UNEP

clasp

ENERGY-EFFICIENT COOLING PRODUCTS IN LATIN AMERICA AND THE CARIBBEAN:

AN OPPORTUNITY TO COOL DOWN THE PLANET AND ACCELERATE THE REGIONAL ECONOMY

EFFICIENT APPLIANCES AND EQUIPMENT

GLOBAL PARTNERSHIP PROGRAMME

TABLE OF CONTENTS

I. FOREWORD

The UN Secretary-General, Mr. Ban Ki-moon, launched the Sustainable Energy for All (SE4ALL) initiative during the 2011 General Assembly in order to promote actions aimed at achieving three goals by 2030:

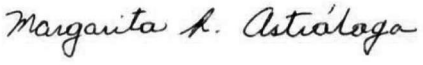
- providing universal access to modern energy services;
- doubling the global rate of improvement in energy efficiency; and
- doubling the share of renewable energy in the global energy mix.

SE4ALL provides an opportunity for Latin America and the Caribbean to strengthen the impact of the energy sector on economic growth and poverty reduction. Seizing this opportunity requires the commitment of governments, the financial sector, industry, and civil society leaders. Latin America and the Caribbean is a region with extensive capabilities and experience to coordinate joint actions and achieve shared sustainability goals. Progress in energy efficient lighting shows an example of best practice in the development of national and regional strategies, while capitalizing on the collaboration and input from government entities, regional bodies, lighting manufacturers, financial institutions and civil society. In this regard, Central America and the Dominican Republic are pioneers in the harmonization of energy efficiency standards for lighting products as a result of a coordinated effort between the leaders of the ministries of energy and environment of each country.

The transition to efficient refrigerators, air conditioners and fans in Latin America and the Caribbean would save 138 TWh annually, amounting to almost $ 20,000 million US dollars, and would avoid the release of approximately 44 million tons of CO_2.

Brazil, Cuba, Ecuador and Mexico stand out as countries with more active policies to accelerate the use of efficient air conditioners, refrigerators and fans. Today, the challenge for the region is to advance from conceptualizing the transition to implementation and, above all, developing minimum energy performance standards (MEPS); reducing the cost involved in monitoring, verification, and enforcement; minimizing the redundancy of standards in the region; and facilitate the penetration of highly efficient products in the regional market.

The United Nations Environment Programme (UNEP) and its international partners in the framework of the Efficient Appliances and Equipment Partnership Programme are ready to support countries in the region to develop and implement policies and concrete actions to accelerate the transition to more efficient products, providing a path to sustainable development.



Margarita Astrálaga

Regional Representative for Latin America and the Caribbean
United Nations Environment Programme

When OLADE was founded 40 years ago, it embodied the concern for the conservation of the region's natural resources, with that specific mandate contained in its charter document. In this regard, one of OLADE's key actions, taken more 25 years ago, is the inclusion of permanent work on the promotion and development of energy efficiency in Latin America and the Caribbean. The region has abundant energy resources of all kinds, including renewable resources with a 25% share of its energy mix, based on the priority use of hydraulic energy, so that energy efficiency is the supplement for sustainable energy.

At the OLADE annual meeting, the Ministers of Energy from all 27 member countries have recognized their commitment to energy efficiency by establishing actions by all countries to work towards reduction in energy resources. Further, these commitments reflect that energy efficiency is the best contribution of the region to the global effort towards reducing the effects of climate change. Based on its effort, OLADE has now become the regional reference on energy efficiency. The regional seminar organized by OLADE each year is mandatory for those who want to be kept abreast of advances in the development of energy efficiency and to learn about the latest experiences both in Latin America and the Caribbean as well as elsewhere.

The regional seminar has served for motivating and encouraging innovative initiatives, such as the UNEP Regional Efficient Lighting Programme launched at the IV Energy Efficiency Seminar for Latin America and Caribbean, which helped to mobilize both the energy and the environment sectors to conduct sustainable actions. As a result, there have been measurable results in several countries across the region. Another concern is the long-term sustainability of energy efficiency programs in the region; OLADE has worked, with the financial support from the Austrian Development Cooperation, in two Central America countries and two Caribbean countries to develop the Institutional Framework for Energy Efficiency as a contribution to the continuity and coordination of national efforts.

The Latin American and Caribbean Network for Energy Efficiency, sponsored by OLADE, is a dynamic group of professionals, governments and businesses, who wish to maintain permanent contact with their counterparts in other countries and to share experiences.

OLADE estimates show that 3,700 billion dollars could be saved in oil at $ 100 dollars per barrel in 25 years, while also avoiding the emission of 2 000 million tonnes of CO_2. This makes it essential for cooperative institutions to join efforts with those of the UN Sustainable Energy for All (SE4ALL) programme.

OLADE has the experience and relationships with the energy sector in all countries in Latin America and the Caribbean, and is hence in a privileged position to act as liaison for the coordination of initiatives.

Fernando César Ferreira
Executive Secretary of OLADE.

II. ACKNOWLEDGMENTS

This regional report was developed by the United Nations Environment Programme (UNEP) within the framework of the Efficient Appliances and Equipment Global Partnership Programme, and the energy efficiency accelerator of the UN Sustainable Energy for All (SE4ALL) initiative. The Latin American Energy Organization (OLADE, by its acronym in Spanish) led the collection and validation of country data, and convened the VI Seminar on Energy Efficiency in Latin America and the Caribbean, where officials from the ministries of energy and the environment in the region reviewed the regional situation and contributed additional information for the development of this report.

The Mexican manufacturer MABE, the International Copper Association (ICA), and the ministries of energy and environment of Latin America and the Caribbean countries provided technical data for cooling products used in each country, as well as data on the status of energy efficiency policies related to these products.

To conduct the analysis, CLASP employed the Policy Analysis Modeling System (PAMS) – an impact-modelling tool designed by Lawrence Berkeley National Laboratory, in collaboration with CLASP. The results of the model show the economic, financial and environmental benefits of transitioning to efficient cooling products in Latin America and the Caribbean.

The Government of Spain provided financial support for conducting the studies presented in this report through the project Regional Gateway for Technology Transfer and Action on Climate Change (REGATTA), implemented by UNEP in Latin America and the Caribbean.

III. EXECUTIVE SUMMARY

The UN Secretary-General, Ban Ki-moon, launched the global initiative Sustainable Energy for All (SE4ALL) in 2011 to increase global action on renewable energy, energy efficiency and access to energy. For energy efficiency, SE4ALL established the accelerator of efficient appliances and equipment, and appointed the United Nations Environment Programme (UNEP) to coordinate, along with other actors, the activities of this accelerator. In order to work with governments and the private sector to accelerate the use of efficient products and equipment, UNEP established the Efficient Appliances and Equipment Global Partnership Programme, together with its partners CLASP, the International Copper Association (ICA), the United Nations Development Programme (UNDP), and the non-governmental organization Natural Resources Defense Council (NRDC).

On August 20, 2014, OLADE hosted the VI Seminar on Energy Efficiency in Latin America and the Caribbean in Managua, Nicaragua. Within the seminar, UNEP and its partners presented the Efficient Appliances and Equipment Global Partnership Programme to the governments of Latin America and the Caribbean. The results are an analysis of the status of energy-efficiency policies for cooling equipment (air conditioners, refrigerators and fans) in the region were presented, together with estimates of the energy, financial and environmental benefits that would be gained through the implementation of advanced policies for these products. The meeting facilitated regional discussions to identify the lessons learned and policy priorities to foster actions in the region.

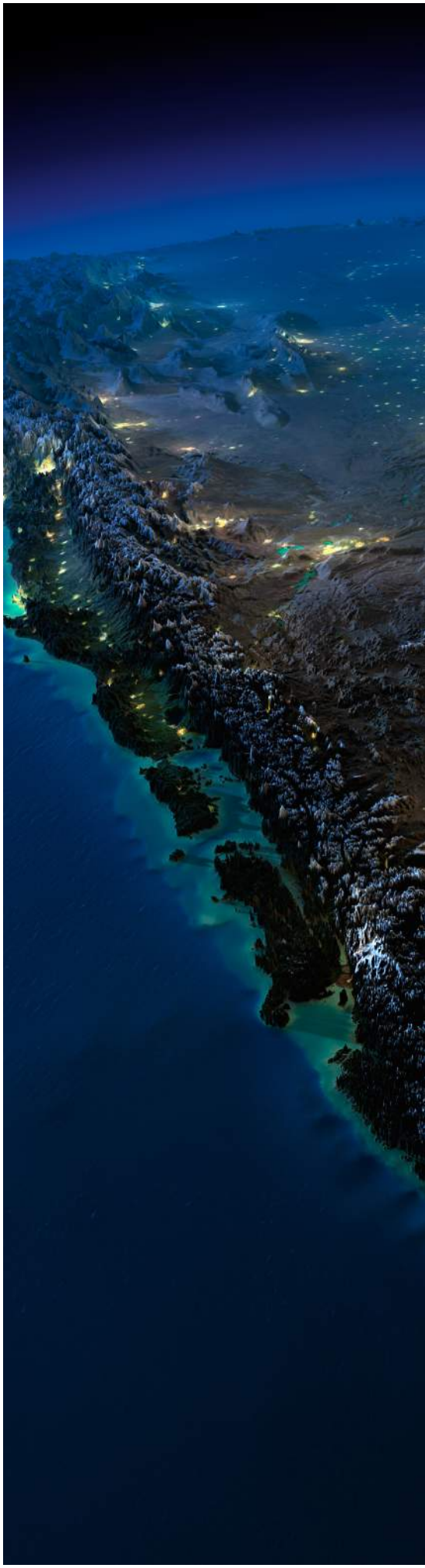
The product that most often has minimum energy performance standards (MEPS) in Latin America and the Caribbean countries is refrigerators, followed by air conditioners and fans. Of the 33 countries of the region, less than half have efficiency standards for the three products studied. Only 13 countries have established MEPS for refrigerators, 12 countries for air conditioners and two countries for fans. It is imperative that these countries continue promoting the advancement of the standards and keep existing standards up-to-date, in line with advancement in technological. It is also necessary to strengthen monitoring, verification, and enforcements systems through regulatory frameworks that guide and establish systems to ensure the effective implementation of energy efficiency regulations and standards.

Should the region implement energy efficiency standards for refrigerators, air conditioners and fans that promote the use of the best available technologies in the market, Latin America and the Caribbean would

save 138 TWh in energy annually, equivalent to almost $ 20 billion dollars in electricity bills. This reduction in demand would also benefit the countries in the region by reducing the costs of energy subsidies. Additionally, the region would avoid the emission of approximately 44 million tonnes of CO_2 per year.

To ensure a permanent and environmentally sustainable transition, UNEP recommends that the region should adopt an integrated policy approach, which includes, in addition to MEPS, supporting policies such as product labelling; mechanisms for restricting the supply of inefficient equipment and promoting the demand for energy-efficient products; monitoring, verification, and enforcement systems to prevent the distribution of products that do not meet performance requirements; and environmentally sustainable management throughout the life cycle of equipment and appliances containing electronic waste, ozone-depleting substances and persistent organic pollutants.

IV. THE EFFICIENT APPLIANCES AND EQUIPMENT GLOBAL PARTNERSHIP PROGRAMME



In September 2011, the UN Secretary-General Ban Ki-moon launched the Global Sustainable Energy for All (SE4ALL) initiative to mobilize actions in all sectors of society in the fields of renewable energy, energy efficiency and access to energy.

