

---

# Super Efficient Refrigerator Program

## Profile #106

Executive Summary	2
SERP's Concept and Structure	3
U.S. Household Electricity Use; Genesis of SERP; Traditional DSM Versus Golden Carrots®	
The SERP Refrigerator	6
Features of the Winning SERP Refrigerator	
Program Design and Delivery	7
The Bid Pool; The Request For Proposals; SERP Member Utility Bid Pool Contributions; The Winning Proposal; Marketing; Staffing Requirements	
Monitoring and Evaluation	11
Monitoring with the ExacTrack® System; Evaluation	
Program Savings	12
Participation Rates; Free Ridership; Measure Lifetime; Savings Overview; Annual Energy Savings; Annual Capacity Savings; Cumulative Energy Savings; Cumulative Capacity Savings	
Cost of the Program	14
Cost Effectiveness; Costs Overview; Cost of Saved Energy at Various Discount Rates; Cost Per Utility Customer; Cost Components	
Environmental Benefit Statement	16
Lessons Learned / Transferability	18
References	21

# Executive Summary

The Super Efficient Refrigerator Program (SERP) is a model energy efficiency program for many reasons. First and foremost, SERP has proven that utilities working together can transform the market for energy-efficient refrigerators, accelerating the adoption of CFC-free sealed refrigeration system units, while simultaneously promoting energy efficiency. Backed by a solid program design crafted by the U.S. Environmental Protection Agency, Natural Resources Defense Council, Pacific Gas & Electric, and Southern California Edison, twenty-four utilities committed a total of \$30 million to push the market for super-efficient refrigerators using a winner-takes-all competition. The manufacturer that could create the most efficient, CFC-free refrigerator, coupled with the ability to manufacture, distribute, and track its sales, won the contract under which incentives would be paid as units were sold in SERP members' territories.

The program's spin-off effects have been huge. As a result of technology developed for the SERP RFP, Whirlpool's entire line is now made up of CFC-free sealed refrigeration system refrigerators. In addition to producing the winning SERP model in record time, as per terms of their bid, Whirlpool has now developed three new SERP sizes for its 1995 series each of which is even more efficient than the original.

The direct energy savings effects of SERP refrigerators are quite dramatic, while the indirect effects will be fantastic. In terms of direct sales, 25,000 SERP refrigerators are forecast to be sold during 1994 which would provide annual energy and capacity savings of 7.1 GWh and 1.6 MW conservatively, based on the margin between the DOE 1993 appliance standard and the efficiency of the SERP model. When the program's complement of 250,000 refrigerators enter the market as planned, the program will result in direct annual energy savings of 96 GWh and 22 MW. The program will result in lifecycle savings of 1,831 GWh. It is the indirect effects of the market transformation, however, that will create the greatest benefit. Because of the program Whirlpool's competitors are now also focused on developing super-efficient refrigerators which is a clear indication of the program's market transformation success.

While SERP provides a potent model of market transformation, the program has fallen short of some of its participating utilities' expectations. Both SERP and Whirlpool were remarkably successful with their initial program responsibilities, but sales information has been slow to reach SERP member utilities. This has apparently been due to a lack of clear communication between Whirlpool, its distributors, and retail vendors as well as the link between participating utilities and SERP's administration. Nevertheless, SERP provides a strong platform and a template for subsequent programs for other end-uses. While it is unclear how this program design will fit into the re-regulated U.S. utility environment, and the design may not be applicable in the transition, SERP has demonstrated that it is possible to provide a win-win solution for utilities, their customers, manufacturers, and the environment.

## **SUPER EFFICIENT REFRIGERATOR PROGRAM**

**Sector:** Residential

**Measures:** Super efficient refrigerators

**Mechanism:** Twenty-four utilities presented an RFP to manufacturers for a refrigerator that was to be 25-50% more efficient than 1993 standards. The Whirlpool Corporation won the winner-takes-all competition based on energy savings and its ability to produce, market, and deliver on a national scale in a timely manner

**History:** First Super Efficient Refrigerators became available in member utilities service territories in January of 1994

### **1994 PROGRAM DATA**

Energy savings: 7,125 MWh

Capacity savings: 1.63 MW

Lifecycle energy savings: 135,375 MWh

Cost: \$2,634,600

### **CUMULATIVE DATA**

Energy savings: 192,750 MWh

Lifecycle energy savings: 1,831,125 MWh

Capacity savings: 21.95 MW

Costs: \$26,345,800

### **CONVENTIONS**

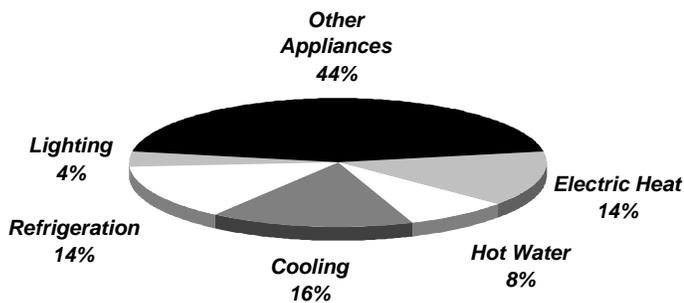
For the entire 1994 profile series all dollar values have been adjusted to 1990 U.S. dollar levels unless otherwise specified. Inflation and exchange rates were derived from the U.S. Department of Labor's Consumer Price Index and the U.S. Federal Reserve's foreign exchange rates.

The Results Center uses three conventions for presenting program savings. **ANNUALSAVINGS** refer to the annualized value of increments of energy and capacity installed in a given year, or what might be best described as the first full-year effect of the measures installed in a given year. **CUMULATIVE SAVINGS** represent the savings in a given year for all measures installed to date. **LIFECYCLE SAVINGS** are calculated by multiplying the annual savings by the assumed average measure lifetime. **CAUTION:** cumulative and lifecycle savings are theoretical values that usually represent only the technical measure lifetimes and are not adjusted for attrition unless specifically stated.

# SERP's Concept and Structure

Household refrigerators in the United States account for approximately 14% of total residential electricity use. While this is still a large share of the total, the efficiency gains in this end-use have been quite dramatic in the past 25 years. The energy use per unit adjusted volume of the typical U.S. R/F has decreased dramatically from 95 kWh/ft<sup>3</sup> annually in 1972 to 49 kWh/ft<sup>3</sup> annually in 1987 to 39 kWh/ft<sup>3</sup> annually in 1993. In 1972, the average annual cost to operate a 22 cubic foot side-by-side refrigerator was \$210. By 1993 this figure had dropped to \$70, with most efficiency gains achieved to date coming from fairly simple changes. For instance, in the 1970s U.S. manufacturers switched from glass-fiber insulation to polyurethane foam to reduce heat gain through the refrigerator shell. More efficient compressors, which account for the largest energy use in R/Fs, have also accounted for major energy savings. Other improvements include higher-efficiency fan motors, larger heat-exchange coils, and improved door seals.[R#20,22]

**U.S. HOUSEHOLD ELECTRICITY USE**



Due to the Montreal Protocol, which was signed by 150 nations in 1987, the use of CFCs used both as a cooling agent and to manufacture foam insulation will be prohibited as of January 1, 1996. While important in order to protect the strato-

spheric ozone layer, unfortunately non-CFC cooling technologies will partially offset recent efficiency gains because they are approximately 5% less effective at cooling as are conventional CFCs. (Note: Before research into non-CFC technology it was feared their cooling effectiveness would be 15% less than CFC's.) Thus without a program like SERP, protecting the ozone layer would inflict another toll on the environment: the need for additional power generation.[R#15]

## THE GENESIS OF SERP

The Super Efficient Refrigerator Program, Inc. (SERP), headquartered in Washington, DC, is a non-profit corporation which was formed in 1991. The stated mission of SERP is to advance the technology of super efficient refrigerators/freezers (R/Fs) and bring these energy-efficient R/Fs to consumers years in advance of normal market projections. SERP hoped to take advantage of a closing window of opportunity between 1994 and 1997 to stimulate development of a non-CFC refrigerator that would surpass 1993 standards and advance technology in anticipation of the new 1998 standards. Twenty-four utilities in the United States are participating in the program. Together they committed just over \$30,000,000 for a competition-based request for proposals (RFP) process, subsequent administration of the program, and the Golden Carrot<sup>®</sup> award which would provide the winning manufacturer with ample incentive to develop, produce, and distribute a specified number of competitively priced, non-CFC refrigerators which would be sold in the participants' service territories between January 1, 1994 and June 30, 1997. The "super-efficient" refrigerators are required to be between 25 and 50% more efficient than those meeting 1993 government standards and in order for the manufacturer to receive incentive payments the SERP models' wholesale prices can not be any higher than standard CFC models with similar features.[R#1,2,24]

