Appliance Standards Transplantation: Applicability of a U.S.-Based Energy Efficiency Standards Model in Costa Rica

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1. Introduction

Costa Rica is a nation of approximately 4 million, 95% of whom receive electric power through the national electricity grid. Over 85% of the country's electricity is driven by hydropower, with the rest primarily generated through biomass and fossil fuel combustion. Costa Rica is quickly transitioning from a third world country to a developed nation, with technology surpassing coffee, bananas, and tourism as the number one export and a resulting increased standard of living for many of the country's educated and skilled workers. The typical Costa Rican household is acquiring more domestic goods, including more electric appliances. The population itself is also growing; it is estimated to reach 6.8 million within 50 years (PCP, 2000). With the onset of energy intensive industries, increasing per capita residential energy use and population growth, the country faces a shortage of power in coming years. While hydropower projects are underway to procure more electric supply, the Ministry of Energy and the Environment (MINAE) is also planning demand side management programs, which include increased energy efficiency and conservation, in order to reduce electrical demand. Energy efficiency can often meet electrical demand much more cheaply than can new installed capacity (CLASP, 2000). Demand side improvements have the added benefit of incurring fewer additional emissions or land transformations than do increased supply measures.

As part of MINAE's demand side energy plan, Costa Rica is currently in the process of adopting a U.S. based model of energy efficiency standards and labels for residential appliances to regulate their energy consumption. The standards, which have yet to go into effect and will so far apply only to refrigerators, will tax at 30% (but not ban from sale) all models that do not meet its specified consumption levels. Mandatory energy performance labeling was enacted in 1996. Since then manufacturers have been under obligation to distribute all refrigerators with informational labels affixed that give the model's adjusted volume and annual energy consumption. Imports must carry labels by the time they reach customs in Costa Rica. The new standard will rely on manufacturers' accurate and truthful presentation of this data on labels. MINAE has expressed great skepticism that manufacturers can be counted on to necessarily provide truthful data (MINAE, 2001). Consequently, monitoring and enforcement of the accuracy of energy performance labels will be essential to the success of this program. This research examines the possible outcomes that could result from implementing a U.S. appliance efficiency standards and labeling model in Costa Rica, given Costa Rica's own social, historical and institutional context. The focus of my analysis and critique is based on the distinction between energy efficiency and energy conservation. I examine how efficiency standards and labels work; the specifics of Costa Rica's own social, historical and institutional context; the potential obstacles and challenges to the goal of the standard; and the policy implications of my findings.

My motivation for beginning this research was based on a concern that MINAE's decision to enact Costa Rica appliance standards by adopting the U.S. standard levels directly might be counterproductive to the goal of reducing energy consumption by refrigerators in the country. Knowing that the average Costa Rican refrigerator tends to be smaller and less energy consumptive than the average U.S. refrigerator (for several reasons, to be discussed in further detail later), I hypothesized that a U.S. standard might weigh heavily on locally produced units. I imagined that local models might be less technologically advanced than their import counterparts of U.S. and Mexican origin, and might not meet the standard. Their penalization under the standard could then swing the market toward larger, more energy consumptive imported units. Such a shift in product classes, tantamount to replacing an average automobile by a "fuel efficient" SUV, could negate any savings the standard might incur. My motivating question, therefore, was "What outcomes could result from implementing a U.S. appliance efficiency standards model in Costa Rica?"

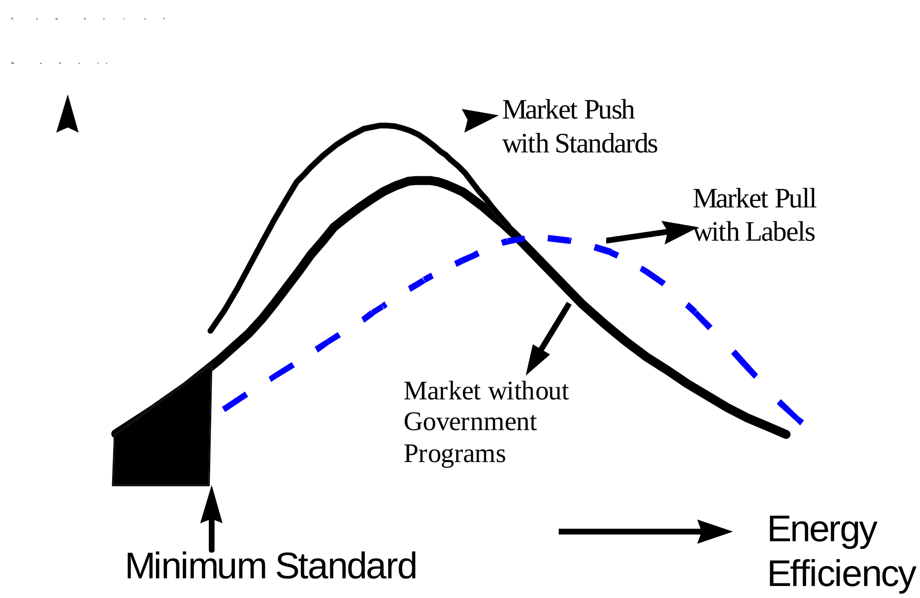
2. Background

2.1 Appliance Efficiency Standards and Labels

Energy efficiency standards, also sometimes known as mandatory energy performance standards (MEPS), are procedures and regulations that prescribe the energy performance of manufactured products by setting a maximum level of energy consumption, or a minimum efficiency level for a given product. How they are established and structured is dependent on whether the goal of the standards is to increase energy efficient technologies, decrease energy consumption, or both.

Energy efficiency standards may be voluntary or mandatory, as they are in the U.S. Voluntary standards may rely on the threat of public non-compliance disclosure, as is current practice in Japan. Non-legally binding voluntary targets may come with threats of mandatory standards if not met, as is the case in Switzerland. Standards are often used in conjunction with energy efficiency labels, which detail a product's energy performance (usually in the form of energy use, efficiency, and/or cost) and theoretically encourage customers to purchase energy-efficient products, which encourages manufacturers to produce and market more efficient models. Mandatory standards "push" the market towards higher efficiency by disallowing or taxing the sale of the least efficient models, while labels "pull" the market towards high efficiency (see Figure 1 below from EES, 2001).

Figure 1. Number of Models as a Function of Energy Efficiency in Three Scenarios



Energy efficiency standards for household and commercial appliances are often lauded by consumer advocates, industry representatives and environmentalists as a win-win approach to reducing domestic energy consumption while increasing economic competitiveness and environmental benefits. If successful, efficiency standards can result in reduced energy costs for consumers, national energy savings, avoided costs of additional generating capacity installation, avoided urban and regional pollution from electricity generation, and reduced carbon emissions. As an added evaluative benefit, these savings are generally fairly easy to quantify. Standards can be a relatively straightforward and effective way of achieving energy conservation because they focus on technical changes of a manageable few (manufacturers) as opposed to energy conservation measures that endeavor to change behavior patterns of the general public.[1] The concept of appliance standards is increasingly becoming part of national energy policies around the world, and as such, many countries are adopting some form of voluntary or mandatory energy efficiency standards for commercial and residential appliances. To date, there are 30 countries around the world that have established some form of energy efficiency standards, and many more have plans under development. (CLASP, 2000, see appendix A for a summary chart.)

