# Philippines Room Air Conditioner Market Assessment and Policy Options Analysis

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CLASP

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# Executive Summary

The world is poised to install 700 million new room air conditioners (RACs) by 2030 and 1.6 billion by 2050.[1] In terms of greenhouse gas (GHG) emissions, this is like adding several countries to the planet. Millions of households and commercial entities in developing and emerging economies - from Vietnam to Nigeria to Brazil - have the financial resources to control their indoor climate for the first time. These same countries are getting hotter with climate change, contributing to the massive wave of both space cooling and refrigeration, and accelerating global GHG emissions. Ambitious international agreements like the Kigali Amendment to the Montreal Protocol (MP) are essential to successfully address the cooling crisis and limit warming – as are stringent and well-enforced energy performance standards for cooling products. According to a recent CLASP analysis, transitioning to energy-efficient RACs in 150 countries would cut 620 TWh of electricity and 480 MT of $CO_2$ annually in 2030, saving consumers $56 billion USD on their electricity bills.[2] A simultaneous hydrofluorocarbon (HFC) phasedown under the MP could avoid another 100 billion tons of $CO_2$ equivalent.[3]

**The Kigali Cooling Efficiency Program (K-CEP) focuses on the energy efficiency of cooling to increase and accelerate the climate and development benefits of the Kigali Amendment to phase down HFCs.** K-CEP is a philanthropic initiative to support the Kigali Amendment of the Montreal Protocol. CLASP has received a grant to support the implementation of K-CEP in priority countries in Southeast Asia, including the Philippines. The goal of CLASP's K-CEP program is to raise efficiency standards, improve testing efforts, provide training and other capacity building activities targeted to local needs, and implement national market transformation initiatives where appropriate.

**CLASP, in collaboration with Innogy Solutions, a local partner, conducted a comprehensive characterization of the RAC market in the Philippines and analyzed impacts from various policy scenarios.** Innogy collected product data for 3,936 models through in-person surveys at 200 retail stores in the Luzon, Visayas, and Mindanao regions. They also conducted a review of government reports and interviews with relevant stakeholders, such as manufacturers, importers, end-users and representatives from government agencies, to gather data on the RAC market size, sales, usage, and the energy sector. CLASP analyzed this data and estimated potential energy savings and avoided emissions at the national level, and lifecycle cost (LCC) savings for consumers, from various policy scenarios. CLASP's RAC market assessment and policy analysis provides the technical evidence to support a revision of minimum energy performance standards (MEPS) in the Philippines.

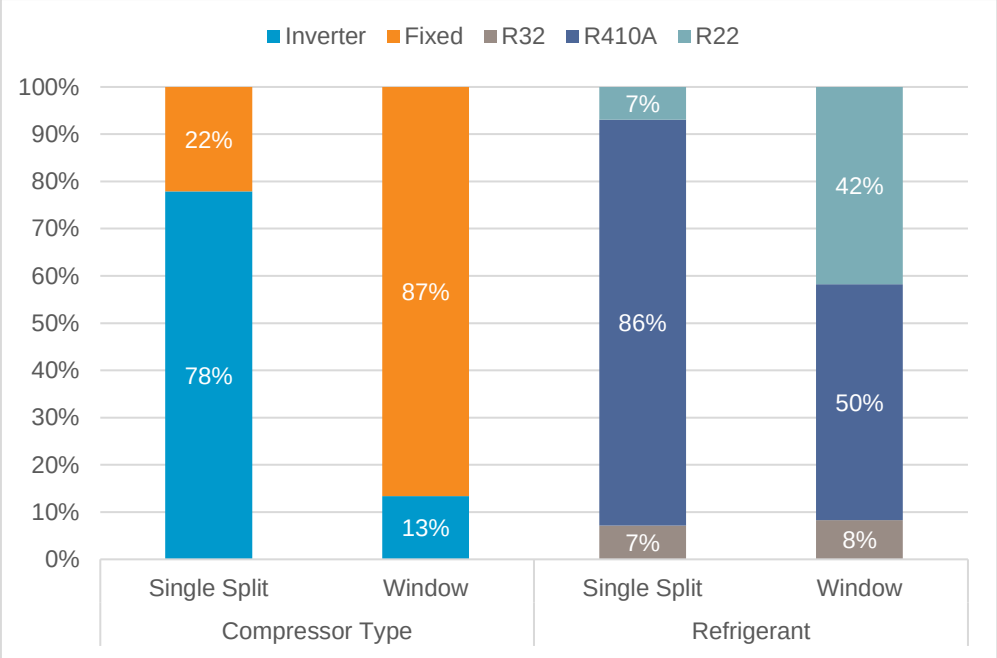
## Overall findings and recommendations

**The RAC market in the Philippines is dominated by small size fixed-speed RAC units.** In 2017, the RAC market size in the Philippines was estimated at slightly over 800,000 units with an annual growth rate of 5% in the last four years.[4] The RAC market in the Philippines is unique in Southeast Asia as it is the only market dominated by fixed-speed window-type units, at 62%. Small size window units, which are inexpensive, but less efficient, are favored by Filipino households, taking up a quarter of market share. About 60% of RACs on the market use R-410A refrigerant. Despite the fact that units with R-22 are still available in the country, there has been a significant transition since 2013, when all RACs were reported to have R-22 refrigerant (Figure ES-1).

Two Filipino-owned companies, the Concepcion Carrier Air-Conditioning Company (CCAC) and Koppel, Inc., which mainly manufacture fixed-speed window units, have the largest RAC market shares in the Philippines at 22% and 9%, respectively. The two companies have supplied RACs for the domestic market for decades, and are highly valued by local households. Overall, the majority of models available on the market come from China and Thailand.

[1] Shah, N. et al., 2015. Benefits of Leapfrogging to Superefficiency and Low Global Warming Potential Refrigerants in Room Air Conditioning, http://eta-publications.lbl.gov/sites/default/files/lbnl-1003671.pdf
[2] Accelerating the Global Adoption of Climate-Friendly and Energy Efficient ACs, https://united4efficiency.org/products/room-air-conditioners/
[3] Harris, J. A Climate Victory in the Making. The Negotiations over the Montreal Protocol. Council on Foreign Relations.
[4] Euromonitor data. World Bank and JARN data also provide similar market size estimates.

*Figure 1: Compressor and refrigerant technology (N=3,568)*




**The Philippines' energy efficiency policy for RACs is currently under review by the Department of Energy (DOE)**. At the moment, standards and labels (S&L) for RACs only regulate fixed-speed units. The MEPS for fixed-speed units have not changed since 2002 and stand at an energy efficiency ratio (EER) of 9.1 kJ/W-h for cooling capacities below 12,000 kJ/h and an EER of 8.6 kJ/W-h for cooling capacities of 12,000 kJ/h and above. This policy stagnation might explain why the market has not advanced towards more efficient technologies in the same way as other markets in the region. DOE has prepared new Product Particular Requirements (PPR) for RACs under the Philippine Energy Efficiency Standards and Labeling Program (PESLP) Implementing Guidelines, which proposes 2020 ASEAN Target[5] MEPS and star rating labeling requirements for both inverter and fixed-speed units[6]. However, MEPS for fixed-speed window RACs will be voluntary and will become mandatory with the next policy revision in 2021.

**A revision to more ambitious MEPS in the Philippines will result in energy and emissions savings at the national level, and LCC benefits to consumers.** The EERs for about 70 percent of models on the market are greater than 10.44[7] kJ/W-h or about 15% above the current MEPS, showing the market is ready for more stringent MEPS (Figure 2). CLASP's market assessment findings and impact assessment supports raising the MEPS above the 2020 ASEAN Target. On average, the EER for RACs is already greater than the 2020 ASEAN Target thus increasing MEPS to this level will not result in a market transformation towards higher efficiency RACs. CLASP recommends the following:

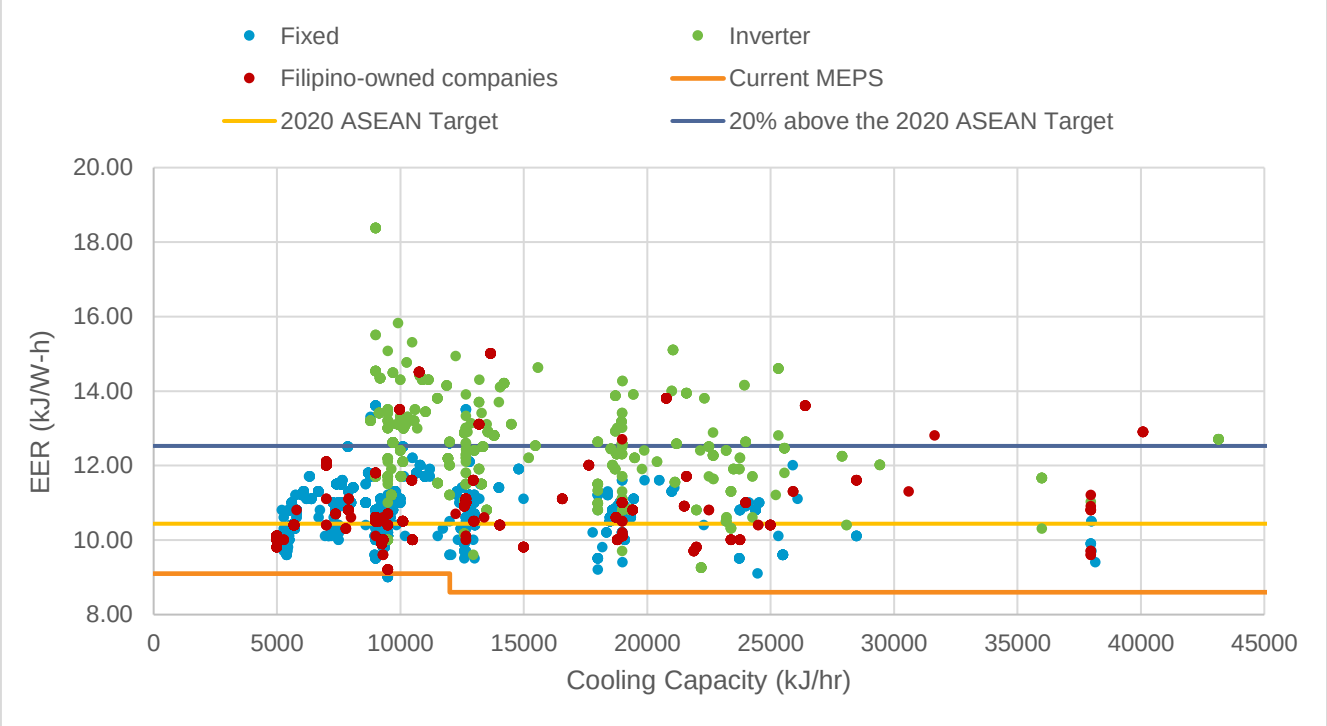
- **Recommendation 1 – Update proposed 2020 ASEAN Target MEPS and labeling requirements in 2021 and every 2-3 years afterwards to accelerate market transformation towards more efficient RACs.** CLASP recommends that DOE develop a policy roadmap, including energy efficiency targets for the RAC sector, and commit to evaluating RAC policy every 2-3 years (to continuously improve or ratchet mandatory MEPS and labeling categories) with the first revision in 2021. The RAC industry will benefit from knowing energy efficiency targets in advance, in order to plan for new investments and/or upgrading of production lines. DOE can build on this market assessment, and continue gathering RAC

[5] In 2015, under the ASEAN-SHINE framework, ASEAN member states agreed to a defined MEPS target for 2020, to remove the least efficient RACs from the regional market. The harmonized 2020 ASEAN target MEPS is 2.9 W/W EER.
[6] As of January 22, 2018.
[7] Equal to 2.9 W/W EER, which is 2020 ASEAN MEPS Target.

sales and product data to inform the update and adoption of more stringent MEPS in the future. This will ensure DOE keeps up with advancements in technology and continues facilitating market transformation in the Philippines.

- **Recommendation 2 – In 2021 increase mandatory MEPS for RACs to at least 3.48 W/W EER[8], equivalent to a 20% increase over the 2020 ASEAN Target.** We project that in 2030, the *20% above the 2020 ASEAN Target* scenario can deliver about 2.6 TWh of energy savings and 1.8 MT of avoided $CO_2$ emissions. Under this scenario about 84% of all models on the current market would be non-compliant – 87% of models currently manufactured domestically would be non-compliant. These numbers look extremely high, but the current efficiency baseline in the Philippines is low. Higher efficiency products are available in the Philippines, but represent a smaller proportion of the market. With additional external assistance domestic manufacturers over the next two years can transition their production lines to more efficient technologies. Additional programs can reduce the cost of high efficiency products in the Philippines and raise awareness of their benefits among consumers.

*Figure 2: Cooling capacity vs. efficiency by compressor type (N=2,999)*




- **Recommendation 3 – Develop incentive policies and programs to support the uptake of energy efficient RACs by the public and/or private sectors.** In order to ramp up efforts to promote high efficiency products in the Philippines and reduce their cost, incentive policies may be considered. Energy labels and standards provide a verified baseline for judging enhanced performance and pull the market towards higher efficiencies, while incentive programs can accelerate the market by encouraging consumers, manufacturers, and suppliers to switch to high efficiency products. Public sector procurement is a very effective means to promote energy efficient products. Additionally, building construction is booming in the Philippines with projected annual growth of 9.8% until 2026.[9] Incentives or bulk procurement programs by private real estate developers can also push the market

8 Equal to EER 12.53 kJ/W-h or CSPF of 3.7 W/W.
9 Philippine News Agency, BMI Research sees steady growth for PH construction sector, http://www.pna.gov.ph/articles/1008920

to more efficient RACs. Subsidies or rebates are also widely used by policymakers around the world to promote high efficiency products.

- **Recommendation 4 – Conduct awareness raising campaigns. An effective communications strategy and awareness campaigns are critical components of successful S&L programs.** Encouraging consumers to buy products at the high end of efficiency and quality creates demand. Consumer awareness campaigns can inform about how labels work and what type of information can be obtained from labels, and how consumers can benefit from choosing appliances with top labels. The best campaigns include industry, consumer groups, and corporate retail representatives as partners, securing stakeholder support from the offset.

# Market Assessment

# 1 Background and Introduction

The Kigali Cooling Efficiency Program (K-CEP) is a philanthropic initiative to support the Kigali Amendment of the Montreal Protocol. K-CEP focuses on the energy efficiency of cooling to increase and accelerate the climate and development benefits of the Kigali Amendment to phase down HFCs. CLASP has received a grant to support the implementation of K-CEP in priority countries in Southeast Asia, including the Philippines. CLASP developed a strategy to deliver maximum $CO_2$ reductions through targeted policy and market interventions that are most likely to yield impacts and/or generate momentum for energy efficiency within the Montreal Protocol process. The goal of CLASP's K-CEP program is to raise efficiency standards, improve testing efforts, provide training and other capacity building activities targeted to local needs, and implement national market transformation initiatives where appropriate.

In the Philippines, the government aims to promote the judicious conservation and efficient utilization of energy resources through adoption of cost-effective options that minimize environmental impact.[10] Energy efficiency is seen as a way to advance the country's economic development and to help ensure energy security and sustainable energy systems by reducing final energy demand by 10% between 2011 and 2030.[11] These activities support the national greenhouse gas (GHG) emissions reduction target of 179 MT of $CO_2$ by 2030 as compared to 2011. In the Intended Nationally Determined Contributions (INDC) submitted to the United Nations Framework Convention for Climate Change (UNFCCC) in 2015, the Philippines intends to reduce emissions by 70% by 2030, relative to a business-as-usual scenario. This highly aspirational target would be achieved through national efforts and with international support. The room air conditioner (RAC) sector has a high potential to contribute to these objectives.

This market assessment and policy analysis provides the technical evidence to support a revision of minimum energy performance standards (MEPS). It defines the Philippines efficiency baseline for RACs and evaluates impacts from various policy scenarios at the national level, to consumers, and local industry. Government agencies can use this information to quantify potential energy and GHG emissions savings in support of national energy efficiency targets or NDC commitments, and to estimate potential benefits of MEPS revisions.

CLASP together with a local partner, Innogy Solutions, conducted a comprehensive characterization of the room air conditioner (RAC) market in the Philippines. This market assessment provides an overview of the RAC market size, product characteristics, usage, and the energy sector. Innogy collected product-level data during the in-person visits to retail stores, conducted a review of government reports and reached out to relevant stakeholders, such as manufacturers, importers, end-users and representatives from government agencies. CLASP analysed this data and estimated potential energy savings and avoided emissions at the national level, and lifecycle cost (LCC) savings for consumers, from various policy scenarios.

The report is divided into two parts, Market Assessment, and Policy Options and Impact Assessment.

Sections 1 through 5 of the report discuss the activities and findings related to the RAC market assessment:

- **Section 1** provides an introduction, background and project objectives;
- **Section 2** describes the approach including scope and key activities;
- **Section 3** provides the overview of the market including key players and a discussion on supply chain;
- **Section 4** describes the market assessment findings; and
- **Section 5** provides background information on the energy sector.

Sections 6 through 11 discuss the analysis of various policy scenarios, including impacts:

- **Sections 6 and 7** provide an overview of the regulatory frameworks and the S&L policies for RACs;
- **Section 8** describes impact analysis methodology;
- **Section 9** discusses the policy scenarios and results of impact analysis;
- **Section 10** discusses impacts to consumers and manufacturers, and at the national level, under three scenarios; and
- **Section 11** concludes the report and provides recommendations.

[10] National Energy Efficiency and Conservation Program, https://www.doe.gov.ph/national-energy-efficiency-and-conservation-program
[11] Philippine Energy plan 2017-2040, https://www.doe.gov.ph/pep

# 2 Methodology

Understanding the characteristics of the RAC market is fundamental to building a technical evidence base to support a revision of MEPS – impact analysis requires identification of the baseline and evaluation of the impacts of policies, such as energy and cost savings and emissions reductions. CLASP, in collaboration with Innogy, applied the following approach to achieve project objectives.

