U.S. Demand Response Information from Case Studies and other Research

Provided to
IEA Task XIII (Demand Response Resources)
By
U.S. Demand Response Coordinating Committee (DRCC)

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I. Introduction/Background

As part of its participation in IEA Task XIII on behalf of the United States, the U.S. DRCC undertook to identify demand response case studies available in the public domain. Some information regarding technology case studies was obtained via a collaborative survey effort between the DRCC and the New York State Research and Development Authority (NYSERDA) and was previously supplied to Task XIII. The items below were identified by DRCC staff in a subsequent web-based research effort as ones that could prove useful to other participants in Task XIII.

II. Enhanced Automation Supports Load Curtailment: Field Studies

Almeda County (CA) Government
http://www.energy.ca.gov/enhancedautomation/case_studies/CS01_Alameda.pdf
To make their BAS more flexible in the face of energy shortages and to "do their part" to mitigate the chance of rolling blackouts, the County upgraded the existing BAS in five of their largest facilities using CMS Viron's Curtailment Vision™, an Internet-based load curtailment program. The upgrades, funded mostly through the California Energy Commission, involved (1) enabling the County to set controls to incrementally power down its chillers and (2) connecting the affected facilities' utility meters to the Internet so that the effect of the chiller load reductions on facility-wide loads could be verified in near-real time from any computer with an Internet connection and standard Web browser.

Doubletree Hotel, Sacramento, CA
http://www.energy.ca.gov/enhancedautomation/case_studies/CS06_Doubletree.pdf
The Doubletree Hotel Sacramento is meeting this challenge with an aggressive energy management strategy that utilizes enhanced automation technologies. Their effort began six years ago, when the hotel installed its energy management system (EMS) and partnered with the local utility, the Sacramento Municipal Utility District (SMUD), to

participate in a demand curtailment program. Since then, the hotel has been an annual partner in this program, installed a real-time energy information system (EIS), and made concerted efforts to reduce loads and improve the efficiency of energy-using equipment. For example, the Doubletree can now monitor real-time energy use through EnerLink, a software interface that is linked to the hotel's interval meter. From a PC, facility operators watch the hotel's overall demand level throughout the day. As demand reaches peak levels, they can start shedding load and avoid excessive demand charges. The Doubletree uses their EMS to target numerous HVAC systems from a central location, and their EIS to immediately see the effects on overall demand.

Staples Office Supply Superstores, CA
http://www.energy.ca.gov/enhancedautomation/case_studies/CS05_Staples.pdf
Almost one-tenth of Staples' 1,300 office supply superstores were located in the territories of the three California investor-owned utilities, which were paying record-high wholesale electricity prices. In Southern California, the high cost of energy was being passed on to the utility's customers—including Staples. Energy Logic, Inc., an energy-consulting firm in Massachusetts, devised and implemented an energy management plan for Staples that would help insulate several California stores from surging demand charges and rolling blackouts. The plan involved the installation of wireless control technology that allows Staples personnel to send electronic pages from the Internet to automatically reduce the lighting and HVAC loads at selected California stores. To verify the load reductions, Staples also installed modem-enabled utility meters at each of the stores. Energy Logic, Inc. secured funding for the project from the California Energy Commission. Action Electric and Novar Controls undertook the electrical and programming aspects of the work, respectively.

Wesleyan University, CT
http://www.iso-ne.com/genrtion_resrcs/dr/broch_tools/Wesleyan_University_Real-Time_Price_Response_Case_Study.pdf
When the University was approached by Connecticut Light & Power to consider enrolling in ISO New England's Demand Response Program, the operations group seized upon the opportunity. ISO New England activated the Real-Time Price Response Program on ten weekdays from March 3, 2003 to March 14, 2003 when wholesale electricity prices were forecasted to exceed 10 cents per kWh. The University responded by reducing their electricity consumption by an average of 206 kW. They performed at more than twice the level they originally enrolled at. In several hours their reduction exceeded 350 kW. By responding to wholesale prices the University earned over $1,400 in incentive payments.

III. Real Time Pricing and Demand Response

Does Real-Time Pricing Deliver Demand Response? A Case Study of Niagara Mohawk's Large Customer RTP Tariff
Goldman, C., N. Hopper, O. Sezgen, M. Moezzi and R. Bharvirkar (LBNL) and B. Neenan, D. Pratt, P. Cappers, and R. Boisvert (Neenan Associates). LBNL-54974. August 2004

http://drrc.lbl.gov/pubs/54974.pdf
Real-time pricing (RTP) is advocated as the most economically efficient way to invoke demand response (DR) benefits, yet actual customer experience is limited and thinly documented. This study examines the experience of 130 large (over 2 MW) industrial, commercial and institutional customers at Niagara Mohawk Power Corporation that have faced day-ahead electricity market prices as their default tariff since 1998. It is the first study of large customer response to RTP in the context of retail competition.

