XIV. NATURAL GAS ANALYSIS AND RESULTS

Overview

This section will provide a high-level summary of the primary analysis performed to support the gas resource plan. PSE's plan goes beyond the typical examination of how different load growth and gas price scenarios affect the optimal future resources needed to serve the Company's gas sales customers. Rather, this plan includes a benefit-cost analysis to determine the optimal peak-day planning standard. Additionally, this plan includes PSE's first application of its long-term gas planning analytical framework (traditionally used to optimize the long-term gas sales or "LDC" portfolio) to its long-term gas for generation fuel portfolio. Also, PSE used this same framework to investigate possible economies of scale and scope to joint planning for gas sales load and generation fuel, relative to planning for them separately. Finally, PSE examined the impact of price and weather uncertainty by applying a Monte Carlo approach using the Company's new resource planning models.

Summary of Key Analytical Results—LDC Analysis

- Higher gas prices relative to the last Least Cost Plan indicate PSE should consider expanding its level of natural gas energy efficiency programs.
- PSE should work with Jackson Prairie co-owners to expand deliverability and work with Northwest Pipeline to obtain seasonal delivery rights similar to today's TF-2 service.
- PSE should consider acquiring additional upstream capacity on Westcoast from Station 2, although maintaining diversity of supply from AECO is an important qualitative factor for consideration.
- Additional load from a fuel conversion program does not appear to put upward pressure on average gas costs to existing customers.
- Monte Carlo analysis to examine physical supply risk indicates that a portfolio designed to meet PSE's design-day peak forecast, in an otherwise normal temperature winter, is sufficient to meet its obligations under a variety of possible winter conditions.
- With regard to cost risk, the 20-Year Monte Carlo analysis demonstrates that viewing risk over a 20-year horizon tends to mute the effects of price and volumetric

variability. Shorter time periods, such as annual variability, should be considered when examining the impact of different resources on cost variability.

- Monte Carlo analysis on optimal portfolio construction highlights that the timing of certain resource additions is highly sensitive to Base Case assumptions.

Key Results from Generation Fuel Analysis

- Based on electric Business as Usual gas-fired generation resources, PSE's gas portfolio for power generation appears to have sufficient firm Northwest Pipeline capacity through 2009.
- Like the sales portfolio, additional upstream transportation capacity to Station 2 may need to be acquired as gas producers and marketers hold less capacity on Westcoast to move gas south to Sumas.

Key Result from Joint LDC and Generation Fuel Analysis

- Analysis showed potential savings of approximately 1 percent per year on an annualized basis relative to the combined stand-alone portfolio costs, a large portion of which would be achievable through short-term optimization without significant changes in long-term planning.

Roadmap for Chapter XIV

Section A describes the benefit-cost analysis PSE performed to determine its primary planning standard—the design peak day planning standard. This analysis provides the basis for the 20-year gas sales load forecast peak-day demand that the Company will plan to meet. Section B presents the Company's estimated need for resources over the next 20 years for gas sales load, based on comparing the design peak day demand forecast with the Company's current resources. Section C presents an overview of PSE's new planning tools. Section D describes the various optimization analyses and scenarios the Company considered for gas resource planning. Section E provides an overview of the input assumptions and the potential resources that were modeled. In addition, this section describes the various gas resource planning and uncertainty analyses performed. Finally, Section F provides an overview of analytical results, and section G summarizes the conclusions of the analysis.

A. Planning Standard

In its 2003 Least Cost Plan, PSE changed its gas supply peak-day planning standard from 55 heating degree days (HDD)[1], which is equivalent to 10 degrees Fahrenheit or a coldest day on record standard, to 51 HDD, which is equivalent to 14 degrees Fahrenheit or a coldest day in 20 years standard. The Washington Utilities and Transportation Commission (WUTC) responded to the 2003 plan with an acceptance letter directing PSE to “analyze” the benefits and costs of this change and to “defend” the new planning standard in the 2005 Least Cost Plan.

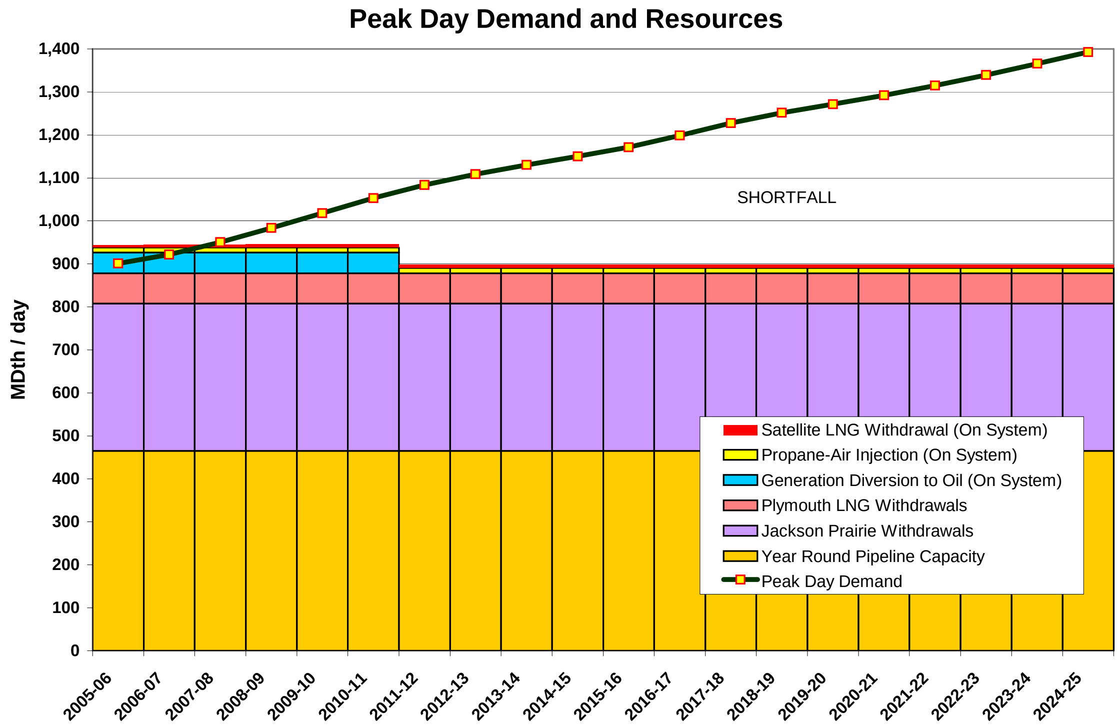
PSE has completed a detailed, stochastic cost-benefit analysis that considers both the value customers place on reliability of service and the incremental costs of the resources necessary to provide that reliability at various temperatures. Based on the analysis, described in more detail in Appendix I, PSE has determined that it would be appropriate to increase its planning standard from 51 HDD (14 F) to 52 HDD (13 F). PSE’s Gas Planning standard is based on a detailed cost/benefit analysis that relies on the value attributed to reliability by PSE’s natural gas customers. As such, it is unique to that customer base, service territory and the chosen form of energy.

B. Resource Need

As described more completely in Chapter XII, PSE currently has adequate resources to meet its design standard for the next two winters. Additional “deliverability” in the form of energy efficiency and supply-side resources will be needed to accommodate forecasted customer demand growth and the loss of certain resources over the planning horizon.

[1] The concept of heating degree days (HDD) was developed by engineers as an index of heating fuel requirements. They found that when the daily mean temperature is lower than 65 degrees, most buildings require heat to maintain an inside temperature of 70 degrees. Thus, an HDD number represents the following equation: 65 – the average daily temperature = HDD.

Exhibit XIV-1



C. Optimization Analysis Tools

PSE has enhanced its ability to model gas resources for long-term planning and long-term gas resource acquisition activities since the 2003 Least Cost Plan and Update were filed. The Company acquired SENDOUT® and VectorGas™ from New Energy Associates in August of 2004. SENDOUT® is a widely used model that helps identify the long-term least cost combination of resources to meet stated loads using a linear programming model. The model determines the portfolio of resources that will minimize costs over the planning horizon, based on a set of assumptions regarding resource alternatives, resource costs, demand growth, and gas prices. SENDOUT® has the capability to integrate demand side resources alongside supply-side resources in determining the optimal resource portfolio. The linear programming approach is a helpful analytical tool to help guide decisions, but it is important to acknowledge this technique provides the model with "perfect foresight," meaning the theoretical results would not really be achievable. For example, the model knows the exact load and price for every day throughout a winter period, and can therefore minimize cost in a way that would not be possible in the real world. Real world decisions must be made where numerous critical factors about the future will always be uncertain. Linear programming analysis provides helpful but not perfect information to guide decisions.

Because decisions must be made in the context of uncertainty about the future, PSE acquired VectorGas™ along with SENDOUT®. VectorGas™ is an add-in product that facilitates the ability to model gas price and load (driven by weather) uncertainty into the future. VectorGas uses a Monte Carlo approach in combination with the linear programming approach in SENDOUT®. This additional modeling capability will provide additional information to decision-makers under conditions of uncertainty. These new tools provide valuable enhancements to the robustness of the Company's long-term resource planning and acquisition activities. See Appendix H for a more complete description of SENDOUT® and VectorGas™, as well as details of the various modeling inputs.

D. Scenarios and Cases

Scenario analysis is a useful method to examine the implications of uncertainty, especially in long-term resource planning. Gas planning scenarios are summarized in Exhibit XIV-2 and discussed further in the sections below.

The goal in developing scenarios was to explore the impact of possible alternative futures on PSE's optimal gas resource portfolio. The gas planning scenarios differ from those used in the electric planning process only in that PSE did not include a gas case comparable to the electric Current Momentum scenario. The gas scenario Base Case should be viewed as the companion to both the Business As Usual and Current Momentum electric scenarios. The gas Green World is based on the same gas price forecast as the electric Green World. Gas price assumptions between electric Robust Growth and the gas Strong Economy are the same, as are gas price assumptions for the electric Low Growth and gas Weak Economy. Additionally, alternative demand forecasts include high load growth for Strong Economy (like electric Robust Growth) and a low load growth scenario in Weak Economy (like electric Low Growth). These alternative gas demand forecasts reflect differences in the growth in customer counts over time. Additionally, the alternative demand forecasts reflect different patterns in use per customer. Additional information on demand forecasts can be found in Chapter VI. An additional gas demand scenario was examined in the fuel conversion case, which adds gas load results from the electric to gas fuel conversion to the Base Case to determine whether a fuel conversion program could have an adverse affect on average gas costs.

The alternative gas price forecasts used in the gas planning scenarios represent a wide range of potential future price paths. As mentioned in the gas price forecast (Chapter V), PSE cannot disclose the specific gas prices used in its Least Cost Plan analysis. However, the spread between the high gas price forecast (CERA's Shades of Green scenario) and the low gas price forecast (CERA's World in Turmoil scenario) is more than three times greater than the range in the EIA-based AECO price scenarios shown in Exhibit V-2 (see Chapter V).

Exhibit XIV-2
Gas Resource Planning Scenarios

		Theme	Gas Demand	Gas Prices
Gas LDC	**Base Case**	Current trends continue.	Base case customer growth and use/customer.	Mid-Prices: CERA Rearview Mirror scenario
	Fuel Conversion	Current trends continue.	Base case customer growth and use/customer + Fuel Conversion loads.	Mid-Prices: CERA Rearview Mirror scenario
	Green World	National gas demand driven up, driving up prices.	Base case customer growth and use/customer.	High Prices: CERA Shades of Green scenario
	Strong Economy	Local economy grows faster than expected.	High customer growth rate and higher use/customer.	Mid-Prices: CERA Rearview Mirror scenario
	Weak Economy	Low regional and national economy.	Low customer growth rate and lower use/customer.	Low Prices: CERA World in Turmoil scenario
Joint Gas Planning	**Gas for Generation Fuel**	Electric Business as Usual.	Generation demand from Electric Business as Usual	Mid Prices: CERARearview Mirror scenario
	Joint LDC + Generation Fuel	Gas: Base Case Electric: Business as Usual.	Gas: Base Case Electric: Business as Usual.	Mid Prices: CERA Rearview Mirror scenario
	Economies of Scale/Scope	Compare results of gas LDC Base Case plus Gas for Generation Fuel with Joint LDC + Generation Fuel analysis.		