The seeds for the SERP program were germinating in the mid to late 1980's when Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and others were thinking about ways

## SERP's Concept and Structure (continued)

---

to increase the savings in their refrigerator programs. Ray Farhang at Southern California Edison had been looking at appliances in Denmark and Sweden and eventually sent out an RFP to manufacturers for a super efficient refrigerator. A Danish company won the RFP but in the end was unable to finalize an acceptable design and sell the units on a broad scale due to engineering challenges, marketing and distribution capabilities. [R#14]

In September of 1988 PG&E was preparing for its 1990 General Rate Case and was also looking into various ways to complement its existing refrigerator incentive programs which had been running for about ten years. As part of the California Collaborative's efforts, David Goldstein of Natural Resources Defense Council, suggested that PG&E pursue funding for a super efficient refrigerator. The utility's initial concern was that it would be incredibly difficult and expensive to persuade refrigerator manufacturers to markedly improve the efficiency of their refrigerators because of consumers' disinterest in paying a premium for efficiency. PG&E also realized that the costs of such an effort, if provided solely by PG&E, would be prohibitive and that it would be impossible for the utility to match the cost effectiveness levels of its existing refrigerator programs. [R#16]

By early 1992, as mandated by the Montreal Protocol, President Bush announced an accelerated phaseout schedule for CFCs, which would require refrigerator manufacturers to eliminate CFCs from refrigerators by January 1, 1996. Furthermore, in 1998, new more stringent U.S. DOE standards would replace the 1993 standards for appliance efficiency. Since non-CFCs are less effective as coolants than CFCs, unless new cost-effective technologies could be introduced, the Montreal Protocol threatened to actually decrease the efficiency of new refrigerators below the 1993 standards. While some manufacturers were producing extremely efficient, although much more expensive models, it seemed very unlikely that broad distribution of these newer technologies would occur unless large manufacturers were provided with a strong incentive to produce highly efficient, environmentally friendly, and most importantly, affordable refrigerators.

The notion of a collaborative effort quickly evolved and the first step was to develop a business structure which could administer the introduction of commercially viable energy-efficient technologies into the marketplace. Together the Natural Resources Defense Council (NRDC), the American Council for an Energy-Efficient Economy (ACEEE), the Washington State Energy Office, the U.S. Environmental Protection Agency (EPA), and leading utilities such as Pacific Gas & Electric, Southern California Edison, Long Island Lighting Company, Sacramento Municipal Utility District, and others, formed the Super Efficient Refrigerator Program. [R#14,16,27]

The U.S. EPA then sponsored an evaluation to determine the potential and cost-effectiveness of various refrigerator technologies. It determined that cost-effective technologies did indeed exist and that there were a variety of ways that manufacturers could utilize those technologies. The evaluation suggested that there could be a healthy design competition and that in the end no one manufacturer could corner the market of super efficient refrigerators by owning patents or technologies.

### **TRADITIONAL DSM VERSUS GOLDEN CARROTS®**

Historically utility DSM programs have motivated consumers and businesses to purchase high-efficiency appliances and equipment. However, these programs have varied greatly, gaining mixed results and often run for limited time periods. Furthermore, these programs stimulate sales of efficient products that are already on the market, but don't give enough lead time or have large enough participation rates to influence big manufacturers who operate on a national scale. Unfortunately, neither utility conservation programs nor consumers had as yet induced manufacturers to shift their longer-term production priorities toward more advanced, super efficient technologies.

A Georgetown Economic Services Study commissioned by SERP in 1991 determined that a direct customer rebate, which could make a Super Efficient Refrigerator available to consumers for the same price as currently available models, would cost a utility 82% more than an incentive paid directly to the

---

manufacturer. But without the manufacturer's incentive to overcome the market risks of developing and producing super efficient models it seemed very unlikely that a super efficient model would be produced in the near future. Thus SERP decided to design an RFP aimed at large refrigerator manufacturers for a non-CFC sealed refrigeration system, super efficient household refrigerator with auto defrost, that would be available nationally in the very near future at a price that would be no more than less efficient models. [R#12]

The idea behind SERP is that by working together, utilities and other interest groups can create attractive, forward-looking, and consistent market-driven programs (Golden Carrots®) to promote energy efficiency. Golden Carrots® are voluntary initiatives aimed at encouraging manufacturers to produce and market more energy-efficient products. Basically, the Golden Carrot® approach is to form customer groups with common goals who can then pool sufficient amounts of money in order to incent manufacturers of a given product to greatly increase efficiency levels of their product. This pool would be offered as reward for winning a design contest in which interested manufacturers could compete. The contest would drive the group's cost of saved energy down by allowing competing manufacturers to bid against each other. Using this Golden Carrot® approach, coupled with cleverly designed RFPs, utilities can help bring more advanced, super efficient products to market quickly and, as mentioned above, incentives can be provided directly to manufacturers at less expense than the rebates required to initiate similar purchases on the part of end-users. [R#6,7,11]

SERP selected an RFP framework for the incentive contract because it provided competition and a predictable process for disbursing funds in return for a product specified well in advance of its market introduction. The SERP framework provides utilities with cost-effective, coordinated program administration and also allows them to recover any unspent investments when the program ends. [R#7]

Under the National Appliance Energy Conservation Act (NAECA), the U.S. Department of Energy (DOE) sets stan-

dards for appliance efficiency based on technical feasibility and cost-effectiveness. This approach has led to significant efficiency improvements, but has placed government and academics against the manufacturers to determine the limits of cost-effective technology. NAECA only sets a performance floor and provides no incentives for significant new innovations that would lead to large efficiency improvements. The Golden Carrot® approach nicely complements NAECA's regulatory stick. As NAECA establishes minimum standards, the Golden Carrot® approach pulls the upper end of the market to greater and greater efficiency levels. Furthermore, by bringing advanced technology to the market, a successful Golden Carrot® program provides the DOE with the information it needs to determine whether higher efficiency standards are technically feasible and economically justified. [R#11]

# The SERP Refrigerator

---

In June 1993 the Whirlpool Corporation, of Benton Harbor, Michigan, was declared the winner of SERP's \$27 million Golden Carrot®. After the initial round of the competition in which 14 manufacturers submitted proposals, in the final round, Whirlpool, which markets refrigerators under the brand names Whirlpool and Kitchen Aid (and manufactures for Sears which markets under the Kenmore name) beat out Frigidaire Refrigerator Products, which is the United States subsidiary of the Swedish manufacturer, AB Electrolux. Rather than developing radical new technologies to win the competition, Whirlpool chose to refine its most efficient current technology. The result was a new model with a CFC-free sealed refrigerant system which was 29.7% more efficient than 1993 federal energy standards require. Subsequently Whirlpool has produced three new 1995 SERP models which are 40% more efficient than the 1993 standards require.[R#12]

Whirlpool had already been manufacturing a 22ft<sup>3</sup> refrigerator that was 20% more efficient than the 1993 standards so they used it as a starting point for designing their prototype SERP model which needed to be at least another 10% better to qualify. Of course the SERP RFP required that the prototype also needed to be CFC-free so there needed to be further technological gains in efficiency to overcome the loss in cooling efficiency of non-CFC coolants. To accomplish these design challenges, first engineers at Whirlpool replaced the CFC-11 blowing agent used to make the foam insulation with a less environmentally harmful blowing agent, HCFC-141b. Unfortunately, when they tried switching from the chlorine-based CFC-12 refrigerant to the environmentally benign HFC-134a (a refrigerant made completely without chlorine) they discovered a chemical reaction between the HFC-134a and the compressor's lubricating oil. The reaction caused clogging in the refrigerator's capillary tubes (which run from the evaporator in the freezer compartment to the compressor below) so Whirlpool had to test nearly 40 other oils before finding a suitable one. (Note: In the future electromagnetically driven compressors which use the refrigerant gas as their lubricant may eliminate this problem.)[R#15,23,35]

Several other features were embedded in the prototype refrigerator. For instance, a small valve inside the compressor, which allows gas into the compression chamber, was redesigned. More efficient condenser and evaporator fan motors replaced the ones used in the standard model. A "fuzzy-logic" microprocessor was installed to record the running times of both the compressor and the defroster which allowed for much tighter control of the defrost cycle and which by itself increased the refrigerator's efficiency 3-4%. The thickness of the insulation in the doors was also increased by an inch and a condensation drain pipe which drains water out the bottom of the unit was bent in two places to keep warm air from coming back up the pipe and back into the refrigerator.[R#12,23]

## FEATURES OF THE WINNING SERP REFRIGERATOR

- Insulation is made using more environmentally benign HCFC-141b blowing agent (non-CFC) rather than the traditional CFC-11.
- Non-CFC HFC-134a refrigerant replaces CFC-12.
- Modification of compressors to achieve greater efficiency and handle the new CFC-free refrigerant fluids which are more corrosive to refrigerator components than conventional refrigerant fluids.
- Fuzzy-logic microprocessor to constantly monitor the defrost cycle and adjust it to go on less often if, for example, the door is opened infrequently or the previous cycles were very short.[R#12,26]
- Permanent Split Capacitor (PSC) condenser fan motor.
- Thick doors containing an extra inch of foam insulation.
- High Efficiency Shaded Pole evaporator fan motor.
- Drain pipe bent to eliminate return of hot air.[R#12]

# Program Design and Delivery

---

Beginning in the spring of 1992, SERP, Inc. started a national campaign to get as many utilities as possible to join in its efforts by educating utilities and utility regulators on the details and potentials of the program. SERP solicited monetary commitments from utilities to cover manufacturer incentive payments and the administrative costs of supporting the RFP and contract performance phases of the program.[R#2,5]

In 1992, PG&E, Bonneville Power Administration, Long Island Lighting Company, Los Angeles Department of Water & Power, Sacramento Municipal Utility District, and Southern California Edison became the first utilities to commit to the Super Efficient Refrigerator Program.

