ASSESSMENT OF DEMAND RESPONSE OPTIONS – A DISTRIBUTION COMPANY VIEW

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This paper summarizes the results of a demand response (DR) assessment project that was conducted for NSTAR beginning in late 2002 and completed in mid-2003. The project was initiated for several purposes: to evaluate and summarize key developments in the field of DR, to perform a process review of the 2002 C&I Demand Response Pilot, to construct a framework for quantifying and comparing the benefits and costs associated with specific DR decisions, and to generate actionable advice and recommendations regarding DR that NSTAR staff can utilize during system planning processes.

The process used to develop the insights in this paper incorporated comments and feedback from several departments within NSTAR, including Engineering, Customer Care, Finance and Accounting, and Strategy, Law, and Policy. In addition, the process relied upon input received from the Massachusetts Department of Environmental Protection, the New England Demand Response Initiative, several Non-Utility Parties engaged in the New England electricity market, and staff and consultants employed by ISO New England (ISO-NE) and the New York ISO (NYISO).

The results of the project are timely considering that regulators and market operators are placing an increasing degree of importance on DR as wholesale electric markets are being deregulated and ISO-NE is transitioning to Standard Market Design with significant changes proposed for its existing Load Response Program (LRP).

Background on Demand Response Activity

Information was collected on strategic and market-driven DR programs currently implemented across the country. Some sixty DR programs offered by more than thirty different utilities and ISOs were reviewed to assess current activity and accomplishments from DR. Key findings include:

- Utilities with customer demographics similar to NSTAR's (i.e., northern tier, light industrial-based) have been able to achieve significant DR capabilities. Xcel Energy, based in Minneapolis, MN, has been operating a successful DR program since 1990. Currently, some 275,000 customers representing 280 MW of load reductions (roughly 3.4% of system peak demand) are participating in the program at a cost to Xcel of approximately $23/kW-yr.
- Aggressive DR programs can be launched quickly. Cinergy's PowerShare program was ramped up in nine months after severe price volatility events in 1999. The program continued to evolve over the next year, developing innovative pricing and call options and an interactive process that enabled customers to provide feedback on viable program design. PowerShare has been well received by the targeted customers; currently, some 640 C&I customers representing 305 MW of load reductions (roughly 2.7% of system peak demand) are enrolled in the program at a cost to Cinergy of approximately $4/kW-yr.
- Utilizing DR to alleviate distribution system constraints has proven challenging. Commonwealth Edison (ComEd) has enlisted 540 MW of demand reductions (roughly 2.5% of system peak demand) into its voluntary DR program; however, it has had limited success in using DR to defer

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or eliminate the need for distribution system upgrades. ComEd staff indicates that DR has performed best at substations characterized by relatively flat load growth and slim capacity surpluses.

- ISO-NE's LRP, which was designed to increase regional system reliability and reduce wholesale price volatility, has met with limited success in the three years it has been operating. The program has achieved only 10% of its enrollment targets and an evaluation completed earlier this year indicates that the program was not cost effective in 2002. However, it should be noted that the one-year retrospective time horizon of the study was insufficient for program benefits to outweigh high initial infrastructure costs.

Analysis Frame and Survey of Recent Studies

This section discusses the analysis frame that was used to conduct the NSTAR project. Any assessment of an investment (e.g., a cost-benefit analysis) is dependent upon the perspective taken – who is incurring the costs and who is receiving the benefits. From among the many perspectives that could be taken in this assessment, it was determined to focus on two that were viewed as most relevant:

NSTAR PERSPECTIVE – A primary objective was to explore a NSTAR view of demand response initiatives. On balance, do different DR market plays (i.e., different combinations of DR programs at different levels of commitment) provide benefits to NSTAR that exceed the associated costs. This view requires a consideration of:

- **One** - the financial aspects of the investment that impact the Company and its stockholders, and
- **Two -** the benefits to NSTAR customers.

MARKET-WIDE PERSPECTIVE – Demand response undertaken by NSTAR in the NSTAR service territory will provide benefits to the regional electricity market, (i.e., regions outside of NSTAR's service territory that comprise the ISO-NE region). These benefits include enhanced reliability for all customers in the ISO-NE, reduced market-clearing prices in spot markets and reduced price volatility which influences the prices all customers pay for electricity through the forward price curve that is used to set future prices.

