

APPENDIX A

STATUS OF APPLIANCE EFFICIENCY POLICY IN THE UNITED STATES

Introduction

In the U.S., a law passed in the late 1970s required that major household appliances have energy labels (the EnergyGuide). In the mid-1980s, threatened by a developing patchwork quilt of minimum appliance efficiency standards in different states, U.S. manufacturers agreed to a sweeping national law that set minimum efficiency standards for a range of household appliances. To date, appliance and lighting standards have saved more than 3% of U.S. annual residential energy consumption (McMahon 1996). Meanwhile, the U.S. EnergyGuide label has played an important role in providing information on appliance energy usage for many utility-sponsored rebate programs across the country. However, there is no evidence that the label has had a significant influence on consumer decision-making in the purchase of household appliances.

This appendix provides an overview of trends in appliance energy use and related policies in the U.S. It describes the growth in appliance-driven energy demand; explores the factors driving increases in demand; documents what is known about historical and projected trends in appliance efficiency; and analyzes the policies that have been enacted to improve appliance efficiency.

Appliances in the United States

Growth in Demand

After World War II, U.S. energy consumption grew rapidly, fueled by the increasing population, economic growth in the commercial and industrial sectors, and the introduction of new appliances into the home. Energy demand outpaced population growth, growing by 2.9% annually during the 1950s and then 4.3% annually during the 1960s.¹ The major interruptions in the pattern of continued growth in energy demand occurred as a result of the OPEC-related oil shocks of 1973 and 1979. During those two years, energy consumption fell by 2.3% and 3.7%, respectively. And during the period 1973 through the mid-1980s, energy consumption stayed essentially constant, with a sharp drop occurring after the 1979 oil shock.

There are five main historical drivers of U.S. electricity demand (Rohmund et al. 1994):

- population increases and growth in the work force;
- productivity gains and growth in output;
- technology diffusion and new applications of electricity (including home appliances);

¹ Population growth averaged 1.7% annually during the 1950s, and then fell slightly to 1.3% during the 1960s, 1.1% during the 1970s, and 0.9% during the 1980s.

- strong competitive gains in the space and water heating markets; and
- fast regional growth in electrified southern climates.

Figure Appendix A .1 shows the growth in U.S. energy consumption over the last 50 years, displayed by end-use sector. Industry’s share of energy use has fallen from 47% to 38% of total demand, while the share of residential and commercial sectors has risen from 27% to 36% of demand.² The share of the transport sector has stayed fairly constant at 26% of U.S. final energy demand.

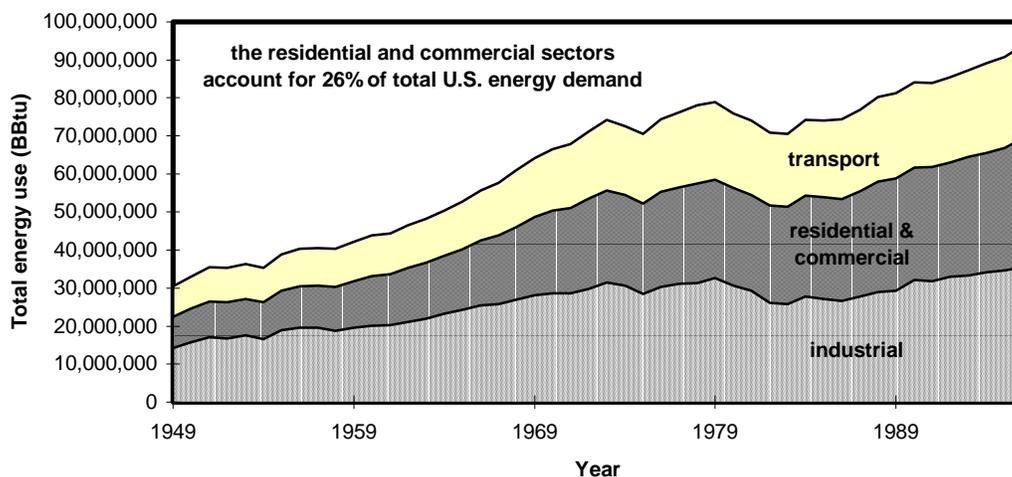


Figure Appendix A .1. U.S. Energy Consumption by End-Use Sector, 1949-1996. (Source: Energy Information Administration, *Annual Energy Outlook* (EIA 1997))

The increase in residential demand was fueled by the phenomenal growth in the market for major home appliances. The continuous marketing of electric appliances during the first three quarters of this century resulted in waves of adoption of appliances: first the electric light, then the refrigerator, then the air conditioner and other kitchen and laundry appliances.

Figure Appendix A .2 shows the decade-by-decade increase in sales (as measured by wholesale shipments) of the major household appliances over the past 50 years. If one compares the sales per decade for each appliance type, the increase in sales over the 50-year period ranged from a low of 2.5- to 3-fold for ranges and refrigerators to as high as 120- to 150-fold for air conditioners and clothes dryers, two technologies which hardly existed back in the 1940s.

By the late-1980s, several appliances had reached full penetration in U.S. households, and most of the “major” appliances³ were present in at least three quarters of U.S. homes. European countries were generally much slower than the U.S. to adopt some household changes and technologies, such as refrigerators and hot running water. However, as Table Appendix A -1 indicates, the penetration of household appliances is now roughly similar in the U.S. and Europe for most of the major appliances, with the exception of air conditioning.

² In 1996, the U.S. residential sector accounted for one-fifth (20%) of final demand.

³ In the parlance of the appliance retailing industry, the “major” appliances include refrigerators, freezers, air conditioners, dishwashers, clothes washers and dryers, ranges, ovens.

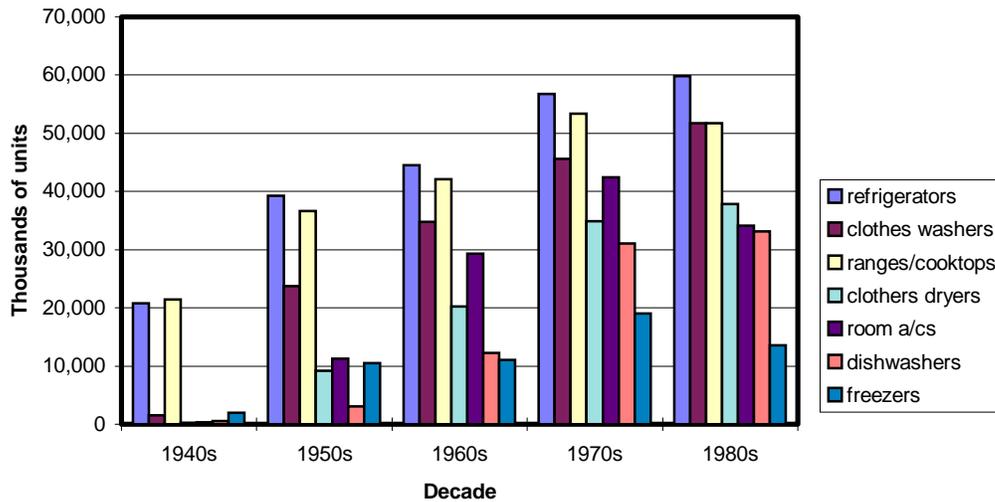


Figure Appendix A .2. Shipments of Major U.S. Home Appliances, 1940-1990. (Source: *AHAM Fact Book, 1996*)

Table Appendix A -1. Penetration of Major Appliances in the U.S. and Europe, 1993.

Appliance	% of Households	
	Europe	United States
refrigerators	98	100
ranges/ovens	95	99
clothes washers	90	77
clothes dryers	20	71
air conditioners, of which	<3 ^a	68
central a/c	na	(44)
room a/c	na	(27)
dishwasher	28	45
freezer	46	35

Source: U.S. data from *Residential Energy Consumption Survey*, Energy Information Administration. European data from *Appliance*, June 1994.

na = not available

^a According to Waide (1998), the saturation of air conditioners in the residential sector of most northern European countries is less than 0.01%. It is slightly higher (~1-3%) for some southern European countries, such as Italy, Spain, and Portugal, and as high as 6% in Greece.

How is Energy Used in U.S. Homes?

Figure Appendix A .3 shows an end-use breakdown of energy consumption in U.S. homes. The largest end use is space heating, with just over one-third of consumption. This is followed by water heating at 20%, refrigerators at 10%, and then cooling, lighting, and laundry. The fastest-growing use of energy in U.S. homes is what has heretofore been labeled as “miscellaneous” or “other”. This includes appliances such as computers, printers, stereos, fax machine, dryers, and other small appliances. In addition to their increasing electric use when on, recent research in this area of “miscellaneous” energy uses has pinpointed “standby” losses when they are switched off or not performing their principal functions. This is often due to transformers that are switched on the secondary side, and has been called “leaking” electricity, since it is invisible to the user. Based on end-use monitoring, Rainer et al. estimate that the amount of leaking electricity in typical U.S. homes represents 50 to 100 watts per home, or about 5 to 23% of the houses’ total electricity consumption (Rainer, Greenberg, and Meier 1996)!

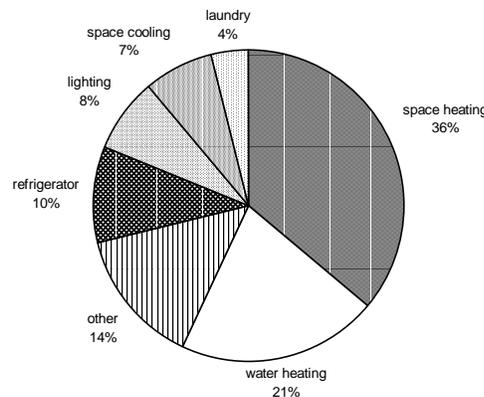


Figure Appendix A .3. U.S. Residential End-Use Breakdown, 1990. (Source: Lawrence Berkeley Laboratory)

Appliance Market Data

This section summarizes information about how major appliances are distributed and purchased; why they are purchased; and how often they are replaced. The Association of Home Appliance Manufacturers (AHAM) is the best source of data on sales and trends in the U.S. appliance market. In addition to providing background, this information illustrates the representativeness of my sample of U.S. stores.

Appliance Distribution

The two main channels for distribution of appliances are household appliance stores and department stores. Together, these account for more than 60% of total appliance sales in the U.S. (see Table Appendix A -2). Household appliance stores are sometimes called “destination” stores: examples are regional appliance superstores and national chains such as Best Buys and Circuit City. Most of the sales

through appliance stores are through two primary chains, Sears and Montgomery Ward (AHAM 1997: 19).

Table Appendix A -2. Primary Retail Outlets for Home Appliances, 1992

Type of Store	Number of Stores	% of total sales
Household Appliance Stores	9,340	30.3
Department Stores	7,243	30.1
Radio, TV, and Music Stores	3,139	12.2
Miscellaneous Retail Stores	3,563	7.6
Other ^a	32,242	18.8

Source: *AHAM Fact Book, 1996*

^a “Other” includes furniture stores, direct selling establishments and mail order houses, building material and supply stores, hardware stores, and auto and home supply stores.

Appliance Ownership

There are more than 600 million large appliances in use in U.S. households today.⁴ A typical U.S. house has six major appliances: a refrigerator, range/oven, microwave oven, washer and dryer, and either a dishwasher or disposer. Since most households are owned rather than rented⁵, the vast majority of appliances will be purchased by the household owner – or in some cases a builder or contractor — rather than a landlord. The percentage of owned appliances ranges from a high of 99% for freezers to a low of 76% for full-size refrigerators with one exterior door (AHAM 1996A: 11).

Why People Buy an Appliance

The most common reason for replacing an appliance is that people are moving to a new residence. For almost all appliances, this reason accounts for more than 40% of replacement purchases. One exception is laundry appliances (clothes washers and dryers; for these appliances, the most common reason for replacement (48-53%) is that the unit broke down or needed costly repairs. Another exception is microwave ovens: 35% of units broke down or needed costly repairs, and 30% of purchasers simply wanted a new or updated model. Remodeling was a lesser factor in deciding to replace an appliance: less than 10% for all major appliance categories.

⁴ In this category of appliances, AHAM includes refrigerators, freezers, room air conditioners, clothes washers and dryers, ranges and cooktops, microwave ovens, dishwashers, disposers, compactors, and dehumidifiers. These data thus exclude the following residential equipment: space heaters, furnaces, boilers, central air conditioners, and water heaters (AHAM 1996B).

⁵ According to the 1993 Residential Energy Consumption Survey, 69% of 66.1 million U.S. households were owned and 31% were rented (EIA 1994).

Trends in Efficiency

Large gains were made in appliance efficiency in the U.S. during the late 1970s, due to the oil shocks and the Energy Policy and Conservation Act of 1975 (see Figure Appendix A .4). Efficiency gains continued throughout the 1980s as states began to impose minimum efficiency standards. Another significant drop in energy use occurred in the early 1990s as a result of the adoption of the National Appliance Energy Conservation Act (NAECA) standards in 1990 and 1993. The policy stimulus for these trends is described in the next section.

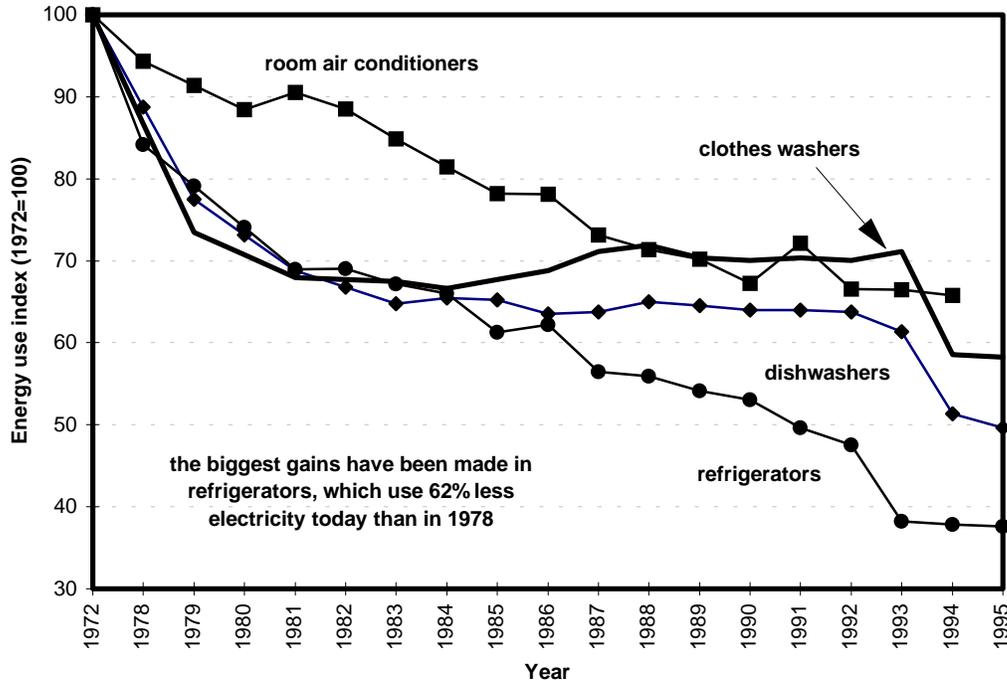


Figure Appendix A .4. Trends in U.S. Appliance Efficiency. (Source: AHAM 1996)

Appliance Energy Policy

The two main national policies enacted to stimulate increases in U.S. appliance efficiency have been the appliance labeling legislation enacted in the late 1970s, and federal minimum efficiency standards for appliances, enacted in the late 1980s. This section describes these policies and discusses their impact and effectiveness. It also discusses the additional policies of demand side management and market transformation.

Labeling

The National Energy Policy and Conservation Act of 1978 requires the Federal Trade Commission to mandate labels for appliances indicating their energy consumption. In November 1979, the FTC promulgated a regulation requiring the manufacturers of seven major home appliances to place energy labels on their appliances⁶ (FTC 1979). The EnergyGuide labels began appearing on appliances in stores in mid-1980. Table Appendix A -3 shows which U.S. appliances are included and excluded in the labeling program.

Table Appendix A -3. Appliances Covered and Not Covered in the U.S. EnergyGuide Labeling Program.

• Label Required	• No Label Required
<ul style="list-style-type: none">• refrigerators and refrigerator-freezers• freezers • dishwashers• water heaters• clothes washers• Room air conditioner, central air conditioners, and heat pumps• furnaces	<ul style="list-style-type: none">• clothes dryers• home heating equipment other than furnaces• television sets• kitchen ranges and ovens• humidifiers and dehumidifiers••

Although the EnergyGuide labeling program has been a central element of U.S. appliance efficiency policy, there has been no definitive study to demonstrate the labels' effectiveness. In fact, several studies have raised questions about the labels and consumers' ability to accurately comprehend their content (Carswell 1989; BPA 1988).

The most complete evaluation of the appliance labeling program was completed by the Federal Trade Commission in 1986 (Dyer 1986, Dyer and Maronick 1988). This longitudinal evaluation was based on surveys taken from a sample of several hundred purchasers of washing machines and refrigerators in 1979, 1982, and 1983. Energy use ranked low on the list of consumer priorities in all three surveys.

In the 1982 and 1983 surveys, slightly fewer than 60% of refrigerator respondents indicated that they were aware of the labels, and roughly half of these people (or about one-third of all refrigerator respondents) indicated that the label affected their buying decision (Dyer and Maronick 1988). Dyer and Maronick concluded that refrigerator purchasers seemed to be more aware of the labels than did purchasers of washing machines; they also tended to rely on the labels to a greater extent in their purchase decisions. There are no studies that have definitively shown whether the EnergyGuide label influences consumers to purchase more energy-efficient appliances.

Several studies have raised questions about the effectiveness of the label and consumers' ability to accurately comprehend its content. Redinger and Staelin (1981) found that the EnergyGuide labels had little impact without additional information and a "sales push". A California utility conducted group

⁶ The 1979 rule covered refrigerators and refrigerator-freezers; freezers; dishwashers; water heaters; clothes washers; room air conditioners; and furnaces. It was subsequently been expanded to include central air conditioners and heat pumps.

interviews and found out that about half of the participants “severely misunderstood” the information presented on the labels (Carswell et al. 1989: 37). A study by the Bonneville Power Administration concluded that the labels are not a very convenient way for consumers to identify energy-efficient models and that the labels are therefore “not particularly effective in specific purchase decisions.” (BPA 1988) In the most recent evaluation of the U.S. EnergyGuide label, I found that only about 20% of U.S. consumers carefully read the label, and fewer than half of consumers who were shown a sample label were able to use the label to tell whether a model was more efficient than most other models.