Since the use of energy-efficient appliances and equipment is essential to achieving the energy efficiency goal, SE4ALL established the accelerator for efficient appliances and equipment. It also appointed the United Nations Environment Programme (UNEP) to coordinate the activities of this accelerator with other actors.

For these reasons, UNEP launched the Efficient Appliances and Equipment Global Partnership Programme. This program includes CLASP, the International Copper Association (ICA), the United Nations Development Programme (UNDP) and the non-governmental organization Natural Resources Defense Council (NRDC).

The Efficient Appliances and Equipment Global Partnership Programme provides a global platform to accelerate the transformation of the market to efficient appliances and products in developing countries and emerging economies. The platform provides countries with technical and financial assistance to encourage and facilitate the adoption of ambitious energy efficiency policies, as well as for the development and implementation of national and regional strategies to sustainably transform the market.

The program provides strategic guidance to countries through an integrated policy approach, including MEPS; supporting policies such as labels and mechanisms to restrict the supply of inefficient equipment and stimulate the demand for energy efficient products; monitoring,

verification, and enforcement systems, to prevent the distribution of products that do not meet the MEPS; and environmentally sustainable management during the life cycle of equipment and appliances that contain electronic waste, substances that deplete the ozone layer, and persistent organic pollutants.

The transition to efficient equipment not only contributes to achieving the efficiency goal of SE4ALL, but is also important for reducing carbon dioxide (CO_2) emissions. In this sense, should Latin American and the Caribbean countries join the Efficient Appliances and Equipment Global Partnership Programme, the region would become both a pioneer and an example to highlight in the Climate Change Summit, led by the UN Secretary-General. The Summit will be held on September 23, 2014 in New York, seeking to encourage action by governments, companies, financial institutions, industry and civil society through new commitments and contributions that are relevant, scalable and exportable, in order to change the course of the planet towards a low-carbon economy.

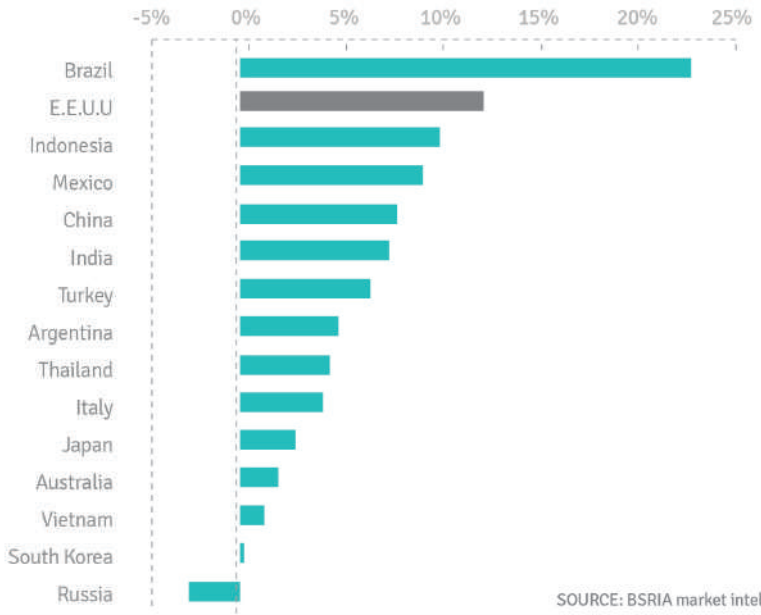
V. COOLING PRODUCTS IN LATIN AMERICA AND THE CARIBBEAN

Air conditioners, refrigerators and fans have attained great importance in the group of appliances at residential, industrial and commercial levels. GIZ (2013) estimates that the demand for appliances, especially refrigerators and air conditioners, will be the primary factor driving the highest proportion of energy demand in the residential sector. The energy demand and CO_2 emissions produced by air conditioners could even exceed the energy demand and CO_2 emissions from heating systems in 2050.

Global warming, population growth, increased revenues, and improved quality of life, especially in developing countries and emerging economies, is accelerating the demand for cooling products. For example, in Brazil the growth rate in the demand for split air conditioners exceeded 20% in only three years (see Figure 1). In general, in developing countries and emerging economies, air conditioners may account for as much as 50% of the total electricity consumption in households, a proportion that tends to increase in large economies such as Brazil, China, India, and Southeast Asia.

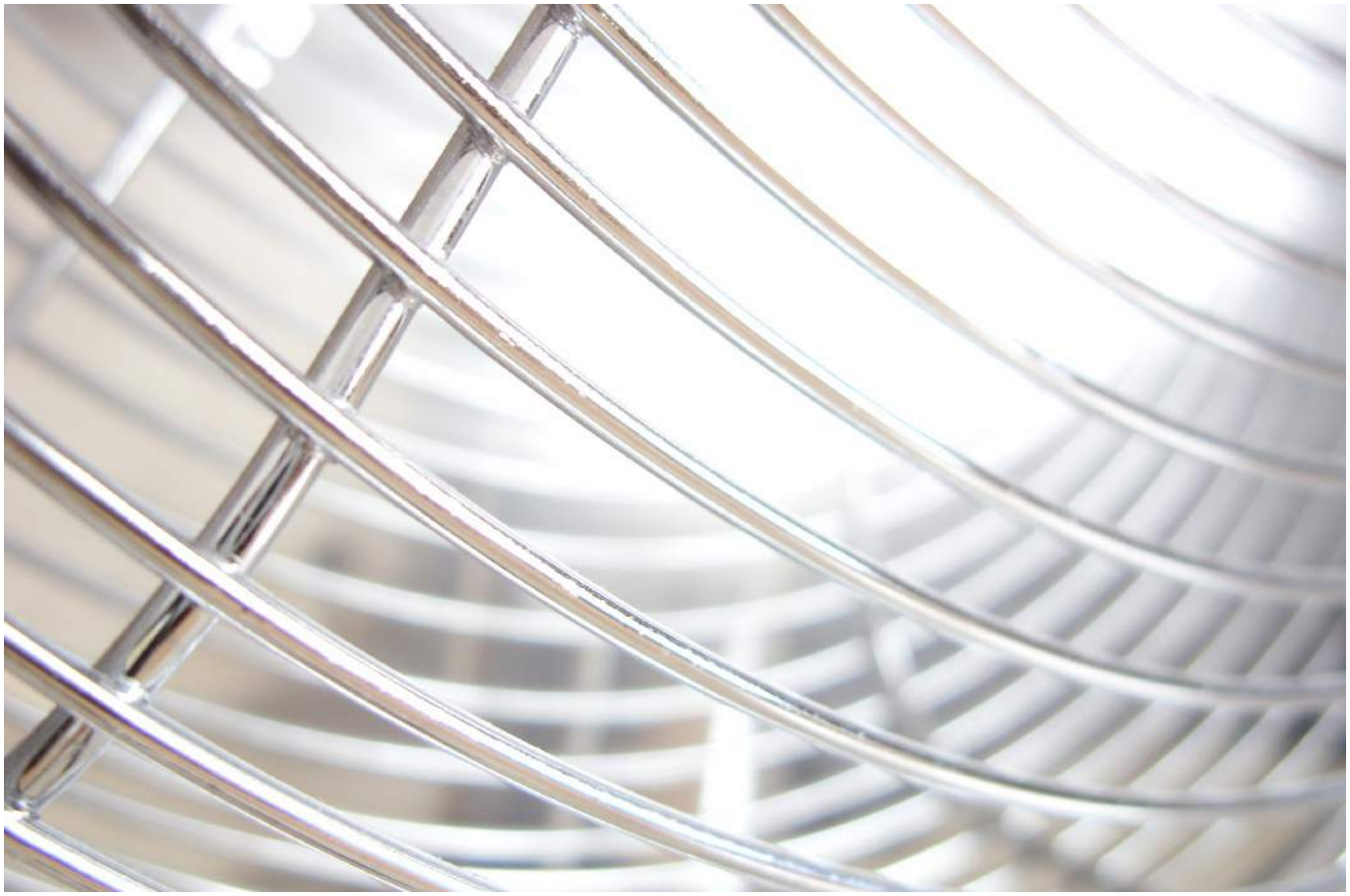
Refrigerators account for 10-15% of the electricity bills in Organization for Economic Cooperation and Development (OECD) countries; however, one fourth of power consumption in developing countries households comes from refrigerators. Assuming a "business as usual", or BAU,

FIGURE 1 . Estimated growth in demand for split air conditioners, 2011 – 2014



SOURCE: BSRIA market intelligence (2014)

[1]GIZ (2013). NAMAs in the refrigeration, air conditioning and foam sectors: a technical handbook



scenario, the global energy consumption for the use of refrigerators and freezers could grow 80% by 2030. However, in emerging and developing economies this growth would amount to over 120% (BUENAS, 2014). In particular, energy consumption by refrigerators and freezers in Latin America and the Caribbean would grow 60% approximately (see Table 1).

TABLE 1. BAU energy consumption scenarios (TWh/year) for 2010, 2020 and 2030 for refrigeration equipment (BUENAS, updated January 31, 2014).

REGIONS	ENERGY DEMAND (TWh)			GROWTH IN ENERGY DEMAND BETWEEN 2010 AND 2030 (%)
	2010	2020	2030	
North America (including Mexico)	131	163	198	51%
Western, Central, and Eastern Europe	100	99	98	-2%
Pacific OECD	50	54	58	16%
Newly independent states	25	36	25	-3%
Sub-Saharan Africa	19	85	51	162%
China	148	209	243	64%
India	25	85	185	641%
Asia (others)	22	40	64	191%
Middle East and North Africa	37	63	85	128%
Latin America and the Caribbean	51	67	81	61%
Total	**609**	**841**	**1089**	**79%**
Total OECD	**281**	**317**	**354**	**26%**
Total non-OECD	**328**	**525**	**735**	**124%**
% non-OECD	**54%**	**62%**	**67%**	

[2]Hoja de datos proporcionada mediante correspondencia personal de Michael McNeil a Jeremy Tait el 31 de enero de 2014. Archivo llamado ' BUENAS update- V2.xlsx ' que consta de 6 tablas de datos, con el acompañamiento de notas de correo electrónico

