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EXECUTIVE SUMMARY

New Minimum Energy Performance Standard for Air Conditioners in Ecuador

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May 2024

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INTRODUCTION

The electricity system in Ecuador relies heavily on hydropower. In 2022, 75% of gross electricity production came from hydroelectric plants (ARCERNNR, 2022a). Although electricity generated from hydropower has a low carbon factor, its electricity generation is highly dependent on the availability of rainfall. In the past few years, due to lack of sufficient rain to fully utilize hydropower capacity, Ecuador has not been able to satisfy electricity demand (ARCERNNR, 2022c). The Ecuadorian government is trying to solve the electricity shortage issue by activating thermal plants, increasing gas imports, and through international tenders (MEM, 2023). In addition to supply-side, demand-side solutions are also considered by the government. This study assessed the opportunities and benefits to reduce demand through improving efficiency in cooling by revising the minimum energy performance standard (MEPS) of air conditioning units (ACs) to more stringent levels.

Space cooling is the fastest-growing energy end use in buildings worldwide. According to the International Energy Agency (IEA), by the end of 2016, approximately 1.6 billion ACs were in use globally, representing approximately 11.7 TW of installed cooling capacity (IEA, 2018). In Latin America, electricity demand is expected to grow by 72% between 2021 and 2040 (IEA, 2021), with cooling electricity use expected to contribute 16% of that growth, or around 150 TWh, accounting for more than a third of all electricity end-uses growth in the buildings sector. AC use is predicted to be the second largest source of electricity demand growth for buildings by 2045, following the industrial sector (IEA, 2018; Osaka, 2023).

Similar trends are seen in Ecuador's rising use of AC and corresponding increased electricity consumption. National electricity consumption in Ecuador increased by 36% from 16.7 TWh in 2018 to 22.1 TWh in 2022. This study identified that electricity consumption from AC use climbed by 57% in Ecuador over the same 4-year period, accounting for approximately 11% of total growth in electricity consumption. Increasing AC electricity consumption became a contributor to Educator's energy shortage crisis, but it also provides a great potential to solve the problem. One feasible strategy is to update the MEPS.

The MEPS for ACs in Ecuador was first introduced in 2017 (EER 3.2W/W); since then, no new standards have been proposed in the country. Therefore, the current MEPS in Ecuador is outdated in several aspects and needs updating to better reflect the evolution of the market and align with the goals of the National Plan for Energy Efficiency (PLANEE) and Energy Efficiency Law, with Executive Decree 68, issued in 2021. The MEPS for ACs is low compared to regional and international best practices and there is no distinct standard for different equipment types or capacity distinction. This report analyzes current AC usage patterns and prospective development scenarios as the foundation for updating AC MEPS in Ecuador.

PLANEE includes lines of action under the Residential, Commercial and Public axis. These sectors represented 60% of total electricity consumption in 2022, according to data from ARCERNNR (2023b). As part of the plan to address these levels of energy and electricity consumption, the Ministry of Energy and Mines (MEM) developed regulatory mechanisms, created tax and financial initiatives, and launched initiatives to advance energy efficiency in these sectors. In coordination with INEN, MEM developed 11 energy efficiency norms since 2007 to advance energy management practices and energy- efficient construction and 23 Technical Regulations (Reglamentos Tecnicos) to ensure the prevalence of high- efficiency domestic and industrial equipment in the Ecuadorian market.

The Energy Efficiency for Development Program (EE4D) is a partnership between the U.S. Agency for International Development (USAID) and Lawrence Berkeley National Laboratory (LBNL) to advance energy efficiency in partner countries. In Ecuador, the partnership is working in collaboration with the Ministry of Production, International Commerce, Investments and Fisheries (MPCEIP), the Ministry of Energy and Mines (MEM) and the Ecuadorian Institute of Standardization (INEN) to provide technical assistance in updating current energy- efficiency regulations for ACs. The proposed update aligns with the general objectives laid out by the National Plan for Energy Efficiency and Energy Efficiency Law and with Executive Decree 68, issued in 2021.