### Step 1 – Data Collection

Innogy collected relevant RAC market and product level data and developed survey questionnaires.

*Table 1: RAC market assessment data needs*

| Data type | Data needed |
|---|---|
| **Economic Data** | • Electricity tariff schedule for residential customers<br>• Residential consumer discount rates<br>• Societal discount rate |
| **Market Data** | • Market structure: manufacturers, importers, and distribution channels<br>• Households ownership levels<br>• Annual sales of each class of product and relative market share of product classes<br>• Imports vs. local manufacturing |
| **Product Data** | • Specifications (AC type, compressor type, Energy Efficiency Ratio (EER), cooling capacity, power, voltage, refrigerant and refrigerant charge)<br>• Manufacture information (manufacturer, model, country of origin)<br>• Presence of a yellow label<br>• Retail price<br>• Average RAC lifetime and usage |
| **Energy Sector Data** | • Transmission and distribution losses<br>• $CO_2$ emissions factor from electricity generation |

Innogy also prepared a data collection plan that included the list of relevant stakeholders to reach out to (Appendix A) and the outreach strategy. They gathered data through the following methods:

- *Focus group meetings with manufacturers and importers.* Data was requested from four domestic RAC producers, and 30 importers of new and second-hand RACs. Meetings were held to solicit participation in the survey, but, despite these efforts, the rate of response was very low. Only one manufacturer and nine importers returned completed surveys. Data protection and privacy concerns prevented many companies from sharing data. Even after CLASP and Innogy signed Non-Disclosure Agreements, some companies were still reluctant to share their data. This resulted in an incomplete set of market level and sales data.
- *Focus group meetings with end-users.* Innogy also conducted meetings with end-users to collect the information on RAC preferences, usage patterns, and end-of-life management. The survey was shared with 17 end-user corporations and associations, of which only two responded. Concerns on data privacy and protection was the main reason behind the majority of end-users declining to respond.
- *Data requests to government agencies.* To validate the primary data gathered from the manufacturers and importers, secondary data was also requested from government agencies. Energy sector and registered product data was obtained from the Department of Energy (DOE). However, neither national RAC sales nor manufacture data were available, as this information is not collected by the agencies contacted. Due to delay in approval of the data request, no data on imported RACs was received.

- *Visits to retail stores.* Innogy collected product data during in-person visits to 200 retail stores in three regions (Table 2). Consultants identified stores located in densely populated and highly urbanized cities and municipalities, where the majority of RAC models are believed to be sold. Innogy collected data for a total of 3,943 window, split, multi-split, and portable RACs.[12] Product data collected included information on RAC brand, model number, type, compressor type, EER, country of manufacture, cooling capacity, price, and refrigerant type. The team gathered data from product name plates, energy labels, product packaging, price tags, and online listings. The consultants also took pictures of each product and the name plate and/or energy label affixed to the product.

*Table 2: Survey of room AC retail stores*

| Region | Number of stores surveyed | Areas surveyed |
|---|---|---|
| Luzon | 100 | Metro Manila, Bulacan, Batangas, Rizal |
| Visayas | 50 | Cebu, Iloilo |
| Mindanao | 50 | Davao, Cagayan de Oro |

Innogy encountered several issues during the retail store surveys, resulting in incomplete data for some RACs:

- Some retailers were unwilling to allow Innogy to conduct the survey in their stores;
- Only data from RACs on display was collected. Some name plates were difficult to access, because of the way the RACs were displayed. Also, name plates were not available for products that only had RAC covers on display.
- Price tags, yellow labels, and name plates were not consistently displayed – only one or the other was available on some units, while some were incorrectly labeled.
- Some name plates did not list relevant information such as country of manufacture and refrigerant type.

### Step 2 – Data Validation and RAC Market Assessment Findings

Innogy conducted a quality check of the collected product data. Because no RAC market level data was collected during the surveys, CLASP complimented the analysis with data from Euromonitor and the World Bank. It should be noted that CLASP did not perform any product testing to verify the accuracy of manufacturer-claimed energy performance data.

The RAC market assessment was performed using collected product data. The dataset includes 3,936 models, of which 66.8% were duplicates found in different stores. There were 774 unique models in the data set. To reflect the overall market characteristics, the duplicate models were not removed.

Some models in the data set are missing one or several characteristics. As a result, analysis of particular product attributes excludes models without that particular attribute. For example, the average price of a RAC was calculated based on models with price data, and models without price data were excluded from analysis.

Key stakeholders from government agencies, private sector and international organizations validated market assessment findings during *The Philippines Room Air Conditioner Market Assessment: Preliminary findings & validation meeting* on September 19th, 2018 in Manila.

### Step 3 – Impact analysis and policy recommendations.

CLASP used the Policy Analysis Modeling System (PAMS) to estimate energy, emissions, and consumer cost savings under different MEPS scenarios. This analysis informed policy recommendations for RACs in the Philippines.

[12] Cassette and central systems were not part of this project scope.

# 3 Room AC Industry at a Glance

## 3.1 Supply Chain Analysis

In 2017, the RAC market size in the Philippines was estimated at slightly over 800,000 units with an annual growth rate of 5% in the last four years.[13] The market is shared by domestically produced and imported units with a ratio at about 60% and 40%, respectively.[14]

Filipino-owned companies, Concepcion-Carrier Air Conditioning Company (CCAC) and Koppel, Inc., have a long history of manufacturing window type RACs for the domestic market. Both companies are located in Laguna province, a major economic hub in the country with twenty-one economic zones.[15] CCAC manufactures all parts for RACs locally, except for compressors and fan motors, which are sourced from China and Thailand.

Two global RAC manufacturing corporations, Panasonic Manufacturing Philippines Corporation (PMPC) and Hitachi, Ltd., have assembly plants in the Philippines.[16] PMPC's plant is located in Laguna province and Hitachi's plant is located in Olongapo. The latter has a capacity to manufacture 70,000 units annually.

Nearly 35 RAC importers import primarily from China followed by Thailand. Small quantities are imported from Malaysia, Korea, and Vietnam. RAC products come to the Philippines through various ports in Metro Manila, South Luzon, Visayas, and Mindanao. Importation regulation falls under the Department of Trade and Industry (DTI) and the Bureau of Customs, which ensure imported products comply with regulatory requirements.

Some RAC importers re-brand imported products with their own brand names, and some source products from the same manufacturers abroad and sell them domestically under different brand names. Several large manufacturing corporations also have licensed local distributors or centers to promote their products, e.g. Haier Center in Davao City.[17]

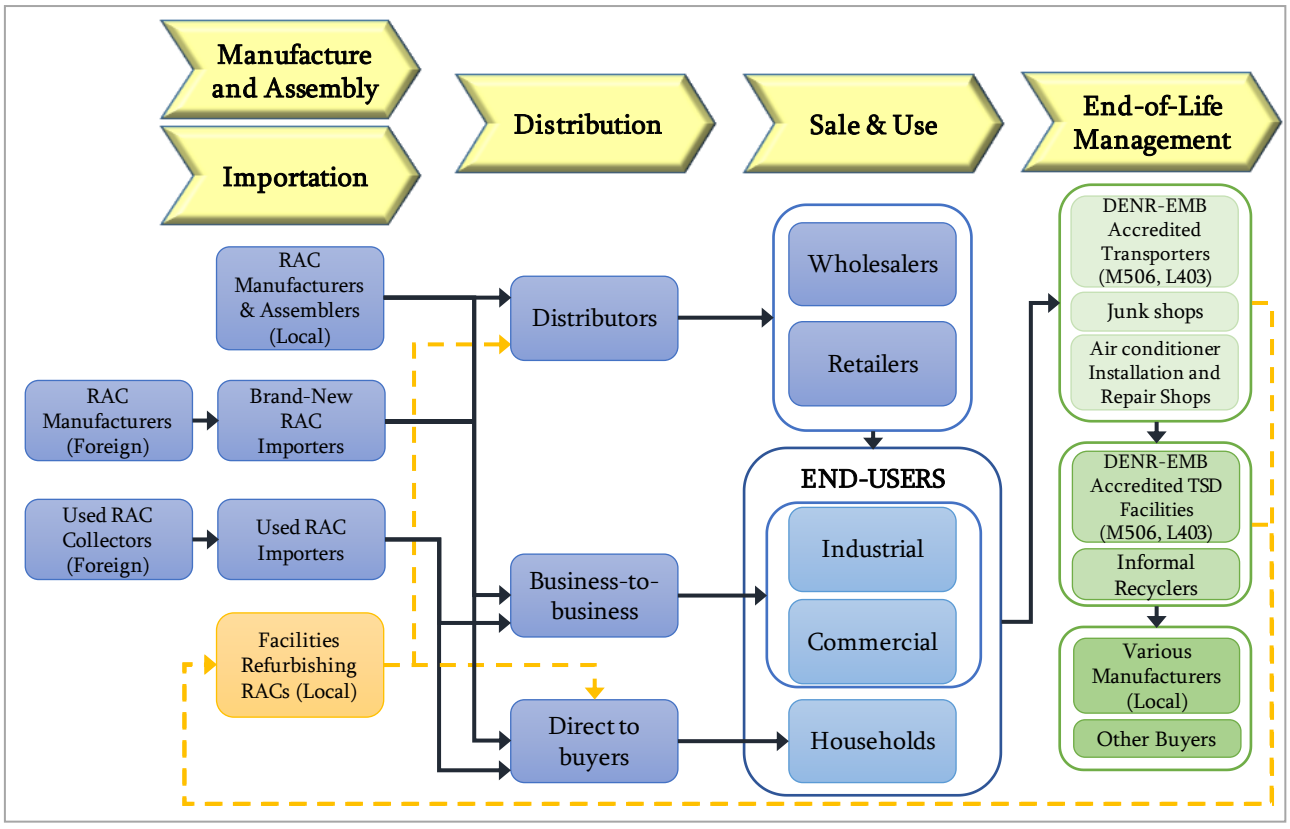
About 76% of imported and manufactured RACs are primarily distributed through wholesale and retail stores. In many cases, wholesalers and retailers are distributors, who procure RACs from domestic producers and importers. Some manufacturers, importers, and licensed distributors conduct business to business (B2B) sales – selling directly to procuring organizations in the industrial or commercial sectors. About 9% of products are sold to consumers through subsidiary companies' or manufacturers' own stores (**Error! Reference source not found.**). **Figure 3** shows the supply chain for RACs in the Philippines.

*Table 3: RAC distribution and sales channels[18]*

| Distribution/Sales channel | In-country produced RACs | Imported RACs | Average |
|---|---|---|---|
| Via distributors | 80.0% | 71.2% | **75.6%** |
| Business-to-business | 10.0% | 20.6% | **15.3%** |
| Direct-to-buyers | 10.0% | 8.2% | **9.1%** |

[13] Euromonitor data (804,700 units) is referenced. The data was compared to World Bank data (841,664 units and JARN data (880,000 units).
[14] Indicated during meetings with local manufacturers. RAC import data from Bureau of Customs was not available. The product data from retailer surveys indicates that about 40% of RAC models on the market are manufactured in the Philippines. The data collected through retail surveys does not reflect sales-weighted data.
[15] Laguna Province Profile. https://www.laguna.gov.ph/province/province-profile
[16] The difference between manufacturer and assembler is that the latter imports all parts and only assemble the product domestically. This distinction is made only in this section and rest of the report will refer to RAC manufacturers and assemblers in the Philippines as producers.
[17] S.E. Asia: The Philippines. http://www.ejarn.com/detail.php?id=49175
[18] Data from manufacturers, assemblers, and importers surveys.

*Figure 3: Supply chain diagram for RACs*

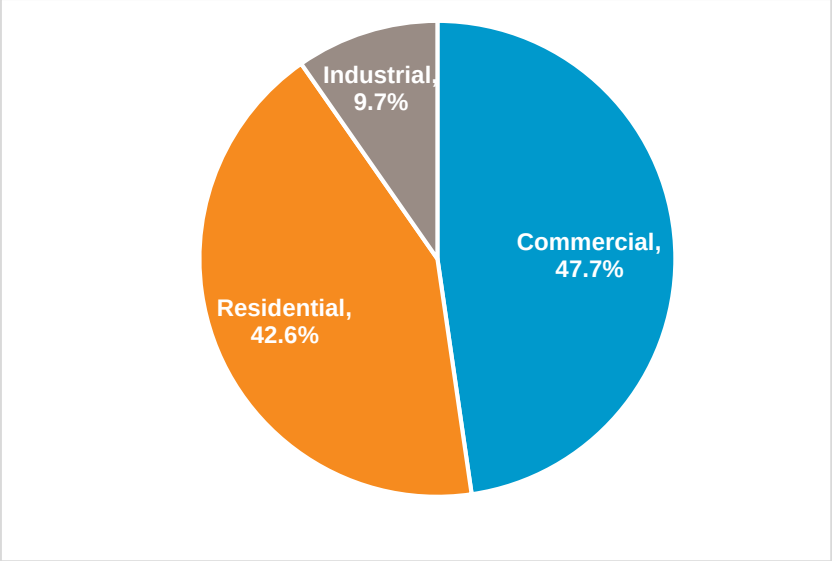



Nearly 43% of RACs are sold to households, while about half are purchased by the commercial sector and 10% by the industrial sector. The breakdown of sales by consumer type is presented in **Figure 4**Figure 4. Residential buyers usually purchase RACs from retail stores such as stand-alone appliance stores or department stores in major malls. Small commercial establishments usually procure RACs through traditional appliance stores, or through distributor or subsidiary company stores. Other major buyers such as hotels, schools, small office rental companies, real estate developers, and other commercial and industrial establishments usually purchase products using a B2B procurement method, which includes a bidding process to determine the winner among participating providers.

Wholesale and retail stores generally have partner companies that install purchased RACs. Installation services are usually provided by RAC distributors or third-party service companies specializing in the installation and maintenance of RACs.

The second-hand RAC market in the Philippines is very small, with products imported from Korea and Japan. In 2017, the country imported a total of 6,250 second-hand units, which corresponds to less than 1% of the entire RAC market. This estimate does not capture locally refurbished RACs. Second-hand RAC importers are required to annually estimate the maximum number of units they will be importing from their source countries and file it with the Hazardous Waste Management Section (HWMS) of the Department of Environment and Natural Resources (DENR). Second-hand RACs are distributed and sold directly to small-scale commercial establishments and households. There are no trade-in or similar programs for RACs in the Philippines.

*Figure 4: Breakdown of RAC sales by sector*[19]




## 3.2 Key Players

The Philippines' RAC market is unique as it is the only market in the region where window units are still predominant.[20] CLASP identified a total of 48 brands from the retail survey. The market is diverse and no brands clearly dominate the market. **Figure 5** shows the most common brands available in the Philippines. Carrier, Koppel, Panasonic and Condura, all of which are produced in the Philippines, are the top brands in terms of models available on the market.

CCAC is the most prominent RAC manufacturer in the Philippines and holds the largest market share for window RACs. The company was established in 1997 as a joint venture between Concepcion Industries and Carrier Corporation. CCAC has dominated the RAC market in the Philippines offering domestically manufactured brands such as Carrier and Condura, and an imported brand – Kelvinator.[21]

Another local manufacturer, Koppel, Inc., manufactures Koppel brand products. Koppel, Inc. was established in 1904 to distribute railway equipment and throughout the years began to focus their business on providing air conditioning products for residential, commercial, and industrial applications. The company has nearly 300 accredited distributors, installers and service centers nationwide.[22] Interviewed stakeholders indicated that Koppel products are known for their high quality.

Panasonic Manufacturing Philippines Corporation (PMPC) runs a plant which produces primarily window units with production capacity of around 300,000 units a year.[23] Hitachi, Ltd., which holds about 3% of RAC market share, has a plant in the Philippines with capacity to manufacture 70,000 units annually.