VI. BENEFITS OF TRANSITIONING TO EFFICIENT REFRIGERATING PRODUCTS

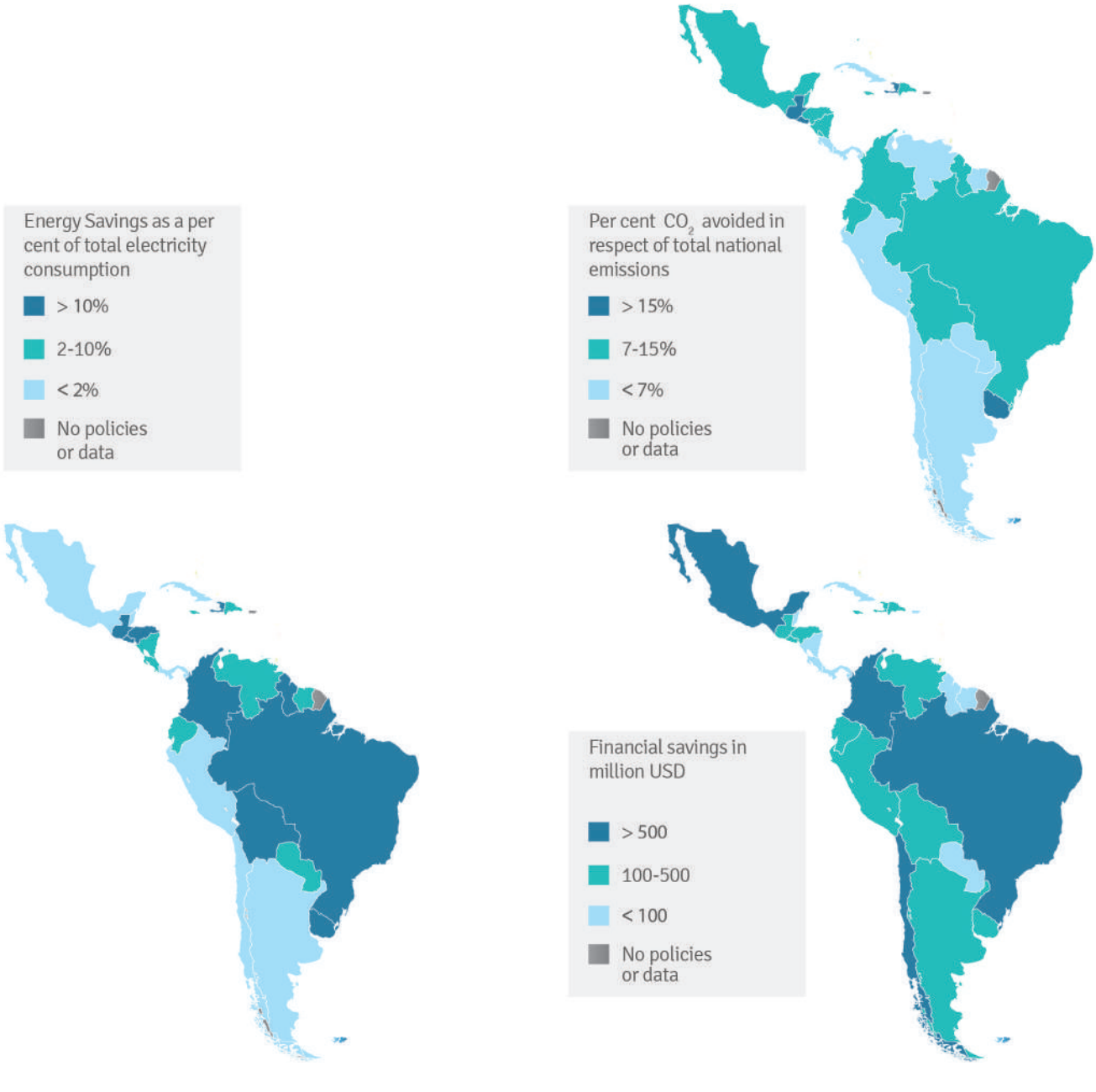
Energy efficiency is one of the fastest and most affordable practices to mitigate climate change, prevent excess demand of electricity, avoid electricity rationing (blackouts), reduce the investment in power generation, and reduce the cost of energy subsidies. Further, the use of efficient cooling products provides savings at country and citizen levels, in financial, environmental and energy terms. These reduce the value of electricity bills as well as imports of fossil fuels, improve consumer welfare and reduce carbon dioxide emissions.

Globally, the use of the best available technologies in efficient air conditioners, refrigerators and fans would translate into savings of 870 TWh per year in 2030. In Latin America and the Caribbean, these energy efficient products would lead to annual savings of 138 TWh, which represent 11% of today's power consumption in the region, equivalent to the power consumption of Venezuela and Peru combined. Additionally, the use of these cooling products would save $20 billion per year on electricity bills paid by consumers, and would prevent the emission of 44 million tonnes of carbon dioxide, equivalent to those produced by 24 million medium-sized vehicles. Annex 2 to this report shows the financial, environmental and energy benefits for the various economies in the region, including the Andean Community, Mercosur, the Caribbean, and Central America.

At the country level, the percentage of electricity savings relative to national consumption figures ranges from 2% to 31%, and is subject to the level of subsidies implemented in the country. In some Caribbean countries, for example, where electricity subsidies are high, percent savings tend to be low. Likewise, the percentage of emissions relative to annual national emissions ranges between < 1% and 21% (see Figure 2).

The stock of the products in the region is expected grow greatly in future and if no action is taken today, the region will lock-in high energy consuming products. For example, it is estimated that by 2030, the number of refrigerators in Paraguay will increase by 128%; in Panama, air conditioners will increase by 409%; and in Belize, the number of fans will increase by 68%. If this growth is realized with the best technology available in the market, backed with appropriate energy efficiency standards and supporting policies to assist consumers to make the initial investment more affordable, the region could achieve unprecedented levels of efficiency and economic savings.

FIGURE 2 Energy savings, financial savings and environmental benefits in Latin America and the Caribbean

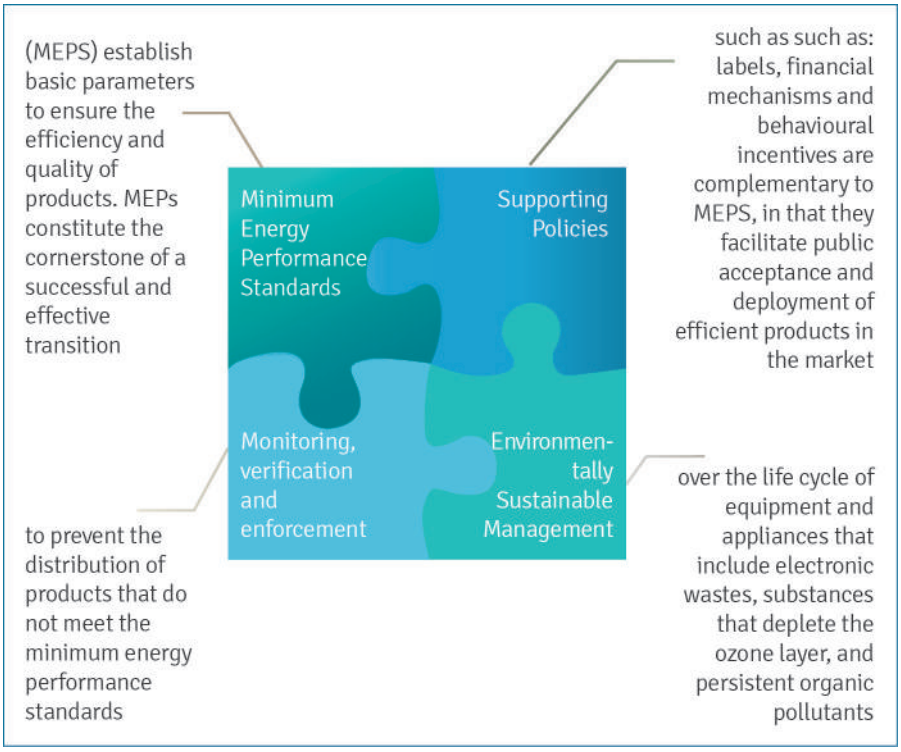


VII. AN INTEGRATED POLICY APPROACH FOR TRANSITIONING TO EFFICIENT COOLING PRODUCTS

In 2010, UNEP convened a group of governments and international specialists in lighting from more than 40 organizations, with the aim to provide advice on the development and successful implementation of national strategies for efficient lighting. Their strategic recommendations resulted in an integrated policy approach that guarantees that best practice activities are mainstreamed into the national energy policy and vision.

This approach was implemented by ten countries in the region (Chile, Uruguay, Central American countries and the Dominican Republic), and allowed for the development of national and regional strategies for efficient lighting. The result has shown the innovative and flexible nature of the integrated policy approach, as well as its effectiveness in the implementation of lighting policies, to such an extent that UNEP recommends the use of this methodology in programs for transitioning to efficient equipment. This approach substantially increases the likelihood of a successful transition to efficient equipment. Furthermore, this approach will facilitate the process for energy policy makers and implementers.

The integrated policy approach includes four components:



Minimum energy performance standards (MEPS) are regulations that establish the minimum acceptable performance for products marketed in a particular country or region. MEPS remove the least efficient products from the market and thereby encourage innovation and rapid adoption of higher efficiency products. MEPS are the foundation for ensuring the success of any strategy aimed at transitioning the market to energy efficient products.

Supporting policies and mechanisms ensure the effective and smooth implementation of MEPS, by facilitate public acceptance and deployment of efficient products in the market.

The successful implementation of MEPS will partially depend on the selection and combination of additional policies that address certain needs of a country, including the following:

- Regulatory and control mechanisms: application regulations required by specific system designs, practices, and devices to optimize energy efficiency.
- Economic and market instruments: market mechanisms that are usually initiated and promoted through regulatory incentives, but which may contain participatory or voluntary action elements.
- Incentives and fiscal instruments: mechanisms that have an impact on prices, such as taxes to reduce energy consumption or financial incentives to reduce initial costs.
- Communication campaigns and voluntary labels: initiatives aimed to persuade end-users to change or modify their behaviour by providing relevant information and examples of successful implementation.

Monitoring, verification, and enforcement (MVE) are needed to ensure the successful implementation and compliance of MEPS. If market surveillance systems are not monitored in a timely and effective manner, inefficient, low-quality products will continue to enter the domestic markets in increasing numbers, thus reducing energy and financial savings. In addition, low-quality products may not meet the expectations of end users, who will be disappointed and, therefore, will cease to purchase such products consistently in the future. Compliance monitoring is intended to protect citizens against unfit products, ensuring compliance in accordance with expectations. These activities also ensure that government regulators meet the goals of their energy performance initiatives. Furthermore, these activities also protect suppliers, ensuring that each manufacturer is subject to the same conditions for entering the program. MVE activities encompass a broad range of actions, including:

- Monitoring is a measurement process through which any party can use to check product efficiency. It involves measuring performance claims against a nominated standard in a consistent manner, using accurate instrumentation and applied by qualified staff in controlled conditions.
- Verification involves declarations of conformance by product suppliers confirmed often by independent third parties.
- Enforcement is the action taken by governments or other parties against suppliers of non-compliant products, as a result of finding fault through either monitoring or verification. Enforcement requires rigorous and transparent monitoring and verification processes.

Sustainable environmental management ensure that standards should be developed on the maximum content and environmental management of electronic waste, ozone-depleting substances, and persistent organic pollutants. Special attention should be paid to the development of a legal framework for the end-of-life environmentally sustainable management of products, making this a national priority and ensuring coordinated law enforcement. Regulations and policies should be developed and implemented very carefully before establishing formal collection channels and recycling centres.

VIII. STATUS OF POLICIES FOR COOLING PRODUCTS IN LATIN AMERICA AND THE CARIBBEAN

Minimum energy performance standards

MEPS are in place in some Latin America and the Caribbean countries, with refrigerators being the most frequent product with policies in place, followed by refrigeration equipment, followed by air conditioning and fans. Of the 33 countries of the region, less than half have performance standards for the products studied. Only 13 countries have established MEPS for refrigerators; 12 for air conditioners; and two for fans (see Figure 3).

Refrigerators

Mandatory MEPS for refrigerators are in place in Argentina, Brazil, Costa Rica, Cuba, Ecuador, El Salvador, Honduras, Mexico, and Nicaragua; and voluntary standards exist in Peru and Guatemala. Costa Rica, Honduras, and Nicaragua have standards that establish the maximum allowable power consumption; Peru and Guatemala have voluntary standards; Venezuela prohibits marketing Class-D and Class-F refrigerators; and Chile has developed standards that are currently under approval.

