

# Unveiling the Consumers' Taste Attributed to Energy Efficient labelled Appliances: Evidence from Energy Efficiency 2019 Appliance Compliance Monitoring Report

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**Keywords**— standards and labels, Compliance,  
Ghana.

**Abstract**— In Ghana, standards and labelling (S&L) for appliances and the Rebate refrigerator initiative were implemented in 2011 and 2012 respectively to offer consumers the awareness they really need making well-informed decisions about monitored appliances when purchasing monitored appliances and then to encourage standards and labelling. The study assessed the consumers' compliance level for home energy saving initiatives based on the report from the Renewable Energy, Energy Efficiency & Climate Change Directorate of Ghana on Compliance Monitoring and Data Collection in December 2019. More precisely, the study looked at the compliance level of standards and labels with the Rating of Energy Labels (ERL) of the Ghanaian market appliances and the influence exerted on the consumers' taste for energy labelled appliances. In the Ghanaian distribution and the retail outlets throughout the regions, a total of 6739 appliances were surveyed including; 6198 refrigeration appliances together with 541 air-conditioners. The compliance level with the availability of its test report of all refrigerating appliances and air conditioners found on the market is 99.62% and 99.37% respectively. The standard of compliance for refrigerating equipment in all retail stores or shops is 97.34%, while that of air conditioners is 97.80%. The results of the report shows 99% compliance level for cooling appliances on the Ghanaian market. This study recommends the need to stimulate and enable Ghanaian importers and manufacturers to bring to the market more energy-efficient refrigerators and air- conditioners. Again, government must take into account national needs and to ensure that efficient energy products are accessible and desirable to enterprises in supplying the appliances.

## I. INTRODUCTION

Energy efficiency has long been referred to as "a first fuel" because it is the only energy endowed resource that any country has in large quantities. In September 2015,

Countries from all over the globe joined forces to decide on 17-Sustainable Development Goals (SDGs). Among the goals, SDG 7 proposes for a readily access to moderate, efficient, sustainable and advanced energy for all countries

in 2030 (International Energy Agency., 2016). Effective energy efficiency measures are critical to achieving the core energy stated goals of lowering energy costs, combating climate change and carbon emissions, enhancing energy protection, and expanding energy access (Nunoo, Mariwah, & Suleman, 2019). Household appliances use a lot of electricity and thus play an major function in improving energy efficiency, specifically in the residential sectors (Ramos, Gago, Labandeira, & Linares, 2015). According to countries that make up the membership of International Energy Agency (IEA), residential appliances or housing appliances, for example, account for about 19% of total energy usage in areas where data is readily available (International Energy Agency., 2016).

In Ghana's scenario in the year 1984, due to prolonged droughts that disrupted water inflows from the Volta River basin into the Akosombo Dam, Ghana began experiencing power shortfalls. In addition to these droughts, the increase in the energy consumption is due to population growth, citing more factories and increasing commercial operation, without the subsequent expansion of generation capacity, is among the causes of the Ghana's power deficits (Ministry of Energy Ghana., 2009). Household energy demand has also risen over the years and a large percentage of household demand is assumed to be wasted by the use of obsolete, faulty and inefficient refrigerating equipment imported into the country. Energy crisis seems to have become a recurrent development problem that is threatening the economic growths of Ghana and transformation (ISSER., 2005).

S&L promote competition to offer the most effective equipment to patrons as consumers are well educated. Equipment or appliance labelling facilitates implementation of requirements by helping regulators to identify irregularities whether un-labelled or mis-labelled are the controlled equipment (Ministry of Energy Ghana., 2009). The Rebate refrigerator program in 2012 allowed consumers, at a subsidized price, to swap their old refrigerating devices for modern more effective ones which are energy efficient. This market control and tracking of compliance has been part of the Energy Commission's key operations, which have contributed to some success in the restructuring of the Ghanaian appliance market. Market surveillance and regulatory reporting studies found that unreliable appliances were already making inroads into the Ghanaian market over the years from 2015-2016, thereby short-changing customers in various delivery and retail shops (Ghana Energy Commission., 2019).

Although there could be substantial potential motive for consumers to reduce their household energy usage, it would be important to learn more about the reasons

motivating consumers to take those steps (Hwang, Park, & Kim, 2016; Struwig & Adendorff, 2018). Consumers are highly motivated by their environmental attitudes, preferences and purchases (Sarigollu, 2009). The consumers' energy saving behaviour is sourced from its natural environment orientation, ecological knowledge and environmental interest (M. M. Mostafa, 2007), and environmental values and beliefs, environmental rules and environmental knowledge are among the factors influencing the consumers' motives for reducing energy consumption (M. Mostafa, 2006). Consumers living in equilibrium with nature select goods that produce less pollution, which can recycle and reduce consumption. Consumers have a role to play in promoting the environmental energy efficiency (Ramanlal, 2015). The current change in efficiency, however, has been objectively catapulted by the dealings of inefficiencies caused by energy consumption including carbon emissions and biodiversity depletion (Barkenbus, 2006; Bird, Holt, & Levenstein, 2008; Goeschl, 2019; Schleich, Durand, & Brugger, 2021).

The primary objective of this research is, thus, to assess consumers' taste for energy labelled appliance on the Ghanaian market by reviewing the report from the Renewable Energy, Energy Efficiency & Climate Change Directorate of Ghana on Compliance Monitoring and Data Collection in December 2019. More precisely, the study reviewed the following headings; energy efficiency standards and labels (S&L), countries that have successfully implemented S&L, S&L in Ghana with the Rating of Energy Labels (ERL) for cooling appliances (labelled, Un-labelled or mis-labelled), compliance and monitoring reports for cooling appliances (refrigerators and air-conditioners) found on the Ghanaian markets as well as the Compliance Level trend in Ghana and Concluded by making some useful suggestions to the government, manufacturers, distributors, retailers and consumers.

## II. LITERATURE REVIEW

### 2.1 Theoretical Review

#### 2.1.1 Energy Efficiency Standards and Labels

Energy efficiency standards is or are collection of rules and policies which specify the minimum or less energy efficiency required of manufactured goods (Essam, 2009; Mernier A., 2009; Weil & McMahon, 2003). Standards define a minimum level of efficiency for an appliance manufacturers to meet to enable them to sell their products (Masjuki, Mahlia, Choudhury, & R., 2000). The term "standards" has two explanations: firstly, well-stated guidelines (or laboratory test processes) for obtaining an adequately accurate evaluation of a product's energy performance as being used usually, or at least a comparative

rating over the product's energy performance relative to other models. Secondly, the limits set for energy performance (normally maximum or minimal usable energy) (McMahon & Turiel, 1997; Weil & McMahon, 2003). Efficiency standards, like that of government safety standards, have important and common benefits, including goods innovation and huge amount of money in consumer energy savings, and a major fall in carbon emissions (Hampton, Okpala, Perez-Reyes, Roycroft, & Sowards, 2017). Standards for energy efficiency are mechanisms for market transformation (Stadelmann, 2020).

