Acquiring T&D Benefits from DSM: A Utility Case Study

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This paper reports on one utility's experience using DSM programs to postpone T&D system upgrades in specific geographic areas. The goal of this project was to maximize benefits from DSM. This paper describes the analysis, market planning and preliminary results obtained in the areas selected for this study.

A downtown spot and grid network system was chosen as the geographic area to receive targeted DSM efforts. DSM programs focused on the commercial market. The utility's sales force was used in the spot network system. Energy services companies (ESCO's) were employed in selected areas of the grid network system.

Utility experiences and lessons learned from employing targeted DSM programs are discussed. Recommendations are presented for future applications of targeted DSM programs.

Introduction

Traditionally, DSM has been used to defer investments in generation resources. Trends indicate that by the late 1990's U.S. utilities will spend more on transmission and distribution (T&D) system improvements than new generation resources (EPRI, NREL and PG&E 1993).

There has been recent interest in methods for analyzing and geographically targeting DSM programs to defer T&D capital investment (EPRI 1990, EPRI and PG&E 1992a, Trobaugh 1993). Several utilities have initiated T&D-DSM pilot projects to experiment with deferring T&D capital projects (Heffner 1993, Engel and Kinert 1993, EPRI and PG&E 1992b, Haeri and Thomas 1993, O'Meara and Lush 1993).

This study explores how one utility attempted to extract maximum benefits from planned DSM expenditures. In 1994, a utility located in the Pacific Northwest will spend approximately $25 million to acquire energy efficiency resources. Can this utility capture extra value or benefits by geographically targeting DSM programs to T&D constrained areas in the utility service area?

This paper describes potential T&D savings that could be captured by targeting T&D constrained geographic areas. Next, pilot marketing programs were designed to acquire the extra T&D benefits. Finally, preliminary results and lessons learned from the pilot program are discussed. This paper concludes with recommendations for capturing T&D benefits using DSM programs.

Potential Savings in Targeted Geographic Areas

The potential T&D benefits from DSM were calculated by identifying the monetary savings from deferring capital projects identified in the T&D five-year capital investment plan. These savings were associated with planned capital projects in targeted geographic areas. Two specific geographic areas were evaluated: suburban substations and downtown network areas.

Suburban Substations

Three suburban substations were studied to determine the potential value from deferred capital investments. All were located in growing areas and had planned capital improvements over the next three years. In each instance, a five-year deferral period was used for planned T&D expenditures. The value of the deferred capital expenditures per KW-yr were calculated (Weijo and Phillips-Israel 1993).

The capital deferral benefit for suburban substations ranged from $7.87/KW-yr to $10.45/KW-yr. The average for the three substations was $8.75/KW-yr.

Downtown Network System

Based on discussions with distribution planning, the downtown network system in the City of Portland was also studied to evaluate potential DSM impacts. Four projects were identified from the five-year transmission and distribution plan that required T&D system upgrades in spot network areas. Three projects requiring T&D system upgrades in the grid network system were also identified.

For each of these projects, the value of deferring capital investments was calculated. All capital improvements were planned to occur during the next three years. In each instance, DSM was expected to defer the capital investment for 15 years.

The utility overall is winter peaking. In contrast, the downtown core area is summer peaking. The projects located downtown were prime candidates for DSM programs that reduce summer afternoon electricity usage. Potential T&D capital deferrals of approximately $1.3 million were identified from these projects.

Table 1 describes potential T&D-DSM benefits in the City of Portland spot network areas. The savings in the spot network areas ranged from $22.88/KW-yr to as high as $40.1l/KW-yr. The average savings were $33.35/KW-yr. These projects required demand reductions between 150 KW and 500 KW. In each of these instances, only one building was included in each spot network area.

Table 1. Spot Network T&D-DSM Benefits

Project	Year Required	Benefit $/KW-yr
Project 1	1993	$22.88
Project 2	1994	$39.15
Project 3	1995	$31.24
Project 4	1995	$40.11
Average		**$33.35**

The potential T&D savings in the grid network system varied more widely (see Table 2). The largest potential DSM impact was $60.97/KW-yr. The least was $17.62/KW-yr. The average for the three grid network projects was $37.94/KW-yr. Required demand reductions in the spot network areas ranged from 100 KW to 1000 KW. Typically about 100 accounts were included in each of the grid network areas.