D.1. Gas Sales (LDC) Scenarios

Static Optimization Analysis

As noted above, five gas sales scenarios were considered to examine the impact of different future demand and gas price scenarios on resource planning. The key to using scenario analysis is to understand how different resources will perform across a variety of conditions. Scenario analysis clarifies the robustness of the optimality of a particular strategy. That is, scenario analysis will help identify if a particular strategy is reasonable only under a unique set of future circumstances.

Monte Carlo Analysis on Base Case Portfolio

This is the first Least Cost Plan in which PSE has used Monte Carlo analysis in conjunction with gas resource planning. Two kinds of Monte Carlo analysis were performed to test different dimensions of uncertainty. The first Monte Carlo analysis was performed to test how a specific portfolio will perform under uncertain price- and temperature-induced demand uncertainty. The portfolio used in this analysis was the resulting optimal portfolio derived from the static Base Case analysis. Analysis of this kind, examining the performance of a specific scenario is helpful to examine financial and physical risk. First, the analysis provides an estimate of cost variability. This can be particularly helpful when comparing two portfolios with similar expected costs, but different resulting cost risk profiles, which would not be evident in the traditional static analysis.

Performing Monte Carlo analysis on the optimal Base Case portfolio to examine physical risk is also helpful. The static optimal portfolio is determined by minimizing the cost of meeting the Company's design-day planning standard. Monte Carlo analysis can help examine the robustness of this optimal portfolio in meeting a variety of loads driven by possible different winter temperature patterns. Thus, Monte Carlo analysis will be helpful in determining whether PSE should consider adding additional dimensions to its gas planning standard in addition to design peak day and otherwise normal weather.

Monte Carlo analysis on the Base Case portfolio was performed using 200 different daily price and temperature scenarios—or draws—for the 20-year planning horizon. The starting point for each price draw was the CERA Rearview Mirror prices. Prices and weather are related in the underlying analysis that generates the scenario for each draw. Details of SENDOUT and VectorGas are included in the technical appendix.

Monte Carlo Analysis Including Resource Optimization

The Monte Carlo analysis described above locked in the optimal resources from the static Base Case analysis to examine how that portfolio will perform physically and financially. The other way PSE used Monte Carlo analysis was to examine the robustness of the optimal portfolio resulting from the static Base Case optimization analysis. Analysis to examine sensitivity of the optimal portfolio was performed by creating 100 scenarios of daily prices and demands for 20 years, then calculating the optimal portfolio to meet each of the 100 scenarios. CERA's Rearview Mirror gas prices were again the starting point for prices underlying this analysis. This analysis generates probability distributions for each of the potential resource additions. Using just the static analysis, it is easy to over-emphasize the importance of determining the "optimal" portfolio. Results of the resource optimization Monte Carlo analysis will provide useful information about how sensitive resource additions in the Base Case optimal portfolio are to the specific price and demand assumptions underlying the Base Case scenario.

D.2. Generation Fuel Planning

Analysis for long-term generation fuel planning was performed using Sendout, in a manner similar to planning for LDC sales load. Gas fuel requirements of the Business as Usual electric scenario were used to run the long-term optimization analysis. These requirements were taken from the Company's Portfolio Screening model. As the portfolio screening model reports monthly gas volumes, the volumes were spread to a daily basis by dividing the gas consumed each month by the total gas consumed if the unit operated 24 hours, to determine the number of full-run days. Those full-run days were assigned to days with the highest imputed market-clearing heat rate. This analysis was the first step in applying the same analytical rigor to optimizing resources to meet generation fuel needs, as is applied to the sales portfolio. Note this is not a financial risk management exercise, but a way to identify the least-cost method to get gas to the generating plants. Static analysis was performed using Sendout. Stochastic analysis using Vector Gas is an ideal application and one the Company plans to pursue. PSE will work to develop modeling techniques that can simulate uncertainty in the daily gas fuel-for-generation demand that are compatible with Vector Gas.

D.3. Joint LDC-Generation Fuel Planning

A joint LDC and Generation Fuel planning analysis was conducted for this Least Cost Plan. To perform this analysis, the gas LDC and generation fuel portfolios were combined, and future demand projections for LDC sales and generation fuel were combined. Sendout was then used to identify the optimal set of long-term resources to meet the combined gas demands. The existence of potential economies of scale and/or scope that could potentially reduce costs for both gas and electric customers were investigated by comparing the 20-year net present value cost of the combined portfolio with the summation of the 20-year net present value costs of the optimal gas Base Case and optimal generation fuel results.

E. Resource Alternatives

Sendout was used to identify the optimal portfolio in each scenario. Supply-side and energy efficiency resource alternatives were generally consistent across the scenarios. Energy efficiency programs were consolidated slightly differently across scenarios, to focus the optimal efficiency analysis on the most relevant programs. For example, in the Green World scenario, PSE tested higher-cost efficiency programs than were rejected in the Base Case, as the higher Green World gas prices may have justified higher-cost efficiency programs. The gas planning process differs from the electric process in that there are no competing alternate portfolio approaches to consider. After energy efficiency programs, there is only one choice of supply—purchased natural gas. The gas planning analysis thus necessarily focuses on where to buy it, how to transport it to customers and whether or not to store some along the way. The following tables summarize the supply- and demand-side alternatives considered in the analyses.

E.1. Resource Alternatives—Gas Supply

Exhibit XIV-3
Gas Supply Alternatives

Resource	Scenario Considered	Notes
Northern LNG Import interconnected with Westcoast Pipeline	All	Flows over Westcoast T-South transport to Sumas and then on existing or incremental NWP capacity to PSE.
Southern LNG Import interconnected with NWP, south of PSE service territory	All	Flows over NWP, North to PSE on incremental transport capacity.
Conventional Gas Supply purchase contracts	All	Current contracts modeled for term then to monthly spot market. Sumas spot supplies assumed shrinking. Supply at Station 2 growing. AECO and Rockies supplies assumed to be sufficient.

E.2. Resource Alternatives—Transportation

Exhibit XIV-4
Transportation Alternatives

Resource	Scenario Considered	Notes
Direct Connect Pipeline		
Northwest Pipeline- Sumas to PSE	All	Several potential dates for capacity offered. New expansion capacity and existing surplus capacity were considered.
Seasonal storage related transport to JP similar to TF-2.	All	Northwest has indicated it does not plan to offer additional TF-2 service, but a displacement-reliant service with similar pricing may be available.
Northwest Pipeline incrementally priced new capacity from LNG import facility south of PSE service territory	All	To match up with assumed LNG import terminal south of PSE service territory
Upstream Pipeline		
Station 2 to Sumas	All	Several potential dates for capacity offered.
AECO via Southern Crossing + ANG & NOVA	Initial Base Case analysis.	Analysis showed higher transport cost and gas prices such that Sendout would not select this resource unless Station 2 supply availability was constrained.

E.3. Resource Alternatives—Storage

Exhibit XIV-5
Storage Alternatives

Resource	Scenario Considered	Notes
Jackson Prairie Storage Project deliverability expansion.	All	(along with the ongoing expansion of inventory)
1-3-year LNG peaking storage service contract.	All	Includes firm exchange delivery to PSE.
On-system LNG storage with liquefaction.	All	Injections and withdrawals from and to PSE distribution.
On-system satellite LNG with trucked in supply.	Initial Base Case analysis	Analysis showed higher costs and clearly indicates this is not a good generic resource. Requires local benefits.

E.4. Resource Alternatives—Gas Energy Efficiency Program Bundles

The following program categories from Quantec were examined for cost effectiveness using Sendout. It should be noted that the Sendout optimization model is able to directly compare the costs and benefits of energy efficiency programs with the costs and benefits of supply-side resources simultaneously. This means that in calculating the optimal portfolio, Sendout treats demand-side resources the same as supply-side resources and thus no “screening” step is required.

Exhibit XIV-6
Commercial and Industrial Gas Efficiency Program Bundles

Efficiency Program	Scenario Considered	Levelized Cost
Commercial Programs A-C Baseload + Heat	Resource considered in all scenarios.	$3.20/Dth
Commercial Program Baseload D1 - New Construction.	Base Case, Green World, and Strong Economy. Not considered in Weak Economy because programs rejected in Base Case.	$6.98/Dth
Commercial Program Baseload D2 - Existing Construction.	Base Case, Green World, and Strong Economy. Not considered in Weak Economy because programs rejected in Base Case.	$7.16/Dth
Commercial Heat Program D3 – New Construction.	Resource considered in all scenarios.	$6.69/Dth
Commercial Heat Program D4 – Existing Construction.	Resource considered in all scenarios.	$6.71/Dth
Commercial Heat Program E1 – New Construction	Resource considered in all scenarios.	$7.94/Dth
Commercial Heat Program E2 – Existing Construction	Resource considered in all scenarios.	$8.00/Dth
Commercial Heat Program F1 – New Construction	Resource considered in all scenarios.	$8.67/Dth
Commercial Heat Program G1 + G2 – New and Existing Construction.	Resource considered in all scenarios.	$9.96/Dth
Industrial	Resource considered in all scenarios.	

Exhibit XIV-7
Residential Gas Efficiency Program Bundles

Efficiency Program	Scenario Considered	Levelized Cost
Residential Programs A-C Baseload + Heat	Resource considered in all scenarios.	$3.55/Dth
Residential Baseload program D1 – New Construction	Resource considered in all scenarios.	$6.58/Dth
Residential Baseload Program E1 – Existing Construction	Considered in Base Case, Green World and Strong Economy, not in Weak Economy, as rejected in Base Case.	$8.18/Dth
Residential Heat Program D1 – New Construction	Resource considered in all scenarios.	$6.58/Dth
Residential Heat Program E1 – Existing Construction	Resource considered in all scenarios.	$8.38/Dth
Residential Heat Program F1 – Existing Construction	Resource considered in all scenarios.	$8.87/Dth
Residential Heat Program G1 – Existing Construction	Considered in Base Case, Green World, and Strong Economy, not in Weak Economy, as rejected in Base Case.	$9.83/Dth
Residential Heat Program G2 – New Construction	Considered in Base Case, Green World, and Strong Economy, not in Weak Economy, as rejected in Base Case.	$10.06/Dth

F. Results of Natural Gas Analysis

As described in the scenario section, PSE performed analysis on seven different scenarios. The results are summarized below, followed by more discussion of each scenario. Additional details are provided in Appendix J.

Cautionary Note

Conclusions from this analysis must be considered broadly. Like all analysis, results of the resource optimization models are dependent on input assumptions. Scenario and Monte Carlo analysis help by providing information on ranges of input assumptions. A key input assumption underlying all the analysis in this plan, however, is the ability to add very small units of capacity resources each year. In reality, capacity resources are more incremental than marginal; i.e., resource additions are “lumpy”. For example, PSE’s analysis assumed that small increments of Jackson Prairie storage deliverability could be added each year up to 2012. In reality, the expansion would likely be completed in one full increment. This approach establishes a theoretically optimal schedule of resource additions that will be useful in guiding future resource acquisition activities, and provides results that can be publicly disclosed without unduly disadvantaging the Company's ability to negotiate the lowest-cost arrangements on behalf of customers. However, given the theoretical nature of the optimal portfolio, specific resource acquisitions must be backed up and supported by specific resource acquisition analysis. The Least Cost Plan analysis should be used to guide resource strategies, not justify specific acquisitions.

