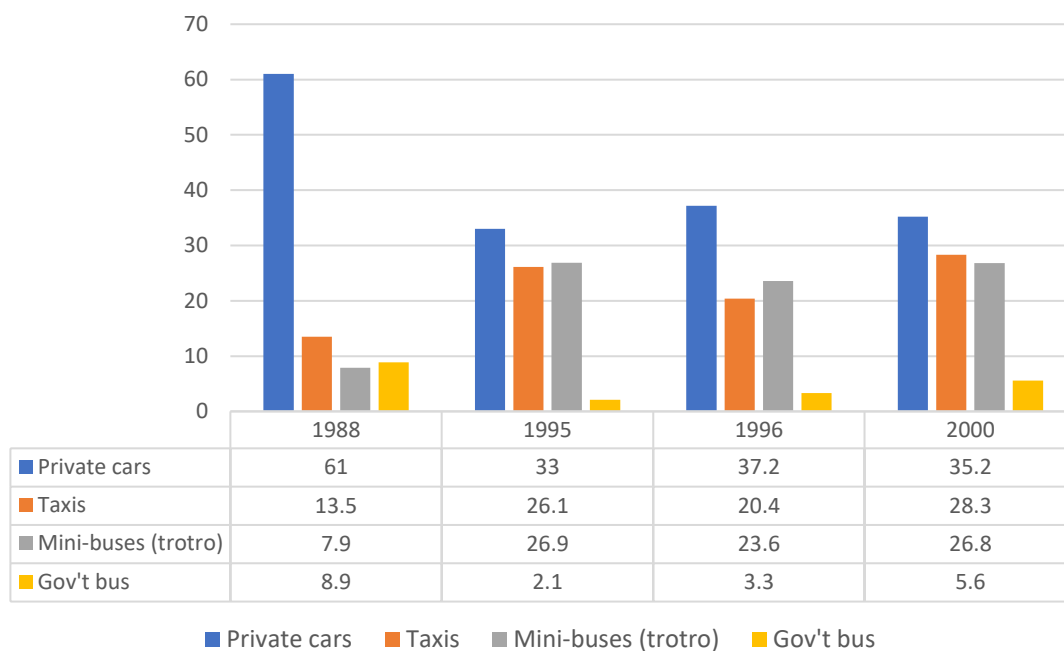


Figure 9.9: Changes in transport modes in Accra (Source: Developed from Ministry of Transport and Department of Urban Roads)

The emergence of the 'trotro' and taxis have had both positive and negative impacts on the transportation system in Accra. On a positive note, they have helped to bridge the gap which was created by growing demand for public transport on one hand, and the inability of the quasi- government transport agencies to meet such demands on the other. Secondly, they partly explain the reduction in private automobile dependence in Accra since the late 1980s (figure 9.9). However, a lack of proper regulation of these transport operators has created

chaos on the roads and exacerbated traffic congestion in Accra (Salifu 2004). Three main factors are identified to contribute to this development. Firstly, there are no limits to the number of new commercial vehicles entering the public transport market. Therefore, the ‘trotros’ and taxis continue to increase on the streets of Accra without constraints. Secondly, these commercial vehicles have less passenger capacity compared with buses; thus, more ‘trotros’/taxis are needed on the road to meet transport demands especially during peak hours. Finally, the trotros operate without a schedule; therefore, there are no mechanisms to regulate the number of trotros on the road at any given time.



Figure 9.10: Traffic scenarios in Accra (Source: modified from myjoyonline.com and ghanaweb)

Among eight performance indicators (i.e. land-use, transport, waste, air quality, energy, water, sanitation, and environmental governance), the 2011 African Green City Index reported urban transport as the worst performing sector in Accra. Similarly, reports from several media sources have variously described Accra’s transportation system as ‘messy’, ‘chaotic’, and ‘unhealthy’ etc. due to traffic congestion. Echoing this frustration, the President of the Republic of Ghana, in his 2018 State of the Nations Address, noted that “I fear that one of these days one more car will join the madness on the roads in Accra, and our city will be completely gridlocked” (Abubakar 2018 para. 7). In fact, traffic congestion is estimated to account for GDP loss of about 8.2 percent due to travel delay and its impact on workers productivity (Mordy 2017).

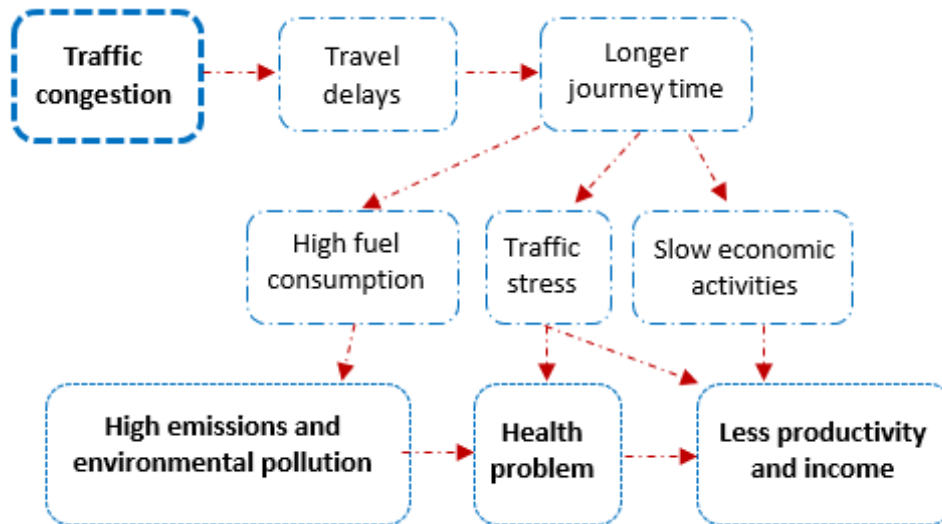


Figure 9.11: Mind mapping of the consequences of traffic congestion in Accra (Developed from an interview with a policy maker at the Ministry of Transport)

In the light of these challenges, successive governments have attempted to reinstitute scheduled bus services in Accra and other metropolitan areas across the country. For example, in the early 2000s, the New Patriotic Party (NPP) government introduced the Metro Mass Transit system to provide intracity transport services in Accra and other regional capitals. Another metro-transit initiative (i.e. Ayalolo bus rapid transit system) was also introduced in Accra by the National Democratic Congress (NDC) government in 2016. However, both initiatives continue to face an uphill struggle against the relatively ‘low quality’ private commercial vehicles (i.e. taxis and trotro) which have become dominant and entrenched in Ghanaian societies.

9.3.2.1.2.1 Metro Mass Transport Service

Metro Mass Transit (MMT) Limited was incorporated in 2003 to operate in the regional capitals across the country. It was a political campaign promise by the then opposition New Patriotic Party (NPP) in the 2000 presidential and parliamentary election. The aim was to reintroduce intracity bus services to provide a more affordable and efficient commuter transport service in all major cities across the country. The main shareholder of the MMT is the Government of Ghana. With the support of the NPP government, the MMT provided intracity services at a lower cost to commuters (i.e. 10% -15% less than trotro fares).

As part of its implementation strategy, the MMT was meant to operate with supporting infrastructure such as dedicated bus lanes and boarding terminals at vantage locations in

Accra. These ideas were embraced when Jaime Lerner visited Ghana in the early 2000s to introduce the bus rapid transit (BRT) system of Curitiba (Participant 13). However, the government's failure to supply these ancillary infrastructure (especially adequate bus lanes) rendered the MMT less competitive than the 'trotros' (in terms of speed, flexibility, and accessibility).

Consequently, the MMT minimized its operations in intracity services and focused more on intercity and rural-urban services to remain in business. In fact, the MMT is said to be running at a loss in recent years with less than half of its fleet in operation (Participant 12). Poor management, lack of public confidence, poor servicing of buses, and corruption are some of the factors considered to undermine the operations of the MMT. Another debilitating factor is the overpoliticization of government institutions in Ghana (Participants 02, 13 and 21). For example, government support for the MMT is said to have reduced significantly after the exit of the NPP government in 2008. The National Democratic Congress (NDC) government which assumed power from 2008-2016 suspended certain privileges to the MMT (e.g. tax waiver), and eventually established a new public transit system (Ayalolo) which is currently being experimented in Accra.

9.3.2.1.2.2 Ayalolo bus rapid transit (BRT) system

'Ayalolo' is a slogan coined from a local dialect (i.e. Ga) which means 'moving on'. It is used to denote progress and persistence despite challenges. In fact, its attributed to the title of a popular local song which was adopted by the President of Ghana during the inauguration of the buses. Ayalolo was established in November 2016 as a "Type B BRT" system: a transit system that is far superior to trotro but does not reach the infrastructural superiority of a standard BRT system. It is an outcome of a World Bank funded transport improvement program in the Greater Accra Metropolitan Area (GAMA). The program aimed to improve mobility in GAMA through engineering interventions, regulations, and the implementation of a BRT system etc. (World Bank 2007).



FEATURES: They are flexible i.e.: drivers can easily manoeuvre and cut corners in traffic to save time; and passengers can also get on board and alight at different vantage points without necessarily going to the bus stops. However, they are less spacious, crowded, hot in the afternoon, poorly maintained, and have lower passenger capacity (11-22 passengers).

Figure 9.12: Characteristics of Ghana trotro services (Author's construct)



FEATURES: Uses card ticketing and IT based fleet management system. Has an operation monitoring center. Has higher passenger capacity (80 passengers). It is air-conditioned with USB chargers, and a more spacious, clean, and comfortable seat arrangement. Ayalolo services only have dedicated lanes where there is serious conflict with mainstream vehicular traffic flow. It has limited bus stops and less frequent in operation.

Figure 9.13: Ghana 'Type B' BRT system (Author's construct)



FEATURES: Well segregated bus lanes with boarding tubes. Uses articulated and bi-articulated buses which can take between 170 to 250 passengers. Uses IT based fleet management system with a control and monitoring center. Have introduced hybrid electric buses which delivers huge environmental gain to the city.

Figure 9.14: Curitiba BRT system: so-called global standard (Modified from urbanizehub.com)

The Ayalolo BRT system differs from the MMT in its administrative and operational setup. Unlike the MMT (which is dominated by government institutions), the Ayalolo is operated by companies formed by the three main transport unions (i.e. Ghana Private Road Transport Union, Progressive Transport Owners Association, and the Corporative Union). These unions currently operate Ayalolo services along the piloted corridors through three limited liability companies: Accra GPRTU Rapid Bus Transit Company LTD; Amalgamated Bus Transit Services LTD, and Ghana Co-Operative Bus Transit Association LTD. Their operations are regulated by the Greater Accra Passenger Transport Executive (GAPTE). The latter is managed by a governing board composed of Chief Executive Officers of all the Metropolitan and Municipal Assemblies in the Greater Accra Metropolitan Area.

GAPTE is not an authority but an executive body. It derives its power from the assemblies to regulate transit routes, and facilitate the planning and development of Ayalolo transport networks. GAPTE's role is similar to that of the Urban Development Authority of Curitiba (URBS) which regulates Curitiba's BRT system. However, unlike the latter GAPTE pays the private operators based on the total number of tickets validated rather than the kilometres travelled. This decision is largely due to the low levels of proceeds derived from the preliminary experimentation of the Ayalolo BRT.

Ayalolo was proposed to be implemented on four main corridors in the GAMA. However, lack of resources and infrastructural constraints have limited its operation to one corridor (figure 9.15). This corridor (Amasaman-Achimota-Accra CBD) covers a 22km stretch with only 5km of dedicated lane. After one year of implementation, passenger ridership on this corridor is said to have increased from 1400 to more than 8000 passengers per day (Participant 03). Figure 9.16 shows the trend of ridership between November 2016 and July 2017.



- A:** Kasoa-Kaneshie-Accra CBD
- B:** Amasaman-Achimota-Accra CBD
- C:** Adenta-37 Military Hospital-Accra CBD
- D:** Ashaiman-Beach road-Accra CBD

Figure 9.15: Proposed and piloted Ayalolo BRT corridors in the Greater Accra Metropolitan Area (Modified from GAPTE's transit corridor map)

Aayalolo Ridership Chart

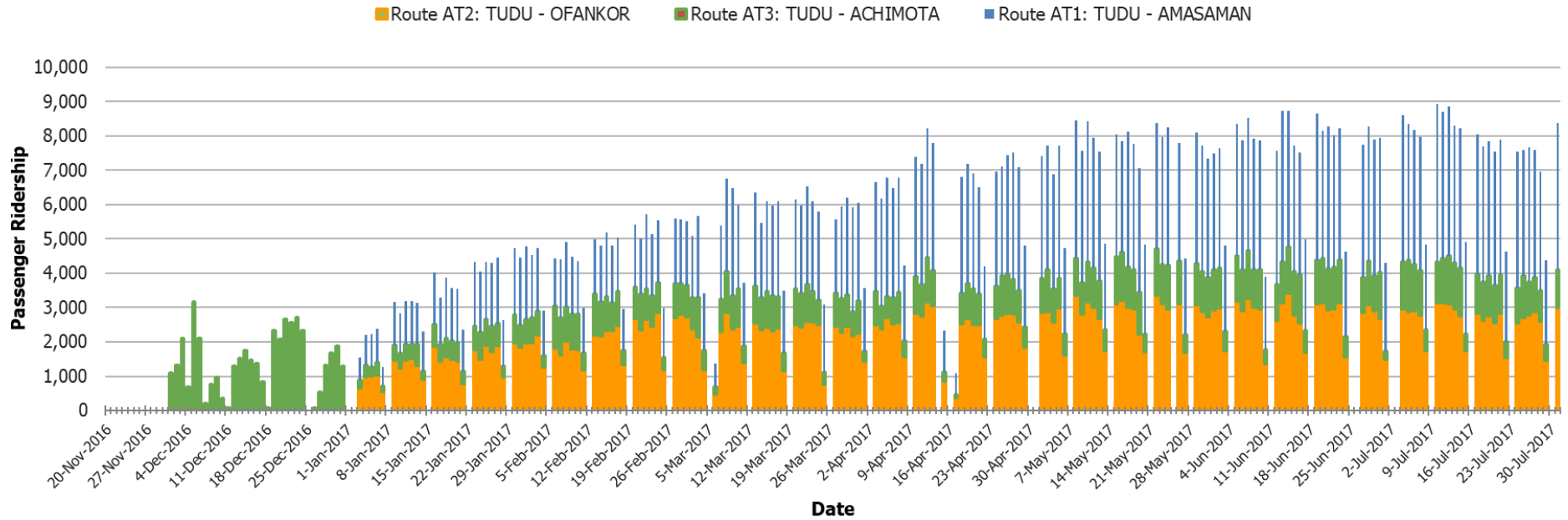


Figure 9.16: Trend of Ayalolo BRT ridership from November 2016 to July 2017 (Source: GAPTE)

As shown in figure 9.16, Ayalolo ridership has been on a steady rise with great potential for future improvement as the service gets more popular and socially acceptable. Effective monitoring and the generation of real-time data to assess the performance of the service for continuous quality improvement put Ayalolo ahead of the MMT. Another positive attribute is the engagement of the existing private transport unions to operate the BRT under GAPTE's supervision. A lack of this engagement between the MMT and trotro operators is said to have fuelled resistance from the latter which resulted in the destruction of properties of the MMT in some instances (Participant 11). Notwithstanding these relative advantages, the Ayalolo BRT faces two fundamental challenges that have the potential for undermining its operations.

Firstly, Ayalolo still lacks the basic infrastructure (e.g. dedicated lanes, independent bus stops, and transport terminals) that can make it more efficient and competitive than the trotro. It remains questionable whether Ayalolo can succeed with the idea of a 'Type B BRT' (which has limited dedicated lanes) given the experiences of the MMT. Successful BRT experiments in other African cities such as the Lagos BRT (Nigeria) made progress by firstly separating its BRT routes from other vehicular traffic (Olawole 2012). However, Ghana's experiment seems to put the cart before the horse. Drawing on passengers' perception about the efficiency of Ayalolo buses on social media (Facebook), it was observed that although the majority of passengers were satisfied with the comfort the buses provided, they were discontent with the lack of adequate bus terminals as well as exclusive bus stops and lanes which extend travel time. Presently, Ayalolo buses compete with trotro vans for these facilities (figure 9.18).

Interviews with some officials of GAPTE and the Accra Metropolitan Assembly (AMA) revealed conflicting demands and opinions on how the Ayalolo BRT should be run. On one hand, GAPTE is pushing for dedicated lanes. According to an official of GAPTE, "it's only when the [dedicated] network is fully developed that we can make an impact" (Participant 03). However, some officials of the AMA believe that GAPTE should justify their request for exclusive space on the already congested roads by increasing their ridership. This conflict has created a chicken and egg dilemma which has significant implications for the future of Ayalolo. It is interesting to note that Lagos, with a relatively higher population (about 21 million people) and far worse traffic conditions, has succeeded in rolling out a more effective BRT system than Accra. Lagos' achievement is largely attributed to political will and the provision of the basic infrastructure for its BRT system (Orekoya 2010).



Figure 9.17: Lagos BRT with dedicated lane and boarding station to the right (Source: Orekoya 2010)



Ayalolo BRT bus competing for space with trotro van at bus stop

Ayalolo BRT buses share road space with other vehicles

Figure 9.18: Competition between Ayalolo BRT and other vehicles in Accra (Author's pictures)

Secondly, a lack of strong political support has been another major setback for the Ayalolo BRT. Echoing this view, the Executive Director of GAPTE noted that Accra needs a “political champion” who can advocate for resources and facilitate the development of the necessary infrastructure to ensure that the Ayalolo BRT works. The experience of Curitiba where a

political champion was a critical catalyst in the success of the public transport system suggests this assertion may be valid. Ghana's democratic system may not allow for an 'authoritarian champion' like Lerner who derived much of his power from a military dictatorship during his first term in office. However, strong political will can trigger change with democratic instruments as was the case in Lagos. How this political interest might be generated and channelled into enhancing the Ayalolo BRT in Accra is a subject worth deeper exploration.

Furthermore, there is a need for the integration of sustainable land-use strategies with GAPTE's proposed development plans for the Ayalolo BRT corridors. Presently, there are no strategies on how to increase densities along the proposed corridors to make the BRT economically viable. The Town and Country Planning Department (TCPD) is not represented on the GAPTE Board. Effective dialogue and cooperation between GAPTE and TCPD may help define a more comprehensive vision for the future development of the proposed Ayalolo BRT corridors.

At present, Ayalolo's future remains doubtful given current infrastructure deficits and the lack of an enabling political environment. These limitations beg the question: does Accra need a new public transit system, or should efforts be directed at improving the existing informal transport system which has proven to be robust over the years? A study by the World Bank shows that trotro services convey 70 percent of all passenger trips in Accra but consume less than 25 percent of road space while private cars and taxis move 30 percent of person trips but occupy 70 percent of road space (World Bank 2004). Consistent with this finding, the field survey (240 residents across the 10 Sub-metropolitan District Councils in Accra) showed that the majority of people in Accra carry out most of their activities using trotro (see figure 9.19-9.24).

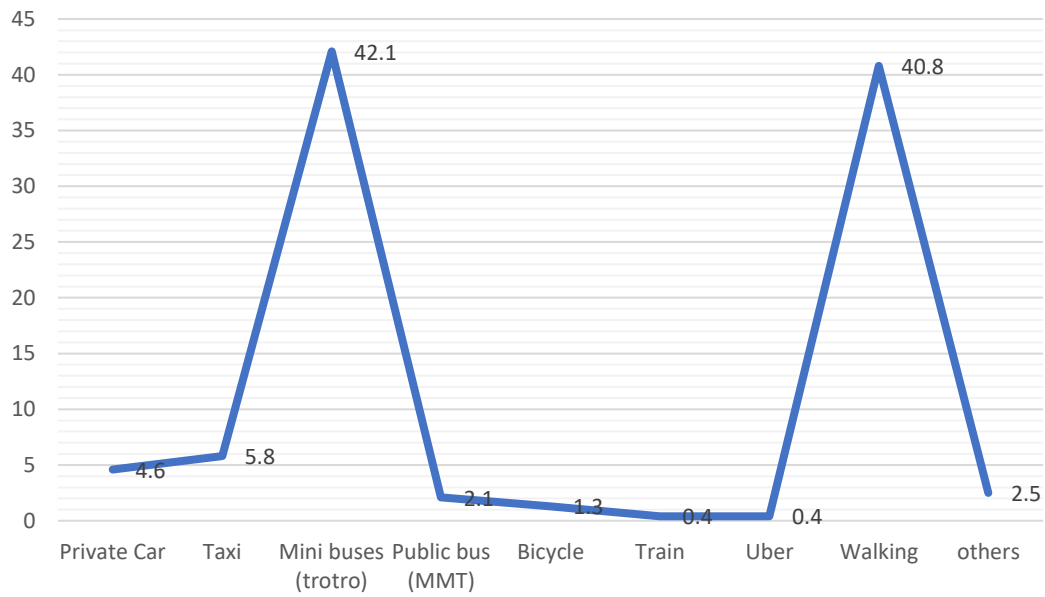


Figure 9.19: Modal share of journeys to market (Field survey)

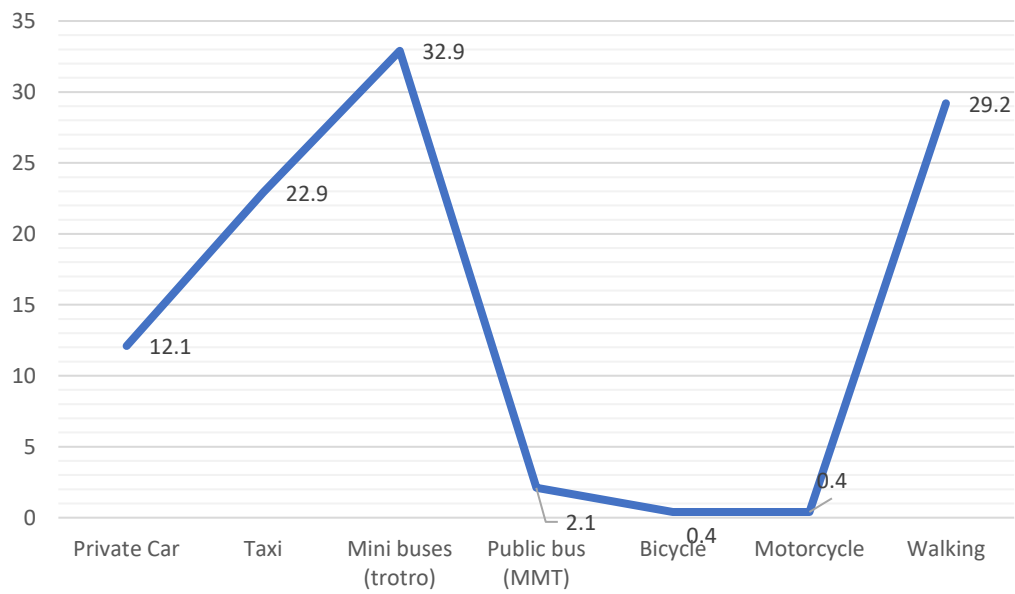


Figure 9.20: Modal share of journeys to hospital (Field survey)

