Athens Institute for Education and Research
ATINER

ATINER's Conference Paper Series
ECL2017-2366

The Sustainability Nexus: Developing Resilient Communities in Emerging Nations via Clean Energy Access

Ebun Akinsete
Associate Lecturer
Robert Gordon University
UK

Victor Osu
Researcher
Robert Gordon University
UK

ATINER CONFERENCE PAPER SERIES No: ECL2017-2366

An Introduction to ATINER's Conference Paper Series

ATINER started to publish this conference papers series in 2012. It includes only the papers submitted for publication after they were presented at one of the conferences organized by our Institute every year. This paper has been peer reviewed by at least two academic members of ATINER.

Dr. Gregory T. Papanikos
President
Athens Institute for Education and Research

This paper should be cited as follows:

Akinsete, E. & Osu, V. (2017). **"The Sustainability Nexus: Developing Resilient Communities in Emerging Nations via Clean Energy Access",** Athens: ATINER'S Conference Paper Series, No: **ECL2017- 2366.**

Athens Institute for Education and Research
8 Valaoritou Street, Kolonaki, 10671 Athens, Greece
Tel: + 30 210 3634210 Fax: + 30 210 3634209 Email: info@atiner.gr URL: www.atiner.gr
URL Conference Papers Series: www.atiner.gr/papers.htm

ISSN: 2241-2891
16/1/2018

The Sustainability Nexus: Developing Resilient Communities in Emerging Nations via Clean Energy Access

Ebun Akinsete
Associate Lecturer
Robert Gordon University
UK

Victor Osu
Researcher
Robert Gordon University
UK

Abstract

Now more than ever, sustainability is at the forefront of global consciousness. In addition to a landmark climate change agreement, 2015 saw the inauguration of the 'Sustainable Development Goals' which seek to address wide ranging issues from carbon emissions to education, health and social justice. However fundamental to achieving these ambitions is a key catalyst – access to clean energy. This remains a pipe dream for a majority of the world's population, with approximately 1.4 billion people in developing nations living without access to electricity. This has far reaching impacts considering an estimated 1.3 million deaths per annum in developing nations are attributed to complications arising from pollutant exposure due to the use of inefficient biomass sources. This paper explores clean energy access as a catalytic point of entry to developing resilient and sustainable communities in emerging nations. The research outlines a model for sustainable development at a local level which integrates community participation and energy delivery, while creating a framework for to scaffold policies and interventions at a national level. The paper is based on ongoing research into the implementation of real-world projects in Nigeria, and examines two case studies from both urban and rural parts of the country.

Keywords: Sustainability, Renewable Energy, Community Participation, Energy Transition, Developing Nations

Acknowledgments: This work has been supported in part by the European Communities 7th Framework Programme Funding under Grant agreement no. 603629-ENV-2013-6.2.1-Globaqua

Introduction

It is widely acknowledged that sustainable energy access has a significant impact on quality of life. Access to energy and the associated anthropogenic activities (primarily fossil fuel production and use) has led to global debate in relation to climate change impact, with such activities being viewed as responsible for the continuous and rapid deterioration in the quality of the environment (Kern and Rogge 2016). In addition to environmental impacts, energy access has considerable economic and social impacts, and is a core driver for economic growth, poverty alleviation, and provision of social services such as better education and healthcare. In essence sustainable energy access could be described as a nexus point for sustainable development within a given community.

This insight into the interdependence between access to energy and sustainable development has made the drive for improved energy access a global priority. The United Nation's Sustainable Development Goals (SDGs) launched in 2015, seek to address wide-ranging energy challenges from access to energy to carbon emissions reduction (United Nations, 2016). In addition to the SDGs, 2015 also saw the inauguration of an unprecedented Climate Change Accord where 195 countries met in Paris and committed to limit global warming to well below 2˚C above pre-industrial levels and to pursue efforts to keep it to 1.5°C. This agreement provides the context for a profound transformation of global energy systems, and consequently a transformation of transportation, industrial processes and day to day lives over the next few decades.

A distinctive feature has been on the persistent debate on global energy systems, has been the transition to clean form of energy access, argued by analyst as one of the key solutions that has a strong pedigree to address climate change impact (UNDP, 2015). However, this paper is concerned less with refining normative arguments than with examining how such transition can occur, specifically in developing economies. This leads to important paradigm shift in how clean energy development ought to be viewed; not merely as a means to mitigate climate change and reduce environmental impacts, but also as a route for transforming systems of energy provision in developing nations.

Despite its well established importance, the state of energy access in developing economies such as those in Africa, South East Asia and Latin America is in crisis. There are an estimated 1.4 billion people living without electricity in the developing world; a staggering 87% of which reside in rural off-grid communities (UNDP, 2011). Furthermore, approximately 1.3 million annual deaths (predominantly women and children) are attributed to pollutant exposure from cooking and heating with inefficient biomass sources (UNDP-GEF, 2012). The key challenge facing policy makers and other stakeholders is how to extend access to energy in these areas, both in theory and practice. This has led to the development of a new era of energy reform where energy policies and firm political commitment create an enabling environment designed to facilitate innovative delivery models for sustainable energy access – especially in developing economies.

At present, contemporary governance mechanisms framed to facilitate access to clean energy are largely inappropriately designed with less attention to the wider scale of the energy challenges being addressed (Cowell et al., 2016). This is also pertinent for developing economies where a distinctive design pattern of its governance mechanisms towards facilitating sustainable forms of energy development has given rise to the low marginal adoption of clean energy options, with little insight into casual relationship between the transition process and the complex display of actions undertaken by key actors (Akinsete, Osu and Kruijsen, 2017). Thus, the question guiding this paper is *how and via what transition processes might clean energy access serve as a catalytic point of entry towards developing resilient and sustainable communities in developing nations?*

It is vital to ask this question in developing countries where clean energy developments have been a marginal feature of energy provision. Nigeria is a useful case in this respect, particularly given the intermittent nature of power supply from the national grid; a national grid which does not extend to most rural and remote regions of the country. Nationally, only approximately 46% for the country's population has access to the national grid, thereby posing a significant limitation to socio-economic development. Though, emerging trends suggest an ongoing transition within the energy sector in Nigeria (FMOP 2015a). This is underpinned by supportive statements about the potential of clean energy sources and the last decade have seen a proliferation of small-scale clean energy technologies (CETs) (FMOP 2015b; Osunmuyiwaa and Kalfagianni, 2016). Two interesting factors appear to be propagating this transition (Osunmuyiwaa and Kalfagianni, 2016): first, Nigeria's dominant energy system which is heavily reliant on fossil fuels has been ineffective towards meeting the inadequacy of access to energy over the years, triggering demand for alternative sources of energy for electricity generation. Secondly, the shift towards the adoption of clean energy sources such as renewable energy is not mainly driven by the Nigerian government but by the wider global drivers in response to the transition to low carbon economy.

Forging more sustainable patterns of development is a fundamentally complex task, in that broader patterns of change are shaped by actions at multiple sites and scales (Cowell et al., 2015). Strategic targets such as the SDGs and Sustainable Energy For All (SE4All) are being utilised as a roadmap by signatory nations in order to foster sustainable energy access and delivery in their respective countries. That notwithstanding, transitioning towards these sustainable patterns of development requires the simultaneous alignment of multiple overlapping actions, and crucially a framework within which such a transition can be scoped (Bride at al., 2013).

This paper therefore seeks *to understand how this essentially emerging transition configures the opportunities for 'decentralized' clean energy access delivery, while creating a framework to scaffold policies and interventions at various scales (national to local) which at their core aim to drive sustainable development.* The emphasis on decentralization picks up on the dominant mode of clean energy access development, which exhibits a continual 'lock-in' to centralization. This is also pertinent for Nigeria where the contemporary clean

energy development path in has seen increased land-use planning arrangement that systematically favours large scale centralized systems despite the ineffectual nature of the transmission grid: leading to limited proliferation of CETs (Akinsete, Osu and Kruijsen 2017).

As such this paper will examine the development and potential of a framework that seeks to place communities at the heart of the clean energy transition. Our framework for undertaking this research draws on concepts from transition theory, which is of the notion that a transition process requires the building up of a broad network of diverse actors that share the vision towards creating the enabling environment for an innovation development (Markard et al., 2012). A central view here is the persistence of the structural and institutional (governance) mechanisms within the transition systems which may support in promoting the development pathways in relation to alignment of actions towards clean energy sources, as well as the 'dis-alignment' of actions on how fossil fuel energy sources - oil and gas – may also persist (Geels, 2012). Thus, the structural and institutional mechanisms being put in place allows for an appreciation of the complexity of change, including the role of different actors in a transition, policy mechanisms, market design and incentives and potential barriers (Strachan et al., 2015).

Generally, transition theory has received increased attention over the last few years due to its relationship to global climate challenges and its various effects on the environment and on resource depletion (Falcone 2014). Despite this, understanding of ongoing transition processes remains limited and approaches have been criticized for lack of insufficient attention to agency and social innovation (Seyfang and Haxeltine, 2012). Furthermore, little attention has been paid to transition theory use in developing economies and there have been calls from research scholars in the transition field to extend its application to developing economies, including the widely used transition management perspective (Markard et al., 2012; Mutoko et al., 2014; Akinsete, Osu and Kruijsen 2017). Transition management aims to steer transition, in particular the socio-technical regime levels of the system, towards desirable social outcomes through engaging with stakeholders at multiple levels. It also includes demonstrating the practicality of the innovation through experimentation, learning and adaptation (Loorbach and Rotmans, 2010).

