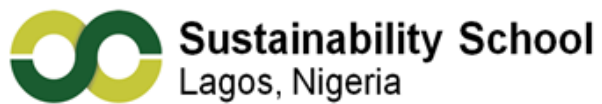




## Implementing an Ethical Circular Economy in Lagos, Nigeria



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## 1. Executive Summary

African leaders have for long been ‘participants’ in global efforts that define collective directions for sustainable development, that tries to ensure human prosperity, like the Millennium Development Goals (MDGs). More recently are the Sustainable Development Goals (SDGs, 2015), and the Intended Nationally Determined Contributions (INDCs) that are outcomes of the 2015 Paris convention on climate change that saw 195 countries agree to independent actions to reduce green-house-gas emissions. Yet African countries, as indicated by several indices that include the Human Development Index (HDI) have not been able to properly translate to the level of development that provides equitable existence for the citizenry.<sup>i</sup> It is without a doubt therefore that the enterprise of sustainable development in sub-Sahara Africa in general and certainly in Nigeria is problematic. Inadequate access to clean and sustainable energy, water, and safe and clean habitation, compounded by exponentially rising waste generation, are some of the challenges of rapidly urbanizing centers like Lagos, Nigeria. These resource challenges are amplified in our environment due to chronic infrastructure deficiencies.

These problems will require multiple approaches and inputs for solutions. They also call for the kind of urgency and scale that makes it impracticable for a single entity to embrace on its own. There is a need to create a “network of stakeholders dedicated to innovative resource management through the creation of circular economies.” Such networks as suggested here will respond to five major enquiries, outcomes to which we believe will enable us build resiliency and local capacity to respond to our most daunting economic, social and environmental challenges:

1. What can be done to establish the crucial network of strong, competent collaborative platforms needed to support achievement of sustainable development goals in Nigeria through the creation of circular economies?
2. What can be done to engender the emergence of a large community of citizen decision-makers able to initiate and harness the vast intellectual resource base necessary to drive sustainable development processes?
3. By what means can the public policy process help incentivize research innovation and capacity-building focused at increasing private-sector involvement for the achievement of the SDGs?
4. What mechanisms are needed to encourage Nigerian businesses to take active roles in the shaping of government policies that will help catalyze adaptation of circular economy approaches to sustainable development?
5. How best can technology be adapted to sustainable development needs?

In a bid to bridge this gap, the Sustainability School Lagos (SSL) in Collaboration with Arizona State University (ASU) USA, began their pioneering certificate course in circular economy with robust deliberations and engagements on how to apply the circular economy concepts to the various sectors in Lagos. A private sector initiative, the SSL/ASU collaboration underscores rising global recognition of the link between strong private sector-driven independent agencies and accountable public governance as strong drivers for sustainable development. As the agencies enhance the strengths and resilience of the participating stakeholders, they strengthen society as a whole by encouraging the cultivation of stakeholders' skills along a number of themes that include: leadership development; information access, use and dissemination; and building alliances, coalitions, networks and partnerships. Essentially, the cross-fertilization of ideas that can occur when all stakeholders link together and exchange experiences can be a powerful tool in building leadership and capacity for development.

This work serves as a foundation of the type of private-sector contribution that can support local capacity building for sustainable development in Lagos, and in Nigeria. Circular economy as a development paradigm has not enjoyed much attention in the developing economies of especially sub-Sahara Africa. With Lagos as case study and in an attempt to contribute to the development dialogue, it uses 8 themes (built environment, electronic waste, energy, food system, plastics waste, sanitation, transport, and water) to take a high-level look at the potential benefits of embedding circular economy as a development paradigm for the city.



## 2. Introduction

The term circular economy is gaining traction in the private sector across Western Europe and the United States as a new approach to transitioning product and service development, urban infrastructure building and economic development around maximum resource efficiency and effectiveness. This is usually through the closing of loops in the production, use and disposal phases of products and materials. For developing economies of sub-Saharan Africa however, little analysis has been conducted so far to assess the potential benefits of the circular economy, which as a development paradigm may hold a different meaning for these developing countries. The biggest problems facing rapidly urbanizing developing economies like Nigeria are inherently social in nature. They include inequality, youth unemployment, poor public education and health systems, poor sanitation, poor habitation, inadequate water supply and energy inequity.

Within the context of a developing economy like Nigeria therefore, the key aim will be to achieve robust economic growth and provide opportunity for all social groups, while simultaneously improving environmental quality. Successful implementation of circular economy as a sustainable development paradigm for our part of the world must then mean that it delivers solutions to these challenges. For this reason, contextualizing the circular economy concept to align with local social conditions is necessitated, and is a major 21st century imperative for businesses, governments, communities and other relevant stakeholders. This in fact is the essence of what has been described as ethical circular economy (ECE) by Arizona State University. In addition to the traditional approach to circular economy, ethical circular economy emphasizes social values, impact, and equity.

### 2.1. Lagos, Nigeria

Lagos is Nigeria's central city of commerce and trade, and houses an estimated five percent of the national population. Lagos has the smallest land mass with 356,000 hectares, of which 75,000 hectares are wetlands. The city's position as the commercial center continues to attract trade, investment and business with an estimated daily influx of up to 1,200 people, making it one of the top 10 mega city migration destinations. Metropolitan Lagos, an area covering 37% of the land area of Lagos State, is home to over 85% of the state's population, making it a very densely populated State. <sup>ii</sup>There has also been a progressive spatial expansion of Lagos to accommodate an ever increasing immigrant population. The Nigerian population is estimated to be over 400 million by 2050, of which 46% will be between 18 and 35 years of age. Immediate implications include amplification of gaps in skills and education required for a sustainable future, and elevated strains on available resources through raising of demand for social services and employment. These are issues that the country has already begun to deal

with, and which any new development paradigm must, as a matter of urgency, help provide solutions to. The *ethical* circular economy we believe can be the key driver of sustainable development for Nigeria.

## **2.2. Circular Economy & Net Positivity**

In the face of rising populations and resource demand, Circular Economy (CE) finds its origins from the attempt of countries of the global north to respond to the current unsustainable approaches to production, consumption and disposal of materials. The linear economic system is an approach that translates to unprecedented consumption, waste generation and heightened stress on natural systems. A circular economy on the other hand drives to close loops by maximizing the utility and useful lifespan of materials. The circular economy as a foundation for systems-driven economic development will mean that materials will be used and reused for longer durations. The Ethical Circular Economy (ECE) is an effort to remedy the discrepancy between CE as a resource effectiveness and efficiency framework, and the current lack of widespread social equity and access around the world, specifically in developing countries.

With the annual profits of many multinational companies outranking the GDPs of many nation states, it is becoming increasingly palpable that the Governments of the world no longer “govern” in the traditional sense of the word. ‘The Forum for the Future’, the ‘World Wildlife Fund’ and ‘The Climate Group’ have recently formulated a new concept that “provides the best chance for common well-being.” This new framework is called Net-Positive. The Net-Positive encourages multi-national corporations, local businesses and individuals to behave, buy, collaborate and make business decisions that can ideally be “good” – investing back into society and the environment, and “*giving in*” than they “*take out*.”

## **2.3. The Sustainable Development Goals**

Global institutions are coming together to define global development issues and solutions in ways that are more assertive than was in the past. Global initiatives like the SDGs provide a great opportunity for developing nations of sub-Sahara Africa to engage with development paradigms that allows access to global frameworks that can help define solutions to the several challenges the continent faces. The aim therefore is to consider:

1. How developing countries like Nigeria can reframe their development narrative to allow for maximum actualization of the SDGs?
2. How these countries make the link that will enable connections to the goals, rather than seeing the SDGs in isolation?

Achieving the above will certainly require a strong implementation tool. We submit here the ethical circular economy (ECE) can be that tool that can help with the alignment of national development goals with the sustainable development goals shown in Figure 1.



Figure 1: U.N. Sustainable Development Goals

## 2.4. Workshop by Arizona State University

To begin the ECE contextualization for local conditions in Nigeria, the Sustainability School, Lagos, in partnership with Arizona State University, conducted a 3-day **"Executive Certificate in the Ethical Circular Economy"** workshop in Lagos, in April 2016. The ECE workshop - the first of its kind in the world, was attended by 35 professionals from the public, private and NGO sectors. The workshop was preceded by 30 days of online ethical circular economy content that merged systems-thinking and systems-mapping, principles of Circular Economy, the Sustainable Development Goals and the Net Positive framework. The attendees then applied this learning in the 3-day workshop to develop ethical circular economic solutions to eight Lagos-area regional, infrastructural and supply chain challenges. With the rapidly urbanizing and densely-populated Central Business District (CBD) of Lagos as the main focus of the effort, findings detailed in this report are intended to represent the foundation for the definition and practical implementation of ethical circular economy in the Nigerian context.

## 2.5. Vision for an Ethical Circular Economy in Lagos

This publication explores how the ECE and Net-Positive framework can help answer questions of transforming Nigeria's economic, social and ecological sectors in pathways that enhance the acceptance of the sustainable development goals.

As a group, the participants of the workshop were asked to envision an ethical and circular Lagos that is founded on the following values (bolded) and associated guiding principles:

1. Transparent governance demonstrates **leadership** in the transition
2. **Diversity** is the key to resiliency
3. Reward value-creating, **innovative solutions**
4. Take **responsibility** for a sustainable future
5. Build capacity through inclusive education and outreach
6. Encourage **inclusivity** by building social networks across all sectors
7. **Manage out waste** (reuse, recycle, recover, redesign and regenerate)
8. **Require** renewable energy.

The group bounded the “system” of interest spatially by the state of Lagos temporally to 2030, and socially by including all sectors and stakeholders. They also agreed on a 2030 vision of Lagos that, as a leader in Africa, Lagos will be a clean, planned and smart commercial city that has:

1. Transparent and responsible governance
2. A cohesive and healthy community
3. Affordable, accessible and reliable city services
4. An effective and efficient multi-modal transportation system
5. An enabling environment for business, innovation and entrepreneurship
6. Only renewable energy systems, and
7. Effective waste and emissions systems.

Based on this broader vision, the group developed an ethical circular economy for eight resource areas – energy, sanitation, water, food, transportation, built-environment, plastics and e-waste.

The groups also mapped out two system maps with relevance to each other the above resources areas – a current state map, and a circular economy vision map. The maps identify the stocks, flows, processes, stakeholders and impacts involved with each system. The legend for the maps is given below:

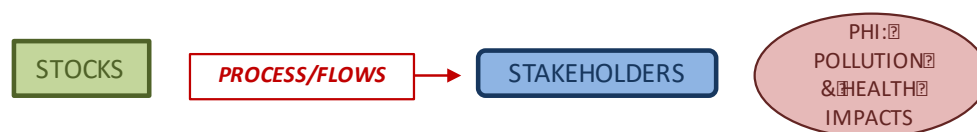


Figure 2: Legend of Systems Mapping

### 3. ENERGY

Authors: *Adebisi Adewole, Ayodeji Aiyegbajeje, Adedeji Omotayo Kehinde, Obi Oputa*

The United Nations estimates that if there are no deliberate interventions to boost energy generation globally by 2030, as many as 900 million people will not have access to electricity<sup>iii</sup>. Despite the significant energy needs, Nigeria's promising renewable energy potentials remain largely untapped and the country still struggles to provide adequate energy for its citizens. In order to achieve a more sustainable city, it will be necessary to transition to a more sustainable energy sector to drive economic and social development in Lagos. Thematic visions are to provide affordable renewable energy, and to provide a resilient energy sector through diversification of resources.

#### 3.1. Current Energy System

The current energy system in Lagos suffers from multiple challenges. The city experiences regular outages, huge transmission and distribution losses, vandalism, infrastructure problems leading to technical glitches and most predominantly, smog and pollution caused by many families opting for personal petroleum fuel-operated power generators. The prevalent use of generators has further deepened the energy divide raising the cost of energy from 45 Naira (\$0.14) to 90 Naira (\$0.28) per kWh. It is estimated that 60 million Nigerians spend an estimated 4.2 billion Naira (\$13.35 million) annually to fuel power generators. Problems due to lack of maintenance and limited transmission capacity gives rise to power losses in the range of 30 to 40%.

<sup>iv</sup>Furthermore, slums and other areas impacted by poor energy infrastructure increase the challenge of outright illegal grid connections and energy theft. Often the reluctance of consumers to pay bills based on estimated consumption and sharp practices by the meter readers further exacerbate the situation. The centralized grid makes power system more vulnerable as sabotage at a transmission tower disrupts a major part of the network. Areas like the Ikeja industrial area account for some of the highest energy usage, while many other parts of the city have no electricity connections at all. Ultimately, the fossil fuel-based energy system results in widespread environmental pollution and harmful human health side-effects.

The current energy system (Figure 3) shows the high dependency primarily on fossil fuels to deliver electricity and cooking fuels directly to energy consumers via inefficient and insufficient energy infrastructure. Unclear policies that overlap roles and responsibilities, inefficient security systems and inadequate technical expertise to implement the adaptation of innovative technologies in the power sector plague the system.