Energy-efficiency labeling are descriptive labeling attached to goods manufactured that clarify the product's energy performance (specifically in terms of energy usage, efficiency, or cost). These labeling offer consumers the necessary awareness needed in making well-informed purchasing decisions (Weil & McMahon, 2003). Energy labeling can be applied in two ways: mandatory or voluntary. Distributors and manufacturers are mandated by law to provide and display energy labels on all air conditioning appliances being sold or produced. Distributors and manufacturers will be charged to use the energy labels properly as defined by policymakers, while policymakers will be charged to supply the appropriate labeling for various appliances (Stadelmann, 2020). Of course, the appropriate authority will have to impose the required energy label. Labels allow manufacturers to prioritize performance in their marketing strategies, as well as enable them to introduce efficiency into their sales campaigns (Masjuki et al., 2000).

In markets across the world, energy labeling is becoming more prominent (Weil & McMahon, 2003). Two major forms of energy labels are identified on the market: the "seal-of-approval" and the "report card" (Banerjee & Solomon, 2003). Stickers of Seal-of-approval, such as the Energy Rating labels (ERL), are commonly identified confirming one or more well-defined measures have been carried out by the product and guarantee greater environmental results than the normal goods of that group (Hwang et al., 2016). These labels are in most cases controlled by a third party. Meanwhile, like that of the Energy Guide label, 'Report card' labels have comparable test results for the individual commodity and compare it to items with a similar standard (Goeschl, 2019).

### 2.1.2 Standards and Label System in Ghana

Ghana has enacted a Mandatory Appliance or Equipment Standards and Labeling system, which allows importers and Ghanaian retailers of room air-conditioners to import only and sell made products that meet the Ghana Standards Board's Minimum Performance and Efficiency Standards. S&L for appliances and the Rebate refrigerator

initiative were implemented in 2011 and 2012 respectively to enable consumers to specifically make well-informed decisions when purchasing monitored appliances and then to encourage S&L to improve on the Ghana's energy efficiency (Ghana Energy Commission., 2019).

Only appliances meeting the minimum energy performance (MEPs) requirements are permitted on the Ghanaian market, as per the regulations of Energy Standards and Labels Program (Nunoo et al., 2019). Appliance manufacturers or producers who have been exporting to Ghana likewise marketers selling mostly in the country are required to show a label representing the energy efficiency rating of the appliance prior to its first retail sale under the regulations of the Energy-Efficiency Standards and Labeling (Non-ducted Air-Conditioners) Regulations, 2005 (LI1815) (Ministry of Energy Ghana., 2020).

### 2.1.3 Standards and Labels for refrigerating appliances of Ghana

Paucity of regulatory policies to limit importation and selling of inefficient used cooling appliances, the refrigerating appliance industry of Ghana previously consisted primarily of used refrigerating appliances. Used and refurbished appliances is a vital source of high energy usage, health risks, and CO<sub>2</sub> emissions. As a result of the implementation and strict enforcement of Legislative Instruments of government (LI 1815, 1958, and 1932) in 2012, the appliance market has been improved (Ministry of Energy Ghana., 2020).

The energy performance of all refrigerating appliances are gauged and defined per the energy-efficiency-index (EEI). This EEI estimates the annual or yearly energy consumption (AC) relatively to the consumption of reference focused on the storage capacity and the refrigerating appliance model. The lower or less the EEI, the energy efficiency of the appliance would be higher and thus consumes less. The EEI of different refrigeration appliances sizes are categorized into star ratings. The appliance is more energy efficient when the star rating is higher (Ministry of Energy Ghana., 2009; Nunoo et al., 2019).

Moreover, in 2008, the Ghana Standards Board proposed that European Standards: IEC 62552: 2007 for the classification and evaluating of consumer refrigerating appliances be adopted. Definitions at the product and standard levels in the European Union, as specified by European Council Directives 92/2/EC and 2003/66/EC (Schleich et al., 2021). Imports of only ST and T class refrigerating appliances should then be permitted. For ST class refrigerating appliances, the Ghana one-star, two-star, three-star, four-star, and five-star levels must be set to be equal to European levels C, B, A, A+, and A++, and for T

class refrigerating appliances, European levels D, C, B, A, and A+. However, T class appliances are permitted to use energy more because they are operated at a higher temperature (32 degrees C) than ST class appliances (which are tested at 25 degrees C) (Ministry of Energy Ghana., 2009).

#### 2.1.4 Standards and Labels for Air-Conditioners

In Ghana, an Energy-Efficiency-Ratio (EER) of 2.8 watts of cooling or freezing per watt of electricity or power input is the minimum acceptable energy efficiency level for air conditioners. 9.55 BTU/Watt is the equivalent. (In Canada and United States, the imperial unit for calculating energy efficiency is used). On the market, there are air conditioners with 3.5 EER and higher. The EER of a product shows how effective it is. The manufacturer, brand, and energy efficiency star-rating (thus, one to five stars, with the increasing number of stars indicating a greater energy-efficiency-ratio) are all described on the Energy Guide label attached to the product (Ministry of Energy Ghana., 2020; Nunoo et al., 2019).

#### 2.1.5 Benefits of Energy Efficiency Standards and Labels

Most countries worldwide have effectively implemented energy standards and energy labeling. Records show that, existed 81 countries worldwide as of the year 2013 have standards and labeling systems, and air-conditionings becoming second highest frequently used appliances among the number of 73 countries that have implemented few other types of energy standards and labeling policies. Standards and labels are clear and efficient method for offering advice to residential consumers when purchasing household appliance (Abas & Mahlia, 2018; Harrington & Brown, 2014).

The implementation of energy standards and labels decrease the need for extra power plants minimizing overall energy consumption in the process of generating electricity (Sarigollu, 2009). As a result, there are economic benefits (for example, capital can be freed up to invest in non-energy social amenities such as schools, bridges, and hospitals) as well as benefitting environmentally (e.g., reducing carbon emissions) (Schleich et al., 2021). The evidence from the United States S&L programs, for example, clearly shows the tremendous economic benefits. As of the year 2020, efficiency standards would have prevented 20% of the States' projected new power generation, saving over \$100 billion and providing a net savings of \$1000 per US households (Meyers & et al., 2003).

