CHAPTER X. GAS PORTFOLIO ANALYSIS AND RESOURCE STRATEGY

Similar to the historical treatment of conservation in PSE's electric portfolio analysis, recent gas Least Cost Plan analysis has reflected conservation resources as a decrement to system demand. In its April 2003 Least Cost Plan, PSE utilized this approach by assuming that approximately 2.1 million therms of new conservation savings will occur every year during the 20-year planning horizon. With an assumed average conservation measure life of 10 years, the annual decrement to system demand in the April 2003 Least Cost Plan grows to approximately 21 million therms by year 10 and remains at this level throughout the remaining years of the planning period.

In this August 2003 Update, PSE has modified this approach by reflecting the load shapes or "supply curves" and the corresponding costs of the gas conservation resource options described in Chapter IV in the least-cost resource planning analysis to determine the resulting impact on the total gas-portfolio cost. This section will describe the approach, assumptions, and methodology used in the gas resource analysis and will summarize the results of the analysis.

A. Modeling Approach for Assessment of Conservation Resources

Modeling Limitations

The analysis of the gas conservation resources utilizes PSE's Uplan-G Resource Planning Model. Unlike the automated portfolio-construction capability provided by the electric Portfolio Screening Model, Uplan-G is currently unable to model gas conservation as a resource, whereby the model would select a set or "bundle" of conservation resources, in combination with supply-side resources, to meet customers' energy needs at the least cost. Instead, each bundle of conservation resources must be successively introduced to the Uplan-G model by decrementing demand according to the load shape of the conservation resource and simultaneously adding the corresponding conservation resource cost to the portfolio, while optimizing the remaining supply resources to achieve a least-cost result. An assessment can then be made on whether the incremental conservation resource bundle reduces or increases the cost of the total resource portfolio.

In view of the need for a "before-and-after" look at the total resource portfolio costs for purposes of assessing the impact of each conservation resource bundle, a consolidating step was employed to reduce the required number of model runs. All bundles within a particular cost level from across the three customer segments (residential, commercial, and industrial) were aggregated for purposes of introducing their demand impacts and resource costs to the portfolio. This reduced the number of required model runs per cost level from as many as 15 down to one. However, once the next incremental level of conservation resources increased the Net Present Value (NPV) of the total portfolio cost, it became necessary to disaggregate the conservation resource bundles in that category to determine which bundles could remain without increasing the total portfolio cost.

Challenges Provided by a Portfolio with Surplus Capacity

Because PSE has sufficient capacity resources to satisfy its requirements for the next several years, and recognizing the relatively high near-term cost of gas, conservation resource cost-effectiveness will be driven primarily by the market price of natural gas. Based on this observation, PSE expected that all the bundles of conservation resources in the cost categories A (Low Cost) and B (Medium Low Cost) would be cost-effective. This was verified with two UPlan-G model runs (See Exhibit X - 2). The results of this test are described in Section C, Analytical Results, of this chapter.

B. Analytical Process Steps

For the gas portion of the August 2003 Least Cost Plan Update, PSE implemented an analytical approach that included the following steps:

1. Develop detailed assessments of the amount of conservation resource potential, including *technical* potential and *achievable* potential (see Chapter IV).
2. Aggregate multiple conservation measures with similar characteristics into 15 bundles (see Chapter IV, Exhibit 10).
3. For each bundle of conservation measures, create a supply curve that identifies the amount of achievable conservation that could be acquired at each of four specified cost levels (see Chapter IV).
4. Update Uplan-G optimization model with any new or revised resource input assumptions to create the Revised Base Case.

5. Use the optimization model to determine the optimal resource-acquisition and dispatch plan for each conservation-adjusted level of demand, under Revised Base Case assumptions, over the entire planning horizon.
6. Run the optimization model with the conservation resource bundles under high and low gas-price scenarios.
7. Run the optimization model with the conservation resource bundles under high and low demand-growth scenarios.
8. Update PSE's long-term gas resource strategy for the impact of the conservation resources on the amount and timing of other supply resource additions.

Update of Modeling Assumptions - Additional Resource: Gig Harbor Satellite LNG Facility

Beginning in the fall of 2003, PSE will supplement its gas-distribution system in the Gig Harbor area with a new, satellite liquid natural gas (LNG) facility. The facility is being constructed to ensure that a remote but rapidly growing region of the distribution system has sufficient gas supply during peak weather events.

The LNG facility is referred to as a "satellite" because it is designed to receive, store, and vaporize LNG that has been liquefied at other LNG facilities. PSE intends to transport the LNG by tanker truck from third-party providers. Because the source of the LNG is outside the PSE distribution system, the Gig Harbor LNG facility represents an incremental supply and thus will be added to the Peak Day resource stack. Although this LNG facility can benefit only that portion of the distribution system adjacent to the Gig Harbor plant, its operation allows gas supply from pipeline interconnects or other storage to be diverted elsewhere. PSE analyzed several options for providing additional high-pressure gas to the Gig Harbor area, including: a new pipeline lateral; an enlarged underwater distribution lateral; purchase of delivery service from another gas utility; compressed natural gas injection facilities; and the satellite LNG facility in Gig Harbor. The specifications of the Gig Harbor facility are shown in Exhibit X-1.

Exhibit X-1

Gig Harbor LNG Facility Capability

On-site Storage capacity	63,000	gallons	or	52,500	therms
(Truck capacity)	9,000	gallons	or	7,500	therms
Sendout - hourly - Max	650,000	cfh	or	6,500	therms/hr
Sendout - hourly - Typical	250,000	cfh	or	2,500	therms/hr
Sendout - daily Max	3,000,000	cfd	or	30,000	therms/dy
Sendout - daily *	1,000,000	cfd	or	10,000	therms/dy
Sendout - annual *	6,000,000	cfy	or	60,000	therms/yr

* Daily & annual numbers are based on a typical winter weather pattern, not design weather conditions.
It will take 7 truck loads to fill the on-site storage each fall.
A typical winter will only need one or two more truckloads to last throughout the winter.
The on-site storage is designed to last 1 design peak day + 2 shoulder days.
Any LNG remaining in storage in the spring will be injected into the distribution system.