One specific area to note is how the marginal nature of future capacity resources affects the determination of cost effectiveness for gas efficiency programs. This theoretical analysis assumes that capacity can be added in small, marginal increments. This means that energy efficiency programs are credited with more capacity cost savings in this analysis than would accrue with more realistic lumpy resource additions. Based on preliminary Base Case analysis, the impact on optimal energy efficiency programs could be a result of the difference between an increase in programmatic savings of 40 percent, shown in the marginal analysis, vs. 20 percent, shown in the more realistic case wherein capacity additions are assumed to be more lumpy. Therefore, the proper conclusion from the Least Cost Plan analysis is that the Company should consider significantly increasing its gas efficiency programs, as opposed to increasing its programs by 40 percent. The actual targeted amount of energy efficiency programs should be based on specific analysis, as is the acquisition of other resources.

Key Analytical Results from LDC Scenarios

Results of the four scenarios that focus exclusively on planning for gas local distribution system loads (LDC) are generally consistent and reveal the following general trends:

- More energy efficiency programs appear cost effective given the new higher gas price forecasts. PSE should consider expanding its level of natural gas energy efficiency programs.
- PSE should work with Jackson Prairie co-owners to expand deliverability and work with Northwest Pipeline to obtain seasonal delivery rights similar to today's TF-2 service.
- Given the trend that suppliers will no longer hold as much transportation capacity on Westcoast to deliver gas to Sumas, PSE should consider acquiring upstream capacity. Generally, capacity from Station 2 on Westcoast appears more cost

effective than capacity from AECO on Nova, ANG and Southern Crossing, though diversity of supply concerns are a qualitative factor that should be considered.

- A medium-term peaking resource may be cost effective as a bridge to the full expansion of Jackson Prairie assumed by 2012.
- Additional transportation on Northwest Pipeline from Sumas, along with additional T-South or other upstream capacity will be required over the planning period. PSE should continue to monitor other proposals to bring gas to its market area.
- PSE should monitor developments of regional LNG import facilities. A long-term supply contract with a supplier from this type of facility may be cost effective, dependent on transport costs from a specific location and the basis of the commodity pricing.
- Local LNG storage, LNG satellite and LNG with liquefaction, do not appear to be cost effective generic resources. Like distributed generation on the power side, localized LNG storage may be a cost-effective solution to a specific situation. Cost estimates should be refined and cost effectiveness considered on a case-by-case basis.
- Additional load from fuel conversions does not appear to put upward pressure on average gas costs to existing customers.
- Monte Carlo analysis to examine physical supply risk indicates that a portfolio designed to meet PSE's design-day peak forecast in an otherwise normal temperature winter is sufficient to meet its obligations under a variety of possible winter conditions.
- With regard to cost risk, the 20-Year Monte Carlo analysis demonstrates that viewing risk over a 20-year horizon tends to mute the effects of price and volumetric variability. Shorter time periods, such as annual variability, should be considered when examining the impact of different resources on cost variability.
- Monte Carlo analysis on optimal portfolio construction highlights the fact that timing of certain resource additions are highly sensitive to Base Case assumptions.

Key Results from Generation Fuel Analysis

Two primary results are observed in the gas for generation fuel analysis:

- Based on the electric Business as Usual gas-fired generation resources, PSE's gas portfolio for power generation appears to have sufficient firm Northwest Pipeline capacity through 2009.

- Like the sales portfolio, additional upstream transportation capacity to Station 2 may need to be acquired as gas producers and marketers hold less capacity on Westcoast to move gas south to Sumas.

Summary of Joint LDC and Generation Fuel Analysis

Results of the analysis to test for potential economies of scale and scope to joint planning did not show significant savings opportunity. The analysis showed a potential savings of approximately 1 percent per year on an annualized basis relative to the combined stand-alone portfolio costs, a portion of which would be achievable through short-term optimization without significant changes in long-term planning.

F.1. Results across LDC Scenarios

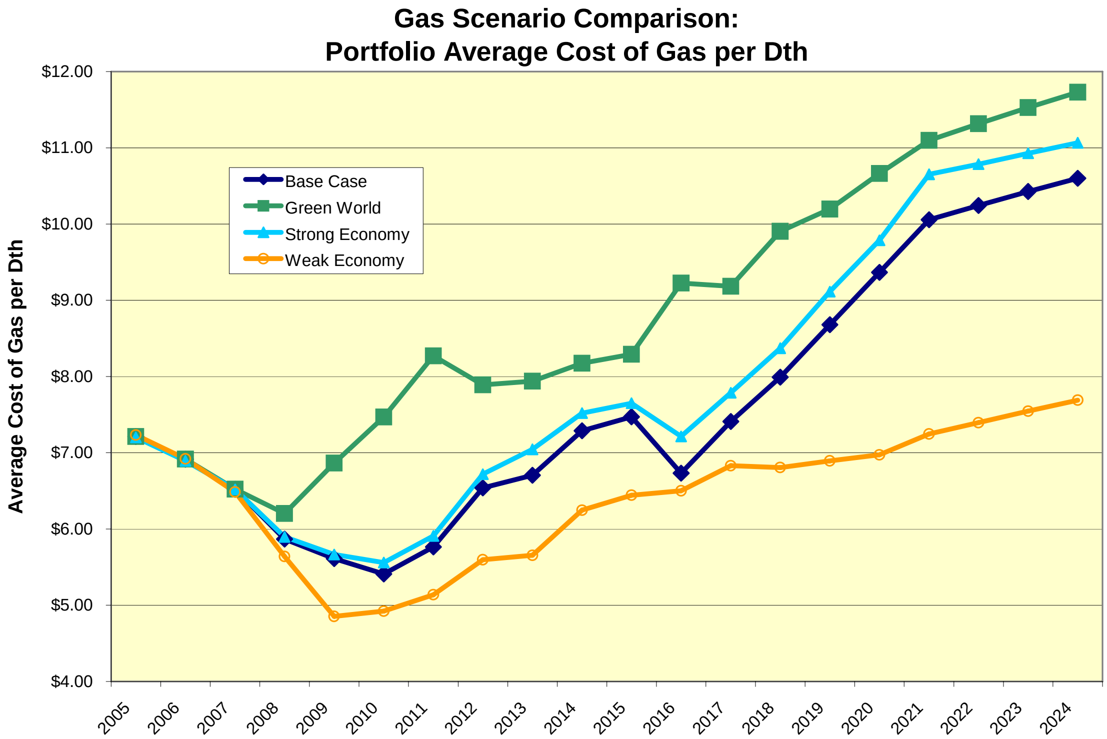
This section will include a comparison of resulting annual average gas costs and a comparison of the relevant differences between resource additions, including energy efficiency programs. Additional details are available in Appendix J.

Comparison of Resulting Average Annual Portfolio Costs

Please note this chart is not a projection of average PGA rates. Costs included here are based on the assumption of highly incrementalized resource availability, which is a theoretical construct. Additionally, costs included in the average portfolio costs include items that are not included in the PGA. These include rate-base related Jackson Prairie storage and costs for energy efficiency programs, which are included on an average levelized basis, not on a projected cash flow basis. Also, please note comments previously expressed in this chapter, which state that the perfect foresight of a linear programming model creates theoretical results that cannot be achieved in the real world.

Exhibit XIV-8 shows that average optimized portfolio costs follow expectations. Average Green World portfolio costs are higher than the other scenarios, driven by higher projected commodity costs. Weak Economy prices drive lower average portfolio costs. Strong Economy average portfolio costs are slightly higher than the Base Case, as the increase in fixed gas supply costs to meet the higher load growth is greater than the corresponding increase in volumes. Thus, average fixed costs are slightly higher in that case.

Exhibit XIV-8



F.2. Comparison of Resource Additions

Differences in resource additions are generally driven by load growth. The exception is for energy efficiency resources, which are influenced more directly by the gas price forecast than supply resources because efficiency programs avoid commodity costs. However, the absolute level of efficiency programs is also affected by load growth assumptions. The following information summarizes the optimal resource additions across the scenarios by resource type.

Energy Efficiency Resources

As noted above, Sendout optimizes energy efficiency programs as part of the resource optimization analysis. Exhibit XIV-9 summarizes the levelized cost of the energy efficiency bundles analyzed using Sendout, along with the results by scenario. This format reveals how various program bundles were accepted (taken) or rejected across the scenarios as part of the optimization analysis.

Sets of increasingly expensive efficiency programs were added to the optimization analysis until SENDOUT rejected programs at a similar cost level. For example, ComA2C, ComHeatD3, ComD1-Bload, ComdD2-Bload, Indust, ResA2C, Res D1-Bload, and Res Heat D1, were run through a SENDOUT optimization run, along with all of the supply-side alternatives to determine if these efficiency bundles would be part of the optimal portfolio. The optimal portfolio included all of these programs except for ComD1-Bload and ComdD2-Bload (Note: This optimization analysis took over 24 hours to run.). In the next SENDOUT run, the low-cost demand resources found to be cost effective were accepted (or “baselined” in the portfolio) and the next set of higher-cost efficiency programs were offered, along with the same supply-side resources, to check whether that next set of higher-cost efficiency programs would be included in the optimal resource portfolio. For programs that were rejected, i.e., ComD1-Bload and ComdD2-Bload, there was no need to test higher-cost commercial base load programs. This approach was used in each category until the model either rejected an efficiency bundle or all the categories from Quantec had been analyzed. For example, in the Base Case SENDOUT selected the highest-cost commercial heat bundle from Quantec ($9.96/Dth) but rejected more expensive residential heat programs.

Alternative scenarios used the Base Case analysis as the starting point for examining energy efficiency programs. In Green World, gas prices are significantly higher than the Base Case forecast. This indicates all the efficiency programs from the Base Case would be part of the optimal portfolio in Green World. Therefore, all efficiency resources accepted in the Base Case analysis were not offered as resource alternatives in Green World, but were assumed to be selected as resources in the optimal portfolio. However, resources that were rejected in the Base Case were offered as resource alternatives in Green World. For example, ResG1-Heat was rejected in the Base Case but accepted in the Green World scenario. Efficiency programs in the Strong Economy scenario were treated in the same manner as Green World. For Weak Economy, since the gas price forecast is significantly lower than the Base Case forecast, the Company did not offer efficiency programs that were rejected in the Base Case, as it was clear these would not be selected in the Weak Economy scenario.

Exhibit XIV-9

Efficiency Program	Levelized Cost	Base Case	Green World	Strong Economy	Weak Economy	Joint Planning
ComA2C	$ 3.20	taken	taken	taken	taken	taken
ComHeatD3	$ 6.69	taken	taken	taken	taken	taken
ComHeatD4	$ 6.71	taken	taken	taken	taken	taken
ComD1-BLoad	$ 6.98	rejected	taken	taken	na	rejected
ComD2-BLoad	$ 7.16	rejected	taken	taken	na	na
ComHeatE1	$ 7.94	taken	taken	taken	taken	taken
ComHeatE2	$ 8.00	taken	taken	taken	taken	taken
Com Heat F1	$ 8.76	taken	taken	taken	taken	taken
ComHeat G1+2	$ 9.96	taken	taken	taken	rejected	taken
Indust	**$** 2.01	taken	taken	taken	taken	taken
ResA2C	$ 3.55	taken	taken	taken	taken	taken
Res D1-BLoad	$ 7.21	taken	taken	taken	rejected	rejected
Res Heat D1	$ 6.58	taken	taken	taken	taken	taken
Res E1-BLoad	$ 8.18	rejected	rejected	rejected	na	rejected
Res Heat E1	$ 8.38	taken	taken	taken	rejected	taken
Res Heat F1	$ 8.87	taken	taken	taken	rejected	taken
ResG1-Heat	$ 9.83	rejected	taken	taken	na	rejected
ResG2-Heat	$ 10.06	rejected	taken	taken	na	na

Exhibit XIV-9 shows that for the Base Case, commercial base load programs with a levelized cost greater than or equal to $6.98 were rejected, but those programs were taken in Green World and Strong Economy. All commercial heat programs were taken in scenarios other than Weak Economy. For residential programs, baseload programs greater than $7.21 were rejected, as were heat programs with a levelized cost at or greater than $9.83. Notice that the efficiency programs for the Green World and Strong Economy scenarios are identical. In both of these scenarios, residential base load program bundles with costs greater than or equal to the $8.18 level were rejected, but all heat program bundles that were offered were taken. Overall, the primary conclusion from this analysis is that gas conservation programs should emphasize heating programs, given current gas price forecasts and the higher future cost of capacity additions.

