Sustainable Design Strategies for Eko Atlantic City

By Bukky Oyedeji

Superstition, cautious optimism, overwhelming rage and complete distrust, these are the range of emotions elicited from residents of Lagos state in an anonymous online survey on the Eko Atlantic City project.

One respondent, said "brilliant ideas, but we have to be careful to fully implement the concepts in this part of the world –professionalism must be the key priority not POLITICS."

Another was more incredulous: "Not so good idea: I'm not sure I'm excited about pushing the Atlantic ocean back to build on such an expanse. If the ocean vex [gets angry] nko? I guess that'll have been taken into account."

From village-dwelling market women to well-educated elites in Nigeria and abroad, most express concern over the ability (or the lack thereof) of the current government to operate and maintain such a significant capital project or handle disasters that can potentially occur as a consequence. The reactions are so strong even among those who may be considered experts on the environment and sustainability and that in response to an invite to discuss creating sustainable design strategies, one invitee said, is it in the same country where response to civil and everyday disaster is zero (that) we want to live in the ocean?" "A o ni r'ija omi o!,(May we not see the rage of the waters!),

The Eko Atlantic City is a massive, land reclamation project on the coastline of Victoria Island, Lagos, purportedly initiated to mitigate flooding and eradicate the effects of erosion on the adjoining Bar Beach. By February 2013, five million square metres of land had been reclaimed.

Victoria Island is Lagos' commercial nerve centre and consistent, severe flooding over the last decade has had significant negative impacts on the city's economy. Endemic tropical storms cause Atlantic Ocean's water level to rise, eroding the beach and flooding poorly-drained road networks. Terrible traffic jams occur, with workers either unable to get to work or to return home at the end of a working day. Consequently, several businesses have moved their headquarters out of some formerly key commercial streets such as Akin Adesola Street.

In response to this, foreign experts suggested to the Lagos State Government that a levee – a sort of high wall – be built to reduce erosion and flooding. This was a cost intensive project (about $9 billion) and the government did not have the funds to support it at the time, (2003). However, while reviewing a 1905 map of Lagos, it was discovered that the city's coastline was once about 2 km away from its current location, suggesting that at least a kilometre of the beach has been eroded over one hundred years. South EnergyX Ltd, a private business entity then made an arrangement with the government to finance and execute construction of the needed wall, and then reclaim the lost land, with the sole intent of selling it at a profit. This meant the Eko Atlantic City project became live, albeit surreptitiously, in February 2008.

Since inception, the city, which aims to accommodate a quarter of a million people, has been marketed as a cutting edge, high-end sustainable development. According to the developers " the *city's planners have*

committed to minimizing Eko Atlantic's carbon footprint with the use of environmentally-efficient construction methods and locally sourced materials *where available and appropriate.*"

Also promised are extensive public roadway transportation, in conjunction with intra-land waterways and heliports. These cursory statements, along with the obvious reclamation of eroded land, consists all of the sustainable design references listed in the city's marketing brochure. The document is inundated with un-cited claims and statements that promise enormous commercial gains, promising foreign investors and buyers the opportunity to 'harvest the potential of Africa' – a phrase that brings to mind the 19th century western scramble for the continent. There is no definite commitment to the implementation of sustainable design strategies that can also help resolve ecological and socio-cultural challenges (such as air pollution and housing for low-income earners) which are prevalent in Lagos.

Going further, a personal review of the city's regulations for specific plots of land in its downtown area did not reveal any strong focus on green design issues. The guidelines provided were generic. There were requirements for greenery in each lot but issues related to site permeability, storm-water quantity control, construction activity pollution prevention, air, noise and light pollution reduction were not addressed.

Also, when further challenged on the sparseness of clearly-defined sustainable design measures, in May 2013 representatives of the city's backers stated unequivocally that such design measures are at best tangential to their ultimate goal of profitability. This unfortunate response to a very pertinent and global issue confirmed the need to intervene by re-envisioning Eko Atlantic City in a more sustainable fashion. One might argue that the very existence of the city in itself is unsustainable, but the unchanging fact is that at least 50% of the area intended for reclamation has already been sand-filled, roads have been built, drainage lines buried and some lots have been bought. The Eko Atlantic City seems here to stay therefore, and in the words of Rastamouse (a character on a children's program by the British Broadcasting Corporation), perhaps it is better to focus on 'making a bad thing good'…or a little less bad.