Update of Modeling Assumptions – Jackson Prairie Storage Deliverability

The availability of additional underground storage deliverability from the Jackson Prairie facility has been updated to the year 2008 for all scenarios from the 2010 (2008 in High Growth case) assumption in the April 2003 Least Cost Plan. The adjustment to this assumption is based on the revised development expectations of the joint Jackson Prairie ownership group and the assumption that the storage services provided by the incremental deliverability will be competitive in the marketplace.

Update of Modeling Assumptions – Revised Gas Price Forecast

A revised gas-price forecast, including new high and low gas-price scenarios, was utilized in this August 2003 LCP Update, as described in Chapter III.

Levels of Demand Analyzed

The levels of gas demand analyzed in Step 5, above, are the following:

a) The forecasted level of demand from the April 2003 Least Cost Plan, which reflected reduced load resulting from the assumed annual level of 2.1 million therms of annual conservation savings;
b) The level of demand in a) reduced by the achievable conservation potential represented by implementation of all “Low Cost” and “Medium Low Cost” bundles across all customer segments;

c) The level of demand in b) further reduced by the achievable potential from the addition of all "Medium Cost" conservation bundles across all customer segments; and

d) The level of demand in c) reduced by the achievable potential from combinations of individual bundles within each cost category where the entire cost category has proved not to be cost-effective; that is, it has increased the total resource portfolio cost. This will determine the point at which to cease adding bundles of conservation resources to the portfolio.

The application of the demand decrement in level b) to the already lowered demand in level a) suggests a double-counting of the conservation resource effects. However, preliminary results of an ongoing review and evaluation of the assumptions and parameters in the gas-demand forecast underlying the April 2003 Least Cost Plan suggest that this double-counting would be offset by other factors that will have the same impact on system gas demand. The specific offsetting factors and anticipated impact on the gas demand forecast are discussed in Section D, Analysis of Model Results, of this chapter.

C. Analytical Results

For this August 2003 Least Cost Plan Update, PSE analyzed multiple levels of conservation resources. Further, the conservation resource levels were modeled under both high and low gas-price scenarios to determine their cost sensitivity, that is, whether higher or lower projected gas prices would measurably impact the amount of cost-effective conservation resources. The High Price scenario utilizes prices in the NPCC Medium gas-price forecast and the Low Price scenario is equivalent to the PIRA Straight-line gas-price forecast used in the April 2003 Least Cost Plan. Finally, the conservation resources were evaluated under High Growth and Low Growth levels of expected customer demand to evaluate both the impact on the amount of cost-effective conservation resources and on the timing of new supply resource decisions.

Conservation Resource Levels

As indicated in Section A of this chapter, PSE confirmed that all the bundles of conservation resources in the cost categories A (Low Cost) and B (Medium Low Cost) would be cost-effective. This was verified with the two UPlan-G model runs shown in

Exhibit X-2. A comparison was made of the Revised Base Case, the Net Present Value (NPV) of the supply portfolio at full customer-demand levels, with Case AB, which is the sum of the NPV of supply portfolio costs (including conservation resources in categories A and B). The level of customer demand, after reflecting the volume decrement and load shapes of conservation measures in categories A and B, indicates the combined NPV of supply plus conservation ($5,589.02 million) at this level of demand is less than the NPV of supply-only resources ($5,682.19 million). However, when the level of demand is further reduced by the achievable potential from the addition of all "Medium Cost" conservation bundles (Case ABC), the NPV of the total portfolio increases to $5,591.61 million. At this point in the analysis, Medium Cost category C must be disaggregated to determine which combination of the nine bundles of conservation resources will not increase the NPV of the total portfolio cost above the level of categories A and B. The NPV of the total portfolio cost that resulted from this process is shown as Case AB+X in Exhibit X-2 ($5,588.64 million). The customer segment and conservation bundle combinations that satisfy this requirement are shown in Exhibit X-3. When the next higher cost bundle of conservation resources is added from category C (Case AB+Y), the total portfolio NPV increases to $5,588.69 million.

Exhibit X–2

Summary of Gas Portfolio Revised Base-Case Analysis Results

Model Run	Total NPV ($MM)	Supply Portfolio NPV ($MM)	Conservation NPV ($MM)	20 Year Firm Sales Dth (MM)	20 Year Conservation Dth (MM)	Annual Conservation Increment (MM therms)
Revised Base Case	$5,682.19	$5,682.2	$0.0	1,995.3	0.0	0.00
Case AB	$5,589.02	$5,529.6	$59.4	1,933.6	61.7	2.94
Case ABC	$5,591.61	$5,479.8	$111.8	1,910.1	85.2	4.05
Case AB+X	***$5,588.64***	***$5,524.1***	***$64.5***	***1,930.9***	***64.4***	***3.06***
Case AB+Y	$5,588.69	$5,523.1	$65.5	1,930.4	64.8	3.09

