Market Evaluation for High Electricity Consuming Products in Central America

Industrial Motors and Room Air Conditioners

in

Costa Rica, El Salvador, Nicaragua and Panama[1]

CLASP/BUN-CA

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INTRODUCTION

Energy efficiency policies seek to address the need to mitigate the harmful effects of energy consumption without reducing the benefit (utility) provided by what are often termed "energy services." In terms of the individual, energy services are what the end-use consumer actually needs or desires: getting from one place to another; preserving groceries in a home; lighting an office building; or powering factory machinery.

In macroeconomic terms, energy services are a necessary input to economic growth which ultimately raises incomes and standards of living. No government can afford to waste energy because of negative impacts on their own population and the global community as a whole. Developing countries have an additional motivation to minimize energy consumption—the already high and increasing capital costs of energy infrastructure and fossil fuels which are often imported.

These specific concerns apply strongly to the countries of the Central American Region, which have small but growing economies with rapidly expanding energy demand and very little fossil fuel resources of their own. In order to prosper, and avoid negative environmental impacts, these countries should make all practical efforts to optimize their energy consumption. This may mean investment in renewable energy sources and improvement of the efficiency of producing and distributing electricity. An important element of energy policy should also be to encourage the growth of a market for high-efficiency equipment through incentives or through regulation.

The current study focuses on two specific end-uses: air conditioners and industrial motors, which are important candidates for efficiency policy in Central America due to their high energy consumption and potential for technological improvement. High efficiency models of these products are widely available in international markets.

However, the adoption of high efficiency equipment in Central America faces two major barriers: (1) a lack of appropriate regulation for technical specifications with respect to

[1] This study has been prepared by the Collaborative Standards and Labelling Program (CLASP) and Biomass User's Network – Central America (BUN-CA) with funding from the United States Agency for International Development (USAID).

energy efficiency and, (2) a lack of awareness of energy efficiency among consumers (end-users), power distributors, and retailers.

This Market Study is meant to be a first step in addressing these barriers by providing technical input to the decision-making process of Central American governments considering energy efficiency regulations for the products studied. It is one component in a larger project directed towards development of markets for energy efficiency at a regional level[2]. It addresses the following questions:

- How important are these products to energy consumption?
- How is the market for these products configured?
- What are the sources of these products?
- What is the current level of efficiency for these products, and the potential for improvement?

Due to limits in resources and data availability the answer to these questions is partial in some cases. Nevertheless, CLASP and BUN-CA believe that the information presented here will initially help Central American governments take the next important steps in determining the feasibility of efficiency policies, choosing particular programs, and setting technical specifications for these products.

UNDP/GEF Regional Project – Programa en Eficiencia Energética para Centroamérica (PEER)

In 2005, the Global Environment Facility (GEF) approved a full sized project (FSP) to promote the development of markets for energy efficiency in the industrial and commercial sectors throughout the Central American region which is now being implemented by the UNDP and executed by BUN-CA. This project includes several focus areas such as: training; dissemination of energy efficiency information resources; and energy policy development in the electricity sector.

The strategic goal of this regional project is to "remove the barriers that inhibit the implementation of energy efficiency (EE) measures in order to promote a market transformation for the efficient use of electricity," in the industrial and commercial service sectors. The project will focus on several important end-uses in these sectors: motors, air conditioning and refrigeration and to a lesser extent on lighting systems. The project focuses activities in four core countries: El Salvador, Nicaragua, Panama, and Costa Rica with more limited activities planned for Guatemala, Belize, and Honduras.

In particular, the FSP supports the development of government energy efficiency policies for the following equipment types and countries:

[2] PEER, a regional project funded by the GEF and implemented by the UNDP whose objective is to trigger energy efficiency markets in the industrial and commercial sectors of Central America.

Table 1 – Equipment Types and Countries Targeted for Energy Efficiency Policies

Air Conditioners	Motors
Nicaragua	Costa Rica
Panama	El Salvador

The FSP was launched in February of 2006. In July of 2006, the first regional Inception Workshop on Energy Efficiency Standards and Labeling (EES&L) Program Development was held in San José, Costa Rica with co-financing from the Renewable Energy and Energy Efficiency Partnership (REEEP). This Workshop included a series of presentations introducing the concept of EES&L and detailing key issues and steps to an audience of delegates from seven countries. Country representatives included officials from energy ministries and related departments, testing agencies, and industry representatives, and provided a forum for discussion of key issues between representatives, local and international experts from Central America, Mexico, the U.S., and the Netherlands.

The GEF project will facilitate the development of energy efficiency markets through various activities including:

- Development / Enhancement of Legislative Framework
- Identification and Capacity Building of Key Public Agencies
- Establishment of Information Networks to Promote Stakeholder Participation and Consultation
- Technical Analysis of Market Barriers for Standards and Labels

Market Study Objectives

A study of the current stock and market for products identified as having a significant potential for efficiency improvement is one of the first major required technical inputs supporting the process of a sustainable energy efficiency policy. There are two related but independent qualities that make a particular type of equipment attractive for an appropriate energy-efficiency regulation environment.

In the first place, the most important quality is the relative importance of the equipment to sectoral energy consumption. Energy efficiency regulations have an advantage of scale over many other types of efficiency programs because the cost of implementation is somewhat independent of the total energy consumption of the product – they involve a relatively small number of actors (government agencies, manufacturers, distributors, etc.) but generate impacts at the national or regional level. Therefore, the highest impact programs are generally those which target high consumption products.

A second quality is the known existence of cost-effective technology options to improve energy efficiency. A study of the current stock and sales of target products helps to refine estimates of how much of the energy consumption in a certain sector is accounted for by the targeted product. Another important factor is the current or potential growth in

the size of the market. This is especially true in developing countries, where uptake rates can be more strongly correlated to economic growth than in industrialized countries. Regulation of small but rapidly growing product markets is highly advantageous because it 'locks in' high levels of efficiency before these products become a large factor in energy consumption, thus minimizing future negative economic and environmental impacts.

For this Market Study, a set of specific analysis areas have been identified for air conditioners and industrial electric motors, in the Central American context. They are:

- Market Size and Growth Rate
- Product Classes
- Distribution Chain
- Trade Flows and Partners
- Efficiency Distribution

Market Size and Growth Rate

For the reasons outlined, one of the main objectives of a product market study is to evaluate the overall size of the equipment stock, the current rate of products entering the market (unit sales), and the rate of growth of sales.

Product Classes

Energy efficiency standards and labeling programs are generally specified for different product classes. For example, North American refrigerator-freezer standards cover 18 product classes separately, mandating different minimum efficiency levels depending on freezer compartment configuration, use of frost-free technology, special features, etc. (USDOE 2002). There are two reasons for this: first, there can be a significant difference between the energy consumption of different product classes (product-class specific regulations put product classes on a "level playing field"); second, certain product classes may have only minor importance, and may therefore be excluded from regulations. An example of this is compact refrigerators, which were originally covered in North America, but have since been added as they have become more commonplace. A product class analysis attempts to establish the relative importance of product classes as important candidates for regulation.

Distribution Chain

The product distribution chain refers to the series of commercial enterprises involved in the delivery of goods to the end user, from manufacture to the point of sale. The market begins with manufacturers, which may be small or medium size enterprises, or multinational corporations, based domestically, joint ventures, or foreign. From the manufacturer, products may be delivered directly to the consumers. More often, however, they pass through major wholesale distributors and/or importers. Finally, consumers usually buy products from retail outlets, such as department stores or

appliance specialty stores. Depending on the product, whether the user is an individual or a business, and the particularities of the local market, products may be sold directly by wholesalers and importers.

Characterization of the distribution chain, as follows, is important first and foremost because it identifies important stakeholders in the process of standards development.

- Manufacturers generally provide the most input on the technical characteristics of the products they sell, and have a large role in informing the process in terms of economic considerations.
- In the absence of local manufactures, some of this role may be assumed by importers and wholesalers, who will have a large stake in the development of regulations.
- Finally, retailers play an important role in consumer education, and development of a culture of efficiency among consumers.

Trade Flows and Partners

Traditionally, national markets for white goods were served primarily by domestic manufacturers creating products exclusively for the home market. Today, such a situation is the exception rather than the rule, as the market for white goods and other energy consuming equipment has become highly international. Many developing countries, particularly the smaller economies rely heavily on imports for these products. The major trade partners for equipment are important to the development of regulations because of existence of standards and labeling regimes in exporting countries. In order to take advantage of existing technical specifications, and avoid creating an unnecessary barrier to trade, it may be advantageous to develop standards in parallel, or aligned (harmonized) with regulations in trade partner countries. A good example of this is the near total harmonization of appliance efficiency standards in the United States, Canada and Mexico, where alignment of technical specifications has benefited exporters from both countries.

Efficiency Distribution

Finally, the efficiency of ‘standard’ equipment varies from country to country. This parameter largely determines the potential for energy efficiency improvement at the unit level. We define baseline efficiency as the technology purchased by most consumers. In countries where products are mostly imported, product efficiency is strongly influenced by regulations in the country of origin.