Exhibit XIV-9 provides a quick way to identify how different program bundles performed across scenarios. Exhibit XIV-10 illustrates the overall impact on load from the optimized programs. Results are intuitive; i.e., the low price Weak Economy scenario has the lowest efficiency savings at 84 percent of the Base Case by 2024, while Green

World and Strong Economy exhibit higher savings, at 114 percent of the Base Case by 2024.

Exhibit XIV-10
Annual Energy Efficiency Savings (MDth)

	Base Case	Green World	Strong Economy	Weak Economy	Joint
2005	-	-	-	-	
2006	389	409	409	361	388
2007	826	884	884	740	825
2008	1,316	1,434	1,434	1,139	1,314
2009	1,833	2,027	2,027	1,552	1,831
2010	2,347	2,622	2,622	1,968	2,344
2011	2,853	3,211	3,211	2,380	2,849
2012	3,328	3,764	3,764	2,770	3,323
2013	3,783	4,291	4,291	3,145	3,778
2014	4,215	4,788	4,788	3,503	4,209
2015	4,633	5,268	5,268	3,854	4,627
2016	5,061	5,760	5,760	4,214	5,055
2017	5,508	6,274	6,274	4,593	5,501
2018	5,924	6,753	6,753	4,948	5,917
2019	6,309	7,194	7,194	5,277	6,301
2020	6,681	7,620	7,620	5,598	6,674
2021	7,055	8,047	8,047	5,921	7,047
2022	7,434	8,478	8,478	6,249	7,426
2023	7,816	8,913	8,913	6,580	7,807
2024	8,197	9,345	9,345	6,910	8,188

The Base Case efficiency savings are significantly higher than those shown in the August 2003 Least Cost Plan Update. Exhibit XIV-11 compares the Base Case results to the same planning period results from the August 2003 Least Cost Plan Update. Overall, the optimal level of conservation programs from the Base Case analysis is 40 percent higher by year 20 than the August 2003 Update.

Exhibit XIV-11
Comparison of Optimal Energy Efficiency – Current vs. Prior Plan

Period #	Current Planning Period	Base Case Optimal Efficiency Savings (MDth)	August 2003 LCP Update Optimal Efficiency Savings (MDth)	Aug 2003 LCPUpdate Planning Period	% Change
1	2006	388.6	306.4	2004	27%
2	2007	825.8	612.9	2005	35%
3	2008	1,316.0	919.3	2006	43%
4	2009	1,833.5	1,225.7	2007	50%
5	2010	2,347.1	1,532.2	2008	53%
6	2011	2,853.1	1,838.6	2009	55%
7	2012	3,327.9	2,145.1	2010	55%
8	2013	3,783.0	2,451.5	2011	54%
9	2014	4,214.6	2,757.9	2012	53%
10	2015	4,633.2	3,064.4	2013	51%
11	2016	5,061.3	3,370.8	2014	50%
12	2017	5,508.3	3,677.2	2015	50%
13	2018	5,924.5	3,983.7	2016	49%
14	2019	6,308.5	4,290.1	2017	47%
15	2020	6,681.3	4,596.6	2018	45%
16	2021	7,054.9	4,903.0	2019	44%
17	2022	7,433.8	5,209.4	2020	43%
18	2023	7,815.8	5,515.9	2021	42%
19	2024	8,197.3	5,822.3	2022	41%
20	2025	8,576.6	6,128.7	2023	40%

It is important to view these results from the proper perspective. As noted above, the Least Cost Plan analysis is not designed to support specific resource acquisitions. It would be an inappropriate use of the analysis to conclude that the Company should increase its conservation programs by 40 percent in the program bundles noted on Exhibit XIV-9. However, the proper conclusion to be drawn from this analysis is that the Company should begin to prepare for a significant increase in its gas efficiency programs, and that such programs should primarily target heating loads. Actual programs and targets must be developed based on more specific program information.

Gas Supply Resources

As discussed in Chapters XII and XIII, there is no substitute fuel for PSE's natural gas customers. PSE will continue to rely on acquisition of natural gas from creditworthy and reliable suppliers at major market hubs or production areas. In the Sendout model, PSE has assumed that its existing geographically diverse, long-term contracts for supply (which currently represent approximately two-thirds of annual requirements) would continue through the planning horizon. Additional gas supply is selected by the model, as needed, from various supply basins or trading locations along with the optimal utilization of existing and new capacity options to create the optimal portfolio. The majority of this additional supply would likely be acquired under short-term contracts (from one month to two years in duration) at market price, as is the standard in the industry. In this Least Cost Plan, PSE has not attempted to determine the appropriate quantity of gas that might be purchased under *Fixed Price* contracts (of short or long term). PSE will be investigating that topic, guided by additional customer value research, at a later date.

A new category of gas supply resources was examined for the purposes of this Least Cost Plan. Imported LNG supply was modeled as being available at two different locations. This is described more fully in the section on new gas supply resource alternatives. The first location was in British Columbia. This project connected to the pipeline system at or south of Station 2, requiring transportation down the Westcoast system to Sumas, then on Northwest Pipeline to PSE's city gates. An alternative location was modeled South of PSE's service territory, connecting to the pipeline system south of PSE's city gates but hydraulically north (or west) of the Columbia Gorge. Transportation costs for the South LNG option were assumed to be identical to Northwest Pipeline expansion capacity costs from PSE's load center to Sumas. It was assumed that South LNG would require incremental new pipeline capacity, as existing capacity from points south are dedicated to accessing supply from AECO and the Rockies. Commodity prices for both North and South LNG were assumed to be AECO index plus $0.05/Dth as a physical premium or to reflect other possible fixed gas supply charges. The contract was assumed to be a 100 percent load factor take agreement. A maximum of 50 MDth/day contract from each of the North and South options was considered across all scenarios.

Exhibit XIV-12 summarizes the results of the LNG projects. North LNG imports were rejected across all Scenarios. This is not surprising, given Station 2 spot market prices are expected to be at a slight discount to AECO prices, rather than at a slight premium. Further, in the long-run North LNG supplies would likely require transportation on two pipelines (rate stacking). South LNG, however, was selected in all scenarios except the

Weak Economy Case. The generation fuel analysis took 11,000 Dth/day of imported South LNG. For the joint planning analysis, a maximum of 62 MDth/day was made available, all of which was taken.

Exhibit XIV-12
Results of LNG Import Analysis

	Base Case	Green World	Strong Economy	Weak Economy	Generation Fuel	Joint Analysis
North LNG	0	0	0	0	0	0
South LNG	50 MDth/d	50 MDth/d	50 MDth/d	0	11 MDth/d	62 MDth/d

Assumptions about commodity cost pricing and transportation costs have a significant impact on the cost effectiveness of LNG imports. This analysis indicates that the Company should continue to monitor development of regional LNG import facilities, as specific location details will considerably impact the cost effectiveness of imported LNG supplies. Imported LNG is also impacted by public policy and other considerations. These factors were not modeled in an optimization model, but will need to be considered.

Storage Resources

Four different storage resources were considered for this Least Cost Plan. Jackson Prairie storage capacity/deliverability expansions were modeled for all but the Generation Fuel analysis, and made available to the model from 2008-2012. The Jackson Prairie deliverability expansion was not modeled in the Generation Fuel analysis because it was selected in each of the LDC scenarios. Thus, as a stand-alone portfolio, the same Jackson Prairie expansion would not be available to both portfolios. LNG storage that has the ability to liquefy natural gas on-site was considered in all scenarios. Satellite LNG, which requires LNG to be trucked to the storage facility (like the Company's facility at Gig Harbor), was considered in the Base Case analysis but clearly would not be selected as a generic supply resource without consideration of localized benefit. As a result, it was not modeled for other scenarios as a generic supply resource. Finally, a shorter-term LNG bridging service was considered in all of the LDC scenarios. This option was based on leasing capacity in a new LNG storage system in British Columbia on an annual basis through 2010. Delivery of the stored LNG would be accomplished through a commercial exchange agreement. Like the Jackson Prairie storage, this LNG bridging service was not made available in the generation fuel study, as it was selected in the Base Case LDC scenario.

- *Jackson Prairie Storage Capacity Expansion*

  As explained earlier, resources for this analysis were assumed to be available in small increments. Jackson Prairie storage capacity/deliverability expansions were assumed to be available in optimally sized increments each year from 2008 through 2012. Exhibit XIV-13 lists the capacity/deliverability expansions by year for each of the scenarios. Storage capacity is shown in thousands of Dth and deliverability is shown in thousands of Dth/day.

Exhibit XIV-13
Jackson Prairie Storage Capacity/Deliverability

	Base Case	Green World	Strong Economy	Weak Economy	Joint Plan
2008	383 MDth 27 MDth/day	375 MDth 27 MDth/day	573 MDth 41 MDth/day	213 MDth 15 MDth/day	651.4 MDth 46.5 MDth/day
2009	621 MDth 44 MDth/day	594 MDth 42 MDth/day	1056 MDth 75 MDth/day	213 MDth 15 MDth/day	1354 MDth 98 MDth/Day
2010	635 MDth 45 MDth/day	597 MDth 43 MDth/day	1,254 MDth 90 MDth/day	464 MDth 33 MDth/day	1429 MDth 102 MDth/Day
2011	1456 MDth 104 MDth/day	1,456 MDth 104 MDth/day	1,456 MDth 104 MDth/day	1,308 MDth 93 MDth/day	1456 MDth 104 MDth/day
2012	1456 MDth 104 MDth/day	1,456 MDth 104 MDth/day	1,456 MDth 104 MDth/day	1,456 Mdth 104 MDth/day	1456 MDth 104 MDth/day

The key resource strategy conclusion from this analysis is that under all scenarios, a Jackson Prairie expansion is desirable and least cost, beginning in 2008 with full expansion in place by 2011 (except in the Weak Economy scenario, which completes the expansion in 2012.) Note that in the Joint Planning scenario, Jackson Prairie developments are approximately twice the level in the Base Case, up until 2011 when Jackson Prairie is fully developed. This suggests that, if the project expansion is developed early, it may be worthwhile until the sales portfolio grows into the capacity to investigate a cost allocation or other state regulatory policy to provide the generation portfolio with access to a portion of Jackson Prairie storage and related deliverability.

- *LNG Bridging Service*

  The shorter-term LNG bridging service was available in all scenarios. Exhibit XIV-14 summarizes the optimal addition across the scenarios. Across all scenarios, the full LNG bridging service is selected, except for the last year of the Weak Economy scenario. Investigating the availability and cost of an LNG bridging service should be part of the Company's gas resource strategy.

Exhibit XIV-14
LNG Bridging Capacity/Deliverability

	Base Case	Green World	Strong Economy	Weak Economy	Joint Plan
2007	50 MDth	50 MDth	50 MDth	50 MDth	50 MDth
	10 MDth/day	10 MDth/day	10 MDth/day	10 MDth/day	10 MDth/day
2008	100 MDth	100 MDth	100 MDth	100 MDth	100 MDth
	20 MDth/day	20 MDth/day	20 MDth/day	20 MDth/day	20 MDth/day
2009	100 MDth	100 MDth	100 MDth	7.8 MDth	100 MDth
	20 MDth/day	20 MDth/day	20 MDth/day	1.6 MDth/day	20 MDth/day

- *LNG Storage*

  LNG storage, as a generic resource, does not appear to be as clear a part of the Company's resource strategy as Jackson Prairie or LNG bridging. LNG storage is selected as a resource only in the Strong Economy case, and then with a storage capacity level of 14 MDth and daily deliverability of 2 MDth/day. As a generic resource, LNG storage does not appear to be cost effective. In terms of its resource strategy, the Company should only consider LNG storage in locations that also provide additional local distribution system benefits, as with PSE's satellite LNG facility in Gig Harbor.