Exhibit X–3

Cost-Effective Gas Conservation Potentials

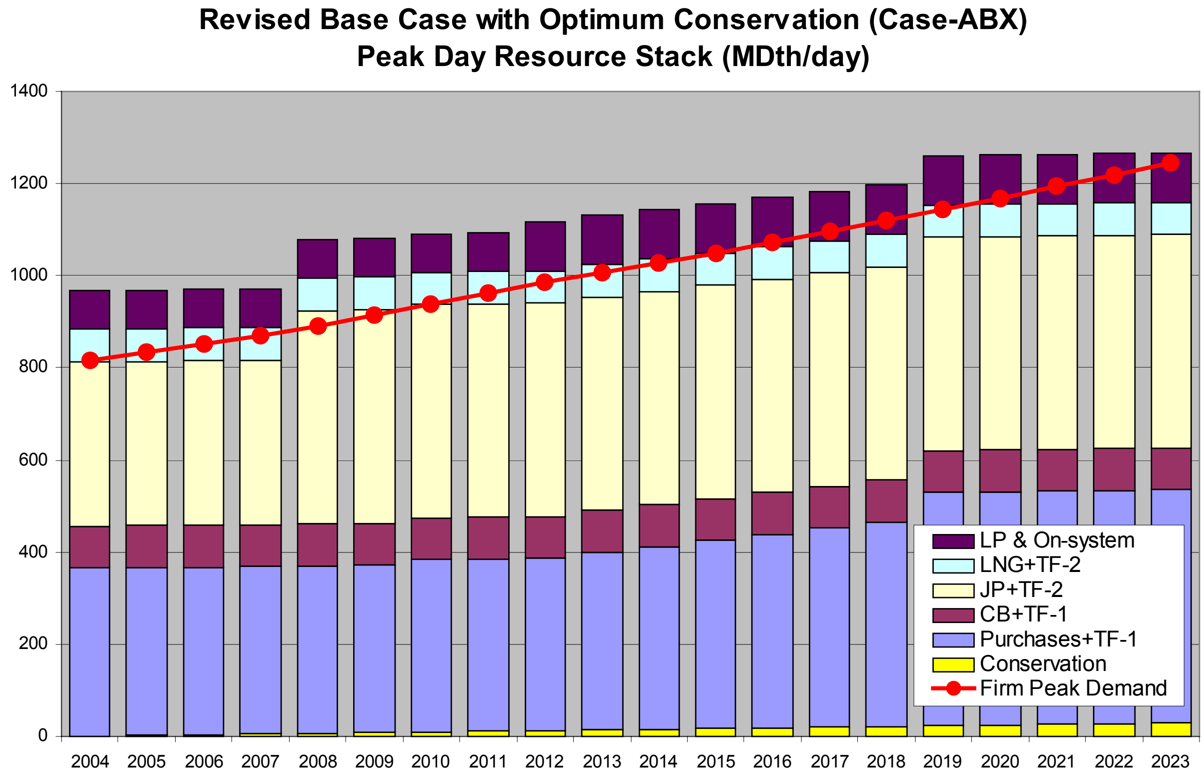
by Resource Bundle and Segment – Case AB-X

Bundle/Segment	**A** Low Cost (</=$0.3/ therm)	**B** Medium Low Cost ($0.3-0.45/therm)	**C** Medium Cost ($0.45-0.65/therm)	**D** Medium High Cost ($0.65-1.00/therm)	Total Cost-Effective Achievable Potential in 20th year (Dth)	Total Cost-Effective Achievable Potential-Annual Increment (therms)
Res. Existing Construction - Appliances	-	-	-	-	-	-
Res. Existing Construction - HVAC	2,292,015	485,777	-	-	2,777,792	1,388,896
Res. Existing Construction - Water Heat	389,166	402,822	-	-	791,988	395,994
Res. New Construction - Appliances	-	-	-	-	-	-
Res. New Construction - HVAC	-	-	-	-	-	-
Res. New Construction - Water Heat	-	556,487	-	-	556,487	278,244
Subtotal Residential	2,681,181	1,445,086	-	-	4,126,267	2,063,134
Com. Existing Const. - Appliances	10,310	-	-	-	10,310	5,155
Com. Existing Construction - Cooking	279,629	-	-	-	279,629	139,815
Com. Existing Construction - HVAC	417,348	228,400	-	-	645,748	322,874
Com. Existing Const. - Water Heat	379,030	22,996	230,898	-	632,924	316,462
Com. New Construction - Appliances	1,743	-	-	-	1,743	872
Com. New Construction - Cooking	462	24,138	21,162	-	45,762	22,881
Com. New Construction - HVAC	68,300	1,023	-	-	69,323	34,662
Com. New Construction - Water Heat	70,483	24,224	-	-	94,707	47,354
Subtotal Commercial	1,227,305	300,781	252,060	-	1,780,146	890,073
Ind. Existing Construction – General	222,331	-	-	-	222,331	111,165
Total All Sectors	4,130,817	1,745,867	252,060	-	6,128,744	3,064,372

Revised Base Case

Exhibit X-4 illustrates that the current gas resource portfolio, including the conservation resources discussed above (Case AB+X), has sufficient supply resources to meet the expected demands of PSE's firm-gas customers through 2009. Additional underground storage deliverability is assumed to be available in 2008. After that point in time, pipeline capacity is added in 2010 and from 2013 to 2019, with propane air (LP) added in 2012. As with the April 2003 LCP, the model identifies relatively small increments of pipeline capacity in the years 2013 to 2019. In practice, the required capacity would likely be added in larger, less frequent amounts. The peak-day demand is expected to grow at the same annual rate (2.27 percent) as assumed in the April 2003 LCP and the total firm load served over the 20-year forecast period remains at 2.2 Tcf, including interruptible loads.

