Lagos Informal Settlement Household Energy Survey

Final Report
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NIGERIAN SLUM /
INFORMAL SETTLEMENT
FEDERATION

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I.   **Executive Summary**

The present study was commissioned by C40 and the Lagos State Ministry of Environment as part of an ongoing city climate action planning process to address identified gaps in available data on stationary greenhouse gas (GHG) emissions from informal settlements in Lagos, as well as opportunities for climate change mitigation and adaptation in informal settlements.

As in other rapidly growing African cities, the majority of the residents of Lagos -- the most populous city in sub-Saharan Africa -- are believed to live in slums or informal settlements. Yet, it is likely that most citywide surveys that gather data potentially useful for estimating GHG emissions and stationary energy usage more broadly do not reach many slums and informal settlements for a number of reasons including lack of familiarity and accessibility challenges.

To overcome these challenges and fill this important gap in citywide data on residential energy usage, the present study was carried out by Justice & Empowerment Initiatives - Nigeria (JEI) in partnership with the profiling/data team of the Nigerian Slum/Informal Settlement Federation (Federation), together being the Nigerian affiliates of Slum Dwellers International (SDI).

The survey was conducted across 181 informal settlements with a wide variety of characteristics from size and density to predominant ethnic/language group and typical structure type/size, etc. The diversity of these settlements represents the diversity of informal settlements or slums in Lagos, from Egun-majority waterfront communities with typical structures built from bamboo on stilts to Ilaje-majority settlements with typical plank structures connected by plank bridges running above a swamp and to Hausa-majority settlements constructed primarily of zinc sheets; from dense multi-ethnic settlements crowded between industrial areas characterized by large cement block face-me-face-you tenement buildings primarily occupied by tenants to quasi rural settlements on islands off of the Apapa Port typified by larger family-occupied compounds but where residents have no access to motorable roads, pipe-borne water, or the electrical grid.

Key findings of the study present a snapshot of the realities of residents of informal settlements, from demographic information to patterns of cooking and lighting/electricity usage that serves as a comparator to citywide data not specific to informal settlements. This snapshot includes:

Demographics and household characteristics
- An average household size of 5.85 with average of 2.05 children under the age of 15 and 0.47 adults over the age of 65;
- An average household occupying 1.93 rooms with an average of 2.71 people per room for the 53% of households that do not occupy the entire structure;
- An average living space of 32 square feet per capita with smaller spaces down to 8 square feet per capita in the more dense/urbanized settlements and up to 56 elsewhere;

Major findings regarding cooking
- Across the households surveyed, 52.1% reported using gas (LPG), 50.6% reported using kerosene, 15.2% reported using charcoal, and 9.17% (n=341) reported using firewood as their fuel sources (combining primary and secondary options)
- Among households that use each fuel type, the average annual CO_2 emissions per household are 0.45 tons CO_2e per household per year/0.08 tons CO_2e per person per year for LPG, 0.80 tons CO_2e per year per household per year/0.14 tons CO_2e per person per year for kerosene, and 1.30 tons CO_2e per household per year/0.22 tons CO_2e per person per year for charcoal. Firewood was not included in our cooking-related GHG calculations for several reasons explained in the body of the report.
- Median monthly household expenditures for cooking fuels were N3,150 ($8.75)[1] for kerosene, N3,000 ($8.33) for charcoal, N6,000 ($16.67) for firewood, and N2,000 ($5.56) for LPG; kerosene, charcoal and firewood are mostly purchased at least once a week and in small quantities (N100-200 each time), while LPG is more often purchase a larger volume on a monthly basis. Kerosene and charcoal are more convenient to purchase within informal settlements, while LPG and firewood more often comes from outside the community. Many gather firewood instead of purchasing. Across all cooking fuel types purchased, median monthly household expenditure is N3,108 ($8.63).
- Very few respondents (11.34%) using gas (LPG) as their primary source of fuel for cooking reported dissatisfaction, while a large majority of respondents (75.74%) using firewood as their primary cooking fuel reported dissatisfaction, and a slight majority of respondents using charcoal (59.39%) and kerosene (51.06%) reported dissatisfaction.
- Across those not yet using LPG, 49.12% would be interested in using LPG. The most common reasons for not wanting to change were cost (46.38%) and fear (42.43%).

Major findings regarding electricity
- 86.4% (n=2,705) reported using public electricity (from the Eko or Ikeja Electricity Distribution Companies, EKEDC or IKEDC) as an electricity source. Respondents using public electricity reported receiving a median of 6 hours of public electricity per day.
- Across the households surveyed, 16.7% reported having at least one generator, but only 2.5% of households reported that the generator was their primary source of light. However, in off-grid communities, just over a quarter (25.33%) of all respondents use generators. Households using generators as a primary electricity/lighting source report running their generators a median of 5 hours daily.
- Just over a quarter of respondents (27.33%) reported using battery powered light as an electricity source. In off grid communities, significantly more (41.17%) of respondents use battery-powered light as their primary source of lighting. Very few households (less than 2.5% each) use solar, candles, or fuel-burning lanterns for lighting.
- Among households that use public electricity, the median annual CO_2 emissions from that source is 0.15 tons CO_2e per year/0.03 tons CO_2e per person per year. The average annual CO_2 emissions from generators is 2.81 tons CO_2e per household per year/0.48 tons CO_2e per person per year. We did not include battery-powered lighting, solar, candles, or lanterns in our assessment of lighting/electricity GHG emissions.

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[1] Based on the prevailing exchange rate (N360 = $1USD) for months immediately preceding the survey.

- For households using public electricity, the median monthly electricity cost was N2,000 ($5.55) paid either directly to the electricity distribution company or to an intermediary (e.g. a "community light committee"). For households using generators, the median total monthly running cost for generator use (monthly fuel cost + monthly servicing cost) is N13,433 ($37.31). We did not assess expenditures for battery-powered lights (69.47% being rechargeable), use of charging stations, solar installations, or purchase of candles and lantern fuel, largely due to small sample sizes.
- Nearly all respondents (90.79%) reported interest in using solar as a source of power for lighting. Of those not already using solar, the top reason why they are not using solar – by a significant margin – is because of the expense (94.94%). Lack of knowledge also constitutes a significant reason why respondents are not already using solar.

A snapshot stationary carbon emissions in Lagos informal settlements

Median Total HH Electricity / Light Co2e (tons per year)	Median HH Total Cooking CO2e (tons per year)	Median Total CO2e (tons per HH per year)	Median Total CO2e (tons per person per year)
0.18	0.52	0.92	0.16

Across all LGAs, the median household carbon emissions from stationary energy usage (cooking and electricity) in Lagos informal settlements is **0.92 tons CO_2e per year**. The median per capita emissions across all households surveyed are **0.16 tons CO_2e per person per year**. To put this in global context, this compares to an estimated 18 tons CO_2e per person per year emitted in the United States; 50 tons CO_2e per person per year in Qatar; and 4 tons CO_2e per person per year globally on average -- although each of these numbers take into account *all* emissions, e.g. including waste and transportation, not just stationary emissions.

Evaluation & Recommendations

Broadly speaking, Lagos is far ahead of the rest of the country in advancing penetration of LPG as a cleaner fuel source. Nevertheless, nearly half of cooking solutions among residents of informal settlements likely contribute to poor indoor air quality and higher greenhouse gas emissions. Availability of fuel in informal settlements is good, particularly for kerosene and charcoal, but affordability of cooking fuel is a concern. We find that residents who use LPG spend less over time on cooking fuel, but many residents still use kerosene and other fuels because of lower up-front costs and ability to make smaller purchases at a time. The major barriers to transitioning to LPG are these costs and fear due to the fact that LPG gas is not pipe borne but is stored in canisters in/near the household raising fears of explosion/fire.

To support greater rates of transition to LPG, improving energy access and reducing GHG emissions for residents of informal settlements, we recommend:

- Government programs that address both the real or perceived *cost barrier* (including start-up costs of transitioning to LPG as well as the real or perceived *fear barrier*.
- Financing schemes tailored to the cash flow realities of urban poor households who tend to purchase cooking fuel "small-small" on a daily or weekly basis as opposed to households using LPG gas who spend a larger sum on a monthly basis.
- Information campaigns that use data generated by this survey to tailor messaging to target audience, e.g. messaging around safety of LPG options tailored to landlords and messaging around net cost savings of using LPG tailored to tenant households; and
- Programs targeting informal settlements in LGAs such as Apapa, Amuwo-Odofin, Eti-Osa, and Lagos Mainland where LPG penetration remains relatively low.

Electricity in Lagos is a major challenge, although a relatively high percentage of informal settlements and their residents are connected to the power grid — certainly much higher than the overall national picture. When there is electricity, the capacity is sufficient for basic household usage; however availability (duration) of supply is a major challenge as is reliability, with a reported median of 6 hours daily with no predictable schedule and regular disruptions. Quality and safety of grid electricity is also a concern. With strong evidence of substantial overbilling for the supply actually delivered, affordability of public electricity remains a major challenge for informal settlement residents, with other options such as generators and solar currently being out of reach for many households. In this context, it must be noted that legality is a problem originating from the electricity distribution companies and their agents. Consequently, community light committees and other bill sharing is a common solution to improve access. Many households rely on battery-powered lighting and charging stations//kiosks are common to enable informal settlement residents to keep phones charged while waiting for "light to come."

Penetration of solar is very low, largely due to cost barriers and lack of widespread familiarity with solar installation and maintenance. There is a high interest in transitioning to solar if these barriers are overcome. To improve energy access and reduce GHG emissions, we recommend:
- Efforts to increase electricity access in informal settlements that are off-grid, particularly those in island or waterfront communities in LGAs such as Amuwo-Odofin, Ojo, and Eti-Osa LGA, potentially through creation of solar mini-grids/IPPs as alternatives to the normal public electricity supply and also efforts to reduce connection costs through distribution companies and improve regulation of such companies to overbilling, etc; and
- Support for transitions to solar in informal settlements through demonstration projects (e.g. solar charging stations), targeted training to increase how-to knowledge of households and local electricians, and a financing scheme to help spread the up-front costs of transitioning to solar to fit cash flow realities of urban poor households.

Overall our survey results point to households in Lagos informal settlements being around **Tier 2-3** for cooking and electricity/lighting related energy access in World Bank/ESMAP Multi-Tier Framework for Energy Access; although lower energy access does mean households have a relatively low carbon footprint, our survey findings point to numerous interventions that could support improved energy access and quality of life improvements, improving household and community resilience while also reducing GHGs as part of Lagos State's climate action plan.

II.   Acknowledgements

Justice & Empowerment Initiatives (JEI) wishes to thank the C40 team that fostered this partnership and supported the survey, especially Maximus Ugwuoke, Lia Nicholson, Giovanni Tedesco, Constant Alarcon, among others. This survey would not have been possible without support and partnership from the Climate Change Team at the Lagos State Ministry of Environment and Water Resources, led by Michael Bankole and with strong assistance from Azeezat Afinowi-Subair We also appreciate the Lagos State Government officials who joined our training and fieldwork, and who participated in the preliminary findings validation workshop. Thanks for the external review offered by Dr. Peter Elias from University of Lagos.

Within our own team, special thanks goes to Elsa Rousset who led professional support for the field survey and principal analysis; Dr. Aaron L. Strong of Hamilton College who advised on the survey design and ran analysis of greenhouse gas emissions; Nicole Wilson who advised on survey design, methodology, and supported data analysis; Andrew Maki who supported survey design and analysis; and Megan Chapman who coordinated the entire effort. To the Nigerian Slum/Informal Settlement Federation team that led the work on field, the biggest thanks goes to the indomitable Samuel Akinrolabu, the Federation's profiling coordinator, along with the core team that led and supported fieldwork in the different LGAs, particularly Imole Dezyno, Rasak Toheeb, Adeleke Adekunle, Adesola Adelani, Abbas Alhaji, Ibrahim Idris (RIP), Mohammed Yunus, Timothy Oladehinde, Habibat Ekemode, Morenike Ewuoso, Sani Mohammed, Bisola Akinmuyiwa, Mustapha Emmanuel, Motunrayo Adesina, Mary Akintunde, Yemi Oladapo, Sunday Ogah, Busola Lawal, Iklima Mohammed, Ogunsanya Adejoke, Oluwatosin Adewusi, Junior Mayipa, Therese Ngalula, Thethe Baongola, Sebastien Dosu, and Kunnu Paul.

C40, JEI and the Lagos State Government would like to offer special thanks to the Children's Investment Fund Foundation (CIFF) for their generous funding which made this project possible.

CIFF is an independent, philanthropic organisation. Our staff and Trustees combine the best of business and the best of development, bringing a wealth of experience from both sectors to CIFF's work. We aim to demonstrably improve the lives of children in developing countries by achieving large scale, sustainable impact. We believe that every child deserves to survive, thrive and mature into adulthood in a supportive and safe environment. However, climate change disproportionately affects children living in poverty in developing countries. A key focus for CIFF is climate-smart urbanisation.

C40 is a global leadership organisation working to deliver the urgent action needed to confront the climate crisis and create a future where everyone can thrive. The C40 network is made up of nearly 100 of the world's biggest, most influential cities, representing 750+ million people and one quarter of the global economy. Mayors of C40 cities are committed to using a science-based and people-focused approach to limit global heating to 1.5°C and build healthy, equitable and resilient communities.

C40 Empowering Cities with Data Programme

For cities to make the best decisions on climate policies, programmes, and projects, to accelerate implementation of their 1.5˚C-aligned climate action plans that increase resilience and equitable outcomes, it is essential that they have readily accessible and reliable data and the right mechanisms to manage such data. The optimal institutional arrangements within cities can also greatly facilitate data-driven actions and enable their impact to be quantified.

The Empowering Cities with Data (ECWD) Programme has been designed to help C40 cities solve particular data sourcing challenges and support them to improve climate data management processes and systems.

III.   Introduction

The present study was commissioned by C40 and the Lagos State Ministry of Environment as part of an ongoing city climate action planning process to address identified gaps in available data on stationary greenhouse gas (GHG) emissions from informal settlements in Lagos, as well as opportunities for climate change mitigation and adaptation in informal settlements.

As in other rapidly growing African cities, the majority of the residents of Lagos -- the most populous city in sub-Saharan Africa -- are believed to live in slums or informal settlements. Yet, it is likely most citywide surveys that gather data potentially useful for estimating GHG emissions and stationary energy usage more broadly do not reach many slums and informal settlements for a number of reasons including lack of familiarity and accessibility challenges.

To overcome these challenges and fill this important gap in citywide data on residential energy usage, the present study was carried out by Justice & Empowerment Initiatives - Nigeria (JEI) in partnership with the profiling/data team of the Nigerian Slum/Informal Settlement Federation (Federation), together being the Nigerian affiliates of Slum Dwellers International (SDI). The team consisted of professionals specialized in survey design and methodology, climate change science and policy, urban planning and related skills, working in close coordination with grassroots field surveyors who themselves come from informal settlements across Lagos.

The survey, which was co-developed with the Lagos State Ministry of Environment and C40, focuses primarily on the two major sources of stationary GHG emissions -- cooking and lighting/electricity -- for households in Lagos informal settlements. It does not attempt to take on issues relating to such households' GHG emissions from transportation and waste. The survey aims to both gather data based on which to estimate stationary GHG emissions, understand behavioural patterns relating to cooking and lighting, and enable planning toward interventions that could support positive behaviour change that help households mitigate GHG emissions.

IV.   Methodology

The findings presented in this report are primarily drawn from a 281-question survey designed to generate primarily quantitative data from a representative sampling of households living in informal settlements across metropolitan Lagos. The survey was co-developed by JEI and the Nigerian Slum/Informal Settlement Federation, with review and inputs from C40 and the MInistry of Environment, as well as from colleagues at the University of Lagos, Hamilton College, and MIT. The questionnaire consists of five sections: (1) introductory household/demographic information, (2) cooking-related information, (3) lighting/electricity-related information, (4) health and behavior change-related information, and (5) household load inventory assessment. The survey was coded into Kobo Toolbox and deployed using mobile phones and tablets operated by the field surveyors. Each questionnaire took approximately 40 minutes to complete, including the load inventory. The final questionnaire as coded on Kobo Toolbox is attached at **Annex A**.

All field surveyors went through a day-long training on the specific questionnaire to be used, with targeted follow-up training based on assessment of initial questionnaires completed. The training covered: (1) overview of the purpose of the survey, (2) interview techniques and strategies to overcome challenges encountered on the field, (3) brief on sampling methodology used, and (4) the survey itself, using an detailed interview guide that is attached at **Annex B**.

Due to the ongoing Covid-19 pandemic and safety protocols, we utilized a rolling training methodology to train the field teams, starting with training of the teams working in the first LGAs where the survey was rolled out during Phase I; later a training for the next LGA teams, where some of the experienced surveyors from Phase I also played a leadership role in training and on-field support. Each of the LGA teams were composed primarily of field surveyors from communities within that LGA or the neighboring LGA to leverage local familiarity and language and reduce the distances travelled in line with the project's Covid-19 safety protocols.
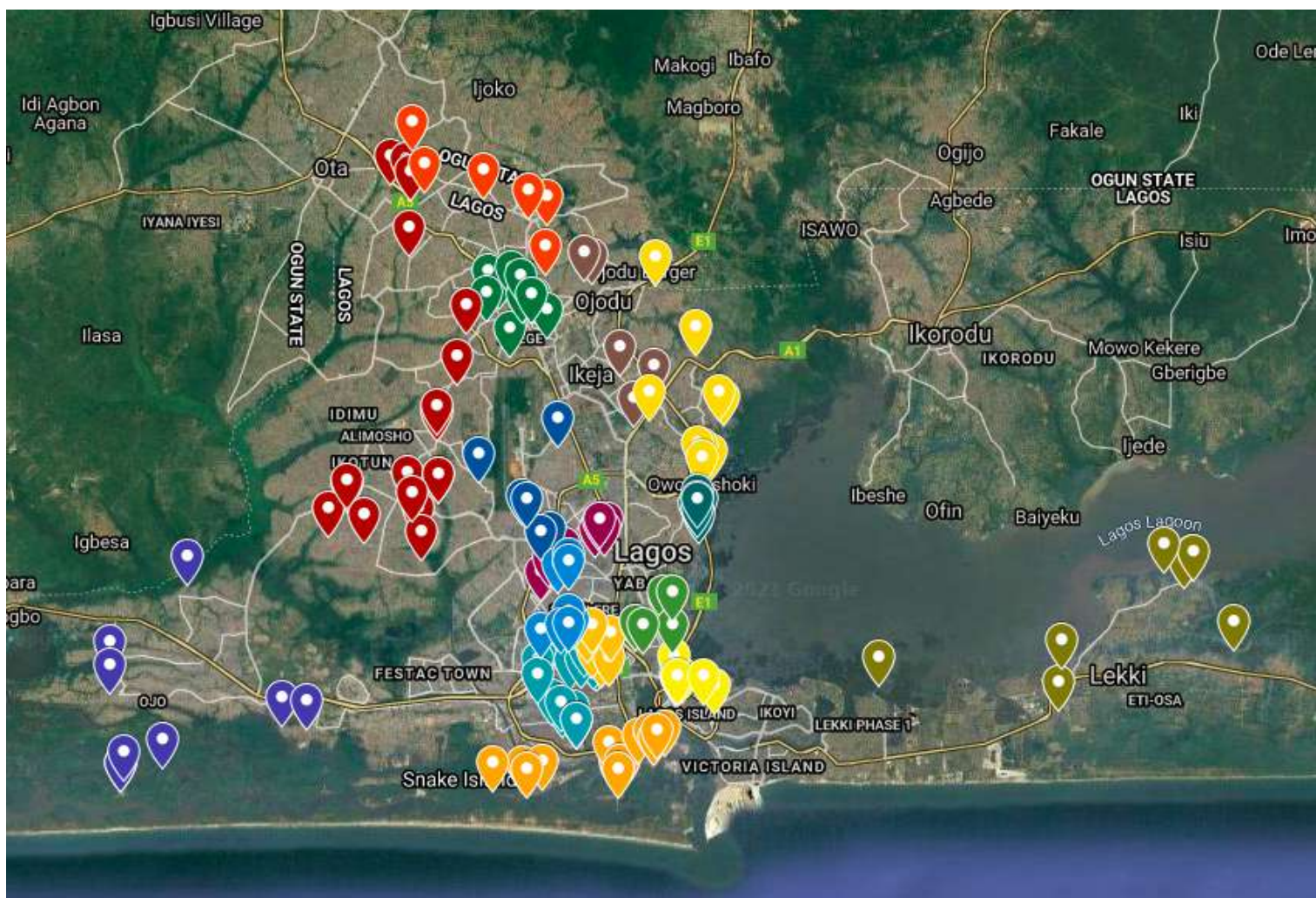
Prior to deployment of the main questionnaire, the LGA teams worked to identify a minimum target number of informal settlements in each of the sixteen (16) LGAs of metropolitan Lagos. For each settlement, a GPS coordinate was taken and a pre-survey questionnaire completed. The pre-survey questionnaire collected general observations as to whether the community was connected to public electricity supply, the typology and size of structures, the predominant ethnic/language groups, as well as settlement locational factors (e.g. proximity to water bodies, railways, etc.) to help with sampling. The community pre-questionnaire is attached at **Annex C**.

Sampling for the final survey was done at three levels. First, we developed a formula for generating the target number of surveys to be conducted in each of the 16 LGAs within metropolitan Lagos, which was based on the total population of each LGA, the population density, and the number of Federation-identified informal settlements within the LGA. The goal was to weight the sampling in each LGA in a way that balanced all three of these factors. The original target for surveys in each LGA based on this formula is attached at **Annex D**.

Secondly, we used the settlement characteristics from the pre-survey questionnaire to select a representative sampling of settlements with a target of 20 surveys per settlement and gave the survey team a target number of surveys to be conducted in each structure type in the settlement, once again aiming for a representative sampling of across the typologies present. Thirdly, the survey teams then used a random sampling method (a randomly generated number and transverse walk methodology) to select the households to respond in a given community. We did not attempt to ensure representative sampling at the household level in terms of occupational status (landlord/tenant), language/ethnic group, or other household characteristics.

Despite the fact that the survey was conducted during the first year of the Covid-19 pandemic, the field teams were able to deploy the survey to reach **3,129 households in 181 settlements across the 16 local government areas (LGAs)** that comprise metropolitan Lagos. The resulting data gives a valuable snapshot of the variety of lived realities and approaches to cooking and lighting among diverse households living in Lagos informal settlements.

Map showing the settlements in which surveys were conducted, color-coded by LGA

🔴 Alimosho (18)		🟡 Apapa (8)	
🔵 Ajeromi Ifelodun (17)		🟢 Eti-Osa (8)	
🟠 Amuwo Odofin (14)		🔵 Surulere (8)	
🟢 Agege (11)		🟡 Lagos Island (7)	
🟣 Mushin (10)		🔴 Ifako Ijaye (6)	
🟡 Kosofe (9)		🟢 Lagos Mainland (6)	
🔵 Ojo (9)		🔵 Oshodi (6)	
🔵 Shomolu (9)		🟤 Ikeja (5)	

In addition to the primary survey, follow-up work was done by the Federation's grassroots youth media team to conduct structured interviews with selected survey respondents to gather qualitative and information about respondents' cooking and lighting usage behaviours. These individual stories help to bring the data to life throughout the report.

The methodology for the different aspects of analysis conducted are presented in the specific sections below, particularly for technical analysis such as calculation of estimated GHG emissions and estimation of household load and household electricity consumption based on the load inventory assessments conducted.

