

Do Savings from Energy Education Persist?

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This report provides the first thorough examination of the persistence of energy savings from energy efficiency education. It does so by comparing gas savings for low-income utility customers who received weatherization to similar customers who also received in-home education and a setback thermostat. Energy use data is analyzed for savings both the first year after treatment and the third year after treatment to compare savings and determine persistence of savings.

This study compares the energy savings for two treatment groups. Weatherization Group households received traditional weatherization based on New York State's Weatherization Assistance Program (WAP). The Education Plus Group received comprehensive energy management including weatherization, energy education and a setback thermostat; they also participated in an affordable payment plan.

The original first year analysis of the Niagara Mohawk Power Partnerships (PP) Pilot (Harrigan 1992) showed savings of 16.3 percent for the Weatherization Group and 25.5 and 25.9 percent for the two Education Groups. Because some households in the original analysis moved or had data that did not meet certain screening criteria, fewer households were included in this analysis, which changed the first year savings. Based on this new analysis, the Education Plus Group saved 456 therms (23.9 percent) of normalized annual consumption (NAC), and the Weatherization Group saved 255 therms (13.8 percent).

In the third year, the Education Plus Group saved 396 therms (20.1 percent) compared with 220 therms (12.6 percent) for the Weatherization Group. When third year savings for the Education Plus group are compared with the Weatherization Group, savings for the Education Group are almost 60 percent higher. First and third year savings for both groups are significant compared to their pre-treatment consumption. The differences in percent savings (heating and NAC) between the Education and the Weatherization Groups are significant in the first and third years.

Persistence of savings is approximately the same between the two groups. Eighty-five percent of first year savings were still evident in the third year for the Education Plus Group, and 90 percent of the Weatherization Group's first year savings were evident the third year. The difference in persistence of savings between the groups was not significant.

Introduction

Education has been considered a "soft" efficiency retrofit: a good thing to do, but without verifiable benefits. Even though recent studies (Harrigan 1992, Harrigan 1991, Quaid 1990, Gregory 1992) have shown large, statistically significant first-year savings from educating consumers, much of the DSM and efficiency community have not taken education seriously as a valuable component of a DSM program. One could argue that measures such as insulation will last almost as long as the house, whereas occupants will forget, get lazy, or lose the enthusiasm for

conservation behaviors engendered by the educators' personal visits. Without evidence that savings persist at least for several years it has not been possible to calculate credible cost-effectiveness results for education. DSM managers have consequently not taken advantage of education as a DSM resource.

This report summarizes the analysis of data on first and third year energy savings of participants in the Niagara Mohawk Power Corporation's Power Partnerships Pilot

program. This original program was conducted in 1990 as a field test to determine the benefits of conducting a comprehensive energy management program for low-income, payment-troubled customers.

Original Power Partnerships Pilot Program

Low-income customers of Niagara Mohawk Power Corporation (NMPC) were selected in 1990 to participate in the field test in one of four groups: 1) a control group that received no services, 2) a weatherization group which received weatherization services from the New York State Weatherization Assistance Program (WAP); 3) an education group that received weatherization and participated in a comprehensive set of energy management services, including energy education sessions, a setback thermostat, a money management exercise and an affordable payment plan; and 4) a feedback group that received all the services that Group 3 received plus a feedback device that provided information on actual gas usage for heating and water heating.

Niagara Mohawk customers were selected who used gas for heating and water heating, had incomes below 150 percent of poverty, were in arrears to the utility, lived in buildings with one to four individually metered units, were responsible for their own energy costs, had one year of pre-pilot gas consumption available, and had not had their homes weatherized in the past year.

Participants in the two education groups reduced their gas consumption by 25.9 percent and 25.5 percent respectively, compared to 16.3 percent for the Weatherization Group (Group 2) and an increase in gas use in the control group. All three groups reduced their gas and electricity consumption compared to the Control Group. The Education Groups (3 and 4) saved more electricity than the Weatherization Group but the difference was not statistically significant. These savings are on the high end of the range of savings found in other research of the effectiveness of energy education in reducing energy use (Quaid 1990).