Against this backdrop, this paper goes on to provide an overview of the theoretical underpinning – transition management approach, outlining contemporary CET development. This is further reviewed with emphasis on developing nations, focusing on Nigeria and its specific challenges. Building on this, the paper contextualizes the issues discussed by employing two separate case studies in Nigeria, considering CET implementation in an urban and rural setting. The paper will then outline a model for sustainable development that integrates community participation and energy delivery while creating a framework to scaffold policies and interventions at a national and local level. Finally, the paper considers the wider implications of the research and contribution to growing literature on transition theory and clean energy access in the context of developing economies.

Transition Management: Concept and Perspectives

Theoretically, classic top-down guidance by government ('the extent to which social change can be effected by government policies') as well as the liberal free market approach ('the extent to which social change can be brought about by market forces') are fast becoming outdated as effective governance mechanisms to generate sustainable solutions at societal level (Scharpf 1994, March and Olson 1995). The inadequacies and problems of such forms of governance are exposed when we consider current government failures in shaping and directing transition processes, especially in developing economies (Hooghe and Marks 2001) and particularly with sustainable goals in mind. This failure is also exacerbated in the light of increased societal complexity and the complex, unstructured nature of policy-making processes (Loorbach, 2007); thus emphasizing the impracticability of classic top-down governance for the wider context of sustainable development. In line with this, many researchers in environmental policy have advocated for new forms of governance to reduce, or better still, eliminate this lack of direction (Hooghe and Marks, 2001).

Indeed, in practice and over the past decades, there appears to be a shift from centralized, authoritarian nation-state towards market-based and decentralized approaches for decision-making. This is partially due to societal developments where the power of central government to make policies and implement these has substantially decreased; increasingly leading to diffuse policy-making structures and processes (Hooghe and Marks; 2001; Loorbach, 2007). The transition management framework tries to utilize bottom-up developments in a more strategic way by coordinating different levels of government and fostering self-organization through new types of interaction and cycles of learning and action.

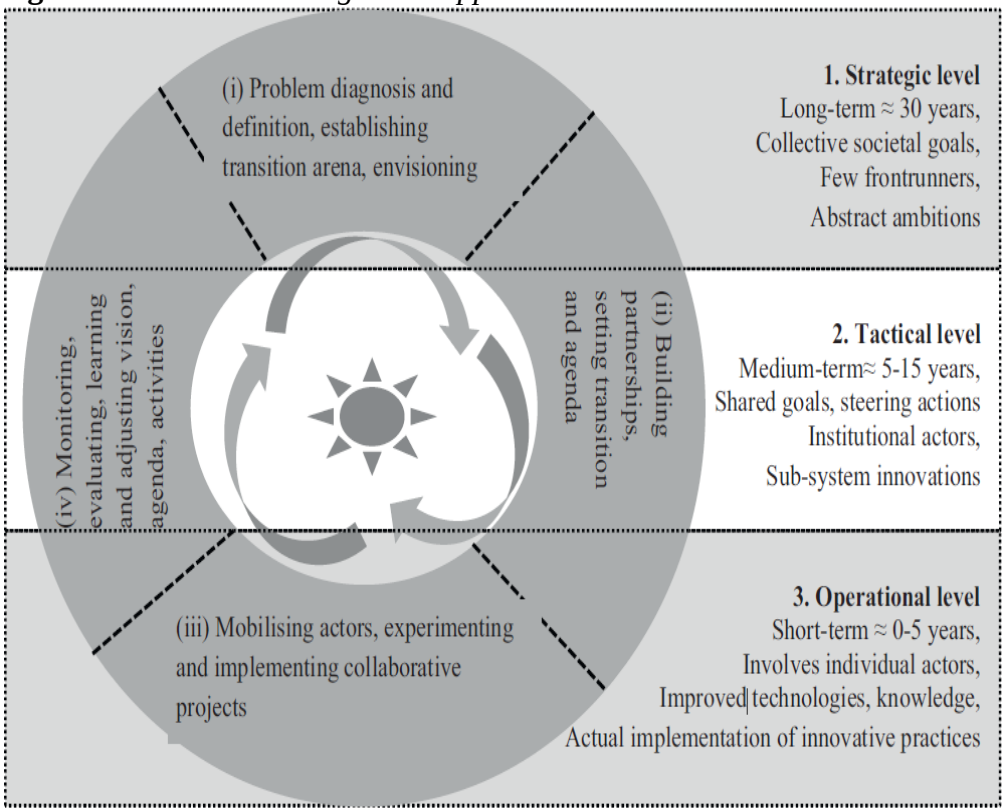
Considering the unsustainable characteristics of existing fossil fuel-based energy systems, which have come under heavy criticism in relation to environmental and social well-being (UNDP, 2015), the present energy concerns may be taken as a starting point for sustainable governance implementation. However, such transitions do not come easily as they involve societal changes along different dimensions or factors including socio-culture, institutions, consumption patterns and preferences, economic regulation and political governance (Rotmans et al., 2001; Loorbach, 2007; Falcone, 2014). Thus, comprehensive information from the integrative assessment of the existing energy systems is crucial in the strategic selection of the most active actors, efficient approaches and diffusion pathways to achieve the desired societal changes (Loorbach, 2007; Mutoko et al., 2014). A further challenge in the implementation of sustainable development is that institutional arrangements are a poor fit to the scale of the problems concerned often attributed to the national or regional level at which problems are addressed (too centralized in this context) (Cowell et al. 2016). It is suggested that there are often unrealistic expectations of the impact of centralized arrangements because the broader governance implications are commonly overlooked. Therefore, there is a need for multi-scale and inter-disciplinary information as well as multi-actor

collaboration in order to develop a coherent institutional arrangement and governance strategies to fit to the scale of the problems concerned – in this case, transitioning to clean energy sources (Mutoko et al., 2014; Loorbach, 2010). Yet in governance terms, research to date on transitions to more sustainable forms of energy has exhibited a strong methodological nationalism (Spath & Rohracher, 2014), with relatively little attention to how systems of energy provision unfold across multiple governance levels and how this in turn affects the scope for change (Cowell et al., 2015). This is an important deficit, as promoting CETs is a complex governance challenge, requiring an alignment of actions—regulatory, market and social—with different socio-spatial dynamics (Van Der Brugge and Rotmans, 2006; Cowell et al., 2016).

The focus of this research is thus, the governance of clean energy and how it is able to contribute towards developing resilient and sustainable communities. The recently developed transition management (TM) concepts provides a multi-level framework as a governance tool for organizing cross-scale and cross-sectoral interactions in order to address such governance challenges while at the same time achieving the required alignment of actions. TM as a management concept contains the main characteristics of new forms of governance involving: actors' network management, interactivity, heterogeneity, multi-level focus and social learning, involving participations from government, societal organizations, companies, knowledge institutes and intermediary organisations. As a result of this participation at various levels, a multi-level network emerges within which different themes are discussed and tackled (Loorbach, 2010; Rotmans and Loorbach 2010).

The TM approach comprises of two key analytical lenses: a descriptive distinction into strategic, tactical and operational innovation spheres and a prescriptive cyclical framework of co-evolving activities that connect these spheres (Loorbach and Rotmans, 2010; Roorda et. al., 2014). The integration of both the descriptive and prescriptive nature of TM is depicted in Figure 1.

Figure 1.*Transition Management Approach Model*



Source: Mutoko et al., 2014

The TM model in Figure 1 was followed in order to assess the prospects for constructing a conceptual scaffold that should guide the development of clean energy transition practice in the context of this study (with particular emphasis on scaling up sustainable energy management for community energy pathways in developing nations). Therefore, to understand this, one must further consider and analysis how clean energy development in Nigeria intersects with the contemporary governance arrangements as well as the wider political landscape.