Exhibit X–4



Low and High Gas Price Scenarios

The Low Gas Price scenario uses the PIRA Straight-line gas-price forecast from the April 2003 LCP and the High Gas Price scenario is the NPCC Medium gas-price forecast shown in Exhibit III–8 through Exhibit III-10. These two forecast scenarios (for gas purchased at Sumas, AECO Hub, and the Rockies) are used to evaluate the sensitivity of the conservation resource additions in the Revised Base Case portfolio to changes in gas prices. Exhibit X-5 illustrates the difference between these two gas-price scenarios on the total portfolio cost. The Low Gas Price scenario would call for a reduction of conservation resources of 2.7 MMDth to the level represented by category AB. Additional pipeline capacity would be required one year later than the Revised Base Case, beginning in 2011, and would also postpone the addition of propane air (LP) peaking capacity until 2014. Conversely, the High Gas Price scenario would indicate the need for significant additional conservation resources of 20.8 MMDth over the 20-year planning horizon, represented by the addition of the remaining bundles in category C (Case ABC) as shown in Exhibit X-5. In contrast to the Low Price scenario, incremental LP resources were selected by the model in 2012 and pipeline capacity was added in small increments beginning in 2012 and continuing until 2019. The Peak Day Resource Stacks for the Low and High Gas Price scenarios are shown in Exhibits X-6 and X-7, respectively.

Exhibit X–5

Summary of Gas Portfolio Low and High Gas Price Analysis Results

Model Run	Total NPV ($MM)	Supply Portfolio NPV ($MM)	Conservation NPV ($MM)	20 Year Firm Sales Dth (MM)	20 Year Conservation Dth (MM)	Annual Conservation Increment (MM therms)
Revised Low Price	$5,122.53	$5,122.5	$0.0	1,995.3	0.0	0.00
Case AB- Low Price	***$5,055.33***	***$4,995.9***	***$59.4***	***1,933.6***	***61.7***	***2.94***
Case AB+X- Low Price	$5,055.60	$4,991.1	$64.5	1,930.9	64.4	3.06
Note: No bundles in Conserv.Cost Categories A&B are higher in cost than marginal avoided supply in Case AB.						
Revised High Price	$5,942.75	$5,942.7	$0.0	1,995.3	0.0	0.00
Case AB- High Price	$5,848.97	$5,789.5	$59.4	1,995.3	61.7	2.94
Case ABC- High Price	***$5,847.27***	***$5,735.5***	***$111.8***	***1,995.3***	***85.2***	***4.05***
Case ABCD- High Price	$5,871.43	$5,664.8	$206.6	1,995.3	113.3	5.39
Note: No bundles in Conservation Cost Category D are lower in cost than marginal avoided supply in Case ABC.						

Exhibit X–6

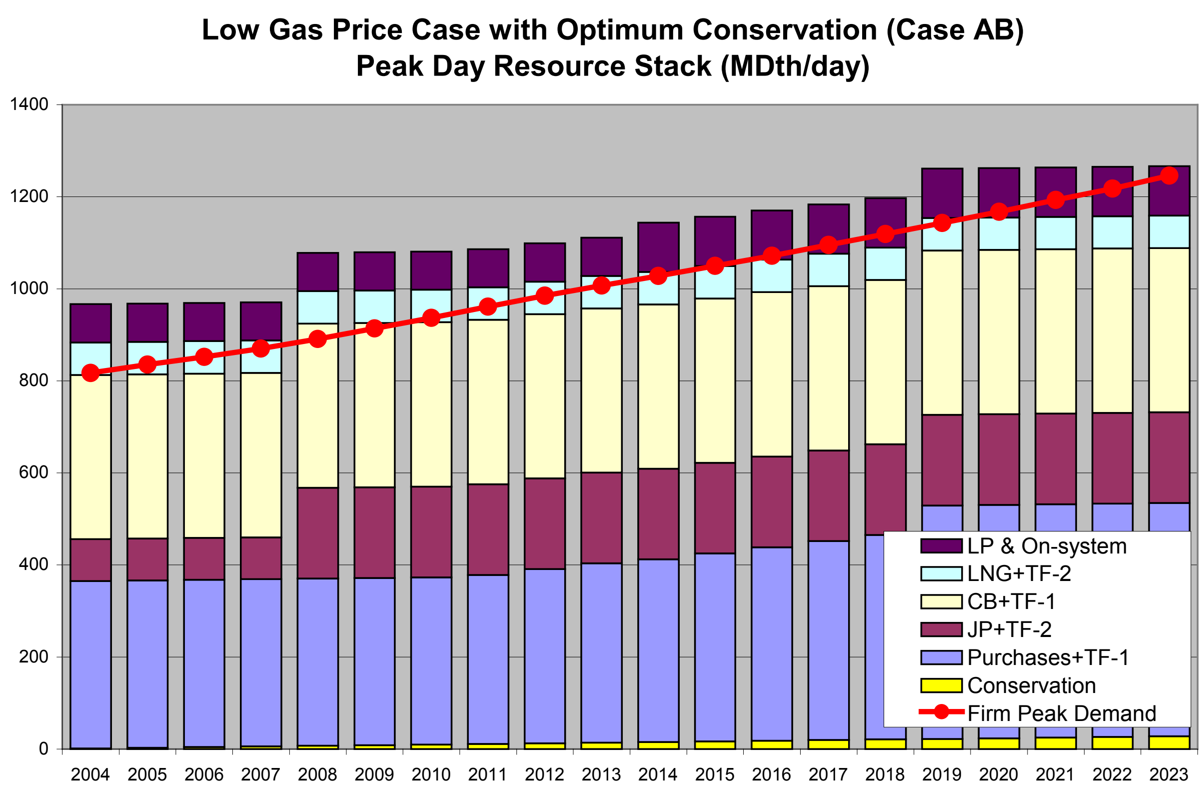
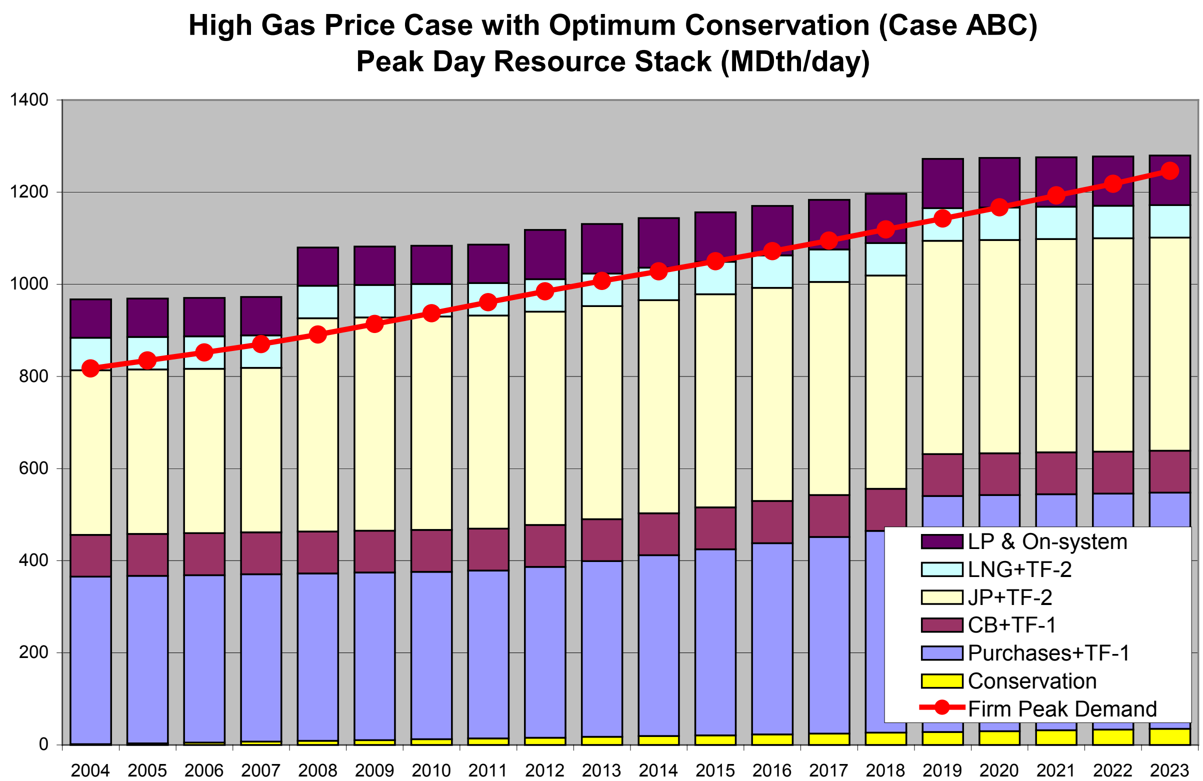