V. Presentation of Findings & Analysis

a. Profile of Settlements, Households, and Respondents
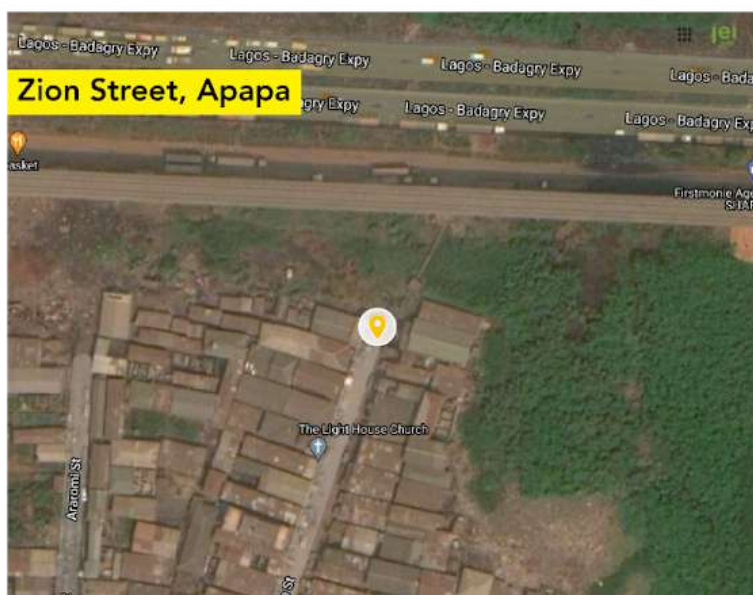
i. Settlement Characteristics

The survey was conducted across 181 informal settlements with a wide variety of characteristics from size and density to predominant ethnic/language group and typical structure type/size, etc. The diversity of these settlements represents the diversity of informal settlements or slums in Lagos, from Egun-majority waterfront communities with typical structures built from bamboo on stilts to Ilaje-majority settlements with typical plank structures connected by plank bridges running above a swamp and to Hausa-majority settlements constructed primarily of zinc sheets; from dense multi-ethnic settlements crowded between industrial areas characterized by large cement block face-me-face-you tenement buildings primarily occupied by tenants to quasi rural settlements on islands off of the Apapa Port typified by larger family-occupied compounds but where residents have no access to motorable roads, pipe-borne water, or the electrical grid.

The comparative analysis of satellite images (**Images A, B, and C**) on the following pages shows the variety of density, plot size, and locational factors across settlements.

The 181 settlements sampled from are spread across 16 LGAs of metropolitan Lagos with the largest number of settlements in a single LGA being 14 (Alimosho LGA) and the fewest being 5 (Ikeja). The largest number of surveys conducted in a single settlement was 73 (a settlement comprising four (4) separate villages and home to over 40,000 estimated residents) and the fewest was 1 with an average of 17.7 surveys conducted in each settlement. A list of the 181 settlements, organized by LGA, is attached at **Annex E**.

It was difficult to get much reliable settlement-level data from the pre-survey questionnaire that was based only on observation and responses from key community contacts, and not all settlements included in the survey had completed the comprehensive community profiling process that the Federation and JEI typically do that includes tallying all structures, etc.

However, the pre-survey questionnaire generated some data to paint a snapshot of settlement characteristics and the variation across LGAs. For instance, 91% of communities across Lagos were on-grid, but in Amuwo-Odofin LGA (which includes many island communities) this figure was as low as 21% and it was as high as 100% in 11 mainland LGAs. In terms of locational factors analyzed based on typical location of slums and informal settlements on less prime land or close to some form of locational hazard, 49% of communities surveyed were close to a water body, 45% were close to a swamp, 26% were close to a major highway, 14% were close to a high tension wire, 3% were close to a pipeline, and 1% were close to a railway line. Unsurprisingly, there was also a great deal of variety in these factors at the LGA level. A very speculative analysis suggests at least 17% of communities are predominantly ethnic minorities. An LGA-by-LGA analysis of these settlement characteristics is attached at **Annex F1-F4**.

Epe Edo, Lagos Island

Ojota Dump Site, Ikeja

Agboyi 1, Kosofe

Badore, Eti Osa

Ewu Tuntun, Oshodi

Zion Street, Apapa

Ope / Arikewuyo, Surulere

Isalo Odo Ile Epo, Agege

Wasimi, Ikeja

Ikota, Eti Osa

Abete, Apapa

Arobadade, Shomolu

Panada, Oshodi

Lafiaji, Lagos Island

Shibiri, Ojo

Odo Eran, Mushin

Temitire, Ajeromi Ifelodun

Itun Agan, Amuwo Odofin

ii. Housing Typology

From the survey, we are able to understand the range of housing types occupied by the respondents, which again reflect a wide variety of lived realities. Across all the settlements, the majority of respondents live in houses with cement floors (77%), cement block walls (82%), and zinc roofs (83%), with glass windows (55%) or wood (38%). A distant second are those living in houses with wood/plank floors (11%) or tile floors (7%), wood/plank walls (11%), and asbestos roofs (10%). All other floor, wall, roof, and window materials are very small percentages overall.

However, there is very significant variation across LGAs in these breakdowns, with rates of cement floors ranging from 29% (Eti-Osa LGA) to 99% (Mushin LGA); rates of cement block walls ranging from 26% (Eti-Osa LGA) to 100% (Mushin and Surulere LGAs); rates of glass windows ranging from 20% (Eti-Osa LGA) and 23% (Lagos Mainland LGA) to 89% (Ifako-Ijaiye LGA); while rates of zinc roofing remained consistently high across all LGAs (73-99%). In Eti-Osa and Lagos Mainland LGAs, the predominant housing materials were wood/plank floors (61% and 41% respectively), wood/plank walls (36% and 39% respectively). Bamboo/palm frond walls also represented a significant percentage (17%) in Amuwo-Odofin and Eti-Osa LGAs, while zinc walls are not infrequent in Amuwo-Odofin, Eti-Osa, and Ikeja LGAs (4-12%). In Amuwo-Odofin, Apapa, Eti-Osa, and Lagos Mainland LGAs, the predominant window type is wood (56-70%) as opposed to glass windows that predominate in other LGAs.

The pre-survey questionnaire also gathered observational data on the average sizes of residential structures in the 181 communities surveyed. From this data across LGAs, single-family homes represent an estimated 19% of structures in informal settlements; the remainder are multi-family units with 2-4 units (37%), 5-10 units (33%), and 11+ units (13%). Once again, there is significant diversity across LGAs reflecting the broad spectrum of lived realities from the more densely populated urban LGAs to the more rural LGAs. For instance, single family structures predominate in informal settlements in Amuwo-Odofin, Eti-Osa, Lagos Mainland (predominantly waterfront informal settlements), and Ojo LGAs (33-61%); 2-4 unit multi-family structures predominate in Alimosho, Apapa, Ifako-Ijaiye, Ikeja, Lagos Island, Oshodi-Isolo, and Shomolu LGAs (40-54%); 5-10 unit multi-family structures predominate in Agege, Apapa, Kosofe, and Surulere LGAs (42-73%); and 11+ unit multi-family structures predominate in Ajeromi-Ifelodun LGA (47%). See **Annex F** for more detailed breakdowns.

iii. Respondent Profile & Household Characteristics

The household survey gathered information both about the individual respondent and the household they were representing and about which they were providing information. Across the LGAs, 56% of respondents were female and 44% male; 46% were above age 45, 29% were 35-45 years old, 22% were 25-35 years old, and only 4% of respondents were under age 25.

Across all LGAs, the **average household size was 5.85 people**,[2] with a wide variation across LGAs ranging from lower average household sizes in Agege LGA (4.08) and Ikeja LGA (4.02) to higher in Eti-Osa LGA (8.52), Lagos Island (8.70) Amuwo-Odofin LGA (10.11). Interestingly, average household size was generally smaller among households that do not occupy the entire structure (5.85 versus 5.24) and for tenant households (5.00 versus 6.9). On average across LGAs, households included **2.05 children under age 15**, **0.47 adults over 65**, and **2.83 women**. Again, there was fair variation between LGAs, with the highest average numbers of children under age 15 in Eti-Osa, Lagos Island, and Lagos Mainland LGAs (3.32-3.84); the highest rates of adults over age 65 in Lagos Island and Mushin LGAs (0.96-1.16); and the highest numbers of women in Eti-Osa, Lagos Island, and Lagos Mainland LGAs (3.87-5.05).

Across LGAs, 47% of respondent households occupied the entire structure, while 53% occupied just part of the structure. Of the 53% of respondent households occupying just part of a structure, 1.93 was the average number of rooms occupied across all LGAs, making **2.71 the average number of people per room** in households that do not occupy the entire structure. There was fair variation in these numbers across LGAs, with the average number of people per room ranging from 1.69 (Lagos Island LGA) to 5.41 (Eti-Osa LGA) for such households.

The average living area occupied by all respondent households in informal settlements across the city was **190 square feet**, making the **average living space per capita 32 square feet**. Once again, there is a fair amount of variation between LGAs, with the total living space per household ranging from 76 square feet (Eti Osa LGA) and 86 square feet (Lagos Island LGA) to 287 square feet (Shomolu LGA) and 301 square feet (Ifako-Ijaiye LGA). The corresponding average per capita living space by LGA ranges from 8 square feet per capita (Eti-Osa LGA) and 10 square feet per capita (Lagos Island LGA) — rates that fall within globally defined overcrowding[3] — to 59 square feet per capita (Ifako-Ijaiye LGA) — closer to regional norms.

Across all LGAs, 45% of respondents are structure owners or a relative of the structure owner, while 55% are tenants or sub-tenants. As with other data points, there is a wide range between LGAs with structure owners representing only 24% of respondents in Surulere LGA or 30-31% in Apapa, Ikeja, and Oshodi-Isolo LGAs and as much as 91% in Amuwo-Odofin LGA. It should be noted that within each settlement sampling was randomized as to whether households were structure owners or tenants, meaning that these numbers should reflect average conditions.

Across all LGAs, 72% of respondent households used their structure/premises for residential purposes only, with 27% using it for residential and business and just 1% using it for residential and other (e.g. religious) purposes. Again there is a wide variation across LGAs, with 99% of

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[2] This figure from households in informal settlements within the metropolitan LGAs of Lagos State compares with an average household size of 5 persons across all of Lagos State from the most recent available state household survey. See Lagos State Government, *Household Survey 2016 Report*.

[3] To put this in context, the global median per capita floor space was 155 square feet as of 1991, with comparable cities such as Ibadan, Accra, and Abidjan averaging closer to 70-85 square feet per capita. Indicators developed for the Millenium Development Goals defined overcrowded housing as anything more than three people sharing a single room of a minimum of 4 square meters (43 square feet), which would translate to a bare minimum standard of just over 14 square feet per capita.

structures used only for residential purposes in Eti Osa LGA and only 48% in Oshodi-Isolo LGA, meaning that the majority (52%) in Oshodi-Isolo LGA are used jointly for business/other uses. This is relevant for interpreting household energy usage and GHG emissions presented below.

iv. Household energy access

To evaluate and put in context our findings about household cooking and electricity/lighting in Lagos informal settlements, we rely on the ESMAP Multi-Tier Framework for Measuring Energy Access,[4] specifically the frameworks for cooking and electricity, excluding the framework for heating which is largely irrelevant to the Lagos context. In this section, we briefly present the major trends and findings discussed in great detail in the subsequent sections against this framework to provide a useful snapshot of energy access across Lagos informal settlements.

Broadly speaking, Lagos is far ahead of the rest of the country in advancing penetration of LPG as a cleaner fuel source. Nevertheless, nearly half of cooking solutions among residents of informal settlements likely contribute to poor indoor air quality. Availability is good, particularly for kerosene and charcoal, but affordability is a concern overall. The data collected and the tier framework stage of development does not allow an assessment of the overall tier for access to cooking solutions by informal settlements residents, however likely it would not be above Tier 3.

Access to Cooking Solutions Attributes	Typical Reality for Lagos Informal Settlement HH	Corresponding Tier
1. Indoor Air Quality	Overall, 47% of cooking solutions used by HHs in Lagos informal settlements likely cause indoor air pollution (e.g. cooking with kerosene, charcoal or firewood in an enclosed space) -- many respondents complain of smoke hurting eyes, etc.	Tier criteria not clear
2. Cookstove Efficiency	Unknown / data not collected -- however respondents complained of their primary fuel being slow to cook (especially kerosene, biomass)	Tier criteria not clear
3. Convenience	Unknown / data not collected to assess time in acquiring fuel and preparing cookstove for each meal	Cannot assess
4. Safety	Unknown / data not collected -- however aside from complaining of smoke, no respondent dissatisfaction linked to safety-related incidents; but fear (for safety) is cited as major	Cannot assess

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[4] World Bank & Energy Sector Management Assistance Program (ESMAP), *Beyond Connections: Energy Access Redefined* (2015). More resources found here: https://www.esmap.org/node/55526

	barrier for those who not using LPG	
5. **Affordability**	Median household monthly cooking fuel expenditures are ~10.5% of the monthly minimum wage in Nigeria	Tiers 1-3
6. **Quality of Fuel**	Unknown / data not collected	Cannot assess
7. **Availability**	Overall 72% report fuel sources are available in their community, with higher numbers (85-87%) for kerosene and charcoal, and lower numbers (63%) for LPG and firewood	Tiers 4-5

Electricity in Lagos is a major challenge, although a relatively high percentage of informal settlements and their residents are connected to the power grid — certainly much higher than the overall national picture. When there is electricity, the capacity is sufficient for basic household usage; however availability (duration) of supply is a major challenge as is reliability, with a reported median of 6 hours daily with no predictable schedule and regular disruptions. Quality and safety of grid electricity is also a concern. With strong evidence of substantial overbilling for the supply actually delivered, affordability of public electricity remains a major challenge for informal settlement residents, with other options such as generators and solar currently being out of reach for many households. In this context, it must be noted that legality is a problem originating from the electricity distribution companies and their agents. Consequently, community light committees and other bill sharing is a common solution to improve access. Many households rely on battery-powered lighting and charging stations//kiosks are common to enable informal settlement residents to keep phones charged while waiting for "light to come." Overall, a Tier 2 or possibly a low Tier 3 is appropriate for electricity access.

Electricity Access Attributes	Typical Reality for Lagos Informal Settlement HH	Corresponding Tier
1. **Capacity**	Typical households have 3-4 light bulbs and a ceiling fan; it is not uncommon to have a TV and electric iron; stereos and small refrigerators are less common; other appliances quite rare	Tier 3
2. **Availability (Duration)**	6 hours daily	Tier 2
3. **Reliability**	Unreliable supply widespread	Tiers 1-3
4. **Quality**	Irregular voltage reported, surges spoil devices	Tiers 1-3
5. **Affordability**	Overbilling widespread and	Tiers 1-2

	affordability is reported barrier to access; average monthly payment is over 5% of min wage	
6. Legality	Most pay directly to distribution company, agent; but also to a landlord on a shared bill or to community light committees	Tiers 1-3
7. Health & Safety	Safety incidents (e.g. falling wires, sparking) reported	Tiers 1-3
8. Annual Consumption Levels (kWh)	Median estimated household consumption = 366 kWh	Tier 3

v. Household & per capita GHG emissions

Across all LGAs, the median household carbon emissions from stationary energy usage (cooking and electricity) in Lagos informal settlements is **0.92 tons CO_2e per year**. The median per capita emissions across all households surveyed are **0.16 tons CO_2e per person per year**. To put this in global context, this compares to an estimated 18 tons CO_2e per person per year emitted in the United States; 50 tons CO_2e per person per year in Qatar; and 4 tons CO_2e per person per year globally on average -- although each of these numbers take into account *all* emissions, e.g. including waste and transportation, not just stationary emissions.

To relate this to more local context, a recent study of carbon emissions among households in Port Harcourt, Nigeria, estimated that an average family of six (6) in Port Harcourt emitted 5.02 tons CO_2e per year, making an estimated 0.83 tons per person per year across all common carbon emissions sources.[5] While the Port Harcourt estimate also included transportation and other categories of emissions, our other surveys of typical Lagos informal settlement residents indicate that most travel by walking or public transport and do not use airplanes; also rates of reuse of waste products is high, suggesting relatively small emissions from these categories.

Table 1a. Average stationary carbon emissions in Lagos informal settlements

Median Total HH Electricity / Light Co2e (tons per year)	Median HH Total Cooking CO2e (tons per year)	Median Total CO2e (tons per HH per year)	Median Total CO2e (tons per person per year)
0.18	0.52	0.92	0.16

HH = household. See further discussion of methodology and calculations below. LGA-by-LGA disaggregation of these numbers appears at **Annex G.*

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[5] O Gershon and O Patricia 2019 J. Phys.: Conf. Ser. 1299 012019.

Further explanation of the methodology for calculating the carbon emissions from cooking and lighting/electricity for Lagos informal settlement households and the survey data on which these calculations are based, see below in the sections on carbon emissions below (IV.b.ii and IV.c.ii).

We have considered carefully the feasibility of doing a citywide projection of household stationary GHG emissions from informal settlements based on the household level data generated through this survey. Certainly, it would be possible to use very broad assumptions, for instance the most recent (2018) World Bank estimate that 54% of people living in Nigerian cities live in slums and the current official Lagos State population estimate of 21 million to project an **estimated slum population of 11,340,000** and then use **our finding of 0.16 tCO2e emissions per capita per year across informal settlement residents within metropolitan Lagos** to estimate **aggregate stationary emissions of 1,814,400 tC02e from informal settlements in Lagos State**. However, given the extreme lack of precision in these assumptions — the use of a national estimated percentage of people living in slums across all cities across Nigeria rather than a Lagos-specific number, the use of an international definition of 'slum' that may be over-inclusive in an Nigerian reality where factors like limited access to basic services is quite widespread, the use of a statewide current population estimate as against survey findings from only 16 out of 20 LGAs, etc. — we find such a calculation not at all reliable or scientific.

Unfortunately, a bottom-up aggregation approach that would be much more scientific and reliable would require significant additional work that focuses on identifying all slums and informal settlements within the city or the state and gathering reliable population data through house tallies and/or satellite image analysis. Since such efforts are currently underway by a Task Force led by the Lagos State Urban Renewal Agency, we envision being able to more reliably and scientifically make such projections in future years or a next iteration of this survey.

b. Cooking

This section of the report presents the survey data collected on cooking by respondents in Lagos informal settlements. As one of the primary sources of GHG emissions, we sought to understand predominant cooking practices, related expenditures and health factors, as well as prospects for behaviour change. This section concludes with recommendations for the city's climate action planning process specific to cooking.

As a starting point, we sought to understand current cooking habits by asking the frequency with which people cooked in their homes, whether they cooked just for themselves or additionally to have food available to sell, as well as the location where cooking took place. We find that across households surveyed, nearly half (**49%**) reported cooking twice a day, while just under a third (**32%**) reported cooking three times a day and **11%** reported cooking once a day. Less or more frequent cooking was minimal. The vast majority (**97%**) of households cooked just for members of their family, rather than cooking food for sale or preparing other foodstuffs for sale.

There was much more significant variation in cooking location, with the most common location (**35%**) being in a separate structure (e.g. an separate kitchen structure), followed by cooking

inside the house/apartment (**26%**), outside in the open air (**20%**), and outside in a corridor (e.g. the corridor between separate one-room apartments in a typical "face-me-face-you" tenement) (**17%**). See chart below.

Where households cook

Cooking location
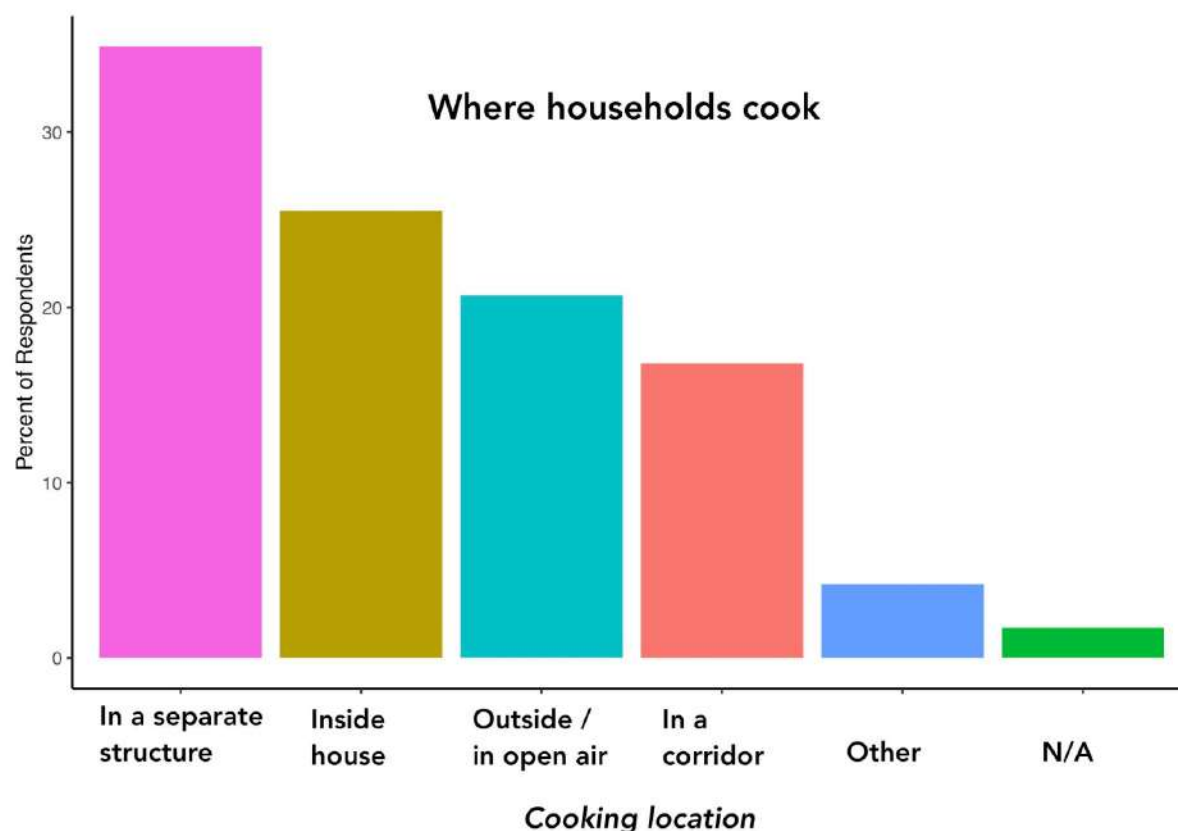
i. Primary and secondary fuel types used

The survey also captured the primary and secondary fuels that each respondent household uses for cooking. Across all survey respondents, **46.4%** primarily use gas (LPG), **35.4%** primarily use kerosene, **8.7%** primarily use charcoal, and **7.2%** primarily use firewood. There are notable variations from these averages when the data is disaggregated by LGA (see **Table 2** below). This section presents this data and analysis broken down by each fuel type.

Table 2. Primary fuel sources used by respondents by LGA

LGA	Charcoal	Firewood	Gas (LPG)	Kerosene	No Source	Other	Total Surveyed (n)
Agege	5.2%	2.6%	68.9%	21.2%	1.6%	0.5%	193
Ajeromi Ifelodun	12.3%	5.6%	35.3%	44.3%	2.5%	0.0%	357
Alimosho	2.4%	3.5%	68.3%	21.9%	3.7%	0.3%	375
Amuwo Odofin	17.0%	22.2%	23.3%	36.4%	1.1%	0.0%	176
Apapa	4.6%	2.3%	21.4%	68.8%	1.7%	1.2%	173
Eti Osa	12.8%	20.9%	16.2%	50.0%	0.0%	0.0%	148

Ifako Ijaiye	5.1%	2.0%	85.7%	7.1%	0.0%	0.0%	98
Ikeja	3.5%	9.4%	60.0%	21.2%	4.7%	1.2%	85
Kosofe	5.2%	8.0%	50.6%	33.9%	2.3%	0.0%	174
Lagos Island	8.5%	0.0%	35.9%	54.2%	0.0%	1.3%	153
Lagos Mainland	22.5%	2.4%	28.4%	45.0%	1.8%	0.0%	169
Mushin	13.3%	1.0%	52.4%	31.3%	2.0%	0.0%	294
Ojo	6.4%	28.6%	43.6%	17.3%	1.8%	2.3%	220
Oshodi Isolo	3.8%	2.5%	75.5%	17.0%	1.3%	0.0%	159
Shomolu	5.1%	8.6%	35.4%	48.0%	1.7%	1.1%	175
Surulere	8.3%	0.6%	43.3%	47.8%	0.0%	0.0%	180
Grand Total	**8.7%**	**7.2%**	**46.4%**	**35.4%**	**1.8%**	**0.4%**	**3,129**

Gas (LPG):

Across the households surveyed, **52.1%** (n=1,630) reported using gas (LPG) as a fuel source (either primary or secondary) and **46.4% (**n=1452) reported using LPG as a primary fuel source for cooking, with a total of **30.6%** (n=956) of all households reporting LPG was their only fuel source for cooking. LPG usage varied significantly across LGAs. As a primary fuel source for cooking, usage was highest in Ifako Ijaiye (85.7% of the 98 households surveyed use LPG as a primary fuel source) and lowest in Eti Osa (16.2% of the 148 households surveyed use LPG as a primary fuel source). See **Table 1** above.