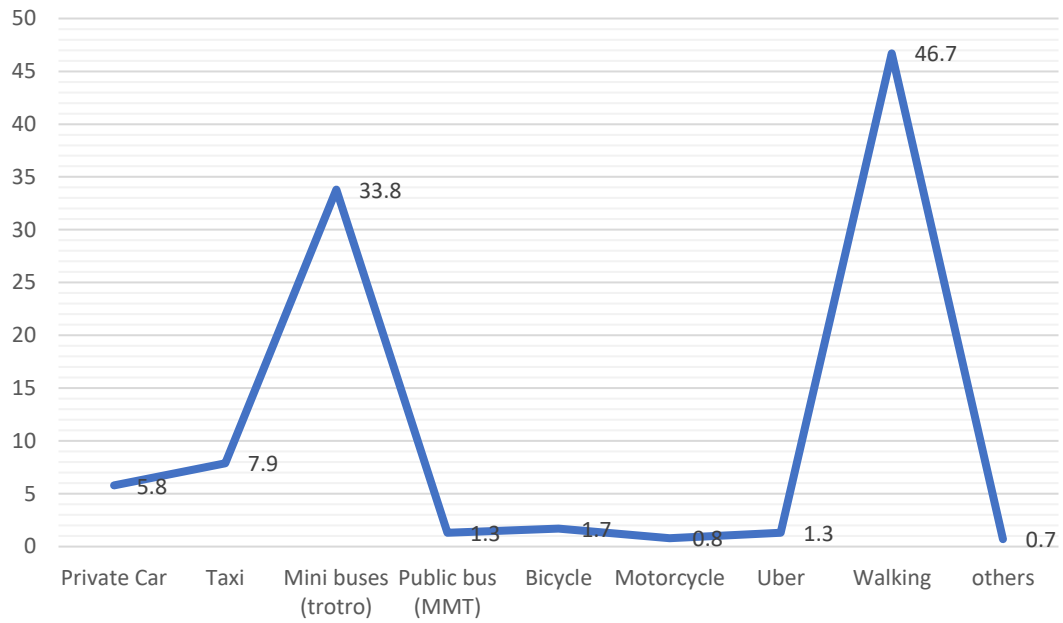


Figure 9.21: Modal share of journeys to shops (Field survey)

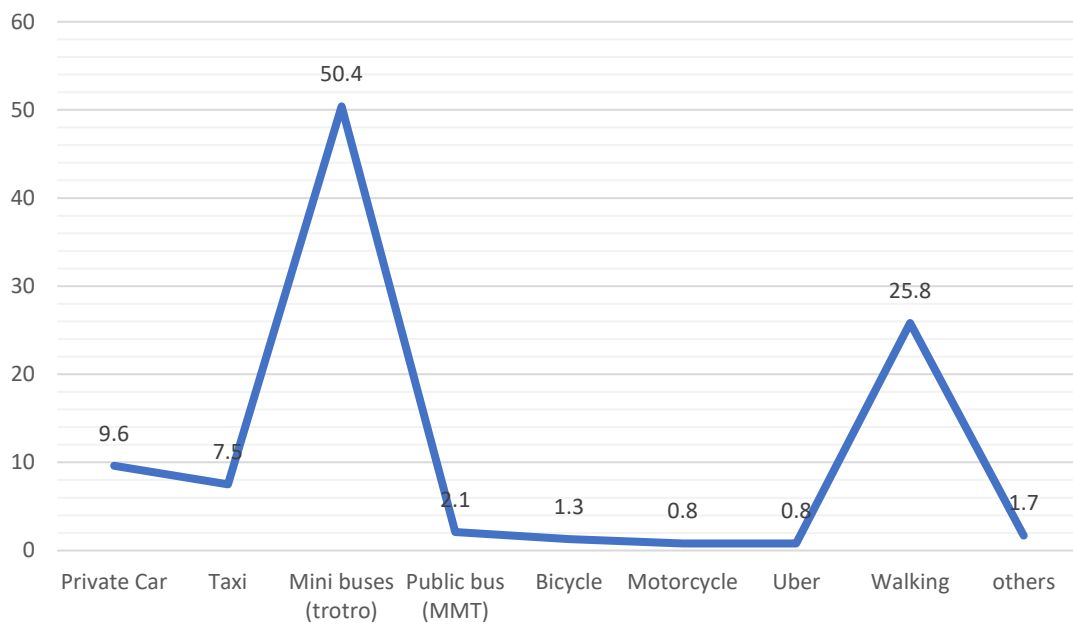


Figure 9.22: Modal share of journeys to work (Field survey)

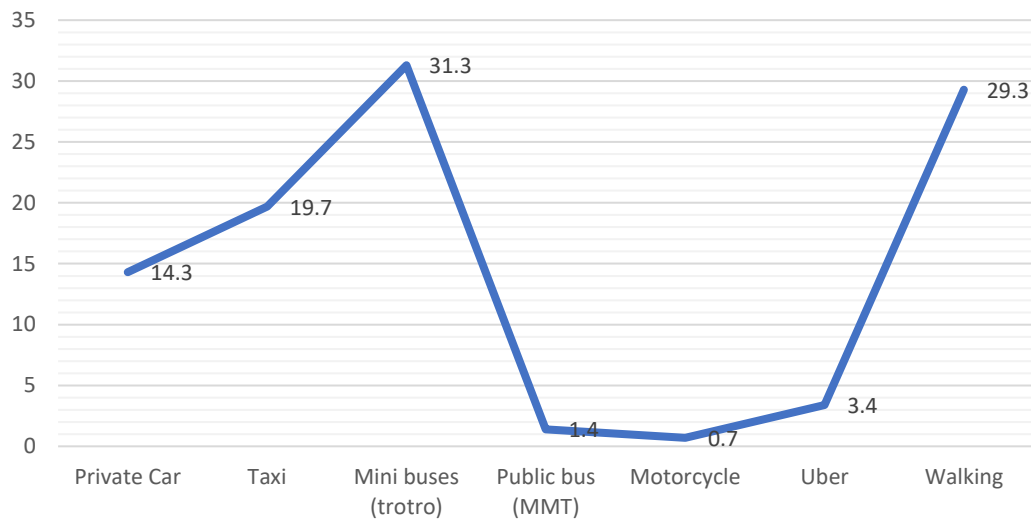


Figure 9.23: Modal share of journeys to recreational areas (Field survey)

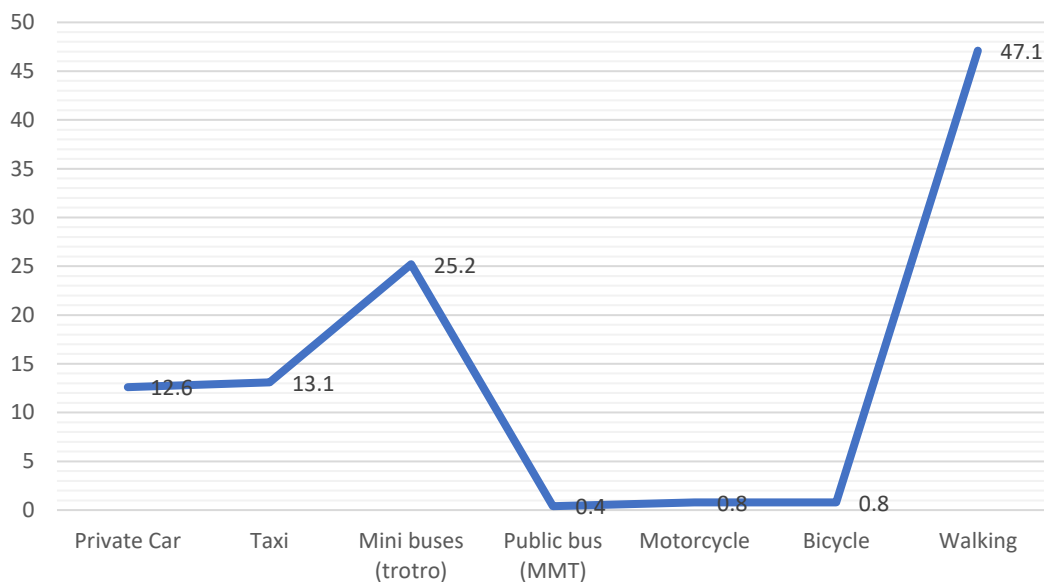


Figure 9.24: Modal share of journeys to places of worship (Field survey)

Given the embeddedness of trotro services in Accra and other parts of Ghana, it is important to direct government’s efforts at streamlining their operations to make them more sustainable. They convey more people and use less road space than private cars. In addition, they provide more intracity transport services than the MMT and Ayalolo BRT which have become an albatross around the neck of government. Some potential levers that merit consideration is how GAPTE’s role might be extended to regulate and monitor the operations of the private transport unions since the local governments in GAMA have been less effective in playing this role. Besides, can the Intelligent Transport System used in the Ayalolo BRT be applied to the trotro services to regularize their operations?

9.3.2.1.2.3 Active transport in Accra

Aside from public transport, another area that demands important attention is the promotion of active mobility. Findings from the field survey portray Accra as a walkable city (figure 9.19-9.24). As pointed out earlier, most communities have a mix of social and commercial services within walking distances. Nevertheless, Accra has a poor cycling culture. From the field survey it was observed that although 87.9 percent of the respondents believed that Accra has a conducive weather for cycling, only 14.2 percent used bicycles. Major reasons assigned to this poor patronage of bicycles are safety and infrastructural issues. These shortcomings call for effective public education and incremental provision of the needed infrastructure to help provide more sustainable mobility options in Accra. Like Curitiba, Accra can create its model of sustainable urban transportation if the potentials of existing transport systems (e.g. trotro) are enhanced, and non-motorized transport are prioritized.

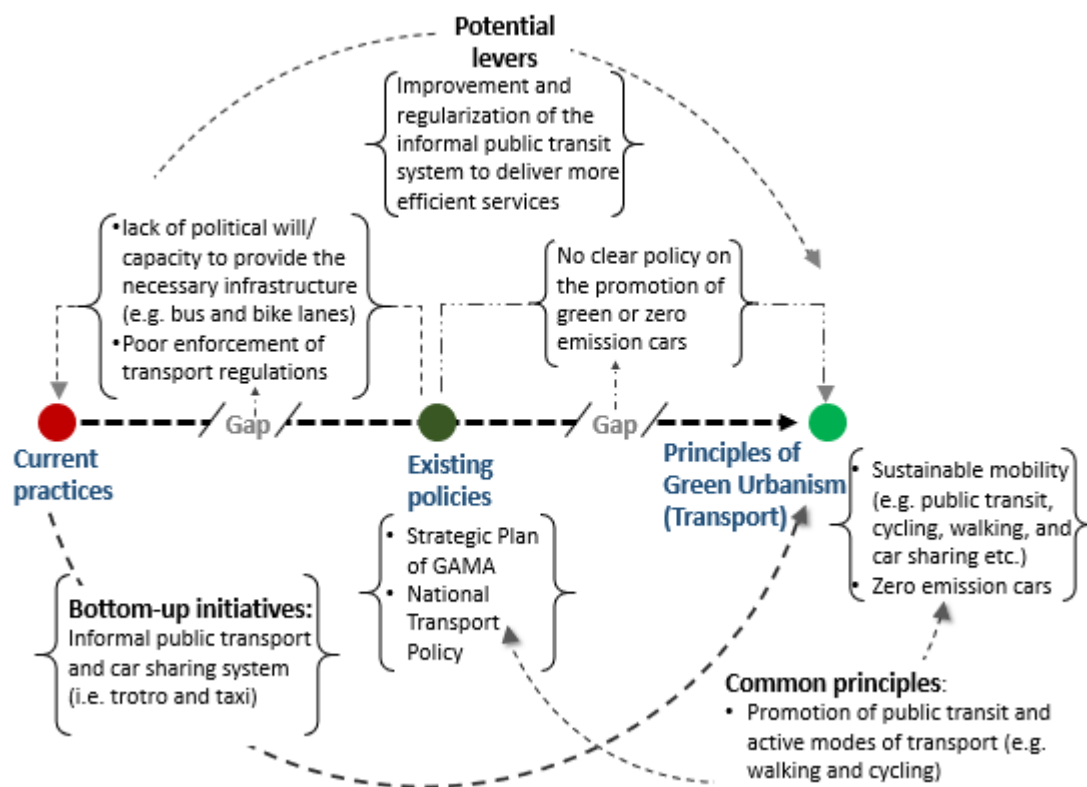


Figure 9.25: Performance gap analysis of the transport system in Accra against the principles of Green Urbanism (Author's construct)

9.3.3 Energy

Energy is the lifeblood of cities. Nevertheless, how it is produced and consumed can have significant implications for the environment and the earth's finite resources. Green Urbanism underscores the production of renewable energies and their efficient use in cities to minimize their environmental impacts. It reckons that although cities consume a greater share of the world's energy, they can also be a "catalysts for more sustainable energy paths" (Newman 2010, p. 150). These pathways may vary from city to city depending on locally available natural resources and technologies. For example, while Freiburg (Germany) is popularly associated with solar energy, Reykjavik (Iceland), Curitiba (Brazil), and Växjö (Sweden) are noted for geothermal, hydro, and biomass energies respectively due to the availability of these renewable resources and technologies at the local level (Agar & Renner 2016; Freytag et al. 2014; Nader 2009). Hence, the potentials of the local context is an important determinant of which pathway cities may take to transition to a sustainable energy future.

9.3.3.1 Renewable energy and energy efficiency in Accra

Ghana's energy sector is largely dependent on biomass, oil, hydropower, and natural gas. As shown in figure 9.26, biomass (mainly wood fuel for household cooking) and oil constitute the greatest share of primary energy supply in Ghana followed by hydropower and natural gas. Despite the abundance of sunlight, solar remains the least developed energy resource in the country. Electricity supply in Ghana is predominantly generated from hydro and thermal power plants. There are three main hydroelectricity power plants and about 13 thermal power plants across the country (Ghana Energy Commission 2016). Since 2010, electricity generation from the thermal power plants has increased steadily, overtaking hydropower as the main source of electricity in Ghana (see figure 9.27).

This shift to thermal power was largely driven by the vulnerability of the hydropower plants to changing climate patterns, and the government's investment in thermal power to bridge the gap between electricity supply and demand (Bekoe & Logah 2016; Eshun & Amoako-Tuffour 2016). Nonetheless, in recent years, the thermal power plants (which are fuelled by oil and gas) have also been susceptible to uncertainties surrounding international oil and gas markets. Consequently, electricity supply in Ghana has been inconsistent since the early 2000s. Between 2012 and 2015, Ghana experienced one of the worst power crises in the

country's history. This crisis resulted in power rationing across the country with deleterious impact on the economy. It is estimated that Ghana lost between 2 to 6 percent of GDP per annum because of the power crisis (GRIDCo 2010).

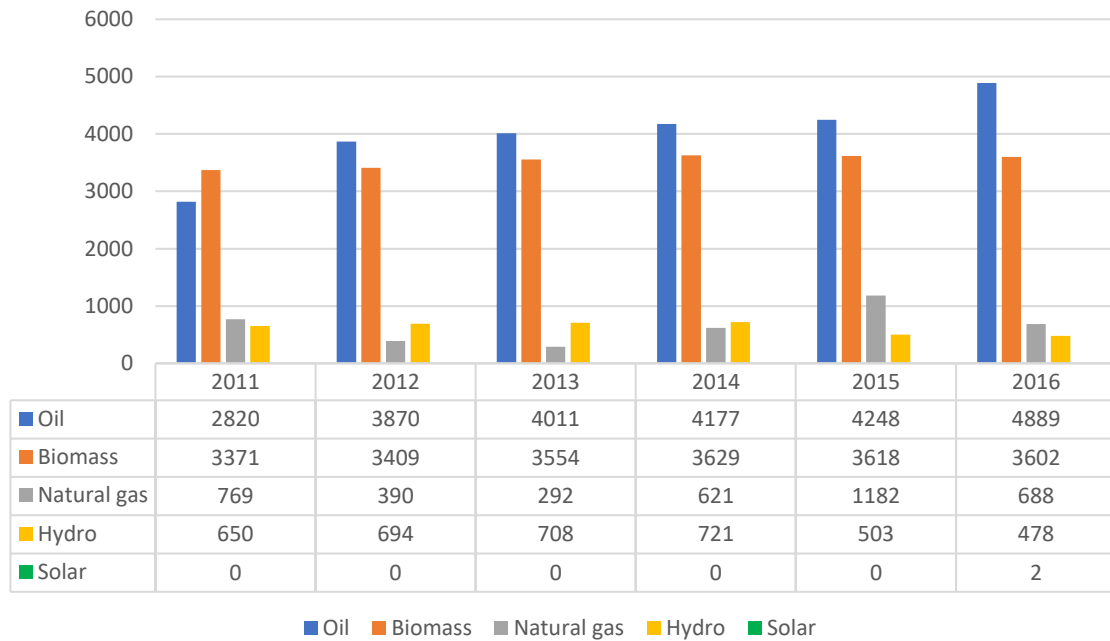


Figure 9.26: Primary energy supply in kilotonne of Oil equivalent-ktOE (Developed from Ghana Energy Commission 2016)

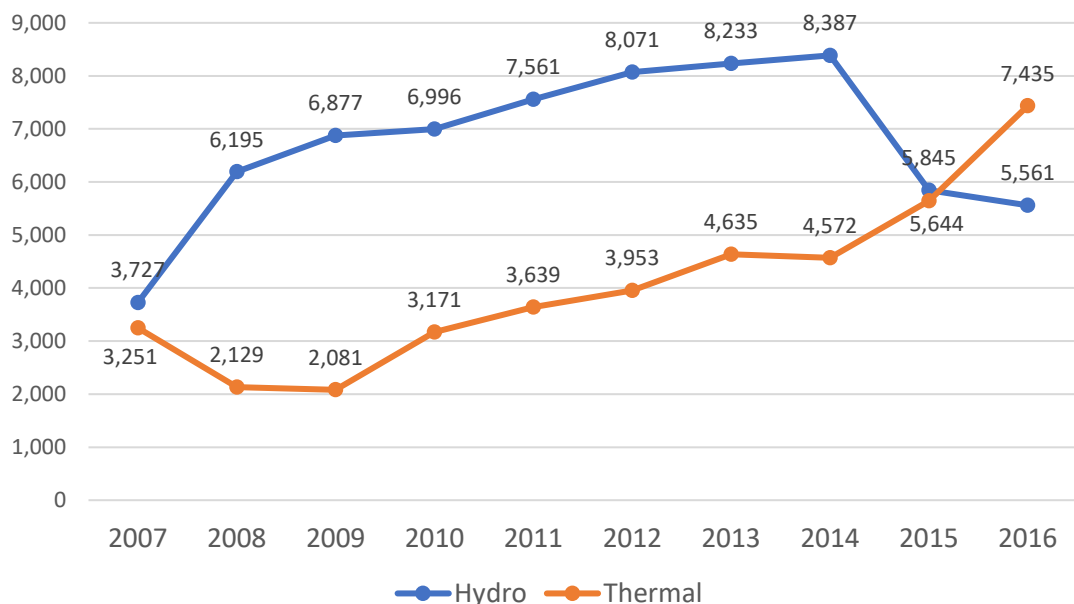


Figure 9.27: Electricity generation from hydro and thermal power plants per installed capacity-MW (Developed from Ghana Energy Commission 2016)

9.3.3.1.1 Policy perspective

Against the backdrop of Ghana's perennial power crisis, a National Energy Policy (NEP) was enacted in 2010 to guide the development and efficient management of the energy resource of Ghana (GoG 2010). As part of its strategic goals, the NEP aims to diversify the energy sector to ensure the availability of an adequate level of energy supply to meet the country's growing demand. It emphasizes the integration of renewable energy sources, particularly solar, wind, mini hydro, and waste-to-energy into the national energy mix to safeguard energy security in the country. According to Ghana's Energy Commission, Ghana has about 39 mini hydropower sites (with an exploitable capacity of 800MW), high solar irradiation levels (4.5 to 6.0 kWh/m²/day), and moderate wind energy potentials which collectively provide opportunities for renewable energy production to augment the country's volatile energy sector.

The NEP also proposes several measures to minimize end-user electricity loss which is estimated at 30 percent of electricity supply (GRIDCo 2010). For example, it proffers: pricing mechanisms that would incentivize consumers to voluntarily manage their energy consumption more efficiently; intensive public education about end-user energy efficiency; and the promotion of energy efficient technologies etc. To facilitate the implementation of the strategic goals underlying the renewable energy sub-sector in the NEP, the Parliament of Ghana passed a Renewable Energy Act (Act 832) in 2011 to provide the legal framework for the development of renewable energy technologies. Among others, the Act seeks to create the enabling environment for private sector investment in renewable energies, and promote public awareness about renewable energy use. However, a number of key policy challenges still exist: building indigenous capacity in renewable energy technologies, making renewable energies affordable; and rolling out an effective feed-in tariff to encourage the use of renewable energies etc. These setbacks, among others, have created bottlenecks in the mainstream application of renewable energy technologies in Accra and other parts of Ghana.

9.3.3.1.2 Energy supply and use in Accra

As illustrated in figure 9.28, the main source of power for lighting and other domestic use is electricity (93.8%) from the national grid. Household cooking fuel is also derived mainly from charcoal (wood fuel) and gas (figure 9.29). From the field survey, although solar energy (alternative source of electricity) and biogas (for cooking etc.) were identified as the most

commercialized renewable energy technologies in Accra, they account for very insignificant share of Accra’s energy mix. For instance, solar energy constitutes only 0.1% of electricity mix in Accra. There is no data on biogas. In addition, public awareness about these technologies is low. The field survey found that about 50 percent and 78 percent of the respondents were unfamiliar with solar energy and biogas respectively. Interviews with renewable energy firms in Accra also revealed major challenges to the supply of these renewables: overly bureaucratic licensing processes, high import tariffs, lack of adequate incentives, and ineffective net metering system among others.