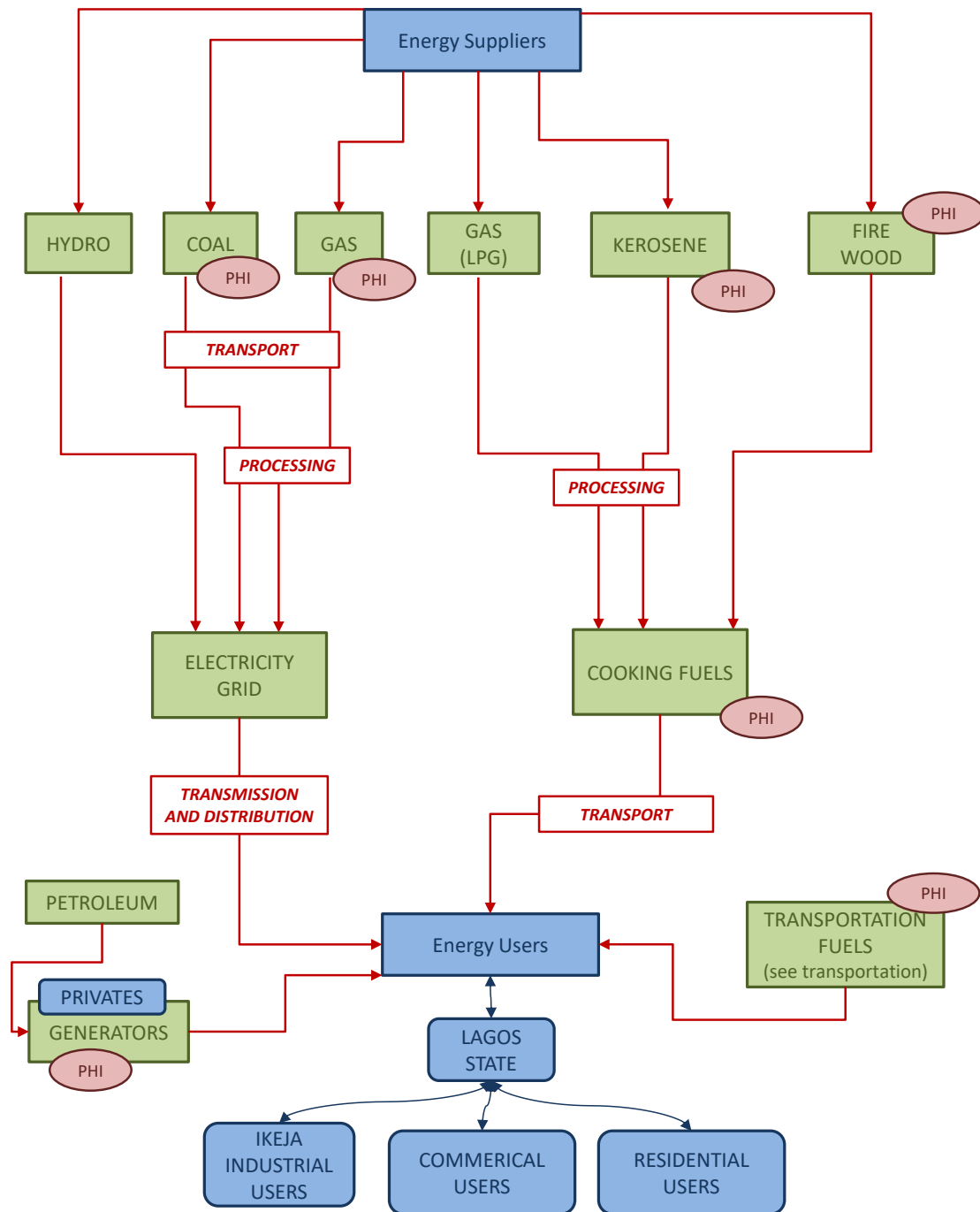


Figure 3: Current Energy System

### 3.2. Envisioned Energy System in an ECE

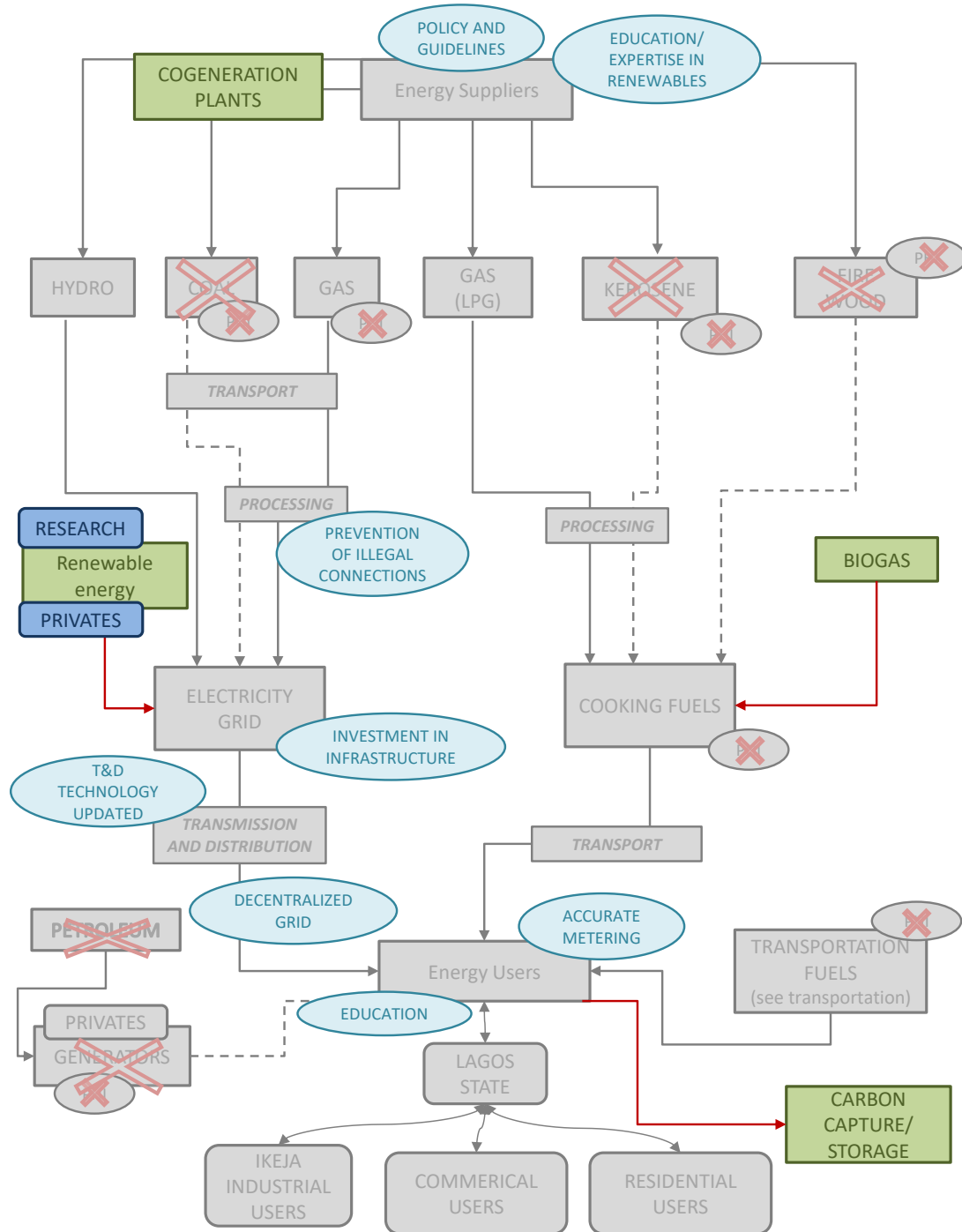


Figure 4: Envisioned Energy System

The envisioned sustainability improvements in the energy sector, shown in Figure 4, include harnessing opportunities in cogeneration power plants, solar, wind and waste-to-energy as well as possibly opting for a decentralized grid system. Licensing Independent Power Producers (IPPs) to sell extra power to the grid would further

incentivize the transition to more sustainable technologies. The future vision also considers encouraging the use of solar PV and inverters to replace the use of private generators. The system map (Figure 4) explicitly highlights moving away from coal, kerosene and fire wood. Critical elements to highlight would be an institutional analysis, the making of a policy framework, adaptive governance factors, and the development of various technologies to support a sustainable energy system.

### **3.3. Energy Notes and Assumptions**

- In the current energy system energy suppliers provide transportation fuels, and electricity to the grid. Hydroelectric energy, coal, and gas are all sources to the grid. Gas (LPG), kerosene, and fire wood are sources for cooking fuels. Transportation fuels are discussed in the transportation system diagram.
- Transmission and distribution loss is a huge issue in the current centralized grid, which is further degraded by illegal connections. Many energy users use generators to make up for the lack of dependable energy, which are fueled by petroleum products (diesel or premium motor spirit).
- Cooking fuels used primarily have harmful human health side effects.
- In the envisioned energy system primarily renewable energy sources are used.
- Transmission and distribution technology is updated and the grid is decentralized to improve electricity dependability.
- Illegal connections are stopped to improve safety and increase reliability of the grid.
- Energy users are accurately metered for energy use and are educated on types of energy.

### **3.4. Net Positive Impact Assessment**

When reviewed against the Sustainable Development Goals, a number of goals were highlighted as net positive including:

SDG 1 – Creation of jobs and economic growth

SDG 2 – Food preservation & storage

SDG 4 – Power for education

SDG 7 – Renewable energy enhances gender equality

SDG 9 – Provision of power for industry & infrastructure development

SDG 11 – Sustainable power for businesses



There were also some aspects that were considered net negative in impact:

SDG 13 – May reduce the water table and harm to aquatic animals

SDG 15 – Possible clearing of natural habitats for renewable power plants

SDG 14 – Carbon from fuel exhaust

### **3.5. Energy System ECE Solutions**

The short-term plan consists of incentivizing or requiring power distribution companies to provide adequate metering systems to all industrial, commercial and residential customers. The longer-term plan is to espouse a more decentralized energy grid system in Lagos where diverse clean energy sources contribute to providing power avoiding high tariffs. Recommendations included community education on the use and advantages of renewable energy sources, and encouraging private sector participation on solar rooftops. The formulation of more conducive policies that will drive the goals of the envisioned system should be put in place at this stage of the transition. There is also a need for an exchange policy framework which allows for the exchange of old equipment for newer and clean energy consuming ones (e.g. kerosene stove for clean stove which makes use of bio-gel). Energy conservation measures also need to be implemented and the public needs to be educated on the dangers of tampering with power lines, distribution systems and street lights. The federal government needs to establish clear roles and responsibilities between the federal government and the state government. A decentralized electricity grid system in Lagos where power is generated from different sources of energy (hydro, gas, waste to energy, solar and wind) and is also made equally competitive to avoid high tariffs is a necessity. Also, construction of a well-connected gas pipeline network and the creation of gas stations will be done to provide stable and constant supply of natural gas and LPG to consumers throughout the state.

## **4. SANITATION**

Authors: *Bukola Babayeju, Bello Mariam Damilola, Fred Nwogu, Oluremi Thomas*

The UN estimates that there are 2.5 billion people who still do not use improved sanitation facilities in the world. A larger proportion of these people live in sub-Saharan Africa and Southeast Asia. A UNICEF report on Water and Sanitation revealed that “Nigeria is in the bottom 25 countries worldwide in terms of sanitation coverage.” This is evident in the sanitary condition of most cities in the country. While some of the states have continued to make efforts at having clean environments others still lag. Sanitation is usually the first determinant of the state of health in any nation and a critical social

development index.<sup>vi</sup> It is estimated that 80% of diseases in developing countries are caused by poor sanitation, including inadequate sanitation facilities.<sup>vii</sup>

#### **4.1. Current Sanitation System**

The Lagos Area Waste Management Authority (LAWMA), established in 2005, is responsible for solid waste management in Lagos while liquid waste is handled by the Lagos State Wastewater Management Office (LSWMO). The authority's approach to its mandate centers in the key areas of waste storage, collection, transportation, disposal as well as training and development. LAWMA uses Private Service Providers (PSP) to collect waste from street to street while LSWMO collects from government institutions, communal dump spots and hospitals. Despite the progress made by LAWMA in waste management in the city, there is still significant work to be done in order to bring Lagos at par with global sanitation standards<sup>viii</sup>.

Waste types can be broadly classified into agricultural, wood, biodegradable, brown, chemical, construction, demolition, electronics, industrial litter and sewage. About 12,000 metric tons of mostly unsorted waste is generated in Lagos daily<sup>ix</sup>. There are several stakeholders providing sanitation services such as funding, documentation, awareness and advocacy, outsourcing and collection, recycling, and processing facilities. The current system is represented in Figure 5 below. Institutional and non-institutional waste collectors deliver the waste into official, as well as, illegal dump sites. The small amount of waste that is collected and delivered into the recycling system, is reused or repurposed where possible and is also predominantly exported. There are many negative pollution and health impacts in this system.

Poor waste management and poor disposal practices have dire implications on human health and the environment. Bad sanitation practices influence the spread of diseases like Ebola, laser fever, diarrhea, and cholera. There are also huge economic consequences of poor sanitation on the country. World Bank studies of countries in sub-Saharan Africa, show that on average, countries (Nigeria) lose more than 4% and 6% of their Gross Domestic Product (GDP), respectively, due to inadequate sanitation<sup>x</sup>.

The biggest challenge are attitudes and behavioral resistance to changing the status quo, in terms of motivating the general population to normalize the changes of source-separating their waste. Infrastructural deficiencies further hinder progress, for example, many buildings in the CBD lack toilet facilities and in some cases, entire districts have no sewage system. The surrounding lagoons serve as disposal areas for untreated fecal discharges. These challenges (see figure 4) can be considered feedstock for the next stage in the sanitation business, which presents opportunities in waste management and sanitation.

The barriers towards progress rest largely on the behavioral actions of the multitude of stakeholders. Furthermore, there are large data gaps in the quantity of waste management required and the type of infrastructure that would be needed to successfully handle the waste. Access to finance while working with financial institutions is another key constraint in Lagos, where currently single source funding is not able to efficiently manage the system. Further added costs are compactor trucks that constantly breakdown and the spare parts must be sourced from foreign countries, with an increasing cost to the country. Technological and social advancements are necessary for the advancement of Lagos's sanitation situation. Due to the formal creation of the waste management agency, considerable achievements have been made towards improving the sanitary condition of Lagos State.

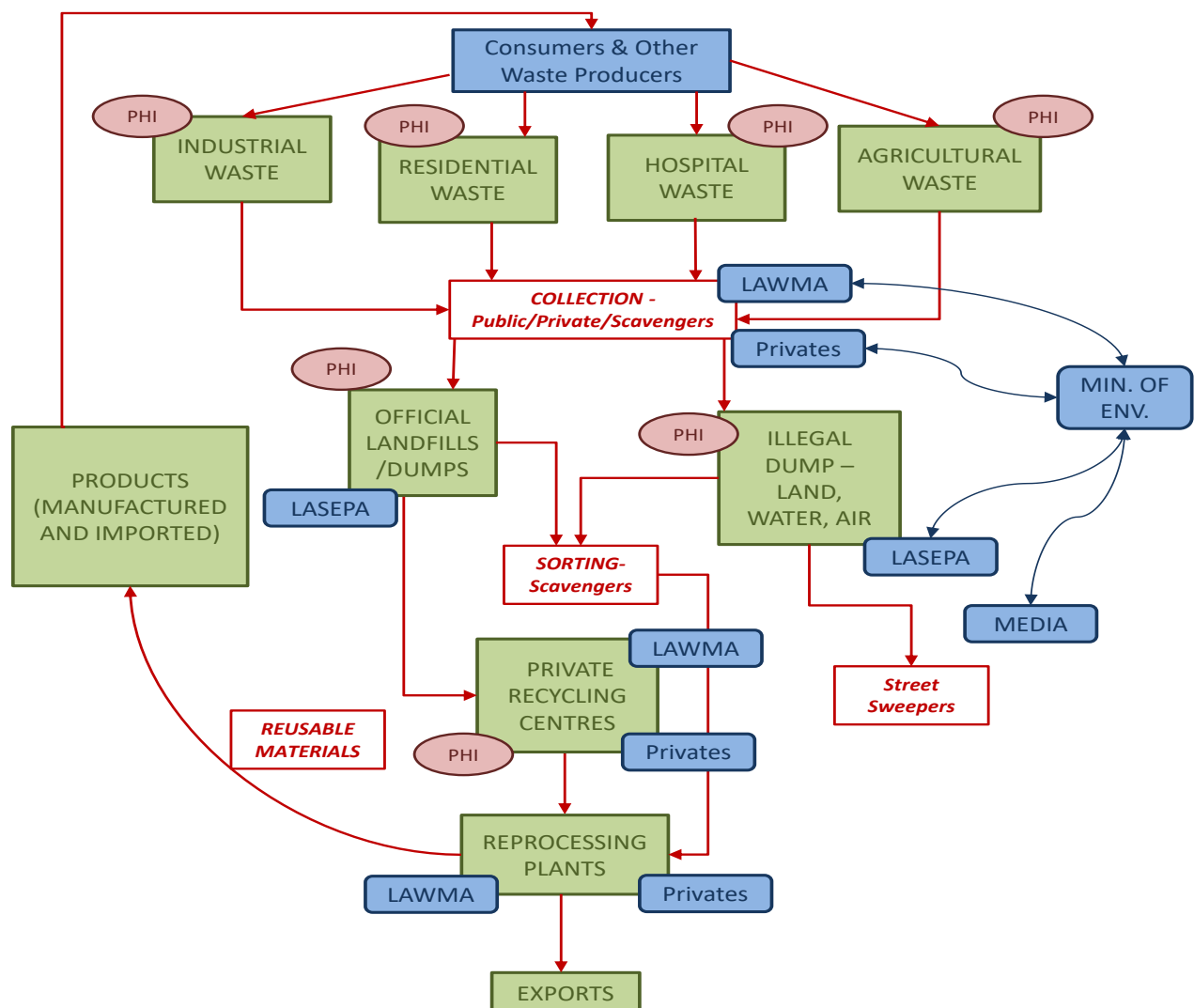


Figure 5: Current Sanitation System in Lagos

## **4.2. Envisioned Sanitation System in an ECE**

The Lagos state government has come up with legislations and policies to ensure a cleaner environment. However, the current enabling law on sanitation faces serious setbacks mainly due to conflicting positions with the federal environmental laws. An example is the declaration of water as a natural resource by the constitution and therefore under the exclusive authority of the federal government, but the federal government has difficulty to monitor unsafe practices impacting these very water bodies. The impracticality of this arrangement has informed the present paradigm.

The ECE is extremely relevant in the light of sanitation in developing countries. Artisanal (informal) recyclers are the backbone of sanitation in many countries, and are often the sole providers of recycling services.<sup>xi</sup> Nigeria is one such country where any efforts in recycling and better waste management must aid those who are inherently part of the system. Figure 4 shows how the system might look as an ethical circular economy.