Multiple other imported brands hold smaller parts of the market. Global brand such as LG, Mabe, GE, Midea, Hitachi and Sharp have market shares between 3-5% each. Brands such as American Home, Fujidenzo and

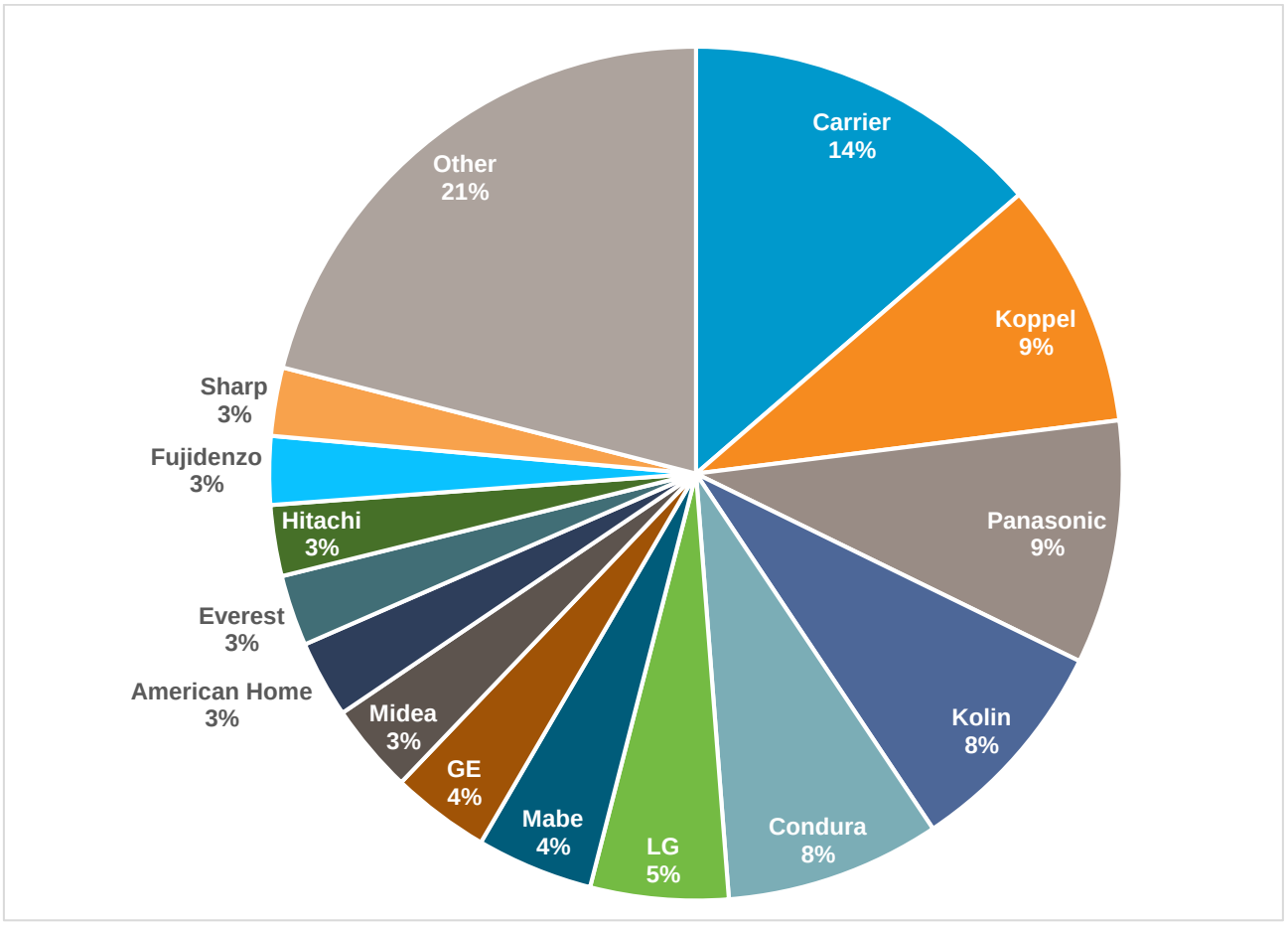
[19] This data was collected during consultant's survey of manufacturers, assemblers, and importers.
[20] S.E. Asia, http://www.ejarn.com/detail.php?id=49170
[21] http://www.carrier.com.ph/about-carrier-aircon-philippines.html
[22] http://www.koppel.ph/about-us/company-history/
[23] S.E. Asia: The Philippines. http://www.ejarn.com/detail.php?id=49175

Everest are particular only to the Philippines market[24] and share 3% of the market each. The rest of the 34 brands, some of which are also only sold in the Philippines, each have market shares of 2% or less.

The Department of Energy RAC certification program[25] has 95 brands registered for fixed-speed window and split models,[26] 47 of which were not identified during the retail surveys. The registry is cumulative and discontinued models have not been removed over the years. The difference in brands identified through the retail survey could be attributed to registered brands that are no longer sold or are sold in remote locations that were not surveyed during this assessment.

For some brands, only a small percentage of registered models were found in retail stores. For example, only 20-30% of registered models manufactured by Filipino-owned companies were found in the retail stores surveyed.

*Figure 5: RAC brands sold in the Philippines*

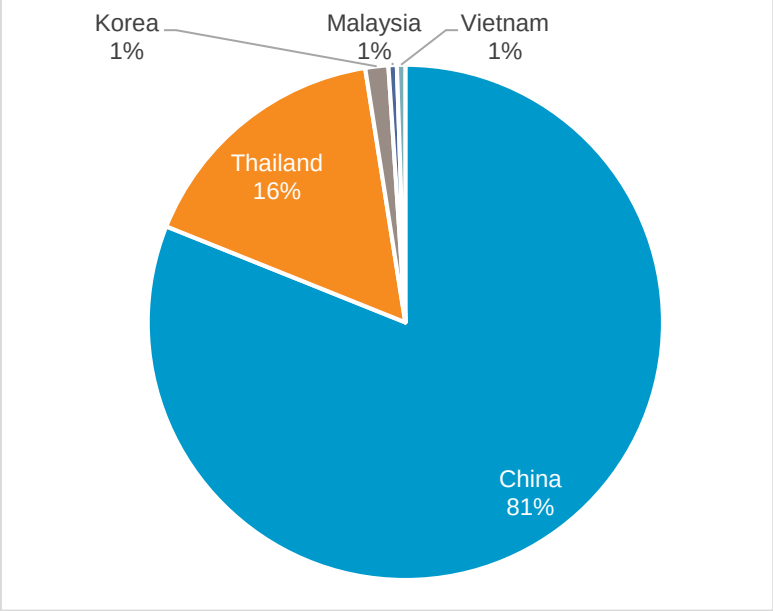



[24] RAC models for these brands are manufactured and imported from other countries. Because many RACs on the Philippine market do not list the country of manufacturer, we are not able to confirm, which manufacturers supply the models for these brands. Some of the brands are distributed only by a specific distributor or sold in a particular appliance store.
[25] Fixed-speed RAC models require DOE certification that they meet MEPS requirement prior to selling them in the Philippines.
[26] Currently RACs with inverter technology are not subject to regulation.

About 40% of models on the market are imported.[27] Chinese models accounts for over 80% of imported RACs (Figure 6). Thai models account for the second largest proportion of imported ACs, at approximately 16% imported RAC market share. A small number of models come from Korea, Malaysia and Vietnam.

Models from 37 brands, many of which might have originated from China, did not list country of manufacture on their name plates.

*Figure 6: Country of manufacture of RAC products (N=761)*




The Philippine Appliance Industry Association (PAIA) is an organization representing the manufacturers and importers of appliances, including RACs. The organization was created in 2003 by integrating the different appliance associations into one large organization to further the cause of all members.

The Lighting & Appliance Testing Laboratory (LATL) under the DOE's Energy Research and Testing Laboratory Services (DOE-ERTLS) is a government-owned laboratory that conducts RAC testing. In 2012, the laboratory was transferred from Quezon City to Taguig City. A new testing facility has been commissioned and is in the process of obtaining the ISO 17025 accreditation. The laboratory can test fixed-speed and inverter RACs up to cooling capacity of 50,000 kJ/h.[28]

Omni Solid Services Inc. has the first third-party AC testing laboratory in the Philippines. The facility was opened in 2012 to provide RAC testing services.[29] In 2015, Meralco, which is a utility company serving metro Manila, established the Meralco Power Lab to test electricity consumption of products, including RACs, to estimate costs of usage.[30] To date, the Power Lab has tested models from 12 different AC brands to determine operating costs.[31]

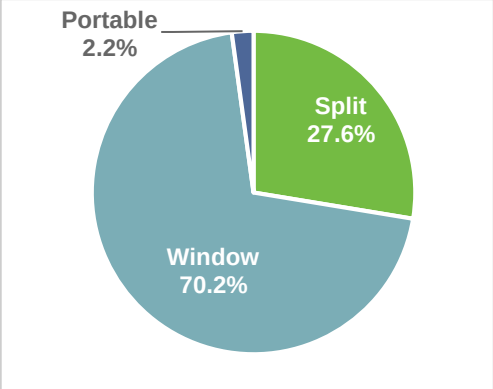
[27] Indicated during meetings with local manufacturers. RAC import data from Bureau of Customs was not available. The product data from retailer surveys shows that about 40% of RACs on the market are manufactured in the Philippines.
[28] ASEAN SHINE, 2016, Promotion of Higher Efficiency Room Air conditioners in the Philippines: National Roadmap, on Energy-efficient Air Conditioners 2016-2025.
[29] Omni Solid Services, Inc., http://www.omni.com.ph/whoisomni.html
[30] Meralco, And Here Comes Power Lab, http://blog.meralco.com.ph/and-here-comes-power-lab/
[31] https://meralcomain.s3.ap-southeast-1.amazonaws.com/images/ckeditor-documents/Aircon.pdf?null

# 4 Room AC Market Characteristics

## 4.1 RAC Types Available

The Philippines RAC market is unique in Southeast Asia as it is the only market dominated by window-type units[32,33] – 70.2% of models surveyed were window type (Figure 7). The market share of split units has only increased by about 5% since 2013.[34] A small number of portable units were also found on the market.

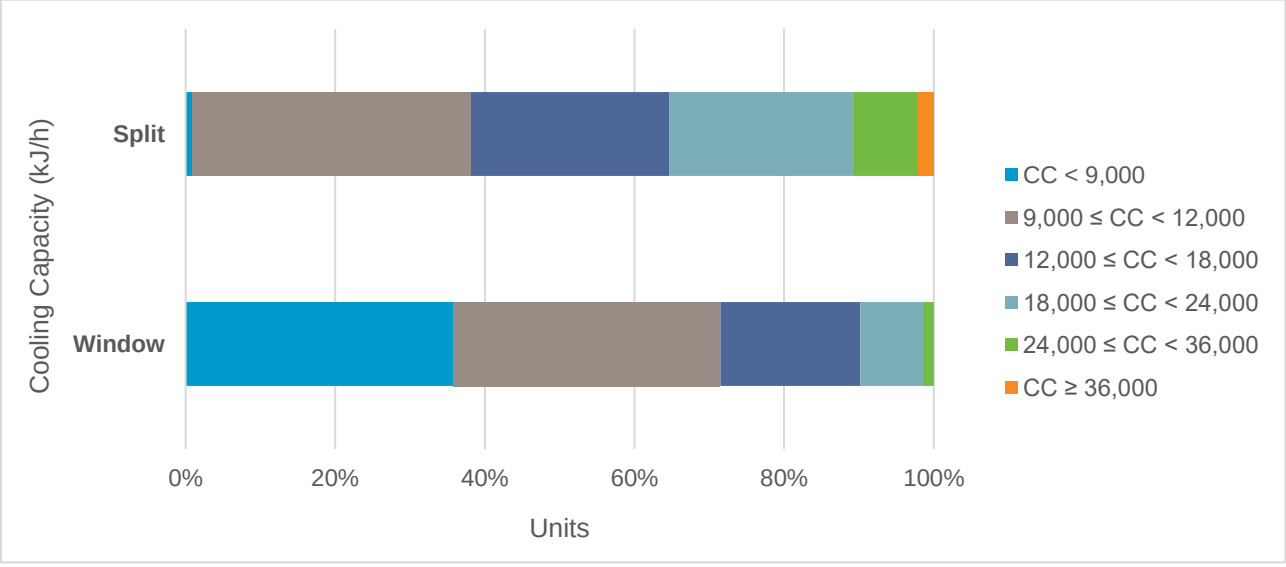
*Figure 7: RAC types (N=3,932)*




Window RAC units with cooling capacities under 12,000 kJ/h are the most popular models. Small window units with cooling capacities below 9,000 kJ/h have a significant window RAC market share, nearly 40% (Figure 8).

Split type RACs of smaller cooling capacities are also popular, nearly 40% are under 12,000 kJ/h. However, there are very few split type models on the market with cooling capacities less than 9,000 kJ/h. Split units on the Philippines market dominate larger capacities, especially above 18,000 kJ/h.

*Figure 8: Overview of RAC models by cooling capacities (N=3,871)*




[32] http://www.ejarn.com/detail.php?id=49170
[33] Because window units dominate RAC market in the Philippines while most of the other countries have transitioned to split type RACs, the subsequent analysis will be done separately for window and split types.
[34] CLASP used 2013 data to conduct the Philippines AC market assessment. The assessment was presented in ASAEN SHINE report Promotion of Higher Efficiency Air Conditioners in ASEAN: A Regional Policy Roadmap, 2015.

In the Philippines, cooling capacity of RACs is measured in kJ/h as well as horsepower (HP). The three most popular cooling capacities on the market are 5,000 kJ/h, 9,500 kJ/h and 12,660 kJ/h, which were used for the impact analysis detailed in **Sections 9 and 10**.

## 4.2 Refrigerants and Inverter Technology

About 60% of RACs available in the Philippines use R-410A refrigerant (Figure 9 and Figure 10). Nearly 8% RACs, primarily imported models, use R-32 refrigerant. Koppel, Inc. is the only domestic manufacturer that produces RACs with R-32 refrigerant.

The Philippine market has undergone a significant transition since 2013, when all RACs were reported to use R-22 (HCFC-22) refrigerant. Although HCFCs are being phased out globally, RACs with R-22 are still available in the country, particularly in window units. At present, 30 imported and domestically manufactured brands of window type and eight brands of split type RACs use R-22 refrigerant.

A common practice is to list the refrigerant content on an AC unit's name plate, to inform the consumer and servicing agents. However, a large number of surveyed RAC units in retail stores did not have refrigerant information on their name plates. For some units, missing refrigerant information was collected from online stores selling the same models.

*Figure 9: Refrigerant types for window RACs (N=2,586)*

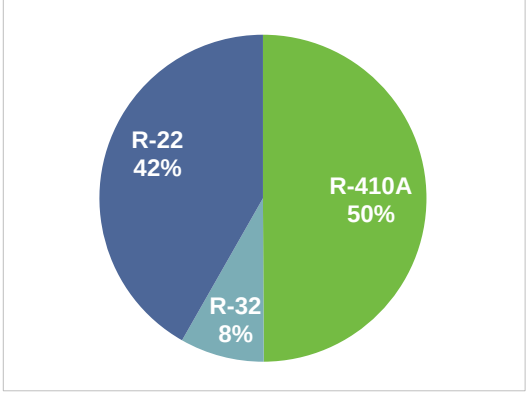
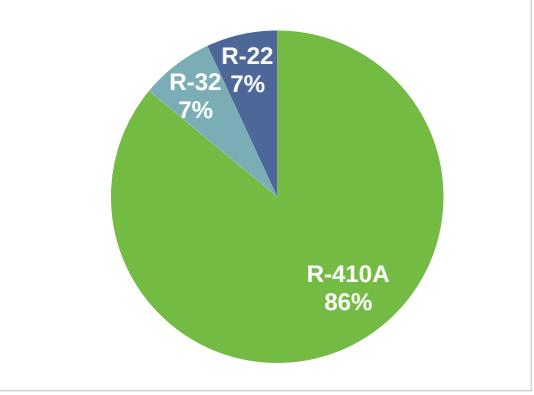



*Figure 10: Refrigerant types for split RACs (N=899)*




The Philippine RAC market has not seen major changes since 2013 and is still dominated by window units with fixed-speed compressors. Small size window units are favored by Filipino households having total market share of 25% – a similar picture from five years ago.

Nearly 87% of window units on the market have fixed-speed compressors (Figure 11), whereas the majority of split units, 78%, have inverter technology (Figure 12). The units with inverter compressors have been introduced to the market during the last five years. CLASP's 2013 study did not report any inverter type RACs.

*Figure 11: Compressor types for window RACs (N=2,762)*

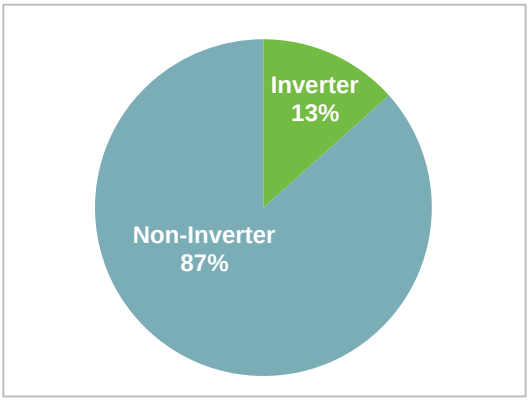
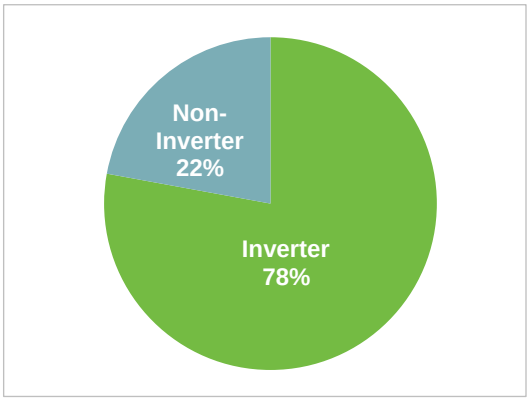


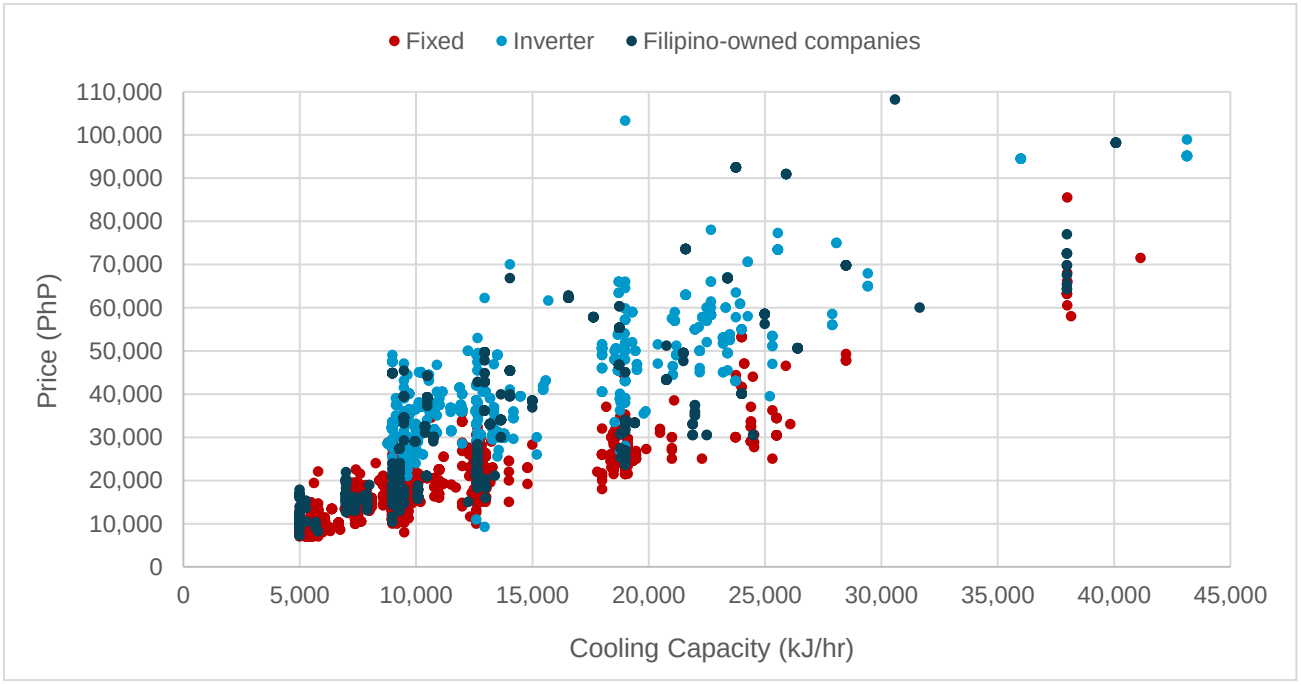

*Figure 12: Compressor types for split RACs (N=1,085)*




## 4.3 Prices

Prices for RACs in the Philippines increase with cooling capacity as should be expected (Figure 13). The prices of models manufactured by Filipino-owned companies are similar those for imported models. Prices vary by brand, and retailers' locations have no significant impact on RAC cost. The RACs sold in Visayas and Mindanao have the same cost as those of the same brand sold in Luzon by the same retailer. Similarly, the prices for identical models sold at multiple retailers are the same or vary only slightly.