Table 2. Grid Network T&D-DSM Benefits

Project	Year Required	Benefit $/KW-yr
Area 1	1993	$17.62
Area 2	1994	$35.23
Area 3	1995	$60.97
Average		**$37.94**

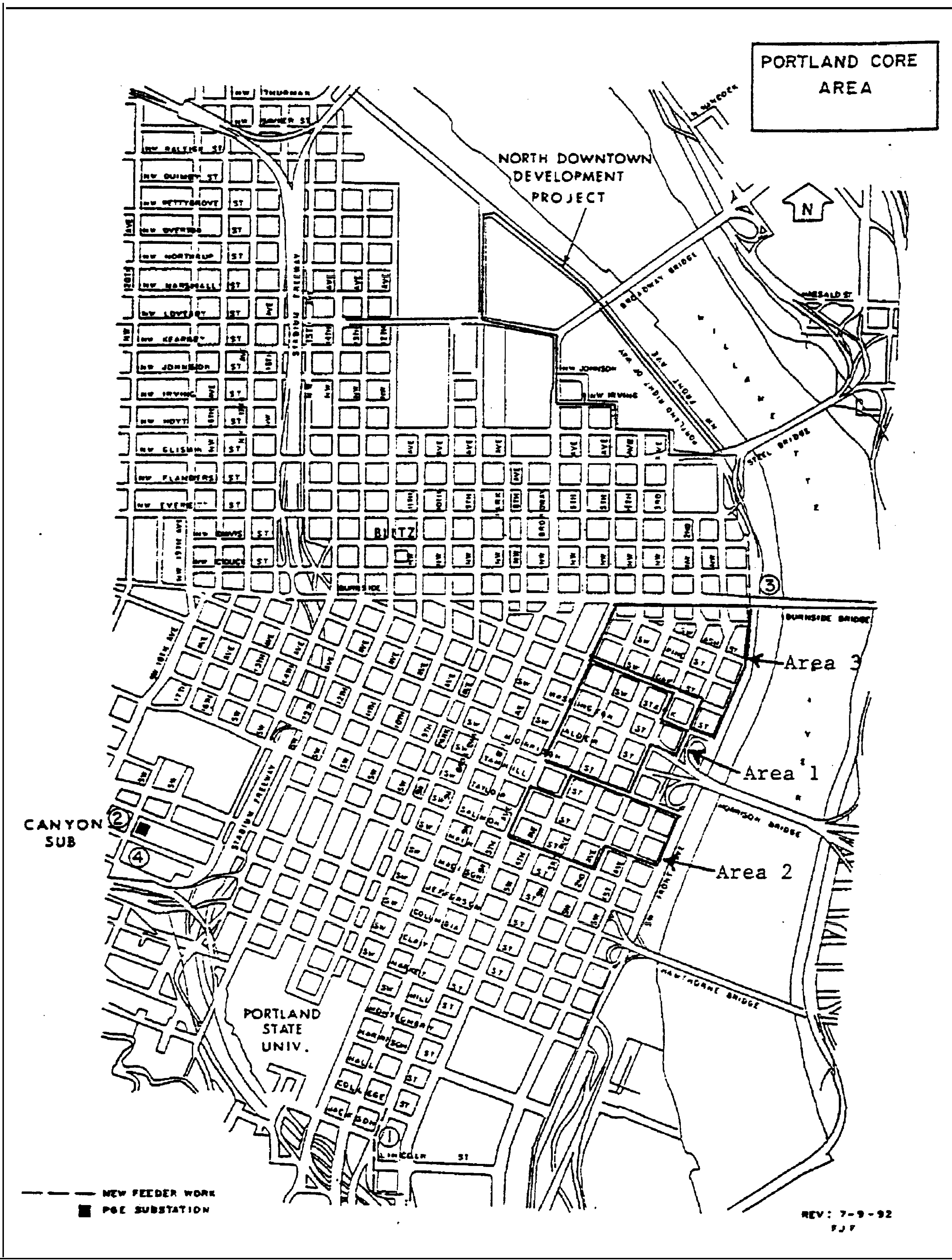
Targeted Geographic Area

Since the projects located in the downtown network system demonstrated the greatest promise, a pilot program was initiated in the City of Portland downtown district. The goal of the pilot was to defer T&D capital investments in both the spot and grid network system. DSM programs focused primarily on the commercial market.

