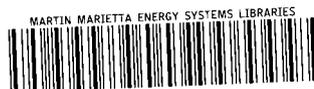


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Dynamics of Participation and Supply of Services in the Hood River Conservation Project

Eric Hirst
Richard Goeltz

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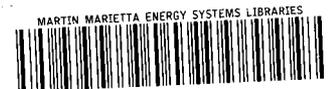
DYNAMICS OF PARTICIPATION AND SUPPLY OF SERVICES IN
THE HOOD RIVER CONSERVATION PROJECT

Eric Hirst
Richard Goeltz

Date Published: July 1986

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SUMMARY

The Hood River Conservation Project (HRCP) is a major residential retrofit demonstration project. HRCP is funded by the Bonneville Power Administration (BPA) and run by Pacific Power & Light Company. The project was conducted in the community of Hood River, Oregon, will cost \$21 million, and will last for three years (mid-1983 through 1986). Installation of applicable retrofit measures was completed by the end of 1985; data collection, analysis, and report writing will continue through 1986.

The Project sought to install as many cost-effective retrofit measures in as many electrically-heated homes as possible in Hood River. To achieve 100% participation, HRCP offered a package of "super" retrofit measures. The Project paid for installation of these measures up to a cost-effectiveness limit of \$1.15/first-year kWh saved, almost four times the limit in BPA's regionwide Residential Weatherization Program. On average, HRCP paid 99% of the retrofit cost in participant homes. Thus, HRCP offers the opportunity to determine levels of household participation in a retrofit program when cost to the household and prior retrofit activities are largely eliminated as barriers. Project data also permit detailed examination of the time needed to deliver program services (energy audits, installation of retrofit measures, and postinstallation inspections).

This report documents the extent to which households participated in HRCP. Differences between participants and eligible nonparticipants are examined. Similarly, differences among participants as a function of when they signed up for HRCP are analyzed. The report also examines the dynamics of program services (i.e., times between audit requests and audit, and between audit and installation of measures). These analyses are based on data from the roughly 3500 Hood River homes eligible for HRCP, 3189 of which received free home energy audits and 2988 of which received HRCP-financed retrofit measures.

The major findings from this study are:

1. HRCP was an extremely popular program among Hood River residents. About 91% of the eligible households received at least an energy audit; 85% of the homes had one or more major retrofit measures installed by the Project. During the first three months (fall 1983) of Project operation, more than one-fourth of the eligible households signed up for participation (Fig. S-1). This dramatic response is in stark contrast to participation rates normally obtained in residential retrofit programs. For example, about 9%/year of the eligible households participated in BPA's Residential Weatherization Program during its first two years of operation. The offer of free retrofits and extensive marketing explain much of the difference between response rates to HRCP and other programs.

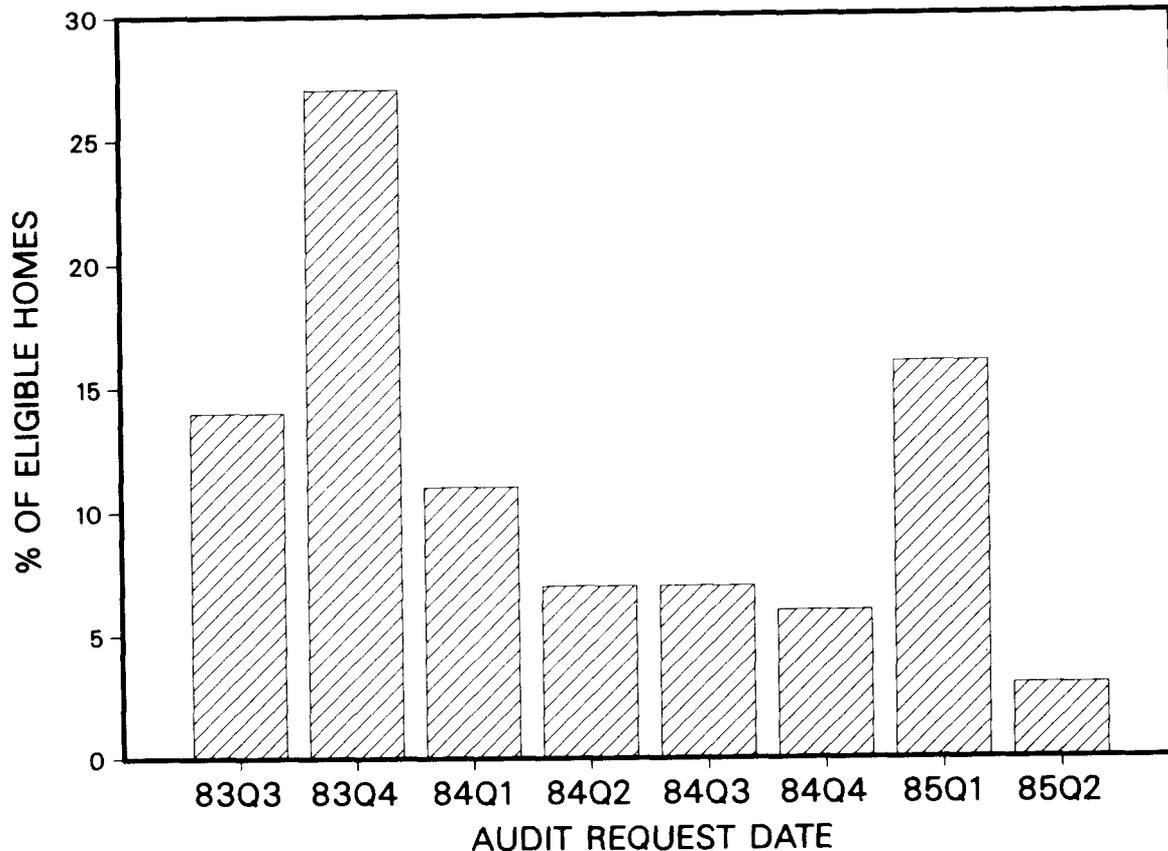


Fig. S-1. Household signups for participation in HRCP, by quarter and year, from summer 1983 through spring 1985.

2. More than half the participants first learned of HRCP from a person not employed by HRCP (friend, neighbor, relative, community leader). Thus, word-of-mouth was the primary information source about the Project, much more important than newspaper articles, radio, TV, or billboards. The local weekly newspaper was the second most important information source, cited by 28% of the participants.
3. Single-family homeowners signed up for HRCP sooner than did occupants of other housing types and renters. That is, the fractions of participants who lived in single-family homes and who owned their homes declined steadily over time as this pool of eligible homes was "depleted." Renters and occupants of other housing types began participating later and increased their participation over time.
4. The mean demographic and housing characteristics of the single-family homeowner participants (who accounted for half the total) showed almost no variation over time. This suggests that the Project was successful in informing and attracting a variety of people.

5. The very small number of eligible nonparticipants (about 250 of the 3500 eligible homes) differed somewhat from participants. Nonparticipants were more likely to live in single-family homes and to own their home. Nonparticipants also had higher incomes and newer homes than did participants. Thus, in contrast to most other conservation programs, HRCF attracted larger fractions of low-income households, occupants of multifamily units, and renters.
6. The dynamics of program operation showed interesting trends over time (Fig. S-2). The mean time between the household request for participation and receipt of the energy audit was three months. Delays were considerably longer during initial months of the Project because of the tremendous household response when HRCF first began, and because this new project was still being "debugged." Delays between request and audit declined slowly throughout 1984 and 1985, because of the decline in household requests and the increase in auditor efficiency.
7. The mean time between energy audit and completion of HRCF retrofits was almost nine months (Fig. S-2). Here again, the delays declined after several months of program operation, averaging eight months during the second half of 1984 and six months during the first half of 1985.

These results show that HRCF was enormously successful in achieving high participation levels. The 91% participation is ten times higher than typically achieved in residential retrofit programs. The key factors leading to this success include the offer of free retrofits, determination on the part of HRCF staff to enlist every eligible household, the use of many community-based marketing approaches, extensive word-of-mouth communication among Hood River residents (initially stimulated by the Project's solicitation of households to participate in the special studies a few months before HRCF officially began), and the early 1985 personal solicitations by HRCF staff among the remaining nonparticipants.

