BULK PURCHASE OF CONSERVATION BY COMPETITIVE BID

Harvey Michaels
XENERGY Inc.

ABSTRACT

Since 1982, electric utilities have been developing innovative bidding processes for fulfilling future needs for plant capacity. Federal and state regulators have developed procedures for qualified cogeneration facilities (QFs) to bid at utility auctions for defined supply blocks, and several utilities have conducted such auctions.

A few utilities have expanded the process to include other supply sources, including consideration of conservation programs on a "price per equivalent kW" basis.

A recent program at New England Electric System (NEES) purchased conservation from Energy Service Companies (ESCOs) on a competitive basis, similar to a supply auction in that the utility selects among competitive bids for DSM projects, the bidder guarantees the energy performance of the project, and the bid format allows direct comparison to bid prices in supply-side auctions.

To date, NEES has conducted two auctions and purchased 13.6 MW in demand-side bids from among its large commercial and industrial customer base.

The author assisted NEES with the design of its program in 1987. This paper will describe the major issues analyzed during the program design and indicate the rationale for the choices made. The program design issues discussed in this paper are:

1. **Segmentation**: Should supply-side and demand-side auctions be conducted jointly or separately? How should the customer base be grouped to define a biddable market segment in a conservation auction? Should a single winning bidder be offered exclusive access to the segment?

2. **Measure Discrimination**: Can a conservation bid include implementation of quick payback measures that customers might have installed without the impetus of a program? Should the conservation bid format preclude installation of measures that appear too expensive for some benefit/cost tests? Alternately, should the bid simply set the kW reduction to be achieved and be "measure-blind" to the manner in which the ESCO achieves the reduction?

3. **Measurement of Impact**: How can conservation impacts be compared on an equal basis to supply-side options? Is metering necessary to determine the impacts, or will engineering estimation suffice? Can some measures have their impacts estimated up-front, or must evaluation be conducted on each individual building?

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INTRODUCTION

State and federal regulatory bodies are steadily increasing the pressure on electric utilities to pursue a least-cost strategy for meeting future supply needs. Almost universally, both regulators and utilities agree that utility investment in conservation programs for their customers is part of a least-cost strategy.

A few utilities, state agencies, and the Federal Energy Regulatory Commission (FERC) are exploring methods of purchasing conservation on a competitive basis in a directly comparable method to purchase of supply from independent power producers (IPPs) or qualifying facilities (QFs) under the definitions of the Public Utility Regulatory Policy Act (PURPA).

The ideal being sought by these parties is inclusion of conservation within the format of capacity auctions. In the same way that IPPs submit a bid to provide power, a conservation bidder would provide a reduced requirement for power. The advantage of such a program is that conservation bidding by its nature both documents a least-cost criterion and "tests the market" for the availability of conservation resources. It holds the potential of being easier and quicker than utility-developed programs, since the utility buys its conservation in bulk on a performance basis.

A recent program at New England Electric System (NEES) purchased conservation from Energy Service Companies (ESCOs) on a competitive basis, similar to a supply auction in that:

1. The utility selects among competitive bids for DSM projects.

2. The bidder guarantees the energy performance of the project.

3. The bid format allows direct comparison to bid prices in supply-side auctions.

To date, NEES has conducted two auctions and purchased 13.6 MW in demand-side bids from among its large commercial and industrial customer base. The bidders are typically ESCOs who then work within a territory composed of 25-50 customers. Another utility beginning such a program is Central Maine Power, which is presently conducting a combined auction for 100 MW of capacity that permits both demand-side bids for conservation as well as supply-side bids such as cogeneration, wood or trash-fueled independent power plants. The proposals under review include 35 MW of conservation offers. A third utility, Orange and Rockland, anticipates a conservation bidding program in the fall of 1988 for its large commercial and industrial customer base.