In 1994, the Federal Trade Commission issued a final rule that revised the format of the EnergyGuide label (FTC 1994). The new label was designed to deal with problems arising from discrepancies in annual operating cost that appeared on labels when the national average electricity price changed from year to year. Based on the results of mall-intercept interviews with 120 consumers in early 1991— as well as on data submitted from a Canadian study that recommended using energy consumption, rather than dollars, as the basis of comparison — the FTC decided to revise the EnergyGuide label so that annual energy use (in kWh) rather than average annual operating cost, is the main comparative indicator.

In summary, the U.S. appliance energy labeling program is the longest-running federal energy efficiency program. Based on my research with U.S. policymakers (du Pont 1998), I conclude that the labeling program is generally seen as having some impact and as being integral to the overall U.S. effort of testing, labeling, and standards. To date, however, there has been no effort to quantify the energy impact of the EnergyGuide labeling program.

Minimum Efficiency Standards

Brief History of U.S. Minimum Efficiency Standards

Table Appendix A -4 provides a timeline of the development of U.S. appliance and equipment efficiency standards. Environmentalists and energy efficiency advocates lobbied for national appliance efficiency standards in the early 1980s and failed. After these groups succeeded in convincing a number of states to pass their own minimum efficiency standards, appliance manufacturers became alarmed by the growing patchwork of different state efficiency standards. They then joined with the Department of Energy and the advocacy organizations (led by the Natural Resources Defense Council) to negotiate a set of national, minimum efficiency standards for a range of residential products. The “consensus standards agreement” also established a timeline for regular review and update of the standards through the year 2007. These standards were enshrined in law in the National Appliance Energy Conservation Act (NAECA) of 1987, which covered 13 classes of residential products. Lamp ballasts were added to this list in a 1988 amendment to NAECA. An additional 12 categories of products, mostly commercial and industrial, were included in the Energy Policy Act (EPAct) passed by the Bush Administration in 1992. The two acts now mandate minimum efficiency levels for products that represent 96% of energy use in the residential sector, 70% in the commercial sector, and 20% in the industrial sector (Duffy 1995).

A sea change in the standards program occurred in 1995, after the 1994 election of a Republican majority in Congress. During 1994, the Department of Energy had submitted advance notices of proposed efficiency standards for eight products, including new or stronger standards for water heaters, fluorescent lamp ballasts, room air conditioners, kitchen ranges and ovens, microwave ovens and televisions. Several of these advance notices described proposed standards that were controversial, including one that would have essentially eliminated electric resistance water heaters and instead required electric heat pump water heaters. Another proposed standard would have banned magnetic ballasts in favor of more energy-efficient, and higher-first-cost, electronic ballasts. Unlike previous

standards, which had proposed incremental changes in products, these two proposed standards would have banned whole classes of products and resulted directly in layoffs and the closure of manufacturing facilities (Duffy 1995).

Table Appendix A -4. Timeline of Progress and Milestones in Development of U.S. Appliance Efficiency Standards. (Adapted from Nadel (1996).)

1964	Warren Alquist Act established the California Energy Commission, with the authority to set appliance efficiency standards.
1975	The Federal Energy Administration chose voluntary appliance efficiency standards, with an average 20% reduction. These were formalized in the Energy Policy and Conservation Act of 1975.
1978	National Energy Conservation and Policy Act gave Department of Energy (DOE) preemptive power over state efficiency standards.
1983	DOE published “no standard standards,” arguing that large savings would occur due to market forces.
1984	California adopted two-tiered standards for refrigerator and central air conditioners.
1986	Joining California, five other states (AZ, FL, KS, MA, and NY) had developed some appliance standards by this year.
1986	Appliance manufacturers reached agreement with Natural Resources Defense Council and other efficiency and consumer advocates to adopt regulations setting efficiency levels for standards and establish a schedule of DOE rulemakings until the year 2007 to consider strengthening the standards.
1987	National Appliance Energy Conservation Act (NAECA) passed, covering 13 classes of residential products.
1988	Amendments to NAECA passed, covering lamp ballasts.
1992	Energy Policy Act (EPAct) passed covering water efficiency standards as well as standards for commercial and industrial equipment.
1995	Newly elected Congress proposes (and eventually passes) moratorium on issuance of new efficiency standards through FY 1996.
1996	DOE revises its standards-setting process to include solicitation of stakeholder involvement earlier and more often
1997	Setting and updating of new efficiency standards resumes with a new standard for refrigerators, which will take effect in July 2001.

Alarmed by the proposed standards described in these advance notices, Rep. Mike Parker (D-Miss.) proposed legislation in early 1995 to place a moratorium on the setting by DOE of all new efficiency standards for one year. Rep. Parker was responding to the concerns of his constituents, since his district is home to a plant that manufactures magnetic ballasts and employs 1,300 people. Rep. Olver (D-Mass.) proposed an alternative amendment that would have directed DOE to repeal and reconsider the proposed ballast amendment. By this time, however, the momentum against standards was growing and was wrapped up in the Republican efforts to reform government and reduce regulations. The moratorium eventually was passed in early 1996 and was in effect through the end of the fiscal year, when it was lifted.

The Congressional debate over standards in 1995 and 1996 illustrates several key points. First, the opponents of standards, who were upset by some of DOE’s proposed standards, used them as a rationale

for putting the entire U.S. appliance efficiency program on hold. Instead of discussing alternative amendments such as the Olver amendment, or efforts to improve the regulatory process, they pushed for legislation to curtail the standards program for at least a year. This moratorium even affected a proposed new standard for refrigerators, which had been agreed upon in late 1994 in a consensus between efficiency advocates and the manufacturers of the products affected by the standards. In effect, the opponents of standards appeared ready to seize on some exceptionally strict proposed standards by DOE and use them as justification for scrapping the entire appliance standards process. By doing so, they were ignoring the evidence of the economic, energy, and environmental benefits of standards (discussed below), and the fact that most of the proposed standards had been agreed to in a collaborative process that included the manufacturers themselves.

Another lesson of this experience is that the U.S. Department of Energy, in its zeal to pass regulations with significant energy benefits, did not adequately consult with affected parties (sometimes called stakeholders). As a response to the Congressional backlash, DOE convened a public workshop on its standards-setting process in early 1996 and has since implemented changes to its procedures. Some of the changes are described by Turiel (1996). Essentially, under the old procedure, the Department of Energy would issue an Advance Notice of Proposed Ruling (ANOPR), which would be followed by a 75-day period for comments. Then DOE's contractors would spend anywhere from one to three-and-a-half years conducting an analysis of the standards before a Notice of Proposed Ruling (NOPR) was issued by DOE. While the NOPR was being prepared, there would be no opportunity for stakeholders to have input into the process.

The new approach is called the *hybrid consensus approach* by Turiel (1996) because it is a hybrid between a *pure consensus approach* and a more formal *statistical and engineering analysis* in the rulemaking. Under the new approach, there is ongoing consultation between stakeholders (manufacturers, public interest groups) and the DOE contractors who are conducting the analysis. The DOE contractors share analytical models and tools with the manufacturers, and are able to have input and make suggestions for changes. According to one analyst involved in the process, it helps the parties quickly come to agreement on many of the factors in the analysis and to develop a common base of agreement about much of the data. Instead of focusing on their negotiating positions, as was the case in the past, the parties wind up being focused on, and engaged in, the analysis (McMahon 1997). This "hybrid consensus" approach was used to develop the first set of minimum efficiency standards issued after the end of the 1996 moratorium on standards: these were updated minimum efficiency standards for U.S. refrigerators, which will take effect in 2001.

Effectiveness of Standards

Overall, standards has been one of the most effective U.S. energy conservation programs to date in terms of both its benefit-cost ratio and the amount of energy saved (see Table Appendix A -5). The projected benefit-cost ratios for these standards range from 2.4 to 4.3, and the average for all of the standards promulgated will be an estimated 3.2 – that is the benefits in terms of cumulative saved energy (consumer dollar savings on their utility bills over the life of the products) will be more than three times the costs (projected increases in first cost of the more efficient products).

To date, it is estimated that appliance and lighting standards have saved more than 3% of US annual residential energy consumption, and that consumers will receive \$3.2 in reduced operating costs for every extra dollar they pay on the higher first price of the efficient appliances. (McMahon 1996).

At the end-use level, the magnitude of the impact of the NAECA standards, which began to take effect in 1990, can be viewed by comparing the average energy use of the stock of appliances in 1990

with the average of new units in 1994 (see Table Appendix A -6). The most dramatic savings (in the range of 50%) occurred for refrigerators and freezers, which had to meet new standards in 1990 and 1993. Smaller, but substantial improvements were made for all other products in the table. This would save \$200 in energy bills for a hypothetical family that replaced all of its pre-1990 appliances with appliances of a 1994 or later vintage (McMahon 1996:160-161).

Table Appendix A -5. Summary of Savings and Cost Effectiveness of U.S. Minimum Efficiency Standards. (Source: Geller 1995 in Nadel and Goldstein 1996)

Standard	Electricity Saved (TWh/year)		Peak Capacity Saved (GW)		Primary Energy Saved (Quads/year)		Cost	Gross Benefit	Benefit Cost Ratio
	2000	2015	2000	2015	2000	2015	(billions 1990\$)		
NAECA	8	43	1.4	15.7	0.21	0.58	28.3	67.9	2.4
Ballasts	18	24	5.7	7.5	0.21	0.28	2.7	10.3	3.8
NAECA updates	20	39	3.6	7.3	0.23	0.45	6.0	19.0	3.2
EPAAct lamps	35	90	7.0	18.0	0.40	1.04	17.0	73.0	4.3
EPAAct other	7	26	3.1	9.5	0.19	0.55	5.0	21.0	4.2
Total	88	222	20.8	58.0	1.24	2.90	59.0	191.2	3.2

Refrigerators exemplify the impact of a high-level standard. The 1993 efficiency standard was so aggressive that in 1990 when the standard was announced, none of the models available in 1990 — all of which met the current 1990 efficiency standard — met the 1993 standard⁷ (Turiel 1991).

Table Appendix A -6. Appliance Energy Usage and Cost Comparison, 1990 and 1994. (Source: McMahon 1995)

Appliance	1990 stock avg. annual energy use (kWh)	1994 new unit avg. annual energy use (kWh)	% decrease in energy use
Refrigerator-freezer	1,220	670	45.1
Freezer	1,010	500	50.4
Clothes washer	890	670	24.7
Clothes dryer (electric)	930	830	10.8
Dishwasher	620	500	10.4
Room air conditioner	970	830	14.4
Gas water heater	300 therms	270 therms	10.0
Gas furnace	610 therms	530 therms	13.1
Total annual energy use	5,640 kWh	4,000 kWh	29.1
	910 therms	800 therms	12.1
Total annual costs	\$1,090	\$880	19.3

⁷ The authors compared models listed in the 1990 AHAM directory with the minimum efficiency levels established for the 1993 standard.

Impact of Standards on Appliance Price

The premise of minimum efficiency standards is that more efficient models will cost more to manufacture, and that these costs will be passed on to the consumer through higher prices. This argument has often been used against standards by its opponents, who complain that standards reduce consumer choice by forcing consumers to pay more for higher-priced units. DOE justifies each proposed standard by estimating a benefit/cost ratio for that standard, which is essentially the net present value of the benefits (in terms of reduced appliance energy bills over the lifetime of the appliance) divided by the net present value of the costs (the increased purchase price of the more efficient appliances).

To date, the data do not appear to show any significant increase in appliance prices due to either the state efficiency standards set in the early 1980s, or the federal appliance efficiency standards that took effect in 1990 and 1993.

Table Appendix A -7 compares consumer prices for refrigerators, freezers, and laundry appliances with the overall consumer price index and prices for other consumer goods and services over the past decade. Clearly, the price of these home appliances has increased at a much slower rate.

Table Appendix A -7. Percentage Increases in Consumer Price Index and Other Products and Services. (Source: AHAM Fact Book 1996)

	% increase from 1982-4 to 1995
College tuition	164.8
Public transportation	75.9
Rent, residential	57.8
All items (Consumer Price Index)	52.4
Food at home	48.8
Laundry equipment	9.6
Refrigerators and freezers	8.0

Greening et al (1996) conducted a longitudinal study of refrigerator prices by comparing data on refrigerator prices for 10 months during 1987-88 with prices for 12 months each in 1990 and 1993. They collected data from several types of retailers, including traditional retail stores, department stores, and warehouse discount outlets. They found that for all refrigerators, current prices increased just 1.4% to 1.5% per year (less than the consumer price index) for the period 1987-88 through 1993. They also found that the coefficients for annual energy use had little impact on the basic price of the unit (i.e. they found no evidence that more efficient units tended to be significantly more expensive to purchase). In addition they found that during this period, while real prices did not increase, the basic amenities offered in refrigerators often increased. They thus postulate that the standards may have resulted in a "social surplus," since newer models of refrigerators provide greater amenity at essentially the same first cost (Greening et al. 196: 107).

Standards, DSM, and Market Transformation

Several U.S. analysts agree that the large increases in appliance efficiency over the past two decades have been primarily due to minimum efficiency standards passed by first states and then the federal government (e.g., Geller 1994; Turiel 1996; Nadel 1996). Turiel asserts that technology development and standards have been more important than labeling in driving increases in appliance efficiency. Nadel and Goldstein note that since 1993, when the last refrigerator efficiency standards went into effect, there has been little or no gain in refrigerator efficiency.

In their review of a range of different “market transformation” policies, Geller and Nadel state that a second factor driving efficiency improvements was the implementation by utilities of refrigerator rebate programs. In 1992, for example, 28 U.S. utilities were offering consumer rebates for the purchase of high-efficiency models. Rebate programs were often linked to the U.S. national standards, and were awarded for refrigerators that exceeded the standards by a certain amount; for example, an analysis of sales data showed that the efficiency levels of top-mounted refrigerators were “clustered” at levels that were 10%, 25%, 20%, and 25% better than the national standards, levels which coincided with the rebate guidelines set by utility DSM programs (Morrill 1993).

Standards are also expected to play a major role in limiting growth in residential demand in the future. Between 1970 and 1990, growth in electricity sales in the U.S. residential sector averaged about 23 billion kWh/year, or about 35% of the total increase in U.S. electrical demand. The rate of demand increase in the residential sector is expected to fall dramatically for the period 1990 to 2010, to just 13 billion kWh/year (Rohmund et al. 1994). This is equivalent to an annual demand growth rate of 1.2% per year.

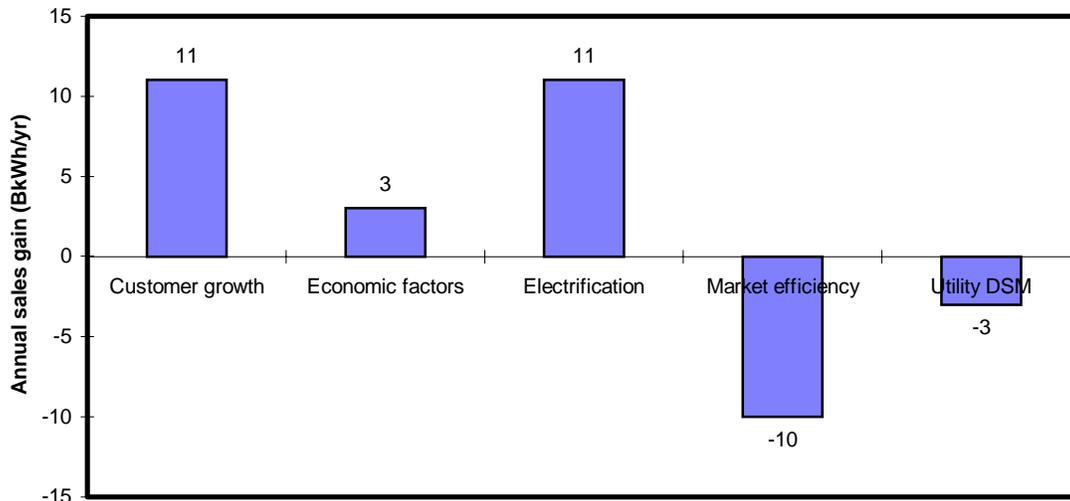


Figure Appendix A .5. Projected Impact of Factors on Growth in U.S. Residential Electricity Sales, 1990-2010 (Rohmund et al. 1994)

Figure Appendix A .5 shows the forces driving, and slowing, electrical load growth. The factors projected to drive demand are customer growth, electrification, and economic factors. These are partially offset by increases in “market efficiency” and utility demand-side management. They estimate that about

10 billion kWh/year will be saved through continuation of manufacturing improvements and due to federal minimum efficiency standards. These factors are termed “market efficiency.” Another 3 billion kWh/year, or about 22% of total savings, will come through utility DSM programs. It should also be noted that these estimates were made in the early 1990s, before the deregulation and restructuring of the electric utility industry, so they do not completely take into account the possible reduction in utility DSM expenditures and effectiveness. This analysis supports the view that minimum efficiency standards will be a major driver of residential efficiency improvements. DSM will play a significant but probably declining role. Without better data on the impact of appliance energy labels, it is impossible to judge what their past or future impact will be in the U.S.; but this impact is likely to be orders of magnitude smaller than the impact of appliance efficiency standards.

Conclusions

The two main national policies enacted to stimulate increases in U.S. appliance efficiency have been the appliance labeling legislation enacted in the late 1970s, and federal minimum efficiency standards for appliances, enacted in the late 1980s.

