SCALING UP SUSTAINABLE COOLING IN NIGERIA'S NATIONALLY DETERMINED CONTRIBUTION

NIGERIA AIR CONDITIONERS' MARKET ASSESSMENT

November 2023

Clean Cooling COLLABORATIVE

U4E United for Efficiency

UN environment programme

Published by:

Energy Commission of Nigeria

Technical Support:

United Nations Environment Programme - United for Efficiency

Financial support:

Clean Cooling Collaborative

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Abuja, Nigeria, October 2023

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Acronyms

ACs	Air Conditioners
BEEG	Building Energy Efficiency Guideline
BSRIA	Building Services, Research and Information Association
CCC	Clean Cooling Collaborative
CIF	Cost, Insurance and Freight
CLASP	Collaborative Labeling and Appliance Standards Program
COP	Conference of Party
CSOs	Civil Society Organisations
DCC	Department of Climate Change
ECN	Energy Commission of Nigeria
ECOWAS	Economic Community of West African State
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
EER	Energy Efficiency Ratio
FBU	Fully Built Unit
FCCPC	Federal Competition and Consumer Protection Commission
FGN	Federal Government of Nigeria
FMENV	Federal Ministry of Environment
GEF	Global Environment Facility
GIZ	German International Cooperation Agency
GWP	Global Warming Potential
HPZ	Haier Paterson Zochonis
HVAC	Heating, Ventilation and Air Conditioning
ICREEE	Inter-Ministerial Committee on Renewable Energy and Energy Efficiency
IRP	Integrated Resource Plan
JRAIA	Japan Refrigeration and Air Conditioning Industry Association
K-CEP	Kigali Cooling Efficiency Programme
MAN	Manufacturers Association of Nigeria
MEPS	Minimum Energy Performance Standards
MVE	Monitoring, Verification and Enforcement
NARAP	National Association of Refrigerators and Air Conditioners Practitioners
NBS	National Bureau of Statistics
N-CAP	National Cooling Action Plan
NCCC	National Council on Climate Change
NCS	Nigerian Custom Services
NDC	Nationally Determined Contribution
NEP	National Energy Policy
NERC	Nigerian Electricity Regulatory Commission
NESP	Nigerian Energy Support Programme
NESREA	National Environmental Standards and Regulations Enforcement Agency
NOO	National Ozone Office
NREEEP	National Renewable Energy and Energy Efficiency Policy
ODS	Ozone Depleting Substance
RAC	Refrigeration and Air Conditioning
SE4ALL	Sustainable Energy for All
U4E	United for Efficiency
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Chapter 1: Introduction

Nigeria, the largest cooling market in Africa and one of the fastest growing in the world[1], has witnessed a surge in demand for air conditioning (AC) systems due to its expanding population and robust economic growth. However, this surge in air conditioner usage has had a significant impact on national electricity consumption, particularly in countries with relatively hot climates like Nigeria, where it is already one of the major consumers of electricity. The Nigerian government has identified it as one of the appliances that have high potential to reduce energy demand at the national and consumer levels. In this sense, the Nigerian government with the support of the Global Environment Facility (GEF), UNDP and GIZ between 2011 and 2017, conducted a study on the refrigeration and air conditioners market, resulting in the publication of air conditioners minimum energy performance standards (MEPS) by the Nigerian Government in 2017. Despite the publication of these standards in 2017, the MEPS were scarcely implemented.

In 2022, the Nigerian government developed the National Cooling Action Plan (N-CAP). The N-CAP proposed actions to be taken nationally to improve energy efficiency and reduce GHG and ODS emissions in the Refrigeration and Air Conditioning (RAC) sector through the use of coherent policies. It provides the pathway for the country to lower the indirect and direct emissions in the cooling sector through the enforcement of energy efficiency policies and regulations and the phasedown of global warming potential (GWP) refrigerants and foam blowing agents. It proposed the review of the current MEPS for air conditioning appliances to more stringent limits and the enforcement of the regulations. It further recommended the adoption of the Seasonal Energy Efficiency Ratio (SEER) metric to define the energy efficiency requirements for the air conditioners (ACs) MEPS and labels, replacing the current Energy Efficiency Ratio (EER) metrics. To achieve these recommendations will require the engagement of relevant stakeholders as well as engaging predetermined national procedures. However, the process of achieving these recommendations is not discussed in the N-CAP document. Furthermore, during the development of the N-CAP, it was not feasible to gather significant data from the air conditioner market in Nigeria due to several challenges.

To address the gaps identified in the N-CAP report and effectively implement energy efficiency policies for ACs in Nigeria, the Energy Commission of Nigeria (ECN), with technical support from the United Nations Environment Programme (UNEP) and United for Efficiency (U4E), is implementing a project titled "Scaling Up Energy-Efficient and Climate-Friendly Cooling in Nigeria's NDC Revision". Funded by the Clean Cooling Collaborative (CCC), this project aims to accelerate the adoption of energy-efficient ACs with climate-friendly refrigerants, aligning with Nigeria's climate targets in the Nationally Determined Contributions (NDCs).

In pursuit of this objective, this report presents a comprehensive market assessment for air conditioners (ACs) in Nigeria, conducted within the framework of the Project "Scaling Up Energy-Efficient and Climate-Friendly Cooling in Nigeria's NDC Revision". This assessment encompasses the collection of essential technical and market data, including energy efficiency levels, cooling capacities, AC types, prices, market size, key market players, and more. This assessment will empower policymakers and regulators to make informed decisions for updating the MEPS and energy label policies that deliver cost-effective energy savings while considering factors like product availability, affordability, and a stable supply chain. It will also serve as a baseline for measuring the regulation's impact once enforcement begins for the

[1] https://united4efficiency.org/wp-content/uploads/2021/06/U4E_FACT-SHEETS_NIGERIA_2022-01-28.pdf

recommended MEPS and labels. This report does not include recommendations for new MEPS and label regulations, it will be published in a separate document.

The assessment is focused on room air conditioners imported, manufactured or assembled in Nigeria. The assessment covers the collection of room air conditioners market data and information from manufacturers/assemblers, major importers and distributors as well as relevant Ministries, Department and Agencies (MDAs) excluding end-users.

Chapter 2: Methodology for the AC Market Assessment

This Chapter presents the methodology used for conducting the AC market assessment, including the study approach (Section 2.1), which outlines the general approach employed to collect data from various stakeholders in the air conditioning sector, and the detailed data collection process (Section 2.2).

2.1 Study Approach

To conduct the AC market assessment, a comprehensive approach was employed, combining desk reviews, field surveys, and the use of semi-structured questionnaires to conduct interviews with stakeholders in the air conditioning sector. These stakeholders include local AC manufacturers, major importers, distributors, retailers, and relevant MDAs. The study relied on both primary and secondary data sources. Prior to data collection, a wide range of key stakeholders were identified including members of the Projects National Technical Committee (NTC). The NTC includes government agencies like the Nigerian Customs Services (NCS), National Bureau of Statistics (NBS), Federal Ministry of Environment (Department of Climate Change), National Ozone Office (NOO), National Council on Climate Change (NCCC), Standards Organisation of Nigeria (SON), National Environmental Standards and Regulations Enforcement Agency (NESREA), and the Federal Competition and Consumer Protection Commission (FCCPC). The non-state members of the NTC are the Manufacturers Association of Nigeria (MAN) and Nigeria Association of Refrigerators and Air Conditioner Practitioners (NARAP).

2.2 Data Collection

The data collection process employed a multifaceted approach, including both primary and secondary research methods. The primary research phase encompassed the following strategies:

- Bilateral Consultative Meetings with Government Agencies: Engaged in constructive discussions and consultations with relevant government agencies.
- On-Site Visits and Questionnaires: Conducted on-site visits and administered questionnaires to local air conditioner manufacturers, major importers, and Civil Society Organizations (CSOs) in key cities such as Lagos, Port-Harcourt, and Abuja.
- On-Site Visits to Distributors and Retailers: Conducted on-site visits to distributors and retailers specializing in air conditioners in Lagos, Port-Harcourt, and Abuja.
- Utilization of National Shipment Database: Leveraging the National Shipment Database to gather valuable insights.

The visited cities for the on-site work were strategically selected due to their high population density and their representation of major business hubs within Nigeria for the air conditioning sector. The secondary research phase involved the following approaches:

- Review of Project Documents and Online Resources: Thoroughly examined project-related documents and conducted extensive research on online resources.
- Review of Existing Laws, Regulations, and Standards: Evaluated existing laws, regulations, and standards related to energy efficiency and low GWP refrigerants, particularly in the context of air conditioners.

The subsequent subsections provide more in-depth insights into the primary and secondary research strategies.

2.2.1 Primary Research

Primary data for the assessment was collected to understand the current market scenario and emerging trends. Well-structured questionnaires were designed and underwent a rigorous review and piloting process to ensure their applicability. These questionnaires were then administered to various stakeholders, including local manufacturers and importers, retailers, and government agencies such as the National Bureau of Statistics and Nigeria Customs Service.

For local manufacturers and importers, the questionnaires aimed to gather the following key information:

- Details about the various air conditioner models being offered in the Nigerian market, including model names/serial numbers, brands, types, countries of origin, annual sales volume, rated cooling capacity, energy efficiency levels (EER and SEER), energy consumption, refrigerant type, compressor technology (fixed or variable speed), pricing, etc.
- Information about their laboratory testing infrastructure and distribution channels, as well as other market practices used by the companies.

In addition to the questionnaires, face-to-face, in-depth interviews were conducted with the local manufacturers and importers in Lagos, Port-Harcourt, and Abuja. Responses were received from one importer and five local manufacturers, accounting for information for 57 different models introduced into the market between 2015 and 2022.

Regarding retailers and distributors, the Project Team directly visited shops to collect data on the available air conditioner models. The type of information gathered for the different air conditioners models closely mirrored the data sought from local manufacturers and importers. In total, over 50 shops were visited, and information was collected on 163 air conditioner models from 38 different brands. In cases where information was missing, efforts were made to supplement it by conducting online research.