Mexico began adopting standards for refrigerators in 1995, with the latest update made in 2012; the Brazilian standard was updated in 2011; Cuba adopted a standard in 2010 and its first update is currently in process; and Ecuador adopted a standard in 2011. Costa Rica (2008) and Nicaragua and Honduras (2010) approved mandatory standards which set out the maximum energy consumption for refrigerators, and Guatemala established a voluntary standard specifying the maximum consumption limit in 2010. Peru began the implementation of voluntary standards in 2009.

Air Conditioners

Standards for air conditioners came into force in recent years. Argentina, Brazil, Chile, Costa Rica, Cuba, Ecuador, El Salvador, Mexico and Nicaragua established performance standards between 2007 and 2013. Saint Lucia, for its part, has issued draft standards currently under public consultation; Panama is in the process of publishing the standard, whereas Venezuela prohibits the importation and marketing of Class-D

through Class–F air conditioners, similar to refrigerators.

Fans

Only Ecuador and Cuba have adopted MEPS for fans, while both Mexico and Brazil consider performance standards for this equipment in their labelling programs. Some other countries in the region consider that the diversity of models and technologies with very different efficiencies hinders the establishment of standards. In some countries, however, the use of fans is not massive; hence, the design and implementation of standards is not considered a priority.

FIGURE 3 Countries with a minimum energy performance standards

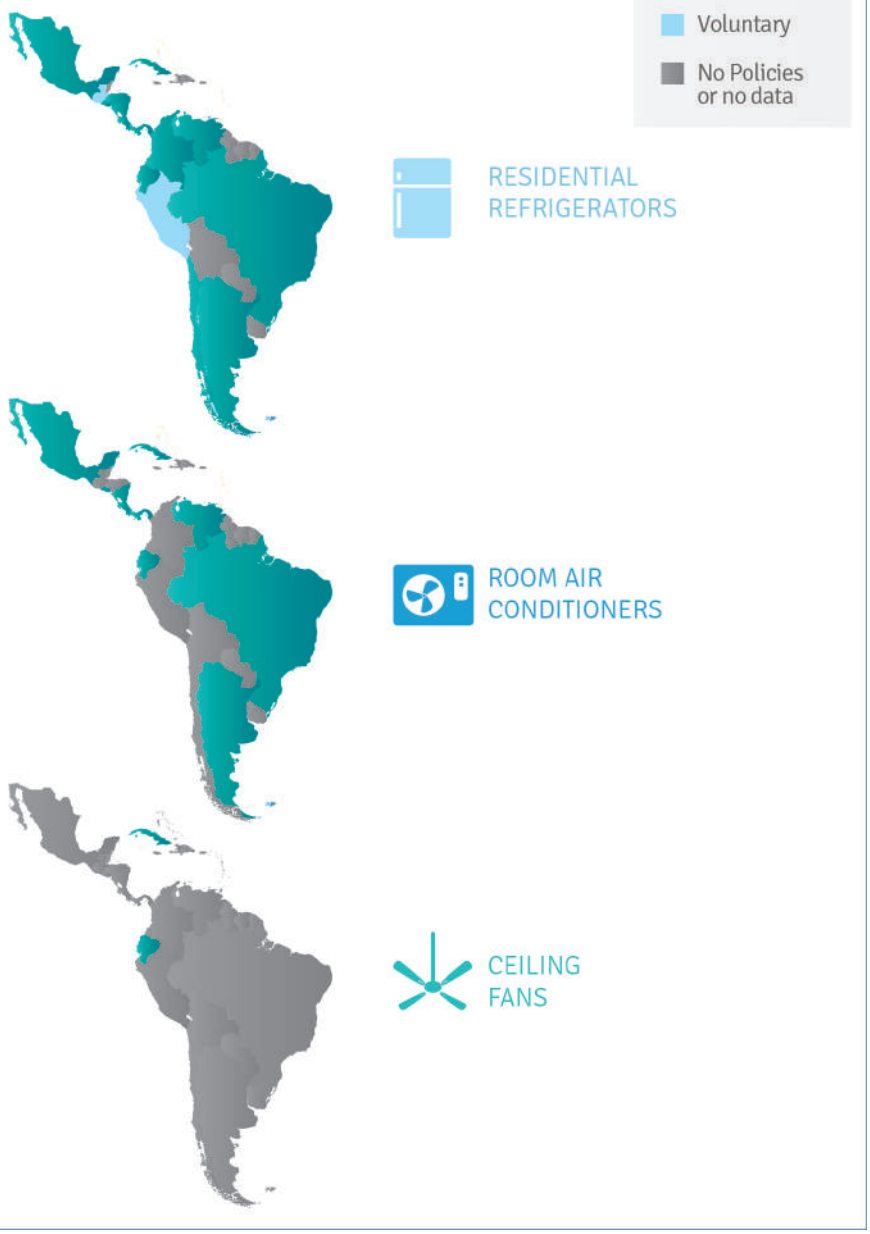
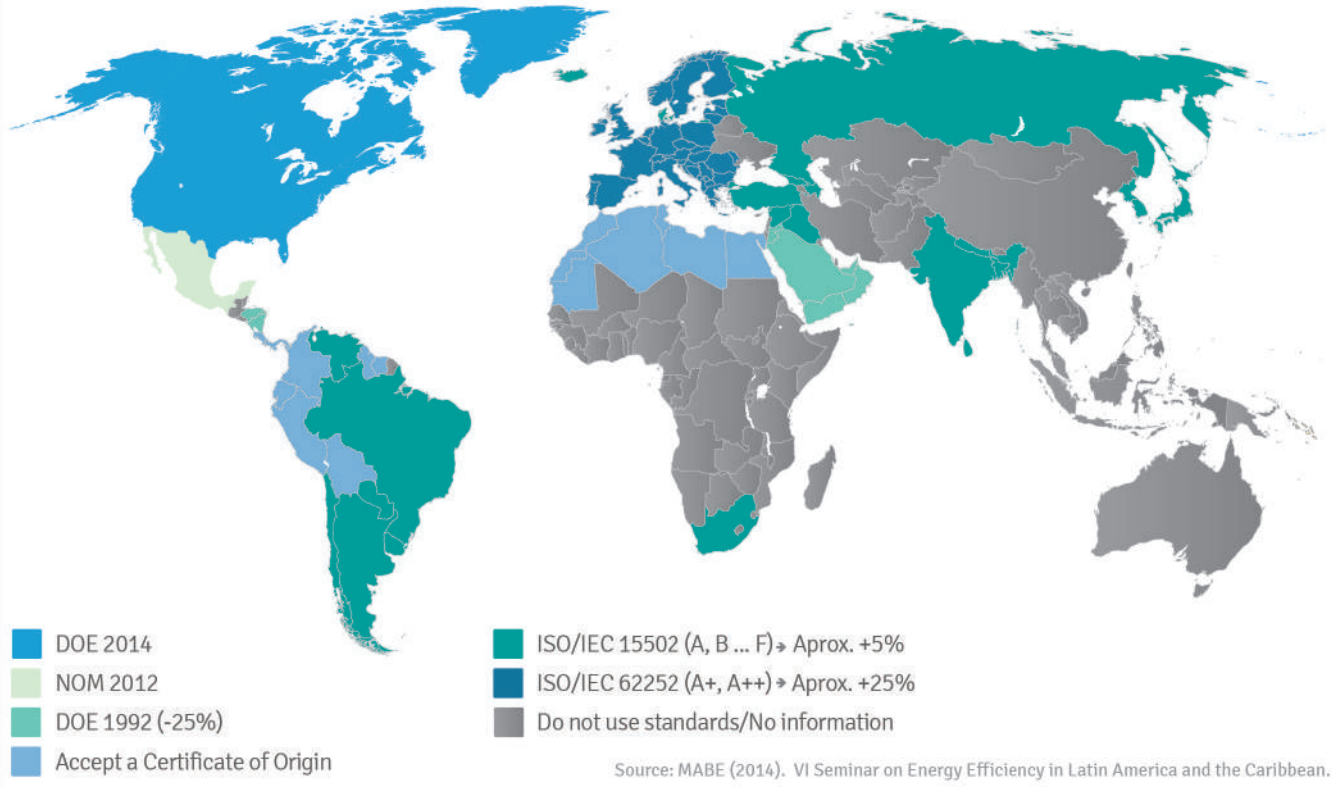


FIGURE 4 Status of energy efficiency standards - refrigerators



Source: MABE (2014). VI Seminar on Energy Efficiency in Latin America and the Caribbean.

A comparative analysis of efficiency standards for refrigeration equipment highlights Mexico as one of the countries in the region with the highest degree of experience in the successful implementation of standards. In about twenty years, Mexico has developed a comprehensive system of standards, including MEPS, minimum quality standards and electrical safety standards. Additionally, the country has regulations detailing laboratory test methods to check each of the parameters set out in the standards. The country is committed to the implementation of strict standards; in the past twenty years the standards for refrigerators have been updated four times, and those for air conditioners have been updated twice.

Brazil, Cuba and Ecuador have also established a comprehensive system of standards; in the three countries, minimum performance limits are in place, importers have to certify that their products comply with them, and non-certified equipment cannot be marketed. The best practice of Brazil, Cuba, Ecuador and Mexico are valuable examples for other countries that are beginning to develop and implement this component.

The regional overview of energy efficiency standards includes a variety of regulations with different product characteristics and ratings. Individually, each country has either developed its own standards or adopted international standards. In some cases, products should be certified; in others, the product certificate issued by the country of origin is accepted; and in still others, a labelling system is the only control measure in place. For example, for refrigerators, some countries only accept the certificate of origin, while others have implemented ISO standards used in Asia; and still others use ISO standards currently used in Europe (see Figure 4).

This lack of harmonization in the refrigerator, air conditioner and fan markets across the region has contributed to the efficient-product market offering products that are more expensive than in other parts of the world, thus making them unaffordable to many low-income families. In addition, the lack of harmonization exposes countries lacking standards to use low-efficiency appliances, thus contributing to excessive energy consumption. In a region such as Latin America and the Caribbean, where energy performance standards vary so much, there is the risk for the standard-lacking countries to become the recipients of inefficient products that are rejected by markets with stringent efficiency standards.