The National Energy Policy and Conservation Act of 1978 requires the Federal Trade Commission to mandate labels for appliances indicating their energy consumption. In November 1979, the FTC promulgated a regulation requiring the manufacturers of seven major home appliances to place energy labels on their appliances. The EnergyGuide labels began appearing on appliances in stores in mid-1980. Although the EnergyGuide labeling program has been a central element of U.S. appliance efficiency policy, there has been no comprehensive study to demonstrate the labels’ effectiveness. The most recent national evaluation of the label’s effectiveness was published in 1986 and based on 1983 data. This study, which found that about one-third of refrigerator buyers said that the label affected their buying decision, but no effort to quantify the label’s impact. Since this study was published, several studies have shown that the label is difficult for consumers to understand and is not an effective vehicle for stimulating consumer interest in energy efficiency.

The vast majority of appliance efficiency gains in the U.S. have been due to national minimum efficiency standards, which were passed into law in 1987 and took effect in 1990. A new refrigerator purchased in 1994 would save 50% compared to the average refrigerator in U.S. homes in 1990. To date, appliance and lighting standards have saved more than 3% of U.S. annual residential energy consumption. These gains have been made without an increase in the first cost of appliances. There has been no significant increase in appliance prices due to either the state appliance efficiency standards set in the early 1980s, or the federal appliance efficiency standards that took effect in 1990 and 1993.

U.S. analysts project that customer growth and electrification will result in an increase in demand of about 25 billion kWh annually in the U.S. residential sector during the period 1990 to 2010. At the same time, there will be an annual savings of 13 billion kWh during this period, for a net increase of just 12 billion kWh/year in sales. Most of these savings (about 78%) will be due to “market efficiency” — the continuation of manufacturing improvements as well as national minimum efficiency standards. The rest of the savings will come through utility DSM programs. It should also be noted that these estimates were made in the early 1990s, before the deregulation and restructuring of the U.S. electric utility industry, so they do not completely take into account the possible reduction in utility DSM expenditures and effectiveness. It thus appears that minimum efficiency standards will continue to be the major driver of residential efficiency improvements. DSM will thus likely play a significant but declining role. Energy labeling can play an important role in reducing energy demand, but there are no data on the energy

impact of the U.S. appliance energy labels; in any event, it is likely that the impact of the labels will be orders of magnitude smaller than the impact of appliance efficiency standards.

APPENDIX B

STATUS OF APPLIANCE EFFICIENCY POLICY IN THAILAND

Growth in Electrical Demand

Figure 0.1 shows the historic and projected growth needed in electricity generation in Thailand. The annual rate of increase in generating capacity is expected to slow, from ~12% in the late 1980s and early 1990s to ~7% in the coming decade. Nonetheless, the figure demonstrates that, although the rate of increase in power demand is slowing, the amount of new generating capacity needed each year will increase sharply, from an average of ~900 MW per year during 1987-1996 to an average of ~1,600 MW per year for the period 1997-2011 (TLFS 1996).

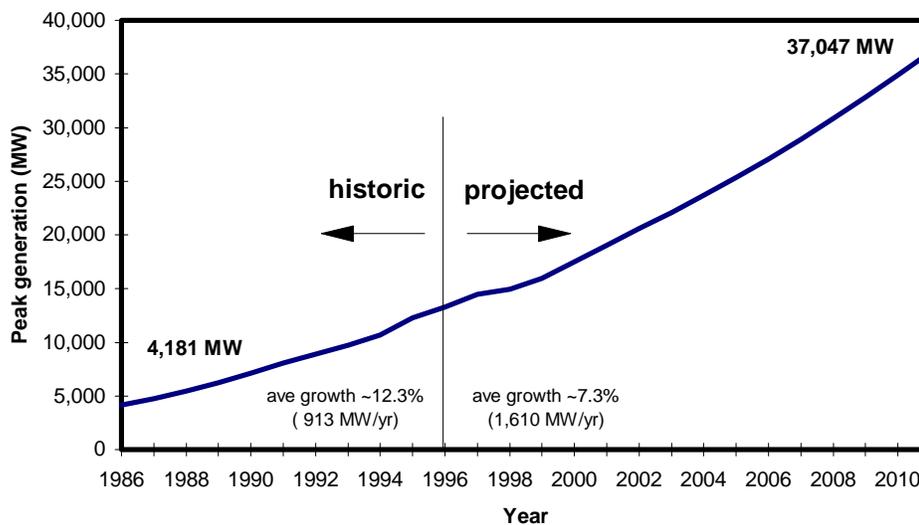


Figure 0.1. Historical and Forecast Generation Requirements for Thailand. In light of the recent economic slowdown, this is the most realistic available forecast of electric demand growth. It is based on the “very low-case scenario” in the 1996 Thai load forecast (TLFS 1996).

The capital requirements of this expansion will be huge – 192.5 billion baht (US\$7.7 billion) for the period 1992-1996 and an expected 253.5 billion baht (US\$10.1 billion) for the period 1997-2001.¹ The cost of this capital expansion will be exacerbated by the fact that roughly half of the capital will come in

¹ Here I have used a conversion rate of B25/US\$, since roughly half of this projected amount will be in foreign currency and since these estimates were made by EGAT in 1995, using a conversion rate of B25/US\$, before the mid-1997 devaluation of the baht.

loans in foreign currency. A complicating factor is the mid-1997 devaluation of the Thai baht, after which the value slid by 40%, from 25 baht/US\$ to as low as ~50 baht/US\$ in late 1997. Energy demand also grew more slowly than forecast in 1997 and forecasts have been reduced to reflected lower-than-expected economic growth.²

The growth in Thai power generation will have significant environmental impacts, both for Thailand and for the region. Most of the new capacity being added to Thailand’s power grid will be lignite- and coal-fired generation, and the power system will become dependent on these fuels. Lignite and coal are “dirty” fuels that produce more pollutants than other fossil fuels per unit of energy produced — e.g., the sulfur and nitrogen oxides that cause acid precipitation, and increased amounts of carbon dioxide, which contributes to global warming. In 1995, the primary fuel for Thailand’s power plants was natural gas, which supplied 43% of electricity production; lignite provided just 19%; and coal was not yet being used. By 2001, lignite and coal (which will be imported as domestic lignite reserves are depleted) will be the largest source of electricity, supplying 58% of electricity production, followed by natural gas at just 23%.

Figure 0.2 compares the forecasts of electricity demand from the different sectors. The industrial sector will continue to account for the largest share, at roughly 40% of total demand. The share of the commercial sector increased from 20% in the early 1980s to its current share of 24%, where it is expected to remain. The residential sector is expected to grow by 7-8% annually and to account for a constant one-fifth (18-19%) of total electricity demand.

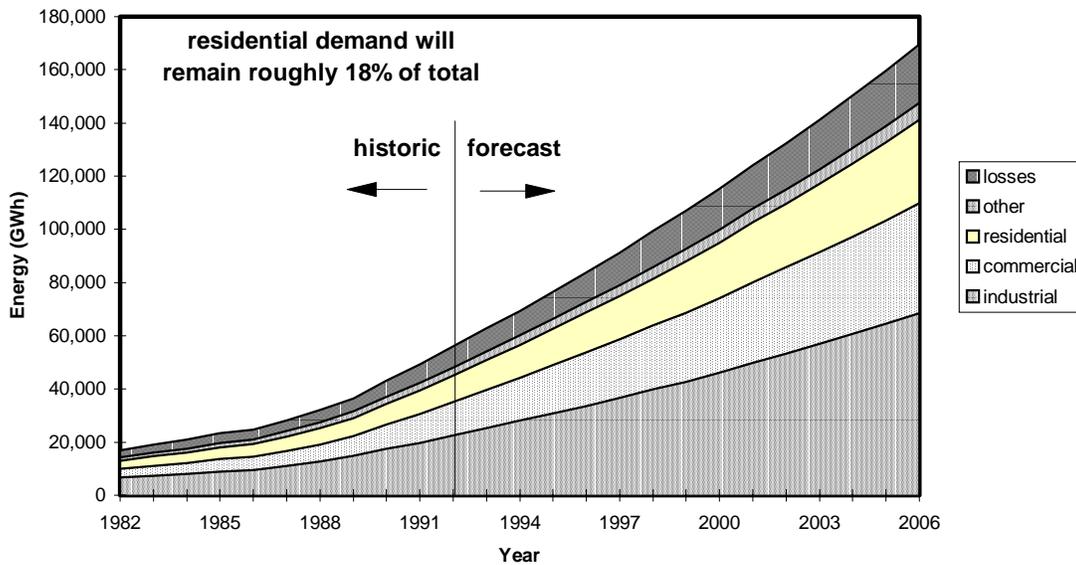


Figure 0.2. Thailand Electricity Generation Requirements by Sector. Based on latest available end-use data, in the 1993 Thailand load forecast (TLFS 1993).

² Thailand’s Peak demand increased 8.99% in 1997, to 14,506 MW. This is 1.98% lower than base demand projected by EGAT. Total electricity generation rose 7.91%, or 4.41 % below the base forecast (Kositchothethana 1998).

The increasing demand for electricity in the Thai residential sector will be fueled by rapid appliance uptake, as the growing middle class purchases, often for the first time, a range of household appliances including refrigerators, air conditioners, rice cookers, and color televisions. As Figure 0.3 demonstrates, the great majority of growth will be driven by “upcountry” consumers who live outside of the Thai capital.

The largest driver of residential demand will be air conditioning, due to Thailand’s tropical climate and the fact that most new Thai housing, especially in urban areas, is not designed to promote passive cooling or natural ventilation and is not insulated. By 2005, air conditioning is expected to account for 29% of residential demand, followed by rice cookers (20%) and refrigerators (17%). Figure 0.4 shows the forecast of residential demand by end use.

The amount of energy consumed by residential air conditioners is expected to rise by 10.7% annually; table fans by 8.4%; and color televisions by 8%. Energy used by refrigerators, which along with air conditioners are the largest residential end use, will grow at a slower pace of 5.5% annually.

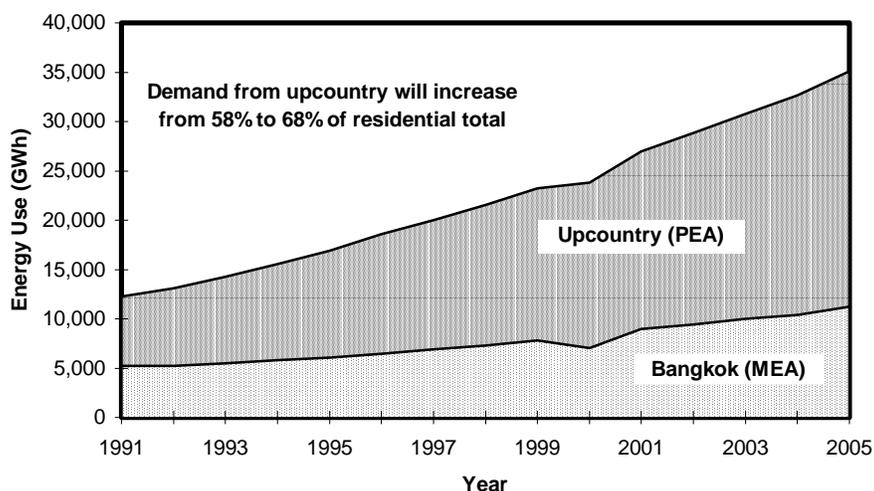


Figure 0.3. Forecast of Thailand Residential Electricity Demand. The great majority of demand growth will come from “upcountry” customers outside of Bangkok (TLFS 1993).

Trends in Efficiency

The Lack of High-Quality Market Information

As is the case in many developing countries, the analysis of the potential for energy-efficiency improvements in Thailand is hampered by the lack of available market data in general, and in particular by the lack of baseline data on factors such as production levels, shipment-weighted averages, and efficiency levels. In the U.S., the Association of Home Appliance Manufacturers (AHAM) is the trade association for manufacturers of home appliances. AHAM dates back to 1915, and it was established in its present form in 1967 as a non-profit trade association to bring together manufacturers from similar businesses. AHAM collects, analyzes and disseminates data on appliance sales, usage, and efficiency trends. While manufacturer associations exist in Thailand (e.g. there are separate associations for manufacturers of air conditioners and lighting equipment), there is no clearinghouse for gathering and disseminating information on trends in appliance sales and efficiency.

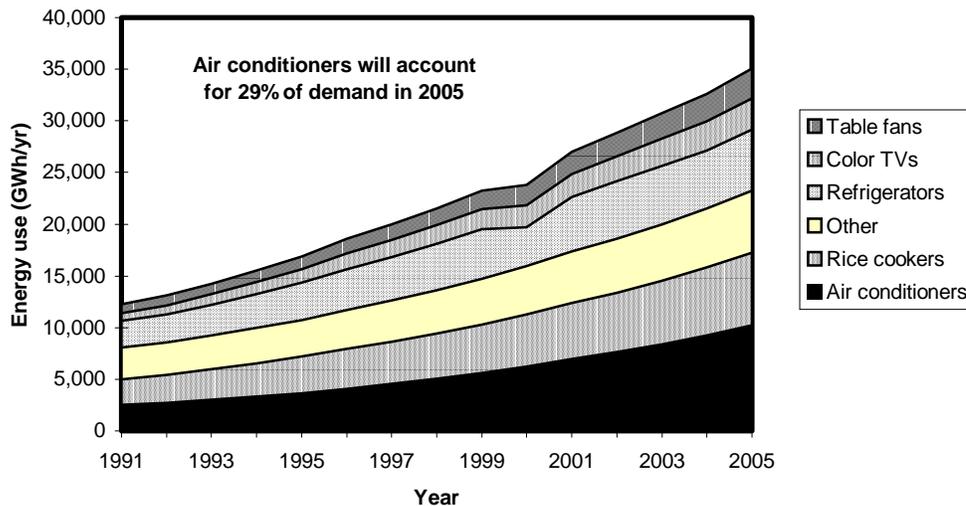


Figure 0.4. Forecast of Thailand Residential Electricity Demand by End Use. The end uses driving demand will be air conditioners (29% of demand in 2005), rice cookers (20%), and refrigerators (17%). Data from the most recent end-use forecast (TLFS 1993).

An example can be used to illustrate the difficulty of collecting up-to-date and accurate information on appliance production and efficiency in Thailand. In 1992, a team of consultants for the World Bank, of which this author was a member, was conducting a pre-investment appraisal for a grant to Thailand's demand-side management program (World Bank 1993). The consultants requested data on efficiency levels of air conditioners from tests conducted by the Department of Energy Development and Promotion (DEDP). The division manager at DEDP refused to share the data with the consulting team, even after the head of the team explained that the data were necessary in order to establish a baseline efficiency level for air conditioners and to estimate potential DSM program savings. The division manager said that he had signed agreements with the manufacturers stipulating that none of the data would be released. Despite pleas by this author and by the project manager of the consulting team that we wanted just data on the size and efficiency of units, and did not care about the name of the manufacturer, the division manager refused to release an edited version of the test results. Eventually, a senior government official had to call DEDP to pressure the division manager to release the data to the consulting team. The data sent by DEDP included just the size and efficiency of the models tested -- the manufacturers names had been erased using "white-out" correction fluid.

In Thailand, the collection of high-quality market information is the exception rather than the rule. Much of this stems from manufacturers' reluctance to disclose actual production data for tax reasons. The consulting team mentioned above collected information on a variety of end-use products for a voluminous assessment of the potential savings of the Thai DSM program. This was published in a 400-page technical annex in early 1993 (World Bank 1993). In early 1997, when I returned to Thailand to gather data for my dissertation, I learned that the data from this 1993 report was still serving as "the Bible" of the Thai DSM Office, and that no more comprehensive information on market characteristics and efficiency levels had been collected in the intervening four years -- largely because of manufacturer reluctance to share information on production and sales. A foreign consultant whom I interviewed

lamented the fact that EGAT’s DSM Office, as part of the conditions for its agreements with manufacturers, did not require manufacturers to share the sales weighted data on unit capacity and efficiency levels (Thai policymaker interview no. 11). The lack of such data makes it extremely difficult to estimate potential program savings or to evaluate the impact of programs once they are completed.

Forecasts of Appliance Efficiency

While the efficiencies of the current stock of appliances are difficult to estimate, it is even more difficult to forecast future trends in Thai appliance efficiency. During the final stages of the 1993 load forecast exercise, the Load Forecast Subcommittee decided to interview appliance manufacturers to assess what product improvements they foresaw as part of their normal product development and improvement cycle. Based on these interviews, the subcommittee increased its estimates of the potential for future efficiency improvements in the stock of some appliances, thus shaving nearly 10% off the projected national electricity demand in the year 2006. Figure 0.5 shows forecast improvements in just three residential end-use technologies – refrigerators, air conditioners, and fluorescent lamps. The forecast of 15-year efficiency improvements range from 23% for air conditioners to 37% for refrigerators. By way of comparison, 15-year efficiency improvements in the U.S. from 1980-1995 (which were largely driven by minimum national efficiency standards) were 28% for air conditioners, and 101% for refrigerators.

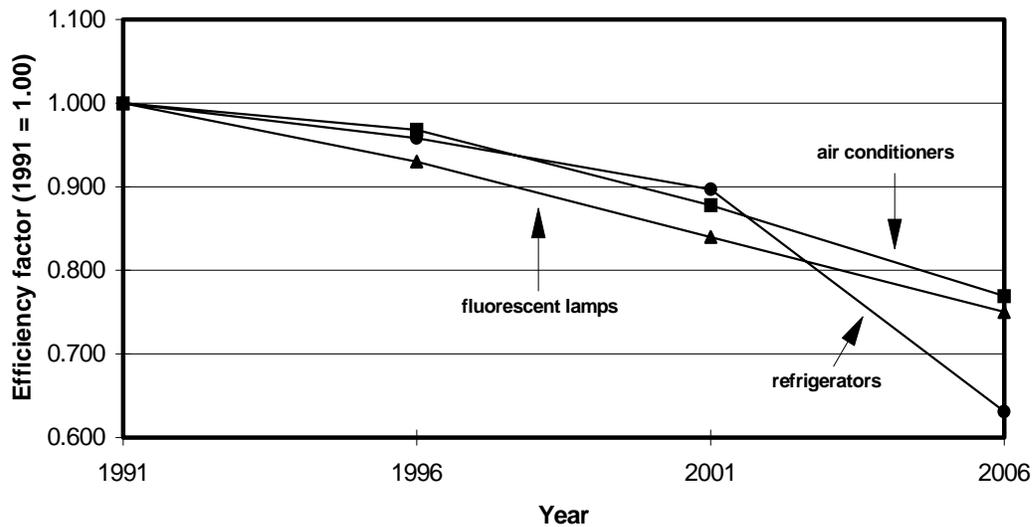


Figure 0.5. Forecast of Efficiency Trends for Thai Appliances, Upcountry. The forecasts are for “upcountry” Thailand – all of Thailand outside of Bangkok – and are based on interviews with Thai manufacturers by the Thai Load Forecast Subcommittee (TLFS 1993).