Similarly, Australia's appliance energy management policy (basically, standards and labels) expected to generate \$4.8 billion in economic benefits by 2030. Moreover,

substantial greenhouse gas emission reductions will be realized, resulting in greenhouse gas emission reduction nearly 204 million tonnes of CO<sub>2</sub> low business as normal within 2005 and 2030, according to recent projections (Abas & Mahlia, 2018; NAEPP, 2007). A recent study of Harrington sales data (2013) has shown that in the previous 13 years of Australia labeling, household cooler systems have improved their efficiency by over 30%. These cost savings are based on a net present value minus \$23/tonnes of CO<sub>2</sub>: In a way of buying more energy-efficient product outlined by the policy, Australians save money. On top of the direct effect on household and company electricity costs, the advantages of more energy friendly goods are numerous. Peak demand reduction increases grid stability, allowing marginal consumers to have more and more reliable energy (Harrington & Brown, 2014).

Appliances, equipment and lighting items that are energy labeled help to increase total energy efficiency (Schleich et al., 2021). First of the assessment of the effects of the new European Union (EU) labelling program for refrigerators, machines for washing, and lamps, for example, revealed a number of change in sales of extra efficient appliances (Schleich et al., 2021). Around 1992, just before the scheme was implemented, and late 1999, the sales-weighted proportionate energy efficiency of refrigerators increased by 26%. Minimum efficiency standards are believed to be responsible for 16 percent of the effect, while labeling is responsible for 10% the year 2000 (Bertoldi, 2000; Schleich et al., 2021). For example, performance of energy for washing machinery has increased from an average of 0.30 kWh/kg (Class C/D) in 1993 to 0.24 kWh/kg (Class B) in 1998, and to 0.18 kWh/kg (A/A+) in 2006, which represents a 40% reduction in energy consumption. For refrigerators, from an average of 102 (E) in 1992 to 79 (Class C) in 1999 and to 42, (A+) in 2006, an average energy efficiency index was increased, representing a total decrease of almost 60 percent of the particular consumption of energy (Bertoldi, 2000).

Standards for energy efficiency are strategies for market transformation. Models on the market will steadily increase their average energy efficiency (Stadelmann, 2020). Market pull as well as market push are two market transformation techniques that work together. By getting rid of the low efficient models from the local market, the energy efficiency requirements "pushes" the market. Labels "pull" consumers to purchase or consume more of energy-efficient products, "pushing" manufacturers to make more of energy-efficient models. Standards and labels joined forces to "push" and "pull" markets to a region of higher energy efficiency depicting in the illustration below (Masjuki et al., 2000).



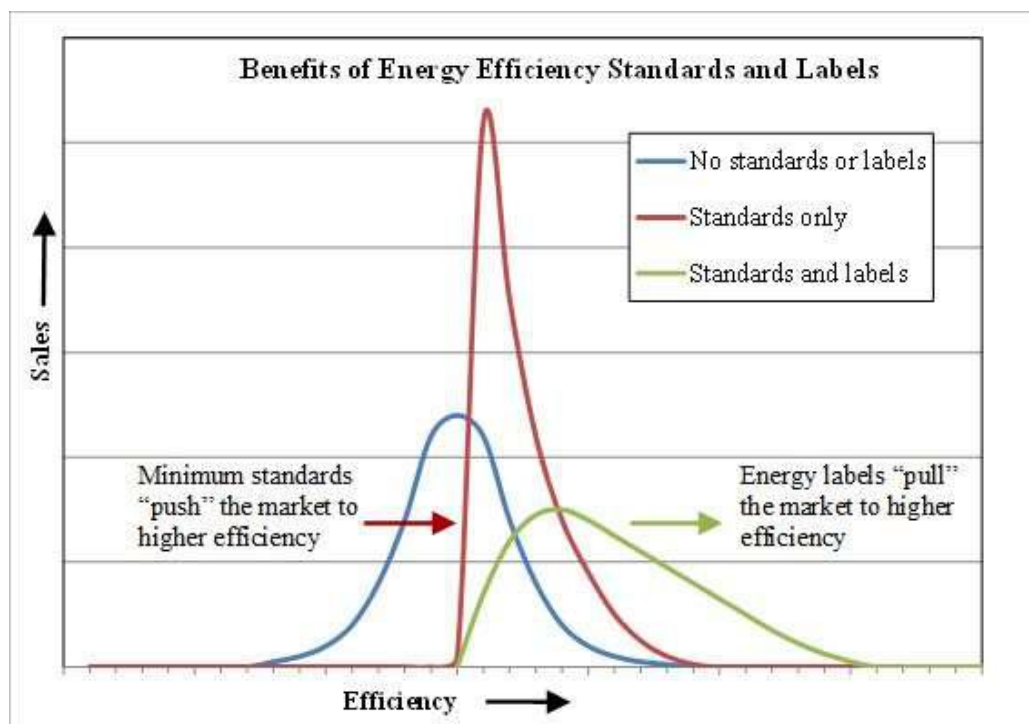


Fig.1: Standards and labels work together to “push” and “pull” markets to a region of greater energy efficiency,

[Clean Energy Solutions Center Webinar Series Presented by: McMahon and Buskirk, 2012]

## 2.2 Empirical Review

### 2.2.1 Environmental Concerns

In the area of energy conservation and environmental concern, there has been widespread studies. Household Consumers are highly environmentally conscious in their personal attitudes, tastes, and purchases (Sarigollu, 2009). Most consumers are ready to pay for extra environmentally efficient goods (Peattie, 2001; Sung-Yoon, Manseok, Jungwoo, & Seung-Hoon Y., 2019). Most especially, consumers' willingness-to-pay (WTP) for the substantial labeling e.g. (Aguilar & Vlosky, 2007; Bjørner, Hansen, & Russell, 2004; Blend & Ravenswaay, 1999; Loureiro, McCluskey, & Mittelhammer, 2002; Srinivasan & Blomquist, 2009); were of particular concern to this analysis in the evaluation of consumer responses to environmental labeling (or 'eco-labels') on appliances. The green revolution over the years has extended from the political science to consumer capitalism and extends from consumer capitalism to advertisement and manufacturing (Zimmer, Stafford, & Stafford, 1994). In several examples, environmental concern for a commodity with favorable environmental externalities has been shown to be favorably linked to respondents' preference or real WTP (Ahuja, Handa, & Jain, 2020; Krarup & Russell, 2005). For both green energies (Farhar & Houston, 1996; Roe, Teisl, Levy, & Russell, 2001; Souza, Filho, Bernardo, Silva, & Neto, 2018; Zarnikau, 2003) and environmentally sound food

goods, this pattern has been noticed (Balasubramanian & Moon, 2001; Wandel & Bugge, 1997).