## THE BID POOL

A total of 24 utilities, with a customer base representing 21% of U.S. households, eventually joined SERP and committed just over \$30 million (unlevelized) to the project. Each utility decided for itself the appropriate level of investment and the number of refrigerators each received for sale in their service territories was directly proportional to the level of their investment. Approximately 4.27% of each utility's total commitment was deposited into a separate account for the purposes of compensating the manufacturer for "cross border" sales of SERP refrigerators to customers outside the participants' service territories. Of the total amount, \$27 million was designated for payment of the per-unit manufacturer rebate also known as the "bid pool" or Golden Carrot® which would be paid to the manufacturer of the SERP refrigerator on a per unit basis. The accompanying table (page 9) lists all of the participating utilities as well as the amount that each made available to the bid pool. (These amounts do not include money set aside for the administration of the program.)

In order to attract a broad spectrum of utility participation, SERP allowed participating utilities to contribute to either of two different bid pools. The different bid pools address the fact that utilities with high avoided costs can afford to pay more in incentives for advanced refrigerators than others can while meeting cost effective criteria for DSM programs. Utilities with lower avoided costs, were able to participate in a second bid pool which would be awarded the winning manufacturer only if their requested incentive was affordable to these utilities.[R#24]

Since manufacturers had to self-determine a per unit incentive level in their proposals the bid pool was structured so as to encourage the manufacturer to request an incentive under 37.5 ¢ per first year kWh savings. This was a level that all participating utilities could contribute to cost effectively. If the manufacturer requested an incentive payment which exceeded 37.5¢ per first year kWh savings, (requested incentives could not exceed 50¢ per first year kWh savings) then its award would be paid solely by the Group A bid pool to which only those utilities with high avoided costs were contributing. But if the manufacturer requested an incentive payment equal to or less than 37.5¢ per first year kWh savings, then it would be awarded a larger sum which would be paid from the combined Group A and Group B pools. (See table page 9.) Whirlpool's eventual proposal, not surprisingly, sought to take advantage of the expanded bid pool which included both Group A and Group B.[R#2]

## THE REQUEST FOR PROPOSALS

In February of 1992 SERP designed a draft RFP which was released to all known interested manufacturers for comment and was also advertised in The Wall Street Journal. The RFP was developed solely by SERP and its advisors. None of the advisors were representatives of any manufacturer, however, individual manufacturers were involved in a process with SERP whereby they provided confidential input in private meetings and through written submissions. This process encouraged manufacturers to be forthcoming with technological, marketing, and tracking ideas. In July of 1992 the final RFP was issued at a public conference in Chicago. More than 400 RFPs were issued although many of these were sent to interested parties who were not refrigerator manufacturers. By October of 1992 fourteen manufacturers had submitted proposals for the opportunity to manufacture the SERP refrigerator and claim the \$30 million contract for the bid pool. Whirlpool and Frigidaire were judged to have the best proposals and were selected for the second phase of the program. In the second phase the two manufacturers had to submit prototypes of their proposed SERP model. Following analysis of the prototypes and evaluation of final offers, SERP awarded the contract to Whirlpool.[R#2,12]

## Program Design and Delivery (continued)

---

SERP's RFP defined "super efficient" as a refrigerator that 1) meets or exceeds Trial Standards Level 5 as developed by DOE for refrigerators under NAECA, and 2) consumes, at a minimum, 25% less energy than a similar unit at the 1993 NAECA standard. SERP also required that the refrigerators have an automatic defrosting capability and an interior capacity of between 14.5 and 26.7.5ft<sup>3</sup>. SERP refrigerators also had to be CFC-free, although hydrochlorofluorocarbons (HCFCs) were acceptable. Participants in the RFP had to propose the number of refrigerators to be produced, the unit incentive, a marketing and tracking plan, and a delivery schedule to retail stores. Proposals also had to certify that the wholesale price to dealers of the proposed refrigerator would not exceed that currently charged for less efficient refrigerators of similar size and features. Finally, deliveries of SERP refrigerators to retailers in each participating utility's service area must be completed by June 30, 1997.[R#12]

Proposals were judged by an independent team of experts and SERP was careful to keep confidential all proprietary information contained in the proposals. The framework for evaluating proposals considered the proposer's mass production capability as well as its ability to distribute the new product nationwide. SERP also wanted to be sure that the manufacturer could actively stimulate sales and accurately track those sales so the proposers' marketing and tracking plans were given careful scrutiny.[R#2,12]

The RFP's scoring system assigned energy savings the greatest weight in the mix of evaluation factors. The proposals of the two finalists presented the best energy efficiency for the least cost and the earliest delivery schedules. Both finalists (Whirlpool and Frigidaire) proposed refrigerator units of a size in which the greatest energy savings could be achieved (units 22 cubic feet and larger). RFP respondents determined that SERP's minimum requirements and DOE Trial Level 5 standards could not be achieved cost effectively in smaller units given the structure of SERP's RFP which stressed cumulative savings. The same amount of money spent on making refrigerators more efficient will produce greater energy savings in a larger

refrigerator than in a smaller unit and therefore in order to realize a certain level of cumulative savings it is more cost effective to produce the bigger units and ship fewer of them than it is to produce more of the smaller units that save less individually. Simply put, the contest emphasized savings as its prime objective and greater savings per unit were achievable in larger models.[R#12,15,24]

Specifically, the scoring system for the RFP was designed as follows.[R#2]

**Unit Energy Consumption Savings:** The bid evaluation formula derived a value for the lifecycle energy savings of the refrigerator based on: 1) the energy saved annually, in kWh, by the proposed unit compared to a unit whose energy consumption is equal to the 1993 NAECA standard for that unit's model type and adjusted volume; 2) the monetary value to SERP utilities of energy saved (a nominal value of 7 ¢/kWh was used); and 3) an expected refrigerator lifetime of 19 years. The scoring formula used a real discount rate of 6% to calculate the present value of the energy saved by the unit bid over its lifecycle.[R#2]

**Number of Units to be Available for Sale and Delivery:** The offerer must state the minimum number of units it shall tender for sale and delivery to retail outlets in SERP service territories. The bid scoring formula was structured so that the higher the number of units an offerer committed to tender for sale and delivery in exchange for the total award pool (and therefore the lower the offered incentive per unit), the higher the offerer's score in the evaluation of proposals.[R#2]

**Delivery Schedule:** The proposal had to include a schedule for the sale and delivery of SERP models into utility service territories, in six-month increments, until all units have been delivered, at least by June 30, 1997.