There is almost always a range of available efficiencies for any product in any country, however, effective policies will attempt to identify technologies already existing in the market and define mechanisms to shift the baseline towards this target level, or at least increase its market share.

DATA SOURCES

The market study relies on two types of sources to gather data. The first is a 'desk review' of available reports which describe the energy sector in general, and the targeted equipment in particular. These include government agencies (especially energy ministries or departments), which publish studies of overall energy flows in the country (energy balance reports) and sometimes detail sector contributions to energy consumption. They can also include studies by local or international experts that specifically addressed questions of energy efficiency. The availability and comprehensiveness of these type of data sources varies greatly in each country as well as region-wide.

The second major source of data is via direct communication with major stakeholders in the market, and in the regulatory process. Interviews were set up by a team of local experts with a BUN-CA representative in each of the four core countries. Interviews were held between a local expert, an international expert from CLASP, and a variety of public and private sector representatives such as importers and Chambers of Commerce and Industry (CCIs). In total, twenty-one interviews were held during a two week period – six in El Salvador, six in Nicaragua, two in Costa Rica, and seven in Panama. Additional information was gathered from Costa Rican stakeholders by BUN-CA staff after the two-week period. Interview topics varied between interviews, but focused on the configuration of the market, major players, trade partners and baseline technology for market stakeholders, and institutional roles and legislative framework for public sector stakeholders

To facilitate the collection of specific data, the CLASP/BUN-CA team designed a series of survey instruments to guide the interviews. In addition, survey forms were sent in electronic form to interviewees (see Appendix 2), who completed and returned them.

Custom Agency Data

Aggregate trade statistics are available from public sources, such as the UN ComTrade database. This type of data was used at a preliminary stage to give an indication of the size of the market, and the major trade partners. For this study, however, the CLASP/BUN-CA team chose to directly query national customs agencies, which had two advantages. First, customs agencies themselves represent important stakeholders in the regulation process, as certification of energy efficiency may eventually be largely controlled upon entrance to each country. Second, the data collected by national agencies is often more reliable and more highly detailed then aggregate statistics provided to international trade monitors.

Customs data generally provide tabulations of products entering the country according to Standard Industrial Classification codes. The current study focuses on one product code for air conditioners, and two codes for industrial motors.

Table 2 – Product Class SIC Codes for Room Air Conditioners and Industrial Motors

Code	Name	Description
841510	Air conditioners window/wall types, self-contained	Window or wall types, self-contained
850152	AC motors, multi-phase, of an output 0.75-75 kW	Other AC motors, multi-phase :-- Of an output exceeding 750 W but not exceeding 75 kW
850153	Name: AC motors, multi-phase, of an output > 75 kW	Other AC motors, multi-phase :-- Of an output exceeding 75 kW

Customs data was provided for each of the four countries, in electronic format, but with significant differences in reporting format and data reported. In all cases, the data included total imports by product code in monetary terms ($US), by country trade partner. Direct current motors are not covered. These may be important consumers of electricity, but are less often used in heavy industrial applications[3]. In addition, Direct Current (DC) Motors imports are combined in the same category as generators in the customs data, making separate assessment of the market difficult.

Table 3 – Customs Data Format

Country	Level of Detail	Includes QTY	Includes Importer
Costa Rica	Shipment	Yes	Yes
El Salvador	Year	Yes	No
Nicaragua	Shipment	Yes	No
Panama	Year	No	No

Quantity (unit) information was provided for every country except for Panama. In the case of Nicaragua, quantity information was imbedded in text fields for either 'Description' or 'Notes', but was present in most cases.

Interviews and Survey Data

Interviews were conducted in the four core countries with government officials, importers, distributors, and industry representatives. A face to face meeting with these individuals was invaluable to this study because they had the most knowledge on the realities of the details of the market, but also because they represented natural stakeholders with a particular interest in the process of designing energy efficiency

[3] For example, a survey of industries carried out in 2000 in Panama found that only 2% of industries used DC motors COPE (2002). Estudio de Usos y Eficiencia Energética - Segundo Informe. Republica de Panamá - Ministerio de Economía y Finanzas - Comisión de Política Energética (COPE) - Elaborador por el Fideicomiso Para Ahorro de Energía Electrica (FIDE), 2002.

regulations. In many cases, concrete aspects of the nature of the market for air conditioners and industrial motors could be gleaned through qualitative descriptions in these discussions.

In order to facilitate the interview process, and to provide a convenient format for stakeholders to provide market data, three targeted survey instruments were developed.

These questions formed the structure of part of each interview. At the end of the interview, a hard copy of the survey instrument was left with the interviewee. In follow-up communication, survey forms were sent electronically to stakeholders, who completed part or all of them, and returned to country level experts. Each survey consisted of a series of narrative questions, along with detailed tables to be completed by stakeholders. The general content of each survey is summarized below, followed by a sample of one of the survey tables. The complete surveys are included in Appendix 2. A complete list of interviews is given in Appendix 1.

Survey 1 - Energy Ministries and Departments

- Existence of Previous Studies and investigating sector/equipment consumption and efficiency
- Ownership and Use Patterns for Equipment in Residential Sector
- Ownership and Use of Air Conditioners in Commercial Sector
- Structure of Motor Use in Industrial Sector
- Consumption and baseline efficiency of major end use equipment

Survey 2 - Industry Associations

- Intensity of motor use by industrial sub-sectors
- Major Motor Manufacturers and Importers
- Enterprise-Level Survey Sample of Motor Use

Survey 3 - Importers and Distributors

- Major Manufacturers and Importers
- Number of Models by Manufacturer
- Market Unit Sales and Annual Growth Rate
- Breakdown of Sales by Product Class and Capacity

MARKET CHARACTERISTICS

The collective population of Central America's 7 countries is about 40 million and is growing at around 2.5% per year. Half of the population lives in the capital cities. After years of civil wars in most of the countries, an ambitious programme of market-oriented reforms took place through privatizing several public services during the 1990s, boosting national development, macro-economic stability, and creating a more attractive environment to foreign investments. These institutional reforms resulted in a steady economic recovery of an average 5% per year for the last decade. The resulting growth in per-capita energy demand, in combination with population growth, is currently straining the energy infrastructures, leading in particular to electricity outages.

Central America has hardly any domestic fossil fuel resources. While most of the large hydropower developments in the 1980s fulfilled the demand for electricity, renewable energy declined to 53% in 2002 because of a rapid expansion of fossil fuel electricity production to meet a rising demand, as well as an aggressive program for grid extension to increase rural electrification. In addition to the harmful effects of pollution created by thermal electricity plants, this development has exacerbated the impact of high global petroleum prices, leading to a sense of crisis.

Table 1 summarizes the current economic situation of the four core countries studied in this report.

Table 1 – Gross Domestic Product in 2004 (2000 $US)

Country	GDP (Millions)	GDP Growth (%)	GDP Per Capita
Costa Rica	$16,118	4.2	$4328
El Salvador	$13,359	1.5	$2088
Nicaragua	$4,053	5.1	$817
Panama	$11,687	6.2	$4170

Source: Development Data Group, The World Bank. 2006

Industrial production has traditionally been low, with the exception of El Salvador and Costa Rica, but the industrial sector shows signs of growth in all countries. An important market feature of the region is that there is very little production of energy-consuming equipment (except for refrigerators which are manufactured in Costa Rica). This means that, in contrast to many other developing countries which have undertaken energy efficiency policies, domestic manufacturers are not a stakeholder. Instead, the main interested parties in the private sector are importers, distributors and retailers.

Current Regulatory Situation for Energy Efficiency in Central America

To date, there have not been any significant programs to regulate energy efficiency over a range of products. The most notable move towards standards was in Costa Rica, in the form of Law #7447 enacted in 1994. This law required the development of minimum

efficiency standards for imported products. The mandatory components of this law, however, have not been fully implemented. Legislation exists in other core countries that relate specifically to the power sector. In some cases, these laws refer to the rational use of energy. None of them, however, specifically call for minimum efficiency standards. Table 2 summarizes the important legislative actions in each country which may relate to energy efficiency.

