

Market Transformation: Does It Work?— The Super Efficient Refrigerator Program

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INTRODUCTION

The Super Efficient Refrigerator Program (SERP or the Program) was created by a group of utilities as a way to initiate the transformation of the market for energy-efficient refrigerators. This paper summarizes PNNL's evaluation of SERP's market transformation effects. Detailed information can be found in Lee and Conger (1996a and 1996b).

Program Overview

Two key factors stimulated the development of SERP. First, refrigerators represent about 14% of total residential electricity use and utilities have conducted programs for years to promote increased refrigerator efficiencies. Second, in 1987 150 nations, including the United States, signed the Montreal Protocol. The protocol prohibited, after January 1, 1996, the use of chlorofluorocarbons (CFCs) to manufacture foam insulation and serve as a refrigerant. Research suggested that non-CFC refrigerants would reduce cooling efficiency, thus making it harder to continue refrigerator efficiency improvements. SERP arose out of utility and environmental group concerns that refrigerator efficiency improvements were likely to slow dramatically when these limitations on the use of CFC refrigerants went into effect.

In 1991, the SERP non-profit corporation (SERP Inc.) was formed by a coalition of 24 utilities from across the country. The member utilities include investor-owned utilities (IOUs) and public utilities. The Natural Resources Defense Council (NRDC), American Council for an Energy-Efficient Economy, Washington State Energy Office, and U.S. Environmental Protection Agency joined the utilities in developing the program. The goal of the Program was to initiate transformation of the refrigerator market by advancing the date when super-efficient CFC-free refrigerators became available.

The member utilities committed over \$30 million to fund SERP Inc. to conduct a competition among refrigerator manufacturers to design, construct, and sell SERP refrigerators. SERP Inc. developed the Golden Carrot award to be pre-

sented to the single winning manufacturer selected through a competitive procurement process. To win the Program competition, a manufacturer had to develop a refrigerator that was at least 25% more efficient than the 1993 federal standards.

In July 1992 the request for proposals (RFP) was issued to the industry and 14 manufacturers responded with proposals. On June 29, 1993, Whirlpool Corporation was selected as the Golden Carrot award winner. Whirlpool committed to produce and distribute 250,000 SERP refrigerators to households in the SERP utility service areas. The winning refrigerators were side-by-side units with an internal volume of 22 to 27 cubic feet. Their rated efficiency was at least 29.7% better than the level required by the 1993 standards.

Whirlpool has primary responsibility for marketing the SERP refrigerators. SERP refrigerators are sold under the Whirlpool, Kitchen Aid, and Sears Kenmore brand names. The Program and SERP refrigerators received considerable initial national publicity through extensive media coverage. SERP was featured in more than 650 magazine and newspaper articles (IRT 1995). Since then, most of the marketing effort has been left to Whirlpool's regional sales offices and dealers.

What is Market Transformation?

Market transformation as a means to increase energy efficiency originated at least as early as 1987 when the NRDC proposed a more balanced approach between the incentive "carrot" and regulatory "stick" (Goldstein 1994). Several factors motivated efforts to develop this alternative approach to traditional demand-side management (DSM) programs: on-going tensions between efficiency proponents and equipment manufacturers; political shifts that created pressures to seek market-oriented, rather than incentivized, ways to improve efficiencies; and concerns about DSM costs and cost-effectiveness. Energy efficiency supporters also perceived a failure of both the market and DSM programs to deliver significantly higher efficiency products that could be

economical if produced in large quantities. Finally, many observers were concerned about the apparent lack of long-term impacts from many DSM programs.

Market transformation is the approach that emerged. Exactly what “market transformation” is, however, remains imprecisely defined. Technology diffusion analogies are used by some analysts to describe market transformation. Nilsson (1992) describes market transformation in terms of the “S-shaped” technology diffusion curve. A market transformation program can 1) speed up the timing at which a new, efficient product is introduced, 2) accelerate how quickly it penetrates the market, and 3) increase the final market penetration for the product. These three possible effects are important, but they are too limited.

Market transformation takes a broad view of the market and changes to it that modify the actions of three key groups: consumers, trade allies, and manufacturers. Many market transformation programs emphasize mechanisms directed at manufacturers; the objective is to leverage the utility payment to have a larger economic effect than a direct consumer rebate (Lee et al. 1995).

Market transformation seeks to cause one or more of three types of market changes (Feldman 1994). The nature or members of the three market groups may be modified. The mix of goods and services exchanged may be altered. Finally, the rules of exchange in the market may be reconstructed.

Another feature usually associated with market transformation is that market changes are long lasting. The term “transformation” implies that the market is changed broadly in fundamental ways; it does not simply revert to its previous state when a program ends. McMenemy, Monforte, and Rohmund (1994) note that it is important to track what happens when the program ends: it is likely that the market share of efficiency measures declines, but how much it changes is critically important in determining program effectiveness. These authors and others have pointed out the need to assess free riders—those program participants who would have adopted the program’s energy-efficient measures without the program.