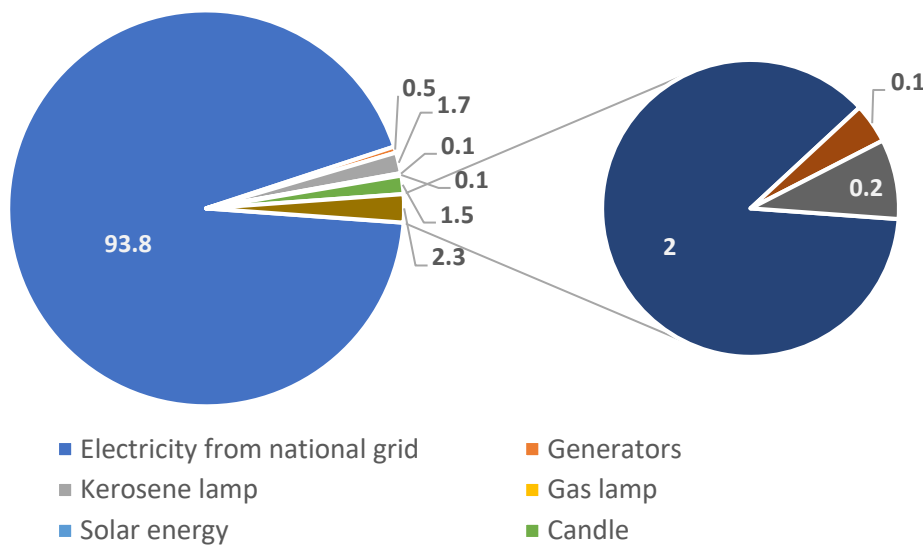


Figure 9.28: Sources of power for lighting (Source: Ghana Statistical Service 2010)

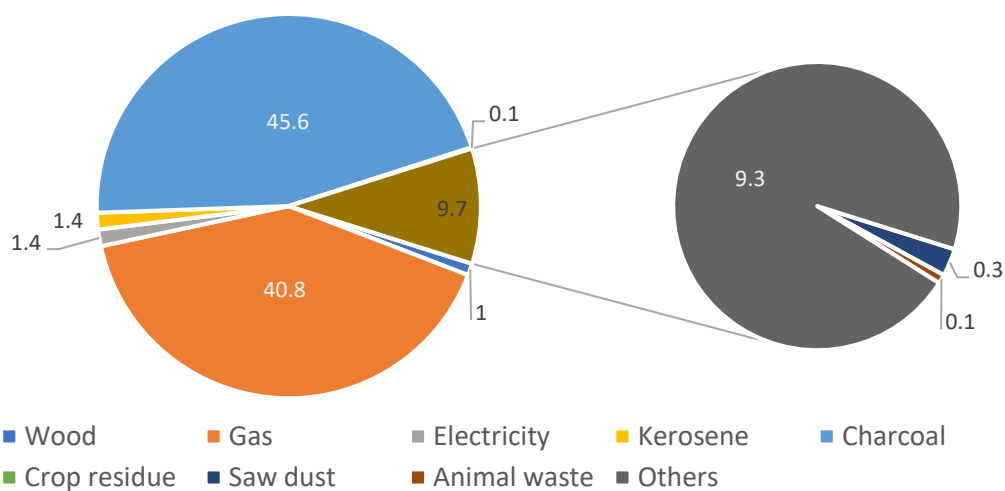


Figure 9.29: Main sources of cooking fuel (Source: Ghana Statistical Service 2010)

These setbacks call for interventions in public education about renewable energy technologies, and the provision of incentives to producers and consumers alike to encourage mass patronage. So far, the government’s commitment to promoting renewable energies in Ghana has been little more than mere rhetoric. In 2015, for example, the government announced plans to provide solar panels on buildings of all government ministries and agencies in Accra (and other regional capital) through a Solar Rooftop Program (Adogla-Bessa 2017). However, this program has yet to be rolled out after three years. According to one participant, “there has to be a little success story to show how things can work” (Participant 06). Perhaps, the Solar Rooftop Program, if implemented well, can be a catalyst for solar energy revolution in Ghana. Another area that needs important attention is energy end- use efficiency to minimize the high end-user electricity waste in the country. Awareness creation, enforcement of existing regulations, and the provision of incentives to firms providing energy-saving solutions may help promote responsible energy consumption behaviours in Accra.

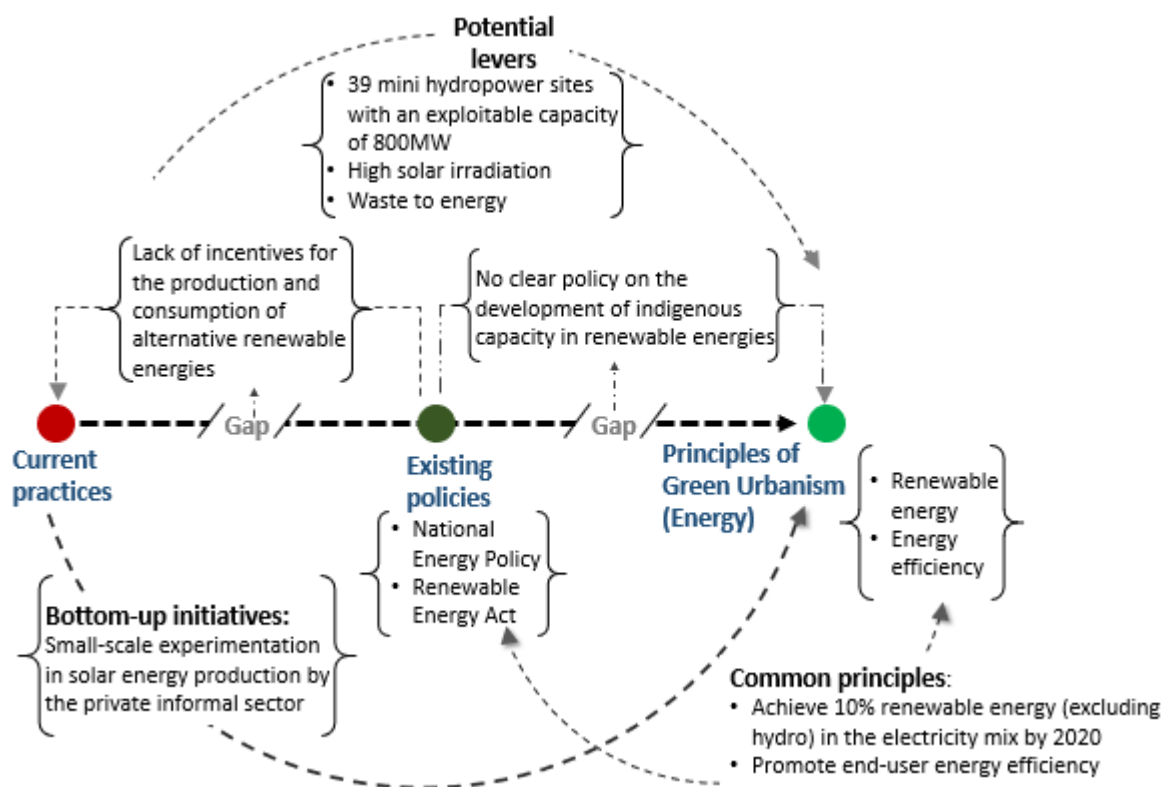


Figure 9.30: Performance gap analysis of the energy sector in Accra against the principles of Green Urbanism (Author's construct)

9.3.4 Building

The built environment is considered to be the “biggest single consumer” of primary energy, and a contributor of a third of global greenhouse gas emissions (Allouhi et al. 2015, p. 118). Thus, reducing energy consumption and emissions in this sector is fundamental to achieving the global sustainability agenda. Against this backdrop, the green building concept has gained considerable traction in the last decades to promote passive design and sustainable construction principles that deliver low energy and zero emission buildings (Lehmann 2010b). It also aims to enhance water efficiency in buildings, improve indoor environmental air quality, enhance the life cycle environmental performance of buildings, and minimize their operational cost etc. (Kibert 2016; Woolley 2012). Following the emergence of several green building rating systems (e.g. Leadership in Energy and Environmental Design -LEED; Building Research Establishment Environmental Assessment Method -BREEAM; and the Green Star etc) the application of the green building principles has gained greater impetus particularly in the Western world. However, they have yet to gain momentum in developing nations despite existing need (Potbhare et al. 2009).

9.3.4.1 Green building concept in Accra

9.3.4.1.1 Policy perspective

Ghana’s National Building Regulation (NBR) 1996 (LI 1630) provides the regulatory framework for the design and construction of buildings across the country. Out of the 187 regulations stipulated in the NBR, very little attention is paid to sustainable design and construction principles. Sections 4 and 8 of the NBR briefly touch on passive design and sustainable materials, but are very generic with no clear application guidelines. Ghana’s Draft Building Code (2012) and the National Housing Policy (2015) also suffer similar limitations. For instance, although the National Housing Policy emphasizes that all housing design and construction should be based on sustainability standards (GOG 2015), it provides no clear direction as to what these standards are, and how they might be applied and evaluated. These policy gaps have, to a great degree, muffled the green building concept in the housing industry in Accra and nationwide.

9.3.4.1.2 Building design and construction practices in Accra

The building and construction industry in Accra and other parts of the country is dominated by the private informal sector (self-built). As much as 90 percent of housing in urban Ghana is supplied by the informal sector with little or no government control (UN-HABITAT 2011). In fact, about 70 percent of these houses are developed without building permit or recourse to existing building regulations (Arku 2009; Grant & Yankson 2003). Consequently, a greater share of the housing stock in Accra fails to meet basic design and construction standards let alone adhere to green design and construction principles. The real estate sector which is well organized and more likely to comply with building regulations does no better with regards to these green principles. In an interview with the Executive Secretary of the Ghana Real Estate Developers Association, it was found that although the association occasionally organizes seminars for its members on green building principles, the latter is of little importance to developers due to lack of consumer interest in green buildings.

Most stakeholders in the housing sector in Accra pay little attention to the life cycle performance of buildings. Data on the environmental/energy performance of buildings in Accra is non-existent. The few existing studies investigating this subject have shown that most commercial and residential buildings in Accra (and other parts of the country) are inefficient in their life cycle energy and environmental performance (Arku 2009; Danso 2013; Djokoto et al. 2014). This problem is underpinned by both the design and materiality of the existing building stock in Accra. The influence of globalization and ‘westernization’ has significantly changed the architectural language and material content of buildings in Accra. They have brought about the proliferation of architectural styles that are better suited for temperate climates than tropical.

Traditionally, buildings were constructed in accordance with most of the basic principles of the green building concept without any particular reference to the latter. The form of these buildings is mostly rectangular with courtyards that provide both natural cross ventilation and private outdoor spaces for diverse uses. Besides, the materiality of the indigenous architecture evolved from the environment. Hence, the vernacular architecture was responsive to the prevalent climatic conditions, vegetation zone, and culture of a place. For instance, in Accra and most parts of southern Ghana where the climate is predominantly

tropical with both dry and humid rainy seasons, the common building materials deployed were bamboo, dense bricks from laterite, timber, palm-thatch roof, and stone.

These materials were mostly unsusceptible to heat, humidity, and heavy rainfall; thus, making the buildings resilient to the microclimatic conditions (Mumtaz & Thompson 1978). The vernacular technologies applied to the design and construction of these indigenous buildings helped to improve their energy efficiency and overall sustainability (Salgin et al. 2017). Nevertheless, in the last decades, these sustainable materials have been ousted by contemporary building materials (e.g. aluminium, glazing, and PVC plastic etc.). The latter are mostly produced overseas (about 80 percent) with little or no consideration to the local climate (Danso 2013). Consequently, the buildings that are produced from them are less responsive to the local environment, more expensive, have higher embodied energy, and generate more carbon emissions from production to transportation (Djokoto et al. 2014).

To redirect Ghana's building industry towards more sustainable trajectories, the Ghana Green Building Council-GGBC (established in 2009) has embarked on a series of awareness campaigns and negotiations with policy makers to drive home the tenets and merits of the green building concept. The GGBC is a non-governmental organization funded by annual membership subscription. It aims to promote more sustainable buildings in Ghana using "energy savings, water conservation, sustainable resource management, and cost-efficient techniques" (Participant 05). At present, the GGBC collaborates with other institutions such as the Green Building Council South Africa (GBCSA), and the International Finance Corporation (IFC) to verify and certify buildings that meet the stipulated green standards. So far, the GGBC has certified one commercial building in Accra (figure 9.31) in collaboration with the GBCSA using a modified (Australian) Green Star rating tool. According to the Chief Executive Officer (CEO) of the GGBC, a transition to green buildings in Accra will require a better-informed public, adequate incentives, changes in existing building regulations to accommodate green building principles, and effective enforcement of these regulations.



Figure 9.31: One Airport Square in Accra CBD- first commercial green building in West Africa (Source:www.archdaily.com)

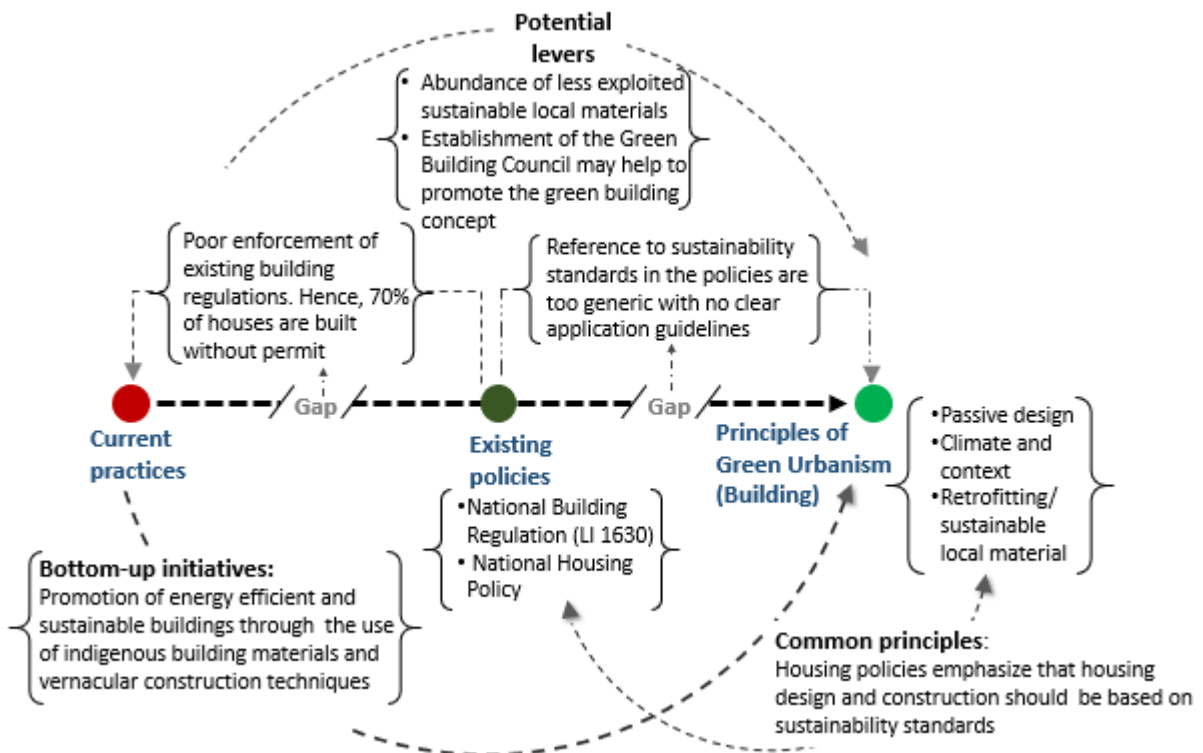


Figure 9.32: Performance gap analysis of the housing sector in Accra against the principles of Green Urbanism (Author's construct)

9.3.5 Waste

Responsible consumption behaviours to reduce waste generation, and the conversion of waste into resources (i.e. closed loop system) are essential principles of Green Urbanism that aim to reduce the resource requirements and ecological footprint of cities (Newman 2010; Zaman & Lehmann 2013). In the wake of the escalating impacts of global climate change and the continuous decline in the world's natural resources, it has become necessary for cities to strive for a circular economy. The empirical case studies in Chapters 6 (Freiburg) and 6 (Curitiba), for example, have shown how cities can redefine waste as a resource to satisfy other urban needs. Both cities recycle about 70 percent of their waste through an efficient waste segregation program. Curitiba, for instance, has shown how waste segregation and recycling can also be used to solve other social problems such as food security in deprived communities, youth unemployment, and pollution-related diseases etc. The experiences of both cities show that attitudinal change and the provision of the necessary infrastructure to support waste recycling are sine qua non of efficient waste management in cities.

9.3.5.1 Waste management in Accra

9.3.5.1.1 Policy perspective

The Ministry of Local Government and Rural Development is largely in charge of Ghana's waste management policies and regulatory guidelines. The implementation of these policies and guidelines are overseen by the Environmental Protection Agency (EPA) which is the main regulatory authority. At the sub-national level, the Metropolitan, Municipal and District Assemblies are the main local government institutions responsible for waste management through their waste management departments. The waste department of the Accra Metropolitan Assembly oversees the day to day management of waste in the Accra Metropolis. Their operations are guided by various national policies and legislations such as the: National Environmental Sanitation Policy (2010); Nation Environmental Sanitation Strategic Action Plan (2010); Local Government Act, 1990 (Act 462); and the Environmental Assessment Regulations, 1999 (LI 1652) etc.

These policies and legislative instruments provide standards for waste management in Accra and other parts of the country. Current waste management policies and regulatory guidelines are embedded in the updated National Environmental Sanitation Policy-NESP (2010). The

NESP outlines several strategies to streamline waste management practices in Ghana e.g.: polluter-pays principle; primary separation of waste at the household and community levels (70% by 2025); and the principle of subsidiarity to ensure grassroots participation in decision-making processes at the lowest appropriate local level etc. The NESP is supported by a National Environmental Sanitation Strategic Action Plan-NESSAP (2010).

The NESSAP identifies seven strategic plans for improving environmental sanitation in Ghana: (1) capacity building for local government institutions in charge of waste management; (2) vigorous environmental campaigns to change people's sanitation behaviours and attitude towards waste; (3) enforcement of existing regulations and by-laws to check environmental sanitation offences; (4) sustainable financing of environmental sanitation policies at the local government level; (5) promotion of a closed-loop system; (6) research and development to facilitate a transition to a 'green economy'; and (7) monitoring and evaluation mechanisms to inform incremental improvement in waste management practices. These plans aim to define a value chain optimization framework for waste management in Ghana (from production to recycling and reuse). However, they fail to address the issue of recycling infrastructure which is a major limitation of the waste sector in Ghana. Besides, how the strategic plans translate into practice remains a major challenge for local government institutions and other relevant stakeholders.

9.3.5.1.2 Waste management practices in Accra

Waste is, perhaps, the biggest challenge confronting Accra in recent years. It is estimated that Accra generates about 3,000 metric tonnes of solid waste daily which is largely composed of organic (60%) and plastic (18%) wastes (Knott 2018). According to the African Green City Index (2011), per capita waste generation in Accra (440 kg/year) is above the average of the 15 African cities in the index (i.e. 408kg/year). Hence, Accra generates more waste per capita than most African cities e.g.: Addis Ababa (160.0kg/year), Lagos (276.0kg/year), and Luanda (292.0kg/year) etc. (EIU 2011). The huge volumes of waste generated daily have created daunting challenges for waste collection and disposal in the city.

However, in the last decade, waste management in Accra has significantly improved due to a public private partnership agreement between the Accra Metropolitan Assembly and private waste collection companies. The Metropolitan Assembly engages private companies to

collect waste bins at designated communities. The bins are collected once every week at a government approved fee from the waste generators. In low-income communities where residents cannot afford the approved fee, the Assembly in collaboration with the responsible private companies provide central communal containers for the residents to dispose of their wastes for collection at a relatively lower cost. Hence, both high and low-income communities have access to a legitimate means of waste disposal.

Nonetheless, a lingering challenge that poses significant environmental threat is where the waste go after collection. Presently, all the landfill sites in the Accra Metropolitan Area have been shut down due to lack of capacity. Collected wastes are transported to landfills (about 37 kilometres) outside Accra. About 200 trips are made daily by garbage trucks to transport Accra's wastes to these landfill sites. These trips contribute to fuel consumption rates and transport-related emissions etc. in Accra. Although the National Environmental and Sanitation Policy recommends waste recycling at community levels to (among others) forestall these transportation challenges, there is no evidence of the impact of this policy on waste management practices in Accra. In recent years, a few private companies and individuals have started small-scale recycling industries which provide a glimmer of hope for waste recycling in Accra (see Box 9.1).

Box 9.1: Case study of Jekora Ventures' approach to waste recycling in Accra

Background: Jekora Ventures was formed in 2003 as a limited liability company. It started as a cleaning service provider at transport terminals with the Accra Metropolitan Assembly. In 2004, Jekora expanded into solid waste collection, responsible for a number of communal container sites in the city of Accra. Following the introduction of the public private partnership agreement on waste collection in Ghana, Jekora has expanded its operational areas in Accra. It now provides services to about 24000 clients.

Approach to waste recycling: Jekora Ventures is the first and only waste management company in Accra that provides recycling services to its clients together with a solid waste segregation program. Presently, this service is available to Jekora's commercial and industrial clients. It is an incentive-based program that offers discounts to clients depending on how efficiently they segregate their wastes. Before a segregation and collection agreement is signed with a client, Jekora provides training to the client and nominates an in-house supervisor who will ensure that the segregation plan is adhered to. Segregated wastes are collected once a week by different garbage trucks. In addition, once every three months, Jekora follows up on clients to get feedback on their performance and challenges etc.

Outcomes: Through this participatory approach, Jekora has increased its waste segregation clientele base from 9 clients in 2011 to 200 clients in 2017. The waste collected are sent to

different recycling plants: organic, plastic, and paper. The organic wastes are converted into compost fertilizer whilst the plastic and paper wastes undergo first stage recycling. Jekora's compost fertilizer (i.e. Fortifer) has undergone the necessary certification processes and it is now available for commercial use. In the light of these successes, the Accra Metropolitan Assembly has partnered with Jekora to pilot a waste segregation exercise in 67 schools across the Metropolis. This initiative is a testing ground for a city-wide waste segregation plan.

Jekora's model presents three key pillars for effective waste management in Accra. Firstly, it shows that educating people about waste segregation and the benefits of this practice is important for changing people's attitudes about in-house waste management. From the field survey, it was observed that a majority of the respondents (69.2%) had no knowledge about waste segregation. Hence, there is a need for public education about this practice. Secondly, Jekora provided adequate incentives for clients to motivate them to segregate their waste more efficiently. Clients were rewarded a discount of between 10%-50% depending on how well they separated their wastes. Aside from serving as an incentive for clients, this approach also helps Jekora to cut down on its operational cost. Finally, Jekora put in place the necessary infrastructure before rolling out its segregation program. A Fortifer compost plant was developed to process about 500 tons of waste daily under a public private partnership between Jekora and the Tema Metropolitan Assembly (TMA).

Apart from Jekora, several initiatives such as the conversion of plastic waste into pavement blocks, designer handbags, and diesel etc. have been experimented by the private sector on a small scale. Given the necessary institutional and policy backing, these small-scale initiatives can be expanded to help alleviate the current challenges of dealing with waste in Accra. According to the CEO of Jekora, the daunting challenge is raising the needed capital to develop an adequate recycling plant for Accra. He believes that the solutions to Accra's waste problems lie in effective public education, incentive structures for waste segregation and recycling, as well as simultaneous development of the necessary recycling infrastructure to ensure that segregated wastes do not end up in landfills. These interventions will require strong support not only from government but also the media, academic institutions, civil society, and the private sector etc. to deliver a more holistic approach to solving Accra's waste problems.