Framing the Challenge in the Context of Developing Nations

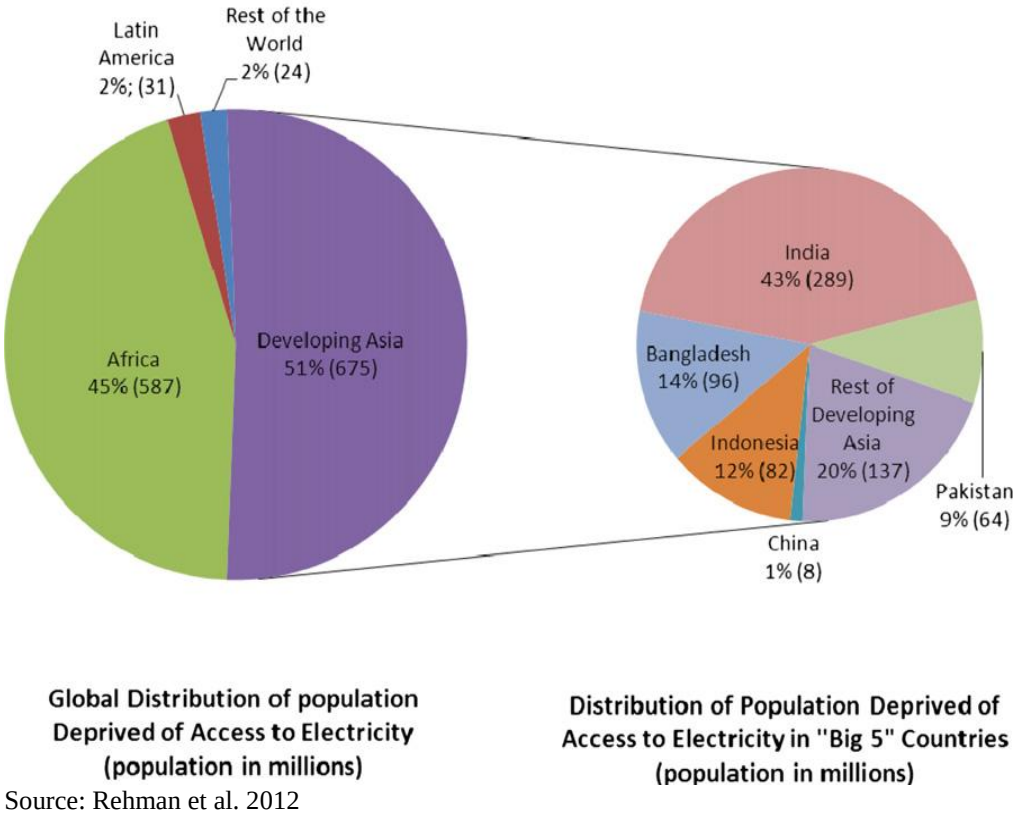
Centralised power generation has been the dominant approach to providing energy access (primarily electrification) in developed countries over the last century; with the advent of improved generation technologies such as large-scale steam turbines, the introduction of transformers and high voltage lines using alternating current. A similar centralised approach has been imitated in many developing countries without consideration of its appropriateness. Centralised electricity generation was seen as a precondition for development, with the delivery of electricity and infrastructure paving the way for economic growth. However, this approach overlooked constraints such as a dispersed population and difficult terrain resulting in high capital and operating costs

associated with the centralised grid, as well as limited potential for load growth (Kirubi et al. 2009). Furthermore, the unsustainability of the current energy supply systems is further exacerbated by issues such as dependency on external suppliers, instability in oil-producing regions, exhaustibility of resources, uncertainties about reserves, high resource prices, air polluting emissions, climate change, and the low purchasing power of a majority of the population within these nations (UNDP, 2007; Loorbach, 2010; UNFCCC, 2011; UNDP-GEF, 2012; Chong and Lam, 2013). Despite the fact that conventional centralised energy supply systems have thus far failed to cater to the considerable demand for energy in rural areas, the majority of current energy policies are focused on grid-based electricity and oil products. Thus, energy issues in urban areas and peri-urban areas tend to receive more attention to the detriment of rural and remote areas.

Given the constraints of centralised energy supply, a shift towards more decentralised systems of energy generation and distribution afford a logical solution to improving energy access. Decentralised energy systems with their 'lean' infrastructure and proximity of generation and demand sites are ideal for energy supply in remote areas where conventional energy systems are not economically viable (Nouni et. al., 2008). Furthermore the adoption of decentralised energy systems assists in mitigation against other issues such as transmission losses (Hande and Rajagopal, 2014). The International Renewable Energy Agency – IRENA (2014) estimate that 60% of the additional generation capacity required to meet the global deficit will be derived from off-grid installations.

On the whole, countries with developing economies in particular, face the challenge of energy access despite all efforts to combat the issue (Ulsrud et al. 2015). As depicted in Figure 2, 51% of the developing Asian continent currently lives without electricity while Africa ranks second with 45%. Latin America has just 3% of its population without access to electricity, and the rest of the world 2%. A number of studies (Mainali, 2012; Rehman *et al*., 2012; Tessema *et al*., 2013) have highlighted the main barriers hindering sustainable energy access in developing economies; these include – ineffective (and over centralised) governance creating unnecessary bureaucracy, anaemic supporting policies, inadequate economic, financial, legal and regulatory frameworks, lack of awareness and capacity development, ineffective stakeholder engagement and finally weak innovation systems (delivery/business models for sustainable energy technologies). These barriers in totality create the lack of an enabling environment for implementation, which in turn discourages much needed investment that is essential to bolster the sector.

Figure 2. *Population without Access to Electricity*



Source: Rehman et al. 2012

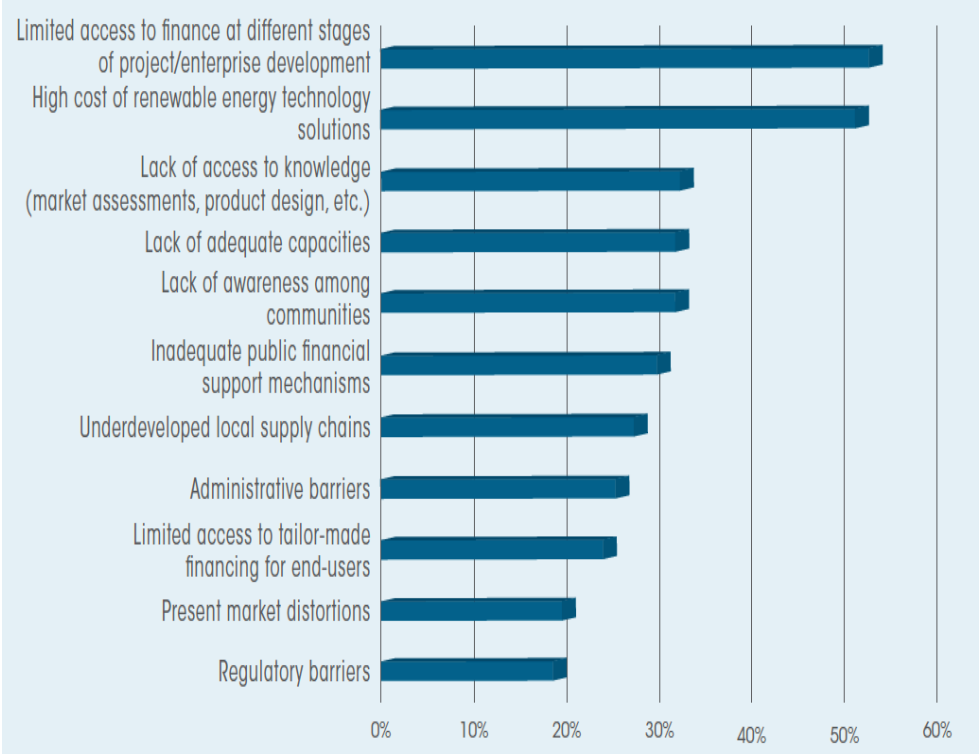
Rural energy access above all remains an uphill task in developing nations, with more than 2.5 billion people in these countries still relying on traditional biomass to meet energy needs such as cooking and heating (Karekezi and Majoro, 2002; Kaygusuz, 2012; Mainali et al., 2014; Surendra et al., 2014). This has a disproportionate impact on women and children, as exposure to indoor air pollution from the burning biomass results in health complications and premature death (Kaygusuz, 2011). The scale of the problem is set to increase with a massive rise in the global energy demand projected over the coming decade by the International Energy Agency – particularly in developing economies where rapid population growth and economic expansion is been witnessed.

The use of renewables as an alternate source of energy generation has been put forward as a more sustainable solution in the drive to improve energy access. This new focus has been described as a move towards the provision of sustainable energy systems (UNEP 1983; IIASA 2012; UNIDO, 2014), underpinned by utilising sustainable energy technologies from renewable energy sources such as solar, wind, bioenergy, and offshore renewable energy. The potential of renewable energy generation to play a catalytic role in the development of decentralised energy systems, particularly in rural and off-grid areas, has not gone unnoticed in developing nations. In Nigeria, national policies in the form of the National Electricity Power Policy (NEPP) of 2002 and the National 'Vision 20:2020' have set targets for renewable energy generation at a country wide level. In addition, parastatals such as the Rural

Electrification Agency which has a specific mandate to cater to energy access in majority off-grid locations are attempting to promote greater private sector participation in rural electrification using renewable energy mini-grid systems in remote communities.

However, notwithstanding the growing optimism and support for fostering sustainable energy access through a renewable energy transition, its widespread adoption has been rather low thereby negating the positive impact of implementing sustainable energy access systems. Even when sustainable energy access systems are designed and implemented, their viability in the context of socio-economic and human development in developing regions like Nigeria is in doubt. IRENA (2014) conducted a study into the main barriers to renewable energy uptake for the purpose of increasing access in off-grid communities (see Figure 3). Not surprisingly, these barriers mirror the key obstacles to delivering effective and sustainable energy access as highlighted earlier in this paper (UNDP, 2007; ECREEE, 2014).

Figure 3. *Barriers to Off-Grid Renewable Energy Uptake Globally*



Source: IRENA, 2014

Consequently, it is clear that fundamental changes are necessary to transition from the current status quo of energy delivery systems towards more appropriate and sustainable energy delivery models which are fit for purpose in the context of developing economies, and can cater to rural off-grid communities just as efficiently as they can to urban and peri-urban settlements.