A market transformation program’s largest effect may be beyond the direct program participants. One benefit sought by utilities through market transformation programs is to leverage the dollars invested to achieve energy savings across a wide range of energy users who are not program participants. These so-called “free drivers” may be future, as well as current, purchasers of the technology. It is important to account for these free drivers when determining transformation program success.

Another program effect that should be accounted for is the spillover effect (Violette and Rosenberg 1995). This occurs when programs induce consumers to purchase efficient products other than the product specifically targeted by the program.

SERP is one of the first large-scale energy-efficiency market transformation programs in the country. SERP’s founders expected manufacturers besides Whirlpool to produce similar products to maintain their competitive position. SERP provided an incentive to the manufacturer, rather than the buyer, with the intention of leveraging the utility investment. As anticipated with market transformation programs, SERP has been harder for individual utilities to control, and SERP Inc. is designed to provide some centralized oversight. The Program relied to a large extent on publicity in the popular and industry media to create awareness and a favorable reception.

Implications for Program Evaluation in General

Because of the differences between market transformation and standard DSM programs, the focus of DSM evaluation on estimating the sales and associated energy savings of energy efficiency measures is less useful for assessing market transformation programs. Feldman (1995b) highlights difficulties using sales data to measure program impacts including cost, contamination of sales data by exogenous factors, and reluctance of industry to provide the data. Feldman argues further that sales data are not a particularly useful metric of program impacts because they are a *lagging indicator*—they come at the end of a long chain of market processes. He believes that this fact and their sensitivity to external influences make sales data fairly poor and ineffectual measures of program impacts.

Feldman (1994, 1995a, and 1995b) and others also argue that different indicators of market effects may be more practical and effective market transformation measures. Feldman (1995b) sees two advantages of using *leading indicators*—those closer in time to the program intervention and earlier in the marketing cycle: First, they increase confidence in causal attribution because there are likely to be fewer confounding factors. Second, they are more likely to provide better insights into how well the program is working or if and how program elements should be changed.

Leading, or proximate, indicators of market transformation reflect the effects of market transformation: modifying the nature or members of market groups; altering the mix of goods and services exchanged; and revising the rules of exchange in the market. Although the ultimate effect desired is a reduction in energy consumption, tracking indicators associated with these three market effects may be a more

feasible and useful way to assess effectiveness than measuring energy savings directly.

The permanence of the changes is also a key element of market transformation. If the market reverts to its pre-program conditions when the program intervention ends, then little market transformation has occurred. Prospectively assessing the persistence of market changes necessitates the use of leading indicators.

Market transformation program evaluations also must address the impact of free riders and free drivers. Market transformation programs are expected to have significant free driver effects. If these effects are not properly accounted for, major program impacts may be neglected.

The assessment of free riders has some unique characteristics in market transformation programs. In many cases, market transformation leads to production of a product that did not exist before so pure free riders cannot exist. Often, some program participants who eventually would purchase the product purchase it sooner because of the program; these participants are termed “deferred free riders” (Nelson 1993). Participants who were already going to purchase an improved efficiency level, are called “incremental free riders” (Nelson 1993).

One problematic issue in assessing market transformation programs is the possibility of misidentifying free drivers as free riders (Saxonis 1992). In energy savings estimates, if a decrease is seen in the energy consumption of a comparison (non-program) group, the change is often attributed to non-programmatic factors and netted out from the estimated energy savings. In market transformation programs, energy consumption reductions in a comparison group may be due in part to the program because of spillover effects *that should be added to program savings rather than deducted from estimated savings* for program participants.

Implications for Evaluating SERP

Similar to the approach recommended by Feldman (1995b), our data collection focused on identifying leading indicators of SERP’s market transformation effects and collecting relevant data. Rather than emphasizing sales data, we concentrated on proximate indicators of market transformation farther up the market chain.

Dealer information on promotion of SERP refrigerators, the number of SERP models on the floor, in-store displays, and sales techniques can indicate the significance of the Program at the dealerships. Dealer information on customer awareness, SERP refrigerator prices, and approximate sales percentages also provide information about the Program’s effectiveness. Information on training received from the manufac-

turer or distributor can indicate how committed the producer is to the Program and how effective its efforts have been. Dealers can also provide insights about the response of other manufacturers and brands to SERP.

Information from participating and non-participating dealers can be compared to identify Program impacts. SERP offers the potential of two comparison groups: 1) dealers outside the SERP areas and 2) dealers within the SERP areas who do not carry any of the brands covered by the Program.

Public statements from the industry can provide indicators of SERP’s effects. Manufacturers’ statements on efficiency standards and the elimination of CFCs before and after SERP can be indicative of Program effects.

Significant organizational changes by manufacturers to respond to SERP could suggest that long-lasting changes had occurred in the market.

Despite the problems noted earlier, sales data and trends can be useful measures of Program impacts. The number of SERP units sold, particularly in comparison with projections, is indicative of Program effectiveness. Market shares data, if available, could be examined to explore Program effects. Because of proprietary concerns and study scope limitations, however, key sales data were impossible to obtain for this study.