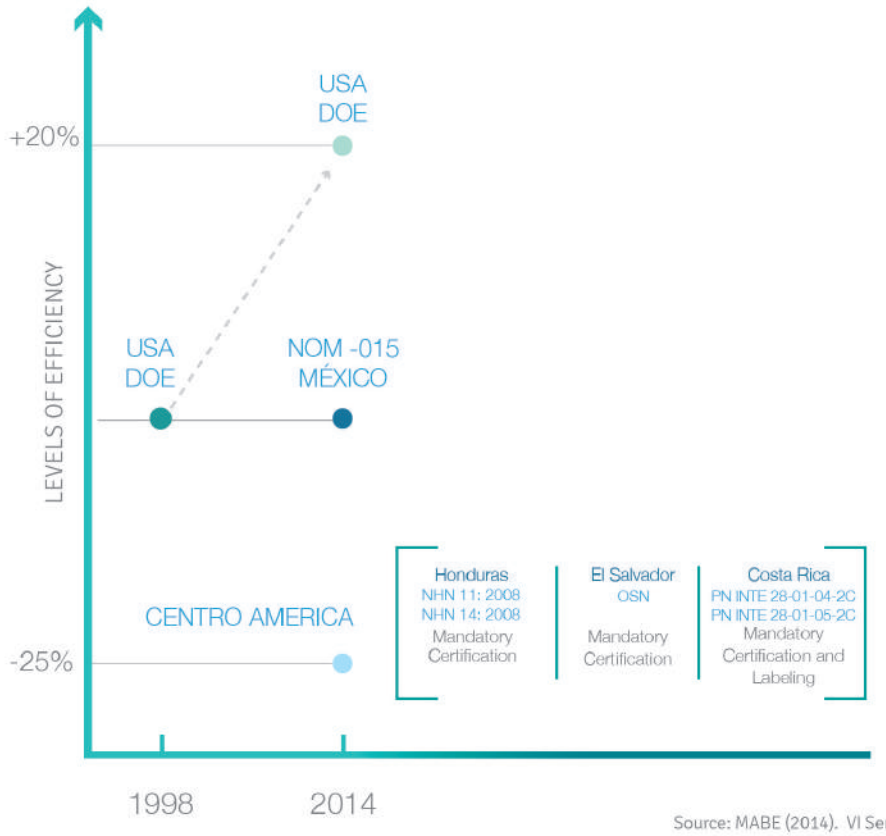
If the Mexican standard (NOM O15 2012) for residential refrigerators

is compared with the mandatory standards of Central American countries, the latter have energy efficiency levels that are, on average, 25% lower than those in Mexico. In the Central America sub-region, only some countries require mandatory certification (e.g. El Salvador, Honduras) or mandatory labelling systems and certificates (e.g. Costa Rica). Countries such as Honduras and Belize accept certificates of origin but lack mandatory energy performance standards.

In South America, most countries use the ISO/IEC standard, which includes conformity assessment tests and testing temperatures and conditions that are not comparable to those of the NOM 015. Projections made by the refrigerator industry estimate that by 2017, Central America should align its energy performance standards to the levels currently established in Mexican regulations. It is also expected that in this year, the Mexican standard will be upgraded to improve refrigerators energy efficiency levels. Projections by the appliance industry estimate that, by 2017, Mexico will increase the levels of energy efficiency required for refrigerators marketed in the country (MABE, 2014) (see Figure 5).

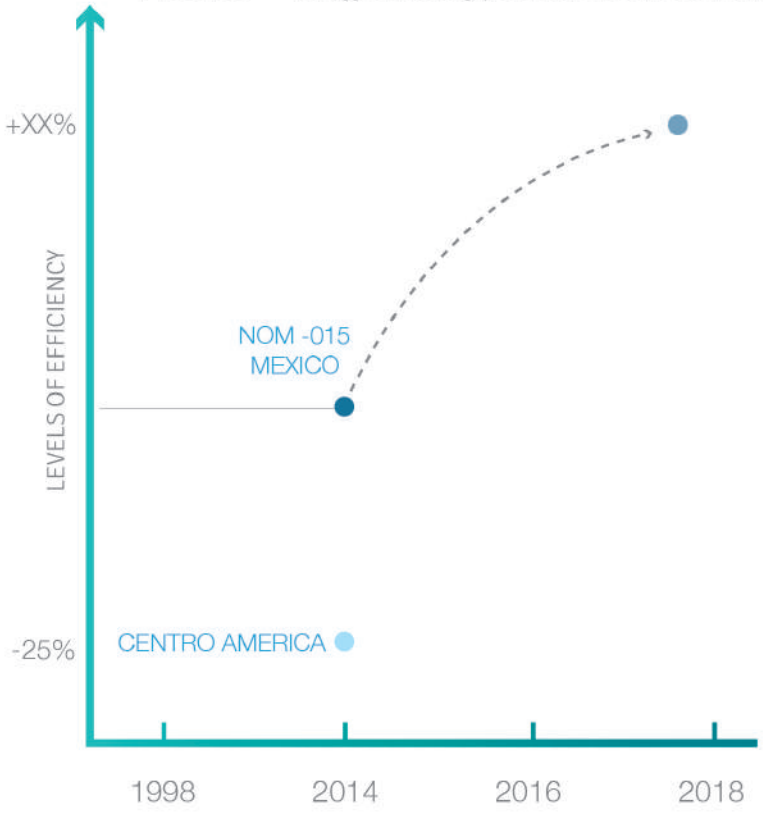
The harmonization of standards across the region is essential if Latin America and the Caribbean want to lead successful efficiency programs with tangible benefits that are sustainable over time. If the standards of these products are harmonized, the market will be transformed in an integrated manner; offer a wider range of efficient products; avoid the supply of inefficient products; and level off prices to ensure affordability for poor families. The region is no stranger to the harmonization of standards; Central America and the Dominican Republic have already successfully harmonized their residential lighting

FIGURE 5 Minimum Energy Efficiency Standards



Source: MABE (2014). VI Seminar on Energy Efficiency in Latin America and the Caribbean.

FIGURE 6 Energy efficiency potential of Central America and Mexico



Source: MABE (2014). VI Seminar on Energy Efficiency in Latin America and the Caribbean.

FIGURE 7 Countries with supporting policies

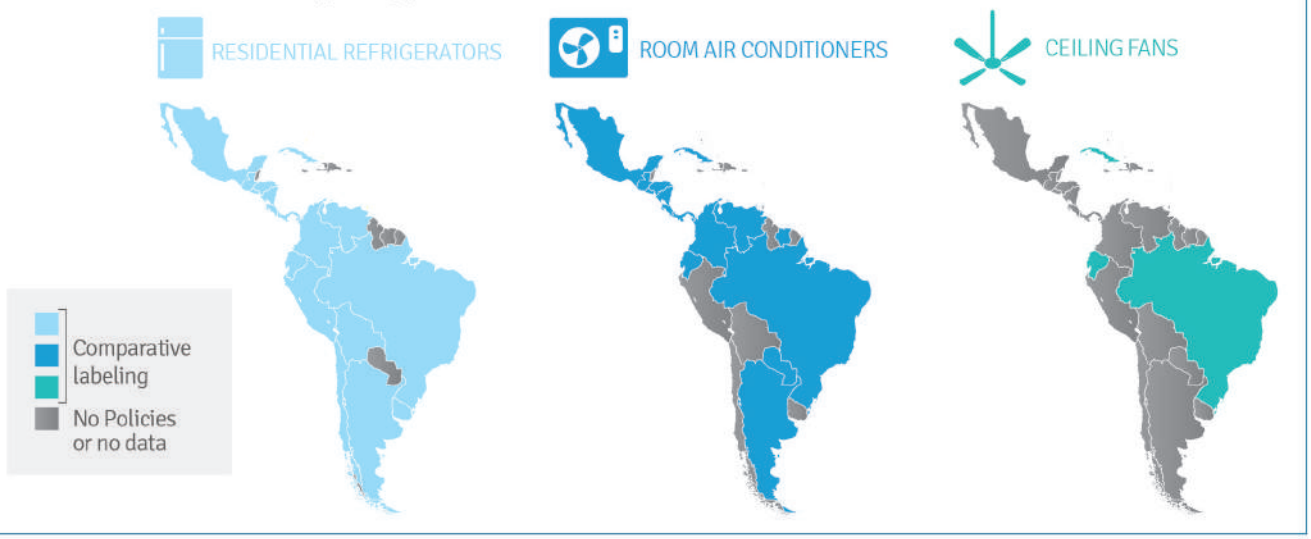
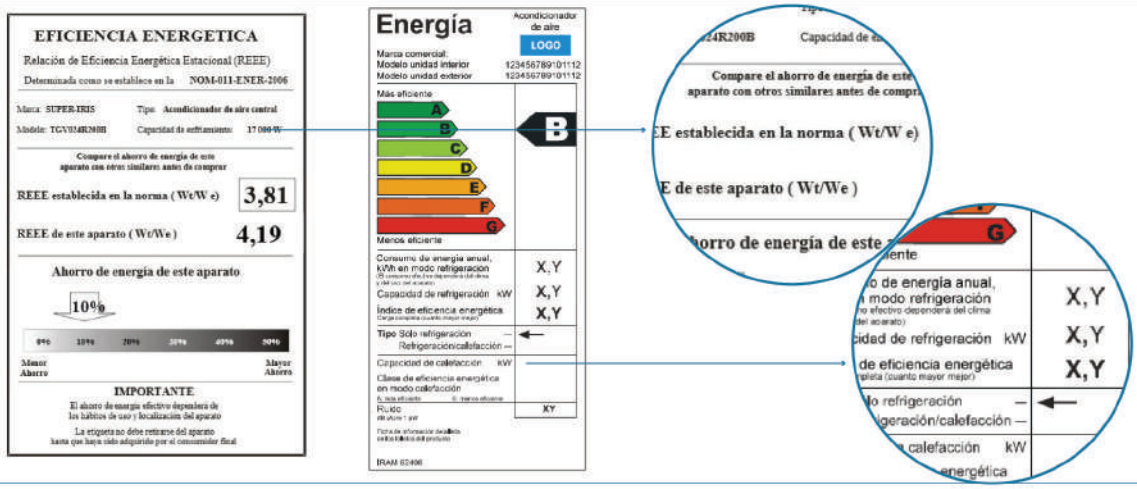


FIGURE 8



market. These countries jointly developed an efficient lighting strategy, which encompasses the implementation of performance, quality, and safety standards; a control system to check compliance with standards using the Costa Rica's lighting laboratory; and a plan for the environmentally sound management of used or discarded lamps.