Table 2: Existing Legal Framework for Efficiency Regulations in Central America

Country	Legal Framework	Role for Energy Efficiency	Leading Agency
Panama	Law #6 of February 3rd, 1997	Art. 2 sets up the guidelines for energy policy with respect to the power sector, including a legal mandate to provide an incentive for the rational use of electricity on the demand side. Art. 157 indicates that the main indicator for the rational use of energy is the price signal.	COPE, Ministry of Finance
Costa Rica	Law #7447 of 1994	Law #7447 regulates the rational use of energy. It is the only legal framework devoted to EE that exists in the Central American region but has never been implemented. It states specific energy consumption of imported equipment as well as fiscal and tax incentives. However, these incentives were abolished by another tax law enacted in 2001.	DSE, MINAE
	National Commission on Energy Conservation (CONACE), created by Executive Degree in 1994	CONACE is in charge of the National Program on Energy Conservation (PRONACE). This is a long term program (1999-2015) effective since 1997 to support education and information, make EE mandatory for large consumers, inter-institutional coordination, and supportive legislation.	
El Salvador	General Law of Electricity, Decree #843, published on October 10, 1996	This Law, even though it makes a reference to the rational use of energy resources, does not indicate specific actions or targets. It assigns the responsibility on the efficient use of electricity to the DGEE.	DGEE, Ministry of Economy
	Import regulations	EE equipment could be subject to "zero" import duties faster than other goods.	
Nicaragua	Electricity Industry Law (LIE), Law #272 on April 23, 1998	The LIE contains the legal framework for power generation, without any specific article related to EE, except for Art. 12, which indicates that energy conservation has to be enforced by CNE.	CNE
	Presidential Decree of March 2004	States the national energy policy, including the promotion for EE by the end-user. Based on this mandate, CNE is elaborating an Action Plan for energy efficiency in different sectors, which includes, among others, the setting of technical standards for EE equipment in the industrial sector, and the development of incentives.	CNE

Source: BUN-CA, 2004

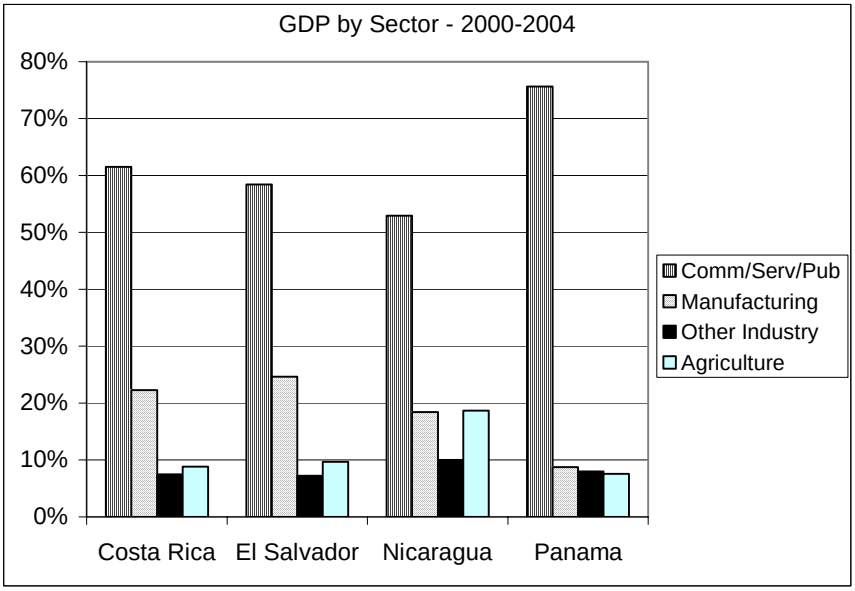
Due to the lack of effective regulations mandating energy efficiency, there are no restrictions on what gets imported or sold, with respect to efficiency in Central America. Since the two products studied by the BUN-CA/CLASP team are imported, the efficiency of products is determined by the importer, manufacturer and consumer demand for efficiency. In practice, however, efficiency is largely influenced by the country of origin, according to that country's standards regime. Even if manufacturers are working within a domestic standards framework, generally they may be allowed to export or 'dump' products of lower quality as imports. In actuality, however, it is rare for manufacturers to

maintain this practice for a significant length of time, since doing so requires having separate assembly lines for export as for the domestic market, which increases production costs.

Sector Energy Consumption

Figure 1 shows the breakdown of the Gross Domestic Product of the core countries by economic sector. The commercial sector, which also includes services and the public sector, is by far the largest sector of the economy, accounting for over half of GDP. This is particularly true of Panama, where this sector accounted for 76% of GDP, averaged from 2000-2004. Correspondingly, manufacturing output in Panama is the smallest of the four countries at 9% of GDP, compared to 18%-25% in the other countries. Non-manufacturing industry contributes roughly the same to GDP in each country, between 7% and 10%. The economic contribution of agriculture is less than 10% in every country except Nicaragua, where it exceeds manufacturing, and accounts for 19% of GDP.

Figure 1 – Contribution to GDP by Economic Sector



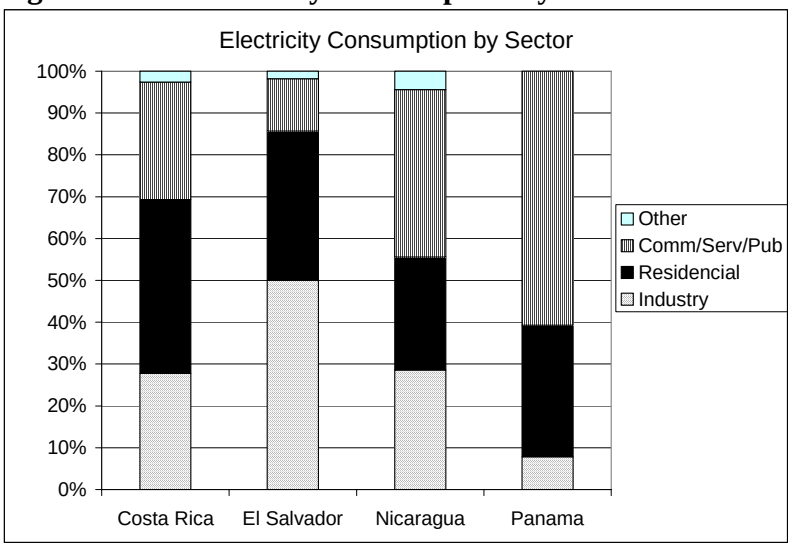
Source: Development Data Group, The World Bank. 2006. 2006 World Development Indicators Online. Washington, DC: The World Bank. Available at: http://publications.worldbank.org/ecommerce/catalog/product?item_id=631625.

The relative fraction of electricity consumption in each of the four core countries, shown in Figure 2, follows roughly from the sector economic activity, with some important differences.

As expected, the main sectors are residences, commercial firms and public institutions, and industry. Agriculture and all other activities are not major electricity consumers. About half of electricity consumption in El Salvador goes to industry. In Costa Rica, where industry has almost as much economic importance, electricity consumption is much less, indicating that Costa Rican industry is less energy intensive, or less important

in comparison with the residential and commercial sectors due to the relatively higher standard of living. Correspondingly, Nicaragua, with the lowest per capita GDP also uses the lowest fraction of electricity in residences. Electricity consumption in Panama is dominated by the commercial and services sector.

Figure 2 Electricity Consumption by Sector



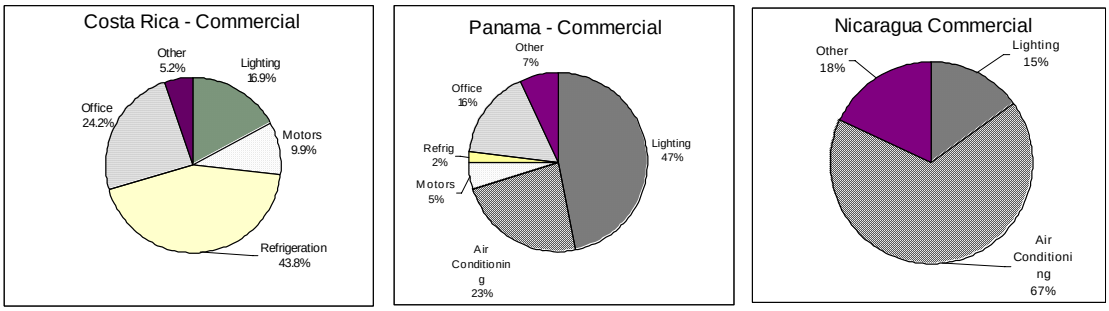
Source: (UN-CEPAL 2006), (BEN El Salvador 2000), (BEN Nicaragua 2004), (Panama 2004)

End Use Contribution to Sector Electricity Consumption

Air conditioners are as yet uncommon in households in Central America, but they are widely used in commercial business. There is, of course also a strong climatic dependence on the use of air conditioning. In Costa Rica, air conditioning may not be as desirable in the densely populated cities and towns of the Central Plateau region as it is in the conditions of San Salvador, Managua and Panama City. On the other hand, Costa Rica enjoys a significant tourist services industry, which is concentrated in the hot coastal areas where air conditioning is most common.

Recent studies of electricity consumption by end use carried out by BUN-CA were available for Costa Rica, Panama and El Salvador. For the first two countries, this breakdown was also available by sector. The electricity consumption for the commercial sector in Costa Rica and Panama are shown in Figure 3. The Costa Rican study includes air conditioning within the broader category ‘refrigeration’, which accounts for 44% of sector electricity consumption. Air conditioning alone accounts for 23% of commercial end use consumption in Panama. In each case, the category containing air conditioning is the second largest electricity consumer. Lighting and office equipment are also large end uses. The Panama source data includes motors and pumps as a separate category. Since the electricity consumption of pumps is through a motor, this study has combined these two categories into a single motors category.