Energy efficiency data for new refrigerators provide a view of market trends that might be impacted by SERP. Trends in efficiency levels offered by different manufacturers are indicative of market changes. Because SERP also aimed to facilitate the switch from CFCs, data on the number of CFC-free units produced gives other insights into SERP’s effects.

Because SERP involves an entirely new product, it is likely to have only limited or no free ridership. Both deferred and incremental free riders are possible, however, but the scope of our study has not permitted a thorough analysis of these issues.

Free drivers are a critically important component of SERP’s impacts. One category is current buyers in the SERP area who purchase a more efficient refrigerator, or other appliance, because of SERP, but for which the utility makes no payment. Probably most significant are free drivers who purchase SERP-like refrigerators after the Program is over and the utility payments have stopped.² These future free drivers are likely to be the core of SERP’s market transformation effect, but their existence and quantity are difficult to predict and measure. However, market changes that ensure production and sales continue after SERP ends are an indicator that the Program has caused such free driver impacts. Finally, current sales of higher efficiency refrigerators out-

side the SERP utility areas are an additional free driver effect. The participating utilities do not benefit directly from these sales.

METHODOLOGY

We used multiple data sources in this assessment of SERP's market transformation impacts. This section discusses the data sources, data collection, and methodologies used to address key research questions.

We reviewed several studies on SERP and similar programs to provide Program background and help develop specific analytic approaches. Key sources of information included the Program process evaluation (Sandahl et al. 1996), a comprehensive overview of the Program (IRT 1995), a Program overview by Eckert (1995), an efficient refrigerator program evaluation by Sampson (1993), and newspaper articles based on Whirlpool's press releases.

A main focus of our data collection was appliance dealerships. We developed dealer lists for each dealer category (SERP dealers, dealers in SERP areas that did not carry SERP brands, and dealers outside the SERP areas), obtained telephone numbers, and developed interview instruments for each dealer group.

We randomly selected dealers from each of these groups. Taking into account budget limitations, we targeted data collection from a sample of about 5% of the SERP dealers. In addition to the telephone interviews throughout the United States, we conducted site visits to dealerships in the Pacific Northwest. We conducted 101 interviews (including 22 in-person interviews) with SERP dealers as well as 13 interviews with non-SERP dealers in SERP utility areas and 21 interviews with dealers outside of SERP areas.

The dealer interviews provided both qualitative and quantitative information. The qualitative data were entered into a text database software package. The quantitative data included sales volume, importance scores for different refrigerator features, percentage of customers inquiring about energy efficiency, SERP sales percentages, and incremental cost of SERP units.

About half the program utilities were interviewed for the previous process evaluation (Sandahl et al. 1996). We updated and enhanced that information with follow-up interviews.

Most major manufacturers were interviewed for the process evaluation (Sandahl et al. 1996). We conducted manufacturer interviews to update that information and also explore impact and market transformation issues.

We used two energy efficiency data sources. The Association of Home Appliance Manufacturers (AHAM) publishes the *Directory of Certified Refrigerators and Freezers* semi-annually. We used the directories published in January for 1988 through 1995 to provide energy consumption data. The California Energy Commission (CEC) provides a comparable electronic database, the California Appliance Database, which is updated on a regular basis. In addition to energy data, it indicates whether a specific refrigerator model is CFC-free. We used two versions of that database (CEC 1995, 1996).

We examined newspaper advertisements to determine when and how often energy efficiency, CFC-free refrigerants, and SERP were mentioned to provide some indication of the effects of SERP. We examined appliance store advertisements in the Los Angeles Times for 1994, 1995, and 1996. Between April 1994 and March 1996, the LA Times ran 13 SERP ads and 46 non-SERP ads related to energy efficiency.

We reviewed available manufacturers' testimony on refrigerator efficiency standards (Frigidaire 1994, GE 1994, Whirlpool 1994), other public comments by manufacturers, and related information to determine how the technology was expected to change in the absence of SERP. This information provided a baseline of expectations against which the achievements of SERP could be compared. We also examined similar sources after SERP started.

RESULTS AND FINDINGS

To assess the market transformation effects of this Program, several research questions must be answered: Did the Program succeed in demonstrating that the production of super efficient, CFC-free refrigerators could be accelerated? Have significant changes occurred in the refrigerator market as a result of SERP? Did SERP induce the non-winning manufacturers to increase their efficiencies and use of non-CFC refrigerants? Are there any spillover effects from the Program into non-SERP areas? Are there lasting changes in the refrigerator market as a result of SERP? This section discusses our findings.

Acceleration of Technology Introduction and Market Penetration

Information available prior to SERP implied that the goals of energy efficiency and CFC elimination conflicted with each other. Whirlpool's ability to design, produce, and market a SERP refrigerator showed that both goals could be satisfied. The technical issues of designing and producing a qualifying side-by-side refrigerator were overcome and SERP units were produced over 18 months ahead of the mandatory CFC phaseout. It seems unlikely that, without

SERP, any manufacturer would have introduced such a unit so soon.