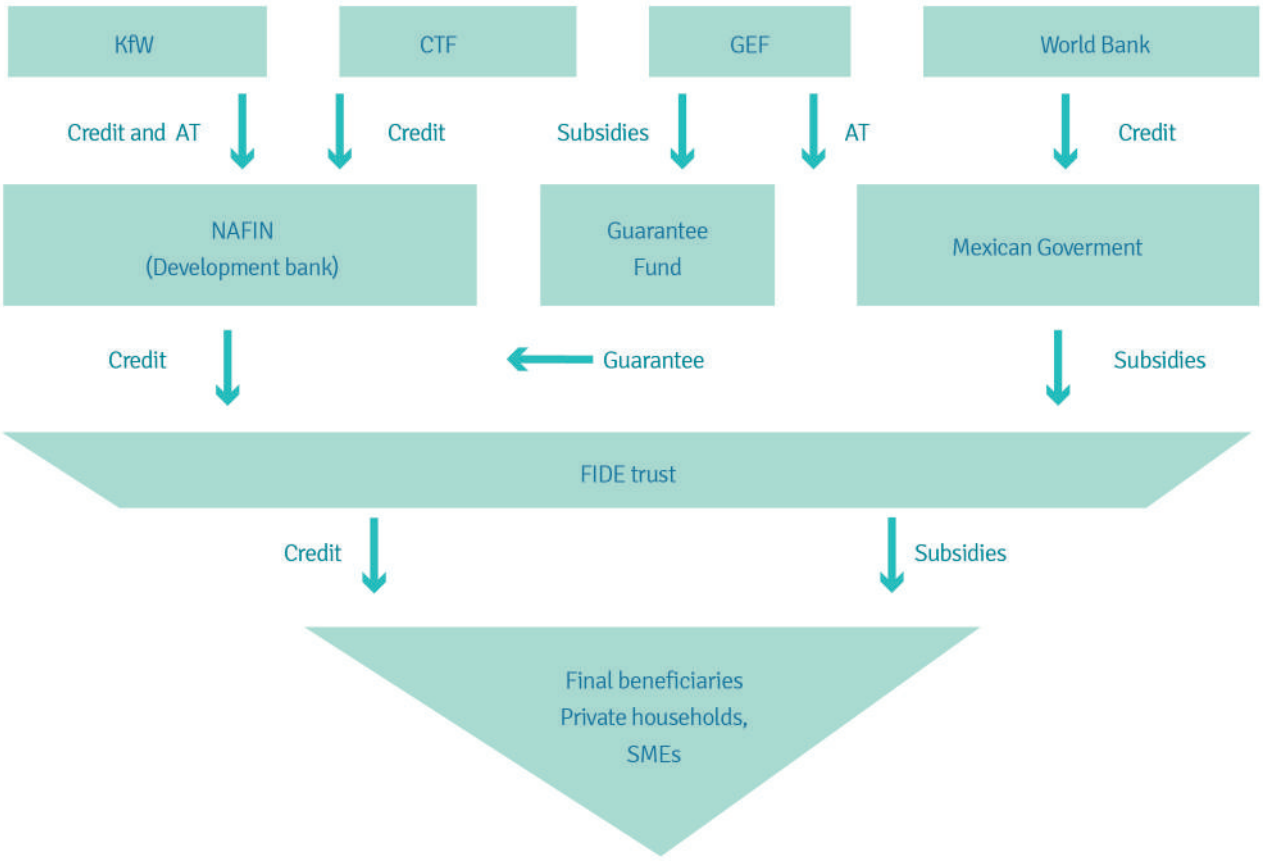
Supporting policies

The region has mostly opted for the use of labelling systems, with 19 countries currently implementing labels for at least one equipment type (see Figure 7). However, Figure 7 the diversity of labels, the lack of harmonization and the burden of technical information in labels are affecting effectiveness. Consumers, who usually have to choose among equipment with various labels, and lacking the ability to understand the technical information in them, may end choosing equipment for reasons other than efficiency. Some examples of the saturation of technical information contained in labels are shown in Figure 8.

Outreach campaigns to promote energy efficiency are another type of supporting policy used by countries across the region. The topics most often promoted in outreach campaigns include tips for installation and use of energy-saving equipment, as well as information to facilitate the understanding of labelling systems. However, the information provided by countries shows that in only a few of them have outreach campaigns that are conducted as part of a systematic strategy for consumers to acquire a solid culture of energy efficiency, empowering them to act and decide at the time of purchasing refrigeration equipment. Frequently, no indicators are in place for measuring the effectiveness of these programs, and in some cases communication only reaches an appropriate level when countries face power supply crises.

Argentina, Cuba, Mexico, and Uruguay are the countries with the best outreach practices in the region; these countries have implemented comprehensive, regular outreach strategies coupled with education

FIGURE 9 Example for Mexico: International cooperation
Program of appliance replacement for energy saving



Source: KfW (2010). Investments in climate change mitigation: Energy efficiency. Bogota, 17 November.

campaigns aimed at changing energy-use habits.

Other supporting policies identified in the region include programs for the replacement of inefficient appliances and equipment by higher-efficiency ones, by applying harmonized support tools that facilitate the process, especially for lower-income families. In Mexico, the Trust Fund for Electricity Savings (FIDE, by its acronym in Spanish) developed a refrigerator replacement program using incentive fees. The program replaced 20% of inefficient refrigerators then installed 2.3 million high-performance refrigerators in the country. This program received subsidies from the Federal Government to the sale price of equipment, as well as bank financing that granted credit facilities to mostly low-income consumers whose instalments were paid through the monthly electricity bill. It was also supported by international financial organizations and environmental organizations (see Figure 9).

Over the 2006-2009 period, Cuba implemented a program for the replacement of inefficient appliances and equipment, including refrigerators, air conditioners and fans. In this project, the government provided price subsidies for equipment and, through public banks, granted financing at low interest rates with long re-payment periods ranging from 3 to 8 years, according to the income of each family. The program was financed by international banks, mainly from countries that had supplied the equipment. Table 1 describes the number of units replaced together with the corresponding savings and emission reductions.

Ecuador recently launched a program for replacing inefficient refrigerators in which approximately 330000 refrigerators with over 10 years of use were replaced by high-efficiency (Class A) equipment. All the refrigerators replaced had a capacity ranging from 280 to 340 litres.

Brazil is currently implementing an ambitious program to replace re-

frigerators by high-efficiency equipment through its National Electricity Agency (ANEEL).

Several countries in the region have implemented pilot programs for the replacement of inefficient products (although most of those targeted the replacement of incandescent bulbs), supported by international cooperation, aimed at measuring the energy, environmental and economic benefits and to encourage the population to replace their inefficient equipment.

On the other hand, there is a good amount of energy services companies (ESCOs) in the region which, in the case of Mexico, were actively involved in programs to replace lighting and refrigerators. ESCOs provide important technical and financial support, and should be considered by countries in the region for the implementation and development of transition programs to efficient equipment and appliances.

Monitoring, verification and enforcement

Actions for the monitoring, verification and enforcement of performance requirements for cooling products are extremely limited in Latin America and the Caribbean. Several international experiences show that, without an effective MVE system, MEPS and labelling cannot guarantee the energy and financial savings promised by the massive use of efficient equipment to be realized.

Only 18 countries in the region have set out regulations regarding MVE systems. Six Central American countries developed a collaborative project with the United Nations Development Programme (UNDP), funded by the Global Environment Facility (GEF), for the establishment of performance standards for appliances during the period 2008-2010. However, Costa Rica is the only Central American country that has established test methods for refrigerators, air conditioners, fans and other equipment.

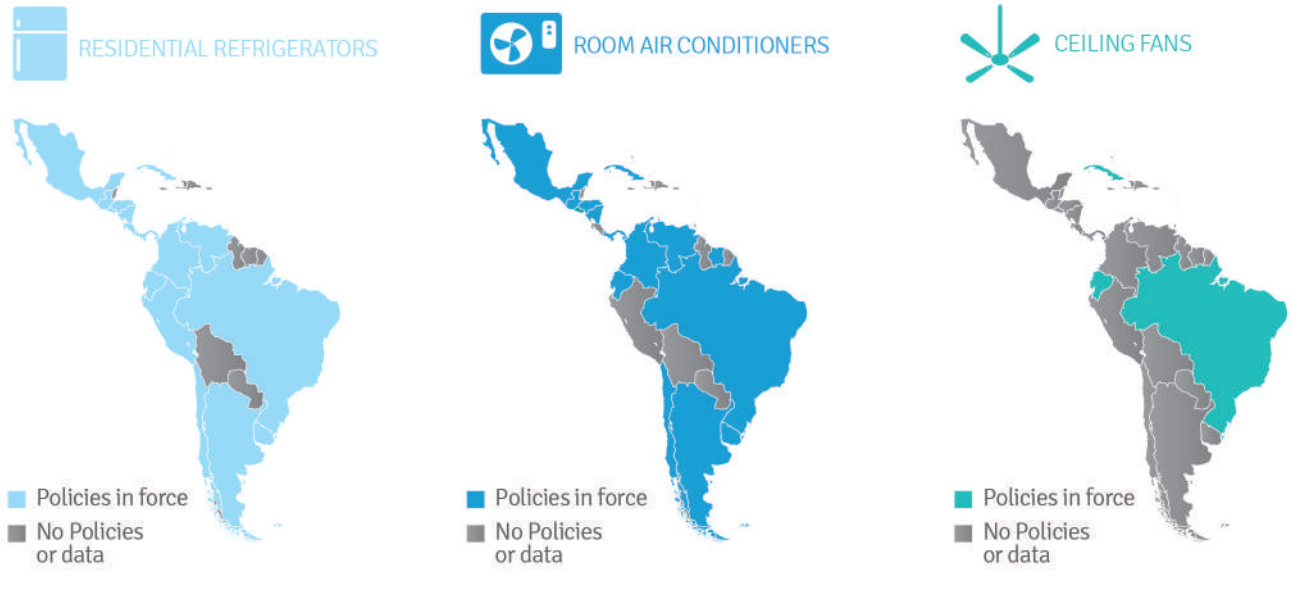
Chile, Colombia, Panama and Peru apply MVE systems for the monitoring and testing of product labelling. In the English-speaking Caribbean, 4 countries (Dominica, Guyana, Jamaica, and St. Lucia) are currently developing MVE systems or these are in the approval process. Only 7 countries in the region, including Argentina, Mexico, Brazil, Colombia, Costa Rica, Cuba, and Ecuador, have laboratories in place for checking compliance with energy performance standards (see Figure 10).

Argentina, Brazil, Cuba, Ecuador, and Mexico have established procedures to ensure compliance with energy efficiency certificates and standards; however, significant gaps in the verification of products entering the market still remain, since laboratories have limited testing capacity, especially in Cuba and Ecuador. In these cases, countries are forced to accept efficiency certificates or results from verification tests conducted in the countries of origin.

TABLE 2

EQUIPMENT	TOTAL PRODUCTS REPLACED (UNITS)	GENERATION REDUCTION (GWh)	REDUCTION OF CO_2 EMISSIONS (TONNES/YEAR)
Refrigerators	2,600,000	935,5	654,326
Air conditioners	209,480	161,1	33,839
Fans	1,043,709	68,6	48,000

FIGURE 10 Countries with monitoring, verification, enforcement systems



IX. RECOMMENDATIONS

The regional status of policies and regulations that address refrigeration, the experiences of several countries in the region regarding the promotion of efficient cooling products, as well as the results of the intergovernmental dialog held in Managua, Nicaragua on August 20, 2014 in the framework of OLADE's VI Seminar on Energy Efficiency, bring together important considerations and recommendations to further public actions targeting the efficiency of cooling products in Latin America and the Caribbean.

- If the region implemented energy performance standards for refrigerators, air conditioners and fans, and promoted the use of the best technologies available in the market, Latin America and the Caribbean would save 138 TWh annually, equivalent to almost 20 billion dollars in electricity bills. This reduction in demand would benefit the countries in the region by reducing the costs of energy subsidies. Additionally, the region would cut yearly CO_2 emissions by approximately 44 million tonnes.
- There are valuable experiences in the region from countries that have already started —some of them several decades ago— the implementation of energy performance standards and policies to support the transition to efficient cooling products. It is important that countries continue these initiatives and keep existing standards up-to-date, in pace with the rapid technological advances and to prevent these standards from becoming obsolete.
- Monitoring, verification and enforcements (MVE) systems are generally weak across the region and, therefore, it is recommended to establish regulatory frameworks to guide and establish MVE systems to ensure that energy efficiency regulations and standards are implemented and effective. The capacities of testing laboratories in the region should also be strengthened to facilitate the verification of performance levels and quality of cooling equipment. The following considerations should be taken into account in the design of MVE systems:
  - Products that do not achieve certification based on the minimum energy efficiency standards adopted by the country should be subject to import and production restrictions.
  - Rated values declared in labels should be those confirmed through testing to grant a certification to a product.
  - Support for customs controls of manufacturers through verification (e.g. laboratory tests) of random samples of equipment.
  - Development and application of sanctions when equipment is found to be non-compliant with standards or labels in force in the country.
- Existing minimum energy performance standards in the region vary widely. Therefore, the risk exists for countries lacking standards to become the recipients of inefficient products that have been displaced

from markets with more stringent efficiency standards. Similarly, this situation exposes countries lacking standards to use low-efficiency products, thereby requiring increased electricity generation due to growth in product stock.