For households which reported using LPG as a fuel source, the **median household reported using 78kg of LPG per year**. Across all households surveyed, the mean reported usage of **75.6±197.6kg LPG** per year.

Kerosene:

Across the households surveyed, **50.6%** (n=1,583) reported using **kerosene** as a fuel source (either primary or secondary) and **35.4%** (n=1,108) reported using kerosene as a primary fuel source for cooking, with a total of **27%** (n=845) of all households reporting kerosene was their only fuel source for cooking. Kerosene usage varied significantly across LGAs. As a primary fuel source for cooking, usage of kerosene was highest in Apapa (68.8% of the 173 households surveyed use kerosene as a primary fuel source) and on Lagos Island (54.2% of 153 households use kerosene as primary fuel source). Kerosene usage was lowest in Ifako Ijaiye (7.1% of the 98 households surveyed use kerosene as a primary fuel source). See **Table 2** above.

For households which reported using kerosene as a fuel source, the **median household reported using 156 liters of kerosene per year**. Across all households surveyed, the mean reported usage of 130.2±260.4 liters per year.

Charcoal:

Across the households surveyed, **15.2%** (n=477) reported using **charcoal** as a fuel source (either primary or secondary) and **8.62%** (n=270) reported using charcoal as a

primary fuel source for cooking, with a total of **5.14%** (n=161) of all households reporting charcoal was their only fuel source for cooking. Charcoal usage varied significantly across LGAs. As a primary fuel source for cooking, usage of charcoal was highest in Lagos Mainland (22.5% of the 169 households surveyed use charcoal as a primary fuel source) and in Amuwo Odofin (17.0% of 176 households use charcoal as primary fuel source). Charcoal usage was lowest in Alimosho (2.4% of the 375 households surveyed use charcoal as a primary fuel source). See **Table 1** above.

Oke Philomena

My name is Oke Philomena. I have been in Makoko for 55 years now. I gave birth to all my children in Makoko.

I use firewood for cooking before but now I'm using charcoal. I also use stove at times. I stopped using firewood because of the heat and the smoke coming from it is not good for my health. But the charcoal doesn't have much smoke. I cook every day, I also sell grinded tomatoes after grinding it I cook it so that it won't spoil.

I can also use gas for my cooking because gas is faster, but I don't use gas because I don't know how to use it. Before I will use gas someone will have to train or teach me how to use it.

For households which reported using charcoal as a fuel source, the **median household reported using 312 kg of charcoal per year**. Across all households surveyed, the mean reported usage was 60.1±224.8kg charcoal per year.

Firewood:

Across the households surveyed, **9.17% (n=341)** reported using firewood as a fuel source and **7.08% (n= 226)** reported using firewood as a primary fuel source for cooking, with a total of **4.63% (n=148)** of all households reporting firewood was their only fuel source for cooking. Firewood usage varied significantly across LGAs. As a primary fuel source for cooking, usage of firewood was highest in Ojo (28.6% of the 220 households surveyed use firewood as a primary fuel source) and in Amuwo Odofin (22.2% of 176 households use firewood as primary fuel source). Firewood usage was lowest in Lagos Island (0% of the 153 households surveyed use firewood as a primary fuel source). See **Table 2** above.

To better understand the differences across communities and LGAs in respondents' choice of fuel source for cooking we additionally analyzed **locational factors**, including whether a community is near a water body, swamp, major highway, pipeline, or high tension wires. We find that if a community is close to a water body (comprising 49.46% of communities surveyed), its residents are significantly less likely to use gas (35.66% versus 57.24%). Instead, residents of communities close to water bodies are somewhat more likely to use firewood (12.01% versus 2.86%), kerosene (39.79% versus 31.23%), and charcoal (10.55% versus 6.22%).

On account of the small sample size of respondent households close to a major highway, pipeline, railway, or high tension wire, we do not draw any conclusions as to correlations between these locational factors and choice of cooking fuel.

Comparing the choice of primary cooking fuel between **structure owners and tenants** across all households surveyed, we found no very significant correlations. However, tenants are somewhat more likely to use gas (49.91% versus 42.84% for structure owners), and somewhat less likely to use firewood (3.50% versus 12.09% for structure owners). This difference may be explained in part by tenants living in face-me-face-you tenement buildings with very limited space for cooking, and/or need for a controlled flame.

Similarly, there were no very significant correlations between **structure use** and primary cooking fuel reported by respondents. However, structures that are residential only are slightly more likely to use kerosene (36.57% versus 31.98% for structures that are residential and business) and firewood (8.27% versus 5.29% for structures that are residential and business). Whereas structures that are both residential and business are slightly more likely to use gas (50.22% versus 45.29% for structures that are residential only). See graph below.

Cooking Fuel Comparisons between Structure Usage
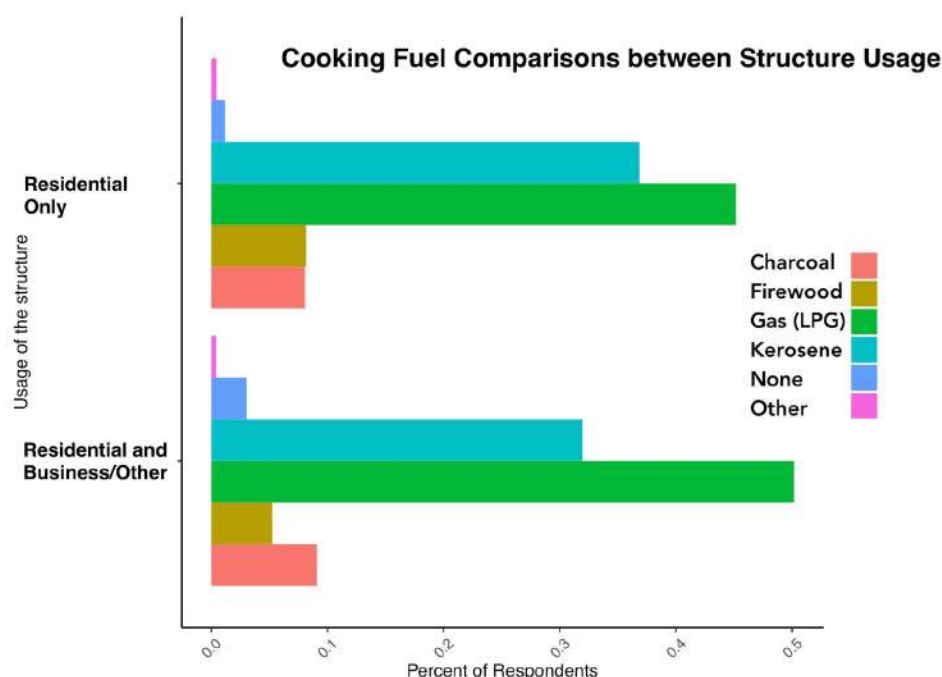
The survey additionally sought to understand whether there are any correlations between primary and **secondary (or back up) fuel types** used for cooking. Of all of the survey respondents, only 35% reported using a secondary source of energy for cooking in addition to their primary source of energy. As reported above, when both primary and secondary fuel sources are aggregated, we find that over half of all respondents use gas (LPG) (**52.31%**) and over half of all respondents use kerosene (**50.41%**), while the percentage of respondents using charcoal (**15.47%**) and firewood (**10.72%**) are much smaller. See graph below.
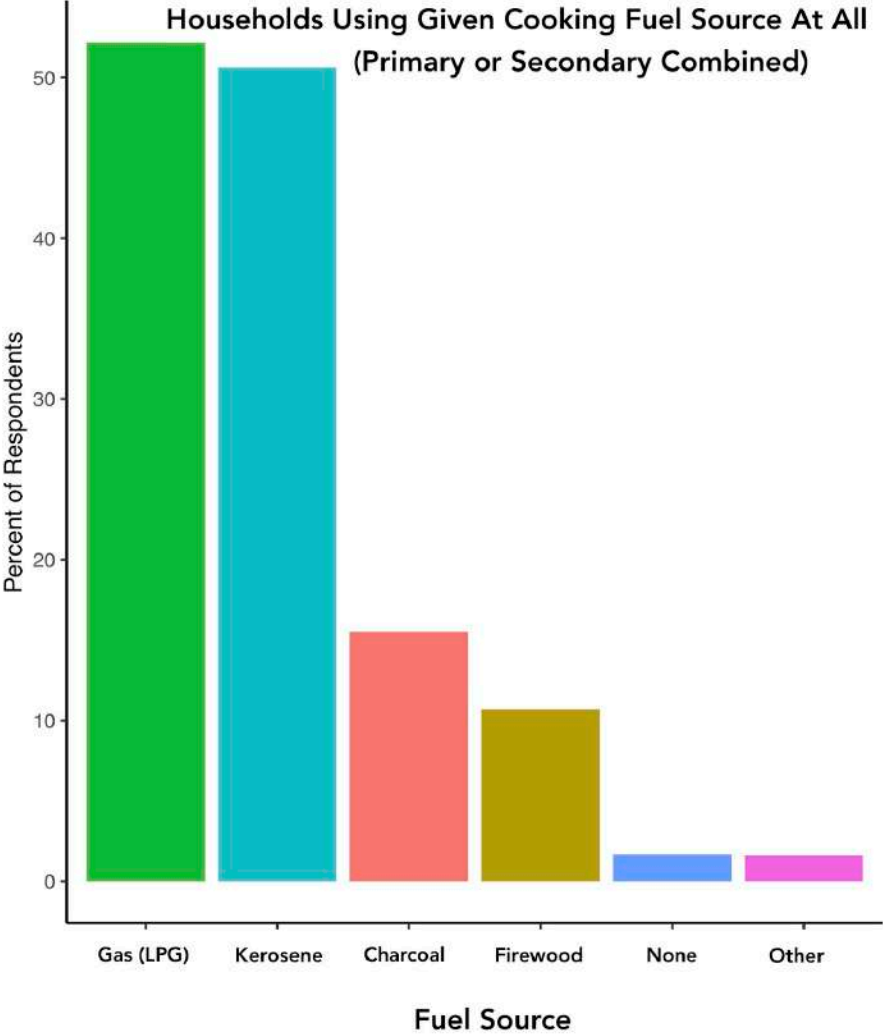
About half of respondents (**49.71%** n=508) who indicated that they use a secondary source of fuel for cooking use kerosene as a secondary source, as compared to **22.60%** (n=231) using charcoal, **16.93%** (n=173) using gas (LPG), and **10.76%** (n=110) using firewood as a secondary source. Across all of the respondents who use a secondary source of fuel, there is no significant correlation between primary fuel type and secondary fuel type.

ii. Carbon emissions from cooking

To estimate the stationary energy source carbon footprints for cooking of informal settlements in Lagos, we analyze the following emissions sources: (1) **Liquefied Petroleum Gas (LPG)**, (2) **kerosene,** primarily for cooking, and **(3)** **charcoal** burning for cooking.

GHG emissions associated with burning firewood was not included in our analysis, despite the fact that respondents reported using this fuel source. The carbon intensity of firewood over its lifecycle depends strongly on the source of the wood and the type of the wood being burned and whether forests are allowed to regrow and sequester carbon; while the combustion of firewood does have a carbon footprint, we do not include it in our analysis due to challenges quantifying it. We note that only **7.08%** of households reported using firewood (or coconut shells) as a primary fuel source for household cooking and only **10.72%** overall. The percentage of these households who reported measurable consumption is smaller. While an assumption should not be made that firewood is carbon neutral, we omit reporting emissions from firewood combustion.

All emissions quantities are in CO_2e. We use the following emissions factors in our analysis:
- *Kerosene:*   2.519 kg CO_2e per liter kerosene
- *LPG:*   2.985 kg CO_2e per kg LPG
- *Charcoal:*   3.304 kg CO_2e per kg charcoal

For **cooking fuels**, usage amounts were self-reported by survey respondents, who were allowed to choose a frequency with which they purchased cooking fuel and the amounts that they purchased at each instance. Some individuals reported daily purchases, while others reported weekly or monthly purchases. All purchase frequencies were annualized. Purchased amounts were generally reported in kilograms (for LPG), in centiliters, soda bottles, or liters (for kerosene) and in kilograms, naira, or nylon sacks (for charcoal). For kerosene, small soda bottles were assumed to be 60cl. For charcoal, small nylon sacks were assumed to be 1kg charcoal and medium/large nylon sacks were assumed to be 2kg, 50 naira of charcoal was assumed to be 1kg of charcoal and 100 naira of charcoal was assumed to be 2kg, all based on informal surveys with charcoal sellers in several communities. For firewood (excluded from emissions calculations), a common bunch/bundle of fuel wood was assumed to be 5kg and, from a small sample (n=128), average reported consumption was **326 kg per person per year**.

No full life-cycle emissions or embedded emissions for goods or products are included in our analysis. All emissions quantities are in units of CO_2e.

Gas (LPG) CO_2e Emissions

     Among households that use LPG as a fuel source for cooking, the average annual CO_2 emissions from combustion of LPG per household was **0.45 tons CO_2e per year**. There was significant variation in average annual household emissions across LGAs, with the highest household emissions from LPG in Lagos Island LGA (0.85 tons) and Amuwo Odofin LGA (1.01 tons) and the lowest in Shomolu LGA (0.21 tons). The average annual

emissions from LPG combustion per person out of all households using LPG as a fuel source for cooking is **0.08 tons CO_2e per person per year.**

Kerosene CO_2e Emissions

Among households that use kerosene as a fuel source for cooking, the average annual CO_2 emissions from combustion of kerosene per household was **0.80 tons CO_2e per year**. There was significant variation in average annual household emissions across LGAs, with the highest household emissions from kerosene in Lagos Island LGA (1.26 tons) and Lagos Mainland LGA (1.01 tons) and the lowest in Ikeja LGA (0.49 tons) and Agege LGA (0.51 tons). The average annual emissions from kerosene combustion per person from all households surveyed using kerosene for cooking is **0.14 tons CO_2e per person per year.**

Charcoal CO_2e Emissions

Among households that use charcoal as a fuel source for cooking, the average annual CO_2 emissions from combustion of charcoal per household was **1.30 tons CO_2e per year**. There was significant variation in average annual household emissions across LGAs, with the highest household emissions from charcoal in Amuwo-Odofin LGA (2.49 tons) and the lowest in Kosofe LGA (0.59 tons). The average annual emissions from charcoal combustion per person out of all households surveyed using charcoal for cooking is **0.22 tons CO_2e per person per year.**

Looking at total household CO_2 emissions from cooking across Lagos informal settlements, the **average emissions from cooking are 0.82 tons CO_2e per year**, with the average per person rate of **0.27 tons CO_2e per person per year.** Once again, there is significant variation between LGAs with highest average per person emissions from cooking in Lagos Island LGA (0.49 tons) and Ojo LGA (0.45 tons) and the lowest in Eti Osa LGA (0.04 tons). The median emissions, which may be more representative for cooking across all LGAs, are **0.52 tons CO_2e per household per year/0.09 tons CO_2e per person per year.** See **Annex G1** for details.

iii. Expenditures on cooking fuel & purchasing habits

To calculate the household expenditure for cooking in informal settlements in Lagos, we analyze the following cooking fuels: (1) **kerosene,** (2) **gas (LPG)**, (3) **charcoal**, and (4) **firewood.** We do not include in our analysis the start-up costs of purchasing the equipment (e.g. fire ring, stove, gas canister, etc) necessary to use the above kinds of fuel for cooking, nor do we include in our analysis any costs associated with regular or infrequent maintenance or repairs.

Generally, across all fuel types for cooking – and especially kerosene, charcoal, and firewood – respondents had difficulty reporting volumes with precision. This is at least in part because these fuels are most commonly purchased by their Naira value, and purchased in non-standardized containers or bags. For example, at the market an individual will purchase 'N500 worth of firewood' or 'N200 worth of kerosene.' Moreover, kerosene is typically purchased in reused bottles – plastic water bottles of varying sizes, glass beer bottles, plastic and glass

mineral bottles of varying sizes – and sometimes in fractions of a bottle. As a consequence, there are outliers that may be due to error but are retained within the data set; to avoid misrepresenting the data through means or ranges, we report median costs only.

All costs are rounded to the nearest whole Naira.

Kerosene:

Across all of the households that use kerosene for cooking (n=1,609), the median reported monthly expenditure on kerosene is **N3,150**. Disaggregated by LGA there is significant range of median monthly expenditures on kerosene with Ifako-Ijaiye (N880) and Oshodi-Isolo (N2,100) being the lowest, and Lagos Island (N7,200) and Eti-Osa (N7,500) being the highest. See **Table 3** below.

Kerosene is generally purchased in small volumes – in reused plastic or glass bottles – and therefore households using kerosene to cook generally make frequent purchases. Of the households that use kerosene to cook, **nearly all (90.24%) report purchasing kerosene at least once a week**, while 40.52% report purchasing kerosene on a daily basis. Households generally do not need to travel far to purchase kerosene; 85.33% report purchasing kerosene inside their own community. There is some variance across LGAs in availability of kerosene within settlements; most notably the lowest percentage of respondents reported availability in Eti-Osa (42.31%) and Ifako-Ijaiye (56.50%), and the highest in Agege (98.48%), Ajeromi-Ifelodun (97.29%), and Apapa (96.83%).

Emilien Idowu

My name is Emilien Idowu. I am 27 years old. The name of my community is Walakoji. I have been in the community for a very long time. We own the house that we live in.

I use firewood and charcoal for cooking. I always cook two times in a day. The food I cook is not for sale. If I have the opportunity to use another source for cooking I will, because the smoke from the firewood and charcoal is not good it makes me cough after coking and makes my eyes red.

In a month I use charcoal of N3,000 and firewood of N2,000. I don't use gas because I don't have money to buy it. If I see gas, I will use it and I also know how to use it. I have made use of it before in my place of work.

Gas (LPG):

Across all of the households that use **gas** for cooking (n=1,362), the median reported monthly expenditure on gas is **N2,000**. Of these households, **the majority (67.25%) report purchasing gas once a month** – as it is purchased in large quantities. As compared to kerosene, a much smaller majority of households purchase gas inside their community (62.98%). There is significant variation across LGAs in availability of gas for purchase within settlements, most notably with Ifako-Ijaiye (19.77%) being the lowest, and Agege (93.02%) and Ikeja (84.62%) being the highest.

Charcoal:

Across all of the households that use **charcoal** for cooking (n=493), the median reported monthly expenditure on charcoal is **N3,000**. Of these households, **nearly all (92.29%) report purchasing charcoal at least once a week**, while 41.58% report purchasing charcoal on a daily basis. Similar to kerosene, most households that use charcoal for cooking do not need to travel far to purchase it; 86.66% report purchasing charcoal inside their own community.

Firewood:

Across all of the households that use **firewood** (or sometimes coconut shells) for cooking (n=340), only 40% report purchasing firewood as opposed to 59% who gather it. Of those purchasing, the median reported monthly expenditure is **N6,000**. Of these households, **nearly all (92.65%) report purchasing wood at least once a week**, while 36.47% report purchasing wood on a daily basis. A majority (74.53%) of the respondents that use wood for cooking purchase or collect the wood within their own community.

Table 3. Median monthly expenditure for cooking fuel by LGA*

LGA	kerosene (n=1,609)	charcoal (n=493)	gas (LPG) (n=1,362)	median monthly expenditure (kerosene + charcoal + gas)
Ifako-Ijaiye	880 ₦	3,000 ₦	1,800 ₦	3,600 ₦
Oshodi-Isolo	2,100 ₦	3,000 ₦	1,800 ₦	2,400 ₦
Kosofe	2,400 ₦	800 ₦	2,000 ₦	3,150 ₦
Ojo	2,400 ₦	3,000 ₦	2,500 ₦	2,520 ₦
Surulere	2,400 ₦	4,500 ₦	1,800 ₦	2,520 ₦
Agege	2,400 ₦	6,750 ₦	4,250 ₦	2,220 ₦
Alimosho	2,400 ₦	1,200 ₦	3,600 ₦	2,520 ₦
Ajeromi-Ifelodun	3,000 ₦	4,800 ₦	1,800 ₦	3,000 ₦
Lagos Mainland	3,000 ₦	1,200 ₦	2,200 ₦	6,000 ₦
Mushin	3,000 ₦	2,400 ₦	4,000 ₦	3,000 ₦
Amuwo-Odofin	4,500 ₦	3,000 ₦	4,000 ₦	3,150 ₦
Ikeja	4,800 ₦	2,800 ₦	1,900 ₦	2,000 ₦

Apapa	4,800 ₦	3,000 ₦	2,000 ₦	3,108 ₦
Shomolu	4,800 ₦	1,200 ₦	1,800 ₦	2,920 ₦
Lagos Island	7,200 ₦	3,000 ₦	2,000 ₦	6,300 ₦
Eti-Osa	7,500 ₦	6,000 ₦	1,900 ₦	3,150 ₦
ALL LGAs	**3,150 ₦**	**3,000 ₦**	**2,000 ₦**	**3,150 ₦**

Notes: monthly expenditure on firewood disaggregated by LGA was omitted from the above table due to the relatively small size of the data set, 'median monthly expenditure' column excludes households that report 0N monthly expenditure on kerosene + charcoal + gas combined

Looking across all different types of fuel used for cooking, respondents reported a **median monthly household expenditure of N3,108 on cooking fuel** (including firewood, not included in the chart above due to low sample sizes when disaggregated. When compared with the median household expenditure for each of the fuel types, we find that households that use gas (LPG) spend the least amount of money monthly on cooking fuel (N2,000), whereas households that use firewood spend the greatest amount of money monthly on cooking fuel (N6,000).

iv. Health factors related to cooking

To determine whether there are any health impacts that may be linked to air pollution related to the source of energy used for cooking, we asked respondents to self-report any health issues that they or another member of their household is experiencing. Specifically, we looked at the following chronic health conditions: hypertension, asthma, bronchitis, pneumonia, emphysema, and cancer. Overall, there was a very low rate of respondents reporting chronic health conditions experienced by themselves or a member of their household (**8.50%, n=266**). It should be understood that there is likely a high rate of under-reporting / under-estimation of such chronic conditions in general and among the respondent population due to overall assumed low rates of health literacy and tendencies not to seek treatment from formal health care facilities where such chronic conditions would be diagnosed in medical terms. While we do not attempt to develop or apply a multiplier factor to reach a more realistic estimate of the prevalence of such conditions among the surveyed households, a high multiplier factor would seem appropriate, particularly for houses using kerosene, wood or charcoal and cooking inside.[6]

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[6] For more discussion on methodology for developing multiplier factors used to adjust for under-estimation in public health data, please see: Gibbons CL, Mangen MJ, Plass D, et al. Measuring underreporting and under-ascertainment in infectious disease datasets: a comparison of methods. *BMC Public Health*. 2014;14:147. Published 2014 Feb 11. doi:10.1186/1471-2458-14-147

We analyzed whether there are any health impacts that correlate with the location in which cooking takes place, the source of fuel used for cooking, or the availability of ventilation. We find one statistically significant positive correlation between cooking inside and an elevated rate of a health condition, specifically **households that cook inside are 4.9 percentage points more likely to have at least one member suffering from hypertension/high blood pressure**. We find no other significant correlation between cooking inside and any of the other health conditions analyzed (including asthma, bronchitis, pneumonia, emphysema, and cancer).

We additionally find one statistically significant positive correlation between cooking with charcoal and an elevated rate of a health condition, specifically **households cooking with charcoal as their primary source of fuel for cooking are 3.13 percentage points more likely to have at least one member suffering from asthma**. There were no statistically significant correlations between any other source of cooking fuel and any of the other health conditions analyzed (including asthma, bronchitis, pneumonia, emphysema, and cancer).