Exhibit X–7



High Growth and Low Growth Scenarios

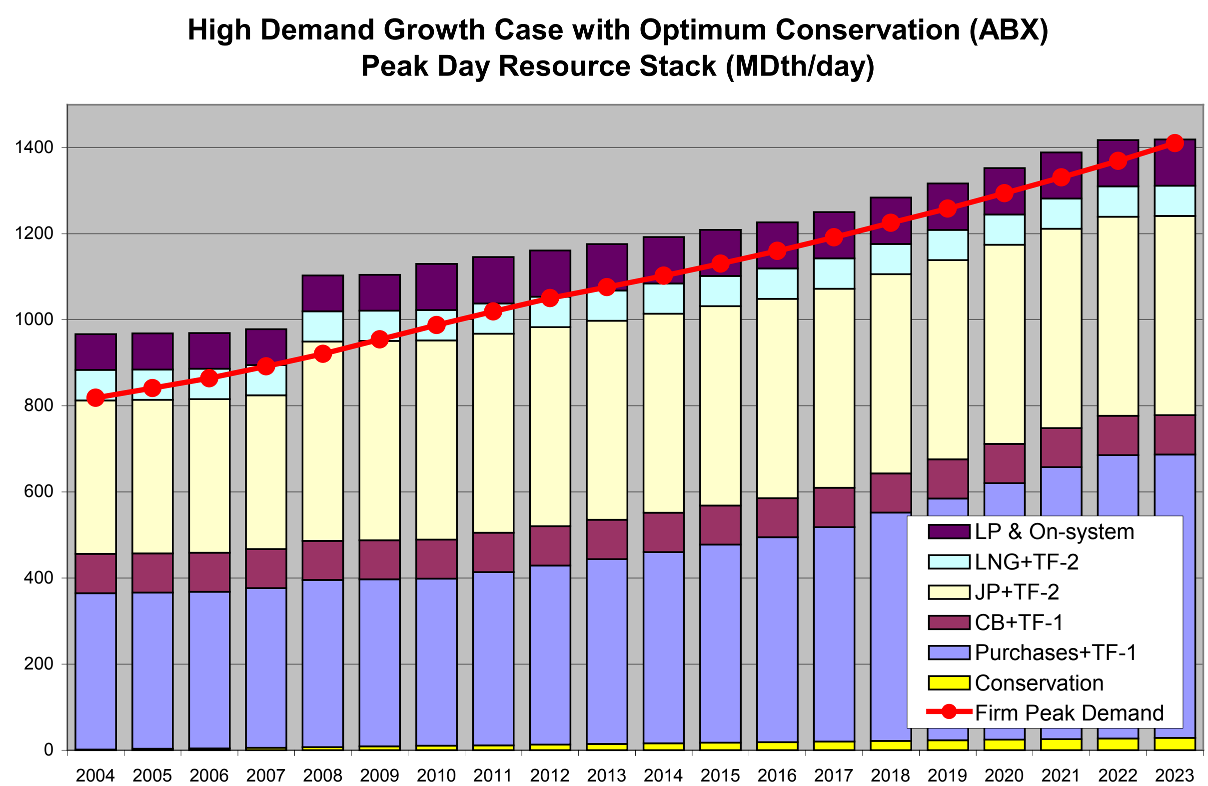
The same High Growth and Low Growth scenarios from the April 2003 LCP were utilized to evaluate the sensitivity of the conservation resources and the timing of new supply resource decisions in the Revised Base Case portfolio relative to changes in demand growth. Exhibit X-8 illustrates the impact on the amount of cost-effective conservation resources under the High Growth scenario. Peak-day demand is expected to grow at an annual rate of 2.89 percent, from 819 MDth/day in 2004 to 1,411 MDth/day in 2023. Despite the higher growth rate, no additional conservation resources were selected over the level of the Revised Base Case (Case AB-X). As shown in Exhibit X-9, the remainder of the current supply portfolio has sufficient resources to meet the increased growth until 2007. Beginning at that time and continuing nearly every year for the balance of the planning horizon, small increments of pipeline capacity are added to the portfolio, followed by the addition of 106 MDth/day to Jackson Prairie deliverability in