Transportation Capacity Additions

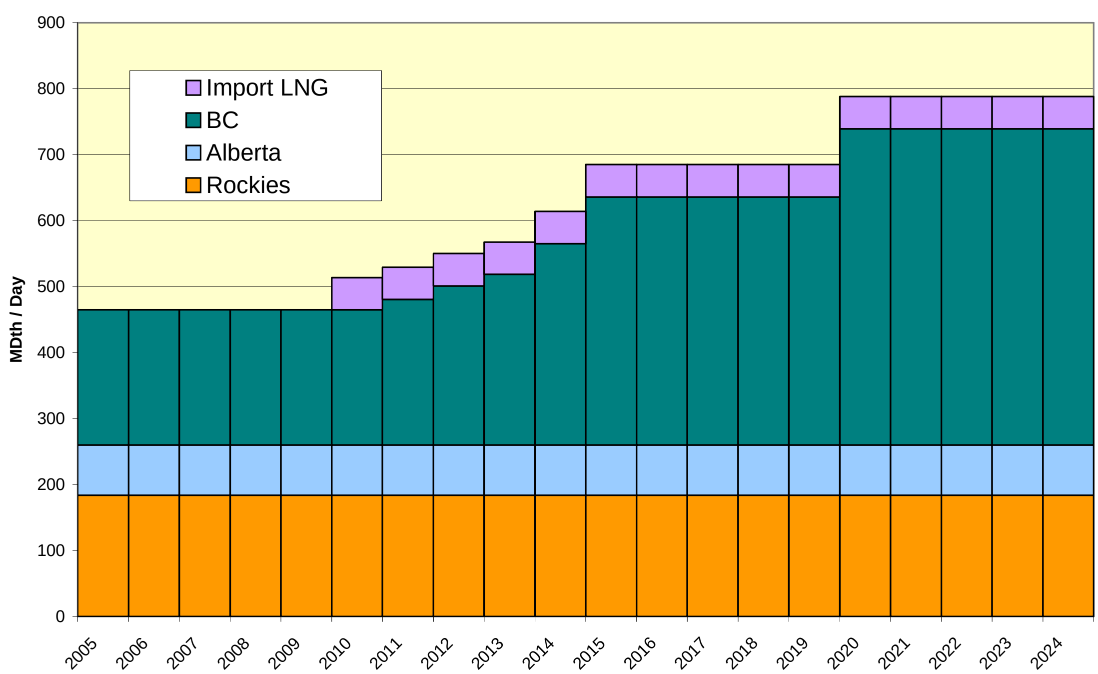
Transportation capacity additions are considered in two primary categories: upstream pipelines to transport gas to Sumas, and Northwest Pipeline capacity to deliver gas to PSE's city gates.

- *Upstream Pipeline*

  A significant amount of Westcoast pipeline capacity is added based on the assumption that decreasing supply will be available at Sumas. The significant upstream analysis was performed in the preliminary Base Case analysis to consider if the capacity to move gas on Terasen Gas's Southern Crossing pipeline (with ANG and Nova capacity upstream) from AECO (rather than Station 2) to Sumas would be the least cost option. The analysis indicated that this is not the case. This is not surprising, considering that gas at Station 2 is expected to sell at a discount to AECO, and that transport on Southern Crossing, ANG, and Nova is more costly than transport on Westcoast from Station 2. There may, however, be substantial benefits to maintaining a degree of supply diversity. The Base Case optimal resource solution indicates that without Southern Crossing capacity, PSE's pipeline capacity portfolio relies increasingly on British Columbia-sourced supply (see Exhibit XIV-15). The Company may wish to consider diversity and other qualitative reasons for increasing capacity from other sources.

Exhibit XIV-15

Base Case- Cumulative Pipeline Capacity by Source



- *Direct Connect Pipeline Capacity*

  Transportation capacity on Northwest Pipeline can be separated into two major categories. First is seasonal transportation service, such as the existing TF-2 service, which is priced to reflect the seasonal availability tied to Jackson Prairie storage. The following discussion will not highlight seasonal transportation, since this kind of transport is essentially the same as daily deliverability, which was included in the storage discussion above. Year-round transportation capacity is the other primary category. PSE modeled up to 100 MDth/day of existing surplus capacity referred to as "secondary capacity" which might be obtained from different counterparties; the second category is capacity obtained as a result of new construction subsequent to an open season offering by Northwest Pipeline, referred to as "expansion capacity."

  Secondary capacity was selected as part of the least cost portfolio in all but the Weak Economy Case. The Base Case and Green World scenarios do not take any secondary capacity until 2011, but Strong Economy begins taking secondary capacity in 2007. The Generation Fuel analysis assumed that the secondary capacity which was not taken in the gas Base Case analysis was available on that schedule, to avoid double counting availability. Please see Exhibit XIV-16.

Exhibit XIV-16
Optimal Secondary Market Capacity Additions

	Base Case MDth/day	Green World MDth/day	Strong Economy MDth/day	Weak Economy MDth/day	Generation Fuel MDth/day	Joint Plan MDth/day
2006	0	0	0	0	12	0
2007	0	0	24	0	12	0
2008	0	0	24	0	12	0
2009	0	0	24	0	81	0
2010	0	0	24	0	81	0
2011	16	12	100	0	76	46
2012	36	32	100	0	63	80
2013	54	49	100	0	0	100
2014	100	100	100	0	0	100

The implication of this analysis for resource strategies is that the Company should investigate whether a commitment for future access to this secondary market capacity could be obtained, or whether the capacity can be obtained now at appropriate pricing, even though it is not needed for several years.

Expansion capacity is ultimately required in all cases. Exhibit XIV-17 shows the cumulative addition of expansion capacity across the scenarios. Please note that this includes additional Northwest Pipeline capacity required to transport gas from the South LNG import facility to PSE's load.

Table XIV-17
Optimal Direct-Connect Pipeline Capacity Additions from Expansions

	Base Case MDth/day	Green World MDth/day	Strong Economy MDth/day	Weak Economy MDth/day	Generation Fuel MDth/day	Joint Plan MDth/day
2006	0	0	0	0	0	0
2007	0	0	0	0	0	0
2008	0	23	23	0	0	0
2009	0	38	38	0	0	0
2010	49	38	38	49	11	0
2011	49	100	100	49	63	70
2012	49	100	100	159	63	70
2013	49	100	100	159	139	96
2014	49	100	100	159	139	96
2015	120	162	162	379	247	285
2016	120	162	162	379	247	285
2017	120	162	162	379	247	285
2018	120	162	162	379	247	285
2019	120	162	162	379	247	285
2020	223	262	262	618	282	411

The primary take-away from this analysis for the gas resource strategy is that PSE will need to monitor and optimize the timing of transportation capacity expansions in conjunction with Northwest Pipeline and other shippers.

F.3. Complete Picture—Base Case

The Base Case Optimal Resource Portfolio is shown below in Exhibit XIV-18. Additional Scenario results are included in Appendix J.

Exhibit XIV-18.1

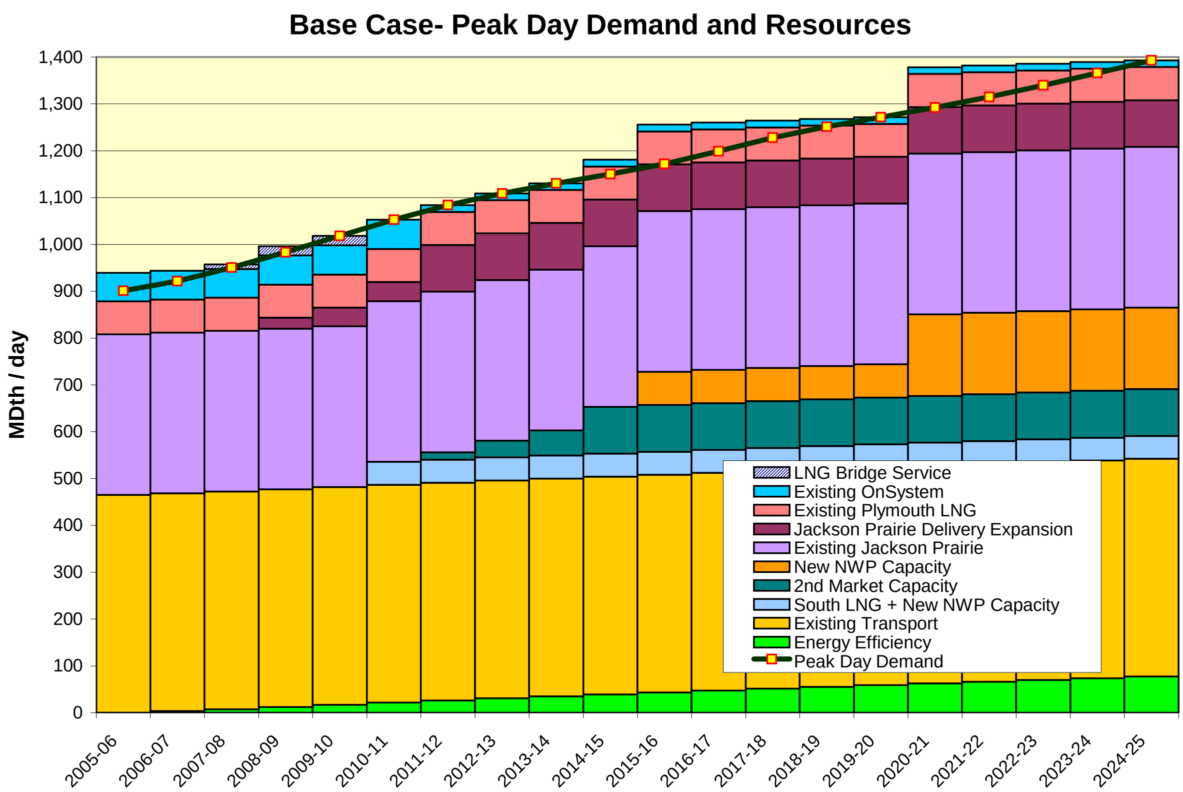
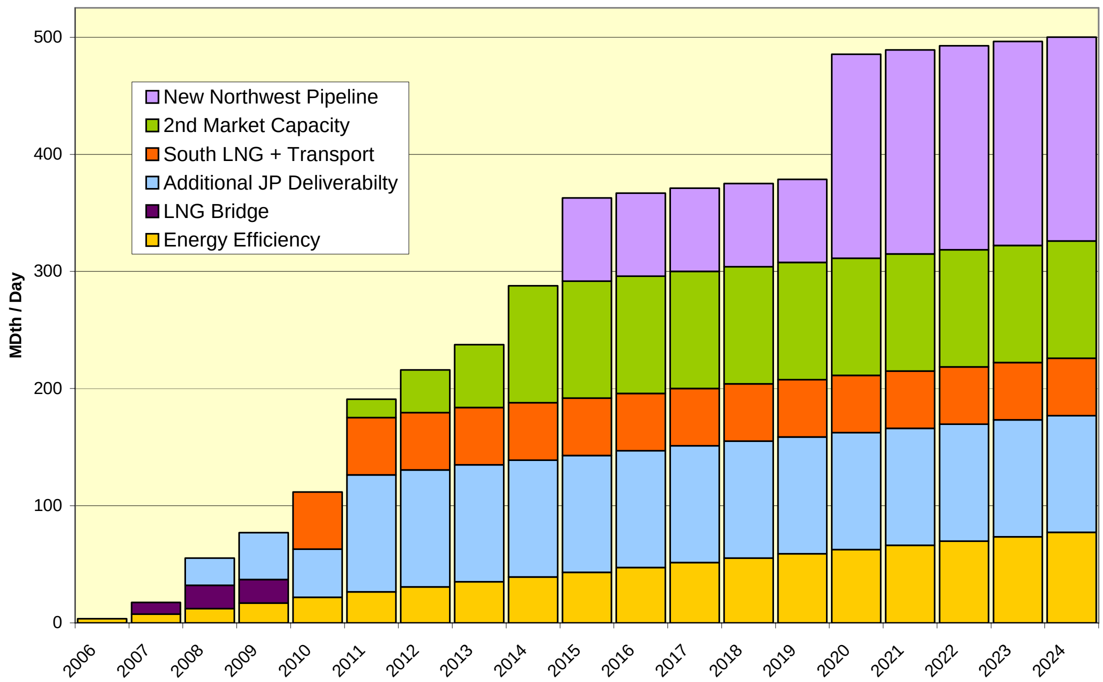