While we find no statistically significant correlation between self-reported ventilation of the cooking space and any of the prevalence of reported health issues, this could be due to poor respondent ability to accurately report on quality of ventilation or perhaps low sample sizes. It is not our intention for such lack of correlation to undercut significant and reliable evidence from the World Health Organization and others that indoor cooking with fuels such as kerosene,

Michelien Fanu

My name is Michelien Fanu. I am 60 years old. This is Whala Kodji community. I have been in this community for 3 years. I am a tenant. I pay N30,000 per year. I use firewood and charcoal for cooking, and cook every day because I also sell food. I used firewood more than charcoal to cook the food I sell. We use charcoal for the one we eat, and at times we use the firewood.

If I have the opportunity to use another source for cooking, I will. But I don't know how to use gas. I was trained with firewood and charcoal. If someone give me gas free, I will collect it and ask people around to teach me how to use it. The heat from firewood and charcoal is not good for our health. After using they causes sickness. I use medicines every day. I know it is bad and still use it because I don't have any other business.

charcoal, and firewood/biomass increases the risk of several health conditions and causes premature deaths, especially in children under 5, and adverse birth outcomes in Nigeria.[7]

v. Prospects for behavior change vis-à-vis cooking

In order to understand the possibility of behaviour change with respect to choice of cooking fuels, we assessed respondent's level of satisfaction/dissatisfaction with their current cooking fuel, preference for alternative cooking fuel, and factors preventing change in cooking fuels.

Overall, **34.87%** of respondents across the city reported that they are dissatisfied with the source(s) of fuel that they currently use for cooking. We find significant variation between LGAs with the lowest levels of dissatisfaction reported in Mushin (**8.92%**) and Surulere (**8.93%**), and the highest levels of dissatisfaction reported in Lagos Island (**84.04%**) and Eti Osa (**69.17%**). See chart below.
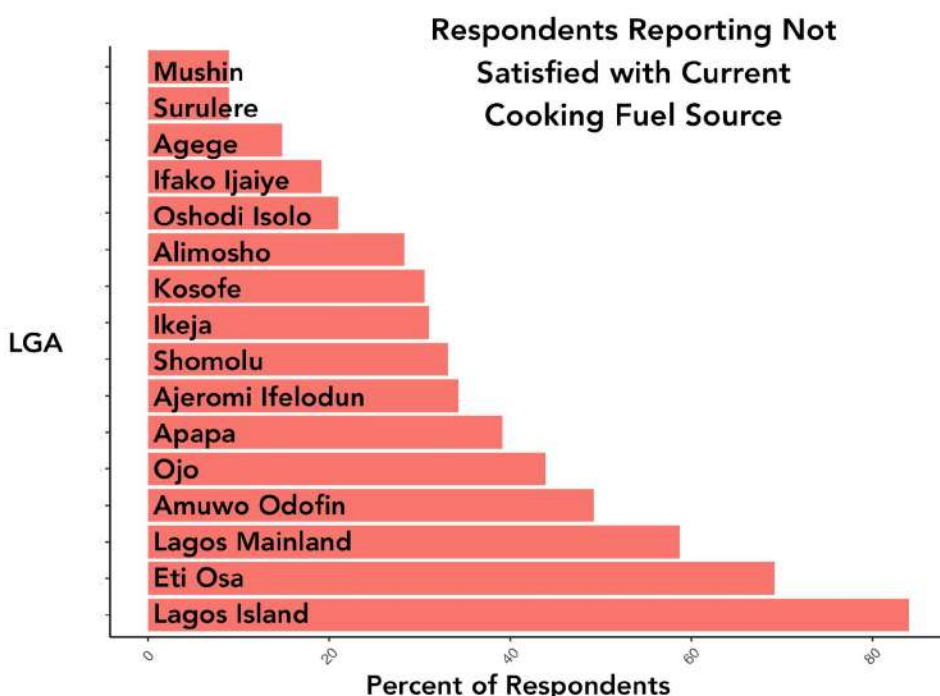
There is significant correlation between the percentage of respondents reporting dissatisfaction and their primary source of fuel for cooking. Very few respondents (**11.34%**) using gas (LPG) as their primary source of fuel for cooking reported dissatisfaction. A large majority of respondents (**75.74%**) using firewood as their primary source of cooking reported dissatisfaction. A slight majority of respondents using both charcoal (**59.39%**) and kerosene (**51.06%**) reported dissatisfaction.

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[7] See, for example, World Health Organization, "Household Air Pollution and Health," https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health. See also Roberman, J., Emeto, T. I., & Adegboye, O. A. (2021). Adverse Birth Outcomes Due to Exposure to Household Air Pollution from Unclean Cooking Fuel among Women of Reproductive Age in Nigeria. International journal of environmental research and public health, 18(2), 634. https://doi.org/10.3390/ijerph18020634.

We additionally analyzed respondents reporting dissatisfaction against tenure status and structure use. When respondents reporting dissatisfaction are analyzed by tenure status, we find that structure owners are 10 percentage points more likely than tenants to be dissatisfied with their primary fuel source used for cooking. When respondents reporting dissatisfaction are analyzed by structure use, we find that residents of structures that are used for residential purposes only are 6 percentage points more likely to be dissatisfied with their primary fuel source for cooking as compared to residents of structures that are used for residential and other (e.g. business) purposes.

To evaluate the likelihood of behaviour change, we additionally asked respondents what alternative fuel for cooking they would prefer, and what were the reasons preventing them from changing to another source of fuel for cooking. When respondents were asked "If you are not already, would you be interested in using gas (i.e 'canister gas' or LPG) for cooking?", **49.12% (n=1,537)** reported they would be interested in using gas. When we look at the subset of respondents reporting dissatisfaction with their present cooking fuel were asked what alternative fuel source they would like to use, **76.09% (n=35)** reported they would like to use gas (LPG) instead of their current fuel source, although only a very small number of respondents answered this question. The most significant reasons respondents gave for not being interested in changing to gas (LPG) for cooking were cost (**46.38%** n=141 reported gas was "too expensive") and fear (**42.43%** n=129 reported "I am afraid to use gas"). See chart and further discussion below.
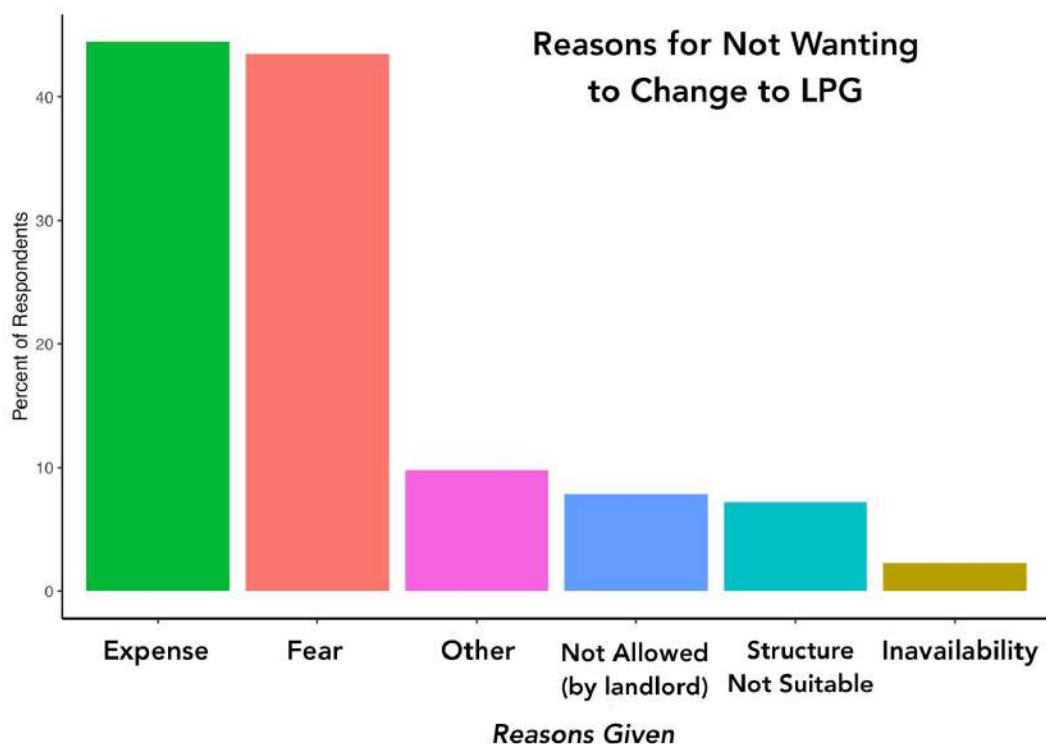
When factors preventing respondents from changing to gas (LPG) are analyzed by tenure status we find that tenants are 10 percentage points more likely than structure owners to report expense as a barrier, and structure owners are 15 percentage points more likely than tenants to report fear as a barrier. See chart below.

Comparison of Reasons for Not Wanting to Change to LPG (Structure Owners v Tenant HHs)
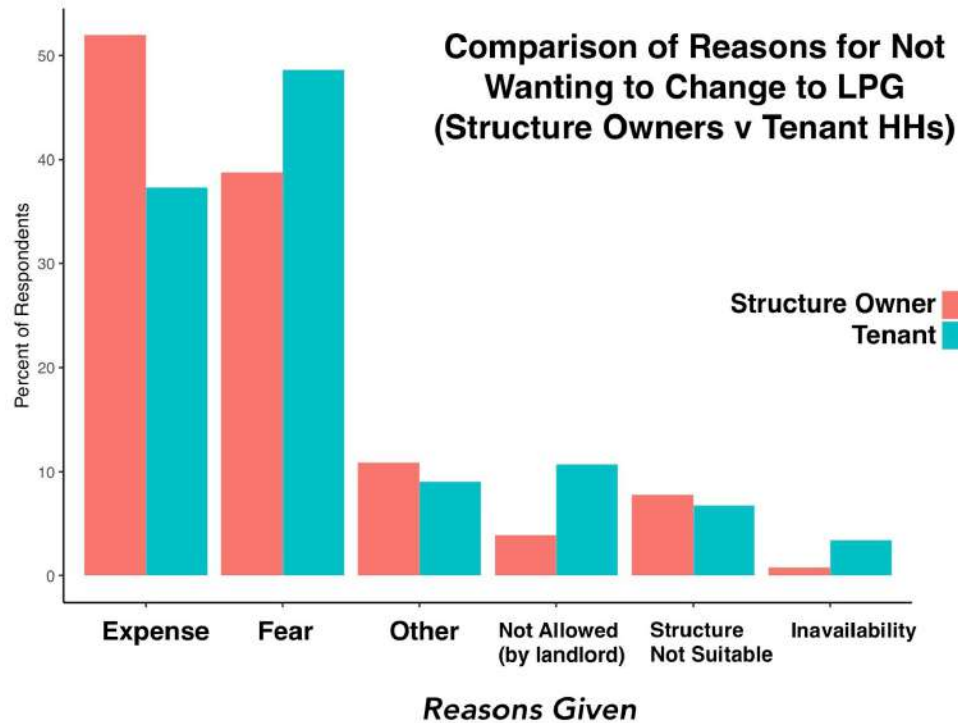
vi. Recommendations for city climate action planning re: cooking

To reduce stationary GHG emissions from cooking in Lagos informal settlements, the city's climate action planning process must address the real and perceived barriers that prevent households from using cooking fuels with lower GHG emissions. Successful government programs or policies will address both the real or perceived *cost barrier* (including start-up costs (e.g. initial purchase of a gas canister), not captured in this survey, but potentially significant to any 'transition' to a new fuels source) as well as the real or perceived *fear barrier*. Understanding the cash flow realities of urban poor households who tend to purchase cooking fuel "small-small" on a daily or weekly basis as opposed to households using gas who spend a larger sum on a monthly basis is important for developing appropriate interventions.

Information generated from this survey -- for example that households that use gas (LPG) spend less money on cooking fuel on a monthly basis than those using other cooking fuels and that households cooking with charcoal may be more likely to suffer asthma -- is essential to messaging around such campaigns. Information from this survey can also be used to help tailor such messaging campaigns, e.g. campaigns addressing the cost factors could be geared more toward tenants, while fear-related messaging could be targeted more toward structure owners/landlords. Additionally, policies and programs should target informal settlements in the LGAs where higher GHG emitting cooking fuels are more common and LPG penetration is lower, e.g. Apapa, Amuwo-Odofin, Eti-Osa, and Lagos Mainland.

c. Lighting / Electricity

This section of the report presents the survey data collected on electricity/lighting from respondents in Lagos informal settlements. As one of the primary sources of GHG emissions, we sought to understand predominant electricity/lighting practices, related expenditures and health factors, as well as prospects for behaviour change. This section concludes with recommendations for the city's climate action planning process specific to electricity/lighting.

Public Electricity Usage:
Across the households surveyed, **86.4% (n=2,705)** reported using public electricity (from the Eko or Ikeja Electricity Distribution Companies, EKEDC or IKEDC) as an electricity source and **78.2% (n=2,446)** reported public electricity as their primary source of electricity and lighting. Survey respondents reported receiving a median of **6 hours of public electricity per day**.

Public electricity usage varied significantly across LGAs. As a primary source of light, public electricity usage was highest in Ifako-Ijaiye (100% of households surveyed) and lowest in Amuwo-Odofin (14.6% of households surveyed) and Eti-Osa (17.8% of households surveyed).

A total of **2,301** households (85% of those who reported using public electricity) reported receiving bills directly from EKEDC or IKEDC, whereas the remainder paid electricity bills to structure owners or through community light committees. Of the 2,301 households receiving bills, 96% reported receiving estimated bills rather than based on actual meter readings.

A majority of households connected to public electricity (78.45%) reported that they have irregular supply of electricity, about a quarter of households (24.47%) reported receiving irregular voltage (e.g. high or low voltage), and 13.44% reported receiving unsafe supply of electricity (e.g. falling wires, electricity surges). A majority of households connected to public electricity (63.09%) reported overbilling (e.g. 'outrageous' estimated bills).

The households not using public electricity **(n=424)** were asked the reason for not using public electricity. Of these, **66.8% (n=283)** reported that public electricity does not reach their community, 17.9% report being disconnected due to payment problems, 5.7% reported supply problems on the side of the distribution company (e.g. spoiled transformer), and 13.2% report other problems, generally related to cost and perceived overbilling, delays in connection by the distribution company also often closely linked to affordability considerations, etc.

Generator Usage:
Across the households surveyed, **16.7% (n=524)** reported having at least one generator, and a total of **603** generators were identified among these households, with 79 households using 2 or more generators. Across all the households surveyed, only **2.5% (n=78)** of households reported that the generator was their primary source of light. Generator usage varied significantly by LGA. In Ojo, **38.6%** of households had at least one generator and in Ifako Ijaiye **37.8%** of households had a generator, whereas in Surulere only **1** household had a generator out of 180 surveyed, and only **3** households in Eti Osa had a generator out of 148 surveyed.

Temitope Adugba

My name is Temitope Adugba. I have been in Makoko now for a very long time. I was born and brought up in the community.

I use solar for lighting. I used electricity before but the bill is high so I stop using it. If the solar damage, I throw it away and buy new one because if it is faulty I don't know where to repair it. I bought the panel at N4,500 and the bulb at N13,000.

The difference between the solar that I am using and electricity is that the panel is small one it can't power anything. It is being used for lighting only. But with [public] electricity you can use it to power everything like the radio, television, charging of phone and so on. If I see any other alternative that I can used for powering and lighting I will use. But I don't like anything with smoke. I don't like anything with smoke because I am a fashion designer I don't want smoke to stain my work.

Of the 603 generators, **97.7%** ran on petrol rather than diesel, which were just **2.3%**. The median capacity of the generators reported was **2 kVA**. The median number of hours respondents ran their generators each day was **5 hours**. Households with a generator that runs on petrol reported using a median of **780** liters of petrol per year.

Battery Powered Light Usage:
Across the households surveyed, **27.33% (n=855)** reported using battery powered light as an electricity source, and **11.55% (n=361)** reported using battery powered light as their primary source of electricity and lighting. A majority of the respondents reported using rechargeable battery powered lights (69.47%). When or if there is no electricity at home, 47.47% of respondents using rechargeable battery powered lights recharge them at a friend or neighbor's house, while 40.72% of respondents recharge them at a charging station, and 24.15% of respondents recharge them at their place of work. The vast majority reported using charging stations / kiosks located within their communities and powered by generators, with about half as many powered by public electricity supply, and a very small number being solar powered.

Solar, Candles, and Lantern (kerosene or other fuel) Usage:
Across the households surveyed, very few respondents used solar, candles, or lanterns (kerosene or other fuel), as a source of lighting (less than 2.5% each), and even fewer used any of them as their primary source (less than 1.5% each). Only 1.18% (n=37) reported using solar for lighting or electricity. Of the households that use solar, the majority (n=21) have a panel that is 10 watts or smaller, and only 3 households have a solar panel of more than 100 watts.

Household Load Assessment & Estimated Consumption:

As part of the survey exercise, surveyors also recorded information about household electrical load. The maximum household electrical load is the sum of the load of all electrical appliances in the household. The load of a particular appliance is the maximum amount of electricity (measured in watts) it requires to operate at any given moment. Therefore a household's electrical load is the maximum amount of electricity the household needs to operate all of its electrical appliances at once. We note that it is unlikely that a household would ever operate *all* of its electrical appliances at once. However, the survey did not collect hourly load data necessary to project a per household load profile, which would reveal the true minimum and maximum (peak) electrical load of a household. Therefore, while this maximum load assessment yields valuable insight into the potential electricity needs of households surveyed, it is not a measure of consumption, which would be measured in Watt-hours, and determined by multiplying each appliance's load by the number of hours it operates.

To calculate the household electrical load, surveyors documented all appliances within each household surveyed. We make certain assumptions regarding the wattage of appliances. Where possible we adopted the same wattage estimates for appliances used by EKEDC when conducting its own load assessments for purposes of issuing estimated bills. Otherwise we based our assumptions on standard ranges for each kind of appliance.

Across all households surveyed, the **median reported household maximum load is 1.21kW**, and the **mean reported household maximum load is 1.89kW.** Using assumptions about typical daily usage for each appliance, we find a **mean household maximum *potential* daily consumption of 7.977kWh**. See **Table 4** below for full details of the assumptions. Using this same methodology and assumptions, we ran a calculation of each household's potential daily consumption based on their specific load inventory. From these calculations, the overall **median household maximum *potential* daily consumption of 3.936 kWh**.

Table 4. Appliance wattage (assumptions) and average maximum load

Appliance	kW per unit (assumed)	Mean # of units per HH inventory	Mean Maximum Load (kW)	Assumed Hours Daily Usage	Resulting Mean Maximum Estimated kWh Daily
40W (standard incandescent) light bulbs	0.04 kW	1.88	0.075	6	0.45
60W (standard incandescent) light bulbs	0.06 kW	1.21	0.072	6	0.432
CFL (energy saver) bulb	0.018 kW	1.61	0.029	6	0.174
Standing fan	0.06 kW	0.53	0.032	12	0.384

Ceiling fan	0.07 kW	1.16	0.081	12	0.972
Standard TV	0.08 kW	0.41	0.033	12	0.396
Flat screen TV (LCD or LED or Plasma)	0.12 kW	0.55	0.066	12	0.792
Small refrigerator	0.07 kW	0.21	0.015	24	0.36
Medium refrigerator	0.1 kW	0.14	0.014	24	0.336
Large refrigerator	0.18 kW	0.05	0.009	24	0.216
Deep freezer	0.35 kW	0.11	0.039	24	0.936
Iron	1 kW	0.60	0.603	0.25	0.151
50 liters water heater	2 kW	0.03	0.070	0.5	0.035
100 liters water heater	3.5 kW	0.01	0.049	0.5	0.0245
Electric kettle	1.2 kW	0.15	0.184	0.5	0.092
Electric cook stove w/out oven	2 kW	0.09	0.176	2	0.352
Electric cook stove with oven	3.5 kW	0.02	0.054	2	0.108
Small (1HP) air conditioner	0.7457 kW	0.04	0.031	12	0.372
Medium (1.5HP) air conditioner	1.11855 kW	0.03	0.035	12	0.42
Large (2HP) air conditioner	1.4914 kW	0.02	0.030	12	0.36
Water pump	1.9 kW	0.07	0.141	1	0.141
Small washing machine	0.4 kW	0.02	0.008	1	0.008
Medium washing machine	0.6 KW	0.01	0.006	1	0.006

Large washing machine	0.8 kW	0.00	0.003	1	0.003
Stereo system / Music player	0.095 kW	0.32	0.031	12	0.372
Desktop computer	0.1 kW	0.03	0.003	12	0.036
Laptop computer	0.05 kW	0.08	0.004	12	0.048
Mean Maximum Estimated Load			**1.893 kW**	**Mean Maximum *Potential* Consumption**	**7.977 kWh Daily**
Median Maximum Estimated Load			**1.210 kW**	**Median Maximum *Potential* Consumption**	**3.936 kWh Daily**

The estimated maximum electricity consumption presented here is based on the assumption of a reliable / consistent household electricity supply throughout the day so that appliances may be operated at the necessary and convenient times of day — an assumption that is not borne out by the survey data or lived experience. In fact, of the 86.4% of households using public electricity, the **median reported supply is six hours daily** — with the specific hours of the day being random and out of the consumer's control. Meanwhile, only 16.7% of households have a generator, the majority using this as a back-up/secondary supply, and those households report running the generator an average of **five hours daily** — hours which are within the consumer's control. However, due to relatively low average generator capacity (2.0kVA average), many respondents report only running certain appliances when they have public electricity supply.