Lastly, in interactions with the National Bureau of Statistics and Nigeria Customs Service, a similar questionnaire was employed to obtain details about the characteristics and quantities of imported air conditioners between 2015 and 2022. However, the databases of these institutions primarily record basic data, such as the imported weight of different Harmonized System (HS) Codes corresponding to various types or parts of air conditioners. This data was used to estimate the size of the air conditioner market in Nigeria.

2.2.2 Secondary Research

Secondary data was sourced from various sources, including national and international AC-related databases, local laws and regulations, market intelligence reports, manufacturer product brochures, articles from leading magazines and journals, and other pertinent reports. The study also utilized desk-top research and literature review of existing national and international data sources (publications from BSRIA, JRAIA, CLASP and Euromonitor websites; used the U4E-developed and ECN-approved Market Assessment template). The data and information found was reviewed and used to complement the primary data.

Chapter 3: Policy Mapping

The Nigerian government has introduced several key policies to address energy efficiency and conservation while meeting the energy demands of its citizens. This chapter provides a summary of these policies relevant to energy efficiency and refrigerant regulations for air conditioners.

3.1 MEPS and Energy Efficiency Labels for Room Air Conditioners in Nigeria

The Nigerian Energy Support Programme (NESP) supported the national process to develop MEPS for air conditioning appliances in Nigeria. The process lasted from 2015 to 2017 and resulted in the establishment of the National Industrial Standard NIS 943:2017 – *Minimum Energy Performance Standards and Labels for Air Conditioners*. However, with development of a regional MEPS by ECOWAS countries, Nigeria swiftly integrated these regional standards into its framework, giving rise to NIS ECOSTAND 071-2:2017EE – *Minimum Energy Performance Standards - Part 2: Air Conditioning Products*. This new standard replaces the NIS 943:2017, which becomes technically obsolete.

The standard covers the requirements for domestic and commercial air conditioners up to 20 kW, encompassing portable units, unitary systems, split systems, and centralized air conditioning systems that are manufactured, assembled, imported or sold in Nigeria. The standard does not apply to air conditioning systems using non-electric energy sources or that are not reliant on alternating current. Energy efficiency is assessed using the Energy Efficiency Ratio (EER), calculated as the cooling capacity divided by input power under standardized conditions (35°C ambient temperature). The standard mandates that all air conditioning systems within its purview must meet a minimum EER requirement of 2.8, prohibiting those below this threshold from entering the Nigerian market. Furthermore, air conditioners intended for sale in Nigeria must prominently display an energy label, providing consumers with crucial information about their energy performance characteristics.

3.2 National Cooling Action Plan

The National Cooling Action Plan (N-CAP, 2020) was developed through series of stakeholders' engagements and surveys by the Federal Ministry of Environment, through the National Ozone Office of the Ministry. The aim of the N-CAP is to mitigate the indirect greenhouse gas (GHG) emissions associated with electricity use for powering cooling equipment and direct GHG emissions and ozone-depleting substances (ODS) associated with the refrigerants used. It identifies potential energy demand reduction, energy efficiency interventions, the transition from high to low GWP refrigerants, and proposes a timeline for the implementation of these actions in an integrated approach. It proposed the appropriate framework to enforce minimum energy performance standards (MEPS) and labelling scheme for RAC equipment, being one of the major contributors to carbon emissions and energy consumption.

Within the framework of the ongoing project, "Scaling Up Energy-Efficient and Climate-Friendly Cooling in Nigeria's NDC Revision" an additional report called 'Complementary N-CAP Report' has been developed. This report summarizes the main recommendations of the N-CAP report, such as the implementation of the Season Energy Efficiency Ratio (SEER) metric instead of the current Energy Efficiency Ratio (EER); identifies the main gaps; and propose the needed actions to fill the gaps and to successfully implement the energy efficiency policies for the air conditioners, for instance, by conducting this market assessment.

3.3 National Energy Policy

The NEP[2] was approved by the Federal Government in 2003 and launched by the President in 2005, represented a pioneering move by the Nigerian government to prioritize energy efficiency, resource diversification, and environmental responsibility. It aimed to bolster economic contributions from energy-based industries, ensure reliable and eco-friendly energy supplies, and foster energy efficiency and conservation through codes, standards and guidelines that apply to domestic appliances, and agricultural and industrial equipment. The policy also stated that the government will put in place the necessary regulations and codes to promote energy efficiency in buildings. Furthermore, the NEP stated the need to strengthen appropriate institutional arrangements and provide incentives for the promotion and monitoring of energy conservation and use of energy-efficient methods. A revised version of the NEP was developed in 2018 and approved in 2022. The overall objective of the revised NEP is to optimally utilize Nigeria's energy resources in an environmentally sustainable manner to pursue sustainable development with the active participation of the private sector. The revised NEP encourages the use of MEPS and mandatory labeling as regulatory instruments to reduce the energy consumption of households' appliances. Furthermore, it proposes the adoption of end-users' incentives (economic, fiscal and financial) to adopt energy efficiency best practices and minimize wastages.

3.4 Nationally Determined Contribution

The 21st Session of the Conference of the Parties (COP21) of the United Nations Framework Convention on Climate Change (UNFCCC) was held in Paris in November and December 2015. A total of 195 participating countries including Nigeria negotiated and adopted the Paris Agreement. Nigeria developed the first NDC in 2015 as a follow up to the ratification of the Paris Agreement. The Paris Agreement includes objectives to reduce greenhouse gas emissions as soon as possible, to limit the global average temperature increase above pre-industrial levels to well below 2°C, and to pursue efforts to limit the increase to 1.5°C. The Paris Agreement, which entered into force on the 4th of November 2016, requires Parties to put forward their best efforts through "Nationally Determined Contributions" (NDCs). These NDCs represent targets and actions for the post-2020 period. The NDC provides a high-level and strategic vision for climate action in Nigeria. To contribute towards achieving these objectives in the Paris Agreement, the Nigerian NDC has set a target of reducing Nigeria's GHG emissions by 20% unconditionally and 47% with external support.

3.5 National Renewable Energy and Energy Efficiency Policy

The National Renewable Energy and Energy Efficiency Policy (NREEEP) was developed by an Inter-Ministerial Committee headed by the Federal Ministry of Power in 2015 to align sustainable energy growth with economic development. It sets the framework for actions to address the nation's challenges of access to modern and clean energy services as well as improve energy security and climate benefits. NREEEP sets targets for renewable energy and energy efficiency contributions to the energy mix, meeting or exceeding the targets set in the ECOWAS regional policies and emphasizes the importance of integrating these principles into state policies and attracting private investments. It further advances the need to develop national action plans for renewable energy and energy efficiency and set a time frame for implementation.

The policy recognizes energy efficiency as a cost-effective resource that can lead to savings, job creation, saving in energy bills, improve industrial competitiveness, and environmental protection. In this sense,

[2] Historically, the NEP was promoted by the Energy Commission of Nigeria (ECN)

NREEEP outlines initiatives to promote energy efficiency, including incentives to consumers, retailers and importers, awareness campaigns, and appliance replacement programs. The Federal Ministry of Power oversees policy implementation and sustainable financing for related projects. Finally, it stated the government's role of monitoring the progress being made in the adoption of energy efficiency best practices. The Ministry of Power was mandated by the NREEEP to develop an integrated resource plan (IRP) and to ensure the continuous monitoring and review of the implementation and effectiveness of the action plan prescribed by the Policy. Furthermore, it should also facilitate the establishment of a framework for sustainable financing of renewable energy and energy efficiency projects and programmes.

3.6 National Energy Efficiency Action Plan

The National Energy Efficiency Action Plan (NEEAP), approved by the National Council on Power (NACOP) in July 2016, is a follow-up policy document to the NREEEP developed primarily to achieve the SE4ALL goals through the gathering of data, exchanges and suggestions from various actors in the public and private sectors. The content of the NEEAP includes baseline data and information on energy efficiency activities and programmes in Nigeria. It also enumerated the barriers that will hinder the adoption of energy efficiency best practices in the country and suggested achievable energy efficiency targets as well as indicators based on national potentials and socio-economic assessments. The NEEAP also provided an overview of policy, regulations, laws, incentives and other measures to be implemented to achieve the set targets. The NEEAP identified the implementation of energy efficiency policies for air conditioners as high priority.

3.7 Sustainable Energy for All Action Agenda

The Sustainable Energy for All (SE4ALL) Initiative was launched by the UN Secretary General in 2011. The global objectives of the SE4ALL Initiative are to ensure universal access to modern energy services, double the rate of improvement in energy efficiency and double the share of renewable energy in the global energy mix by 2030. Premised on these objectives, national governments are expected to design and implement in-country actions to drive transformational change in the energy sector as well as create the right investment environment for private sector participation. Furthermore, to achieve these objectives, national governments are expected to engage the civil society organizations to identify, advocate and monitor public policy and business actions; mobilize social innovation and grassroots actions; take the lead in behavioral change; and helping to create awareness on best practices and capacity development of stakeholders in partnership with businesses.

Regarding energy efficiency actions, the Nigeria's SE4ALL Action Agenda aims to put in place the regulatory framework and a coordinating group for the implementation and administration of energy efficiency programmes arising from the NREEEP, such as MEPS and efficiency labels, including a monitoring, verification and enforcement policy to facilitate its implementation. The SE4ALL AA stipulated that the management of the actions proposed in the document will be built on existing structure of the already established Inter-Ministerial Committee on Renewable Energy and Energy Efficiency (ICREEE). Consequently, it advanced the need for the Federal Government to establish the SE4ALL Secretariat which will be domiciled in the Federal Ministry of Power, the focal point of the country's SE4ALL activities.

3.8 Building Energy Efficiency Guidelines for Nigeria

The Building Energy Efficiency Guidelines (BEEG) was developed by the Federal Ministry of Power, Works and Housing in partnership with the Nigeria Energy Support Programme (a programme funded by the GIZ and the European Union). The aim of the BEEG is to provide practical advice to professionals on how to design, construct and operate more energy efficient buildings. The other objectives of the BEEG are to

educate the public on energy efficiency measures and provides intended users with the information that will help them choose energy efficient buildings. The Guidelines are designed to create awareness of the energy consumption in the buildings sector and the potentials for improvement; understand the importance of energy efficiency and the goals that should be set for Nigeria; and show possibilities to implement energy efficiency in the building sector. The Guidelines is complemented by case studies where different building energy efficiency packages have been modified and compared to identify optimal solutions for Nigerian climatic conditions.