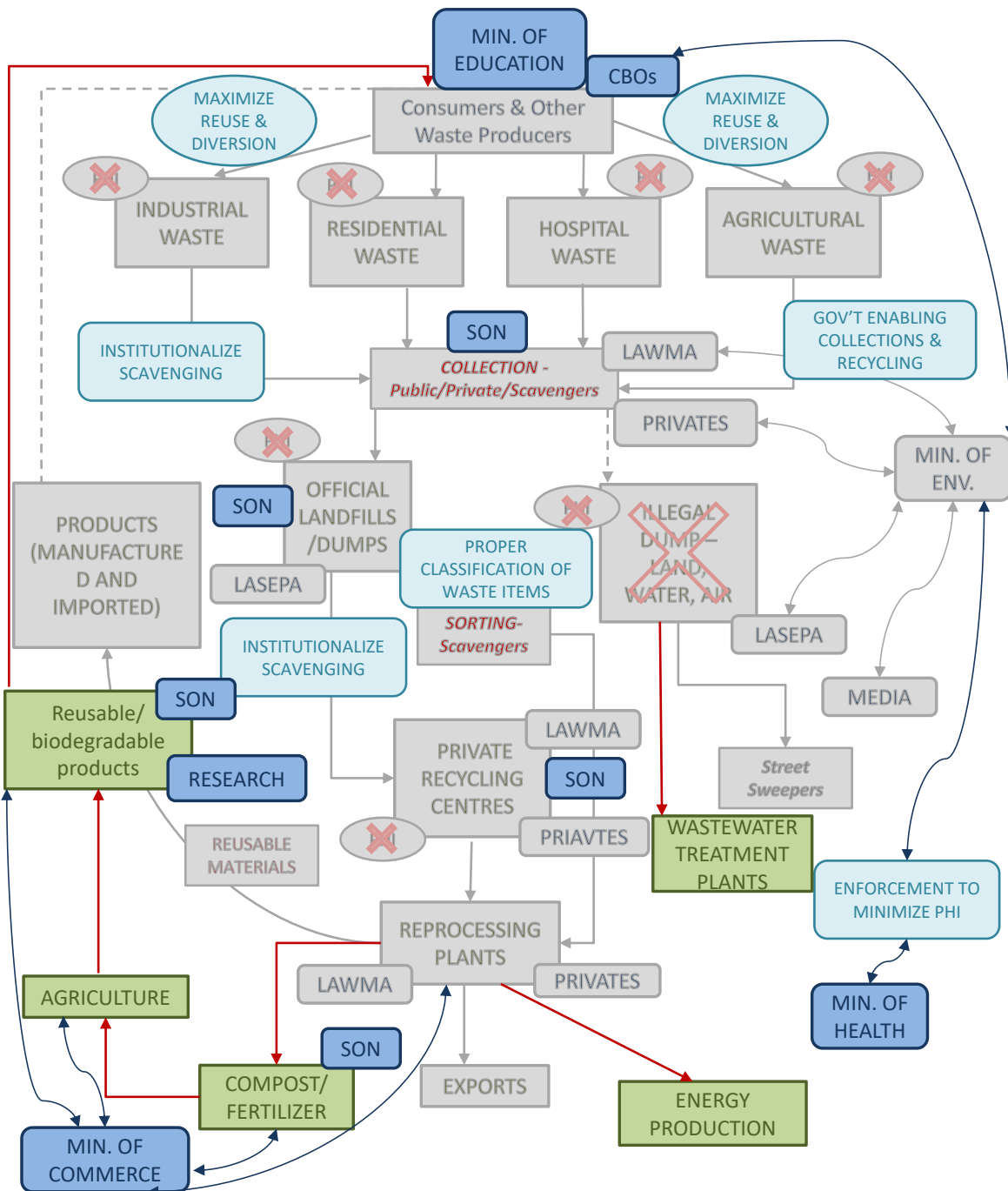


Figure 6: Envisioned Sanitation System

The government of Lagos State confirms that a number of buildings in the Central Business District lack toilet facilities<sup>xii</sup> and indeed the entire District has no sewage system. The surrounding lagoons serve as disposal bay for untreated fecal discharges. Many of the challenges could be capitalized on for the next stage in the sanitation business, thus, presenting business opportunities in waste management in Lagos. Awareness on cleanliness are aired on Radio Stations in English, Yoruba and Pidgin on

how to properly handle the environment and the obligations of the citizens. There are also outreaches to schools to teach children sanitation and hygiene. The state has a program called “Kick Against Indiscipline” (KAI) which addresses open defecation. KAI is enforced by the Lagos State Task Force on Environmental Offences Tribunal.

A key constraint in sanitation in Lagos is limited finance. The present single-source funding will not be enough to efficiently manage the volume of waste generated in the city. The current policy and indeed regime of government/donor funded sanitary program and projects in Lagos have, at best, yielded marginal results. This therefore necessitates the involvement of the financial institutions in Lagos to collaborate with state government and explore the business opportunities presented. Like truck purchases, other equipment – PPE, waste bins and waste conversion plants require financing.

The state government started a beautification program with the aim of reclaiming public spaces used by hoodlums, illegal trading and unauthorized waste dump site. This has helped clear the areas while adding beauty to the city. Small business and artisanal recyclers can play a special role to tap into electricity generation from bridgeable, biomass energy, biogas and organic manure production. The envisioned circular system will need significant structural and institutional improvements with the government creating the policies, enforcing compliance and encouraging market-based product solutions where necessary.

#### **4.3. Sanitation Notes and Assumptions**

- Consumers of manufactured products are the primary drivers of the current sanitation system.
- Waste is produced by industrial, residential, and agricultural sectors. The types of waste produced vary by each sector, but they are collected together and taken to official landfills or dumped illegally.
- Reusable materials are sorted out by private and public recycling centers or scavengers, reprocessed, and then reused to make additional products. The remainder of the waste stays in landfills or in the environment.
- In the envisioned sanitation system, consumers are educated on the sanitation issues Lagos is facing. Products are designed for maximum reuse and made from biodegradable materials to maximize waste diversion.
- Scavenging is institutionalized in order to protect workers and their jobs. A system is put in place by the government to enable the collection of recyclable material. The proper classification of waste items is legalized and allows for the correct sorting of waste and non-waste.

- Compost and fertilizer facilities, wastewater treatment plants, and recycling facilities are created to prevent illegal dumping, create energy, and improve sanitation in Lagos.

#### **4.4. Net Positive Impact Assessment**

When reviewed against the Sustainable Development Goals, a number of goals were highlighted as net positive including:

SDG 3 – Efficient sanitation systems may lead to improved health

SDG 6 – Effective sanitation may lead to better water sources

SDG 7 – Use of Biodegradable waste for clean energy

SDG 8 – New business opportunities would bring economic growth

SDG 15 – Improved agriculture from the use of organic manure

There were also some aspects that were considered net negative in impact:

SDG 13 – Emissions from landfilling

SDG 14 – Increased discharge from sewage may lead to marine pollution

#### **4.5. Sanitation ECE Solutions**

There are several solutions that can begin the transition to an ECE. First, to influence attitudes and behaviors, outreach and educational campaigns should be developed to target schools, businesses, market places, and key waste contributors. Also to be targeted are key influencers like the leadership of faith-based organizations to drive waste reduction and recycling advocacy through segments of the society. LAWMA should as a matter of urgency provide electronic counter/monitoring at the gates of the Transfer Loading Stations to accurately capture the work of the waste workers. There are untapped opportunities in the sanitation value chain which include activities at the landfills where wastes can be regenerated, reused or recycled. The potential for business opportunities exists in the following fields; electricity energy from biodegradables, biomass energy, biogas, organic manure production, and wastewater harvesting. To tap into these opportunities, LAWMA should enable viable private service providers (PSP) to allow private people own a stake by buying compactor trucks, doing enumeration of their franchise area and developing their businesses. As an example, street sweepers were employed and enabled with cleaning specific areas where LAWMA pays the franchisees and a stipulated amount is in turn paid to workers. Another short-term solution is to immediately provision toilet facilities in slums, BRT stations and other public places, by identifying and instituting a government office or

potentially partnering with a PSP. LAWMA should also familiarize with the Extended Producer Responsibility (EPR) law of the National Environmental Standards and Regulation Enforcement Agency (NESREA) which is created to enable a nationally coordinated effort for waste management.

## **5. BUILT ENVIRONMENT**

*Authors: Eyitope Aremu, Michael Essien, Abiodun Macgregor*

Cities matter because they offer the best chance to dramatically reduce pollution and health impacts, provide shelter and community for the world's growing human population, and protect rural habitat for species in decline<sup>xiii</sup>. To do this, we must not ignore the relationships between built and natural environments and must highlight that like most cities, Lagos' built environment is deeply tied in with other systems such as sanitation, energy and transportation. The currently linear design thinking with regard to the infrastructure within a city is that it is built without proper planning.

### **5.1. Current Built Environment**

The design of the current Lagos built environment has a linear model, which operates on the take-make-use and dispose principles without taking into cognizance systems thinking, interconnectivity and the end of life of the infrastructures. Houses are not only unsustainable but some are unreliable. According to the special adviser to the Lagos State Governor on Central Business District, many buildings around the Lagos Island are built on gutters/drainages and some do not have toilets and the government regulation on squatters and slum settlements is poor. For the purposes of this ECE workshop, the built environment was defined as a Lagos network to support citizen mobility, provide water and sanitation services, and provide shelter and support economic development in the form of residential, commercial and industrial buildings.

The road networks, especially at the CBDs, are disconnected from the purpose of the CBD area. Figure 7 elucidates the current system where only a few houses within Lagos metropolis have a central sewage system. Household waste is mostly discarded at unsanitary and unsustainable landfills. A study conducted in 2004 shows that 56.1% of Lagosians are living in a derelict or near derelict housing.

Research has also shown that huge direct and indirect environmental consequences are associated with the ways we design, build, operate, maintain and ultimately dispose of buildings<sup>xiv</sup>. Progress toward a sustainable future cannot ignore the importance of the built environment. This section aims to foster a wide-ranging and intellectually substantial exploration of sustainability as it relates to the built environment, which relies heavily on the other sectors: unclean without sanitation, hungry without food, restrictive without transportation, hectic without electronics and unimaginable without energy.



However, the availability means nothing without accessibility, affordability and sustainability. This takes us to our vision of a new Lagos where the systems are properly interconnected. There is also the prevalence of land grabbers called “Omo-oniles” who disrupt construction activities and actively undermine the safety and sanctity of housing procedures.

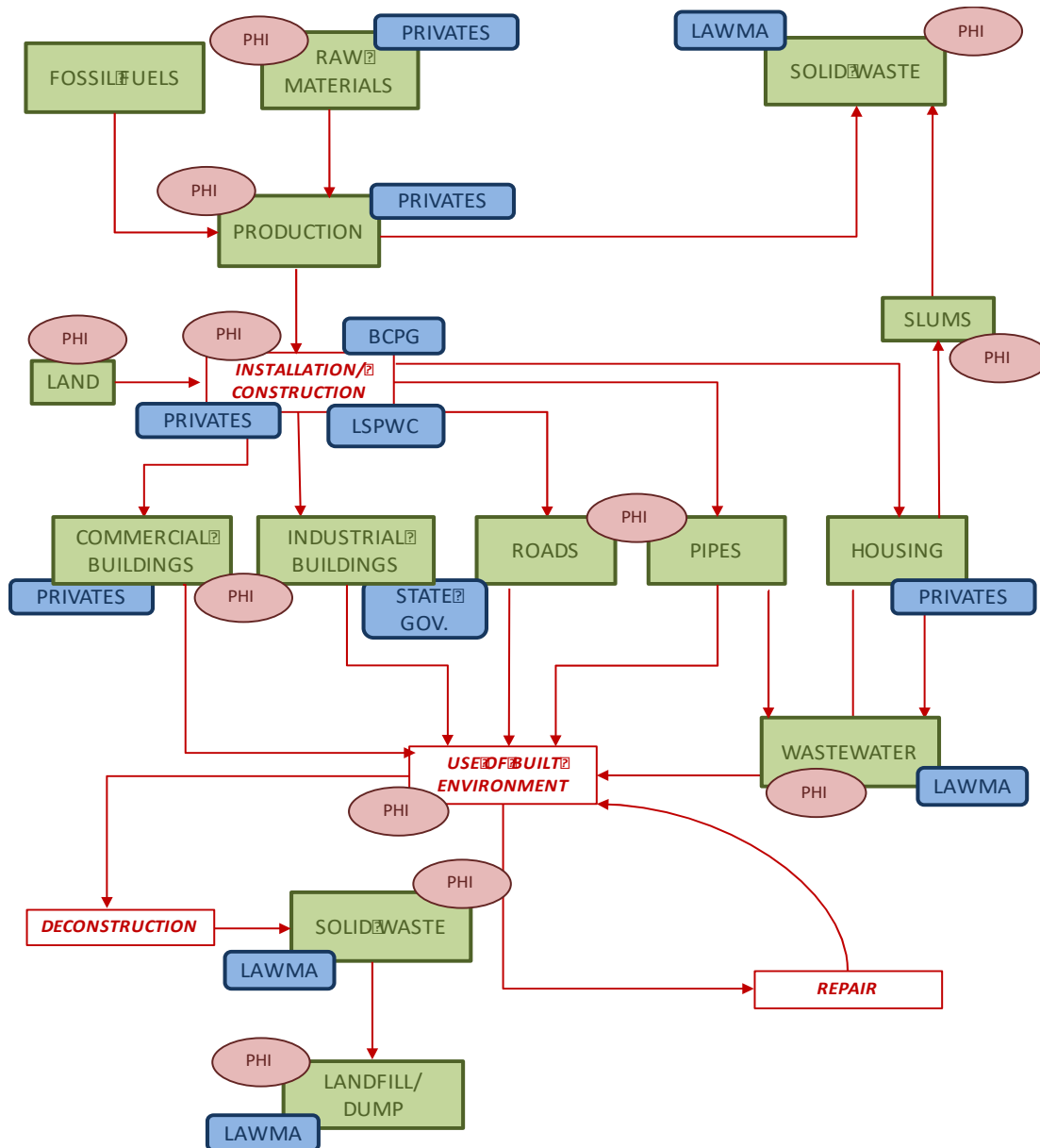


Figure 7: Current Built Environment Systems in Lagos

Currently, the built environment is poorly planned, with lack of coordination between systems, and with insufficient quantities of highly unreliable services in many cases. The external stressors on the built environment include climate impacts, rapid

population growth, and lack of economic opportunity, which then exacerbates these deficiencies.