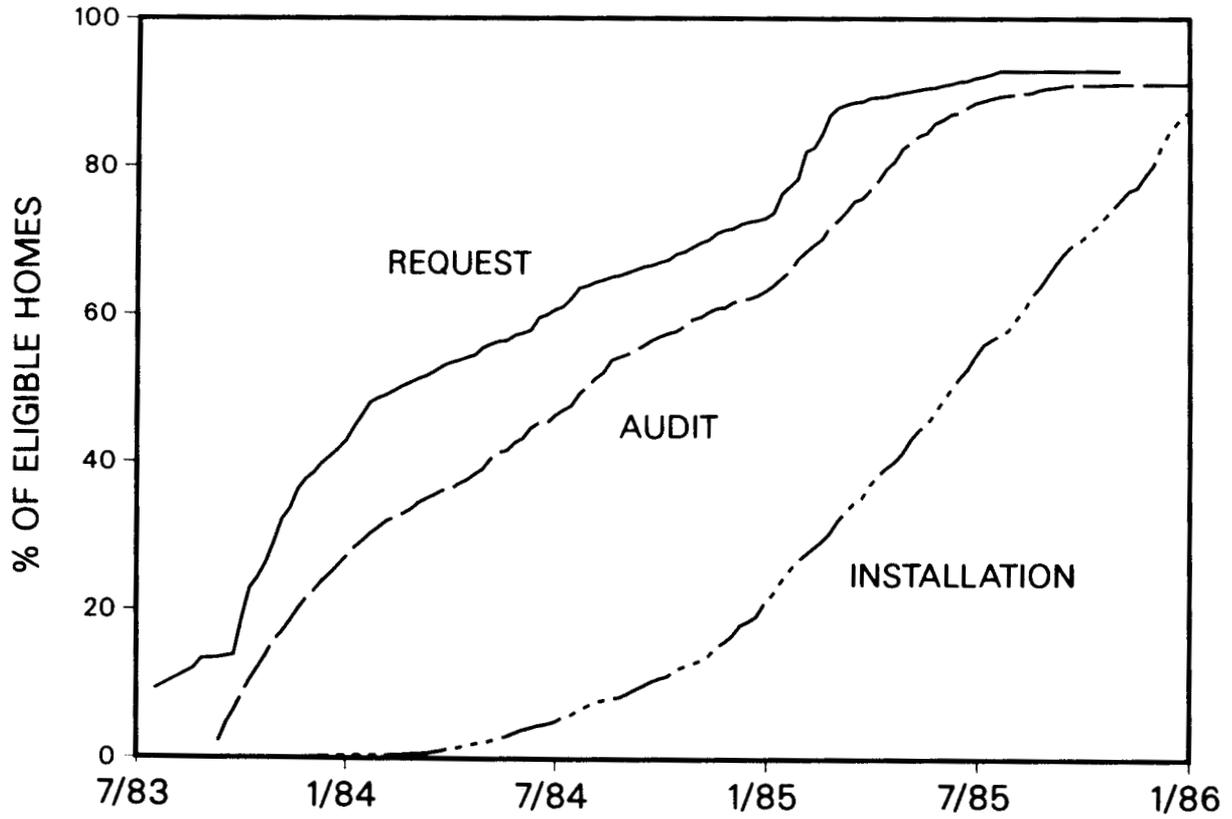


Fig. S-2. Cumulative record of HRCP participation from July 1983 through December 1985: audit requests, energy audits, and installation of retrofit measures.

1. INTRODUCTION

One of the critical issues related to utility and government conservation programs concerns participation. No matter how sophisticated the energy audit is, how attractive the financial incentives are, or how much energy is saved by the program-sponsored conservation measures, the program's ultimate success depends on attracting eligible customers and citizens to the program. Of the many issues associated with design and operation of effective conservation programs, those related to the determinants and dynamics of program participation are probably the least well understood. Outstanding questions include: What fraction of the eligible population will participate in a particular program? When will people sign up for a program? What kinds of marketing efforts and/or financial incentives will they respond to? How do participants differ from nonparticipants, and earlier participants from later participants?

Similar questions occur with respect to the implementation of conservation programs. How quickly can a program organize itself and train its staff to deliver onsite energy audits? How promptly can contractors be selected to install recommended retrofit measures? Will program-approved materials (e.g., insulation, clock thermostats, and storm windows) be available when needed? How long does it take for the utility to inspect contractors' work and to pay for completed jobs?

The Hood River Conservation Project (HRCP) affords a unique opportunity to examine issues related to program participation and delivery of program services. HRCP, initially proposed by the Natural Resources Defense Council, is an experimental residential retrofit project. HRCP is sponsored by the Bonneville Power Administration (BPA) and operated by Pacific Power & Light Company (PP&L) in cooperation with the Hood River Electric Cooperative (HREC).

The Project sought to install as many cost-effective retrofits as possible in all electrically heated homes in the community of Hood River, Oregon. As noted by the Northwest Power Planning Council (1986), another participant in the Project, HRCF "will provide a great deal of information on what to expect when the Region implements conservation acquisition programs on a large scale."

The Project offered a substantial package of retrofit measures (e.g., triple-pane windows rather than the double-pane windows that would be recommended in a typical utility program). HRCF paid for installation of these measures up to a cost-effectiveness limit (\$1.15/first-year estimated kWh saving) that was almost four times the limit in BPA's regionwide Residential Weatherization Program (PP&L 1982; BPA 1982).

The financial incentive and high level of retrofit measures (e.g., R-49 rather than R-38 in ceilings) provide the opportunity to examine levels of implementation when cost to the household and prior retrofit activities are largely removed as barriers. HRCF's goal of retrofitting 100% of the eligible homes and the Project's marketing and outreach activities used to encourage participation ensured that the Project will help define the maximum reasonable market penetration and energy savings of residential retrofit programs. These results will help determine the viability of such programs as an energy conservation resource in the Pacific Northwest (Northwest Power Planning Council 1986).*

The purpose of this report is to document the extent to which eligible households participated in the Project. This involves examination

*See PP&L (1982 and 1983), Peach et al. (1984), Philips et al. (1986), and Goeltz and Hirst (1986) for additional discussion of HRCF objectives, operations, and results.

of household and dwelling unit characteristics as a function of when households asked to participate and includes comparison of participant and nonparticipant (NP) characteristics. These issues reflect the dynamics of demand for conservation programs. Other issues related to the dynamics of supply (delivery of energy audits, contractor installation of retrofit measures, utility inspection of contractor work, and payment for completion of installed measures) are also examined.

Specifically, we consider the following questions:

1. How do the characteristics (demographic, structure, appliances, and electricity use) of participating households vary as a function of when the household requested participation in HRCF?
2. What relationships exist between the dynamics of participation (e.g., the number of signups per week) and HRCF marketing efforts? Do the sources of information about HRCF and the reasons for participation vary over time?
3. How do those eligible households who did not participate in HRCF differ from those who did?
4. How much time elapsed between the household request for HRCF participation and receipt of the energy audit? Between the energy audit and installation of HRCF retrofit measures? How did these times change during the life of the Project?

Answers to these questions can help designers of future programs better identify different market segments, improve appeals to nonparticipants, and estimate the effects of logistical problems on participation.

Chapter 2 briefly summarizes the data available for analysis. Additional detail on the HRCF data are in Hirst and Goeltz (1986), Kaplon (1986), and Oliver, Peach and Modera (1984). Chapter 3 examines characteristics of participants as a function of when households first called the HRCF office. Chapter 4 examines HRCF implementation in terms of times between initial household request for participation and the energy audit, and between the audit and installation of retrofit measures.

2. DATA ON HRCP PARTICIPATION AND PROGRAM OPERATION

PROJECT TIMING

The contract between BPA and PP&L to initiate the \$21 million HRCP was signed in May 1983. Random samples of homes in Hood River were contacted that summer for three special projects (Hirst and Goeltz 1986; Engels et al. 1985): end-use metering, House Doctor Study, and Blower Door Study. The field office officially opened its doors in October 1983, at which time they began accepting requests for participation; delivery of energy audits also began then (Fig. 1). The deadline for requesting an energy audit was July 31, 1985. Installation of retrofit measures occurred between January 1984 and December 1985.

Although all Hood River homes were eligible for free home energy audits, HRCP-financed retrofits were installed only in homes with permanently installed (before March 1983) electric space heating equipment. This eligibility requirement was imposed because HRCP was intended to purchase "conservation electricity resources" as alternatives to more expensive traditional power supplies.