2.2 How Energy Efficiency Standards Have Been Used in the United States

Energy efficiency standards began in Europe and the U.S. in the 1970's, partly in reaction to high oil prices. In the U.S., existing standards include residential furnaces, water heaters, dishwashers, clothes washers, dryers, central air conditioning (A/C), room A/C, freezers, and refrigerators, as well as lighting and a variety of commercial heating and air conditioning equipment. Energy efficiency advocacy groups and governmental policy analysis groups attribute substantial energy, pollution and monetary savings to these standards. According to the Energy Efficiency Standards group at Lawrence Berkeley National Laboratory (LBNL) U.S. appliance standard savings, compared to the projected 'business as usual' case scenario include:

Primary energy savings
- 0.7 EJ in 2000 or approximately 3.0% of residential energy use; equivalent to avoiding fourteen new additional 500 MW power plants in 2000
- 3.9 EJ cumulative through 2000

Pollution savings
- 9.8 metric tons in 2000 or approximately 3.9% of residential carbon emissions; equivalent to taking 7.7 million cars off the road in 2000
- 57 Mt cumulative through 2000

Consumer energy bill savings
- $4.7 billion in 2000 and $28 billion through 2000 (EES, 2001)

[1] As a caveat, it is important to note potential rebound effects of energy efficiency. Numerous studies (see Rudin, 2000) indicate that the benefits of efficiency improvements are often diminished by increases in consumption. For example, leaving lights on longer after switching to compact fluorescent bulbs, or choosing a larger unit when replacing a refrigerator, since new refrigerators are generally perceived to have higher efficiency.

The first U.S. refrigerator standards were developed based on refrigerators available at the time of their enactment in 1987. Among their explicit goals were to avoid any restrictions which were "likely to result in unavailability in the United States of products with performance characteristics, features, sizes, capacities and volumes that are substantially the same as those generally available in the U.S…." (reiterated in Federal Register, 2000).

The U.S. standard for refrigerators and combined refrigerator/freezers currently lays out seven major product classes, based on structure and features (there are also three separate classes for stand-alone freezers):

- whether the unit is a refrigerator, freezer, or combination;
- whether it is manual defrost or automatic defrost;
- how the freezer component of the unit is situated (top, bottom, side); and
- whether or not it has 'through the door' features like ice or water.

For refrigerators and refrigerator/freezers combinations (which I will hereafter refer to simply as refrigerators), standards for each product class are defined by maximum allowable levels of energy consumption. For each class, the level is set based on the product of its adjusted volume (AV) and a product class-specific multiplier, plus an allowable baseline consumption amount (see Table 1 below).

Table 1. U.S. Refrigerator Standards Maximum Allowable Energy Use (kWh/yr)

Category	1990	1993	2001
Manual Defrost	16.3*AV+ 316	13.5*AV+ 299	8.82*AV+ 248.4
Semi-Automatic Defrost	21.8*AV+ 429	10.4*AV+ 398	8.82*AV+ 248.4
Top-mount Automatic Defrost	23.5*AV+ 471	16.0*AV+ 355	9.80*AV+ 276
Side-mount Automatic Defrost	27.7*AV+ 488	11.8*AV+ 501	4.91*AV+ 507.5
Bottom-mount Automatic Defrost	27.7*AV+ 488	16.5*AV+ 367	4.60*AV+ 459
Top-mount Automatic Defrost with 'through the door' features	26.4*AV+ 535	17.6*AV+ 391	10.2*AV+ 356
Side-mount Automatic Defrost with 'through the door' features	30.9*AV+ 547	16.3*AV+ 527	10.1*AV+ 406

In the interest of consumer utility, the standard was set up as such to allow the continuation of desirable features like automatic defrost, 'through the door' features, and vertical freezer space, despite the fact that such features entail substantial increases in energy consumption. Under this standard, volume is also assumed to be a direct unit of consumer utility. As a result, the U.S.

refrigerator standards, DOE 1990 in particular, are less stringent in terms of absolute consumption for larger units with extra features. Consider, for example, the difference in allowable energy consumption between a manual defrost unit and a side mounted automatic defrost unit with “through the door” features. The proposed standard for Costa Rica corresponds to the 1990 U.S. refrigerator standards (DOE 1990, shown in first column above). Under DOE 1990, a manual defrost unit is permitted 16.3 times its adjusted volume, plus 316. In equation form: (16.3 ^{x}AV + 316) kWh/yr. Its higher end counterpart is allowed (30.9 ^{x}AV + 547) kWh/yr. This difference is exacerbated by the practice of using an adjusted volume, rather than actual volume.

Adjusted volume refers to the volume of the refrigerator plus a multiple of its freezer capacity. This multiplier accounts for the fact that freezing requires lower temperatures than does refrigeration. The freezer multiplier is usually around 1.6. A unit with 6 cubic feet of refrigerator space and 6 cubic feet of freezer space has an adjusted volume of 15.6 cubic feet rather than 12. This allows the unit to consume more energy than a similarly sized unit with a smaller freezer to refrigerator ratio, and still comply with the U.S. standard. In this way, automatic defrost units are given leniency over manual defrost units, which consume much less energy than do automatic defrost units. Manual defrost refrigerators typically have much smaller freezer space, as the freezer compartment is often located within the refrigerator compartment.

To demonstrate the potential repercussions of this difference, one may compare two units, one low end and one high end, both with straight (not adjusted) volumes of 12 cubic feet. Let the first be a manual defrost unit with a 2:1 refrigerator to freezer ratio (i.e.: 8 cubic feet of refrigerator space and 4 cubic feet of freezer space). The second is a side-mount automatic defrost unit with through the door features that has a 1:1 refrigerator to freezer ratio (6 cubic feet of each). The adjusted volume for the first unit is 14.4 cubic feet, and under DOE 1990 would be allowed to consume 551 kWh/yr. The second unit has an adjusted volume of 15.6 cubic feet, and would be DOE 1990 compliant consuming 1029 kWh/yr.