Due to these conditions, we assume that the vast majority of households have a much lower *actual* daily consumption due to limited and generally random number of hours of supply — potentially as low as 25% of what their consumption would be with a regular predictable supply. See further discussion below regarding the implications of this assumption on CO2e emissions — and overall evaluation of access to electricity in terms of the ESMAP multi-tier framework.

i. Primary and secondary lighting / electricity sources used

The survey also investigated both the primary and secondary/back-up lighting types used by respondents. The majority of respondents (**78.25% n=2,446**) reported that public electricity (provided by EKEDC or IKEDC) is their primary source of power for lighting. The only other two common primary sources of power for lighting reported by respondents are battery-powered lighting (**11.55% n=361**) and generator-powered lighting (**6.81% n=213**). All other sources of

power for lighting, including solar, candles, lantern (kerosene), are rarely used as the primary source of power for lighting (i.e. less than 1.5% of respondents each). See chart below.
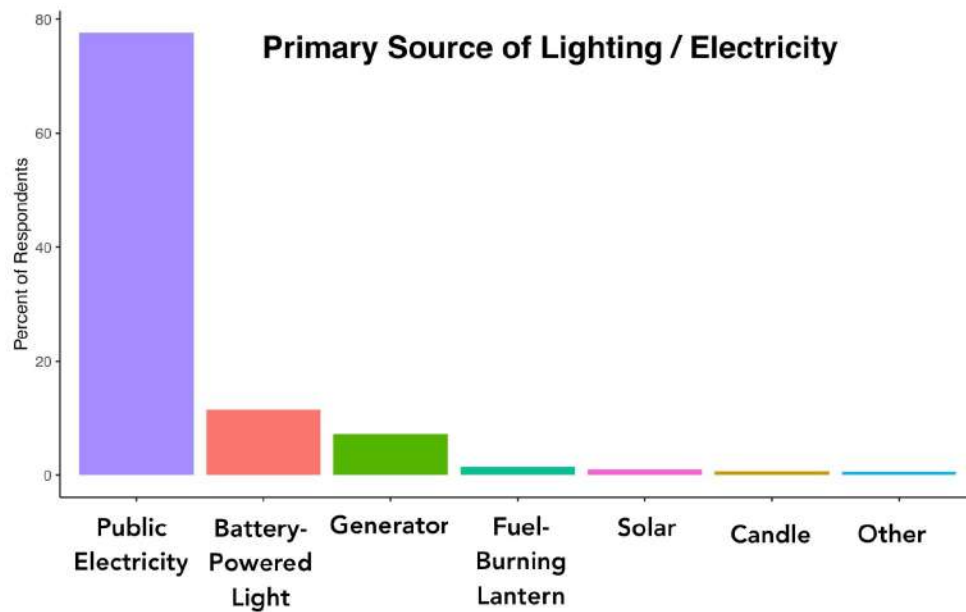
When disaggregated by LGA we see some notable variations between LGAs, for instance very low penetration of public electricity in informal settlements in Amuwo-Odofin and Eti-Osa LGAs and correspondingly high usage of battery-powered lights (Eti-Osa LGA) and generators (Ojo LGA) or both (Amuwo-Odofin LGA). See chart below.
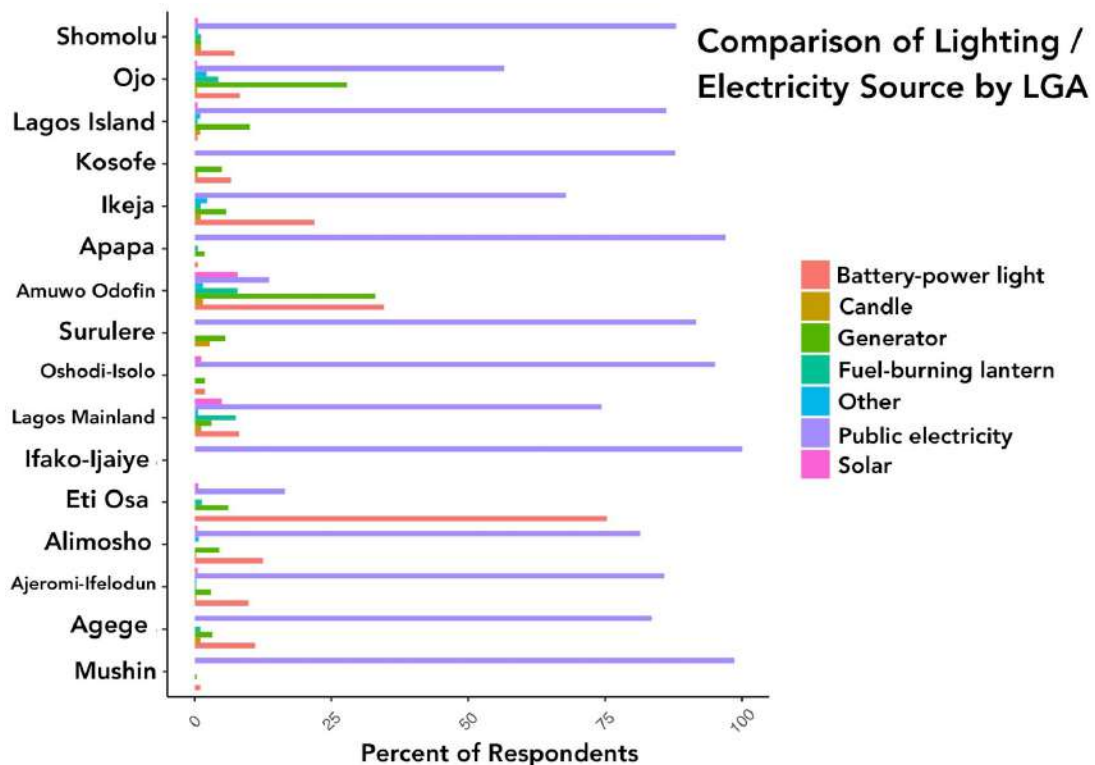
Whether a community is connected to the public electricity grid correlates significantly to respondents' primary source of power for lighting. Nearly half (**41.17%**) of respondents living in an off-grid community use battery-powered light as their primary source of energy for lighting, as compared to only **9.2%** of respondents living in communities connected to public electricity. Only a small portion of respondents (**5.8%**) living in a community connected to public electricity reported using generators as their primary source of energy for lighting, as opposed to a quarter (**25.33%**) of all respondents living in communities that are off grid. Residents in communities that are off-grid are also more likely to use lanterns (6.78% versus 1.08%) and also solar systems (6.78% versus 0.56%) for lighting. See table below.

Table 5. Percentage using lighting option disaggregated by on-grid/off-grid status

Lighting options	On-grid/off-grid - yes/no?	
	No	Yes
	0.000000000	0.001013856
Battery-powered light	0.411764706	0.092598851
Candle	0.004524887	0.006759040
Generator	0.253393665	0.058127746
Lantern (kerosene or other fuel)	0.067873303	0.010814464
Other	0.027149321	0.004055424
Public electricity (NEPA)	0.167420814	0.820885434
Solar	0.067873303	0.005745184

We additionally analyzed location factors correlated with respondents' reported primary source of energy for lighting. The factors we analyzed were whether a community is near a water body, swamp, major highway, pipeline, or high tension wire. The most statistically significant correlation that exists is between whether a community is close to a water body and whether respondents report using public electricity as their primary source of power for lighting. While 87.61% of respondents living in a community not located near water use public electricity as their primary source for lighting, a significantly smaller percent (67.26%) of respondents living in a community located near water reported using public electricity as their primary source of power for lighting. This corresponds to communities near water being less likely to be on grid.

There are also statistically significant, though smaller, correlations between whether a community is close to a water body and whether respondents report using battery-powered lights or generators as their primary source of power for lighting. For both, living in a community close to a water body correlates with higher rates of use of battery-powered lights (16.78% versus 6.28%) and generators (10.23% versus 4.16%) as primary sources of power. This is consistent with such communities more often being off grid. All other correlations between location factors and primary source of power for lighting reported were not significant.

When each of the reported primary sources of power for lighting was analyzed by tenure status, the most significant correlation exists for those reporting public electricity as their primary source of power for lighting. Landlords were 13.62% less likely to report using public electricity as their primary source of power for lighting (70.16% for landlords versus 83.78% for tenants). A second, though less significant, correlation exists for those reporting generators as their primary

source of power for lighting. A higher percent of landlords (11.04%) as compared to tenants (3.89%) report using generators.

There were determined to be no significant correlations between the primary source of power used for lighting and whether a structure is used solely as a 'residence' as compared to structures used as a 'residence and other' purpose.

Bernard Ukwete

My name is Bernard Ukwete. I stay in Walakodji community. I have been here over 30 years now. We use torchlight and candle for lighting.

We spend up to N1,000 each week in buying batteries. I use three torchlights at night. I will choose solar over any other power if I have the chance. I use gas for cooking on my stove.

ii. Carbon emissions from lighting

To estimate the stationary energy source carbon footprints for lighting in informal settlements in Lagos, we analyze the following emissions sources: (1) **generators** for electricity production**,** and (2) **purchased electricity** from EKEDC or IKEDC**.**

Although respondents reported using candles and fuel-burning lanterns for lighting, GHG emissions associated with burning candles or fuel-burning lanterns were not included in our analysis. The carbon footprint of candles depends on the type of candle being used and can be relatively minimal. We note that only 60 out of 3129 households (**2%**) reported using candles for lighting. The rate of usage of lanterns is also very low (49 out of 3129 households or **1.5%**) and so we did not include it. Similarly, we do not calculate emissions from off-site usage of electricity to charge battery-powered lights (even though respondents reported this information) because the watt hours used cannot be accurately known.

No full life-cycle emissions or embedded emissions for goods or products are included in our analysis. All emissions quantities are in units of CO_2e.

We make the following methodological assumptions: 1) for **purchased electricity** from EKEDC or IKEDC, we use a standardized emissions factor for Nigerian electricity in kg CO_2 per kWh. To estimate kWh we used reported monthly payments for electricity bills and the pre-August 2020 NERC tariff rate of 30.23 naira per kWH; 2) for **generators** we use standard emissions factors for petrol and diesel fuel. We use the following emissions factors in our analysis:

public electricity:	0.44 kg CO2e per kWh,
petrol:	2.272 kg CO_2e per liter of petrol,
diesel:	2.676 kg CO_2e per liter of diesel.

Public Electricity CO_2e Emissions
We restrict our analysis of GHG emissions to the 2,301 households that reported receiving bills directly from EKEDC or IKEDC (comprising 85% of those who reported using public electricity).

Billing-Based Methodology. Assuming a uniform tariff of N30.23 per kWH in place prior to August 2020 when the majority of surveys were conducted, metered households who reported their bills were reportedly based on actual metered usage reported using an average 232.2kWH per month. The 96% of households with estimated metering reported paying bills that would equate to 167.4kwH per month on average, with **a median household usage of 49.8kWH per month**. For the 15% of households who paid electricity bills to committees or structure owners, using the same uniform tariff, average payments equated to 81.7kwH per month. Overall, across all households using public electricity, median kWH usage per month is estimated (based on reported payments and uniform tariff rate) to be 99.2kWH per month or **1,191 kWH per household per year.**

Load-Inventory Based Methodology. Alternatively, if we use the average household estimated load based on the load inventories conducted under survey and apply the assumptions laid out in Table 4 and its related discussion above, we start with each household's assumed *maximum* potential annual consumption. With the erratic and unpredictable average daily supply of six hours reported by respondents, as opposed to 24 hours of regular supply to maximize potential consumption, we assume the average household consumes only 25% of the maximum potential consumption. Looking across all the households using public electricity, this approach produces a median annual household consumption of **344.7 kWh per household per year**.

To put these numbers in context and compare these different methodologies for calculating estimated household kWH consumption, we now refer to the ESMAP multi-tier framework for energy access and the multiple indicators used to evaluate energy access for electricity. The two indicators primarily considered here are **duration** and **daily capacity** — although others such as reliability, quality, affordability, and health and safety may also come into play. Respondents reporting a median of six hours' supply daily points falls barely within a **Tier 2 ranking and possibly Tier 1**. Estimated daily consumption under the first methodology above points to **Tier 4 ranking**, a ranking which would normally be accompanied by a minimum 20 hours per day supply, along with other criteria such as a maximum of 14 disruptions per week, no voltage problems that affect the use of appliances, and an absence of safety-related

incidents. Estimated daily consumption under the second methodology points to a *Tier 3 ranking*, which would normally be accompanied by at least 11 hours daily supply. The side-by-side comparisons and resulting ESMAP tier rankings are laid out in **Table 6** below.

Table 6. Side-by-Side Comparison Electricity Consumption Estimation Methodologies

	Load Inventory-Based Method				Billing-Based Methodology
	Median Assumed Max Potential HH Consumption (kWh)	Actual # Hours Public Electricity (Reported Median)	Usual % of Time with Electricity	Median Estimated Actual HH Consumption (kWh)	Median Consumption from Billing (kWh)
Daily	3.78	6	25%	0.94	3.26
Monthly	114.91	72	25%	28.73	99.25
Yearly	1378.97	2190	25%	344.74	1190.98
Corresponding ESMAP Tier for HH Energy Access	Tier 4	Tier 2		Tier 2 (nearly Tier 3)	Tier 4
Resulting tCO2e HH emissions	0.61			0.15	0.52
Per capita tCO2e	0.10			0.03	0.09
Notes	See Table 5 for underlying assumptions/calculations. See Annex G2 for breakdown.				Annex G2 for breakdown

With a majority of households connected to public electricity (78.45%) reporting irregular supply of electricity, and the median six hours' daily reported supply of public electricity, **we find the results of Methodology 2, resulting in an lower overall *actual* consumption and a lower ESMAP tier ranking, to be more reflective of respondents' lived and reported realities**. This lower Tier ranking is reinforced by the supply quality problems (24.47% reporting irregular voltage) and safety problems (13.44% reporting unsafe supply, e.g. falling wires, electricity surges). The extreme divergence in order of magnitude between outcomes from Methodology 1 to Methodology 2 is explained and reinforced by the majority of households connected to public electricity (63.09%) that report overbilling ("'outrageous" estimated bills) by EKEDC and IKEDC. Further, the lower estimated consumption resulting from Methodology 2 tracks with the much lower median estimated consumption, as compared to means, generated by Methodology 1. Consequently, we adopt Methodology 2 resulting in **366.7 kWh per household per year**.

Therefore, among households that use public electricity as an electricity source, the median annual CO_2 emissions from that source is **0.15 tons CO_2e per year**. The average annual emissions from public electricity per person is then **0.03 tons CO_2e per person per year.**

Generator Usage CO_2e Emissions
Among the 524 households that use a generator as an electricity source, the average annual CO_2 emissions from that source is **2.81tons CO_2e per household per year**. We do not present the LGA-by-LGA variations because of the relatively small sample size at each LGA level. The annual emissions from generator fuel combustion per person *in the households with generators* out of all households surveyed is **0.48 tons CO_2e per person per year.**

Looking at all sources included in our assessment, the median annual household CO_2 emissions for electricity across all LGAs is **0.18 tons CO$_2$e per year**. There is significant variation between LGAs, with the highest emissions in Lagos Island LGA (0.94 tons) and the lowest in Lagos Mainland LGA (0.09 tons). Across all LGAs, the average CO_2 emissions per person for electricity is **0.03 tons CO$_2$e per person per year.** See **Annex G2**.

iii. Expenditures on lighting & purchasing habits

To calculate the household expenditure for lighting in informal settlements in Lagos, we analyze the following lighting sources: (1) **generators** for electricity production**,** and (2) **purchased electricity** (from EKEDC and IKEDC)**.** For both of the above lighting sources we only include in our analysis the running costs, and not the start up costs. For generators our assessment includes the cost of purchasing fuel and the cost of maintenance or servicing (cost distributed on a monthly basis), but does not include the up-front cost of purchasing a generator or any other related expenses. For purchased electricity this only includes monthly electricity bills, and does not include fees charged for establishing a connection, installing a meter, repairing a transformer, or any other related expenses.

Respondents also reported using lanterns (using kerosene fuel), solar, battery-powered lights, and candles for lighting, however expenditure for purchasing kerosene fuel for lanterns, solar systems, and battery-powered lights was not included in our analysis. Out of 3,129 households, only **2% or less** of households use each of these three lighting options. We did not collect data on the purchase price for lanterns, solar systems, or battery powered lights. Similarly, although **40.68% (1,273 total)** respondents reported charging rechargeable devices (including rechargeable battery powered lights) at commercial off-site charging stations (e.g. charging kiosks), we do not include in our analysis expenditures from off-site usage of electricity as the survey did not collect such expense information. Nevertheless, it is relevant to note that over a quarter of respondents (**27.33%, 855 total**) reported using battery-powered lights, **69.47% (594 total)** of which are rechargeable, and **30.53% (261 total)** of which are non-rechargeable.

All costs are rounded to the nearest whole Naira.

Expenditure on Generator for Electricity
For respondents that use generators for electricity (**n=603**), the median household spends **N12,600** on fuel each month, and **N833** on servicing and maintaining their generator. Thus, for these households, the median total monthly running cost for generator use (monthly fuel cost + monthly servicing cost) is **N13,433**.

Nearly all (**94.36%**) of respondents that reported using generators for electricity purchase fuel at least once a week, with 33.67% of these households purchasing fuel on a daily basis. The most common frequency for generator servicing and maintenance is on a monthly basis (45.27%), while 23.22% report servicing their generator every 2 months, and 13.10% report servicing their generator every 3 months.

Expenditure on Public Electricity

For the respondents that use public electricity as their primary source of power for lighting (**n=2,446**), the median monthly electricity cost was **N2,000** with payments either direct to the electricity distribution company or to an intermediary (e.g. a "community light committee"). See **Table 3** below for comparison between LGAs.

Table 6. Median monthly expenditure for public electricity by LGA*

LGA	public electricity (n=2,446)
Ifako-IjaIye	2,000 ₦
Oshodi-Isolo	1,800 ₦
Kosofe	2,000 ₦
Ojo	1,500 ₦
Surulere	2,500 ₦
Agege	2,800 ₦
Alimosho	2,300 ₦
Ajeromi-Ifelodun	1,500 ₦
Lagos Mainland	1,500 ₦
Mushin	3,000 ₦
Amuwo-Odofin	2,800 ₦
Ikeja	3,500 ₦
Apapa	1,000 ₦
Shomolu	2,000 ₦
Lagos Island	6,300 ₦
Eti-Osa	5,000 ₦
ALL LGAs	2,000 ₦

iv. Health factors related to lighting

In order to determine whether there are any health impacts that may be linked to air and noise pollution related to the source of power used for lighting we asked respondents to self report any health issues that they or someone else in their household is experiencing. Specifically, we looked at the following chronic health conditions: hypertension, asthma, hearing loss, bronchitis, pneumonia, emphysema, and cancer. Overall, there was a very low rate of respondents reporting any chronic health conditions experienced by themselves or a member of their household (**8.50%, n=266**) -- as a consequence correlating health factors with energy sources and other factors draws on a relatively small sample size.

The primary statistically significant correlation we found exists between households that reported asthma and those that used battery-powered light, generators, and public electricity. Specifically, respondents are 3.38 percentage points more likely to report that at least one of their household members suffer from asthma if they use battery-powered light as their primary source of energy for lighting. Respondents are 3.5 percentage points more likely to report that at least one of their household members suffer from asthma if they use a generator as their primary source of energy for lighting.

There were no statistically significant correlations between the source of power used for lighting and households reporting whether or not any of its members experienced high blood pressure or hypertension, bronchitis, pneumonia, or emphysema.

v. Prospects for behavior change vis-à-vis lighting

Gbossa Josias

My name is Gbossa Josias. I was born in this community. This community is called Walakoji. I'm not a tenant, I am the owner of the house.

I use battery light. I buy battery of N1,250 every week. I don't use solar because I don't have access to it. If I see solar I will use it. Anything you know, you can do that will favor us to use solar.

The survey also sought to assess the possibility of behaviour change in the choice of power used for lighting by the respondents. The majority (**66%**) of the respondents are dissatisfied with their current source of power for lighting. There was some variation across different LGAs with respondents in Surulere reporting that they are least dissatisfied, and respondents in Lagos Island reporting that they are most dissatisfied (see chart below).

Respondents Reporting Not Satisfied with Current Lighting / Electricity Source
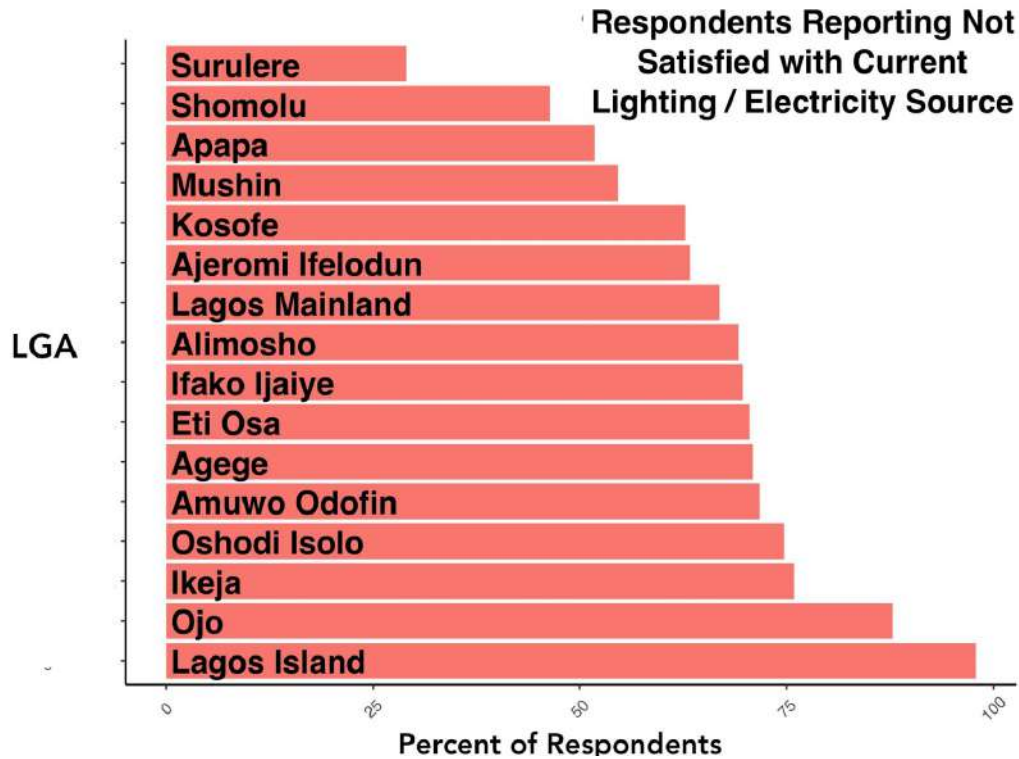
Respondents' dissatisfaction with their source of power for lighting also varied somewhat depending on what was their primary source of power for lighting. The respondents who reported using a generator as their primary source of power for lighting reported the highest percent reported dissatisfaction (80%), with those using public electricity supply at just 63% and those reporting the lowest dissatisfaction primarily using solar (60%) and candles (59%), although the latter two sources are numbers drawn from admittedly very small sample sizes.

There was no statistically significant correlation between whether an individual is a tenant or landlord and their level of dissatisfaction with the source of power used for lighting.

A higher percent of respondents living in a community not connected to the public electricity grid are dissatisfied with their current primary source of energy for lighting (**75.5%**) as compared to respondents living in a community connected to public electricity (**65.5%**).

Overall, nearly all respondents (**90.79%**) reported interest in using solar as a source of power for lighting. Of the respondents not already using solar, the top reason why they are not using solar – by a significant margin – is because of the expense (**94.94%**). Lack of knowledge also constitutes a significant reason why respondents are not already using solar, including lack of knowledge of how solar systems work (**29.61%**), lack of knowledge of how to install and use solar systems (**22.94%**), and lack of knowledge of the materials involved in solar systems (**17.64%**). See chart below.
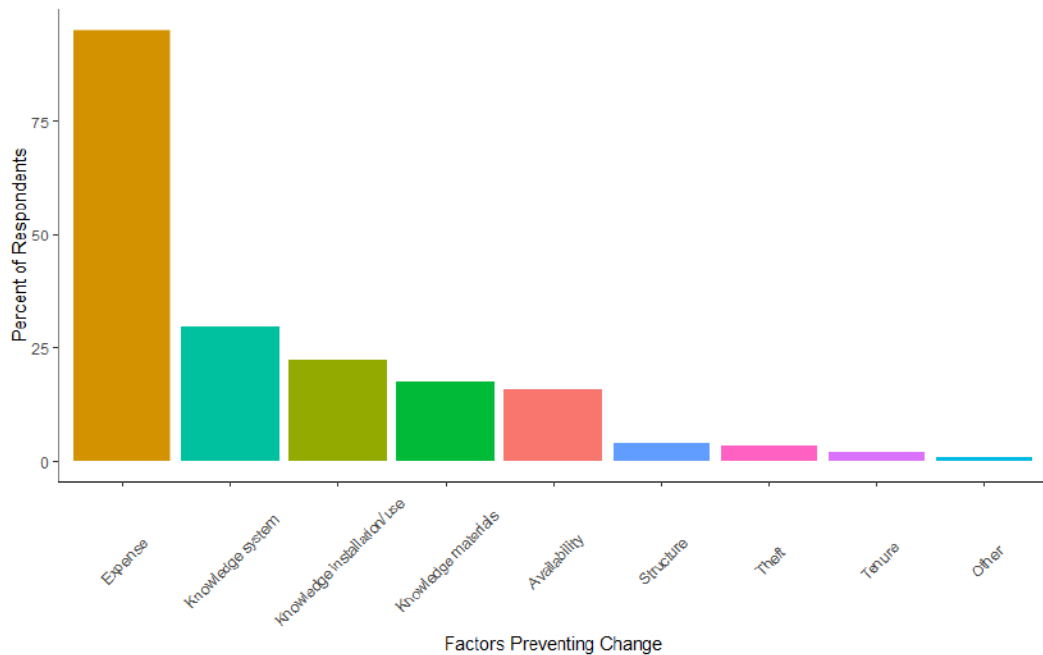
There was no statistically significant correlation between the reasons why a respondent does not already use solar and whether they are a landlord or tenant, or whether their community is connected to the public electricity grid or not.

vi. Recommendations for city climate action planning re: lighting

Overall, there is much less variation in electricity usage patterns among residents of informal settlements across the city and the vast majority of residents are already relatively lower-emission electricity sources since the use of generators is relatively low. The recommendations to reduce GHG emissions from stationary use in informal settlements could then be framed as two stages or as two different strategies running simultaneously:

1. **Increase usage of public electricity where it is not already prevalent.** This would involve helping to connect the informal settlements that are off-grid, particularly those in island or waterfront communities that are more likely to be off-grid, including those in Amuwo-Odofin, Ojo, and Eti-Osa LGA. To do this and to increase connection rates more broadly, the State Government could help work with distribution companies to reduce or subsidize costs of connection or could prioritize off-grid communities for independent power projects (IPPs), while also encouraging better regulation of distribution companies with respect to the many problems consumers report encountering with their supply.