Real Time Pricing as a Default or Optional Service for C&I Customers: A Comparative Analysis of Eight Case Studies
Barbose, G., C. Goldman, R. Bharvirkar, N. Hopper, and M. Ting, Lawrence Berkeley National Laboratory; and B. Neenan, Neenan Associates. LBNL-57661. August 2005
http://drrc.lbl.gov/pubs/57661.pdf
Demand response (DR) is broadly recognized to be an integral component of well-functioning electricity markets, but currently underdeveloped in most regions. In recent years, there has been renewed interest among a number of public utility commissions (PUC) and utilities in implementing real-time pricing (RTP), typically for large commercial and industrial (C&I) customers, as a strategy for developing greater levels of DR. A key question for policymakers is how much DR can ultimately be expected from RTP, which requires analyzing customers' willingness to be exposed to dynamic hourly prices over a sustained time period and their actual price responsiveness.

IV. Advanced Controls for Demand Response

Advanced Controls and Communications for Demand Response and Energy Efficiency in Commercial Buildings
Kiliccote S., Piette M.A. and Hansen D., *Proceedings of Second Carnegie Mellon Conference in Electric Power Systems: Monitoring, Sensing, Software and Its Valuation for the Changing Electric Power Industry, Pittsburgh, PA.* LBNL Report 59337. January 2006.
http://drrc.lbl.gov/pubs/59337.pdf
This paper discusses recent research results and new opportunities for advanced building control systems to provide demand response (DR) to improve electricity markets and reduce electric grid problems. The main focus of this paper is the role of new and existing control systems for HVAC and lighting in commercial buildings.
A demand-side management framework from building operations perspective with three main features: daily energy efficiency, daily peak load management and event driven, dynamic demand response is presented. Case studies involving energy management and control systems and DR savings opportunities are presented. The paper also describes results from three years of research in California to automate DR in buildings. Case study results and research on advanced buildings systems in New York are also presented.

V. Automated Demand Response

Findings from the 2004 Fully Automated Demand Response Tests in Large Facilities Piette, M.A., D.S. Watson, N. Motegi, and N. Bourassa, Lawrence Berkeley National Laboratory. LBNL-58178. September 2005.
http://drrc.lbl.gov/pubs/58178.pdf
This report describes the results of of research to develop and evaluate the performance of new Automated Demand Response (Auto-DR) hardware and software technology in large facilities. Demand Response (DR) is a set of time dependant activities that reduce or shift electricity use to improve electric grid reliability, manage electricity costs, and provide systems that encourage load shifting or shedding during times when the electric grid is near its capacity or electric prices are high. Demand Response is a subset of demand side management, which also includes energy efficiency and conservation. The overall goal of this research project was to support increased penetration of DR in large facilities through the use of automation and better understanding of DR technologies and strategies in large facilities. To achieve this goal, a set of field tests were designed and conducted. These tests examined the performance of Auto-DR systems that covered a diverse set of building systems, ownership and management structures, climate zones, weather patterns, and control and communication configurations.

Update on Automated Demand Response Research, Mary Ann Piette, LBNL, February 2006
http://ciee.ucop.edu/dretd/Auto-DR%20Update.pdf
This presentation to the DR Enabling Technologies Development Program provides an update on research efforts by Lawrence Berkley National Laboratory, focusing on findings from specific projects.

VI. Actual vs. Estimated Demand Response Results

Independent Review of Estimated Load Reductions for PJM's Small Customer Load Response Pilot Project, Heffner, G., M. Moezzi and C. Goldman. LBNL-54835. June 2004
http://eetd.lbl.gov/EA/EMP/reports/54835.pdf
This study describes the results of a low-cost approach used to measure reported load reductions from a residential electric water heater (EWH) load control program operated as part of PJM Interconnection's Demand Response small customer pilot program. Lawrence Berkeley National Laboratory (LBNL) conducted this independent review of the engineering estimates for EWH load control reported by a Curtailment Service Provider (CSP) at PJM's request. LBNL found that the observed load reductions for the premise-level data aggregated over all households in the two participating electric cooperatives were, respectively, 40%-60% less and 3 % less-10% higher than the estimated diversified demand reduction values assumed by the CSP, depending on whether observed or normalized results are considered.

A Survey of Utility Experience with Real Time Pricing, Barbose, G. and C. Goldman (LBNL) and B. Neenan (Neenan Associates). LBNL-54238. December 2004
http://eetd.lbl.gov/EA/EMP/reports/54238.pdf

While other mechanisms can be used to induce price responsive demand and/or reduce peak demand, many economists argue that RTP represents the most direct and efficient approach, and therefore it should be the primary focus of policymakers' efforts to improve the performance of wholesale and retail electricity markets (Borenstein et al. 2002). While clearly appealing from a theoretical perspective, questions remain about the extent to which RTP can ultimately affect wholesale market performance and utility resource planning. First, assuming that RTP is offered on a voluntary basis, how many customers would choose to enroll in RTP, given the additional risks and transaction costs compared to traditional, fixed price retail supply service? Second, even if a sizable number of customers did choose to enroll, to what extent, and how consistently, would a diverse population of participants respond to the prices they face?