DATA RESOURCES

Because HRCP is an ambitious and complicated project, the data associated with it are correspondingly extensive and detailed. These data include pre- and post-program mail surveys conducted among random samples of households in Hood River and in two comparison communities [early 1983 (Berg and Bodenroeder 1983) and early 1986]. The comparison communities are Grants Pass and Pendleton, both in Oregon. Monthly electricity bills and rate schedules for all households in Hood River

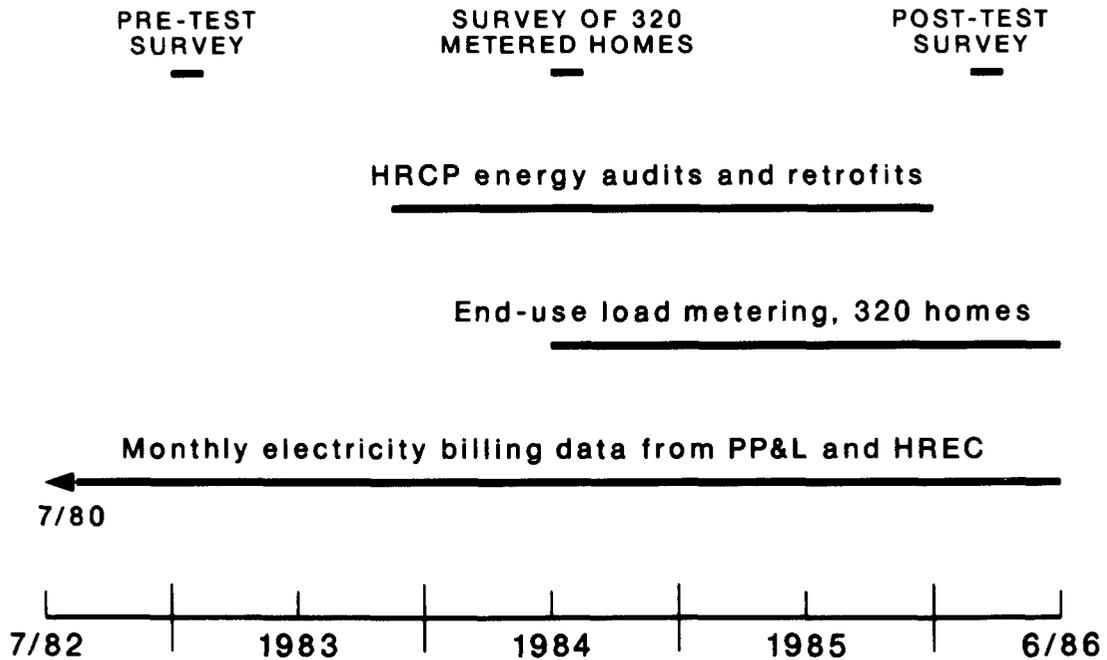


Fig. 1. Timeline of the Hood River Conservation Project.

and the two comparison communities were collected.* Detailed weather data from three special weather stations in Hood River as well as the National Oceanic and Atmospheric Administration (NOAA) weather stations in the three communities were used in analysis of household electricity use.

Other information sources include end-use load data from 319 HRCP homes and the responses to a detailed onsite home interview with these households; a telephone survey of nonparticipants conducted in December 1985; a mail survey on use of wood for heating conducted among HRCP

*About 60% of the households in Hood River are served by PP&L (an investor-owned utility); the remaining 40% are served by HREC (a public utility). All households in Grants Pass and Pendleton purchase electricity from PP&L.

participants in April 1986; and the field-office data base, which includes considerable information on all HRCP participants.*

The primary source of information on program participation and on the dynamics of program delivery is the field-office data base. The following data collection forms** provide most of this information:

Marketing Response Questionnaire
Customer Information
Customer Appliances/Equipment

The Marketing Response Questionnaire was completed when people first contacted the HRCP office to request participation in the Project. People were asked how they first learned about HRCP and their reasons for wanting to participate in the Project.

The Customer Information and Customer Appliances/Equipment forms were completed during the home energy audit. The former includes questions on the number of years the household has lived in its present home, the number and ages of household members, formal education of adults, and annual income. The second form includes questions on the presence of various kinds of electric appliances and equipment (e.g., air conditioner, dishwasher, electric range, home computer, hot tub) and questions on basic characteristics of the structure (year built, floor area, dwelling type, primary construction material).

In addition, monthly electricity billing data are used to estimate normalized (weather-adjusted) annual electricity consumption (NAC) for each eligible household in Hood River (Hirst and Goeltz 1986).

*See Goeltz and Hirst (1986) for additional discussion of HRCP data.

**Copies of these forms are available from the authors.

Computation of NAC values required daily weather data, available from the National Oceanic and Atmospheric Administration (NOAA) Hood River Experiment Station. Pre-HRCP (1982/83) NAC values are used in comparisons among groups of participants and nonparticipants.

Data on program operation, especially the dates of energy audits and retrofit installations, are available from the field-office data base. These data, alone and in combination with the other data sources noted above, provide information on the times required to complete the major HRCP steps and the factors that influence these times.

NUMBER OF PARTICIPANTS AND NONPARTICIPANTS

A telephone survey of nonparticipants was conducted in December 1985 (Kaplon and Engels 1986). The purposes of this survey were to help estimate the number of eligible households that did not participate in HRCP (see the Appendix for details), to identify their demographic characteristics, and to ascertain their reasons for nonparticipation.

It is important to recognize that the terms "participant" and "nonparticipant" can be defined in different ways. A strict definition of participation would include only those homes that received HRCP-financed major retrofits (i.e., more than the low-cost auditor-installed measures). A less stringent definition might include those homes that received an energy audit only,* or even those homes that had some contact with the Project but received no HRCP services. These

*HRCP included four low-cost measures installed by the energy auditors (water heater wrap, insulation on cold and hot water pipes connected to the water heater, low-flow showerheads, and outlet and switchplate gaskets.) The 11 major measures include ceiling, floor, wall, and heating-duct insulation; storm windows, sliding glass doors, and thermal doors; caulking, window weatherstripping, and door weatherstripping; and clock thermostats.

distinctions are of only minor significance in HRCF, because such a large fraction of the eligible households received retrofits (Table 1).

We define all eligible homes that received an energy audit (3189) as participants. The remaining 311 households, regardless of whether they contacted the Project, are defined as nonparticipants. Thus, HRCF succeeded in providing energy conservation services to 91% of the eligible households during a two-year period. Of the 3189 participants, 469 were contacted by the Project during Summer 1983 for participation in three special studies. For certain analyses, these 469 are excluded because they did not actively seek participation in HRCF.

Table 1. Participation in the Hood River Conservation Project

HRCF status	No. of eligible homes
Participants	
Weatherized ^a	2988
Audit only ^b	201
Nonparticipants	
Contact with HRCF, but no services	60
No contact with HRCF ^c	251
Total	3500

^aOf these 2988 homes, 459 were contacted by HRCF in summer 1983 for participation in one of the special projects.

^bOf these 201 homes, 10 were contacted by HRCF in summer 1983 for participation in one of the special projects.

^cInformation on these (approximately) 251 homes is based on responses to the nonparticipant survey from 111 households.

3. CHARACTERISTICS OF HRCP PARTICIPANTS AND THEIR HOMES

AUDIT REQUESTS

About 91% of the 3500 eligible households* participated in HRCP between July 1983 and July 1985. Project staff solicited participation from about 13% (469) of the eligible households during the summer of 1983. Subsequently, almost 1,000 households contacted the field office during the first three months after the Project officially began in October 1983 (Fig. 2).

This dramatic response to the HRCP offer is in sharp contrast to that experienced in most residential retrofit programs (Coltrane, Archer and Aronson 1986). For example, a review of state reports on the federal Residential Conservation Service shows that only about 2% of the eligible households request energy audits each year (Centaur 1985). Even when programs include financial incentives, response rates are typically much lower than that experienced in Hood River. During the first two years that BPA operated its regionwide Residential Weatherization Program, 211 thousand homes were audited (Eissler 1984). This represents an annual participation rate of 9%. HRCP, on the other hand, achieved a 27% response in three months and an annualized response rate of about 45%.**

Some conservation programs that use community groups to solicit participation achieve high participation rates. For example, the Santa

*The unit of observation is the dwelling unit/household rather than building. This distinction is important for multifamily structures.

**HRCP's success relative to other programs is a function of differences in financial incentives, marketing strategies, size of the potential market, and program goals.