These forecast of future efficiency improvements manufacturers’ estimates and do not take into account large, additional efficiency improvements expected to be achieved through Thailand’s two major

appliance efficiency programs -- the demand-side management program and the Energy Conservation Promotion Fund and Act. These policy initiatives are described in the following section.

Thailand's Energy Policy Framework

Background

Thai energy policy is directed by a cabinet level agency, the National Energy Policy Council (see Figure 0.6). Transportation is the largest source of final energy consumption (37%), followed by the industrial sector (30%) and the residential and commercial sectors (29%). Thailand's energy-efficiency policies have focused on energy use in homes, buildings, and factories. Most of this effort has been directed at increasing the end-use efficiency of electricity.

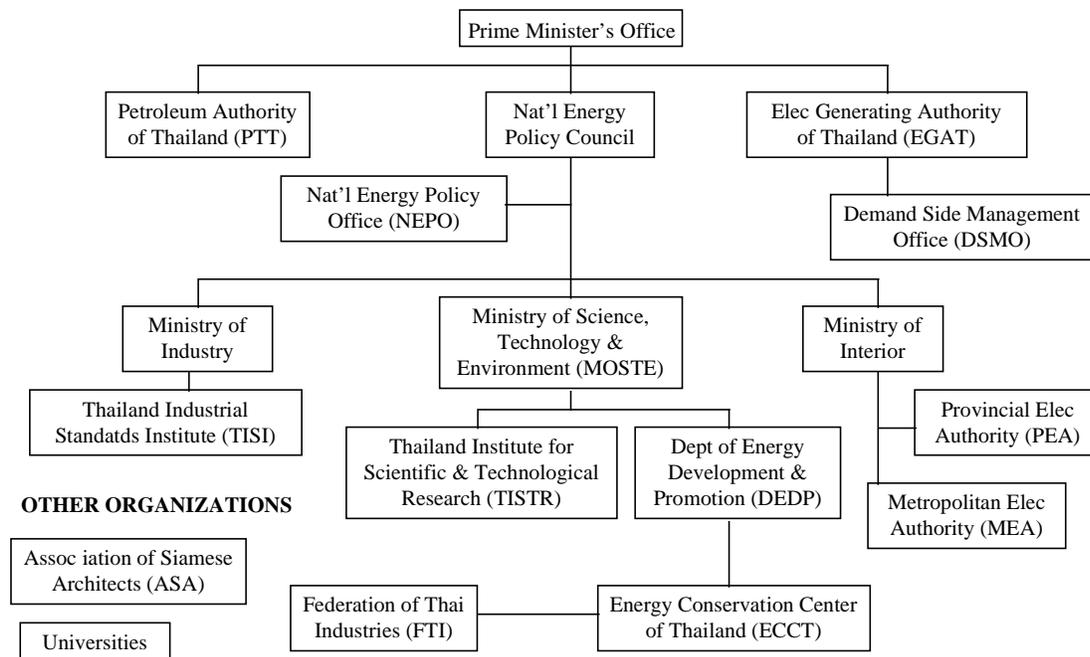


Figure 0.6. Thai Energy Organizations. The Thai policymakers whom I interviewed as part of this research work in the National Energy Policy Office, EGAT's DSM Office, the Department of Energy Development and Promotion, the Energy Conservation Center of Thailand, a university, and a consulting firm that provides input to senior-level policy committees.

In 1991, Thailand became the first Asian country to formally approve a countrywide demand-side management (DSM) plan (Cherniack and du Pont 1991). The Thai DSM programs got under way in late 1993, and the office implementing the programs now has a staff of 260³ who are developing and

³ This comprises 160 permanent EGAT employees and 100 staff hired on a temporary basis (Ratanopas 1997).

implementing residential, commercial, and industrial energy-efficiency programs. Beginning in 1992, Thailand also initiated a national energy conservation law (the Energy Conservation and Promotion Act), supplemented by a ~US\$80 million annual fund (the Energy Conservation and Promotion Fund) to finance investments in energy efficiency throughout the economy.

The DSM Office, which is operated by a state enterprise, the Electricity Generating Authority of Thailand, is currently the main policy driver for increasing the efficiency of household appliances, through its voluntary labeling programs for refrigerators and air conditioners. However, the energy conservation law gave the Thai government the authority to implement minimum efficiency standards for appliances and equipment, and the government is now commissioning an action plan for such standards. Below, I provide a brief overview of these two major programs. In Chapter 5 I report on the results of my semi-structured interviews with 11 Thai policymakers responsible for developing and implementing Thailand's the programs.

Thailand's DSM Program

Background

In 1989, the National Energy Administration (now called the Department of Energy Development and Promotion) completed a comprehensive plan for end-use electricity efficiency improvements in Thailand. (NEA 1989) The plan identified 600 MW of savings, to be achieved through a combination of government and private-sector investment. While this plan generated widespread interest and discussion of energy efficiency in the Thai media, it was never implemented because the government did not allocate adequate funding.

Also during 1989, the International Institute for Energy Conservation, a U.S. based non-profit organization, established an office in Bangkok and began to work with Thai government agencies and electric utilities to support their efforts to gather information on energy-efficiency technologies and programs in other countries. IIEC organized a two-week study tour of demand-side management (DSM) programs at a number of leading U.S. electric utilities. The study tour convinced senior Thai managers and executives in state energy agencies and electric utilities that DSM was a concept that could work in the Thai context.

The study tour helped spur a 1990 directive by the National Energy Policy Committee (now Council) to the three state-owned electric utilities to develop a DSM Master Plan by mid-1991. Thailand has a state-owned generating utility, the Electricity Generating Authority of Thailand (EGAT), and two state-run distribution utilities, the Metropolitan and Provincial Electricity Authorities (MEA and PEA). With assistance from IIEC, the three utilities developed and submitted a five-year DSM master plan, which was approved by the government in November 1991 (Cherniack and du Pont 1991). Thailand thus became the first Asian country to approve and implement a nationwide, comprehensive demand-side management (DSM) program.

Table 0.1. Summary of Thai DSM Programs and Savings Targets for 1998

Program	Start Date	Description	Peak MW Savings Target	Energy Savings Target	Achieved Through May 1997
Cross-Sectoral Programs					
Thin-tube (T8) Lighting	9/93	Voluntary shift to production of 36W and 18W Lamps	139 MW	759 GWh/yr	106 MW
Low-loss ballasts ^a	1996	Mass procurement of low-loss (<6W) magnetic ballasts to support the Green Buildings program	na	na	na
Residential Programs					
Refrigerators	9/94	Voluntary testing and labeling	27 MW	186 GWh/yr	31 MW
Air conditioners ^b	9/95	Voluntary testing and labeling	22 MW	117 GWh/yr	28 MW
Compact Fluorescent lamps ^c	1996	1.5 million lamps offered at reduced prices through mass procurement	na	na	na
Low-income lighting	1996	Direct replacement at no cost to customer	na	na	na
Commercial Programs					
Green Buildings	9/95	Zero-interest financing of energy-efficient equipment. Paid back over 3-5 years.	20 MW	140 GWh/yr	0 MW
Thermal Storage	1997		na	na	na
Industrial Programs					
Motor systems	3/96	Zero-interest financing of energy-efficient motors. Motor efficiency testing lab and motor rewinding efficiency program.	30 MW	225 GWh/yr	0.2 MW
Industrial ESCO	1997	Pilot program to develop turn-key energy services for industry.	na	na	na
Load Control Program					
Direct load control	1997	Direct load control and standby generator operation.	na	na	na
TOTAL (1993-1998)			238 MW	1,427 GWh/yr	165 MW

Source: Adapted from EGAT (1997A) and World Bank (1996)

na = estimate not available

Notes: The DSM Office expects that by the end of 1998 it will easily exceed the target reduction of 238 peak MW and 1.16 million tonnes of avoided CO₂ emissions (Ratanopas 1997).

This DSM Master Plan called for a total five-year investment of US\$189 million to achieve a peak demand reduction of 238 MW and energy savings of 1,427 GWh/yr at a cost of saved energy less than half of the utilities' long-run marginal cost of production. In recognition of the unique potential of the Thai DSM effort to serve as a model for energy conservation and greenhouse gas emissions reduction efforts in other developing countries, the Global Environment Facility in 1993 approved a US\$15.5

million grant to the Thai government to assist the DSM effort.⁴ The balance of the US\$189 investment was funded by Thailand through a fuel adjustment mechanism in the Thai electricity tariff.

Table 0.1 shows the program descriptions and current savings targets for the Thai DSM effort. The average cost of the Thai DSM programs will be an estimated US\$0.017/kWh, compared to the utility's long-run marginal cost of US\$0.050/kWh (Biysem 1997). Figure 0.7 demonstrates that the projected savings will offset a small but growing fraction of projected future demand – ~9% of total demand by the year 2011. Yet the budget for power plant construction still dwarfs the DSM budget: the US\$7.7 billion that EGAT invested in power plant construction during 1992-1996 represents more than 40 times the budget for the DSM Master Plan (1993-1998).

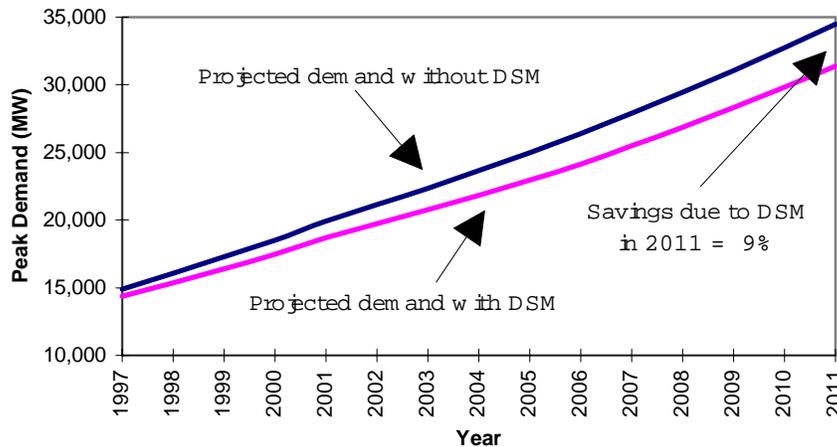


Figure 0.7. Projected Impact of DSM on Thailand's Peak Electricity Demand. (Source: World Bank 1996)

Shift in Focus: Voluntary Agreements

The original DSM Master Plan called for a broad range of programs that were based largely on DSM experience in North America, and relied on a combination of incentives and program marketing to spur a shift toward more energy-efficient products and services.⁵ As actually implemented since 1993, the Thai approach to DSM has been to seek voluntary agreements with manufacturers and to supplement these agreements with nationwide advertising campaigns and interest-free loans for customers where necessary.

Fluorescent Lamps: "Washing" the Local Market. In 1993, when the DSM Office began the detailed design of its first DSM program, the Thai managers felt uncomfortable with the Western model of

⁴ This amount included a \$6 million grant from the Australian government.

⁵ The Thai DSM Master Plan relied on a combination of customer rebates and incentives for manufacturers. The majority of the DSM programs implemented in North America during the 1980s provided rebates to the consumer or end user and not to the manufacturer.

rebates and incentives. They felt that incentive-based and rebate programs would not make a lasting impact on Thai consumer behavior and instead preferred voluntary agreements with manufacturers in combination with a nationwide advertising campaign to raise consumer awareness (Ratanopas 1996, 1997, Thai policymaker interview no. 4).

The Thai DSM managers approached the five manufacturers of fluorescent tube lamps and asked them to shift from production of T-12 (“fat tube”) fluorescent lamps to T-8 (“thin tube”) lamps, which require about 10% less energy input to emit an equivalent amount of light. To get the manufacturers on board, EGAT offered to promote the new energy-saving lamps via a nationwide, US\$8 million advertising campaign. The manufacturers agreed, and by early-1995, nearly a year ahead of schedule, all of them had shifted to production of “thin” tubes. Managers in the Thai DSM Office refer to this program with a Thai phrase that means “market washing.”

The lighting program best represents the spirit of the Thai DSM philosophy. EGAT plans by the end of 1998 to reduce peak demand due to lighting by 139 MW at a total cost of \$8 million. At just \$50 per peak kW, this is an order of magnitude below the typical avoided costs for most demand-side management programs and two to three orders of magnitude below EGAT’s long-run marginal cost. What makes the Thai programs different is that they are attempting to adapt an overall program, which was originally based on a combination of rebates, financial incentives, program marketing, and education, and achieve the same goals without most of the financial incentives.⁶ The EGAT approach is similar in many respects to other market transformation programs recently undertaken in Sweden and the U.S., which rely largely on public-private partnerships that develop incentives (e.g., the marketing associated with a national program, or a pool of guaranteed buyers) for manufacturers to produce, and buyers to purchase, high-efficiency equipment (Nilsson 1992, Kwartin 1992, Granda et al. 1994, Goldstein 1994).

Testing and Labeling Programs

Refrigerators. In early 1994, EGAT approached the five manufacturers of household refrigerators and quickly gained their cooperation for a voluntary energy labeling program for the largest category of Thai refrigerators, which range in size from 4 to 6 cubic feet. The efficiency scale on the new energy labels ranges from level 1 to 5, with level 3 as the average and level 5 as the most efficient. A selection of the models in this size range was tested during the fall of 1994 to establish the average efficiency level. Models that fell within 10% of the mean are rated at level 3; models that are 10-25% more efficient than the mean are rated at level 4; and models that are more than 25% more efficient than the mean are rated at level 5.

An important element to securing manufacturer cooperation in the labeling program is that it was voluntary. There is no “penalty” for having an inefficient unit, since the manufacturer is not required to apply a label. Rather, the manufacturers of energy-efficient units rated at level 4 or 5 have an incentive to put the label on the product and market it as an energy-efficient model.

Initially, just one model was rated at level 5. This was a model that had been brought to market in early 1993 in anticipation of the Thai DSM program. Once the labeling program began, however, the shift in the market was dramatic. When the program began in the first quarter of 1995, 32% of the participating refrigerators (i.e. refrigerators for which manufacturers requested labels) were rated at level

⁶ Some of the EGAT programs provide incentives. These include zero-interest loans for building owners and for purchasers of high-efficiency air conditioners, and rebates for factory owners to purchase high-efficiency motors.

3, 55% were rated at level 4, and just 13% were rated at level 5. By the final quarter of 1996, more than 1.6 million labels had been supplied to manufacturers, and more than 70% of participating models were rated at level 5. (EGAT 1997B) Figure 0.8 tracks the number of labels sent to refrigerator manufacturers during 1995 and 1996. It shows a marked shift, as manufacturers upgraded the efficiency of their units: in 1996, more than half of the labels issued were for the highest efficiency rating, level 5. Figure 0.9 shows that the average energy use of participating models (models for which the manufacturer requests a label) has decreased by 14% since the program's inception. This figure can be misleading, however: it does not mean that the average energy use of Thai refrigerators has decreased by 14%. We cannot accurately estimate the change in the overall market because of a lack of market data.

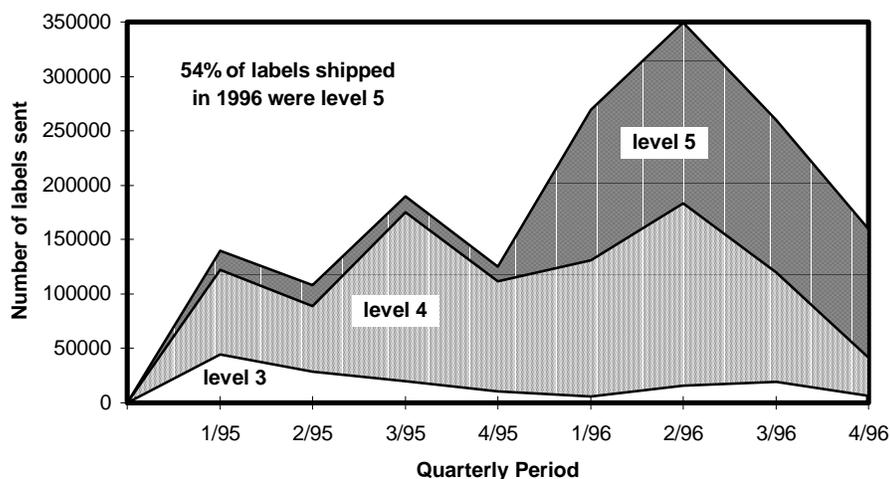


Figure 0.8. Refrigerator Labels Sent to Thai Manufacturers. (Source: DSM Office, EGAT)

As mentioned above, the lack of baseline market data makes it difficult to interpret either the absolute impact of the labeling program or the potential for further improvements in refrigerator efficiency. Annual sales of refrigerators in Thailand in 1993 were an estimated 700-800,000 units (IIEC 1995). The DSM Office estimates that the refrigerator labeling program reduced peak demand by 31 MW through May 1997 (Yim, 1997). These estimates are based on changes in the ratio of labels issued to participating manufacturers; however, the DSM Office has neither a reliable estimate of the efficiencies of non-participating models, nor of what percentage of refrigerators in the market as a whole have labels.

It is also worth mentioning that while the labeling program is apparently succeeding in increasing the efficiency of models available in the marketplace, there remains significant additional potential for cost-effective improvements. For example, initially, it was thought that the major efficiency improvements in refrigerators would come from increasing the wall insulation and improving gasket seals on the door, since Thai refrigerators typically have very thin walls (about 3-4 cm in thickness). Thus far, however, only one manufacturer has introduced a new model with thick wall insulation.⁷ The other manufacturers

⁷ According to Angsuputiphath (1997), this thick-walled model has not been accepted into the mainstream market because of resistance among wholesalers and retailers to a new type of product. In contrast, this thick-walled model is one of the most popular refrigerator models sold by the one Thai appliance company — Singer (Thailand) —

have been content to increase the efficiency of models by substituting higher-efficiency compressors. This suggests that substantial additional efficiency gains are possible through improving refrigerator wall and door insulation.