2.3 Efficiency vs. Conservation

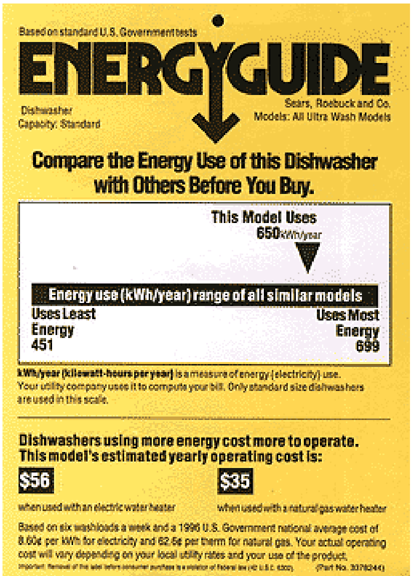
The crux of this dilemma lies in the definitions and implications of energy efficiency as opposed to energy conservation. Energy conservation deals with reducing the absolute amount of energy consumed. Energy efficiency, on the other hand is a measure of how much energy is used relative to services provided. For example, a large refrigerator that uses more total energy may be more energy efficient in general terms (i.e.: "produce" more, or provide more features or services per kWh). Yet a smaller refrigerator uses less total electricity. (Moezzi, 1998) While U.S. appliance standards promote efficiency—as defined by energy use per service provided—they do not have a clear end goal of conservation. Compared to the average manual defrost refrigerator, a large automatic defrost unit is held to a standard based on a greater freezer adjustment, times a larger per volume multiplier, plus a larger baseline consumption. As shown in the example above, these differences can lead to dramatically different allowable consumption levels. Because both units described above are compliant with the same set of standards, they may be seen to be of comparable efficiency. But while the unit with more features may arguably be just as 'efficient' as its manual counterpart, in terms of energy use given services provided, it is undeniably more energy consumptive; 87% more consumptive in the case above.

2.4 The U.S. Experience with Energy Performance Labels

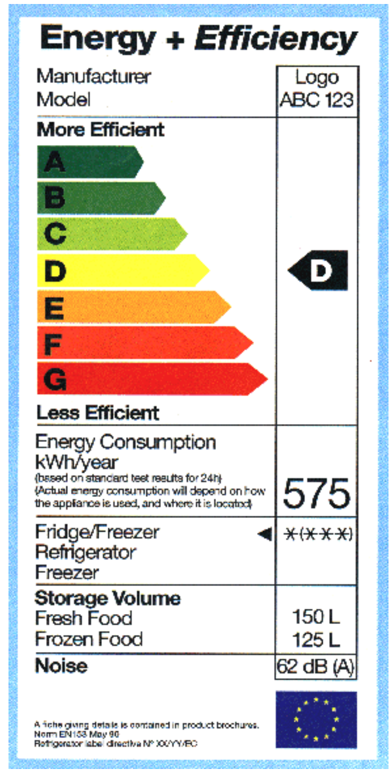
Energy performance labels for appliances have been part of the U.S. consumer experience since the introduction of EnergyGuide labels in 1980. (see Figure 2 on left) Consensus is growing that this label is confusing to consumers and has little impact on purchase decisions. (Egan, 2000) Among other criticisms regarding its readability is the critique that this label only allows for comparisons within product classes for a given size, and does not allow consumers to gauge the difference among units of different product classes or volumes. The European label (see Figure 2 on right) is also sometimes critiqued for not being easily comprehensible.

Figure 2. Sample Energy Lables in the U.S. and E.U.

U.S.



E.U.



Other designs have enjoyed a better reception by consumer focus groups in the U.S. and Canada, most notably the Australian design below. (Egan, 2000)

Figure 3. Sample Energy Label from Australia

3. The Development of Standards in the Costa Rican Context

In 1994 Costa Rica proposed, and in 1996 passed, Law #7447; the Regulation of the Rational Use of Energy (URE). The objective of this law was "to consolidate State participation in the promotion and gradual execution of the URE program, and to establish mechanisms to achieve energy efficiency, taking environmental protection into account." (MINAE, 2000). Given that the residential sector comprises approximately 45% of end use energy in Costa Rica, the Dirección Sectoral de Energía (DSE), which is the body in MINAE held responsible for implementing the URE, decided to first focus on residential appliances. Household end use energy in Costa Rica is currently broken down as follows: 40% for lighting; 19% for refrigeration; 17% for cooking; 15% for water heating; and 9% for other (TVs, radios, rice cookers, coffee makers, etc.) (DSE, 2000). After lighting, refrigerators comprise the largest percentage of residential energy use. While lighting transformation is a much more complicated endeavor from the consumer's perspective, as it requires switching from one product type to another[2], improving refrigerator efficiency simply involves design modifications to the next generation of products to improve their efficiency. Additionally, the refrigerator is one product found in most homes, even those of lower income level. Refrigerators enjoy a saturation rate of about 80-90%, and a market of around 55,000 new units sold per year: one for every 17 households per year (Atlas, 2000).

For these reasons, among others, MINAE decided to implement efficiency standards first and foremost for refrigerators. No other appliance standards are currently planned. In adopting efficiency standards for refrigerators, MINAE has decided to adopt the levels of energy consumption developed under U.S. standards directly and without modification, following in Mexico's footsteps. MINAE first plans to adopt the United States Department of Energy's (DOE) 1990 standards, and after some undetermined transition period, adopt DOE 1993 (current U.S.) levels. Because the country's lawmakers have interpreted the Costa Rican constitution to disallow the ban of any imports into the country (MINAE, 2001), in application the standard would mandate an additional 30% tax on any non-compliant units. The DSE would be in charge

[2] Note how unsuccessful the transformation from incandescent light bulbs to compact fluorescent bulbs in U.S. residences has been to date.

of administering the program, and the Costa Rican Electricity Institute's (ICE) Energy Efficiency Testing Laboratory would be tasked with testing units for compliance. Manufacturers of all imported and domestically produced refrigerators are currently required to affix informative energy performance labels to all units prior to departure from the factory in the case of domestically-produced units, and prior to arriving at customs in Costa Rica for imports.

Costa Rica has decided to depart from the U.S. style of comparative energy performance labels, as it deems constant evaluation of the market too difficult, given continuous changes in the import sector of the market (ICE, 2001). Instead, MINAE has opted to institute an information-only label (see Figure 4 below). Information-only labels provide information on the technical performance of the single labeled product, and offer no simple way (such as a ranking system) to compare energy performance between products. These types of labels are generally not consumer-friendly because they contain purely technical information. (CLASP, 2001) While the exact design has not yet been determined, an information-only format leaves few design options that are graphically useful to consumers. I do not think it is likely that such a label will significantly affect consumer purchasing decisions.