## 5.2. Envisioned Built Environment in an ECE

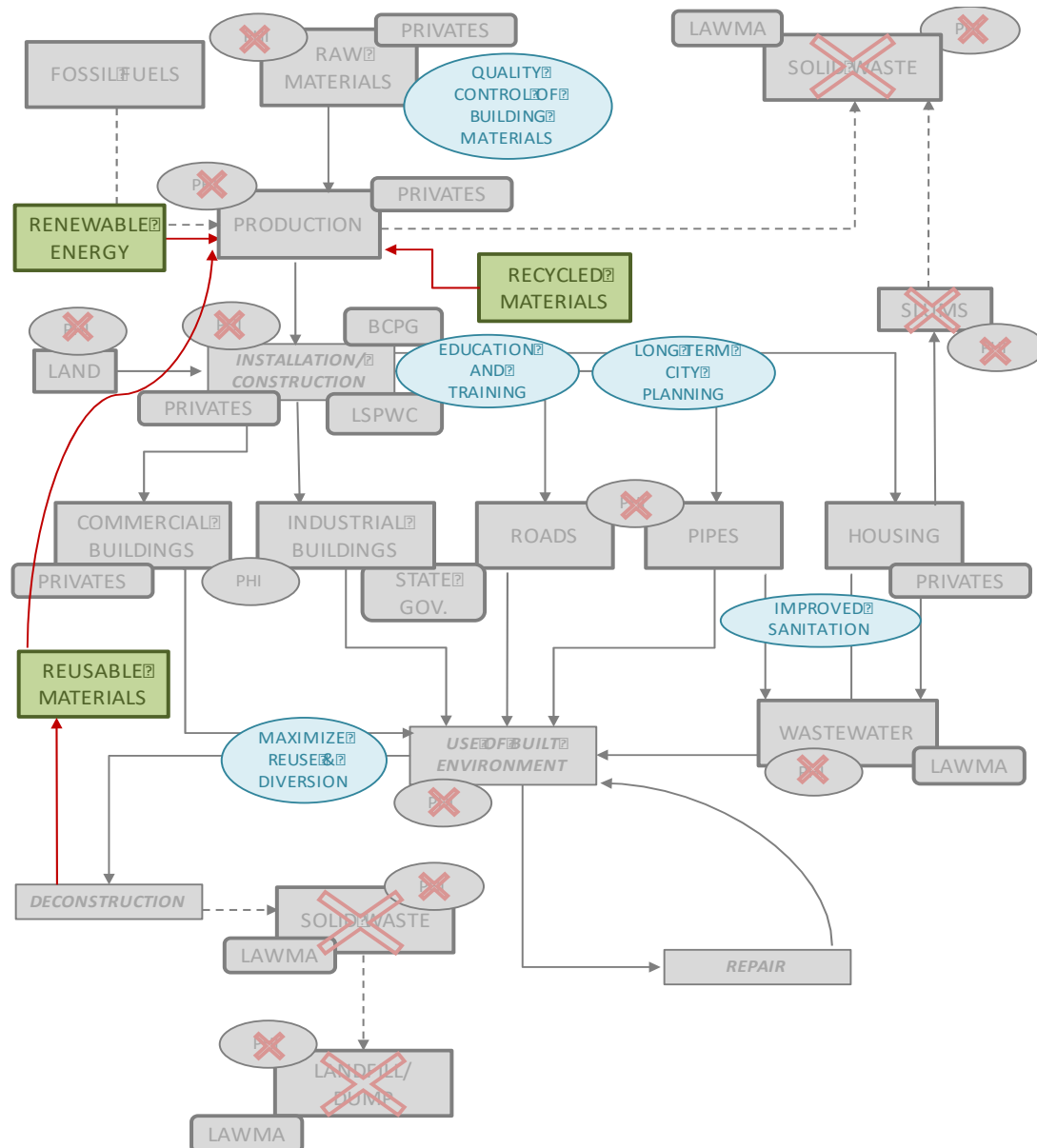


Figure 8: Envisioned Built Environment Systems

Integrated design, supportive regulatory agencies, progressive financial partners and participation from all relevant public and private stakeholders would enhance the built environment of Lagos substantially. Proper planning of future developments along with specification for building LEED (Leadership in Energy and Environmental Design) certifications, energy and water efficiency measures, green roofing efforts, ventilation and other environmentally sound practices should be tailored into policies to incentivize

their application. Opportunities exist in community regeneration as a way of rethinking slum settlements and incorporating 21<sup>st</sup> century circular economy built environment. A holistic, circular process with integrated design that keeps in mind the needs of the people using the infrastructure is vital. The long term plan is to build a new Lagos with circular economy principles in 2030 by integrating systems that is designed to work with nature and without waste. The project will have to be designed from the inside-out with the system strategies coming first. The experience of the pilot community (in Epe Lagos) could be expanded and extended to other areas including the existing unorganised built environment like Lagos CBD. The idea of the building as an integrated system will factor in climate forces within Lagos environment with water and waste systems. This design intent is clearly articulated through the energy, water, and material connections. Urban planning, mobility systems, and food systems are vital parts of the design, one that is a performance based design that aims at harnessing the talents and insights of all stakeholders to optimize project goals, reduce waste, increase value to the users, and maximize efficiency through all phases of design, fabrication, construction and end of life.

### **5.3. Built Environment Notes and Assumptions**

- The current built environment starts with the use of fossil fuels and raw materials to create building materials. These are installed to create commercial buildings, industrial buildings, roads, piping, and housing.
- The use of poor building materials and unregulated building practices has resulted in collapsing of buildings and creation of slums within the city.
- There is no proper system of piping to handle wastewater in most housing.
- Once the built environment is run down it is either repaired and used again or it is deconstructed, with most of the material ending up as waste in a landfill.
- In the envisioned built environment renewable energy and recycled materials are used to create building materials. There is also quality control of the types of building materials that are allowed to be used.
- The decisions for construction are based on long term city planning, which accounts for population density and future growth. The construction work is done by qualified and well-trained workers to improve quality of outputs, prevent injuries and better mitigate building collapses.
- A network of improved piping for sanitation and water are extended to housing communities to increase quality of life.
- Once the built environment is run down it is either repaired or deconstructed and as much material as possible is reused for future building requirements.

## 5.4. Net Positive Impact Assessment

When reviewed against the Sustainable Development Goals, a number of goals were highlighted as net positive including:

SDG 9 – Resilient infrastructure by better designed built environments

SDG 11 – Making human settlements more inclusive, safe and resilient

SDG 13 – Mitigating climate change by better use of energy and water in buildings

There were also some aspects that were considered net negative in impact:

SDG 11 – May not be possible to make this area low cost and affordable

SGD 10 – May not reduce inequalities, as the wealthier people may have easier access to better infrastructure.

## 5.5. Built Environment ECE Solutions

It is estimated that two-thirds of residents of Lagos live in substandard housing areas. Given the overall population of the State as approximately 20 million this means that about 145 million inhabitants experience poor conditions. <sup>xv</sup>Lagos urgently needs a full complement of Regional, District and Neighborhood Master Plans to guide the next phases of development and establish some priorities for neighborhood planning. Slum upgrading is required to improve basic facilities such as water supplies, sanitation and rubbish removal. In all these, system thinking, interconnectivity and the natural environment are to be considered as paramount. To achieve this vision, a body should be set up to evaluate the current environment in order to identify the loop holes and ways of closing them, and concurrently address environmental and health issues. An ECE strategy should be developed, integrating bottom up strategies for urban planning instead of static top-down urban planning methods. Spatial planning for current and future needs must be done, avoiding unplanned development that can obstruct roads, pathways and human progress. For example, by identifying a new development area around the EPE axis that is closer to the Lagos Free Trade Zone as a pilot scheme for the commencement of an ECE built environment. To get support and buy-in, advocate the Lagos State Ministry of Physical Planning and Urban Development and even the Federal Government where necessary to review some existing laws and policies that will facilitate early approvals for the entire building process and other relevant policies. Finally, collaborate with education and training institutions to organize training and retraining for relevant stakeholders.

## 6. TRANSPORTION

Authors: *Douglas Adeola, Laolu Agboola, Aolat Alade, Cyril Inegbedion*

The role of transport is vital to the realization of the State's mega city status and the efficiency with which people, goods and services can move from one point to the other largely determines the quality of life of the society<sup>xvi</sup>.

Availability of public infrastructure makes the society comfortable and habitable. However, a combination of an expanding population and escalating demand for public services have continued to exert pressure on available resources, exacerbating the problems of traffic congestion, housing shortages and inadequate economic infrastructure.<sup>xvii</sup>

The State has a total road network of 9900km comprising of 509.97km of 71 Federal roads, 5,816.71 km of State roads and the total length of roads in the Local Government areas is 3,573.71km. In addition, the State has about 30km of rail network.<sup>xviii</sup>

The modes of transport consist of Buses (Molues), Mini-Buses (Danfos), Bus Rapid Transit (BRT), Taxis, Motor-Cycles and Tri-Cycles (Okadas), Ferries and Trains. The total traffic per day is put at 7 million passenger trips. It provides the second largest sector in Lagos by GDP value. The dominant factor in terms of value is road transport as it is the most commonly used mode of transportation in the State today. It also provided substantial employment opportunities to the population. The establishment of Bus Rapid Transport (BRT) services has expanded the passenger's choice in term of service quality and timeliness.

### 6.1. Current Transportation System

The Lagos State Ministry of Transportation is directly responsible for the regulation of the transport system in the state while enforcement of regulations and standards are carried out by different agencies of both the State and Federal governments.

In addition to the State Ministry of Transport there are presently six (6) agencies in the Sector with different degrees of autonomy, namely: Lagos State Traffic Management Authority (LASTMA); Lagos State Waterways Authority (LASWA); Lagos Metropolitan Area Transport Authority (LAMATA); Lagos State Drivers Institute (LASDRI); Motor Vehicle Administration Agency (MVAA); and, Lagos Bus Asset Management Limited (LAGBUS). LASG currently spends 5% of its budget – about 0.7% of GDP on transport.

Railway transportation is on the exclusive list of Federal Government functions managed by Nigeria Railway Corporation with the mandate to provide transport links between productive and well populated parts of the country with traffic origin and

destination areas well separated. However, Lagos State only enjoys passenger fleets on the Iddo - Ijoko axis which represents a very low proportion of passengers as well as goods traffic volume usually carried by rail.

Water transport includes transportation of passengers or freight over water, operations of tours, excursion, cruise or sightseeing boat, ferry and water taxis. Lagos being a coastal State with an enviable proportion of water mass, there is need to comprehensively overhaul water transportation system in the State. This would enhance reduction of road traffic congestion.

The Lagos state government has continued to explore several avenues to improve public transportation. The city's transport policy focuses on the development of a multi-modal system involving land, water and rail. So far, the measure of success achieved by the government remains on land transportation through maintenance, expansion and/or upgrade of some existing roads, construction of new roads, and the introduction of BRT and LAGBUS. However, there is still a big lack in terms of the development of other modes of transportation. Both the rail and water modes of transportation are yet to be fully developed and incorporated in the transport system in Lagos.



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## 6.2. Envisioned Transportation System in an ECE

Transport serves different markets and sectors, and is a vital component for the movement of people and goods and thus play an important role in integrating the State, thereby facilitating economic growth, and ultimately reducing poverty.<sup>xx</sup> In view of the large unmet needs, perhaps, the single most important opportunity in the sector is to make transport services more efficient so that people, goods and services can move from one point to another with ease. Opportunities would help farmers transport their produce to markets on time, increase export competitiveness, accelerate export-led growth and contribute to sustained economic development. In addition, it would boost tourism, trade investments, hosting of sports/global events like World Cup and Olympics, employment generation and more.<sup>xx</sup>

In an ECE in Lagos (Figure 10) a more sustainable transport sector envisioned involves a sustainable, integrated, multi-modal transport system that drives other sectors of the economy. A breakdown of the vision entails transport services with mobility options (road, water, rail, and in the long run, cable line, tube) and seamless connectivity between these different transport modes for speedy, safe, pleasant and comfortable movement of passengers<sup>xxi</sup>. A regional transport strategy for Lagos is key in the realization of the envisioned transport system, which entails planning that considers various modes (road-based, rail-based and water-based) and connections among these modes. The ultimate goal is to link the regions through different modes of transportation or feed all the regional transport modes into a central point of convergence.<sup>xxii</sup> The 3 tiers of governments (Local, State and Federal) should be involved in transport planning. The long-term plan involves implementation of an integrated multi-modal transport system that the Government of Lagos needs to establish, here called the “Lagos Integrated Multi-modal Transit Agency (LIMMTA),” which will be responsible for all aspects of implementation, operation and maintenance of the proposed multi-modal network i.e. planning, design, financing, implementation and the development of an end-of-life policy for vehicles. Motor vehicles at end of life stage should be managed correctly, and electric vehicles encouraged and subsidized.

The CE workshop highlighted that there is a huge opportunity in transportation. A multi-modal transport system (MMTS) involves various modes of conveying passengers from the starting point to destination. Multi-modal transportation framework includes the mass transport modes of travel.<sup>xxiii</sup> Water transport and infrastructure should be developed at three pilot routes: the Lekki area of Lagos to link Marina and complement the road expansion work at Lekki; Ikorodu to Marina and the Badagry water route right up to Mile 2 linking to Marina, which would highly serve to decongest the traffic situation. The ferry service from Ebute-Ipakodo in Ikorodu to Marina is provided through a PPP initiative (Lagos State Budget 2010) and is encouraged.



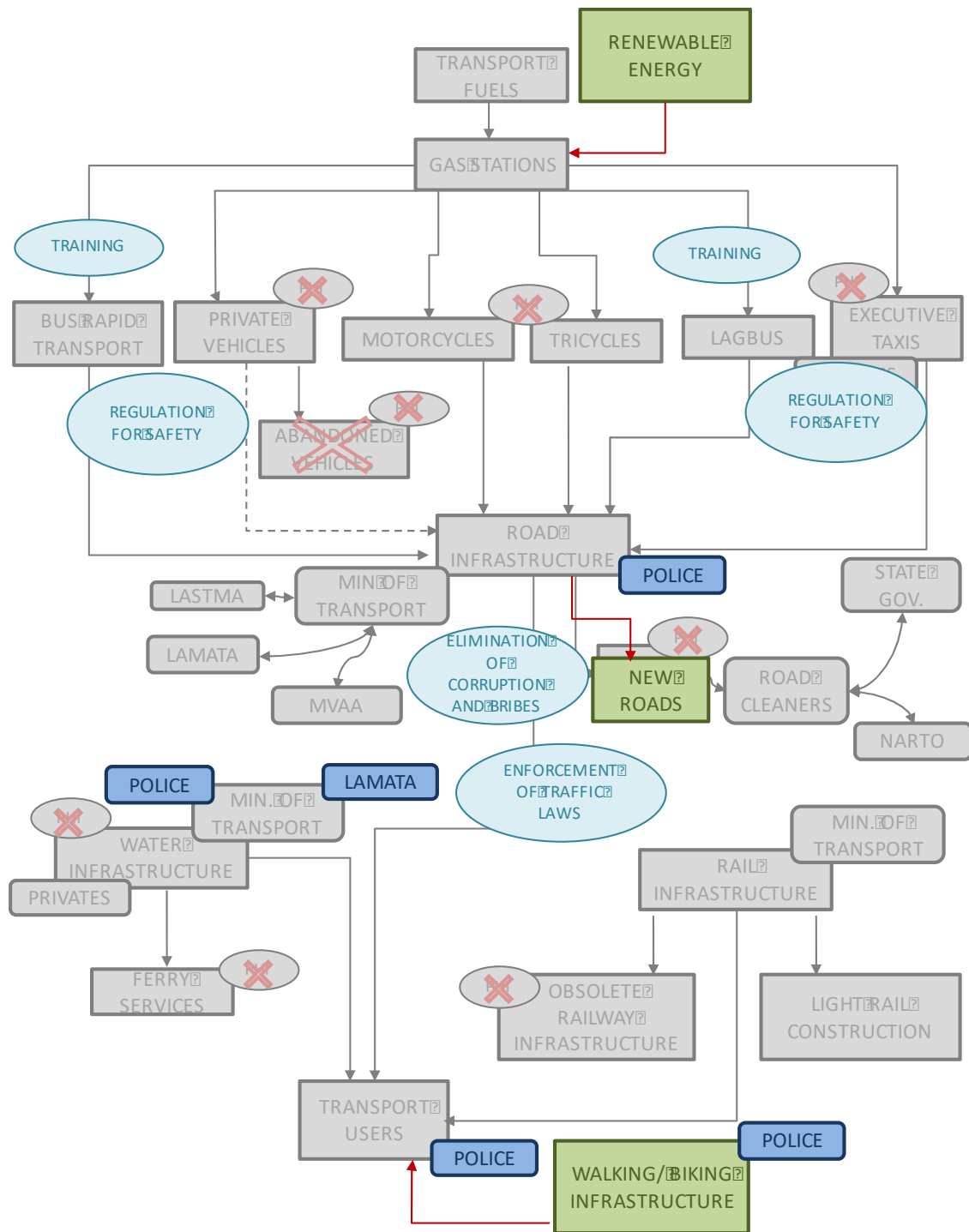


Figure 10: Envisioned Transportation Systems

### 6.3. Transportation Notes and Assumptions

- The current transportation system is made up of roads, water, and rail infrastructure.
- Transport fuels are moved by road to gas stations and then used by buses, private vehicles, and taxis. Roads are heavily congested and vehicles that break down are left on the road. There is very little regulation on vehicles and drivers. Police have illegal roadblocks that can also slow down traffic.
- Waterways are used for some ferry services, but often the water is not clear enough to use for travel and people do not feel safe on the ferries.
- Walking and biking infrastructure rarely exist and often people do not use it if it does.
- The rail infrastructure is mostly made up of an obsolete railway system, however light rail construction has begun.
- In the envisioned transportation system renewable energy is used to fuel vehicles. There is a major shift to public transportation and a limitation in personal vehicle use.
- Police have an invested interest in keeping citizens safe, and help to keep roads clear of accidents, abandoned vehicles, and traffic stops.
- Vehicles are regulated for safety and air quality and drivers must have a proper license or training to operate different motor vehicles.
- Walking and biking infrastructure is built and regulated for safety by police.