This report provides technical assessment of a MEPS AC revision in Ecuador, and serves as the basis for stakeholder engagement as part of the regulatory development process to update the AC MEPS in Ecuador. This report can be used as guidance by policymakers in designing a well-founded, impactful MEPS program that is consistent with regional and international best practices and to highlight the energy, environmental, and economic benefits of the MEPS on users and the nation as a whole.

The methodologies used in this report include the scenario analysis of five different MEPS levels, the logistic estimation of the current AC ownership rate, and the projection of AC stock in Ecuador to 2045. The energy use analysis assesses the potential energy savings from increasing the efficiency of ACs in Ecuador and forms the basis for the energy-savings values used in the subsequent analyses and the life cycle cost (LCC) analysis.

BASELINE INFORMATION AND KEY FINDINGS

The commercial and residential sectors (the buildings sector) represented 60% of electricity consumption in Ecuador in 2022. AC household ownership rates have more than doubled in the past 9 years, as gross domestic product (GDP) per capita increased by more than 50%. More than 90% of AC users are located in the Littoral region. Residential electricity use for ACs in the Littoral region is 26% of residential electricity use (52% population). From 2015 to 2020, AC imports grew at a rate of 12% per year, almost doubling in 5 years.

Results from this study show that in 2022, approximately 470,000 of installed ACs were less efficient than the energy- efficiency regulation, indicating that 47% of ACs in Ecuador do not meet the requirements of the current regulation. The national ownership rate in 2020 was less than 10%, while in the Littoral region it reached about 17%. Even for the latter, the market is far from saturated because of the climate constraints present in the region, indicating that Ecuador may experience an acceleration of the rise in AC ownership in the upcoming years. From October to May, the Littoral region experiences a rise of electricity production from hydroelectric plants, coinciding with the peak electricity demand season revealing a somewhat strong dependence on this energy source to help cover for the peak consumption season.

The CO2 emissions due to AC use in Ecuador between 2018 and 2022 increased about 20%, from around 0.9 to 1.1 million tons of CO2. This represents approximately 2.5% of unconditional Nationally Determined Contributions for 2025 (Climate Resource, 2021).

SCENARIO ANALYSIS RESULTS

Five scenarios with different-efficiency levels were analyzed and compared to a baseline scenario. These efficiency levels are:

- Sc 1: Current MEPS enforcement: Ecuador MEPS level

- Sc 2: Proposed new MEPS: Mexico MEPS level
- Sc 3: Regional best practice: Argentina MEPS Leve
- Sc 4: "A" rating from the Pan American technical standards commission, COPANT 1711 standard
- Sc 5: EU MEPS level: European Union MEPS level
- Sc 6: High Efficiency: a combination between EU MEPS levels for conventional equipment and the medium efficiency levels for inverter equipment found in Karali, et al., 2020.

The total number of ACs is projected to more than double by 2035 and more than quadruple by 2045, as AC ownership rate is projected to triple and the number of households increase by more than 50% by 2045. In the business as usual (BAU) scenario, AC electricity consumption in the residential sector is therefore projected to double by 2035 and more than quadruple by 2045, increasing from around 1 TWh in 2020 to around 2.4 TWh in 2035 and around 4.3 TWh in 2045.

For the proposed new MEPS corresponding to Sc2 defined above, estimates indicate that avoided capacity due to energy-efficiency improvements could reach 240 MW by 2035 and 460 MW by 2045. This is especially of interest for the Littoral region, because the peak load demand is satisfied with thermal power plants using fossil fuels.

Scenario 2 has lower electricity consumption than the regional best practice (Sc3) and scenario 1, reaching an approximate annual 9% reduction in electricity consumption compared to the BAU scenario.