Figure 4. The Proposed Energy Label for Costa Rica

ETIQUETA ENERGETICA	
REFRIGERADOR-O REFRIGERADOR-CONGELADOR	MARCA: MODELO:
VOLUMEN AJUSTADO (LITROS)	
TIPO DESCONGELACION	
CONSUMO DE ENERGIA (kWh/AÑO) PARA ESTA UNIDAD	
CONSUMO DE ENERGIA (kW-h/AÑO) MAXIMO PARA ESTE TIPO DE UNIDAD	
PERSONA FISICA O JURIDICA QUE COLOCO ESTA PLACA O ETIQUETA	
La información contenida en esta etiqueta es para que usted compare el desempeño energético de este refrigerador con otros similares que se ofrecen en el mercado nacional. Dichas características han sido determinadas mediante métodos controlados en laboratorio, por lo tanto podrán variar según las condiciones y los hábitos de uso y el estado del equipo. Consultas al teléfono 192, apartado 126/2120	
IMPORTANTE REMOVER ESTA PLACA ANTES DE SU COMPRA POR EL CONSUMIDOR FINAL ES UNA VIOLACION A LA LEY 7447.	

Nota: - Dimensiones mínimas de la placa trece centímetros de largo por trece centímetros de ancho
- Debe adherirse al equipo en lugar visible

4. Hypothesis

While efficiency standards are generally expected to save energy, the way in which they are set, and the outside influences on the markets they regulate may thwart the intended goal of reduced energy consumption. The specifics of the standard, and the context into which it will be implemented, including market impacts and influences, trade regimes, and social factors, are important in determining its effectiveness. Transplanting an industrial country standard into a developing context, for example, may have repercussions of product class leakage—encouraging a shift from one product class to another.

My motivation for beginning this research was based on a concern about MINAE's decision to enact Costa Rica appliance standards by adopting the U.S. standard levels directly. I suspected that this decision might be counterproductive to the goal of reducing energy consumption by refrigerators in the country.

One of my primary concerns in the transplantation of this U.S.-based refrigerator standard directly into the Costa Rican context is that the current refrigerator market in Costa Rican bears little resemblance to the U.S. market in 1987. While manual defrost units had all but disappeared from the U.S. market by the end of the 80s, these units are still the norm in Costa Rica today. The average refrigerator is also much smaller in Costa Rica, and as such, much less energy consumptive.

The local Costa Rican refrigerator market caters to the general population, which is primarily middle-class. High end users often turn to the import market for goods that appeal to luxury predilections. There is one Costa Rican refrigerator manufacturer, Altas Industrial, and six importers. Four of these importers are U.S.-based, one of which is a joint U.S.-Mexican corporation, and the other two are from Korea and Mexico. The U.S. imports include major brands such as Whirlpool, Westinghouse, Frigidaire, and Maytag, among others. One can assume that units imported from the U.S. meet DOE 1990 and DOE 1993 standard levels, and will thereby meet Costa Rican standards, despite the fact that they are much more energy intensive than the smaller local units that could be penalized under the new standard.

If my hypothesis that the smaller, low end units could be eliminated by such standards were valid, the implementation of the U.S. refrigerator standard in Costa Rica could actually push the market toward higher end, more consumptive units, thereby increasing national energy use by domestic refrigerators. Such a standard would thereby sacrifice energy savings (or actually incur an increase in consumption) in its strive for efficiency. It could also push the market from locally manufactured units toward foreign imports.

5. Research Methods

To best evaluate the impact the new Costa Rican refrigerator standards might have on the refrigerator market in Costa Rica and on the one national producer, I wanted to determine an accurate representation of the pre-standard refrigerator market. While in Costa Rica during January, 2001, I attempted to make this evaluation through interviews and data collection.

In researching potential impacts of the standard, I relied primarily on interviews with employees at the DSE in MINAE; ICE; and Atlas Industrial, the national refrigerator manufacturer. My communications with these organizations have consisted of e-mail correspondences over the course of the past 8 months, and personal interviews with each in January, 2001. At MINAE I spoke at length with two upper level managerial employees; one administrator and one engineer. These interviews provided me with detailed information on the background and specific details of the standard. My interviewees also shared with me their thoughts on the obstacles that the standard faces, and how its enactment might play out. At ICE I spent several hours speaking with a member of the agency’s Environment Division, who gave me another perspective on Costa Rica’s ability to enforce such a standard. As this interviewee is also on staff at ICE’s Energy Efficiency Testing Lab, I was also given a tour of the Testing Lab, complete with a narrative of the Lab’s role in the standard implementation and enforcement as well as the challenges the Lab will face in fulfilling its duties. At Atlas I spoke with a manager of the Market Development division, who gave more information on Atlas’ history, as well as general information on the Costa Rican refrigerator market. All interviews were semi-structured. I also researched Costa Rican demographic and economic data, primarily on the web.

Little information was available from MINEA or ICE or from Atlas on shipment and consumption data for the Costa Rican refrigerator market. Given the statistical data constraints, I attempted to approximate the energy consumption of current units on the market through metering existing units, and relying on obligatory manufacturer-supplied energy performance labels in retail venues.

I visited six retail distributors in the cities of San Jose (the national capital) and Heredia, and the town of Atenas. At each location I transcribed data from labels on each of the units, including the brand, model, automatic/manual defrost categorization, any additional features, refrigerator/freezer volume when separately provided, adjusted volume, and energy consumption. I transcribed this data for all those units with labels-- 84 refrigerators in all. (see attached spreadsheet as Appendix B)

During the first two weeks of January 2001, I also attempted to meter individual residential refrigerators in Costa Rica using a Real Goods 'Watts Up' meter. This proved challenging due to a number of factors. While the actual metering itself consisted of nothing more than plugging the refrigerator into the meter, and the meter into the wall and waiting a few days, I often had to repeat the process several times. In the first home, momentary and sometimes more lasting power outages would reset the meter. In the home where I was staying, the woman of the house had the habit of turning off the power going into the house at the utility meter circuit breaker when leaving the house, "just in case." Because my time in Costa Rica was limited, I was unable to collect substantial data in this way. My analysis therefore relies primarily on new models currently on the market without comparisons to historical consumption levels of older units.