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BACKGROUND OF THE NEW ENGLAND ELECTRIC PROGRAM

In 1985 and 1986 NEES conducted a pilot program to evaluate the use of third parties such as ESCOs to deliver conservation services to its customers. As part of its "Economic Strength through Conservation" program, NEES offered subsidies to ESCOs for contracting with customers over 100 kW in selected economically stagnant areas of Massachusetts. The program was operated by Massachusetts Electric, the operating company for NEES in its Massachusetts service territory. This earlier program served to provide important insights applied to the later program on conservation bidding. The program was conducted as follows:

- Massachusetts Electric (MECO) performed an audit of each candidate facility. The audit was released to potential ESCO bidders.

- ESCOs submitted performance contracting bids on each facility individually. Submissions included a combination of conservation and cogeneration equipment. Selection of bidder was made jointly by the facility and the utility.

- MECO paid an agreed-upon subsidy based on its average avoided cost for all savings. Payments were made according to actual measured consumption and a negotiated baseline formula.

Although the pilot concluded that the concept yielded some degree of comprehensive customer demand-side management, several barriers were noted:

- Transaction costs were very high. The time and cost of negotiating each agreement averaged twelve months and required 3-6 man-months of utility effort.
- Subsidy calculations were complex, requiring negotiation of a baseline in each case, and future measurement of consumption.
- Program performance was guaranteed by the ESCO for each building individually; this made projection of total program impacts difficult.
- The avoided cost formula did not time-differentiate; as a result, kW and kWh savings were not necessarily coincident with peak demand.
- ESCOs generally were most interested in dealing with customers of 500 kW or over.

ISSUES OF SEGMENTATION IN DESIGNING A CONSERVATION BIDDING PROGRAM

Working with the author, NEES sought a new program that would leverage ESCOs to help meet its DSM goals, while minimizing transaction costs. The concept developed of offering ESCOs exclusive access to NEES subsidies for a specified group of customers, with a competition among ESCOs based on promised performance as measured in kW, and a requested subsidy measured in dollars per kW.

The main segmentation characteristics chosen by NEES were size and geographic territory. The program was limited to customers over 500 kW, organized into groups of 25 to 50 customers by geographic area.[1] This segmentation, combined with exclusive access to the subsidy in territories where selected, was an attractive package to ESCOs, encouraging aggressive and inexpensive bids. The initial implementation of NEES's conservation bidding program attracted conservation bids priced below 20% of the utility's avoided cost, while providing demand reductions of 8% to 12% at the market segment level.

By comparison, Orange and Rockland intends to segment with territories defined by building type (i.e., office buildings, hospitals, etc.) rather than geographical territory. Orange and Rockland hypothesizes that the uniformity of facility characteristics will further stimulate the bidding process.

Central Maine Power did not segment, but has expressed interest in developing territorial boundaries through negotiations among the winning bidders.

Therefore, territorial segmentation has been judged desirable in each of these three cases.

A second form of segmentation in the NEES program was that the ESCOs were limited to conservation options, while a separate auction was conducted for cogeneration or other QF capacity. By comparison, Central Maine Power conducted a combined supply and demand capacity auction.

The advantages of separate auctions include the following:

- The segmentation permits a utility to predetermine the mix of resources meeting its supply needs, while combined auctions tend to have a single approach that best meets the rules of the game.

- Also, a separated auction prevents relatively inexpensive conservation from being bid up to the costs of marginal supply-side capacity, reducing the costs of conservation to the utility and the ratepayers.

The combined auction has an advantage of direct comparability of all options in the same timeframe. In the case of Central Maine Power, the format also appeared to encourage a greater quantity of conservation bids.

ISSUE OF MEASURE DISCRIMINATION

A major issue considered in the NEES design was measure discrimination. Could the bid evaluation be limited to the proposed kW reduction, or was it necessary to discriminate on the type of measures installed?