Whirlpool accelerated the introduction of several new technologies in response to the Program. Whirlpool overcame compatibility problems with the R134a refrigerant and switched refrigerants as early as any other manufacturer. Whirlpool installed fuzzy-logic electronics to optimize the defrost cycle, improved the condenser and evaporator fan motors, and modified other components to achieve the highest efficiency levels in the industry (Langreth 1994). In 1995, Whirlpool introduced evacuated panels and other refinements to reduce consumption another 16%.

Vince Anderson of Whirlpool noted in 1994 that many of Whirlpool's SERP technologies were already under development, but the Program spurred the company into production much earlier than planned (Langreth 1994, p. 67). Comments from Frigidaire, the other SERP finalist, suggested that the Program cut in half the normal 18-month product development process (Schiller 1993, p. 81).

Proprietary issues and project budget constraints prevented us from accurately analyzing the market penetration of SERP. Dealers, however, did estimate their SERP sales and we used these data to estimate market penetration. From dealer data, we estimated that the volume-weighted average SERP sales were significant—about 14% of all units sold by SERP dealers in that category. Some dealers noted, however, that sales had fallen after the first year, in part because of reduced publicity.

We examined the relationship between the share of SERP units sold and other factors. Four factors were correlated with sales: promotion, having models available on the floor, incremental cost (if any) of SERP models, and electricity rates.

Dealers who mentioned that they had conducted more promotional activities tended to sell a larger share of SERP units. Dealers who did not stock SERP units consistently said that they sold an almost negligible amount. Although not surprising, this finding confirmed the importance of having a SERP model on the floor for consumers to see and ask about.

Additional cost of SERP units was negatively correlated with the SERP sales percentage (the correlation coefficient was statistically significant at the 0.01 level). A simple regression analysis suggested that at no added cost, SERP units would comprise about 30% of sales and that each \$100 of added cost lowered the SERP share by about 10 percentage points.

We found that SERP sales appeared to be higher in utility areas with higher electricity prices. Comparing the ratio

between actual and forecasted rebates for SERP units, we found that utilities that were above the average had electricity prices that averaged 2.4¢/kWh higher than prices charged by utilities that were below the average. The difference was statistically significant at the 0.05 level. This result, like the added unit cost, demonstrated the important role of economics in consumer choice.

Changes in the Refrigerator Market

Although SERP clearly accelerated the introduction of new technology, its objectives included broader changes in the refrigerator market. This section discusses our findings regarding some key indicators of market changes.

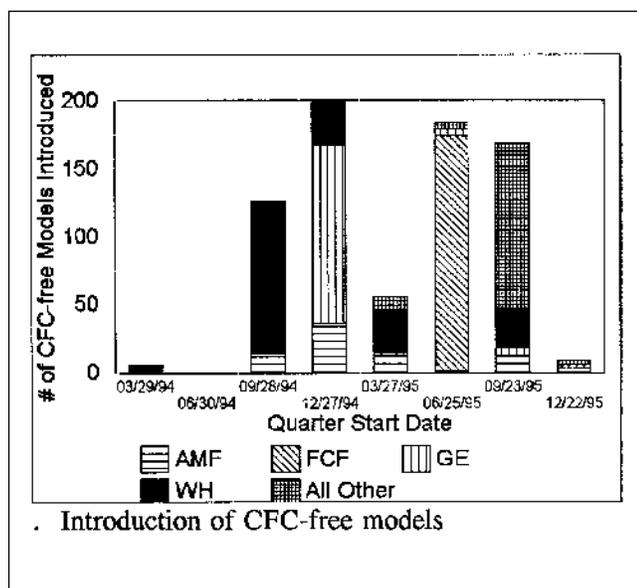
Manufacturer Behavior. What effects SERP had on manufacturer production and marketing decisions are speculative. To protect their bargaining position in future negotiations and to avoid disclosures of corporate plans to competitors, manufacturers were unwilling to discuss in detail how they responded to the SERP competition.

SERP utilities were hopeful that the Program would induce other manufacturers to produce products to compete with the winning model. Ray Farhang, SERP Inc. chairman, noted in 1994 that the SERP refrigerator would “transform the very nature of the market by encouraging all manufacturers to develop and deliver appliances that are as efficient and without CFCs” (PR Newswire, Inc., 1994). The CFC phaseout, negotiations on new efficiency standards, and manufacturers' reluctance to reveal strategies, however, made it difficult to pinpoint manufacturers' responses to SERP, so we explored several indirect indicators of market changes.

Sandahl et al. (1996) noted that utilities and manufacturers expressed different views on whether SERP affected the phaseout of CFCs. Two-thirds of utilities said that SERP had sped up the phaseout by prompting manufacturers to address the need for CFC-free units in their SERP bid and stimulating competition by the non-winning manufacturers. Nearly all manufacturers, on the other hand, said that SERP had no impact on CFC phaseout because they were already working on replacing CFC compounds prior to SERP.