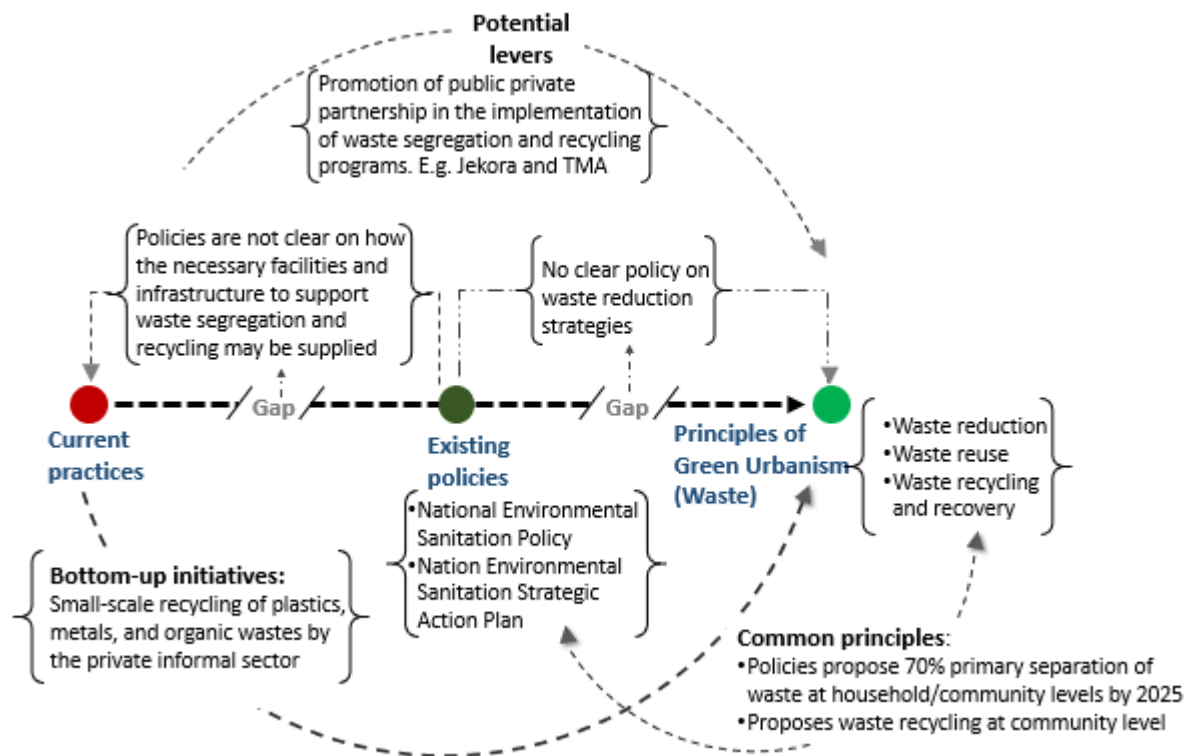


Figure 9.33: Performance gap analysis of the waste sector in Accra against the principles of Green Urbanism (Author's construct)

9.3.6 Water

Water is a crucial resource that sustains life, economies, and ecological processes. In the last decades, the world's water resource has been under tremendous pressure due to rapid increase in human population, economic growth, climate change, and environmental degradation etc. Water security has become a major concern in many countries not only for sustaining human livelihood but also ensuring the preservation of the ecosystem and the services we derive from it. According to a study by Vörösmarty et al. (2010, p. 1), about "80 percent of the world's population is exposed to high levels of threat to water security". Against this backdrop, Green Urbanism proposes a 'closed-loop water management' approach that enables efficient use of water resources, preservation of natural aquatic habitats, recovery of rainwater, and wastewater recycling etc. (Ma et al. 2015; Norton et al. 2015). Cities are critical hotspots for the experimentation of these ideas to safeguard global water security given their impacts on the ecosystem, and embedded socio-technical innovations that present opportunities for a transition to a more sustainable urban water management.

9.3.6.1 Water management in Accra

9.3.6.1.1 Policy perspective

Ghana has an abundance of water resources from both surface and groundwater sources. Estimated water demand for consumptive use accounts for only 12 percent of the total surface water resources of the country (GOG 2007). Nevertheless, there are significant challenges with water supply coverage in urban areas. The African Green City Index, for example, reports that access to potable water in Accra is considerably lower than the index average. In the light of this shortfall, Ghana's National Water Policy-NWP (2007) was promulgated to (among others) address issues of accessibility, quality, end-user efficiency, and the preservation of aquatic habitats. It draws on three key international, regional, and local development policies: Millennium Development Goals (MDGs); the African Water Vision 2025; and the Ghana Growth and Poverty Reduction Strategy (II). The NWP outlines ten strategic plans for water resource management in Ghana (see Appendix 7). Fundamental to these strategic plans is the NWP's goal of integrating water resource planning with land-use planning to promote water sensitive urban development. The latter has been shown to enhance the ecological and social functions of the urban environment (Radcliffe et al. 2017; Sharma et al. 2016; Wong 2006).

The NWP covers many important aspects of efficient water resource management; however, it is less elaborate on the institutional mechanisms for its implementation. Much of the policy initiatives are generic and little more than typical textbook water and environmental issues. Besides, there are no indicators to monitor progress towards the policy objectives to inform both practice and future policy review (Monney & Ocloo 2017). Thus far, the NWP has had little impact because it has not been implemented as stipulated in the strategic plans. According to Acheampong et al. (2016), the implementation of the NWP has been encumbered by political, socio-economic, and managerial lapses. Consequently, there has been a perennial rationing system of water supply in Accra and other parts of the country.

9.3.6.1.2 Water management practices in Accra

Accra is largely dependent on pipe-borne water supplied by the Ghana Water Company Limited (GWCL) for drinking and other domestic use (figures 9.35-9.36). In the last decades, water supply from the GWCL has significantly declined, resulting in rationing of the water

supply. From 2000 to 2010, for example, the total coverage of water supply from the GWCL to Accra fell from 80.9 percent to 54 percent (GSS 2010). The GWCL blames this dramatic decline on prolonged dry seasons (due to climate change impacts), indiscriminate felling of trees along river banks, and the contamination of water bodies through illegal mining and poor waste management (Gadugah 2018). In addition, poor maintenance of the existing water supply infrastructure is identified to contribute significantly to this shortage. It is estimated that a third of water supply is lost due to leakages in the water infrastructure system (EIU 2011).

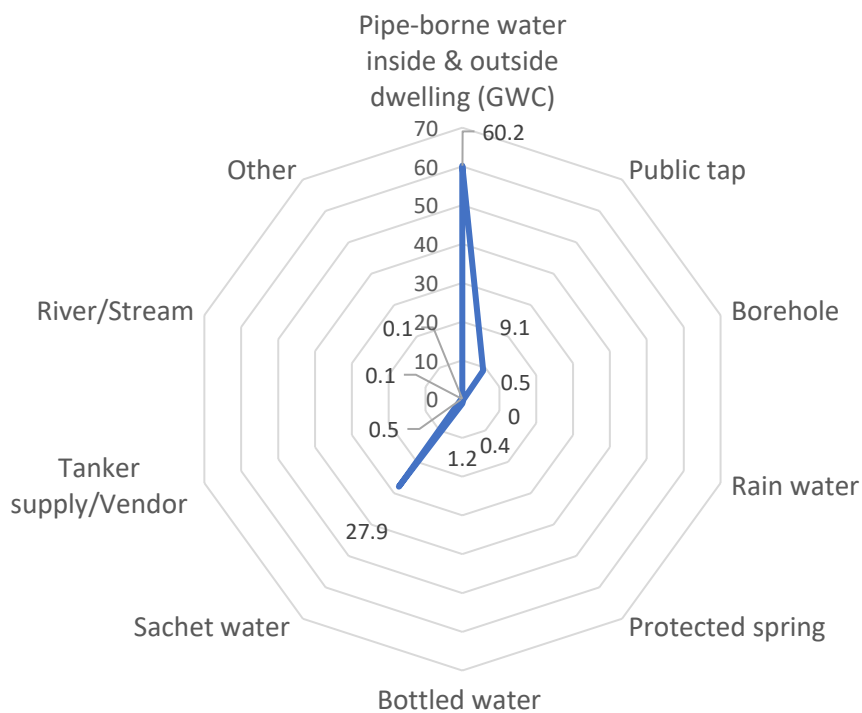


Figure 9.34: Sources of drinking water in Accra (Developed from Ghana Statistical Service 2010)

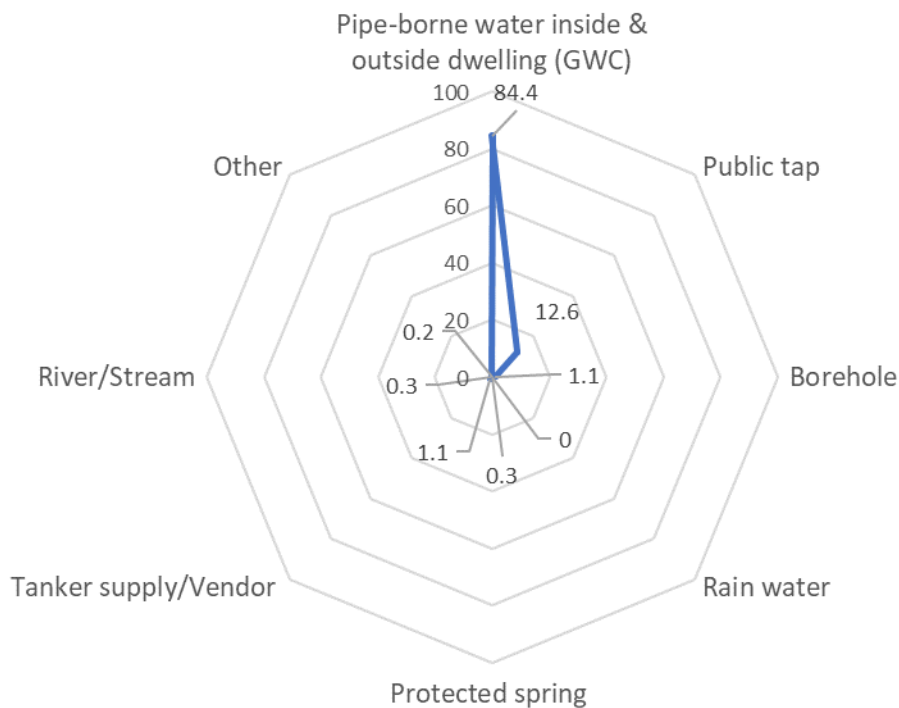


Figure 9.35: Sources of water for other domestic use (Developed from Ghana Statistical Service 2010)

One of the major outcomes of this water shortage problem in Accra is the rise of new actors in the water sector. Outside actors from the private informal sector stepped in to fill the void created by the GWCL’s supply deficit by introducing vended drinking water in sachet plastic bags. Aside from ameliorating the water crisis situation in Accra (accounts for about 27.9% of drinking water for households in Accra), the sachet water industry has become a major source of employment (from production to sales) in Accra, but not without its downsides. Sachet plastic bags have emerged as one of the main sources of nondegradable pollutants in Accra. Apart from their negative environmental externalities, they are a major cause of storm drain clogs which have exacerbated the risk of flooding in Accra (Stoler et al. 2012). In recent years, calls by some government institutions and private stakeholders to ban sachet bags have failed to receive public support due to the embeddedness of the latter in mainstream society. This development shows how grassroots innovations can fuel transitions towards unsustainable new-regimes if such innovations are not properly regulated.

As pointed out in Section 9.3.5, several small-scale initiatives have been undertaken to recycle sachet plastic waste in Accra. However, they have yet to gather momentum and cause a radical change. It is high time Accra exploited other alternative sources of water such as rainwater harvesting which remain largely underutilized. As shown in figure 9.35, the

proportion of rainwater used by households for domestic purposes in Accra is insignificant. From the site observations and field survey, it was found that there were no communal rainwater recovery systems in Accra; and only a small number (17.1%) of the respondents practiced rainwater harvesting. This number is very low given the fact that Accra has abundance of water from rainfall every year. Poor management of these huge volumes of rainwater underpins Accra's perennial flooding situation (Asumadu-Sarkodie et al. 2015).

In the field study, five factors emerged as important for addressing Accra's water challenges. Firstly, the inclusion of on-site stormwater management regulations in the building code to reduce surface runoff. Secondly, strict regulation and monitoring of the sachet water industry to minimize its negative impacts on the environment. Some interview participants were of the view that government should insist on the use of biodegradable plastic bags to reduce the volume of nondegradable municipal waste. Thirdly, improvement in GWCL's infrastructure to forestall water losses (about 30% of total supply) to system leakage. Fourth, the introduction of new pricing mechanisms to ensure end-user water efficiency. Finally, the provision of incentives to encourage the construction of more decentralized water sources, particularly domestic boreholes to minimize pressure on the national supply network. These interventions will require effective harmonization of the roles of government, the private sector, and civil society.

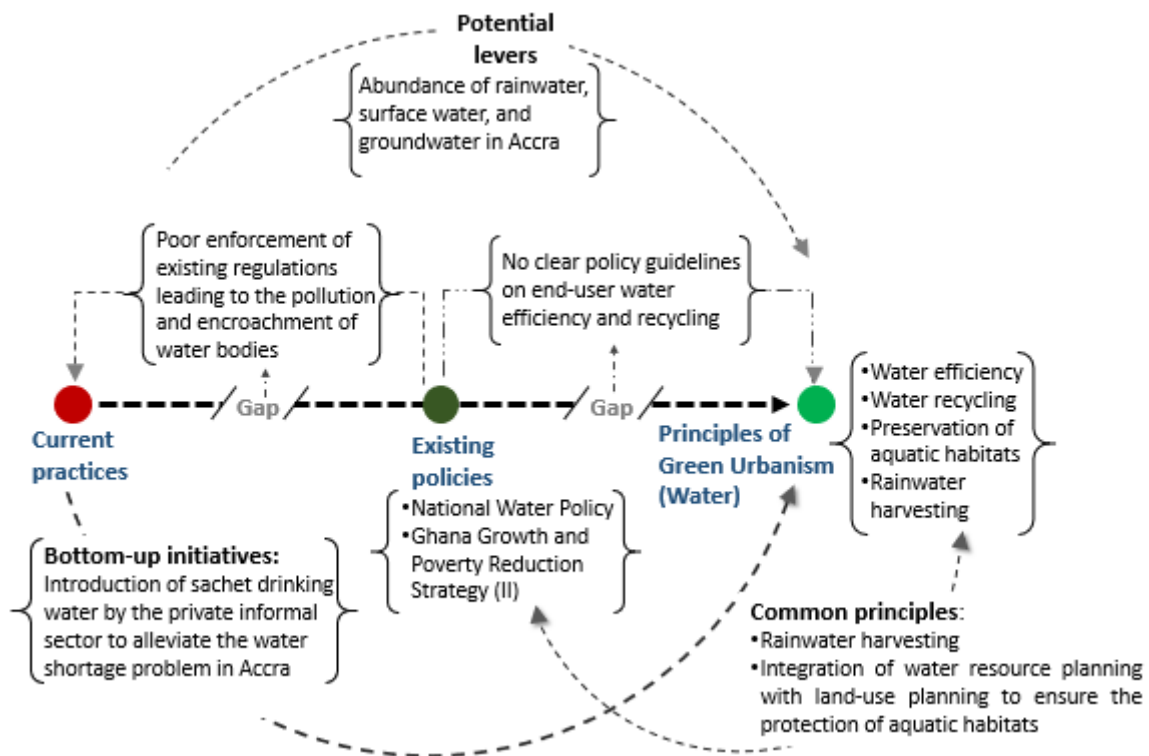


Figure 9.36: Performance gap analysis of the water sector in Accra against the principles of Green Urbanism (Author's construct)

9.3.7 Urban Governance

Governance embodies rules, systems, relationships, and mechanisms through which stakeholder interests are articulated and negotiated to inform development decisions. Green Urbanism underlines the principle of participatory urban governance. Jaime Lerner (former mayor of Curitiba) identifies this principle as an ‘equation of co-responsibility’ i.e.: distributing responsibilities in urban decision-making and development activities between government and the people (Lerner 2012). Drawing on the experiences of Freiburg and Curitiba, participatory governance may be initiated from bottom-up or top-down processes depending on the social and political realities of cities. Both approaches have inherent merits and limitations which must be modulated by cities to achieve desired outcomes.

9.3.7.1 Urban governance in Accra

9.3.7.1.1 Participatory approach to policy formulation

The principle of participative decision-making underpinned the formulation process of most government policies covering the various sectors in Ghana. Most of the policy documents discussed in Section 9.3 were developed through effective engagement with civil society

among other relevant stakeholders. Ghana's first National Urban Policy and Action Plan, for example, was developed through nine sets of activities that included cross-country field consultations with traditional authorities, civil society groups, selected professionals, and the private sector etc. Similarly, the formulation of the National Spatial Development Framework involved multi-sectoral participatory plan-making.

This participatory approach also underpinned the design of the National Transport Policy, National Housing Policy, and the National Environmental Sanitation Strategy and Action Plan etc. To a great degree, these processes have helped to enrich the various sectoral policies by capturing the nuances of public expectations. Nonetheless, as can be observed in many sectors in Accra, participative decision-making alone does not guarantee effective policy implementation. These processes must be complemented with strong political will and effective engagement of all relevant stakeholders in the implementation process (Bäckstrand 2006; Kronsell 2013; Schmidt 2013).

9.3.7.1.2 Governance practices in Accra

Local level governance in Ghana is made up of two parallel systems: a modern democratic governance system adopted through colonization, and chieftaincy institutions which have deep cultural and historical roots. The Accra Metropolitan Assembly, which is the political and administrative authority of Accra, represents the modern state government. It has a general assembly which comprises government appointees and elected representatives from 76 electoral areas within the Accra Metropolis. The Local Government Act- 1993 (ACT 462), identifies these electoral area representatives as the mouthpiece of the local people. They are to maintain close contact with their electoral areas, collate and present their views at the general assembly, and report to their electorates the general decisions of the Assembly. This formal democratic process has enabled grassroots participation in local decision-making processes at arm's length.

Chieftaincy institutions represent traditional authorities. These institutions are structured in a hierarchy i.e.: regional or tribal chief, paramount chiefs, and community chiefs. The Ga Mantse is the tribal/regional chief of Accra with several paramount and community chiefs under his authority. Although the chieftaincy institutions do not exercise the same power as they did in pre-colonial times, they still play an important role in both local and national

development. They are the kingpins of cultural heritage and customary laws, custodians of a significant share of lands in the country, and key agents of local development. The latter is achieved through community driven development initiatives which are mostly orchestrated by the traditional authorities in collaboration with community-based associations etc. These initiatives are commonly known as ‘communal labour’ in Ghana.

Communal labour (see figures 9.37) is an occasion where residents in a community voluntarily participate in local development activities. These activities offer a cost-effective approach to promoting community development. From the field survey, it was found that 94.6 percent of the respondents regarded communal labour as a useful exercise for improving communities; and about 76 percent acknowledged that they participate in a communal activity at least once every month. Although communal labour is generally not considered in the light of participatory governance for urban sustainability, it offers a medium for achieving the latter at the community level. It is a type of creative placemaking that enables people to collectively reinvent their public spaces, strengthen the connection between people and the places they live, and fosters grassroots innovation etc. How the potential of communal labour may be enhanced to facilitate sustainability transitions in Accra is an important issue for further investigation.



Figure 9.37: Communal clean-up exercise and art in Accra (Sources: www.urb.im/cities and www.topbusinessjournal.com)

9.3.8 Summary

A quantitative analysis of the performance of Accra against the principles of Green Urbanism is difficult to construct due to paucity of data. Nevertheless, content analysis of existing policies, as well as site observations and field surveys of common practices revealed some gaps between desired (policy) and actual (practice) performance. On one hand, most of the sectoral policies analysed in Section 9.3 were in sync with the underlying principles of Green Urbanism. A major shortfall observed in these policies was a lack of clear strategic implementation guidelines that address the who, when, and how of reaching and/or assessing desired policy objectives. On the other hand, common practices also showed considerable strengths and weaknesses against the principles of Green Urbanism. The strengths were largely underpinned by grassroots initiatives in the private and informal sectors which were mostly situated outside the direct influence of government policies.

Typical examples of these grassroots initiatives are the blend of residential and commercial uses of most community spaces, robust public informal transport system (trotro), small-scale recycling industries, and communal labour etc. These bottom-up initiatives also have their downsides which call for effective regulatory mechanisms to redirect them on desired trajectories. Major weaknesses (gaps) identified in common practices were largely engendered by poor enforcement of existing regulations, lack of political will and/or capacity to provide the necessary public infrastructure, and path dependence (i.e. difficulty in changing current practices due to previous commitments).

A typical example of the latter (i.e. path dependence) is the customary practice of lumping together waste at the household level which has been a major barrier to the introduction of a segregation and recycling program in Accra. Determining how (unsustainable) old paths may be broken, and (sustainable) new pathways may be created are essential to facilitating a transition towards Green Urbanism in Accra. Through the theoretical lens of the Multi-level perspective (MLP), the following section (Section 9.4) assesses factors that present barriers, opportunities, and potential sources of leverage for green urban transition in Accra. Section 9.4 draws on a thematic analysis of the field survey responses and interviews.

Table 9.1: Summary of the performance of Accra against the principles of Green Urbanism

Principles of Green Urbanism	Policies	Practices	
		Strengths	Weaknesses/Gaps
1. Land-use <ul style="list-style-type: none"> • Transit oriented development (i.e. compact and mixed-use along transit corridors) • Biophilic development • Preservation of urban biodiversity 	<ul style="list-style-type: none"> • Strategic Plan for GAMA (1993) • National Urban Policy (2012) • National Spatial Development Framework (2015-2035) 	<ul style="list-style-type: none"> • Most communities in Accra are functionally integrated; hence, most social and commercial services can be accessed within walking distances. 	<ul style="list-style-type: none"> • Poor enforcement of land-use regulations. • Accra’s rapid growth is largely spurred by market forces rather than proper planning. Hence, current developments pay less attention to public transit and the preservation of the natural environment. • Inefficient land tenure system.
2. Transport <ul style="list-style-type: none"> • Sustainable mobility (i.e. promotion of public transit, car sharing, and active mobility) • Zero emission/green vehicles 	<ul style="list-style-type: none"> • Strategic Plan for GAMA (1993) • National Transport Policy (2008) 	<ul style="list-style-type: none"> • The informal mini buses (trotro) convey more than 70% of all passengers in Accra. • Its accessible and a flexible mode of public transport. 	<ul style="list-style-type: none"> • Trotro services are poorly regulated, have less passenger capacity, and operate without any schedule. Hence, they create congestion and chaos on the road. • Limited infrastructure for the Ayalolo BRT. • Poor cycling culture
3. Energy <ul style="list-style-type: none"> • Renewable energy • Energy efficiency 	<ul style="list-style-type: none"> • National Energy Policy (2008) • Renewable Energy Act, (2011) 	<ul style="list-style-type: none"> • About 42% of electricity is supplied from renewable source (i.e hydropower). 	<ul style="list-style-type: none"> • Vulnerability of hydro and thermal power to climate change and international oil price uncertainty. • Limited political support for alternative renewable energies. • Poor end-user energy efficiency.
4. Building <ul style="list-style-type: none"> • Passive design • Climate and context • Retrofitting/sustainable local materials 	<ul style="list-style-type: none"> • National Building Regulations (1996) • National Housing Policy (2015) 	<ul style="list-style-type: none"> • Existing traditional design and vernacular construction technologies are largely in sync with the green building principles. They present a model for sustainable buildings in the local context. 	<ul style="list-style-type: none"> • Lack of investment in the improvement of local materials. • Proliferation of non-sustainable imported building materials • Poor enforcement of building regulations. • Low public awareness about green buildings

<p>5. Waste</p> <ul style="list-style-type: none"> • Waste reduction • Waste reuse • Waste recycling and recovery 	<ul style="list-style-type: none"> • National Environmental Sanitation Policy (2010) • Nation Environmental Sanitation Strategic Action Plan (2010) 	<ul style="list-style-type: none"> • Improved waste collection system through public private partnership • Equitable strategies for waste collection from both low and high-income communities. 	<ul style="list-style-type: none"> • Inadequate infrastructure for waste recycling. • Over-dependence on landfills • Limited public knowledge about waste segregation • Poor enforcement of waste regulations.
<p>6. Water</p> <ul style="list-style-type: none"> • Water efficiency • Water recycling • Preservation of aquatic habitats • Rainwater harvesting 	<ul style="list-style-type: none"> • Ghana Growth and Poverty Reduction Strategy II (2006) • National Water Policy (2007) 	<ul style="list-style-type: none"> • Innovation in affordable potable water (sachet water) has helped to alleviate the water shortage crisis in Accra 	<ul style="list-style-type: none"> • Encroachment on aquatic habitats due to poor enforcement of existing regulations • Poor infrastructure management leading to high system leakage
<p>7. Urban governance</p> <ul style="list-style-type: none"> • Subsidiarity • Inclusive development • placemaking 	<ul style="list-style-type: none"> • Ghana Local Government Act of 1993 • Strategic Plan for GAMA (1993) • National Urban Policy (2012) 	<ul style="list-style-type: none"> • Communal labour creates strong sense of place in most communities in Accra. • Promotion of participatory governance processes through the general assemblies of local governments 	<ul style="list-style-type: none"> • Conflicts between the formal democratic governance system and the traditional chieftaincy institution especially with regards to land tenure processes.