There was not a significant difference between the savings of Group 3 and Group 4. The feedback device does not seem to have resulted in additional savings beyond those achieved by the education sessions; however technical and installation problems with the device prevents any definite conclusions about the effectiveness of feedback of this type. Because of the similarity of savings, Groups 3 and 4 are combined as the Education Plus Group for the purposes of this report.

Education of Participants

The education provided consisted of three in-home education sessions: two focused on energy use; the other focused primarily on payment issues. The following components were included in the energy-use focused education sessions: establishing an empathetic relationship, developing participants' motivation for participation in the program, developing an understanding of the house as a system, learning to operate the setback thermostat, understanding the financial and comfort consequences of alternative energy use behaviors, and having participants develop and committing to their action plan.

The educators did considerable preparation before conducting the first session, reviewing past consumption and a lifestyle survey previously conducted and determining goals for the session. After the sessions, follow-up letters accompanied the utility bills providing feedback on actual change in energy use. As long as the mutually determined affordable payment amount was made on time, participants were guaranteed they would not be shut off even if their payment was not for the full amount owed.

Treatment of Education Participants After the Pilot Year

After the post-treatment year, the only contact Education participants had in relation to the pilot was—if they had maintained their affordable payment—an annual renegotiation of the affordable payment. Some participants initiated contact with Niagara Mohawk, but none of the participants in any group were contacted by the company in regards to their energy use after the pilot year.

Research Methodology

Data Collection and Screening

An attempt was made to collect consumption data for all households originally assigned to one of the two education groups, as well as weatherization and control group participants who were included in the Pilot. Data were collected for Power Partnerships (PP) households even if the household dropped from the program before the end of the Pilot, as long as they completed two of the education sessions. Data was not available for Pilot participants if the household moved or if they had been otherwise terminated as a NMPC customer.

Third year consumption data (11/92 to 12/93) were weather-normalized using the Princeton Scorekeeping Method (PRISM).

Houses were dropped from the third year study if:

- third year consumption data was not available from NMPC;
- pre-treatment first post-treatment year, and third post-treatment year data was not available;
- a final bill had been issued to the occupant during the third post-treatment year;
- R-square for any of the three years of data was less than .70; or
- PRISM output suggest that data was unreliable (heating component greater than NAC, etc.).

Participants in Third-Year Analysis

The availability of data and screening criteria resulted in fewer participants in the third-year analysis in the Pilot. The original analysis of the treatment groups (Groups 2, 3 and 4) had a sample size of 47 for each group. By the end of the third year numbers were as follows:

Group 1 (Control)	13
Group 2 (Weatherization)	30
Group 3 (Education–combination of original Groups 3 and 4)	71

Saving for Group 3 participants were originally investigated in two sub-groups: 1) households that are still active Power Partnership households and households that dropped from the program either during the Pilot or subsequent to the Pilot. (Dropped households also were examined based on when they dropped.) No significant differences were found between education households who are active PP customers and those who are not. Because of this and the fact that the sample size is already quite small, education households were further investigated as a single group.

Pre- and Post-Treatment Time Periods

Third-year weather-normalized consumption (NAC and heating consumption) was compared to both the pre-treatment year and the first post-treatment year.

Pre-treatment Period	10/1/88 to 11/30/89
First post-treatment period	9/1/90 to 10/31/91
Third post-treatment Period	11/1/92 to 12/31/93

To account for the possibility of a different number of days in the three time periods included in the analysis, the 14 months of electric usage data available for each of the three years was translated into use per day.

Subset Analysis

In addition to treatment group, several variables were found to have a significant relationship to energy savings in the Pilot study. They included:

- pre-treatment consumption;
- income;
- number of occupants;
- size of structure (square footage); and
- weatherization measures installed (insulation).