We examined refrigerator model data to shed some light on SERP's effects on elimination of CFCs. Figure 1 shows that over 300 CFC-free refrigerator and freezer models were available over a year prior to the required January 1996 date (CEC 1995, 1996). Whirlpool (WH) led other manufacturers by 3 to 6 months in introducing CFC-free units; about half their models were introduced prior to December 1994. Whirlpool's accelerated schedule across several products was probably attributable in part to SERP.

Figure 1.



The data in CEC (1995, 1996) showed that several manufacturers have not only eliminated CFCs, but have met the SERP 25% minimum efficiency improvement target in various refrigerator sizes and styles. Over one year before the CFC phaseout, Amana and Whirlpool offered over 40 models of high-efficiency, CFC-free refrigerators. By about the same time, GE had introduced five top freezer models meeting the SERP minimum requirements. By January 1996, over 75 CFC-free models were available from different manufacturers that were at least 25% more efficient than the standards.

Although little confirmation was available from manufacturers that the industry responded directly to the SERP units, these data showed that several manufacturers introduced CFC-free, high-efficiency models that could compete effectively with the SERP models.

To examine possible effects of SERP on efficiency alone, we analyzed the data for 21 to 23 cu.ft., side-by-side units (AHAM 1988-95; CEC 1995, 1996). From 1988 to 1996, both the maximum and minimum efficiencies of all brands improved substantially. For example, the energy consumption of both Frigidaire's least efficient and most efficient models declined about 48% over this period. The 1993 appliance standards had a significant effect: the energy consumption of Frigidaire's least efficient model in this category decreased almost 300 kWh/year. The Frigidaire data, however, showed no apparent effects of SERP on efficiency.

Data for other brands, however, did suggest that SERP affected efficiencies. Amana appeared to respond to SERP by improving the efficiency of its most efficient units in both 1995 and 1996. Data for the two other major brands,

GE and Maytag, showed that the efficiency of both brands' least efficient units increased substantially in 1996.

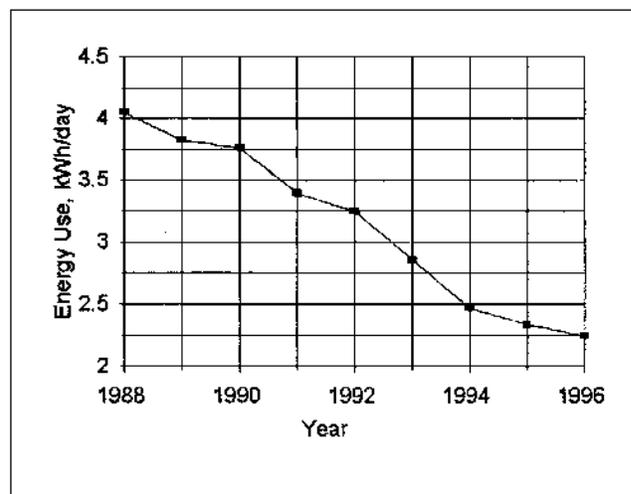
Figure 2 shows that the average consumption for all brands in this size range and style declined 45% between 1988 and 1996. The biggest impact resulted from the 1993 standards; almost 50% of the improvement occurred as the standards went into effect. Comparing the period before any influence from the standards and the period after SERP started, the annual percentage increase in efficiency was comparable: about 5% per year. These results could suggest that SERP promoted no increase in average efficiency levels.

As noted earlier, however, the data for individual brands suggested that SERP had some effect. Three manufacturers made fairly broad efficiency improvements in 1995 and 1996. Whirlpool introduced a comparably efficient "Energy Wise" model outside the SERP utility areas and by 1996 nearly all of Whirlpool's side-by-side units used at least 25% less energy than allowed by the standards. Amana, Whirlpool, and GE produced efficient, CFC-free units in a range of styles, expanding the availability of such units beyond the single style produced for SERP. It is probable that without SERP, these manufacturers would have elected to not make these efficiency improvements.

In mid-1993 no major manufacturers were producing refrigerators in any style and size that consumed 25% less energy than the 1993 standards. By January 1996, over 75 models were available that consumed at least 25% less than the standards and were CFC-free. This suggested that SERP had some effect on multiple manufacturers by advancing when CFC-free, high-efficiency units became available.

Visits to dealer showrooms tended to corroborate the perception that both Amana and GE were competing on the same

Figure 2.



ground as the SERP models. The more energy-efficient GE refrigerators had labels saying that they were “Energy Smart” and some Amana models had stickers saying that they were “Energy Efficient.” Some Amana units had “CFC-Free” stickers and some GE models had “CFC-Free Sealed System” labels.

Although most dealers that we interviewed felt that SERP had not had a direct effect on non-winning manufacturers, about 20% did feel that SERP had influenced other manufacturers. Many noted, however, that efficiencies of all brands had been improving and that CFCs were no longer being used. Most dealers attributed these changes to regulations, rather than SERP. Consistent with our quantitative data, several commented that Amana had increased the efficiency of its units, and one noted that both GE and Amana were mentioning energy efficiency in print ads.