Consumers' ability to pay a higher price for energy-efficient goods has been investigated in previous studies. (Wallander, 2008) looked at the price or payment premium available for Energy Star labels on residential (domestic) clothes washers and concluded that, upon the hedonic price feature, there is no substantial eco-label price premium (Liu, Chang, & Den, 2013) and positive at 10% but statistically insignificant price premium as per the quasi-experiment estimate. The findings indicate that the Energy Star initiative could have no impact on energy efficiency policy. (Fuerst & McAllister, 2009) looked into the influence of the LEED and associated Energy Star systems on US commercial office properties and discovered that eco-certified buildings had a 6% rental price premium.

Data on the effects of environmental concerns on buying of energy-use devices by consumers is limited. Ecological concern, however, was used as an explanatory vector to assess WTP for things such as quality of water (Cooper, Poe, & Bateman, 2004; Guilfoos, Hayden, Uchida, & Oyanedel-Craver, 2020), rainforest protection (Armstrong, 2014; Kramer & Mercer, 1997), and help for destroyed species (Abell, 2012; Kotchen & Reiling, 2000; Ojea & Loureiro, 2007). A contingent valuation study was undertaken by (Cooper et al., 2004) research on quality of water to find out the relationship between the specified environmental

concerns (EC) as well as WTP for the quality of water changes to a lake in the middle of the grounds of East Anglia University. To assess WTP, a vehicle payment was designed and environmental concerns (EC) were assessed by the responses of each person to a set of queries known as the New Ecological-Paradigm (EP) (Dunlap, Van Liere, Mertig, & Jones, 2000; López-Bonilla & López-Bonilla, 2015). The findings were consistent with the existed studies showing that WTP is associated with environmental concerns and altruism (Guilfoos et al., 2020; Takashima, 2016).

The current studies provide details on the impacts of eco-labels on the shopping habits of consumers (K. Govender & Govender, 2013; Hwang et al., 2016; Struwig & Adendorff, 2018). The proliferation of public interest about their daily environment has begun to hotshot their consuming habits and has triggered the creation of another market meeting - green consumers (K. Govender & Govender, 2013). The result of terrible environmental destruction and shifting consumer behavior, green production as well as its use are need specifically by this new century (P. Govender & Govender, 2016). In order to respond to, customer demand is a diverse factor; new systems and innovations are generated from the product piece to help in increasingly competitive markets (Sravani Chari, 2018; Won & Hong, 2014).

### 2.2.2 Energy Savings

There is limited past study also on forces energy labels have had on WTP (Ahuja et al., 2020). A meta-evaluation on five (5) energy labels conducted in the United States by (Banerjee & Solomon, 2003; Tunçel & Hammitt, 2014), two among the five are funded by the government (Energy Guide and Energy Star) and with the three being financed by private sponsors, that is, Scientific Certification System, Green Seal and Green-e. Consumer response, determined by perception, knowledge and attitude, and manufacturer/marketer response, were the metrics used to test these marks. The study found that in these terms, government-financed initiatives, specifically the Energy Star program, were more effective over private labeling programs. In addition, 54% of those respondents who were conscious of the Energy-Star labels and already bought energy appliances during last 12 months attested the label was very relevant in decisions for buying. An indication that consumers are in support of energy saving programs implemented by the government.

Research reveals that consumers appreciate energy saving initiatives (Ahuja et al., 2020; Banfi, Farsi, Filippini, & Jakob, 2008); however, the premium or price households want to pay for energy-efficient items in certain cases may not be as greater as economic theory would expect (Howarth

& Anderson, 1993). The disparity is simply termed as the "efficiency gap" (Howarth & Anderson, 1993). Imperfect data, liquidity limitations, and speculation regarding possible energy savings include potential reasons for the difference. The indications of an efficiency gap are uncertainly showing vast discount rates on equipment consuming energy (Howarth & Sanstad, 1995; Stadelmann, 2020). For instance, in their reported preferential research on refrigerators on a discount, loans, or no reward on high-efficiency units, (Revelt & Train, 1998) explored this difference. They found that on energy efficient refrigerators, customers willingly want to pay for an amount between \$2.12 and \$2.46 up front for \$1 of the yearly energy savings. These WTP estimates suggest discount rates of between 46% and 39%, estimating a lifetime of 10 years.

A study of particular concern on the effect on Shanghai consumers of the Energy Efficiency labeling policy of China undertaken by Shen and Saijo. Although the actual objective of the Shen and Saijo research was to examine the effectiveness of the energy labeling systems in China, related procedures were also analyzed in their study as elucidated here (Shen & Saijo, 2009). A theoretical choice experiment was used through a web-based data collection and face-to-face interviews to assess customers' WTP for a single scale upgrade in the energy efficiency ratings on the China Energy Efficiency Label and also the cooling appliance sectors were assessed. Price or premium, energy efficiency rating, labels representing electrical bill savings, everyday power consumption, capacity, and low pollution were all factors considered in the refrigerator choice experiment. The first three characteristics, accompanied with per hour power usage, cooling space, and whether or not purification of air feature existed, were all the same for air conditioners. The 15 options were chosen based on their state and model source (exotic or local). In relation to state (used or new) and model source, the alternatives were fixed (foreign or domestic). Their finding showed a WTP for an each energy efficiency upgrade of \$76-\$89 for refrigerators and \$35-\$54 for air conditionings.

In comparison, in face-to-face interviews, their results revealed significantly higher WTP values than that of the web-based survey for cooling appliances. Similarly, as a survey tool assessing the relevance of the European Energy Label in consumers choices for buying (Sammer & Wüstenhagen, 2006; Schleich et al., 2021) published a discrete preference study. Again, to clearly understand energy savings effect on behavioral factors and to clarify the difference between the behaviors and orientations of consumers towards energy conservation and their real behaviour, energy and environmental consciousness has been studied (Liu et al., 2013; Sarigollu, 2009).

### III. METHODOLOGY

#### 3.1 Data

The data used for the study was collected from a report by the Renewable Energy, Energy Efficiency & Climate Change Directorate of Ghana on Compliance Monitoring and Data Collection in December 2019. The objective of the exercise was to create the baseline market data for energy efficient appliances, which will facilitate the creation and accumulating of the energy efficient appliances database, most especially the upgrading of the existing air-conditioners and refrigerating appliances database with the appropriate application (Ministry of Energy Ghana., 2009, 2020). The country was divided into four parts, and every quarter of each zone was covered. In the different regions across the country, the group visited every distributor and retail outlet and shop owners were aided to download the app from Google Play Store and trained in the use of the modified app to help them validate appliances prior to importer acquisition. The southern Ghana is primary concentrated by refrigerating appliances sales and air-conditioners sales. The regions of Greater-Accra and Ashanti are the leading regions of refrigerator and air conditioner purchases followed by the provincial capitals likewise the border towns including Paga, Aflao, Elubo and Bawku with most of the appliance shops available (Ghana Energy Commission., 2019).