### 6.4. Net Positive Impact Assessment

When reviewed against the Sustainable Development Goals, a number of goals were highlighted as net positive including:

SDG 2 – Transportation of food through alternative means by truck or rail will improve food security and support drive for zero hunger.

SDG 3 – Active transportation activities (like cycling) can support good health by helping to prevent weight gain and lower the risks of obesity, diabetes, and heart diseases.

SDG 7 – Alternative energy sources for clean and affordable transport driven by research and innovation.

SDG 8 – Job creation for transport workers and technicians contributes to decent work economic growth.

SDG 11 – Effective and efficient transport systems positively impact cities and communities.

SDG 12 – Minimizing waste and building effective CE systems promote promotes production and consumption.

SDG 13 – Developing a broad range of clean alternative energy sources will reduce emissions and solve climate change problems.

There were also some aspects that were considered net negative in impact:

SDG 3 – Pollution through increased transport activities (cars, rails) are linked to negative health outcomes like respiratory illnesses.

SDG 13 – Increased infrastructure and heavy mechanization generates carbon emission.

## **6.5. Transportation ECE Solutions**

Integrated multimodal transportation system entails synchronization among various modes of transport for better, advanced and efficient service.<sup>xxiv</sup> Multimodal transportation integration is important to maximize the impact of transport services and enable sustainable urban mobility. Full-scale multimodal integration is characterized by two key features: Integration of mass transport modes with each other- mass transport systems like bus rapid transit (BRT), light rail, monorail, metro-rail, and water-based transportation as they are much more user-friendly when they connect to one another. Secondly, integration of mass transport modes with other “feeder” modes such as taxis, tricycles and bikes to provide first and last mile connectivity. Measures to curb the rapid growth of motorization is also recommended along with the corresponding improvements in public transport.

## **7. FOOD SYSTEMS**

*Authors: Nike Olabode, Elizabeth Olayide, Ganiyat Tijani*

Lagos has a cultivable area of 1.41 million hectares (ha), of which 0.030 million ha is currently cultivated. Total swamp area is about 40% of all land. Agriculture, including fishing, accounts for only about 1% of the Lagos GDP<sup>xxv</sup>, but this requires attention because of its importance to the livelihood of many people living in the rural zone of the state and how it contributes to meeting food security in the State. Sixty percent of the population of metropolitan Lagos falls within the poverty bracket. Generally, expenditure on food takes a high percentage of urban household resources as the poorest households may spend up to 90% of their meagre income on food. <sup>xxvi</sup>Household

decision-making behavior with regard to food is influenced by nutrition knowledge and by cultural practices to food allocation within the household as well as by purchasing power and market prices.

## **7.1. Current Food System**

Currently, interconnectivity exists between the actors (producers, suppliers/processors and consumers) to facilitate food sustainability, availability, accessibility and security. This would be further enhanced through interactions with other systems, e.g. effective transportation within the Central Business Districts as well as across regions. Urban agriculture contributes to food security and food safety in many ways: by increasing the amount of food available to people living in cities, by allowing the supply of produce for the populace, by adding greenery to the city built environment and thus stimulating growth.

In Nigeria, 40% of the population lives in urban centers<sup>xxvii</sup>. Metropolitan Lagos is the most urbanized area of the nation harboring over 60% of Nigeria's industrial and commercial establishments, international sea and airports, 70% of the nation's banking institutions and 90% of foreign trade and corporate headquarters of multinational corporations. These economic opportunities continue to pull migrants from other parts of Nigeria in particular and other parts of the West African sub region in general. 60% of the population of metropolitan Lagos falls within the poverty bracket. Generally, expenditure on food takes a high percentage of urban household resources as the poorest households may spend up to 90% of their meagre income on food

Food security is an integral part of the Lagos State Economic Empowerment and Development Strategy (LASEEDS) document, as well as the resolutions of the Ehingbeti summit.<sup>xxviii</sup> Farmers have poor access to credit, technical inputs, machines and agricultural inputs and prohibitive transport costs for food further cripple their capacities. Forest degradation is also high and adversely affects the ecosystem. It has also had a negative impact on agricultural production through the degraded soils, water distribution and unstable rainfall pattern. The major forest reserves and conservation centers are located at the Nigeria Conservation Fund project at Eti-Osa, the Langbasa Centre (Eti-Osa), Majidun and Erikorodo at Ikorodu and Ologe and Yewa in Badagry<sup>xxix</sup>.

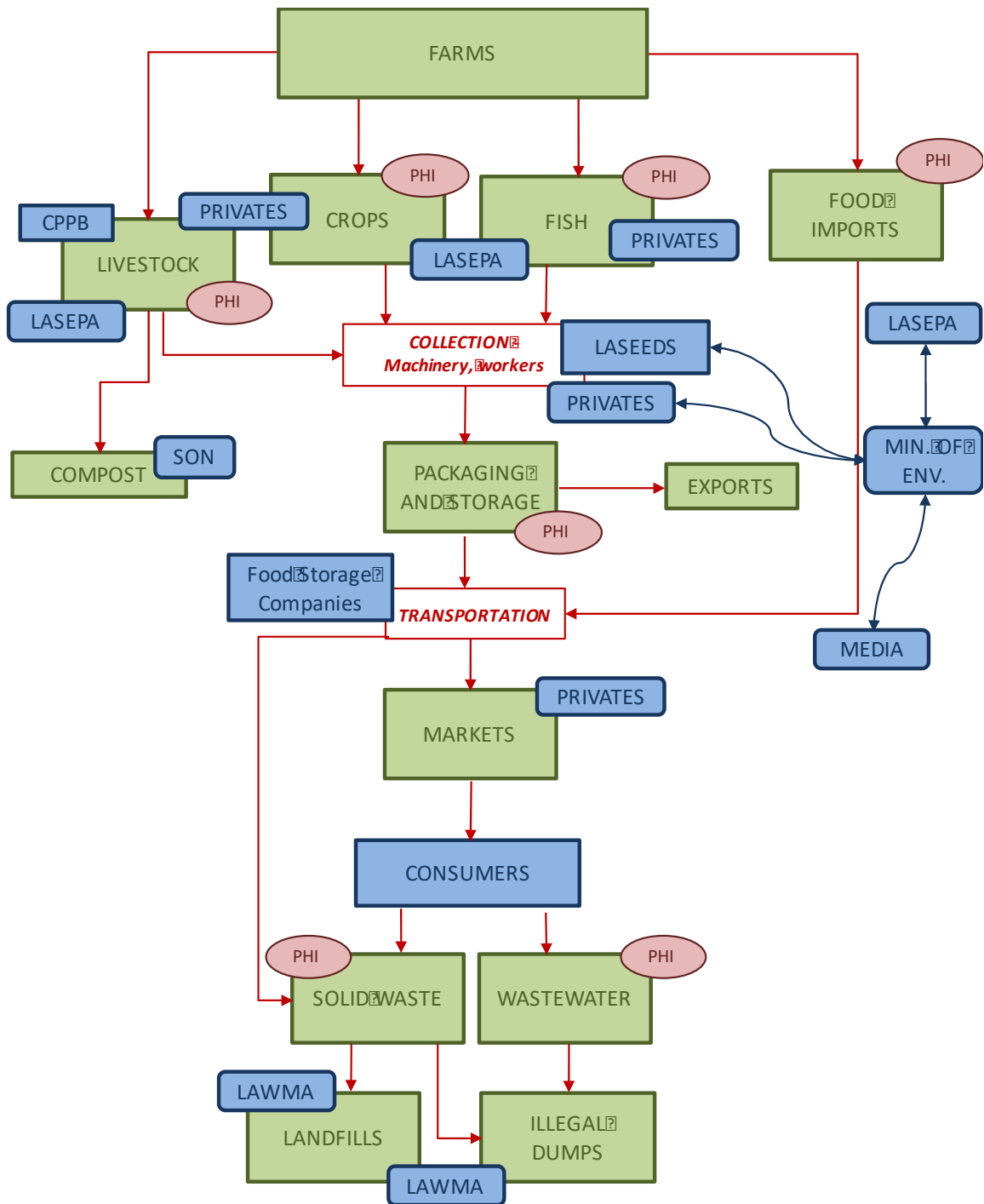


Figure 11: Current Food System in Lagos

Currently, livestock production in Lagos is dominated by poultries and piggeries while cattle from outside the State dominate consumption. The State has a modern meat processing and livestock feed production facility at an abattoir at the Lairage Complex, Agege, with a slaughtering capacity of 2,000 cattle and 2,500 sheep/goats per day. Lagos has the fastest growing fish farming sector in Nigeria, utilizing earthen, concrete

based as well as cage and pens culture on open water bodies. Urban fishing in Lagos remains relatively undeveloped, both in terms of artisanal coastal and lagoon fishing and Lagos continues to import more than 50% of its fish consumption even though local potential has remained largely untapped. On the other than Forest degradation is high and adversely affects the ecosystem. It has also had a negative impact on agricultural production through the degraded soils, water distribution and unstable rainfall pattern. The envisioned systems need to affect and rectify these negativities.

## **7.2. Envisioned Food System in an ECE**

Rail would be effective in transporting fresh produce faster to the markets and this would reduce waste of perishable foods. Cold vans are useful for transporting meat and poultry produce and can be useful in storage and preservation. Plastics are useful majorly in food packaging and should be explored in packaging of processed foods, vegetables and drinks. Through interactions with the plastics system plastic boxes can be used for storing beans and cereals. They are also useful as means of growing plants in nurseries e.g. flowers and domestic crops.

The biggest barriers to circularity within the food system are the land policy, as the majority of urban farmers do not own the land they use for food production. Furthermore, access to traditional bank loans or any type of financial assistance is an obstacle.<sup>xxx</sup> Urban farmers who pursue direct sales to institutions, grocery stores and restaurants may be faced with competition from wholesale distributor monopolies. Because urban farmers are growing on less land than their conventional counterparts, they may not be able to produce year-round high yields demanded by larger scale purchasers<sup>xxxii</sup>. Circular economy regarding the food system implies reducing the amount of waste generated in the food system, utilization of by-products and food waste, and nutrient recycling. <sup>xxxiii</sup>The measures must be implemented both at the producer and consumer levels, and finally in the food waste and surplus management. The current food system depends mostly on the import of products from around the world with heavy reliance on fossil fuels contributing to climate change challenges, and transported long distances for packaging and distribution before reaching consumers<sup>xxxiii</sup>. The key is to understand the mechanisms and policies that can promote the realization of CE in food systems and make evident the barriers for overcoming these issues.

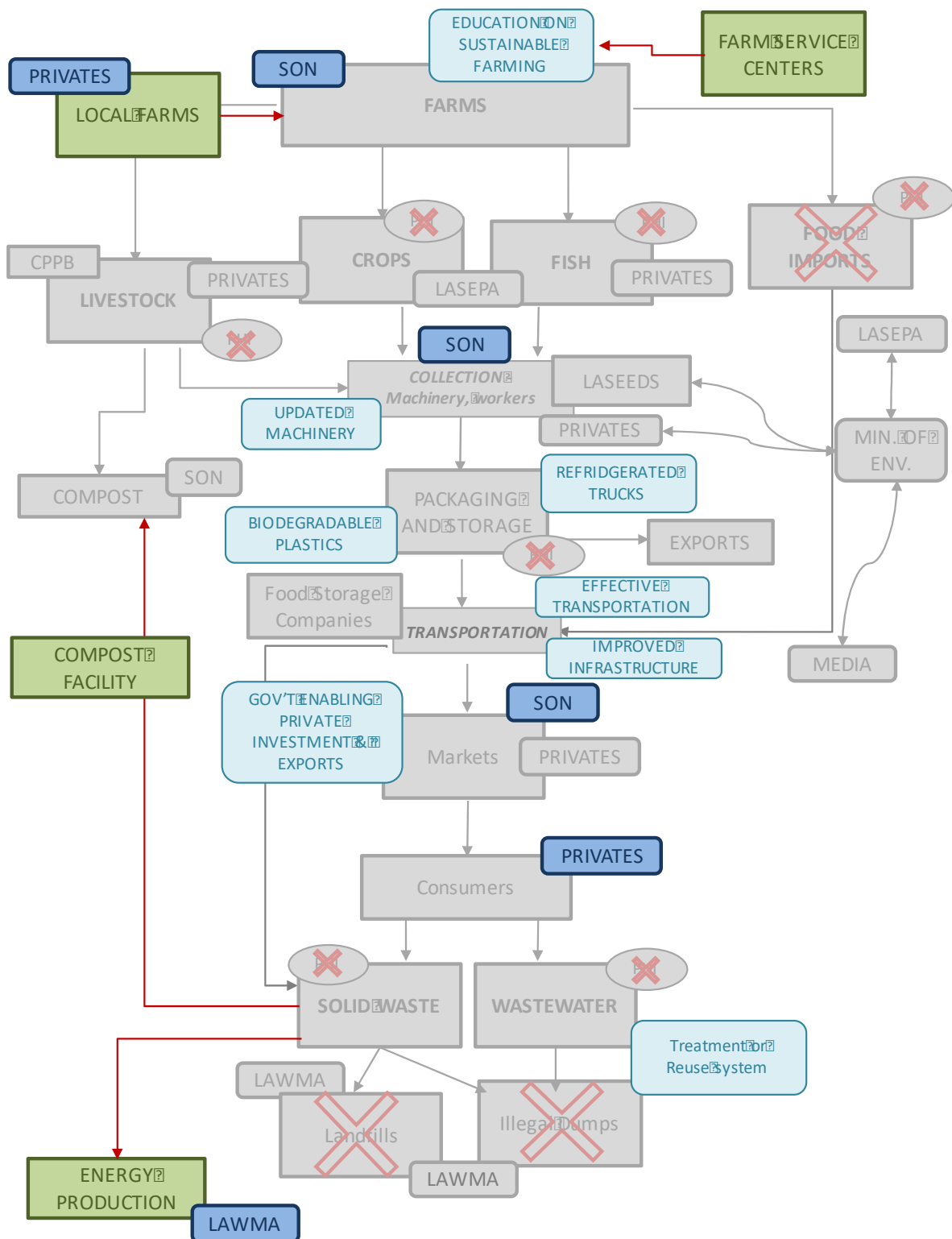


Figure 12: Envisioned Food System

### **7.3. Food Systems Notes and Assumptions**

- Commercial and small scale farms produce the food for the current food system. Livestock, crops, and fish are produced in the region, but not enough to sustain the current population. Additional food is imported to make up for this deficit. Current agricultural practices deplete the land and water resources.
- Food produced locally is collected using outdated machinery or by hand. It is then packaged, transported, and sent to markets. Packaging and transportation methods are poor and result in high volumes of food waste.
- Consumers then buy food from the markets. The food either goes bad and results in solid waste or is eaten and human waste and wastewater is produced. This waste ends up in landfills or is dumped illegally. Many homes lack wastewater treatment.
- In the envisioned food system, all food is produced locally with a focus on small scale farms. These farmers are educated on sustainable farming practices through local coalitions.
- Technology updates in the form of improved farm machinery, use of refrigerated trucks and biodegradable plastic packaging, and updated transportation infrastructure highly reduce the volume of solid waste produced before reaching the market.
- Solid waste produced by consumers is used for energy production and enters a compost facility, where it can be used again by local farmers for more fertile soil. Wastewater is treated or reused at farms.