   Alternatively and preferably would be to create solar mini-grid alternatives to public electricity in otherwise off-grid communities. This might require greater up-front investment by the public electricity companies and/or the Lagos State Government supporting IPPs, but would both reduce carbon emissions more quickly and create a more reliable electricity supply reducing the need for other back-up options.

2. **Support transitions to solar in informal settlements.** From the data collected, it is evident that there is a high level of interest in transitioning to solar, but supporting increased rates of solar among households in informal settlements would require a targeted program to finance solar installations, reducing the up-front costs while also increasing awareness about solar as an affordable long-term alternative to generators or public electricity supply. There is also a need to increase knowledge among households in informal settlements or local electricians serving these communities on how to install and utilize solar electricity. Training on the basics of solar energy geared towards informal settlement residents, combined with financing (e.g. small-scale low-interest loans) to help spread the up-front costs of solar installations could go a long way. The data from this survey can inform a financing model that would make solar affordable to households in informal settlements. Given the prevalence of charging kiosks in informal settlements and high rates of usage, a starting point could be to help support transitioning such charging stations to solar as an opportunity to demonstrate the

Dosugan Afisu

My name is Dosugan Afisu. I am 47 years old. I have been in Makoko for 35 years. I came from Ogun state to Makoko. I own the house I live in.

I use electricity and lamp for lighting. I pay N1,000 every month for the electric bill. The light helps me a lot as it makes my children not to go outside and get into trouble. When they come back from school they watch TV and rest. It also helps them to do their school assignments and reading at night.

If I have the opportunity to use anything better than NEPA light [public electricity], I will use it because light is really good for my children. They do study at night more than day. I don't use solar because I don't know how to use it. But now if I see solar I will use. And people are also saying that solar is good.

benefits of solar.

VI. Conclusion

Overall our survey results point to households in Lagos informal settlements being around **Tier 2-3** for cooking and electricity/lighting related energy access in World Bank/ESMAP Multi-Tier Framework for Energy Access; although lower energy access does mean households have a relatively low carbon footprint, our survey findings point to numerous interventions that could support improved energy access and quality of life improvements, improving household and community resilience while also reducing GHGs as part of Lagos State's climate action plan.

To support greater rates of transition to LPG, improving energy access and reducing GHG emissions for residents of informal settlements, we recommend:

- Government programs that address both the real or perceived *cost barrier* (including start-up costs of transitioning to LPG as well as the real or perceived *fear barrier*.
- Financing schemes tailored to the cash flow realities of urban poor households who tend to purchase cooking fuel "small-small" on a daily or weekly basis as opposed to households using LPG gas who spend a larger sum on a monthly basis.
- Information campaigns that use data generated by this survey to tailor messaging to target audience, e.g. messaging around safety of LPG options tailored to landlords and messaging around net cost savings of using LPG tailored to tenant households; and
- Programs targeting informal settlements in LGAs such as Apapa, Amuwo-Odofin, Eti-Osa, and Lagos Mainland where LPG penetration remains relatively low.

To improve electricity access and reduce electricity related GHG emissions, we recommend:
- Efforts to increase electricity access in informal settlements that are off-grid, particularly those in island or waterfront communities in LGAs such as Amuwo-Odofin, Ojo, and Eti-Osa LGA, potentially through creation of solar mini-grids/IPPs as alternatives to the normal public electricity supply and also efforts to reduce connection costs through distribution companies and improve regulation of such companies to overbilling, etc; and
- Support for transitions to solar in informal settlements through demonstration projects (e.g. solar charging stations), targeted training to increase how-to knowledge of households and local electricians, and a financing scheme to help spread the up-front costs of transitioning to solar to fit cash flow realities of urban poor households.

Such programs/interventions will be most effective at reaching informal settlement residents -- as was the present survey -- if implemented in strong working partnership with organized urban poor communities and their trusted NGO partners who are already working on small-scale solar and green waste management projects in slums and informal settlements across Lagos. Further, to measure the impacts of such programs/interventions and progress towards these goals in informal settlements, a household survey such as the current one should be iteratively conducted over the coming years, drawing lessons from the current study.

Annex A

Lagos Informal Settlement Household Energy Survey

Preliminaries: to fill by the surveyor

1. Date of the survey:

yyyy-mm-dd

2. Name of the surveyor:

A. Respondent & Household Information

1. Name of community:

2. LGA

- ◯ Agege
- ◯ Ajeromi Ifelodun
- ◯ Alimosho
- ◯ Amuwo Odofin
- ◯ Apapa
- ◯ Eti Osa
- ◯ Ifako Ijaiye
- ◯ Ikeja
- ◯ Kosofe
- ◯ Lagos Island
- ◯ Lagos Mainland
- ◯ Mushin
- ◯ Ojo
- ◯ Shomolu
- ◯ Oshodi Isolo
- ◯ Surulere

3. Name of the respondent:

4. Age of the respondent:

_____

5. Phone number:

_____

6. Gender of respondent:

◯ Female

◯ Male

7. Tenure status of the household:

◯ Structure owner

◯ Tenant

◯ Sub-tenant

◯ Other

7a. If other, please specify

_____

8. Number of occupants in the household:

_____

9. Number of children under the age of 15 in the household:

_____

10. Number of people over the age of 65 in the household:

_____

11. Number of female in the household:

_____

12. Adress or physical description of location of structure (landmarks)

_____

13. GPS coordinates of the building

latitude (x.y °)

_____

longitude (x.y °)

_____

altitude (m)

_____

accuracy (m)

_____

14a. Material used for the floor

- ○ Cement
- ○ Wood/Plank
- ○ Rubble/Garbage/Saw dust
- ○ Sand
- ○ Tiles
- ○ Other

14a*. If other, please specify:

_____

14b. Material used for the walls:

- ○ Cement block
- ○ Tarpaulin
- ○ Bamboo/Palm Fronds
- ○ Wood/Plank
- ○ Other

14b*. If other, please specify:

_____

14c. Material used for the roof:

○ Zinc

○ Wood/Plank

○ Tarpaulin

○ Abestos

○ No roof

○ Other

14c*. If other, please specify:

_____

14d. Material used for the windows:

○ Glass

○ Plastic

○ No material

○ Wood

○ Other

14d*. If other, please specify:

_____

15. Does the household occupy the entire structure?

○ Yes

● No

16. If no, how many rooms does the household occupy:

_____

17. Gross floor area of space occupied (in square feet):

_____

18. Please indicate the number of sources of ventilation for each of the following

_____

18a. Doors opening to open space:

_____

18b. Doors opening to enclosed space (interior or adjacent wall very close):

_____

18c. Windows opening to open space:

_____

18d. Windows opening to enclosed space (interior or adjacent wall very close):

_____

19. Do the windows and doors alllow for cross ventilation?

◯ Yes

◯ No

20. Are there other structural features that reduce heat or increase cooling? (multiple answers possible)

☐ None

☐ Thick block walls

☐ Insulated roof

☐ "Fancy blocks" that allow ventilation

☐ Bamboo/raffia walls with spaces that allow ventilation

☐ Other

20a. If other, please specify:

_____

21. What's the usage of the stucture?

◯ Residential

◯ Residential and Business

◯ Residential and other

21a. If Residential and other, please specify:

_____

22. Year of the construction of the building if known by the respondent (e.g. 2005, 1990. If not known by the respondent fill: don't know)

_____

B. Cooking

Explanation: in this section, "cooking" refers to preparation of meals using heat, as well as heating water and preparation of processed foods for sale using hear (e.g. roasting groundnuts, smoked fish) etc.

_____

1. How often does you household cook?

○ Once (1) a day

○ Twice (2) a day

○ Thrice (3) a day

○ More than thrice (3) a day

○ Only a few times a week

○ Rarely

○ Never

2. For what purpose(s) does your household cook for? (multiple answers possible)

☐ Meals for the household members

☐ Prepared meals for sale - fixed location

☐ Prepared meals for sale - mobile vendor

☐ Preparation of foodstuffs for sale

☐ Heating water

☐ Not applicable - don't cook

☐ Other

2a. If "preparation of foodstuffs for sale", please specify:

_____

2b. If other, please specify:

_____

3. Where does your household cook? (multiple answers possible)

☑ Inside the house

☐ Inside a separate structure used for cooking

☐ Outside the house/room in a corridor

☐ Outside the house/room in open air

☐ Not applicable - don't cook

☐ Other

3a. If 'inside the house', 'inside a separate structure used for cooking', 'outside in corridor' are selected, is the space ventilated?

○ Yes

○ No

3b. Please explain:

_____

3c. If other, please specify:

_____

4. What source(s) of energy does your household use for cooking? (multiple answers possible)

- ☑ Kerosene
- ☑ Charcoal
- ☑ Firewood
- ☑ Gas (LPG)
- ☐ No source used - the household doesn't cook
- ☐ Other

4a*. If other, please specify:

_____

5. Which of these is your primary source for cooking (the one used the most)? ONLY one answer possible

- ◯ Kerosene
- ◯ Charcoal
- ◯ Firewood
- ◯ Gas (LPG)
- ◯ No source used - the household doesn't cook
- ◯ Other

6. If multiple sources are chosen, please explain briefly how/when each different fuel type is used. If only one source used write: only source

_____

6a. Kerosene

_____

6b. Charcoal

_____

6c. Firewood

_____

6d. Gas (LPG)

_____

6d. Other

_____

B1. Kerosene

1. how often do buy kerosene?

◯ Daily

◯ Once a week

◯ Multiple time a week

◯ Monthly

2. What quantity do you usually buy?

3. How much does kerosene cost (per liter)?

4. Where do you usually buy kerosene?

◯ Inside the community

◯ Outside the community

◯ Both

◯ Other

4a. if other, please specify:

5. Are there times kerosene is not available?

◯ Yes

◯ No

5a. If yes, under what circumstances is it not available?

6. Does the price of kerosene fluctuate?

◯ Yes

◯ No

6a. If yes, under what circumstances does the price change?

B2. Charcoal

1. How often do you buy charcoal?

◯ Daily

◯ Once a week

◯ Multiple time a week

◯ Monthly

2. What quantity do you usually buy?

_____

3. How does it cost?

_____

4. Where do you usually buy charcoal?

◯ Inside the community

◯ Outside the community

◯ Both

◯ Other

4a. If other, please specify:

_____

5. Are there times chacoal is not available?

◯ Yes

◯ No

5a. If yes, under what circumstances is it not available?

_____

6. Does the price of charcoal change during the year?

◯ Yes

◯ No

6a. If yes, under what circumstances does the price change?

_____

B3. Gas

1. How often do you refill your gas?

◯ Daily

◯ Once a week

◯ Multiple time a week

◯ Monthly

◯ Other

1b. If other, please specify:

_____

2. What quantity do you usually buy?

_____

3. How much does it cost?

_____

4. Where do you usually refill your gas?

◯ Inside the community

◯ Outside the community

◯ Other

4a. If other, please specify:

_____

5. Are there times gas is not available?

◯ Yes

◯ No

5a. If yes, under what circumstances is it not available?

_____

6. Does the price of gas fluctuate?

◯ Yes

◯ No

6a. If yes, under what circumstances does the price change?

_____

B4. Firewood

1. Do you buy firewood or gather it? (multiple answers possible)

☐ Gather

☐ Buy

☐ Other

1a. If other, please specify:

_____

2. How often do you buy/gather firewood?

○ Daily

○ Once a week

○ Multiple time a week

○ Monthly

3. What quantity do you usually buy/gather?

_____

4. How much does this quantity cost?

_____

5. Where do you usually buy/gather firewood?

○ Inside the community

○ Outside the community

○ Both

○ Other

5a. If other, please specify:

_____

6. Are there times firewood is not available?

○ Yes

○ No

6a. If yes, under what circumstances is it not available?

_____

7. Does the price of firewood fluctuate?

○ Yes

○ No

7a. If yes, under what circumstances does the price change?

C. Lighting

1. What sources of energy do you use for lighting? (multiple answers possible)

☑ Public electricity (NEPA)

☑ Generator

☑ Solar

☑ Lantern (kerosene or fuel)

☑ Candle

☑ Battery-powered light

☐ Other

1b. If battery-powered light: are they

○ Rechargeable

○ Non-rechargeable

1c. If other, please specify:

---

2. Which of these is your primary source of lighting?

○ Public electricity (NEPA)

○ Generator

○ Solar

○ Lantern (kerosene or other fuel)

○ Candle

○ Battery-powered light

○ Other

2a. If other, please specify:

---

3. If you do not use public electricity (NEPA), why not? (multiple answers possible)

☐ Public supply does not reach community

☐ Disconnected due to payment problems

☐ Spoiled transformer/NEPA connection

☐ Other

3a. If other, please specify:

C1. Public electricity (NEPA)

1.On a typical day, how many hours of NEPA do you receive?

_____

2. Do you have a meter?

◯ Yes

◯ No

2a. If yes, is it for your household only or for multiple households?

◯ one household

◯ multiple households

2b. If yes, is it prepaid or postpaid?

◯ Prepaid

◯ Postpaid

2c. If yes, is the meter working?

◯ Yes

◯ No

3. Does your household receive electricity bills from the electricity distribution company?

◯ Yes

◯ No

3a. How is the bill calculated?

◯ Estimated

◯ Metered

3b. How much did you last pay for your household bill?

_____

3c. If yes, for what period of time was the bill?

3d. How do you pay for electricity?

○ Community light committee

○ Structure owner

○ Do not pay

○ Other

3d*. If other, please specify:

3e. How often do you pay?

○ Daily

○ Weekly

○ Monthly

○ Twice a year (every 6 months)

○ Every year

○ Other

3e*. If other, please specify:

3f. how much did you last pay?

4. Does your household experience any of the following problems with public electricity supply? (multiple answers possible)

☐ Irregular supply

☐ Irregular voltage (high/low voltage)

☐ Unsafe supply (falling wires, electricity surges, etc)

☐ Overbilling (e.g 'outrageous" estimated bills)

☐ Corrupt practices by distribution company officials/agents

☐ Abusive practices by distribution company officials/agents

How many generators does your household have?

1

Please run the next set of questions for EACH generator

C2. Generator

1

* 1. **What's the capacity (Kva) of the generator?**

_____

* 2. **Does your generator run on petrol or diesel?**

○ Petrol

○ Diesel

* 3. **On average, how many hours per day do you run your generator?**

_____

* 4. **How often do you refuel your generator?**

○ Daily

○ Once a week

○ Multiple time a week

○ Monthly

* 5. **When you refuel your generator how much fuel do you add (in liters)?**

_____

* 6. **How much do you pay for 1 liter of fuel?**

_____

* 7. **How often do you have to service or repair your generator?**

○ Weekly

○ Monthly

○ Every 2 months

○ Every 3 months

○ Every 6 months

○ Once a year

* 8. **How much do you typically spend each time to service or repair your generator?**

_____

C2. Generator continuation

9. Where do you purchase fuel for your generator(s)?

◯ Outside the communtiy

◯ Inside the community

◯ Both

◯ Other

10. Are there times when fuel is not available?

◯ Yes

◯ No

10a. if yes, under what circumstances it is not available?

_____

11. Does the price of fuel fluctuate?

◯ Yes

◯ No

11a. If yes, under what circumstances does the price change?

_____

How many solar panels do you have?

1

_____

Please answer the following question for each solar panel

_____

C3. Solar

1

* **1. What's the capacity for each solar panel (in watts)?**

_____

C3. Solar continuation

2. Do you have an inverter?

○ Yes

○ No

2a. If yes, what's the capacity of the inverter (in Kva)?

_____

3. Do you store solar energy in batteries?

○ Yes

○ No

3a. If yes, how many batteries do you have?

_____

3b. If yes, what is the capacity of the batteries (in Amps)? Please precise for each

_____

4. How did you pay/are paying for your solar?

○ Paid in full up front

○ Borrowed money to buy

○ Rent-to-own or other supplier-financed installment payment scheme

○ Other

4a. If other, please specify:

_____

5. Does the power generated by your solar fluctuate over the year?

○ Yes

○ No

5a. If yes, under what circumstances does it change?

_____

6. Do you have any solar powered devices? (multiple answers possible)

☐ Yes, I have devices with their own solar panel (integrated)

☐ Yes, I have devices adapted to run on solar without an inverter

☐ No

6a. If integrated devices, please specify:

_____

6b. If devices adapted to run on solar, please specify

C4. Lantern

1. Which kind(s) of fuel do your lanterns use? (multiple answers possible)

☐ Kerosene

☐ Petrol

☐ Other

1b. If other, please specify:

---

2. How many lanterns do you typically use?

---

3. On a normal day, how many hours do you use your lantern(s)?

---

4. How often do you refuel your lantern(s)?

◯ Daily

◯ Once a week

◯ Multiple time a week

◯ Monthly

5. When you refuel your lantern(s) how much fuel do you add (in liters)?

---

6. Where do you purchase fuel for your lantern(s)?

◯ Inside your community

◯ Outside your community

◯ Both

7a. How much do you pay for 1 liter of kerosene for your lantern(s)?

7b. How much do you pay for 1 liter of petrol for your lantern(s)?

7c. How much do you pay for 1 liter of fuel for your lantern(s)?

_____

8. Are there times lantern fuel is not available?

◯ Yes

◯ No

8a. If yes, under the what circumstances is it not available?

_____

9. Does the price of lantern fuel fluctuate?

◯ Yes

◯ No

9a. If yes, under what circumstances does the price change?

_____

C5. Candle

1. How often do you use candles?

◯ Everyday

◯ Multiple times a week

◯ Once week

◯ Once a month

2. On a day you are using candles for lighting, how many candles do you use?

_____

3. How often do you purchase candles?

◯ Everyday

◯ Multiple time a week

◯ Once a week

◯ Once a month

4. How many candles do you typically purchase?

_____

5. How much do you pay for one candle?

_____

6. Does the price of candles fluctuate?

○ Yes

○ No

6a. If yes, under what circumstances does the price change?

C6. Charging devices

1. If/When you do not have electricity at home, where does your household usually charge your deviced? (multiple answers possible)

☐ At a place of work

☐ At a friend/neighbor's house

☐ At a charging station

☐ Other

1b. If other, please specify:

1c. If at a charging station, indicate the source(s) of power used: (multiple answers possible)

☐ NEPA-powered

☐ Generator-powered

☐ Solar-powered

1d. Where is the charging station located?

○ Inside the community

○ Outside the community

D. Behavior Change

Cooking

1. Are you satisfied with your current power sources for cooking?

○ Yes

● No

1a. If no, why not?

1b. If no, which other sources would you like to use? (multiple answers possible)

☐ Kerosene

☐ Charcoal

☐ Firewood

☐ Gas (LPG)

☐ Other

1b*. If other, please specify:

_____

2. If you are not already, would you be interested in using gas (i.e "canister gas" or LPG) for cooking?

◯ Yes

● No

◯ Not applicable - already using gas

3. If no why not? (multiple answers possible)

☐ Too expensive

☐ Gas not readily available

☐ Structure of the house is not suitable (no space, not ventilated, not safe)

☐ Landlord will not allow

☐ I am afraid to use gas

☐ Other

3a. If other, please specify:

_____

4. If yes, what is stopping you from using gas?

_____

Lighting

_____

5. Are you satisfied with your current power sources for lighting?

◯ Yes

◯ No

5a. If no, why not?

_____

5b. If no, which other sources would you like to use? (multiple answers possible)

☐ Public electricity (NEPA)

☐ Generator

☐ Solar

☐ Lantern

☐ Candle

☐ Battery powered devices

☐ Other

5b*. If other, please specify:

---

6. If you are not already, would you be interested in using solar energy for lighting?

◯ Yes

◯ No

◯ Not applicable - already using solar

6a. If no why not?

6b. If yes, what is preventing you from using solar energy? (multiple answers possible)

☐ Too expensive

☐ Materials not readily available nearby

☐ Don't know where to acquire materials

☐ Don't understand how solar energy works

☐ Don't understand how to install and use solar energy

☐ Structure of the house is not suitable (i.e no roof access, roof not durable)

☐ Insecure/short-term tenure (therefore not interested in "upgrading')

☐ Threat of theft or breaking of solar panels installed outside/on roof

☐ Other

6b*. If other, please specify:

Health impacts

Explanation: this section asks about chronic health conditions that may be linked to air and noise pollution and other impacts related to cooking and/or electricity generation methods

Please indicate how many members of your household suffer from the following health challenges

A. Asthma

B. Bronchitis (chronic/repeated)

C. Pneumonia (chronic/repeated)

D. Emphysema

E. Cancer

Ea. If known please specify kind:

F. High blood pressure/hypertension

G. Hearing loss

E. Energy Load Inventory

Explanation: this section aims to capture the total energy load of a household. For electrical appliances, the numbers should represent the items that are plugged and/or should represent the items that are plugged in and/or presently used. If a household has appliances that are broken or otherwise not in used they should not be counted

Electrical appliances

1a. 40W (standard incandescent) light bulbs

_____

1b. 60W (standard incandescent) light bulbs

_____

1c. CFL (energy saver)

_____

1d. Which energy source(s) do you run your light bulb(s) on? (multiple answers possible)

☐ Public electricity

☐ Generator

☐ Solar grid

☐ Other

1d*. If other, please specify

_____

2a. Standing fan

_____

2b. Ceiling fan

_____

2c. Which energy source(s) do you run your fan(s) on? (multiple answers possible)

☐ Public electricity

☐ Generator

☐ Solar grid

☐ Other

2c*. If other, please specify:

_____

3a. Standard TV

_____

3b. Flat screen TV (LCD or LED or Plasma)

_____

3c. Which energy source(s) do you run your TV(s) on? (multiple answers possible)

- [ ] Public electricity
- [ ] Generator
- [ ] Solar grid
- [ ] Other

3c*. If other, please specify:

_____

4a. Small refrigerator

_____

4b. Medium refridgerator

_____

4c. Large refrigerator

_____

4d. Which energy source(s) do you run your refrigerator(s) on? (multiple answers possible)

- [ ] Public electricity
- [ ] Generator
- [ ] Solar grid
- [ ] Other

4d*. If other, please specify:

_____

5a. Deep freezer

_____

5b. Which energy source(s) do you run your deep freezer(s) on? (multiple answers possible)

☐ Public electricity

☐ Generator

☐ Solar grid

☐ Other

5b*. If other, please specify:

_____

6a. Iron

_____

6b. Which energy source(s) do you run your iron(s) on? (multiple answers possible)

☐ Public energy

☐ Generator

☐ Solar grip

☐ Other

6b*. If other, please specify:

_____

7a. 50 liters water heater

_____

7b. 100 liters water heater

_____

7c. Which energy source(s) do you run your water heater(s) on? (multiple answers possible)

☐ Public energy

☐ Generator

☐ Solar grid

☐ Other

7c*. If other, please specify:

_____

8a. Electric kettle

_____

8b. Which energy source(s) do you run electric kettle(s) on? (multiple answers possible)

- [ ] Public Energy
- [ ] Generator
- [ ] Solar grid
- [ ] Other

8b*. If other, please specify:

_____

9a. Electric cook stove without oven

_____

9b. Electric cook stove with oven

_____

9c. Which energy source(s) do you run your electric cook(s) on? (multiple answers possible)

- [ ] Public Energy
- [ ] Generator
- [ ] Solar grid
- [ ] Other

9c*. If other, please specify:

_____

10a. Small (1HP) air conditionner

_____

10b. Medium (1.5HP) air conditionner

_____

10c. Large (2HP) air conditionner

_____

10d. Which energy source(s) do you run your air conditionner(s) on? (multiple answers possible)

☐ Public Energy

☐ Generator

☐ Solar grid

☐ Other

10d*. If other, please specify:

_____

11a. Water pump

_____

11b. Which energy source(s) do you run your water pump(s) on? (multiple answers possible)