#### 3.2 Features of Shops Visited

As per compliance with the scale and availability of the quantity of appliances on exhibition in the showroom, the appliance shops and retail outlets were classified. Shops with maximum appliances below 10 are classified as small,

10 to 20 are classified as intermediate, and stores with appliances over 20 are classified as large shops. Of the surveyed appliance stores, 37.62% were large, 30.03% were medium, and the remaining 32.34% were small stores. Twenty-five (25) new warehouse and retail centers were identified and the database captured and revised their demographics data. These new stores are focused primarily in the Ashanti region (Ghana Energy Commission., 2019).

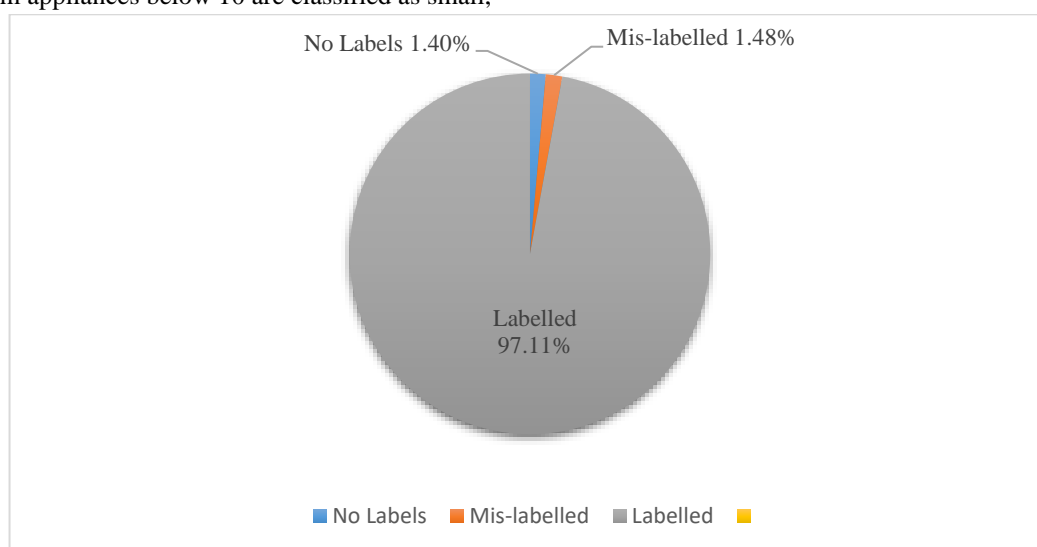
#### 3.3 Appliances on Sale

**Fig. 1.** A total of 6739 cooling appliances including 6198 refrigerating appliances and that of 541 air- conditioners were surveyed, 34.62 % of which came from the Greater Accra Region, making it the dominant market for appliances. The Ashanti Region accumulated 16.32%, making it the country's second leading appliance industry (Ghana Energy Commission., 2019).

### IV. RESULTS AND DISCUSSIONS

#### 4.1 Compliance Level Analysis

For the 6198 total of the tested refrigerating appliances, 6177, representing 99.67%, had their test reports and 20, representing 0.33%, had no test reports, so it was not possible to check whether they follow the minimum requirements needed for refrigerating appliances on the Ghanaian market as shown in **Fig. 2**. The refrigerating appliances with no compliant test includes 10 exclusive brands and 18 distinct models (refer to **Table 1** and **Fig. 5** in the appendix). The above analysis shows that retailers or shops and distributors in Ghana have a test report of compliance level for most of the refrigerating appliances (Ghana Energy Commission., 2019).

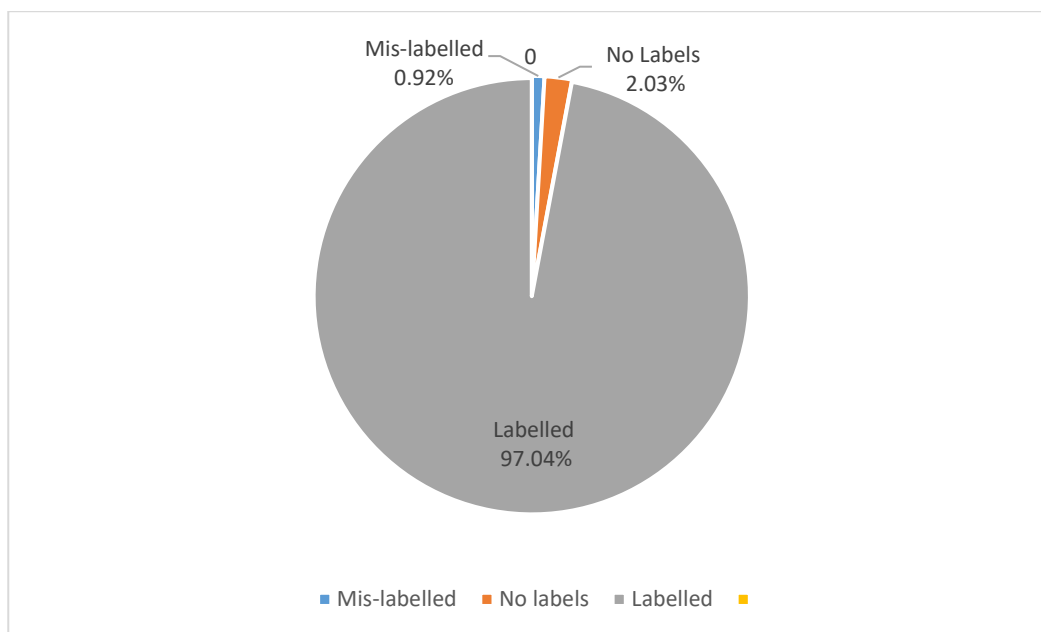


*Fig.2: Test report and labeling compliance level for refrigerators.*

[Source: Ghana Energy Commission (2019)]

The **Fig. 2** above represents the labelling compliance level for refrigerating models. Compliance with labeling plays a vital role in the modification of the appliance market, so critical attention is needed to identify irregularities in the information available on the labels shown on each appliance. Of the 6198 properly branded, 6019 refrigerating appliances representing 97.11% were properly labeled, 87 representing 1.4% had no labeling at all and 92 representing 1.48% were mislabeled (Ghana Energy Commission., 2019).