Of the 100 total maximum points possible in the overall bid score, 75 were based on unit energy savings and this is clearly why both Whirlpool and Frigidaire's proposals were for large

<b>SERP MEMBER UTILITY BID POOL CONTRIBUTIONS</b>	<b>MANUFACTURER INCENTIVE GROUP A</b>	<b>MANUFACTURER INCENTIVE GROUP B</b>	<b>NUMBER OF RESIDENTIAL CUSTOMERS</b>	<b>CROSS BORDER GROUP A</b>	<b>CROSS BORDER GROUP B</b>
<i>Atlantic City</i>	\$427,370		399,300	\$21,350	
<i>Arizona Public Service</i>		\$208,912	545,000		\$10,462
<i>Bonneville Power Administration</i>	\$1,794,954		1,520,000	\$89,670	
<i>Baltimore Gas</i>	\$1,218,073		1,100,000	\$60,851	
<i>Central Maine Power</i>		\$256,356	445,670		\$12,874
<i>Commonwealth Electric</i>		\$427,370	303,547		\$21,350
<i>Jersey Central Power</i>	\$828,619		840,000	\$41,395	
<i>Long Island Lighting</i>		\$1,661,615	898,974		\$83,008
<i>Los Angeles DWP</i>	\$1,709,480		1,000,000	\$85,400	
<i>Madison Gas</i>		\$115,390	98,000		\$5,764
<i>New England Electric</i>		\$1,282,110	1,130,000		\$64,050
<i>Northern California Power Agency</i>	\$109,786		108,660	\$5,484	
<i>Northern States Power (WI)</i>		\$158,127	160,300		\$7,899
<i>Northern States Power (MN)</i>		\$341,896	1,000,000		\$17,080
<i>Pacific Gas &amp; Electric</i>	\$5,641,824		3,708,000	\$281,820	
<i>PacifiCorp</i>	\$854,740		1,091,453	\$42,700	
<i>Public Service Electric &amp; Gas</i>	\$2,564,220		1,615,000	\$128,100	
<i>SMUD</i>	\$641,055		400,000	\$32,025	
<i>Southern California Edison</i>	\$5,000,229		3,585,900	\$249,795	
<i>Superior Water Power &amp; Light</i>		\$11,624	10,000		\$580
<i>Western Mass. Electric</i>		\$271,655	183,468		\$13,571
<i>Wisconsin Electric</i>		\$161,460	800,000		\$8,540
<i>Wisconsin Power &amp; Light</i>		\$244,256	283,500		\$12,202
<i>Wisconsin Public Service Co.</i>		\$296,909	299,224		\$14,832
<b>Total</b>	\$20,790,350	\$5,437,680	21,525,996	\$1,038,590	\$272,212

## Program Design and Delivery (continued)

---

22 ft<sup>3</sup> units in which large amounts of savings could be realized at a cost no more or less than that associated with developing super efficient technologies in smaller units. Of the 25 remaining points available, 20 were based on corporate capability and reliability factors such as experience with proposed technologies; marketing plans; commitment of staff and resources to the project; corporate history and economic factors; product warranty; and type of long-term materials management. Purchaser tracking information accounted for another 2 possible points, and proposed models which are HCFC free and/or have separate air flows could receive up to 3 points. The RFP was designed so that there was also a scoring benefit associated with minimizing the unit incentive. (As mentioned previously, Whirlpool requested an incentive of less than 37.5¢/kWh saved in the first year in order to take advantage of the expanded bid pool.)[R#2]

### THE WINNING PROPOSAL

Whirlpool was announced the winner of the contract on June 29, 1993 and the first of the 22 cubic foot refrigerators rolled off the assembly line on February 21, 1994. Whirlpool proposed to manufacture and distribute 250,000 refrigerators in participating utilities' service territories between 1994 and June of 1997. The winning 1994 model had to be in production just nine months after the completion of the prototype and, as per the RFP, the SERP model was priced wholesale at the same level as comparable standard 22ft<sup>3</sup> side-by-side models. The company believes that the incentive checks it receives for each unit sold will cover the marginal difference in expense for producing the new model. The incentives will be paid by SERP on a per-unit basis according to the sales tracking information provided Whirlpool using its ExacTrak<sup>®</sup> system.[R#9,13]

### MARKETING

As part of the RFP, manufacturers had to present a marketing plan for their refrigerator, and as a result, Whirlpool is responsible for marketing its winning refrigerator. The company has produced about a half dozen press releases as well as a consumer brochure which explains details of the refrigerator to potential customers but Whirlpool's regional sales offices within the SERP service territories have been responsible for advertising in local media. A national advertising campaign has not been possible since the target market is limited to the

service territories of participating utilities, some 21% of residential customers. Nevertheless, Whirlpool has received a great deal of national publicity about winning the Golden Carrot<sup>®</sup>. In total, SERP has been featured in more than 650 magazine and newspaper articles. Whirlpool's SERP refrigerator has also been featured in Business Week, USA Today, and numerous television news programs. A prototype of the SERP model was on display at the White House as well, as part of the President's announcement of the Climate Change Action Plan in October 1993.[R#13,19]

### STAFFING REQUIREMENTS

A tremendous, in fact immeasurable, amount of time and attention went into crafting the highly successful SERP program model, a process that involved the collaboration of a range of participants. This was followed by literally hundreds of professionals at the refrigerator manufacturers who worked to design bids for SERP's infamous Golden Carrot<sup>®</sup>. Then the winner, Whirlpool, amassed a "dream team" of dozens of professionals at its manufacturing plants located in three continents who worked in record time to design, test, and develop the winning refrigerator. Now that the SERP refrigerators are being distributed the program is largely being executed by Whirlpool, its distributors, and retail establishments.

Following the initial development stages the program is now administered by a small staff under the direction of a Board of Directors who are employees of utility members but receive no compensation from SERP. The program's administration has required a staff of approximately five full-time equivalents (FTE). These include the director, who is also Chairman of the Board, the Chief Counsel who is a paid staff member, a Financial Officer, Vice Chairman, both members of the board, and an accountant and miscellaneous consultants who are paid on an hourly basis.[R#24]

Participating utilities typically engage only a one-quarter FTE to oversee the administration in their service territories. In addition, some utilities, such as PG&E, are evaluating the program internally, expending additional staff resources to measure the program's impact and process on an individual basis. Clearly, however, one of the most attractive program features is that most of its administration and quality control is handled by SERP itself.[R#14]

# Monitoring and Evaluation

---

## **MONITORING WITH THE EXACTRACK® SYSTEM**

The ExacTrack® is Whirlpool's monitoring system and early indications are that it will eventually give SERP better tracking than was originally expected. SERP established as its initial criterion that the manufacturer provide data for tracking at least 25% of the units produced and shipped. This figure was derived from manufacturer's experience with the rate of return of warranty cards. SERP initially felt that if 25% of the sales were recorded there would be enough data to extrapolate the locations of the majority of the SERP units. Later, in the runoff between Whirlpool and Frigidaire, this requirement was increased to 75% to provide greater assurance to the participating utilities that their investments were well placed.

In order to meet the data tracking requirement of the RFP, Whirlpool developed the ExacTrack® system. Most details of the system are proprietary but it played a key role in Whirlpool being selected as the winner of the RFP. In order to insure that retailers provide details of SERP sales for ExacTrack®, Whirlpool charges slightly higher wholesale prices for SERP refrigerators before subsequently reimbursing the retailers for that amount after they have submitted the sales data collection information. Then the data entry for ExacTrack® is handled by a third party contractor before Whirlpool itself eventually provides SERP with the actual sales information required for the incentive awards to be paid. SERP expects to have almost 100% of SERP refrigerator sales tracked using this system. One important new aspect of this program from the utility perspective is that never before have they had accurate information on the energy use and location of specific appliances. SERP expects the ExacTrack® mechanism will eventually give utilities a very accurate picture of where the refrigerators are being used. [R#13,14,15,33]

The tracking requirements relating to sales in SERP member service areas will also provide critical data to identify regional markets, identify behavior in those markets, and identify sales in a particular timeframe with which to study market behavior. SERP members must also be able to demonstrate to their rate regulating authorities that there is a benefit to the ratepayers they serve. Both the DOE and EPA have indicated their willingness to conduct a comprehensive study of the market transforming effects of the SERP program. [R#12]

## **EVALUATION**

U.S. DOE has commissioned Pacific Northwest Laboratories to complete a process and impact evaluation of the SERP program. The goals of the evaluation are multifold. The evaluation is intended to answer why the program was designed as it was, the intended outcomes of the design's features, and of course, the actual outcomes of those features. The evaluation is intended to determine the transferability of the program while also analyzing the preliminary energy savings expected from the program. [R#28,30]

At the time of this writing this evaluation is in process. Other evaluation efforts will be undertaken by participating utilities such as PG&E which expects to be metering individual SERP refrigerators in its service territory in the near future and BPA which has commissioned Pacific Northwest Laboratory to do an impact evaluation of the program. [R#14,25,28]

# Program Savings

---

**Data Alert:** All savings are based upon sales projections of 25,000 for the 22ft<sup>3</sup> 1994 SERP and combined sales of 90,000 1995 SERP 22ft<sup>3</sup>, 25ft<sup>3</sup>, and 27ft<sup>3</sup> models for the years 1995 and 1996 and 45,000 for the period between January 1 and June 30 1997. (Actual sales will depend of course on how the market receives these refrigerators.) First year per unit energy savings are 285 kWh per refrigerator based on the difference between the annual energy usage for a 22 ft<sup>3</sup>, side-by-side refrigerator allowed by 1993 federal standards and the annual usage of the 1994 22 ft<sup>3</sup> SERP refrigerator. Following the same methodology, savings from the 1995 22, 25, and 27 ft<sup>3</sup> models will be 388, 399, and 403 kWh/year respectively. These figures are conservative because most SERP models will replace older units with usage much higher than 1993 standards allow. The annual usage of the SERP refrigerators was determined by using Whirlpool's estimated annual cost to operate each model at \$.083 per kWh. (1994 22 ft<sup>3</sup> \$56, 667 kWh/year; 1995 22 ft<sup>3</sup> \$47, 566 kWh/year; 1995 25 ft<sup>3</sup> \$53, 639 kWh/year; 1995 27 ft<sup>3</sup> \$55, 663 kWh/year.)