The highest efficiency scenarios (Sc5 and Sc6) have the lowest electricity consumption of all scenarios, reaching an annual reduction in electricity consumption of 25% and 29%, respectively, compared to the BAU scenario. The purchasing price difference between a BAU scenario AC and a scenario 2-4 AC is around 50 USD, while compared to Sc5 and Sc6 AC, the price difference is 290 USD. Even though the higher efficiency scenarios (Sc5 and Sc6) have significant impacts compared to the other scenarios in terms of energy and operating cost savings and are cost effective over the long term, the high up-front cost may pose an undue burden on cash-strapped households.

MEPS REVISION BENEFITS

Figure ES 1 presents the cumulative savings in electricity bills and the avoided investment in power capacity addition for the proposed new MEPS from 2025 to 2045. From 2024 to 2035 the cumulative energy savings in electricity bills are around 150 million USD and reach 550 million USD by 2045. Avoided investment capacity is estimated at 240 million USD in 2035 and almost doubles to reach 460 million USD in 2045. AC electricity use reduction is also shown in Figure ES 1, considering the base year as 2024. It can be seen that annual AC electricity consumption reaches a peak in 2035 at around 9%, and remains constant through the rest of the analysis period.

FIGURE ES 1. Summary of national impact results from 2025 to 2045 for proposed new MEPS

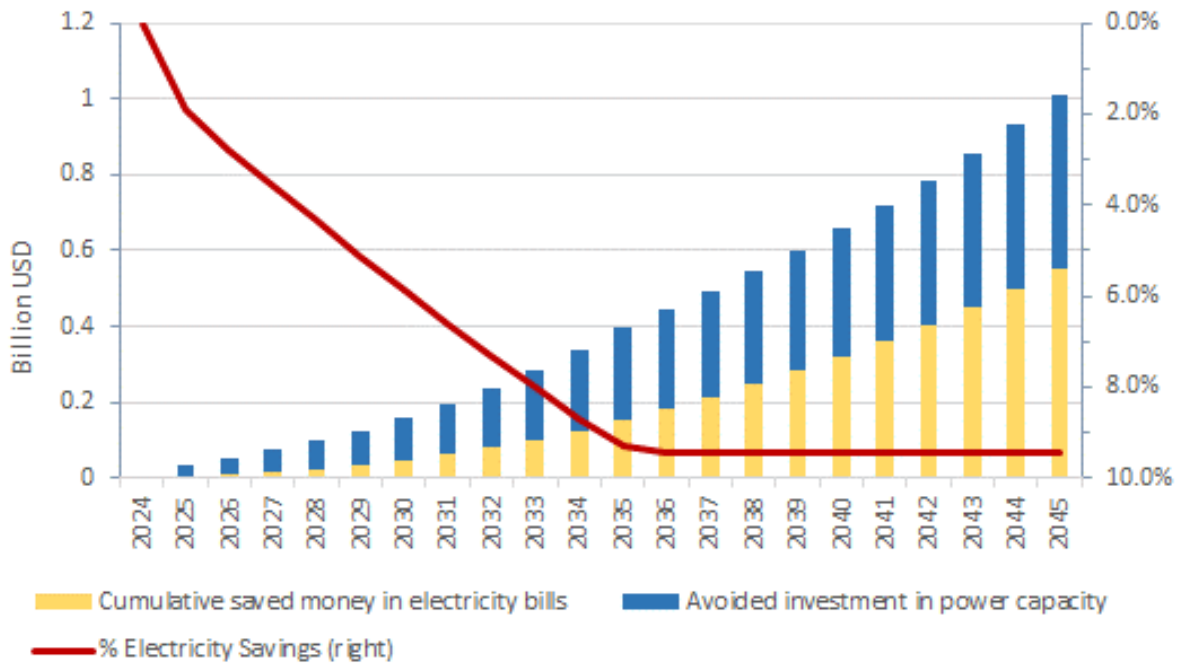

Table ES 1 summarizes the impacts associated with the adoption of higher- efficiency standards (Sc2 and Sc 6) for ACs in Ecuador. The impacts are presented for the new proposed MEPS and for the resulting impacts in 2045. It is projected that with the adoption of the new proposed MEPS, savings in electricity bills and avoided investment in new power capacity would amount approximately 1 billion USD by 2045.