Grounding the Theory in Practice: Case Studies

In Nigeria, the region in which the study underpinning this research focuses, the national rate of access to electricity is approximately 55%. This figure falls to 26% in rural areas of the country (EIA, 2012; 2013; World Bank, 2015). The country is currently facing a massive generation gap, with things reaching a crisis point in 2015 as national electricity grid generation fell to a low of 2,800MW. This despite the fact the installed capacity of the National grid is already inadequate at 10,000MW (Premium Times, 2015). With national power consumption expected to double over the next 5 years, the Nigerian Federal Government has set its sights on increasing the country's power generation capacity to 40,000MW by 2020 (National Planning Commission, 2009). An annual projected population growth rate of 2.6%, coupled with an economic growth rate of 7% (African Development Bank-UNDP, 2015) means that the country is primed for a massive spike in energy demand. Existing supply systems are struggling to cope with demand and the government has unveiled a raft of policies and commitments geared towards sustainable energy access – particularly in rural areas of the country. On an individual level, many turn to decentralised energy supply in the form of off-grid self-generation in a bid to bridge this energy generation gap; using either fossil fuelled generators or open burning of biomass. While the adverse impacts of the latter have already been highlighted in this paper, the former constitutes a major blight in its own right. In 2012, Nigerians spent approximately $4million on fuelling generator sets (NERC, 2012); a figure which rose to an estimated $17.5million in 2014 (GIZ, 2014). These diesel and petrol powered generators constitute a major sources of greenhouse gas emissions in addition to generating high levels of noise pollution. Furthermore, the these generator sets emit other pollutants such as Sulphur Oxides, Nitrogen Oxides, Lead, Ozone, Benzene, and Arsenic which pose a public health hazard (Komolafe et al, 2014). At national level, there has been a distinct policy shift in favour of decentralised (off-grid and mini-grid) forms of energy generation and distribution.

It is expected that renewable powered decentralised energy systems in the form of green mini-grids (GMGs) will play a pivotal role in the campaign to extend access to rural and remote communities across the nation. Interventions such as 'Operation Light up Rural Nigeria', targeted at bringing electrification to the most remote locales of the country, have been redesigned in consideration of micro-generation from renewable sources under the umbrella of the 'Renewable Energy Micro Utility' (Federal Ministry of Power, 2015a). More recently, the Federal Ministry of Power has taken on an active role in spearheading this process seeking to create an enabling environment for sustainable decentralised energy systems to take root, with emphasis being placed on pulling together various stakeholders and actors in the sector. It is against this backdrop that the case study underpinned by this research is being conducted.

Case Study 1: Off-Grid Rural Community in Bayelsa State

The first case study examined in this paper forms part of ongoing research investigating the viability of a marine renewable energy based system (such as offshore wind and Marine Hydrokinetic sources) as a means of delivering sustainable development in rural communities. The site of the study is located in Bayelsa State, in the southern Niger-Delta region of Nigeria on a latitude of 4.75 (4/45' 0 N) and longitude of 6.08 (6/4' 60 E). Due to the wetland nature of the state's vegetational zone (almost 70% of communities in Bayelsa are situated in the creeks), the primary income generating activity of the local population is fishing on both subsistence and commercial scales. However, it is one of Nigeria's fastest growing states with an almost daily increase in energy demand. Nevertheless, Bayelsa's connection to the national grid did not solve the problem of the growing energy demand within the state as the only means of power supply in the available was through a state-owned gas turbine which was used to power the state capital and its environs, leaving out the rural communities in the creeks. The power generation capacity of the State is about 70MW from three major sources. These include 40MW from the Okilo Gas Turbine power plant, 20MW from Kolo Creek Power Station, and 10MW bulk purchase from the Power Holding Company of (PHCN). However, the Okilo power plant, built in 1988 is obsolete leaving the state with just 30MW of existing generation capacity.

With a majority of the communities in Bayelsa (such as Akassa, Lobia, Ezetu, and Nembe) partially (or in some cases completely) surrounded by water, several of them are rendered inaccessible by road making it exceptionally difficult to transmit electricity to these communities (Ainah and Afa 2013). As a result of the highly imbalanced demo-spatial distribution in the country (with disproportionately high population densities in Nigeria's main towns and cities), the inadequacy or absence of infrastructure and the distances between major load centres, grid extension to some areas is currently not commercially viable; notably in the coastal region situated in the Niger-Delta in areas like Bayelsa State. Thus an increasing number of unelectrified businesses and households in the state are literally left 'in the dark', faced with inferior, more costly options for lighting and power for local service amenities and income generating activities. This lack of access to energy undermines the pace and scope of rural development as it hinders productive and income generating activity. It also detracts from the rural quality of life, and has a negative impact on the welfare of the under-privileged population. Without electricity, the quality of basic social services (where they exist) such as schools and health clinics is seriously diminished. Kerosene lanterns, candles, and battery operated torches are the main sources energy for lighting in these communities, while the main source of electricity is through petrol and diesel generator sets (sometimes operated almost 24 hours a day by those who can afford it) resulting in massive rates pollution and greenhouse gas emission. Due to this, the government of Bayelsa has committed to targeting rural energy access and achieving sustainable

development, via the utilisation of re-newable energy sources in combination with decentralised energy delivery systems.

In developing the scope of the case study, the research team engaged the Bayelsa State Government in several rounds of consultations held between June 2013 and July 2014, on the basis of the underlying theoretical model for delivering community-based renewable energy systems – thereby increasing clean energy access and promoting sustainable development. As a result, the state government made the decision to exploit its coastal environment towards a potential transition to offshore renewable energy forms in a bid to provide electricity to one of the coastal community in the State - Akasa community - as part of Bayelsa's sustainable energy strategy. The consultation process was undertaken by a team from Robert Gordon University, supported by a group of Nigerian associates, GEN Sustainable Solutions and E-Zoned Oil and Gas Ltd. The level and depth of consultation and local involvement in developing the case study was crucial as one of the concepts in which the approach is grounded is participatory local stakeholder collaboration under the stakeholder engagement element of the model. Consequently, the project seeks to catalyse access to energy [SE4ALL Objective 1: Energy Access] by addressing the supporting policies, coordinated stakeholder efforts and an enabling environment in order to facilitate distributed mini-grid development powered by marine renewable energy [SE4ALL Objective 3: Renewable Energy] (United Nations, 2012). The project will address the fundamental challenges of transforming the energy landscape via the intervention of the proposed solution, that is the combination of new sustainable energy delivery model with emphasis on providing clean, reliable, and affordable energy to 'bottom-of-the-pyramid' consumers who will likely never be served by conventional centralised electricity grids.

Focusing on the Akasa community, initial data collection and analysis has been conducted utilising both qualitative and quantitative methods. Technical viability of the renewable energy resource at the selected location has commenced with a preliminary resource assessment based on theoretical results. However, a more detailed resource assessment will be conducted during the main project, in a bid to:

(1) Understand the site for installation: water depth, debris, river bed, river width area allowed to extract from.
(2) Evaluate the installed cost: including the installation of the unit, existing infrastructure available for installation which has effect on the unit size as the project aims for multiple units
(3) Identify possible decentralised electrical evacuation mode: such as cabling from the offshore energy conversion unit to shore and onto the sub station

Furthermore extensive qualitative data has been collected utilising a synthesis of data collection methods including interviews and other participatory methods such as brainstorming, focus group sessions and workshops. The data

collection involved in-depth engagement with stakeholders from the Nigerian government (including relevant departments, key decision makers within the Ministry Of Energy in Bayelsa State, the Niger Delta Development Commission, Federal Ministries of Power and Environment, the Energy Commission of Nigeria, the Department for International Development, and the Rural Electrification Agency), regional agencies such as ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), and academic institutes (the Niger Delta University, the Petroleum Training Institute and the Nigeria Institute of Oceanography and Marine Research). The preliminary findings of the qualitative analysis have provided invaluable insights into the current state of affairs in sustainable energy development activities in West Africa, Nigeria and Bayelsa State, elements of which have contributed to the development of the model discussed earlier in this paper.

As the study is still ongoing, the next phase of the case study will involve engaging a wider stakeholders, including Akassa community to conduct a baseline assessment of the community taking into consideration socio-economic data like demographics and income generating activity, as well as current energy demand and usage patterns. This next phase will also see the development of a transition team and transition arena in order to scope the desired changes and assess the preconditions required for applying the Comm-SES model in the Akassa community. Eventually the project will see the implementation of a fully functional off-grid renewable energy system, powered by an appropriate offshore renewable energy technology (based on the outcomes of a detailed resource mapping and technological feasibility study).