The bidding program at Central Maine Power set a restriction on long payback items (generally over six years). Other ESCO programs (non-bidding in nature) at Bonneville Power and Northeast Utilities set a restriction on quick payback items (under three years). NEES raised the question, therefore, if any method of measure discrimination was necessary or desirable. If so, the implementing ESCO would need to predetermine its measure mix as part of the bid package.

The answer depends primarily on the standard for benefit-cost analysis used by the utility. To illustrate this dependence, the following data were developed from analyses performed by New England Electric.[2]

An evaluation of 30 measures was performed for their typical cost of implementation per installed kW of savings. The results for twelve sample measures in Massachusetts office buildings are shown in Figure 1.

COST AND PRIOR IMPLEMENTATION OF TWELVE MEASURES

Measure	Cost/kW	% of Technical Potential already Achieved	Average payback (years)
High Efficiency Fluorescent Lamps	$550	27%	1.8
Compact Fluorescent Lamps	$280	2%	.6
Incandescent to Fluorescent Conversion	$771	1%	2.5
Electronic Dimmers and Ballasts	$2150	0%	5.3
Specular Reflectors, Light and Ballast Replacement	$850	0%	1.8
Economizer Cooling	$932	8%	2.0
HVAC Controls	$1820	9%	2.7
Window Film	$2400	5%	3.5
High Efficiency Air Conditioning *	$4500	12%	7.0
Variable Air Volume	$7100	5%	10.0
High Efficiency Motors *	$2242	8%	5.8
Building Shell Improvements	$2600	10%	6.0

* Installed as a retrofit measure

Figure 1

Definition of Measure Types

These measures, as well as others analyzed, can be labeled as three categories, using the following definitions:

- **"Cream" Measures** are so defined because they are viewed as "cream skimming" when subsidized by the utility and are assumed to have high free market penetration due to their quick paybacks. In fact, as shown from the analysis of audit data, there has only been modest penetration. Cream measures have unsubsidized paybacks to the customers of less than two years. Because of their cost-effectiveness, only modest subsidies per kW are necessary to encourage them.

- **Mid-Range Measures** have paybacks of two to six years and are rarely implemented without utility subsidy. Their costs are high enough, therefore, to ignore the free rider effect. Also, their costs are low enough, as will be shown, to meet societal efficiency tests.

- **Expensive Measures** have paybacks over six years. In many utility environments, the full cost of the measure per kW is higher than the marginal cost of capacity to the utility. Nonetheless, they may become cost-effective to the customer if a utility subsidy of 60% to 100% of the utility's avoided costs is provided.

Figure 2 provides examples of these three types of measures. Figure 3 summarizes the characteristics of the measures.

EXAMPLES OF THREE TYPES OF MEASURES

Cream	Mid-Range	Expensive
EE Fluorescents	Incand. to Fluor.	High Efficiency A/C
Compact Fluorescents	Dimmers/Ballasts	Variable Air Volume
Economizer Cooling	HVAC Controls	High Efficiency Motors
Specular Reflectors	Window Film	Building Shell Improvements

Figure 2

CHARACTERISTICS OF THREE TYPES OF MEASURES

	MEASURE TYPE		
CHARACTERISTIC	Cream	Mid-Range	Expensive
Payback Range	0-2 yr.	2-6 yrs.	6-12 yrs.
Needed Subsidy (% of Avoided Cost)	10-20%	20-60%	60-100%
Free Rider Effect (10 years)	High	Low	Low
Availability in Large C/I (Reduction in kW)	10-15%	10-15%	10-15%

Figure 3

Effect of Measure Type on Benefit-Cost Tests

The three tests in common use are defined briefly below. The reader unfamiliar with these concepts will need to reference other sources for more comprehensive definitions.

- **The Revenue Test** calculates reduced revenue requirements. It compares the utility subsidy to the avoided costs resulting from lowered electrical demand and energy requirements.

- **The Societal Test** determines if the measure is resource efficient. It adds the customer's supplemental payments to the utility subsidy and compares the total to the utility's avoided costs.