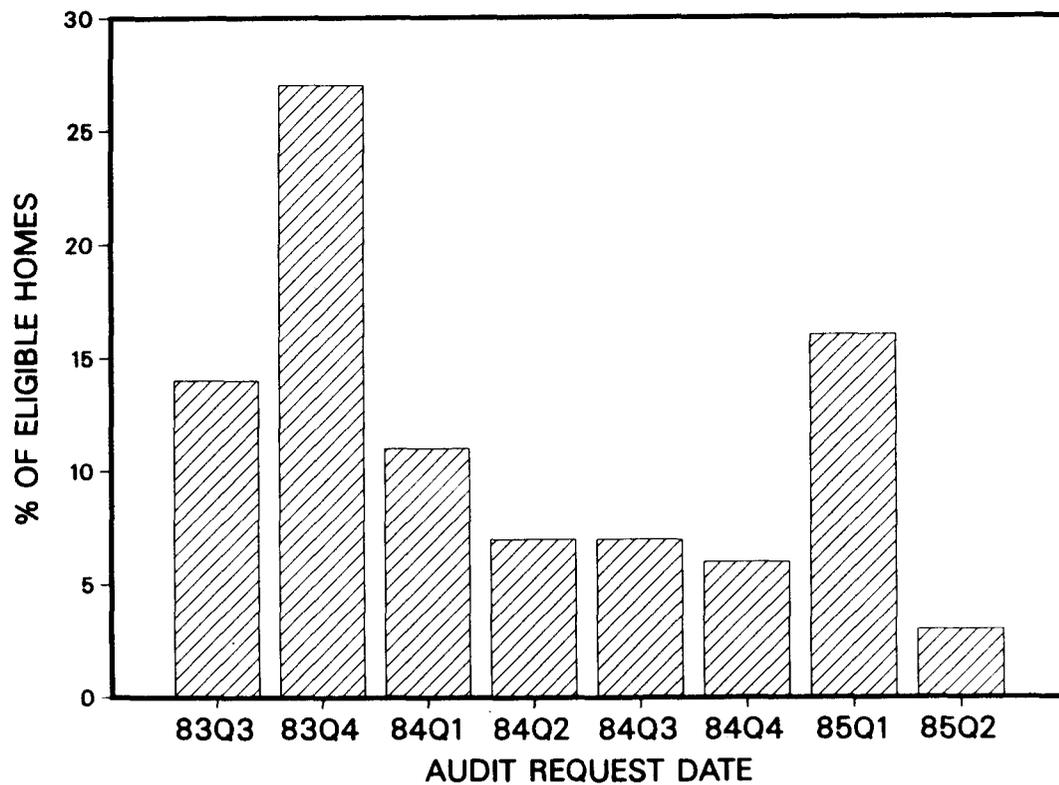


Fig. 2. Household signups for participation in HRCP, by quarter and year, from summer 1983 through spring 1985.

Monica Energy Fitness Program, operated by the municipal government, conducted energy audits among one-third of the eligible homes between May 1984 and May 1985 (Egel 1986). Similar experiences with community programs have been reported in Minnesota (Brummitt 1984) and Maine (Morgan 1986). But none of these programs comes close to the participation achieved by HRCP.*

After the first two months of Project operation, the rate of audit requests declined. For example, about 400 requests per month were received during October and November 1983, about 200 per month in

*The Residential Energy Conservation Action Program, operated by General Public Utilities, attracted 84% of the eligible households in a New Jersey retirement community (Brown and Reeves 1985). Success was due to the near homogeneity of households and GPU's close coordination with the condominium association.

December 1983 and January 1984, and less than 100 per month during the next several months.

Initial design of HRCF called for extensive marketing efforts to encourage participation (Engels 1985; Engels, Kaplon and Peach 1985). Because the initial response was so positive (beyond the Project's ability to deliver services; see Chap. 4), many of these marketing efforts were not implemented.

According to Project personnel, three main factors were important in achieving this high participation (Table 2). First, word of mouth from

Table 2. List of major marketing activities employed by HRCF

Date	Activity
July 1983	Community Advisory Committee is formed First contacts made with end-use metered, House Doctor, and Blower Door households
October 1983	Article and pictures in Hood River News HRCF administrator on KIHR radio program
November 1983	Several ads in Hood River News Several articles in Hood River News Open House at HRCF office - TV coverage
December 1983	Ads in Hood River News
January 1984	Article in Hood River News
February 1984	Article in Hood River News
May 1984	Article in Hood River News
June 1984	HRCF administrator on KIHR radio program
July 1984	Article in Hood River News
November 1984	Testimonial ads in Hood River News for six weeks
January 1985 - March 1985	Personal contacts (telephone calls and onsite visits) with eligible households not yet signed up
June 1985	HRCF administrator on KIHR radio program Last ad in Hood River News, announcing July 31 deadline for requesting HRCF energy audit

Source: Quinn (1986).

those households participating in the special studies generated many requests during Fall 1983. Second, frequent stories in the weekly newspaper kept the people informed about the Project's purposes and progress. Finally, in early 1985 a special one-on-one effort was made to contact (by telephone or in person) all those eligible households who had not yet signed up for the Project; the success of this effort is shown in the dramatic increase in participation rate during early 1985 (Fig. 2), especially for housing/tenure types other than single-family homeowners (Fig. 3).*

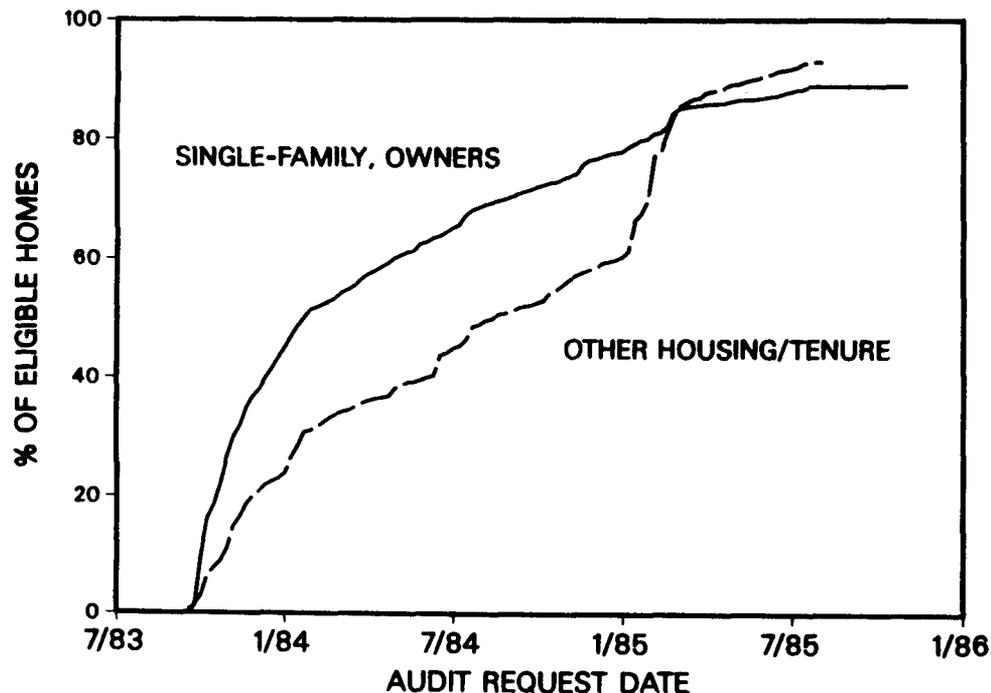


Fig. 3. Cumulative participation in HRCP (excluding the 469 households in special studies), single-family homeowners vs all other housing type/tenure combinations. Note the substantial increase in participation among other combinations in early 1985, in response to HRCP's personal contacts.

*To some extent, the later participation of other housing types (multifamily buildings and mobile homes) was intentional. For example, the procedures and specifications for mobile-home retrofits were not defined until early 1985 (Philips et al. 1986); mobile homes accounted for 18% of the housing units retrofit by HRCP.

DYNAMICS OF PARTICIPANT CHARACTERISTICS

The characteristics of HRCF participants varied with time (Table 3). Those who requested audits early generally had higher incomes, had more household members, had more education, had lived in their home for a longer time, were more likely to own their home, and were more likely to

Table 3. Characteristics of HRCF participants by date of audit request

Household/structure characteristics	Mean values, by date of household request ^{a,b}								NP
	83Q4	84Q1	84Q2	84Q3	84Q4	85Q1	85Q2	85Q3	
Household income (thousand-\$)	23.5	21.7	20.0	20.0	19.5	15.3	17.1	23.9	27.4
No. of household members	2.9	2.5	2.6	2.6	2.4	2.3	2.3	2.6	2.8
Years of education for household head	13.2	12.5	12.6	12.9	12.3	12.0	11.3	12.7	13.1
Years in present home	8.9	9.3	7.4	7.2	8.4	6.6	8.1	7.5	8.0
% who own home	74	61	59	60	68	44	57	67	88
% who participated in prior program	11	9	8	9	8	5	0	0	-
Floor area (ft ²)	1420	1260	1190	1190	1190	1000	930	1050	-
Year house built	1955	1955	1958	1956	1960	1967	1961	1953	1962
% single-family	75	61	58	64	54	27	38	57	73
% served by PP&L	56	61	58	67	61	70	53	73	55
Electricity use, 1982/83 (kWh/year)	19,300	18,000	17,400	16,300	17,300	14,600	16,800	17,000	18,100
Audit estimate of savings (kWh/year)	6,800	6,200	6,200	6,300	6,300	4,500	5,300	7,400	-
% of homes with air conditioner(s)	21	24	19	20	18	13	29	16	-
central heat	31	28	26	31	36	32	44	33	-
No. of homes	942	395	253	235	205	544	96	49	311

^aThe dates are quarter/year; for example 83Q4 is the fourth quarter of 1983.