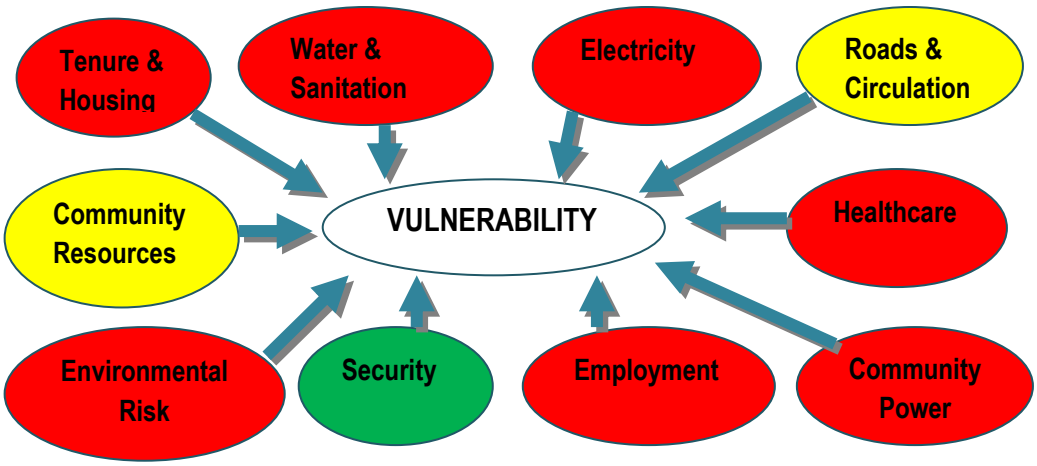
Case Study 2: Off-Grid Urban Community in Lagos State

This case study focuses on Makoko, an informal settlement located in the city of Lagos. Lagos is Nigeria's most populous city with a population of over 18million inhabitants (Lagos State Government, 2012), approximately 13% of which live in informal settlements (Morakinyo *et al*., 2012). Despite this, the city's population is still set to rise to a staggering 25million by 2030 (United Nations, 2014) thereby placing additional strain on already inadequate services, energy provision included. A major contributor to the population hike, is extensive rural-urban migration in pursuit of economic opportunity in 'the big city'. More often than not, the first port of call for most of these migrants are informal settlements such as Makoko, where day to day life is a struggle but rent is cheap. In Makoko, like most parts of Sub-Saharan Africa, approximately 40% of the population lives below the poverty line (Hoelzel and Akinsete, 2015). It is one of the largest low-income communities in Lagos and is located along the shores of the Lagos Lagoon. It has rich history in aquatic trading and has co-existed harmoniously with neighboring communities over the years. Its economic structure revolves around the use of water predominantly for fishing, boat making and craft. The community relies on basic traditional technology in the processing and production of its goods contributing to slow economic growth and prosperity. Isolated pockets within the city, communities such as

Makoko are essentially off-grid, with little or no recourse to public services including healthcare, education, sanitation and electricity.

In 2013, a community based project led by the Lagos-based NGO the Social and Economic Rights Action Centre (SERAC) brought together a multi-disciplinary team in order to work community to develop a 'Sustainable Regeneration Plan' which would seek to address the complex challenges facing the community. As a first step the project conducted a needs assessment in order to prioritise local challenges (see figure 4). The resultant analysis simply made the known evident, in that the community faced a number of interconnected social, environmental and economic challenges - electricity supply is obtained from dangerous unauthorised cable connections and low capacity generators. Existing healthcare facilities are grossly overstretched with each centre catering to approximately 5,000 residents, and unemployment remains above the average. Furthermore, with next to no facilities provided for the disposal of organic and solid waste, water ways are clogged with litter and raw sewage is currently deposited directly into the open water which further exacerbates health related issues An additional dimension to these issues is the disproportionate impact they have on women and children within the community. What was equally evident was that these challenges would require complex compound solutions that address several of these issues simultaneously (Akinsete et al, 2014).

Figure 4. *Vulnerability Analysis for Makoko/Iwaya Waterfront Community*



Source: Makoko/Iwaya Waterfront Community, 2014

Energy access was soon identified as a nexus which marked the convergence of a number of the priority issues (water & sanitation, environmental risk, employment, electricity, and healthcare) – and thus the confluence of their solutions. The project sought to identify and develop a mode of sustainable energy delivery, that was particularly suited to the local context. It would need to be decentralized given the local constraints, and it would need to provide a compound solution – targeting multiple issue simultaneously. Thus the Neighbourhood Hotspot was born, with the intention of tackling some of the most acute risk factors facing Makoko such as waste, energy, employment and

healthcare and turning one of these challenges in particular (waste) into a source of opportunity (Hoelzel and Akinsete, 2015).

The Neighbourhood Hotspot is a community structure, which principally functions as a biogas plant by utilizing the organic waste produced within the community as feed. Thus it fundamentally addresses two of the community's core issues (waste management and energy provision). In addition, the structure also provides a shared community space with the potential to houses a wide range of community facilities and services, including workshop facilities, cooking facilities, doctor's rooms, urban gardens and reading rooms. The structure is therefore a business incubator, a place for social exchange, a knowledge centre for renewable energy production, waste management, urban gardening, and water harvesting at the same time. The innovative approach to decentralized energy provision with emphasis on wider societal benefits, coupled with the framing of a waste-to-value philosophy, within a flexible, robust, easy to maintain, affordable, and low-technology infrastructure, which additionally creates jobs and delivers much needed services earned the project a place at both the 2014 International Architecture Biennale Rotterdam as well as the 2014 Venice Biennale (Akinsete et al, 2014). Furthermore, the wider Sustainable Development Plan earned the project an honourable mention as a 2014 Buckminster Fuller Prize Finalist.

Both these case studies illustrate the potential for decentralized energy systems to not only provide much need access to energy within off-grid communities (be they urban or rural), but also highlights the fact that as a 'nexus point' energy access can pave a pathway for wider sustainable development within the community. Focus on energy access in off-grid communities is a key overnment priority in Nigeria, with the federal government has set out a national target of 75% electricity access by 2020, working towards 100% access by 2040 (Federal Ministry of Power, 2015). The draft Rural Electrification Strategy and Implementation Plan – RESIP (2014) puts the scale of this task into perspective, siting the fact that between the years 2015 and 2020, access will need to be extended to 471,000 rural households per annum; with a further 513,000 rural households per annum requiring access between 2020 and 2040 if the stated targets are to be met. A key obstacle to achieving Nigeria's energy targets is the fact that policy frameworks promoting energy access in areas where decentralised sustainable energy systems have greater market opportunities to be developed (such as remote regions in emerging economies) remain weak or non-existent. This is in part due to the lack of existing models which can successfully ground such policy frameworks in the context of local energy needs, and crucially clean energy opportunities.

The Comm-SES Model for Local Energy Delivery

In a bid to address the issues identified as key barriers to energy access in rural and off-grid areas within emerging nations, the concept espoused by this research aims to bring about the fundamental changes required by outlining a model for sustainable energy delivery in developing countries – Community-driven Sustainable Energy Systems (Comm-SES).

While the improved energy access seeks to drive development in host communities, the process of modernisation in the industrialised world has produced so called 'symptoms of unsustainability' as a side-effect of economic development, technological progress and the continued quest for increased wealth. The manifestation of this unsustainability both on a global and local scale are visible in the over-consumption of natural resources, loss of biodiversity, flooding, poor air and water quality, starvation, social and economic inequalities, inadequate access to services, and in general a negative impact on people's lives (Loorbach, 2010).

Therefore at the heart of the model is the core principle of promoting sustainable development. Sustainability in this context is seen as encompassing not just the environmental factors that go along with development but also issues of social empowerment and economic opportunity. Adequate access to energy is viewed as a critical element in driving sustainable community development, particularly in rural areas. The model is based on four key elements:

- **Decentralised Energy Systems**
- **Renewable Energy**
- **Local Context**
- meaningful **Stakeholder Engagement** at all levels

The concept of ***Decentralised Energy Systems*** is not new as discussed in previous sections of this paper and in many cases has been adopted in various guises over the years. Decentralised energy systems lend themselves well to energy provision in rural off-grid areas, and offer a number advantages including:

- mitigation of costs associated with grid connection in financially unviable locations
- enhanced energy security
- reduction of influence due to vested interests of big business
- driving technological innovation and real competition
- incubation of technologies which are safe and appropriate for the given context
- saving consumers money in the longer term
- increasing opportunities for local leadership in the energy sector

(Greenpeace 2005)

Considering these advantages, a rise in the utilisation of decentralised energy systems is being observed. Furthermore, it is projected that if decentralised

energy strategies continue to be adopted globally at current rates, savings are estimated to reach 2.7trillion dollars by 2030 (World Alliance for Decentralized Energy, 2005; Kaundinya *et. al.,* 2009). Decentralised energy systems form the one half of the technological component of the model, and are the cornerstone around which the rest of the model is constructed.

The next element in the scaffolding of the model, and the second half of the technological component, is the incorporation of ***Renewable Energy*** sources. This sees the magnification of the aforementioned benefits of decentralised energy systems by coupling them with potential benefits to be gained by utilising renewable energy. A combination of factors including the increasing global energy demand, fluctuations in the price of fossil fuels, the declining cost of renewable energy technologies and various government policies, have seen a steady increase in the uptake of renewable energy (IPCCC, 2012). The adoption of renewable energy to power decentralised energy systems will serve to make strides in addressing issues associated with environmental sustainability by slashing CO2 and other pollutant emissions as well as consequent mitigation of climate change impacts and increasing public involvement and awareness on the issue of climate change. Furthermore, the adoption of renewable energy has other socio-economic impacts like benefits with respect to health concerns associated with air pollution, increased levels of energy security, cost savings in comparison to non-renewable sources (particular in remote off-grid communities), as well as fostering competition and in turn further improvement of renewable technologies (Greenpeace 2005; IPCCC, 2012; IRENA, 2014). An important aspect of the model is flexibility in the selection of the form of renewable energy to be utilised. The model supports the incorporation of one or more of the various renewable energy technologies available (solar, wind, hydro, geothermal, marine etc.).

The choice of renewable energy technology is determined by the ***Local Context***. Due attention must be given to the context in which the energy system is to be deployed, in order to assess what form of renewable energy technology is most appropriate. This includes consideration of physical elements such as what resources are locally available, location and terrain of the site. In addition, the local context also encompasses social and economic elements such as the cost of the technology, affordability for the end users, as well as the community's energy needs.