9.4 Barriers, opportunities, and potential levers for green urban transition in Accra: insight from the Multi-level perspective

9.4.1 Overview of the assumptions of the Multi-level perspective (MLP)

How may we unpick the complexities underlying unsustainable practices in Accra to understand the challenges and potential sources of leverage for a transition to more sustainable trajectories? As an emergent theory in transition studies, the MLP presents a heuristic model for assessing the processes of change through the interaction of three analytical concepts: landscape, regime, and niche. Regimes (i.e. established practices and technical structures) are characterized by different sets of lock-in mechanisms which

contribute to path dependency. To unlock these lock-ins and create new paths for sustainability transitions, the MLP identifies pressure from landscape factors and niche-innovations as key triggers of system change. Landscape factors (i.e. trends and changes in society and globally) expose the weaknesses in entrenched sociotechnical regimes and create windows of opportunity for niche-innovations (radical ideas or innovations that sit outside the mainstream) to emerge (Geels 2011). That said, it is important to note that developments at the landscape and niche level do not directly control transition processes, but they offer a medium for influencing and adjusting these processes (Loorbach & Rotmans 2006). As argued by some proponents, the MLP is not restricted to any strict methodological procedures; therefore, it requires some 'element of creative interpretation' in its application (Geels 2011, p. 36).

9.4.2 Lessons from the empirical testing of the MLP: the case of Freiburg and Curitiba

Applying the MLP to assess green urban transitions in both Freiburg and Curitiba (Chapter 8), it was found that transitions are mostly stalled by the inertia of entrenched socio-technical regimes. Also, pressures from landscape factors and niche-innovations were identified to be important for regime shift. However, their influence is largely modulated by the agency of social actors. Therefore, how social actors interpret and respond to landscape factors determine the extent to which the latter (may) influence existing regimes, and create favourable conditions for emergent innovations to become mainstream (Grin et al. 2010). Consistent with the existing literature, the maturity of niche-innovations and how niche actors articulate their technical, economic, cultural, and environmental benefits were also found to be important determinants of the 'output legitimacy' of emergent innovations (Kronsell 2013; Raven et al. 2010; Witkamp et al. 2011).

Building on these findings, the following sections examine the barriers, opportunities, and levers for green urban transition in Accra through the lens of regime-landscape-niche interaction. It draws on a thematic analysis of the field survey responses and interviews to examine: (1) challenges in entrenched socio-technical regimes and how they present barriers to green urban transition in Accra; (2) landscape factors in Accra and how they (may) influence regimes to create favourable conditions for niche to become mainstream; and (3)

opportunities in emergent socio-technical innovations (niche) and how they (may) provide the seed for change. It concludes with a discussion on the potential sources of leverage for green urban transitions in Accra.

9.4.3 Barriers to green urban transition in Accra: analysis of challenges in entrenched socio-technical regimes

Regimes are the locus of established practices and technical structures that are hard to dissolve in mainstream society (Kemp et al. 1998). They are stabilised by various lock-in mechanisms such as user preferences, established regulations and standards, norms, sunk investments, bureaucracies, and resistance from vested (social, private, and/or political) interests etc. (Acheampong et al. 2016; Grin et al. 2010). In this analysis, socio-technical regimes encompass established institutions, power relations and prevalent political processes, common practices, existing technologies and infrastructure, sunk cost, and the regulatory framework that govern the various sectors in Accra. From the field survey and interviews, three main factors (underpinned by entrenched socio-technical regimes) were identified to present significant barriers to green urban transition in Accra i.e.: political, institutional, and social factors. The following sections examine how these factors influence transition processes in key sectors in Accra.

9.4.3.1 Political factors

A major political factor identified to obstruct successful transitions in various sectors in Accra is the politicisation of public policy initiatives by political interest groups (regime actors) to promote their vested interests. According to some respondents, almost ‘everything in Ghana has become politicized’, resulting in the prioritization of partisan interest, mostly, to the detriment of broader national interest. To put this political interference in context, an understanding of the evolution of Ghana’s political system is necessary. In the first decade of the post-colonial era, Ghana established a democratic system which was later destabilized by a series of military coups. The country regained a relatively stable political environment under a military government (Provisional National Defence Council- PNDC) from 1981 to 1992. In the early 1990s, Western governments and the Bretton Woods Institutions begun to demand political reforms (landscape changes) in Africa. These landscape actors succeeded in ‘coercing’ most African countries to transition from military authoritarian regimes to civil

democracy by imposing sanctions and pressure through financial aids and loans etc. Due to these landscape pressures, Ghana experienced a shift from a military regime to a multiparty democracy in 1992.

A return to democracy has brought major benefits to the country (e.g. voting rights and grassroots participation in decision making etc.) but is not without its downsides. Presently, there are more than eight political parties in Ghana. The quest for political power has created a 'prisoner's dilemma', particularly, between the two dominant political parties in the country (i.e. New Patriotic Party and National Democratic Congress). Both parties undercut one another to gain political capital sometimes to the detriment of the country's development. In the field interview, one policy maker pointed out that "the kind of democracy that we are practicing here [in Ghana] does not give you independent mind to do things" (Participant 13). Most government initiatives are characterized by parochial partisan interest which result in quick fixes and sub-optimal solutions. Hence, sustainability initiatives which are mostly oriented towards long-term goals are given less consideration. In the view of another participant, even when governments propose innovative sustainability ideas, these ideas are barely carried through "because anytime we try to do things we politicise it and make a mess of it" (Participant 21).

For example, in 2005, the New Patriotic Party's (NPP) government introduced an affordable housing project in Accra and other parts of Ghana to alleviate the acute housing shortage in the country. About 4700 housing units were constructed nationwide. However, following the exit of the NPP government in 2008, the National Democratic Congress' (NDC) government showed less interest in continuing the project, and introduced a new social housing scheme. Consequently, the NPP's affordable housing scheme was allowed to go to waste (for the most part) for eight years. The project regained political attention in recent years, following the NPP's victory in the 2016 presidential and parliamentary election. A similar trend of politicization and neglect could also be observed in the energy, waste, and public transport sectors.

According to an official of the Metro Mass Transit (MMT) company, one of the major factors that contributed to the decline in the company's services is the cut in government (who is the majority shareholder) support for the MMT after the exit of the NPP government in 2008

(Participant 12). In lieu of improving the existing MMT, the NDC government introduced a new public bus system (i.e. Ayalolo BRT) in 2016, but failed to provide the necessary infrastructure to support it. Since the NPP government came to power in 2017, there has been no clear policy on how the government intends to improve the Ayalolo BRT, especially, with regards to infrastructure development. There seems to be more government interest in improving the MMT (introduced by the NPP in 2003) than investing in the Ayalolo (Participants 03 and 12). Recent media report about the incumbent government's rhetoric on the Ayalolo BRT has been one of accusation of past government for "shoddy implementation" of the Ayalolo BRT (Adogla-Bessa 2018). This blame game and lack of political will raise doubts about the future of Ayalolo.

Although this 'political game' is common to most democracies around the world, its impacts on developing countries are more telling given the absence of strong institutions in the latter. According to one respondent, Ghana's democracy is only "symbolized by how elections are held and whether they are free and fair, but to the extent that they deliver development is doubtful" (Participant 21). Others also share the view that the pattern of politicisation in Ghana's democratic governance kills initiatives, threatens public sector governance, engenders policy inconsistency and implementation gaps, and undermines development in most sectors of the country. As shown in the empirical analysis in Chapter 7 (Curitiba), developing consistent urban policies across the entire local government sectors, and ensuring continuous political and institutional support to implement these policies are important success factors for sustainability transitions. Most respondents agreed that the negative impacts of politicisation on national development can be minimized by the introduction of a national development plan that will serve as a basis for political decision-making.

9.4.3.2 Institutional factors

Two major institutional barriers to transitions towards Green Urbanism in Accra were identified i.e.: (1) conflict between traditional and formal state institutions; and (2) decentralization with little empowerment and local government autonomy. Firstly, as explained in Section 9.3.7, Ghana's local governance system embodies both traditional (chieftaincy) institutions and inherited Western governance institutions. The former enjoyed undisputed authority over land and people in the pre-colonial period, albeit along tribal or

ethnic lines. Due to colonization and subsequent transition to modern democracy, attempts have been made to incorporate the role of traditional authorities into the modern system of governance in Ghana. However, the existing constitutional provisions have failed to sufficiently define their functions, particularly, with regard to issues of jurisdiction and power (Mahama 2009; Rathbone 2000). This vacuum tends to fuel conflicts between traditional leaders and local government officials. A major area where this conflict is most prevalent is land tenure and land-use management.

As pointed out earlier, traditional authorities are custodians of most lands in Accra, but the use of these lands is determined by the Town and Country Planning Department (TCPD). According to a respondent from the Ghana Institute of Planners (GIP), a lack of understanding of the dichotomy between land ownership and land use, as well as poor collaboration between traditional authorities and the TCPD have resulted in a parallel system where formal planning and land-use management co-exist with informal land-use planning and development (Participant 06). The latter is more prevalent because it is faster and cheaper. Hence, much of the growth of Accra in the last decades has unfolded with little or no regard to land-use regulations (Participant 19). A typical consequence of this development trend is the loss of about 80 percent of the natural vegetation of Accra since the early 1980s (see figure 9.7).

Commenting on the poor compliance with existing planning regulations, a planning official of the Accra Metropolitan Assembly acknowledged that customary land tenure practices in Accra are a major hindrance to strategic planning for urban sustainability (Participant 01). He noted that “owners of land can determine whether... [the Assembly] is successful with its plans or not”. In most instances, traditional authorities sell unplanned lands to developers without recourse to the appropriate planning institutions (Participant 20). Hence, the local government’s plans to control and/or determine the use of these properties are thwarted by these informal (unplanned) developments (see figure 9.38). Against this backdrop, the education of traditional authorities and local people about existing planning regulations, and the empowerment of local government institutions to effectively monitor and enforce compliance with these regulations were identified by most respondents as essential for resolving land-use conflicts in Accra.

The empowerment of local government institutions has much to do with the effectiveness of Ghana's decentralization system. As argued by some scholars, decentralization in its essence embodies the devolution of responsibilities and resources to local governments with less control from the center (Besley & Coate 2003; Rosenbaum 2000). Ghana's decentralization system, in the view of most respondents, amounts to deconcentration: a situation where much power and resources are retained at central government ministries. Local governments (across the country) are largely non-autonomous in political decision-making and the mobilization of resources to support local developments (Akrofi et al. 2018; Totin et al. 2018). Thus, important local development plans are often stalled by the inertia of central government bureaucracies and limited local funds.



Figure 9.38: The Accra Metropolitan Assembly's plan to develop one of the major natural water resources in the city (i.e. Korle Lagoon) into an ecological corridor has been obstructed by informal settlements (Source: Kquofi 2011)

For example, according to one planning official, a potential solution to the rapid depletion of Accra's green spaces is the acquisition of these green areas by local government (Participant 08). However, the latter has limited financial resources to purchase these lands. Similarly, the provision of the necessary infrastructure to support sustainability innovations such as dedicated lanes for the Ayalolo BRT and waste recycling plants etc. largely depends on central government intervention due to the limited fiscal capacity of the Accra Metropolitan Assembly. In the administrative sphere, it was also found that the human resources of most

local government institutions such as the Town and Country Planning Department was highly inadequate. Therefore, their capacity to monitor and enforce planning regulations was limited. These shortcomings call for some reforms in Ghana's decentralization policy to ensure that central government formally cedes power and resources to actors at the local government level to enhance their capacity to act (e.g. policy formation, funding of local projects, regulatory oversight, and enforcement etc).

9.4.3.3 Social factors

From an analysis of participants' responses to questions, it was observed that the social barriers to green urban transitions in Accra largely stem from the cultural foundation of Ghanaian society, as well as the attitudes and subjective norms of individuals. According to Ajzen (2011), attitudes are determined by the extent to which an individual has a favourable or unfavourable evaluation of a behaviour; and subjective norm refers to an individual's belief about whether other people approve or disapprove of a behaviour of interest. Putting the two together, Ajzen (2011), argues that the decision of an individual to engage in a behaviour is not only informed by her personal evaluation but also the perceived social pressure arising from the expectations of others. This theorem holds true for the case of Freiburg where normative social influence on individual behaviours led to the entrenchment of certain sustainability practices such as the use of renewable energies, preservation of green spaces, and car-free living among others. In the case of Curitiba, these sustainability values were inculcated in the local people through intensive education, regulations, and incentives by the local government.

From the field survey and observations, it was found that the attitudes of most people in Accra were not in accord with some basic sustainability practices such as the preservation of the natural environment, efficient waste management, end-user electricity and water efficiency, and bicycling etc. For example, only 20 percent of the respondents in the field survey attached importance to the usefulness of public green spaces. Active modes of transport such as cycling was also evaluated unfavourably within the local culture. Worse still, there was a lack of social pressure and proactive agenda by local government to promote sustainability practices. Against this backdrop, most participants in the field interviews emphasized the need for a change in people's behaviours (attitudes) towards their

environment as fundamental to bridging the gap between Accra's performance and the underlying principles of Green Urbanism. This change was identified to be necessary for both government officials (national and local) and local people to ensure that there is the political will to promote sustainability policies on one hand, and grassroots support to sustain such policies on the other.

Public education was found to be an important tool for creating environmental awareness and driving a shift to more sustainable living. Nevertheless, it was also considered by some people as incapable of propelling change alone. For some respondents, Ghanaian society is more responsive to enforcement than voluntary compliance. Therefore, efforts by government should be directed towards strict monitoring and application of existing regulations. Echoing this point, an official from the Ghana Education Service noted that "adults need enforcement, but children need education" since behaviour change in children is faster than in adults (Participant 07). In addition, some respondents called for a review of existing structures of (dis)incentives to modulate the environmental externalities of people's behaviour outcomes. One way of achieving this goal, according to Kemp et al. (1998, p. 175), is to "make environmental benefits an integral part of the structure of incentives and constraints in which people... interact".

Although the problem of poverty in the developing world and its implications for green urban transition was less explicit in participants' responses, studies have shown that the latter can present significant barriers to sustainable living (Hansen et al. 2018; Ramos-Mejía et al. 2018). The daily lives of many in the developing world is a struggle to meet basic needs; therefore, issues of sustainability may be inconsequential. This phenomenon is no different in Accra where food security, energy crisis, access to potable water and sanitation, and unemployment etc. are more critical subjects of topical interest than sustainability (Abraham & Martin 2016; Addae et al. 2019; McKay et al. 2015). Therefore, as suggested by Ramos-Mejía et al. (2018), sustainability advocates and green urbanists need to make poverty alleviation an integral part of their core principles to make these concepts relevant to cities in the developing world.

Ghana's transition from a Low-income country to a Middle-income economy presents an opportunity for reducing poverty-associated sustainability barriers such as lack of financial resources to promote sustainability initiatives, deprioritization of sustainability principles,

and dysfunctional institutions etc. (Khavul & Bruton 2013; Newton 2008). However, as can be observed in the case of Curitiba, the rise of the country's middle-income class (particularly in Accra which is Ghana's economic growth pole) can also induce what Newton (2008, p. 28) identifies as "consumption-related" sustainability challenges. Therefore, there is a need for a holistic policy framework that addresses both poverty-induced and/or consumption-related barriers to green urban transitions in Accra.

9.4.3.4 Summary

The analysis in Section 9.4.3 highlights major lock-in mechanisms that derail transitions towards Green Urbanism in Accra. These lock-ins are reproduced and sustained by various social groups and actors embedded in entrenched socio-technical regimes (i.e. institutions, bureaucracy, culture, social norms, and politics etc.). The analysis points to the important role of governance as a driver or barrier to change. Essentially, it reveals that political will, adaptive capacity (i.e. power, knowledge, and resources) of local governments, and the interplay of expectations of different interest groups (traditional authorities, policy makers, political parties, civil society) determine how governance may influence the particular form and direction of transitions. In addition, the role of central government was identified to be crucial for successful transitions in Accra since the latter has significant control over the power and resources required to make change happen. Hence, as is the case with Curitiba, how political leaders at the center may embrace and support sustainability principles, matters to how these principles will be prioritized at the local level. Given that national policies are largely driven by election promises and party manifestos, empowering people (especially traditional leaders and electorates) to lead the way to urban sustainability (like in Freiburg) may enhance the importance political parties attach to issues of sustainable development. A change in attitudes towards the environment (ecological worldview) has the potential of creating favourable conditions for green innovations to become mainstream.

9.4.4 Landscape factors in Accra: creating the window of opportunity for socio-technical niche-innovations

Landscape factors are essential preconditions for transitions as they create windows of opportunity in incumbent regimes for socio-technical innovations to emerge. The existing literature identifies three key factors that collectively define what constitute sociotechnical

landscapes: (1) exogeneous or macro-level developments; (2) autonomous developments beyond the direct influence of individual actors; and (3) developments that provide influential backdrop for regime-niche interactions (Grin et al. 2010; Smith et al. 2010). Landscape processes encompass: macro-economic restructuring, demographic change, environmental problems, climate change, natural/man-made disasters, oil and gas trends, worldviews, urbanization, epidemic disease, and widespread environmental awareness among others. These factors prompt responses from social actors and generate a sense of urgency for change. From the field study, two sets of landscape factors were identified to exercise influence over Accra spatiotemporally: (1) landscape changes that have led to Accra's current development (i.e. landscape factors in retrospect); and (2) those that have the potential of determining the future development of Accra (i.e. prevalent landscape factors). The following sections examine the implications of these landscape factors for both current and future development trends in Accra.

9.4.4.1 Landscape factors in retrospect: implications for current developments in Accra

From an analysis of the field interviews and existing literature, it was observed that a major landscape factor that has had significant implications for the developmental trajectory of Accra is the economic restructuring program (i.e. Structural Adjustment Program) of the mid-1980s. This landscape development engendered changes at the regime level (e.g. transport, housing, energy, waste etc.) through policy reforms. As explained in Chapter 5, the Structural Adjustment Program (SAP) was introduced by the World Bank and IMF to support countries experiencing economic crisis. To be eligible for loans from the two Bretton Woods Institutions, beneficiary countries had to commit to implementing free-market policies (e.g. privatisation, free trade, and deregulation etc). The economic reforms (landscape changes) dictated by these external landscape actors resulted in the removal of restrictions on private sector participation in most sectors of the Ghanaian economy. These rule changes led to a marked transformation in the network of regime actors. New actors appeared leading to the disappearance of some existing regime actors.

For example, as discussed earlier in Section 9.3.2, landscape processes in the form of transport deregulation resulted in the disappearance of the government public transit agencies and the emergence of the informal public transit (trotro) unions (GPRTU, CU, and

PROTOA). Although the trotro may not qualify as a radical innovation, it may be considered as a niche-development in the sense that its formation was orchestrated by actors outside the mainstream with different organizational structures and operational modalities. After more than three decades of operation, the trotro has become widely entrenched in society forming a new transport regime. As pointed out earlier, its embeddedness in mainstream society has become a major hindrance to the emergence of a more convenient and properly organized public transport system (i.e. Ayalolo BRT).

The housing sector has also seen two significant transformations due to the economic reform program. These changes largely border on the re-organization of the existing housing regime (in terms of materiality and supply) with no significant influence from niche. Firstly, the housing deregulation policy enabled the importation of foreign building materials which eventually ousted the more sustainable local building materials (Danso 2013; Grant & Yankson 2003). Secondly, there was significant increase in the property market participants with serious implications for the spatial growth of Accra. Less government investment in housing (due to the deregulation policy) coupled with further landscape changes (population increase) created a serious housing shortage in Accra (Brun & Blaikie 2016; Grant & Yankson 2003). Hence, outside actors (i.e. private developers and the informal sector) who are profit driven and less environmentally conscious predominated the housing market to take advantage of this opportunity. A combination of a housing speculation bubble and poor enforcement of land-use regulations resulted in rapid spatial growth of Accra with little planning. Consequently, the built-up area of Accra has increased tremendously with a significant decrease in the city's natural vegetation. This case illustrates how landscape changes can redirect existing sociotechnical systems in a rather unsustainable path.

The energy (especially electricity supply) and water sectors have seen moderate changes although there were significant landscape pressures to deregulate the sectors. Public protest against the privatization of electricity and water supply in Ghana counteracted pressures from the external landscape actors (World Bank and IMF) to deregulate the sectors. In the water sector, for examples, a new group of actors appeared (formation of the National Coalition Against Privatisation of Water) to mount “one of the fiercest opposition” against privatization of state enterprises in Ghana (Acheampong et al. 2016, p. 1844). These resistances were motivated by fear of price hike if ownership of these sectors were transferred from public to

private hands. Thus, social actors (in this instance civil society) are likely to resist landscape pressures if their vested interest is threatened.

Changes in the waste management regime are more recent (early 2000s). Despite the introduction of the SAP, local government was largely responsible for waste collection in Accra. Further landscape changes (demographic change and urbanization) led to a marked increase in the volumes of waste produced daily. Regime actors (i.e. local government) lacked the capacity to deal with these wastes, resulting in significant environmental problems. Surface water and soil contamination, air pollution, and the spread of both water and vector-borne diseases (e.g. cholera, malaria, and typhoid fever etc.) became prevalent in Accra due to poor management of the city's wastes (Owusu 2010; Songsore 2017). Hence, major changes in rules were made to enable the participation of outside actors (private waste collection companies). These changes have helped to reduce the waste burden of Accra.

Altogether, the SAP has had both positive and negative impacts on Accra's development. The analysis above shows that the destabilization of existing regimes by landscape pressures (SAP) do not necessarily lead to more sustainable (new) regimes. It also points out that how social actors respond to landscape pressures determines the extent of change in existing regimes. Therefore, to achieve desired transition outcomes, the mediating role of agency is critical.

9.4.4.2 Prevalent landscape factors in Accra: implications for green urban transitions

Findings from the field study also revealed some prevalent landscape factors that exercise influence over the various sectors in Accra with implications for the city's future development. These factors include climate change, global trends in oil and gas supply, demographic change, urbanization, macro-economic patterns, disasters, and environmental problems.

9.4.4.2.1 Energy sector

Two major landscape factors were identified in the energy sector: hydrological drought due to climate change impacts, and shortfalls in oil and gas supply. As noted earlier, these factors have brought significant pressure to bear on Ghana's hydro and thermal power plants (energy regimes), resulting in a perennial power crisis in Accra and other parts of the country. The power crisis has been aggravated by further landscape factors (i.e. demographic change and

rapid urbanization) which have engendered a recurrent rationing system of electricity supply across the country. Although the power crisis has been moderated in the last few years by improvements in the existing electricity infrastructure, there remains no long-term solution to the power generation and supply bottlenecks (Eshun & Amoako-Tuffour 2016). The window of opportunity created by these landscape factors in the hydro and thermal power regimes has yet to be fully exploited.