For the first year of the program, 1994, based upon projected sales of 25,000 22 ft<sup>3</sup> refrigerators, SERP resulted in 7,125 MWh of electricity savings and 1.63 MW of capacity savings throughout members' service territories. From 1994 to 1997, with total sales of 250,000 units, SERP has the potential to produce over 96 GWh in energy savings and 22 MW of capacity savings.

The Results Center has calculated lifecycle energy savings of 1,831 GWh for SERP refrigerators, based on an average measure lifetime of 19 years, and 250,000 refrigerators being sold. [R#12]

The total annual capacity savings of 21.95 MW has been determined by The Results Center based on the following methodology: Using standard DOE test procedures Whirlpool has determined what their SERP models will cost per year to operate at \$.083/kWh. The Results Center has used these estimates to determine the energy savings over the 1993 Federal standards from each of the four models. The test procedures on the prototype model indicated that at 70° ambient room temperature, with no door openings, the refrigerator ran approximately 30% of the time, and at an ambient temperature of 90° it ran approximately 50% of the time. The latter situation is assumed to be similar to normal home use where the door is opened fairly regularly. For comparison's sake, a refrigerator in ambient temperatures of 110° may run as much as 100% of the time. For this exercise, if we assume the SERP refrigerators run approximately 50% of the year, including both defrost and

cooling, we can calculate the average watt-hours each model consumes and divide that figure by the number of hours in half a year to get an averaged capacity for each model. The capacity savings attributable to the program, at any given time of the day, is the capacity difference between 250,000 1993 DOE standard refrigerators and 250,000 SERP refrigerators.

## PARTICIPATION RATES

Participation is defined as the projected number of SERP refrigerators to be sold from 1994 through 1997. Whirlpool is committed to offer for sale 250,000 SERP models. In 1994 an estimated 25,000 SERP refrigerators were sold. Projected sales are 90,000 each year for 1995 and 1996 and 45,000 for the period between January 1 and June 30, 1997. [R#14,15,24]

## FREE RIDERSHIP

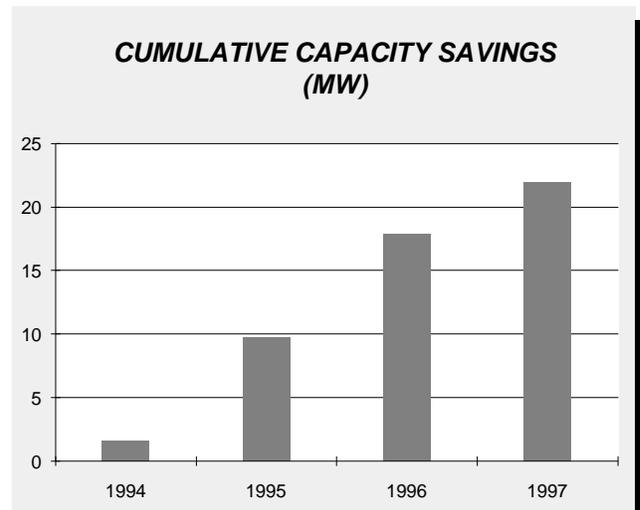
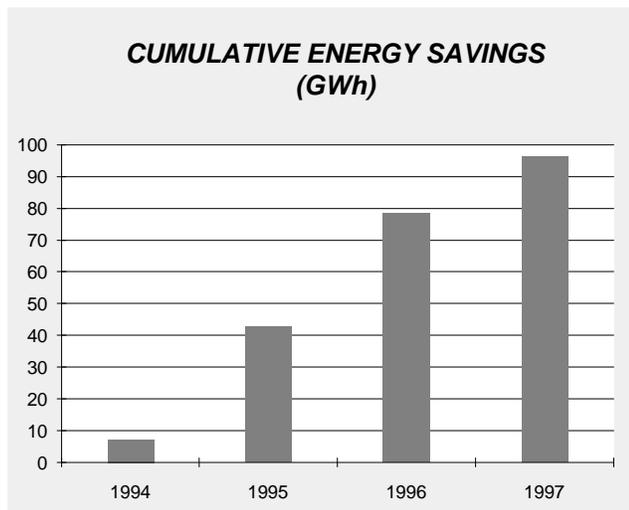
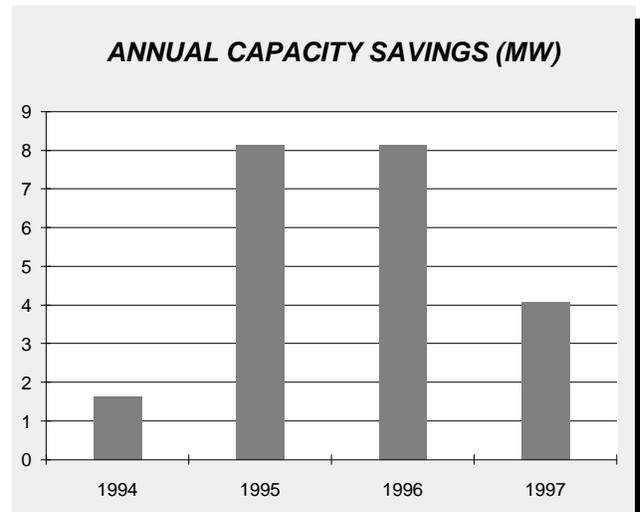
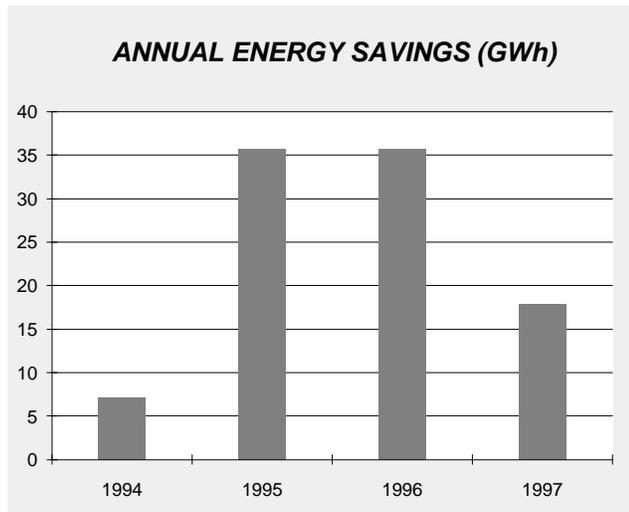
Because it is extremely unlikely that the refrigerator industry would have developed, manufactured, and offered for sale a super efficient refrigerator on a mass-production basis in the absence of the SERP program (especially by 1994), free ridership is thought to be nonexistent. However, cross-border sales are highly likely. This occurs when sales of SERP refrigerators are made to customers outside a participating utility's service territory. Utilities are compensated for this from the original funding pool. [R#16]

While free ridership is not considered an issue with the SERP program, certainly one of its most successful features is just the inverse: free drivership, which is defined as the non-incented activity that results from the original program. Already Whirlpool has announced and made available a whole new line of CFC-free sealed refrigerant system refrigerators. Furthermore, to respond to the ongoing competition that the program has created, other manufacturers such as General Electric, Amana and Frigidaire are closely following Whirlpool's lead to maintain market share by also producing super efficient CFC-free sealed refrigeration system refrigerators. These and other factors show what a profound effect the SERP program has had and will continue to have in transforming the refrigerator market in the United States. [R#37,38]

## MEASURE LIFETIME

The average measure lifetime for the refrigerator used by the SERP program is 19 years. This has been used to calculate the lifecycle energy savings listed above and to calculate the program's cost of saved energy presented in the next section. [R#27]

<b>SAVINGS OVERVIEW</b>	<b>ANNUAL ENERGY SAVINGS (MWh)</b>	<b>CUMULATIVE ENERGY SAVINGS (MWh)</b>	<b>LIFECYCLE ENERGY SAVINGS (MWh)</b>	<b>ANNUAL CAPACITY SAVINGS (MW)</b>	<b>CUMULATIVE CAPACITY SAVINGS (MW)</b>
<b>1994</b>	7,125	7,125	135,375	1.63	1.63
<b>1995</b>	35,700	42,825	678,300	8.13	9.76
<b>1996</b>	35,700	78,525	678,300	8.13	17.89
<b>1997</b>	17,850	96,375	339,150	4.07	21.95
<b>Total</b>	96,375	192,750	1,831,125	21.95	



# Cost of the Program

---

The total cost of implementing the SERP program is approximately \$30,000,000 (unlevelized) which was committed by 24 utilities across the United States to cover costs of the program including the development of an RFP, establishing an incentive award for the winning manufacturer, and providing program administration and quality assurance on behalf of the participating utilities.