- The region would benefit from strengthened cooperation links and information-sharing mechanisms as well as lessons learned from successful energy efficiency processes in countries within the region. Coordination in the establishment of efficiency standards would prevent the high-efficiency product market from offering equipment more expensive than in other parts of the world, thus making them unaffordable for low-income families.
- MEPS should be mandatory in order to ensure quality, safety, minimum environmental impact and high efficiency of the large amount new products that are expected to enter the market in coming years. Also, mandatory MEPS will set the basis for the replacement of inefficient equipment and appliances by high-efficiency products.
- Labelling systems should be mandatory to ensure that consumers have access to reliable and detailed information on the efficiency and quality of equipment. It is recommended that label designs are simplified to facilitate the understanding and decision-making by the consumer when choosing a product. This can be reinforced through educational and outreach campaigns that enable consumers to make informed decisions.
- The implementation of policies and support actions to promote the increased acceptance of efficient products among low-income families is recommended, through soft loans, subsidies, favourable tax policies, equipment replacement programs and nationally appropriate mitigation actions (NAMAs); according to each country's characteristics.
- It is necessary to make significant progress in environmentally sound management, and to advance regulations to concrete implementation actions, and consider banning non-ecological refrigerants in standards and/or labelling of cooling products.

X. ANNEXES

Annex 1. Potential savings in Latin American and Caribbean Countries

COUNTRIES	PRODUCT	ENERGY SAVINGS (GWh)	GHG EMISSION REDUCTION (kTon CO_2)	REDUCTION IN END-USERS' ELECTRICITY BILLS (In thousands of dollars)
Antigua	Refrigerators	2.14	2.2	317.7
	Air conditioners	11.64	1.8	1,724.0
	Fans	1.84	11.7	268.7
	Total savings	**15.60**	**15.7**	**2,310.4**
Argentina	Refrigerators	1,145.54	517.1	43,530.4
	Air conditioners	5,365.17	2,422.0	203,876.4
	Fans	943.65	426.0	35,858.6
	Total savings	**7,454.35**	**3,365.1**	**283,265.5**
Bahamas	Refrigerators	13.52	10.5	1,615.5
	Air conditioners	49.07	38.0	5,863.8
	Fans	4.10	3.2	490.2
	Total savings	**66.69**	**51.7**	**7,969.5**
Barbados	Refrigerators	14.03	10.9	2,469.4
	Air conditioners	49.04	38.0	8,631.2
	Fans	5.76	4.5	1,013.7
	Total savings	**68.83**	**53.3**	**12,114.4**
Belize	Refrigerators	12.37	10.0	1,422.7
	Air conditioners	20.37	16.5	2,342.2
	Fans	5.78	4.7	664.1
	Total savings	**38.51**	**31.2**	**4,429.1**
Bolivia	Refrigerators	196.71	94.3	16,444.8
	Air conditioners	915.98	438.9	76,576.3
	Fans	103.00	49.3	8,610.4
	Total savings	**1,215.69**	**582.5**	**101,631.5**
Brazil	Refrigerators	16,154.81	2,754.6	2,907,866.0
	Air conditioners	54,852.67	9,353.1	9,873,480.9
	Fans	6,807.75	1,160.8	1,225,394.5
	Total savings	**77,815.23**	**13,268.5**	**14,006,741.5**
Chile	Refrigerators	667.95	338.6	153,241.6
	Air conditioners	1,689.25	856.3	387,548.5
	Fans	447.56	226.9	102,679.5
	Total savings	**2,804.77**	**1,421.8**	**643,469.5**
Colombia	Refrigerators	949.25	173.1	92,931.3
	Air conditioners	6,520.36	1,189.1	638,342.9
	Fans	858.35	156.5	84,032.4
	Total savings	**8,327.95**	**1,518.7**	**815,306.6**
Costa Rica	Refrigerators	182.11	13.5	20,360.4
	Aires acondicionados	492.90	36.5	55,105.8
	Fans	112.15	8.3	12,538.3
	Total savings	**787.16**	**58.3**	**88,004.6**
Cuba	Refrigerators	98.61	82.5	12,819.2
	Air conditioners	105.71	88.5	13,742.6
	Ventiladores	178.00	149.0	23,140.1
	Total savings	**382.32**	**320.0**	**49,701.8**
Dominica	Refrigerators	2.87	2.2	860.4
	Air conditioners	15.39	11.9	4,618.2
	Fans	1.36	1.1	407.7
	Total savings	**19.62**	**15.2**	**5,886.3**

COUNTRIES	PRODUCT	ENERGY SAVINGS (GWh)	GHG EMISSION REDUCTION (kTon CO_2)	REDUCTION IN END-USERS' ELECTRICITY BILLS (In thousands of dollars)
Dominican Republic	Refrigerators	193.77	137.1	27,128.1
	Air conditioners	935.24	661.8	130,933.3
	Fans	184.41	130.5	25,817.4
	Total savings	**1,313.42**	**929.5**	**183,878.8**
Ecuador	Refrigerators	601.31	360.4	96,209.8
	Air conditioners	574.43	344.3	91,908.4
	Fans	670.25	401.7	107,240.3
	Total savings	**1,845.99**	**1,106.5**	**295,358.5**
El Salvador	Refrigerators	355.02	285.8	67,453.0
	Air conditioners	291.81	234.9	55,443.2
	Fans	157.86	127.1	29,993.0
	Total savings	**804.68**	**647.7**	**152,889.3**
Grenada	Refrigerators	1.78	1.4	230.6
	Air conditioners	3.17	2.5	409.2
	Fans	1.93	1.5	249.3
	Total savings	**6.88**	**5.3**	**889.1**
Guatemala	Refrigerators	677.09	537.2	155,730.2
	Air conditioners	876.45	695.3	201,582.7
	Fans	387.74	307.6	89,179.8
	Total savings	**1,941.27**	**1,540.1**	**446,492.7**
Guayana	Refrigerators	33.99	34.3	8,632.2
	Air conditioners	118.03	119.0	29,978.8
	Fans	11.81	11.9	2,999.7
	Total savings	**163.82**	**165.1**	**41,610.7**
Haiti	Refrigerators	23.56	17.5	4,147.0
	Air conditioners	436.95	324.3	76,903.2
	Fans	138.66	102.9	24,404.2
	Total savings	**599.17**	**444.7**	**105,454.4**
Honduras	Refrigerators	143.51	63.3	15,785.7
	Air conditioners	809.83	357.1	89,081.1
	Fans	164.57	72.6	18,102.6
	Total savings	**1,117.90**	**492.9**	**122,969.4**
Jamaica	Refrigerators	74.09	43.2	25,930.6
	Air conditioners	278.18	162.1	97,364.0
	Fans	38.97	22.7	13,638.8
	Total savings	**391.24**	**228.0**	**136,933.4**
Mexico	Refrigerators	611.08	482.9	54,277.1
	Air conditioners	13,807.26	10,911.8	1,226,388.5
	Fans	1,748.36	1,381.7	155,292.8
	Total savings	**16,166.70**	**12,776.4**	**1.435,958.3**
Nicaragua	Refrigerators	82.06	69.3	19,529.8
	Air conditioners	135.92	114.7	32,348.8
	Fans	122.36	103.3	29,121.8
	Total savings	**340.34**	**287.2**	**81,000.4**
Panama	Refrigerators	163.11	58.1	29,996.5
	Air conditioners	243.19	86.6	44,723.6
	Fans	96.37	34.3	17,723.0
	Total savings	**507.68**	**179.0**	**92,443.0**
Paraguay	Refrigerators	130.67	0.2	9,147.1
	Air conditioners	285.96	0.3	20,017.5
	Fans	137.93	0.2	9,655.4
	Total savings	**554.57**	**0.7**	**38,820.0**

COUNTRIES	PRODUCT	ENERGY SAVINGS (GWh)	GHG EMISSION REDUCTION (kTon CO_2)	REDUCTION IN END-USERS' ELECTRICITY BILLS (In thousands of dollars)
Peru	Refrigerators	480.96	140.6	70,220.0
	Air conditioners	1,3331.56	389.2	194,407.7
	Fans	463.50	135.5	67,670.9
	Total savings	**2,276.02**	**665.2**	**332,398.5**
Saint Kitt and Nevis	Refrigerators	3.64	2.8	877.0
	Air conditioners	10.02	7.8	2,412.4
	Fans	1.09	0.8	261.4
	Total savings	**14.75**	**11.4**	**3,550.7**
Santa Lucia	Refrigerators	3.93	3.0	1,030.6
	Air conditioners	10.67	8.3	2,797.0
	Fans	3.53	2.7	926.7
	Total savings	**18.13**	**14.0**	**4,754.3**
Saint Vincent and the Grenadines	Refrigerators	4.64	3.6	878.2
	Air conditioners	7.70	6.0	1,456.2
	Fans	1.96	1.5	371.4
	Total savings	**14.30**	**11.1**	**2,705.8**
Suriname	Refrigeradores	15.52	6.6	1,784.7
	Air conditioners	83.63	35.6	9,617.4
	Fans	8.52	3.6	979.3
	Total savings	**107.66**	**45.9**	**12,381.4**
Trinidad and Tobago	Refrigerators	44.93	37.2	1,797.1
	Air conditioners	179.26	148.3	7,170.5
	Fans	23.93	19.8	957.3
	Total savings	**248.12**	**205.2**	**9,925.0**
Uruguay	Refrigerators	162.98	153.0	34,666.0
	Air conditioners	1,274.40	1,196.7	271,064.4
	Fans	83.05	78.0	17,663.8
	Total savings	**1,520.43**	**1,427.7**	**323,394.5**
Venezuela	Refrigerators	911.30	211.6	15,492.1
	Air conditioners	7,298.31	1,694.8	124,071.3
	Fans	565.81	131.4	9,618.7
	Total savings	**8,775.42**	**2,037.8**	**149,182.1**

Annex 2. Potential savings in sub-regional Latin American and Caribbean economies

ECONOMIES*	ENERGY SAVINGS (TWh)	EMISSION REDUCTION (MTon)	REDUCTION IN USERS' BILLS (in millions of dollars)
Andean Community	13.7	3.9	1,544.6
Mercosur	98.9	21.5	15,444.9
The Caribbean	1.8	1.4	342.2
Central America	6.8	4.2	1,172.1
Others	16.4	13.0	1,490.0
Regional Total	**137.7**	**43.9**	**19,993.7**

*Andean Community: Bolivia, Colombia, Ecuador and Peru

Mercosur: Argentina, Brazil, Chile, Paraguay, Uruguay, and Venezuela

The Caribbean: Antigua and Barbuda, Bahamas, Barbados, Cuba, Dominica, Grenada, Haiti, Jamaica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago
Central America: Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama
Others: Mexico, Guyana, and Suriname

Annex 3. Proposals made by representatives of Latin America and the Caribbean governments

PROPOSALS FROM THE SIXTH SEMINAR ON ENERGY EFFICIENCY IN LATIN AMERICA AND THE CARIBBEAN TO THE MINISTERS OF ENERGY AND ENVIRONMENT OF LATIN AMERICA AND THE CARIBBEAN

Those in charge of Energy Efficiency at federal Ministries or Boards of Energy, and the representatives of the Ministries of Environment dealing with climate change, as well as other delegates of these Ministries and representatives of the region, civil society and business sector, gathered in Managua, Nicaragua, on the 20th and 21st of August, 2014 in the framework of the VI Seminar on Energy Efficiency in Latin America and the Caribbean of the Latin American Energy Organization (OLADE), in collaboration with the United Nations Environment Programme (UNEP) and the Ministry of Energy and Mines (MEM) of the Republic of Nicaragua.

