MAP: What I Think We Know, . . . And What I Think We Don't

Claude Davis, Idaho Power Company
Ken Eklund, Idaho Department of Water Resources Energy Division

The Manufactured Home Acquisition Program, or MAP, operated in the Pacific Northwest, has played a major role in transforming the market for energy efficient manufactured homes. In the process, this $100,000,000 program developed a large number of stakeholders, including the Northwest Power Planning Council, Bonneville Power Administration, six investor owned utilities, numerous municipal and public utilities, seven state agencies, nineteen home manufacturers and their dealer network, and approximately 50,000 purchasers of MAP homes. The program ended in July of 1995 and has been succeeded by a new program aimed at keeping alive the MAP momentum, and the reputation for quality it created. This successor, the Northwest Energy Efficient Manufactured Home™ Program, has eliminated utility payments to the manufacturers and actually has the manufacturers paying a small fee for each home produced under the program. MAP had no less than three 'impact' evaluations performed in 1994-1995, as well as a number of other analyses. While the findings are diverse and have led to some heated debate, a number of 'truths' appear to come forward.

This paper seeks to reveal those 'truths' and provide a groundwork upon which the stakeholders should be able to agree. It will also outline areas of potential disagreement to foster discussion and resolution. In short, this paper discusses '*what I think we know, and what I think we don't*' about the impacts of MAP. Agree or disagree, this paper will spark the interest of those involved in major collaborative efforts.

BACKGROUND

The Manufactured Home Acquisition Program, or MAP, began officially in April 1992. Unofficially, MAP represents the culmination of prior years research and efforts to improve the energy efficiency of manufactured housing in the Northwest region. This region consists of four states (Washington, Oregon, Idaho and Montana) that have representation on the Northwest Power Planning Council (NWPPC), an agency created under the Northwest Power Planning Act of 1980. NWPPC Staff and the State Energy Offices (SEOs) of the four Pacific Northwest states of Idaho, Montana, Oregon and Washington were largely responsible for developing MAP and persuading various entities to participate. The manufactured home segment of the residential market has historically lagged behind the site built segment in energy efficiency gains. This is due in part to national code being preemptive over state and local ordinances. This was exacerbated by the manufactured home dealers and builders primarily targeting an entry level market, where initial costs are often of more concern than life cycle costs. This tends to drive the market toward code minimums, and the code minimums, established by the U.S. Department of Housing and Urban Development (HUD), were considerably less efficient than the region's Model Conservation Standards (MCS), which are applicable to site built homes. MCS has been endorsed by the NWPPC as an appropriate and cost-effective energy efficiency code.

According to engineering calculations, the space heating energy usage for a 1976 HUD code minimum built manufactured home would exceed that of a comparable home built to minimize space heating life cycle costs by more than 9,000 kWh per year in the region's most moderate climate zone, and more than 14,000 kWh per year in the most severe climate zone. It was estimated that manufactured housing made up 25% of the new single family housing market and nearly 40% of the electrically heated new single family housing market. The magnitude of the market share and the tremendous potential energy savings were recognized early on.

In the 1980's, several studies and pilot programs were done. These efforts led to the Super Good Cents® (SGC®) Manufactured Home Program in 1989. The SGC® program is a classic utility DSM program, with an incentive payment going to the purchaser of SGC® qualified manufactured homes. While meeting with some success, this program was able to move only a portion of the market toward the desired efficiency level for two reasons.

- Not every utility participated in the program.
- Not all customers opted to take the incentive payment and purchase a SGC® home.

In April 1992, MAP was formally instituted. It is a true regional market transformation program. Every regional

manufacturer agreed to participate. To this end, each agreed to produce only homes that met MAP's energy efficiency requirements through the inclusion of a list of measures from a prescriptive path or its equivalent. The Bonneville Power Administration (BPA) agreed to operate the program and to serve as the program's banker. They would pay the incentive, initially $2500, directly to the manufacturer as each unit was completed. In turn, the regions IOU's agreed to pay the incentive to the BPA, along with an administrative fee, for each unit sited in their service area. While bringing this diverse group together is a definite strength of MAP, it also creates a program with a multitude of stakeholders. Among the stakeholders:

- NWPPC, the agency that facilitated negotiation of MAP and provides a strong endorsement for the program,
- BPA, which is legally bound to pursue regionally cost-effective DSM and contractually bound to serve as the administrator of MAP,
- Pacific Northwest National Labs, consultant to BPA,
- Ecotope, Inc., consultant to BPA,
- State Energy Offices from the four Pacific Northwest state[1],
- Public Utility Commissions from the four Pacific Northwest states,
- Numerous Public Utility Districts that purchase wholesale power from the BPA,
- Six investor-owned-utilities (IOUs) operating in the region[2],
- Eighteen home manufacturers located in the region (plus five additional manufacturers from neighboring areas that later joined the program),
- Numerous manufactured home dealers serving the region,
- Approximately 50,000 families that have purchased MAP homes.