Each of these variables, and whether the occupant was a home owner or renter (tenure), were included in these analysis of persistence of savings. Tenure was not a significant factor in energy savings in the Pilot; however, given the passage of time, researchers were concerned about the shift from a study of both owners and renters to a study of primarily home owners.

Because of the smaller sample sizes, not all the comparisons made in the original study could be repeated. Although presented for the purposes of illumination, numbers presented for groups with a sample size less than 20 should be interpreted cautiously.

Statistical Tests

Standard descriptive statistics (mean, median, standard deviation, minimum, maximum, etc.) were calculated. Neither the input data values nor the calculations for energy savings were normally distributed. To standardize savings relative to pre-treatment consumption, percent change for heating and total consumption was calculated for both first year and third year savings. Although savings is reported in both therms and percentages, tests for significance were based on percent change calculations.

There is an assumed natural pairing between pre- and post-treatment consumption. To take this correlation into account, the mean change from pre-treatment to post-treatment scores were analyzed using a means test together with the t-statistic and probability options. An analysis of variance (ANOVA) was used to determine the significance of savings between groups and within each group and to determine the significance of savings between groups and within each group and to determine the effect of factors, other than program treatment, on energy savings.

Control Group

The Pilot included a non-treatment control group which was selected from the same pool of houses from which houses in each of the three original treatment groups were selected. At the beginning of the Pilot, houses were

selected from a pool of program-eligible households (households that met all the guidelines necessary to be weatherized under the State of New York’s weatherization program) and randomly assigned to one of the three treatment groups described earlier in this report. At the same time, a pool of 474 houses were set aside as the potential control group.

At the end of the Pilot, households in each of the four groups were surveyed to determine, among other things, changes that may have occurred during the first post-treatment year. In addition to being surveyed about changes that may have effected energy consumption, the control group was surveyed to determine program eligibility and interest in the Power Partnership Program. The timing of the survey was scheduled so as not to contaminate this “non-treatment” group.

A complication in continuing to utilize these households as a control group was NMPC’s desire to weatherize Control Group houses as soon after the completion of the Pilot as possible. During the data collection stage of this study, an attempt was made to identify all Control Group houses that received weatherization treatment following the completion of the Pilot. These households were not included in the study.

In addition to houses that were dropped from the persistence study because they were identified as having been weatherized or because they had moved, remaining houses were subjected to the same screening criteria described earlier. This left the study with only 13 houses for which there was good data. Even these houses, however, may have been “contaminated” through the survey process.

The possibility of contamination by either the extensive survey or other exposure to Niagara Mohawk’s Power Partnerships or other programs seemed sufficiently high that these households no longer constitute a non-treatment control group. They are therefore not included in the analysis of persistence of savings. Savings are compared between the Education and Weatherization Groups only and not to the Control Group used in the Pilot.

Results

Pre-Treatment Consumption

Pre-treatment consumption was examined to determine whether levels were comparable for each group. The difference between the groups was not significant (see Table 1).

Table 1. Pre-Treatment Consumption—Therms

	Weatherization	Education Plus
NAC	1718	1750
Heating	1402	1439

Gas Savings

There are two ways to look at the longevity of gas savings due to education plus the setback thermostat. One is the comparison of the energy savings for each group for both the first and third years (see Table 2). The second is the calculation of the persistence of savings for each group, and the comparison of persistence between the Education and Weatherization Groups. Each are outlined below.

During the first post-treatment year, average savings (NAC) in the Weatherization Group were 244 therms (13.8 percent). The Education Plus Group during the same period saved 465 therms (23.9 percent). The results for the heating component of the NAC show similar respective savings: the Weatherization Group saved 255 therms (17.2 percent), and the Education Plus Group saved 458 therms (27.8 percent).

As stated earlier, these figures differ slightly from the original Pilot results because the population is different, only including participants in all groups who had not moved and who had data that met certain screening criteria. As a result of the change in sample included, savings for the first year are approximately two to three percentage points below the results of the original study for both education and weatherization groups.