Scoping of the local context is heavily contingent on effective and meaningful ***Stakeholder Engagement*** at all levels. This refers to informing, consulting, and actively involving the different groups of stakeholders (producers, users and facilitators) including government agencies, private sector investors, technology providers, development agencies, NGOs, and most importantly members of the local community. The stakeholder engagement process is underpinned by two key methodologies in the forms of 'Transition Management' and 'Neighbourhood Management'.

Transition Management is a participatory methodology designed to facilitate sustainable change. The approach can be applied to a variety of sectors with the aim of involving multiple groups of stakeholders in creating shifts in practices

and mind-sets in a bid to achieve sustainable transformations on various scales; from regions, cities and neighbourhoods, to specific public services such as healthcare, as well as socio-technological systems such as energy, water and mobility (Loorbach and Rotmans, 2006; Roorda *et al*, 2012).

Transition Management is based on six principles to facilitate sustainable change:

- Gaining insight into the system
- Driving innovation in small but radical steps
- Creating room for diversity and flexibility
- Co-creation
- Facilitating change agents
- Social and institutional learning

(Roorda *et. al.*, 2014)

The main focus of the process is facilitating a dialogue between a wide range of relevant actors brought together under a structured framework. A core group of stakeholders (frontrunners) work in collaboration with the project team engaging in a series of workshops (transition arenas) overseen by a facilitator. These workshops provide a platform to develop clear visions, ideas and specific actions towards realising the goals of the project.

The transition process can be broken down into five main stages as shown in the table below.

Table 1. *Overview of Transition Management Process*

Stage	Key Activities	Output	Actors
1. Preparation & Exploration	• Transition Team formation • Process design • System analysis • Actor analysis	• Transition Team • Process design • Insight into major issues and tensions of the system • Shortlist of relevant actors	• Comm-SES Project Team
2. Problem structuring & Envisioning	• Transition Arena formation • Participatory problem structuring • Selection of key priorities • Participatory vision building	• Frontrunner network • Shared problem perceptions and change-topics • Joint vision • Guiding principles	• Comm-SES Project Team • Frontrunners
3. Backcasting, Pathways & Agenda Building	• Participatory backcasting • Definition of transition paths • Prioritisation of transition paths • Formulation of agenda and specific actions	• Transition paths • Transition experiments • Action plan / transition agenda • Change agents network	• Comm-SES Project Team • Frontrunners

4. Experimenting & Implementing	• Broadening the network • Working group formation • Development of transition experiments & implementation within current policy and projects • Dissemination of vision, pathways and agenda	• Transition narrative • Activities for broader public awareness and involvement. • Transition experiment portfolio • Launch Event • Learning & implementation	• Comm-SES Project Team • Frontrunners • General Public
5. Monitoring & Evaluation **(Ongoing)**	• Participatory evaluation of method and content (process) • Reflection on vision & agenda • Monitoring interviews	• Lessons for local governance • Lessons for National governance • Energy Transition monitoring framework	• Comm-SES Project Team • Frontrunners

Adapted from: Akinsete, 2013; Roorda *et. al.*, 2014

The Transition Management process is particularly well suited to addressing the core issues raised over the lack of cross-sectoral cooperation and the inadequacies of existing policies. While a raft of guidelines, targets and policies have been put forward by various governments, and international organisations (United Nations, 2012; IRENA 2013; UNIDO 2014) their objectives in many cases do not take into account the complex societal contexts (political choices, multi-actor issues, organisational, institutional and network designs) in which they are meant to be implemented. This has given rise to of some the previously discussed barriers such as poor governance, clumsy policies, ineffective regulations and frameworks, inadequate access to finance, and lack of awareness – all of which are disproportionately prevalent within emerging economies (UNDP, 2007; ECREEE, 2014; IRENA, 2014) – consequently resulting in inappropriate delivery models for 'sustainable' energy access.

A transition management process geared towards pulling together policy makers, industry financiers, technical experts, researchers, government officials, development workers, non-governmental agencies and local community members creates a forum for addressing macro issues such as regulatory and financial frameworks; while at the same time taking concise action on project specific issues on the micro level, such as choice of renewable technology, community aspirations, and local development. This broad and deep interaction across multiple levels of stakeholders as applied within the model will go a long way to root policies in 'on the ground' realities as well as tackling the existing lack of awareness of key issues that is pervasive within the sector – not only on the part of the general public but amongst various groups of industry practitioners (IRENA, 2014).

While Transition Management is primarily focused on addressing the institutional, regulatory and structural barriers, the principal intention of Neighbourhood Management is community involvement, participation and ownership. It is a grassroots governance approach aimed at community-led development with emphasis on taking a holist view of the community's priorities as well as the solutions to address them. Neighbourhood Management was developed in the UK and originally implemented as a system of urban regeneration which seeks to 'narrow the gap' between affluent and deprived communities. Neighbourhood Management is a place-based approach and it focuses on the identification of locals issues and needs within a particular geographic boundary; considering issues ranging from energy, housing and security to education, health, and employment (Power and Bergin, 1999). Based on the outcome of local needs assessments, service delivery is brought in line with community priorities to meet the unique needs within a given area in an attempt to improve the local quality of life. Despite its origins in the UK, Neighbourhood Management lends itself particularly well to the context the informal and micro-level of operation in which service delivery tends to operate in emerging nations – this is especially true for rural communities. The ability of Neighbourhood Management to comfortably overlay the informal community governance structures which exist in emerging nations has seen its successful application within the context of sustainable infrastructure provision in low income communities within emerging nations (Hoelzel and Akinsete, 2015).

Table 2. *Delivering Neighbourhood Management*

Neighbourhood Management	
Features	**Tools**
• Someone with overall responsibility at the neighbourhood level for managing the process • Community involvement and leadership • A systematic, planned approach to tackling local problems • Effective delivery mechanisms • The tools to get things done	• Agreements with service providers • Decentralised service delivery and purchasing • Pressure on agencies and Government • Special resources for enabling and cross-cutting activities

Source: Social Exclusion Unit, 2001; CLG, 2010

The central figures within the Neighbourhood Management approach are the neighbourhood managers, who are embedded within the community and are responsible for the day-to-day service delivery within the local area. The key actors concerned with implementing the features and tools outlined in Table 2 are:

- representatives of the local community (including local government councillors)

- representatives of local service providers
- a small professional team led by the Neighbourhood Manager to facilitate change

(Department for Communities and Local Government, 2008)

Within the context of the Comm-SES model, Neighbourhood Management ensures the community participation not just at the project development stage, but also in the service delivery. Initially seeking to identify local energy needs and priorities in terms of use, before designing appropriate renewable based solutions, the process in conjunction with Transition Management will ensure the involvement of the local community from inception through to implementation, operation and management – a feature which raises levels of community empowerment by giving citizens a real say in the direction of their energy transition and local development. As part of this process local capacity development and awareness generation plays a major role, thereby addressing related barriers. The scale of community involvement facilitated by the model, fosters a greater level of ownership which would otherwise be non-existent; this has a follow on effect on security and maintenance of the facility (again, issues that are of particular concern in rural areas of emerging nations). Importantly, the fundamentally bottom-up nature of Neighbourhood Management and its emphasis on devolution of governance and service delivery, make it a logical fit for managing a decentralised energy delivery system at community level.

Figure 5 depicts the key elements within the structure of the Comm-SES model; with ***Decentralised Energy Systems*** coupled with ***Renewable Energy*** forming the technological component, set within the ***Local Context***. The ***Stakeholder Engagement*** element is governed by Transition Management and Neighbourhood Management processes and philosophies. The technological components (decentralised energy systems and renewable energy technologies) primarily address environmental sustainability via CO2 and other greenhouse gas reductions, but also socio-economic sustainability in terms of health benefits and income generating activity – and as such poverty alleviation. The local context and the stakeholder engagement elements mainly address the socio-economic aspects of sustainable development such as community empowerment, economic development, and local services/amenities (e.g. health and education); they also address environmental sustainability to some extent by raising awareness on climate change issues.

Figure 5. *Structure of the Community-driven Sustainable Energy System Model*

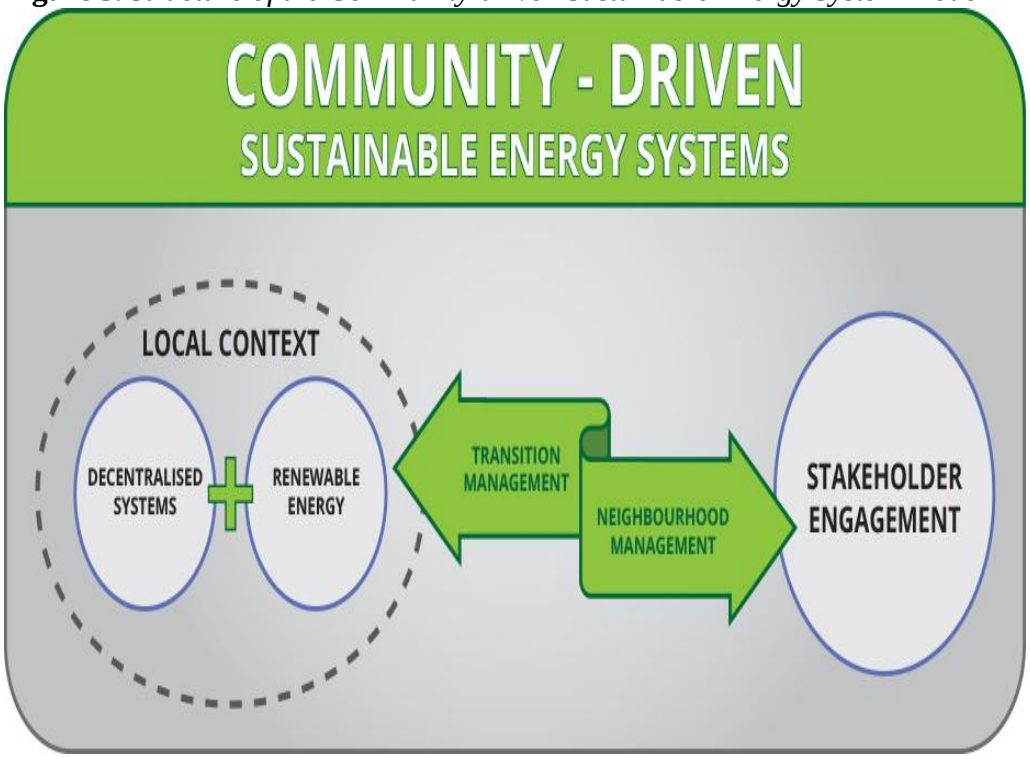


Figure 6. *Application of Multiple Community-driven Sustainable Energy Systems in Different Contexts*

