

Achieving Energy Efficiency in Manufactured Housing Through Direct Resource Acquisition

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The Bonneville Power Administration, a wholesaler of electricity in the Pacific Northwest, has implemented an innovative approach for acquiring demand side resources in manufactured housing by negotiating directly with the manufacturers to build only homes that are significantly more energy efficient than HUD code requirements. In a demonstration project, manufacturers built 150 homes to a proposed model conservation standard (MCS). In 1990, BPA offered a consumer incentive to purchase manufactured homes built to MCS, and in one year, achieved a 20 percent penetration rate. In order to accelerate the penetration rate and improve cost effectiveness, BPA led a regionwide effort to negotiate with the manufacturers to build to BPA specifications that would be slightly better than the MCS used in the demonstration program and the consumer rebate program. This effort involved reaching agreements with the region's 18 manufacturers and over 130 utilities. The negotiations were successful and the direct acquisition program started in April 1992, for a period of four years. The region produces 12,000 manufactured homes each year, and based on a conservative estimate of 6,000 kWh energy savings per unit per year, the total conservation resource acquired is over 8 average megawatt (aMW) per year.¹

Introduction

The Bonneville Power Administration (hereafter "Bonneville") is a U.S. Department of Energy agency that wholesales electric power from public generating projects to retail utilities in Washington, Oregon, Idaho, and western Montana. Bonneville serves the electricity needs and load growth of 130 customers, primarily public utility districts, municipal agencies, rural electric cooperatives, and larger industrial plants. Bonneville customers' load total more than 8000 MW, which is about half of the region's total load. Furthermore, because of its extensive main grid transmission system, Bonneville also serves as the region's principal power broker, playing a key role in power sales, transfers, and exchanges in an area extending from the Canadian border to Southern California, and from the Rocky Mountains to the Pacific Ocean.

The Pacific Northwest is blessed with a tremendous hydro system, which supplies 70 percent of the region's electricity needs. The region is, however, currently in load and resource balance; that is, Bonneville will not be able to serve new loads without adding new resources. Furthermore, the region may in fact be in a deficit situation in any given year, depending on the water condition of that year and other special river operations requirements. It is expected that during the next decade, the region will need to bring 2,000 megawatts of new resources on-line to meet expected load growth. This is a significant amount in view of the limited generation options the region possesses. The hydro system is fully developed. It is not likely there will be major facility

development or capacity additions, except for perhaps a few "small" hydro sites. Furthermore, because of new demands on the river system (for irrigation, navigation, recreation and the survival of endangered salmon species), the amount of electricity the existing hydro system can provide will be reduced. Other traditional thermal generation is deemed to have extremely high capital and operating cost; and many citizens in this region find the environmental impacts unacceptable. In order to meet this load growth, Bonneville plans to meet at least one third of this additional load with demand side resources.

The Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Public Law 96-501, enacted by the U.S. Congress) mandates that conservation and renewable energy resource options be investigated first, before large thermal plants can be considered. It further states that it is acceptable public policy to pay a premium price of up to 10 percent for conservation resources over conventional generation. This legislation challenges the region's power planners to meet future loads with demand side resources. Along with this legislation, the Northwest Power Planning Council was created to provide guidance to the region on power planning and resource acquisition issues.

In the past ten years, Bonneville has acquired over 200 megawatts of demand side resources. In order to acquire three times that amount in the next ten years, it is clear that aggressive strategies and innovative approaches are

necessary. Figure 1 shows the actual demand side resource acquisition accomplishments in the past decade and the target for the next ten years by various sectors. Even though the residential sector accounted for most of the acquired resource in the past, it is still deemed to have a significant potential for additional amounts. One of the areas in the residential sector that was identified as having significant resource potential at very low cost was manufactured housing. This paper reports the strategy Bonneville employed, and the results to date, of acquiring this resource.