TABLE ES 1. Impacts in 2045 of the proposed Sc2 and Sc6 MEPS

	Proposed MEPS (Sc2)	Technical Potential (Sc6)
Annual energy savings (TWh)	0.60	1.88
Money Saved in Electricity Bills (Billion USD)	0.55	1.7
Avoided Capacity (MW)	474	1,485
Investment in Capacity Avoided (Billion USD)	0.47	1.5
Avoided Subsidies (Million USD)	24	75
Cumulative avoided CO_2 emissions (Million CO_2 Tons)	4.1	12.8
Energy- Efficiency Improvement	13%	46%
Increased Cost of Equipment (USD/AC)	$46	$287

LIFE CYCLE COST ANALYSIS

The life cycle cost (LCC) analyzes the trade-off between higher acquisition costs for a more efficient AC and the subsequent savings in the form of lowered electricity bills during the 10-year AC lifetime.

This study showed that all of the efficiency levels that were analyzed are cost-effective for the consumers in all the Ecuadorian climatic zones, except in the Highlands region where only Sc1 was cost effective for the consumers. The most cost-effective scenario is the high efficiency level, which is equivalent to an increase of 46% in efficiency compared to the BAU scenario. Payback periods vary between 3.3 years in the Littoral region and 8.8 years in the Highlands region, depending on the size of the AC unit. For the proposed MEPS, benefits range from around $60 to $300 USD over 10 years in energy bills saving for the consumer.

RECOMMENDATIONS

Regulation

- Based on the LCC analysis results, we recommend revising the MEPS as soon as possible to efficiency levels corresponding to either scenario 2 or 4 and propose to revise to level 5 by 2029 to facilitate market adaptation, as this level offers cost-effective economic benefits for consumers. This includes a change in the efficiency metric to the Seasonal Energy Efficiency Ratio (SEER), as this a more accurate measure of ACs efficiency than the current used measure (Energy Efficiency Ratio EER).
- Design other programs targeting the adoption of high efficiency ACs, to prepare the market for future updates to higher MEPS. Adopting higher efficiency standards for ACs (scenarios 4 and 5) is even more beneficial for the society in terms of energy savings, emissions reduction, money saved in electricity bills, and avoided investment in new power capacity.

Compliance

- In order to increase the compliance rate of the regulation, we recommend developing a certification database to better monitor the market. This can be managed by MPCEIP with support from the Ecuadorian Accreditation Service (SAE), INEN and the National Customs Service of Ecuador (SENAE), including training to manage the certification database and related monitoring, verification and enforcement activities.
- Create guidelines for importers and retailers of AC products to understand the MEPS and the process of compliance verification.
- Work with MPCEIP, SAE, SENAE and the certifying agencies to identify possible gaps or inaccuracies in the information provided for the certification process (certificates of compliance, labels, custom declarations) from the point of manufacturing to the point of entry.

Complementary programs

- Establish a working group with government, industry, research community and international development organizations to explore financial mechanisms to set up an energy- efficiency testing lab in-country.
- Continue the efforts to improve energy efficiency and decrease electricity consumption in the buildings sector (60% of national electricity consumption). The ongoing review of the

Ecuadorian Construction Norm, undertaken by the Ministry of Urban Development and Housing, represents an opportunity to update the energy efficiency component of the code.

- Leverage ongoing efforts by international development organizations (PTB, JICA, KOICA, BID, World Bank) to explore financial mechanisms that could be created in coordination with Ecuador's National Investment Fund for Energy Efficiency to support the implementation of initiatives such as an AC substitution program.