Consequently, in July 2013 the Code Green Campaign was initiated, due to the strong reaction perceived amongst construction industry professionals surveyed for their views regarding the city. The aim is to develop sustainable guidelines for the Eko Atlantic City in the hope that these can be adopted for future construction projects. Bearing in mind the City's proponents' unapologetic focus on financial gains, the Code Green group decided to approach the initiative from an investor's perspective. It determined that true sustainability in an emerging economy such as that of Lagos must have a strong economic component, along with ecological and socio-cultural aspects. Typical challenges that investors may face during a project delivery process –from land acquisition to building occupancy– were identified and then addressed from a sustainability point of view. This means ecological concerns and socio-cultural issues were noted, while attempting to solve mostly economic and profitability challenges.

Sustainable Construction

The first major challenge identified was funding costs. Most Nigerian banks provide construction loans at interest rates of between 18% - 30% per annum. Typical high-rise construction projects often take at least two years to develop, implying that at minimum, a typical investor would have accrued an additional 36% in interest during the project delivery process. The challenge therefore, was to investigate faster, greener ways to construct

high-rise buildings so that loan interest accruement and construction activity pollution decreases while building envelope, energy and construction efficiency increases.

One of the ways identified was the use of prefabricated building systems. Existing prefabricated building systems are proven to significantly reduce construction time, and have green design components that could be adapted to meet local climatic and energy needs. An example is the China-based Broad Sustainable Building system where whole sections of a skyscraper are manufactured in a factory, thereby reducing construction costs and time, as well as construction activity pollution. Furthermore, it has a high thermal efficiency which helps reduce cooling costs and can withstand magnitude 9 earthquakes and thunderstorms. It also helps keep the air quality within its buildings pure.

Several skyscrapers have been built using this system, one of which is a 30-story hotel constructed in 15 days in Hunan Province, China. To sustainably implement such a system in Eko Atlantic City however, a manufacturing facility for it may have to be set up in Lagos or in the Eko Atlantic city itself, and local construction workers will need to be trained. This will provide additional jobs, and increase the quality and level of skills in the construction industry. Also, the savings generated from using the system compared to traditional construction methods may offset the initial cost of adapting the technology to Lagos.

Sustainable Cooling, Heating and Power Generation

The city requires every ground floor in the downtown area to be mercantile, in order to create a high-end, pedestrian shopping promenade. The lot regulation stated that the ground floor's front facade must be about 5 meters high and glazed. This will result in excessive solar heat gain within these mercantile spaces, making them hot and difficult to keep cool. Of course, green design building techniques –such as the use of exterior building shading systems (e.g. awnings), natural ventilation, vegetation, and building orientation –can be incorporated in skyscraper designs so that heat gain is minimized. However, artificial cooling will still be required, especially during the hot and dry harmattan season. This generated a discussion amongst Code Green Campaign members, regarding the availability of sustainable cooling systems that could potentially harvest solar heat gain or waste heat and re-use it for other heating needs (such as hot water) within a building structure.

The idea of adapting poly-generators – an engine system that generates electricity and useful heat and cooling sequentially or simultaneously for use within a building facility or district – seemed most feasible. This is because they are tested, are easily deployed and are not a significant risk for profit-minded investors.

Known as Combined Cooling, Heat and Power Systems (CCHP), poly-generators produce electricity, heating and cooling from either the combustion of fuel or from a solar heat collector, or both. Fuel powered CCHPs burn either natural gas or fossil fuel and have a fuel efficiency of about 80%. Most power-only generators have a fuel efficiency that is below 50%.

The preference, of course, would be to power, heat and cool the whole city with a project-wide, solar heat-based CCHP, since that energy source is renewable. However, this may not be feasible as the energy generated will have to travel great distances to reach all skyscrapers. Instead, the electricity needs of the city alone (including streetlights, parks, etc) can be provided this way (distance is no barrier here) and the resultant cooling and heating energy used in adjacent buildings. Other skyscrapers can have their cooling and heating energy provided by individual solar-based CCHP, assuming that the city, through good governance, can provide and

maintain power supply to its inhabitants. Should city-wide electricity generation fail, each building or street may have a backup dual source CCHP in lieu of the ubiquitous, inefficient, noisy, and air-polluting power-only generators. A dual source CCHP can generate electricity, as well as provide cooling and heating energy, using either fossil fuel or stored solar power. It can also provide just cooling and heating energy from stored solar power when/if electricity generation is not needed. This approach to power generation can be mandated or incentivized, by providing tax breaks to compliant building owners.

Opting for adapted CCHPs at the Eko Atlantic City has several advantages. It reduces the environmental impact of power generation by reducing carbon emissions and air pollution, while re-capturing much of the waste heat energy that has contributed to unusually high temperatures experienced in Lagos in recent times. It helps cool the spaces within buildings efficiently and its energy source versatility can further reduce reliance on fossil fuel energy. It initiates another opportunity for job creation, by equipping local technicians with the skills to install, operate and maintain these systems, while providing another exemplary alternative to power generation for the rest of Lagos. Moreover, CCHPs can easily be adopted by existing buildings and can be used for different applications, including industrial ones.