Manufactured Housing Resource Potential

The Manufactured Housing Industry

Manufactured housing refers to factory constructed homes that are transported to the eventual home site. It is different from "modular construction" or "prefab" housing in that the construction is completed in the factory, except for the joining of two halves if the unit is double wide. This industry is not regulated by local building codes, but rather by the U.S. Department of Transportation (DOT) and the U.S. Department of Housing and Urban Development (HUD). DOT's involvement is from the days these units were single wide, small, and very mobile. Today, most manufactured homes built in the Pacific Northwest are double wide, average 1,400 square feet, and once sited, are seldom moved even though ownership might change.

The manufactured housing industry is regulated by HUD's Federal Manufactured Housing Construction and Safety Standard (FMHCSS) of 1976. This standard also prevents any state or local jurisdiction from enacting alternate standards. This is called Federal preemption. Unfortunately, the energy efficiency standard under the FMHCSS is minimal, compared to what is technically achievable and economically justifiable. Since the industry is quite competitive, and the target market is the lower income purchaser, the manufacturers have little incentive to voluntarily improve energy efficiency beyond the Federal standard. They do, however, offer the home buyers the option of upgrading the home's thermal efficiency, and in the Northwest, most home buyers do purchase the insulation upgrade. Table 1 shows the HUD minimum standard and the "average" home built in the Northwest, called "current practice".

Demonstration Project To Improve Thermal Efficiency

In the early 1980s, the Northwest Power Planning Council and Bonneville jointly developed the Model Conservation Standard (MCS) for site built homes that were 40 percent about prevailing building practice at that time. Through demonstration projects and subsequent DSM programs (Northwest Energy Code, Super Good Cents) where new home builders were given incentives to build to MCS standards, Bonneville was able to achieve a thirty percent penetration rate in four years. Eventually, the MCS became code in Washington in July 1991 and in Oregon in

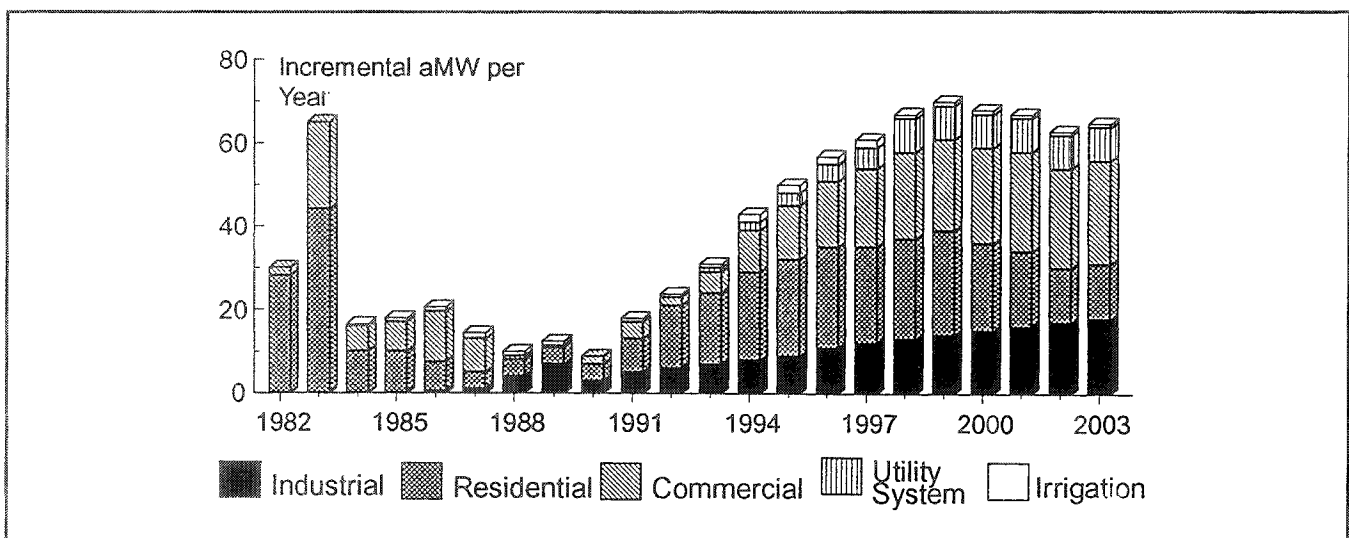


Figure 1. Bonneville Demand Side Resource Acquisition Targets

Table 1. HUD-Code and "Current Practice before MAP"