Figure 3 – Commercial Sector End Use Electricity Consumption

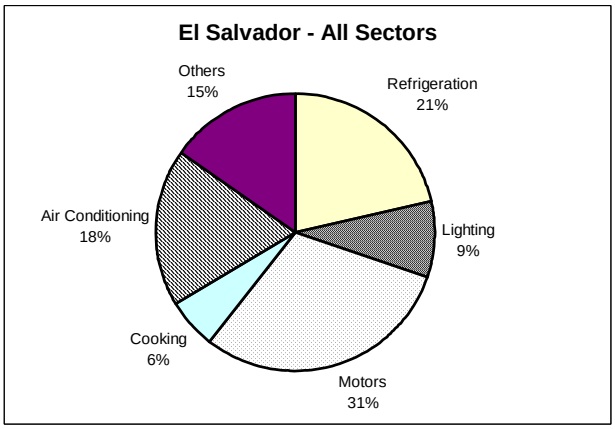


Source: Costa Rica – (DSE 2003); Panama – (COPE 2002); Nicaragua – (CPMLN 2003)

Motors are general purpose equipment that are used in a wide variety of industrial applications, as well as throughout the commercial sector and in a more limited way in the residential sector as water pumps or components of other appliances. They are particularly important in the manufacturing sub-sector, where large motors may operate at full load for long hours (multiple shifts per day). Some reports have estimated that motors account for up to 50% of national load in developed countries with a well-developed industrial sector (Geller 1991).

Figure 4 shows the distribution of total electricity consumption (not sub-divided by sector) in El Salvador. Motors account for 30% of all electricity in the country. This is perhaps not surprising, due to the high contribution of the industrial sector (50%) to national electricity consumption. Air conditioning is also a big consumer of electricity in El Salvador, accounting for 18%. Air conditioners and motors together account for nearly half of electricity, and are the highest end uses except for refrigeration, which is probably largely in the residential sector.

Figure 4 – End Use Electricity Consumption – El Salvador

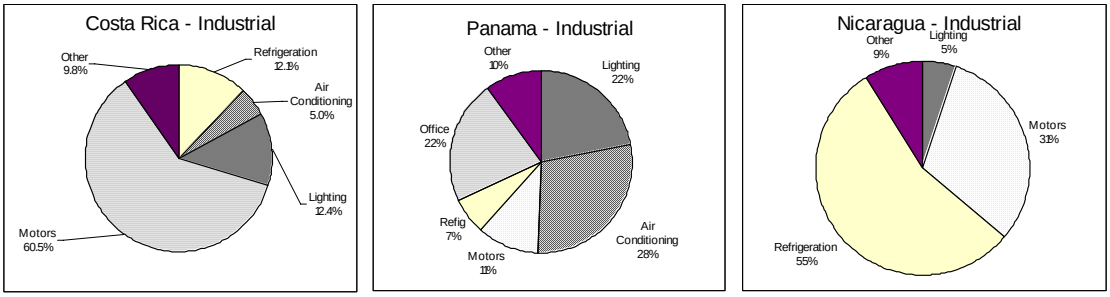


Source: (FIDE 2000)

The contribution to electricity consumption from motors appears to be considerably lower in Panama. The fraction of electricity to industrial electricity consumption in Panama is less than 10%, and about 25% for Costa Rica and Nicaragua, indicating a

difference in the structure of industrial sub-sectors in these countries, compared to El Salvador. Interestingly, air conditioning is also the most electricity intensive end use in Panamanian industry, accounting for about a quarter of consumption. Refrigeration accounts for about 12% of industrial electricity in Costa Rica, but it is difficult to know if this is attributed to air conditioning, since the food and beverage industry is the largest sub-sector in that country, and likely utilizes a large amount of refrigerators and freezers.

Figure 5 – Industrial End Use Electricity Consumption – Costa Rica, Panama and Nicaragua



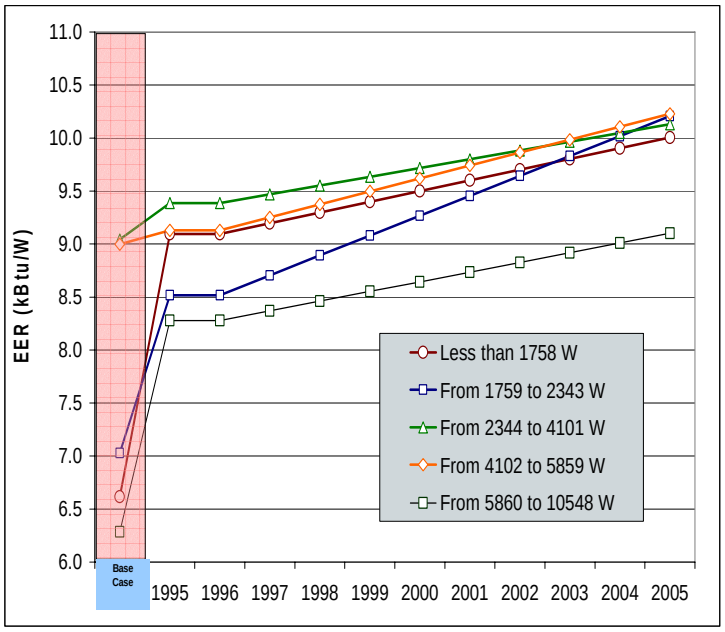
Source: Costa Rica – (DSE 2003); Panama –(COPE 2002); Nicaragua –(COPE 2002)

Savings Potential for Air Conditioners and Motors

A detailed quantitative analysis of potential impacts of supporting public policies for air conditioners and motors in Central America is beyond the scope of this report, but it is useful to give an idea of the general potential for efficiency improvement for these products.

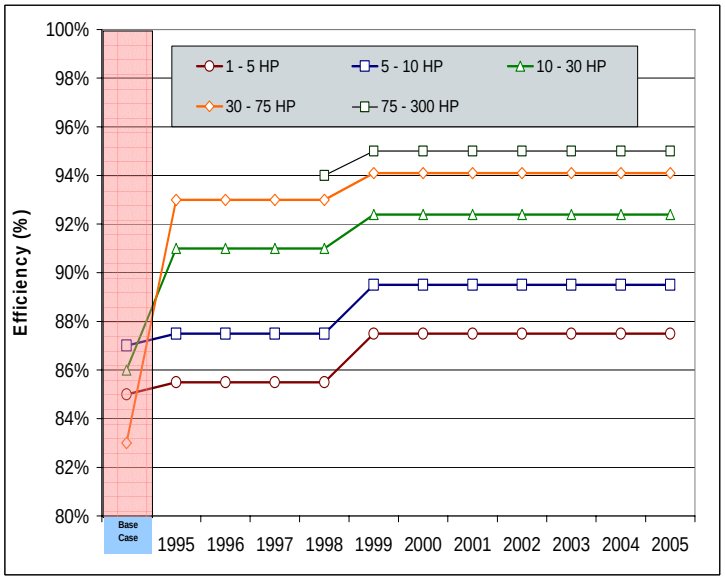
Possibly the best example relating to Central America is the Mexican market, and the highly successful program implemented there by the Comision Nacional para el; Ahorro Energética (CONAE). Mexican minimum efficiency performance standards were first introduced in 1995 for four products: refrigerators; air conditioners; industrial motors; and washing machines. Since then, these regulations have been updated, often several times. Further, over 20 products have been added to the standards regime (Sanchez, Pulido et al. 2006). Energy efficiency improvement due to minimum efficiency performance standards (MEPS) in Mexico has been highly significant for both air conditioning and industrial motors. Efficiency trends in Mexico for air conditioners are shown in Figure 6. Trends for motors are shown in Figure 7.

Figure 6 – Efficiency Improvement due to Air Conditioner Regulations in Mexico



Source: (Sanchez, Pulido et al. Forthcoming)

Figure 7 – Efficiency Improvement due to Motors Regulations in Mexico



Source: (Sanchez, Pulido et al. Forthcoming)

Since manufacturers were consulted throughout the process of standard-setting and development in Mexico, they were well prepared for the final implementation of standards in 1995. As a result, in this year efficiency jumped by several units of EER[4] for air conditioners, and several percentage points. After 1995, the average model of

[4] Energy Efficiency Ratio

efficiency for air conditioners on the Mexican market continued to rise, partially in anticipation of further standards, and also due to the desire of Mexican manufacturers to compete in a wider North American market in the framework of the North American Free Trade Agreement particularly since relatively stringent standards had been put in place in the United States and Canada. Likewise, the efficiency of motors jumped several percentage points in 1995. Another clear step is seen in 1995, when efficiency requirements were ratcheted.

The Mexican experience is important in the Central American context for two reasons. First of all, it demonstrates the impact that a well-planned and implemented efficiency standards and labeling program can have on energy consumption – the reduction in energy consumption for these two products alone is estimated at 4.8% percent(Sanchez, Pulido et al. Forthcoming). Secondly, BUN-CA through the UNDP-GEF funded project –PEER- and the REEEP/CLASP S&L project, have engaged public Mexican institutions (particularly CONAE and FIDE[5]) as experts in the Mesoamerican region, in order to maximize the transfer of institutional experience to government agencies and private sector stakeholders in Central America.