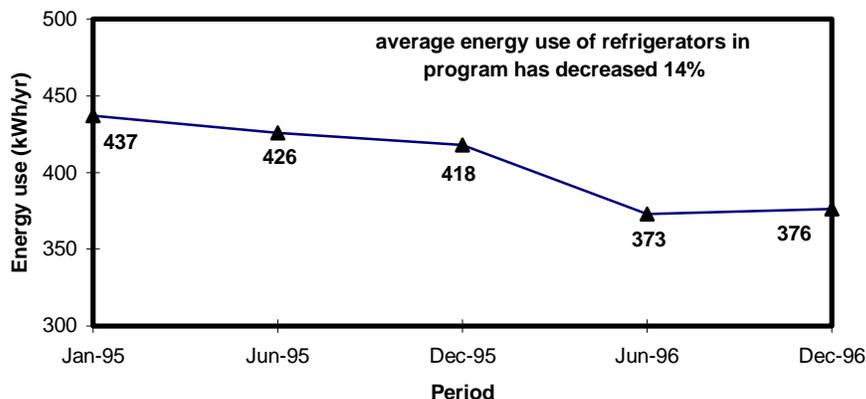


Figure 0.9. Average Energy Use of Refrigerators in Thai Labeling Program. (Source: DSM Office, EGAT)

Air Conditioners. A similar labeling program for air conditioners began in early 1996. The negotiations with air conditioner manufacturers were more difficult than those with the refrigerator manufacturers because of the diverse and fragmented nature of the Thai air-conditioner industry, which consists of 55 manufacturers, many of which are small, local assembly operations (Ratanopas 1995). Efficiency testing of air conditioners began in late 1995. Air-conditioners produced by multinational corporations received the highest ratings. These firms launched large promotional campaigns touting the energy-saving benefits of their air conditioners. Unlike the refrigerator market, air conditioner manufacturers chose to place energy labels almost exclusively on the most efficient units, those with a rating of level 5.⁸ Thus, consumers were typically faced with a choice between buying a unit with a label (i.e. a rating of level 5) or a unit with no label (i.e. an “invisible” rating of 4 down to 1).

Figure 0.10 shows the number of labels sent to manufacturers participating in the air conditioner labeling program. EGAT distributed 106,000 labels for air conditioners during 1996. Based on rough estimates of the market size from industry sources⁹, this is roughly 25% of annual refrigerator sales. More than four-fifths (83%) of the labels were for models rated 5; just under one-fifth (17%) were for

which bypasses the regular retail chain and sells directly to consumers through its many rural outlets around the country. A Singer representative claimed that this thick-walled models was Singer’s most popular refrigerator and that customers liked it because its thick-walled design makes it appear strong and durable.

⁸ My interviews with Thai retailers in early 1997 revealed that the number 5 label was associated with the highest level of quality and energy savings and that manufacturers perhaps felt that if their models could not achieve a 5 rating, it was better not to have a label at all.

⁹ Accurate data on the market size for air conditioners are not available.

models rated 4; and none were for models rated at 3. (The dip in both 4 and 5 labels in the third quarter is due to lower air conditioner sales during the rainy season, which occurs from August through October.)

Figure 0.11 shows a slight increase (~4%) in the average efficiency of air conditioners participating in the labeling program during its first year. The DSM Office estimates that the labeling program resulted in peak demand savings of 28 MW through May 1997 (Yim, 1997). Again, this estimate is based on inadequate market data. It was derived by tracking changes in the ratio of the number of labels shipped to manufacturers, and the DSM Office is not yet able to track either the number of units actually sold or changes in shipment-weighted average efficiencies of the market as a whole.

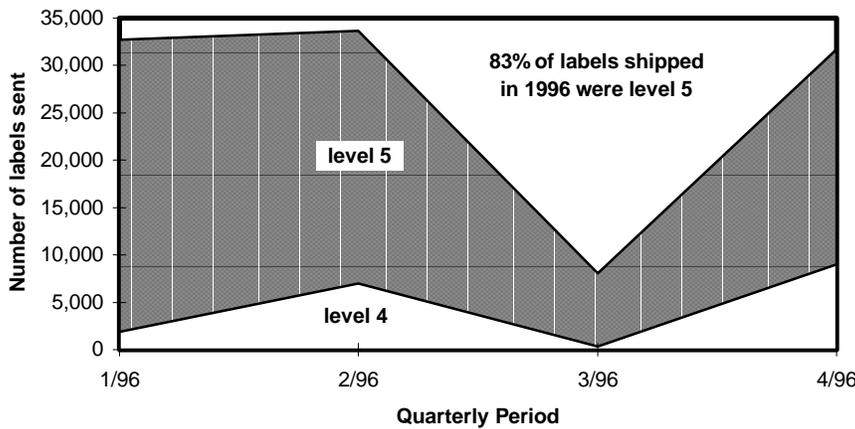


Figure 0.10. Air Conditioner Labels Sent to Thai Manufacturers in 1996. (Source: DSM Office, EGAT)

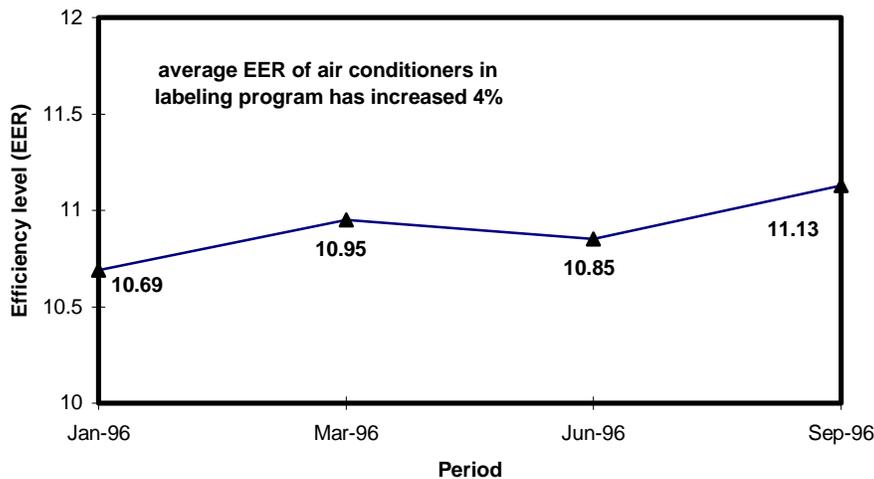


Figure 0.11. Average Energy Use of Air Conditioners in Thai Labeling Program. (Source: DSM Office, EGAT)

The air conditioner testing and labeling program has highlighted a gap in quality between imported air conditioners and most other models, which are produced locally. Locally manufactured and assembled units tend to be less efficient and of lower-quality. Since these models cannot compete on quality, they compete on price. Another, unintended impact of the air conditioner program has resulted from the associated publicity and marketing efforts, which have increased the appeal of air conditioners to the Thai public. Preliminary projections suggest that air conditioner demand may increase significantly compared to previous projections (Lemoine 1996). This could overwhelm the efficiency savings and result in a net increase in electricity demand.

The Energy Conservation Promotion Act and Fund

The Energy Conservation Promotion Act (the Act) was passed by the Thai government in March 1992. The Act established government authority and public financing to support energy efficiency in Thailand (in addition to the DSM program operated by EGAT). The Act: (a) gave authority to the Ministry of Science, Technology, and Environment to issue building energy codes and appliance efficiency standards; (b) identified a class of large energy users as “designated facilities” and required that they hire energy managers, conduct energy studies and develop energy conservation plans, or else face large financial penalties; and (c) established the Energy Conservation Promotion Fund, by diverting funds that had previously been accruing in Thailand’s Oil Price Stabilization Fund.

When the DSM Master Plan was being drafted in 1991, Thai policymakers began to see the value of an incentive-based rather than a purely regulatory approach to government energy-efficiency programs. The Energy Conservation Promotion Fund was thus conceived as a way of providing incentives to Thai businesses and consumers to assist them in meeting mandatory requirements of the Energy Conservation Promotion Act.

The key impetus to the creation of the Fund was the outbreak of the Gulf War in 1991. As oil prices soared, the reserves in the government’s Oil Price Stabilization Fund began to be rapidly depleted. Oil price deregulation occurred after the end of the Gulf War, when the price of oil on the world market quickly collapsed. The government delayed the reduction in the domestic retail price, thereby allowing the Oil Fund to accumulate a large cash balance. When the government did eventually deregulate oil prices, the Oil Fund became redundant. Four billion baht (US\$160 million) in the Fund was transferred to a newly created Environment Fund, and another 1.5 billion baht (US\$60 million) was transferred to a newly created Energy Conservation Promotion Fund. The mechanism for collecting the oil fund levy was also transferred to the Energy Conservation Promotion Fund, and a levy of US\$0.0028 per liter was imposed, allowing the newly created fund to earn a revenue of about US\$80 million per year from the sale of oil in Thailand. By early 1997, the Energy Conservation Promotion Fund had an account balance of nearly \$500 million (Piyasvasti 1997).

The Fund serves as an alternative and complementary mechanism (to the DSM program) for financing energy-efficiency improvements in large buildings and factories in Thailand. It provides incentives for the owners of large facilities to conduct audits and to develop and implement energy conservation plans for their facilities. It also funds development and demonstration of energy-efficiency and renewable energy technologies, as well as for energy-efficiency programs in rural areas.

A Mandate for Minimum Efficiency Standards

With regard to appliance efficiency, the most important part of the Energy Conservation Promotion Act was its empowerment of the Ministry of Science, Technology, and Environment with the authority to establish building energy codes and minimum efficiency standards for appliances and other electric equipment, such as motors and ballasts.

The Ministry of Science, Technology, and Environment issued voluntary building energy codes in 1995, and in mid-1996 these became mandatory for new buildings that are expected to become designated buildings (i.e. demand greater than 1,000 kW) when completed. In addition to the designated facilities, the government plans to spend more than US\$60 million to upgrade the energy efficiency of 475 government buildings, hospitals, colleges, and universities – all buildings with demand greater than 100 kW.

Although the Thai government has yet to establish minimum efficiency standards for electric appliances, it has recently taken a number of steps in that direction, and it appears that standards for some products may be established within the next two to three years. Below is a brief summary of recent activities:

- The Department of Energy Development and Promotion (DEDP), with support from the German aid agency, GTZ, commissioned an investigation of the needs and costs for developing improved testing facilities for appliances and electrical equipment. It is now conducting ongoing activities with support from the Danish government (NEPO 1997).
- DEDP also commissioned a report called “Study to Propose Draft Ministerial Orders to Improve the Energy Efficiency of Equipment, Set Up an Implementation Scheme for Producers and Distributors and Energy Efficiency Labeling for Electric Appliances.” This study is still in progress (NEPO 1997).
- The National Energy Policy Office contracted with a consulting firm to prepare a strategy for energy-efficiency standards and labeling in Thailand and to outline what types of support (technical and financial) would be necessary in order to assist Thai manufacturers to meet the proposed efficiency standards. This work was completed in mid-1997.
- The National Energy Policy Office has also issued terms of reference for consultants to develop an “Energy Efficiency Standards Regime” for Thailand. This will include the development of an implementation plan for standards and labeling program and the development of a strategy to ensure the program’s longevity. It is expected that this work will begin in 1998 (NEPO 1997).

While the Energy Conservation Promotion Act has to date had no impact on appliance efficiency, it could play a significant role in the future. One step would be the development of the first minimum efficiency standards for appliances in Thailand. Another, which was mentioned to me by two Thai policymakers in early 1997, was the possibility of adapting the current DSM label and developing it as the standard label design for a mandatory national labeling law for refrigerators, air conditioners, and eventually other appliances.

Conclusions

The policies implemented to improve appliance efficiency in the U.S. and Thailand have been remarkably different. In the U.S., a ruling issued in 1979 required that manufacturers of major household appliances post energy labels on their products. There is no evidence that the labels have had a significant impact, and no evaluation of the labeling has been carried out since the early 1980s. There is

also much evidence that the U.S. EnergyGuide label is largely ineffective. These data are discussed in more detail in Chapters 3 (literature review), Chapter 6 (retailers) and Chapter 7 (consumers). There seems to be a consensus among energy policy analysts that efficiency standards (first at the state, then at the federal level) have been the real policy driver for the dramatic increases in appliance efficiency that have occurred in the U.S. over the past two decades.

In Thailand, the policies implemented to improve appliance efficiency are more recent, and have only taken effect within the past three to four years. Thai policymakers have relied not on standards, but rather on voluntary energy labeling programs to stimulate improvements in appliance efficiency. The appliance labeling programs have been supplemented by a massive, nationwide advertising campaign funded by the state-owned electric utility.¹⁰ Based on available data, it appears that the Thai programs have stimulated modest but significant improvements in the efficiency of refrigerators and air conditioners in a remarkably short time period. However, due to a lack of baseline market data, it is difficult to estimate the magnitude of the savings from these labeling programs. Thailand's energy policymakers also realize the need for minimum efficiency standards and have issued terms of reference for a consulting firm to develop an implementation plan for a standards regime for a number of household appliances. This work is expected to begin in 1998.

We thus are faced with two different approaches to influencing appliance energy efficiency. In the U.S., the primary emphasis is on minimum appliance efficiency standards, and the energy labeling program has received little attention from policymakers or funding to provide marketing, consumer education, and evaluation. In Thailand, the energy labeling program is the centerpiece of the country's first nationwide DSM program, and is being supported by Thailand's largest television advertising account. The marketing effort has drawn in movie and television celebrities, as well as sports stars, in an effort to catch the attention of consumers.

Why are policymakers in the two countries pursuing the same goal (improving appliance efficiency) through such different means? How do the policymakers view consumer behavior and interest in energy efficiency? In the next chapter, I address the critical issue of how consumers think about energy efficiency, make purchase decisions, and read labels, with an aim toward developing a framework for considering what types of policies will affect consumer behavior and, more specifically, for evaluating the potential of labeling programs to transform the marketplace.

¹⁰ EGAT's advertising budget during the years 1995 and 1996 was approximately US\$12 million per year. The majority of this advertising budget was spent to promote EGAT's DSM programs, although some was also used to promote the utility's corporate image and to build awareness of the benefits of nuclear power, a technology that EGAT managers would like to adopt in the future. In terms of number of spots on TV, this is the largest advertising campaign in the country (Ratanopas 1997).

Appendix C

U.S. INTERVIEW PROTOCOLS

U.S. Policymaker Interview Protocol

Research Questions

- How do policymakers perceive their role in improving the energy efficiency of household appliances and consumer durables?
- How do policymakers interact with manufacturers? How do they get information about manufacturer attitudes, product development, and business strategy?
- Do policymakers feel that government policy is effective at influencing consumers to purchase more energy-efficient appliances?
- Do policymakers have standardized ways of getting information about consumer and manufacturer behavior? Is this information used to change the design of programs?

Introduction

We are graduate students at the University of Delaware. We also both have several years experience working on energy policy issues with the International Institute for Energy Conservation. We are researching the effectiveness of various government policies designed to influence consumers to purchase more energy-efficient appliances. In this research project, we are interviewing a number of different policymakers from Congress, government agencies, and advocacy organizations.

We would for you to know that in reporting our results, we will not use the names of any individuals. If it is O.K. with you, we would like to use a tape recorder. This will make the interview go faster, since we won't have to write down everything as we go along. Do you mind if we turn on the tape recorder now?

1. What are your responsibilities at _____? (Prompt for role in designing energy-efficiency programs.)
2. How long have you worked here? Did you have experience prior to coming to here that relates to this job?
3. What barriers exist to the production and sale of energy-efficient technologies? How does your agency address these barriers?

4. Are some products better suited to different policy approaches? Can you give an example?
5. What sorts of approaches has the Federal government undertaken to educate consumers about energy efficiency? (Prompt: Are they effective? Has there been an evaluation?)
6. What are the most effective government programs to promote energy-efficient appliances and consumer durables? How do you know they are effective? (Press for details.)

The next few questions will focus on a specific program with which you have been involved ...

7. Pick one program you have worked on. Has it been effective? How do you know? (Press for details. Was there an evaluation? Who did it?)
8. What unexpected problems did _____ face in the program's implementation?
9. What role, if any, did manufacturers play in the development of the program?
10. How have consumers reacted to the program?

The last several questions will be of a more general nature ...

11. Do you evaluate program effectiveness? Has the evaluation affected the policy?
12. What sort of mechanisms does your agency use to communicate with or get information from the manufacturers of appliances and consumer durables? (Prompt: Formal or informal means? Associations? Working groups? How does your agency find out about new appliance-related products?)
13. What are consumer priorities when purchasing appliances and durables? (Prompts: How high does efficiency rank? How do you know this?)
14. How would you compare these different approaches: standards, manufacturers' incentives, and voluntary programs? (Prompt: Which is most cost-effective? Which will have the largest impact?)
15. Assume that you have the power and freedom to programs to design the most effective energy efficiency programs possible? Describe what your programs would look like.
16. Do you consider yourself an advocate of energy efficiency? (Prompt for explanation.)
17. Do you personally believe that the government should promote energy-efficient appliances and consumer durables? (Prompt: Why? Do you feel the government is doing enough?)

Background info:

- * Age
- * College major
- * Previous job experience

Wrap-up:

Apart from your personal background, did you give any sensitive information regarding which you would like us to be especially careful that no one reading the paper would associate with your personally?

(If no) Conversely, in these reports it is sometime helpful to identify the agency or job responsibilities of the person we quote. However, from the specific job information an insider can sometimes infer the identity of the person. Would you say that everything that you said is sufficiently public that, although we still won't use your name, we need not be especially careful to disguise your identity?

Parting question: What is your overall reaction to this conversation? (Probe...) To Federal policy and its role in improving efficiency of energy durables?

U.S. Appliance Salesperson Interview Protocol

Research Questions

- What role does energy efficiency or other environmental considerations play in the sale of a home appliance?
- What is the salesperson's level of knowledge with regard to energy efficiency and environmental considerations?
- What factors might influence an appliance salesperson to use energy efficiency as a tool for closing the sale?