		<u>HUD Code</u>	<u>"Current Practice"</u>
Insulation for	Wall	R-7	R-14
	Roof	R-14	R-16
	Floor	R-7	R-9
	Door	R-5	R-5
Glazing	Uo ^(a)	0.80	0.80
Overall	Uo	0.126	0.108
Overall	UA ^(b)	640	530

(a) Uo is the transmission heat loss coefficient in BTU/Hr./Sq. Ft./Deg.F

(b) UA is the overall heat loss coefficient in BTU/Hr./Deg.F

January 1992. In January 1992, Bonneville offered an updated Super Good Cents program for site built homes. This new program offers three tiers of building envelope improvements over code, plus a number of optional items such as efficient lighting, high efficiency water heaters, shower heads, heat recovery ventilation, exhaust air heat pump water heaters, etc.

Bonneville also recognized that comparable efficiency is achievable in the manufactured housing sector. In 1987, an energy standard equivalent to the site built MCS was developed. Under Bonneville's Residential Construction Demonstration Program (RCDP), 150 manufactured home buyers were recruited to have their homes built to this standard, with Bonneville paying the full incremental cost. This project ran in 1988 and 1989, with Bonneville collecting incremental cost data and monitoring the thermal performance of these homes through mid-1990. The results indicated that it is technically feasible and costs effective to build manufactured homes to energy standards equivalent to site built homes. Table 2 shows the thermal performance of the RCDP homes compared to those built to HUD minimum standards and "current practice" at that time (that is, what the consumers bought as "insulation upgrade").

Potential Resource Available

Within Bonneville's service area, there are eighteen manufacturers producing approximately 12,000 manufactured homes each year. On the basis of the RCDP data, and additional refinement in the technical specifications, we believed energy savings in the range of 6,500 - 7,000 kWh/year per unit was achievable. This would represent

a demand side resource potential of almost ten average megawatts per year. This is a significant amount and is considered quite firm and well supported by research data.

From Resource Estimate to Resource Acquisition

In 1989, Bonneville began to offer manufactured home buyer's payments to upgrade their purchases to RCDP specifications under the Super Good Cents (SGC) program. In little over a year, the SGC rebate program achieved a 25 percent penetration rate and was well received by the consumers. By any measure, this could be considered a successful program introduction. However, having designed and offered DSM programs for a long time, mostly of the type that calls for voluntary participation with a strong information/education campaign, and aggressive advertising and marketing, Bonneville came to realize the best it could hope for was a 35 percent penetration rate. This is consistent with other utilities offering DSM programs using similar approaches.

As soon as the consumer rebate program was offered, Bonneville began to look for other ways to maximize the acquisition of this resource. It was felt that in order to meet the ambitious demand side resource acquisition target of 660 MW over the next 10 years, it is imperative to investigate creative approaches to designing and implementing DSM programs.

The manufactured housing sector presents unique opportunities to explore innovative approaches to resource acquisition. It is a rather homogeneous industry. The plant setup, materials used, and production methods vary little from plant to plant. Unlike site built home builders, there are a relatively small number of manufacturers (18 compared to hundreds of site built home builders) in the region. Since it is a very competitive and first-cost sensitive industry, the manufacturers are generally not known to be innovative. Yet for these same reasons, it was felt that if a few manufacturers could be convinced to change their practices, most others would follow suit. Thus, Bonneville decided to approach the manufacturers about building all their homes to an improved energy standard, and in return, Bonneville would reimburse the manufacturers.

Preliminary informal dialogue with some manufacturers, Bonneville's customer utilities, and other interested parties such as the state energy offices and the Northwest Power Planning Council indicated that such an approach was indeed feasible. As a result, Bonneville committed to a

Table 2. Thermal Performance of HUD-Code, Current Practice, and RCDP Homes

	Manufactured Housing Space Heating in kWh/Yr			
	Zone 1 (<6000 HDD)	Zone 2 (6-8000 HDD)	Zone 3 (>8000 HDD)	All Zones Weighted ^(a)
HUD-Code	13,800	20,000	23,500	16,100
Current Practice	10,900	16,200	19,100	12,780
RCDP	5,600	9,200	10,900	6,850
	Incremental Energy Savings			
Current Practice over HUD	2,900	3,800	4,400	3,320
RCDP over Current Practice	5,300	7,000	8,200	5,930

(a) The weighted figure is based on the home distribution of 70% in Zone 1, 20% in Zone 2, and 10% in Zone 3.

strategy of acquiring this resource directly from the manufacturers, known as the Manufactured Housing Acquisition Program (MAP).