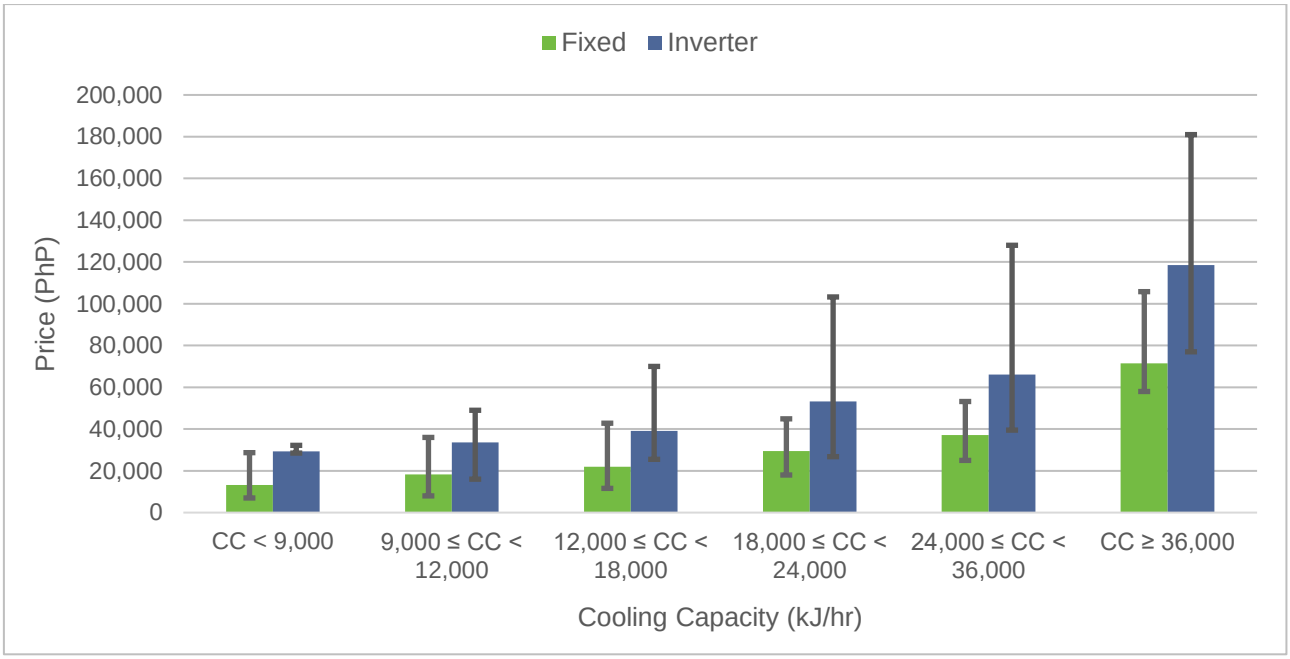
*Figure 13: Cooling capacity vs. price by compressor type (N=3,144)*




Inverter type RACs, on average, cost more than fixed-speed RACs (Figure 14). For all cooling capacities, excluding those below 9,000 kJ/h, the average price of an inverter unit is 40-45% higher. The price difference between units with fixed-speed and inverter compressors for the lowest cooling capacity group is 55%. Also, the prices of higher capacity models with inverter compressors have greater price variation.

The window and split type RAC price varies significantly depending on compressor type. On average the price difference between fixed-speed and inverter window units is greater than 70%, whereas the prices of split type RACs with inverter compressors are on average 55% higher than for fixed-speed split units.

*Figure 14: Price Ranges for Different Cooling Capacities (N=3,143)*




Other factors such as brand, functionality, appearance, technology used, or energy efficiency levels can explain some variation between prices for the same cooling capacities, but with limited data it is difficult to assess the impact of each factor on RAC prices.

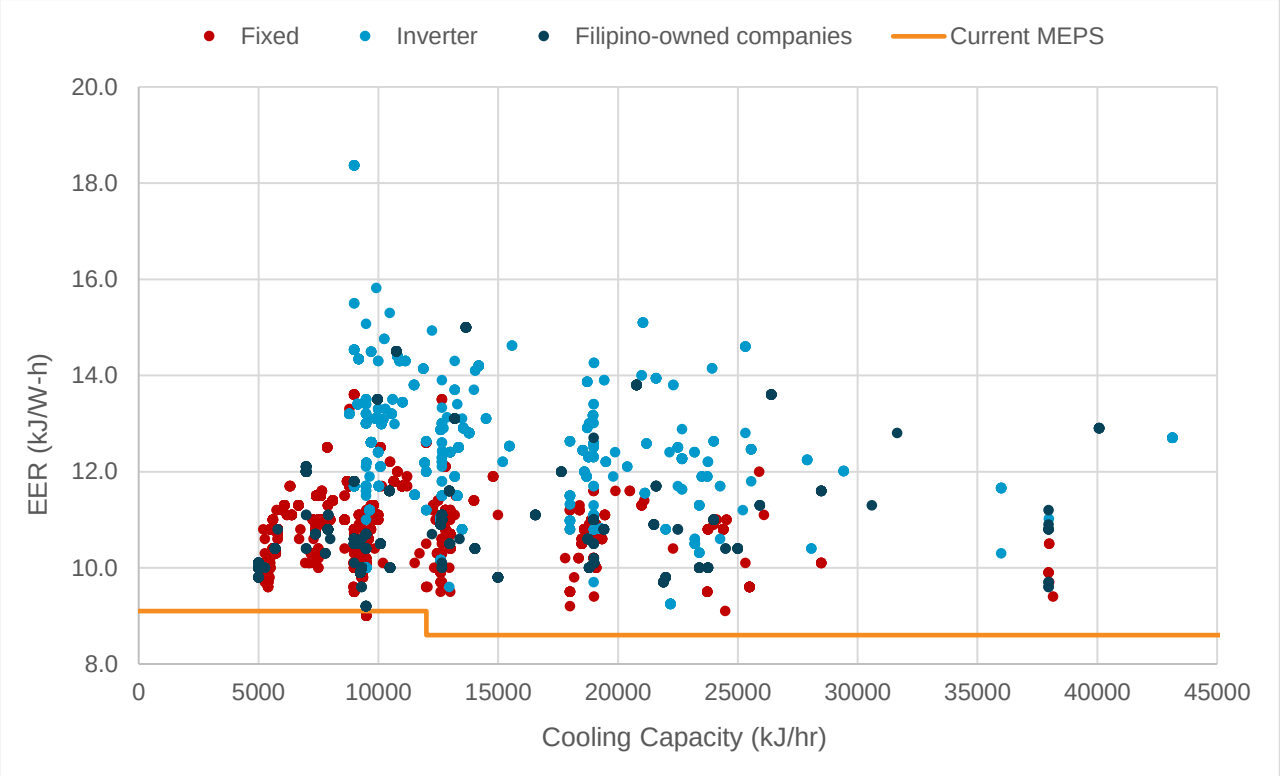
## 4.4 Energy Efficiency and Performance Metrics

The official energy efficiency metric for RACs, which is displayed on the energy label, is the energy efficiency ratio (EER) measured in kJ/W-h. Some models, especially those with inverter compressors, list an EER range, (e.g. 10.2-14.5 kJ/W-h) on the label. In such cases, the lower limit was recorded for the surveyed unit. Several inverter models from domestic brands had efficiency evaluated by seasonal energy efficiency ratio (SEER). At the regional level, under the ASEAN-SHINE initiative, W/W units are used for EER for the harmonized ASEAN 2020 Target. For this analysis we used kJ/W-h units. The conversions between kJ/W-h and W/W are as follows:

- 1 kJ/W-h = 0.2778 W/W; or
- 1 W/W = 3.6 kJ/W-h

Most fixed-speed RACs have EERs between 9.8 and 12.0 kJ/W-h, whereas the efficiencies of inverter units reach 16 kJ/W-h and above. Efficiencies of most models produced by Philippine-owned companies are between 10.0 and 12.0 kJ/W-h and some reach as high as 15.0 kJ/W-h. Efficiencies of all products on the market, except for two, are above the RAC MEPS, which correspond to the 2002 level of 9.1 kJ/W-h for capacities up to 12,000 kJ/h and 8.6 kJ/W-h for capacities at or above 12,000 kJ/h (Figure 15).

*Figure 15: Cooling capacity vs. efficiency by compressor type (N=3,096[35])*




## 4.5 Energy Labeling Practices

The DOE energy efficiency labeling program is mandatory only for fixed-speed RACs. Nearly all, 99%, of surveyed fixed-speed RACs sold in retail stores bore the energy efficiency label, commonly called the 'yellow label' (Figure 16 and Figure 17) This label indicates that the energy performance of the product has been certified by DOE. To distinguish the precedence of the performance information in this analysis, "certified" means that RAC bears a yellow label, whereas "advertised" means that the EER claimed is not DOE-certified. Advertised EER values are commonly listed on the RAC's nameplate. None of the surveyed inverter products had the energy efficiency label as they currently are not subject to energy labeling requirements.

The yellow label is a comparative label listing only energy performance and other product information; it does not feature any rating levels (star or other categories) to inform consumers of relative efficiency. Consumers do not find this label informative, as shown by the 2011 Household Energy Consumption Survey (HECS).[36] Only about 26.3% of all households were aware of the energy labeling program and only 9.2% could understand the information written on the energy label.

[35] The EERs for RACs were collected during retail store surveys. Some inverter type RACs indicated an EER range, in which case the lower bound of the range was used for the analysis. No conversion calculations were performed for EER.
[36] As published by the Philippine Statistics Authority and DOE.

*Figure 16: Labeling of fixed-speed RACs (N=2,591)*

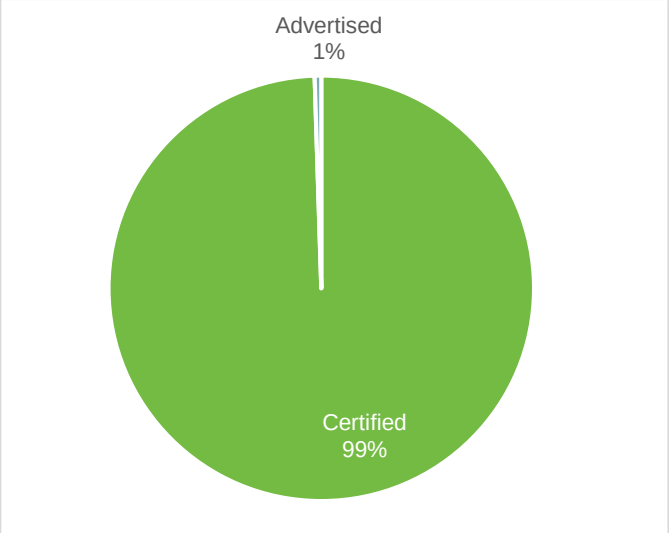
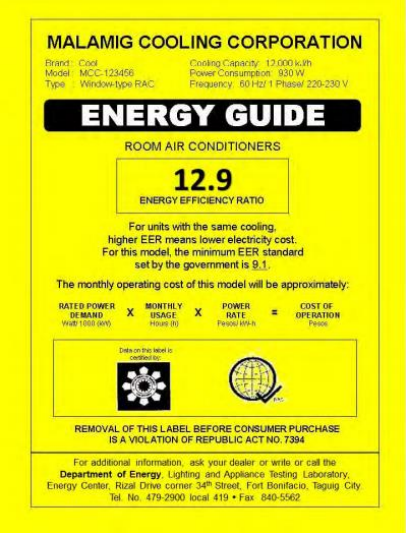
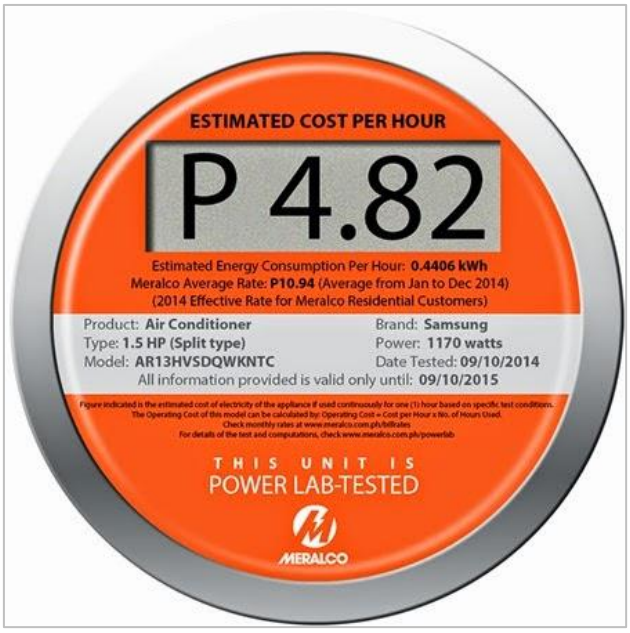



*Figure 17: DOE energy label (yellow label)*




Another initiative worth noting is Meralco's Orange Tag Program. Meralco, a utility serving primarily metro Manila, test some appliances (including RACs) at its Power Lab and provides them with an energy label similar to the DOE energy label. The orange tag (Figure 16Figure 18) provides information on the financial cost of operating an appliance (in Philippine pesos per hour) instead of the EER. This information is arguably much more useful to ordinary consumers than EER, provided that the consumer understands that electricity rates change monthly and that operating RACs at lower temperatures translates to higher energy consumption. As of August 2018, Meralco has provided at least 99 RAC models with the orange tag.[37]

*Figure 18: Meralco Orange Tag*




[37] https://meralcomain.s3.ap-southeast-1.amazonaws.com/images/ckeditor-documents/Aircon.pdf?null

## 4.6 Consumer Practices and Preferences

Residential buyers typically purchase RACs at retail stores such as stand-alone appliance stores or department stores in major malls. Some online stores sells RACs as well. The Philippines has a tropical climate and all the units available on the market provide cooling only.

Generally, consumers in the Philippines prefer low-cost units but some of them favor domestically produced brands, which have higher prices as compared to imported ones. The preference is reflected in the larger market shares of domestic brands. The reasons behind this preference for domestic brands may include their prominence, known good quality (with excellent after sales service), and associated perception of greater value.

A limited number of commercial and institutional RAC users that procure large quantities of RACs were interviewed, including property developers and a government organization. These surveys offered additional insights, but, due to a very limited number of responses, the data is not representative of the entire sector. Nevertheless, most of respondents indicated that energy efficiency was the most important factor when procuring RACs, giving preference to units with EERs of 12 kJ/W-h and above. The cost and refrigerant type used is a concern only to some.

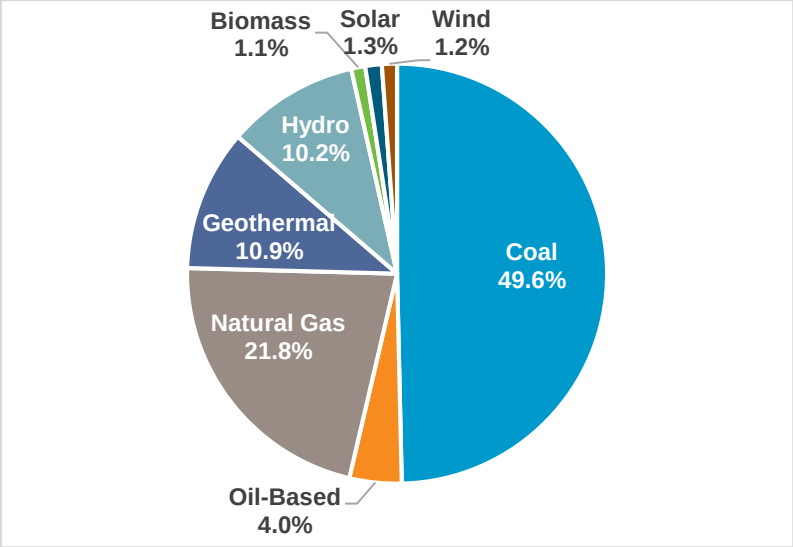
In regards to usage, residential users generally operate RACs only at night while sleeping, with occasional daytime usage during the hotter months of April and May. RAC usage at commercial offices coincides with the offices' operating hours, typically 8:00 am to 5:00 pm.

# 5 Power Sector

## 5.1. Power Generation and Consumption

The Philippines' primary source of energy supply is coal, which constitutes approximately half of the energy generation mix (Figure 19). Natural gas has a significant share of 21.8% in power generation and only 4% of energy is produced from oil-based sources by gas turbine, oil thermal, and combined cycle systems. Nearly a quarter of energy is produced by renewable energy sources, of which geothermal and hydro are the largest.