2008, and 24 MDth/day of LP capacity in 2010. The total load served by this portfolio over the forecast period remains at the April 2003 LCP High Growth level of 2.4 Tcf.

Exhibit X–8
Summary of Gas Portfolio High Growth Analysis Results

Model Run	Total NPV ($MM)	Supply Portfolio NPV ($MM)	Conservation NPV ($MM)	20 Year Firm Sales Dth (MM)	20 Year Conservation Dth (MM)	Annual Conservation Increment (MM therms)
Revised High Growth	$6,104.50	$6,104.5	$0.0	2,153.3	0.0	0.00
Case AB+X- High Growth	***$6,023.71***	***$5,959.2***	***$64.5***	***2,089.0***	***64.4***	***3.06***
Case AB+Y- High Growth	$6,023.78	$5,958.2	$65.5	2,088.5	64.8	3.09
Case ABC- High Growth	$6,027.00	$5,915.2	$111.8	2,068.2	85.2	4.05
Note: No additional bundles in Conserv.Cost Category C are lower in cost than marginal avoided supply in Case ABX.						

Exhibit X–9



The Low Growth scenario models a significantly lower growth in annual and peak-day gas demand. Under this scenario, the peak-day demand is expected to grow at an annual rate of 1.60 percent, from 818 MDth/day in 2004 to 1,132 MDth/day in 2023. Exhibit X-10 illustrates the impact on the amount of cost-effective conservation resources under this Low Growth scenario and Exhibit X–11 shows the related impact on the timing of incremental supply resources. Under the lower growth rate, the same level of conservation resources as in the Revised Base Case (64.4 MMDth) was selected. As modeled, the remainder of the current supply portfolio, following the addition of Jackson Prairie deliverability in 2008, has sufficient resources to meet the reduced growth until 2014. At that time, 24 MDth/day of LP capacity is added, followed by pipeline capacity in 2017-2020, as shown in Exhibit X-11. The total load served by this portfolio over the forecast period remains at the April 2003 LCP Low Growth level of 2.1 Tcf, including interruptible volumes.