Exhibit XIV-18.2

2006-2024 LDC Gas Resource Strategy (Additions)

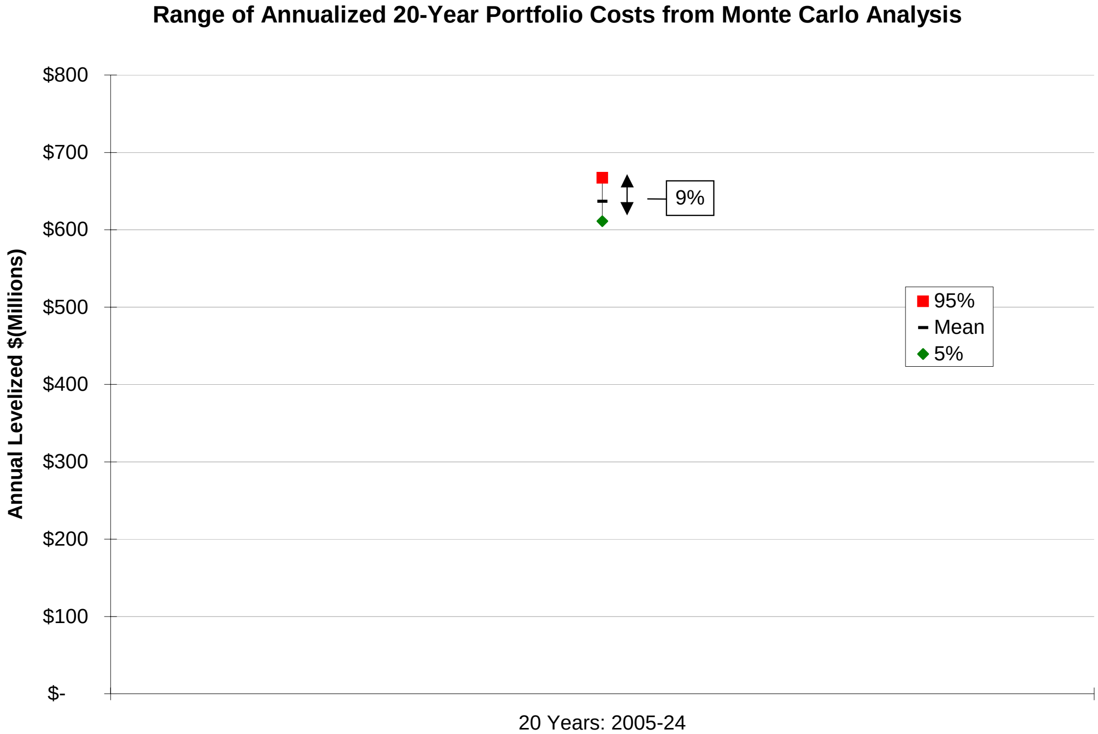


Base Case—Results of Monte Carlo Analysis on Base Case Portfolio

As noted above, the Company used the Monte Carlo capabilities of Vector Gas to examine the effects of temperature-induced load uncertainty and price uncertainty on the Optimal Base Case portfolio. The portfolio PSE examined was the resulting optimal portfolio from the Company's Base Case analysis. In this analysis, daily temperatures affect both load and daily gas prices. The Monte Carlo analysis was performed using 200 draws. Each of the 200 draws results in 20 years worth of daily prices and loads.

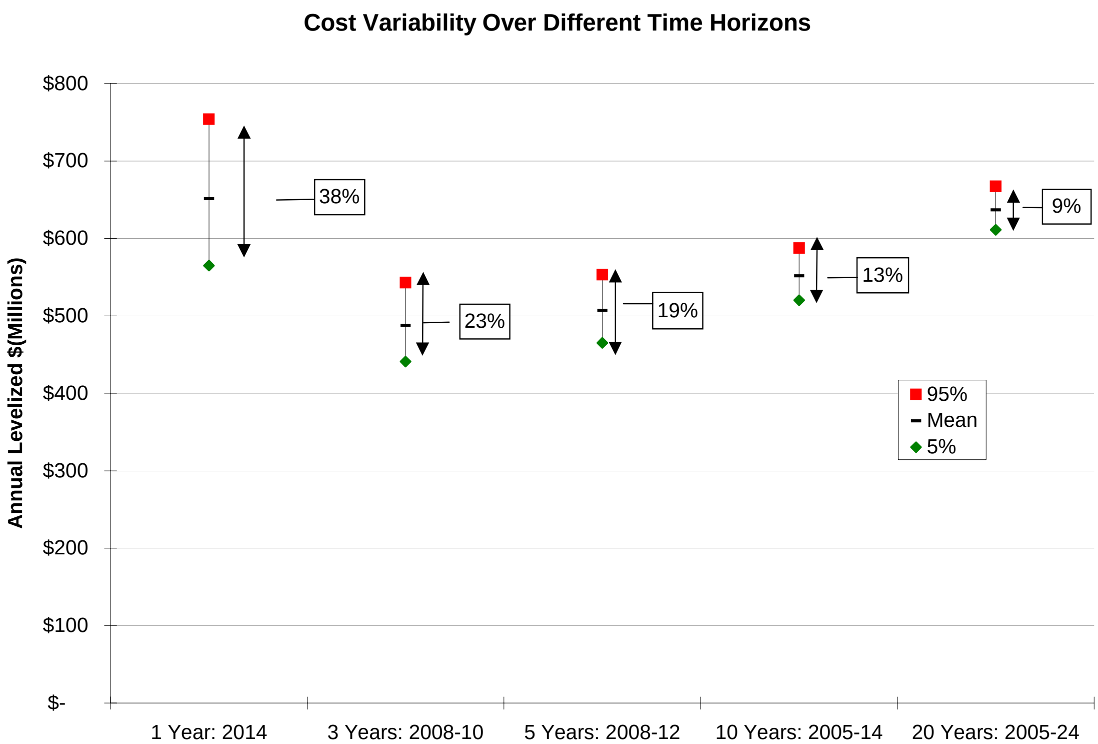
Exhibit XIV-19 shows the mean, and the 5th and 95th percentiles of the 20-year annual levelized portfolio costs.

Exhibit XIV-19
Annual 20-Year Levelized Monte Carlo Results



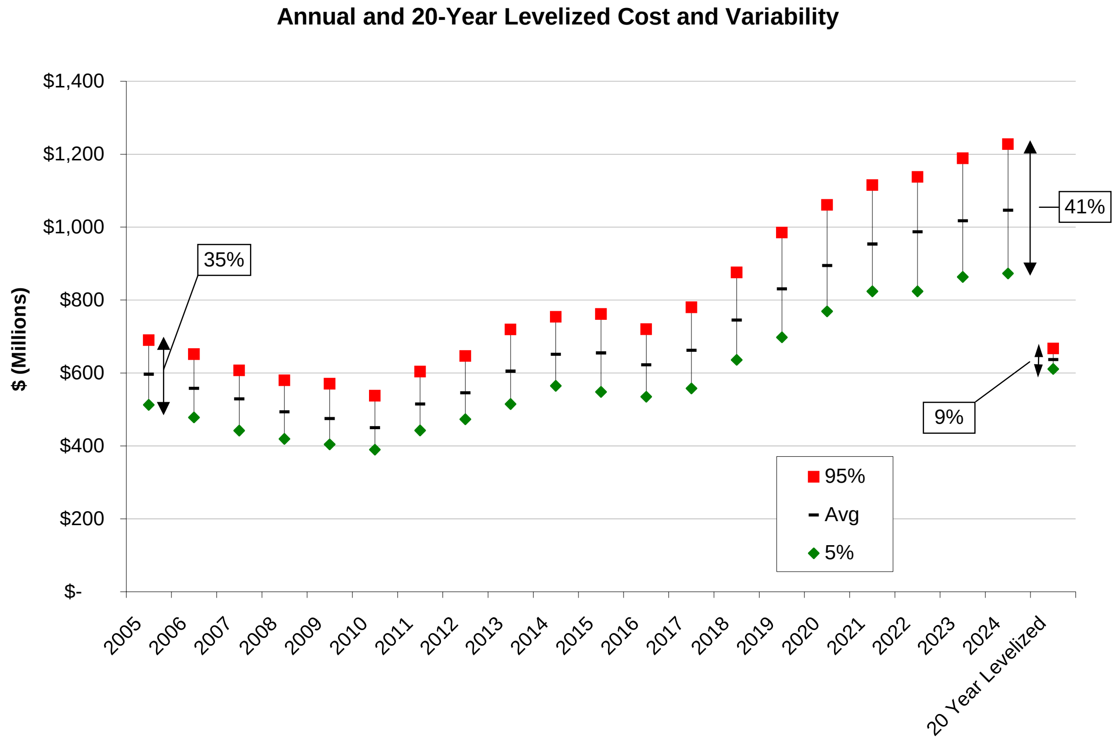
Results of the 20-Year Monte Carlo analysis shown in Exhibit XIV-19 do not portray the kind of variability one might initially expect. The range in annualized cost from the 5th to the 95th percentiles is only a 9 percent spread—given the significant volatility in gas prices, one might expect much more variability. However, as one stretches out the time horizon over which the Monte Carlo analysis is performed, variability within each draw is reduced. This is because extreme high and low draws have a greater probability of canceling each other out. For example, in a 20 year analysis, the effect of a December 2014 gas price of $12/Dth could be offset by a January 2018 gas price of $3.80/Dth, whereas if the analysis were just done on 2014, the effect of the $12/Dth would not be as muted. Exhibit XIV-20 illustrates how variability changes as the period considered increases from 1 to 20 years. Note, 2014 was chosen as the annual period for this exhibit because the mean is quite close to the mean of the 20-year levelized annual result, but shows a significant difference in variability. This exhibit supports the notion that results will appear less variable as the time frame under consideration is increased, because highs and lows tend to average out over time.

Exhibit XIV-20
Comparison of Variability across Different Time Horizons



This analysis suggests that while the 20-year view of risk is accurate, it may not be particularly helpful in making long-term resource decisions. Were the Company comparing the impact of different resources, such as Jackson Prairie deliverability expansion in 2008, or adding a large block of secondary capacity, the 20-year picture of cost volatility would most likely show very little difference in variability because highs and lows average out. It may be more informative to consider the annual variability resulting from the portfolio alternatives. An annual perspective is quite reasonable, because gas cost rates charged to customers are generally calculated on an annual basis; i.e., the 20-year horizon is comprised of 20 annual periods for which customers will pay bills. Exhibit XIV-21 illustrates the nominal mean, and the 5th and 95th percentiles of total portfolio costs on an annual basis, along with the 20-year levelized results.

Exhibit XIV-21
Annual and 20-Year Levelized Cost and Variability



The key take-away from a review of the Monte Carlo portfolio cost analysis is that measuring risk in the long term tends to dampen the effects of variability, thus short-term measures of risk in the context of the long-term analysis should also be considered.