One issue to be examined concerned the bifurcation of benefits and costs among different parties in the restructured electric markets in New England. Due to this restructuring, the costs of a DR effort may be borne by one party, but the benefits may accrue to others.

Three studies were identified that address the benefits and costs of DR programs. The NYISO had conducted benefit/cost analyses of its programs for two years – one study covering 2001 and a second covering 2002. The ISO-NE performed a benefit/cost study of its 2002 programs. Both the NYISO and ISO-NE studies were retrospective and did not attempt to project benefits that might accrue in the future. The analyses were restricted to examining only the benefits and costs that accrued in the one year being studied. DR programs that are relatively new and have not yet reached a critical mass in terms of participation fare poorly in these retrospective analyses.

One study did take a prospective look at the benefits of DR. The most recent ISO-NE Regional Transmission Expansion Plan (RTEP02) did examine specific areas of congestion and developed scenarios reflecting the benefits for specific levels of DR being available. This study showed that DR in specific load pockets can have substantial benefits in terms of lowering locational marginal prices

(LMP). In Southwest Connecticut (SWCT) and Nor-Stam (NOR), 170 MW of DR would reduce load serving entity costs by $300 million.

Based on the review of recent DR cost-effectiveness studies, the analytic framework developed for this effort is unique in that it provides a more forward-looking analysis of the respective benefits and costs. This type of approach is needed for investment analyses which must take into account future benefits and costs.

It should also be noted that the methods for assessing the value of demand response have not been standardized and that additional work is required to increase the confidence of the stakeholders in demand response decision making.

Benefit/Cost Assessment

The analytic framework was used to dimension and quantify the benefits and costs associated with various DR market plays from two perspectives – NSTAR and Market (ISO-NE). The different perspectives distinguish between 1) the benefits that accrue specifically to NSTAR and its customers and 2) the benefits that accrue to the wider market and market participants. This distinction is important because NSTAR may realize only a small portion of certain market benefits and may not capture returns from other benefits at all.

The assessment was applied to a specific slate of DR efforts that could be undertaken by NSTAR. The DR portfolio was limited to call option programs that would provide guaranteed reductions in demand. This was believed to be necessary if investments in T&D infrastructure were to be deferred.[b] For balance and reasons of equity, programs were developed for both large C&I customers and mass-market customers. The magnitude of DR that could be developed over the 5-year time frame was based on a potential analysis using customer data from NSTAR; the costs of delivering the program to customers were obtained from a variety of sources including equipment vendors and other utilities implementing similar programs. The result of this DR program design process was a C&I call option program with 160 MW enrolled, and a mass-market direct load control (DLC) program with 10 MW enrolled in 2004 and increasing by 10 MW per year until 50 MW are enrolled in 2008. The assessment was designed to examine the benefits and costs of this DR investment (termed "DR Market Play") by NSTAR from the distribution company perspective and the market-wide perspective.

The framework incorporated a variety of NSTAR-specific data regarding planned distribution system upgrade costs, potential impacts to billing determinants, and other financial and operational criteria and assumptions developed in conjunction with NSTAR personnel. These data were supplemented with information obtained from research into existing DR programs, discussions with DR product and services vendors, and conversations with the authors of recently completed benefit/cost analyses performed for ISO-NE and NYISO. This comprehensive approach enabled the benefits and costs attributable to specific DR decisions to be captured and analyzed.

The framework is unique in that it provides an investment horizon analysis rather than a retrospective analysis of benefits and costs. The values are developed for a five-year planning horizon and converted into net present values according to NSTAR's corporate discount rate. For planning purposes, a

[b] There are a variety of DR programs that were considered. Pricing programs, such as two-part tariffs, have been popular with many utilities; but, the customers' response to changes in price are variable, (i.e., there is no mandatory reduction required in these programs). Since this assignment was looking at DR programs that could impact T&D investments, call option programs with mandated reductions were examined and pricing programs were not considered.

forward-looking analysis is required to appropriately allocate initial program costs and to allow scenarios to be developed that can dimension variability in program designs, participation rates and operating variables.

Key results of the benefit/cost analyses are summarized below.