The MAP Negotiation Committee

In February 1991, a MAP negotiation committee was formed, consisting of members from Bonneville (2), customer utilities (2), the state energy offices (1), the Northwest Power Planning Council (1), the manufacturers (1), and the manufacturer associations (1). While there were only eight committee members, many people were also involved in a variety of functions. Meetings were often attended by upwards of 30 people. Many were subject specialists who advised the negotiation committee and added value to the process.

The MAP Program Issues

An undertaking of this magnitude involved many parties and issues. The committee identified several basic issues for discussion to confirm the feasibility of such a program. The basic issues identified were:

(a) Could the manufacturers and the utilities agree upon a technical specification that optimizes energy efficiency without significantly changing the manufacturing practices;

(b) Could the three major utility groups (Bonneville's full requirement customers, partial requirement customers, and investor owned utilities) agree on a common goal;²

(c) Could the manufacturers and the utilities agree on a payment level;

(d) Could the quality of the product be assured;

(e) Is it a realistic goal to reach agreement between the 18 manufacturers and over 130 utilities in the region; and

(f) Are there legal issues (such as antitrust) that would prevent such an approach.

The Negotiation Process

The committee met about once a month. Invariably, more questions were raised than answered. The committee members then took the issues and questions back to their respective constituents, discussed alternatives and returned with potential solutions.

Each of the major issues listed above also involved many other secondary issues. For example, the technical specification's issue had implications on material availability,

construction practices, assembly line process, and limiting consumer choice. The quality assurance issue concerned both the manufacturers and the utilities since most homes in the region are double wide, with final set up at the home site. The traditional industry practice was that the manufacturers were not responsible for site set up, and it was the dealers' job to make the arrangements. With MAP, the utilities wanted manufacturers to guarantee that the homes would be set up properly to yield projected energy savings. The payment amount was an issue with the partial requirement utilities (who cost share DSM programs with Bonneville); and the investor owned utilities' participation was very much dependent on the state utility commission's view on such expenditures. Some utilities were about to institute "hookup charges" for manufactured homes that were not comparable to site built homes in thermal efficiency in order to force the manufacturers to increase energy efficiency.

Technical Specifications. It did not take long for all interested parties to commit to negotiating an agreement. Once that was established, it took almost ten months (till December 1991) to agree on the technical specifications. Table 3 shows the technical specifications for homes to be built under MAP. Negotiations occurred on many parallel paths so that when the specifications were finalized, the amount of payment, method of payment, and cost effectiveness questions were nearly settled as well. In December 1991, Bonneville mailed to all manufacturers and customer utilities a memorandum of understanding and asked all to indicate their intent to participate. One of the presumptive criteria of MAP was that all utilities will participate, and if a manufacturer participates, all of that plant's production will meet this specification.

Table 3. MAP Home Specifications (All Climate Zones)

		U-Value	R-Value ^(a)
Ceilings	Flat	0.025	40
	Sloped	0.030	33
Walls		0.052	19
Floors		0.033	30
Exterior Doors		0.19	5
Glazing, 15% of Floor		0.35	
Crossover Duct			8
Main Trunk Duct			4

(a) R value is reciprocal of U value.

With the specifications in place, the manufacturers had to be convinced that materials (high density insulation, high performance windows, new types of exhaust fans, etc.) would be available and that their production lines could be converted without significant investment or interruption. Bonneville, through the Manufactured Housing Technical Advisory Group, arranged for suppliers to give verbal assurances that such new materials would be available, and for the state energy offices to provide technical support to the manufacturers on new construction methods and processes. These activities reduced the manufacturers' anxiety about the wholesale conversion of their products and practices.