In summary, there is circumstantial evidence that Whirlpool and other manufacturers selectively modified their product line and marketing in response to SERP. It appears that the availability of CFC-free models may have been advanced by SERP. Also, SERP may have promoted production of non-SERP, CFC-free, highly efficient refrigerators in a range of styles. Clearly, SERP’s effect on overall efficiency improvements is speculative. It appears that some manufacturers have improved their efficiencies to remain competitive with the SERP model and that the efficiency improvements have extended beyond the SERP size and style.

Marketing and Dealer Activities. Overall, SERP experienced a major splash of publicity in the beginning and has seen diminishing ripples of local promotion since. Principal responsibility for promoting SERP models rests with Whirlpool, primarily through its regional distributors.

Several dealers felt that Whirlpool’s efforts to promote the Program had slacked off since SERP started. Similarly, it appeared that dealer training had occurred at the beginning of the Program, but not recently. There was no evidence that Whirlpool had publicized, as it did its original SERP unit, the significant advances in its new models.

About 60% of SERP dealers said that they promote SERP models. SERP stickers on the units were the most common promotion. Most dealers had SERP brochures. Some showed consumers articles from the popular press about SERP. About 20% of those who promoted SERP units did so in print ads. Most of the information was from Whirlpool.

The key to generating in-store consumer interest was having SERP models on display. The SERP stickers distinguished the units from others and stimulated consumer questions. The smallest stores, however, were unlikely to have SERP

units on the floor and, consequently, were the least likely to generate consumer interest in SERP.

Most SERP dealers indicated that 5% to 10% of consumers were aware of SERP. Many dealers noted that awareness was much higher at the start of the Program and inquiries had dropped off dramatically in recent months. Consumer awareness was higher for the small share of dealers that mentioned SERP in their ads. Some consumers, especially early in the Program, were specifically looking for CFC-free models and knew that SERP was CFC-free. The most effective, but not very common, ways to increase consumer awareness were steps taken by utilities. In one utility area, the utility ran an “energy store” where efficient appliances, including SERP refrigerators, were displayed. This increased consumer interest substantially. Other dealers noted that utility mail-outs that mentioned SERP had increased awareness.

Dealers also identified obstacles to selling SERP refrigerators. The most common obstacle was added cost. About 20% of the dealers said that higher price was a deterrent to sales. It was hard to compare costs, however, because the SERP models were loaded with features that made comparisons difficult. Dealers who mentioned price as a problem estimated that a SERP unit sold for about \$150 to \$400 more than a comparable model. For dealers who said that price was not an obstacle, about half said that the SERP model was no more expensive than a comparable unit. The remainder typically said that SERP units were between \$20 and \$180 more than comparable models.

Rebates appeared to be a very effective way to respond to perceptions of higher prices for SERP models. In one utility area, SERP units qualified for a rebate of \$120 and this was a great sales stimulant; all qualifying refrigerators had a green sticker on them indicating the rebate amount. Salespeople said that consumers were very aware of the rebate and dealers used the rebate as a selling tool. It appeared that even a small rebate, because of the interest generated, might stimulate sales and reduce concerns about cost.

There was some indication that SERP had increased the promotion of high efficiency refrigerators and CFC-free refrigerants in general. About 70% of the SERP dealers said that they or their store emphasized energy efficiency in their sales pitch, through in-store displays, or in print or radio ads. Only about 50% of non-SERP dealers indicated that they promoted energy efficiency.

Almost all dealers in both SERP and non-SERP areas indicated that some consumers asked about energy efficiency or CFC-free refrigerants. About 40% said that over half the consumers asked about efficiency. The Energy Guide Labels were a broadly used tool for comparing energy efficiency. Consumer interest in refrigerants was about evenly split

between concerns over environmental impacts and potential reliability problems with new refrigerants.

Almost all dealers said that consumer interest in energy efficiency and refrigerants had increased in the last few years. Most felt that interest in efficiency was driven by general information in the media; only one mentioned that SERP had increased consumer interest. Concerns about CFC refrigerants had usually come from media information about ozone depletion. Concerns about performance problems with CFC-free refrigerants had come from word-of-mouth and media stories about problems with new refrigerants.

Together, this information suggested that SERP has affected the promotion of energy efficiency and CFC-free refrigerants somewhat, with the largest effect related to SERP models. Dealers were very positive about the effectiveness of media advertisements and utility promotions.

Spillover Effects

One spillover effect is the efficiency improvements across a range of models offered by Whirlpool and other manufacturers that we suggested earlier were attributable partially to SERP. These changes have benefitted utilities and consumers in SERP and non-SERP areas.

Dealer interviews suggested that SERP stimulates consumer inquiries about energy efficiency, primarily when consumers see SERP units on display. Some non-SERP dealers said that consumers occasionally asked about SERP units because they had seen them at SERP dealers. It appeared that the Program did produce an increase in consumer awareness about energy efficiency, leading to consumers being more likely to buy an efficient refrigerator, even if not a SERP unit.