AIR CONDITIONER MARKET

The current study considers room air conditioners (A/C), of which there are two major product classes: window units and mini-split, including high-wall units. Window units are common in the United States and other areas, but mini-split units have emerged as the product class of choice in much of the world. Both of these product classes condition individual rooms without the use of large venting ducts distributing cool air from a central cooling unit throughout the building. Central air conditioning is nearly universal in new homes and commercial buildings in the United States, but it is uncommon in Central America. Furthermore, some large commercial buildings and industrial buildings use high-capacity chillers for air conditioning. There may be a high potential for energy savings on a unit basis with these, but smaller units are likely to be simpler to regulate and provide greater overall savings because of their more widespread use. Therefore, this study concentrates on the two main room air conditioner product classes—window units and mini-splits.

Sales and Imports of A/C

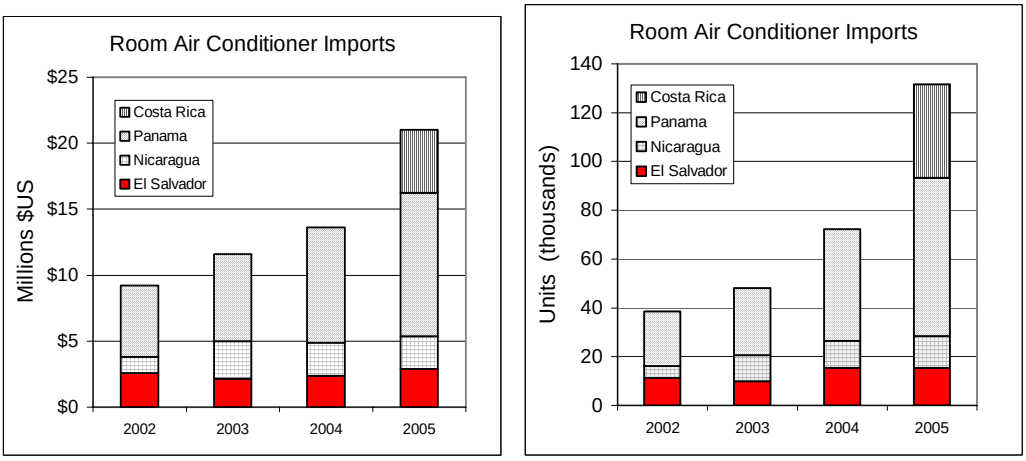
There is no domestic production of air conditioners in Central America therefore imports represent the entire market. This fact has two important consequences for the development of standards:

- The strong role that domestic manufacturers normally play in the development of technical standards will be taken up by importers, distributors, and possibly manufacturers from outside the region; and

[5] Fideicomiso para el Ahorro de la Energía

- National customs agencies become important actors, both in providing market data and potentially as the point of control for regulated products entering the market.

Figure 8 – Room Air Conditioner Imports by Country and Year



Source: Customs Data gathered by the BUN-CA/CLASP Team, 2006

Figure 8 shows imports of room air conditioners between 2002 and 2005, both in terms of import value (in U.S. dollars) and in units for four countries. For Costa Rica, data was only available for 2005 and part of 2006. The customs data does not distinguish between window and mini-split units. Both fall under the SIC (Standard Industrial Classification) category 841510. Nicaragua's air conditioner imports are the smallest on average, as might be expected from the overall size of the economy compared to the other three. On the other hand, Panama's imports are much higher than either those of Costa Rica or El Salvador's even though its economy is slightly smaller than those countries. This is likely due to the difference in climate between urban areas in Panama and Costa Rica as well as the dominance of the commercial sector in Panama where air conditioning is most important. Economic growth is also currently highest in Panama at over 6% in 2004. It is interesting to note that air conditioner import growth in Panama is over 40% per year. Further, average air conditioner import growth over all years greatly exceeds the rate of overall economic growth in Panama during the same time periods.

Unit imports follow closely to monetary figures, indicating that, at least to first order, the type and size of equipment are similar across the country for this product category. Unit imports were not available for Panama. Instead, they were estimated by dividing monetary figures by the average unit dollar amount for imports into the other three countries.

Table 3 summarizes air conditioner imports, in terms of monetary and unit volume in 2002 and 2005. The average annual growth rage (AAGR) is calculated from monetary figures. Since only one year of data was available for Costa Rica, a growth rate was not calculated for that country. In El Salvador, the growth rate was only 4%. In both Nicaragua and Panama, however, growth was 26%. This extremely high growth rate, if accurate and sustained, will represent a dramatic shift towards air conditioning as a very high energy consumption product. Such growth rates are similar to other warm climate regions experiencing rapid economic growth (such as India, and the coastal urban areas of China).

Table 3 – Air Conditioner Imports in Core Countries

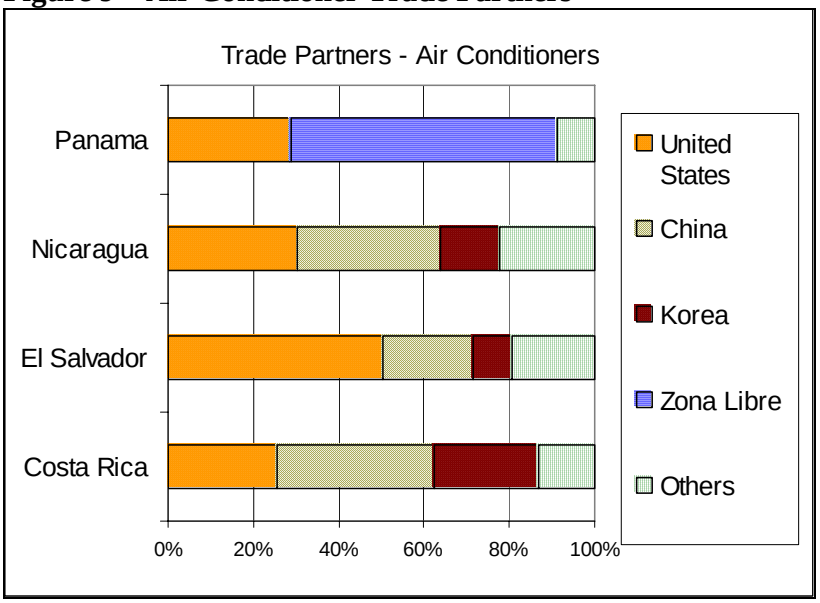
Country	Imports 2002	Imports 2005	Imports 2002	Imports 2005	AAGR
	$Millions	$Millions	Units ('000)	Units ('000)	(from $)
Costa Rica	N/A	$4.8	N/A	38.3	N/A
El Salvador	$2.6	$2.9	11.3	15.3	4%
Nicaragua	$1.2	$2.5	4.9	13.2	26%
Panama	$5.4	$10.9	22.4	64.9	26%

Source: Customs Data gathered by the BUN-CA/CLASP Team, 2006

A/C Manufacturers and Trade Partners

Customs agency data also identifies the source country for each shipment, which this study can use to identify the major trade partners for the region as a whole, and the differences between each country. For each importing country, imports were divided by country of origin, and summed the total monetary value of air conditioner imports over all years for which data were available. Over 20 countries were represented, but a few countries were observed to be major trade partners in all countries. These were: the United States; China; and Korea. The percentage of air conditioner imports by trade partner is shown in Figure 9.

Figure 9 – Air Conditioner Trade Partners



Source: Customs Data gathered by the BUN-CA/CLASP Team, 2006

The United States and China were major trade partners for Nicaragua, El Salvador and Costa Rica. Together, they accounted for between 60% and 70% of imports in each of these countries. The United States alone exported half of El Salvador's air conditioners. The top three trade partners accounted for between 75% and 85% of imports. Identification of trade partners is more difficult for Panama, due to the Colon Free Trade Zone (Zona Libre) through which products pass tariff-free. For products entering Panama via the free trade zone, country of origin was not identified by customs. This is the case for the bulk of air conditioner imports. In fact, virtually no products were identified as originating from either China or Korea. Some imports from the U.S. were identified however, so in the light of this study it is assumed that the U.S. accounts for at least 30% of air conditioner imports into Panama.

No comprehensive list of manufacturers was available at the time of this survey, but there was some anecdotal information regarding major players. These come from two sources: (1) Distributor interviews and (2) Product catalogs of distributors known anecdotally to enjoy a large share of the market.

A partial list of major manufacturers, by country of origin includes:

- U.S. - Carrier, York, Lennox, TempStar, Innovair, Airpro
- China – Comfortime
- Korea – LG
- Japan – Hitachi
- Germany – Cooltek

One distributor (in El Salvador) indicated that Carrier and Comfortime together control over 50% of the market in that country.