Acquisition Payment Level. After much negotiation, with payment ranging from \$1,700 to \$3,500, a payment of \$2,500 per unit was agreed upon. This was based on the estimated incremental cost for the manufacturers to build to MAP specifications, and what the utilities felt was a reasonable cost for this program. The RCDP research data showed the incremental cost ranged from \$1,700 to over \$3,000 per unit. The MAP specifications are actually more stringent than RCDP and SGC specifications. At this payment level, the cost of this resource, including program administration costs, is estimated to be 20 mills (2 cents) per kilowatt-hour.

The MAP contract is for a four year duration. Bonneville and its customer utilities will have the option of re-evaluating the program after the first year. The payment level can be re-negotiated when the new HUD code becomes effective. (The proposed new code was published in the Federal Register in February 1992 and the public comment period closed on May 26, 1992; and there is no announced schedule when this would become law. The proposed new standards, however, fall way short of MAP standards.)

Program Participation. Since the homes that are produced will be sited throughout the region's serving utilities, it was not only necessary to reach agreement on a payment level, but it was also necessary that every utility participates. For Bonneville's one hundred plus full requirement customers (where it pays the entire costs for their DSM programs), participation was not a major issue, although these utilities did provide input on payment level and cost effectiveness evaluation. For the "partial requirement" customers (there are about 15 that share the cost of DSM programs), additional negotiations were necessary to reach agreements. For the investor owned utilities, program participation to a large degree depended on the state utility commissions' ruling on such program

expenditures. Since the state commissions were consulted and involved throughout the concept development and contract negotiation process, they took a very favorable view of this program, and in fact encouraged the utilities to participate.

By March 1992, all but a handful of utilities had signed agreements to participate. This represents a 92 percent participation rate (based on the number of homes expected to be sited in participants' territories). Bonneville decided to go forward with the program, and at the same time continued to negotiate with the non-participating utilities, to avoid prolonging this lost opportunity.

After over a year of negotiations, the MAP program started operation on April 1, 1992. Prior to this date, 15 of the region's 18 manufacturers signed contracts to build homes to MAP specifications. The other three also signed within a week of April 1. With their signatures, Bonneville has managed to obtain full participation from the manufacturers at the beginning of the program, far exceeding the original goal of achieving 40 percent the first year, and ramping up to 90 percent by the third year.

Quality Assurance. The participating utilities were also concerned with the quality of these homes, both when they are produced in the plants and when they are eventually sited in their service territory. Traditionally, utilities have had a strong role in DSM program implementation, and take a lot of ownership in such programs. This feeling of ownership is actually very desirable for MAP's success.

In-plant inspection of manufactured homes is usually performed by the state's Labor and Industry Department inspectors, paid by HUD who in turn assesses the manufacturers a "tax" for each home built. With MAP, there are additional inspection requirements to ensure that the materials used and construction practices conform to BPA specifications. The utilities agreed to pay this incremental inspection cost. The other concern, that of on-site set up, was mollified with the state energy office's plan to provide additional training for the set up crews. In Oregon, the set up crews are state certified, whereas there is no such requirement for other states. The manufacturers in Washington and the Washington Manufactured Housing Association pledged to endorse legislation, now under consideration, to require set up crews to be examined and certified. This is a dramatic departure from the traditional manufacturers' position that, "Site set up is not our problem."

With these steps, the utilities' concerns about the quality (and energy savings) of manufactured homes under MAP were adequately addressed.

Cost Effectiveness of the Program

The direct cost (acquisition payment) of the program is \$2,500 per unit. The indirect cost (in house program administration, payment to states for technical support, etc.) is estimated to be an additional \$670 per unit.

The regionwide weighted average energy saving for each unit (taking into consideration different sizes built and locations where homes are sited) are estimated to be 6,710 kWh per year. This figure is based on the data from the 150 RCDP demonstration homes Bonneville built; submetered data from a sample of homes under the SGC rebate program; and energy use modeling calculations of the MAP specifications. Bonneville further de-rated the expected savings another 10 percent and rounded down to 6,000 kWh per year; thus taking a rather conservative approach for cost effectiveness calculation and program impact evaluation.