6. Findings

6.1 Market Characterization

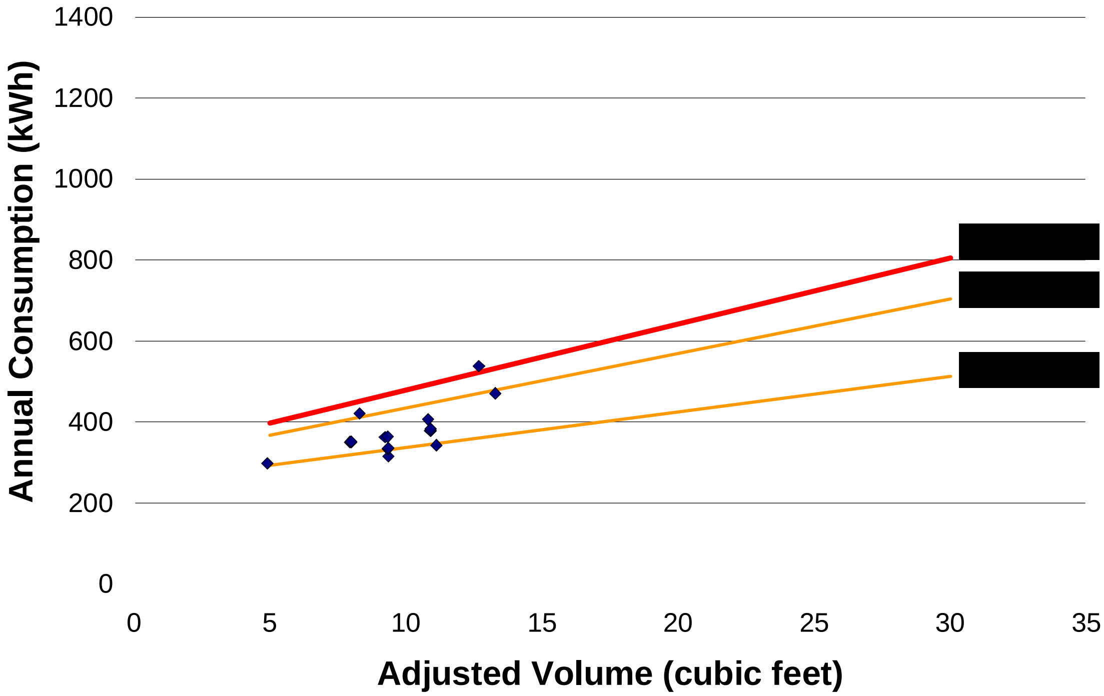
Fortunately, I have concluded that my hypothesis that the implementation of the U.S. refrigerator standard in Costa Rica could eliminate smaller, low end units, and thereby push the market toward higher end, more consumptive units, was disproved.

The expectations I had about how the new Costa Rican refrigerator standard would impact the market, overall energy consumption and the local manufacturer were mainly based on incorrect assumptions I made regarding the local manufacturer. I assumed Altas to be a small local company with only a national distribution audience and little access to capital for efficiency improvements.

In actuality, Atlas has a substantial capital base: Electrolux, the Swedish manufacturer of electrical appliances, owns 20% of Atlas. (FDI, 1996) With such capital backing, Atlas has been able to substantially improve the efficiency of its models. According to one Atlas representative, Atlas expects to be DOE 2001 compliant (a substantially more stringent level than that which CR is currently proposing) by the time this U.S. standard comes into effect in the U.S. in July, 2001. Atlas exports to most of Central America, and has intentions to expand its markets to Mexico and perhaps eventually the U.S. Consequently, Atlas has incentive to go above and beyond the proposed Costa Rican standard, and also has the capital to be able to conform to the tighter standards in place in these markets.[3]

With control over approximately 70% of the local market (Atlas, 2001) and completely in compliance with the proposed standard, Atlas will not be negatively impacted by the standard in any way. The U.S. and Mexican refrigerators are also unlikely to be affected, as both are currently at DOE 1993 levels. If anything, the impact will be small, and will only affect limited numbers of large inefficient Korean imports. In my data gathering, I indeed found few units that did not report themselves to be compliant with the yet to be enacted standards. The graphs below show data points in comparison to DOE 1990, 1993, and 2001 standard levels. Date points below the line labeled "DOE 1990" comply with the proposed standard for Costa Rica.

Figure 5. Comparison of Current Models with Proposed Standards for Manual Defrost Refrigerators



[3] While Atlas conforms to high energy efficiency norms, there is nothing in the standard that would necessarily deter Atlas from following the trajectory of increasing volume resulting in higher per unit consumption levels that we have seen in the U.S.

Figure 6. Comparison of Current Models with Proposed Standards for Semiautomatic Defrost Refrigerators

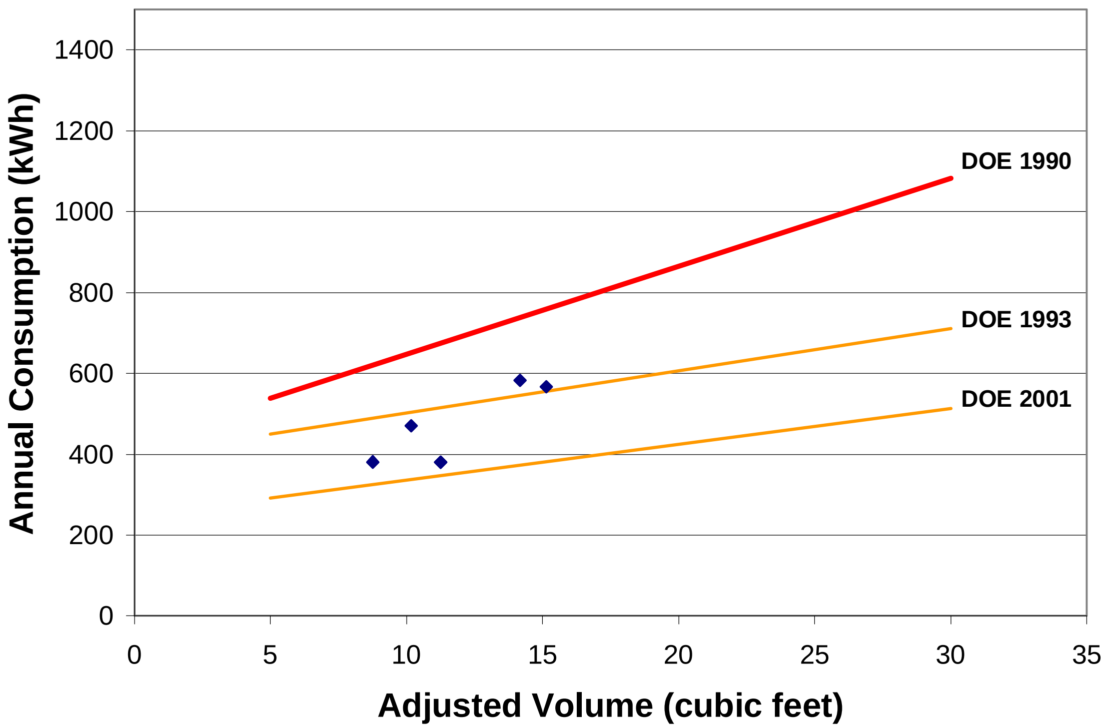


Figure 7. Comparison of Current Models with Proposed Standards for Top-mount Automatic Defrost Refrigerators