During the third year after weatherization, the savings (NAC) for the Weatherization Group decreased slightly to 220 therms (12.6 percent). During the third year NAC for the Education Plus Group dropped to 396 therms (20.1 percent). Savings for the heating portion of NAC for the same period were: Weatherization Group, 199 therms (13.6 percent); and Education Plus Group, 406 therms (24.9 percent). The data suggest that the education and/or setback thermostat helps households achieve greater savings than weatherization alone. Savings for the first and third years are statistically significant for both the Education Plus and Weatherization Groups.

Table 2. Gas Savings — Percent and Therms

	Weatherization Group			Education Plus Group		
	Therms N=30	Percent N=30 (+,-)	Std. Dev	Therms N=71	Percent N=71 (+,-)	Std. Dev
NAC--First Year	244	13.8 (3.2)	16.6	465	23.9 (1.9)	16
Third Year	220	12.6 (3.2)	17.6	396	20.1 (1.8)	16
Heat--First Year	255	17.2 (3.6)	19.8	458	27.8 (2.3)	19.8
Third Year	199	13.6 (4.3)	23.7	406	24.9 (2.2)	18.8

The other way to compare the savings of the Weatherization Group with the Education Plus Group is to calculate the persistence of savings for each group and compare the persistence between groups. The persistence in savings was determined by calculating the persistence for each household in each group, then averaging those numbers to result in a group average (see Table 3).

The Weatherization Group had a slightly higher persistence in savings than the Education Plus Group. Persistence is lower for heating in the Weatherization Group; the Education Group had a slightly higher persistence in the heating portion of the NAC. The differences in persistence between the groups was small and was not statistically significant.

Eighty-five percent of first year savings ($465 - 396 / 465 = 14.8$ percent) were still evident in the third year for the Education Plus Group, and 90 percent ($244 - 220 / 244 = 9.8$ percent) of the Weatherization Group's first year savings were evident the third year.

There may be a lesson for energy educators in the difference in persistence between heating and NAC. Perhaps more could be done to enhance the persistence of gas savings in water heating, clothes drying and cooking. If the setback thermostat helped maintain the heating saving (a hypothesis), there may be other devices that could help people maintain water heating savings.

Relationship of Insulation to Savings. When the treatment groups were broken out by whether they received insulation as one of the weatherization measures, differences in savings are striking. Table 4 compares savings according to whether participants received insulation in either the attic, floor or walls, to participants who received no insulation. The savings are shown for heating only, not NAC, since insulation is primarily related to heating energy.

As expected, savings were higher the first year in all groups for households that had insulation installed than for household that did not. The savings were fairly persistent

Table 3. Change in Savings from First Year to Third Year

Group	Wx—Therms N=30	Wx—Percent N=30	Ed—Therms N=71	Ed—Percent N=71
NAC--First Year	244	13.8	465	23.9
Third year	220	12.6	396	20.1
<i>Change in Savings</i>	9.8	-1.1	14.8	-3.7
Heat--First Year	255	17.2	458	27.8
Third Year	199	13.6	406	24.9
<i>Change in Savings</i>	22	-3.6	11.3	-2.8

Table 4. Savings on Heating by Insulation

Group	N	Wx—Therms	Wx—Percent	N	Ed—Therms	Ed—Percent
Insulation/First Year	23	313	21.7	55	618	30.2
Third Year	23	286	19.2	55	432	25.5
No Insulation/First Year	6	116	6.2	15	259	18.7
Third Year	6	-42	-.2	15	342	24.6

in the Weatherization Group among those who received insulation, only dropping from 21.7 percent to 19.2 percent in the Weatherization Group and only slightly less persistent in the Education Plus Group, from 30.2 percent to 25.5 percent.

The surprising finding is the high savings among those who did not receive insulation among the Education Plus Group, and the increased saving in the third year relative to the first year in that group. The Education Plus Group households which did not receive insulation saved 18.7 percent the first year and increased savings to 24.6 percent the third year, almost equaling the third year savings of the group that did receive insulation. The Weatherization Group saved 6.2 percent the first year and had negative savings the third year. It appears that the education has an even greater energy-saving effect in houses which were not insulated. It should be noted, however, that the number of households which did not receive insulation is small, especially in the Weatherization Group, and these results should be interpreted cautiously.