With an assumed measure life of 45 years and Bonneville's standard discount rate of 3 percent, and allowing for 7.5 percent "line loss" credit, the levelized cost of this resource is 20 mills (2 cents) per kilowatt-hour. Bonneville is currently paying a slight premium for the non-participating utilities, but has every reason to believe it will reach agreement with these utilities. (See Table 4.)

Twenty mills is a very attractive cost for new resources. Typically, a utility's avoided cost for conventional thermal generation is three times this amount. This cost also compares favorably with other demand side resources. For example, Bonneville, like many other utilities, has been entertaining proposals from energy service companies through a process called competitive bidding. The demand side proposals currently being considered average over 30 mills per kilowatt-hour.

Conclusion

The Bonneville Power Administration has successfully embarked on a demand side resource acquisition program in the manufactured housing sector. The levelized cost of this resource is 20 mills per kilowatt-hour, well below other DSM program costs and supply side alternatives.

By negotiating with the manufacturers for direct acquisition, Bonneville was able to achieve 100 percent penetration rate for this resource. This is precedent setting in DSM program implementation.

Table 4. Expected Energy Consumption and Savings of MAP Over Current Practice Homes, kWh/yr

	<u>Zone 1</u>	<u>Zone 2</u>	<u>Zone 3</u>	<u>All Zones Weighted</u>
Current Practice	10,900	16,200	19,100	12,780
MAP	4,800	8,700	9,700	6,070
<u>Incremental Energy Savings</u>				
MAP over Current Practice	6,100	7,500	9,400	6,710 ^(a)

(a) For the purpose of cost-effective analysis, the figure was further reduced to 6,000 kWh per year.

Additionally, following are a few key points Bonneville learned along the way: conducting a demonstration project, operating a rebate type DSM program, negotiating for direct acquisition, and finally implementing the program.

- (a) A demonstration program is an effective way to prove a technology, to make converts out of skeptics in the industry and the end user.
- (b) A demonstration program raises the confidence level of energy efficiency technologies and resource potential estimates. It also provides data for cost effectiveness analysis for the purpose of DSM program design.
- (c) It is more cost effective to acquire the resource at the front end of the production-wholesale-retail chain, avoiding cost mark ups in the intermediate steps.
- (d) It is possible to have agreements with 18 different manufacturers and over 100 utilities, provided there is a shared vision, a common goal, and the perception that it is in their own interest to do so.
- (e) It is important to identify all the stakeholders early on, and invite their involvement and participation. Many of the stakeholders may not have a mandate or financial interest, but their participation can be imperative to a regionwide effort like this one.

- (f) A well designed direct acquisition program reduces the cost of program administration.
- (g) Direct acquisition is the preferred way to maximize program penetration rate. It may be the only way to surpass the 40 to 50 percent penetration rate cited most often by utilities with experience in DSM programs.
- (h) The time required to achieve a higher penetration rate is significantly shortened by negotiating for direct acquisition.
- (i) Negotiating directly with the manufacturers to supply products that are more efficient than prevailing standards or "current practice" is a sound concept. Currently, there are utility efforts underway using the same principle to acquire new DSM resources, such as the "Golden Carrot" program for super efficient refrigerators.

Endnotes

1. There are two common ways to report energy savings from DSM programs. One way is to report the ECM's (energy conservation measure) energy savings in kilowatt-hours. The other way, which is more useful from the perspective of capacity planning, is to report the energy savings in terms of avoided generation. For DSM measures, this is reported as average

megawatts (aMW), derived from dividing the energy savings (in kWh) by 8,760,000 (numbers of hours in a year times 1000). Furthermore, an aMW in DSM resource is "worth" about 1.5 MW of generation resource since in generation capacity planning, it is common to use a plant load factor of 65 to 70 percent.

2. There are three major utility groups in the Pacific Northwest. The first group of public utilities that do not possess generation and purchase all their electricity from Bonneville is called full requirement customers. The second group of utilities, with some generation of their own, purchase some of their electricity from Bonneville, and are called partial requirement customers. The third group are investor owned utilities that do not purchase electricity from Bonneville.

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