☐ Public Energy

☐ Generator

☐ Solar grid

☐ Other

11b*. If other, please specify:

_____

12a. Small washing machine

_____

12b. Medium washing machine

_____

12c. Large washing machine

_____

12d. Which energy source(s) do you run your washing machine(s) on? (multiple answers possible)

☐ Public Energy

☐ Generator

☐ Solar grid

☐ Other

12d*. If other, please specify:

_____

13a. Stereo system/ Music player

_____

13. Which energy source(s) do you run your stereo/music player(s) on? (multiple answers possible)

☐ Public Energy

☐ Generator

☐ Solar grid

☐ Other

13b*. If other, please specify:

_____

14a. Desktop computer

_____

14b. Laptop computer

_____

14c. Which energy source(s) do you run your computer(s) on? (multiple answers possible)

☐ Public Energy

☐ Generator

☐ Solar grid

☐ Other

14c*. If other, please specify:

_____

15a. Outlets/sockets

_____

15b. Which energy source(s) do you run your outlets/sockets on? (multiple answers possible)

☐ Public Energy

☐ Generator

☐ Solar grid

☐ Other

15b*. If other, please specify:

_____

16. Extensions:

_____

17. Other, please specify:

_____

Informal Settlement Household Energy Survey: Interview Guide

1.   Date of the survey :
→ **must be the date the survey is done**
2.   Name of the surveyor:ùm
→ **indicate your name, please always spell your name <u>the same way</u>**

A. Respondent & Household Information
1.   Name of the community
→ **if the name given to you by the respondent is different that the name of the community you're supposed to work in, ask why there aren't using this name**
2.   LGA
→ **you should not get an answer that is not in the list. If that is the case please raise this point quickly to the coordinator on the field.**
3.   Name of respondent:
→ **please remind to the respondent this will not be shared**
4.   Age of the respondent:
→ **please indicate the age in number not date/year of birth**
5.   Phone number
6.   Gender of respondent
7.   Tenure status of the household:
-     **Tenant = pays the rent directly to the owner**
-     **Sub-tenant = pays the rent to someone who is renting the place**
-     **Structure owner = do not pay rent**
-   8.   Number of occupants in the household:
→ **please indicate the number of people living (sleeping in the same house) with the respondent**
9.   Number of children under the age of 15 in the household:
10. Number of people over the age of 65 in the household:
11. Number of women in the household:
12. Address of physical description of location of structure:
→ **if no official address please indicate landmarks around (ex: between Cherubim and Seraphim Church and Mama Bisola buka)**
13. GPS coordinates of the building (Latitude, Longitude)
→ **Please select "detect current location" (under the red arrow), make sure that the location tool of the device (tab, phone) is on**

14. Material of the structure
→ **if more than one material is used please select multiple**
→ **if the material used is not proposed in the list, select other and specify**

<u>14a. Floor</u>

Cement	*Wood/Plank*	*Rubble/Garbage/Sawdust*	*Sand*

<u>14b. Walls</u>

Cement block	*Tarpaulin*	*Bamboo/Palm Fronds*	*Wood/Plank*

<u>14c. Roof</u>
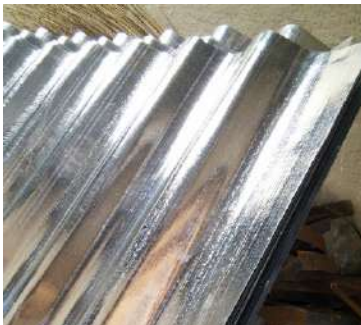
Zinc	*Wood/Plank*

<u>14d. Windows</u>: **this means what material is use for windows (not the frame but the actual windows)**

15.   Does the household occupy the entire structure?
→ **do they occupy all the rooms?**
16. If no, how many rooms does the household occupy?
17. Gross floor area of space occupied (in square feet):
→ **Estimate or measure the total area the household occupies (practical exercises during training)**
18. Please indicate the number of sources of ventilation for each of the following
→ **doors and windows do not need to be made with a specific material, any space in the walls that lets air and light going through is a window, any space that allows someone to enter the structure is a door**
      a.   Doors opening to open space
    → **nothing blocks the air from entering the interior of the structure, no other walls, no fencing, no big gate. The door is directly opening to outside, not to another room/corridor/hallway.**
      b.   Doors opening to enclosed space (interior or adjacent house/wall very close)
    → **the door opens to another room, another hall, another corridor, is in front of a gate, a fence..**
      c.   Windows opening to open space
    → **nothing blocks the air from entering, same as doors. There is a big space in front of the window with nothing blocking the air.**
      d.   Windows opening to enclosed space (interior or adjacent house/wall very close)

→ the windows open to another room, hall, corridor, or to a very close fence or gate

19. Do the windows and doors allow for cross ventilation?

→ cross ventilation = when doors and windows allow the air to move and create a breeze inside a place.
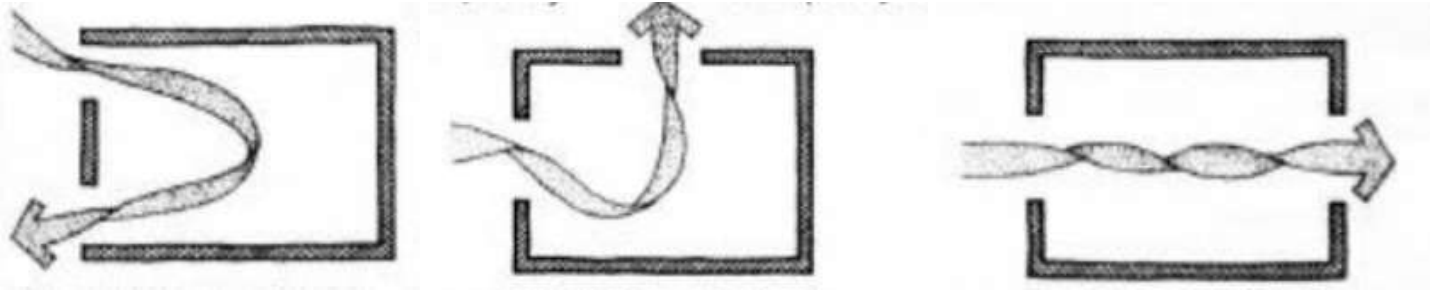
20. Are there other structural features that reduce heat or increase cooling? (multiple answers possible)
- None
- Thick block walls

→ large block will allow cool air to remain inside the house
- Insulated roof

→ additional layer(s) of material on the roof to try to prevent heat and trap the cool air inside
- "Fancy blocks" that allow ventilation

→ blocks with gaps or designs in them that allow air to flow through the block wall
- Bamboo/Raffia walls with spaces that allow ventilation

→ space between bamboo/raffia helps creating ventilation and keeps the place cool
- Other

21. What's the usage of the structure?

→ Because of the scope of the study all the structures should have a residential use, if not do not continue the survey please.

    a. Residential

→ The household only lives here and works elsewhere, please check that no member of the household works inside or right outside the structure (e.g: women selling food or water)

    b. Residential and Business

→ Some or all the members of the household also work in the structure or right outside

    c. Residential and Other

21. If "Residential and Other", what is the 'other' use of the structure?

22. Year of construction of the building if known by the respondent (e.g. 2005,1990. If not known by the respondent fill: don't know)

→ please answer with the YEAR of construction NOT the duration of time the respondent has been living there (15 years). Also we need the year of construction NOT the year the respondent starts living there.

B. Cooking

1. Does your household cook food regularly?
- Once (1) a day
- Twice (2) a day
- Thrice (3) a day
- More than thrice (3) a day
- Only a few times a week
- Rarely
- Never

2. For what purpose(s) does your household cook for? (multiple answers possible)
- Means for the household members

→ for everyone living (sleeping) in the same house as the respondent
- Prepared meals for sale - fixed location

→ ask the respondent where the food is sold to know if it's a fixed location or a mobile vendor
- Prepared meals for sale - mobile vendor
- Preparation of foodstuffs for sale

- Heating water
- Not applicable- don't cook
- Other

2a. I "preparation of foodstuffs for sale", please specify:
    → **ask what foodstuffs are prepared (i.e: roasted groundnuts, smoked fish) and how it is prepared**
2b. If other, please specify:
3. Where does your household cook (multiple answers possible)?
    → **make sure to tick all the places where the household cooks, if they only give you one answer check to be sure if it is where they cook <u>all</u> their meals and their market**
- Inside the house
- Inside a separate structure used for cooking
- Outside the house/room in a corridor
- Outside the house/room in open air
- Not applicable - don't cook
- Other

3a. If "Inside the house", "Inside a separate structure used for cooking", "Outside the house/room in a corridor"are selected, is the space ventilated?
→ **additional questions to know if the space is ventilated: Are there windows in the room where the food is cooked? Is the material used for the walls help for ventilation? Is the air moving in the room?**
If YES to any of those questions choose YES.
3b. Please explain:
3c. If other, please specify
4. What source(s) of energy does your household use for cooking? (multiple answers possible)
→ **make sure you get an answer for all the types of energy used for cooking, if they give you only one answer double check that is is the only source of energy they use for cooking**
- Kerosene
- Charcoal
- Firewood
- Gas (LPG)
- No source used - the household doesn't cook
- Other

4a. If other, please specify:
5. Which of these is your primary source for cooking (the one used the most?) ONLY one answer possible
- Kerosene
- Charcoal
- Firewood
- Gas (LPG)
- No source used - the household doesn't cook
- Other
    → **here ask what source of energy they use to cook the majority of the food**
6. If multiple sources are chosen, please explain briefly how/when each different fuel type is used. If only one source is used write: only source
→ **Please fill for each source of energy how is it used by the household and if it is used throughout the year or only at certain times, Ex: firewood only used to cook/prepare a certain type of food (smoking fish), gas is only used during raining season**

> → **the following sections will show up depending on the answers on question 4, for each source of power selected a set of questions will appear**

> B1. If kerosene
> 1. How often do you buy kerosene?
>   - Daily
>   - One a week
>   - Multiple time a week
>   - Monthly

2. What quantity do you usually buy?
→ **please specify which unit is used, e.g: 1 soda bottle, 1 liter..**
3. How much does kerosene cost (per liter)?
→ **if the respondent doesn't know for one liter, ask the price for a mineral bottle and multiply by 2**
4. Where do you usually buy?
- Inside the community
- Outside the community
- Both
- Other
4a. If other, please specify:
5. Is kerosene available year round?
→ **is it always available? By available we mean it cannot be found, not that the respondent cannot buy for some reasons (no money, price too high..)**
5a. If not, under what circumstances is it not available? [open]
→ **try to get a detailed answer here, especially what factors would make it not available**
6.Does the price of kerosene change during the year?
6a. If yes, under what circumstances does the price change?
→ **for this questions try to get a precise answer on why the price change, if it's always happening around the same time of the year or after a certain event**

B2. Charcoal
1. How often do you buy kerosene?
- Daily
- One a week
- Multiple time a week
- Monthly
2. What quantity do you usually buy?
→ **please specify which unit is used (e.g: Kg or pieces)**
3. How much does it cost?
4. Where do you usually buy charcoal?
- Inside the community
- Outside the community
- Both
- Other
5. Are there times charcoal is not available?
→ **is it always available? by available we mean it cannot be found, not that the respondent cannot buy for some reasons (no money, price too high..)**
5a. If yes, under what circumstances is it not available?
→ **try to get a detailed answer on the reason it is not available**
6. Does the price of charcoal change during the year?
6a. If yes, under what circumstances does the price change?
→ **for this questions try to get a precise answer on why the price change, if it's always happening around the same time of the year or after a certain event or under certain circumstances**

B3. If Gas (LPG)
1. How often do you refill your gas?
- Daily
- Once a week
- Multiple time a week
- Once a month
2. What quantity of gas do you usually buy?
→ **please specify which unit is used, if bottle or cylinder try to get the number of KG/L**
3. How much does it cost?
4. Where do you usually refill your gas?
- Inside the community
- Outside the community

- Both
  5. Are there times gas available year around?

→ **is it always available? by available we mean it cannot be found, not that the respondent cannot buy for some reasons (no money, price too high..)**

  5a. If yes, under what circumstances is it not available?
  6. Does the price of gas fluctuate?
  6a. If yes, under what circumstances does the price change?

→ **for this questions try to get a precise answer on why the price change, if it's always happening around the same time of the year or after a certain event**

B4. If Firewood
1. Do you buy firewood or gather it (multiple answers possible)?
   - Gather
   - Buy
   - Other
2. How often do you buy firewood?
   - Daily
   - Once a week
   - Multiple time a week
   - Monthly
   - I don't buy it
3. What quantity do you usually buy?

   → **please specify which unit is used**
4. How much does it cost?
5. Where do you usually buy firewood?
   - Inside the community
   - Outside the community
   - Both
   - Other
6. Are there times firewood is not available?

→ **is it always available, by available we mean it cannot be found, not that the respondent cannot buy for some reasons (no money, price too high..)**

  6a. If no, under what circumstances is it not available?
  7. Does the price of gas fluctuate?
  7a. If yes, under what circumstances does the price change?

→ **for this questions try to get a precise answer on why the price change, if it's always happening around the same time of the year or after a certain event**

C. Lighting
→ **the entire following section is about how the household get power for lighting**

1. What sources of energy do you use for lighting? Multiple answers possible
   1. Public electricity (NEPA)
   2. Generator
   3. Solar
   4. Lantern (kerosene or other fuel)
   5. Candle
   6. Rechargeable light
   7. Other, please specify

→ **make sure to ask additional questions and tick all the sources used by the household**

1b. If battery-powered light are they
- Rechargeable
- Non rechargeable
2. Which of these is your primary source of lighting?

→ which one they use the most for light, only one answer possible
    a. Public electricity (NEPA)
    b. Generator
    c. Solar
    d. Lantern (kerosene or other fuel)
    e. Candle
    f. Rechargeable light
    g. Other, please specify
3. If you do not use public electricity (NEPA), why not? (multiple answers possible)
- Public supply does not reach community
- Disconnected due to payment problems
- Spoiled transformer/NEPA connection
- Other

→ the following sections will show up depending on the answers of question 1, for each each sources of power selected a specific set of questions will appear

C1. Public Electricity (NEPA)
1. On a typical day, how many hours of NEPA do you receive?
2. Do you have a meter?
2a. If yes, is it for your household alone or for multiple households?
- One household
- Multiple households

2b. If yes, is it prepared or postpaid?
2c. If yes, is the meter working?
3. Does your household receive electricity bills from the electricity distribution company?
3a. How is the bill calculated?
- Estimated
- Metered

3b. How much did you last pay for your household bill?

→ if the bill is for multiple households, make sure you get the amount paid only for the household portion not the entire bill (example: for bill is NGN4,000 for four households, each pays NGN1,000 so you need to write down NGN1,000)

3c. If yes, for what period of time was the bill?
3d. How do you pay for electricity
- Community light committee
- Structure owner
- Do not pay
- Other

→ please remind the respondent that personal information will not be disclosed, so people who do not pay cannot be tracked down by anybody.

3e. If other, please specify:
3f. How much did you last pay?

→ This question is shown only if the respondent says she/he doesn't receive bills.

4. Does your household experience any of the following problems with public electricity supply? (multiple answers
- Irregular supply (power on/off)

- Irregular voltage (high voltage/low voltage)
- Unsafe supply (falling wires, electricity surges, etc)
- Overbilling (e.g "outrageous" estimated bills)?
- Corrupt practices by distribution company officials/agents

→ **for instance, demands for unreceipted payments to avoid disconnection**
- Abusive practices by distribution company officials/agents

→ **for instance, threats of arrest or violence by officials to get payment**

How many generators does your household have?

→ **Please run the next set of questions for EACH generator**

C2. Generator

1. What's the capacity of the generator?
2. Does your generator run on petrol or diesel?
3. On average, how many hours per day do you run your generator?
4. How often do you refuel your generator?
   - Daily
   - Once a week
   - Multiple time a week
   - Monthly
5. When do you refuel your generator how much fuel do you add (in liters)?
6. How much do you pay for 1 liter of fuel?
7. How often do you have to service or repair your generator?
   - Weekly
   - Monthly
   - Every 2 months
   - Every 3 months
   - Every 6 months
   - Once a year

→ **to get a good answer to this question you can also ask: "when was the last time you serviced your generator?" and then ask the time before the last. This helps if the respondent tells you "I don't know" or if you feel the need to verify the answer**

8. How much do you typically spend each time to service or repair your generator?

Question 9-11a, will only show up once. Make sure you capture information for all the generators owned by the household before answering question 9.

9. Where do you purchase fuel or your generator(s)?
   - Outside the community
   - Inside the community
   - Both
   - Other
10. Are there times when fuel is not available?
10a. If yes, under what circumstances is not available?
11. Does the price of fuel fluctuate?
11a. If yes, under what circumstances does the price change?

How many solar panels do you have?
→ **Please answer the following questions for each solar panel**

C3. Solar
1. What's the capacity or each solar panel (in watts)?
2. Do you have an inverter?
2a. If yes, what's the capacity of the inverter (in Kva)?
3. Do you store solar energy in batteries?
3a. If yes, how many batteries do you have?
3b. If yes, What is the capacity of the batteries (in Amps)? Please precise for each
4. How did you pay/are paying for your solar?
   - Paid in full up front
   - Borrowed money to buy
   - Rent-to-own or other supplier-financed installment payment scheme
   - Other
4a. If other, please specify
5. Does the power generated by your fluctuate over the year?
5a. If yes, under what circumstances does it change?
6. Do you have any solar powered devices? (multiple answers possible)
   - Yes, I have devices with their own solar panel (integrated)
   - Yes, I have devices adapted to run on solar without an inverter
   - No
6a. If integrated devices, please specify:
6b. If devices adapted to run on solar, please specify;

C4. Lantern
1. Which kind(s) of uel do your lanterns use? (multiple answers possible)
   - Kerosene
   - Petrol
   - Other
2. How many lanterns do you usually use?
3. On a normal day, how many hours do you use your lantern(s)?
4. How often do you refuel your lantern(s)?
   - Daily
   - Once a week
   - Multiple times a week
   - Monthly
5. When you refuel your lantern(s) how much do you add (in liters)?
6. Where do you purchase fuel for your lantern(s)?
   - Inside your community
   - Outside your community
   - Both
7a. How much do you pay for 1 liter of kerosene for your lantern(s)?
7b. How much do you pay for 1 liter of petrol for your lantern(s)?
7c. How much do you pay for 1 liter of fuel for your lanterns(s)?
8.Are there times lantern fuel is not available?
8a. If yes, under what circumstances is it not available?
9. Does the price of lantern fuel fluctuate?
9a. If yes, under what circumstances does the price change?

C5. Candle

1. How often do you use candles?
   - Everyday

- Multiple times a week
- Once a week
- Once a month

2. On a day you are using candles for lighting, how many candles do you use?
3. How often do you purchase candles?
    - Everyday
    - Multiples times a week
    - Once a week
    - Once a month
4. How many candles do you typically purchase?
5. How much do you pay for one candle?
6. Does the price of candles fluctuate?
6a. If yes, under what circumstances does the price change?

C6. Charging devices
1. If/when you do not have electricity at home, where does your household charge your devices? (multiple answers possible)
    - At a place of work
    - At a friend/neighbor's house
    - At a charging station
    - Other
1b. If other, please specify
1c. If at a charging station, indicate the source(s) of power used (multiple answers possible)
    - NEPA-powered
    - Generator-powered
    - Solar-powered
1d. Where is the charging station located?
    - Inside the community
    - Outside the community

D. Behaviour Change
→ this section aims at understanding what changes people want to see concerning their access to power and what is currently preventing them from making these changes. There is also a section on the impact sources of energy use can have on health.

<u>Cooking</u>

1. Are you satisfied with your current power sources for cooking?
1a. If no why not? **→ try to get a complete answer on this**
1b. If no, which other sources would you like to use?
    - Kerosene
    - Charcoal
    - Firewood
    - Gas (LPG)
    - Other, please specify
→ please make sure it is not one they already use
2. if you are not already, would you be interested in using gas (i.e "canister gas" or LPG) for cooking?
    - Yes
    - No
    - Not applicable - already using gas

3. If no why not? (multiple answers possible)
    - Too expensive
    - Gas not readily available nearby
    - Structure of the house is not suitable (i.e no space, not ventilated, not safe)
    - Landlord will not allow
    - I am afraid to use gas
    - Other, please specify
4. If yes, what is stopping you from using gas?

<u>Lighting</u>

5. Are you satisfied with your current power sources for lighting?
    a. If no, why not?
    b. If no, which other sources would you like to use?
        i. Public electricity (NEPA)
        ii. Generator
        iii. Solar
        iv. Lantern (kerosene or other fuel)
        v. Candle
        vi. Rechargeable light
        vii. Other, please specify:
    → **please make sure it is not one they already use**
6. If you are not already, would you be interested in using solar energy for lighting?
    - Yes
    - No
    - Not applicable, already using solar
6a. I no why not?
6b. If yes, what is currently preventing you from using solar energy? (Multiple possible)
    - Too expensive
    - Materials not readily available nearby
    - Don't know where to acquire materials
    - Don't understand how solar energy works
    - Don't understand how to install and use solar energy
    - Structure of the house is not suitable (no roof, roof not durable)
    - Threat of eviction (not interested in 'upgrading'/invest)
    - Threat of theft or breaking of solar panels installed outside/on roof

Health impacts
→ **this section asks about chronic health conditions that may be linked to air and noise pollution and other impacts related to cooking and/or electricity generation methods**

Please indicate how many members of your household suffer the following health challenges:

    - Asthma
    - Bronchitis (chronic/repeated)
    - Pneumonia
    - Emphysema
    - Cancer (if known, please specify which type of cancer)
    - High blood pressure/hypertension
    - Hearing Loss

Annex C

<center>

C40 Community Pre-Questionnaire

</center>

To be completed by volunteers responsible for outreach to the community based on their observations in the community. Please scan and return together w/ community coordinates.