Discussion of Effect of Insulation on Savings.

The high rate of savings among households which did not receive insulation is unusual in weatherization studies. This finding provides an indication that programs that do not install measures expected to achieve high levels of savings, such as low-cost/no cost Energy Fitness programs, might want to look at utilizing education to increase energy savings. While energy educators and weatherization providers always want to see education added to weatherization rather than substituted for it, there may be circumstances in which the funds for extensive weatherization are not available. In these cases it seems that it may still be worthwhile to provide education.

Tenure. As expected, over the three year study period many households moved or terminated their accounts, and of those who remained in the same homes for that period the percentage of homeowners increased compared to renters. The difference in proportion of renters to owners

was not statistically significant between the groups. The proportion of owners to renters in the original study was 59 percent. In this study of household who had not moved the proportion of owners to total participants increased to 71 percent. In the original study the savings of households did not significantly differ according to whether they were owners or renters. In this study the difference is significant, especially in the Weatherization Group.

For both groups, renters' savings were consistently higher than owners. This was especially true in heating in the Weatherization Group, in which third year savings for owners were 9.6 percent and for renters were 24.3 percent. These savings were close to Education Plus Group savings of 26.1 percent for renters in heating. In the Education Plus Group, owners saved 480 therms (24.1 percent) in the first year and 402 therms (20.3 percent). Again, the small number of renting households, especially for the Weatherization Group (9 households), means these findings should be interpreted with caution.

The higher savings of renters over owners may explain the difference in first year savings between the original PP study, which included 41 percent renters, and the longevity study, which included 29 percent renters.

Discussion of Tenure. There has been concern in the weatherization community that weatherization, as an improvement to property, may provide greater benefits to homeowners and landlords than to renters. This evidence indicates that renters in this study benefited by lower bills to a greater extent than owners. With only nine renters in the weatherization group, however, these numbers must be interpreted cautiously.

An issue with more relevance to education is what happens to the utility or government efficiency investment when an educated household moves from a weatherized home (as tenants do more often than homeowners). The weatherization measures presumably stay in place; another low-income household probably moves in and benefits

from the weatherization (as does the utility). When a family participating in energy education or individual moves, their knowledge moves with them; we assume that they continue to benefit from that knowledge. Since this education was provided by the utility, the utility continues to benefit as long as they move within the utility's service territory. Society benefits wherever they move.

Three other variables were examined and not found to be an alternative explanation to the differences between groups: savings per square foot, income and number of occupants .

Savings of Households that Dropped from the Affordable Payment Plan vs. Those that Did Not. Households in the Education Plus Group include all those who participated in at least two of the three in-home education sessions (all but four participated in all three) for whom data was available. For the purposes of this analysis of savings, households who dropped from the affordable payment plan and therefore are not still participants in the Power Partnerships program were not separated from those who kept up their affordable payments and are still participants.

Table 5 summarizes the differences in consumption between those households that remained in the Power Partnerships program as of January 1994 and those that dropped at some point between October 1990 and January of 1994.

While the differences are not large, they are consistent—in every category the regular payment households averaged greater savings. The numbers are not statistically significant, and we cannot conclude that dropped households save more energy. However, they are consistent with the Willet and Ling finding that more frequent actual bills lead to greater customer-initiated energy savings (Willet and Ling 1992).

Discussion of Effect of Dropping from Power Partnerships. One could hypothesize that if it true that dropped households saved more, it might be because they had a specific motivation to save energy—if they did, their costs were lower. Perhaps if the PP program had included a financial motivation for saving energy, their savings in the original pilot might have been even greater. On the other hand, it may be that for those people, who have little chance of paying their entire utility bill no matter how efficient they are, the affordable payment was the key to engaging their attention and efforts.