Some benefits associated with SERP have extended beyond the borders of SERP utilities.³ Whirlpool introduced its "Energy Wise" model for sale in non-SERP areas, and efficient refrigerators produced by other manufacturers are available in both SERP and non-SERP areas. These effects could be classified as free drivers for which the SERP utilities incurred no costs. Some of the energy savings benefits would accrue to the SERP utilities and some would accrue to non-SERP utilities.

One problematic category of spillover in this Program are SERP units installed in non-SERP areas, but for which SERP utilities pay Whirlpool. SERP's planners anticipated such sales and set aside funds to cover them, but the associated energy savings are not direct benefits to SERP utilities. We did not have adequate data to analyze these negative spillover effects, but they were expected to be relatively small.

Lasting Changes

We investigated several possible categories of lasting changes attributable to SERP.

We looked for institutionalized organizational and product line changes at Whirlpool and other manufacturers. None of the manufacturers indicated that SERP led to any lasting organizational changes to focus better on energy efficiency or CFC phaseout. Whirlpool integrated the production of the SERP units into its regular production process and this represented a transformation of the production process because SERP units did not continue to be treated as unique.

Most manufacturers commented that SERP had little, if any, long-term effect on their product lines. Even the Whirlpool spokesman stated that SERP had little effect on its other products. Despite the fact that they did not market their SERP unit, however, a Frigidaire representative noted that it did use some of the cost-effective technologies from its SERP model in other products. One manufacturer representative noted that the winning SERP model was in such a small market niche that his company did not feel it needed to compete with SERP models and they did not influence its products.

Overall, manufacturers felt that SERP had not induced significant long-lasting market changes. The Whirlpool spokesman articulated this view as follows: "I assume that market transformation means long-lasting change so that consumer preferences are shifted, manufacturing infrastructure is altered, and undoing these changes is not feasible. Since refrigerators are a collection of components, we can take out the SERP components easily after the Program ends. [Furthermore] the efficient technologies [need to have] consumer benefits that will convince buyers to not go back." Generally, manufacturers felt that the efficiency improvements in refrigerators offered consumers few of the other benefits that would create a lasting shift in consumer demand.

Although manufacturers expressed doubts that SERP had induced any long-lasting market changes, it seems unlikely that the efficiency gains in Whirlpool's non-SERP models and other manufacturers' products will disappear when SERP ends. To the extent that these gains are related to SERP, SERP will have lasting effects on future efficiency levels.

There is less evidence that long-lasting changes have been made in dealer behavior or consumer preferences. Although there is evidence of such changes during the Program, it appears that they are modest enough that they are unlikely to last long after SERP ends.

The most significant lasting change resulting from SERP could be its effects on the next generation of appliance efficiency standards. Sandahl et al. (1996) noted that perceptions were mixed about SERP's effect on tightening the standards. Nine of 11 SERP utility representatives they interviewed felt that SERP would have at least some positive impact on tightening refrigerator standards. About half the refrigerator manufacturer representatives stated that SERP would have some effect on tightening the standards. The study authors quoted one participant in the standards negotiation process who said that "It is likely that SERP had at least some effect on the proposed 1998 NAECA standard. While the technical aspects of the SERP model reportedly were not discussed in the negotiations, the SERP model was referenced as evidence that an energy-efficient CFC-free refrigerator could be produced cost effectively."⁴

CONCLUSIONS AND RECOMMENDATIONS

This section provides some answers to the question of whether SERP accomplished market transformation and provides some lessons for future market transformation programs.

Did SERP Succeed at Transforming the Market?

The possibilities of SERP succeeding as a market transformation effort were limited by the context in which the Program occurred. The CFC phaseout schedule, for example, minimized the impact of the CFC-free feature of SERP refrigerators. To control production disruptions and meet the January 1996 deadline, most refrigerator manufacturers began phasing out CFCs in their products shortly after SERP began. Therefore, the uniqueness of SERP units as CFC-free products was relatively short-lived. Ironically, the success of previous refrigerator efficiency standards also limited the market impacts of SERP. Many dealers noted that they emphasized energy efficiency to their customers by comparing the consumption of an old refrigerator with **any** new refrigerator because all refrigerators were now required to meet the 1993 standards; consequently, the additional energy savings of SERP refrigerators were at the margin, and hard to justify, if the consumer had to pay any additional amount, or preferred styles or features were not offered in the SERP units. Because of these limitations, it should not be surprising that few observers would attribute major market changes to the Program.

SERP did succeed in transforming the energy-efficient refrigerator market from the technology perspective. It led to the design, production, and sales of an entirely new refrigerator that has achieved efficiency levels unmatched by com-

parable units. It appears that the SERP units provided a foundation for Whirlpool to improve the efficiency of all its side-by-side units substantially. SERP demonstrated that major efficiency gains could be made, even without CFC refrigerants, and provided a basis for future production of Whirlpool's other efficient models and development of the next efficiency standards.

Major changes across the entire refrigerator manufacturing industry, however, were not apparent. A few efficiency improvements by other manufacturers did occur in direct response to SERP, but the average effect across all brands was relatively modest. The impact of even modest changes, however, could affect the overall Program benefits significantly.