Introductions

[Presumably, I have already cleared the interviews with the store or shift manager ...] Hi, I am a researcher with the University of Delaware. I am doing market research about what factors are important when consumers buy a home appliance. Do you have a few minutes to answer some questions? (Pause ...) I am interviewing appliance salespeople as well as customers at 4 different stores. My goal is to gain a better understanding of the sales process. I will use the results of the interviews to prepare my dissertation research. In reporting my results, I will not use any names. The interview will go faster if I use a tape recorder, since I won't have to write everything down as we go. Do you mind if I turn on the tape recorder?

1. What is your name? (Pause ... introduce myself.) What type of appliances do you sell? (If does not list significant a energy-consuming appliance -- refrigerator, freezer, water heater, furnace, air conditioner -- stop interview and thank them for their time.)
2. How long have you been selling appliances? At this store? Did you have any experience prior to coming here that related to appliance sales?
3. What are the main things that the company emphasizes as the keys to becoming a successful salesperson? What type of training did you receive?
4. About how much time do you spend with an average customer?
5. Can you describe a typical sales interaction? (Probes: Can you tell up-front whether they will make a purchase? Do you "type" customers into different categories? How much does your sales pitch vary depending on the customer?)

6. Do customers usually have an idea of what are the major features that they want? How much influence do you have over their purchase decision?
7. What are the most important types of features that customers seek? (Prompt: size, color, convenience, service, warranty, brand name, energy) How do you know their preferences? (E.g, personal interaction or market research?)
8. What about the yellow energy labels on the front of the appliances? What type of information do the labels contain? (Press for specific details ... ask to explain a label)
9. How often do customers look at these? Do you use them in your sales pitch? Do they make a difference in the purchase decision?
10. Let's say you have two similar models with all of the same features. Do you think customers would be willing to pay more for an appliance with all of the same features that uses less energy? How much more?
11. Where do you get information about appliance energy usage? (Press for details.) How do you tell whether an appliance is energy-efficient? (Press for distinction between "standard", energy efficient, and high efficiency.)
12. Were you aware that the government sets minimum national standards for energy efficiency of appliances? (Pause ...) Do you think this is an appropriate activity for the government? (Pause ...) Do you think that providing the EnergyGuide labels is an appropriate activity for the government?
13. Do you consider yourself an environmentalist? (If yes ...) Does this affect your sales pitch at all?
14. Are there any other environmental considerations besides energy use that consumers consider when buying an appliance (possible prompts: e.g., whether it can be recycled or whether it uses CFC as a refrigerant)?
15. What types of strategies do you think would be effective for increasing sales of energy-efficient appliances?

Background info:

- * Age
- * Occupation
- * College major

Parting question: What were your impressions of this interview? (Probe ...)

U.S. Consumer Interview Protocol

Research Questions

- What role does energy efficiency or other environmental considerations play in the purchase of a home appliance?
- What factors might influence a consumer to purchase a more energy-efficient appliance?

Introductions

Hi, I am a researcher with the University of Delaware. I am doing market research about what factors are important when consumers buy a home appliance. Do you have 5 minutes to answer a few questions? (Pause ...) I am interviewing _____ different appliance purchasers from _____ and _____, and will use the results of the interviews to prepare my dissertation research. In reporting my results, I will not use any names. The interview will go faster if I use a tape recorder, since I won't have to write everything down as we go. Do you mind if I turn on the tape recorder?

1. What is (are) your name(s)? (Pause ... introduce myself.) Did you purchase an appliance today? [If no, continue:] Have you purchased an appliance within the past six months?
2. What type of appliance did you purchase?
(If not a significant energy-consuming appliance -- refrigerator, freezer, water heater, furnace, air conditioner -- stop interview and thank them for their time.)
3. Why did you decide to purchase this model of _____ (e.g., refrigerator)?
4. When you went into the store, what -- if anything -- did you plan to buy? Were there certain features that you knew you wanted? Did you have a particular brand or model in mind? (If so, why did you want these features or this particular brand and model)
5. Can you describe the process you went through to decide which model you wanted to buy? Where did you get your information?
6. What did the salesperson do? How did they affect your decision?
7. What is the most important feature for you in this type of appliance?
8. What are the next three [second, third and fourth] most important features?

9. What do you know about the energy-efficiency of appliances (of this appliance) ?
10. Do you have some idea of how much this type of appliance will cost you on your energy bill this year? Was energy cost important in your purchase? {If it wasn't listed among the top four features: "Does that mean that energy cost is less important than those four factors you listed?}
11. Would you be willing to pay more for an appliance with all of the same features that uses less energy? How much more?
12. Are you familiar with the yellow EnergyGuide labels on appliances? (Pause) What type of information do the labels contain? What information from the label do you recall about the particular model that you purchased?
13. Were you aware that the government sets minimum national standards for energy efficiency of appliances? (Pause ...) Do you think this is an appropriate activity for the government? (Pause ...) Do you think that providing the EnergyGuide labels is an appropriate activity for the government?
14. Do you consider yourself an environmentalist?
15. Did this affect your decision to purchase this appliance?
[If yes, "How did this affect your decision?]
16. Are there any other environmental considerations besides energy use that you consider when buying an appliance (possible prompts: e.g., whether it can be recycled or whether it uses CFC as a refrigerant)?

Background info:

- * Age
- * Occupation
- * College major

Parting question: What were your impressions of this interview? (Probe ...)

Appendix D

THAILAND INTERVIEW PROTOCOLS

Thai Policymaker Interview Protocol

Research Questions

- How do policymakers perceive their role in improving the energy efficiency of the Thai economy?
- How do policymakers interact with manufacturers? How do they get information about manufacturer attitudes, product development, and business strategy?
- Do policymakers feel that government policy is effective at influencing consumers to purchase more energy-efficient appliances?
- Do policymakers have standardized ways of getting information about consumer and manufacturer behavior? Is this information used to change the design of programs?

Introduction

I have worked on energy policy issues in Bangkok for 4 years with the International Institute for Energy Conservation. I am now doing graduate research on energy policy at the University of Delaware. Specifically, I am researching the effectiveness of both U.S. and Thai government policies designed to influence consumers to purchase more energy-efficient appliances. In this research project, I am interviewing a number of different policymakers from Parliament, Thai government agencies, Thai universities, and the Thai electric utilities.

I would also like to let you know that in reporting my results, I will not use the names of any individuals. If it is O.K. with you, I would like to use a tape recorder. This will make the interview go faster, since I won't have to write down everything as we go along. Do you mind if I turn on the tape recorder now?

1. What are your responsibilities at _____? (Prompt for role in designing energy-efficiency programs.)
2. How long have you worked here? Did you have experience prior to coming to here that relates to this job?
3. What barriers exist to the production and sale of energy-efficient technologies in Thailand? How does the Thai government/your agency address these barriers?

4. How do you learn about energy-efficiency research, technologies, and programs?
5. How do you choose among alternative policy options?
6. Do you know about programs in other countries that have successfully reduced appliance energy use? How could these programs be applied or adapted for Thailand?
7. What sorts of approaches has the Thai government undertaken to educate consumers about energy efficiency? (Prompt: Are they effective? Has there been an evaluation?)
8. How effective do you think that the Thai DSM programs have been at promoting energy-efficient appliances? How do you know they are effective? (Press for details.) Are there other programs, existing or planned, to promote appliance efficiency?

THIS SECTION FOR AGENCY STAFF

The next few questions will focus on a specific program with which you have been involved ...

9. Pick one program you have worked on. Has it been effective? How do you know? (Press for details. Was there an evaluation? Who did it?)
10. What unexpected problems did _____ face in the program's implementation?
11. What role, if any, did manufacturers play in the development of the program?
12. How have consumers reacted to the program?

13. How do you think energy-efficiency programs should be evaluated? What types of evaluations are typically carried out for Thai programs? Have the evaluations affected policy or program design?
14. What sort of mechanisms does your agency use to communicate with or get information from the manufacturers of appliances and consumer durables? (Prompt: Formal or informal means? Associations? Working groups? How does your agency find out about new appliance-related products?)
15. Do you think that consumers actively seek information about energy use when they buy an appliance?
16. What are consumer priorities when purchasing an appliance? (Prompts: How high does efficiency rank? How do you know this?)

17. How would you compare these different approaches: standards, manufacturers' incentives, and voluntary programs? (Prompt: Which is most cost-effective? Which will have the largest impact?)
18. Assume that you have the power and freedom to design the most effective energy efficiency programs possible? Describe what your programs would look like.
19. Do you consider yourself an advocate of energy efficiency? (Prompt for explanation.)
20. Do you personally believe that the government should promote energy-efficient appliances and equipment? (Prompt: Why? Do you feel the government is doing enough?)

Background info:

- * Age
- * College major
- * Previous job experience

Parting question: What were your impressions of this interview? (Probe ...)

Thai Appliance Salesperson Interview Protocol

Research Questions

- What role do energy efficiency or other environmental considerations play in the sale of a home appliance?
- What is the salesperson's level of knowledge with regard to energy efficiency and environmental considerations?
- What factors might influence an appliance salesperson to use energy efficiency as a tool for closing the sale?

Introductions

[Presumably, I have already cleared the interviews with the store or shift manager ...] Hi, I work in Bangkok with the International Institute for Energy Conservation. I am doing market research about what factors are important when consumers buy a home appliance. Do you have a few minutes to answer some questions? (Pause ...) I am interviewing appliance salespeople as well as customers at 4 different stores. My goal is to gain a better understanding of the sales process. In reporting my results, I will not use any names. The interview will go faster if I use a tape recorder, since I won't have to write everything down as we go. Do you mind if I turn on the tape recorder?

1. What is your name? (Pause ... introduce myself.) What type of appliances do you sell? (If does not list significant a energy-consuming appliance -- refrigerator, freezer, air conditioner -- stop interview and thank them for their time.)
2. How long have you been selling appliances? At this store? Did you have any experience prior to coming here that related to appliance sales?
3. What are the main things that the company/store emphasizes as the keys to becoming a successful salesperson? What type of training did you receive?
4. About how much time do you spend with an average customer?
5. Can you describe a typical sales interaction? (Probes: Can you tell up-front whether they will make a purchase? Do you "type" customers into different categories? How much does your sales pitch vary depending on the customer?)
6. Do customers usually have an idea of what are the major features that they want? How much influence do you have over their purchase decision?

7. What are the most important types of features that customers seek? (If they can't say at first, prompt: size, color, convenience, service, warranty, brand name, energy) How do you know their preferences? (E.g, personal interaction or market research?)
8. Are you familiar with EGAT's energy-saving program? What does the program do? Is it effective?

8A. FOR GREEN STORES: What is the Green Store program? How does it work? Is it effective? Has it increased your sales?
9. What about the energy labels that I see on some of the refrigerators and air conditioners? What type of information do the labels contain? (Press for specific details ...)
10. How often do customers look at these? Do you use them in your sales pitch? Do they make a difference in the purchase decision?
11. Let's say you have two similar models with all of the same features. Do you think customers would be willing to pay more for an appliance with all of the same features that uses less energy? How much more? How do they decide whether it is worth it?
12. Where do you get information about appliance energy usage? (Press for details.) How do you tell whether an appliance is energy-efficient? (Press for distinction between "standard", energy efficient, and high efficiency.)
13. Do you think that it is a good idea for EGAT to ask the manufacturers to put the energy labels on these appliances?
14. How would you rate your level of concern for the environment? (not concerned, somewhat concerned, very concerned, extremely concerned) (If yes ...) Does your concern for the environment affect your sales pitch at all?
15. Are there any other environmental considerations besides energy use that consumers consider when buying an appliance (possible prompts: e.g., whether it can be recycled, whether it uses CFC as a refrigerant, whether it uses a lot of water)?
16. What types of strategies do you think would be effective for increasing sales of energy-efficient appliances?

Background info:

- * Age
- * Occupation
- * Level of education

Parting question: What were your impressions of this interview? (Probe ...)

Thai Consumer Interview Protocol

Research Questions

- What role does energy efficiency or other environmental considerations play in the purchase of a home appliance?
- What factors might influence a consumer to purchase a more energy-efficient appliance?

Introductions

Hi, we are doing market research about what factors are important when consumers buy a home appliance. We are doing this research for the National Energy Policy Office. Do you have 5 minutes to answer a few questions? (Pause ...) I am interviewing _____ different appliance purchasers from _____ and _____. In reporting my results, I will not use any names. The interview will go faster if I use a tape recorder, since I won't have to write everything down as we go. Do you mind if I turn on the tape recorder?

1. What is (are) your name(s)? (Pause ... introduce myself.) Did you purchase an appliance today? [If no, continue:] Have you purchased an appliance within the past six months?
2. What type of appliance did you purchase?
(If not a refrigerator or air conditioner -- the two appliance categories that have labels -- stop interview and thank them for their time.)
3. Why did you decide to purchase this model of _____ (e.g., refrigerator)? Is this your first one?
4. When you went into the store, what -- if anything -- did you plan to buy? Were there certain features that you knew you wanted? Did you have a particular brand or model in mind? (If so, why did you want these features or this particular brand and model)
5. Can you describe the process you went through to decide which model you wanted to buy? Where did you get your information?
6. What did the salesperson do? How did they affect your decision?
7. What is the most important feature for you in this type of appliance?
8. What are the next three [second, third and fourth] most important features?
9. What do you know about the energy-efficiency of appliances (of this appliance) ?

10. Do you have some idea of how much this type of appliance will cost you on your energy bill this year? Was energy cost important in your purchase? {If it wasn't listed among the top four features: "Does that mean that energy cost is less important than those four factors you listed?}
11. Would you be willing to pay more for an appliance with all of the same features that uses less energy? How much more?
12. Are you familiar with the energy rating labels that EGAT [Electricity Generating Authority of Thailand] puts on appliances? (Pause ...) What type of information do the labels contain? Did the model that you purchased have a label? [Labeling is voluntary on the part of manufacturers, and the manufacturers only put labels on the models that are rated in the most efficient categories.] What information from the label do you recall about the particular model that you purchased? [Eg., what was the numerical rating of their unit?]
13. Do you think that providing these energy rating labels is an appropriate activity for EGAT? (Pause ...) Would you like to EGAT or the government do more to promote energy-saving appliances?
14. Do you consider yourself an environmentalist?
15. Did this affect your decision to purchase this appliance?
[If yes, "How did this affect your decision?]
16. Are there any other environmental considerations besides energy use that you consider when buying an appliance (possible prompts: e.g., whether it can be recycled or whether it uses CFC as a refrigerant)?

Background info:

- * Age
- * Occupation
- * Income level
- * Level of education

Appendix E

THAILAND CONSUMER SURVEY

Introduction

We are working with a professor from Thammasat University to study the purchase and use of electric appliances in Thailand. Could you spare just 5 minutes to answer this survey?

1. Did you buy a refrigerator or air conditioner today?
yes no

1A. If NO, did you buy a refrigerator or air conditioner within the last year?
yes no

If YES, continue with survey. If NO, thank them and stop the interview.

2. What type of appliance did you buy?
refrigerator
air conditioner
washing machine
water heater
oven
other _____ (list)

2A. Did you have a refrigerator or air conditioner before?

A/C: yes no

Refrigerator: yes no

2B. If yes, are you still using it?
yes no

2C. If you are still using it, how long have you had the appliance?
_____ years

3. What is the most important factor in your decision to purchase this air conditioner or refrigerator?
(Use free listing technique, ask respondents to list at least three factors. Mark the first, second, and

third most important factors. Clarify with respondent. If factors they mention are not in list below, write them in space provided.)

brand
price
color
warranty
delivery
design and features
financing available
energy-saving
other _____(list)

4. Before going to the store to buy an appliance, did you gather information about this type of appliance?
yes no

4A. If YES, how and where did you get information? (Use free listing technique and do not prompt with answers.)

TV
newspaper
magazines
friends
family
brochure
other _____(list)

4B. Before you made the purchase, how many stores did you visit

1 store
2 stores
3 stores
4 stores
> 4 stores

4C. At what type of store did you buy your refrigerator?

department store shophouse store

At what type of store did you buy your air conditioner?

department store shophouse store

5. How satisfied were you with the salesperson and her/his service at the store?

not satisfied somewhat satisfied very satisfied extremely satisfied

5A. How much influence did the salesperson have in your purchase decision?
not influential somewhat influential very influential extremely influential

5B. Why did you decide to buy this model of ...
refrigerator? air conditioner?
_____ (write out reason)

6. Assume you have a choice between two models, one that is more expensive but saves energy, and another that is less expensive but doesn't save energy, which would you choose?
more expensive model that saves energy less expensive model that doesn't save energy

7. If you would pay more for the energy-efficient appliance, how long would you be willing to wait to get your money back
about _____ years don't know

8. What is the monthly electric bill in your house?
about _____ baht don't know

8A. Do you know roughly how much your refrigerator costs per month to operate?
about _____ baht don't know

8B. Do you know roughly how much your air conditioner costs per month to operate?
about _____ baht don't know

9. How interested are you in the topic of energy-saving?
not interested interested very interested extremely interested

10. Are you aware of the energy-saving program?
yes no

10A. How did you become aware of the program? (Use free listing technique and do not prompt.)
T.V.
newspaper
magazine
friend
family
brochure
other _____ (list)

10B. What energy-saving programs are there? (Use free listing technique and do not prompt with answers.)

thin-tube program
appliance energy labeling program
energy saving in buildings
energy saving in factories
other _____ (list)

10C. Are you familiar with the energy labeling program for appliances?

yes no

10D. If YES, on what appliances are the labels posted? (Use free listing technique and do not prompt with answers.)

air conditioners
refrigerators
washing machines
water heaters
oven
microwaves
other _____ (list)

10E. When you bought your refrigerator did you look at the energy label?

yes, in passing yes, in detail no

When you bought your air conditioner did you look at the energy label?

yes, in passing yes, in detail no

10F. Did the refrigerator you bought have an energy label posted on it?

yes no

10G. If the refrigerator had a label, do you recall what the rating was?

1 2 3 4 5 other _____
don't remember

10H. Did the air conditioner you bought have an energy label posted on it?

yes no

10I. If the air conditioner had a label, do you recall what the rating was?