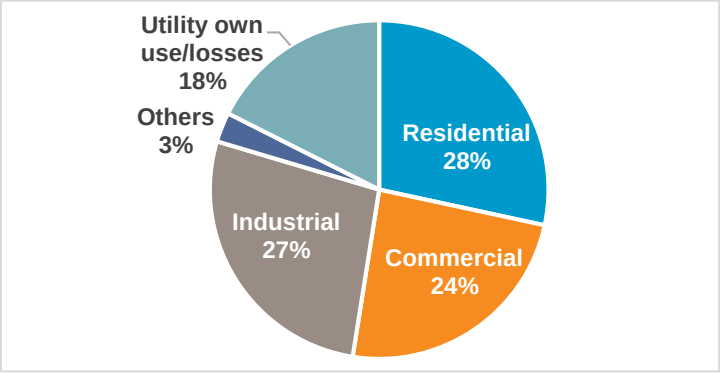
*Figure 19: Power generation by source*[38]




In 2017 total installed generating capacity was 22.7 GW, which grew by 6.1% relative to the year before. The added capacity came from expanded coal-fired, solar, oil-based, and hydropower facilities.

According to the DOE, gross power generated in 2017 by various generating facilities in the Philippines totaled 94,370 GWh. Residential, commercial, and industrial sectors consume nearly equal amounts of energy, with the residential sector having a slightly larger consumption equal to 26,782 GWh in 2017 (Figure 20). According to the 2011 HECS survey, about 9.5% of households own at least one RAC. These households are responsible for approximately 14% of total residential sector energy consumption.

*Figure 20: Philippine power consumption by sector*[32]




In 2017, transmission and distribution losses were 8,261 GWh, equal to 8.8% of total energy consumption.[32]

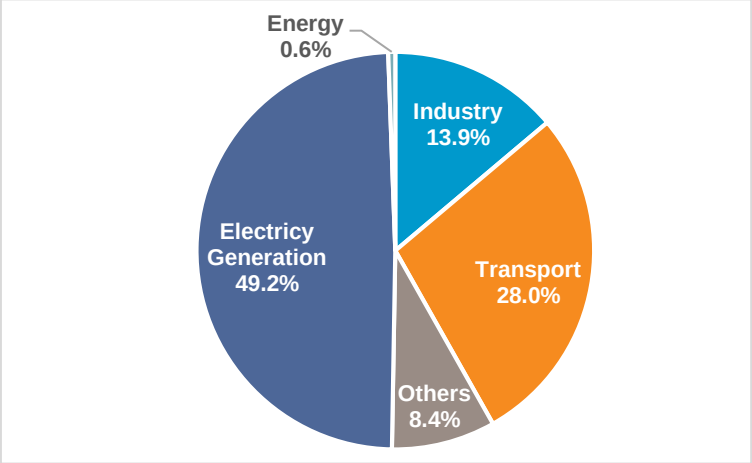
[38] Philippine Power Statistics, https://www.doe.gov.ph/philippine-power-statistics

## 5.2. GHG Emissions

The DOE estimated that of the 118.5 MT of $CO_2$ equivalent ($CO_2e$) generated in 2017, the Philippine power sector was the largest contributor, generating nearly 58.2 MT (49.2%) of CO2e (Figure 21). About 28% of emissions were generated by the transport sector, and nearly 14% by the industrial sector. Residential, commercial, and agricultural sectors accounted for 8.4% of all emissions.

GHG emissions in the Philippines have been increasing at an annual rate of about 3.14%, as calculated from the total GHG emission data from 1990 to 2017.[39] This may be attributed to general economic growth as well as the rapid expansion of electricity generation capacity. Energy generated by coal-fired plants has nearly tripled since 2007, while generation from renewable energy sources increased only slightly.[40] DOE estimates that in 2017 the Philippines emitted 0.62 MT of $CO_2e$ for each MWh of electricity generated.

*Figure 21: Philippine GHG emissions by sector[41]*




## 5.3. Power distribution and electricity rates

The electrification rate in the Philippines is 83%. It is higher for urban areas – 94% – as compared to rural areas, where the electrification rate is at 73%.[42] Generated power is transmitted to load centers, which are operated by the National Grid Corporation of the Philippines (NGCP) with supervision of the government-owned National Transmission Corporation. Electricity is then distributed to users by over 100 private distribution utilities (DUs), electric cooperatives, and local government units, as regulated by the Energy Regulatory Commission (ERC).

Manila Electric Company (Meralco) is the largest power distribution company in the Philippines, providing energy for 4,298 on-grid and 36 off-grid *barangays*[43] in metro Manila and the surrounding provinces.[44] The areas outside metro Manila are served by smaller private DUs, electric cooperatives, and local government units under the supervision of the National Electrification Administration. Aside from electricity distribution, the DUs also manage charges on behalf of NGCP, National Power Corporation, and independent power producers. These charges are part of the monthly electricity bill, which also includes other ERC-regulated wheeling and pass-through charges such as supply, metering, and system loss charges.

[39] Philippine Power Statistics, https://www.doe.gov.ph/philippine-power-statistics
[40] Ibid.
[41] Energy sector includes oil refining, electricity, and other energy sector's own use and losses.
[42] https://www.pids.gov.ph/press-releases/134
[43] Divisions which can be a village, district, or a ward.
[44] https://www.doe.gov.ph/ducsp/profile/meralco

DUs provide the Lifeline Discount for marginalized residential users as mandated by the Republic Act 9136 or the Electric Power Industry Reform Act of 2001 (EPIRA Law). This discount is applicable to consumers using 100 kWh or less a month, following a graduated scale as shown in **Table 4**. Since the government of the Philippines does not subsidize electricity, this discount is subsidized by users consuming more than 100 kWh of electricity per month.

*Table 4: Lifeline Discount scale*

| Consumption (kWh) per month | % Lifeline Discount |
|---|---|
| 20 kWh and below | 100% |
| 21 to 50 kWh | 50% |
| 51 to 70 kWh | 35% |
| 71 to 100 kWh | 20% |

Based on the ERC Resolution No. 23 Series of 2010, qualified residential senior citizens are given another 5% discount if they consume 100 kWh or less of electricity for a particular month. The Senior Citizen Subsidy is subsidized by consumers using more than 100 kWh, similarly to the Lifeline Discount.

There are inherent differences in the charge rates of each DU, prompting variations in the effective electricity rates between utilities. Additionally, under the EPIRA Law, consumers connected to the main grid subsidize a percentage of the cost of electricity for areas outside the grid through a Universal Charge on Missionary Electrification. None of the government agencies collect and consolidate data on the monthly rates of all DUs in the Philippines. **Table 5** shows Meralco residential electricity rates for October, 2018. The rates are lower for the consumers who use 100 kWh or less.

*Table 5: Meralco electricity rates (October, 2018)*[45]

| Consumption per month (kWh) | Rate per kWh (PhP) | Rate per kWh (USD) |
|---|---|---|
| 50 | 5.4 | 0.10 |
| 70 | 6.8 | 0.13 |
| 100 | 8.1 | 0.15 |
| 200 | 10.0 | 0.19 |
| 300 | 10.3 | 0.19 |
| 400 | 10.6 | 0.20 |
| 500 and above | 11.2 | 0.21 |

Meralco rates are lower than the rates of most DUs, which can be by as much as PhP 4.00. Because Meralco provides power to over half of consumers in the country, the national electricity rate will only slightly differ from Meralco rates.

[45] Meralco Rates Archives, https://company.meralco.com.ph/news-and-advisories/rates-archives

# Policy Options and Impacts Assessment

# 6 Legal & Regulatory Framework Overview

The Philippines' Republic Act No. 7638, also known as the Department of Energy Act of 1992, created the Department of Energy and mandated it to prepare, integrate, coordinate, supervise and control all plans, programs, projects and activities of the Government related to energy exploration, development, utilization, distribution, and conservation. DOE implements programs, projects and policies aiming to build a more energy-efficient country and "help making energy efficiency and conservation a way of life for all Filipinos".[46]

The Bureau of Product Standards of the Department of Trade and Industry (BPS-DTI) is the National Standards Body of the Philippines, as mandated by Republic Act 4109, known as the Standardization law of the Philippines. It develops, promulgates, implements, and coordinates standardization activities in the country. The Bureau is mainly responsible for development of relevant Philippine National Standards, product certification, and enforcement activities. When developing standards, BPS consults with stakeholders representing government and the private sector.

The Energy Efficiency Standards and Labeling (EES&L) Program started in 1992 when DOE, DTI, and the Association of Home Appliance Manufacturers (AHAM), now called the Philippine Appliance Industry Association (PAIA), signed an agreement for voluntary labeling of household air conditioners. In 1993 the program became mandatory. EES&L program has expanded since then to include refrigerators (1999) and lighting products (2003 and 2010).

EES&L has been jointly developed and implemented by DOE and DTI through their bureaus, departments, and regional offices. DOE is responsible for overseeing performance and labeling requirements through product certification, and issuance and validation of energy labels. DTI is the authority responsible for market monitoring and enforcement activities, which are implemented in collaboration with DOE. Under the Memorandum of Agreement between the two agencies, the Lighting & Appliance Testing Laboratory (LATL) under Energy Research and Testing Laboratory Services (DOE-ERTLS) conducts energy performance testing of the appliances. The institutional structure of EES&L program implementation is shown in Figure 22.

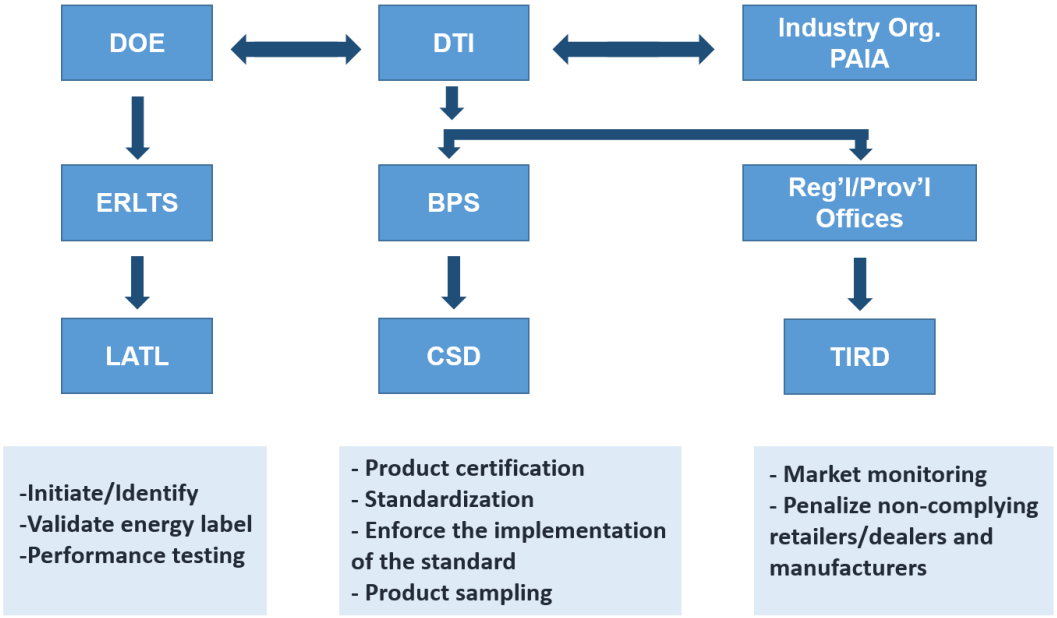
The EES&L program falls under the National Energy Efficiency and Conservation Program (NEECP), launched in 2014, which aims to strengthen the implementation of energy efficiency and conservation plans and programs under the Philippine Energy Plan (PEP). The latest Energy Efficiency and Conservation Roadmap 2017-2040 lists energy standards and labeling for key residential appliances such as RACs, refrigerators, televisions, and washing machines as one of the initiatives to achieve energy efficiency goals.

In 2016, DOE issued Department Circular No. DC 2016-04-005 titled "Declaring the Compliance of Importers, Manufacturers, Distributors and Dealers of Electrical Appliances and Other Energy-Consuming Products with the PESLP as a policy of the Government," supporting the Philippine Energy Efficiency Standards and Labeling Program (PESLP)[47] and mandating that DOE implement compliance activities as it relates to appliance energy efficiency. The Circular requires importers, manufacturers, distributors, and dealers of electrical appliances and energy-consuming products to comply with PESLP requirements. The implementing guidelines of this circular are currently under review. The product particular energy performance and labeling requirements for the three product groups will be covered under the guidelines, shifting from requirements in mandatory national standards, which will provide more flexibility and reduce the time it takes to update the policies.

An Energy and Conservation Act, which is under review in the Congress and yet to be passed would provide the authority to the DOE to implement the PESLP program and a dedicated budget for it.

[46] DOE Sectoral Plans and Roadmaps, 2017-2040, https://www.doe.gov.ph/sites/default/files/pdf/pep/pep_volume_2_sectoral_plans_and_roadmaps.pdf
[47] Former Energy Efficiency Standards and Labeling (EES&L)

*Figure 22: Implementing agencies of EES&L program*




The Philippines signed the Montreal Protocol on September 14, 1988 and ratified it on March 21, 1991. As a signatory to and party that ratified the Montreal Protocol, the Department of Environment and Natural Resources (DENR) issued an Administrative Order (DAO) 2000-18 (Chemical Control Order on ODS) to set a phase-out schedule for Ozone Depleting Substances (ODSs) such as CFCs and HCFCs. This was amended with DAO 2004-08 and finally, DAO 2013-25, which reinforces the banning of CFCs and provides details on the phasing-out of HCFCs. The phase-out schedule for the refrigerant R-22 (HCFC-22) based on DAO 2013-25 is shown in **Table 6**. On the other hand, there are currently no regulations being implemented on the usage, manufacture, and importation of HFCs.

*Table 6: Phase-out Schedule for R-22*

| Schedule | HCFC Usage Prohibition |
|---|---|
| **By January 1, 2020** | Importation of HCFC-22 for the manufacturing of refrigeration and air conditioning will be absolutely prohibited, except for in the servicing sector |
| **By January 1, 2030** | Importation of blends containing HCFCs will be absolutely prohibited |
| **By January 1, 2040** | All kinds of importation of HCFC substances for manufacturing and servicing sector will be prohibited, except for essential use |

The Philippines is yet to ratify the Kigali Amendment. If ratified, the Philippines will follow the phase-down schedule for countries under Article 5 Parties Group 1, marked by a freeze in HFC consumption by 2024.

# 7 RAC Policy Framework (S&L)

Initially published in 1995, the Philippine National Standard (PNS) 396-1, or the Household Appliances – EER and Labelling Requirements Part 1: Non-ducted air conditioners provided MEPS and labeling requirements for fixed-speed window RACs has undergone several revisions. In 2002, the scope of the mandatory labeling and MEPS requirements was expanded to include all non-inverter split-type RACs. The last revision of PNS 396-1 in 2007 included fixed-speed window and split air conditioning systems with capacities up to 30,000 kJ/h. RACs that are subject to this regulation are required to obtain DOE certification and have affixed an energy label (yellow label) on the product at the point of sale.

The last update for RAC MEPS was in 2002 (Table 7). Fixed-speed RACs are subject to the 2002 level MEPS: 9.1 kJ/W-h EER for RACs with cooling capacity below 12,000 kJ/h and 8.6 kJ/W-h EER for cooling capacity of 12,000 kJ/h and above.

*Table 7: Philippine MEPS for RACs from 1995 to 2002*

| Classification of RACs | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|
| **Cooling capacity < 12,000 kJ/h** | 8.3 | 8.3 | 8.3 | 8.7 | 8.7 | 8.7 | 9.1 | **9.1** |
| **Cooling capacity ≥ 12,000 kJ/h** | 7.4 | 7.8 | 7.8 | 7.8 | 8.2 | 8.2 | 8.2 | **8.6** |

Inverter-type RACs are not covered by current requirements. The new PPR for RACs under the PESLP IG, will include requirements for both, inverter and fixed-speed type units. The energy efficiency metric will also change from EER to the cooling seasonal performance factor (CSPF). Proposed mandatory MEPS levels for fixed-speed and inverter type RACs with rated capacity up to 9.99 kW are as follows:

- 3.08 CSPF[48], for rated capacity below 3.33kW; and
- 2.81 CSPF, for rated capacity 3.33kW to 9.99 kW[49].

The above MEPS will be voluntary for fixed-speed window type RACs and will become mandatory during the next revision of MEPS in 2021.

PNS 240:1998/ISO 5151:1994 - Non-ducted air conditioners and heat pumps – Testing and rating performance is a mandatory testing protocol for fixed-speed RACs. When PESLP IG comes into force, testing of inverter RACs will be required in accordance with PNS ISO 16358-1: 2014 Air-cooled air conditioners and air-to-air heat pumps - Testing and calculation methods for Seasonal Performance Factors-Part 1 Cooling Seasonal Performance Factor. The testing protocol for fixed-speed RACs will be updated to PNS ISO 5151:2014 - Non-ducted air conditioners and heat pumps – Testing and rating performance.

PNS 396-1:2007 also requires that an energy label be affixed to the RAC units. The label contains information such as EER, cooling capacity, rated voltage, current, frequency, power input, name of manufacturer or importer, brand name, model, and type (Figure 23). In the PPR, an enhanced energy label that includes a star rating for energy efficiency levels is proposed (Figure 24). The levels for the star ratings are summarized in **Table 8**. Note that the RACs with capacities of 10.0 kW to 14.0 kW are subject to labeling requirements, but there will be no MEPS for these capacities.

[48] Equal to 2.9 EER.
[49] Department of Energy (DOE), 2018. DC2016-04-0005, PPR 01: AC. Annex B.1 Particular Product Requirements: Air Conditioners.