3.9 National Building Energy Efficiency Code

The National Building Energy Efficiency Code (BEEC) specifies a set of minimum standards for new buildings in Nigeria to achieve reduction in energy use, leading to savings and a reduction in the GHG emissions over the life of the building. By implementing this code, it is expected to save 40% of current energy usage in buildings. The process to develop the BEEC was initiated by the Housing Sector of the Federal Ministry of Power, Works and Housing and supported by the Nigeria Energy Support Programme (NESP). The BEEC will complement the existing National Building Code, contributing to ensure stable electricity availability and implement energy efficiency in the building sector in conformity with the overarching energy efficiency policy. Once the BEEC enters into force, it shall be voluntary for a period up to a maximum of two years to allow for an adoption and inception phase. At the end of two years after adoption, the competent authority shall then make the requirement of the BEEC mandatory. Elements addressed in the BEEC include the process of developing a labelling and incentive scheme, procedures for control and enforcement of the minimum energy efficiency requirements, and finally recommendations on calculation and compliance tools.

3.10 Refrigerant Policies

Regarding emission due to the refrigerants, the Federal Government of Nigeria (FGN) ratified the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer. Since becoming Party to the Montreal Protocol, and through the assistance from the Multilateral fund, the FGN has over the years implemented Ozone Depleting Substance (ODS) phase out projects. Furthermore, during the 28th meeting of parties to the Montreal Protocol in Kigali in November 2016, Nigeria and other parties to the Montreal Protocol recognized the importance of promoting energy efficiency while transiting from high global Warming Potential (GWP) refrigerants to low GWP alternatives. This led to the amendment to the Montreal Protocol which has since been adopted and ratified by the Nigerian Government.

Chapter 4: Key Stakeholders

This chapter presents the list of identified key stakeholders involved in the energy efficiency program for air conditioners and their respective roles. These stakeholders are categorized into three distinct groups:

- Public Agencies and Institutions
- Civil Society Organizations (CSOs)
- Private Institutions

4.1 Public Agencies and Institutions

Standards Organization of Nigeria (SON)

The Standard Organization of Nigeria (SON) is a federal government entity tasked with the responsibility of ensuring that all products (imported and manufactured in Nigeria) adhere to stipulated standards. One function of the SON is to develop Nigerian Industrial Standards and ensure the compliance of products and methods with such standard. SON also assesses the conformity of imported products in the port of origin (pre-shipment verification). In this sense, SON will be a central institution on the implementation and enforcement of the air conditioner MEPS and labeling scheme in Nigeria.

Nigeria Customs Service (NCS)

The Nigeria Customs Service (NCS) is the government agency charged with major responsibility for controlling all cargo and goods entering, exiting or transiting through Nigerian territory. The NCS has a role in protecting Nigerian society and also securing international trade. In this regard, the NCS is responsible for policing the Nigerian border to ensure that only ACs that conform with national standards are allowed into the country. The NCS will help to enforce energy efficiency policies and regulations, especially along the Nigerian territory.

National Environmental Standards and Regulation Enforcement Agency (NESREA)

NESREA is mandated to carry out enforcement of environmental standards, regulations, rules, laws, policies and guidelines. They will work with SON and other stakeholders to ensure proper implementation of the MEPS and labelling scheme.

National Ozone Office (NOO)

The National Ozone Office (NOO) is under the Department of Pollution Control in the Federal Ministry of Environment. NOO is the focal point for the implementation of the Montreal Protocol in Nigeria. They will provide support on the implementation of energy efficiency policies in Nigeria.

National Bureau of Statistics (NBS)

NBS is a Federal Government of Nigeria agency responsible for collecting, compiling, analyzing, interpreting, publishing and disseminating statistical information relating to the socio-economic life and conditions of the people of Nigeria. They will constantly provide useful data for the analysis of the air conditioner market in Nigeria.

Federal Ministry of Environment -Department of Climate Change (DCC)

The Federal Ministry of Environment (FMENV) was established to protect the environment against pollution and degradation and to ensure the conservation of natural resources for sustainable development in Nigeria. The DCC has 4 divisions, (Vulnerability and Adaptation; Green House Gases; Mitigation; and Education, Awareness and Outreaches) most of the divisions will play a major role in promoting energy efficiency for air conditioners in Nigeria.

Federal Ministry of Industry, Trade and Investment (FMITI)

FMITI has the mission to create an economic environment in Nigeria that attracts investments, advances the industrialization process and expands trade and export in order to strengthen the domestic economy. Among other sectors the FMITI supervises products, processes and companies in the energy industry and supports and enacts renewable energy and energy efficiency measures. The Standards Organization of Nigeria is one of the key parastatals under this Ministry.

Federal Competition and Consumer Protection Commission (FCCPC)

The agency's role is to promote fair, efficient and competitive markets in the Nigerian economy and to also facilitate access by all citizens to safe products and secure the protection of rights for all consumers in Nigeria. The agency organizes and undertakes campaigns and other forms of activities that will lead to increased public consumer awareness. It encourages trade, industry and professional associations to develop and enforce in their various fields quality standards designed to safeguard the interest of consumers. In terms of energy efficiency of ACs, the agency can collaborate with state-level consumer organizations, and play a major role for education and market surveillance/enforcement activities among retail distribution channels.

National Council on Climate Change

Established by the Climate Change Act 2021 to formulate appropriate policies and other mechanisms for achieving low Green House Gas (GHG) emissions, including green growth and sustainable economic development for Nigeria.

Nigerian Electricity Management Services Agency (NEMSA)

The Nigerian Electricity Management Services Agency (NEMSA) was established by the NEMSA Act:2015 to carry out the functions of enforcement of technical standards and regulations, technical inspection, testing and certification of all categories of electrical installations, electricity meters, and instruments, to ensure the efficient production and delivery of safe, reliable and sustainable electricity power supply and assure safety of lives and property in the Nigerian Electricity Supply Industry (NESI), and other Allied Industries/Workplaces. They will work with SON and other stakeholders to ensure proper implementation of the MEPS and labelling scheme.

Project Technical Committee

The technical committee comprises the following agencies: NOO, NBS, NCS, FMENV, NARAP, MAN and NCCC. They are charged with the responsibility of ensuring the success of the “Scaling Up Energy-Efficient and Climate-Friendly Cooling in Nigeria’s NDC Revision” project. It's important to note that this committee might differ from the one established by SON to review energy efficiency standards.

4.2 Civil Society Organizations (CSOs)

Manufacturers Association of Nigeria (MAN)

MAN has a mission to promote, in close cooperation with its members, other organs of the Organized Private Sector (OPS), the government and other stakeholders in the economy, an enabling environment for industrial development, growth and prosperity of the society at large. The association is a trade group that act as a platform that manufacturers use to influence economic, industrial, labor and social policy within Nigeria. They will provide continuous market insights on ACs brand manufactured in Nigeria and the contact of main manufacturers among other inputs.

Nigeria Association of Refrigerators and Air Conditioner Practitioners (NARAP)

NARAP is a professional association committed to promoting high-quality air conditioning installation services throughout Nigeria. It ensures that the installed air-conditioning is working properly and safely. They will keep providing trained professional technicians/installers for the ACs market in Nigeria.

E-waste Producers Responsibility Organisation of Nigeria (EPRON)

EPRON is a non-profit organization set up by electrical and electronic producers in Nigeria. It is the Producer Responsibility Organization set up to implement the Extended Producer Responsibility policy and ensure the environmentally sound management of electronic waste (e-waste) in Nigeria. The organization is set to provide a cost effective and transparent platform for fulfilling Producer obligation as well engaging all the players in the e-waste value chain (formal and informal collectors, recyclers, repairers). They will provide support on the implementation of energy efficiency policies in Nigeria.

4.3 Private Institutions

Main importers and manufacturers

They are responsible for sourcing the market with air conditioners. They hold a firsthand information about the characteristics of the air conditioners in the Nigerian market and are directly affected by the implementation of energy efficiency policies, having to undertake the design and testing of products in line with applicable policies.

Distributors/wholesalers/retailers

They are responsible for placing the products in the market. They will continuously provide insights on product's brand, type, technology in demand, prices, usage patterns across various segments, etc.

Chapter 5: Characteristics of the Nigerian Market for Air Conditioners

This chapter presents the main characteristics of the air conditioning market in Nigeria, such as distribution channels and main market players, the size of the market (number of sales) from 2015 to 2022; market share between local manufacturers and importers of new appliances, as well as other characteristics, such as installation practices and life expectancy of the air conditioners.

5.1 Distribution channels and main players of the AC market

Table 1 presents the distribution channels for air conditioners in Nigeria, listing key companies, trade types, affiliated AC brands, and the distribution channel to get to the final customer. The traditional marketing system is partially employed for air conditioners in Nigeria, where manufacturers typically operate independently of distributors, wholesalers, and retailers. In some instances, importers also take on the role of wholesalers. The prevailing distribution path for most brands of ACs involves manufacturers, distributors, wholesalers, retailers, and, ultimately, consumers. However, many manufacturers also leverage online sales and business-to-business (B2B) platforms.

Field data highlights the broad coverage of Nigeria's air conditioning market, with most companies serving all states, except for a few with more limited geographical presence. Alongside the brands in Table 1, additional brands were observed during shop visits conducted as part of this Market Assessment.

Manufacturers often collaborate with authorized distributors, typically numbering two or three. Although some manufacturers produce their own brands while also assembling brands from other companies, in other cases, manufacturers both assemble their own brand and serve as distributors for other brands. Distributors typically showcase air conditioners in branded showrooms, while wholesalers and retailers often display them alongside other appliances like gas cookers and televisions. Nationwide retailers play a pivotal role in determining product prices.