In 1994, the SERP program cost \$2.63 million. Proportional to participation, total annual costs will increase to \$9.5 million in 1995 and 1996. Costs for the period between January 1 and June 30, 1997 will be \$4.7 million. Total program costs, levelized to 1990 U.S. dollars, will be \$26.3 million.

In addition to these direct program costs, each participating utility bears some administrative costs. There are board meetings and typically each utility also has a staff person who

spends part of his or her time administering the program. PG&E, for one, also expects to meter some of the SERP refrigerators in its service territory as part of its own evaluation of the program.[R#25]

## COST EFFECTIVENESS

The RFP gives benchmarks for cost effectiveness by allowing participants to choose either Group A or Group B. The idea was to find a "gag" point at which utilities would lose interest in participating. PG&E initially determined cost effectiveness using Barakat & Chamberlin's Demand Side Strategist PC model. This was done by comparing the per unit cost to the utility based on the number of refrigerators that were estimated to eventually be distributed within its service territory to the estimated first year savings from the SERP units over 1993 Federal Appliance Standards. What PG&E found was that the

<b>COSTS OVERVIEW</b>	<b>ADMINISTRATION (x1000)</b>	<b>INCENTIVE (x1000)</b>	<b>CROSS BORDER PAYMENTS (x1000)</b>	<b>TOTAL PROGRAM COST (x1000)</b>	<b>COST PER PARTICIPANT</b>
<b>1994</b>	\$184.4	\$2,337.7	\$112.5	\$2,634.6	\$105.38
<b>1995</b>	\$663.9	\$8,415.6	\$405.0	\$9,484.5	\$105.38
<b>1996</b>	\$663.9	\$8,415.6	\$405.0	\$9,484.5	\$105.38
<b>1997</b>	\$332.0	\$4,207.8	\$202.5	\$4,742.2	\$105.38
<b>Total</b>	\$1,844.2	\$23,376.6	\$1,125.0	\$26,345.8	

<b>COST OF SAVED ENERGY AT VARIOUS DISCOUNT RATES (¢/kWh)</b>	<b>3%</b>	<b>4%</b>	<b>5%</b>	<b>6%</b>	<b>7%</b>	<b>8%</b>	<b>9%</b>
<b>1994</b>	2.58	2.82	3.06	3.31	3.58	3.85	4.13
<b>1995</b>	1.85	2.02	2.20	2.38	2.57	2.77	2.97
<b>1996</b>	1.85	2.02	2.20	2.38	2.57	2.77	2.97
<b>1997</b>	1.85	2.02	2.20	2.38	2.57	2.77	2.97

program clearly passed both the participant (3.78), the total resource cost test (1.14), and the societal cost test (1.92) benefit-cost analyses, while failing both the ratepayer impact measure test (0.33) and the utility cost test (0.60). [R#24,25]

The Results Center calculations of the annual cost of saved energy are shown in the table above. This calculation is presented at various discount rates ranging from 3-9% and based upon annual savings and cost figures for the projected years from 1994 to 1997. Results range from 1.85 ¢/kWh to 4.13 ¢/kWh for 3% and 9% discount rates, respectively. At a 5% discount the program has an average cost of saved energy of 2.42 ¢/kWh.

### **COST PER UTILITY CUSTOMER**

The bid pool pays the manufacturer a direct incentive for each unit sold. The wholesale price for a SERP unit cannot be any more than comparable models so other than dealer mark-ups there will be no additional costs for the utility customer who

chooses to buy the SERP model over another comparable unit. The Results Center has calculated the cost to the utilities per participant to be \$105.38 based upon the projected number of units sold and corresponding costs per year.

### **COST COMPONENTS**

SERP originally estimated its administrative costs over the life of the program would be 10.2% of the total \$30,000,000 (unlevelized) invested by the member utilities, or approximately \$3,000,000, but Director Ray Farhang now believes this figure may be closer to 6-8%. Incentive costs make up the largest component of total program costs at 85.5%, or \$25,700,000. The members have also agreed to allocate 4.3% of the fund, or approximately \$1,300,000 to pay for cross border leakage or sales of refrigerators to customers who buy a SERP unit but don't actually live in a participating utility's service territory. [R#1,11,14,24]

# Environmental Benefit Statement

**AVOIDED EMISSIONS: Based on 192,750,000 kWh saved 1994 - 1997**

<i>Marginal Power Plant</i>	<i>Heat Rate BTU/kWh</i>	<i>% Sulfur in Fuel</i>	<i>CO2 (lbs)</i>	<i>SO2 (lbs)</i>	<i>NOx (lbs)</i>	<i>TSP* (lbs)</i>
<b>Coal</b>						
<i>Uncontrolled Emissions</i>						
A	9,400	2.50%	415,569,000	9,859,000	1,993,000	199,000
B	10,000	1.20%	443,132,000	3,816,000	1,287,000	954,000
<i>Controlled Emissions</i>						
A	9,400	2.50%	415,569,000	986,000	1,993,000	16,000
B	10,000	1.20%	443,132,000	382,000	1,287,000	64,000
C	10,000		443,132,000	2,544,000	1,272,000	64,000
<i>Atmospheric Fluidized Bed Combustion</i>						
A	10,000	1.10%	443,132,000	1,166,000	636,000	318,000
B	9,400	2.50%	415,569,000	986,000	797,000	60,000
<i>Integrated Gasification Combined Cycle</i>						
A	10,000	0.45%	443,132,000	784,000	127,000	318,000
B	9,010		398,607,000	284,000	96,000	19,000
<b>Gas</b>						
<i>Steam</i>						
A	10,400		241,709,000	0	551,000	0
B	9,224		209,905,000	0	1,315,000	62,000
<i>Combined Cycle</i>						
1. Existing	9,000		209,905,000	0	806,000	0
2. NSPS*	9,000		209,905,000	0	382,000	0
3. BACT*	9,000		209,905,000	0	53,000	0
<b>Oil</b>						
<i>Steam--#6 Oil</i>						
A	9,840	2.00%	349,841,000	5,301,000	625,000	594,000
B	10,400	2.20%	371,044,000	5,258,000	787,000	382,000
C	10,400	1.00%	371,044,000	751,000	632,000	199,000
D	10,400	0.50%	371,044,000	2,205,000	787,000	121,000
<i>Combustion Turbine</i>						
#2 Diesel	13,600	0.30%	464,335,000	924,000	1,435,000	78,000
<b>Refuse Derived Fuel</b>						
Conventional	15,000	0.20%	551,265,000	1,421,000	1,870,000	416,000

---

In addition to the traditional costs and benefits there are several hidden environmental costs of electricity use that are incurred when one considers the whole system of electrical generation from the mine-mouth to the wall outlet. These costs, which to date have been considered externalities, are real and have profound long term effects and are borne by society as a whole. Some environmental costs are beginning to be factored into utility resource planning. Because energy efficiency programs present the opportunity for utilities to avoid environmental damages, environmental considerations can be considered a benefit in addition to the direct dollar savings to customers from reduced electricity use.

The environmental benefits of energy efficiency programs can include avoided pollution of the air, the land, and the water. Because of immediate concerns about urban air quality, acid deposition, and global warming, the first step in calculating the environmental benefit of a particular DSM program focuses on avoided air pollution. Within this domain we have limited our presentation to the emission of carbon dioxide, sulfur dioxide, nitrous oxides, and particulates. (Dollar values for environmental benefits are not presented given the variety of values currently being used in various states.)

## HOW TO USE THE TABLE

1. The purpose of the accompanying page is to allow any user of this profile to apply the level of avoided emissions saved through the Super Efficient Refrigerator Program to a particular situation. Simply move down the left-hand column to your marginal power plant type, and then read across the page to determine the values for avoided emissions that you will accrue should you implement this DSM program. Note that several generic power plants (labelled A, B, C,...) are presented which reflect differences in heat rate and fuel sulfur content.

2. All of the values for avoided emissions presented in both tables include a 10% credit for DSM savings to reflect the avoided transmission and distribution losses associated with supply-side resources.