^bThe number of participants during the last two quarters (2nd and 3rd quarters of 1985) is quite small, which may account for the apparently anomalous trends.

Source: HRCF data on 2720 participants and survey responses from 111 nonparticipants (NP).

have participated in a prior PP&L or HREC energy conservation program than were later participants. These differences in demographic characteristics as a function of audit request date are all statistically significant.

In addition, early HRCF participants had larger homes, older homes, and were more likely to live in single-family units (Table 3). Perhaps because their homes were larger and older, early participants used more electricity pre-HRCF (1982/83) and had larger retrofit potentials (the audit estimate of likely electricity savings for recommended measures). The fraction of HRCF participants from among PP&L customers increased over time, which shows that urban and multifamily units tended to sign up for audits later than rural households.*

These differences in demographic and structure characteristics over time paint a consistent picture. They suggest that early participants were more demographically and economically "upscale" than later participants and could benefit more from installation of HRCF retrofit measures (i.e., these participants had larger, older homes that used more energy).

More than half (57%) of the respondents to the HRCF marketing questionnaire cited rising electricity prices and the need to control electricity costs as the primary reason for participation. Roughly 15% cited a belief in energy conservation and environmental protection. The distribution of primary reasons offered varied little over time. The only major temporal change was the percentage who participated because

*PP&L's customers are concentrated in the town of Hood River, while HREC's are in the rural parts of Hood River County.

HRCF is free; while 5% cited this reason during most of the Project's lifetime, 32% cited this reason during the first quarter of 1985.* Perhaps those who participated in response to the one-on-one marketing efforts (Table 2) were most impressed with the free retrofits.

Almost 55% of the participants first learned of HRCF from another person not employed by the Project (friend, relative, neighbor, community leader). Another 28% first learned of the Project from the local weekly newspaper, the Hood River News. The percentage of people learning about the Project from other people increased over time, from 52% during the first quarter to 80% during the last half year. Thus, as more and more people participated in the Project, word-of-mouth became an increasingly powerful way to inform even more people. About 10% of the participants first learned of HRCF from a Project employee; during the first quarter of 1985, this figure jumped to 28%.

SINGLE-FAMILY HOMEOWNERS

To further explore the dynamics of participation, we examined an important subset of these households: single-family homeowners. As noted above (Table 3), the trends in housing type and tenure (i.e., ownership) are substantial and nearly monotonic. The percentage of participants in single-family homes declined from 75% during the first quarter to 44% during the last two quarters; the percentage who were homeowners declined from 74% to 61% during the same period. Because these two factors changed so much over time and because single-family

*This finding is consistent with diffusion of innovation research (Rogers 1983), which suggests that early adopters of innovations are less price elastic than are later adopters.

homeowners constitute the dominant housing/tenure type (51% of all participants), we examined this group in greater detail (Table 4). Almost half of these participants signed up during the first three months; two-thirds signed up during the first eight months (Figs. 3 and 4).

In contrast to all HRCF participants, few clear temporal patterns emerge among single-family, homeowner participants (Table 4). For example, the correlation between income and audit request date is almost zero and completely insignificant; on a month-to-month basis, income increases and decreases without pattern. Only two variables - number of household members and education of household head - are correlated with date of audit request: as discussed above, early participants have more household members and more education than later participants; however, the correlations are weaker among single-family homeowners than among other participants. Finally, house floor area declined slightly over time among single-family homes.

These comparisons of HRCF participants suggest that much of the dynamics discussed earlier are a consequence of house type and tenure. Controlling for these two factors eliminates almost all temporal differences among participants. HRCF was successful in informing and attracting a variety of people to the Project as indicated by the limited variation over time in the mean characteristics of the single-family, homeowner participants.

Table 4. Characteristics of HRCP participants by audit-request date: single-family homeowners

Household/structure characteristics	Mean values, by date of household request								NP
	83Q4	84Q1	84Q2	84Q3	84Q4	85Q1	85Q2	85Q3	
Household income (thousand-\$)	26.9	27.0	26.0	23.8	25.1	27.5	25.2	32.2	31.5
No. of household members	3.1	2.8	3.0	2.9	2.6	2.6	2.6	3.1	2.9
Years of education for household head	13.8	13.1	13.2	13.2	13.0	13.1	12.5	13.5	13.4
Years in present home	10.9	12.3	10.0	10.8	12.3	12.4	16.7	11.9	9.3
% who participated in prior program	14	15	17	11	17	0	0	0	-
Floor area (ft ²)	1700	1620	1500	1470	1620	1670	1490	1210	-
Year house built	1952	1955	1954	1955	1952	1958	1951	1942	1960
% served by PP&L	58	58	49	64	60	61	71	65	49
Electricity use, 1982/83 (kWh/year)	20,500	20,200	20,000	18,600	19,700	20,900	15,900	16,400	19,300
Audit estimate of savings (kWh/year)	7,900	7,400	7,800	7,200	8,600	7,300	7,800	9,900	-
% of homes with air conditioner(s)	22	30	26	20	22	27	37	22	-
central heat	28	31	25	27	20	25	29	9	-
No. of homes	587	196	117	106	87	114	24	23	199

Source: HRCP data on 1255 participants and survey responses from 71 nonparticipants.

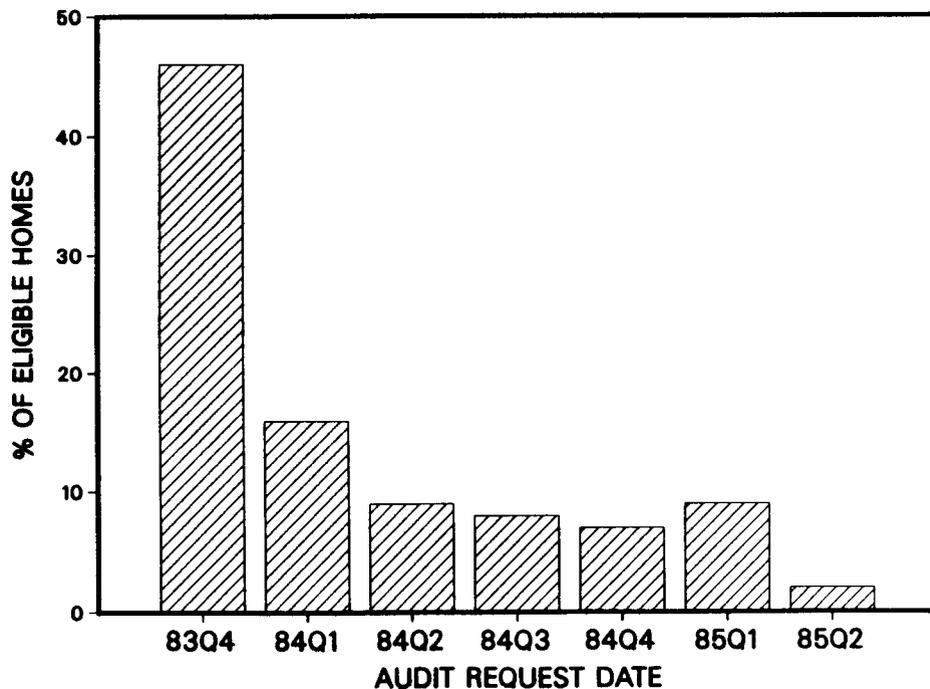


Fig. 4. Percentage of single-family homeowners who requested participation in HRCP, by date of request.

NONPARTICIPANT CHARACTERISTICS

Only 9% of the eligible households did not participate in HRCP. The major differences between participants and nonparticipants are house type and tenure (Table 3): larger fractions of nonparticipants are homeowners (88 vs 68%) and live in single-family homes (73 vs 58%). Limiting the comparison to single-family homeowners (Table 4) shows that nonparticipants had higher incomes, newer homes, and had lived in their homes for fewer years than participants.

Nonparticipants were asked an open-ended question (during the December 1985 telephone survey) about why their home was "not weatherized by the Hood River Conservation Project." Almost 40% of the respondents said that they did not need the weatherization (i.e., their homes were already energy-efficient), almost 15% said they thought their home did not qualify, another 15% said they were never contacted by the Project, and 10% said they missed the deadline. (We have no way of knowing whether the homes of those who claimed they did not need HRCP services were really energy-efficient. Those who said their home did not qualify indicated use of electricity as a heating fuel or ownership of permanently installed electric heating equipment and, therefore, were eligible.)

The nonparticipant survey also asked people for "any comments you would like to make about the Hood River Conservation Project." Half of the respondents to this question said they thought HRCP was a worthwhile project. Overall, two-thirds of the comments offered were positive. These positive views of the Project, from people who did not participate, strike us as remarkable.