Two different program strategies were employed in the downtown area. The utility's sales force was used in the spot network system because of their prior relationships with the building owner or property management firms. Four large commercial buildings had planned transformer upgrades over a three year period. No special changes were made in the utility's current DSM programs. The utility's current DSM programs focus on energy efficiency, not load control.

In the grid network system, energy services companies (ESCO's) were employed. Figure 1 illustrates the three grid network areas included in the pilot program. ESCO's were employed to achieve a very high market penetration rate among commercial establishments located in 10 to 15 square block areas. The utility DSM programs were not designed to achieve a high penetration rate in defined geographic areas. Two of the three areas hoped to achieve 20% peak reductions in those areas. The third area required a 10% peak reduction.

To gain experience utilizing ESCO's, two different firms were selected for the pilots. In each of their contracts, a two-tier pricing arrangement was employed. The first tier included energy efficiency savings equivalent to the first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BURNSIDE BRIDGE
MORRISON BRIDGE
HAWTHORNE BRIDGE
STADIUM FREEWAY
NEW FEEDER WORK
PGE SUBSTATION
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20% of the electricity consumption of the building. The second tier, priced at a significantly higher rate, included all remaining energy efficiency savings (i.e., beyond 20% of the building annual electricity consumption). The tiered price structure was designed to provide incentives for the ESCO's to go after all feasible energy efficiency savings. The ESCO's were paid a significant bonus payment if they achieved a threshold level of savings in the grid network area.

Verification

Engineering calculations of the pre- and post-installation performance of energy efficiency measures were used to verify energy savings in commercial buildings located in the spot and grid network systems. For luminaire system performance, the Oregon Code Compliance manual was utilized. Run hours of operation were determined from either computerized energy management systems, data loggers, or were stipulated for small non-electric space heated buildings.

For those measures that affect or result in variable loads, a computer simulation was performed. Estimates of the post-installation energy consumption were made by adjusting inputs to the baseline model to reflect changes that would result from installation of energy efficiency measures.

In the future, additional analysis will be performed to evaluate actual whole building load reduction. Hourly end-use meters were installed in many large buildings located in the pilot areas. This metering will provide actual pre- and post-measures of building demand.

Spot Network Results

Table 3 describes the status of the spot network results achieved by the utility sales force.

Table 3. Spot Network Project Status

Project	Targeted Reduction	Achieved Reduction	Delay T&D Upgrade?
Project 1	266	150	No
Project 2	300	58	Open
Project 3	488	850	Yes
Project 4	150	10	Open
Total	**1,204**	**1,068**	

One of the projects was successful in delaying transformer upgrades planned for a large commercial building. Approximately 500 KW of demand reduction was required in the building. An estimated 850 KW load reduction was achieved in the facility. As a consequence of this project, a $250,000 capital project was either deferred or permanently avoided.

A second project was unsuccessful due to new load growth in the building. The building required a load reduction of approximately 266 KW. The DSM project was successful in reducing building demand by 150 KW. Power factor correction was explored to reduce load further on the transformer. The unexpected replacement of a gas absorption chiller with a conventional electric chiller, however, eliminated any opportunity to defer the transformer upgrade.

The remaining two projects in the spot network system are still in-progress.

Grid Network Results

Contracts were signed with ESCO's to achieve comprehensive energy efficiency savings in each of the three network grid areas downtown. Each ESCO has approximately a one year time period to complete the DSM improvements in each area. Table 4 depicts the DSM improvements completed in Area 1. There are no results available to report for Areas 2 and 3.

One-hundred accounts were included in Area 1. Twenty accounts were classified as large, having energy usage of greater than 200 Mwh annually. The remaining 80 accounts were classified as small, using less than 200 Mwh annually. The area has a peak summer demand of approximately 5100 KW. Demand reductions of 20% were targeted for this area. Total savings of 3,260 Mwh were planned from Area 1. Projected savings of at least 2,470 Mwh were expected from the largest 20 accounts. 790 Mwh savings were anticipated from the remaining 80 small accounts.

DSM appears to have achieved the desired level of savings in Area 1. Savings of between 20% and 40% were achieved in buildings participating in DSM programs. DSM projects were completed on only 4% of the small accounts and 60% of the larger accounts. Approximately 21% of the targeted savings were achieved in small accounts. Approximately 156% of the expected savings were achieved in the large accounts. Overall, approximately 123% of the targeted savings were achieved in Area 1.