It is worth noting that the companies identified as local manufacturers are primarily assemblers, not producing key AC components like compressors and heat exchangers in Nigeria; instead, they import these parts as Completely Knocked Down (CKD) units and assemble them locally. Conversely, companies categorized as importers bring in complete air conditioners, known as Fully Built Units (FBUs). The Nigerian government encouraged local assembly of air conditioning units by setting significantly lower import duty (5%) for Completely Knocked Down (CKD) units as compared to 20% duty for Fully Built Unit (FBU). This has motivated several international AC manufacturing companies to set up assembly plants locally either through joint ventures or setting up local subsidiaries. Furthermore, as the importation of used appliances (Tokunbo) is not prohibited as long as the unit is in good working conditions, there are also importers of used air conditioners. Importers of used appliances are not identified in Table 1.

Table 1:Distribution Channels for Air Conditioners in Nigeria

Companies	Trade Type	Own ACs Brand	Other Brands Promoted	Distribution Channel
HPZ Limited	Manufacturer[3]	Haier Thermocool	None	Exclusive Showrooms, Modern Trade, Online, B2B and Traditional Trade
Daikin Nigeria	Manufacturer	Daikin	None	Distributors-Wholesalers-Retailers-Consumers
New Home Distribution Africa Ltd	Manufacturer	Scanfrost	Beko	Distributors-Wholesalers-Retailers-Consumers
Somotex Nigeria Limited	Manufacturer	Midea and Bruhm	None	Distributors-Wholesalers-Retailers-Consumers
Scott Integrated Business Services	Importer and Distributor	None	Several	Wholesalers – Retailers - Consumers
SIMS Nigeria Ltd	Manufacturer and distributor[4]	Royal	Samsung and Panasonic	Wholesalers-Retailers-Consumers
Jamara Operations Ltd	Importer and manufacturer	TCL and AEON	Not Known	Distributors- Wholesalers-Retailers- Consumers
Mandilas Nigeria	Importer and Distributor	Carrier	None	Wholesalers-Retailers-Consumers
Grand Product Co. Ltd	Importer and Distributor	Omaha	None	Wholesalers-Retailers-Consumers
Fouani Nigeria Ltd (LG)	Manufacturer	LG	Hisense	Distributors- Wholesalers-Retailers- Consumers
Sacral Assembling Ltd	Manufacturer	Kenstar	Panasonic	Distributors- Wholesalers-Retailers- Consumers
Skyrun International	Manufacturer	Skyrun	None	Distributors- Wholesalers-Retailers- Consumers
Panaserv	Distributor	None	Panasonic, Kenstar and Daikin	Wholesaler, Retailer and Consumer

Source: Nigeria AC Market Assessment, 2023

5.2 Size of the Nigerian market from 2015 to 2022

Nigeria does not have yet a product registration system with the number of commercialized air conditioners and their characteristics. In this sense, in order to estimate the size of the market, other sources need to be investigated. The size of the Nigerian market or number of sales of air conditioners were determined from data and information from National Bureau of Statistics (NBS)/Nigerian Customs on trade flow data on air-conditioners and its related parts imported into the country. They do not have information on the number of units being imported and their characteristics, they only have bulk numbers in weight and value classified according to the Harmonized System (HS) Codes for importation. The importation can be grouped using the 10 - digits of the HS Code as follows:

- **HS Code 8415101000:** This code is for **C**ompletely Knocked Down (**CKD**) Air Conditioners. These could be self-contained or "split system" air conditioners.

[3] The manufacturers import CKD parts and assembles them into complete ACs. All assemblers are termed manufacturers

[4] Distributes other brands in addition to its locally manufactured Royal brands

- **HS Code 8415100011:** Similar to the previous code. However, it specifies that they are produced by “Established Manufacturers”
- **HS Code 8415109000:** This code is for Fully Built Unit (**FBU**) Air Conditioners. These could be self-contained or "split system" air conditioners.
- **HS Code 8415100019:** This code is for other FBU air conditioners (also self-contained or "split system".
- **HS Code 8415901000**: This code covers parts of Air Conditioners that are intended for the Assembly Industry.
- **HS Code 8415909000**: This code covers parts of Air Conditioners that are Not intended for the Assembly Industry (spare parts to repair existing units).
- **HS Code 8415810000:** This code covers Air Conditioners that incorporate a Refrigerating Unit with a heating option (Reversible Heat Pumps Product).
- **HS Code 8415820000**: Other Air Conditioning Machine, with a Refrigerating Unit Product

While the available information does not provide specific details about air conditioner capacities, efficiency, or types of AC, it does provide valuable insights into both the market's size and the market share distribution between local manufacturers and importers. It is possible to obtain local manufacturing information from the import HS codes because most of the local manufacturers are in reality assemblers, meaning that they import the main part of the air conditioners as a CKD to be assembled in Nigeria in order to pay less taxes. To facilitate a comprehensive analysis of this data in relation to locally manufactured and imported air conditioners, the HS codes have been structured into three groups:

1. **Parts of ACs to be used by the local manufacturers**: This will include the codes 8415101000, 8415100011 and 8415901000, and will account for the air conditioners locally assembled.
2. **FBU imported Air Conditioners**: This will include the codes 8415109000, 8415810000, and 8415820000.
3. **Parts of ACs to be used as spare parts**: This will include the codes 8415909000.

The following sub-sections offer insights into the size of the air conditioning market in Nigeria by analyzing data sourced from the National Bureau of Statistics (NBS) and the Nigerian Customs Service.

5.2.1 Market size by weight

Figure 1 presents the weight of imported aforementioned groups: the components used by local manufacturers for air conditioner assembly in Nigeria, the fully built (FBU) air conditioners imported for sale within Nigeria, and the spare parts designated for maintenance. As expected, the imported spare parts represent a relatively smaller share when compared to the imported components used by local manufacturers. Notably, the weight of imported components destined for local assembly exceeds that of fully imported air conditioners (FBUs). It's worth highlighting that this disparity lessened in 2022, indicating that importers of FBUs regained market share over local manufacturers during that year. The highest volume of parts for local manufacturers was imported in 2019, the year preceding the COVID-19 pandemic. Even in 2020, despite a reduction in imports compared to 2019, it still exceeded pre-pandemic levels, and importation has been on an upward trajectory since then, particularly for FBUs, with imports in 2022 nearly doubling those seen prior to the pandemic.

It is important to note that part of the air conditioners imported or manufactured in Nigeria might be exported to other countries. However, the number of exports is considered small compared to the imports. In 2021, Nigeria exported air conditioners for the value of Five Million Naira (₦5,000,000), making it the

127th largest exporter of air conditioners in the world, and representing only 0.006% of the air conditioners imported and assembled in the country. In this sense, it can be concluded that most of the air conditioners imported as FBU and the ones assembled in the country will be commercialized in Nigeria.

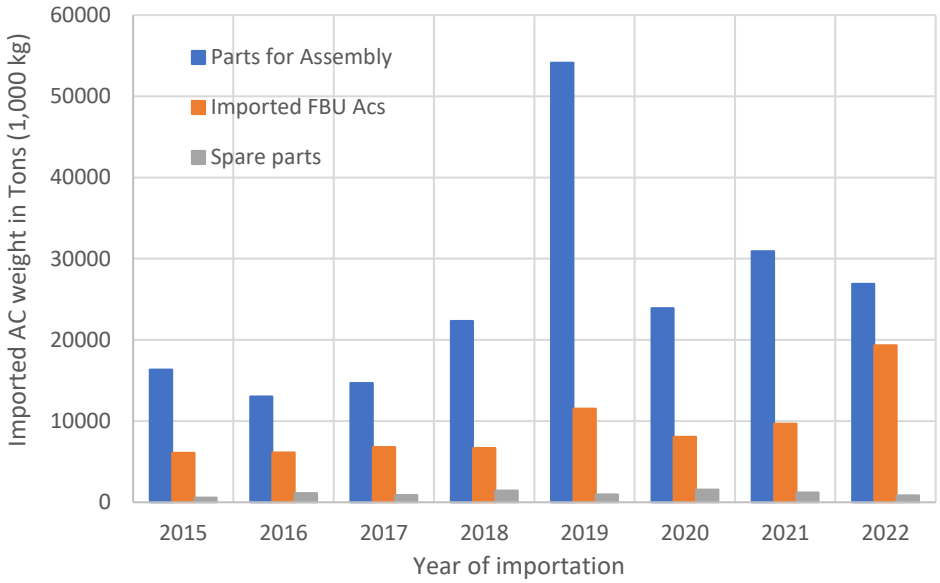

Figure 1: Nigeria annual import of parts of ACs to be used by the local manufacturers, imported CKD and FBU parts, and spare parts from 2015 to 2022

5.2.2 Market size by number of units' approximation and market share between importers and local manufacturers

Although the data from the National Bureau of Statistics (NBS) and Nigerian Customs lacks specific counts of imported air conditioners, we can derive approximations by assuming average weights for these units. Accordingly, with an estimated average weight of 55 kg per fully built (FBU) imported AC and roughly 41 kg per imported completely knocked down (CKD) parts to become a full air conditioner in the local manufacturer, we can approximate the annual sales figures for both locally manufactured and imported ACs. For locally assembled units, it was considered that the weight of the imported CKD parts corresponding to a complete AC is around 75% of the weight assumed for an FBU AC, as certain components, like the AC frame, may be sourced locally for assembly rather than imported as CKD units. Figure 2 provides an overview of the estimated annual sales of air conditioners in Nigeria, encompassing both imported and locally assembled units. This estimate of the market size aligns with projections from other studies, as illustrated in Figure 3, which incorporates data from BSRIA, JRAIA, and Euromonitor.