There was little evidence that SERP caused fundamental changes in the retailer and consumer segments of the market. Nevertheless, there was evidence that the initial Program publicity created extensive buyer and dealer interest and this showed that the market could be responsive to effective promotion.

SERP Impacts

Lee and Conger (1996a) present a preliminary benefit-cost analysis of SERP based on data available at the end of 1995. Using the total resource cost test, reasonable assumptions, and accounting for no free rider or free driver effects, they arrived at a base case benefit-cost ratio exceeding one. The major free driver benefits estimated were those associated with future Whirlpool units that were more efficient as a result of SERP. A conservative estimate of these benefits more than doubled the base case benefit-cost ratio. A major unanticipated uncertainty in the benefit-cost analysis was the extent to which dealers charged more for SERP units for which Whirlpool also received an incentive payment. Evidence indicated that this did occur and it could have major impacts on overall cost effectiveness.

Lessons for Future Market Transformation Programs

A conflict is almost inevitable in market transformation programs between advancing the technological state-of-the-art and widespread adoption of new technology. SERP was designed to strike a balance between these competing objectives by providing adequate incentives to lead to production of a new technology, but not one so advanced that it would take years to be widely adopted. To a large extent, SERP achieved these ends, and the balancing of these objectives in SERP should serve as a model for other programs.

Many manufacturers, however, questioned the "winner-take-all" approach of SERP. These manufacturer concerns

represented their self interest, of course, but also pointed out a potential risk of such approaches: the risk inherent in relying on a single producer. It would probably be advisable in future market transformation programs to permit more winners by setting a qualifying performance level at which any product could be certified as a “winner.” How far the technology could be pushed in such an approach, however, remains an open question.

Although manufacturers and utilities were involved in the design of SERP, some manufacturers felt that utilities lacked an understanding of the appliance industry and market. Some utility representatives echoed this theme, and both utility and manufacturer representatives suggested that a more solid base of mutual understanding be built as the foundation for future programs.

In a program such as SERP, where utilities expend funds for appliances that might be sited outside their service territory, tracking is critical. Technological solutions, such as bar coding and improved automation, may overcome tracking problems eventually. In the meantime, simple agreements between adjoining participant utilities may be preferable to complex accounting systems. However, widespread geographical dispersion, which results in extensive mixing of participating and non-participating utilities, amplifies the problem. The lesson for future programs may be to emphasize the participation of adjoining utilities across entire geographic regions.

Because labeling and consistency are very important in developing consumer awareness, planners should give thorough consideration to creating standardized labels, such as the Golden Carrot, for future sets of similar market transformation programs.

One of the major lessons from SERP that should be considered in the future is the importance of addressing consumer preferences and economics. Dealers and refrigerator manufacturer representatives frequently mentioned the necessity of educating consumers about the benefits of energy-efficient appliances (including improved performance, reduced environmental damage, quieter operation, and reduced utility bills) in ways that addressed consumer needs. Dealers need to have effective information, including current and future monetary impacts, available to address the basic economics for consumers. To address preferences, non-monetary benefits need to be identified and communicated to consumers. The key implications for future market transformation efforts are that 1) consumer economics and preferences must be an integral, major consideration during program design and 2) activities must be included in the program to ensure that relevant economics and preferences are identified and analyzed, and necessary information is then communicated effectively to consumers.

Finally, issues associated with regulatory treatment of market transformation programs are of critical importance to both utilities and regulators. Although this paper does not address these issues, it provides some relevant lessons. In our view, SERP has affected the market for energy-efficient refrigerators directly by making the SERP models available and, indirectly, by spurring Whirlpool to raise the efficiency of all its side-by-side units and prompting other manufacturers to introduce models that, although not as efficient as SERP units, are efficient enough to compete effectively with the SERP models.⁵ There is strong circumstantial evidence that these market changes are attributable to SERP. The issues for regulators in SERP and other market transformation programs are the weight of the evidence, the magnitude of effects, and the mechanism for rewarding utilities. SERP has demonstrated that in at least some programs publicly available data can be used to assemble substantial evidence of market transformation effects. As some authors have suggested (e.g., Wirtshafter and Sorrentino 1994), the issues of assessing the magnitude of such effects and rewarding utilities might best be established through procedures negotiated before the programs begin. Experiences with SERP and other programs can begin to provide the framework for conducting such negotiations in the future.

ENDNOTES

1. The Pacific Northwest National Laboratory is a multi-program national laboratory operated for the U.S. Department of Energy by Battelle Memorial Institute under Contract DE-AC06-76RLO 1830.
2. There is no information available at this point on what the SERP organization intends to do after SERP ends. It is unknown, for example, whether the SERP label will still be applied to complying refrigerators.
3. As noted before, these effects outside the SERP territories should be attributed to the Program rather than included in the baseline trend when estimating impacts.
4. From personal communication with Howard Geller, American Council for an Energy-Efficient Economy.
5. Comments from Whirlpool’s competitors suggested that other manufacturers did not introduce models equivalent to the SERP units because they would not have been able to produce and sell them at a profit without the benefit of the SERP incentive payment.

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