### \* Acronyms used in the table

TSP = Total Suspended Particulates

NSPS = New Source Performance Standards

BACT = Best Available Control Technology

3. Various forms of power generation create specific pollutants. Coal-fired generation, for example, creates bottom ash (a solid waste issue) and methane, while garbage-burning plants release toxic airborne emissions including dioxin and furans and solid wastes which contain an array of heavy metals. We recommend that when calculating the environmental benefit for a particular program that credit is taken for the air pollutants listed below, plus air pollutants unique to a form of marginal generation, plus key land and water pollutants for a particular form of marginal power generation.

4. All the values presented represent approximations and were drawn largely from "The Environmental Costs of Electricity" (Ottinger et al, Oceana Publications, 1990). The coefficients used in the formulas that determine the values in the tables presented are drawn from a variety of government and independent sources.

# Lessons Learned / Transferability

---

## LESSONS LEARNED

**Large coalitions can work:** SERP has shown that a diverse group of organizations can, and in fact are essential to, forming a powerful coalition which can bring about the production of technologically advanced products faster than natural market forces. SERP received input from investor-owned utilities, federal power authorities, municipal utilities, federal and state regulatory agencies, and environmental groups. Clearly this coalition was successful in accelerating a market transformation that has and will continue to have profound effects. [R#12]

**The contest design was an important aspect of the program's success:** The decision to make the program a winner-takes-all program was the topic of substantial internal discussions. The SERP Board decided that the winner-takes-all process would produce a highly competitive environment and achieve the most cost-effective results. SERP believes that the principal lesson learned is that a competitive environment must be created to draw out manufacturers' technologies, either using a winner-takes-all approach or some other design. [R#12]

**Maintaining privacy and strictly adhering to the proprietary aspects of manufacturers' proposals is essential in order to ensure serious proposals:** SERP realized that manufacturers would not produce serious proposals unless clear safeguards were established to achieve a fair solicitation process including the protection of confidential information during the bid and pre-production phases. Thus representatives of the manufacturers were not invited to join SERP Board, did not attend SERP's advisory committee sessions, and did not participate in the initial program design although they were involved in providing feedback on first draft of the RFP. SERP made certain that input and submissions of manufacturers were not disclosed to their competitors or to the public during the process. All of these procedures were undertaken in an attempt to encourage manufacturers to be forthcoming with technological, marketing, and tracking ideas, essential to program success in such a competitive industry where market share is of paramount importance to the manufacturers. [R#12]

**Addressing antitrust issues was important to program success:** Substantial attention was given to antitrust aspects of designing and implementing SERP. The first level of concern dealt with the coalition and the possibility that competing or potentially competing utilities might engage in anti-competi-

tive conduct. To combat this, the SERP Board, its advisory process, and all committee activities have been conducted in compliance with antitrust guidelines adopted as the policy of the Board of Trustees at its first meeting. Another area of concern was the interaction between SERP and its members with manufacturers, distributors, dealers, and others involved in the refrigerator industry. All aspects of SERP were designed and developed with advice of counsel. SERP then sought and obtained a Business Review Clearance from the Antitrust Division of the U.S. Department of Justice which enhanced the comfort level of interested parties in the program and hopefully establishes a precedent for future national DSM programs. [R#12]

**Given the time sensitive nature of technology procurement programs such as SERP, utilities must treat energy efficiency strategies with the same time frames as supply-side strategies:** SERP gives credence to the notion that if utilities adopted long-term conservation procurement strategies with the same lead time allotted to planning, permitting, and constructing new supply-side resources, they could provide manufacturers with incentive commitments sufficient to overcome the market risks of introducing advanced, super efficient technologies, as well as time to develop them. Manufacturers typically release a new product to a limited test market which allows them to iron out the bugs before broad distribution takes place. This important test market period was completely eliminated for the SERP R/F which made its unveiling somewhat riskier for the manufacturer. [R#7,29]

**Whirlpool received some very significant publicity:** Whirlpool's Vince Anderson, Program Manager for Refrigeration Technology, feels that aside from the financial rewards, Whirlpool's involvement with SERP has provided the company with some spectacular publicity. He says that he would bid on another Golden Carrot® if he felt strongly that it would be a money maker for the company. Interestingly, he still favors traditional consumer rebate programs over Golden Carrot® programs because rebate programs eliminate the need for a sophisticated and expensive tracking system as well as the financial risks of a winner-takes-all contest incurred by manufacturers. Whirlpool thinks rebate programs should be standardized across the country and that utilities should limit the rebate requirements to the level of energy efficiency and let manufacturers determine which technologies to use to achieve that level. [R#13,15]

**The ExacTrack® system is slow to report sales information:** Utilities are frustrated that sales information for the first

---

year of the program has not been provided in a timely fashion. This information is essential for reporting program expenditures and savings to public utility commissions. While this system, considered a core ingredient in the program, is expected to provide excellent tracking information eventually dealerships are gathering their sales figures over six or twelve months before sending them in, and therefore Whirlpool is not receiving immediate sales figures.

**Insufficient communication between SERP and participating utilities is hurting the program's success:** Many participating utilities are reportedly reluctant to try another Golden Carrot® because they don't feel satisfied with the way the SERP program is running. In fact, some participants have been sharply critical of SERP and some have expressed a desire to withdraw from their commitment to the program. These misunderstandings could certainly be addressed with improved communication from SERP about the actual benefits of the program and with assurances that problems such as the slowness of the ExacTrack® system will be resolved quickly. [R#24,26]

**Lack of promotion of the SERP models by regional distributors is hurting sales:** Whirlpool's regional sales offices have not done enough to advertise the SERP refrigerator or coordinate marketing efforts with local dealerships. Consequently dealers don't have much call for SERP models and therefore have little incentive to become involved in their sales efforts. This underscores the importance of thorough follow-through in such programs. While Whirlpool was clearly successful at the front end of the program, developing a winning entry to the design competition in record time, the back end of the program has suffered, creating a degree of disillusionment and disappointment for utility participants.

**Lack of understanding on the part of dealers about details of pricing and ExacTrack® is stifling the whole program:** In some cases there is confusion among Whirlpool distributors about the higher wholesale prices of the SERP model as compared to conventional models. The program was designed so that dealers could sell the SERP refrigerators for the same price as comparable models because their wholesale prices are the same. The confusion arises because wholesale prices listed are not the same. Dealers recoup the marginal difference by submitting their records of sales (ExacTrack® data) to Whirlpool. However, many dealers are unclear about this mechanism and instead feel they must pass the difference on to consumers because they don't understand that they will recoup the difference after returning the ExacTrack® data. This

problem can create a double penalty for the program. First, in some cases consumers may pay more for SERP refrigerators. Second, unless the SERP sales data is returned to the manufacturer the SERP utilities have no way of knowing how successful the program has been.

**Some consumers can't afford the SERP model:** Retailers are very clear about the fact that their customers choose products mainly based on price and are not usually thinking about the costs of operating and maintaining a product over its lifetime or the environmental impacts of their choices. For instance, one Whirlpool dealer interviewed by The Results Center reported that this year only two out of hundreds of prospective buyers had requested a non-CFC model. In another instance, a salesman at a SEARS store in Augusta, Maine mentioned that his customers were very interested in the SERP refrigerator's low annual energy usage but were not able to afford its \$1,000 to \$1,400 price tag. The SERP's high price prompted another dealer to call it "a rich man's game" because for \$600-700 customers can buy a similarly sized R/F and "still keep their food cold." Obviously no amount of advertising will be effective for selling to those who cannot afford the product. It was expected that due to the requirements and timeframe of the SERP RFP, the advanced technology associated with super efficiency would not be cost effective for manufacturers to include in smaller units during the first production runs. SERP concluded that similar to air bags in automobiles, the new technology would enter the higher-end market first and then eventually become standard in other models. Ironically, in the short term, the main sales competition for non-CFC refrigerators will be from CFC refrigerators selling at close-out prices.

**Sales of SERP R/Fs may have been improved due to added incentives:** Some utilities such as Southern California Edison (SCE), Long Island Lighting Company (LILCO), and Sacramento Municipal Utility District (SMUD) have offered rebates to customers who purchase SERP refrigerators. SCE offers purchasers a \$45 rebate for buying the SERP as well as an additional \$75 rebate for turning in an old refrigerator. A Sears salesman there says his customers are quick to choose the SERP over comparable models while in Rhode Island and Wisconsin some dealers are frustrated with Whirlpool's lack of promotion of the SERP and won't stock SERPs in their showrooms because they don't get any call for them and have no confidence that they will sell.