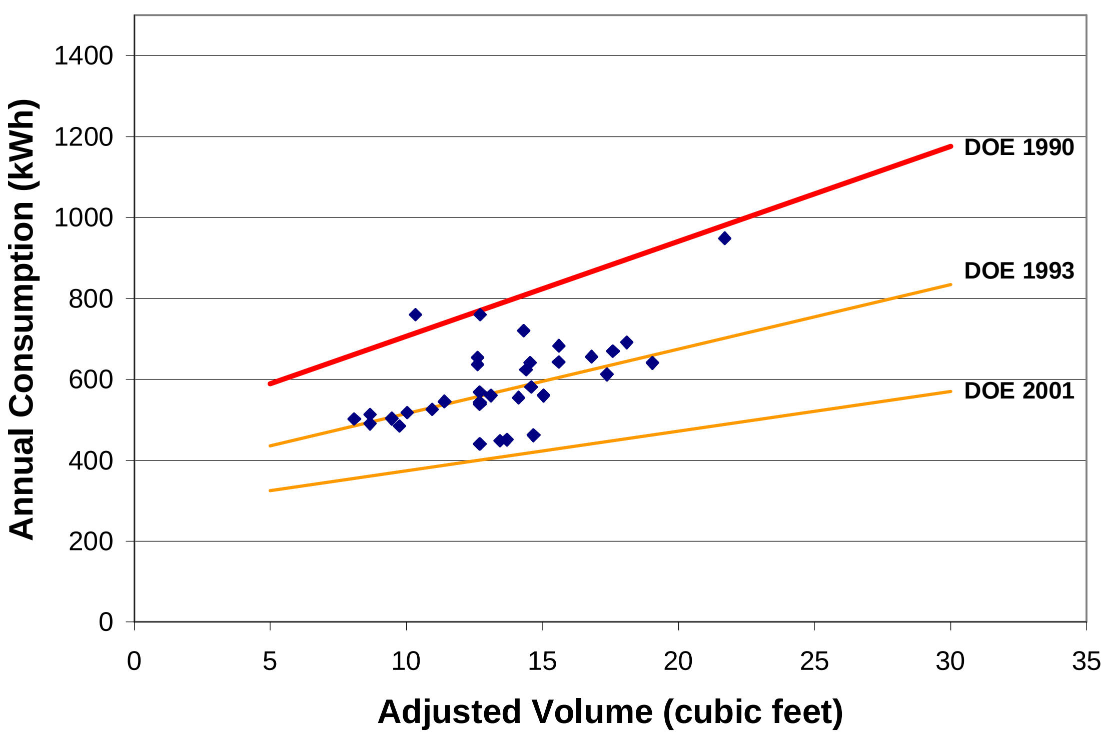


Figure 8. Comparison of Current Models with Proposed Standards for Side-mount Automatic Defrost Refrigerators with Through-the-Door Features

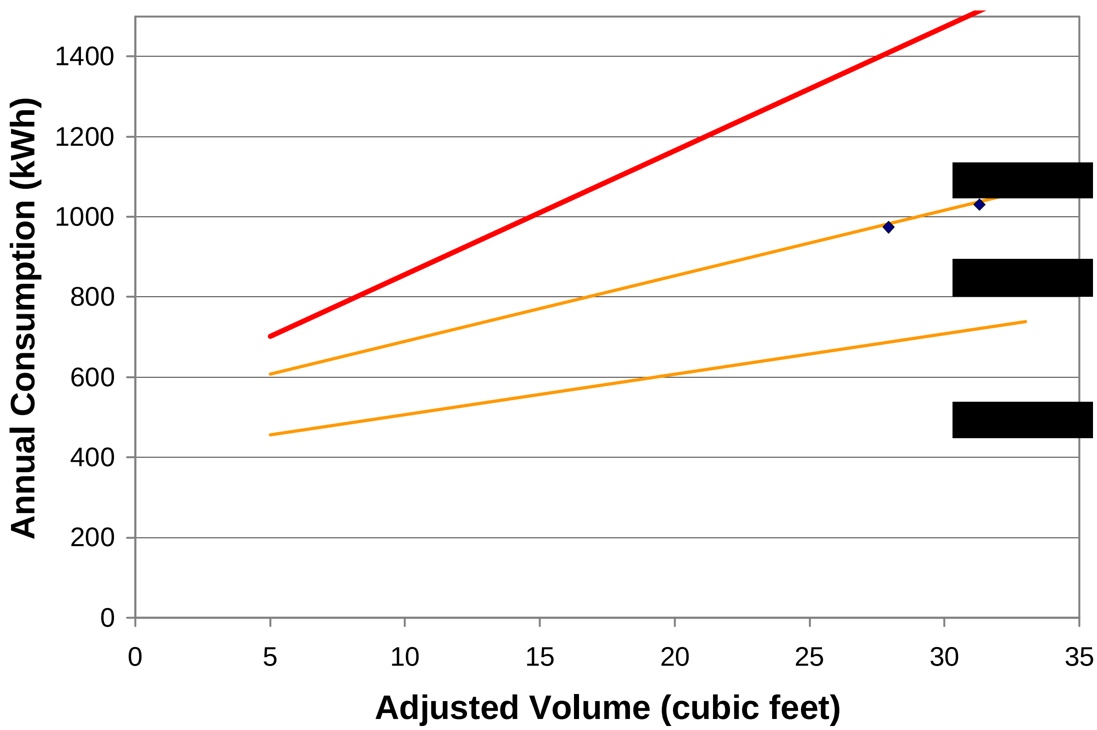


Table 2 below shows more specific breakdowns by locally produced versus imported units, and by product classes (Table 3). DOE 1993 and 2001 levels have been shown for comparison.

Table 2. Number of Observed Refrigerator Models and Percent Compliant with Proposed Standards

		Total	1990 compliant	1993 compliant	2001 compliant	% 1990 compliant	% 1993 compliant	% 2001 compliant
Atlas	Manual	17	16	16	2	94%	94%	12%
	Semi	2	2	0	0	100%	0%	0%
	Top Auto	13	13	7	0	100%	54%	0%
	TOTAL	**32**	**31**	**23**	**2**	**97%**	**72%**	**6%**
Imports	Manual	6	6	5	3	100%	83%	50%
	Semi	5	5	5	0	100%	100%	0%
	Top Auto	38	37	21	0	97%	55%	0%
	Side Auto	1	1	1	1	100%	100%	100%
	Side Auto-TTD	2	2	2	0	100%	100%	0%
	TOTAL	**52**	**51**	**34**	**4**	**98%**	**65%**	**8%**
		84	**82**	**57**	**6**	**98%**	**70%**	**11%**

Table 3. Number of Observed Refrigerator Models and Percent Compliant with Proposed Standards

By product class		Total	1990 compliant	1993 compliant	2001 compliant	% 1990 compliant	% 1993 compliant	% 2001 compliant
	Manual	23	6	5	3	26%	22%	13%
	Semi	7	5	5	0	71%	71%	0%
	Top Auto	51	37	21	0	73%	41%	0%
	Side Auto	1	1	1	1	100%	100%	100%
	Side Auto-TTD	2	2	2	0	100%	100%	0%
	TOTAL	**84**	**51**	**34**	**4**	**61%**	**40%**	**5%**