- **The Rate Test** determines the impact on the average cost of electricity. To pass, the utility's subsidy must be less than the difference between avoided costs and lost revenue.

A strength of conservation bidding is that its structure guarantees passage of the revenue test. By purchasing conservation on a cost-per-kW basis, it is necessary only to impose a ceiling on the bids at the utility's avoided cost to ensure that utility revenue requirements are reduced. Since the utility subsidy is the only basis of evaluation, a program with a revenue test criterion can be "measure blind," accepting conservation by whatever means encouraged by the ESCO.

The revenue test was the only authorized criterion in Massachusetts, and, therefore, NEES chose a relatively "measure-blind" program. Obviously, lack of measure discrimination simplified the administration of the program as well.

The societal test criterion requires a limitation to be set on the total cost of the measure (utility and customer). At Central Maine Power, the bidder must ensure that measures installed in each building pass the test. As defined, the *expensive* measures fail the test, because the full cost is greater than the utility's avoided cost, whether paid by the customer or the utility in any combination. A similar requirement was placed on ESCO subsidy programs at Bonneville Power and Northeast Utilities. The effect of the criterion is to add substantial administrative burden, which may not be cost-effective, since the expensive measures are rarely selected by ESCOs for implementation, even if subsidized.

The rate test criterion is the most limiting. Because the margin between avoided costs and lost revenue is small, measures will pass the test only if the subsidy is low. In the Northeast, only subsidies below 20% of avoided cost will pass the rate test, and therefore, it is typically the "cream" measures that pass. These results are summarized in Figure 4.

EFFECT OF MEASURE TYPE ON BENEFIT-COST TESTS

TEST	MEASURE TYPE Cream	Mid-Range	Expensive
Revenue Test Net Benefit = Avoided Cost - Utility Cost	Pass	Pass	Pass
Societal Test (Net Benefit = Avoided Cost - Utility Cost- - Customer Cost)	Pass	Pass	Fail
Rate Test (Net Benefit - Avoided Cost - Utility Cost - Lost Revenue)	Pass	Fail	Fail

Figure 4

A final basis for measure discrimination is an effort to eliminate free-ridership. Since the cream measures are highly cost-effective, they are the ones most likely to have been installed, even if the program was not in place. Some ESCO programs such as Bonneville and NU have sought to eliminate cream measures on this basis.[3] At NEES, there was no prevention of "cream-skimming." Therefore, some portion of the program subsidy is clearly being spent on free riders. However, the low purchase price (20% of avoided cost) was deemed an adequate factor of safety for free-ridership, which will be measured downstream through a planned evaluation.

ISSUES IN THE MEASUREMENT OF IMPACT

Conservation measures produce a pattern of kW reductions over the year that vary depending on the measure installed and on the operating characteristics of the facility where installed. In the effort to design the NEES conservation bidding program, great importance was placed on developing an impact measurement structure that was directly comparable to supply options, with a minimum of administrative effort required by the utility or the ESCOs.

Engineering Estimates vs. Metering

One issue in the design was a choice between use of engineering estimates and building metering as the basis of measurement. Both were viewed as having risks. An engineering estimate could have an inaccurate methodology. Further, reliance on engineering estimates as the basis of measurement left open the possibility that the equipment would fail to perform or be removed from the facility.

Metering also has risks. Changes to the underlying pattern of energy use in the facility cannot be separated easily from the effects of installed conservation measures. Further, determining the impact of the equipment requires a yearly analysis in each facility for the life of the equipment.

NEES chose to rely on engineering estimates, citing its relative simplicity. Evaluation research is planned to determine the accuracy of this approach in the coming year.