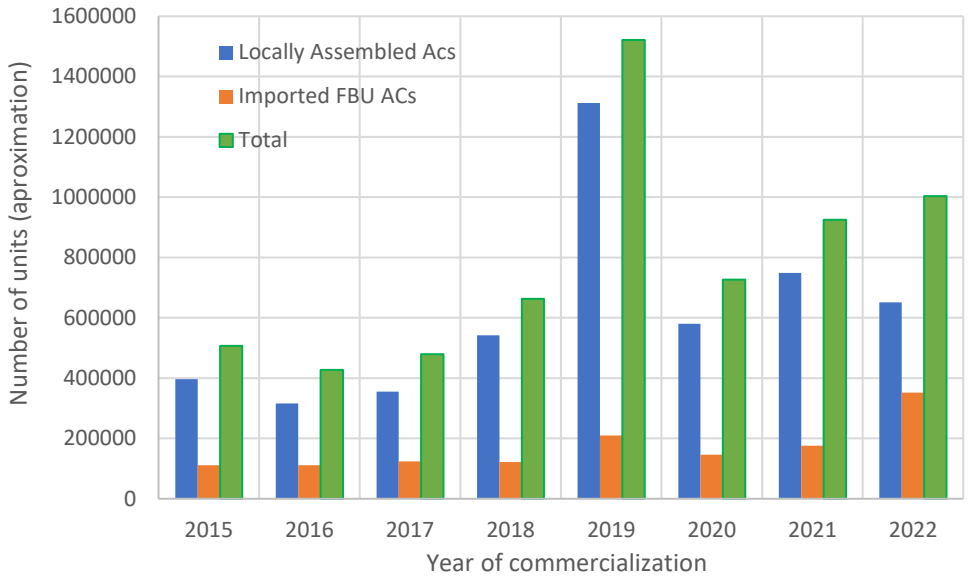

Figure 2: Number of Air Conditioning units commercialized in Nigeria. Estimation from the imported CDK (Locally Assembled) and the fully imported air conditioners (FBU).

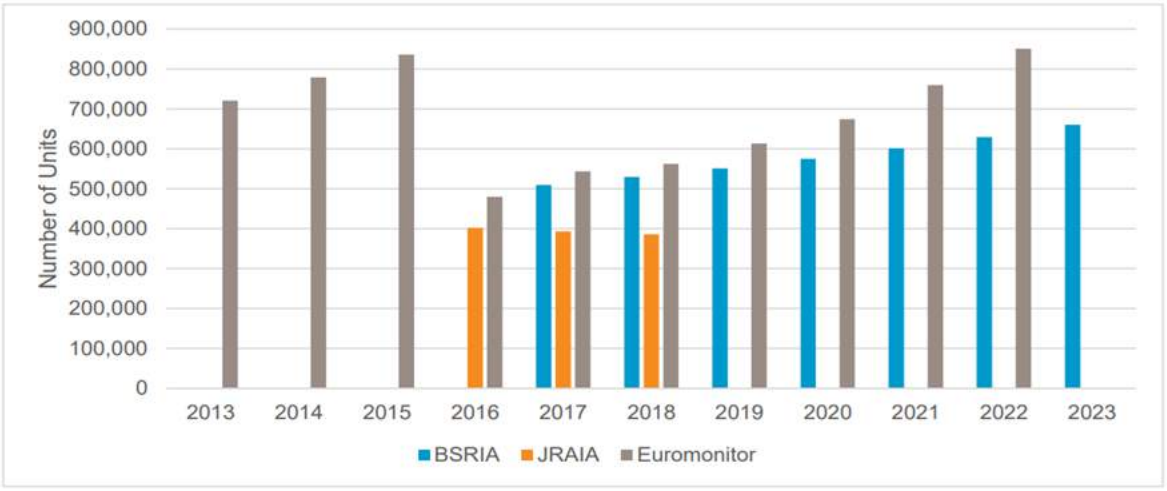

Figure 3: Nigeria Annual Market Size Projected to 2023 for single split air conditioners
Source: *CLASP, 2020*

It is worth noting that Figure 4 specifically focuses on the market size for single split air conditioners, while the estimation derived from the HS Codes encompasses all types of air conditioners, although split systems anticipated to constitute the majority. It is important to notice that these figures correspond to annual sales, rather than the overall penetration[5] of air conditioners in Nigerian households.

When comparing the estimated imported units and the locally assembled units obtained with the HS codes data, it is estimated that, on average, between 2015 and 2022, approximately 78% of the air conditioners sold in Nigeria were locally assembled, with the remainder imported as FBUs, as illustrated in Figure 4. This estimation is in the same order of magnitude of previous studies, such as the one from CLASP 2020,

[5] According to CLASP 2020, the market penetration of air conditioning in the residential market is estimated to be 20% for the year 2020 and it's expected to increase to 25% by 2023.

which estimates that 86% of the room air conditioner units sold in Nigeria are manufactured (or assembled) locally while the remaining 14% are imported as FBU.

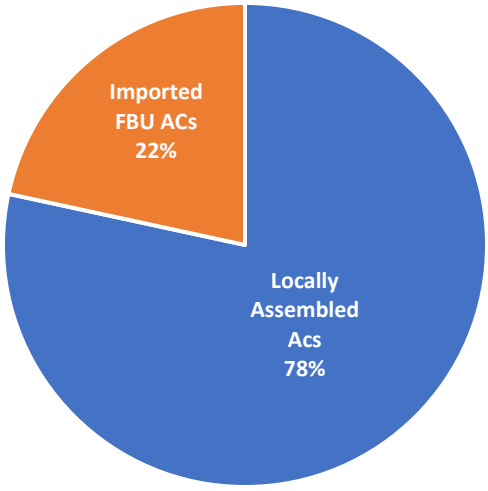

Figure 4: Market share between locally assembled ACs and the fully imported air conditioners (FBU) in Nigeria (average between 2015 to 2022)

5.2.3 Market size by value

Figure 5 shows the cost/value in millions of Naira for the three imported categories. The Value covered Cost, Insurance and Freight (CIF), and the values for years before 2022 have been adjusted to 2022 value with the annual inflation rates. The trend is similar to the imported weight presented in Figure 1. The market size in value of the imported FBU air conditioners and CKD parts in 2022 has been estimated as 85,000 million of Naira.

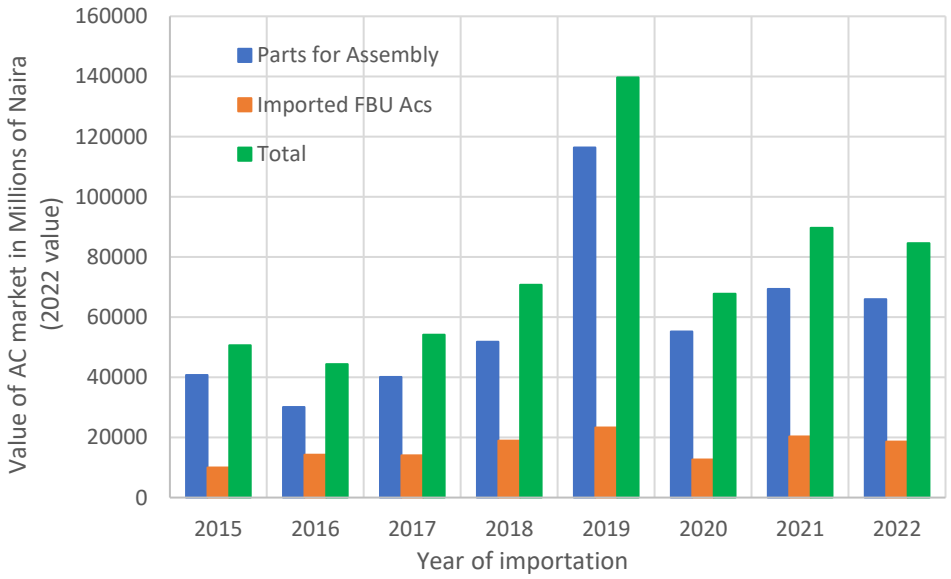

Figure 5: Nigeria Annual Import Value of parts of ACs to be used by the local manufacturers and complete imported FBU ACs. Values have been adjusted to year 2022 according to annual inflation rates

5.3 Source Countries for Air Conditioner Imports

Table 2 presents the imported weight of Fully Built Units (FBU)and Completely Knocked Down (CKD) parts intended for assembly in Nigeria, categorized by the country of importation for the year 2022. The majority of imports for FBU air conditioners originated from China and Malaysia, both of which are the world's largest AC manufacturing economies. In contrast, for CKD parts, over 96% of the imports came from China, with South Korea representing the second-largest importer, albeit accounting for only 2.1% of the CKD importations. This consistent pattern of dominant importers has been observed throughout the entire eight-year period from 2015 to 2022.

Table 2:Nigeria Import of FBU and CKD Air Conditioning Machine, Window/Wall - Types, Self-contained/"Split System" by Country, 2022

Countries	Total FBU 2022 (Kg)	Share of FBU by country (%)	Total CKD 2022 (Kg)	Share of CKD by country (%)
China	3,185,918	56.6	24,798,729	96.4
Malaysia	1,594,519	28.3	14,688	0.1
India	65,739	11.7	136,403	0.5
Hong Kong	61,369	1.1	85,222	0.3
United Arab Emirates	37,632	0.7	45,729	0.2
Italy	28,497	0.5	745	0.0
Spain	16,692	0.3	500	0.0
France	9,268	0.2	300	0.0
South Korea	8,466	0.2	536,577	2.1
Germany	2,472	0.0	31,492	0.1
Gambia	300	0.0	200	0.0
Republic of Benin	140	0.0	30	0.0
United Kingdom	2	0.0	190	0.0
Others[6]	26126	0.5	69,534	0.3
Total	**5,630,789**	**100.0**	**25,720,338**	**100.0**

Source: Nigeria AC Market Assessment, 2023

5.4 Installation practices of Air Conditioners in Nigeria

During this study, manufacturers and importers were surveyed regarding installation practices for air conditioning systems. To ensure optimal performance and prevent potential hazards such as electrical fires and shocks, manufacturers prioritize the avoidance of amateur installations. Responses from the interviewees indicated that a significant portion of air conditioners in the Nigerian market are typically installed by professional technicians. However, there are instances where customers assume installation responsibilities independently or engage informal installers without involving the seller in the process.