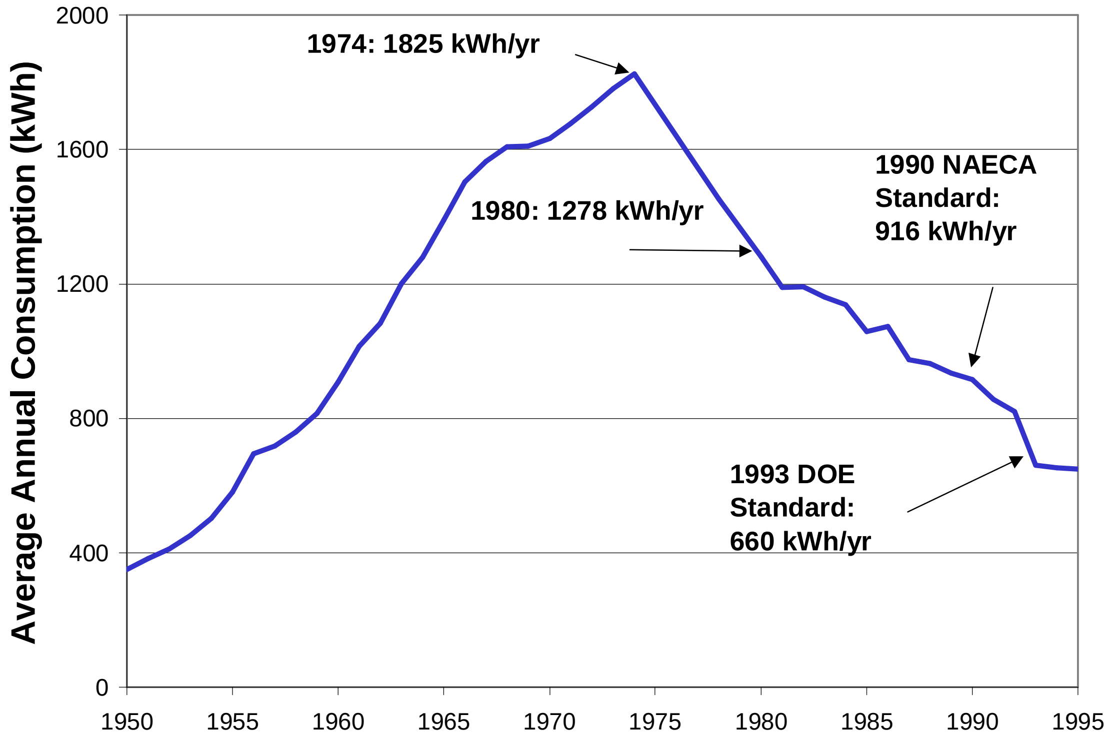
Note that these figures are NOT sales-weighted; rather they simply represent the numbers of models on display that are compliant with the three standards; one model might feasibly generate an order of magnitude more sales than the next. As the officials at MINAE reported, it is difficult to get a representative snapshot of the sales-weighted refrigerator market in Costa Rica. This is in part due to the difficulty of getting data from manufacturers, and in part due to the import sector being so fluid, with constantly changing brands and models contributing to its makeup.

When collecting my data, I found that most units carried the labels—the consistent exceptions tended to be large imports, although most of those from the U.S. often still contained EnergyGuide labels. While any comparative worth of the EnergyGuide label is lost outside of the U.S. context, it is no less useful than the information-only label that Costa Rica has proposed. Because the design of the Costa Rican energy performance label is not yet regulated, there were many different variations. Most were versions of the original Costa Rican design shown previously, while other were imitations of the U.S. label or European labels. Some units carried several different labels, at times with conflicting data, which raises a red flag regarding consumer comprehension, and certainly has implications regarding the accuracy of the labels. These differences could perhaps be due to differing calculations for adjusted volume, or different testing procedures rather than dishonesty on the part of the manufacturer. Irrespective of the reason, inconsistent labeling prevents consumers from getting standard data with which to make their purchasing decisions. The key to identifying noncompliant units lies in the ability of MINAE to verify labels and their energy consumption claims.

While conducting my interviews, I discovered that there is a substantial secondary market for refrigerators in Costa Rica. These are old, used units, mostly of U.S. 1980s and 1990s origin, that are re-sold in Costa Rican secondary market venues. Because these units are not shipped directly from manufacturers, they are not required to carry informational labels, and would not be subject to the proposed standards. Depending on the age of the models and the size and level of degradation, these used imports could be two to three times more consumptive than the many refrigerators on the Costa Rican market. The average U.S. refrigerator in 1980 used 1278 kWh/yr.; by 1990 the consumption of the average U.S. model had only gone down to 976 kWh/yr. These figures are for new models—it can be presumed that as a unit ages it becomes less efficient, perhaps leaky with worn out seals, and that the consumption increases further yet.

An additional potential complication in the Costa Rican refrigerator market is the effect that the new U.S. refrigerator standards could have. In July of 2001, updates to the current refrigerator standards (DOE 1993) in the U.S. will take effect. Once DOE 2001 is enacted, U.S. manufacturers will no longer be allowed to sell units not compliant with DOE 2001 domestically. The logical response on the part of manufacturers would be to export them at a discounted rate to markets with less stringent efficiency standards. These units will certainly meet new Costa Rican standards. If the Costa Rican market is flooded with cheap, larger refrigerators, it could further exacerbate the potential move toward more energy consumptive goods, as the average U.S. refrigerator under DOE 1993 has a consumption rate of 686 kWh/yr. (EES, 2001). The graph below depicts the average consumption levels of U.S. refrigerators from 1950 to 1995, to better illustrate this point. As a rough comparison, my best (and likely high) estimate of the consumption level of the average unit on the Costa Rican market is in the mid-500 kWh/yr range. I suspect this number is high because I arrived at it by taking an average of the consumption ranges of the units for which I collected label data. In reality, based on my observations of refrigerator sizes and classes in typical Costa Rican homes, I would expect the sales-weighted average to tend toward smaller, less consumptive units. Many new refrigerators on the Costa Rican market consume between three hundred and five hundred kWh/yr.

Figure 9. Average per Unit Energy Consumption of U.S. Refrigerators over Time



6.2 Monitoring and Verification Capacity

With a loan from the Interamerican Development Bank, the Costa Rican Electricity Institute (ICE) constructed a state of the art national testing laboratory for electric appliances. The building contains office space, a temperature controlled entrance chamber to the testing room, and the testing room itself, configured to accommodate up to ten refrigerators at a time. As of yet, however, the lab remains empty, as the ICE staff designated to run the lab has not received training on how to do so. The lab staff and employees of the 'Environment' division of ICE are currently looking for funds to enable them to visit other testing labs in the region (for example, in Brazil or Mexico) to glean insight on the details of how such a lab should optimally be run.

7. Analysis

The total energy consumption of the Costa Rican refrigerator market could potentially be impacted by several factors:

- The market "push" of an energy efficiency standard on energy consumption levels of new retail units;
- The market "pull" of energy performance labels on consumer product choice;
- Secondary market unit consumption; and
- Increased high-end imports from abroad in response to new U.S. standards.