WHEREAS:

I. That, according to estimates by the International Energy Agency, the implementation of energy efficiency policies would reduce in up to fifty percent the energy-related emissions needed to stabilize CO_2 concentrations at 450 parts per million by year 2050, thereby preventing a catastrophic climate change.

II. That the use of high-efficiency electrical appliances, equipment and lighting provides a clear opportunity to create economies that are smart, more energy- and environmentally sustainable, more competitive, and less dependent on oil imports and on fluctuating international prices, and which would also reduce the fiscal burden in some states by reducing energy subsidies.

III. That, according to studies carried out by UNEP, OLADE and their international partners, the region would achieve highly significant energy savings through the implementation of efficiency standards and integrated programs for lighting and appliances, thereby reducing considerably energy consumption across all sectors, and promoting a greater availability of resources for other economic, productive and development purposes.

IV. That the region has a wide variety of experiences, lessons learned and successful initiatives to transform the markets toward more efficient lighting and, to a lesser extent, with regard to appliances and/or equipment, including advances in the establishment of minimum performance standards, labelling programs and control, testing and inspection mechanisms, with the aim that new marketed equipment be of higher efficiency.

V. THAT energy efficiency programs for lighting products and appliances significantly contribute to mitigate climate change while generating substantive economic benefits, making it convenient to:

1. Accelerate efforts in the region to promote the transition to efficient equipment and appliances, as well as consolidating the transition to efficient residential lighting, and promote more efficient lightning technologies in all sectors.

2. Promote the development and updating of minimum performance standards as a cornerstone to accelerate the transition to more competitive and efficient economies.

3. Facilitate the implementation of support policies, such as labelling, outreach and public awareness campaigns, energy efficiency in the public sector, as well as fiscal policies that facilitate the acceptance and access to more efficient products.

4. Promote measures for phasing out obsolete air conditioners and refrigerators through the use of financial mechanisms, such as the Nationally Appropriate Mitigation Actions (NAMAs).

5. Establish the regulatory framework and the control, testing and inspection systems necessary to ensure strict compliance with the provisions and the sustainability of the shift to efficient equipment.

VI. That the United Nations Secretary-General's Sustainable Energy for All initiative promotes the acceleration of the transition to efficient lighting, equipment and products in order to double the participation of energy efficiency for year 2030.

VII. That UNEP, together with its international partners in the framework of the UN Sustainable Energy for All initiative, in collaboration with OLADE, has the capacity to provide services to countries in the region in order to establish integrated systems for accelerating the transition to more efficient appliances and equipment, and to provide the technical assistance and collaboration needed to countries interested in achieving this objective, as well as assistance for accessing financing sources, particularly the Inter-American Development Bank.
Therefore:
THEY PROPOSE THE FOLLOWING TO MINISTERS:

1. Encourage OLADE Member Countries to subscribe to the UN Global Efficient Appliance and Equipment Partnership as a voluntary mechanism to receive technical and regulatory support and realize the continued transition to more efficient appliances and/or equipment technology.

2. Continue promoting the development of standards and regulations to consolidate the transition to energy-efficient lighting across all sectors, as well as to accelerate the transition process to more efficient appliances and/or equipment in Latin America and the Caribbean.

3. Promote the exchange of experiences and cooperation between countries to harmonize, to the maximum extent possible, the standards and control, testing and inspection systems, because of the potential of this cooperation for product cost reductions and to ensure more transparent and competitive markets for manufacturers of efficient equipment.

4. Address these matters in the forthcoming OLADE's Council of Ministers to be held in November 2014, and in the 2015 UNEP Ministerial Environment Forum.

Managua, Nicaragua,
August 21, 2014.

Annex 4. Methodology for the analysis of economic, energy, and environmental benefits of a transition to energy-efficient cooling equipment in Latin America and the Caribbean

CLASP has developed first-order estimates of the savings potential from implementing policies that improve the energy efficiency of new household air conditioners, refrigerators, and ceiling fans in each of 33 Latin American and Caribbean countries:

- Antigua and Barbuda
- Argentina
- Bahamas
- Barbados
- Belice
- Bolivia
- Brazil
- Chile
- Colombia
- Costa Rica
- Cuba
- Dominica
- Dominican Republic
- Ecuador
- El Salvador
- Grenada
- Guatemala
- Guyana
- Haiti
- Honduras
- Jamaica
- Mexico
- Nicaragua
- Panama
- Paraguay
- Peru
- Saint Kitts and Nevis
- Santa Lucia
- Saint Vincent and the Grenadines
- Suriname
- Trinidad and Tobago
- Uruguay
- Venezuela

The analysis assumes policies are implemented in 2020 and evaluates impacts through 2030.

We defined the reference case (business-as-usual scenario) and two policy cases:

- Minimum consumer lifecycle cost (LCC)
- Most efficient or "best available technology"

We brought together data from a number of different sources for this analysis. Principal sources of information included:

- United Nations online databases
- World Bank Group online databases
- International Energy Agency (IEA) online databases
- Inter-American Development Bank (IADB) online database
- Public version of the CLASP/LBNL Policy Analysis Modeling System (PAMS)
- CLASP/LBNL Bottom-Up Energy Analysis System (BUENAS)
- Secondary research carried out by UNEP and CLASP staff
- Market intelligence gathered by UNEP staff from International Copper Association (ICA), MABE, and other in-region contacts

The following table gives an overview of the types of data used in the analysis and, for each type, key assumptions and sources. Additional detail for each of the three products analyzed follows the table.

Category	Propósito	Suposiciones	Fuentes
Market Size	Used to determine the overall scale of the savings opportunity for each country	Sales data were preferred; where they were not available, import volume provided a lower bound for sales; projected sales growth such that household penetration rates would stay at reasonable levels within the period of analysis	MABE; ICA, UN Commodity Trade Statistics Database (Comtrade); in-country representatives; IADB; household penetration forecasts generated by PAMS from population, climate, and macroeconomic indicators
Unit Energy Consumption and Efficiency Levels	Used to determine how much energy would be saved for each unit sold in each policy case (relative to the reference case)	Energy efficiency improves at 1% annually in the business-as-usual scenario; other assumptions as shown below	MABE; ICA; in-country representatives; BUENAS; technical reports developed by LBNL and others for CLASP and the SEAD Initiative
Cost-Efficiency Relationship	Used to determine the incremental cost of more efficient products and identify the efficiency level that minimizes consumer LCC	The cost of efficiency is constant [though in reality it tends to decrease over time]	Technical reports developed by LBNL for CONUEE (refrigerators) by LBNL for the SEAD Initiative (ceiling fans) and by ARMINES for the European Commission (air conditioners)
Electricity Price	Used to determine energy cost savings and identify the efficiency level that minimizes consumer LCC	Varies by country from $0.02 to $0.35 per kWh	Web research; in-country representatives
Transmission & Distribution Loss Factor	Used to determine how much electricity must be generated to meet a given end use demand	Of the total electricity generated, 15.5% is lost in transmitting and distributing it to end consumers	Regional average calculated from electricity production and consumption data published by the IEA
CO_2 Emissions Factor	Used to determine how much CO_2 emissions are avoided for each kWh reduction in electricity generation	Varies by country from 0 to 850 g/kWh, depending primarily on the mix of fuels used for power generation	UNEP; extrapolation for seven small island nations
Discount rate consumer	It is used to discount the future stream of savings in energy costs in the costing LCC	Varies by country between 7% and 13%; less developed countries have higher rates	Derived from Human Development Index published by the UNDP

Refrigerators

Assumptions:

The typical unit sold in the 2020-2030 period is a 2-door top-mount 300-liter refrigerator-freezer.

Local Baseline Price: 600 USD
Local Baseline UEC: 485 kWh/year (except in Brazil, Ecuador, El Salvador, Guatemala, Mexico, and Uruguay)
Appliance Lifetime: 15 years

The relationship between cost and efficiency is taken from the analysis LBNL conducted for CONUEE (Mexico), which was based on an earlier analysis published in the U.S. DOE's Refrigerator Notice of Proposed Rulemaking (NOPR) Technical Support Document (TSD), September 23, 2010.

Design options for improving the efficiency of this product class included: vacuum-insulated panels, improved compressor efficiency, variable-speed compressor, increased evaporator surface area, increased condenser surface area, brushless DC evaporator and condenser fans, and adaptive defrost. The highest efficiency level in our analysis (#5) was the "maximum technologically feasible" level and not on the market when DOE conducted the original engineering analysis on which our cost-efficiency curve is based. However, we have seen evidence that such refrigerators are now available, at least in Europe.

Efficiency level	Price (Dollars)	Energy consumption (kWh/year)	Design Options
Baseline	548	485	
Design #1	557	458	ENERGY STAR old*
Design #2	625	431	ENERGY STAR current*
Design #3	667	404	CEE Tier 2**
Design #4	759	377	CEE Tier 3**
Design #5	892	347	Best feasible technology

* Levels at the time of modeling

** Levels of the Consortium for Energy Efficiency (CEE) are more efficient than the current ENERGY STAR requirements

Ceiling Fans

Assumptions:

Local Baseline Price: 100 USD
Local Baseline UEC: 88 kWh/year (except in Ecuador, El Salvador, and Guatemala)
Appliance Lifetime: 10 years

The relationship between cost and efficiency is taken from the analysis LBNL conducted for the SEAD Initiative and published in "Potential Global Benefits of Improved Ceiling Fan Energy Efficiency," April 2013.

Efficiency Level	Price (USD)	Unit Energy Consumption (kWh/year)	Improvement option
Línea base	100.00	88	
Design #1	103.50	75	Efficient blades (1)
Design #2	101.50	56	Improved AC induction motor (2)
Design #3	105.00	48	1+2
Design #4	110.50	44	Brushless DC motor (3)
Design #5	114.00	38	1+3

All of the efficiency levels considered were commercially available at the time of LBNL's analysis.

Air Conditioners

Assumptions:
The typical unit sold in the 2020-2030 period is a window/wall air conditioner with 3.5 kW (12,000 Btu/hour or 1 ton) cooling capacity.

Local Baseline Price: 650 USD
Local Baseline UEC: varies depending on climate (960–3683 kWh/year)
Appliance Lifetime: 12 years

The relationship between cost and efficiency is taken from the "Preparatory study on the environmental performance of residential room conditioning appliances" led by ARMINES, published in March 2009, and conducted for the European Commission (Ecodesign Lot 10).

Efficiency Level	Price (USD)	Energy Efficiency Ratio (EER)	Improvement option
Línea base	650	3.1*	
Design #1	735	3.4	Higher EER compressor #1
Design #2	809	3.6	Higher EER compressor #2
Design #3	861	3.8	DC compressor variable speed drive
Design #4	985	4.3	Improved heat exchanger #1
Design #5	1037	4.7	Improved heat exchanger #2
Design #6	1124	5.0	Improved heat exchanger #3
Design #7	1175	5.2	Improved heat exchanger #4
Design #8	1330	5.8	Higher EER compressor #3

* Except in Brazil, Guatemala, and Mexico, where a baseline EER of 2.9 was assumed.

All of the efficiency levels considered were commercially available at the time of ARMINES's analysis.

EFFICIENT APPLIANCES AND EQUIPMENT

GLOBAL PARTNERSHIP PROGRAMME

olade
Organización Latinoamericana de Energía

GOBIERNO DE ESPAÑA

REGATTA

Cu Copper Alliance

NRDC
The Earth's Best Defense

UNDP