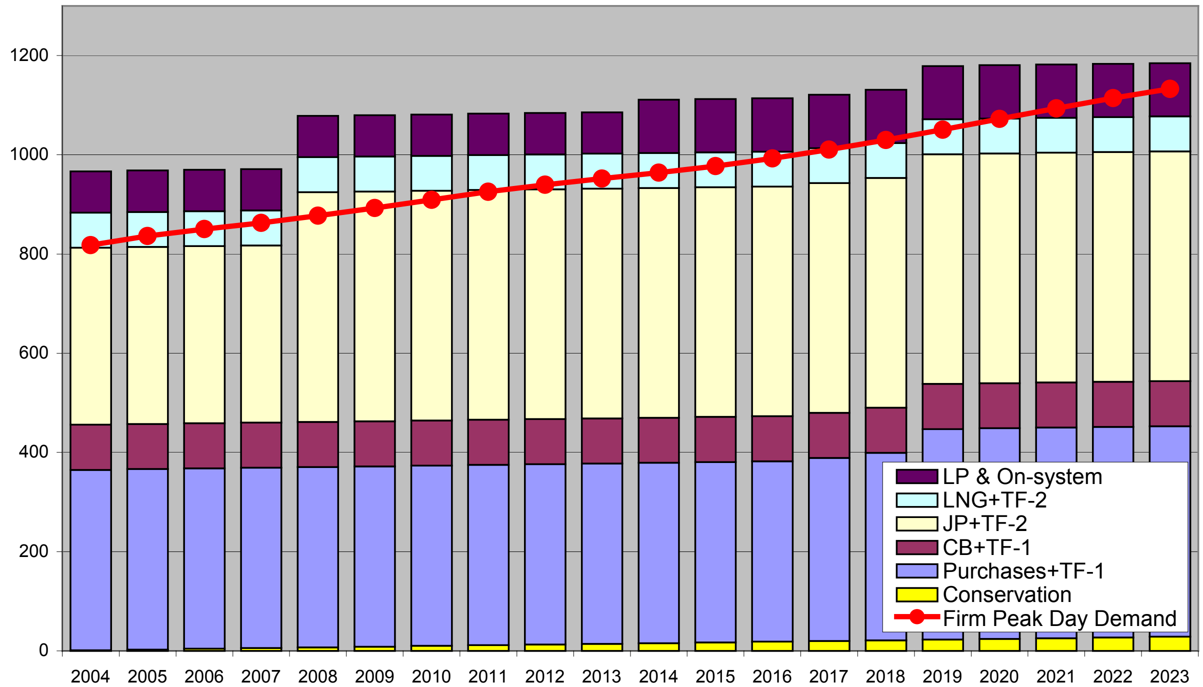
Exhibit X–10

Summary of Gas Portfolio Low Growth Analysis Results

Model Run	Total NPV ($MM)	Supply Portfolio NPV ($MM)	Conservation NPV ($MM)	20 Year Firm Sales Dth (MM)	20 Year Conservation Dth (MM)	Annual Conservation Increment (MM therms)
Revised Low Growth	$5,299.01	$5,299.0	$0.0	1,848.9	0.0	0.00
Case AB- Low Growth	$5,224.04	$5,164.6	$59.4	1,787.1	61.7	2.94
Case AB+X- Low Growth	***$5,223.74***	***$5,159.3***	***$64.5***	***1,784.4***	***64.4***	***3.06***
Case ABC- Low Growth	$5,228.93	$5,117.1	$111.8	1,763.6	85.2	4.05
Note: No additional bundles in Conserv.Cost Category C are lower in cost than marginal avoided supply in Case ABX.						

Exhibit X–11

Low Demand Growth Case with Optimum Conservation (ABX)
Peak Day Resource Stack (MDth/day)



D. Analysis of Model Results

Implications from Gas Load Forecast

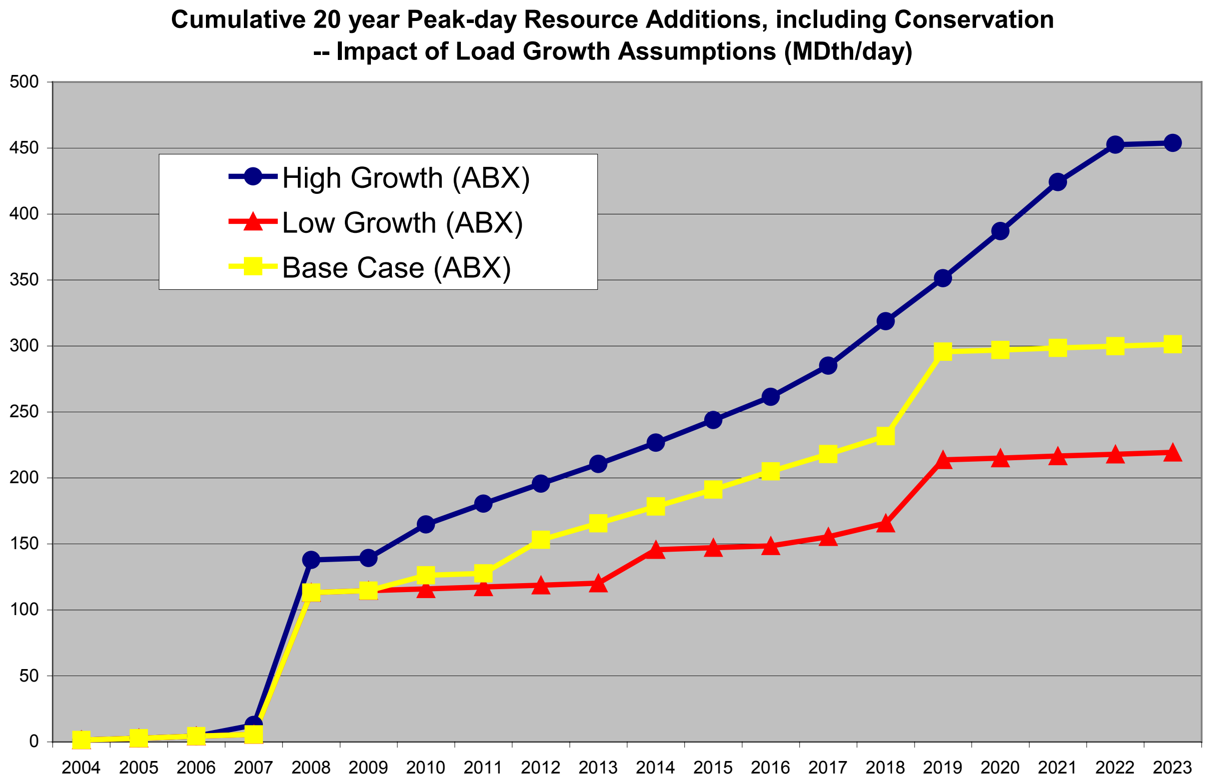
As indicated in Chapter III, the gas-load forecast for the August 2003 LCP Update remains unchanged from the version used in the April 2003 LCP. Assumptions underlying this gas-load forecast included an assumed level of 2.1 million therms of new conservation savings (or 0.3 percent of total billed sales) occurring every year. The distribution of the conservation savings among the customer sectors attributed 20 percent of the total savings to the residential sector, with the commercial and industrial sectors accounting for 60 percent and 20 percent, respectively. The application of the demand decrements for conservation resources modeled in the current LCP Update to the already lowered demand levels in the April 2003 LCP suggests a double-counting of the conservation resource effects will result. However, preliminary results of the ongoing review and evaluation of the economic assumptions and pricing parameters underlying the gas-demand forecast suggest that this double-counting would be more than offset by other factors having the same directional impact on forecasted system gas demand.

The specific offsetting factors are long-term projections for lower employment levels and lower population growth as well as the impact of higher retail gas rates stemming from increased gas costs. The resulting anticipated impact of the upcoming version of the gas-demand forecast approaches the impact represented by the Low Growth scenario modeled in Section C, above. It should be noted that a reduced long-term demand forecast would likely result in a lower estimate of achievable conservation resource potential as the conservation assessment is based in part on expected new customer growth.