During the fall of 1993, a portion of the planned T&D capital upgrade was completed in Area 1. Distribution

Table 4. Grid Network Area 1 Results

	Less Than 200 Mwh	Greater Than 200 Mwh	Total
Accounts:			
Total	80	20	100
Completed	3	12	15
% of Total	4%	60%	15%
Kwh Savings:			
Targeted	790,000	2,470,000	3,260,000
Achieved	166,374	3,842,664	4,009,038
% of Target	21%	156%	123%
Total:			
Kwh Load	3,950,000	12,350,000	16,300,000
KW Load	1,384 KW	3,747 KW	5,131 KW

engineering did not wait until the end of the one year ESCO contract period before initiating T&D construction. Further, the marketing staff was not aware of the decision to proceed with the capital upgrade until after construction was initiated in Area 1.

Discussion

Though preliminary field results are very encouraging, the DSM pilot programs have been only modestly successful in delaying planned T&D capital upgrades. There are several factors that may have influenced the pilot program's success:

Limited Communication Between Marketing and Distribution

Traditionally, there has not been a high level of interaction between the marketing and distribution departments. Communication between marketing and distribution is not helped by the lack of geographic proximity between these departments. The marketing and distribution planning areas are located in separate buildings in downtown Portland. Distribution engineering is located about one mile away.

Lack of Trust in DSM

The distribution area does not seem to trust DSM. There was considerable doubt that energy efficiency could reduce building loads by an average of 20%. Finally, there is skepticism over the persistence of DSM savings.

Its Reliability, Reliability, Reliability Stupid

The marketing department does not have sufficient understanding of the problems and concerns of distribution. Reliability is the standard of performance for the distribution area. They are evaluated by the level of reliability achieved for customers—particularly commercial and industrial customers with high outage costs. The marketers and DSM planners are viewed as wanting to increase the risk exposure of the distribution system.

Allowing Adequate Time to Prove the Savings

The marketing and DSM functions are guilty of asking distribution engineers to "trust me". This project failed in giving distribution engineers adequate time to evaluate whether sufficient savings were achieved to merit canceling the T&D upgrade project. The projects considered by this utility looked at distribution projects planned over the next one, two and three years. It might be wiser to consider projects that are three to five years in the future. However, a tradeoff is that senior management may have little interest in projects that show no benefits for several years.

The Narrow Scope of Projects

The T&D-DSM projects piloted were intentionally kept very narrowly focused. They were dependent on achieving savings in a specific commercial building or in narrowly defined 10-15 block areas. Would it be better to broaden the scope of the projects contemplated? Instead of considering the scope of the project a ten block area, would it not be better to define the scope as the entire downtown Portland network area? Any construction in the downtown area will be expensive, therefore any T&D projects delayed will be beneficial. Therefore, why not comprehensively target all of the downtown area with DSM programs and not search for just immediate benefits?

Focus on Only Energy Efficiency Programs

The goal of this pilot program was to use only existing utility programs. The utility has developed a full array of energy efficiency programs. The utility is only recently initiated new load control programs (i. e., water heat load control, space heat load control, and interruptible/ curtailable rate programs).

Conclusion and Recommendations

The success of the T&D-DSM projects described in this report have been modest in delaying planned T&D capital projects. Several reasons have been suggested that help explain these results including inadequate communication between marketing and distribution departments, lack of trust in DSM, the importance of reliability to distribution, allowing adequate time to prove savings, the narrow scope of the pilot projects, and focusing only on energy efficiency programs.

Listed below are several recommendations for future T&D-DSM projects. First, allow plenty of time to implement DSM projects and verify savings. This will help overcome the lack of trust about DSM and the perceived risk to reliability. Carefully meter and evaluate the results to "prove" the savings achieved. Allow time so distribution engineers can plan and make capital improvements if they are necessary.

Second, develop liaison roles to bridge the communication gap between marketing and distribution. Create temporary assignments that move marketing staff to the distribution department or distribution staff to the marketing department. Use cross-functional teams in ever opportunity possible. The benefits of better communication will accrue to more than just T&D-DSM projects.

Third, do not focus only on energy efficiency programs. Consider a full repertoire of DSM options, including water and space heat load control as well as interruptible or curtailable rate options. If possible, don't make DSM the only alternative for reducing demand. Consider other technological solutions as well, such as mobile standby generation and battery technology.

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