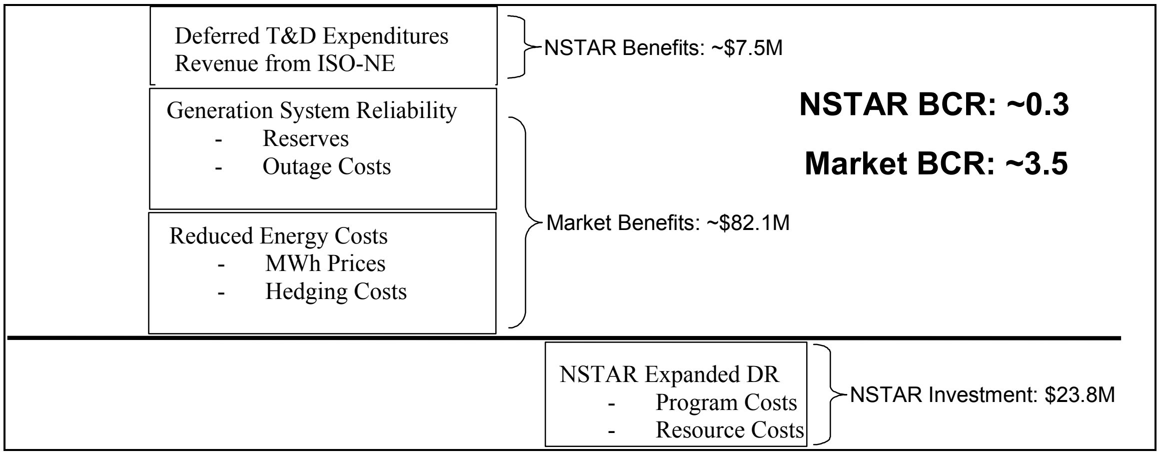
- An aggressive DR market play by NSTAR (160 MW enrolled in a C&I call option program and 10 MW enrolled in a mass market DLC program in 2004 increasing by 10 MW per year until 50 MW are enrolled in 2008 yields the following benefit/cost ratios when considered over a five year planning horizon:
  - NSTAR perspective:
    - Shareholder perspective - approximately a 0.3 b/c ratio.
    - Customer perspective - approximately a 1.4 b/c ratio.[c]
  - Market (ISO-NE) perspective - approximately a 3.5
- Revenue differentials represent the smallest of the primary cost components associated with NSTAR's development and implementation of a DR program. This is true because NSTAR uses a customer's monthly peak demand to determine billing kW (i.e., the magnitude of DR's impact on billing determinants is influenced by whether or not the curtailment event occurs coincident to the customer's monthly peak demand).

- This study reviewed current methodologies for quantifying the benefits and costs associated with DR and integrated those techniques with existing best practices and NSTAR-specific operating parameters to perform the analyses. Nonetheless, because the methods for estimating benefits have not been standardized and the magnitude of the market benefits are highly dependent upon an uncertain future, the results are subject to revision as the assessment methodologies mature.

Many organizations share a basic belief that the market benefits associated with DR are substantial; however, as Figure 1.1 illustrates, when the economics of DR are considered from the distribution company perspective, the benefits are found to be considerably less than those perceived at the market perspective. This situation creates a variety of intriguing questions – including whether or not regulators would encourage distribution companies to promote DR via cost recovery mechanisms and whether or not LSEs would pay distribution companies for commodity price risk protection via DR.

[c] This analysis shows that the NSTAR customer benefit-cost ratio is 1.4 using the assumptions that produce an overall market benefit of 3.5 and including the incentives paid to participants as a customer benefit.

Figure 1.1 NSTAR-specific and Market (ISO-NE) benefit/cost ratios calculated according to the Combined DR Market Play by NSTAR.



Distribution Company DR Investment - General Considerations

The results of this project will help NSTAR determine the position it wants to take with respect to the development of DR in New England. The results must be considered in concert with the best available information regarding future regulatory and market conditions, including:

- Regulatory treatment of DR program costs (i.e., potential for program cost recovery);
- LSE willingness to pay for commodity price risk protection via DR;
- NSTAR customer benefits and costs under each DR scenario;
- Structure of ISO-NE DR programs and interaction with potential NSTAR programs;
- Environmental permitting considerations; and
- Evolution of a competitive curtailment service provider industry to serve the DR market function.

The results also must be considered in accordance with NSTAR's internal management and operational environment. These considerations include:

- Beliefs about customer and market benefits;
- Consistency with other NSTAR positions;
- Views regarding the distribution company risk/reward environment; and
- Potential impacts on NSTAR's market position and customer relationships.