Certain manufacturers provide a list of certified technicians recommended for installing their air conditioners, often selected from the Nigeria Association of Refrigerators and Air Conditioner Practitioners (NARAP) and provided with supplementary training. These trained technicians may have the opportunity

[6] Other countries importing FBU not displayed on Table 5.3 include Thailand, Ghana, South Africa, Belgium, United States, Turkey, Slovakia, Mexico, Netherlands, Ethiopia, Switzerland, and Iraq while other countries importing CKD not displayed on Table 53 include Thailand, Ghana, Singapore, Indonesia, and Czech Republic.

to carry out AC installations for customers, often without additional charges, with installation fees arranged by the manufacturers. To facilitate installation and ensure the use of appropriate components, some AC units are sold with accompanying installation kits. However, it is important to note that there are no measures in place to prevent untrained individuals from carrying out installations, as some customers may choose to make this decision independently, with or without a full understanding of the associated risks.

5.5 Life expectancy of air conditioners in Nigeria

The interviews with manufacturers and importers revealed that there are two (2) types of electronics including air conditioners in the Nigerian market – Premium and Max. The premium has a minimum lifespan of 10 years while the Max has a minimum lifespan of 5 years. Most of the air conditioners in Nigeria are Max. Only a few brands are Premium. However, the lifespan for both types depends on its installation, usage and maintenance, which will lead to average lifespan higher than the minimum indicated in this section. In many countries, the lifespan of a room air conditioner is considered around 12 years. The practice in developing countries might be to keep the air conditioning working much more time than that, which in many times leads to higher energy consumption due to inefficiencies coming from the age of the appliance.

5.6 Testing and Laboratory Capacity for Air Conditioners in Nigeria

It was discovered during the surveys that major manufacturers have their own testing laboratories, which is used for quality control. Even though the main suppliers have their own laboratory, none of the interviewed manufacturers declared that their laboratory was accredited with ISO 17025. It is important to note that the Standards Organisation of Nigeria has an air conditioner testing facilities in its office in Ogba, Lagos State to test for energy performance, and safety. The facility was built and equipped by the German International Cooperation Agency (GIZ) through its Nigeria Energy Support Programme (NESP). The facility is yet to be commissioned as at the time of this assessment.

Chapter 6: Characteristics of the Air Conditioners

This chapter presents the following information obtained from these two different approaches explained in the methodology, the questionnaires from the manufacturers and importers and visit to retailers' shops.

- Market share of the different types and capacities of air conditioners;
- Energy Efficiency Ratio (EER) distribution by type and cooling capacity.
- Seasonal Energy Efficiency Ratio (SEER) distribution by type and cooling capacity.
- Market share of air conditioners with fixed-speed compressors and variable speed compressors.
- Market share depending on the refrigerant used (consider type and size of the ACs).

6.1 Types of Air Conditioners in Nigeria

Figure 6 presents the number of models encountered during shop visits for different types of air conditioners. The single split system is the most common type, accounting for around 89% of the models. This is followed by floor-standing units at approximately 9%, and window-type units at just 2% (comprising three models). Notably, no portable air conditioner models were found in the visited shops. Data received from manufacturers and importers is in line with the models observed in the shops, the majority of models were of the split type, with only a few belonging to the floor-standing category.

For clarity, descriptions of each air conditioning type are provided below:

Split Systems: The air conditioner is divided in two parts, the outdoor unit houses the compressor and evaporator, while the indoor unit contains the evaporator responsible for cooling the room or space. The indoor and outdoor units are connected through insulated copper pipes. In some instances, a single outdoor unit can be connected to multiple indoor units to cool several rooms (Multi-Split). However, the most common type in Nigeria is the Single Split, featuring one indoor unit for a single room or space. Split systems offer installation flexibility and are generally more efficient than window units, though they tend to be more expensive.

Window Unit: This type of air conditioner integrates all components into a single unit (not split). It is typically installed on a window or an opening in a building's wall, with the evaporator and control panel facing indoors and the condenser facing outdoors. Designed to cool a single room or space, window units are cost-effective in terms of installation, as they do not require extensive pipework. However, due to the nature of installation, air leakage from outdoors to indoors can lead to inefficiencies and higher energy consumption.

Floor Standing Units: These air conditioners are essentially split systems, but instead of wall-mounted indoor units, floor standing units have freestanding indoor units that sit on the floor. The choice between a split and floor standing air conditioner depends on individual needs and preferences. Floor standing units are typically available in larger sizes and are used in both residential and commercial settings.

Portable Units: These units consist of a single unit containing both the evaporator and condenser, similar to window AC units. However, the entire unit is positioned indoors, with hot air expelled outside via flexible ducts, usually through the window. The primary advantage is their portability, allowing them to be moved within the conditioned space from one room to another. Nevertheless, portable units tend to be less energy efficient compared to other air conditioner types.

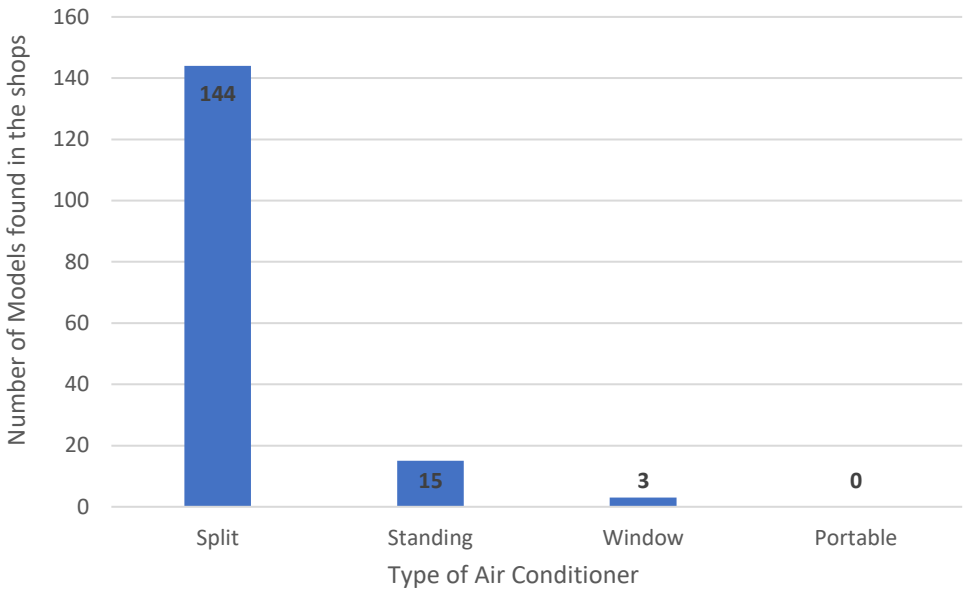

Figure 6: Number of models found in the shops for different types of air conditioners

6.2 Capacities of Air Conditioners in Nigeria

Different units are utilized worldwide to convey the cooling capacities of air conditioning units, often influenced by regional preferences and standards. Despite the Nigerian Standard's use of kilowatts (kW) as the unit of measurement for cooling capacity, it was evident that a significant portion of air conditioner brands in the Nigerian market opts for British Thermal Units per hour (BTU/h) to specify cooling capacity. Hence, for the sake of consistency, this section employs BTU/h as the unit of measurement. To provide a clear reference, it is worth noting that 12,000 BTU/h is equivalent to approximately 3.52 kW. In some instances, capacity was denoted in Refrigeration Tons (RT); however, this unit is less common in Nigeria (note that 1 RT equals 12,000 BTU/h).

Figure 7 shows the number of models encountered during shop visits, categorizing them by their cooling capacities. The 12,000 BTU/h capacity is the most common, constituting roughly 35% of the observed models. Following closely are the 9,000 BTU/h with around 31% of the observed models, and then the 18,000 BTU/h capacities, which is 24% of the models. The majority of air conditioners in this capacity range are split systems. In contrast, models exceeding 18,000 BTU/h are less frequently encountered, with only a handful available, including the highest capacity option of 60,000 BTU/h. It is important to note that these larger capacity models are primarily associated with Floor Standing Units, typically offering 24,000 BTU/h or higher. The data obtained from manufacturers and importers align with these observations, reflecting a similar trend in cooling capacity distribution in the market.

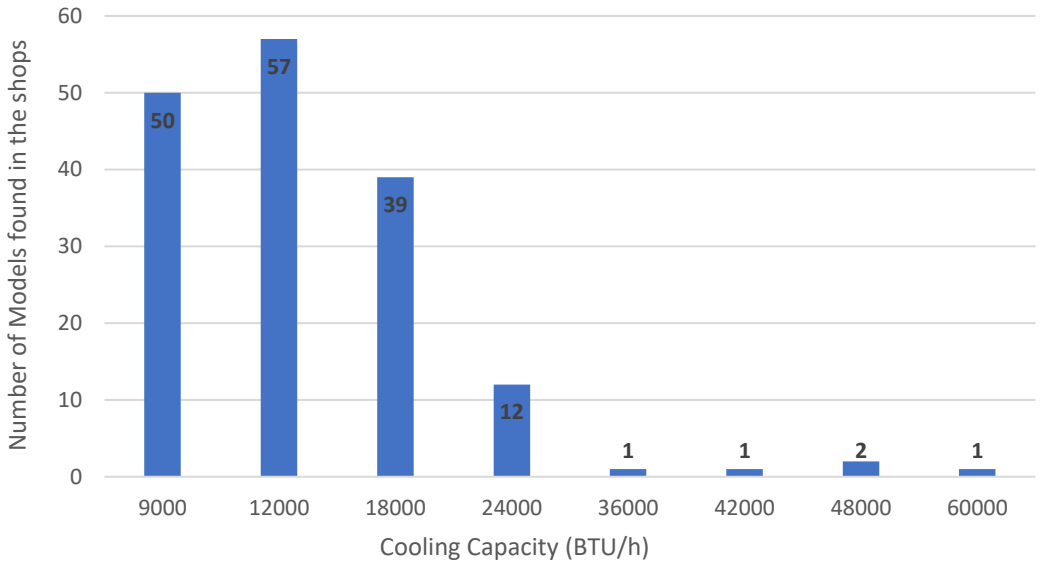

Figure 7: Number of models found in the shops for different cooling capacities

6.3 Energy Efficiency Ratio of Air Conditioners in Nigeria

As previously mentioned, the current Nigerian standard adopted the Energy Efficiency Ratio (EER) metric to establish requirements for MEPS and efficiency labels. EER measures energy efficiency under specific conditions, notably at a fixed ambient temperature of 35°C, with the air conditioner operating at maximum capacity. A higher EER means greater energy efficiency in an air conditioner.