### **7.4. Net Positive Impact Assessment**

When reviewed against the Sustainable Development Goals, a number of goals were highlighted as net positive including:

SDG 1 – Food security reduced general poverty impact

SDG 2 – Increasing access to affordable and healthy food varieties and quality

SDG 3 – Increasing access to better food options lead to better health and well being

SDG 7 – Affordable and cleaner energy via converting food waste to clean energy

SDG 8 – Decent work and growth due to job for skilled workers and technicians

SDG 11 – ECE food systems contribute to sustainable cities and communities

SDG 13 – A circular food system may mitigate climate change

SDG 14 – Better fisheries and fishing practices improving quality of life



There were also some aspects that were considered net negative in impact:

SDG 8 – Unskilled workers may lose jobs due to automation

SDG 13 – Increased infrastructure and mechanization can increase carbon emissions

SDG 14 – Exploitive activities and mechanization might pollute water bodies and

## 7.5. Food Systems ECE Solutions

Investment in efficient infrastructure and storage facilities cannot be overemphasized if food waste is to be reduced. The country needs policies for inclusive growth to maximize its food production potential, and this means supporting smallholder-led agriculture. Policies that offer incentives should be enforced for investment in agriculture, reducing the risks for farmers and private sector partners, and encourage inclusive business models which facilitate the ability of poor farmers to access finance and technology as well as rights to water and land. Lagos should make agriculture a top priority. In Burundi, for example, the International fund for Agricultural Development (IFAD) supported the Comprehensive Africa Agricultural Development Program (CAADP) in lobbying for policy changes. As a result, the government has introduced fertilizer subsidies and increased the share of the agricultural budget from 3.6 per cent in 2010 to 10 per cent in 2012<sup>xxxiv</sup>. More than one third of the rural population of sub-Saharan Africa lives five hours from the nearest market town of 5,000 people, making transport and marketing costs too high<sup>xxxv</sup>. Badly maintained roads should be rehabilitated. Equally important are processing and storage facilities. An estimated 20 to 40 per cent of crop production is lost because of deterioration after harvest<sup>xxxvi</sup>. What Lagos needs is effective institutions, infrastructure from production to processing plants, warehouses and roads.

## 8. ELECTRONIC WASTE

Authors: *Layide Adesanya, Fisayo Alo, Chikodi Chiedo, Lekan Olapeju*

Electronic waste (E-waste) management is one of the biggest environmental challenges of our time. Many countries around the world are grappling with the challenge of reducing levels of unsafe disposal and processing of e-waste and are trying to increase the levels of recycling and safe e-waste handling processes. E-waste is the fastest growing sector of the municipal solid waste stream and currently comprises more than 5% of its total flow, which is equivalent to 20-50 million tons a year worldwide<sup>xxxvii</sup>. These enormous quantity and hazardous component of e-waste has brought it as a global environmental issue. E-waste gives rise to serious impacts on human health. It is

crucial that e-waste is properly taken care of throughout the life cycle of collection, handling, recycling and disposal<sup>xxxviii</sup>.

## **8.1. Current State of E-Waste**

Nigeria ranks among the top ten importers of e- waste after China. The other major importers of E-waste are India, Pakistan, Vietnam, the Philippines, Malaysia, and Ghana (Robinson, 2009)<sup>xxxix</sup>. The exporting of E-waste and WEEE (Waste Electrical and Electronic Equipment) to poor and developing countries makes the subject of E-waste management more complicated, owing to environmental and health problems and because some recycled contaminated products associated with its recycling are probably re-exported<sup>xl</sup>. The current management of e-waste in Lagos is mainly informal, the sector lacks adequate regulations by the government despite the existence of policies and regulatory agencies to implement and monitor the adherence to the policies. <sup>xli</sup>At present, in Lagos state, there is no available and accurate information that describes the characteristics and generation rate of e-waste or the actual practice of management and handling of the waste.

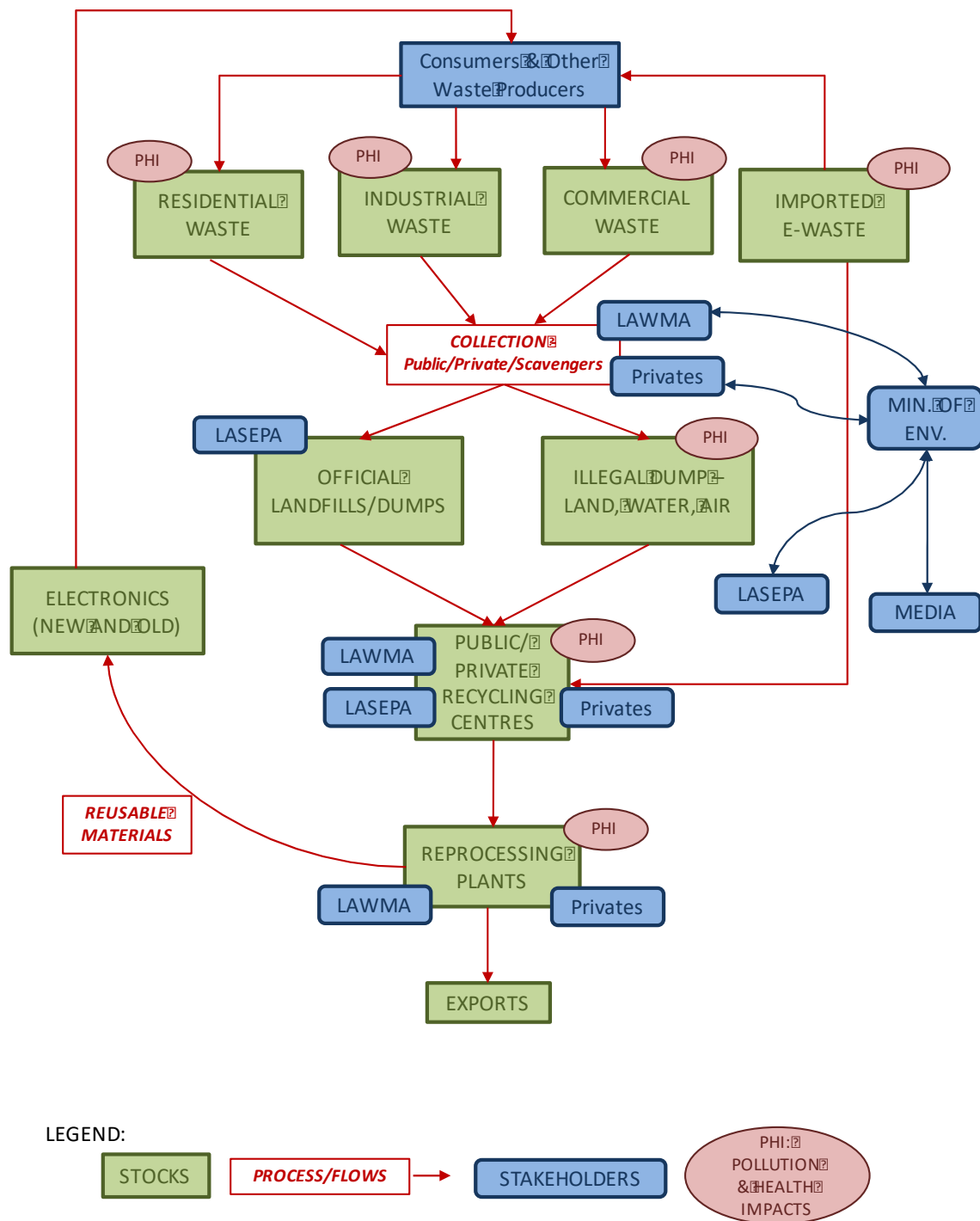


Figure 13: Current E-Waste System in Lagos

In practical terms, there is no definite policy or plan for the allocation of funds to prepare suitable equipment and facilities for the management of e-waste. Lagos plays a major role in international trade, and often e-waste is part of that trade.

## 8.2. Envisioned E-Waste System in an ECE

The scope of the E-waste management strategy in Lagos involves; build an adequate infrastructure which can be achieved by partnering with private organizations in establishing recycling plants for E-waste, regulate the crude recycling by informal sector through training and workshops, involve service providers in creating awareness to Lagos citizenry on the effects of E-waste on Health and Environment, build capacity to audit all EEE in corporate, household and informal sectors, provide appropriate equipment, technical and environmental expertise to process e-waste materials, and encourage citizen participation in all phases of the e-waste management planning along the chain and EEE lifecycle to help gain community awareness.

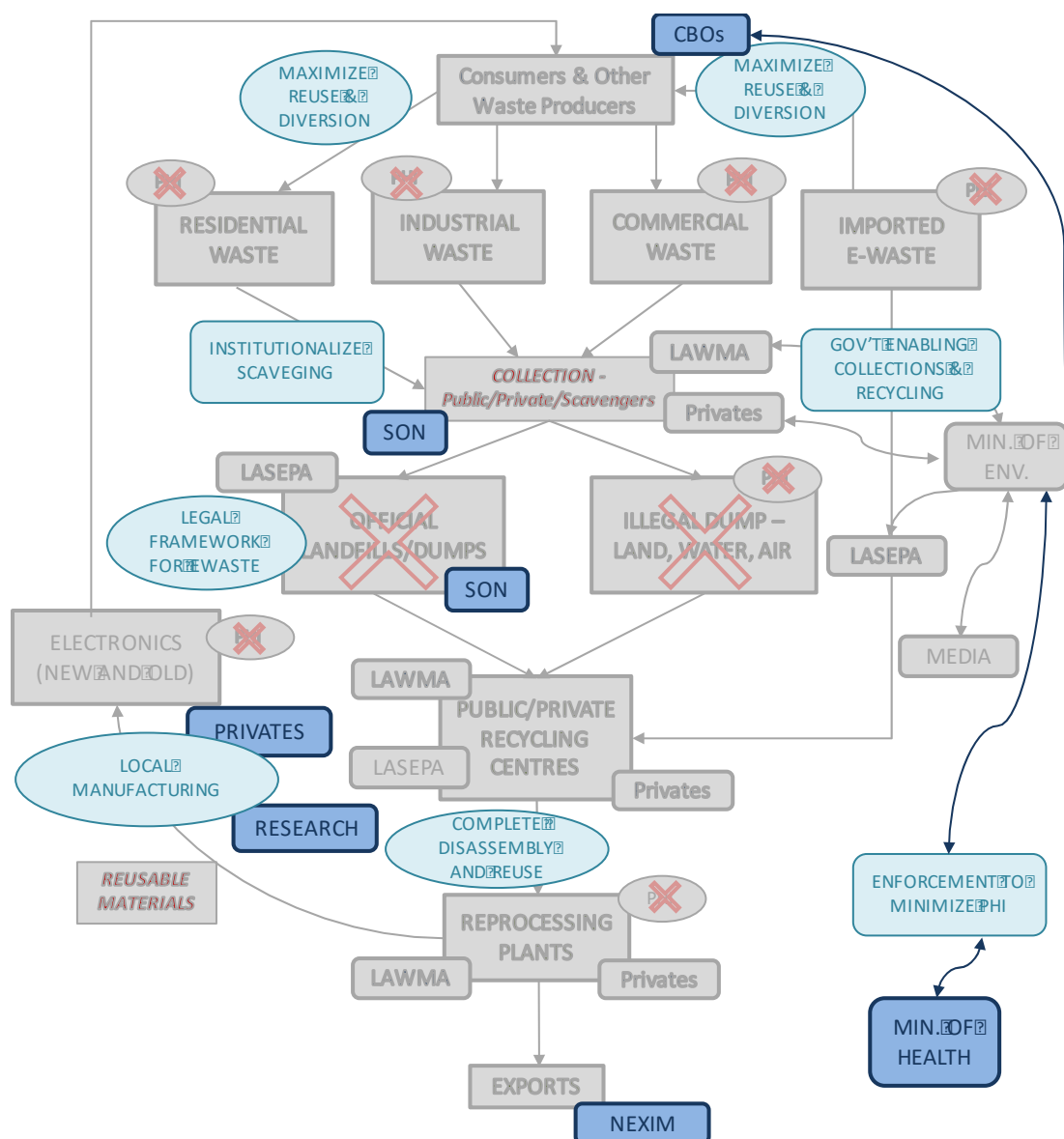


Figure 14: Envisioned E-waste system

### **8.3. Electronic Waste Notes and Assumptions**

- Consumers of electronic products are the primary drivers of the current e-waste system.
- E-waste is created from residential, industrial, and commercial electronic use. It is also imported from other markets. E-waste is imported for secondhand use or material harvesting.
- E-waste is collected along with other waste and sent to official landfills or dumped illegally. It then can be resorted out and sent to public and private recycling centers, where it is then reprocessed and either exported back out or used to make new electronics locally.
- In the envisioned E-waste system, a legal framework for the proper processing and procedures for handling E-waste is created. All e-waste is recycled and disassembled for reuse or resell. Local manufacturing promotes the collection and reuse of these materials, and supports growth in the local economy.

### **8.4. Net Positive Impact Assessment**

When reviewed against the Sustainable Development Goals, a number of goals were highlighted as net positive including:

SDG 1 – Increases jobs that help people get out of poverty

SDG 8 – Promote inclusive and sustainable economic growth & employment and decent work for all

SDG 12 – Ensure sustainable consumption and production patterns

But it must be said that in making E-waste circular, there are currently too many unanswered research questions that must first be identified before any net positive conclusions can be taken.

### **8.5. E-Waste ECE Solutions**

An approach consisting of a mandated product take back is proposed for implementing extended producer responsibility (EPR) program in combination with a training program at different levels of society. EPR in the state should be implemented with a targeted financing scheme rather than government subsidy. The existing environmental protection laws at the states and federal Levels need to harmonize. There is need to ensure man-power training and development to implement efficient waste management system, and drive effective monitoring and enforcement of existing Laws for compliance. Providing investment opportunities in the waste management sector will

encourage tripartite cooperation (Producers-Public-Government) and aid absorption of the informal sector in e-waste management<sup>xlii</sup>.

## **9. WATER**

Authors: *Abayomi Adelodun, Obafemi Ajibola, Tonia Chibuogwu, Bunmi Olatunde*

Lagos is surrounded by water bodies. There are about ten lagoons, with the Lagos and Lekki lagoons being the major ones. Others are Yewa, Badagry, Ologe, Iyagbe, Kuramo, Apese, Epe, and Mahin lagoons. Most of these resources are brackish (salty) especially Ologe, Lekki and Lagos Lagoons, and the Badagry Creek<sup>xliii</sup>. There are also major rivers that drain into the lagoons and water bodies in the state. These include Osun, Owo, Aye, Oworu and Ogun rivers. The growing population of the state puts a lot of pressure on the city's resources and infrastructure and one of such critical resource is water. Water fuels all major human and industrial activities in the state. In addition, many residents do not comply with well water extraction regulations, consequently, the water sources are subjected to avoidable abuses and pollution<sup>xliv</sup>. Major drivers of groundwater pollution are rapid urbanization, agricultural and industrial activities.

### **9.1. Current Water System**

Lagos is endowed with abundant groundwater which is often extracted by skilled and unskilled technicians for private wells and boreholes, leading to unplanned and uncontrolled groundwater extraction. All the water bodies in Lagos, both fresh and brackish are polluted, and the water sources are mostly unprotected.<sup>xlv</sup> There is a high level of water contamination from pipes laid in sewers and blocked sewer pipes through which sewage drains out into the environment. Majority of the water supplied in Lagos are susceptible to pollution from agricultural runoff, illegal dumping, and human waste. It is not clear that the State has a water resource protection plan<sup>xlvi</sup>.