A/C Product Classes

There is no obvious preference of room air conditioner product classes in Central America. Several interviewees indicated that the mini-split was seen to be a more desirable product, and is gaining market share. However, window units are still generally common in the stock, For instance, according to a survey of commercial enterprises in Panama (COPE 2001) 40% of business used mini-splits, while 37% used window units (other businesses used chillers or package units). A distributor in El Salvador estimated that currently, mini-splits hold 60% of the room air conditioner market, with the other 40% is held by window units. Window units tend to be more common in residences, but household saturation rates are generally quite low (5.2% in Panama, for example[6]).

In Panama, air conditioner capacity ranges from 12,000 BTU to 60,000 BTU, while residential window units are much smaller, ranging from 8,000 BTU to 12,000 BTU (COPE 2001). The largest capacity category in El Salvador is estimated to be between 8,000 and 12,000 BTU, for either window or mini-split, although 30% of the market is for larger units over 20,000 BTU (distributor survey response).

A/C Efficiency Distribution

Detailed efficiency level data is generally difficult to come by, especially in countries where there are no technical standards to evaluate efficiency by a common framework, and where products may not be labeled according to efficiency. Luckily, efficiency ratings for air conditioners (in terms of Energy Efficiency Ratio, or EER), are standardized internationally. Furthermore, manufacturers generally give efficiency as an important technical parameter and may report efficiency in order to comply with regulations in the country of origin or other trade partners. Therefore, while it is almost impossible to get sales-correlated model efficiencies for countries without a standards regime, distributors and importers generally have a good idea of the efficiency of the products they sell. In this study, these were generally given anecdotally in interviews, or explicitly in the surveys.

The predominant determining factor in air conditioner efficiency is the efficiency of the compressor system. Increasing compressor efficiency is one of the most cost-effective means by which air conditioner manufacturers can improve efficiency. The use of variable speed compressors can also significantly increase efficiency but inclusion of this design option generally incurs a significant increase in equipment cost. Finally, there are other mechanical means of increasing overall A/C unit efficiency including use of: grooved condenser tubes; increasing evaporator/condenser area; and use of more efficient fan motors.

[6] Source COPE (2002). Estudio de Usos y Eficiencia Energética - Segundo Informe. Republica de Panamá - Ministerio de Economía y Finanzas - Comisión de Política Energética (COPE) - Elaborador por el Fideicomiso Para Ahorro de Energía Electrica (FIDE), 2002.

Interviewees consistently indicated that most room air conditioners sold in Central America fall between 8 and 10 EER (kbtu/kWh). Some interviewees indicated that models with either 9 or 10 EER were most popular, but more efficient models were rare. Distributors indicated that U.S. products were considered to have the most reliable energy efficiency ratings. Products with efficiency below 8 were acknowledged by most interviewees, but they indicated that these products were often not labeled for efficiency, or if they were, such a rating was considered unreliable.

An analysis of the minimum efficiency performance standards (MEPS) in the major Central American trade partners tends to support interviewees' estimates of the efficiency of air conditioner products entering the region. As Table 4 shows, MEPS for room air conditioners are in place in the U.S., China and Korea. These three countries account for 80% of all air conditioners imported to Costa Rica, El Salvador and Nicaragua. Panama is not included in the market share calculation, because of the large fraction of products entering the country through the Colón Free Trade Zone, for which country of origin data is not available.

Table 4 – Existing Air Conditioner Efficiency Standards for Central American Trade Partners

Class/Country	U.S.	China	Korea
EER Window	9.8	7.8	9.8
EER Mini-Split	11.6*	8.2 - 8.9	9.4 - 11.5
Market Share**	37%	29%	14%

Source: (Lin and Fridley 2004)
* Estimate based on 13 SEER
** Excludes Panama

The United States, which accounts for 37% of the Central American market, has relatively stringent MEPS for room air conditioners, with a level of 9.8 EER for window units[7]. Mini-split units are regulated in the U.S. using Seasonal Energy Efficiency Ratio (SEER), with a minimum efficiency of 13 SEER. SEER cannot be directly converted to EER. According to the U.S. Department of Energy's technical analysis, however (USDOE 2002), the median unit just meeting the 13 SEER standard has an EER of 11.6.

The minimum efficiency level for Chinese units is significantly lower than those from the United States: 7.8 EER for window units and between 8.2-8.9 EER for mini-splits, depending on capacity. Therefore, imports from China just meeting the standards there are likely to be in the 8 to 9 EER range. Finally, Korea has relatively stringent standards, equal to those of the U.S. for window units. For mini-splits, Korean standards significantly exceed those of China, but are somewhat lower than those of the U.S.

Finally, most of the distributors interviewed expressed a desire to sell more efficient products, and were confident that these products represented a good investment to the consumer. They universally expressed, however, that there exists a complete lack of awareness or a 'culture' of efficiency among Central American consumers, who are

[7] Excludes units with non-louvered sides or reverse cycle, which account for a small portion of the market

largely concerned only with first costs (equipment price). Additionally, they indicated a lack of interest in efficiency from contractors and installers, who were not the energy ratepayers.

INDUSTRIAL MOTORS MARKET

In order to clearly define the industrial motor product classes, this study considers only three-phase motors of greater than 1 HP (750W) for this market study. Direct current motors are not considered for the reasons given above in the section describing Custom Agency Data. Small motors with less than 1 HP capacity are also not considered, because these are most often used as parts of other equipment, and therefore may be more complicated to regulate. In addition, smaller motors are often used in commercial and residential applications. This study is focused on motors typically used in industrial applications. Finally, single phase AC motors are excluded because they are also less common in industrial applications[8].

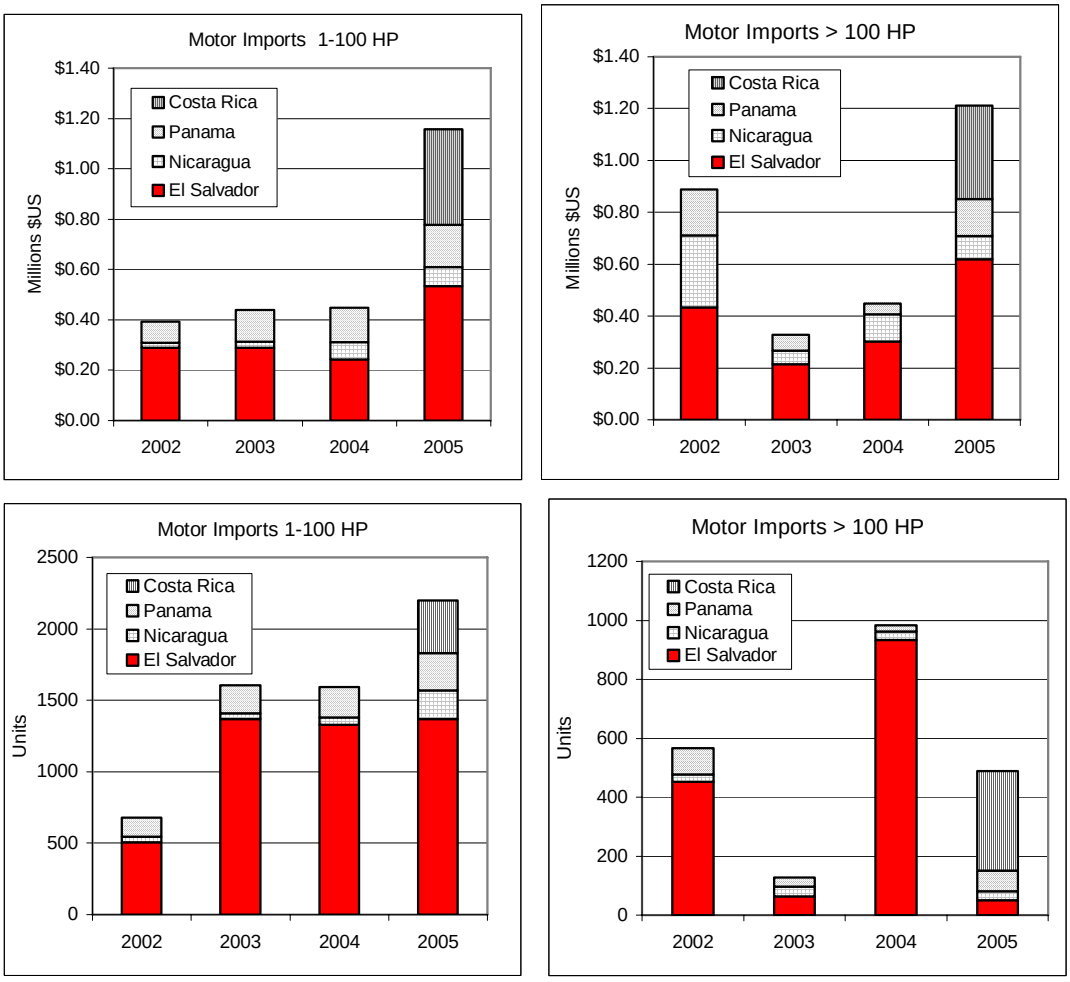
Three-phase AC motors are subdivided into two broad capacity category codes: motors from 1-100 HP (SIC code 850152); and motors greater than 100 HP (SIC code 850153).