Since the Nigerian standard has not been enforced, energy efficiency labels are seldom displayed on appliances in retail stores, and information regarding EER or any other parameter related to energy consumption and efficiency is rarely provided to customers. During visits to shops, only 15% of the models had any information about EER readily available. However, it was feasible to estimate the EER of many models by collecting data from the air conditioner nameplates or searching for the EER values online, which typically include collecting details of the cooling capacity and power input. By making efficiency calculations based on these parameters and assuming they were measured under the standard ambient conditions used for EER calculations, the EER values for 153 out of 163 models were determined.

From the information provided by manufacturers and importers, most of the models provided the EER values, with EER data available for 41 models sold within the past three years, (EER data for the remaining 16 models sent by the manufacturers, and sold exclusively before 2020, were not considered in the study).

Figure 8 illustrates the relationship between EER values and air conditioner capacity for the models observed during shop visits and the ones provided by the manufacturers. For the models found in the shops, for capacities below 20,000 BTU/h, a range of efficiencies spans from 2.35 to 3.65 W/W. In contrast, for capacities exceeding 20,000 BTU/h, energy efficiency tends to remain around 3.00 W/W or lower. A similar trend is observed in the models sent by the manufacturers.

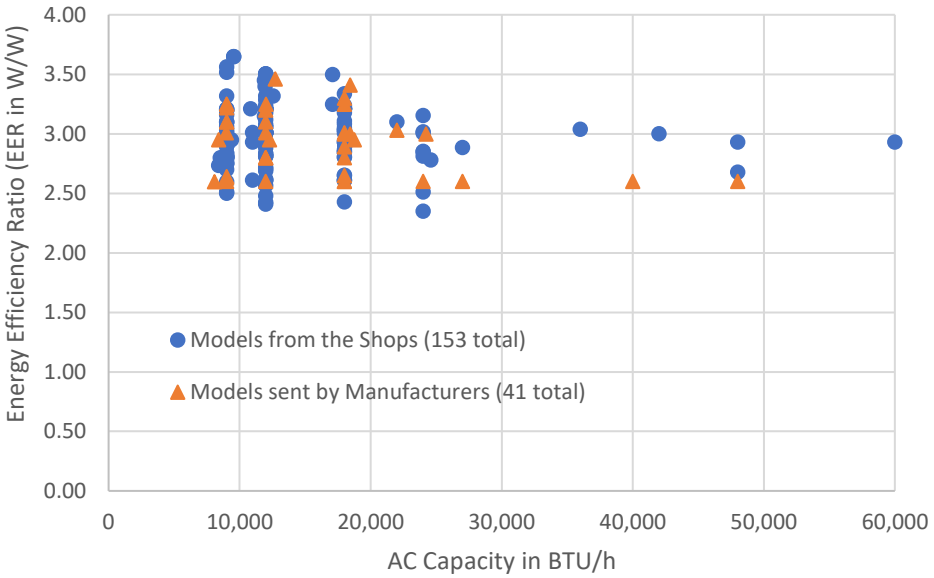

Figure 8: Energy efficiency of the models found in the shops and sent by the manufacturers and importer as a function of air conditioner capacity

Figure 9 displays the distribution of Energy Efficiency Ratio among the models available in the shops. Over 50% of the models fall within the EER range of 2.80 to 3.19 W/W, with the most prevalent range being EER 2.80 to 2.99 W/W, accounting for 32% of the models. Approximately 19.6% of the models have an EER below 2.80 W/W, which is the current minimum MEPS level in the Nigerian standard, confirming that standards are not followed if they are not mandatory and enforced. About 24.8% of the models have energy efficiency level equal to or greater than an EER of 3.20 W/W.

Figure 10, on the other hand, illustrates the distribution of energy efficiency level among the models in the shops, categorized by compressor type: fixed or variable speed (inverter). It is worth noting that 77% of the models feature fixed-speed compressors, while 23% incorporate inverter technology. Most of the inverter models fall within the EER range of 3.00 to 3.49 W/W, although there are a few with lower efficiency levels. Fixed-speed compressors, on the other hand, are more prevalent among models with lower efficiencies. Similar trends in energy efficiency distribution were observed in the data provided by manufacturers.

However, it is important to emphasize that EER may not be the best metric for comparing fixed and variable speed air conditioners, as it does not account for the energy losses associated with the on-and-off cycling of fixed-speed compressors. A more appropriate metric for such comparisons is the Seasonal Energy Efficiency Ratio (SEER), which considers various ambient conditions and accounts for losses incurred when air conditioners cycle switch on and off to match thermal demand. SEER would likely reveal a more significant difference in energy efficiency between fixed and variable speed air conditioners.

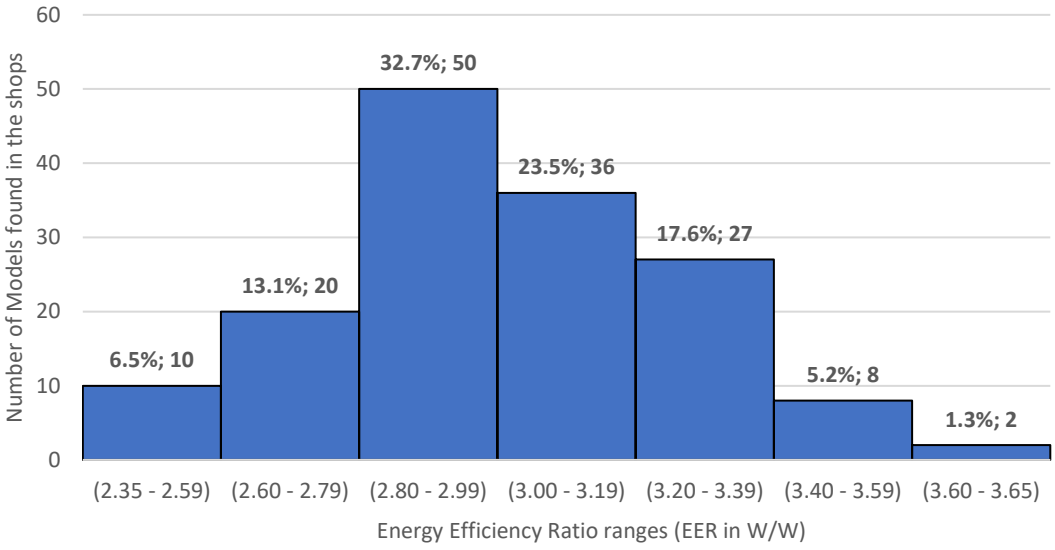

Figure 9: Energy efficiency distribution of the models found in the shops.

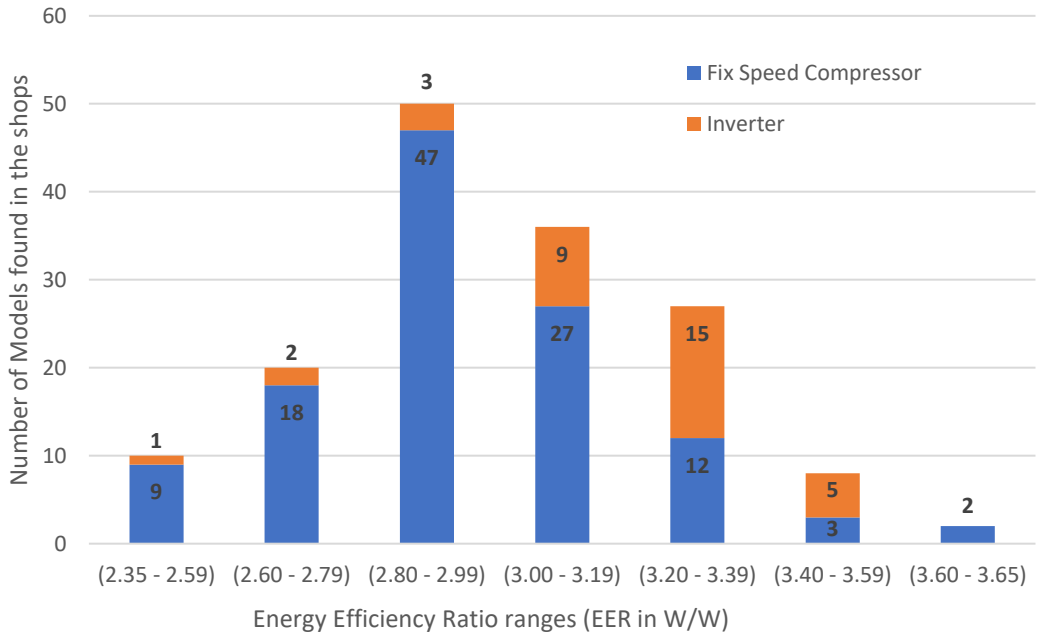

Figure 10: Energy efficiency distribution of the models found in the shops categorized by compressor type: Fix Speed and Inverter

6.4 Seasonal Energy Efficiency Ratio (SEER)

Unlike the EER, the Seasonal Energy Efficiency Ratio (SEER) takes into account the energy efficiency losses that air conditioners experience when cycling on and off to meet the thermal load. This cycling typically occurs when the ambient temperature is lower than the design temperature, considering the climate of a specific region and the expected temperatures the air conditioner will encounter. Inverter air conditioners, which adjust cooling capacity by modulating the compressor's speed rather than cycling on and off, have

an advantage in these situations. Therefore, SEER provides a more equitable metric for comparing the efficiency of different air conditioner technologies. For this reason, the N-CAP recommended updating the Nigerian standard to adopt SEER as the preferred metric.