As it currently stands, the proposed standard and labeling protocol is only likely to have any impact on the first element, and its initial influence will be marginal. While the new standard will not likely affect a substantial population of current models on the market, it nonetheless sets an important precedent for future regulation. Once the standard is in place, with regulatory legitimacy and monitoring and verification institutions, it could theoretically be easier to introduce a stricter standard at a future point[4]. Moreover, it sets a per unit consumption cap on any new unforeseen entrants into the market.

If experience to date in the U.S. and Europe is any indication, (Egan, 2000) the Costa Rican labeling scheme can expect to have little impact on consumer choice. This is especially true should Costa Rica continue with its plan to utilize an information-only label. Few consumers anywhere, I would argue, think in terms of kWh/year to know whether a given reported consumption figure is a reasonable or outrageous level of annual energy consumption for a refrigerator.

The fact that the standard and labeling program overlooks the highly consumptive sector of the market comprised by the 'secondaries' is a substantial drawback. Without targeting these units, what are likely the worst offenders will not be affected by the proposed standard, nor will consumers be able to identify or know to avoid such highly consumptive units.

[4] It has also been argued that such 'getting a foot in the door' approaches can be unproductive, as change can be easiest to engender from a worst-case scenario, rather than one that has already received attention and experienced some sort of regulation, which could be considered 'enough.'

8. Policy Implications

While Costa Rica's proposed standard and labeling program is likely to have little impact as presented, the program could be substantially improved with a minimal amount of financial investment—it presents an excellent microfunding opportunity.

In achieving its most basic goal of energy savings, the major challenges this standard will face are verification of labels and enforcement of standards compliance. Without the Energy Efficiency Testing Lab running at capacity, these challenges will be difficult to overcome. Training for Lab employees will be essential to the Lab's ability to perform its designated functions. Funding of less than $20,000 would be sufficient to send various lab employees to visit other testing facilities in Brazil and Mexico, and learn how those testing labs operate.

Label design could also greatly improve the outcome of the program. A comparative label design is the only way to realistically reach consumers and inform their purchasing decisions. Fortunately, there are options for label design and enhancement that would increase the effectiveness of the labeling program with minimal research and development costs. Consumer focus groups have been used in the U.S. in redesigning the EnergyGuide labels; Costa Rica could also pursue this option. Possibilities exist for structuring a comparative labeling program in such a way as to avoid the complication of having different comparisons among product classes and volumes. Costa Rica could base each ranking on a comparison between the given unit and the average consumption values of all models of the previous year. This strategy could be more easily incorporated into the Costa Rican system than would the U.S. strategy of separate comparisons for each product class. It would be easier to adapt, simpler to enact, monitor and update and would be more user-friendly. It would also address the criticism of the U.S. EnergyGuide system of not comparing between product classes and among units of differing volumes.[5]

[5] EnergyGuide limits comparisons to other units of the same product class and similar volume as the unit in question. As such, the consumer can see only how said unit compares in energy consumption to other units of similar design, and not to units in other classes. A particular side-by-side automatic defrost unit with through-the-door features may look attractive when compared to other similar units, but could consume twice the energy of a simple top-mount automatic defrost unit. Comparisons limited to like units conceal such differences.

Additional funds could be used to finance the inclusion of the secondary import market into the standard protocol, to have the greatest reduction in energy consumption by refrigerators. One possible way to include these units is to estimate consumption based on the model, the known consumption at the time of manufacture (which should be easy to procure for U.S. imports), and assign a consumption mark-up based on the estimated (or determinable) age of the unit, to account for degradation. Again, the funding necessary to carry out such research would be minimal. Inclusion of used models under the standard will further necessitate a fully operational testing lab, even more so than would the primary market. The secondary market will not be able to rely on manufacturer claims, but would have to rely on distributor estimates. Training of testing lab staff should thus be given high priority, as it has the potential to reinforce compliance of both primary and secondary sectors of the market.

There are no easy solutions to the problem of increased high-end imports from abroad in response to new U.S. standards. One strategy Costa Rica might undertake could be to shape the standard along a logarithmic regression rather than linear progression, so that larger models must meet a stricter standard on a per-volume basis. This would effectively set a consumption cap above a certain volume. When setting the European Union regulations, the EU considered defining energy efficiency performance using such a curved line of energy consumption as a function of adjusted volume (Waide, 2001). Such a standard could potentially keep out the highest consuming units from the U.S., if the 30% additional import tax were seen as a substantial barrier. Minimal market research funding could provide for evaluation of modifications to the U.S. standard, and how alternate options might impact the Costa Rican market.

9. Conclusions

I was initially concerned that the implementation of a U.S. refrigerator standard in Costa Rica could eliminate smaller, low end units, and thereby push the market toward higher end, more consumptive units. The findings outlined in this project show that on its own, the standard will not necessarily incur such an impact on energy consumption in the Costa Rican context, although it may not have positive outcomes to the extent anticipated. However, given the right resources, and with key provisions, this standard and labeling program has the potential to realize its goal of achieving substantial energy savings. Verifying energy consumption reporting will be key to the standard's success, whatever shape it takes. Training for ICE Testing Lab staff should thus be a high priority in building monitoring and verification capacity.

A more quantitative analysis of the potential impacts of the Costa Rican refrigerator efficiency standard is needed, and a more thorough market characterization would aid in this process. A significant knowledge gap in this research is identifying the consumption levels of models currently on the market, both in terms of sales-weighted averages, and broken down by product classes. There is especially a need for gathering more data on the secondary market—the volumes of sales, consumption of these units, approximate ages, and countries of origin. If at all possible, this sector should be included in the standard. And finally, research on the likely reception and utility of energy performance labels, perhaps through focus groups and other consumer studies, will further increase the program's potential impact.

RESOURCES

Atlas; personal communication with employee of Atlas Industria via electronic mail, 9/00 to 5/01; personal interview 1/11/01.

CLASP (Collaborative Labeling and Appliance Standards Program) website: http://www.clasponline.org/index.php3

CPC (Central America Population Program), University of Costa Rica http://populi.eest.ucr.ac.cr/

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Egan, C., C. Payne and J. Thorne. "Interim Findings of an Evaluation of the U.S. EnergyGuide Label." Presented at the American Council for an Energy-Efficient Economy 2000 Summer Study on Energy Efficiency in Buildings. Pacific Grove, CA, August, 2000.

EES: Energy Efficiency Standards Group presentation at Lawrence Berkeley National Lab ("LBNL Analysis of U.S. Mandatory Efficiency Standards"), March 2, 2001

FDI: Foreign Direct Investment in Latin America in the 1990s; March 1996: http://www.fias.net/pubs/fdinews/v1n2/#Publications

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