Sensitivity Analysis and Impact of Conservation Resource Additions

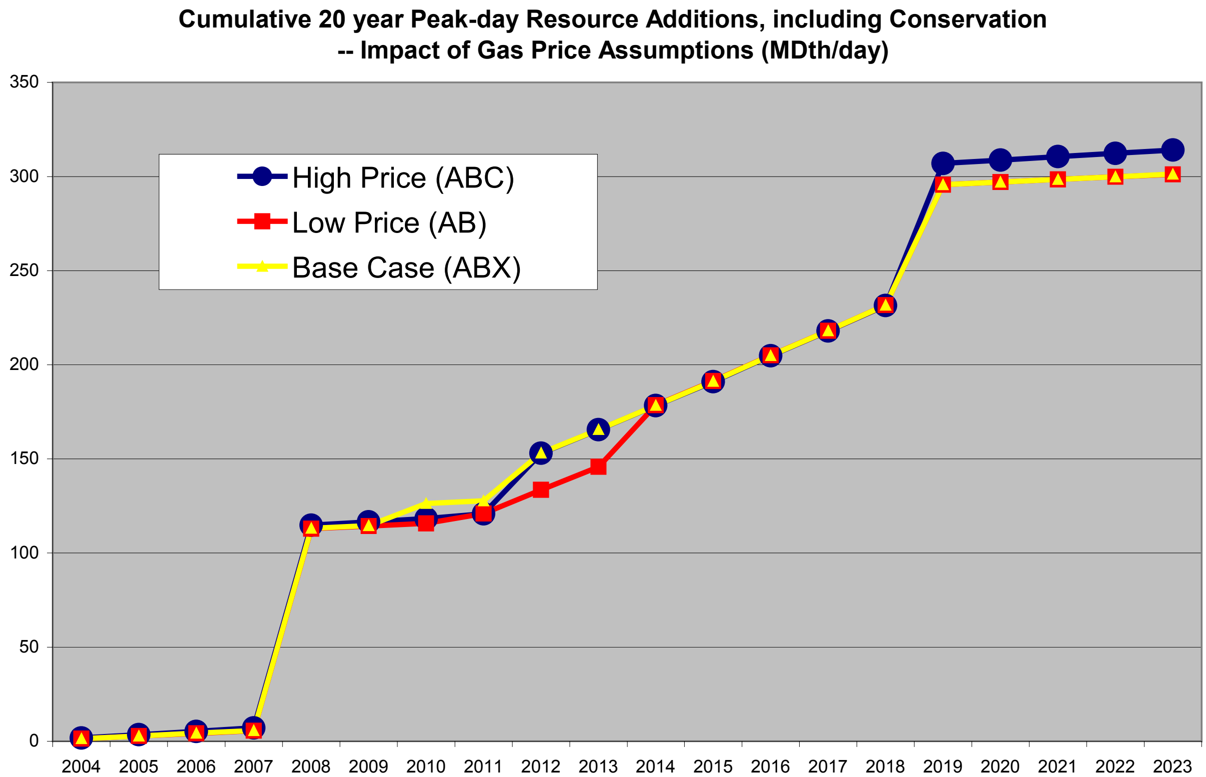
As described in Section C, above, the optimal level of cost-effective conservation resources in the Revised Base Case (Case AB-X) is 64.4 MMDth over the 20-year planning horizon, or an annual increment of 3.06 MDth per year, at a first-year cost of $4.8 million. The sensitivity of the modeled results to volatility in gas prices is much greater than the impact of variations in customer-demand growth. The spread of optimal conservation potential due to gas-price variability is 23.5 MMDth. Whereas, the level of optimal conservation resources remains unchanged under a lower customer-growth scenario, one not dissimilar from the level of gas demand expected under more current demand forecasting parameters. The sensitivity analysis indicates that only in the case of a significant increase in gas prices, to the level of the NPCC's Medium gas-price forecast, would a dramatic departure from the level of gas conservation resource additions in the Revised Base Case be warranted. The graphs in Exhibits X–12 and -13 depict the impact of load growth and gas-price assumptions on the cumulative peak-day resource additions, including conservation, by year for the Revised Base Case.

Exhibit X–12



Cumulative 20 year Peak-day Resource Additions, including Conservation
-- Impact of Load Growth Assumptions (MDth/day)
500
450
400
350
300
250
200
150
100
50
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
High Growth (ABX)
Low Growth (ABX)
Base Case (ABX)

Exhibit X–13



E. Summary and Conclusions

In this August 2003 LCP Update, PSE expanded its gas resource portfolio analysis to incorporate a robust evaluation of various bundles of conservation resources with similar load shapes, at their corresponding cost levels, to determine an optimal level of annual conservation potential across all three customer segments. The portfolio model results were reported for the various cost levels and compared in terms of the NPV of each resulting supply portfolio. The evaluation included a sensitivity analysis of the optimal level of annual conservation potential to changes in assumptions about future demand growth and gas prices. The optimal level of cost-effective conservation resources determined in this LCP Update is an annual increment of 3.06 million therms, growing to a 61.3 million therm impact in the 20th year, for a total 64.4 MMDth over the 20-year planning horizon.

While long-term gas prices may influence the level of cost-effective conservation resources, gas price has little impact on the timing of supply-side resource acquisitions.

Conversely, demand growth has little or no impact on cost-effective conservation levels. However, demand growth has a significant and direct impact on the timing of supply-side resources.

Consistent with the conclusions reached in the April 2003 LCP, no supply-side resource-acquisition decisions are required for several years. In the interim, PSE continues to face little risk as a consequence of higher-than-expected growth. If the high-growth scenario materializes, then required resource additions may be accelerated by two to three years.