*Table 8. Energy Efficiency Classification for energy label (window and split type RACs)[50].*

| Level | Cooling Seasonal Performance Factor (CSPF) | | |
|---|---|---|---|
| | < 3.3 kW | 3.33 kW to 9.99 kW | 10.0 kW to 14.0 kW |
| **One Star** | 3.08 to 3.31 | 2.81 to 3.11 | ≤ 3.11 |
| **Two Stars** | 3.32 to 3.55 | 3.12 to 3.42 | 3.12 to 3.42 |
| **Three Stars** | 3.56 to 3.79 | 3.43 to 3.73 | 3.43 to 3.73 |
| **Four Stars** | 3.80 to 4.00 | 3.74 to 4.00 | 3.74 to 4.00 |
| **Five Stars** | ≥ 4.01 | ≥ 4.01 | ≥ 4.01 |
| **One Star** | 3.08 to 3.31 | 2.81 to 3.11 | ≤ 3.11 |

*Figure 23: DOE energy label (yellow label)*

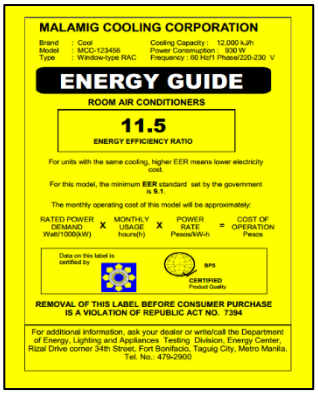
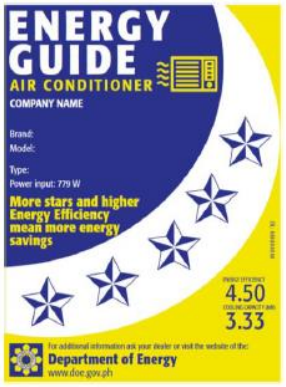



*Figure 24: Proposed DOE energy label with star rating*




[50] Ibid.

# 8 Introduction and Methodology

CLASP evaluated policy scenarios to assess impacts from increasing the RAC MEPS to various levels.

To achieve this CLASP used the Policy Analysis Modeling System (PAMS), which CLASP and Lawrence Berkeley National Laboratory developed to help policymakers assess the costs and benefits of S&L programs.

PAMS is an easy-to-use software tool that helps policymakers assess the benefits of S&L programs and identify the most attractive targets for MEPS levels. It is an Excel workbook designed to give first-order policy impacts projections with a minimal preparatory research on the part of local policymakers. The model can be also used to perform robust technical analysis to support the development of MEPS, by customizing the tool with any country-specific data that is available.

PAMS can estimate savings potential from implementing policies that improve the energy efficiency of products in any economy. The impacts are examined from two perspectives – the consumer and national perspective:

- **At the consumer level,** savings are estimated using life-cycle cost (LCC) metric - the total costs of owning the appliance, including the purchase price and the electricity cost throughout its life between business as usual and the improved policy scenario.
- **At the national level,** energy savings are expressed in terms of the reduction in national energy consumption due to more efficient appliances as well as in terms of avoided $CO_2$ emissions resulting from reduced electricity consumption.

In this analysis, CLASP evaluated the impacts to consumer as well as impacts at the national level for selected policy scenarios. Additionally, CLASP estimated the impacts to the manufacturers by calculating the number of models eliminated from the market under more stringent MEPS.

## 8.1. Cost-Efficiency Relations

Many factors such as brand, appearance, technologies used, refrigerant used or smart functionalities, may affect the price of RAC. However, usually improved efficiency increases the up-front cost of the appliance. CLASP uses cost-efficiency curves to establish the relationship between price and efficiency, in order to assess the impacts to consumers of raising MEPS. The best way to develop a cost-efficiency curve is through an engineering analysis where individual costs and efficiency improvements are obtained for each component of the AC. This process often requires substantial resources to complete. In this impacts analysis, we develop a relationship between cost and efficiency through the market data collection and regression analysis.

We performed a multiple regression analysis on EER, cooling capacity (CC) and price. The analysis included data for 2,999 RAC models with capacities varying from 5,000 kJ/h to 64,355 kJ/h and EER between 9.0 kJ/W-h to 18.37 kJ/W-h. The output of the regression analysis can be found in **Appendix B**. The R square value of the regression model was 0.746, indicating that the model, using cooling capacity and efficiency, explains approximately 75% of the variation in price. The p-values for both variables, EER and cooling capacity, are much smaller than 0.01, indicating the relationship between both variables and AC prices is highly statistically significant. This relationship can be expressed by the following equation:

$$Price = -32{,}506.7 + 3{,}078.5(EER) + 2.04(Cooling\ Capacity)$$

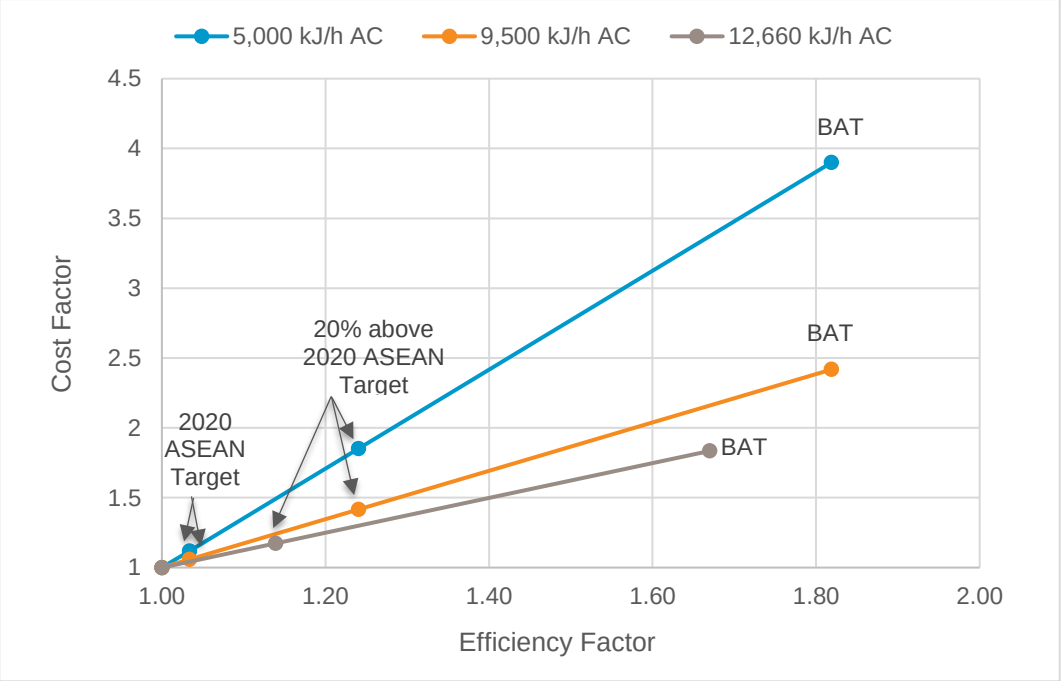
Whereas: Price is in USD/unit, EER is in kJ/W-h and CC is in kJ/h.

By using the above equation, we calculated cost and efficiency factors and plotted cost-efficiency curves for the three most popular cooling capacities found on the market, - 5,000 kJ/h, 9,500 kJ/h, and 12,660 kJ/h (Figure 25). These three most popular cooling capacities were analyzed separately. The baseline EER for each capacity was obtained by identifying the EER, which occurred most frequently among those models. Baseline prices were calculated by taking the average price of those models on the market with the most common EER for that particular cooling capacity. The inputs are summarized in **Table 10.**

The cost curve for smaller capacity models is steeper indicating that increase in efficiency is more costly as compared to larger capacity models. This could be, because the smaller capacity models are window units that

have less relevance in the international market, dominated by split units. There are only a handful of economies where window units dominate the market, making competition among international manufacturers and innovation less likely.

*Figure 25: RAC cost-efficiency curve*




Starting efficiency for the three base cases (equal to 1.0 efficiency factor in  This could be, because the smaller capacity models are window units that have less relevance in the international market, dominated by split units. There are only a handful of economies where window units dominate the market, making competition among international manufacturers and innovation less likely.

Figure 25) corresponds to the most common EER for the selected cooling capacity as shown in Table 9.

*Table 9: Baseline models selected for PAMS analysis*

| Base Case | Cooling Capacity | Estimated Market Share (% of total) | Most Popular EER on the Market | Average Price (PhP) | Average Price (USD) |
|---|---|---|---|---|---|
| Base Case A | 5,000 kJ/h | 25% | 10.1 kJ/W-h | 10,241 PhP | 190.2 USD |
| Base Case B | 9,500 kJ/h | 35% | 10.1 kJ/W-h | 13,335 PhP | 247.6 USD |
| Base Case C | 12,660 kJ/h | 40% | 11.0 kJ/W-h | 23,369 PhP | 343.0 USD |

## 8.2. Data Inputs

PAMS estimates the impacts of implementing policies that improve energy efficiency of new equipment by calculating the difference between a business-as-usual scenario (i.e., no policies implemented) and a policy scenario (i.e., higher MEPS or Best Available Technology). The model uses a bottom-up approach, based on a stock model and sales forecasts considering first purchase (increase in number of households and ownership levels) and replacement of retired appliances.

In the model, total energy consumption is estimated per year for the stock[51] in use under each policy scenario. Emissions are estimated using an electricity CO2-intensity emissions factor, CO2/kWh. Costs consider appliance prices (defined for each scenario using a cost-efficiency curve reflective of the market) and local electricity prices to estimate total life cycle cost (purchase price and cost of electricity bill over appliance lifetime).

CLASP used the following data inputs and assumptions to estimate the impacts under different scenarios:

- AC Sales data and forecasts for 2003 to 2022 are from Euromonitor, and validated with the AC sales estimates reported by the World Bank and JARN. The geometric mean compound annual growth rate (CAGR) of sales from 2003 to 2022 was calculated and used to project sales data from 1980 to 2002 and from 2022 to 2030. CAGR estimated at 4.3%.
- Lifetime of 8 years and 2,190 operating hours per year. These assumptions are based on 2011 HECS survey responses and information provided by local partners.
- Electricity price for the Philippines of 10.219 PhP/kWh, equivalent to 0.19 USD/kWh, based on the cost of electricity in August 2018 provided by Meralco.
- The standard year or year when policy is implemented is set at 2020.
- Consumer discount rate of 1.9%, national discount rate of 3.2% and real income growth rate of 5.1% from World Bank for 2017.
- Population and urbanization data from World Bank and Philippine Statistics Authority.
- Unit energy consumption was calculated based on the baseline values in **Table 9.**
- The exchange rate used for conversion to and from PhP and USD was 53.85 PhP/USD.[52]

[51] Appliances. In this case RACs.
[52] Exchange rate taken in October, 2018.

# 9 Policy Options and Results

## 9.1 Policy Options

CLASP identified the following three policy options for the impact analysis.

### 2020 ASEAN Target

The first policy option under consideration is adoption of the 2020 ASEAN Target of EER 2.9 W/W.[53] The RAC MEPS in the Philippines have not been revised since 2002 and are currently at EER 2.53 W/W (EER 9.1 kJ/W-h) for capacities below of 12,000 kJ/h and EER 2.39 W/W (EER 8.6 kJ/W-h) for capacities of 12,000 kJ/h and greater. The Philippines AC market is dominated primarily by small size fixed-speed window units with efficiencies between 9.2 kJ/W-h and 12.5 kJ/W-h, while most of the region has been rapidly transitioning to split units with more efficient inverter technologies, which in Thailand holds over 40% and in Vietnam - over 60% of the market. The Philippines will be in line with the ASEAN goal to harmonize AC MEPS in the region by 2020 by adopting this MEPS.[54]

### Adopting MEPS 20% above the 2020 ASEAN Target

The second policy option looks at increasing stringency of MEPS by 20% above the 2020 ASEAN Target. The MEPS for this policy scenario are equal to EER of 3.48 W/W (EER 12.53 kJ/W-h).

### Best Available Technology (BAT)

The third scenario, Best Available Technology (BAT), looks into increasing MEPS to the efficiency level of the best technology available on the market. The highest EER for AC available in the Philippines was found to be 18.37 kJ/W-h or 5.1 W/W.

## 9.2 Outputs

**Table 10**, **Table 11** and **Table 12** show the summary outputs of the three scenarios evaluated for the selected RAC cooling capacities identified as base cases A, B and C. It can be observed that all three policy options are cost-effective for the Philippines. Of the three scenarios, the 20% above the 2020 ASEAN Target scenario provides the greatest overall benefits as compared to the associated costs for larger capacity units under base cases B and C. More in depth discussion of the PAMS analysis is included in the following section.

*Table 10: PAMS Output Summary for 2020 ASEAN Target scenario[55]*

| Metric | Base Case A (5,000 kJ/h) | Base Case B (9,500 kJ/h) |
|---|---|---|
| **Consumer-Level Benefits** | | |
| Payback Period (years) | 2.8 | 2.2 |
| LCC savings (PhP) | 1,635 | 3,183 |
| **National-Level Benefits** | | |
| Total Electricity Cost Savings through 2030 (millions of PhP) | 4,763 | 11,334 |
| Cost/Benefit Ratio[56] | 2.1 | 2.8 |

[53] Equal to EER 10.44 kJ/W-h.
[54] The 2020 ASEAN target MEPS at EER 2.9 W/W only applies to ACs under 3.52 kW approximately 12,672 kJ/h. However, we assumed that the MEPS level applies to all cooling capacities.
[55] Base Case C is not evaluated under 2020 ASEAN Target scenario as the EER for selected size of unit for this case is already greater than ASEAN MEPS.
[56] Cost-benefit ratio is estimated at the national level using the national discount rate, whereas the payback period is estimated at the product level using the consumer discount rate.

| Metric | Base Case A (5,000 kJ/h) | Base Case B (9,500 kJ/h) |
|---|---|---|
| Total Energy Savings[57] in 2030 (GWh) | 75.0 | 179.0 |
| Total Energy Savings through 2030 (GWh) | 432.0 | 1027.0 |
| $CO_2$ Emissions Mitigation through 2030 (MT $CO_2e$) | 0.3 | 0.7 |

*Table 11: PAMS Output Summary for 20% above the ASEAN Target scenario*

| Metric | Base Case A (5,000 kJ/h) | Base Case B (9,500 kJ/h) | Base Case C (12,660 kJ/h) |
|---|---|---|---|
| **Consumer-Level Benefits** | | | |
| Payback Period (years) | 4.3 | 1.3 | 1.3 |
| LCC savings (PhP) | 6,589 | 24,680 | 19,323 |
| **National-Level Benefits** | | | |
| Total Electricity Cost Savings through 2030 (millions of PhP) | 27,447 | 73,037 | 65,810 |
| Cost/Benefit Ratio | 1.4 | 4.7 | 4.9 |
| Total Energy Savings in 2030 (GWh) | 425.0 | 1130.0 | 1031.0 |
| Total Energy Savings through 2030 (GWh) | 2504.0 | 6662.0 | 5976.0 |
| $CO_2$ Emissions Mitigation through 2030 (MT $CO_2e$) | 1.7 | 4.5 | 4.0 |

*Table 12: PAMS Output Summary for BAT scenario*

| Metric | Base Case A (5,000 kJ/h) | Base Case B (9,500 kJ/h) | Base Case C (12,660 kJ/h) |
|---|---|---|---|
| **Consumer-Level Benefits** | | | |
| Payback Period (years) | 6 | 2 | 1.5 |
| LCC savings (PhP) | 7,068 | 51,198 | 56,473 |
| **National-Level Benefits** | | | |
| Total Electricity Cost Savings through 2030 (millions of PhP) | 63,841 | 169,986 | 211,619 |
| Cost/Benefit Ratio | 1 | 3.2 | 3.3 |
| Total Energy Savings in 2030 (GWh) | 988 | 2,630 | 3,274 |
| Total Energy Savings through 2030 (GWh) | 5,824 | 15,506 | 19,304 |
| $CO_2$ Emissions Mitigation through 2030 (MT $CO_2e$) | 3.9 | 10.5 | 13.1 |

[57] Total energy savings are estimated as the difference between RAC energy consumption under base case and energy consumption under the policy scenario.