Of the 541 total air conditioners examined, 533, representing 98.52%, had test reports and 8, representing 1.48%, had no test reports, so it is not possible to check whether they meet the minimum requirements needed for the Ghanaian market for refrigerating appliances. With reference to labelling, out of 541, 525 appliances were correctly branded, 11 representing 2.03% had no labeling at all and 5 representing 0.92% were mislabeled as shown in **Fig. 3** below.



*Fig. 3: Test report and compliance level for air conditioners.*

[Source: Ghana Energy Commission (2019)]

Nationally, as seen in **Table 2**, a shop's total level of compliance is 98.51%. In all the countries, this phenomenon is well represented. None of the regions recorded a total compliance rating below 95%. As compliance with the test report was substantially high across the countries, the average output of shops was influenced by the marking of non-compliance amounts.

Six regions reported 100% compliance with the test report and 99% and above were recorded by the remaining 4. The appliance mislabeled were, for the most part, different in terms of star ratings and annual power ratings according to the evaluation results available to the Commission. As depicted in **Table 2** in the appendix, no shop dealing in refrigerating appliances recorded below 70% over all compliance (Ghana Energy Commission., 2019).

#### 4.2 Test Report and labeling Compliance of Air Conditioners by Retail Shops

High compliance level in retail shops or outlets dealing in Air Conditioners was recorded in the similar vein as the refrigerating appliances. The overall compliance level

of a retail shop on a national level is 98.58%. It was quite impressive that about six regions recorded 100% overall compliance and the remaining 4 regions did not record below 94% overall compliance.

As shown in both **Table 3** in the appendix and **Fig. 3** above compliance level of a shop dealing in the market of air-conditioners is above 80% except Enderick Takoradi branch with compliance level of 37.5%. Again, results obtained from 2018 exercise recorded compliance level for refrigerating appliances of 90.24% and that of Air Conditioners was 33.11%. In 2019 however, compliance for refrigerating appliances was 99.68% and that of air conditioners to be 99.37% respectively (Ghana Energy Commission., 2019).

#### 4.3 Compliance Level Trend for cooling appliances from 2015 to 2019

The **Fig.4** below shows the compliance level trend for both refrigerating appliances and air-conditioners. The compliance level for refrigerating appliances are 77.4% in 2015, 89.1% 2016, 91.6% in 2017, 94.0% in 2018, 2019 was



98.5% associated with compliance level for air-conditioners 33.11% in 2018 and 98.58 in 2019. A significance increase over the sequential years for both refrigerating and air-conditioning appliances found on the Ghanaian markets and

more sense of awareness on the part of the distributors, retailers and consumers (Ghana Energy Commission., 2019; Ministry of Energy Ghana., 2020).

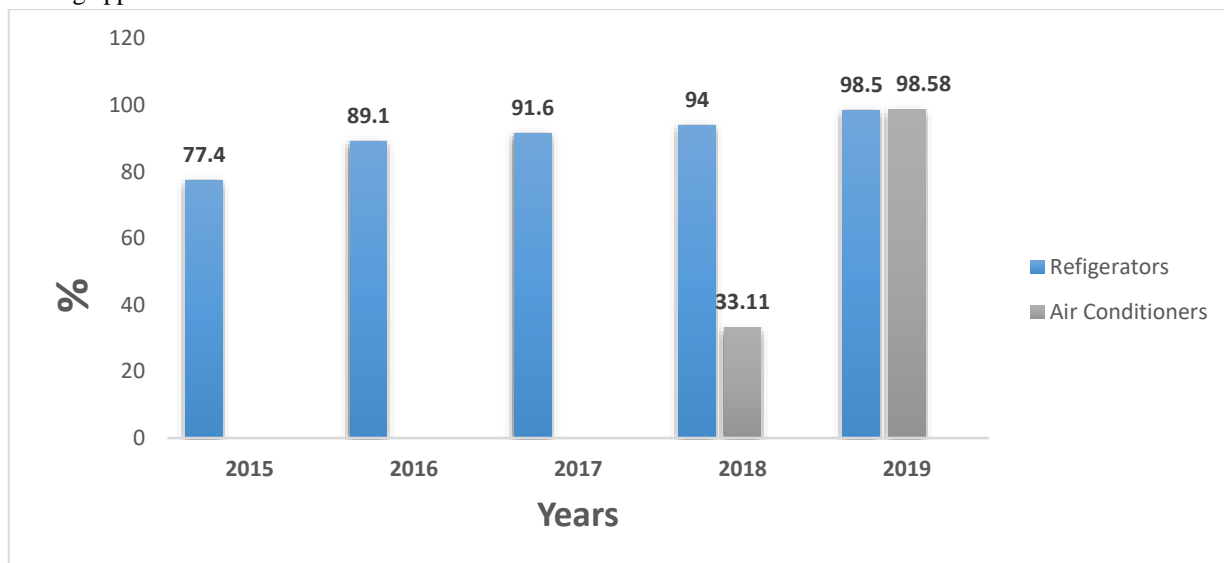


Fig.4: Compliance level trend for refrigerating appliances and ACs from 2015 to 2019

[Source: Ghana Energy Commission (2019)]

Home energy efficiency is based on energy efficient appliances being purchased and their efficiency. However, appliances being used in a manner that can increase or minimize both energy usage and energy bills (Ramos et al., 2015). To examine the consumers' taste for standard and labelled appliances most especially refrigerators and air-conditioners in Ghana, the reports on compliance monitoring appliances by Energy Efficiency of Ghana in 2019 reveals the households' taste for energy labels based on the proportion of the labelled appliances compared to non-labels and mis-labelled appliances on the Ghanaian market. The approval standard of the test report for a retail store is expressed as the number of appliances with approved test reports available as a percentage of the total appliances seen in the store. This measure is intended to improve consumer assurance in the patronization of appliances offered by shops with high availability of test results, labels and overall levels of compliance (Ghana Energy Commission., 2019).

On the basis of the labeling status of each refrigeration and air-conditioning appliance externally shown in the shop, the labelling compliance level was calculated. The total compliance of the appliance outlets or shop is measured by finding average rate of compliance with test reports and labelling. Mandatory environmental labelling or certification programs providing consumers with information on the environmental characteristics of one or more elements of the life span of a product have been

commonly embraced in one form or another around the globe (Shi, 2014; Ward, 2010). This study examined compliance with the Energy Star, energy labels and the influence they had on consumers' taste for cooling appliances as per the EE 2019 compliance monitoring report of Ghana. The overview and key results are listed below.

1. The data collection exercise included all 10 regions and involved 303 suppliers or distributors and retail outlets in 91 towns and cities.
2. The level of compliance with the availability of its test report of all refrigerating devices found on the market is 99.62%.
3. The level of compliance with the availability of the test report for all listed air conditioner models is 99.37%.
4. The standard of compliance for refrigerating equipment in all retail stores or shops is 97.34%, and then for air conditioners is 97.80%.
5. In all the regional distribution and retail outlets, a total of 6198 refrigeration appliances recorded and 541 air conditioners were surveyed.