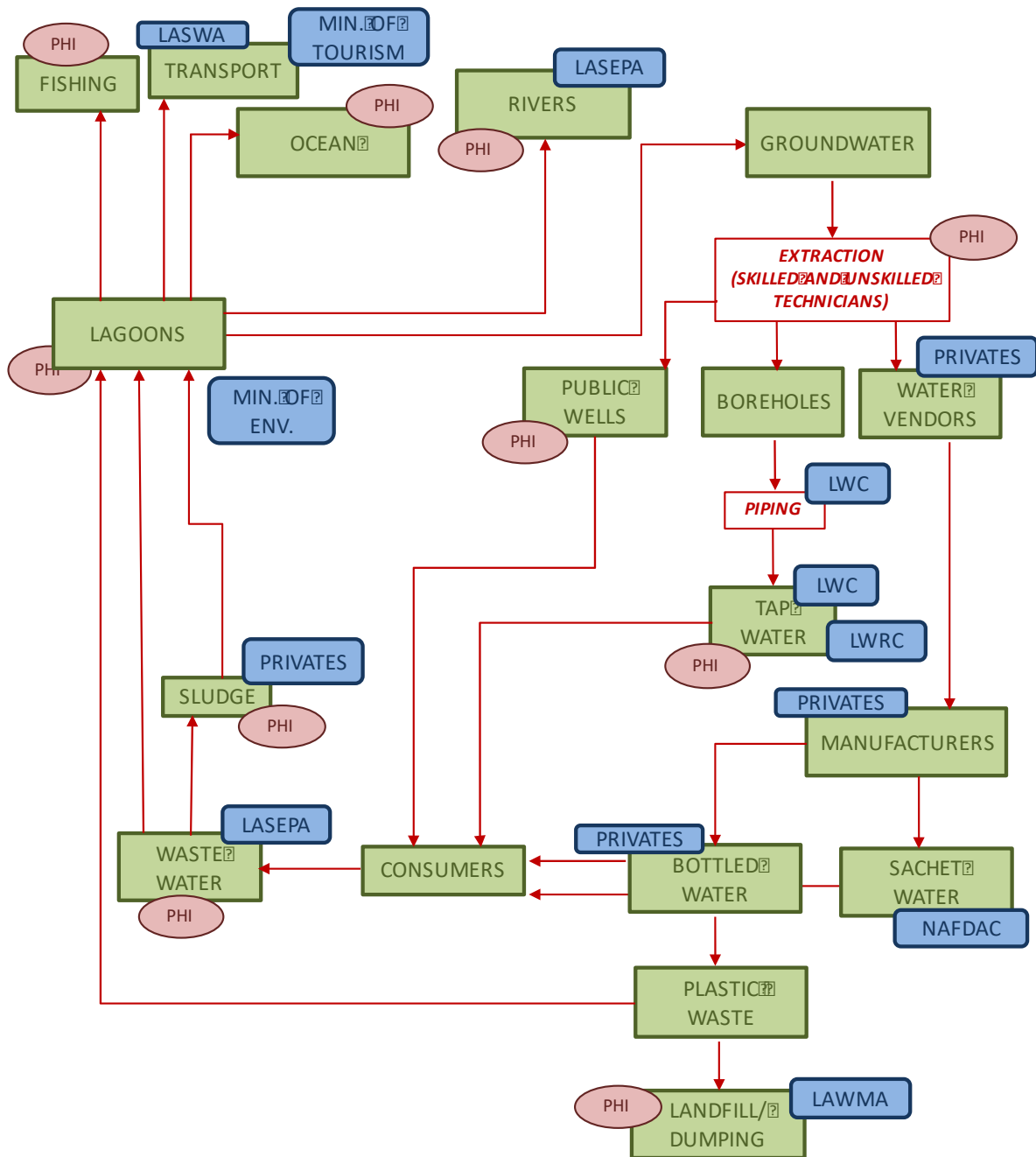


Figure 15: Current Water Systems in Lagos

The state does not supply sufficient safe drinking water for its citizens. One of the major sources of drinking water for medium and low income earners in the state is sachet water, popularly known as “pure water.” It is produced by small and medium-sized manufacturers and sold throughout the city by vendors under a variety of brand names. Those in the higher income class drink bottled water. The National Agency for Drug and Alcohol Consumption (NAFDAC) is the regulatory body that ensures that manufacturers of such packaged water meet the required standards<sup>xlvii</sup>. The Lagos Water Supply

Master Plan highlights proposed activities to be undertaken by the state to improve water supply through extensive infrastructure development. Although this plan presents an opportunity to improve the performance of the sector, the scope of the master plan is limited (addresses mainly supply issues) and does not holistically address other pertinent issues confronting the water sector such as demand related issues, wastewater and unaccounted water losses, poor service delivery, poor implementation of regulations, governance issues, institutional capacity limitations, private sector participation, technological requirements, funding and other sustainability issues, among others<sup>xlviii</sup>. A more comprehensive plan should be developed with the circular economy principles incorporated.

## **9.2. Envisioned Water System in an ECE**

Amid myriads of challenges lie opportunities for improving the sector. Some of such opportunities are - existing master plan which can be revised to accommodate circular economy principles; abundance of waste water sludge which could be used for independent power production of renewable energy/electricity; abundant water resources that can be optimally harnessed for generating employment to many vibrant public private sector, which can be encouraged to collaborate with government to achieve its goals; and a progressive government that is passionate about the sustainable development of the state<sup>xlix</sup>. There are also opportunities to partner with beverage companies such as the Coca-Cola Company that is currently supporting water initiatives in several countries across the world.

There are several requirements in the various water related laws and policies that are currently not being implemented or enforced. These makes such regulatory documents and agencies appear weak and ineffective, particularly the Lagos Water Regulatory Commission (LWRC). For instance, permits are to be granted before wells and boreholes are constructed, but these laws have not really been effective. The same applies to the use of water resources<sup>i</sup>. There is no enforcement of the laws that stipulates how these resources should be used and protected which has made it easy for industries and other institutions to continue to pollute the water bodies with chemicals and other toxic materials. The water sector need to collaborate with the relevant law enforcement agents to ensure citizens compliance to the laws that protect the water resources. Public education is also very important to ensure behavioral change. Moreover, the current polluted waters need to be cleaned and revived so that the ecosystems that have been destroyed can be revived.



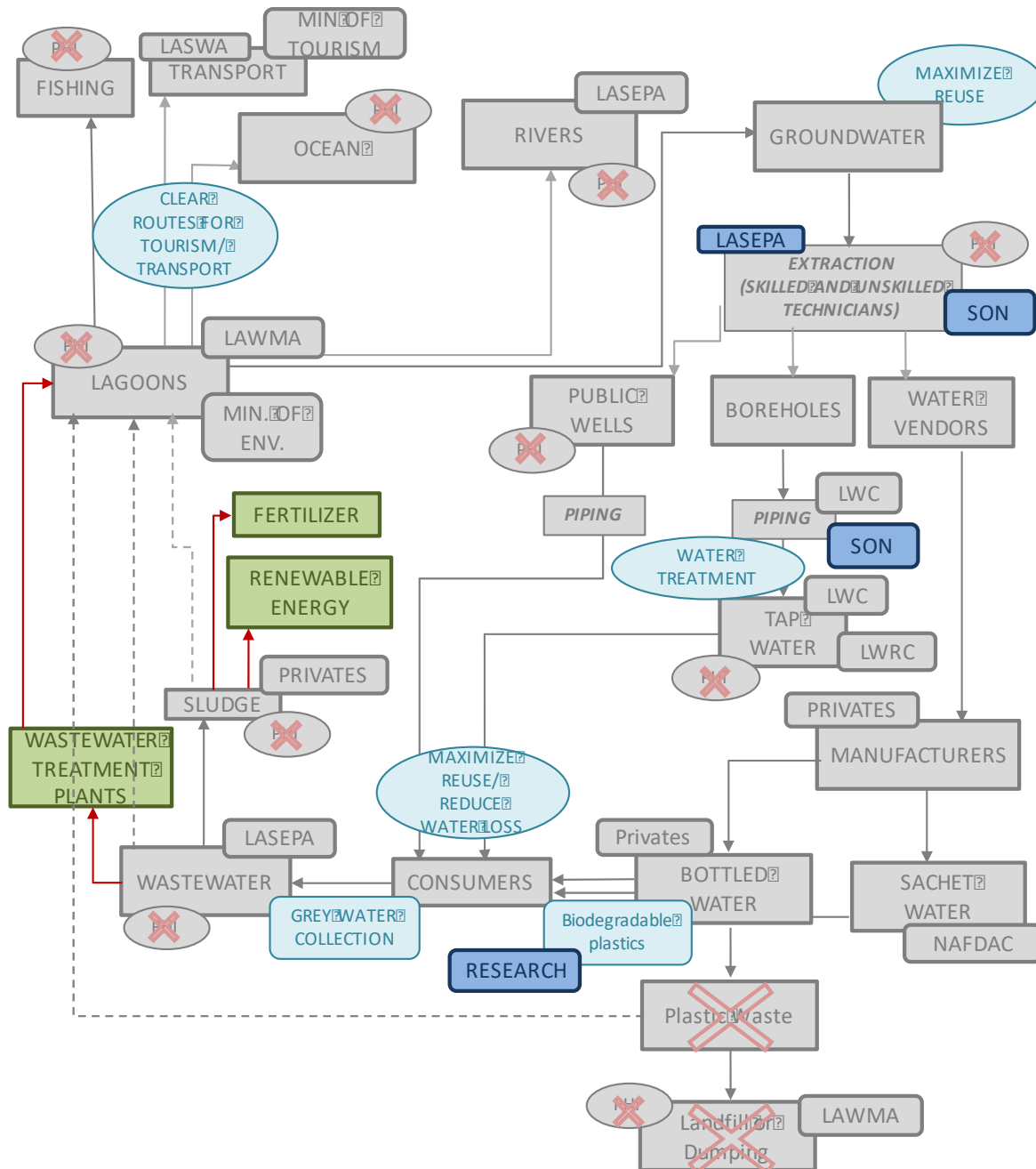


Figure 16: Envisioned Water System

**Re-use and recycle of water:** Water should be used in such a way that it retains full value after each use and eventually returns to the system. However, rather than focus solely on purification, attempts should be made to prevent water contamination or create a system in which water circulates in closed loops, allowing repeated use. Thinking in “circles” can help businesses, as demonstrated in the case of the successful Billund BioRefinery in Denmark which generates heat and power from sludge and other organic wastes through thermal hydrolysis. This process sterilizes the sludge and

makes it more biodegradable. The membrane-based treatments that separate water from contaminants allows for reuse and commercialization at a large scale<sup>li</sup>. In addition to innovative membrane-based technologies, experts have developed new source-separation systems that reduce mixing between chemical-carrying industrial and household waste water, making purification easier<sup>lii</sup>. For example, in Singapore, gray water had been transformed into high-grade reclaimed water; and in China, wastewater reuse was first required in new hotels and in new public buildings<sup>liii</sup>. In 2008, reclaimed wastewater (17 percent) contributed more to Beijing's total water demand than surface water (13 percent). In 2013, reclaimed wastewater increased to 803 million m<sup>3</sup> (22 percent) of total annual water use<sup>liv</sup>.

### **9.3. Water Notes and Assumptions**

- In the current water system, the lagoon, ocean, rivers, and groundwater are the primary sources of water. The ocean and rivers feed into the lagoons. Groundwater is the source of all drinking water.
- All tap water and piping for the tap water is provided by the LWC, however the water is not drinkable on its own.
- Unskilled workers create public wells that are used by consumers, which is also not drinkable.
- Water vendors manufacture two types of water, either bottled water or sachet water. The waste from these products ends up in landfills or is dumped.
- Wastewater from consumers dumped into the lagoons and the sludge is pumped into the lagoons by private companies. The lagoons are then used for fishing and some transport.
- In the envisioned water system water treatment facilities are institutionalized and regulated.
- Sludge from treated wastewater is used for energy and to make fertilizer. Wastewater and sludge do not enter the lagoons.
- Water extracted from the ground is regulated and only skilled technicians are used.

### **9.4. Net Positive Impact Assessment**

When reviewed against the Sustainable Development Goals, a number of goals were highlighted as net positive including:

SDG 3 – Access to clean water ensure healthier living

SDG 6 – Safe and affordable water is provided to citizens

SDG 7 – Renewable energy for water management

SDG 8 – Job opportunities created from investments in infrastructure

SDG 9 – Promotion of new infrastructure and opportunities for innovation in water

SDG 13 – Increase in renewable water energy decreasing carbon

SDG 14 – Conservation and sustainable use of the seas and marine resources.

SDG 17 – Partnerships that aid resource mobilization for the development of water infrastructure.

There were also some aspects that were considered net negative in impact:

SDG 10 – A centralized CE system will eliminate low level service providers who may find it difficult to find alternative employers

SDG 11 – Basic social services are provided to everybody in terms of water

## 9.5. Water System ECE Solutions

**Partnerships with beverage companies:** One of the popular beverage companies that visibly supports water sector initiatives is the Coca-Cola Company. The Coca-Cola Foundation supports the global water stewardship goal of the Coca-Cola Company to safely return to nature and to communities an amount of water equivalent to what it uses in all its beverage and production by 2020<sup>lv</sup>. As reported in the 2011/2012 Sustainability Report, the company promotes efficient use of water by reducing the amount it uses per liter of product produced, even as production volumes increase. The company is also recycling wastewater and replenishing, or balancing, the water used in the finished beverages by about 35 percent, with the ultimate goal of being water neutral by 2020 through projects intended, among other things, to protect or conserve water resources or to bring safe drinking water or sanitation to the people in the communities it serves. <sup>lvi</sup>The company is a founding member of the Water Resources Group (WRG) created in 2008 with other businesses and governmental organizations. The group is a neutral public-private-expert-civil society platform that provides a partnership to help government water officials and their partners accelerate reforms that will ensure sustainable water resource management for the long-term development and economic growth of their countries.

WRG is helping to change the “political economy” for water reform by leveraging a wide-ranging and unique network of experts; by convening and promoting ongoing dialogue among communities, civil society, water user groups, experts and government officials

(including government ministers not traditionally considered responsible for water resources management); and by building bridges between water experts and non-experts, enabling a wider set of government, community and business leaders to become engaged in the water reform process. As of the end of 2011, WRG had engaged with governments in Mexico, Jordan and India and had been invited to engage with governments in South Africa and Mongolia, and there are also ongoing discussions with Chinese authorities.<sup>lvii</sup>

## 10. PLASTICS

Authors: *Wale Ojo, Patience Ogwara, Esther Aderinto, Bimbola Onanuga*

Lagos state has a population of about 20 million people with an annual growth rate of about 8%. The State generates about 10,000MT of waste per day with a waste growth rate of about 10%. About 80% of the wastes generated are recyclable. Plastic waste is about 15% of the total waste generated in Lagos making it the second highest type of waste generate<sup>lviii</sup>

### 10.1. Current Plastics System

The current system map of plastic in Lagos state shows that most of the plastic manufactured and used are made from fossil feedstock and most plastic packaging used in Lagos are only used once and discarded. A good large percentage of plastic waste escapes the conventional waste collection system and are disposed of in gutters/drainages, water bodies (Lagoons), roads etc.

The annual out of PET bottle in Nigeria is estimated at 15,000 – 20,000tonnes and only about 32% is recycled<sup>lix</sup>. Plastic packaging used more than once after manufacture are bowls for food and storage. Beverage and water bottles in a few cases are re-used for local beverage/drinks. Scavengers pick plastic waste from the landfills and assemble the waste around the landfills for onward sale or transfer to the collection centers or factories where they are sorted and re-processed for use. <sup>lx</sup>

The main collectors of wastes in Lagos state are the franchised private sector operators known as PSPs. Waste collected from homes and offices are dumped at the landfill or the transfer loading stations (TLS). The waste pickers or scavengers do not operate at the TLS. LAWMA, LASEPA and the Ministry of Environment are the regulatory bodies saddled with the responsibility of waste management and environmental protection.

There are several opportunities for plastic waste in Lagos state which include high potential for more organized collection/sorting given the huge volume of plastics waste generated. This will not only generate huge employment opportunities but also rid the environment of unwanted materials in natural systems and urban infrastructure.

Opportunities also abound in the re-use of plastics to best value before it is being finally discarded.

Plastic is very versatile and useful in several value chain of manufacturing and production activities. Plastic is used as components for electronics manufacture and plastic from disposed electronics will end up as plastic waste. The plastic industry/recycling produce some items like the conductive adhesives that are used in electronic refurbishing. Plastic are used also for electronic casing<sup>lxi</sup>.