9.4.4.2.2 Water sector

The water regime has also come under two major landscape influences (i.e. climate change and demographic change), leading to water rationing in Accra. In addition to rising consumption patterns due to population growth, the Ghana Water Company Limited acknowledged that prolonged droughts (arising from changes in climate systems) have made some raw water sources unproductive; causing significant shortfalls in supply. Poor maintenance of the water infrastructure is also identified as a major contributor to this water shortage. The window of opportunity created by these landscape factors and the inefficiencies in the water regime opened up the space for the emergence of sachet water production. The latter has turned out to be unsustainable due to the negative environmental externalities of sachet plastic bags. Hence, how government regulates niche developments to ensure they deliver safe and environmentally benign technologies is critical to ensuring that transitions are directed on desired trajectories.

9.4.4.2.3 Waste sector

Landscape changes on socio-spatial (population growth and urbanization) and environmental (pollution) dimensions have brought significant pressure to bear on the waste management regime in Accra. In the first place, the spatial and population growth of the city has fuelled tremendous growth in the volumes of waste generated in the city. According to an official of the Accra Metropolitan Assembly, although the PPP in waste management has helped to lessen the waste burden of Accra, most of the private operators have limited capacity. Hence, less than 50 percent of the waste generated are collected by these accredited operators. This shortfall has created a vacuum which has been filled by informal private operators commonly known as '*borla taxis*'. Due to the lack of landfill sites in Accra, and the absence of government control over the operations of the informal collectors, the latter tends to dump the waste at

illegitimate sites, creating serious environmental problems for most communities in Accra. In fact, a recent report by the African Business Magazine (2017), ranked Accra as one of the dirtiest cities in Africa due to poor waste management and littering attitudes. The waste crisis in Accra call for changes in the various dimensions of the existing waste management regime: social (behaviour), policy (regulation), and disposal and infrastructure (recycling plant).

9.4.4.2.4 Transport sector

As discussed in previous sections, selection pressure (in the form of policy reforms) brought about significant changes in the network of actors in the transport sector. The informal public transit system (trotro) displaced the formal scheduled bus system, forming a new transport regime. However, the poor quality of service provided by the trotro make them less convenient and appealing to the middle-income class. Following Ghana's rise from a Heavily Indebted Poor Country (HIPIC) to a low middle-income status in the last two decades, there has been a steady rise of the middle-class population, especially, in Accra which is the epicenter of innovation and economic growth. This landscape change has resulted in a significant increase in car ownership in Accra. Reinforcing this development is the rapid urbanization of Accra (further landscape change) which is forcing many residents to the outskirts of the city; hence, perpetuating a car dependent lifestyle.

As noted earlier in Section 9.3.2.1, the rise in car ownership has created traffic gridlock on most roads in Accra. Although the concerns of road users and government have mostly hovered around issues of travel time loss and the effects of traffic congestion on the local economy, the environmental impacts of this gridlock are insidiously deleterious (e.g. high fuel consumption and transport emissions). This case reveals how landscape changes (economic growth and urbanization) can undermine sustainable regimes (public transit) and perpetuate unsustainable lifestyle (car dependency). It shows that landscape factors can have a negative (lead to changes along unsustainable trajectories) or positive (lead to changes towards sustainability) influence on existing regimes. How this negative landscape influence on the transport systems in Accra may be mitigated is essential to identifying a sustainable solution to Accra's transport system.

9.4.4.2.5 Building sector and land-use

The building sector in Accra has been dominated by the informal sector since independence (Grant & Yankson 2003). Developments by these informal actors are mostly undertaken without the necessary land-use approval or building permit. Hence, encroachment on urban streams, wetlands, and green belts has become a common practice in Accra. As noted earlier, this phenomenon is reinforced by the customary land tenure system which tends to undermine planning processes. These unplanned developments have been a major contributor to perennial flooding disasters (landscape development) in Accra. For example, the year 2018 alone has seen several life-threatening flooding incidences in various communities in Accra which are largely unplanned (Davies 2018). These disasters are a wake-up call to policy makers and government to reconsider existing land-use regulations and building permit processes. In a recent radio interview on February 2017, the Minister of Water Resources, Works and Housing intimated his decision to demolish illegal buildings in Accra to fix the city's flood crisis. This landscape pressure (flood disasters) can be viewed as having a positive influence over the existing informal housing regime as it prompts responses that lean towards sustainable transformation. Nonetheless, it remains to be seen how this pressure can bring about the desired change necessary to align practice with policy in the building industry.

9.4.4.2.6 Summary

The analysis above shows that selection pressures from landscape factors can have positive or negative influences over regimes. These influences can prompt responses from regime or outside actors that lead to the transformation of incumbent regimes towards greater sustainability (positive), or redirect regimes on unsustainable trajectories (negative). Therefore, landscape factors do not necessarily facilitate regime shifts to sustainability as implied in some MLP studies. Moreover, the analysis shows that the presence of landscape pressures is not a guarantee for regime shift (e.g. energy and waste sectors in Accra). As argued by some proponents, the influence of landscape pressures on regimes is a function of how social actors effectively articulate these pressures in a manner that “renders [them] explicit and translate them into a form that prompts” responses from all relevant stakeholders (Smith et al. 2005, p. 1495).

The case of the anti-nuclear protest in Freiburg presents a good example of how landscape factors can be effectively articulated to generate the type of responses (from both regime and niche actors) that deliver change. In the context of Ghana, the emergence of Ebola and the responses it generated from government, civil society, and health professionals etc. also give a cue to how landscape pressures may be articulated to engender regime transformation (see box 9.2). Nonetheless, as pointed out by Geels and Kemp (2007), landscape pressures alone do not automatically lead to transitions. They must coalesce with developments at the niche level which provides the seed for change (Kemp, R et al. 1998). The next section examines niche developments in Accra and how they might influence landscape-regime dynamics to facilitate green urban transitions in Accra.

Box 9.2: Ebola virus epidemic in West Africa and responses from Ghana

Background: The Ebola virus epidemic in the West African subregion was the most widespread outbreak of the disease. It claimed thousands of lives in neighbouring countries such as Liberia, Sierra Leone, and Guinea etc. between 2013 and 2016. Fear of an outbreak of this epidemic disease in Ghana prompted swift responses from government, health professionals, civil society groups, and the media etc.

Impacts of articulation and responses: These responses had two major impacts (i.e. technical and social). On the technical side, the government supported health institutions with the necessary logistics and training for health staffs to build their capacity to effectively deal with reported case. On the other hand, health professionals and the media, among other stakeholders, carried out intensive campaigns to raise public awareness about the disease. Among others, these campaigns changed people's eating habits and attitudes towards certain traditional practices. For example, bush meat (which is a staple source of protein) was largely abandoned. Besides, the common practices of shaking hands, hugging, sharing drinking cups etc. at funerals, festivals, and other public events were also discouraged.

Outcomes: Although Ghana never experienced any Ebola cases, the country was well prepared to curb this menace. Various stakeholders (government, health professionals, media etc.) responded swiftly to this landscape development by effectively articulating the threats, and prevention and control measures for the Ebola virus. This proactive response resulted in the reorganization of existing socio-technical regimes (social norms, health services, lifestyle etc.) to prevent and/or effectively manage any outbreak.

9.4.5 Socio-technical niche developments in Accra: providing the seed for green urban transitions

The existing literature emphasizes niche as a major source of leverage for sustainability transitions. It is at this level where deviation from common practices occurs as a result of novel ideas or technological innovations. Niche developments have two major impacts on regimes i.e.: reconfiguration effect -improving existing regimes; or substitution effect-replacing existing regimes (Geels 2012). To what extent these innovations influence transition outcomes depends upon their socially shared legitimacy. The latter is largely determined by the formation and application processes of niche developments.

Proponents of Strategic Niche Management (SNM) maintain that effective niche development requires: (1) the coupling of the expectations of all relevant stakeholders to ensure that the outcomes of niche experiments are socially acceptable; (2) formation of actor networks (i.e. producers, consumers, and regulators etc.); (3) creation of temporary protected space for niche to develop and grow; (4) scaling up the experiment through incremental learning; and (5) effective articulation of niche to enhance the perceived behavioural control (i.e. perception of the ease to use niche) of end-users (Kemp et al. 1998; Raven et al. 2010). These processes help to enhance the promise and capabilities of niche to trigger transitions. From the field interviews and site observations, several innovations were identified at the niche level which have the potential of reconfiguring or substituting incumbent regimes in the various sectors in Accra.

9.4.5.1 Transport sector

In the transport sector, there has been small scale production of home built electric cars by the Apostle Safo Suaye Technology Research Centre (ASSTRC). The electric cars (commonly known as Kantanka Odeneho II) have no internal combustion engine; hence, they release less greenhouse gases into the atmosphere. The cars run on an electric motor powered by 12 rechargeable batteries. The batteries can be recharged by solar energy or electricity. All the 12 batteries do not work simultaneously. They are built with a power changeover system that enables the cars to travel long distances. Site visit and interviews with the ASSTRC revealed that these cars have extraordinary features such as a voice prompt that alerts pedestrian to

stand aside when the car is in reverse gear. The ASSTRC has also developed eco-friendly television sets, fridges, and neonatal incubators etc. from wood to avoid e-wastes.

Similarly, several small-scale enterprises have introduced bamboo bikes to provide an affordable and environmentally friendly mode of active transport in Accra. One of the pioneers of this industry (i.e. Ghana Bamboo Bike Initiative) mostly engages women in the production and supply of these bikes to equip them with some vocational skills, as well as empower them economically. Given the necessary support, these niche-innovations (i.e. electric cars and bamboo bikes etc.) have the potential of creating more employment opportunities in Accra, engendering economic growth, and transforming Accra's transport regime to become more sustainable.

9.4.5.2 Energy sector

The energy sector has also seen grassroots innovations in solar energy, waste-to-energy technologies, and eco-friendly charcoal briquettes for household cooking. For instance, Rassaboat Limited (a small-scale solar energy enterprise) has introduced a solar home system that incorporates mosquito electric killer. Malaria (caused by mosquitos) is one of the leading causes of death in Ghana. Thus, Rassaboat's solar system aims to achieve two goals by providing sustainable energy solutions, and addressing a predominant health problem in Ghana. In addition, to minimize the use of wood fuel (the most common source of energy for household cooking in Accra) and save trees, Global Bamboo Products Limited-GBPL (a hybrid social enterprise) cultivate bamboo and process them into green fuel charcoal briquettes. Some studies have shown that the use of wood fuel (charcoal) do not only destroy the environment but also expose women to high risk of lung and heart diseases (Boadi & Kuitunen 2006; Bunting 2010). Therefore, the GBPL's charcoal briquettes have been designed to produce no smoke. According to some users, it is more economical and efficient for cooking as it burns longer and produces higher heat output than ordinary charcoal. Similarly, Slamson Ghana Limited has also introduced smokeless charcoal, biofuel, and fertilizers developed from treated human waste. Other innovations in waste-to-energy technologies (e.g. biogas) have also received considerable attention in recent years with some demonstration experiments in Accra and elsewhere. Thus far, these alternative renewable energy technologies have yet to gain sufficient momentum to compete in the market.

9.4.5.3 Waste sector

As pointed out earlier in Section 9.3.5, waste (especially plastic waste) poses a major environmental problem to Accra. About 22,000 tons of plastic wastes are generated annually in Ghana but only 2 percent is recycled (Lambert & Sabutey 2016). To turn this challenge into an opportunity, Comeph and Associates (a consulting firm in sustainable energy and waste management) has introduced a system of producing clean and efficient fuel from plastic wastes using a reverse logistics model and thermal decomposition approach. According to the CEO of the company, Comeph's waste-to-energy innovation aims to get rid of plastic wastes in Accra and other parts of the country, produce fuel (diesel and petrol) for local consumption, and create employment opportunities that also have positive environmental externalities. In recent years, Comeph has started commercial production of petrol and diesel (called the Osagyefo fuel) for use by vehicles. In addition, there have also been small-scale experimentations in the conversion of plastic wastes into paving blocks by the private informal sector. The plastics are shredded, melted, and mixed with sand. The mixture is then poured into locally designed moulds which determine the size and form of the paver blocks. Since its introduction, the recycled paving block has proven useful in both road and industrial construction. Put together, these innovations can help provide a more sustainable approach to resolving Accra's plastic waste menace.

9.4.5.4 Social innovations

Most transition studies consider socio-technical niche-developments in the light of technological innovations. There is less emphasis on non-technological innovations (i.e. ideas that sit outside the mainstream) which underlie most transition processes. As discussed in Chapter 8, a broader conceptualization of niche-innovation to capture both hard and soft innovations is particularly important in cities where ideas (in the form of policies etc.) are a major driver of change. A typical example is the car free living concept in Vauban. This idea engendered radical changes at the regime level. For instance, in contrast to existing planning standards, residential units and neighbourhood streets were designed without parking lots, leading to significant changes in lifestyle, regulations, and societal values.

Several social innovations were identified in Accra that aim to promote urban sustainability. Some of these initiatives include Prototype Zero and Eco-planners Ghana. Prototype Zero is a

community-based demonstration project organized by a group of architects and building professionals to educate communities about how to build with sustainable local materials (e.g. laterite earth, rammed earth wall, bamboo, stone, and agricultural waste etc.). Participants in this event are guided to build a prototype house with local materials within 24 hours. This demonstration experiment provides participants with practical knowledge about sustainable buildings and the application of locally available building materials. In addition, Eco-Planners Ghana is a social enterprise that helps to make public events more environmentally friendly. They teach people how to separate their wastes at public events (e.g. weddings, funerals, parties, and festivals etc.) for recycling. As noted earlier, waste segregation is a fairly new concept in Accra; therefore, such practical demonstrations offer a medium for changing people's waste management behaviours.

9.4.5.5 Barriers to mainstream application of niche

Altogether, the socio-technical niche-innovations discussed above present opportunities for transforming the various sectors in Accra towards more sustainable trajectories. Nonetheless, despite their positive social, economic, and environmental externalities, they remain largely underutilized. There is no clear strategy to coordinate these isolated innovations at the niche level to create critical mass. Interviews with some niche actors revealed three fundamental barriers to the adoption of these innovations in mainstream society: lack of policy support, social factors, and economic factors. Firstly, most of the respondents lamented the absence of a clear government policy to support the incubation and mainstream application of niche-innovations. Hence, niche actors have no temporary protected space to develop sufficient momentum to compete in the market.

Secondly, public acceptance of most of the niche-innovations were found to be very low. Two key factors were identified to underpin this phenomenon. First, the lack of public confidence in some of the niche developments such as the electric cars, local solar panels, and bamboo bikes etc. was found to contribute to their low patronage. As shown by some studies, there is a general lack of consumer confidence in products made in Ghana (Obeesi 2012; Opoku & Akorli 2009). Second, cultural factors were also found to discourage usage of certain products and technologies such as biogas and the 'Slamson' smokeless charcoal briquettes etc. The general perception is that these products are 'unclean' because they are produced from

human waste. These factors are mostly attitudinal barriers which, in the words of Kemp et al. (1998, p. 190), require education and effective “articulation of the cultural and psychological” aspects of emergent innovations.

Finally, lack of funding is also a major barrier to scaling up most of the innovations at the niche level. Ghana has one of the highest lending rates in the world, placing eighth in a recent global ranking by Trading Economics (see: tradingeconomics.com). Presently, the bank lending rate in Ghana stands at 35.5 percent. This stifling cost of borrowing has been a major disincentive for the business community in the country. Not only are these loans expensive, but they are also difficult to access (Abor & Biekpe 2006; Narteh 2013). Hence, most niche actors struggle to expand their businesses and bring down production cost to remain competitive in the market.

To help alleviate these challenges, the Governments of Denmark and the Netherlands through the World Bank have inaugurated a Ghana Climate Innovation Center (GCIC) in Accra. The GCIC was launched in May 2016 in collaboration with some local institutions (Ashesi University College, Ernst and Young, and SNV Ghana etc.). The main aim of the GCIC is to serve as an incubator for homegrown green technology businesses. Ghana is one of seven countries (South Africa, Kenya, Vietnam, Ethiopia, Morocco, and the Caribbean) to benefit from this initiative. The GCIC provides a global platform that helps emergent green businesses to build international networks. It also facilitates access to funding opportunities to alleviate the economic barriers to local innovations. According to some of the niche actors, GCIC also helps to build their capacity in market ecosystem creation, project management, and effective planning among other business advisory services to make them competitive. In addition to these support systems, how the GCIC might help to break the political and cultural barriers to green innovations in Ghana is critical to identifying a holistic solution to the latency of niche-developments in the country.

9.4.6 Potential sources of leverage for green urban transitions in Accra: insights from the Multi-level Perspective (MLP)

Proponents of the MLP maintain that for transitions to take place, developments at the landscape, regime, and niche level have to coalesce (Geels & Kemp 2007). In other words, transitions cannot be caused by one element (i.e. landscape or niche) but may be influenced

by the co-evolution and conjunction of developments at different levels (landscape, regime, and niche). Thus, transitions are likely to occur when landscape pressures bearing on regimes happen at a time when niche-innovations have gathered sufficient internal momentum to compete with regimes (Grin et al. 2010). As discussed in Chapters 4 and 8, the outcomes of the interactions between the three analytical concepts of the MLP are largely modulated by the agency which social actors bring to transition processes.

Consistent with the assumptions of the MLP, the current study has found that despite significant pressures from landscape factors on regimes in the various sectors in Accra, there have not been any significant changes in the latter due, in part, to the constraints and immaturity of emergent innovations. To address these limitations, two main sources of leverage are identified: transforming the elements of existing regimes along sustainable trajectories, and empowering green innovations (both hard and soft) at the niche level. These levers are consistent with Loorbach and Rotmans (2006) strategies for managing transitions i.e.: system improvement and system innovation. Both strategies are contingent on the agency which social actors bring to landscape-regime-niche dynamics.

9.4.6.1 Regime transformation towards Green Urbanism

The current study has found that the barriers to green urban transitions in Accra are largely associated with various elements of entrenched socio-technical regimes (culture, knowledge, institutions, user preferences, sunk cost, routines, and policy etc.), and the underlying interests and expectations of regime actors (government, political parties, traditional authorities, industry, and public etc.). These barriers are evident in the gaps in existing policies and common practices. At the policy level, it was observed that the pursuance of parochial political interest by regime actors (i.e. political parties), political interference in public policies, an inefficient decentralization system, and lack of a clear definition of the role and authority of traditional leaders in the modern local government system etc. were major setbacks to the prioritization and efficient implementation of certain public policies that aimed to promote urban sustainability. These setbacks also underlie the inconsistencies in government policies, and the limited capacity of local governments to act. As shown in the empirical analysis in previous chapters (Chapters 6 & 7), consistency in government policies, for example, was a fundamental success factor for sustainability transitions in both Freiburg and Curitiba.

To address these policy challenges, major actions should be taken to forestall the negative impacts of Ghana's polarized political system and inefficient institutions. One such important measure is the establishment of a long-term national development plan. A plan that would ensure that national development is not dictated by sectional political party manifestos, but presents a blueprint for visionary and consistent planning. In addition, the empowerment of local government institutions is also critical. Some respondents in the field interviews pointed out the need for a referendum to elect Metropolitan Chief Executives (MCE) to ensure that local government autonomy is attained. Presently, MCEs are nominated by the ruling party which makes them more loyal to their political parties than the local people. Thus, the election of MCEs by the people is believed to enable local governments to prioritize local issues, ensure accountability and transparency at the local government level, and avoid unnecessary interferences from central government (Debrah 2016; Van Gyampo 2008). Moreover, there is a need for clarity on the role of traditional authorities in local developments. This effort should be coupled with the creation of a common platform that enables effective dialogue between traditional authorities and local government institutions such as the Town and Country Planning Department. This dialogue may help to ensure effective synchronization of land-use planning and land development in the region.

With regards to common practices, the current study found lack of knowledge about (or interest in) some sustainability practices and technologies (e.g. waste segregation, biking, solar technologies, and green building principles etc.), disapproval of some green technologies based on cultural values (e.g. biogas and green charcoal briquettes from human waste etc.), and poor attitudes to the natural environment etc. as major barriers to transitions towards Green Urbanism in Accra. These setbacks call for behaviour change interventions. Public education through electronic media (TV and Radio) is one major source of leverage. From one state-owned radio and television station (i.e. Ghana Broadcasting Corporation) in the mid-1990s, Accra presently has about 50 authorized radio stations and more than 30 television stations. A longitudinal analysis of the programmes aired by these electronic media revealed that much attention is paid to politics, sports, and entertainment with no particular interest in sustainability and environmental issues. The latter only come to the limelight when there is an ecological crisis. Thus, how the media might be engaged to increase awareness about the environment and urban sustainability in general is essential to creating an

environmentally conscious society. The rising prominence of social media platforms (e.g. Facebook, WhatsApp, Twitter, YouTube, and Instagram etc.) also present an enormous opportunity for sustainability awareness creation.

Furthermore, the use of fiscal incentives, taxes, and regulations have been emphasized in the existing literature as effective tools to modulate people's behaviour outcomes (Loorbach & Rotmans 2006; Michie et al. 2011). These tools proved effective in the empirical cases presented in previous chapters. For example, Vauban used fiscal incentives to promote its car free living concept, but applied strict regulations and fines to ensure effective management of stormwater and solid waste. In the case of Curitiba, the success of the "Green Exchange Program" was largely predicated on government incentives (in the form of food and bus tickets) to the local people. Curitiba also used environmental taxes and fines to discourage environmental pollution from industrial activities and indiscriminate felling of trees etc. Thus, as emphasized by Ding et al. (2016), both positive and negative incentives are important for modulating the environmental externalities of people's behaviour outcomes. In the context of Accra, positive incentives may take the form of subsidies for green technologies, bamboo bikes, and waste segregation bins etc. Negative incentives may include CBD congestion tax to discourage the use of private cars, fines for unauthorized developments, littering fines (e.g. Singapore), and a review of current water and electricity pricing mechanisms to ensure end-user efficiency. These 'carrot and stick' interventions can be used as triggers to elicit behaviour change for urban sustainability.

Altogether, the transformation of incumbent regimes towards more sustainable trajectories from both policy and practice perspectives offers a unified approach to addressing the lapses in Accra's performance against the underlying principles of Green Urbanism. Central to this transformation process is the influence of regime actors. As shown in the analysis in Section 9.4.3, the various barriers to green urban transition in Accra are underpinned by the values, expectations, and interests of different regime actors. Therefore, aligning these value systems and normative preferences with sustainability principles is critical to breaking old paths that are appraised as unsustainable, and creating new paths for urban sustainability. New sustainability paths may be created through the application of green (both hard and soft) innovations at the niche level to reconfigure or replace existing regimes.

9.4.6.2 Empowering niche-innovations to provide the seed for change

As emphasized in the existing literature, niche-innovations provide the seed for transitions (Kemp, R et al. 1998; Raven et al. 2010). They can be applied to reconfigure existing regimes or replace (substitute) destabilized regimes (Geels & Schot 2007). However, their diffusion in mainstream society is stalled by resistance from entrenched regimes and/or internal constraints of the innovation. The current study found several factors that contribute to the inability of niche to break through: lack of supportive policies, lukewarm support for niche, limited capacity of niche actors, and lack of complementary infrastructure. These limitations call for favourable policies to enhance the supply and demand for niche-developments. As suggested by Kemp et al. (1998, p. 184), such policy measures should be “drastic to have an impact” given the dominance of existing regimes. They should facilitate the experimentation of niche in a temporary protected space to enable them gain sufficient internal momentum to compete with regimes (Kivimaa & Kern 2016).