Standardized vs. Custom Engineering

A second issue was whether engineering estimation was needed in each facility, or whether a standardized analysis could be performed on a measure basis that could be applied to all facilities. .A study was performed to determine the feasibility and accuracy of using standard adjustment factors for certain measures and facility types. The data for the study included energy audits of 300 commercial facilities performed the previous year for a variety of end-use research purposes[4]. In each audited facility, simulations were performed of energy and demand impacts for 102 standard measures. The audit database contained facility inputs, end-use consumption, end-use load profiles, and impacts that could be examined cross-sectionally to determine:

- frequency of availability of the measure,
- cost-effectiveness of the measure, and
- consistency of load shape impact across the customer base.

Standard factors were proposed for measures that were frequently available, were typically cost-effective from the viewpoint of the utility, and most importantly, had a consistent and predictable load shape impact. It was found that a standard factor could be computed for 26 measure types, when the facilities were sorted into three groups by operating hours.

Type 1 facilities were most retail and office facility types. Type 2 facilities were two-shift operations such as manufacturers and most wholesalers. Type 3 facilities were continuously operating facilities such as hospitals, municipal pump stations, and three-shift manufacturers.

Some measures (such as variable speed drives) could not justify a standard factor due to their highly variable load impact. These measures are permitted within the program, but require a custom building study.

Development of Adjustment Factors

A third issue was whether a straightforward representation of these load shape impacts was possible that could be easily applied to bid documentation and validation. To accomplish this, the concept of an adjusted demand reduction was developed in the design of the NEES program.

The goal of the NEES program was to achieve avoided kW over a ten-year program life. An avoided kW was defined as a uniform 1 kW reduction during all hours of the day for a period of ten years. For example, in a facility that operates continuously, a 1 kW reduction in lighting load through efficiency improvements, as computed through engineering design standards, results in a "1 avoided kW" benefit to NEES.

Most measures won't fit this model. They produce less benefit as a result of:

- non-continuous building and equipment operation,
- varying demand reduction based on operating or weather conditions, and
- measure life under ten years.

For such measures, a method was devised to compute "adjusted demand reductions." For a particular measure's characteristics, the design kW saved were converted to "adjusted demand" as follows:

- Average kW reductions were calculated in 11 time-of-use periods. For example, building shell measures would produce electric heat and air conditioning demand reductions. For a design kW reduction, as calculated at standard design weather conditions, relative average kW reductions need to be calculated for 11 annual periods:

  - Summer Super Peak, Peak, Shoulder, Off-peak.
  - Winter Peak, Shoulder, Off-peak.
  - Spring Shoulder, Off-peak.
  - Fall Shoulder, Off-peak.

- The avoided cost per kW was computed by the NEES rate department for these 11 periods and estimated for the following 10 years using avoided cost methodologies similar to those used in small power purchases.

- A kW adjustment factor for a device could then be computed as follows:

  $$\text{Adjustment Factor} = \frac{\text{10 year value of avoided cost/design kW}}{\text{10 year value of continuous kW savings}}$$

- The Adjusted Demand Reduction was computed as follows:
  Adjusted Demand Reduction = Design kW Savings x Adjustment Factor

As an example, if a contractor replaced incandescent lighting with fluorescent in a retail facility, he would use conventional engineering methods to compute the design kW reduction. For a design reduction of 50 kW, the design kW would be reduced to reflect the non-continuous operation of the affected lighting system. The adjustment factor was computed to be 0.52. The "Adjusted Demand Reduction" was therefore 26 kW. NEES would pay the bid price for 26 kW in such a case. Adjusted demand reductions are shown in Figure 5.

CONCLUSIONS

The NEES program design produced workable solutions that greatly simplified the mechanics of conservation bidding. Through two solicitations, the design choices accomplished the goal of permitting competitive bulk conservation purchase by the utility in a framework comparable to a supply auction. The most essential elements of that design were the following:

- Size and territorial segmentation of customers provided an effective organization of bidding structure from the viewpoint of the utility and the ESCO. Building type segmentation, as being considered by Orange and Rockland, may prove even more effective.