The differences between participants and nonparticipants point out an important success of HRCP. Most residential conservation programs appeal primarily to single-family homeowners and are able to attract only small fractions of eligible renters, low-income households, and occupants of multifamily buildings (Hirst 1984; Berry, Hubbard and White 1986; Coltrane, Archer and Aronson 1986). HRCP, on the other hand, attracted larger fractions of these traditionally hard-to-reach groups (Table 5). For example, 39% of the HRCP participants had incomes of \$16,000 or less, while only 23% of the nonparticipants fell into this "low-income" group. Much larger fractions of participants than nonparticipants were renters (34 vs 12%) and occupants of multifamily buildings (14 vs 1%).

Table 5. Comparison of HRCP participants and eligible nonparticipants

	Percentage of households	
	Participants	Nonparticipants
Household income		
Less than \$10,000	21	14
Less than \$16,000	39	23
Greater than \$16,000	61	77
Housing tenure		
Renters	34	12
Owners	66	88
Housing type		
Multifamily buildings with five or more units	14	1
Other housing types	86	99
Number of households	3189	311

Source: HRCP data on 3189 participants and survey responses from 111 nonparticipants.

HOUSEHOLD MOVES

Household moves confound interpretation of the data concerning dynamics of participation. Consider, for example, a family that moved into a house in Hood River in April 1984 and then called the Project office two months later to request an energy audit. Our analysis (discussed above) treats this household as a laggard because it did not sign up until several months after the Project began. However, it took only two months for the family to learn about the Project and decide to participate.

Of the 3189 dwelling units that received at least an energy audit, fully 81% were occupied by the same household throughout the life of the Project (mid-1983 through 1985). Twelve percent of the units were occupied by two households and the remaining 7% were occupied by three or more households during this 30-month period.

Not surprisingly, movers and stayers differed considerably in tenure and housing type. More than half (55%) of the units occupied by the same household were single-family homes occupied by their owner. On the other hand, only 40% of the units that had two households and only 18% that had three or more households were owner-occupied, single-family homes.

Of the 1617 owner-occupied, single-family homes audited, 88% were occupied by only one household. But, only 62% of the dwelling units in buildings with four or more units were occupied by the same household throughout the 30-month period. These data suggest that examination of the trends in dwelling unit and demographics for all HRCP participants is complicated by household moves. On the other hand, examination of the single-family, owner-occupied subset is not.

4. DYNAMICS OF PROGRAM OPERATION

Conservation program planners are concerned about the dynamics of program operation as well as the dynamics of participation. The HRCP data base permits examination of the time lags from initial household request for participation until the energy audit and from the energy audit to HRCP completion (Fig. 5). Because the initial response to HRCP was greater than anticipated, delivery of audits and installation of retrofit measures were substantially delayed. As the Project developed, these delays were reduced. See Philips et al. (1986) for discussions of HRCP logistics and how problems with audits, retrofits, and inspections were handled.*

The following discussions of these two operations (audits and installation of retrofit measures) are based on the 2529 homes that received HRCP-financed retrofits and were not part of any special study.**

TIME FROM INITIAL REQUEST TO AUDIT

The mean time between household request for participation and the energy audit was three months (Fig. 6). Half the homes received their audit within two months of the request, but 10% of the homes were not audited until six or more months after the household request.

*The report by Philips et al. (1986) and this report are complements. This report presents and analyzes statistics related to program participation and delivery of HRCP services. Philips et al. discuss the logistics (BPA/PP&L relationships, selection of retrofit contractors, functions of Community Advisory Committee, changes in the number and functions of HRCP staff, and so on) in a qualitative fashion.

**Special-study homes were audited and retrofit at times dictated by research requirements. For example, the 319 end-use metered homes were all retrofit in May/June 1985 to ensure a full year of preretrofit load research data.

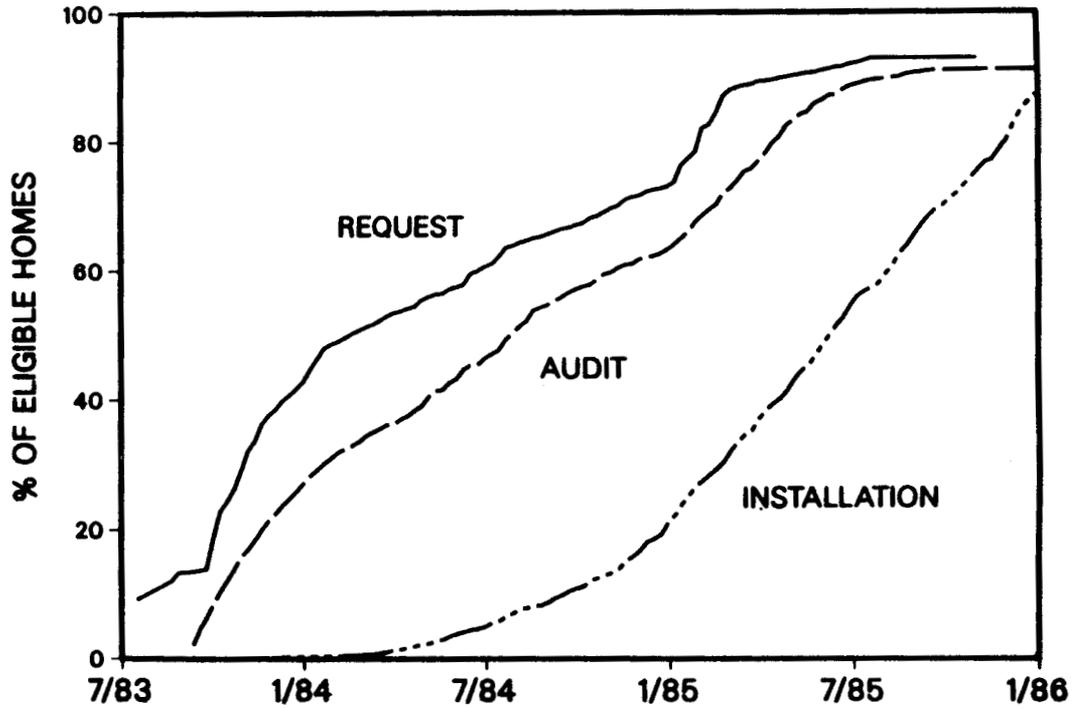


Fig. 5. Cumulative record of HRCP participation: audit request, energy audit, and installation of retrofit measures from summer 1983 through 1985 relative to eligible homes in Hood River.

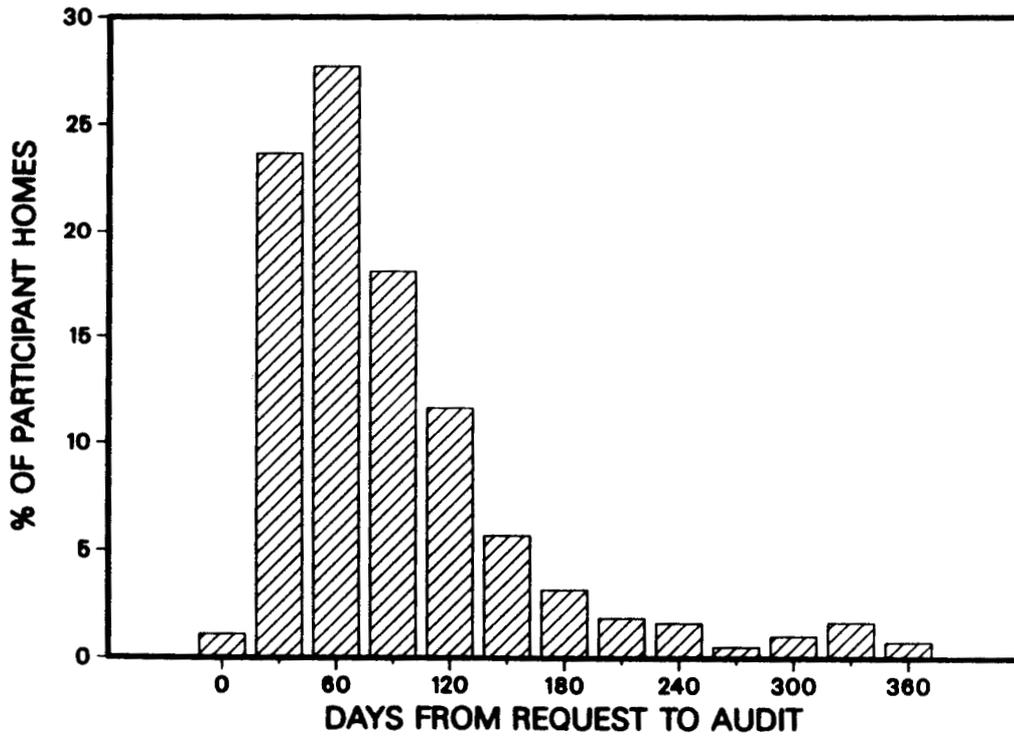


Fig. 6. Distribution of time between household request and receipt of an HRCP energy audit for 2529 homes.