Converting EER values directly into SEER values is not straightforward, as it relies on laboratory test results specific to each appliance and the climate for which SEER is calculated. During the market assessment, efforts were made to gather SEER information during the visits to the shops and to inquire from manufacturers and importers about SEER values. Additionally, the country of declaration for SEER was considered, as SEER is influenced by climate conditions stipulated in individual countries' regulations. However, it was only possible to obtain the SEER value for a couple of models. The topic of the SEER and the recommendations to be implemented in Nigeria will be further explored in a separate report for this project.

6.5 Common Air Conditioners Refrigerants

When assessing the environmental impact of an air conditioner, it's crucial to consider not only the indirect emissions resulting from the electricity needed to operate the AC but also the type of refrigerant used in the cooling cycle. When released into the atmosphere, refrigerants can have adverse effects on the ozone layer and contribute to global warming. Many countries have implemented laws to prohibit refrigerants with Ozone Depletion Potential (ODP) and prioritize those with low Global Warming Potential (GWP).

Figure 11 provides an overview of the distribution of refrigerants based on the number of models found in shops, focusing on the four most commonly used refrigerants worldwide in air conditioners. Despite the prohibition of hydrochlorofluorocarbons (HCFCs) in Nigeria due to their ozone-depleting impact (banned in 2015)[7], it's notable that 19% of the models in the Nigerian market still utilize the HCFC R22. All R22 units in Nigeria are fixed-speed units. Following the ban on R22, the majority of compliant brands have transitioned to using the hydrofluorocarbon R410a (72%), and with a lesser adoption, the hydrofluorocarbon R32 (9%). Notably, no models utilizing natural refrigerants, such as Hydrocarbon R290 (Propane), were identified.

Here are the characteristics of these refrigerants:

- R22: ODP = 0.05, GWP = 1810; banned in Nigeria for air conditioners.
- R410A: ODP = 0.00, GWP = 1890; used as a replacement for R22 but being banned in some countries due to its high GWP.
- R32: ODP = 0.00, GWP = 675; used as a replacement for R410A in some countries but still considered to have a relatively high GWP, making it a potential target for future bans.
- R290: ODP = 0.00, GWP = 3; a natural refrigerant with favorable environmental characteristics, slowly gaining traction in certain markets.

[7] https://dailytrust.com/nigeria-bans-hcfc-refrigerants-from-dec/

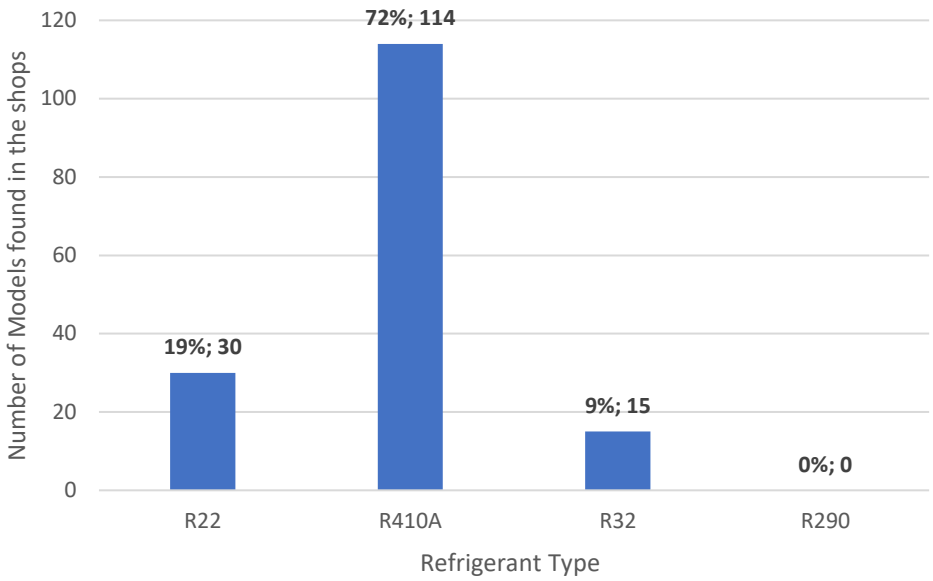

Figure 11: Refrigerant distribution of the models found in the shops

6.6 Prices of Air conditioners

Figure 12 illustrates the initial prices of air conditioners relative to their Energy Efficiency Ratio (EER), categorized for models with cooling capacities of approximately 9,000 BTU/h, 12,000 BTU/h, and 18,000 BTU/h to facilitate comparisons among similar sizes. Due to a limited number of models with higher cooling capacities, they have not been included in the plot. For each capacity category, a linear trend line has been generated, accompanied by the line's equation and the corresponding R-squared (R^2) value. The data suggests that cooling capacity does have a discernible impact on pricing. As expected, larger units tend to come with higher price tags. However, when examining the relationship between price and energy efficiency, it observed a more nuanced picture. While the trend lines generally exhibit a positive slope with respect to energy efficiency, the low R-squared (R^2) values indicate that energy efficiency alone does not strongly dictate pricing decisions. This observation implies that factors beyond energy efficiency, such as brand reputation, specific features, warranty terms, and other product attributes, exert a substantial influence on air conditioner pricing more than energy efficiency itself.

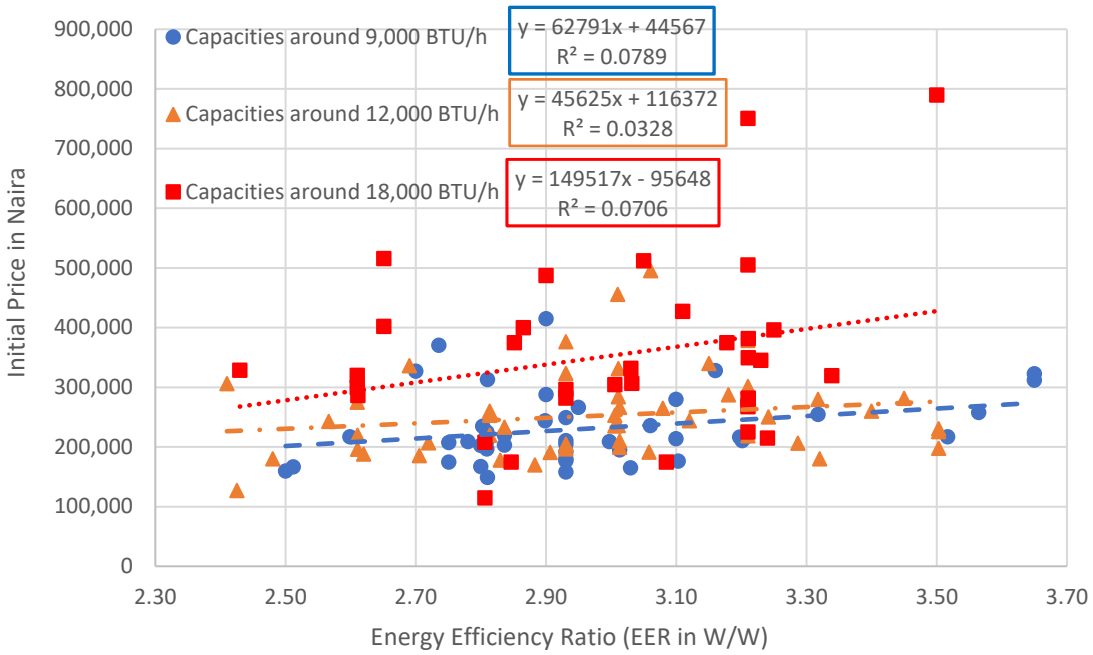

Figure 12: Initial price as a function of the EER for the models found in the shops

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Annex 1: List of Stakeholders' Consulted

Name	Position	Organization	Location
Engr. Yahya Ahmed Bukar	Director. Standards Development	Standards Organisation of Nigeria (SON)	52. Lome Crescent. Zone 7. Abuja
Bolaji Foluso	Director	Standards Organisation of Nigeria (SON)	52. Lome Crescent. Zone 7. Abuja
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Ugwu Patience	AOI	Standards Organisation of Nigeria (SON)	52. Lome Crescent. Zone 7. Abuja
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Ezemonye Nelson	P.S.O	Standards Organisation of Nigeria (SON)	52. Lome Crescent. Zone 7. Abuja
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Engr Achema C. Alewu		Standards Organisation of Nigeria (SON)	Ogba. Lagos
Engr. Michael Timi	Ass. Chief Standing Engr.	Standards Organisation of Nigeria (SON)	Ogba. Lagos
Mr. Adenwumi	Director	Standards Organisation of Nigeria (SON)	Ogba. Lagos
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Samson Oyejide	Operations	Somotex Nigeria Ltd (Midea & Bruhm)	5. Olorunfunmi Street. off Oregun Road. Behind Philips. Ojota. Lagos
Nze Emmanuel	Production/QC	Somotex Nigeria Ltd	Lagos
Dinash Kiuekar	Regional Business Head	Somotex Nigeria Ltd	Ojota. Lagos
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Kenneth Nwauzoma	HOS	Mandilas Nigeria (Carrier)	35. Simpson Street. Lagos Island. Lagos
Fab Uzor	Executive Director	SIMS Nigeria Ltd	40. Akin Adesola. Victoria Island. Lagos
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Uduak Irem		Haier Paterson Zochonis (HPZ) Ltd	45/47 Town Planning Way. Ilupeju. Lagos
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Michael K. Agoro	Sr. Sales Engineer – English West Africa	Daikin Nigeria	3rd Floor Muliner Towers. Ikoyi. Lagos
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Grace Josiah	Manager	Idolor Electronics Ltd	172. Aba Port Harcourt Expressway opp Waterline bus stop. Port-Harcourt
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Mr. Moses O. Abu		Spar Nigeria	Ceddi Plaza. Abuja
Mr. Mahesh Kumar		Panaserv Nigeria Ltd.	Central Business District. Abuja
Mr. Ali		Medi Global Services Ltd	Jabi Mall. Jabi. Abuja
Mr. Hussein Nasser			Banex. Wuse 2. Abuja
Mr. Sharaf Aldeen		Fouani Nigeria Limited	LG Office, Banex. Wuse 2. Abuja
Mr. Hasan Darwich		Colors by Fouani	Wuse, Abuja
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