As noted earlier, a lack of effective government policies to coordinate and facilitate niche developments was identified as one of the major setbacks of innovations at the niche level. Hence, the activities of niche actors (e.g. green technology businesses) remain fragmented with no clear collective goals. The introduction of the Ghana Climate Innovation Center, for example, presents an opportunity for niche actors to collaborate and develop their capacity. However, it is not likely that the GCIC in itself will be capable of creating the necessary conditions for niche-innovations to develop and grow; given their limited influence and power in the Ghanaian economy. Thus, there is a need for favourable government policies to facilitate niche experimentations and their mainstream application. Such policy measures may include fiscal subsidies, venture capital incentives, tax exemptions, strategies to build indigenous capacity, knowledge creation about emergent innovations, and government support for research and development etc. (Kemp et al. 1998; Ruggiero et al. 2018). These interventions can help reduce the production cost of emergent innovations to make them more competitive. Government could also play a leading role in promoting niche-innovations by procuring the latter (e.g. locally made electric cars and solar panels etc.). Such a move can serve as a boost to homegrown green technologies, and promote public confidence in indigenous innovations. That said, innovation policies should not overlook the externalities of niche activities. As shown in Section 3.6, niche-innovations (e.g. plastic sachet water) can have

debilitating effect on the environment if they are not properly regulated. Hence, innovation policy instruments should be framed to guide niche activities along desired trajectories.

9.5 Conclusion

Based on data from field interviews, surveys, site observations, and GIS mapping, this chapter has presented an analysis of the performance of Accra against the principles of Green Urbanism, and how a transition towards the latter might be achieved. Consistent with findings from the case of Curitiba (Chapter 7), the analysis shows that, in the context of developing countries, governments have a key role to play if successful transitions are to be achieved. This phenomenon is largely explained by the fact that governments in developing countries tend to control more resources and authority in decision making than in the developed world. However, unlike the case of Curitiba where the local government was in the vanguard of the city's revolutionary ideas, Accra depends largely on the central government for resources and political decision-making because of the ineffectiveness of Ghana's decentralization system. Consequently, the local government (Accra Metropolitan Assembly) has less capacity to determine and modulate the city's developmental trajectory. Thus, there is a need for a shift from current deconcentration of power to a devolution of responsibilities and resources to local governments to empower the latter to foster local developments.

Moreover, given the fact that the criteria of Green Urbanism is overarching (Beatley 2012), and no one city may tick all the boxes, it is important for cities to prioritize areas that present the best lever for change. This notion resonates with the concept of urban acupuncture where small-scale initiatives are applied to transform the broader urban context. As shown in previous chapters, green urban initiatives in both Freiburg and Curitiba were not applied at the same time. Arguably, Freiburg's transition began with a renewable energy revolution while Curitiba started off with transit-oriented development. According to some observers, the successes of these initiatives (in both cities) gave impetus to other green initiatives. This approach is particularly important in Accra because of the limited resources of the local government. In a world where "all good things cannot be pursued at once", prioritization is critical (Grindle 2004, p. 525). As pointed out by one interview respondent, "there has to be a little success story to show how things can work" (Participant 06). Several initiatives in Accra present an opportunity for an '*acupuncture experiment*' in various sectors e.g.: the Ayalolo

BRT (transport), Jekora segregation and recycling program (waste), Solar Rooftop Program for government buildings (energy), and Prototype Zero (building) etc. There is a need for a deeper analysis of the potentials of these initiatives for driving change, and how their institutional, political, economic, and social barriers might be overcome.

10.1 Introduction

The current study investigated the dynamics and processes of transitioning cities towards Green Urbanism. Through a review of literature, content analysis of policies, and case studies, this study aimed to address the following objectives:

1. To examine and synthesize the underlying principles of Green Urbanism.
2. To understand how the local dynamics in different contexts influence how Green Urbanism is conceived and applied to existing cities.
3. To systematically assess the processes and potential sources of leverage for transitioning cities towards Green Urbanism.

These research objectives were addressed in different phases of the study. Altogether, the study was undertaken in four major phases: (1) literature review; (2) review of theories on transitions; (3) post hoc analysis of acclaimed green cities; and (4) application case study.

The first phase of the study addresses the first research question: ***how does Green Urbanism define its tools and principles in theory?*** A narrative literature review was used (in Chapter 2) to examine existing knowledge on the concept of Green Urbanism. Both historical and contemporary literature reviews were undertaken to delineate the underlining principles of Green Urbanism, and identify discourse patterns in this field of research. The analysis helped to identify gaps in the existing literature, and define the focus of the current study. Two main gaps were identified. Firstly, it was observed that the existing literature is replete with examples of how the principles of Green Urbanism apply to cities in the developed world. However, there is limited insight into how these principles might be applied to the developing world, given that the latter has many characteristics (e.g. socio-cultural, economic, political, and physical etc.) which are different from those of the developed world. Secondly, it was identified that the question of how green urban transitions might be examined and/or

influenced had been previously assessed only to a very limited extent. Previous studies have almost exclusively focused on defining a set of criteria for Green Urbanism, and assessing how cities (mostly in Western countries) meet these criteria. These gaps were addressed in subsequent phases of this study.

The second phase of this research addresses the third research question: ***how may green urban transitions be assessed and influenced? What are the potential drivers, opportunities, and barriers to green urban transitions?*** It sought to define a theoretical framework for analysing the dynamics of green urban transitions (in Chapter 4). Thus, the second research gap was partially addressed in this phase of the study. Building on the analysis in phase one, various approaches to sustainability transitions were reviewed in the second phase. Five key transition theories were critically analysed: (1) Strategic Niche Management; (2) Transition Management; (3) Multi-phase concept; (4) Socio-ecological transition; and (5) Multi-level Perspective. The Multi-level perspective (MLP) was co-opted as the theoretical lens for this research because of the comprehensive framework it proposes to analyse both internal and external factors that influence transition processes. The MLP distinguishes three analytical concepts that collectively influence transition processes: **landscape, regime, and niche**. It proffers that transition is a function of the nature and timing of interaction between these analytical concepts. Drawing on insights from other theoretical constructs, it was identified that the interface between landscape, regime, and niche is largely modulated by the agency which social actors bring to transition processes. Therefore, agency was explicitly introduced in the MLP framework to highlight the mediating role of social actors in transition processes. Building on the modified MLP framework, a systematic analysis of the drivers, opportunities, and barriers to green urban transitions was undertaken in phase three and four of this study (i.e. Chapters 8 and 9).

The third phase of the research addresses both the second and third (see question 3 above) research questions: ***how have the principles of Green Urbanism been applied to reframe existing cities? And how do the characteristics of the local context influence the application of these principles?*** A post hoc analysis of cities that claim to be green was undertaken. The analysis involved an evaluation of how the principles of Green Urbanism apply to both developed and developing country context; and how transitions towards Green Urbanism in both contexts unfolded. Hence, both research gap one (Green Urbanism in a developing

country context) and research gap two (processes of green urban transition) were addressed. Firstly, the cases of Freiburg and Curitiba were analysed against the principles of Green Urbanism (in Chapter 6 and 7). Following this analysis, the MLP was applied *a posteriori* to understand the drivers, opportunities, and barriers to green urban transition in both cities (in Chapter 8). The analysis revealed two contrasting approaches to transitioning cities towards Green Urbanism (i.e. bottom-up niche-actors driven transition, and top-down regime-actors led transition). Both approaches were found to be successful in their given context but with inherent limitations.

Finally, phase four of this research addresses the fourth research question: ***how can Green Urbanism be applied to cities in developing countries; and what strategies are appropriate for transitioning cities in the developing world towards Green Urbanism?*** In this phase, the case of Accra (Ghana) was analysed to understand how the unique characteristics of developing countries present opportunities and/or barriers to green urban transitions (in Chapter 9). Both research gap one and two were addressed in this case study. Firstly, how existing policies and common practices in Accra support or deviate from the principles of Green Urbanism were analysed. Both primary data (interviews, field surveys, and GIS mapping) and secondary data (review of policies and literature) were used. Building on this analysis, the MLP was applied *a priori* to examine the opportunities and barriers to transitioning Accra towards Green Urbanism.

Put together, the underlining goals of this study have been achieved through the analysis in the four (theoretical and empirical) phases of this research. Major findings arising from the study are summarized below (in Section 10.2). Drawing on these findings, Section 10.3 discusses the theoretical and practical contributions of the study. Finally, Section 10.4 concludes with some suggestions for further research.

10.2 Summary of key findings

This study aimed to examine how the concept of Green Urbanism might be operationalized, and how green urban transitions might be assessed and/or modulated to achieve desired outcomes. Through the theoretical lens of the MLP, several key factors were identified to influence transition processes in cities towards Green Urbanism. The following sections highlight these key findings emerging from the study.

10.2.1 Operationalizing the concept of Green Urbanism

Firstly, the study aimed to assess how Green Urbanism is defined in both theory and practice, and examine how this concept might be operationalized to enhance an understanding of its goals and criteria. From the analysis in phase one of this research, it was observed that Green Urbanism is an overarching concept, with significant overlap with other urban modernization concepts (e.g. Ecological Urbanism, Smart Urbanism, and New Urbanism etc.). However, unlike the latter which mostly proffer fragmented approaches to solving complex challenges in cities within certain disciplinary silos, Green Urbanism offers a multidisciplinary and comprehensive approach to addressing complex problems in cities. An unresolved dilemma, however, is how the notion of 'green' (in urbanism) differs from the concept of 'sustainability'. Both terminologies are portrayed as distinct theoretical constructs; however, they are often used interchangeably in both theory and practice (De Jong et al. 2015). From an analysis of the existing literature, this study found that sustainability was often cited as an underlying goal of Green Urbanism (See: Beatley 2012; Lehmann 2010b; Low 2005; Newman & Matan 2013). This observation was no different in the empirical analysis (in phase 3).

For example, although Freiburg promotes itself as a "Green City", many of its policies (in transport, waste, land-use planning, and energy etc.) are framed around the concept of sustainability. Thus, as part of the field study in Freiburg, interviews were conducted with city officials, urban researchers, and laypersons etc. to understand why Freiburg labels itself as a "Green City" rather than a "Sustainable City". A common theme emerging from the interview responses is the notion that the 'green label' provided a better place branding or image communication tool for the city than sustainability. Essentially, green was noted to resonate with people's emotions and connection with (or care for) nature. Besides, it was identified to create a sense of tranquillity, freshness, emotional balance, and healthy living.

At first glance, one may be quick to associate Freiburg's 'green image' with the abundant distribution of nature in its urban setting. However, underlying this image is the promotion of policies and practices that support the sustainable growth of the city. This phenomenon was also found to be true for Curitiba. Although the 'green label' is not so much emphasized in Curitiba in contrast to Freiburg, many investments have been made in Curitiba in the last four decades to preserve and promote nature in the city to enhance its 'green' identity (Macedo & Haddad 2016). According to some scholars, the 'green image' has emerged as an effective branding or marketing tool in the 21st century; though it is often abused (Dangelico & Vocalelli 2017; Ottman 2017). This label has become important for cities, especially, in an age where competition between cities for global attention, capital, and talents has reached a crescendo (Govers & Go 2016; Hoffman 2011). Therefore, Green Urbanism can be conceived as a conceptual model for enhancing the (green) image of cities while promoting their development on sustainable trajectories.

10.2.2 Dynamics of green urban transitions

10.2.2.1 Socio-technical landscape as key driver of transitions

The MLP identifies socio-technical landscape factors as key drivers of transitions as they create windows of opportunity in regimes for radical (niche) innovations to emerge (Geels et al. 2016). Consistent with this assumption, the analysis in phase three of this study found that pressures from landscape factors were important for creating a sense of urgency for change in the first place. For instance, in the case of Freiburg, the anti-nuclear movement which resulted from several landscape factors (e.g. nuclear disaster, change in public perception about nuclear energy, and environmental awareness etc.) was found to be the main trigger of the city's renewable energy transition. Similarly, Curitiba's urban revolution was also found to be instigated by several developments at the landscape level (e.g. rapid urbanization, flood disasters, environmental pollution, and a shift from democratic government to military dictatorship at the national level etc.). These landscape factors created the need for fundamental changes in existing systems and practices.

Furthermore, the study found that landscape factors do not trigger change mechanically; however, their impacts are highly influenced by how social actors interpret and act upon them. For example, in the case of Freiburg, it was found that the mediating role of scientific

experts and civil society in articulating developments at the landscape level related to nuclear power was key to the nullification of the nuclear power plant in Wyhl; and the creation of momentum for innovations in alternative (renewable) energy sources. In Curitiba, the articulation of and responses to changes at the landscape level was engineered by the political leadership of the city. Curitiba city officials deployed environmental campaigns, novel ideas, and rule change to articulate and respond to pressures from landscape factors. Drawing on these observations, it can be argued that the presence of landscape pressures is essential for transitions, but it is not a guarantee for the latter. They must be coupled with effective articulation to generate appropriate responses from regime. This phenomenon can be observed in Accra where several landscape factors (e.g. climate change, flood disasters, environmental pollution, and rapid urbanization etc.) have failed to create the needed momentum for change due to poor articulation.

10.2.2.2 Socio-technical niche: providing the seed for change

The MLP identifies niche developments as innovations that sit outside the mainstream. Niches emerge when pressures from landscape factors create windows of opportunity in existing regimes. The study found the characterization of niche in the literature as biased towards technological innovations. Much of the existing literature fails to account for non-technological niche-innovations. The latter was found to be critical in cities where ideas (that lead to policies and rules) are important for system change. Indeed, technical approaches to solving complex problems in cities is not enough; therefore, soft and/or behavioural change interventions are critical. In the case of Freiburg, it was found that radical ideas such as the car free living concept in Vauban is one of the landmark achievements of the city. This idea challenged the status quo (i.e. existing planning standards), and inspired a new way of life outside the automobile. In addition, Curitiba's urban transition largely hinged on non-technological innovations. For example, the Green Exchange Program, the Garbage that is not Garbage initiative, and the celebrated bus rapid transit system etc. were all driven mainly by ideas rather than hard technologies. This observation reflects that a broader conceptualization of niche to capture both technological and non-technological innovations that sit outside the mainstream is critical. This broader characterization of niche will help address criticisms of MLP studies as being technologically deterministic.

Moreover, a critical question that emerged in the study is how niche influences green urban transitions. The study found niche to play two important roles. Firstly, when niches have a symbiotic relationship with regimes, they can be applied to reconfigure the latter. Secondly, competitive niches may serve as substitutes for existing regimes. From the empirical analysis, it was found that regimes are likely to adapt to symbiotic niches, and resist competitive or substituting niches. Five key factors were identified to present significant barriers to the emergence of competitive niches: bureaucratic bottleneck, lack of adaptive capacity of actors at the niche level, social inertia, economic factors, and lack of complementary infrastructure for niche-innovations. These barriers were underpinned by a degree of path dependency which provided stability for incumbent regimes and forestalled the mainstream application of emergent green innovations. Thus, as pointed out by Geel (2005), a regime shift may take several decades to unfold. Freiburg's energy transition provides a typical example of this phenomenon. After more than four decades of Freiburg's renewable energy development, the latter has yet to completely displace its nuclear energy. Nuclear power in Germany is only projected to be phased out by 2022. This reflects that urban policies that aim for a transition from unsustainable regimes to sustainable niche can hardly be planned for in the short-term. Therefore, such policies should be based on long-term visions that accommodate short-term expectations.

10.2.3 Selective application of the principles of Green Urbanism

The empirical analysis also showed that Freiburg and Curitiba were selective in which aspects of the criteria of Green Urbanism to prioritize given their inherent challenges and potentials. As noted earlier, the principles of Green Urbanism are overarching; thus, no one city may perfectly meet all its requirements. Besides, cities have different needs and capacities to respond to these needs; therefore, prioritization is necessary. As shown in both cases, effective application of prioritized principles (of Green Urbanism) may provide further impetus for the application of other principles.

Furthermore, it was found that the type of pressures emerging from developments at the landscape level were major determinants of which aspects of the principles of Green Urbanism both cities prioritized. On one hand, Freiburg started off with an energy transition because pressures from landscape factors were mainly directed at the city's nuclear power

regime. On the other hand, Curitiba's urban revolution was instigated by landscape pressures that necessitated the reconfiguration of the city's master plan. Both cities took advantage of the windows of opportunity created by the prevalent landscape pressures. Reflecting on these experiences, it was found that landscape pressures present a major source of leverage for cities like Accra to initiate reforms that can direct the city's growth towards desired trajectories.

10.2.4 Governance of green urban transitions

The post hoc analysis showed different governance approaches to green urban transitions. Freiburg's transition was largely motivated by bottom-up initiatives while Curitiba was predominantly top-down. Both approaches were found to be effective in their given context. Firstly, it was found that the socio-economic and political conditions in both cities were fundamental to the governance approach applied in either context. In the case of Freiburg (developed country context), the citizens were highly educated, and they had the capacity to mobilize resources to initiate a change process (e.g. formation of the Oeko-Institut and the Fraunhofer ISE etc.). The political milieu (democratic governance) in Freiburg also allowed for grassroots movements with little political resistance.

Conversely, like most developing countries, much of the resources and power in Curitiba lied in the hands of the local government. Thus, the role of the local government was critical to the conceptualization and application of Curitiba's revolutionary initiatives. Similar to Curitiba's experience, it was found that both central and local governments have critical roles to play to facilitate a transition towards Green Urbanism in Accra. This observation is largely due to the limited adaptive capacity (i.e. resources, know-how, and power) of actors at the grassroots level. Hence, strong government support was found to be a key prerequisite for initiating a transition towards Green Urbanism in developing countries. Therefore, how Green Urbanism can be made a political priority in cities in the developing world like Accra is critical.

Drawing on Freiburg's experiences, this study suggests that one major source of leverage for galvanizing political support for Green Urbanism in the developing world is to promote an ecological worldview among the local people. By so doing, the people will be enlightened to demand such standards from their political leaders, and/or elect leaders who buy into these ideas. As pointed out earlier, Freiburg was the first city in Germany to elect a Green Mayor in

order to garner political support for the city's green agenda. Consequently, both top-down and local bottom-up processes were aligned to sustain the city's green initiatives. In Curitiba where much of the green initiatives were predominantly top-down, the exit of the key proponents of these ideas from the political scene has caused some of the initiatives to slide into a downward spiral. Therefore, green urban transitions should not only be about governing change, but also about empowering people to co-create this change. A merger of both top-down and bottom-up interests would help to promote the longevity of such change.

10.2.5 Strategies for green urban transitions in developing countries

An analysis of the existing literature showed that the concept of Green Urbanism is mostly conceived in the light of the developed world. How this concept applies to the developing world has been sparsely discussed. Generally, going green is considered to be an expensive undertaking. Therefore, funding mechanisms present one of the major barriers to the application of the green concept to cities in the developing world. However, an analysis of the case of Curitiba has shown that green urban transitions can still be achieved with basic low-cost solutions. Four key factors were found to be fundamental to Curitiba's approach:

1. Optimization of local potentials.
2. Enforcement of collective responsibility (identified by Lerner as an equation of co-responsibility).
3. Cost and time efficiency in policy implementation.
4. Creation of mutually reinforcing urban policies.

These factors helped to promote the efficient use of resources and lessen the cost burden of Curitiba's green initiatives.

Furthermore, an analysis of the case of Accra revealed that empowering actors at the grassroots through policy reforms can help to promote bottom-up initiatives that may have the potential to propel a transition towards Green Urbanism. For example, the Structural Adjustment Program (SAP) created favourable conditions for several grassroots innovations in transport, waste, water, and housing etc. to emerge. These bottom-up initiatives were found to be particularly important in the developing world where governments are mostly limited by budget. However, the analysis also showed that such grassroots initiatives must be effectively regulated to avoid negative externalities. In addition, several strategic levers for

system change towards Green Urbanism were identified in Accra. Fundamental to these strategies is a need to align the culture, normative beliefs, and perceived behaviour control of people with the underlying principles of Green Urbanism. These factors were found to be major barriers to sustainability transitions in many sectors in Accra. Such an undertaking will require: effective and continuous public awareness campaigns; making the benefits of sustainable living an essential element of the structure of incentives in mainstream society; and effective monitoring and enforcement of regulations.

10.3 Contributions of the study

10.3.1 Contribution to knowledge

The research framework has enabled both theoretical and methodological innovations in the study of Green Urbanism and its application to contemporary cities. Theoretically, the current study combines two strands of research (i.e. Green Urbanism and transition theories) to enhance an understanding of the dynamics and trajectories of urban transformation towards greater sustainability. Presently, much of the existing literature on Green Urbanism almost exclusively focuses on defining a set of criteria for its application to cities, and examining how these criteria might be assessed. The question of *how* a shift from current unsustainable practices to more desirable 'green practices' might be achieved in cities has received little treatment in the literature. Therefore, by examining Green Urbanism through the lens of transition theories, this study provides insights into the opportunities and barriers confronting cities in their efforts to develop and implement initiatives aimed to promote socially and ecologically responsive developments. Specifically, the study proposes a modified MLP framework (in Chapters 4 and 8) that provides a lens through which researchers can systematically examine the potential drivers and mechanisms of green urban transitions; and how social actors could influence these processes. By so doing, the study also contributes to an improvement of the MLP framework by operationalizing its analytical concepts (i.e. landscape, regime, and niche) in the context of cities, and explicitly addressing the issue of agency in its stylized representation.

Furthermore, the methodological approach adopted in this study enabled the collection of original empirical data on factors that present opportunities and/or barriers to green urban

transitions in both developed and developing country context. As previously discussed in Chapter 2, the existing literature fails to sufficiently account for how different cultural, political, and socio-economic conditions influence how Green Urbanism is conceived and applied. The need for this research was first raised in Lehmann's (2011) fifteenth principle of Green Urbanism. This study has taken the concept of Green Urbanism a step forward by interrogating how it is (or could be) applied in practice by analysing it through three international case studies in both developed and developing country context. It has done so through the theoretical lens of the MLP to tease out what the relevant levers for transition might be for different cities, given the windows of opportunity created by changes at the landscape level.

The applied analysis shows that there is no universal recipe or one-size-fit-all solution that can transform cities to become 'green'. Therefore, there is a need for an understanding of the triggers of change and processes through which green urban transitions might be achieved in different contexts. It is clear from the empirical analysis in Chapters 6, 7, and 9 that although cities in the developed and developing world can learn from one another, they cannot have the same strategies and discourses on Green Urbanism because of the marked differences in their sociocultural, economic, political, technological, infrastructure, and spatial configurations. Therefore, this study suggests that Green Urbanism should not be imposed dogmatically, but needs to be responsive to the specific requirements of its application domain.

10.3.2 Contribution to practice

Findings from the theoretical and empirical analyses make major contributions to policy making on green urban transitions at both the global and local (i.e. Accra) levels. Building on the modified MLP framework, the analysis in Chapter 8 suggests several strategic levers for propelling a transition towards Green Urbanism. Firstly, it identifies effective articulation of prevalent landscape factors in cities as a key step to creating a sense of urgency for change. The evidence presented in the empirical case studies (in Chapters 6 and 7) confirms that this sense of urgency is a first step in galvanizing local support for a needed urban change. Therefore, how policies might be framed to leverage this key stimulus (or window of opportunity) for change is critical.