An important feature of the model is its replicability due to its intrinsic flexibility and adaptability – in terms of location, individual actors and technology. While the key elements remain the same, the constitution of those elements can (and must) be adapted to suit the local context. This has a tremendous implication on sustainable energy access not just for other rural communities in emerging nations, but also for urban areas as illustrated by case study 2. Comm-SES facilities can be implemented in towns and cities across developing nations; from to slum upgrade programmes in low-income communities (many of which have illegal or no grid connection at all) as is the case in Makoko, to local housing associations wishing to supplement inadequate grid supply in areas that often experience frequent power cuts (and currently run diesel powered generators to make up the shortfall).

Conclusion

The link between adequate access to clean energy and sustainable development has been well established. This in turn has fuelled an international drive to institute energy access as a global priority. Despite this, a large proportion of the developing world (predominantly in rural and remote areas) remains without access to clean energy, often resulting in severely negative impacts on the local economy, environment, health and general quality of life. This has largely been put down to the fact that the prevailing mode of modern energy delivery is based on centralised grid systems, that are too often too costly to extend to rural regions which remain off the grid. In a bid to overcome this hurdle, many are turning to decentralised energy systems based on self-generation and mini-grids. However most of these decentralised systems are powered by fossil fuels, making them less sustainable. In response there has been a push from governments and international agencies to promote the adoption of renewable technologies to power these systems in an attempt to make them more sustainable. Despite the clear impetus, these efforts have yielded little results – especially in developing nations where they had been expected to make the greatest impact. It was found that this failure had been on account of the fact that there was an inadequacy of policies to take into consideration context-appropriate solutions, coupled with a lack of cross-sectoral cooperation and community engagement and awareness.

The research proposes the Community-driven Sustainable Energy System (Comm-SES) as a potential solution to address the critical task of sustainable energy access in rural communities within developing nations. The model is composed of four key elements namely – Decentralised Energy Systems, Renewable Energy, Local Context and meaningful Stakeholder Engagement on all levels. The fundamental principles of the model are community participation and ownership facilitated by the adoption of Transition Management and Neighbourhood Management. The model is currently being applied to a case study in Bayelsa State in Nigeria, which seeks to bring sustainable energy access to a rural off-grid community using marine renewable energy technology.

The potential benefits of the project in terms of development will be transformational and will impact on all the elements of sustainable development: lighting for homes and schools, cleaner indoor air, better equipped health facilities, electricity for agricultural pumps and sanitation, more small and medium sized enterprises and more income-generating opportunities (thereby playing a crucial role in poverty eradication), reducing infant mortality, improving education, ameliorating gender inequality, attaining environmental sustainability, and accelerating economic growth and prosperity.

The potential benefits of the model are exponential and virtually endless. The fact that the model focuses on creating an enabling environment for sustainable energy access and development due to its emphasis on adaptability and flexibility means that it is easily replicated in a variety of different locations. The Comm-SES model marks a true paradigm shift in emerging nations, not just within energy delivery but in local service delivery, where communities are empowered to chart the path for their own development powered by sustainable energy access.

References

African Development Bank-UNDP (2015) *"Regional Development and Spatial Inclusion: African Economic Outlook 2015"* [Online] Available: http://www.africaneconomicoutlook.org/fileadmin/uploads/aeo/2015/PDF_Chapters/E-Book_Thematic Edition_AEO2015-EN.pdf (Accessed: 15th August 2015)

Ainah, K and Afa, J (2013). "Developing Sustainable Power Supply for Rural Communities in Akassa of Bayelsa State Using Photovoltaic System and Battery". *Research Journal of Applied Sciences, Engineering and Technology* 6, pp 545-550

Akinsete, E, Hoelzel, F. and Oshodi, L. (2014) "Delivering Sustainable Urban Regeneration in Emerging Nations: Introducing Neighborhood Hotspots". *Journal of Architectural Education*, 68:2, 238-245. DOI: 10.1080/10464883.2014.937245, 2014

Akinsete, E. Osu, V. and Kruijsen, J., (Forthcoming, 2017) Sustainable Energy for Sustainable Development: Towards a Community-driven Model for Energy Delivery in Emerging Nations. *Renewable and Sustainable Energy Reviews*.

Chong, H. & Lam, W. (2013) "Ocean renewable energy in Malaysia: The potential of the Straits of Malacca". *Journal of renewable and sustainable energy review*, 23, pp.169 – 178

Cowell, R., ellis, G., Sherry-Brennan, F., Strachan, P., and Toke, D., 2015. Rescaling the Governance of Renewable energy: Lessons from the UK Devolution Experience. *Journal of Environmental Policy and Planning*, DOI: 10.1080/1523908X.2015.1008437

Cowell, R., Ellis, G., Sherry-Brennan, F., Strachan, P., and Toke, D., 2016. Energy transitions, sub-national government and regime flexibility: How has devolution in the United Kingdom affected renewable energy development. *Energy Research and Social Science*, 2016.

Department for Communities and Local Government (2008) *"Neighbourhood Management Pathfinders"*. [Online] Available: http://www.sqw.co.uk/files/5713/8712/8264/80.pdf (Accessed: 28th Dec 2014)

ECREEE (2014). *"The ECOWAS Process and Strategy on the Development of the Sustainable Energy for All (SE4ALL) Action Agendas, National Renewable Energy Action Plans (NREAPs) and National Energy Efficiency Action Plans (NEEAPs)",* Status report: September 2014. [Online] Available: www.ecreee.org/.../ecowas_ se4all_aa_and_re_ee_action_plans_status (Accessed: 14th Jan 2015)

EIA (2012) *International Energy Statistics* [Online] Available: http://www.eia.gov/ cfapps/ipdbproject/IEDIndex3.cfm?tid=6&pid=29&aid=12 (Accessed: 16th April 2015)

EIA (2013) *World Energy Outlook* [Online] Available: http://www.worldenergyout look.org/publications/weo-2013/ (Accessed: 16th April 2015)

Falcone, M.P., 2014. Sustainability Transitions: A survey of an emerging field of research Field of Research. *Environmental Management and Sustainable Development*, 3, pp. 61- 83

Federal Ministry of Power (2014) *"Draft Rural Electrification Strategy and Implementation Plan".* Abuja: Federal Ministry of Power

Federal Ministry of Power (2015a) "*National Renewable Energy and Energy Efficiency Policy"*. [Online] Available: http://www.power.gov.ng/.(Accessed: 12th June 2015)

Federal Ministry Of Power [FMOP], 2015b. *"Expression of interest For African Development Bank Sustainable Energy Fund for Africa".* Abuja: Federal Ministry of Power.

Geels, F.W., 2012. A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. Journal of Transport Geography, 24, pp.471–482

Greenpeace (2005) *"Decentralising Power: An Energy Revolution for the 21st Century".* [Online] Available: http://www.greenpeace.org.uk/MultimediaFiles/Live/FullRe port/7154.pdf (Accessed: 15th August 2015)

GIZ (2014) "*The Nigerian Energy Sector - an Overview with a Special Emphasis on Renewable Energy, Energy Efficiency and Rural Electrification."* Hamburg: GOPA International Energy Consultants GmbH

Hande, H. and Rajagopal, S. (2014) *"*Effective Leapfrogging to Decentralized Energy Access", *Global Energy Affairs*, pp. 20-21.

Hoelzel, F., & Akinsete, E. (2015) "Towards a new community-led governance approach, integrating the global into the mundane – and why design matters", *The Public Sphere: The Journal of Public Policy, LSE Africa Summit Special Issue,* pp. 26-

Hooghe, L. and Marks, G., 2001. *Multi-level governance and European integration*. Oxford, Rowman & Littlefield Publishers.

IIASA (2012) "Access to Modern Energy: Assessment and Outlook for Developing and Emerging Regions". [Online] Available from:www.iiasa.ac.at/.../Energy/IIA SA-GEF-UNIDO_Access-to-Modern-Energy. [Accessed 16th October 2014]

IPCCC (2012) *"Special Report on Renewable Energy Sources and Climate Change Mitigation"*. Cambridge: Cambridge University Press

IRENA (2013) *"West African Power Pool: Planning and Prospects for Renewable Energy"*. [Online] Available: http://www.irena.org/DocumentDownloads/mPubli cations/WAPP.pdf [Accessed: 12th June 2014].