The review of the reports shows that the 99% compliance level for cooling appliances (refrigerator and air-conditioners) is a strong indicator that Ghanaian customers have built a taste for energy-efficient appliances and even an increasing demand for energy-efficient air conditioning and refrigerating appliances. Compliance level of appliances on the market shows whether or not the

distributors, retailers and various shop owners in Ghana comply with the Energy Efficiency Policies implemented by the governmental boards to reduce energy consumption in the country are adhered and patronized. Any level below 50% depicts an extremely low patronage and support for energy saving policies and therefore, less taste for labelled appliances by the consumers. The 99% compliance level is an evidence of a higher compliance level which indicates the supports and confidence Ghanaians have in Standards and Labels as a means of ensuring energy savings. This would help to transform the market for appliances from expensive to more energy efficient appliances. S&L according to information obtained from retailers, customers have begun demanding for 3-star and probably 4-star quality ones for air conditioners, while the 1-star and 2-star ratings are the most known on the market.

The findings obtained from the report indicate substantial improvement in the transition of the appliance industry in Ghana. Compliance levels of monitored appliances have increased over the years and there has always been a full and changed demand for regulated appliances in 2019 (Refrigerating Appliances and Air Conditioners). There is therefore the need to stimulate and encourage importers and retailers to introduce higher energy efficient refrigerators and air conditioning appliances into the market.

It can also be deduced that households alternatively chooses labelled appliances over non-labelled or mis-labelled in the market which consciously promotes energy efficiency in urban Ghanaian homes. Often, Standards and Labelling promotes competition to offer the most effective equipment to households as consumers are well educated. Equipment labelling facilitates implementation of requirements by helping regulators to identify irregularities whether un-labelled or mis-labelled are the controlled devices.

## V. CONCLUSION AND RECOMMENDATIONS

The Consumers and shop owners in Ghana are strongly confident that modernizing appliance energy efficiency is profiting and supports efficiency standards and labels. The shops or retailers with compliance test reports are aware of efficiency standards implemented by the government and solemnly patronize them as per the 99% compliance level reported. The results show that the average shop owner, retailer and the final consumer in Ghana would choose labeled appliances over un-labeled or mis-labeled. Consumers patronizing labelled appliances show their taste for and willingness-to-pay extra for the product with assurance that no extra payment could be incurred with time in minimal energy bills, clearly that, they

will obviously save money. The household awareness of the significance of energy efficiency and patronage of efficiency across products and across time is consistent with much improvement in the appliance market in terms of conformity to standards and labeling. The consumers taste for labelled appliances on the Ghanaian market is thus revealed by their compliance level for energy appliances.

Moreover, for suppliers and government regulators, this study indicates that when purchasing a new appliance, the Energy Star label may play key role in the decision-making time of a customer. These effects, however, are focused primarily on refrigerators and could or could not be valid for other large home appliances. Therefore, there is a need to stimulate and enable Ghanaian importers and manufacturers to bring to the market more energy-efficient refrigerators and air-conditioners. It is recommended that recognition is given to importers who deal in very energy efficient appliances.

Finally, we recommend that, to determine the impact of standards on low-income groups, the government must take into account national needs and to ensure that efficient goods are accessible and desirable to enterprises in supplying the technology. Example; if consumers' payback on previous incremental energy efficiency investments for room air conditioners is less than 9 months, and consumers can save average US \$64 million annually in Ghanaian low-income energy bills because they lack air conditioners, with little implications on the Ghanaian households' income. In Ghana, the wide demand for secondhand appliances exists for refrigerators/freezers, and this standard regulates new as well as used refrigerators and freezers, so the harmonization of products with Europe and other countries facilitates Europe-certified import products. A sponsored experiment on market change will help decide how Ghana's compliance and reward systems can be approached and designed. Further studies may be warranted on the influence of Energy Star labels having on similar appliances.

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## Appendix

Table 1: Regional breakdown of Appliances Surveyed

REGIONS	REFIGERATORS		AIR CONDITIONERS		TOTAL APPLIANCES	SHARES
	NUMBER OF SHOPS	TOTAL REFIGERATORS	NUMBER OF SHOPS	TOTAL AIRCONDITIONERS		
Ashanti	40	1022	23	78	1100	16.32
Brong Ahafo	45	609	7	16	625	9.27
Central	17	420	10	41	461	6.84
Eastern	40	597	4	16	613	9.10
Greater Accra	70	2101	47	232	2333	34.62
Northern	16	273	11	40	313	4.64
Upper East	14	272	6	13	285	4.23
Upper West	6	86	2	7	93	1.38
Volta	25	309	7	35	344	5.10
Western	30	509	20	63	572	8.49
<b>Total</b>	<b>303</b>	<b>6198</b>	<b>137</b>	<b>541</b>	<b>6739</b>	<b>100</b>

Source: EE, 2019 accessed 19 November, 2020

Table 2. National and Regional Retail Shops Labelling and Test Report Compliance.

Regions	Number Of Shops	Refrigerators	Average Compliance Level (%)		
			Test Report	Labelling	Overall
Ashanti	40	1022	100.00	96.77	98.38
BrongAhafo	45	609	99.53	98.81	99.17

Central	17	420	100.00	96.45	98.23
Eastern	40	597	100.00	98.29	99.14
Greater Accra	70	2101	99.24	96.84	98.04
Northern	16	273	99.69	97.79	98.74
Upper East	14	272	100.00	95.26	97.63
Upper West	6	86	100.00	99.02	99.51
Volta	25	309	100.00	98.91	99.46
Western	30	509	99.39	95.43	97.41
<b>National</b>	<b>303</b>	<b>6198</b>	<b>99.68</b>	<b>97.34</b>	<b>98.51</b>

Source: EE, 2019 accessed 19 November, 2020

Table 3. National and Regional Compliance Levels of Dealers of Air Conditioners.

Regions	Number Of Shops	Air Conditioners	Average Compliance Level (%)		
			Test Report	Labelling	Overall
Ashanti	23	78	100.00	100.00	100.00
Brong Ahafo	7	16	100.00	100.00	100.00
Central	10	41	100.00	100.00	100.00
Eastern	4	16	100.00	100.00	100.00
Greater Accra	47	232	99.39	100.00	98.16
Northern	11	40	99.79	96.94	98.23
Upper East	6	13	100.00	98.48	100.00
Upper West	2	7	100.00	100.00	100.00
Volta	7	35	98.48	97.22	97.85
Western	20	63	98.75	94.00	96.38
<b>National</b>	<b>137</b>	<b>541</b>	<b>99.37</b>	<b>97.80</b>	<b>98.58</b>

Source; EE, 2019 accessed 19 Nov 2020.