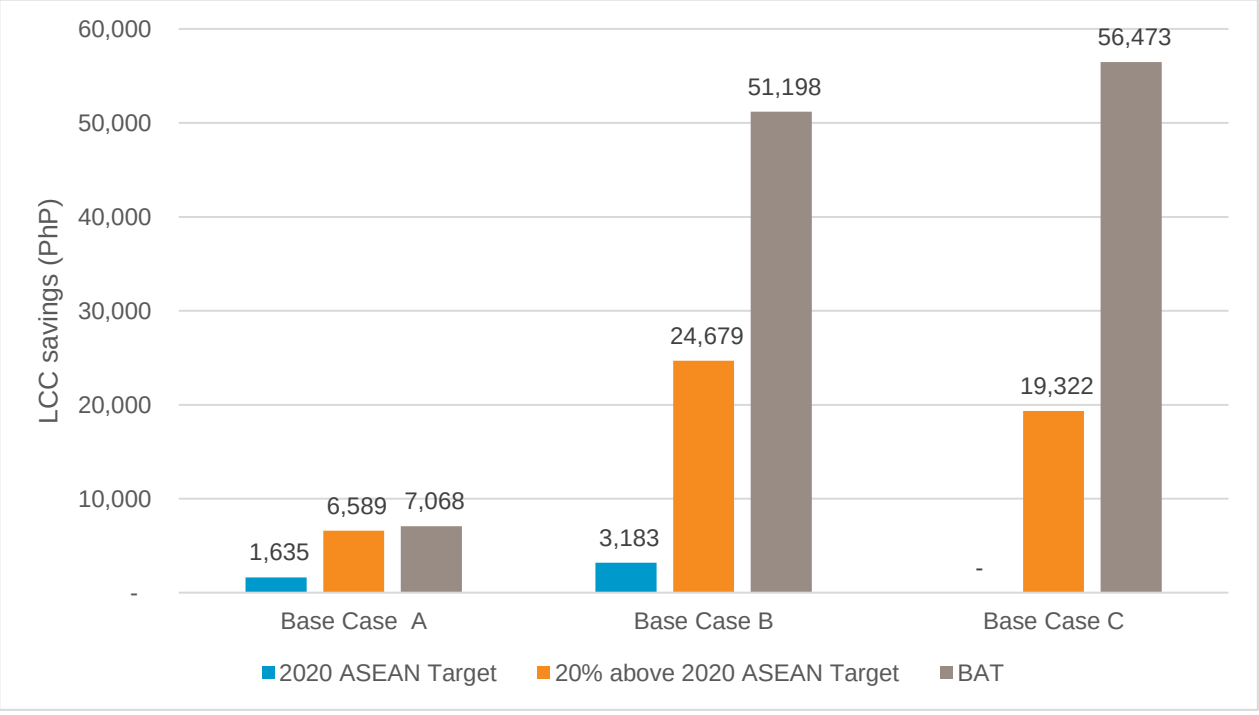
# 10 Impacts Assessment Results

## 10.1 Impacts to Consumers

We assessed the impacts to consumers under three policy scenarios:

- **2020 ASEAN Target scenario** predicts relatively low LCC savings for base cases A and B of PhP 1,635 and PhP 3,183, respectively (Figure 26). The payback period under this scenario is 2 to 3 years. There are no estimated savings for base case C under this scenario, because the most popular EER of 11.0 kJ/W-h is already higher than the 2020 ASEAN Target of 10.44 kJ/W-h. Overall, the analysis shows that the adoption of the 2020 ASEAN Target will have low impact on savings for the consumers.
- **20% above the 2020 ASEAN Target scenario** predicts savings ranging from PhP 6,589 for base case A to PhP 24,679 – for base case B (Figure 26). The payback period is just over 1 year for base cases A and B. Considering that average lifetime of RACs in the Philippines is 8 years, the payback period of 1 to 2 years is considered short. A long payback period for base case A under this scenario of 4.3 years indicates that the price of small capacity AC units would increase significantly with increased efficiency, making the policy less cost-effective for consumers. Larger capacity RACs provide greater savings as the electricity tariff in the Philippines is relatively high.
- **BAT scenario** predicts significant lifecycle cost (LCC) savings, especially for larger capacity RACs, -PhP 51,198 and PhP 56,473 for base cases B and C, respectively (Figure 26). However, the up-front cost of these RACs also increases by a large margin making it less affordable for consumers.

*Figure 26: Lifecycle cost savings from three policy scenarios*



### Sensitivity analysis

We performed a sensitivity analysis to assess which factors have a more significant effect on LLC savings. A +/- 20% change in price, operating time, electricity tariff and lifetime was used for the comparative analysis. The sensitivity analysis showed that:

- A 20% change in the electricity tariff, operating time, and lifetime resulted in 29-37% change in LCC savings under the **2020 ASEAN Target** scenario.
- Under the **20% above the 2020 ASEAN Target** scenario, the change in the aforementioned factors resulted in a 48-57% change for small units - base case A - and 24-39% change for larger capacity units (Figure 27, Figure 28). This indicates that, especially under more stringent policy scenarios, households with smaller capacity units are more sensitive to the changes in the cost of electricity, operating time, RAC lifetime.

The impact of changes in the up-front cost of AC unit was less significant. **Appendix C** Figures C-1 through C-5 includes all the graphs for the two scenarios.

*Figure 27: LCC Savings Sensitivity Analysis for 5,000 kJ/h RACs – 20% above the 2020 ASEAN Target*

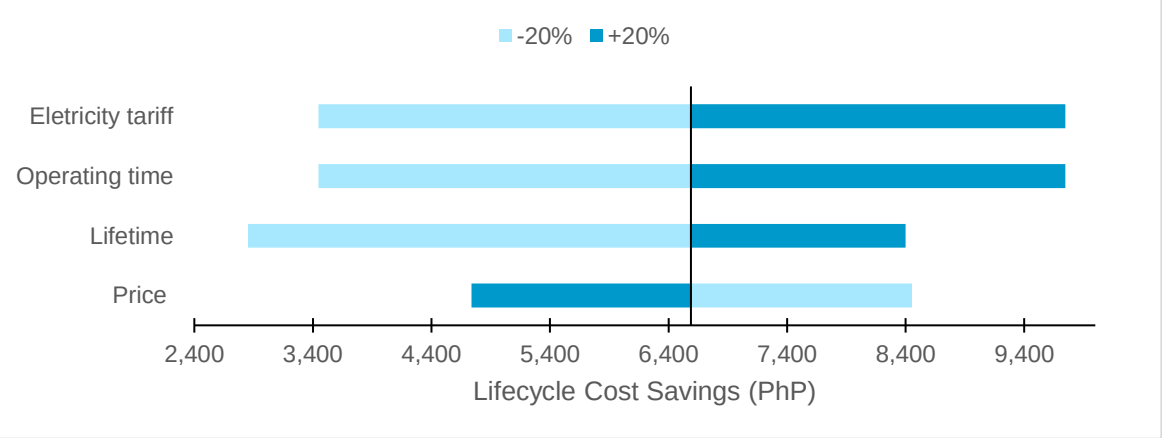
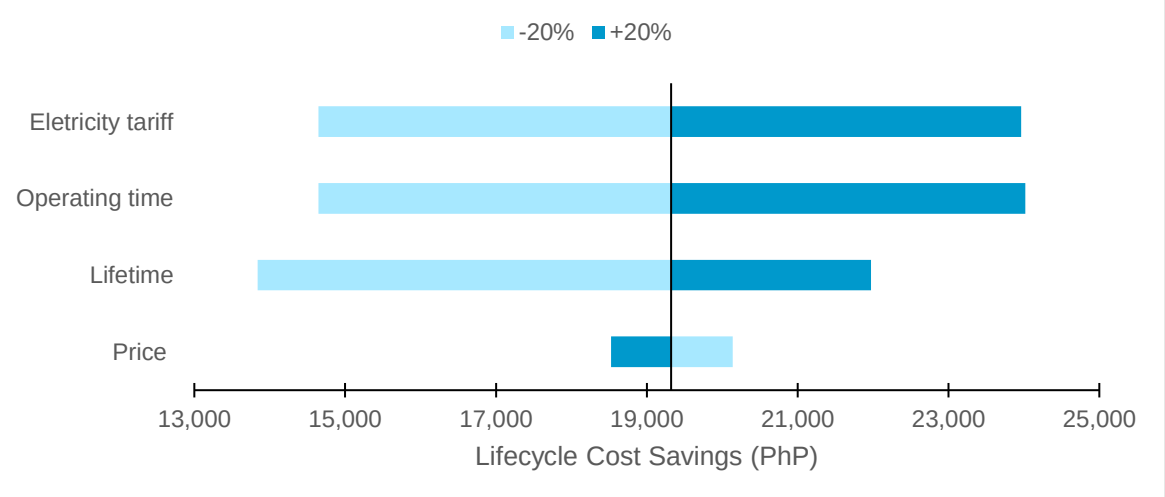



*Figure 28: LCC Savings Sensitivity Analysis for 12,660 kJ/h RACs – 20% above the 2020 ASEAN Target*



## 10.2 Impacts to Manufacturers

More stringent MEPS would eliminate models from the market that are not compliant with the new requirements. We evaluated impacts on manufacturers by considering the number of models currently on the market which would be eliminated under the three policy scenarios. **Table 13** shows that:

- Under the **2020 ASEAN Target** scenario about 30% of models found on the market would be eliminated;
- Under the **20% above the 2020 ASEAN Target** scenario a total of 84% of models would be eliminated;
- Nearly all models will be eliminated under the **BAT** scenario.

More models with fixed-speed compressor would be removed from the market as compared with models with inverter technology, which, on average, are more efficient.[58]

*Table 13: Models eliminated from the market under different policy scenarios*

| Policy Scenario | Fixed (% eliminated) | Inverter (% eliminated) | Total (% eliminated) |
|---|---|---|---|
| 2020 ASEAN Target | 41% | 9% | 30% |
| 20% above the ASEAN Target | 99% | 56% | 84% |
| BAT | 100% | 100% | 100% |

We also looked at the impact on models that are manufactured by the Filipino-owned companies – CCAC and Koppel, Inc. About 39% of these models would be non-compliant under 2020 ASEAN Target policy scenario (Table 14), of which nearly half would be fixed-speed models and 21% of models with inverter technology. Under 20% above the 2020 ASEAN Target scenario all fixed-speed models would be taken off of the market and about 59% of inverter RACs would be eliminated.

*Table 14: Models manufactured by Philippine-owned companies eliminated under different scenarios*

| Policy Scenario | Fixed (% eliminated) | Inverter (% eliminated) | Total (% eliminated) |
|---|---|---|---|
| 2020 ASEAN Target | 48% | 21% | 39% |
| 20% above the ASEAN Target | 100% | 59% | 87% |
| BAT | 100% | 100% | 100% |

This analysis only estimates the number of models that will be eliminated, some of which might be more popular among users than other models. Without having sales data for each model, we cannot estimate the true overall impact on the manufacturers.

[58] Duplicates of the models were not included in this analysis.

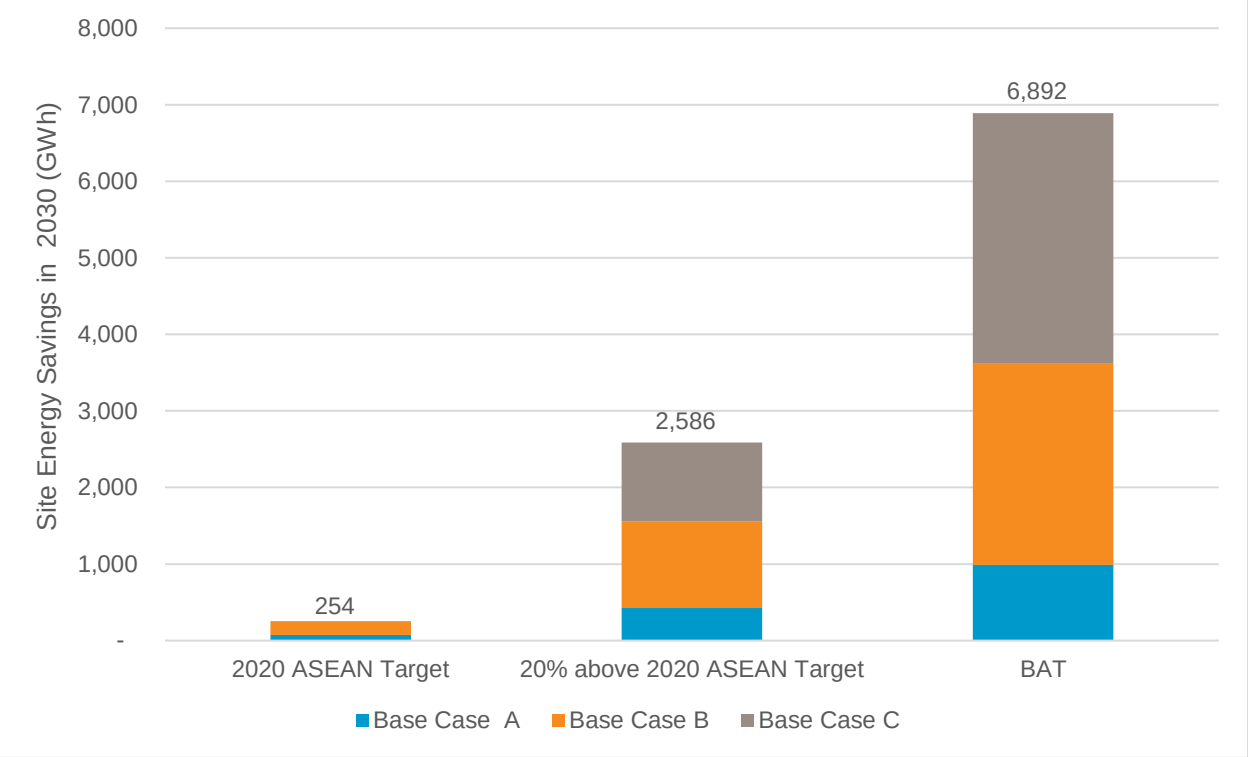
## 10.3 Impacts at the National Level

At the national level, we estimated energy savings and GHG emissions avoided under the three policy scenarios.

### Energy savings

- **2020 ASEAN Target** scenario would generate small energy savings in 2030, about 254 GWh (Figure 29).
- Under **20% above 2020 ASEAN Target** scenario realized 2030 energy savings would be ten times more – about 2,586 GWh, which is equal to about 9.6% of total residential energy consumption in 2017.
- **BAT** scenario would save nearly 7,000 GWh in 2030, which is more than a quarter of total residential energy consumption in 2017.

*Figure 29: Energy savings in 2030 under different policy scenarios*




### Sensitivity analysis

We also performed a sensitivity analysis for energy savings in 2030 using a +/- 20% change in market size/sales, operating time, and lifetime. **Figure 30 and Figure** 31 show that a 20% change in market size/sales or operating time results in a direct 20% change to energy savings in 2030, while a change in the lifetime of the RACs results in a 10-13% change.

*Figure 30: Sensitivity analysis for site energy savings in 2030 for 2020 ASEAN Target*

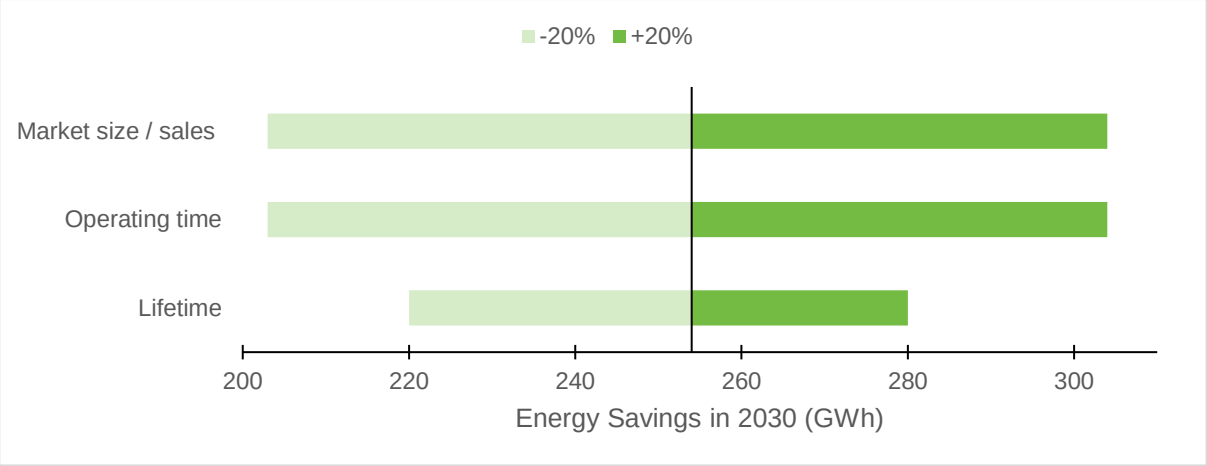
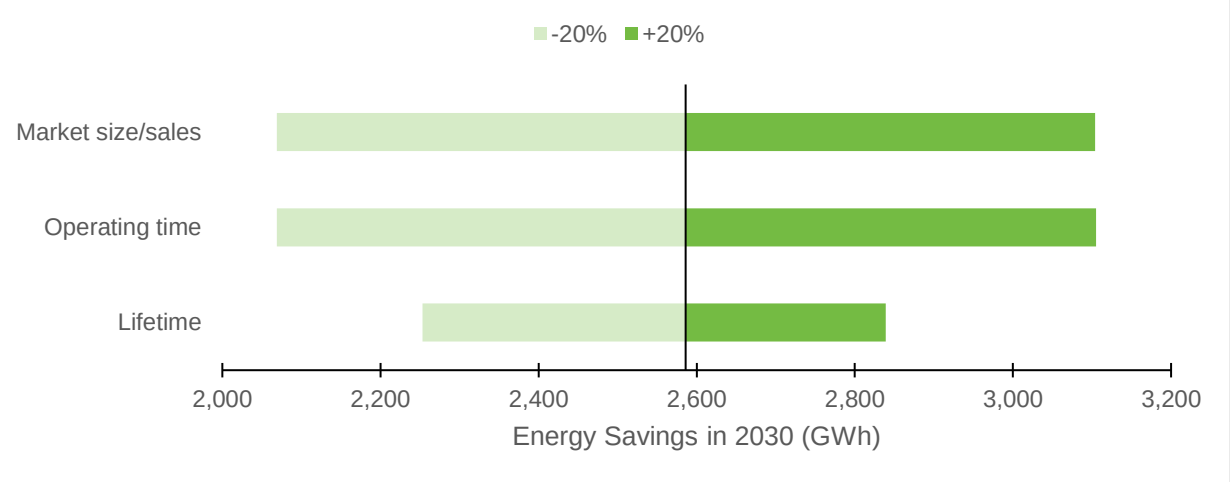



*Figure 31: Sensitivity analysis for site energy savings in 2030 for 20% above the 2020 ASEAN Target*




## Emissions reductions

Analysis estimates that in 2030 RACs in the Philippines will consume approximately 17.7 TWh of electricity, resulting in 11.95 MT of $CO_2$ released into the atmosphere[59]. We estimated that in 2030:

- The **2020 ASEAN Target** scenario can deliver a relatively minor emissions reduction – about 0.2 MT $CO_2$ (cumulative through 2030 is equal to 0.94 MT CO2).
- The emissions avoided under **20% above the 2020 ASEAN Target** scenario are about 1.8 MT $CO_2$ in 2030, which is equal to 15% of emissions avoided in 2030.
- Under **BAT** scenario, the $CO_2$ emissions from operating RACs in households can be reduced by about 40%.