Community Name: _____   Date Visited: _____

LGA: _____   LCDA: _____

Volunteers: _____   Date Visited: _____

Key Community Contacts:

Name	Position	Phone

Key Questions/Observations:

1. Is the community connected to public electricity supply?   Y   N

    a. If yes, which distribution company: Eko   Ikeja   Other: _____

    b. If yes, which kind of billing/metering?   Each Structure   Bulk

    c. If yes, does it appear there are illegal connections? Y   N

2. What kinds of structures are in the community? (indicate your guess as to percentage)
    a. Block: _____   Single family (one unit): _____
    b. Plank: _____   Multi-family (2-4 units): _____
    c. Bamboo: _____   Multi-family (5-10 units): _____
    d. Tarpaulin: _____   Multi-family (11+ units): _____
    e. Zinc: _____   **TOTAL: 100%**
       TOTAL: 100%

3. What are the major ethnic/language groups in the community? (list)

4. Is the settlement located on/adjacent to any of the following?
    a. Water body   Y   N   Major highway   Y   N
    b. Swamp   Y   N   Pipeline   Y   N
    c. Railroad   Y   N   High tension   Y   N

Annex D. LGA-Level Sampling Methodology

LGAs in Metropolitan Lagos	2016 Population *	Land mass (sq.km)	Percentage Total Metro Population / LGA (Factor 1)	# HHs Based on Factor 1	Population density (pop. per sq. km)	Factor Relative to Pop. Density of Entire Metro Area	Percentage Based on Pop Density (Factor 2)	Factors Combined (2:1)	# HHs Based on Factors 1 & 2	Increase / Decrease	No of Federation-Identified Settlements in LGA (Factor 3)	Percent Based on Informal Settlements / LGA	Factors Combined (1:1:1)	# HHs Based on Factors 1, 2 & 3	Increase / Decrease
AGEGE	1,415,547	17.00	6.43%	193	83,267.47	4.43	9.99%	7.62%	229	36	7	2.33%	6.25%	187	-6
AJEROMI/IFELODUN	1,966,700	13.90	8.94%	268	141,489.21	7.53	16.97%	11.61%	348	80	31	10.30%	12.07%	362	94
ALIMOSHO	2,804,919	137.80	12.75%	382	20,355.00	1.08	2.44%	9.31%	279	-103	43	14.29%	9.82%	295	-88
AMUWO-ODOFIN*	719,337	179.10	3.27%	98	4,016.40	0.21	0.48%	2.34%	70	-28	42	13.95%	5.90%	177	79
APAPA*	715,792	38.50	3.25%	98	18,592.00	0.99	2.23%	2.91%	87	-10	29	9.63%	5.04%	151	54
ETI-OSA	1,347,653	299.10	6.12%	184	4,505.69	0.24	0.54%	4.26%	128	-56	31	10.30%	5.65%	170	-14
IFAKO-IJAIYE	1,019,902	43.00	4.63%	139	23,718.65	1.26	2.84%	4.04%	121	-18	8	2.66%	3.38%	101	-38
IKEJA	888,903	49.92	4.04%	121	17,806.55	0.95	2.14%	3.40%	102	-19	3	1.00%	2.39%	72	-49
KOSOFE	1,280,646	84.40	5.82%	175	15,173.53	0.81	1.82%	4.49%	135	-40	19	6.31%	4.65%	140	-35
LAGOS ISLAND	1,178,200	9.26	5.35%	161	127,235.42	6.77	15.26%	8.66%	260	99	8	2.66%	7.76%	233	72
LAGOS MAINLAND	862,524	19.62	3.92%	118	43,961.47	2.34	5.27%	4.37%	131	14	25	8.31%	5.83%	175	57
MUSHIN	1,810,797	14.05	8.23%	247	128,882.35	6.86	15.46%	10.64%	319	72	2	0.66%	8.12%	243	-3
OJO	1,290,113	182.00	5.86%	176	7,088.53	0.38	0.85%	4.19%	126	-50	23	7.64%	4.78%	144	-32
OSHODI/ISOLO	1,554,604	41.98	7.06%	212	37,032.02	1.97	4.44%	6.19%	186	-26	13	4.32%	5.27%	158	-54
SHOMOLU	1,404,666	14.60	6.38%	191	96,210.00	5.12	11.54%	8.10%	243	52	12	3.99%	7.30%	219	28
SURULERE	1,746,183	27.05	7.93%	238	64,553.90	3.44	7.74%	7.87%	236	-2	5	1.66%	5.78%	173	-65
TOTAL	22,006,486	1,171.28	100.00%	3000	18,788.41	44.38	100.00%	100.00%	3000	0.00	301	100.00%	100.00%	3000	0
								Avg / LGA	187.5						

		SAMPLE SIZE (Variable)	3000					

* SEE p. 64 Y2016 Household Survey

Blue indicates > avg;
Red indicates < avg

Annex E. List of Communities Surveyed

Community	LGA
Abekoko	Agege
Agunbiade	Agege
Balogun	Agege
Dopemu	Agege
Isale Odo	Agege
Kaji Hausa	Agege
New garage	Agege
Ogba	Agege
Otta road	Agege
Sango	Agege
Tabon Tabon	Agege
Adeolu	Ajeromi-Ifelodun
Ago Shite Olu	Ajeromi-Ifelodun
Ajegunle	Ajeromi-Ifelodun
Alaba	Ajeromi-Ifelodun
Amukoko/Mosafejo	Ajeromi-Ifelodun
Anthony Agboje	Ajeromi-Ifelodun
Holy Land	Ajeromi-Ifelodun
Idewu	Ajeromi-Ifelodun
Lawani	Ajeromi-Ifelodun
Mechanic Village	Ajeromi-Ifelodun
Mission	Ajeromi-Ifelodun
Nylon village	Ajeromi-Ifelodun
Ogbowankwo	Ajeromi-Ifelodun
Ojo Road	Ajeromi-Ifelodun

Okorogbo	Ajeromi-Ifelodun
Okoya	Ajeromi-Ifelodun
Olumokun/Olayinka	Ajeromi-Ifelodun
Oridilu	Ajeromi-Ifelodun
Second Badagry	Ajeromi-Ifelodun
Ugbonwankwo	Ajeromi-Ifelodun
Aboru	Alimosho
Abule Oki	Alimosho
Afilaka	Alimosho
Agbelekale	Alimosho
Ajegunle-Ilo	Alimosho
Akinola	Alimosho
Akinrosoye	Alimosho
Alagbado	Alimosho
Alakuko	Alimosho
Asalu	Alimosho
Bolorunpelu	Alimosho
Cele	Alimosho
Egbe	Alimosho
Egbeda	Alimosho
Ijegun	Alimosho
Imesan	Alimosho
Imuto Egan	Alimosho
Isheri Osun	Alimosho
Mojogun	Alimosho
Omoroga	Alimosho
Onitire	Alimosho
Rasheed Belo	Alimosho

Abule Glass	Amuwo-Odofin
Araromi	Amuwo-Odofin
Bishopkoji	Amuwo-Odofin
Chicago beach	Amuwo-Odofin
Chiku	Amuwo-Odofin
Ganvie Koji	Amuwo-Odofin
Ifako	Amuwo-Odofin
Igboeseyore	Amuwo-Odofin
Igbologun	Amuwo-Odofin
Itun Agan	Amuwo-Odofin
Sagbokoji	Amuwo-Odofin
Tie Gate	Amuwo-Odofin
Tomaro	Amuwo-Odofin
Whlakoji	Amuwo-Odofin
Abete	Apapa
Badia West	Apapa
Gaskiya west	Apapa
Oke oja	Apapa
Orinsunmibare	Apapa
Sari	Apapa
White sand	Apapa
Zion	Apapa
Ajah isale ijebu	Eti-Osa
Badore	Eti-Osa
Ijoyi New Road	Eti-Osa
Ikota Housing Estate	Eti-Osa
Ito Omu	Eti-Osa
Lekki Phase 2	Eti-Osa

Oke Ira Kekere	Eti-Osa
Sangotedo	Eti-Osa
Agbado	Ifako-Ijaiye
Akinde	Ifako-Ijaiye
Ibari	Ifako-Ijaiye
Idiagbon	Ifako-Ijaiye
Ishaga	Ifako-Ijaiye
Okoro	Ifako-Ijaiye
Papa Ogundimu	Ifako-Ijaiye
Akiode Town	Ikeja
Alafia estate	Ikeja
Ojota Dumping Site	Ikeja
Oregun Oluyole	Ikeja
Wasimi	Ikeja
Agboyi 1	Kosofe
Agboyi 2	Kosofe
Ago Egun Mosafejo	Kosofe
Gida Kwali	Kosofe
Idi Araba Oworonshoki	Kosofe
Isheri Oke	Kosofe
Maidon Mile 12	Kosofe
Mosafejo	Kosofe
Olubori	Kosofe
Epe Edo	Lagos Island
Faji	Lagos Island
Folawiyo	Lagos Island
Isale Eko	Lagos Island
Lafiaji	Lagos Island

Oju Oto	Lagos Island
Olowogbowo	Lagos Island
Pashi/Willoughby	Lagos Island
Sakiti street/Obadina	Lagos Island
Aiyetoro	Lagos Mainland
Baba Ijora	Lagos Mainland
Herbert Macaulay By Olotto	Lagos Mainland
Makoko	Lagos Mainland
Makurdi	Lagos Mainland
Otumara	Lagos Mainland
Abiodun	Mushin
Adedeji	Mushin
Alhaji yahaya	Mushin
Idi Araba	Mushin
Isiba	Mushin
Itire	Mushin
Iyeshutedo	Mushin
Kabiyesi	Mushin
Kajola	Mushin
Lalaigbo	Mushin
Mashewale	Mushin
Mushin	Mushin
New Balogun	Mushin
Odo Eran	Mushin
Oyelade	Mushin
Shotinoye	Mushin
Waigbo	Mushin
Agonu	Ojo

Ese Ofin	Ojo
Ibode	Ojo
Iganmo	Ojo
Ilogboelegba town	Ojo
Irewe	Ojo
Isachi	Ojo
Ito gbesa	Ojo
Muwo	Ojo
Ojo	Ojo
Ojota surulere	Ojo
Okogbo	Ojo
Origele	Ojo
Orufo	Ojo
Ponpoku	Ojo
Sibiri	Ojo
Tedi	Ojo
Akinbaye	Oshodi-Isolo
Alhaji Yaya	Oshodi-Isolo
Ejigbo	Oshodi-Isolo
Ewutuntun	Oshodi-Isolo
Isolo	Oshodi-Isolo
Orilowo Ejigbo	Oshodi-Isolo
Panada	Oshodi-Isolo
Shogunle	Oshodi-Isolo
Sofuye/Adijatu	Oshodi-Isolo
Adedoyin	Shomolu
Ago Egun Bariga	Shomolu
Araromi	Shomolu

Arobadade	Shomolu
Ayedun	Shomolu
Bamijilawal	Shomolu
Isale Akoka	Shomolu
Olatunji	Shomolu
Abiodun right	Surulere
Alagba	Surulere
Arikewuyo	Surulere
Baale	Surulere
Bankole Kekere	Surulere
Coker	Surulere
Kekere Ekun	Surulere
Onibuore	Surulere
Ope	Surulere
Oredola	Surulere
Savage	Surulere
181 Communities	**16 LGAs**

ANNEX F1. LGA-by-LGA Settlement Level Analysis from Pre-Survey Questionnaire (Part 1)

LGA	# Communities	# On Grid	% On Grid	# Eko DISCO	% Eko DISCO	# Ikeja DISCO	% Ikeja DISCO
Agege	11	11	100%	0	0%	11	100%
Ajeromi-Ifelodun	20	19	95%	20	105%	0	0%
Alimosho	22	22	100%	1	5%	21	95%
Amuwo-Odofin	14	3	21%	3	100%	0	0%
Apapa	8	8	100%	8	100%	0	0%
Eti-Osa	8	6	75%	5	83%	1	17%
Ifako-Ijaiye	7	7	100%	0	0%	7	100%
Ikeja	5	4	80%	0	0%	4	100%
Kosofe	9	9	100%	0	0%	9	100%
Lagos Island	9	9	100%	9	100%	0	0%
Lagos Mainland	6	6	100%	6	100%	0	0%
Mushin	17	17	100%	16	94%	1	6%
Ojo	17	16	94%	13	81%	3	19%
Oshodi-Isolo	9	9	100%	2	22%	7	78%
Shomolu	8	8	100%	0	0%	8	100%
Surulere	11	11	100%	11	100%	0	0%
TOTAL	**181**	**165**	**91%**	**94**	**57%**	**72**	**44%**

ANNEX F2. LGA-by-LGA Settlement Level Analysis from Pre-Survey Questionnaire (Part 2)

LGA	No. Communities	% Close to Water	% Close to Swamp	% Close to Railroad	% Close to Major Highway	% Close to Pipeline	% Close to High Tension
Agege	11	0%	0%	0%	55%	0%	9%
Ajeromi-Ifelodun	20	65%	55%	0%	5%	0%	10%
Alimosho	22	9%	73%	0%	82%	14%	9%
Amuwo-Odofin	14	100%	43%	0%	0%	0%	14%
Apapa	8	25%	63%	0%	0%	0%	25%
Eti-Osa	8	100%	50%	0%	63%	0%	13%
Ifako-Ijaiye	7	0%	43%	14%	29%	0%	57%
Ikeja	5	0%	40%	0%	40%	0%	20%
Kosofe	9	56%	67%	0%	33%	0%	0%
Lagos Island	9	22%	22%	0%	22%	0%	0%
Lagos Mainland	6	50%	67%	0%	17%	0%	17%
Mushin	17	35%	18%	0%	0%	0%	6%
Ojo	17	82%	41%	0%	6%	6%	29%
Oshodi-Isolo	9	11%	33%	0%	56%	11%	22%
Shomolu	8	100%	100%	0%	0%	0%	0%
Surulere	11	100%	0%	0%	0%	0%	0%
TOTAL	**181**	**49%**	**44%**	**1%**	**25%**	**3%**	**13%**

ANNEX F3. LGA-by-LGA Settlement Level Analysis from Pre-Survey Questionnaire (Part 3)

LGA	No. Communities	Avg % Block	Avg % Plank	Avg % Bamboo	Avg % Tarpaulin	Avg % Zinc	Avg % (one unit)	Avg % (2-4 units)	Avg % (5-10 units)	Avg % (+11 units)
Agege	11	95%	0%	0%	0%	5%	8%	22%	73%	29%
Ajeromi-Ifelodun	20	66%	25%	5%	0%	1%	2%	9%	35%	47%
Alimosho	22	93%	3%	2%	0%	2%	11%	40%	38%	13%
Amuwo-Odofin	14	71%	12%	15%	1%	2%	33%	23%	32%	16%
Apapa	8	69%	30%	0%	1%	0%	7%	43%	43%	5%
Eti-Osa	8	59%	23%	13%	3%	8%	61%	38%	1%	0%
Ifako-Ijaiye	7	100%	0%	0%	0%	0%	14%	43%	37%	5%
Ikeja	5	85%	8%	4%	2%	1%	16%	48%	26%	2%
Kosofe	9	58%	35%	4%	1%	17%	12%	18%	42%	30%
Lagos Island	9	100%	0%	0%	0%	0%	3%	51%	42%	4%
Lagos Mainland	6	66%	16%	6%	0%	12%	45%	41%	8%	4%
Mushin	17	96%	4%	0%	0%	0%	4%	82%	13%	1%
Ojo	17	87%	2%	6%	0%	5%	55%	19%	22%	4%
Oshodi-Isolo	9	96%	8%	0%	0%	0%	20%	54%	23%	11%
Shomolu	8	44%	46%	16%	3%	1%	33%	48%	24%	1%
Surulere	11	100%	0%	0%	0%	0%	6%	35%	60%	0%
TOTAL	**181**	**82%**	**12%**	**4%**	**1%**	**3%**	**19%**	**37%**	**33%**	**13%**

ANNEX F4. LGA-by-LGA Analysis of Building Materials from Household Survey

FLOOR	Agege	Ajeromi-Ifelodun	Alimosho	Amuwo-Odofin	Apapa	Eti-Osa	Ifako-Ijaiye	Ikeja	Kosofe	Lagos Island	Lagos Mainland	Mushin	Ojo	Oshodi-Isolo	Shomolu	Surulere	TOTAL
Cement	93%	73%	80%	56%	77%	29%	92%	75%	82%	96%	39%	99%	75%	96%	60%	89%	77%
Tiles	4%	10%	12%	11%	2%	0%	1%	5%	2%	3%	15%	0%	14%	2%	3%	11%	7%
Wood/Plank	2%	9%	3%	19%	20%	61%	0%	1%	13%	1%	42%	0%	4%	1%	22%	0%	11%
Mud	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Zinc	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Sand	1%	4%	2%	11%	0%	10%	7%	17%	4%	1%	3%	0%	5%	1%	15%	0%	4%
Rubble/ Garbage/ Sawdust	0%	2%	1%	1%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Rug	1%	1%	0%	1%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	1%	0%	0%
Carton	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Rubber tiles	0%	1%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Zinc	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Tarpaulin	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

WALLS	Agege	Ajeromi-Ifelodun	Alimosho	Amuwo-Odofin	Apapa	Eti-Osa	Ifako-Ijaiye	Ikeja	Kosofe	Lagos Island	Lagos Mainland	Mushin	Ojo	Oshodi-Isolo	Shomolu	Surulere	TOTAL
Cement block	92%	81%	90%	65%	79%	26%	99%	75%	86%	97%	51%	100%	86%	96%	65%	100%	82%
Wood/Plank	4%	12%	3%	14%	20%	36%	0%	13%	12%	2%	39%	0%	6%	3%	28%	0%	11%
Bamboo/Palm Fronds	0%	4%	0%	17%	1%	17%	0%	0%	1%	0%	5%	0%	4%	0%	6%	0%	3%
Mud	2%	0%	4%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Zinc	1%	2%	2%	4%	0%	12%	0%	7%	1%	1%	4%	0%	3%	1%	1%	0%	2%
Tarpaulin	1%	1%	1%	1%	1%	5%	1%	5%	1%	0%	0%	0%	1%	1%	0%	0%	1%
Nylon	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Iron	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%

ROOF	Agege	Ajeromi-Ifelodun	Alimosho	Amuwo-Odofin	Apapa	Eti-Osa	Ifako-Ijaiye	Ikeja	Kosofe	Lagos Island	Lagos Mainland	Mushin	Ojo	Oshodi-Isolo	Shomolu	Surulere	TOTAL
Zinc	86%	73%	75%	85%	82%	95%	58%	78%	76%	99%	94%	95%	76%	85%	93%	92%	83%
Asbestos	12%	10%	22%	3%	8%	0%	41%	10%	9%	0%	0%	1%	15%	14%	2%	4%	10%
Aluminium	0%	12%	0%	5%	2%	0%	0%	0%	10%	0%	0%	1%	7%	0%	0%	1%	3%
Bamboo/Palm Fronds	1%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Slate	0%	3%	0%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
No roof	0%	1%	1%	0%	2%	0%	0%	0%	3%	0%	1%	0%	0%	0%	1%	0%	0%

	Agege	Ajeromi-Ifelodun	Alimosho	Amuwo-Odofin	Apapa	Eti-Osa	Ifako-Ijaiye	Ikeja	Kosofe	Lagos Island	Lagos Mainland	Mushin	Ojo	Oshodi-Isolo	Shomolu	Surulere	TOTAL
Cement block	0%	1%	1%	0%	0%	0%	0%	2%	0%	0%	0%	1%	0%	1%	0%	0%	0%
Nylon	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other	0%	0%	0%	0%	1%	0%	1%	0%	1%	0%	0%	0%	0%	0%	0%	1%	0%
Wood/Plank	1%	0%	1%	3%	1%	1%	0%	0%	1%	1%	6%	2%	0%	1%	5%	2%	1%
Net	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%
Tarpaulin	1%	0%	1%	2%	1%	3%	0%	9%	0%	0%	0%	0%	1%	0%	0%	0%	1%

WINDOWS	Agege	Ajeromi-Ifelodun	Alimosho	Amuwo-Odofin	Apapa	Eti-Osa	Ifako-Ijaiye	Ikeja	Kosofe	Lagos Island	Lagos Mainland	Mushin	Ojo	Oshodi-Isolo	Shomolu	Surulere	TOTAL
Glass	55%	51%	70%	32%	37%	20%	89%	54%	61%	61%	23%	60%	57%	70%	58%	79%	55%
Plastic	1%	1%	0%	1%	4%	0%	0%	0%	2%	2%	3%	1%	0%	0%	1%	2%	1%
Wood	38%	38%	22%	56%	58%	66%	10%	41%	33%	36%	70%	37%	34%	30%	36%	18%	38%
Net	4%	6%	5%	2%	0%	0%	0%	1%	1%	2%	1%	1%	2%	0%	1%	0%	2%
Nylon	0%	0%	0%	1%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
No material	0%	2%	1%	5%	1%	4%	0%	1%	2%	0%	1%	1%	4%	0%	4%	1%	2%
No window	2%	1%	1%	0%	0%	3%	0%	1%	1%	0%	0%	0%	1%	0%	1%	0%	1%
Tarpaulin	0%	0%	0%	1%	0%	2%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Zinc	0%	1%	2%	1%	0%	0%	0%	1%	0%	0%	3%	0%	2%	1%	0%	0%	1%
Aluminium	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%

Annex G. LGA breakdown of stationary carbon emissions in Lagos informal settlements

LGA	Median Electricity / Lighting Co2e kg per HH per year*	Median Cooking CO2e (kg per HH per year)*	Median Total CO2e (tons per HH per year)	Avg Total CO2e (tons per person per year)
Agege	139.64	262.02	0.14	0.02
Ajeromi Ifelodun	134.90	637.41	0.89	0.15
Alimosho	183.08	393.02	0.74	0.13
Amuwo Odofin	95.88	655.04	1.21	0.21
Apapa	95.88	625.82	0.77	0.13
Eti Osa	0.00	655.04	0.79	0.13
Ifako Ijaiye	271.25	894.91	1.19	0.20
Ikeja	166.14	232.80	0.51	0.09
Kosofe	283.78	524.03	1.05	0.18
Lagos Island	939.91	786.05	1.72	0.29
Lagos Mainland	91.54	859.04	1.29	0.22
Mushin	234.12	465.60	1.03	0.18
Ojo	332.68	280.98	1.07	0.18
Oshodi Isolo	204.20	564.83	0.95	0.16
Shomolu	178.67	576.42	0.91	0.15
Surulere	276.71	465.60	0.97	0.17
All LGAs	**178.67**	**524.0**	**0.92**	**0.16**

*HH = household. * See underlying breakdowns of cooking and electricity at G1 and G2.*

ANNEX G1. LGA-by-LGA Analysis / Breakdown of GHG Emissions from Cooking

LGA	Mean HH LPG kg CO2 per year	Mean HH Kerosene kg CO2 per year	Mean HH Charcoal kg CO2 per year	Mean HH Total Cooking CO2 (kg per year)	Median HH Total Cooking CO2 (kg per year)	Median Cooking CO2 (kg per person per year)
Agege	357.11	510.93	1699.67	610.79	262.02	44.79
Ajeromi Ifelodun	417.24	634.61	1698.44	888.84	637.41	108.96
Alimosho	479.88	614.38	1133.27	629.66	393.02	67.18
Amuwo Odofin	854.61	1129.38	2485.36	1422.40	655.04	111.97
Apapa	279.42	659.07	1564.17	673.20	625.82	106.98
Eti Osa	438.07	1137.61	921.32	823.50	655.04	111.97
Ifako Ijaiye	564.01	695.70	730.18	1053.33	894.91	152.98
Ikeja	261.06	488.76	816.09	338.79	232.80	39.80
Kosofe	432.33	707.44	589.82	696.87	524.03	89.58
Lagos Island	1013.84	1262.04	1088.12	1359.29	786.05	134.37
Lagos Mainland	675.20	1014.05	1042.11	1211.93	859.04	146.84
Mushin	293.00	895.40	991.36	746.00	465.60	79.59
Ojo	425.05	806.32	1468.96	689.25	280.98	48.03
Oshodi Isolo	480.54	599.88	1010.06	825.18	564.83	96.55
Shomolu	213.35	740.79	1116.75	676.82	576.42	98.53
Surulere	334.25	963.94	1426.26	819.86	465.60	79.59
ALL LGAs HH	**451.25**	**800.69**	**1301.89**	**829.10**	**524.0**	
ALL LGAs PP	**77.11**	**136.82**	**222.46**			**89.58**

ANNEX G2. LGA-by-LGA Analysis of GHG Emissions from Lighting/Electricity

LGA	Mean Generator kg CO2e per HH per year	Median Public Electricity kg CO2e per HH per year*	Median Total Electricity / Lighting Co2e kg per HH per year	Median Electricity / Lighting CO2e Per Person (kgs per person per year)
Agege	1628.79	349.03 / 125.67	139.64	23.87
Ajeromi Ifelodun	2455.12	261.8 / 122.38	134.90	23.06
Alimosho	1904.59	349.03 / 144.94	183.08	31.30
Amuwo Odofin	6531.39	0.00 / 51.55	95.88	16.39
Apapa	2134.84	174.5 / 95.88	95.88	16.39
Eti Osa	2008.26	0.00 / 0.00	0.00	0.00
Ifako Ijaiye	2491.97	349.00 / 186.70	271.25	46.37
Ikeja	1649.32	401.4 / 161.32	166.14	28.40
Kosofe	2530.74	349.00 / 196.25	283.78	48.51
Lagos Island	4590.32	1047.1 / 610.22	939.91	160.67
Lagos Mainland	3304.04	209.4 / 87.13	91.54	15.65
Mushin	5918.42	523.5 / 222.75	234.12	40.02
Ojo	2824.41	174.5 / 160.60	332.68	56.87
Oshodi Isolo	2103.08	322.90 / 158.99	204.20	34.91
Shomolu	3845.89	314.10 / 161.56	178.67	30.54
Surulere	5168.33	436.30 / 272.94	276.71	47.30
ALL LGAs HH	**2813.78**	**524 / 151.69**	**178.67**	
ALL LGAs PP	**480.80**	**89.58 / 25.93**		**30.54**

In each cell, the first number presented includes the result of calculating via the bill-based methodology (mean) and the second is the load-inventory methodology (median). As discussed further above, after full consideration we adopt the second number as more representative.