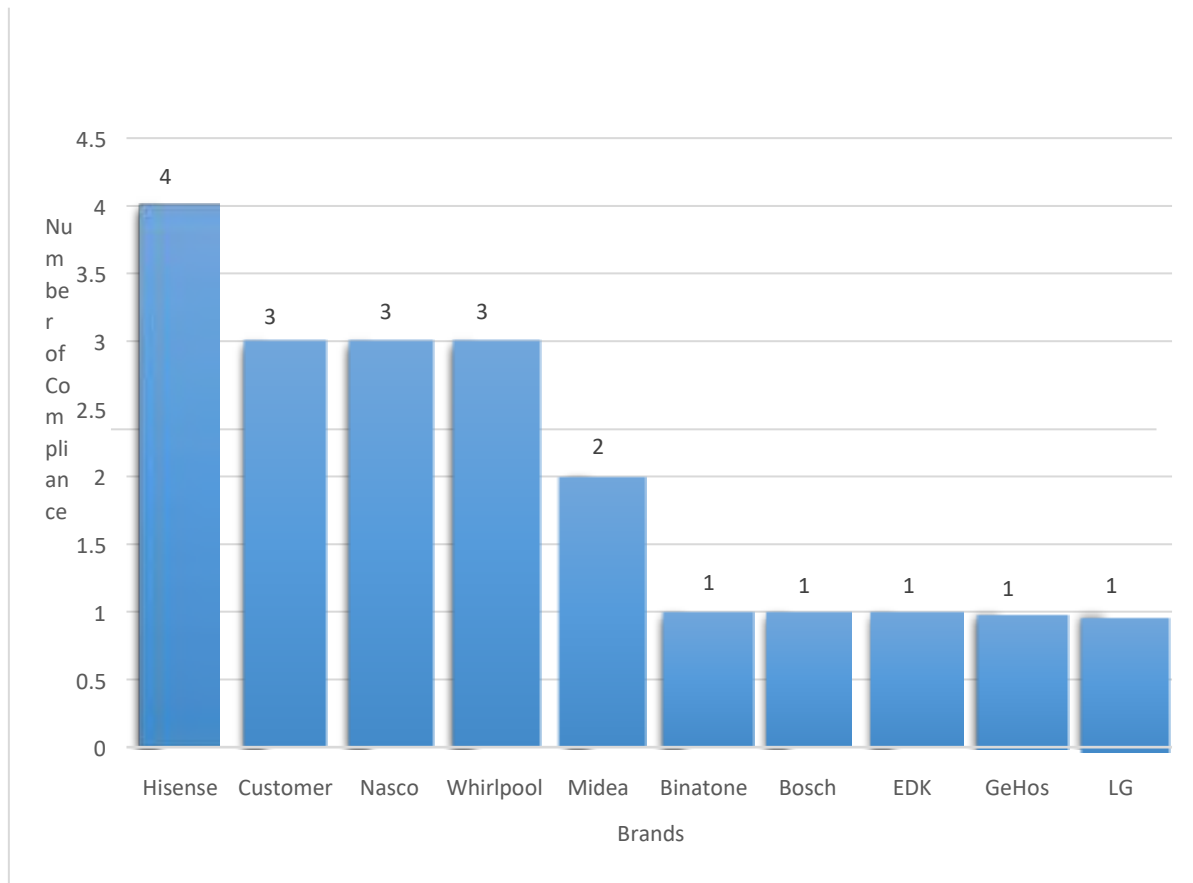


Fig. 5: Number of non-compliant refrigerator by Brand and Unique Models.

[Source: EE, 2019, accessed 19 November, 2020]

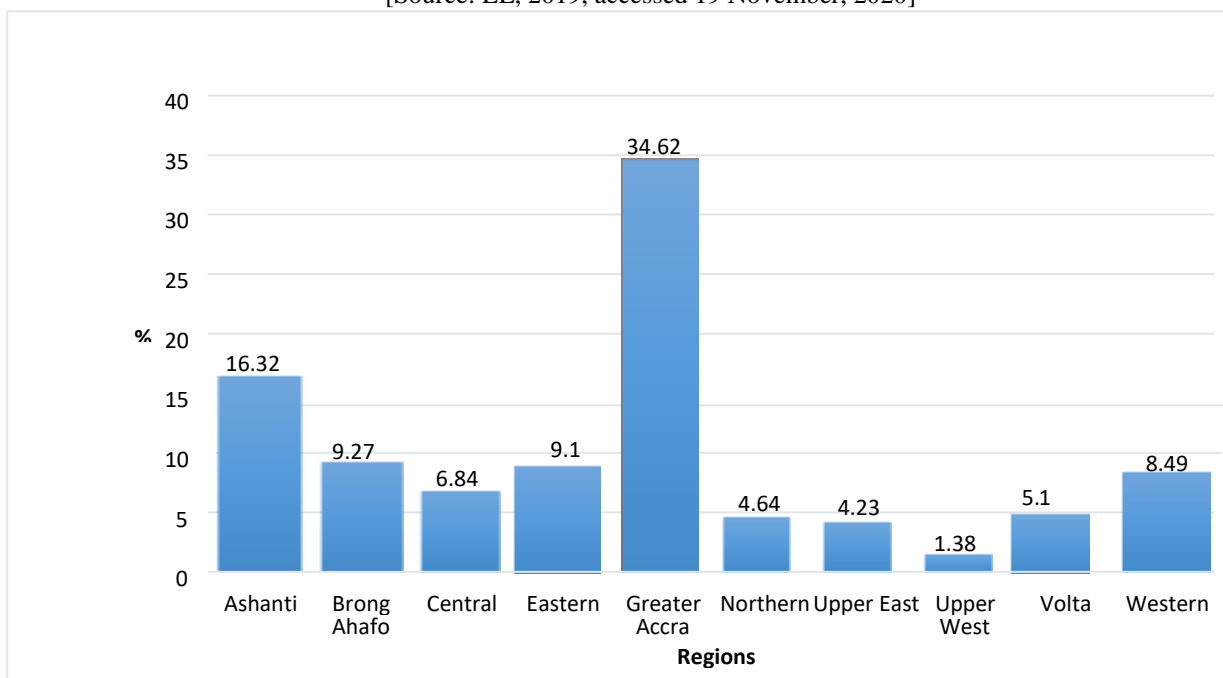


Fig. 6. Regional share of total Appliances surveyed.

[Source: EE, 2019, accessed 19 November, 2020]