Sales and Imports of Motors

As in the case of air conditioners, there is no domestic production of industrial motors in Central America, so that importers and distributors of this equipment play much of the role that local manufacturers would in countries with a local manufacturing base.

[8] A recent study of motors use in industry in Costa Rica found that less than 5% of AC motors were single phase DSE (2003). Encuesta De Consumo Energético En El Sector Industrial. Ministerio De Ambiente Y Energía-Dirección Sectorial De Energía, 2003.. A similar survey in Panama found that 29% of industries owned single-phase motors, compared with 69% that used multi-phase motors.

Figure 10 – Industrial Motors Imports by Country and Year



Source: Customs Data gathered by the BUN-CA/CLASP Team, 2006

Figure 10 shows imports of industrial motors between 2002 and 2005 both in terms of import value (in U.S. dollars) and in units. The two motor size categories are shown separately. For Costa Rica, data was only available for 2005 and part of 2006. From the charts, the importance of heavy industry in El Salvador is apparent. In addition, motor sales for the one year for which data was available in Costa Rica also show high imports. Motor imports are very small in Nicaragua, but show signs of growth at least for smaller motors. Comparing with Figure 7, the total monetary value of motor imports is only a fraction of that for air conditioners which are becoming a widely diffused product. However, electricity consumption from the stock of motors is on par with that of air conditioning,.

Imports of large AC motors are similar to small ones in monetary terms, but only about half as large in unit terms reflecting the higher cost of the larger motors. There are significant fluctuations from year-to-year in imports of large capacity motors in El Salvador. This is due to the fact that this equipment is often purchased in large quantities as part of a large, single investment into an industrial facility.

Table 5 summarizes motor imports, in terms of monetary and unit volume in 2002 and 2005. The average annual growth rate (AAGR) is calculated from monetary figures. Since only one year of data was available for Costa Rica, a growth rate was not calculated for that country. In El Salvador, the growth rate was a high 17%, which would indicate strong growth in industrial capacity and electricity consumption. Care must be taken in the interpretation of this value, however, since only a few years of import data were available. Imports of motors to Panama showed moderate growth, while those in Nicaragua actually declined significantly.

Table 5 – Industrial Motor Imports in Core Countries

Country/Imports	Imports 2002	Imports 2005	Imports 2002	Imports 2005	AAGR
	$Millions	$Millions	Units	Units	(from $)
Costa Rica	N/A	$0.7	N/A	705.0	N/A
El Salvador	$0.72	$1.15	960	1,421	17%
Nicaragua	$0.29	$0.17	64	229	-17%
Panama	$0.26	$0.31	222	332.4	5%

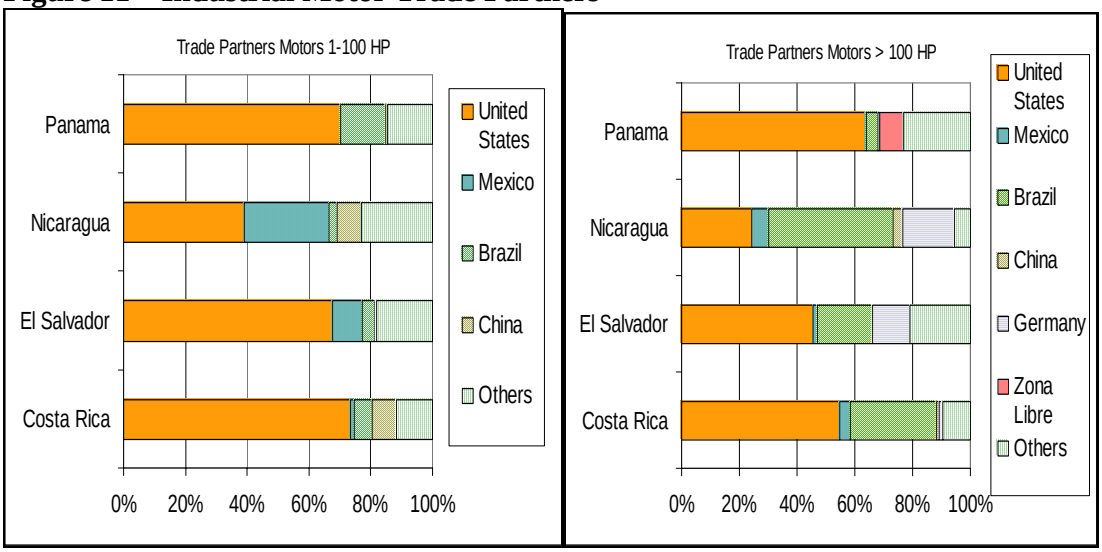
Source: Customs Data gathered by the BUN-CA/CLASP Team, 2006

Manufacturers and Trade Partners in Motors

As in the case of air conditioners, the industrial motors are imported from a variety of trade partners, but a few exporters dominate the market. As Figure 11 shows, the United States is an even more important trade partner for motors. This is especially true of motors in the 1-100 HP range where U.S. firms control over 60% of the market in every country except for Nicaragua. China exports these motors, but it and other Asian countries, are less important trade partners for motors than for air conditioners. Instead, imports from Mexico and Brazil are quite significant.

The situation for larger motors is somewhat different. The U.S. holds less dominance in the market for this equipment. By contrast, Brazil is a very significant player. Finally, Germany and other European countries hold a significant fraction of the market for large industrial motors.

Figure 11 – Industrial Motor Trade Partners



Source: Customs Data gathered by the BUN-CA/CLASP Team, 2006

Manufacturers names are not provided by customs agency data, but the major players in the motors market were provided through interviews and survey responses. A partial list of major manufacturers by country of origin includes:

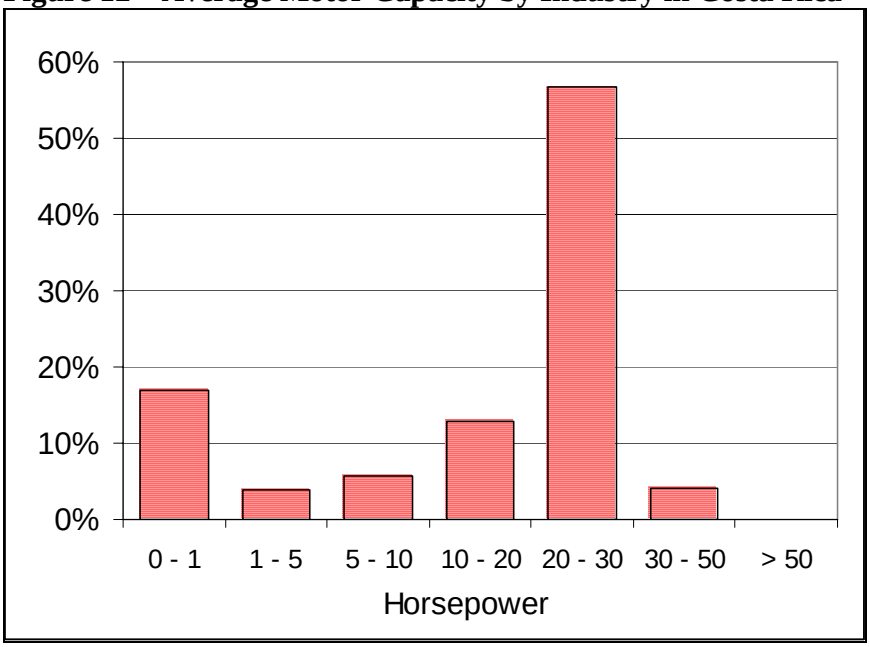
- U.S. – Baldor, US Motors, General Electric, A.O. Smith,
- Brazil – WEG[9], Kolbach
- Germany – Siemens[10], ABB

Motor Product Classes

Details about the distribution of motor capacity used in industrial facilities in Central America were not easily available but a qualitative description can be gleaned from previous studies of the industrial sector.

[9] WEG Motors also originate from WEGs Mexico division
[10] SIEMENS Motors also originate from Siemens' Mexico division

Figure 12 – Average Motor Capacity by Industry in Costa Rica



Source: (DSE 2003)

According to a detailed survey of industrial facilities conducted in Costa Rica in 2003 (DSE 2003), there were approximately 65,000 motors operating in Costa Rican industries. The configuration of motors were reported by application with 'General Force', 'Sewing Machines' and 'Pumps' accounting for almost 70% of installed motors. The report gives an average capacity for each application along with the number of motors represented in each category.

Figure 12 shows the approximate distribution of motor capacity in the Costa Rican industry. This is only an approximation because of the averaging in the data. In general, however, it indicates that the majority of motors are probably within the 1-50 HP range, and of these, the 10-50 range dominates. In all likelihood, a minority of motors are below 1 HP.

Although a rough approximation, the Costa Rican data fits well with interviewee comments in Nicaragua who stated that the vast majority of motors in that country are between 10-50 HP. Survey results in Panama (COPE 2002) indicate that: 29% of the motors there are less than 1 HP; 45% are between 1-20HP; 16% are between 25 and 50 HP; and 8% are greater than 50 HP. The distribution of motor capacity was not available for El Salvador.