These results between the affordable payment and regular payment households bring up the question of how many education sessions are necessary to achieve these savings. All but four households classified in the Education Plus Group took part in all three sessions, but only two of the sessions were focused on energy savings. The other session (the second) primarily focused on money management. If savings are not related to the payment aspect of the Power Partnerships program, then it appears that the money management education session did not contribute to the savings. Therefore the education was essentially accomplished with two sessions, not three. The expanded program NMPC has been conducting since the original Pilot has utilized two sessions. This difference has significant implications for the cost of the education.

Electrical Savings

Electric savings in the original Pilot study ranged from 4.5% for Group 2 to 7.4 for Group 3 and 7.1 for Group 4. For the group of households included in this study, electric savings were negligible for all groups both in the first year and in the third year, being in all cases less than 1% more or less than in the pre-treatment year.

These findings are not too surprising, since the program focused on savings in participants' heating and water

Table 5. Savings - Affordable Payment vs. Full Payment

Group	N	Affordable Payment Therms	Affordable Payment Percent	N	Regular Payment Therms	Regular Payment Percent
NAC--First Year	36	479	22.8	35	450	24.9
Third Year	36	407	19.9	35	384	20.4
Heating--First Year	36	474	27.5	35	441	28.1
Third Year	36	396	23.1	35	418	26.8

heating (and sometimes clothes drying and cooking) uses, which was provided by gas. The Pilot originally anticipated a greater focus on electrical DSM measures but ended up simply replacing two to five incandescent lights used at least four hours per day with compact fluorescent.

The incremental savings in the original study of less than three percentage points for the education groups indicates that an education program that focuses on heating and water heating savings would not be effective in producing long-term electrical savings. Perhaps a program that focused more specifically on educating participants about electrical energy savings would have more success.

Contribution of Setback Thermostat to Savings

The Education Plus Group received not only education but also a setback thermostat, installed through New York State's Weatherization Assistance Program by the seven weatherization agencies that installed the weatherization measures. The education emphasized ways to use the thermostat to save on heating energy. Households in the Weatherization Group could have had thermostats installed, and a few did, but weatherization program providers have generally not made great use of setback thermostats because of client dissatisfaction and callbacks.

There is no data available that provides information on what role the setback thermostat played in the Education Plus Group savings. However, the high persistence of savings in the heating portion of NAC (89 percent) for education compared with 78 percent persistence for heating savings for the Weatherization Group indicates that something was quite effective in helping educated participants maintain heating savings. This may have been the setback thermostat; it does seem logical that once they got used to setting back the temperature during the night and possibly during the day they would not go to the effort to change it.

It is worth noting that the follow-up survey conducted after the first post-treatment year found that while almost half of participants in the education groups lowered the temperature in their home after the treatment, education group participants were more satisfied with the temperature of their home than weatherization households (Harrigan 1992). It could be hypothesized that there is less of a take-back effect in households with weatherization *and* education.

Conclusions

This study reinforces the evidence provided by other studies that when education and a setback thermostat are added to weatherization, savings increase dramatically (13.8 compared with 23.9, a 73 percent increase in savings the first year). It also provides documentation that those increased savings persist quite well over three years. In the third year after weatherization and education, the average household that participated in education is still saving 7.5 percentage points, or 60 percent more than the average household that received weatherization but not education (12.6 percent compared to 20.1 percent). Persistence of savings between the groups is similar.

The question of how savings will hold up in subsequent years remains unanswered, but this study provides some indications. Since the savings have lasted three years with little degradation, there is little reason to believe that a sudden drop will occur in the near future. It seems more likely that savings will continue to degrade gradually over time.

If this is the case, it is time to not only integrate energy education into low-income weatherization programs but to bring it into consideration as a DSM resource. Many low-income programs are already beginning to integrate education into their weatherization programs, but almost no utility DSM programs have done so. Many utilities conduct general information programs, but very few of those are considered DSM programs with either assumed or verified energy savings.

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