Monte Carlo analysis on the Base Case optimal portfolio also provided information on the physical robustness of the optimal portfolio. This provides a reasonable test of whether the Company's planning standard of using normal weather with one design peak day per year creates a portfolio that will meet firm demands under a wide range of different temperature conditions. Results indicate that the Base Case portfolio, based on PSE's planning standard, will meet firm demands in 98 percent of the draws. This result is consistent with the Company's estimate that its peak day planning standard of 52 HDD will meet or exceed 98 percent of peak day temperatures based on temperature data from 1950-2003. This standard was selected as the result of a stochastic benefit cost analysis (for more information, refer to Appendix I). Therefore, PSE's planning approach of relying on a design peak day temperature in an otherwise normal weather winter provides reasonable results.

Base Case—Results of Base Case Monte Carlo Analysis with Resource Optimization

Monte Carlo analysis to test the sensitivity of resource additions in the static Base Case scenario, to assumptions in the Base Case, was described in section D.1. Three specific resources will be examined in the following discussion: timing of the Jackson Prairie storage deliverability expansion, results of the Southern LNG import supply, and addition of secondary Northwest Pipeline capacity. The following tables will compare results from the static Base Case with the mean results from the resource optimization Monte Carlo analysis along with probability distributions for each of the resources, which is informative.

Monte Carlo Optimization Results—Jackson Prairie's Storage Expansion

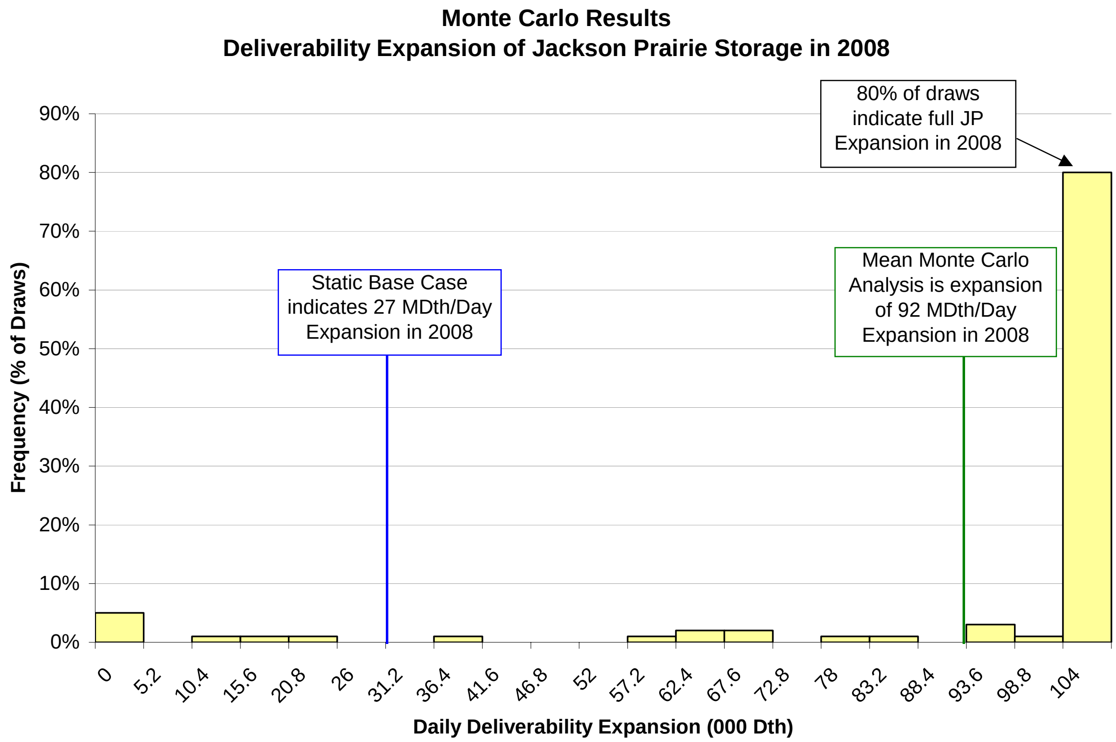
Jackson Prairie storage expansion in the optimal static Base Case analysis appears to be sensitive to the specific underlying assumptions. Exhibit XIV-22 shows results from the optimal static Base Case analysis (presented above) with the mean capacity expansions from the 100 Monte Carlo scenarios. Notice that the mean of Monte Carlo analysis indicates Jackson Prairie would be expanded at a faster rate than the static case.

Exhibit XIV-22
Jackson Prairie Expansion Results—Static and Stochastic Results

	Static Base Case Optimal Cumulative Expansion	Mean Cumulative Expansion from Monte Carlo Analysis
2008	383 MDth 27 MDth/day	1288 MDth 92 MDth/day
2009	621 MDth 44 MDth/day	1428 MDth 102 MDth/day
2010	635 MDth 45 MDth/day	1456 MDth 104 MDth/day
2011	1456 MDth 104 MDth/day	1,456 MDth 104 MDth/day
2012	1456 MDth 104 MDth/day	1,456 MDth 104 MDth/day

The frequency distribution of how Jackson Prairie expansion is selected across the 100 scenarios for 2008 is shown in Exhibit XIV-23. This exhibit focuses on daily deliverability component of the storage. The Monte Carlo analysis demonstrates that in 80 percent of the 100 draws, the full Jackson Prairie expansion is selected in 2008.

Exhibit XIV-23
Frequency Distribution of JP Deliverability Expansion



The Monte Carlo analysis indicates it would be reasonable for the Company to consider expanding Jackson Prairie fully in 2008.

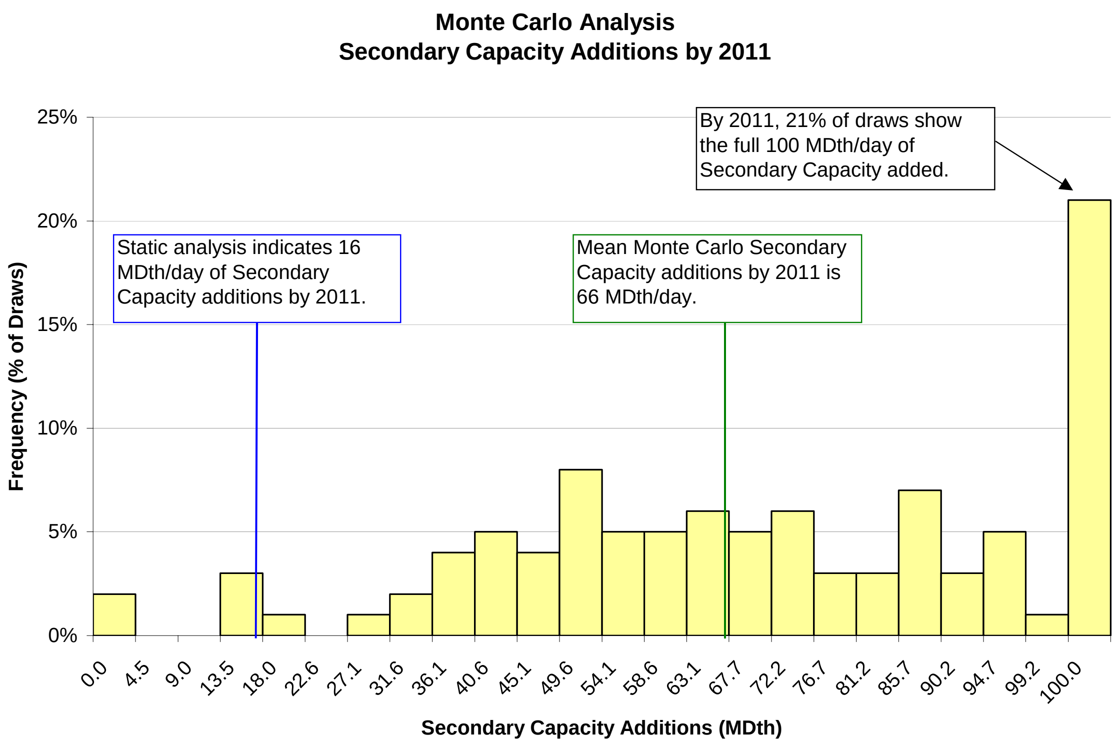
Monte Carlo Optimization Results—Secondary Capacity on Northwest Pipeline

Addition of Secondary Capacity in the Monte Carlo analysis generally shows a similar trend as in the static analysis, though the stochastic results indicate a faster rate of acquisition. Exhibit XIV-24 provides a table comparing the static and mean stochastic results. Exhibit XIV-25 provides the frequency distribution for secondary capacity additions in year 2011, the first year in which the static Base Case adds capacity. Exhibit XIV-25 illustrates that the static analysis addition in 2011 is in the bottom 5 percent of the stochastic analysis, which suggests the Base Case analysis may somewhat understate consideration of timing for adding secondary capacity relative to the stochastic analysis.

Exhibit XIV-24
Static and Mean Stochastic Results for Secondary Capacity

	Base Case MDth/day	Mean Cumulative Secondary Capacity Acquisition from Monte Carlo Analysis
2006	0	0
2007	0	11
2008	0	19
2009	0	47
2010	0	47
2011	16	66
2012	36	78
2013	54	89
2014	100	100

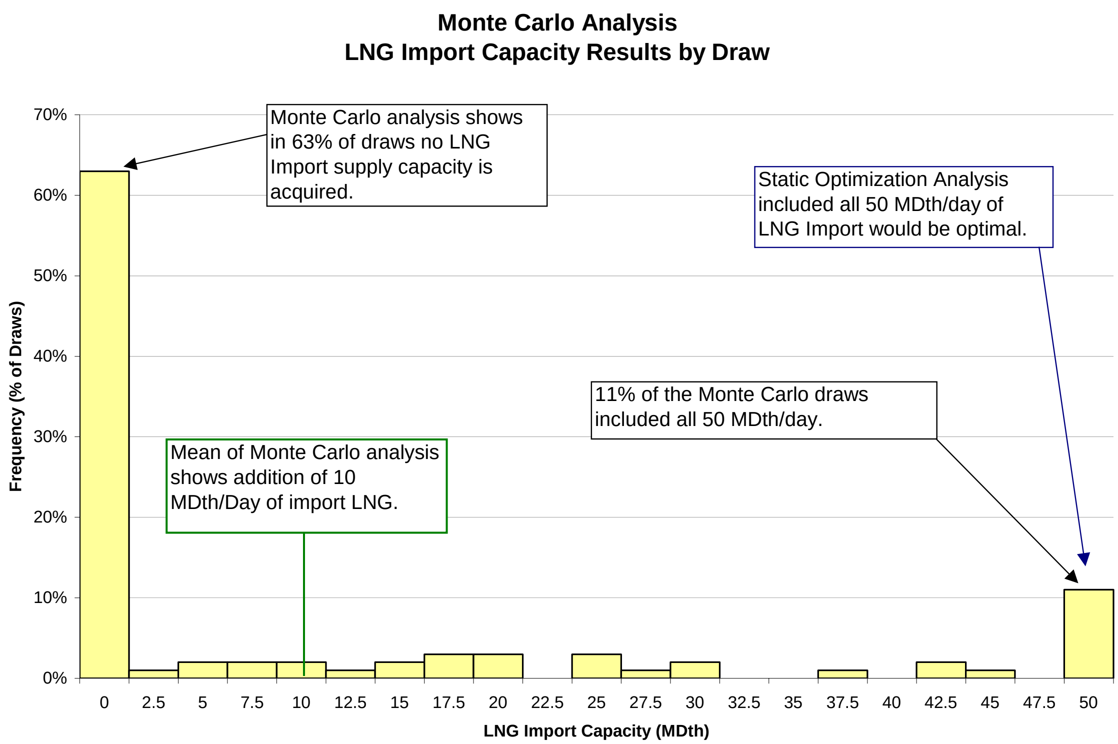
Exhibit XIV-25
Frequency Distribution for Secondary Capacity Additions in 2011



Monte Carlo Optimization Analysis—LNG Import Supply

Import LNG results appear to be highly sensitive to Base Case assumptions. Exhibit XIV-26 illustrates the frequency distribution for the Southern LNG Import Supply and shows results of the static Base Case analysis. The Exhibit illustrates that in 63 percent of the Monte Carlo scenarios, Import LNG was not selected as part of the optimal resource portfolio. Only 11 percent of the Monte Carlo results include the full 50 MDth/day of LNG import supply would be optimal. These results support the prior conclusion that PSE should carefully consider the specific terms and conditions of a long-term LNG import supply contract, should one become available.