Sustainable Building Use Optimizations

The third investor-driven perspective explored was maximization of leasable space. The lot regulations reviewed indicated that each skyscraper must step back as it goes higher, in order to minimize shadows cast over other buildings. What this means for investors though, is that as the building goes higher, there is less square footage to monetize. The task therefore, was to find ways in which the 'lost space' could be utilized and even monetized. One idea that gained traction was to move all 'sociable' communal spaces (lobbies, staff-break rooms, cafeterias, non-private meeting rooms, or restaurants) to the perimeter of the building in balconies and porches that overhang the lower floors.

These balconies can be vegetated, providing shade and reducing solar heat gain, purifying the air and providing additional opportunities for natural ventilation in other spaces. They can also be expressed as a form of vertical urban farming, where consumable vegetables are planted. Since these gardens will be cantilevered spaces, technically, the exterior walls of that floor will begin where the lot regulation requires, providing more money-generating spaces within the floor area. If every skyscraper in Eko Atlantic City were to adopt this strategy and become a vertical urban farm, then a significant chunk of food security issues and urban poor challenges in neighbouring low-income areas may be addressed.

Sustainable Waste Management

Asides the cost of constructing a building and leasing it out, the other most significant cost for owners is that of operating and maintaining it. While power, heating and cooling costs have been addressed by the use of passive solar design strategies as well as sustainable cooling systems, waste management costs tend to be considerable over the life span of a building too. Waste disposal has been a major challenge in the city of Lagos for decades and as such, Eko Atlantic City has an excellent opportunity to display how it can be managed cost effectively.

Definitely, each building user – owner or tenant –should be required to separate their waste, with separate bin receptacles and/or chutes should be provided. Non-compliant residents could be fined or deprived access to some

of the city's communal privileges in order to ensure complete compliance over time. In addition, kitchen sinks should be equipped with garbage disposal grinders that crush food waste and have them collected at locations where it can be processed into bio-mass fuel and/or manure via compost heaps/bins. The manure can be used for the building's lawns and gardens – which of course, ought to be planted with indigenous grass and consumable local vegetables. The gardens could be rented out to low-income earners who can, through this form of urban farming, generate additional income from the sale of produce. Care must be taken though, to ensure the water quality of the surrounding ocean is not compromised by the planting activities.

Where food waste is converted to biomass fuel, it can be used to power the building's Combined Cooling Heating and Power poly-generator, so that the building's waste is also its energy source. This will further reduce air pollution, carbon emissions and reliance on fossil fuel energy. Other waste such as paper, metals and glass can be contracted for a minimal fee to local movers who will transport and sell these to recyclers. In a development as large as the Eko Atlantic City, this recycling-based waste collection process can generate enormous job opportunities, contributing significantly to the local economy.

Sustainable Transit Systems

There is general concern for the impact of the city on traffic conditions, especially in Victoria Island and Ikoyi. The city's marketing brochure currently states that waterway transportation will be provided in addition to public roadway transport. This waterway transportation system should incorporate existing boat and ferry stations across Lagos such as Ikorodu, Apapa, Oworo, Unilag Lagoon Front, CMS and Makoko. In addition, all public transportation vehicles – air, water or land – could run on alternative energy sources such as electricity or natural gas. Keke 2.0 – a re-designed, low-emission, clean energy and updated version of the ubiquitous Keke Marwa commercial tricycle on Lagos' streets – can be used in the city's transportation system. Parking within the city should attract a high fee, in order to encourage use of the city's public transportation system. Aside from minimizing air pollution and carbon emissions in the city, this will also reduce the cost of running the public transportation system, making it accessible to low income earners.

The marketing brochure also states that heliport services will be made available from the city to the Murtala Mohammed International airport. This idea can be successful environmentally if multiple passengers are transported each time. In the absence of a known disaster management plan for the city, it may be necessary for some buildings to also have helipads in order to aid air evacuation, should certain types of disasters (e.g. flooding) occur.

The Way Forward

This vision for a truly sustainable Eko Atlantic City is a huge but implementable one. Over the last decade, green design measures and products have undergone significant testing and development and are no longer a 'grey area' when it comes to cost efficiency and validity. If the economically supportive measures discussed above become mandatory and are implemented, then Eko Atlantic City may be well on its way to being the most sustainable city in the Sub-Saharan Africa region – and that, we are sure, is a tag line its developers would like to take to the bank.