1 2 3 4 5 other _____
don't remember

10J. What type of information is on the energy label? (Use free listing technique but keep prompting for details.)

electricity cost
size of unit
units of electricity use
efficiency level
other _____ (list)
don't remember

11. Is the appliance energy labeling program an appropriate activity for EGAT?

yes no

11A. Would you like to see EGAT do more to promote energy-efficiency?

yes no don't know

11B. Would you like to see the government do more to promote energy-efficiency?

yes no don't know

12. What is your level of interest in the environment?

not interested interested very interested extremely interested

12A. Do you think buying appliances has an effect on environment?

yes no

12B. If YES, list the effects. (Use free listing technique and do not prompt.)

CFC
amount of water use
atmosphere
pollution
other _____ (list)

Background Information:

Gender: M/F

Age: _____ years

Occupation: _____

Number of people in home _____

Family income level (per month):

0 - 10,000 baht	10,001 - 20,000 baht	20,001 - 30,000 baht
30,001 - 50,000 baht	50,001 - 70,000 baht	> 70,000 baht

Appendix F

SURVEY ANALYSIS AND QUALITY CONTROL

This appendix expands on the methodology chapter (Chapter 3). It describes some of the lessons I learned during the development of the national consumer survey in Thailand. The particular lessons of interest are the importance of pretesting and a methodology I developed for monitoring survey researchers. It also discusses my methodology for recording interviews and data analysis.

Importance of Pretesting

Despite admonitions in the literature and from my academic advisor, I did not allow enough time for pretesting of the survey instrument in Thailand. After developing a draft survey, testing it on several acquaintances in Bangkok, and getting extensive feedback and comments from Dr. Paktrawimol at Chulalongkorn University, we planned one afternoon to pretest the final draft of the survey before modifying it into its final form.

In reality, the “time saving” strategy of having a quick pretest proved to be a huge “time waster.” After a the first few days of surveys, I realized that I wanted to add additional questions to the survey instrument. During the first four weeks of surveying, we made two more revisions to the survey instrument, sometimes writing the new questions in by pen and photocopying enough to complete that day’s quota of surveys. In one case, in order to save paper, we asked each survey researcher to modify their 15 survey forms by writing in one additional question hand.

While these late revisions could complicate the later analysis and probably confused the researchers, the biggest threat to the validity of the survey results came when I discovered a significant flaw in the way the researchers were questioning the respondents. This problem, which is described in the section below on the importance of monitoring researchers, would have been detected and solved in a more lengthy pretest period.

Importance of Monitoring Researchers

Prior to initiating the survey, we conducted two rounds of training – one with the initial draft survey and one with the final draft. The training basically consisted of role-playing during which Prof. Tagud and I took turns playing the role of consumer and the researchers would interview us. Once we started administering the surveys, we were confronted with the issue of how to monitor the quality. During the second and third days of surveying in Thailand, Prof. Tagud and I attempted to spot-monitor the interviews by following the researchers and standing nearby while they conducted the surveys. The researchers felt uncomfortable with this strategy, and said they felt awkward conducting the survey with us looking over their shoulder. Faced with this situation, I decided to give them a small dictaphone tape recorder and asked them to tape record their interviews. On the fourth day, I asked each of them to tape record two of their interviews, and to ask the permission of the respondents. At the end of the day, we sat together and listened to a total of six tape-recorded survey interviews. What we found confirmed my worst fears – that the researchers were not probing properly and were, in some cases, leading the respondents.

For example, in one case, the researcher asked which energy-efficiency programs the respondents were aware of and then suggested possible responses. In fact, he had gotten so used to the respondents answering this question (most of them were aware of Thailand's two primary DSM programs) that he was asking the question and then leading them directly to the two most common answers. Faced with this evidence, the researchers were more inclined to listen closely to what I had been telling them for the past few days about the importance of probing and not leading the respondent. After another hour of training and role-playing, I felt confident that they had gotten the message, but realized that I would have to throw out the first four days of surveys (N=191) and start over again.

From that point on, I decided to take no chances and instituted an ongoing system to monitor the quality of the surveys. Each day, I asked two of the researchers to tape record two of their interviews. At the end of the day, we would spend about half an hour listening together to the interviews, and Prof. Tagud and I would offer advice and encouragement, pointing out areas for improvement. However, after the initial problems, we found no evidence that the interviewers were leading the respondents or improperly prompting them for answers. Only later, after enduring this experience, did I read about the experiences of Billiet and Loosveldt, who found that asking their interviewers to tape all their surveys produced a higher response rate and improved the quality of the interviews (Bernard 1994: 265).

Recording the Interviews

All of the interviews for this dissertation research were recorded on a small, hand-held tape recorder. I always asked for permission and did not switch on the recorder until the respondent had agreed. I found it important to keep an extra set of batteries on hand to always check the

battery power immediately before the interview. Still, I found it useful to occasionally glance at the recorder during the interview to make sure the tape was still moving. And although I started this research using a dictaphone tape recorder, I eventually switched to using a hand-held cassette recorder, and preferred the latter for two reasons. First, it was easier to deal with the larger, cassette-sized tapes, since they are a more standard size and can be used with cassette-sized transcribers, in a car stereo, or with a Walkman tape player. In addition, I found the quality of the microphone on my cassette recorder was much better than that on the two dictaphones that I initially used.

I decided not to take notes, since I found it distracting to try to hold a tape recorder, maintain eye contact with the respondent, take notes, and concentrate on the meaning of the response at the same time. I later transcribed all of the interviews, numbered them sequentially, and organized them in three-ring binders. I performed the analysis and comparisons from the transcripts in these binders. Two methodological issues are worth mentioning: during the first two days of interviews, there were two interviews during which the batteries stopped functioning. In each case, I discovered the problem immediately after the interview and dealt with this mini-crisis by putting in a new set of batteries and dictating my remembered responses to the missing questions into the tape recorder. I quickly learned to use a set of rechargeable batteries and to make sure the batteries were fully charged at the start of each day of interviewing.

Another more serious technical glitch occurred when I was interviewing the senior refrigerator buyer for a national appliance chain. I had been trying to contact the buyer for several weeks, and he finally called when I was in the middle of preparing a meal in my kitchen. I quickly switched to a phone in another room, switched on the tape recorder, and began to fire away questions. It was only at the end of the interview that I discovered that, in my haste, I had accidentally plugged the cord for the suction-cup microphone (which attaches to the earpiece on the receiver) into the earplug socket of the tape recorder, rather than the microphone socket. Thus, when I went to transcribe the interview, I could hear my voice, but not the respondent's. The next morning I sat down for three hours and recreated (as much as I could) a paraphrase of the entire interview from memory.

Data Analysis

I performed qualitative analysis by closely reading, coding, and analysing transcripts of the semi-structured interviews with policymakers, retailers, and consumers in both countries. I also used the U.S. data set of 100 consumer interviews to perform quantitative analysis and tallied the results from these interviews for analysis and for comparison with the results of the Thai survey questionnaire.

I used the standard version of SPSS version 7.5 for Windows to conduct the quantitative data analysis. Once the data were entered into the SPSS format, it was a simple matter to run descriptive and frequency summaries of the data, and to evaluate the impact of variables in the Thai data such as income, buyers versus non-buyers, urban versus rural, and gender.

In both data sets, I had a number of cases where there were missing values. Because of the nature and format of the U.S. interviews (i.e. I was not administering a closed-ended survey), there were instances in which the respondent did not answer certain questions. Any such blank responses were coded as missing values and the appropriate sample size is shown for that question in the data tables. There is no reason to believe that the missing values would introduce an element of bias into the analysis. (e.g., I did not ask certain questions selectively based on how someone looked or responded to my initial questions). In the Thai data set there were also some missing values as a result of the fact that during the first four weeks of surveying, we made three minor revisions to the survey instrument, in each case adding one or two questions. Thus, on the buyers survey, the sample size was 633, but for three of four of the questions, the sample size is smaller, and this is noted in the tables of results.

Appendix G

APPLIANCE ENERGY LABELS FROM AROUND THE WORLD

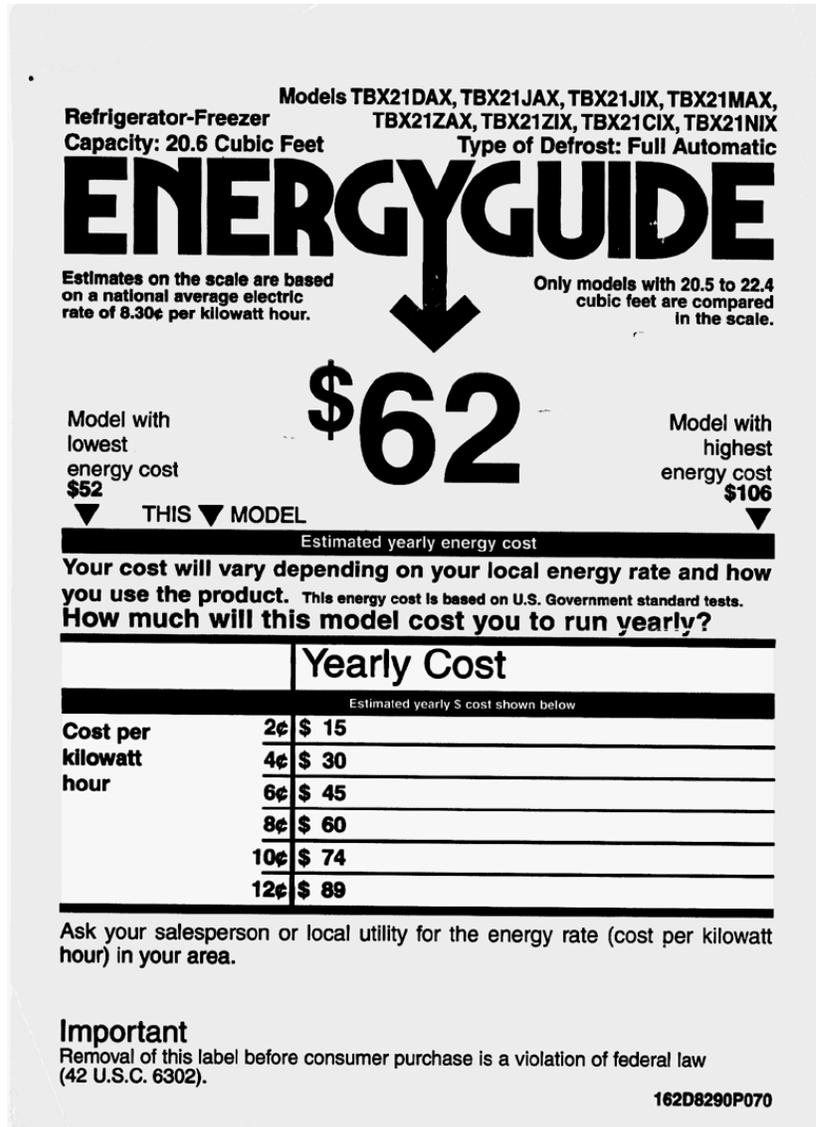


Figure Appendix G .1. The Original U.S. EnergyGuide Label. (It is still in stores, but began being phased out in 1995.)

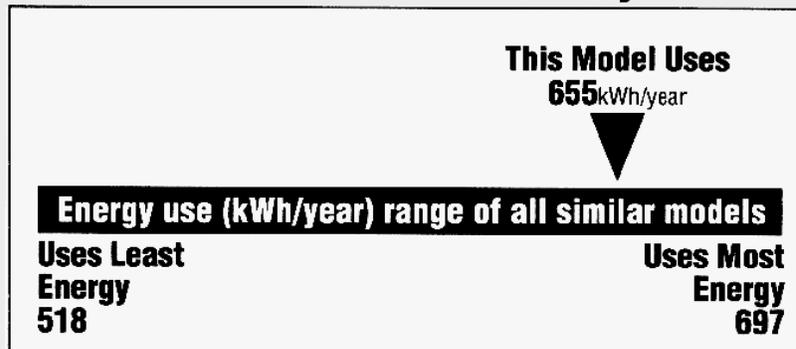
Based on standard U.S. Government tests

ENERGYGUIDE

Refrigerator-Freezer
With Automatic Defrost
With Top-Mounted Freezer
Without Through-The-Door-Ice Service
Capacity: 17.9 Cubic Feet

Whirlpool Corporation
Model ET18SK*E*0*

**Compare the Energy Use of this Refrigerator
with Others Before You Buy.**



kWh/year (kilowatt-hours per year) is a measure of energy (electricity) use. Your utility company uses it to compute your bill. Only models with 16.5 to 18.4 cubic feet and the above features are used in this scale.

**Refrigerators using more energy cost more to operate.
This model's estimated yearly operating cost is:**

\$57

Based on a 1995 U.S. Government national average cost of 8.67¢ per kWh for electricity. Your actual operating cost will vary depending on your local utility rates and your use of the product.

Important: Removal of this label before consumer purchase is a violation of Federal law (42 U.S.C. 6302).

2175271

Figure Appendix G .2. The New U.S. EnergyGuide Label. (It began being used in 1995)

ENERGUIDE

Energy consumption / Consommation énergétique

1032 kWh
per year / par année

▼ This model / Ce modèle



**Uses least energy /
Consomme le
moins d'énergie**

**Uses most energy /
Consomme le plus
d'énergie**

Similar models
compared

Standard

Modèles similaires
compares

Model number

17BJ120(4C)

Numéro de modèle

Removal of this label before first retail purchase is an offense (S.C. 1992. c.36)
Le retrait de cette étiquette avant le premier achat au détail constitue une violation de la loi (S.C. 1992. c.36)

3949870

Figure Appendix G .3. The Canadian EnerGuide Label.

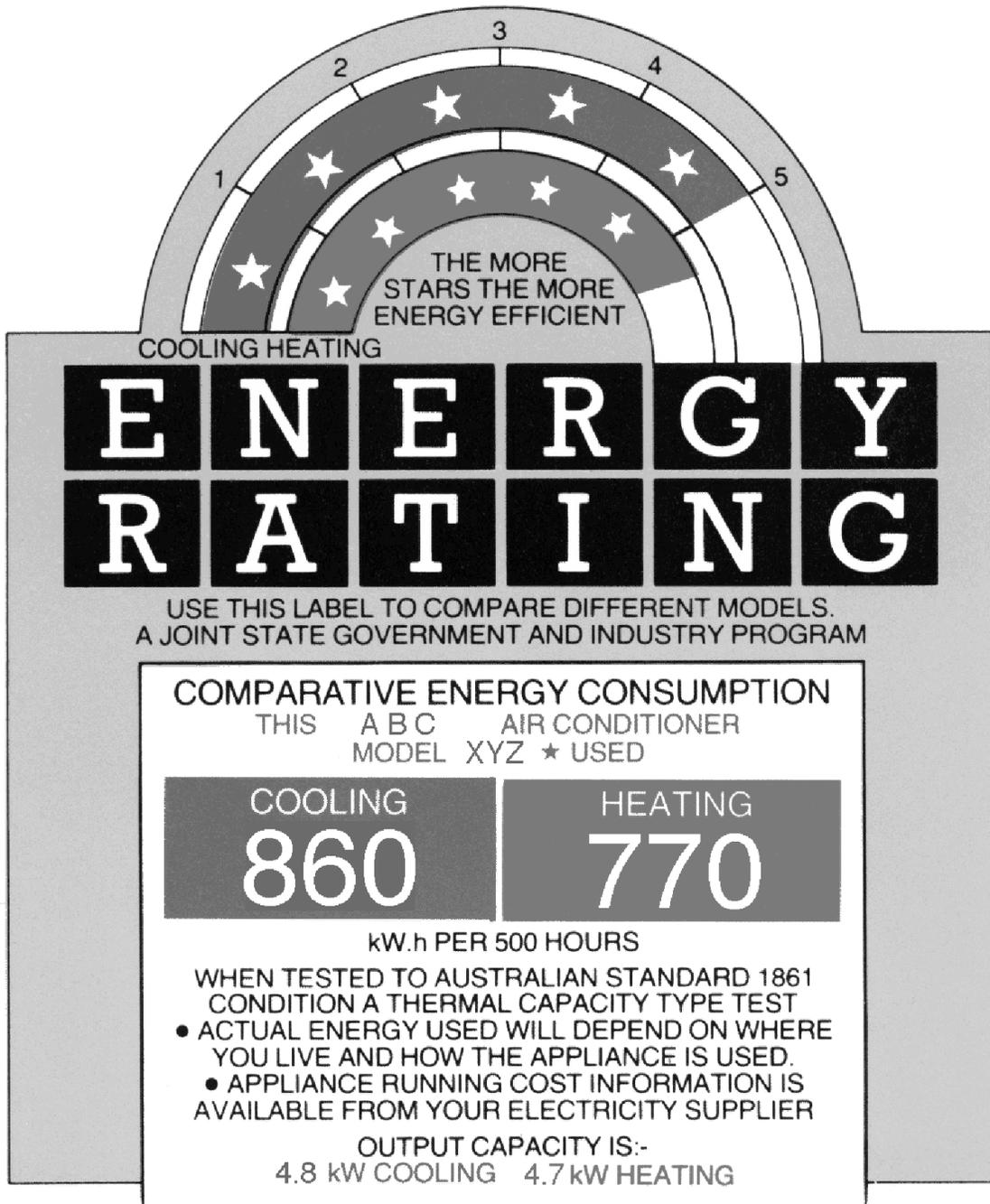


Figure Appendix G .4. The Australian Appliance Energy Label



Figure Appendix G .5. The Korean Appliance Energy Label.



Figure Appendix G .6. The Hong Kong Appliance Energy Label.



CONCEPCION INDUSTRIES, INC.

Cooling Capacity: 10,022 kJ/h

Brand: CONDURA

Power Consumption: 1,002 W

Model: CQSRT090BA

Tested @ 230 Volts, 1ø-60 Hz

ENERGY GUIDE

ROOM AIR CONDITIONERS

10.0
ENERGY EFFICIENCY RATIO

For units with the same cooling capacity,
higher EER means lower electricity cost.