Exhibit XIV-26
Frequency Distribution for Southern LNG Import Supply



Monte Carlo Optimization Analysis—Summary Conclusion

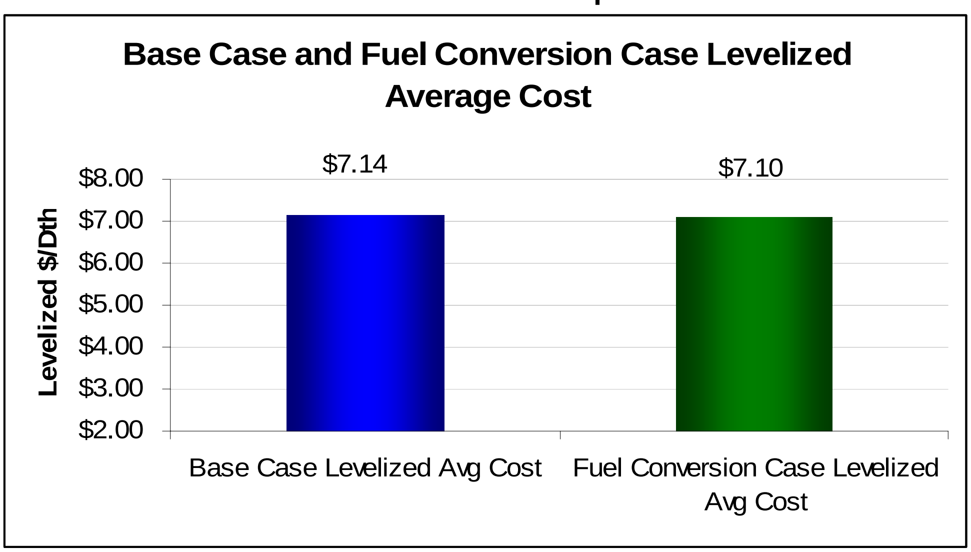
Monte Carlo analysis in the resource optimization approach provides information about the sensitivity of the optimality of resource additions to underlying assumptions of price and demand variability. As with the static optimization analysis, results of the Monte Carlo analysis will not provide the answer as to what kind of resources should be added to the portfolio at different times. Rather, this analysis will provide additional information to help support the Company's efforts to make informed resource acquisition decisions.

F.4. Impact of Fuel Conversion

The Company performed an optimization analysis using the same sets of resource availability and gas price assumptions as in the Base Case, but adding in the base and heat loads that were estimated to result from the electric to gas fuel conversion program. Generally, these were not large volumetric additions. Fuel conversion load would increase residential load by approximately 1 percent to 5 percent relative to Base Case volumes. An important aspect of the fuel conversion load is that roughly 60 percent of the projected increase in sales is related to water heat load, while the other 40 percent comes from heat load.

The purpose of this analysis was to study whether an electric to gas fuel conversion program would adversely affect gas costs to existing customers. Exhibit XIV-27 below shows the 20-Year levelized average cost of gas from the Base Case and the Fuel Conversion Case. The 20-year levelized average cost in the Fuel Conversion case is half a percent lower than the Base Case, so the conclusion here is that the fuel conversion program modeled is not expected to adversely affect gas costs to existing sales customers. These results are intuitive, given that most of the fuel conversion load is expected to be base load thus lowering resource requirements year-round.

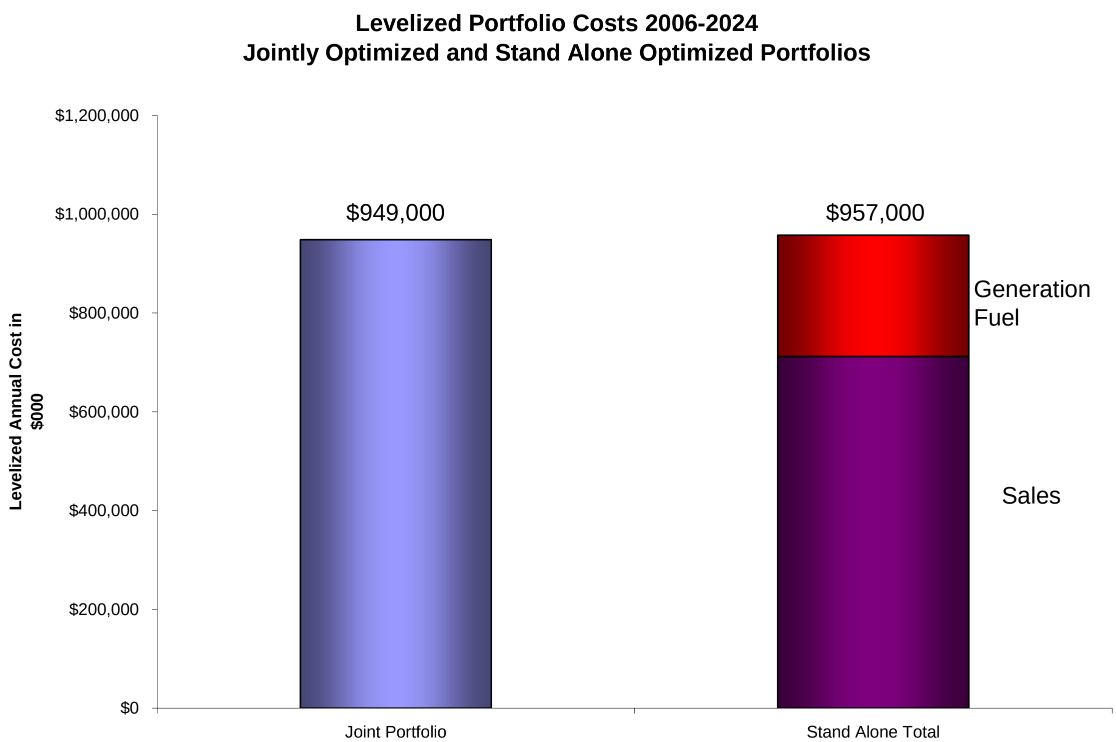
Exhibit XIV-27
Fuel Conversion Impact



F.5. Results of Joint Planning Analysis

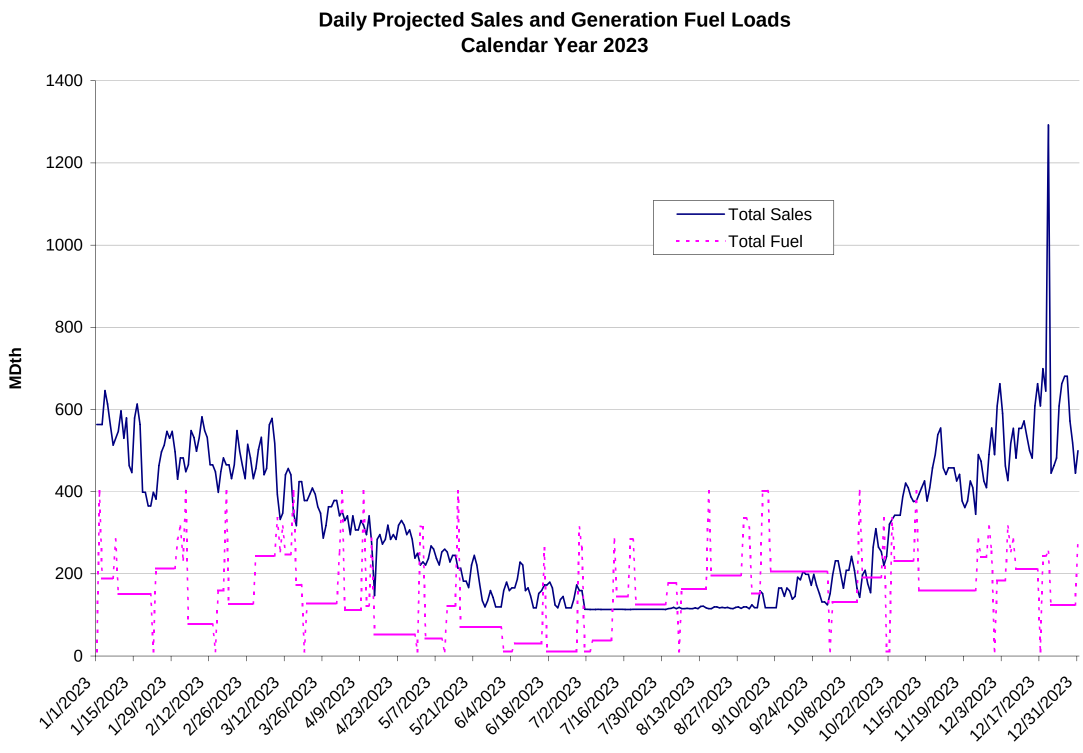
The Joint Planning analysis was performed by combining the loads for the gas sales Base Case and the gas for Generation Fuel case and optimizing across what are generally the same resources as those available in the stand-alone optimization cases. (Please refer to section D.3 for an explanation of how daily generation fuel loads were determined). Comparison of the jointly optimized portfolio cost with summation of costs of the stand alone optimal portfolio costs did not identify significant levels of savings. Exhibit XIV-28 shows the annual levelized costs from the Joint Plan study and the summation of the Sales and Generation Fuel studies. The results show an approximate $8 million/year savings, which is only a 1 percent cost savings from the Stand Alone results. This is a very modest level, especially given that some short-term optimization details were not present in the model. Some of the savings result from simplifying assumptions pertaining to short-term optimization opportunities, so even the $8 million is on the high side of what would be available in reality.

Exhibit XIV-28
Joint Planning Analysis



The primary reason larger savings are not seen in this analysis is the lack of the kind of load diversity that would drive capacity saving/sharing opportunities. Exhibit XIV-29 illustrates the daily forecast gas sales load and the daily forecast gas fuel for generation load during calendar year 2023. The relatively high generation load levels in the winter periods means capacity must be acquired to meet these generation loads and gas sales loads. The Company did not perform Monte Carlo analysis to support these results, as the gas for generation fuel demand is a completely different kind of function than gas for the sales portfolio. Such analysis would require a significant amount of effort to develop uncertainty factors for VectorGas, but such analysis would not really provide any additional information. That is, because the generation portfolio is expected to have significant capacity needs to meet winter fuel requirements, there is little opportunity to capture joint planning benefits.

Exhibit XIV-29
Comparison of Sales and Generation Demand



G. Conclusions

The natural gas resource planning analysis suggests that the following key items should be considered as PSE moves forward with a gas resource strategy:

1. PSE should investigate the ability to expand its gas energy efficiency programs, especially space heat programs.
2. PSE should monitor developments in regional LNG import terminals to determine if any specific location can favorably influence transportation costs.
3. Feasibility and timing of Jackson Prairie storage expansion should be investigated with the co-owners.
4. PSE should investigate the availability and pricing of an LNG bridging service.
5. LNG storage or satellite LNG should not be pursued as a generic supply resource without local system benefits.
6. In acquiring upstream transportation capacity, PSE should continue monitoring the Sumas market, but primarily plan on acquiring transport to Station 2. PSE should also weigh the benefit of supply diversity against the additional cost of obtaining supplies from AECO.
7. Possibilities for acquiring existing secondary transportation capacity, possibly at a discount, should be considered.
8. In examining long-term cost variability, the risk analysis should include consideration of how different portfolios perform in shorter-term increments during a long-term period.
9. In acquiring long-term resources, the Company should consider sensitivity to key underlying assumptions.