Efficiency Distribution in Motors

In absolute terms, motors convert electric power into mechanical energy at efficiencies between 75-100%, depending on their size. Even small differences in efficiency in percentage terms can have a significant impact on overall energy consumption, however, due to the high energy intensity of this type of equipment. For example, a detailed survey

in Costa Rica (DSE 2003) found that the average motor used in industry there was 18.2 kW and operated for 4,400 hours per year. The average efficiency was estimated to be 85.2%. Therefore, the electricity consumption of each motor can be estimated as

Consumption = 18.2 kW x 4400 hours / 0.852 = 94.0 MWh

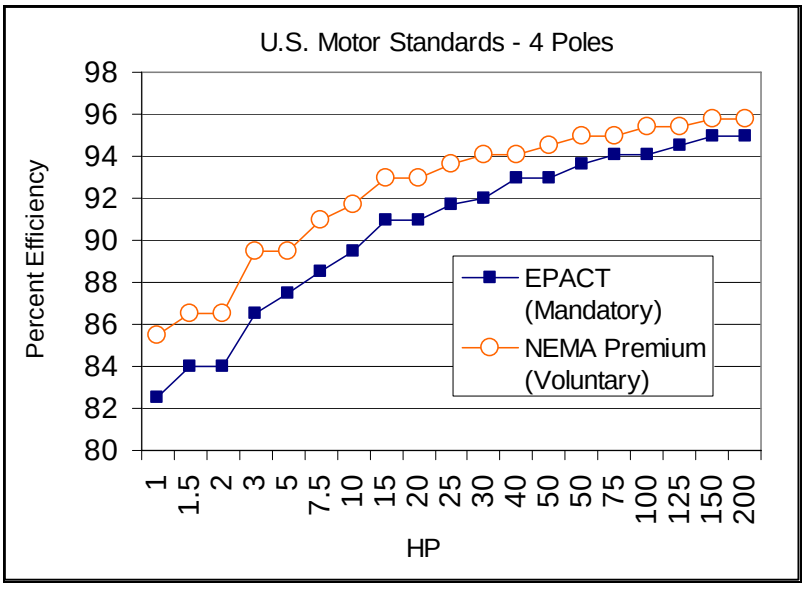
At this intensity, even a one percent improvement in efficiency would save the end-user roughly a MWh of electricity which corresponds to roughly 100 $US in savings per year per motor.

Motor efficiency can be improved in several ways but the main two improvements are: (1) to reduce magnetic field losses in the core of the motor by improving the grade of steel used; or (2) decrease losses from electrical resistance in the coils by adding copper. Both of these options can significantly increase material costs but the resulting increase in equipment price is usually more than offset by utility cost savings over the life of the motor.

As in the case of air conditioners, motor efficiency is described by a single indicator of efficiency. Efficiency for motors is given in terms of percent efficiency which is the ratio of output mechanical power to input electrical wattage when the motor is operating at full rated capacity load (100%). The ratings situation is somewhat complicated, however, by the existence of two major and distinct test procedures which are both widely used.

The test procedure, as established by the International Electrotechnical Commission (IEC 34-2), is used in the European Union and China. The other, defined by the Institute of Electrical and Electronics Engineers (IEEE 112), is used in the United States, Mexico, and Brazil. The main technical difference between the two test procedures is that the IEEE standard measures all losses directly using a dynamometer. The IEC method measures Joule losses in the coils directly, but, assigns other ‘stray’ losses according to a fixed percentage. Effectively, this means that the IEC method generally results in a higher measured efficiency and is less stringent and the IEEE method.

Figure 13 – Mandatory and Voluntary Efficiency Levels for 3-Phase motors in the United States



Source: NEMA, US Department of Energy

Figure 13 shows two sets of efficiency ratings developed in the United States but recognized internationally. Efficiency ratings differ depending on number of poles (rotation speed) – for simplicity, the figure shows only one category. Efficiency ratings generally increase with motor capacity since larger motors are generally more efficient.

The first set of efficiency levels represents the minimum allowable efficiency, as determined by the U.S. Department of Energy according to the Energy Policy Act (EPACT) of 1992. Motors having efficiency levels below this level cannot be sold in the U.S. The second set of levels is voluntary. These levels are defined by the U.S. National Electrical Manufacturers Association (NEMA), and have the designation 'NEMA Premium'. As Figure 13 shows, NEMA Premium motors are about 1-2% more efficient than the EPACT minimum depending on capacity.

According to interviews with motors importers and distributors, both of these rating schemes (premium and EPACT minimum) are well-known in Central America. In fact, motors manufacturers generally carry two separate product lines, with 'standard' motors meeting the EPACT standards, and 'high efficiency' motors meeting the NEMA Premium requirement.

It is difficult to precisely assess the market share of high-efficiency motors, but anecdotal evidence from interviews provides some insight. All of the motors distributors interviewed had a keen awareness of high-efficiency products and believed these motors to be a cost-effective investment for end-users. They all indicated, however, that the market share of high-efficiency motors was "very low". They also agreed that the primary reason for this was consumer resistance to higher first-costs and pointed to the need for raising consumer awareness of payback in the form of lower utility bills.

CONCLUSIONS

Markets for energy-consuming products in developing countries tend to be data-poor environments. In particular, the countries studied in this report lack comprehensive data sources for: sales of air conditioners and industrial motors; market segmentation; and efficiency levels. Even in large industrialized countries, this type of data is often rare but it is even less available in Central America. This is partly because of the lack of local manufacturers and associated trade organizations. But it is also because of the lack of energy efficiency regulations which might provide a mechanism for the tracking of these technologies in the market.

Despite these limitations, however, the CLASP/BUN-CA team feels that the present study provides important insights into the market for the targeted products and the technical groundwork for further steps to be taken by governments considering the benefits of appropriate energy efficiency regulations for them.

First, it is abundantly clear that the end-uses studied are appropriate targets for efficiency improvement since they account for a major contribution to the countries' electricity consumption. Air conditioning probably accounts for between a quarter (Panama) and two-thirds (Nicaragua) of the electricity consumption in the commercial sector. It is also an important end-use in industrial facilities although industrial air conditioning is more likely to be provided by central package units and chillers which are not studied here. Finally, though traditionally low, air conditioning ownership rates in the residential sector is growing throughout the region. Air conditioning is estimated to account for 18% of all electricity consumption in El Salvador.

Motors are also a very energy intensive end-use, especially in industry. They account for 30% of industrial electricity in Nicaragua and 60% in Costa Rica where heavy industry is more common. Panamanian industry, which is generally lighter and on a smaller scale than that of the other three countries, uses only 11% of its electricity to drive motors. By comparison, El Salvador, with the most heavy industry in the region uses 30% of electricity in all sectors for motors.

In the region, both air conditioning and motors are imported and mostly from a few important trade partners. The United States is a very significant provider for both products. Other than the U.S., China and Korea are major players in the air conditioning market, while Brazil, Mexico, and Germany each hold a significant share of the motor market. All of these countries enforce regulations for these products, in the form of both minimum efficiency performance standards (MEPS), and labels. Therefore, Central American governments may benefit by pursuing a policy of harmonization with one or more of these countries.

Finally, the efficiency of the products studied seems to be strongly influenced by the regulations enforced by the country of origin. Most, but not all of the air conditioners, seem to conform roughly to U.S. standards. However, according to interviewees, there is

a significant fraction of the market below this level and higher efficiency products are available. Therefore, it is likely that significant savings could be gained by setting a minimum standard similar to the levels currently enforced in Mexico, the U.S. or Korea.

A large fraction of the motors imported to Central America originate from the United States, Brazil and Mexico[11] and thus are likely to meet current U.S. minimum efficiency standards. Significant efficiency improvements may be gained, however, through harmonization of MEPS with those of the major importing countries. Furthermore, high-efficiency product lines are widely available, but represent a small market share according to interviewees. The market share of these products might be increased through a program to increase consumer awareness of the financial benefit of efficiency, which might include a voluntary endorsement label, such as currently exists in the United States, the European Union, and China.

This market study suggests some possible options for the development of effective energy efficiency policies for air conditioners and motors in Central America. The important next steps in the process should depend on the political will and institutional capacity of local governments. Some of these include:

- Establishment and reinforcement of the legislative framework for implementing efficiency policy;
- Definition of institutional responsibilities and mandates, and training of key staff;
- Establishment of a network of interested parties to provide technical input and consultation about appropriate technical specifications and enforcement procedures; and
- Consideration of the pros and cons of harmonization with internationally recognized technical standards and establishment of region-wide policies.

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[11] Mexican motor standards are harmonized with those of the U.S. Brazil has recently passed new regulations that will require that all motors sold in Brazil meet an efficiency level that is roughly equivalent to the U.S. standards.

We also thank Greg Rosenquist, of Lawrence Berkeley National Laboratory, for sharing his technical expertise in the area of air conditioner efficiency.

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