Moreover, the analysis showed that the urgency for change at the instance of pressures from landscape factors is not a guarantee that change will happen. Thus, the need for change must coalesce with the capacity of social actors to deliver this change. Following the application of the MLP to the empirical case studies in Chapters 8 and 9, it was found that actors at the niche level play an important role in developing the seed for system change. However, they are faced with external selection pressures that pose a threat to their ability to thrive in a given environment. Therefore, as argued by Sushandoyo and Magnusson (2014), the formulation of favourable policies that provide a protected space for the incubation of new (green) ideas is essential for identifying new (green) paths of development. These policy instruments may take the form of tax incentives, government investment in research and development, capacity building for niche actors, public awareness creation about niche developments, and incentives to encourage public demand or support for niche innovations. Besides, as shown in the case of Curitiba, governments can lead by example by patronizing these niche innovations to scale up the operations of niche actors, and promote public trust and confidence in the former.

In the context of Accra, three key factors were identified to be relevant for policy making to foster a transition towards Green Urbanism. Firstly, it was found that public awareness about certain sustainability practices (e.g. waste segregation, end-user energy efficiency, and the benefits and need to preserve urban green spaces etc.) and green technologies (e.g. solar energy and biogas etc.) was low. Therefore, the introduction of policies that would promote public education about these green technologies and practices through both formal and informal media are necessary. Like Curitiba, these orientations could be embedded in academic curriculums especially at the basic and middle school levels. Secondly, evidence from the field study in Accra also showed that many of the grassroots green innovations were undertaken by the informal sector. However, this sector is faced with many challenges (e.g. inability to access credit, lack of competent human resources, and constraining government regulations etc.) that create major bottlenecks and barriers to their growth. Therefore, there is a need for a change in government attitude towards the informal sector from neglect to policy support.

Finally, the capacity of local governments to take independent decisions was found to be low in Accra. Ghana's decentralization system gravitates towards deconcentration which keeps

power and resources at the center. Therefore, efforts to promote the devolution of government functions is necessary to empower local governments. As pointed out by some interview respondents, policy reforms that enable the election of Metropolitan and Municipal Chief Executives by the local people can go a long way to ensure that local interests are prioritized. In addition, collaborations between local government institutions and traditional authorities have to be streamlined and strengthened especially in the areas of land tenure and land-use management.

10.4 Suggestions for further research

The theoretical and empirical analysis revealed three key areas for further research. Firstly, as acknowledged by its main proponent, the application and interpretation of the MLP is largely based on a researcher's inductive reasoning (Geels 2011). Hence, most MLP studies use a qualitative case study approach to investigate socio-technical transitions. Therefore, there is a need for the application of a quantitative methodological approach that enables objective analysis of the underlying assumptions of the MLP. This undertaking will help to add rigour to the MLP. Secondly, findings from the empirical case studies showed that Green Urbanism is as much a governance issue as it is about sustainability. The governance approach (top-down or bottom-up) adopted at the local level was found to be a major determinant of the trajectories and outcomes of green urban initiatives. Due to the scope of this research, this observation was briefly discussed in Chapters 6 and 7. Thus, there is a need for a deeper exploration of the link between different governance approaches and the longevity of policies promoting green urban transitions. This investigation may focus on identifying appropriate mechanisms for sustaining green urban initiatives or policies in different governance contexts. Finally, in the case of Accra, further research is needed to enhance understanding of the challenges and opportunities available to different actors (especially central government, local governments, traditional authorities, private informal sector, and civil society) to leverage the key stimulus (landscape pressure) and seed (niche-innovations) for urban change. This analysis will help to deepen an understanding of the agency which various social actors can bring to green urban transition processes in Accra.

Appendix 1: Ethics approval letter



RESEARCH BRANCH
OFFICE OF RESEARCH ETHICS, COMPLIANCE
AND INTEGRITY
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CRICOS Provider Number 00123M

5 August 2016

Professor J Kellett
School of Architecture & Built Environment

Dear Professor Kellett

ETHICS APPROVAL No: H-2016-170

PROJECT TITLE: Green Urbanism: Towards an operational framework and application to cities. A socio-technical systems approach

The ethics application for the above project has been reviewed by the Low Risk Human Research Ethics Review Group (Faculty of Arts and Faculty of the Professions) and is deemed to meet the requirements of the *National Statement on Ethical Conduct in Human Research (2007)* involving no more than low risk for research participants. You are authorised to commence your research on **05 Aug 2016**.

Ethics approval is granted for three years and is subject to satisfactory annual reporting. The form titled *Annual Report on Project Status* is to be used when reporting annual progress and project completion and can be downloaded at <http://www.adelaide.edu.au/rb/oreci/human/reporting/>. Prior to expiry, ethics approval may be extended for a further period.

Participants in the study are to be given a copy of the Information Sheet and the signed Consent Form to retain. It is also a condition of approval that you **immediately report** anything which might warrant review of ethical approval including:

- serious or unexpected adverse effects on participants,
- previously unforeseen events which might affect continued ethical acceptability of the project,
- proposed changes to the protocol; and
- the project is discontinued before the expected date of completion.

Please refer to the following ethics approval document for any additional conditions that may apply to this project.

Yours sincerely

DR JOHN TIBBY
Co-Convenor
Low Risk Human Research Ethics Review Group
(Faculty of Arts and Faculty of the Professions)

Appendix 2: Interview guide (Freiburg, Germany)

1. What makes Freiburg a green city? (Is it because of its geographical location, political philosophy, or people etc.?)
2. Why green city but not, for example, sustainable or solar city?
3. What is the history behind Freiburg's green urban transition?
 - a. What changes have taken place in the regime system (institutional arrangements, regulations, lifestyle, prevalent technologies etc.) to facilitate this transition?
 - b. What and/or who are the key drivers of these changes?
 - c. What were the main barriers to overcome?
4. Freiburg mix (Political priority for sustainable development, targeted business promotion, Geographical and climatic conditions, and environmental awareness of people), are identified as factors that underpin Freiburg's green success:
 - a. How would you rank these factors in terms of their contribution to Freiburg's green transition?
 - b. Could the size of the city (relatively small) also be a contributory factor?
5. Is Freiburg's history as a university town a contributory factor to her green identity?
 - a. Can similar trend be observed in other university towns in Germany?
6. What major changes have taken place over the years? (Energy, transport, housing, waste, water, green infrastructure, employment, food supply etc.)
7. Is Freiburg's green achievement largely due to top down management or bottom-up initiatives?
 - a. Which aspects of Freiburg's green initiatives are more top-down, and which aspects are propelled by bottom-up initiatives?
 - b. What bottom-up initiatives have been undertaken to support Freiburg's green agenda (eg. in transport, waste, energy, water, housing, food etc.)
8. How do you assess the outcomes of Freiburg's green initiatives?
 - a. Which aspects have been successful?
 - b. Which aspects have been less successful? What factors account for this?
 - c. Do you observe any unintended consequences in Freiburg's green ambitions?
9. Are there issues that have been ignored or deserve more attention?

Appendix 3: Interview guide (Curitiba, Brazil)

1. What motivated Curitiba's sustainability revolution?
 - a. How did this transition begin? Did existing policies change/ were new ones introduced?
2. Who was (or were) the key actor(s) in the transition process?
3. What are the main sustainability policies that have been applied?
4. What were the major barriers to the implementation of these policies?
5. How were these barriers overcome?
6. What opportunities did you have to facilitate the implementation of these policies?
7. How were citizens engaged?
8. How socially acceptable were these policies? Was there resistance to any of the policies by the local people?
9. Which of the policies were more difficult to progress and which were easier; and what factors account for these scenarios?
10. Which of the policies have been successful, and which have been less successful?
 - a. What factors account for these outcomes?
11. Do you consider Curitiba a model for sustainable urban development?
 - a. What distinguishes Curitiba from other Brazilian cities that made this transition towards sustainability possible?

Appendix 4: Questionnaire survey form (Accra, Ghana)

Research title:

A socio-technical approach to green urban transition: towards an operational framework and application to cities.

Project summary: This research investigates the drivers of urban change, and their implications for sustainable urban transition in Accra. It pays particular attention to how prevalent land-use planning, transport, energy, and waste management systems present opportunities or barriers to sustainable urban development in Accra. The research aims to identify a transition pathway for urban sustainability in developing country context, and the agency of social actors in realizing this change. For any enquiries, please contact the following: martin.larbi@adelaide.edu.au

Declaration

The information you give during this survey is for academic purposes only. Therefore, the confidentiality of your identity, and the information you may provide are assured.

Enumerator's name: Location:..... Activity:.....

Personal Profile																																																																									
Survey ID (initials/sheet no.)	Sex: <input type="checkbox"/> Male <input type="checkbox"/> Female																																																																								
Age	<input type="checkbox"/> 18-24 years; <input type="checkbox"/> 25-35years; <input type="checkbox"/> 36-45 years; <input type="checkbox"/> 46-59 years; <input type="checkbox"/> 60 years and above																																																																								
Education	<input type="checkbox"/> None <input type="checkbox"/> Basic <input type="checkbox"/> Secondary <input type="checkbox"/> Tertiary																																																																								
Marital status	<input type="checkbox"/> Never married <input type="checkbox"/> Married <input type="checkbox"/> Separated <input type="checkbox"/> Widowed																																																																								
Occupation	<input type="checkbox"/> Student <input type="checkbox"/> Self-employed <input type="checkbox"/> Private employee <input type="checkbox"/> Government employee <input type="checkbox"/> Unemployed																																																																								
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2	How long have you stayed in Accra? <input type="checkbox"/> Below 5 years; <input type="checkbox"/> 5-10 years; <input type="checkbox"/> 11-20 years; <input type="checkbox"/> above 20 years																																																																								
3	Which of the following best describe the house you live in. <input type="checkbox"/> Personally Owned <input type="checkbox"/> family owned <input type="checkbox"/> Renting If rented, how much do you pay per month GH¢.....																																																																								
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		Access to public transport.	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
		Proximity to city center	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
		Availability of green or recreational parks	1 <input type="checkbox"/>	2 <input type="checkbox"/>	3 <input type="checkbox"/>	4 <input type="checkbox"/>	5 <input type="checkbox"/>
		Others (please specify).....					
5	How severe are the following climate related phenomena in your community?	Least severe	Most severe				
		1	2	3	4	5	
		Flooding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Unseasonal/heavy rains	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Hotter weather condition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Others (please specify).....					
6	To what extent do you think these climate change phenomena are likely to threaten the following dimensions of your life or your community?	Very unlikely	Very likely				
		1	2	3	4	5	
		Physical health/life	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Physical assets (e.g. buildings, roads, electricity lines etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Job and/or income	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Food production and prices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Others (please specify).....					
Section 2: Transport							
7	Which part of Accra do you work/school?						
8	How long does it take you to get to work/school? (minutes)						
9	On average, how much do you spend on transport a day to work/school?						
10	Which of the following modes of mobility do you mostly use to access the following facilities from your house?	Market	Hospital	Shops	Place of work/school	Recreation	Place of worship
		Private cars	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Taxi	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Mini buses (trotro)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Public buses (gov't)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Motorcycle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Bicycle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Train	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Uber	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Walking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	How do you evaluate mini buses (trotro) in Accra?	Very poor	Very good				
		1	2	3	4	5	
		Accessibility	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		comfort/convenience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Affordability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Frequency (time)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

		Safety	1	2	3	4	5	
		Others (please specify).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
12	To what extent do you agree that transportation cost in Accra is increasing?	Strongly disagree	1	2	3	4	5	Strongly agree
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13	How significantly do you think these factors contribute to increase in transport cost in Accra?	Least significant	1	2	3	4	5	Very significant
		Increase in global fuel prices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Cedi depreciation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Poor governance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Others.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14	Do you use a bicycle?	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>			
15	If NO , how important are the following factors to why you don't use a bicycle?	Least important	1	2	3	4	5	Very important
		It is not safe to bike in Accra	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		My family/friends will not approve of it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		I cannot afford it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		The weather is not conducive for riding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		There are no bicycle lanes in Accra.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Others.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16	Do you know about Uber in Accra?	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>			
17	If Yes , how do you assess Uber in relation to conventional taxis?	Cheaper.....	Yes[]	No []				
		More comfortable/decent.....	Yes[]	No []				
		More accessible.....	Yes[]	No []				
		Safer.....	Yes[]	No []				
		More efficient (time).....	Yes[]	No []				
18	How likely are you to use Uber given the challenges with other means of public transportation (e.g. trotro/taxi)	Least likely	1	2	3	4	5	Most likely
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section 3: Water								
19	How often do you use the following sources of water?	Not at all	1	2	3	4	5	Very often
		Ghana Water Company	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Private borehole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Public borehole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Rainwater harvest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Buy from private suppliers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Section 4: Energy								

20	How significantly did the electricity crisis impact your life?	Least significant 1 2 3 4 5 Very significant <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
21	What alternative source(s) of electricity did you use?	None <input type="checkbox"/> Generator <input type="checkbox"/> Solar <input type="checkbox"/> Biogas <input type="checkbox"/> Others (please specify).....
22	How familiar are you with the following renewable sources of energy?	Not at all 1 2 3 4 5 Very familiar Solar panels <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Biogas <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
23	Do you use or intend to use any of the renewable energies identified in Q22 due to the instability of electricity supply in Ghana?	Solar Panel: Yes <input type="checkbox"/> No <input type="checkbox"/> Biogas: Yes <input type="checkbox"/> No <input type="checkbox"/>
24	If No to any of the options in Q23, how important are the following factors to why you don't use or intend to use renewable energy (i.e. solar and/or biogas)	Least important 1 2 3 4 5 Very important Cost <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Knowledge about how to use the technology <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Availability in market <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Reliability <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Others (please specify).....
Section 5: Green parks / urban agriculture		
25	How often do you visit a green park?	Very often <input type="checkbox"/> Not often..... <input type="checkbox"/> Not at all.... <input type="checkbox"/>
26	If you answered Not often or Not at all to Q25, which of the following best explain your action?	Strongly agree 1 2 3 4 5 Strongly disagree There are no green parks in my community <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> It is not safe to visit a park in my Community <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> I don't see the need to visit a park <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> The parks are unattractive and/ or dirty <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Others (please specify).....
27	Do you have a farm in your backyard/ neighbourhood?	Yes <input type="checkbox"/> No <input type="checkbox"/>
28	How common is backyard/ neighbourhood farming in your community?	Very uncommon 1 2 3 4 5 Very common

		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Section 6: Governance and sense of place

29	Do you have communal labour in your community?	Never <input type="checkbox"/> Not often <input type="checkbox"/> how many times a year?..... Very often <input type="checkbox"/> how many times a year?.....																																																																								
30	How important is communal labour to you? And what is the reason for your choice?	Very important <input type="checkbox"/> Reason Important <input type="checkbox"/> Don't know <input type="checkbox"/> Less important <input type="checkbox"/> Not important <input type="checkbox"/>																																																																								
31	How significantly did the following factors influence your voting decision in the 2016 election?	<table border="0"> <thead> <tr> <th></th> <th>Least significant</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>Very significant</th> </tr> </thead> <tbody> <tr> <td>Political affiliation</td> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Employment</td> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Health</td> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Education</td> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Energy crisis</td> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Waste in Accra</td> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Fuel price increase</td> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td colspan="8">Others (please specify).....</td> </tr> </tbody> </table>		Least significant	1	2	3	4	5	Very significant	Political affiliation		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Employment		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Health		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Education		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Energy crisis		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Waste in Accra		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fuel price increase		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Others (please specify).....							
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Others (please specify).....																																																																										

Section 7: Waste / environmental stewardship

32	How do you assess the environmental conditions in Accra?	Very dirty <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> Very clean
33	How do you dispose of your waste?	Community landfill <input type="checkbox"/> Private waste collector..... <input type="checkbox"/> Name..... Government waste collector.. <input type="checkbox"/> Burning..... <input type="checkbox"/> Others (please specify).....
34	Do you know (or have you heard) about waste segregation?	Yes []; No []
35	If No , waste segregation is the separation of biodegradable waste from non-biodegradable waste to facilitate waste recycling. How likely are you and your household to adopt waste segregation?	Least likely <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> Very likely

Section 8: informal education/ media

36	What are your 5 most favourite programs on radio and TV?	Radio: 1.....2..... 3.....4.....5..... TV: 1.....2..... 3.....4.....5.....
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Thank you for your time!!

Appendix 5: Interview guide (Accra, Ghana)

Key sectors	Interview questionnaire guide
1. Land-use planning	<ul style="list-style-type: none"> a) How has Accra's land-use changed in space and time? b) What are the key drivers of this change? c) How does this change impact the sustainable growth of the city? d) Does the city have a sustainable development plan? What are the priorities of this plan and what are the main barriers to their implementation? e) How do you assess Accra in the light of the following concepts: transit-oriented development (TOD); mixed-use development; compact development; biophilic development? f) What are the opportunities and barriers to promoting these concepts in Accra?
2. Transport	<ul style="list-style-type: none"> a) How do you assess the efficiency (frequency, cost, comfort, accessibility) of Accra's public transit system? b) What are the key challenges and opportunities for improvement? c) How do you assess active modes of transport (walking and bicycling) in Accra? <ul style="list-style-type: none"> i. What are the challenges to and potential of these modes of transport?
3. Energy	<ul style="list-style-type: none"> a) Ghana has experienced recurrent energy crisis in the last two decades. What are the main drivers of this crisis, and what opportunities are available to address them? b) How do you assess the potential of renewable energy (especially solar and biogas) as alternative source of power in Accra? c) What are the main barriers to their mainstream adoption (e.g. policy, economic, social, cultural, technical etc.)? d) How may these barriers be overcome?
4. Building	<ul style="list-style-type: none"> a) How has the materiality of the building industry changed over time? b) What are the implications of this change for Accra's sustainable development? c) How do existing policies promote or ensure the sustainable construction of buildings in Accra? d) How relevant is the green building concept to the building industry in Accra? <ul style="list-style-type: none"> i. How may this concept be promoted in policy and practice?
5. Waste	<ul style="list-style-type: none"> a) What are the main challenges associated with waste management in Accra? b) What role may government, civil society, and the private sector etc. play to address these challenges? c) What are the potentials of and challenges to waste segregation and recycling in Accra? d) What sustainable solutions are appropriate for addressing Accra's waste management problems?
6. Water	<ul style="list-style-type: none"> a) Accra has experienced perennial water supply crisis for several decades. What are the key drivers of this crisis and how have they been addressed over the years? b) There are many devastating floods in Accra every year. What are the main causes of these floods, and how may stormwater be re-envisioned as a resource?

-
- c) How do you assess the practice of rainwater harvesting in Accra?
 i. How may this practice be enhanced at the community and household levels?
-

Note: The questions above were used as a guide in interviews conducted with various stakeholders (policy makers, practitioners, civil society groups, private sector, researchers, and local government officials etc.) in different sectors in Accra (see appendix 6). Follow-up questions were asked where necessary.

Appendix 6: Interview participants (Accra, Ghana)

Participant's code	Institutions of interview participants
01	Planning officer- Accra Metropolitan Assembly
02	Resilience Officer- Accra Metropolitan Assembly
03	CEO- Greater Accra Passenger Transport Executive
04	Monitoring Officer- Greater Accra Passenger Transport Executive
05	Director- Ghana Green Building Council
06	Planning Professional- The Consortium
07	Regional Officer- Ghana Education Service
08	Planning Professional- Ghana Institute of Planners
09	Executive Secretary- Ghana Real Estate Development Association
10	Staff- International Finance Corporation, World Bank Group
11	Secretary- Cooperative Union
12	Staff- Metro Mass Transit
13	National Statistician- Ministry of Transport
14	Secretary- Progressive Transport Owners' Association
15	Staff- Uber Ghana
16	Administrator- Umawa Solar Company
17	Research Official- Zoomlion Ghana Limited
18	CEO- Jekora Ventures
19	Planning professional- Kwame Nkrumah University of Science and Technology
20	Staff- Town and Country Planning, Accra
21	Director- 'IMANI' Center for Policy and Education
22	Researcher- Ghana Atomic Energy
23	Secretary- Ghana Institute of Architects
24	Regional Statistician- Ghana Judicial Service
25	Judge- Accra Lands Court

Appendix 7: Strategic plans for water resource management

No.	Strategic area	Policy measures
1	Integrated water resource management	<ul style="list-style-type: none"> • Adopt water resources planning as a cross-cutting basic component of national economic planning. • Ensure water resources planning to be made with due recognition of “environmental flow” requirements. • Adopt sustainable practices that avoid damage to critical natural capital and irreversible ecological processes.
2	Access to water	<ul style="list-style-type: none"> • Increase the stake and clearly define the role of the formal and informal private sector in the provision of water and sanitation in urban and rural communities and ensure the facilitative role of Government agencies. • Improve efficiency in production and distribution taking into account the poor and vulnerable.
3	Water for food security	<ul style="list-style-type: none"> • Support the establishment of micro-irrigation and valley bottom irrigation schemes among rural communities with the assistance of district assemblies. • Promote partnership between the public and the private sector in the provision of large commercial irrigation infrastructure taking into consideration effects on economy, culture, environment and health. • Encourage the efficient use of fertilizers to reduce pollution of water bodies and ensure conservation of water.
4	Water for non-consumptive use	<ul style="list-style-type: none"> • Ensure availability of water for hydropower generation, various industrial and commercial uses, mining operations, water transport and recreational purposes. • Require industries, including mining operations, to develop and implement environmental management systems which take into account the impact of industries on the country’s water resources.
5	Financing	<ul style="list-style-type: none"> • Permit the application of cost sharing with vulnerable communities to cover capital costs. • Institute appropriate water charges, e.g. water use fees, with the dual purpose of providing a tool for regulating water use; and the means of defraying the costs incurred in maintaining an efficient system.
6	Climate variability and change	<ul style="list-style-type: none"> • Apply appropriate technologies to provide the necessary information for detection and early warning systems for floods and drought. • Establish and enforce appropriate buffer zones along river banks including measures to compensate for loss of lands. • Ensure that land-use planning/building regulations are adequate and enforced in respect of waterways and flood-prone areas.

		<ul style="list-style-type: none"> • Ensure rainwater harvesting techniques are incorporated into the building code and enforced.
7	Capacity building and public awareness creation	<ul style="list-style-type: none"> • Adequately empower and equip water management institutions at the local government level with appropriate tools and sustainable resources to effectively undertake their functions. • Ensure public awareness is propagated through a network of major stakeholders, including NGOs and traditional self-help organisations
8	Good governance	<ul style="list-style-type: none"> • Deepen democratisation of society, through transparent and accountable leadership. • Accelerate the representation of women at all levels and in all spheres of water management activities. • Expand the private sector's role and participation in identification and implementation of water resources development projects.
9	Planning and research	<ul style="list-style-type: none"> • Support water sector institutions to extend the traditional fields of water research. • Support the data collection agencies to provide data and information on land use and water resources. • Encourage interdisciplinary and participatory research that recognises the need for a link between technology and communities.
10	International cooperation	<ul style="list-style-type: none"> • Encourage standardisation of data collection and exchange of data and information, and their use with respect to trans-boundary issues. • Encourage the sharing of benefits of water resources of shared basins and aquifers, for example, by extending hydropower, potable water and water transport to the other co-riparian countries, where feasible.

Source: (National Water Policy 2007)

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