More than $100 million in incentives have been paid under MAP. MAP directly influenced a $2.5 billion market (Peach 1995).

A transition point in this program occurred on October 24, 1994, when new federal HUD standards for manufactured homes became effective. These new standards were designed to improve the shell characteristics of manufactured homes built outside of DSM programs, and effectively 'raised the floor' under the MAP standards that manufacturers could fall to. The introduction of the new HUD standards served to reduce the marginal (with respect to the hypothetical non-participants) savings attributable to the program, and set the stage for renegotiation of the manufacturer contract.

The program ended in July of 1995 and has been succeeded by a new program aimed at keeping alive the MAP momentum, and the reputation for quality it created. This successor, the Northwest Energy Efficient Manufactured Home™ Program, has eliminated utility payments to the manufacturers and actually has the manufacturers paying a small fee for each home produced under the program.

While recognizing that MAP has been a successful market transformation program, concerns existed early-on regarding the cost effectiveness of the program's direct benefits. Analysis of the program's cost-effectiveness had been done (Baylon & Davis 1993) based on comparison of simulations referenced to a submetered 150 home sample of pre-MAP demonstration homes in BPA's Residential Conservation Demonstration Program (RCDP) (Baylon et al. 1991). Despite suggestions by the SEOs that a portion of the MAP homes be submetered together with a sample of agreed-upon control homes, no field data was gathered until the SEOs began field testing a random sample of 150 MAP homes in October 1993 with the intention of determining MAP performance. The sample was identified by Ecotope, Inc., which also designed the field protocol, including blower door testing, duct blast, site audit, occupant interview and billing release forms.

In late 1993, several other entities felt the need for an impact evaluation, and both utility and commission staff were beginning to ask the question: ''How much energy is being saved by MAP?''

EVALUATIONS, STUDIES, AND DEBATE

In 1993, the BPA contracted with Pacific Northwest National Labs to perform an impact evaluation. After reviewing a presentation on plans for the BPA sponsored evaluation, two things became evident: the BPA/PNL plan would not adequately address the needs of the IOU's, and the timing of its expected completion would not allow it to contribute to the renegotiation process.

The BPA/PNL analyzed data, including twelve months billing history, from 134 MAP homes in the SEO random sample built during the first year of MAP and 123 ''baseline'' homes, with the baseline defined as homes built during January 1992 through March 1992 and not participating in the

utilities' SGC program. These ''baseline'' homes were ''not intended to define the efficiency levels of homes that would have existed without MAP and its precursor programs (Lee et al. 1995 626).'' Rather, they represented observations with sufficient variation in U_0 value from the MAP homes to allow the estimation of PNL's energy use model. Characteristics of the baseline dwellings (dimensions and U0 values) were extracted directly from manufacturer records for each home. The analysis used a regression based approach with household electricity consumption as the dependent variable, however the model specification did not allow the direct estimation of space heating energy usage.

Concerns about the BPA/PNL study primarily focus on:

- The somewhat limited sample size, both in number of dwelling units and months of energy use;
- The selection of a three month window for the ''baseline'' sample which may have been affected by previous utility programs; and,
- The inability of the model specification to estimate electricity usage for the space heating end-use.

The use of an analysis of 12 months data on 134 MAP homes to represent the energy efficiency of the more than 46,000 MAP homes built by 19 manufacturers during the course of the program raised concern by some analysts of the effects of possible sampling error. The selection of the baseline complicates matters further, in that this sample has energy efficiency characteristics superior to those attributed what ''would have existed without MAP and its precursor programs.'' Finally, the inability of the specified model to estimate actual space heating usage greatly limits the value of the results and does not enable the analysis to address the accuracy of the engineering models in predicting space heating energy usage.

The BPA/PNL evaluation (Lee et al. 1995) found MAP to be cost-effective, on average, based on the direct 'acquisition' energy savings due the program, however, the evaluation found those savings to be substantially less than anticipated prior to the program. This analysis also led the authors to the conclusion that the market transformation effects of MAP were dramatic and used an innovative analysis to attempt to quantify this impact.

Early in the BPA/PNL evaluation, five IOU's participating in the program met and decided, by consensus, that IOU specific information was important. After noting several concerns with the BPA/PNL work plan, a scope of work was drafted, agreed to, and incorporated into a request for proposals by the group. The successful proposal, by Regional Economic Research, Inc. (RER), was selected by a consensus of the sponsoring five IOU's. Subsequently, however, only three of the initial five IOU's decided to proceed and fund the study. The IOU/RER evaluation was the first to go public with its findings.