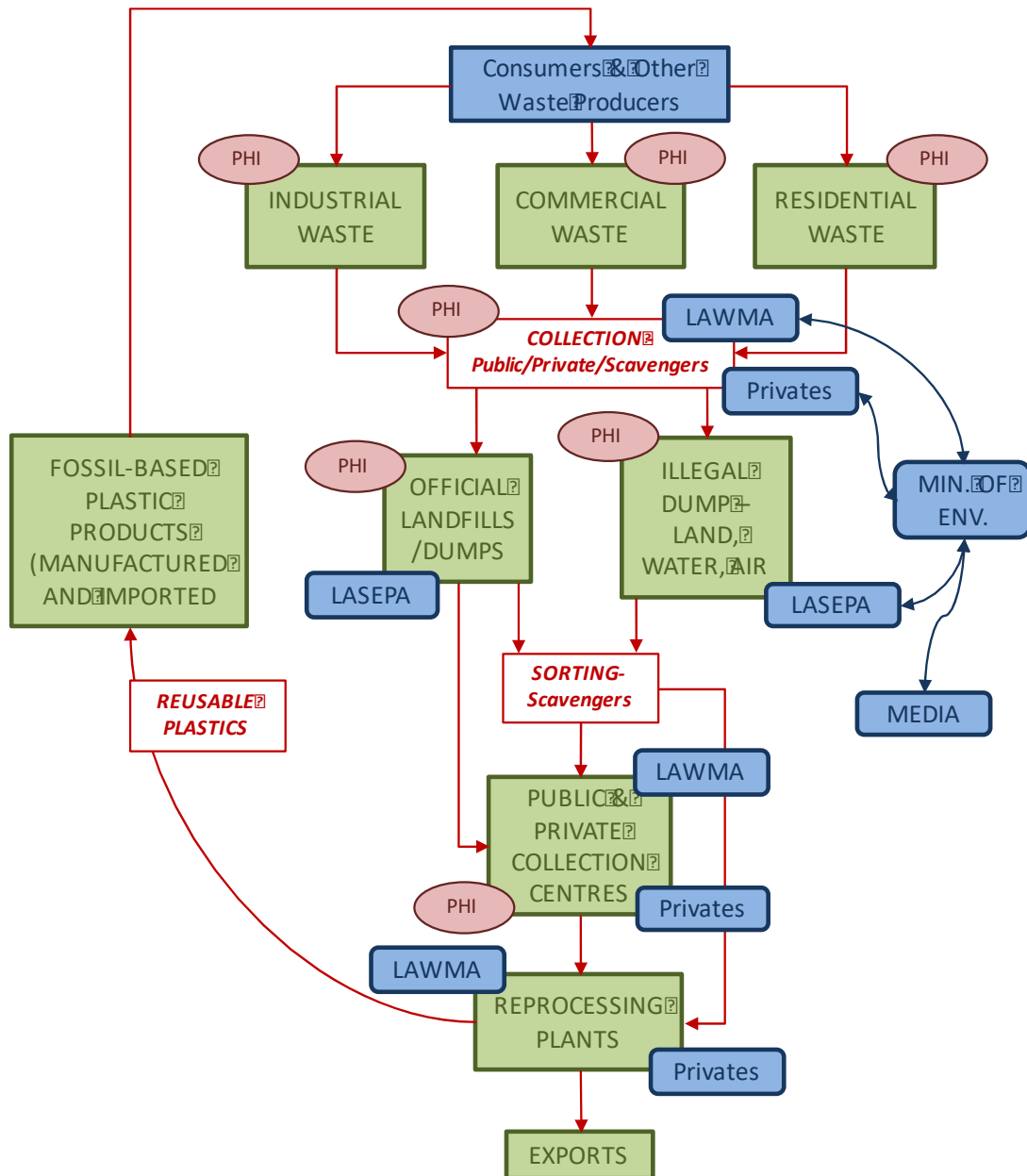


Figure 17: Current Plastics System

## 10.2. Envisioned Plastic System in an ECE

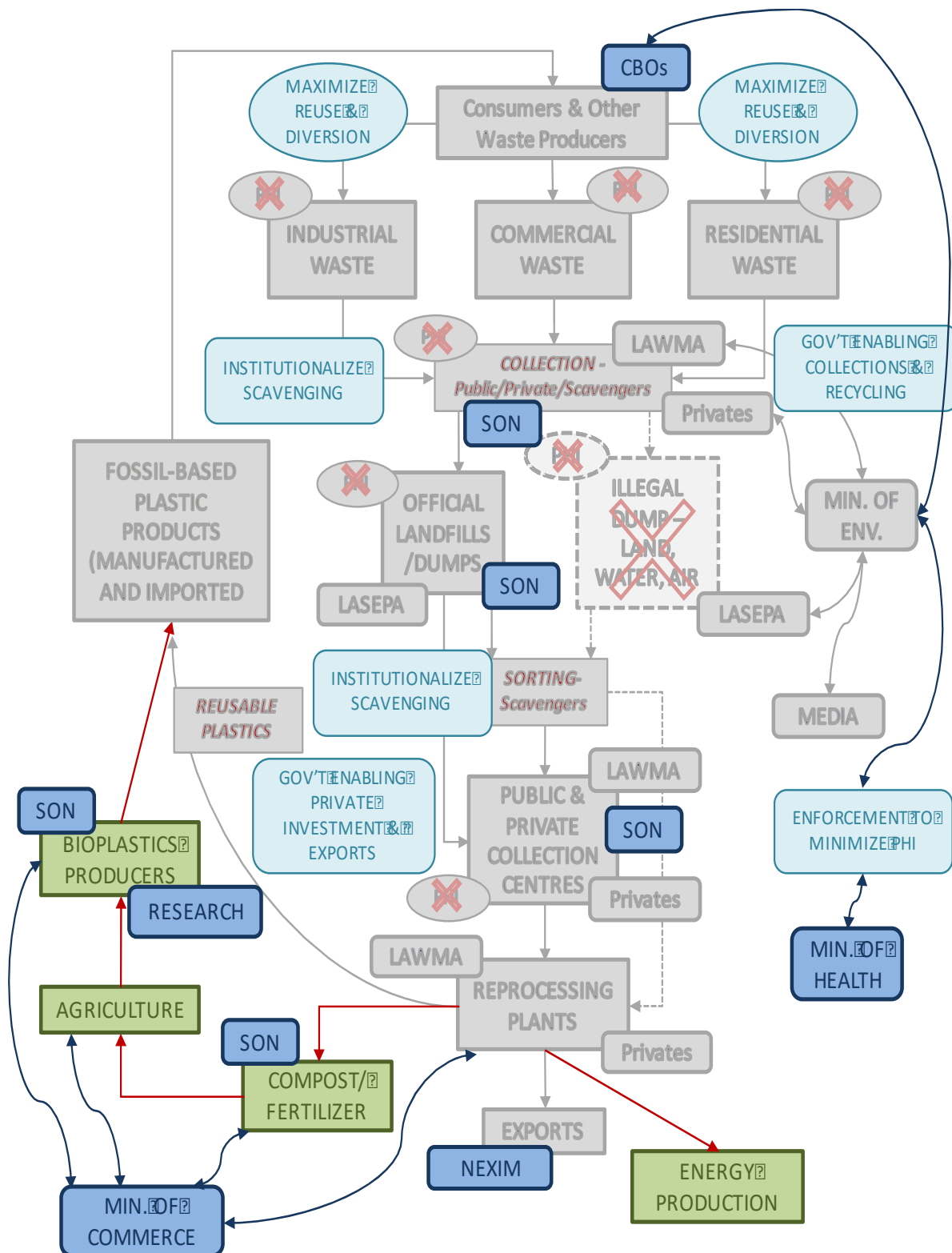


Figure 18: Envisioned Plastics System

Waste disposal in Lagos and most places in Nigeria is such that waste is usually not separated from source. Recyclers are the only operators identified as at the time of this report that go to low income areas to collect recyclable materials (plastics, cans and plastic bags) from households. There are plastic and metal scavengers (waste collectors) that go to waste bins around homes and offices to collect waste but this has reduced over the years because of the operations of the franchised waste collectors. The main collectors of waste in Lagos are the PSPs (private sector participation) operators working with the Lagos State Waste Management Agency. As the PSPs collect and dump waste at the dumpsite/landfills or transfer loading stations (TLS), plastic scavengers go to pick out the plastics and heap them around the dumpsite/landfills for onward sale or transfer to the collection centers or factories where they are sorted and re-processed for use. Scavengers do not have the opportunity to pick plastic from the TLS.<sup>lxii</sup> LAWMA, LASEPA (Lagos State Environmental Protection Agency) and Ministry of Environment (MOE) are the regulatory bodies associated with waste management and environmental protection in Lagos State. They have laws and policies that guide how waste and the environment are managed.

Among the duties of LAWMA, LASEPA and the Ministry of the Environment is education and awareness creation on waste and environmental management using the media and other platforms to achieve the objectives.<sup>lxiii</sup> As at the time of this report the team could not identify civil society organizations/ NGOs working on plastics and plastic waste management in Lagos.

There are several opportunities for plastic waste in Lagos state, including for more organized collection/sorting given the huge tones of plastics waste. As mentioned earlier, this will not only generate huge employment opportunities but also rid the environment of unwanted materials in the built environment. Opportunities also lie in the re-use of plastics to best value before the being finally discarded.<sup>lxiv</sup> This saves cost of purchasing new plastics all the time, and the savings can be put to other uses. It also saves a lot of energy used in the production of new plastics.

The plastics economy cannot be in isolation. If we want to have an effective plastic waste management, the built environment will be put into perspective as the built environment is where the plastic is produced, used, waste generated and managed. Plastics is connected to food system as the system makes use of the packaging produced from plastics and the food system will be the source of biodegradable plastics from natural sources. Water (especially portable water) will play a vital role in the reuse of plastics (especially for PET bottles) too and in consideration for biodegradable plastics from natural sources

### 10.3. Plastics Notes and Assumptions

- Consumers of plastic products are the primary drivers of the current plastic system.
- They produce plastic waste, which is collected along with other waste by either public or private entities, or independent scavengers.
- The plastic waste is either taken to official landfills or it is dumped illegally.
- Scavengers sort plastics out of the landfills and dumped waste as a source of income. These plastics are taken to reprocessing facilities where the plastics are recycled. Public and private collection centers also collect plastics and take them to reprocessing facilities. The recycled plastics can be used to make additional plastic products locally, or exported to other markets.
- In the envisioned plastics system, plastic reuse and diversion is maximized to reduce overall waste. Scavenging is institutionalized in order to protect workers and their jobs. In addition, collection and recycling systems are put in place in industrial, commercial, and residential spaces.
- Biodegradable plastics are primarily used to eliminate environmental impact concerns.
- Through this circular economy system all plastic waste is removed from landfills or dumps and is reentered into the product stream.

### 10.4. Net Positive Impact Assessment

SDG 1 – by encouraging reusable plastic to save income for other purposes.

SDG 8 – Creating employment opportunities

SDG 9 – Provision of cost effective innovation and infrastructure for waste management and plastic production & Capacity building to adopt innovation and use infrastructure

SDG 12 – Partnerships that aid resource mobilization for the development of waste infrastructure.

SDG 13 – Reduction of GHG's through standards in the plastic industry

SDG 14 – Conservation and clean-up of plastics from seas and marine resources.

There were also some aspects that were considered net negative in impact:

SDG 12 – Disposing used plastic properly and reusing plastics optimally



## 10.5. Plastics ECE Solutions

The new plastic economy envisioned for Lagos State takes into cognizance the principles of circular economy which are to preserve and enhance natural capital; optimize resource yield and foster system effectiveness. Emphasis are based on producing biodegradable plastic which help decouple plastic from fossil fuel as this conserves non-renewable fossil fuel. Biodegradable plastic produced after optimal use decomposed to produce fertilizer that will be used as nutrient for the soil. By promoting re-use, recovery and recycling of plastics to keep component and materials circulating in the system and contributing to the economy allows for energy preservation as a result of reduction in the quantity of virgin plastics produced. Waste is designed out by re-use, recovery and cleaner recycling thus reducing the amount of solid waste going to the landfills and the emission of gases like carbon dioxide into the atmosphere.

## 11. Research Questions

The above sections aim to elucidate some of the aspects of ethical circular economy for the different sectors in Lagos. As presented in the Executive Summary, key high-level questions stand as motive drivers for the achievement of sustainability and sustainable development in Lagos and in Nigeria. The questions are here re-presented:

1. What can be done to establish the crucial network of strong, competent collaborative platforms needed to support achievement of sustainable development goals (SDGs) in Nigeria?
2. What can be done to engender the emergence of a large community of citizen decision-makers able to initiate and harness the vast intellectual resource base necessary to drive sustainable development processes?
3. By what means can the public policy process help incentivize research innovation and capacity-building focused at increasing private-sector involvement for the achievement of the SDGs?
4. What mechanisms are needed to encourage Nigerian businesses to take active roles in the shaping of government policies?
5. How best can technology be adapted to sustainable development needs?

To help find key answers to these questions, and to begin implementation of the concepts described in this paper it is important to get clear situational clarity for some key themes in Lagos: water, energy and waste. The following research questions has been highlighted to help achieve this:

**Current Situation Research:**

- How much water and energy is currently used and which sectors (commercial, domestic, Industrial) use the most of these resources?
- How much water and energy is used in particular for a) transportation and b) food systems?

**Quantification Research:**

- How much energy and water does Lagos need for the implementation of ECE within each sector?
- How significant is the difference when compared to the current state?

**Financial Research:**

- What is the Cost Benefit Analysis of current system within each sector?
- What is the Cost Benefit Analysis of the ECE system within each sector?
- What is the Cost Benefit Analysis of E-waste to natural and city systems?
- What is the Cost Benefit Analysis of Plastics to current natural and city systems?
- What are better financing options for better waste and sanitation systems?

**Policy research:**

- How can actors be incentivized in the ECE approach?
- How can ownership be increased and behavioral changes encouraged?
- How can PPPs be encouraged in all the sectors discussed?
- Which institutions could drive the incorporation of ECE for all the above sectors?
- How can current renewable resources be harnessed in an ECE manner to provide better energy, water, and sanitation systems?

**Research on Barriers:**

- What are the barriers to better sanitation?
- What are the barriers to better waste management?

**Human Integration research:**

- How can the above sectors be integrated in a manner to improve human livelihoods, increase business opportunities and decrease poverty?

## 12. Conclusion

Circular Economics finds its origins from the attempt of countries of the global north to, in the face of rising populations and resource demand, respond to the unsustainable approach to consumption and disposal of materials.<sup>lxv</sup> The linear economy system is a take-make-dispose approach that translates to unprecedented consumption, waste generation and heightened stress to natural systems. A circular economy on the other hand drives to close loops by maximizing the utility and useful lifespan of materials. This suggests that the circular economy as a foundation for systems-driven economic development will mean that materials be used and reused for a much longer period. In the most simplistic term then, 3 key requirements will enable the ability to create this near-infinite longevity of materials utilization and waste reduction:

1. Ability to build required effectiveness into the manufacturing process. This means that thinking of the usefulness of the material at its end of life must be part of the manufacturing process from the beginning. This basically means designing out waste.
2. Ability to utilize renewable sources of energy, which automatically reduces reliance on non-renewables like hydrocarbons.
3. Ability to identify and converge all inputs necessary for the achievement of systems-wide circularity of the economic system. This will include capacity (manufacturing, technological innovation, human resource, others), enabling policies, inputs from relevant stakeholders and access to information. This overall capacity requirement will necessarily require that we catalyze the collective intelligence of the globe.

What is sought from the above, as underscored by the circular economy principle, is for society at large to have the overall capacity to couple “economic growth and development and the consumption of finite resources in a more intelligent, more sustainable way.” Achieving this will most certainly require the type of capacities that are not necessarily in abundance in the developing countries of sub-Sahara Africa, raising the question of whether or not these countries can capture the value of the circular economy. The more developed countries of the world have applied the concept of circular economy in a variety of contexts but all are honed at transforming current systems to be more sustainable. Yet countries have to understand their unique circumstances and define what immediate opportunities are attainable that will help stimulate economies and better foster a sustainable future. This is the essence of what the SSL/ASU ECE Executive Certificate program was about; to begin the conversations and training that will drive local capacity building. Defining how the circular economy approach can be used to solve the multifarious social, environmental and economic challenges faced by Lagos for example, enables the broader drive for sustainable development in fast developing economies like Nigeria. Regardless, that developing countries build on circular economy principles as a development paradigm is a major

imperative for a sustainable future. The restorative and regenerative design of the circular economy makes it a necessary tool for sustainable development in a rapidly populating and young sub-Saharan Africa

According to a 2012 Chatham House briefing paper for example, the EU under the umbrella of its “Europe 2020 Strategy” agreed on a ‘a resource-efficient Europe’ and introduced an initiative to address raw-materials security<sup>lxvi</sup>. Examples include National Resource Efficiency Program in Germany; high-grade recycling of materials and products in the Netherlands; and in the United Kingdom, a focus on economic instruments and raw-materials security. The question on the African situation is then two-fold: (1) *what has been done to date in defining circular economy as a development paradigm in the local context?* and (2) *given known capacity gaps as mentioned previously, how does Africa commence on implementing circular economy principles as a development strategy?* Helping to lay the foundation that will contribute answers to these questions is the core of the executive certificate program in ethical CE held in Lagos Nigeria, in collaboration with Arizona State University.

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