The time between initial request and audit varied during the life of the Project (Fig. 7). In October 1983, when HRCP began, delays were short. However, delays quickly grew to about four months. So many people signed up for the Project soon after it was announced that the limited energy audit staff could not keep up. Beginning in early 1984, however, the auditors began to reduce this backlog. Delays between request and audit declined slowly throughout 1984 and 1985 to about three months because of the decline in household requests and increases in auditor efficiency.

TIME FROM AUDIT TO HRCP COMPLETION

After the audit was complete, one or more contractors bid on the job (installation of recommended retrofit measures). After review by the HRCP office and approval by the household, contractors were notified to proceed. After each contractor's work was completed, HRCP staff

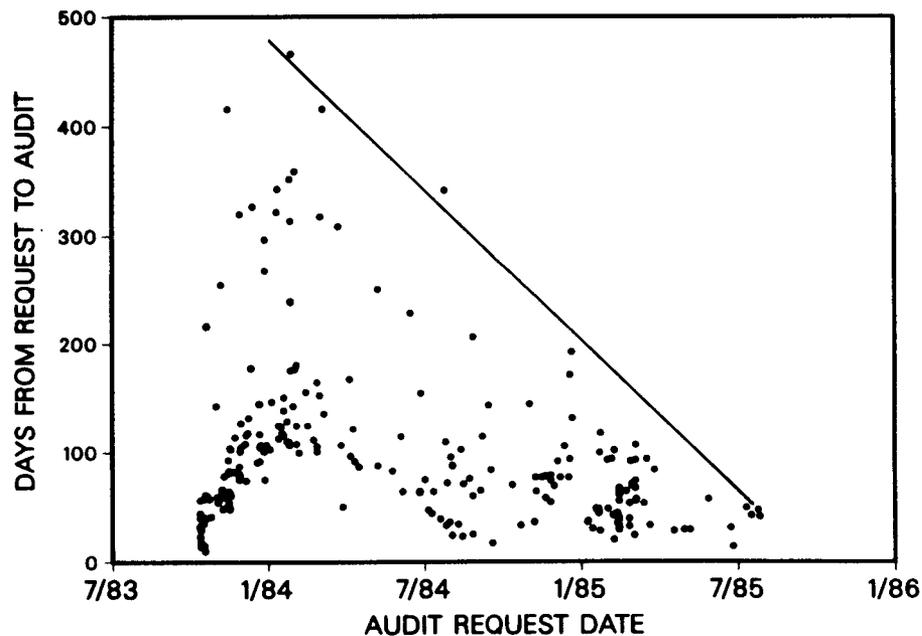


Fig. 7. Elapsed time between request for, and receipt of, energy audit as a function of audit request date for 2529 homes. (To improve clarity, the figure includes only a 1/10 random sample of these homes.)

inspected the home to ensure that the correct measures were properly installed. If problems were identified during the inspection, the contractors returned to the house to rectify the problems, and the inspection was repeated. After the work passed inspection, the contractor was paid by HRCF. A house "completed" the HRCF process when all approved retrofit measures were installed and inspected, and the contractor was paid.

The mean time between the energy audit and completion of HRCF retrofits was almost nine months (Fig. 8). The time between audit and completion was less than four months for only 10% of the homes; the delay was more than a year for almost 20% of the homes. A slight correlation ($r = 0.22$) exists between the time from audit to completion and retrofit cost, which suggests that larger, more complicated jobs took longer to complete.

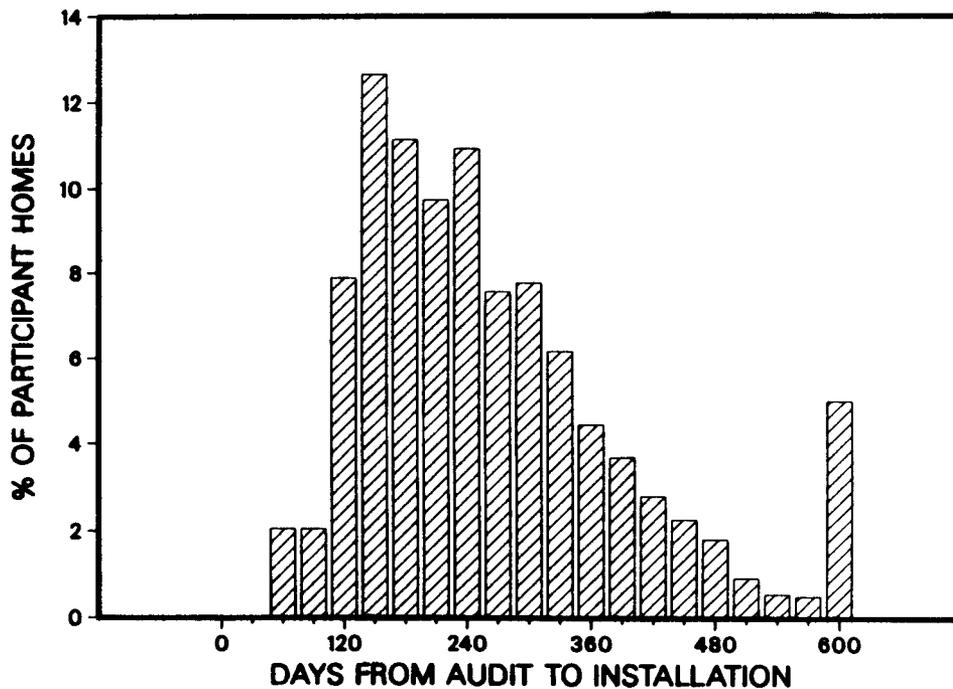


Fig. 8. Distribution of time between energy audit and installation of HRCF retrofit measures for 2529 homes.

The average delay between audit and completion was ten months for single-family homes, compared with eight months for larger, multifamily units. This difference occurred because contractors generally retrofit all the units in an apartment building at one time. Also, multifamily buildings participated in the Project later than did single-family homes (Fig. 3), by which time many of the startup problems had been resolved.

The time between energy audit and completion varied during the life of the Project (Fig. 9). In October 1983, when HRCP began, the time between audit and completion varied enormously. Probably those homes audited during the first days of HRCP operation were retrofit with little delay. However, the large number of requests for audits and the correspondingly large number of audits led to longer and longer backlogs for the contractors. On average, homes audited during the last quarter of 1983 experienced a 13-month lag between audit and HRCP completion. In part, these long delays were caused by problems with two contractors (who were later eliminated from the Project); problems identified during inspections of their work required additional time to correct and reinspect (Philips et al. 1986).

This delay decreased to 12 months during the following quarter as the contractors began to catch up with the auditors. The average time between audit and completion continued to decline, averaging eight months during the second half of 1984 and six months during the first half of 1985. Reductions in time required to install and inspect retrofit measures declined, in part, because contractor and HRCP staff became more efficient as they gained experience. Also, the BPA/PP&L commitment to complete all retrofits by the end of 1985 helped motivate HRCP staff and the contractors to get work done quickly as the deadline approached.