The IOU/RER evaluation (Sebold et al. 1995) used a sample of more than 900 MAP homes and more than 900 homes built prior to MAP going back as far as 1985. In addition, the Statistically Adjusted Engineering (SAE) approach used allowed the comparison of the models estimated space heating electricity use with the engineering priors. This evaluation, however, found the energy savings directly attributable to the MAP to be even less than those found by BPA/PNL, and at a level that did not result in cost-effectiveness based on these directly attributable benefits. The study was criticized by the SEOs, NWPPC staff and Ecotope because the results of the SAE approach were not replicable using engineering simulation, and because the heat load estimates for the reference baseline sample were felt to be too low to represent the actual pre-utility intervention cohort.

A third study, commissioned by BPA and conducted by Ecotope, entailed analysis of billing and field data gathered by the SEOs from the random sample of 150 MAP homes (Baylon, Davis & Palmiter 1995). Field audit data were used to disaggregate outbuildings, pumps and outdoor lighting from the remaining load for each home. These were then compare to weather-adjusted simulations for each home using SUNDAY™. The simulation correlated well with the billing analysis. SUNDAY™ was then used to simulate the heating loads for the same buildings built to the 1994 HUD Code standards. The main criticisms of this approach are (1) the attribution to outbuildings in the MAP sample heat loads is too high, (2) the comparison case does not accurately reflect a conventional practice that is actually above 1994 HUD Code minimum, and (3) the simulation is less accurate when simulating the heat load of buildings with higher UAs.

It seems that all three studies have been criticized for one reason or another. In the process, it appears that much of the knowledge and insight available from these studies and evaluations has been overlooked in the debate.

WHAT I THINK WE KNOW, . . .

When pondering what I think we know as a result of this research, I am heartened by the number of positive statements that can be made with confidence. I am further heartened because we may already know the most important things.

First, I think we know MAP homes use energy for space heating in line with the expectations and estimates derived from the engineering models. This seems to be a clear con-

clusion from all three studies cited above, one which should be immediately agreed upon by all stakeholders. I have seen no information put forth to challenge this position. This knowledge is important in that it means that the performance of MAP homes is not in question. The purchasers of MAP homes received energy efficient housing. The utilities can rely on the engineering estimates for these homes in predicting future energy needs. The manufacturers' reputation is enhanced.

Second, I think we know utilities and related agencies can wield tremendous influence in a market. MAP demonstrated the ability of diverse investor owned utilities, government agencies and others to work together cooperatively and bring about a major change in an industry. When one considers the number of stakeholders in MAP, it is impressive that agreement and consensus could be reached to undertake a project of this magnitude.

Third, I think we know MAP, and its predecessors, stimulated a demand for energy efficient manufactured housing that may have been overlooked by manufacturers (or at least, underestimated) prior to utility involvement. This is important because a portion of the market transformation benefits of MAP rely on a continued demand for energy efficient manufactured homes after MAP's end. Manufacturers in this region recognize the strength of that demand and will continue to make product available to fill the market.

Fourth, I think we know MAP influenced the standards adopted by HUD in 1994. The RER report cites very specific information and interviews with key players that shows this direct link. MAP demonstrated that a product could be built to meet the requirements. Again, I have seen no information which would dispute this conclusion. This means that the market transformation benefits attributable to MAP extend beyond the borders of the Northwest region. In fact, the standards adopted for the entire tier of Northern states was influenced by MAP.

AND WHAT I THINK WE DON'T

There are still two primary things that we do not know about MAP. For one it is too early to tell. The other is a question about the past and what might have been.

I think we don't know, yet, the magnitude of the market transformation benefits of MAP. Even assuming some level of slippage in efficiency within the region, the societal benefits of MAP, through the HUD 94 standards, will accrue for a number of years across the nation. And evidence of any slippage is limited. Estimating the magnitude of MAP's market transformation benefits is still important in that they play a role in determining the overall cost-effectiveness of (and in hindsight, justification for) MAP. Once we know that these market transformation benefits are sufficient to off-set possible less than expected acquisition benefits to make the overall program cost-effective, then their estimation becomes more of an intellectual pursuit to obtain bragging rights than necessary information upon which to make decisions. In his paper presented in Chicago at the National Energy Program Evaluation Conference (Lee et al. 1995) last year, Allen Lee demonstrated the power of these market transformation benefits to effect program cost-effectiveness. If we limit our view of the market transformation benefits of MAP only to the Northwest region, only to the gain above HUD94 standards, and only for a period of five years after MAP, these benefits alone have the power to cut the program cost per kWh in half. When we drop these limitations and recognize these additional benefits, it is clear to me that in the long-run, MAP will be cost-effective. I believe, though I don't know, that the market transformation benefits alone are sufficient to find MAP cost-effective.