- Minimizing measure discrimination simplifies program mechanics and lowers administrative costs. It adds a risk that some suboptimal conservation investment will occur, as viewed from the perspective of the societal or rate tests.

- The adjustment factor system represents an important step forward in purchasing conservation. It allows a performance agreement to be signed between the utility and the ESCO for a predetermined load impact that can be met by the ESCO with a mix of conservation measures that need not be predetermined.

REFERENCES

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2 H. G. Michaels, J.P. daSilva, *Development of Demand Reduction Factors for Performance Contracting,* prepared for Demand-Side Planning Department, New England Electric System, June 1987.

3 F. Gordon and M. Weedall, *Review of Performance Based Utility Conservation Programs in the Commercial Sector Incorporating Bidding Elements*, paper delivered at the New York State Energy Research and Development Authority Conference on Bidding, March 25, 1987.

4 XENERGY Inc., *Study of Commercial Customer End Use and Energy Conservation,* New England Power Service Company, January 1987.

DEMAND REDUCTION ADJUSTMENT FACTORS

MEASURE DESCRIPTION	TYPE I FACILITIES	TYPE II FACILITIES	TYPE III FACILITIES
Lighting Measures:			
High Efficiency Fluorescent Lamps	0.44	0.53	0.66
Compact Fluorescent Lamps	0.35	0.44	0.56
High Efficiency Ballasts	0.52	0.70	1.00
Interior Lighting Fixture Conversion	0.52	0.70	1.00
Exterior Lighting Fixture Conversion (Evening Only)	0.12	0.23	0.23
Exterior Lighting Fixture Conversion (Dusk to Dawn)	0.33	0.33	0.33
Automatic Interior Light Dimmers	0.38	0.38	0.41
Interior Lighting Occupancy Sensors	0.24	0.31	0.43
Exit Sign Lighting Conversion Retrofit	1.00	1.00	1.00
Specular Reflectors	0.52	0.70	1.00
Building Shell Measures:			
* Increase R-value Through Additional Glazing, Reduced Glazing, Storm Doors or Insulation (Electric AC Only)	0.07	0.07	0.07
* Increase R-value Through Additional Glazing, Reduced Glazing, Storm Doors or Insulation (Electric Heat Only)	0.05	0.05	0.06
* Loading Docks Seals (Electric AC Only)	0.05	0.05	0.07
* Loading Dock Seals (Electric Heat Only)	0.03	0.04	0.06
Window Film	0.05	0.05	0.05
Air Conditioning Measures:			
High Efficiency Air Conditioners	0.20	0.21	0.24
Economisers	0.03	0.04	0.04
Chiller Water Reset Controls	0.01	0.01	0.02
Hot or Cold Deck Reset Controls	0.02	0.02	0.04
Compressor Demand Control	0.01	0.01	0.01
Variable Air Volume System	0.07	0.08	0.12
Other Measures:			
High Efficiency Motors (Operating Hrs/Yr. Less Than 2500)	0.21	0.19	0.14
High Efficiency Motors (Operating Hrs/Yr. Between 2500-6000)	0.64	0.63	0.49
High Efficiency Motors (Operating Hrs/Yr. Over 6000)	0.92	0.92	0.92
Refrigeration Case Covers	0.12	0.12	0.11
Refrigeration Polyethylene Strip Curtains	0.03	0.03	0.03
Refrigeration Anti-Condensate Heater Controls	0.48	0.48	0.48
Refrigeration Demand Defrost Controls	0.03	0.03	0.03
High Efficiency Refrigeration Compressor Motors	0.65	0.65	0.65
Low Temperature Dishwashers	0.02	0.03	0.05

* For these measures, if a facility has both electric heat and air conditioning, separately calculate the adjusted demand reductions (for both electric heat only facilities and electric air conditioning only facilities) and add the two demand reductions together. This is the total adjusted demand reduction for the facility.

Figure 5