For this model, the minimum EER
standard set by the government is 8.3

The monthly operating cost of this model will be approximately:

RATED POWER DEMAND watt/1000 (kW)	X	MONTHLY USAGE hours (h)	X	POWER RATE Pesos/kW-h	=	COST OF OPERATION Pesos
--------------------------------------	---	----------------------------	---	--------------------------	---	----------------------------

0097008

Data on this label is certified by




Certified to PNS 396 Part 1:1995



REMOVAL OF THIS LABEL BEFORE CONSUMER PURCHASE IS A VIOLATION OF Republic Act No. 7394

For information on the cost of operation and selection of correct cooling capacity, ask your dealer or write or call the Dept. of Energy, Fuels and Appliance Testing Laboratory, Commonwealth Avenue, Diliman, Quezon City, Tel. Nos. 927-72-01 or, 927-71-37.

Figure Appendix G .7. The Philippines Energy Label for Air Conditioners.

Appendix H

ANNOTATED BIBLIOGRAPHY OF LABELING EVALUATIONS

This appendix summarizes articles and reports that evaluate the effectiveness of energy labeling programs for appliances, as well as the U.S. fuel economy label for automobiles and the U.S. nutrition labeling program requiring labeling on food products. The summaries describe how the studies were carried out, the sample size, and the most important results relating to consumer understanding of and effectiveness of the label.

Redinger and Staelin (1981)

The authors conducted a simulated experiment in which a convenience sample of 123 people “shopped” for a refrigerator at a White-Westinghouse showroom in Pittsburgh. The experiment was designed to estimate the effects of three variables – the EnergyGuide labels, advertising, and energy “sales push” – on the decision to purchase a more energy-efficient refrigerator. Consumers were asked to “buy” a refrigerator from among a set of 12 refrigerators, which differed along six attributes: size, freezer location, type of shelves, price and operating costs.

The authors concluded that the consumers did not make direct trade-offs between first cost and energy efficiency. They found that their direct measurements of payback (through three different questions) were not reliable predictors of purchase at either the individual or aggregate level. The respondents who were shown refrigerators with energy labels did not follow the “payback rule” (i.e. they did not appear to calculate the payback for higher-first-cost, more efficient refrigerators) but they were more likely to select an energy-efficient model, compared to consumers shown refrigerators with no label.

The authors found that “sales push” had by far the largest impact on efficiency selection: the chance that a customer would buy an energy-efficient model increased from 48% to more than 90% when the salesperson was pushing energy. They attributed this impact to the fact that the salesperson would show the consumer how to trade off price and energy savings. Interestingly, although the salesperson did seem to have a large impact on the purchase decision, the consumers in both treatment conditions felt that the salesperson had very little influence on their product selection. The authors concluded that enlisting the salesmen to “sell” energy efficiency will require not only education but financial incentives (“spiffs”) for taking the time to show the consumers how to make the tradeoff.

Consumers who saw energy-related advertisements before the “purchase” were much more likely to list energy as an important item on their pre-shopping questionnaire (80% vs. 24%). The advertisements also made the consumers more aware of the energy labels. Most consumers were “aware” of the label and the presence of the label did increase their knowledge of operating cost. However, the presence of the label did not affect the rated importance of any of the product attributes (including energy).

Dyer and Maronick (1988)

This study has been the only complete evaluation of the effectiveness of the EnergyGuide labeling program. It consisted of a longitudinal series of three national samples of recent purchasers of refrigerators and clothes washers. The design was a quasi-experimental pre-post test design with an intervening experimental treatment – introduction of the Federal Trade Commission’s EnergyGuide labels in 1980. The study was conducted in three “waves”: a baseline in April-May 1979 (N=725); a first postwave in April-May 1982 (N=559); and a second postwave in April-May 1983 (N=573).

After the labeling program was initiated, energy efficiency ranked 6th as a consumer priority for clothes washers and 5th for refrigerators. Roughly half of the purchasers (45.2% for washers and 56.6% for refrigerators) were aware of the labels when asked afterward. One-third of the “label aware” washer buyers and roughly half of the “label aware” refrigerator buyers said that the label information affected their purchase in some way; however, a much smaller proportion of the label-aware buyers (11.1% for washers and 6.4% for refrigerators) said that they used the label for comparison purposes.

The study did not show how much of an effect the label had on the purchase decision. The labels helped to increase consumer awareness, but it was not clear whether they actually affected the purchase decision directly.

Patterson (1991)

Patterson conducted a study of energy label designs for the Canadian government. This study, which consisted of three phases, included 18 focus groups across Canada, mostly with consumers (one was with retailers). In Phase I, the researchers tested labels that used efficiency as a scale, and these labels received poor reviews. Participants were confused by the concept of having higher efficiency -- and thus and thus lower energy use and operating cost -- at the right end of the scale. In Phase II, the researchers used two focus groups to test three types of scales -- efficiency, dollars, and energy use. They tested the following factors:

- which scale is easiest to understand?
- extremity orientation (e.g., low to high or vice versa?)
- representation (best way to depict elements)
- calibration (quantification of measure, gradation, etc.)
- adequacy of information (is the information understood, complete, clear?)

The focus group participants found the notion of a kilowatt-hour very confusing, and many of the participants said they did not know what it means: "The notion of 'kWh' is unfamiliar and/or obscure to the majority of participants." (p 27) The researchers also found problems with using dollar symbols on a scale: it was not clear whether the dollars represented operating costs or savings. (Note that they did not show the participants scales which clearly labeled the dollar units as either “costs” or “savings”.) Because of this potential ambiguity, they concluded that energy was the least potentially confusing of the alternative scale measurements.

In Phase III, the researchers tested four different label designs with energy consumption as the scale metric. The label preferred by most of the participants, and which was selected as easiest to understand, looks like a car speedometer.

There was also some inconsistency in the report's justification for not radically changing the form of the EnerGuide label. The author stated that, "The majority of participants in most groups were unfamiliar with the EnerGuide label." (p 25) On the next page, he writes that the label "does appear to have a certain notoriety that warrants maintaining its present form (increases the recognition factor)."

de Loor and Zeelenberg (1991)

De Loor and Zeelenberg conducted a laboratory experiment in which participants were shown slides of five different sample labels and asked a number of questions to test their understanding of, and recall of, information on the label. The test sample was 75 residents of Leiden, The Netherlands, recruited from a random sample of 300 persons. The major findings were that:

- absolute energy use is very important;
- relative energy use is also very important;
- it is important to group conceptual elements together; and
- extra information not necessary for the particular purpose of label should be left out (e.g., some of the detailed product information, which they found "masks" the ability of the consumer to understand the label.)

The criteria that they used to compare label effectiveness were informativeness, recall, and response time. They concluded that a label with a vertical scale was the most effective, and that two labels with a horizontal scale also scored well. The label that scored least well was a purely informational label, with no comparative or graphical elements. They concluded that since consumers tend to conduct a primary scan of available purchase options (e.g., refrigerators) on only a few dimensions (e.g., price and size), it is important to make the energy information as salient as possible, so that it becomes one of these dimensions. The purely informational label failed because information was not easily acquired from the label.

They also concluded that it is important that the label allow consumers to compare one particular appliance with similar models not actually present. They suggested that "such information is best presented on a linear scale, with end points indicated in absolute numbers, and divided into a relatively large number of segments in order to sufficiently differentiate between different models (p. 4)."

Daamen, Weenig, and Zeelenberg (1992)

The authors consulted five experts in graphic design, marketing, and cognition to optimize an energy label with a vertical scale that had earlier been tested by de Loor and Zeelenberg (1991). The experts liked idea of a thermometer as a visual representation of relative energy use, related explicitly (possibly using an arrow) to a kWh value in second column. They also recommended putting "standard product information" on a separate label, since this it hinders the ability of label to "inform" the consumer about

the energy use of the appliance. They agreed on the need to be more explicit about the message, prompting consumers to save energy, in order to stimulate the purchase of energy-efficient appliances. They suggested that field studies were needed to test their proposed ideas.

Weenig and Maarleveld (1993)

The study involved 128 subjects who completed a computer task and questionnaire in which they were asked to make a choice between six refrigerators that differed along six dimensions (price, refrigerator volume, freezer volume, freezer capacity, energy consumption, and expected lifetime). Information was presented on a computer display board. The participants were shown three different label formats: (a) a text-only label, (b) a label with a continuous vertical scale, and (c) a label with a similar vertical scale divided into categorical ratings of 1 to 4. They found the categorical label slightly superior to the continuous label: "The categorical label evoked significantly more cognitive responses on energy consumption that the continuous label did, attracted more of the subject's attention, made it significantly easier for respondents to remember the information they had watched on the screen, and made choices a bit easier and more certain (although not significantly) than other formats (p. ii)."

Time pressure (i.e. when participants were given a 90-second limit to decide between six models) caused consumers to use less complex decision strategies. The study findings suggest that study of information on energy consumption and efficiency is "strongly impeded by the complexity of decision strategy used" (p. ii) Of all the dimensions, energy consumption was most affected by time pressure. Subjects under time pressure examined energy use 4.3 times more often than subjects not under time pressure. (p 15-16)

The authors concluded that the formats *did not differ significantly* with respect to the energy efficiency of the model ultimately selected. However, they found the categorical label slightly superior at conveying information. The categorical label made it significantly easier for the subjects to remember the information they had watched on the screen, and it made choices easier.

Maronick (1991)

This research is described in a memo to the Federal Trade Commission. The study was used to support the change from old EnergyGuide label to new EnergyGuide label in the early 1990s. It consisted of an experiment with three groups of 40 subjects at a mall in suburban Maryland. There were three test labels. Subjects were shown two of the three labels and asked which one they preferred and why. They were then shown the EnergyGuide label and asked whether they preferred the new label they had just chosen to the EnergyGuide label.

The sample labels were for dishwashers. The scales on the test labels used efficiency as the metric, with the energy efficiency displayed as an "energy factor." One of the labels consisted of a bar graph on a horizontal scale (the model in the middle compared to the least and most efficient models at the extremes); one label used a horizontal scale with an arrow indicator; and one label used a vertical scale with an arrow indicator. More consumers preferred the bar graph; the horizontal and vertical scales were seen as more difficult to understand.

When subjects were asked to compare the bar-graph label to the EnergyGuide label, a higher percentage of respondents preferred the former. However, the comparison with the existing EnergyGuide label was problematic, since the label used was for dishwashers: this is by far the most complicated of the EnergyGuide labels since it displays costs (and associated kWh/cost tables) for both electricity and gas.

SEC Victoria (1991)

This study examined the effectiveness of a labeling scheme for electrical appliances that was initiated in 1986. The study was based on a survey of 604 Australian consumers; 307 had purchased an electric appliance during the past year and 297 were selected at random from the Melbourne phone directory. There was a high level of awareness of the label: 83% of recent appliance buyers and 45% of the general public. By far the greatest source of information about the label was television: 74% of recent label-aware buyers learned of the label through television, followed by 11% via newspapers. Seventy percent of the label-aware appliance buyers were able to recall at least one detail about the information presented on the label. The great majority of recent buyers who were surveyed (99%) correctly interpreted the stars on the label as indicating either energy-efficiency level or cost savings. Ninety-two percent of recent buyers thought the presentation of the label was either “good” or “very good”, and 77% of buyers said the label was completely understandable. Nine out of ten buyers said they had read the label – 51% said thoroughly and 39% said briefly. Most of the buyers (85%) also described the label as either “quite important” or very important” in their choice of appliance; however, only 55% of respondents could recall the star rating of the appliance they bought. The study did not compare the actual energy use of appliances purchased by label-aware and non-label-aware consumers, or between buyers who said the label affected their decision and buyers who said the label did not affect their decision.

Recent refrigerator buyers were asked what were the most important attributes in their choice. Capacity ranked first (61%), followed by efficiency or operating costs (49%), purchase price (36%), presence of a frost-free freezer (28%), and other attributes. The researchers also conducted (for both recent buyers and the general public) an analysis of consumer willingness to “trade off” purchase price vs. lower operating costs. Based on their results, they calculated that consumers have a 9.5 year payback time when considering the savings from energy-efficient appliances. The researchers also slightly longer payback time when the energy-efficient appliance choices were described as “high-efficiency appliances.”

The results of this study may have been biased by the Hawthorne Effect, since researchers introduced themselves as energy researchers conducting a study for the utility on “energy efficiency and energy labeling schemes. For example, one result which may be biased is their finding that running costs and efficiency were the most important attribute in the choice of a dishwasher.

Strang (1996)

The European Union label for cold appliances has been displayed in UK stores since the beginning of 1995. Leaflets are provided at the point of sale by the UK government, but there is no training and sales

support. The Environmental Change Unit (ECU) at Oxford did an in-depth, retrospective survey of 100 consumers in Oxford who had recently purchased a refrigerator: 52 had noticed the label, and 35 said their choice of refrigerator had been influenced by the label. Models purchased by these 35 were 20% more efficient than the models bought by the 17 label-aware consumers who said they had not been influenced by the label. ECU's extensive survey also covered a range of qualitative and behavioral issues such as identity and role, socialization, commitment to local community, trust in institutions, knowledge of global warming, technical knowledge of energy efficiency, religious beliefs, world views, and environmental concern. The responses on this survey were susceptible to response bias (the Hawthorne Effect) due to the survey design. The evaluation form began with a full-page reproduction of the EU refrigerator energy label. On the following page, the survey began by asking respondents to list the three most important factors in their choice of refrigerator.

Kuusela (1996)

Summarizing previous research into consumer energy behavior, Kuusela concluded that while consumers have a positive attitude toward energy saving, in practice, energy efficiency is of little significance when evaluating and selecting a product. Kuusela obtained data from a national survey of 1,039 Finnish households representing 3.8 million households nationwide. About half of these (568) considered themselves the decision-maker in the household. The most important feature in cold-storage equipment mentioned spontaneously by the respondents was energy consumption (37%), followed by price (35%), space/size (14%), inside space (14%), durability/guarantee (14%), brand name (8%), technical features (8%), and country of origin (7%). However, when decision-makers were asked what were the most important comparison and selection criteria, energy consumption was third, after guarantee/warranty and inside space.

Automobile Labeling

Pirkey et al. (1982)

The authors briefly summarize a previous survey of 12,000 new car and light truck buyers in 1978 and 1979, which indicated that fuel economy was the single most important factor affecting the choice of an individual model. Almost 70% of all buyers rated fuel economy either extremely or very important. About 70% of new car buyers were aware of the Fuel Economy Label, and about half used the label for comparison shopping. However, 70% of the buyers believed that the EPA ratings overstate actual fuel economy.

This study included two surveys of 5,000 car drivers and owners, nine focus group sessions, interviews with auto dealers, auto manufacturers, and advertising agencies, a literature review, and a review of advertising and media. Eighty-nine percent of 1981 motor vehicle buyers were aware of the label, and 63% of label-aware buyers used the label to comparison shop while buying a car. As a purchase priority, fuel economy fell to third place in the past year, after quality/dependability and purchase price. The label was the most important source of fuel economy information, followed by

dealers, advertising, friends and relatives, and magazines. The authors concluded that since 80-90% of new car buyers have decided what type (and size) of car they want to buy prior to visiting a dealer, it is important for consumers to have access to information about fuel economy (i.e. the label and the Gas Mileage Guide) *before* they visit the dealer.

In focus groups, consumers found the current label design confusing. In this study, the researchers tested the current label against two prototypes. They recommended a new label with a simple, clear, easily read design with a logo to give it visual identity; and will use two mileage numbers to provide estimates of fuel economy under city and highway conditions.

Hill And Larsen (1990)

The federal effort to provide consumer information on fuel economy dates back to 1974, when the U.S. Environmental Protection Agency began to print a listing of fuel economy values for cars and light trucks. In 1985, the Energy Policy and Conservation Act established the Fuel Economy Information Program, which was “designed to furnish potential buyers with objective and reliable information about vehicle fuel efficiency so that they could compare vehicles and make informed purchasing decisions. In a 1976 study, 53% of car buyers were aware of the Fuel Economy Label, and they selected vehicles that were on average 2.7 mpg higher than the surveyed buyers who were unaware of the label. Only 7% of car buyers who were aware of the Gas Mileage Guide, a booklet that lists the fuel economy of all cars and light trucks sold in the U.S. Those who used it purchased vehicles that were on average 2.1 mpg higher than those who were unaware of the guide. In a 1979 study, 75% of car buyers were familiar with the Fuel Economy Label and one-third of these (25% of total sample) said they used the fuel economy information on the label as a factor in their purchase decision. Only 20% of car buyers used were aware of the gas mileage guide, and 5% used it. These 5% bought vehicles that were on average 1.7 mpg higher than vehicles purchased by consumers who did not use the guide. In a 1982 analysis of data from a 1981 study, 90% of car buyers were aware of the Fuel Economy Label, and nearly two-thirds of car buyers used it to compare has mileage among the models that they were considering when visiting dealers.

This 1990 study found (as did Pirkey et al. in 1982) that new car users need fuel-economy information early in their decision-making process, before they visit the dealer. Fuel economy ranks below numerous other factors in the purchase decision. Sixty-seven percent of consumers recognized the fuel economy label, and 53% said they got their fuel economy information from the label. However, many said that the label contained too much information and was confusing.

Nutrition Labeling

Guthrie et al. (1995)

The Nutrition Labeling and Education Act of 1990 mandates nutrition labeling on virtually all processed foods. Previous research indicates that most label readers use the label to determine the nutrient content of a particular product or to compare different food or brands, rather than as a tool for meal planning and overall diet management. The researchers used data from more than 4,000 households

who participated in the Continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey. Seventy-one percent of meal planners/prepares used the nutrition label at least sometimes. Education level, gender (female), and nutrition knowledge were positively associated with label use. As far as dietary differences, label use was associated only with lower cholesterol levels and higher vitamin C nutrient levels.

FDA Consumer (1995)

A survey of 1,000 U.S. adults found that 44% had seen the new food label. Slightly more than half of these label-aware consumers said the label had changed their decision to buy or use a food for the first time. Seventy percent said that fat content was the reason for the changes. The next most common reason was sodium content. Of those who had seen the label, 70% said the new label was “more clear and understandable” than the old one; 90% said the new label makes it easier to tell if a food is high in fat; 70% said the new label confirmed what they thought was wrong with their diets; and 37% said they didn’t pay any more attention to the new label than to the old.

APPENDIX J

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