Secondly, I don't think we know the energy efficiency characteristics of the ''baseline'' manufactured homes. That is, how bad was the baseline? Some have maintained that their energy efficiency was very poor, with a U0 value around .114. Others have maintained that their energy efficiency was somewhat better (though still poor by MAP standards), perhaps with a U0 value of around .09. And regardless of the envelope efficiency of the dwelling unit, how did its residents respond to cold weather? Did they use electric heat, as the engineering model assumes, to heat the entire dwelling unit and behave as they would have in a more efficient home? Did they use an alternative fuel to provide heat? Do they use an alternative method to increase the effective energy efficiency of the home, such as purchasing insulated curtains and storm windows and doors, closing off bedrooms when not in use, or even placing bales of straw around the perimeter of the home? Or do the residents simply trade some level of personal discomfort and inconvenience for lower energy bills? The true baseline, from most points of view, becomes moot if the market transformation benefits are sufficient to carry the balance of the load, and to make MAP cost-effective overall. Again, once we know that the program is cost-effective, additional research in this area will be more for bragging rights than to gain necessary information.

CONCLUSION

It is wise to consider the importance of what we know about MAP. We know that MAP homes were built and perform in line with the engineering expectations. We know that those participating in MAP can and did have a tremendous influence on a large market. We know that MAP and its predecessors stimulated a demand for energy efficient manu-

factured housing that has lasted beyond the program. And we know that MAP has played a significant role in the future energy efficiency of manufactured housing far beyond the borders of the region. To me, these are very important things. It also seems that the direct acquisition benefits attributable to MAP may be less than originally planned; that the baseline homes, for whatever reason, may not have consumed as much electricity as the MAP planners thought. Because the program failed to identify and submeter space heat on an agreed upon reference baseline cohort at the beginning of MAP and submeter a random sample of the MAP homes, it is, at best, academic what the baseline consumption was and uncertain exactly what the MAP homes used for space heat. Therefore, a precise estimate of the energy savings directly attributable (acquisition savings) to the program is not possible.

The interested parties probably need not and should not aim significant further effort at determining the 'true' baseline and resulting cost-effectiveness. It may have been as 'bad' as the original planners had feared. It may have been as 'good' as the RER analysis estimates. It may have been somewhere in between. However, I am confident that the market transformation benefits attributable to MAP make the program cost-effective overall.

The BPA has chartered a two year evaluation focusing on the market transformation effects of MAP. The study, conducted by H. Gil Peach and Associates, does not have definitive data available yet. It is fully expected, however, that these benefits, when added to the direct acquisition benefits of MAP, will show the program to be cost-effective, even in a worst case scenario.

ENDNOTES

1. The four Pacific Northwest State Energy Offices are the Washington State Energy Office, the Oregon Department of Energy, the Idaho Department of Water Resources Energy Division, and the Montana Department of Natural Resources.
2. The six investor-owned-utilities operating in the region participating in the program are Idaho Power, PacifiCorp, Portland General Electric, Puget Sound Power & Light, Washington Water Power, and Montana Power.

REFERENCES

Baylon, David, Bob Davis, Ian Brown, Mike Kennedy, Mike Lubliner and Steve Onisko. 1991 ''Manufactured Homes Thermal Analysis and Cost Effectiveness Report,'' DOE/BP-35738-4, BPA, April.

Baylon, David and Bob Davis, Ecotope, Inc. 1993. ''Cost Effectiveness of the Manufactured Housing Acquisition Program (MAP),'' BPA, April.

Baylon, David, Bob Davis, and Larry Palmiter, Ecotope, Inc. 1995. ''Manufactured Home Acquisition Program, Analysis of Program Impacts,'' Final Report, BPA, August

Lee, Allen D., Z. Todd Taylor and Linda J. Sandahl, Pacific Northwest Laboratory, and Sheila Riewer, Bonneville Power Administration. 1995. ''Impact Evaluation of a Major Residential Efficiency Program: The Importance of Market Transformation,'' In *Proceedings: Energy Program Evaluation: Uses, Methods, and Results. CONF-950817*. Chicago, IL: National Energy Program Evaluation Conference, August.

Peach, Gil (H. Gil Peach and Associates). 1995. Personal communication to author.

Frederick D. Sebold and Keith E. Fuller, Regional Economic Research, Inc., Angeline Chong, Portland General Electric, Claude Davis, Idaho Power Co. and Wylo Schwartz, PacifiCorp. 1995. ''Impact Assessment of Manufactured Home Acquisition Program (MAP),'' Energy Program Evaluation: Uses, Methods, and Results. CONF-950817. Chicago, IL: National Energy Program Evaluation Conference, August.