IRENA (2014) *"International Off-Grid Renewable Energy Conference Key Findings and Recommendations"* [Online] Available: http://www.irena.org/DocumentDo wnloads/Publications/IOREC_Key%20Findings%20and%20Recommendations.p df (Accessed:16th April 2015)

Karakosta, C., & Askounis, D., (2010) "Developing countries' energy needs and priorities under a sustainable development perspective: A linguistic decision support approach". *Energy for Sustainable Development*, 14, pp.330 – 338

Karekezi, S & Majoro, l. (2002) "Improving modern energy services for africa's urban poor". *Energy policy 30, pp 1015–1028*

Kaygusuz, K, (2011) "Energy services and energy poverty for sustainable rural development". *Renewable and Sustainable Energy Reviews 15, 936 – 942*

Kaundinya, D., Balachandra, P., & Ravindranath, N. (2009) "Grid-connected versus stand-alone energy systems for decentralized power-A Review of Literature", *Renewable and Sustainable Energy Reviews* 8, *pp. 2041–2050*

Kaygusuz, K. (2012) "Energy for sustainable development: A case of developing countries". *Renewable and Sustainable Energy Reviews, 16. 1116 – 1126*

Kern, F. and Rogge, K., 2016. The pace of governed energy transitions: Agency, international dynamics and the global Paris agreement accelerating decarbonisation processes? *Energy Research & Social Science* 22, pp.13–17

Kirubi, C., Jacobson, A., Kammen, D. and Mills, A (2009) "Community-Based Electric Micro-Grids Can Contribute to Rural Development: Evidence from Kenya." *World Development , pp 1208-1221.*

Komolafe, A. A., Adegboyega, S. A., Anifowose, A.Y., Akinluyi, F. O., & and Awoniran, D. A. (2014) Air Pollution and Climate Change in Lagos, Nigeria: Needs for Proactive Approaches to Risk Management and Adaptation, *American Journal of Environmental Sciences*, Vol 10(4), pp.412-423

Lagos State Government (2012), Y2012 abridge annual budget, Lagos socio - economic profile

Loorbach, D. (2010) *"Transition Management for Sustainable Development: A Prescriptive, Complexity-Based Governance Framework".* [Online] Available: www.public.asu.edu/~ybudiya/old/sos511/Loorbach_2010.pdf (Accessed: 7th June 2015)

Loorbach, D., 2007. *Transition Management: New mode of governance for sustainable development*, PhD Thesis, University of Rotterdam, Rotterdam.

Loorbach, D. & Rotmans, J. (2006) *"Managing Transitions for Sustainable Development"* [Online] Available: http://www.upc.edu/sostenible2015/menu2/Seminaris/Post_Seminari_STD/docs/derk_loorbach.pdf (Accessed: 7th Mar 2013)

Loorbach, D. and Rotmans, J., 2010. Transition Management and Strategic Niche Management. Dutch Research Institute For Transitions, Rotterdam.

Mainali, B., Pachauri, S., Rao, N.D. & Silveira, S. (2014) Assessing rural energy sustainability in developing countries. *Energy for Sustainable Development*, 19, 15 – 28.

Makoko/Iwaya Waterfront Community (2014), *Makoko/Iwaya Waterfront Regeneration Plan.* Urban Spaces Innovation: Lagos

March, J. G. and J. P. Olson., 1995. Democratic governance. New York, The Free Press.

Markard, J., Raven, R. and Truffer, B., 2012. Sustainability Transitions: An emerging field of research and its prospects. *Res. Policy* 41 (6), 955–967.

Mutoko, M., Shisanya, M. And Hein, L., 2014. Fostering technological transition to sustainable land management through stakeholder collaboration in the western highlands of Kenya. Land Use Policy 41, pp. 110–120

National Planning Commission (2009) *"Nigeria Vision 20:2020".* Abuja: National Planning Commission

NERC (2012) In: Federal Ministry of Power (2014) *Press Review "Generators' importation".* [Online] Available: http://www.power.gov.ng/Press%20Reviews/MONDAY%20OCTOBER%2027%202014.pdf (Accessed: 15th August 2015)

Nouni, M.R.., Mullick, S.C. & Kandpal, T.C. (2008) "Providing electricity access to remote areas in India: an approach towards identifying potential areas for decentralized electricity supply", *Renewable and Sustainable Energy Reviews*, Vol 12(5). pp1187–220.

Osunmuyiwaa, O. and Kalfagianni, A., 2016. Transitions in unlikely places: Exploring the conditions for renewable energy adoption in Nigeria. *Environmental Innovation and Societal Transitions* (2016)

Power, A. & Bergin, E. (1999) *"Neighbourhood Management"* London: London School of Economics and Political Science.

Premium Times (2015) "*Nigeria's power generation drops to 2,800MW*" [Online] Available: http://www.premiumtimesng.com/business/182309-nigerias-power-generation-drops-to-2800mw.html (Accessed: 15th August 2015)

Rehman, H., Kar, A., Banerjee, M., Kumar, P., Shardul, M.,Mohanty, J. & Hossain, Ijaz (2012). Understanding the political economy and key drivers of energy access in addressing national energy access priorities and policies. *Energy Policy*, 47, pp 27–37

Roorda, C., Wittmayer, J., Henneman, P, Steenbergen, F. van, Frantzeskaki, N., & Loorbach, D. (2014) *"Transition management in the urban context: guidance manual." Rotterdam:* DRIFT, Erasmus University Rotterdam,

Rotmans, J., Kemp, R., Van Asselt, M., Geels, F., Verbong, G. and Molendijk, K., 2001. Transitions & Transition management: The case for a low emission energy supply. Maastricht, ICIS.

Scharpf, F., 1994. Community and Autonomy. Multi-Level Policy Making in the EU. Journal of European Public Policy, 1, pp.219-242.

Surendra, K., Takara, D., Hashimoto, A. & Khanal, S. (2014) Biogas as a sustai sustainable energy source for developing countries: Opportunities and challenges. *Renewable and Sustainable Energy Reviews* 31, pp 846–859

Tessema, Z., Mainali, B., and Silveira, s. (2013) Mainstreaming and sector-wide approaches to sustainable energy access in Ethiopia. *Energy Strategy Reviews*, 2, pp 313 – 322

Ulsrud, K., Winther, T., Palit, D.and Rohracher, H. (2015) Village-level Solar Energy in Africa: Accelerating solar power through a socio-technical design in Kenya. *Energy Research & Social Sciences,* 5, p34-44

UNDP (2007) *"A Review of Energy in National MDG Reports"* [Online] Available: http://www.undp.org/content/dam/aplaws/publication/en/publications/environment-energy (Accessed 12th September 2014)

UNDP (2011) "*Grynspan: Bloomberg New Energy Summit 2011"* [Online] Available: http://www.undp.org/content/undp/en/home/presscenter/speeches/2011/04/07/grynspan-.html (Accessed 15th August 2015)

UNDP, 2015. *Sustainable Development Goals.* [Online]. Available: www.undp.org/content/undp/en/.../post-2015-development-agenda.html [Accessed 7th November 2015]

UNDP-GEF (2012). *A Review of UNDP-GEF Support for Feed-in Tariffs and Related Price and Market-Access Instruments.* [Online] Available: http://web.undp.org/gef/document/UNDP_FIT_Port_TransformingREMarkets_15oct2012.pdf. (Accessed 12th September 2014)

UNEP (1983) Ocean energy potential of the West African region. UNEP Regional Seas Reports and Studies, 30. [Online]. Available: www.unep.org/regionalseas/publications/reports/RSRS/pdfs/rsrs030.pdf (Accessed 12th March 2014)

UNFCCC (2011). *Clean Development Methodology*. [Online] Available: http://cdm.unfccc.int/projects/projsearch.thml, 2011. P.25. (Accessed 12th September 2014)

UNIDO (2014). "*Energy access for productive uses"*. [Online]. Available from: http://www.unido.org/en/what-we-do/environment/energy-access-for-productive-uses. html. (Accessed 16th October 2014)

United Nations (2012) "*Sustainable energy for all"* [Online] Available: http://www.sustainableenergyforall.org/ (Accessed 11th August 2015)

United Nations (2016) *Sustainable Development Goals.* [Online] Available: https://sustainabledevelopment.un.org/sdgs (Accessed: 26/9/16)

United Nations, Department of Economic and Social Affairs, Population Division (2014) *World Urbanization Prospects: The 2014 Revision, Highlights* (ST/ESA/ SER.A/352). New York: United Nations.

Van der Brugge, R. and Rotmans, J., 2006. "Towards transition management of European water resources." *Water Resource management* (Special Issue on advances in global change research).

Verolme, H., 2014. Renewables on the Rise: A West African Energy Transformation. Heinrich Boll Stiftung, Abuja

World Alliance for Decentralized Energy Security (2005) In: Decentralized Energy (2005) *"Energy Security",* Climate Change and Decentralized Energy

World Bank (2015) *World Bank Data: GDP per Capita* [Online] Available: http://data.worldbank.org/indicator/NY.GDP.PCAP.CD?order=wbapi_data_value_2013+wbapi_data_value+wbapi_data_value-last&sort=desc (Accessed 11th August 2015)