Assessment of Demand Response Resource Potentials for PGE and Pacific Power

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I. Introduction

Executive Summary

This report summarizes the results of a study to assess "gross" and "achievable" technical potentials for demand-responsive resources (DRR) in the Portland General Electric (PGE) and Pacific Power (Pacific) service territories. The study was commissioned jointly by the utilities in compliance with the Oregon Public Utility Commission's July 1, 2003, order, Order No. 03-408, to provide "an assessment that evaluates demand response potential by market segment . . . ."

The report uses a six-step process to estimate gross and achievable technical potentials for DRR in each major market sector. For both utilities, estimated gross potentials are proportionate to their respective sales and closely approximate actual peak system loads.

A full description of the technical and economic potentials is provided in Section III. The assessment of the economic potential shows that only a few of the demand response strategies are cost effective at this point. Only standby generation, irrigation load control, non-residential time-varying prices and low-cost demand buyback options appear to be justifiable from an economic perspective. Market potential is primarily driven by customers' willingness to participate. Barriers to participation are described as significant and are detailed in Section IV.

This indicates that even for cost-effective measures incentives and marketing efforts will have to be extensive to garner substantial enough participation to be considered a system resource. It is recommended to conduct direct customer behavior research to obtain realistic estimate of potential participation in the cost-effective resource programs, to monitor the activities and success of other utilities and regional programs, and to regularly reassess the system and capacity costs for changes that will render other demand response strategies and programmatic options into cost-effectiveness.

Overview of Demand Response

For the past two decades, electric utilities have experimented with a broad range of load-management strategies and dynamic, marginal cost-based pricing structures to enhance their ability to manage loads and to reduce overall resource costs. These initiatives have been based on a variety of programmatic instruments including interval-varying price options, time-of-use (TOU) rates, interruptible tariffs, direct load control, and market-based day-to-day curtailment programs.

Demand-responsive resources (DRR) are comprised of flexible, price-responsive loads, which may be curtailed or interrupted during system emergencies or when wholesale market prices exceed the utility's supply price. Certain demand-response resources such as on-site generation and demand buyback arrangements can interact directly with the wholesale market institutions by allowing consumers (or aggregators, acting on their behalf) to participate in the electricity spot markets. Acquisition of DRR may be based on either reliability considerations or economic/market objectives:

- ***Reliability Considerations***: These objectives address the need to ensure reliability of supply during system emergencies and to provide an optional resource under emergency conditions.
- ***Economic/Market Objectives***: From an economic point of view, DRR serves the three-fold objective of:
    - *Price Objectives* – Helping avoid or reduce extreme price spikes; and managing market risks by creating a hedge against short positions and market exposure.
    - *Elasticity Objectives* – Facilitating an elastic demand curve by sending appropriate price signals to develop liquid wholesale markets with full demand-side participation.
    - *Efficiency Objectives* – Reducing market-clearing prices at the grid operation level by alleviating pressure on reserves and expanding liquidity in the energy market.[1]
- ***Customer service*** might also be considered as an additional benefit of demand-response programs as an added service or product offering to customers.

Resource Potential Definitions

The overall approach in this study is based on the recognition that "resource potential" in general encompasses four distinct, yet interrelated, definitions: 1) gross technical potential, 2) achievable technical potential, 3) economic potential, and 4) market potential.

Gross Technical Potential assumes that all end-use loads in all customer sectors are potentially available for curtailment, except for those, which clearly do not lend themselves to DRR strategies.

Achievable Technical Potential is a subset of gross potential and represents the portion comprised of technically feasible reductions in load associated with applicable end-uses. For example, while total kW demand for lighting in

1 For a discussion of the economic justifications for demand response see Ruff, Larry, Economic Principles of Demand Response in Electricity, Edison Electric Institute, October 2002.

the commercial sector might be targeted for load reduction, only a certain portion of this load may be effectively curtailed through energy management approaches such as dimming, partial turn-off, or reductions in perimeter lighting.

Economic Potential is defined as that portion of achievable technical potential that meets a specific per-unit cost threshold. The amount of economic potential, therefore, varies depending on market capacity prices. This study does not attempt to estimate the magnitudes of economic resource potentials explicitly. Instead, it provides an estimate of average per-unit cost of various demand response resources available under different strategies. Economic potential may then be determined by comparing these costs against alternative capacity price scenarios.

Finally, ***Market Potential*** is a subset of economic potential and takes into account the customers' ability and willingness to participate in load reduction programs subject to their unique business priorities, operating requirements, and economic (price) considerations. An accurate assessment of market potential requires empirical market research of actual customer behavior given program design parameters. This report will discuss the barriers that are likely to prevent participation and experiences of other utilities with similar programs to provide a perspective on market potential for demand response programs.

Demand Response Strategies

Options for DRR acquisition encompass a broad range of price-based (e.g., time-varying rates and interruptible tariffs) or incentive-based (e.g., direct load control, demand buy-back, demand bidding, and dispatchable stand-by generation) strategies.[2] For purposes of this study, demand response options are categorized in terms of their relative availability and reliability as "dispatchable" resources into the following five classes.[3]

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2 A comprehensive survey of utility demand response programs conducted by the Western Governors Association has identified ten distinct program designs: Real-Time Dynamic Pricing, Time of Use Pricing, Demand Buyback or Bidding, Demand or Direct Load Control, Dispatchable Standby Generation, Interruptible, Black-Out Protection, Event Driven Demand Reduction, Pre-Determined Demand Reduction, and Curtailment (voluntary). For a classification of demand response programs see Schwartz, 2003. An ample treatment of time-varying prices is found in Borenstein et al, 2002.

3 In its 2003 Integrated Resource Plan, Pacific Power distinguishes among four classes of demand-side management resources: 1) fully dispatchable, 2) non-dispatchable growth neutral, 3) non-dispatchable buydown, and 4) non-dispatchable conservation education. The five classes of demand response resources discussed here closely correspond with class (1) and class (3), respectively.

Dispatchable Standby Generation: Standby generation resources are comprised of back-up generation units at the customers' facilities, which can be dispatched at the utility's discretion. The utility generally provides the necessary interconnections to the grid and compensates the owner for its right to use the unit.

Direct Load Control: These strategies allow the utility to remotely interrupt or cycle electrical equipment and appliances such as electric water heaters, space heaters, and central air-conditioners. Direct load control programs are generally best suited for the residential and to some extent small commercial sectors.

Curtailment Contracts: These refer to agreements between the utility and its large customers who agree to curtail or interrupt their operations for a predetermined period when requested by the utility. The duration and frequency of such requests and levels of load reduction are also stipulated in the contract. Customers who agree to participate are typically compensated either through lower rates or fixed payments. Examples of programs in this category include traditional interruptible rates and long-term demand buyback contracts such as PGE's extended Demand Buyback Program.

Demand Buyback: Under demand buyback arrangements, such as the current Energy Exchange and Demand Exchange programs offered by PGE and Pacific, the utility offers payments to customers for reducing their demand when requested by the utility. The buyback amount generally depends on market prices published by the utility ahead of the curtailment event and the level of reduction is verified against an agreed upon baseline usage level.

Time-Varying Prices: This category of demand response resources consists of pricing structures and incentive mechanisms designed to encourage customers to shift consumption to off-peak hours. Time-varying prices refer to the general class of rates designed to reflect the utility's marginal cost of power supply and include traditional two-part TOU rates, seasonal rates, real time pricing, and critical peak pricing.