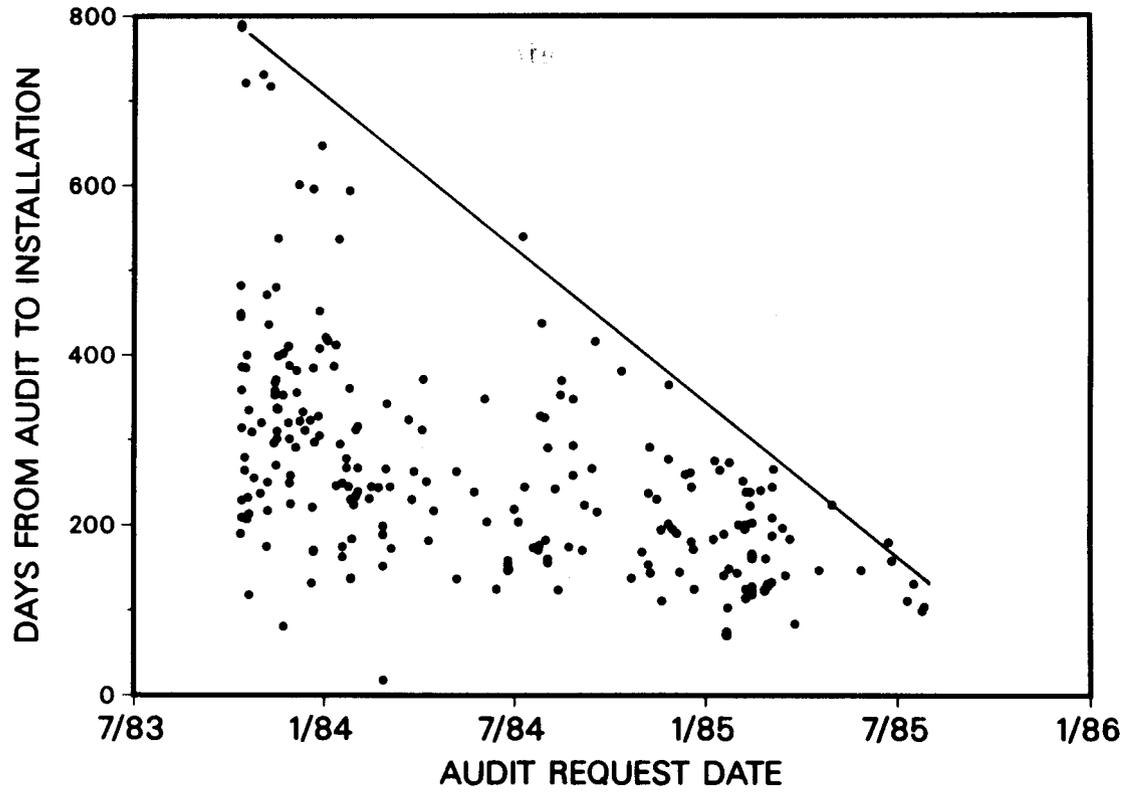


Fig. 9. Elapsed time between energy audit and installation of HRCP retrofit measures as a function of audit request date for 2529 homes. (To improve clarity, the figure includes only a 1/10 random sample of these homes.)

5. DISCUSSION

The overall success of a conservation program depends on the product of three factors: the number of eligible customers who participate in the program, the number of recommended conservation actions adopted by participants, and the actual energy savings achieved by the adopted actions. Because the Hood River Conservation Project included development of a rich, detailed, and high-quality data base, addressing each of these factors is feasible. These data and analyses thereof will provide important insights concerning the design, operation, effects, and costs of residential retrofit programs.

Our earlier report (Goeltz and Hirst 1986) examined the details of the second factor - installation of recommended retrofit measures. That report analyzed the reasons for recommendation, installation, and noninstallation of the measures included in the HRCF retrofit "package."

The present report analyzed participation in the Project, and included comparisons of participants with nonparticipants and comparisons among participants as a function of when they signed up for HRCF. In addition, we examined the dynamics of HRCF supply - delivery of energy audits and installation of recommended retrofit measures.

Of the roughly 3500 eligible housing units (with permanently installed electric space heating equipment) in Hood River, 91% received a free home energy audit from HRCF; major retrofit measures were installed in 85% of the eligible homes. This remarkably high participation rate (roughly 45%/year) is an order of magnitude greater than that typically achieved in residential retrofit programs.

Several factors accounted for HRCP's success in achieving nearly 100% participation. The free retrofits were surely important. In addition, the recruitment (in summer 1983, three months before the Project officially began) of 469 households for special studies fortuitously created a group of citizens who were well-informed about and interested in HRCP. These people told many others about the Project, which helped stimulate almost 1000 requests for participation during the first three months of HRCP operation. Word of mouth proved to be the most important means for people to learn about HRCP: conversations with neighbors, friends, relatives, and community leaders.

In addition, HRCP staff were determined to achieve a very high participation rate, and they employed a variety of marketing techniques to encourage signups. Formation of a Community Advisory Committee, appearances before local groups, articles and ads in the local newspaper, appearances on the local radio station, and widespread use of the HRCP logo (including placement on two billboards) all helped to inform Hood River residents about the Project. Finally, in early 1985 a special effort was made to recruit the remaining eligible households that had not yet participated. This special effort involved visits and telephone calls from PP&L and HREC staff, which substantially boosted signups during the first quarter of 1985.

It is hard to know whether and how results from HRCP can be generalized to other situations. The free retrofits, extensive marketing, staff enthusiasm, and small town flavor of Hood River all contributed to the high participation levels from all demographic strata.

The Project's dramatic success in achieving high participation levels led to problems with delivery of HRCP services. During the first

several months of HRCP operation, long delays occurred between signups and energy audits and between audits and installation of retrofit measures. As the Project gained experience during 1984, however, these delays diminished. Ultimately, all 2988 homes were retrofit by the end of 1985.

Although HRCP succeeded in gaining participation from more than 90% of the eligible households and was successful in installing more than 80% of the recommended retrofit measures, it is too soon to know how much energy the Project actually saved. Information on actual kWh and kW reductions must wait until sufficient postretrofit electricity-billing and load-meter data are available in the summer of 1986.

Finally, we note that the large, detailed, and rich HRCP data base deserves to be mined further. We think there remain important insights hidden within the data that additional analysis will reveal. For example, more analysis might show the importance of HRCP's financial incentives relative to their marketing efforts in stimulating such high participation.

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APPENDIX. ESTIMATION OF NUMBER OF ELIGIBLE NONPARTICIPANTS

PP&L conducted a telephone survey among nonparticipating households in December 1985. The first task in developing this survey was defining the sample frame. Analysis of the HRCP field-office data base and the customer information systems from PP&L and HREC led PP&L staff (Kaplon 1986) to estimate a total population of 428 eligible nonparticipants (Table A-1). Of this total, 84 households were unreachable (no phone, unconfirmed address, identity of tenant unknown), leaving a final survey sample of 344.

Table A-1. Disposition of households in HRCP nonparticipant survey

Disposition	No. of households
Initial estimate of population	428
Eliminated from population (e.g., no phone, no address)	- 84
No. with whom telephone survey attempted	344
Surveys not completed (e.g., refusal, not reached)	-107
Surveys completed	237
Not eligible (no electric heat)	
Terminated during survey	- 54
Classified later as not eligible	- 27
Master-meter accounts	- 2
Contacted HRCP, no audit	- 15
Received HRCP audit, no retrofits	- 27
Received HRCP retrofits	- 1
Eligible nonparticipants	111

Telephone interviews were completed with almost 70% (237) of the 344 households. Interviewers terminated 54 of the interviews because the respondents indicated that they neither used electricity for space heating nor had any "permanently installed electric heating equipment in [the] home."

Our analysis of the survey responses from the remaining 183 (of which 43 were in the field-office data base) suggested that 111 were eligible nonparticipants, 27 were nonelectric heat homes, 2 were master-meter accounts,* 15 had contacted HRCP but received no energy audit and no retrofits, 27 had received only an audit, and one had been retrofit by HRCP (Table A-1).

Our estimate of 111 eligible nonparticipants was then adjusted upward to account for nonresponse to the survey. The original survey population totaled 428, with whom 237 surveys were completed. Thus, we estimate the total number of eligible nonparticipants as 200 ($111 \times 428 / 237$). PP&L's initial estimate of the population, based on HRCP and utility account records, was 329. Kaplon (1986) estimated the population as 295, based on the survey responses.

Differences between our estimate and Kaplon's occurred because of differences in classification of households based on survey responses and the field-office data base. For example, 25 respondents to the non-participant survey claimed to use electricity for heating and claimed to have received HRCP weatherization. However, these households were not in the field-office data base. Because the field-office records were

*These accounts were eligible but very hard to analyze because the households could not be uniquely identified.

the basis for BPA's payment to PP&L, we assumed that these homes had not been weatherized, and that they were not eligible (i.e., heated with oil or gas) and had therefore received only the low-cost, auditor-installed measures during the energy audit. Kaplon, on the other hand, assumed that these homes were eligible because the respondents claimed to use electricity and/or have permanently installed electric heating equipment in their homes. Both interpretations accept the field-office data base implication that these homes were not weatherized; Kaplon accepts the household self-report of electricity use for heating while we accept their report of weatherization.

The differences in these estimates of the number of eligible nonparticipants is small given the ambiguities in some survey questions,* the discrepancies between household reports and the field-office data base,** and the inherent difficulty in identifying all eligible households. Therefore, we assume that there are 251 eligible nonparticipants (to yield a round number of 3500 Hood River households eligible for HRCF, as shown in Table 1). Fortunately, the number of nonparticipants is so small that errors in estimating this number have little effect on HRCF participation rates.

*Households were asked whether they had "contacted" HRCF and whether their home had been "weatherized" by the Project; unfortunately, these terms were not defined in the survey and respondents may have interpreted them differently. The question on "permanently installed electric heating equipment" did not ask whether that equipment was installed before March 1983 (the eligibility date for HRCF participation).

**As an example of these discrepancies, 25 households claimed to have received an HRCF energy audit and HRCF weatherization, although Project records show no information on these households. Some household responses were internally inconsistent: three claimed to have received HRCF-financed weatherization but never contacted the Project office.

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