**The SERP program has created far reaching spin-off effects:** The good news for both consumers and retailers is that

## Lessons Learned / Transferability (continued)

---

a new line of R/Fs with non-CFC technology is now available nationwide. Because of its involvement in the SERP program and in response to Federal mandates banning the use of CFCs by January 1996, Whirlpool is already introducing non-CFC refrigerators in all sizes that will be priced exactly the same as their CFC predecessors. These models are not quite as efficient as the SERP model but improvements in efficiency are being made all the time. Furthermore, for those looking for even greater energy savings, the newly released EnergyWise model, which is a SERP with vacuum insulating panels, promises to be another 11.3% more efficient than the 1994 SERP, fully 41% below 1993 National Appliance Standards. With its more expensive insulating panels and lacking a consumer rebate, the EnergyWise will cost more than its older brother, but this may make the original SERP model look that much more attractive to price conscious consumers in the SERP territories.

**A win-win situation for all involved:** Because of its experience with designing the non-CFC SERP model Whirlpool has a jump on competitors toward nationwide introduction of their non-CFC line of refrigerators. Since the participating SERP utilities will reward Whirlpool based solely on sales of SERPs in their service territories, they will only pay for savings measures actually installed in their service territories and they will not be required to pay for unsold inventories of R/Fs.

Prior to the development of the SERP refrigerator it seemed quite clear that non-CFC refrigerators would be much more environmentally friendly, but on the other hand could have been as much as 15% less efficient than previous CFC models. (After further research and development of non-CFC technologies it is now known that this figure is closer to 5%.) Happily, the recent introduction into the global marketplace of the SERP and other efficient non-CFC sealed refrigerant system refrigerators significantly benefits utilities, consumers, and the environment. Both utilities and consumers can take heart in the environmental benefits of the SERP's non-CFC technology while also realizing significant dollar and energy savings.

### TRANSFERABILITY

The Clinton Administration's Climate Change Action Plan of October 1993 strongly endorses market-pull strategies and points to the SERP program as a significant case study. Thus SERP is part of a new national policy to encourage market forces to develop gains in energy efficiency above and beyond the levels achieved through government regulation. The SERP program also confirms that, at little cost, the services and guidance of federal agencies in partnership with the private sector can leverage substantial public benefits. [R#12]

It was the apparent success of the SERP model that caused its founders to establish the Consortium for Energy Efficiency (CEE), a non-profit group located in Boston. CEE is supported by utilities, government agencies, and various advocacy groups using the SERP market transformation model for other end-uses such as horizontal axis washing machines and air conditioners. The re-regulation of the utility industry, however, has indeed caused a "sustained panic" for efficiency program managers at the CEE and many utilities. Clearly the effectiveness of the Golden Carrot<sup>®</sup> approach could be greatly reduced depending on what shape and form the industry takes following re-regulation. For example, a utility will be unlikely to provide incentives, in the form of rebates or financing, for its customers to install energy savings measures if those customers are free to choose another provider at any time after the measures have been installed. Energy service companies (ESCOs) may be in a better position to work with customers in that they can make money regardless of which utility the customer signs on with, but at this time there are no ESCOs that are large enough to offer a Golden Carrot<sup>®</sup> of the size necessary to influence a national manufacturer to redesign its products. Unfortunately, until new regulations are fully in place and the restructuring of the U.S. electric utility industry is defined, it is impossible to tell what adjustments will be necessary to implement programs of this type in the new regulatory environment. [R#32]

# References

---

1. Super Efficient Refrigerator Program, Inc., promotional materials, January 1992.
2. Super Efficient Refrigerator Program, Inc., "Request for Super Efficient CFC-Free Refrigerator Proposals," July 7, 1992.
3. Super Efficient Refrigerator Program, Inc., "Request for Super Efficient CFC-Free Refrigerator Proposals, Amendment #1" July 27, 1992.
4. Super Efficient Refrigerator Program, Inc., "Request for Super Efficient CFC-Free Refrigerator Proposals, Amendment #2" September 11, 1992
5. Super Efficient Refrigerator Program, Inc., "Request for Super Efficient CFC-Free Refrigerator Proposals, Amendment #3," September 29, 1992.
6. Consortium for Energy Efficiency, Inc., promotional materials and press releases, 1994.
7. Michael L'Ecuyer, Global Change Division, Environmental Protection Agency, "The Golden Carrot Super Efficient Refrigerator Program: Commercialization of Advanced, CFC-Free Refrigerators in the Mid-1990s," March 1, 1992.
8. Pamela Russell, "Facing Mulish Market, Utilities Offer Reward to Manufacturers," Conservation Monitor, May 1992.
9. John Holusha, "Whirlpool Takes Top Prize In Redesigning Refrigerator," New York Times, June 30, 1993.
10. "Whirlpool Wins Prize of \$30 Million to Build Efficient Refrigerator," The Wall Street Journal, June 30, 1993.
11. Michael L'Ecuyer, Harvey Sachs, Gary Fernstrom, David Goldstein, Elizabeth Klumpp, Steven Nadel, "Stalking the Golden Carrot: A Utility Consortium to Accelerate the Introduction of Super-Efficient, CFC-Free Refrigerators," proceedings from the 1992 ACEEE Asilomar Summer Study program.
12. John Feist, Ray Farhang, Janis Erickson, Elias Stergakos, Paul Brodie, Paul Liepe, "Super Efficient Refrigerators: The Golden Carrot from Concept to Reality," proceedings from the 1994 ACEEE Asilomar Summer Study program.
13. Vince Anderson, "Chasing the Golden Carrot: Whirlpool's Winning Experience," proceedings from the E-Source Members' Forum, October 4-6, 1993.
14. Ray Farhang, Chairperson of the Board, Super Efficient Refrigerator Program, personal communication, September 1994 - July 1995.
15. Vince Anderson, Program Manager for Refrigeration Technology, Whirlpool Corporation, personal communication, September 1994 - July 1995.
16. Gary Fernstrom, Senior Product Manager, Pacific Gas & Electric, personal communication, September 1994 - July 1995.
17. David Goldstein, Co-Director of the Energy Project, Natural Resources Defense Council, personal communication, August 1994.
18. Paul Brodie, Senior Product Manager, Pacific Gas & Electric, personal communication, April 1995.
19. Suellen Russell, Public Relations, Whirlpool Corporation, personal communication, September 1994.
20. E-Source, "The State of the Art: Appliances," August 1990.
21. Jeanne Briskin, H. Alan Fine, U.S. Environmental Protection Agency, "The Sino-U.S. Super-Efficient Refrigerator Project," proceedings from the 1994 ACEEE Asilomar Summer Study program.
22. Whirlpool Corporation, SERP press releases, June 29, 1993 - April 21, 1994.

## References (continued)

---

23. Robert Langreth, "The \$30 million Refrigerator, How Whirlpool Designed America's Most Energy-Efficient Icebox," Popular Science, January 1994.
24. John Feist, SERP General Counsel, personal communication, February - July 1995.
25. Ed Mah, Senior Planner, Pacific Gas & Electric, personal communication, February 1995.
26. Romi Chin, Pacific Northwest Laboratories, personal communication, April 1995.
27. "Super Efficient Refrigerator Program: Program Description," Pacific Gas & Electric staff, August 1991.
28. Linda Sandahl, Battelle Labs, personal communication, April 1995.
29. Holly Wimmer, Sales Manager, Barksdale Appliance Company, Glenwood Springs, Colorado, personal communication, February 1995.
30. DOE SERP Evaluation, Statement of Work, May 13, 1994.
31. Popular Science, "The \$30,000,000 Refrigerator" by Robert Langreth, January 1994, pgs.65,66.
32. Chris Granda, Program Manager, Consortium for Energy Efficiency, personal communication, April 1995.
33. Carolyn Verweyst, Marketing Department, Whirlpool Corporation, personal communication, February 1995.
34. Al Lee, Pacific Northwest Laboratory, personal communication, May 1995.
35. E-Source, Tech Update, Super Efficient Refrigerator Systems, Bristol Stickney, November 1992.
36. E-Source, Residential Appliances, Joan Gregerson, Karen L. George, Michael Shepard, Lia Webster, Debbie Davia, October 1994
37. Tony Evans, Director of Communications, Frigidaire Corporation, Dublin, Ohio, personal communication March 1995.
38. Denise Garthwait, Consumer Affairs Representative, Amana Corporation, personal communication, May 1995.
39. Jim Bartley, Trade Marketing Manager for Refrigeration, Whirlpool Corporation, personal communication, May 1995.
40. Elaine Akley, Project Engineer, Long Island Lighting Company, personal communication, July 1995.
41. Mary Boyd, Executive Secretary, Southern California Edison, personal communication, July 1995.

ExacTrack® is a registered trademark of the Whirlpool Corporation.

Golden Carrot® is a registered trademark of the Consortium for Energy Efficiency.

Special thanks to Ray Farhang and Vince Anderson for their invaluable assistance throughout the development of this report.