Emissions reduction over the years is shown in **Figure 32.**

[59] Emissions from refrigerants are not considered for this analysis.

*Figure 32: Emissions savings under different scenarios*

# 11 Conclusions and Recommendations

*The Philippines Room Air Conditioner Market Assessment and Policy Options Analysis* provides the technical evidence to support a revision of MEPS. Government agencies can use this information to define their efficiency baseline for air conditioners, quantify potential energy and GHG emissions savings in support of national energy efficiency targets or NDC commitments, and estimate other potential benefits from revising the S&L program.

The analysis presented in this report was based on the product data for 3,936 models from 200 retail stores in the Luzon, Visayas, and Mindanao regions. Because Philippine government agencies do not collect market and sales data on RACs, and manufacturers and importers were reluctant to share data, this analysis is limited to primary data collected through in-store retailer surveys. To overcome this limitation, CLASP validated the findings during two meetings with key stakeholders in Manila - on September 19 and November 20, 2018.

**This assessment found that the RAC market in the Philippines is unique in Southeast Asia as it is the only market dominated by fixed-speed window-type units, at 62%.** Small size window units, that are less expensive and less efficient, are favored by Filipino households taking up a quarter of market share. Even with relatively high electricity tariffs in the Philippines, households prioritize up-front cost in their purchasing decisions. This could partially explain the slow transitioning of the market to more efficient split type RACs with inverter technology, which currently hold 22% market share. About 60% of RACs on the market use R-410A refrigerant. Despite the fact that units with R-22 are still available in the country, there has been a significant transition since 2013, when all RACs were reported to have R-22 refrigerant.

**Two Philippine-owned companies, CCAC and Koppel, Inc., which mainly manufacture fixed-speed window units have the largest RAC market shares in the Philippines.** The two companies have a long history, spanning decades, of supplying RACs to the domestic market, and are highly valued by residential consumers. Two other local assembly plants owned by PMPC and Hitachi Inc. assemble primarily window-type units. The majority of models under other brands come from China and Thailand, some of which are particular only to the Philippines market.

**Currently DOE is reviewing the MEPS for RACs under the proposed PESLP Implementing Guidelines**, which include the proposed 2020 ASEAN Target MEPS and labeling requirements for both inverter and fixed-speed units. The current S&L policy for RACs in the Philippines only covers fixed-speed units only and the MEPS have not changed since 2002. Current MEPS stand at 9.1 kJ/W-h EER for cooling capacities below 12,000 kJ/h and 8.6 kJ/W-h EER for cooling capacities of 12,000 kJ/h and above. This policy stagnation could also explain why the RAC market has not advanced in the same way as the other Southeast Asian markets, such as Thailand and Vietnam. CLASP's RAC market assessment and policy options analysis provides the technical evidence to support more stringent MEPS.

**The EERs of RACs found on the market are above current MEPS.** CLASP estimated the energy and emissions savings and LCC savings for consumers under various policy scenarios. Based on this analysis, CLASP recommends the following:

- **Recommendation 1 – Revise mandatory MEPS for RACs in 2021 to increase them to 3.48 W/W EER, equivalent to a 20% increase above the 2020 ASEAN Target.** Increasing MEPS to the 2020 ASEAN target, which currently is proposed by DOE, will not result in a market transformation towards higher efficiency RACs, because on average the EER for RACs is already greater than the 2020 ASEAN Target. We project that national energy savings in 2030 under the 20% above the 2020 ASEAN Target scenario will be about ten times greater than under the 2020 ASEAN Target scenario – about 2.6 TWh, or 9.6% of total residential energy consumption in 2017. Furthermore, in 2030 RACs will consume about 17.7 TWh of electricity resulting in 11.95 MT of $CO_2$ released into the atmosphere. Under the 20% above the 2020 ASEAN Target scenario, 1.8 MT of $CO_2$ emissions will be avoided, equal to 15% of total emissions from RACs in 2030. Under this scenario, about 84% of models on the current market would be non-compliant – 87% of models currently manufactured domestically would be non-compliant. Higher efficiency RACs are available on the market, but represent a smaller proportion of the market. With external assistance, domestic manufacturers can transition their production lines to incorporate more efficient technologies over the next two years. The estimated

additional cost of increasing the efficiency for small capacity units is about PhP 10,000, which is relatively low and can be supplemented by LCC savings.

- **Recommendation 2 – Update proposed 2020 ASEAN Target MEPS and labeling requirements in 2021 and every 2-3 years afterwards to accelerate market transformation towards more efficient RACs.** CLASP recommends that DOE develop a policy roadmap, including energy efficiency targets for the RAC sector, and commit to evaluating RAC policy every 2-3 years (to continuously improve or ratchet mandatory MEPS and labeling categories) with the first revision in 2021. The RAC industry will benefit from knowing energy efficiency targets in advance, in order to plan for new investments and/or upgrading of production lines. DOE can build on this market assessment, and continue gathering RAC sales and product data to inform the update and adoption of more stringent MEPS in the future. This will ensure DOE keeps up with advancements in technology and continues facilitating market transformation in the Philippines.
- **Recommendation 3 – Develop incentive policies and programs to support the uptake of energy efficient RACs by the public and/or private sectors.** In order to ramp up efforts to promote high efficiency products in the Philippines, incentive policies may be considered. Energy labels and standards provide a verified baseline for judging enhanced performance and pull the market towards higher efficiencies while incentive programs can accelerate the market by encouraging consumers, manufacturers and suppliers to switch to high efficiency products.

  Public sector procurement is a very effective means to promote energy efficient products. The adoption of high efficiency products by the government will also have symbolic significance by demonstrating the Philippines' commitment to environmentally conscious sustainable growth.

  In most cases, either a government agency or a utility offers financial incentives directly to end users. Sometimes incentives are provided to manufacturers or builders to encourage them to supply more efficient products with the assumption (or requirement) that at least some of the incentive will be reflected in a lower price to the final buyer. Building construction is booming in the Philippines with projected annual growth of 9.8% until 2026.[60] The incentives that support bulk procurement programs by private real estate developers can push the market to more efficient RACs. Subsidies or rebates are also widely used by policymakers around the world to promote high efficiency products.
- **Recommendation 4 – Conduct awareness raising campaigns.** An effective communications strategy and awareness campaigns are critical components of successful S&L programs. Encouraging consumers to buy products at the high end of efficiency and quality creates demand. Buyer purchasing decisions that favour energy-efficient and high quality products ultimately provide a "pulling" force in the market. Consumer awareness campaigns can inform about how labels work and what type of information can be obtained from labels. The best campaigns include industry, consumer groups, and corporate retail representatives as partners, securing stakeholder support from the offset.

[60] Philippine News Agency, BMI Research sees steady growth for PH construction sector, http://www.pna.gov.ph/articles/1008920

# Appendix A: Sources for Data Collection

*National Data Collection: Manufacture and Assembly*

| Agencies | Data Requested | Issue/s |
|---|---|---|
| Department of Trade and Industry (DTI) | Sales and Production of RACs | No data available from DTI |
| DOE | List of Certified RACs | Only non-inverter window and split-type RACs are currently required to be certified; inverter-type RACs are excluded |

*National Data Collection: Imports*

| Agencies | Data Requested | Issue/s |
|---|---|---|
| DTI | • Sales and Production or RACs<br>• List of Filed Import Commodity Clearance (ICC) Applications | • No data available from DTI<br>• No actual importation data |
| DOE | List of Certified RACs (all types, inverter and non-inverter) | Only non-inverter window and split-type RACs are currently required to be certified; inverter-type RACs are excluded |
| Bureau of Customs | Volume of RACs Imported and Exported | • Delays in approval of data request<br>• Data are not classified per RAC type |
| Environmental Management Bureau (EMB) | List of Filed Applications for Permit to Import Second-hand RACs | • Data are not of actual importation<br>• Data are not classified per RAC type |

# Appendix B: Regression Output

SUMMARY
OUTPUT

| *Regression Statistics* | |
|---|---|
| Multiple R | 0.863774103 |
| R Square | 0.7461057 |
| Adjusted R Square | 0.745936212 |
| Standard Error | 8731.885457 |
| Observations | 2999 |

ANOVA

| | *df* | *SS* | *MS* | *F* | *Significance F* |
|---|---|---|---|---|---|
| Regression | 2 | 6.71282E+11 | 3.35641E+11 | 4402.093078 | 0 |
| Residual | 2996 | 2.28432E+11 | 76245823.63 | | |
| Total | 2998 | 8.99715E+11 | | | |

| | *Coefficients* | *Standard Error* | *t Stat* | *P-value* | *Lower 95%* | *Upper 95%* | *Lower 95.0%* | *Upper 95.0%* |
|---|---|---|---|---|---|---|---|---|
| Intercept | -32506.70284 | 1369.560394 | -23.73513645 | 2.9394E-114 | 35192.07675 | 29821.32892 | 35192.07675 | -29821.32892 |
| X Variable 1 | 3078.496404 | 122.1055405 | 25.21176674 | 2.3349E-127 | 2839.077219 | 3317.915589 | 2839.077219 | 3317.915589 |
| X Variable 2 | 2.038815404 | 0.023800599 | 85.66235625 | 0 | 1.992148234 | 2.085482575 | 1.992148234 | 2.085482575 |

# Appendix C: Sensitivity Analysis Output

## 2020 ASEAN Target policy scenario

*Figure C-1. LCC Savings sensitivity analysis for 5,000 kJ/h RACs*

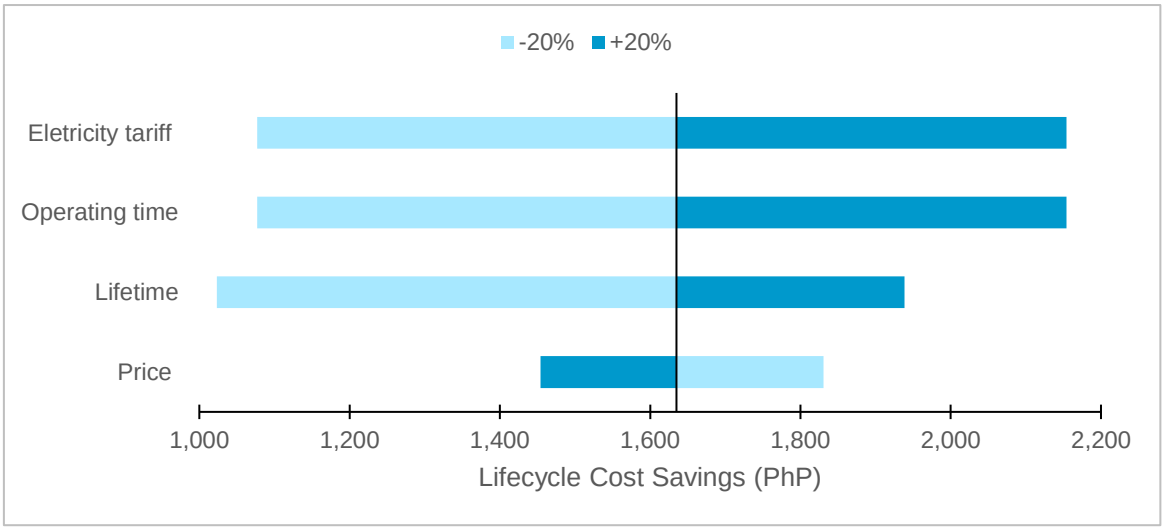
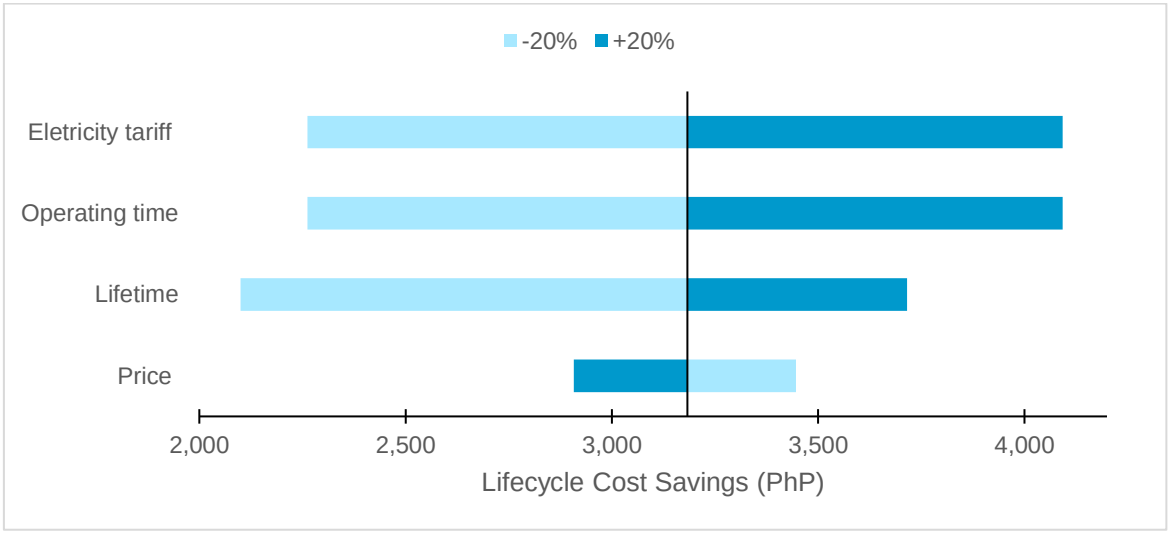



*Figure C-2. LCC Savings sensitivity analysis for 9,500 kJ/h RACs*



## 20% above the 2020 ASEAN Target policy scenario

*Figure C-3. LCC savings sensitivity analysis for 5,000 kJ/h RACs*

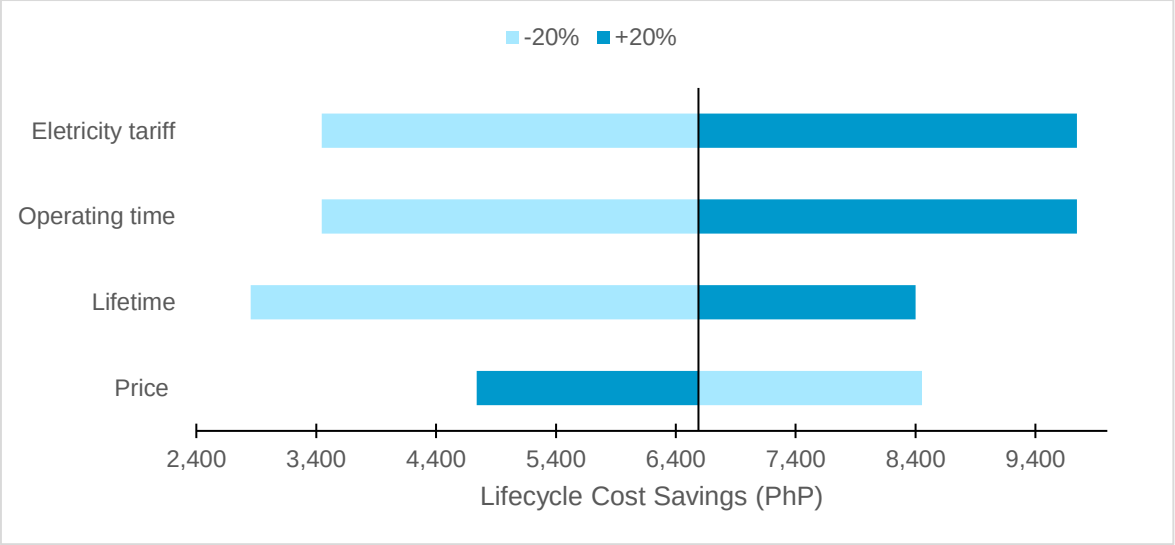



*Figure C-4. LCC savings sensitivity analysis for 9,500 kJ/h RACs*

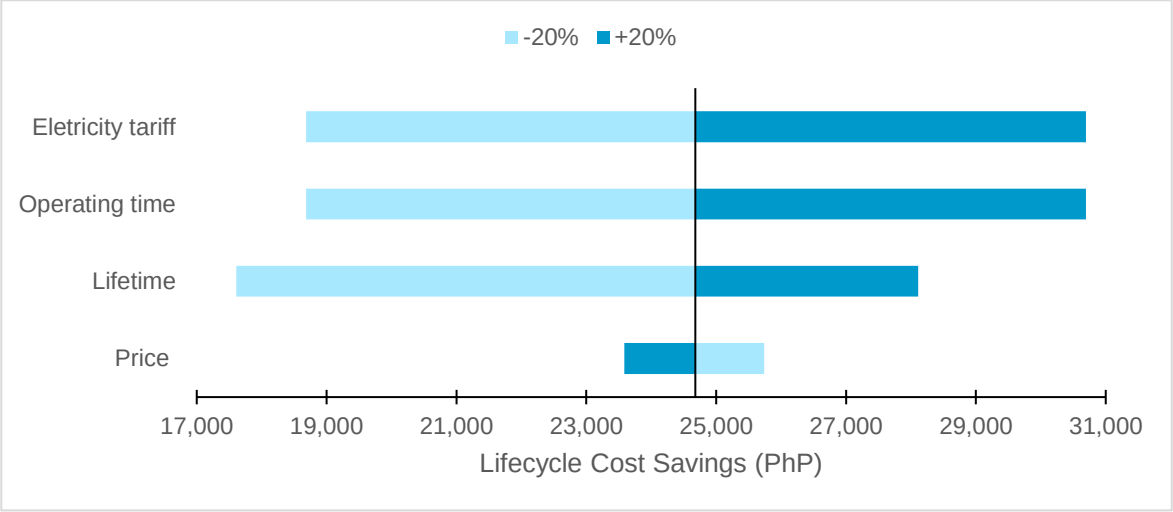


*Figure C-5. LCC savings sensitivity analysis for 12,660 kJ/h RACs*