Power & Natural Gas Planning Task Force

I-5 Corridor Analysis
Phase 1 Report

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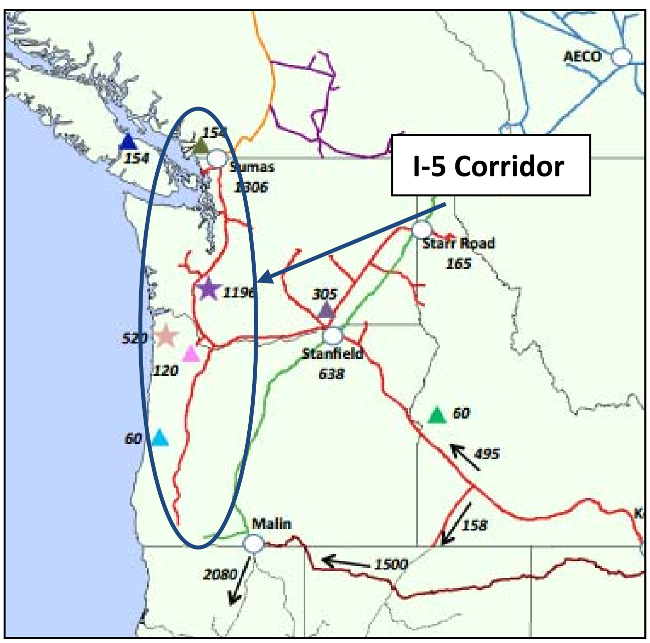
1. Executive Summary

PNUCC's Northwest Regional Forecast tells us utilities will increase gas-fired generation significantly over the next decade. With an uptick in the demand for natural gas on the horizon, a PNUCC and Northwest Gas Association (NWGA) task force is digging deeper into whether today's gas infrastructure is adequate to meet tomorrow's generating needs. Although the current infrastructure appears to be adequate, there are more questions that need to be answered.

A number of items are driving the move to gas. The growing demand for electricity, the need for "flexible" resources to respond to the ups and downs of wind and solar generation and the push to replace coal-fired power plants are all factors. Over the next decade these factors will increase the region's natural gas-fired generation by around 25%.

The biggest issue for gas-fired generation in the Northwest isn't the availability of the fuel. It's the infrastructure to transport gas to where it's needed. Unlike electricity, gas doesn't move at lightning speed and getting it from one place to another has to be planned well in advance.



In the first phase of its study, the Power and Natural Gas Planning Task Force focused on gas supply and infrastructure in the Interstate 5 corridor. I-5 runs through Washington and Oregon's major population centers, home to millions of people and large industries that consume natural gas directly. There are many large natural gas-fired power plants in the corridor and more are planned. Only one major pipeline serves the I-5 corridor – see adjacent map – with gas storage facilities to augment the supply.

The task force zeroed in on this area because it appears to be where regional gas supply problems will occur first. NWGA's annual outlook for natural gas indicates questions about the adequacy of pipeline and storage capacity to meet peak demand in the corridor arise as early as 2014-2015. Although this analysis finds that the current infrastructure is sufficient to meet today's needs, the ability to meet tomorrow's needs is still uncertain. Specifically, several important questions should be explored:

- Can the existing gas infrastructure respond to rapid swings in electricity demand?
- How heavily can the region rely on fuel switching as a gas demand reduction measure?
- Do we need new pipeline and/or storage facilities in the next decade? If so, when and where?

The Power and Natural Gas Planning Task Force will look into these and other questions. We encourage you to read the initial report and stay tuned as the issues develop and the answers take shape.

# # #

2. Background and Need for Study

The recent and continued growth in natural gas demand in the Pacific Northwest has largely been fueled by increased gas use in the electrical generation sector. This trend will continue in response to three societal needs. The first is the need to meet increasing demand for electricity including energy, capacity and flexibility requirements. While the economy has not grown substantially due to the Great Recession, it is clear that economic activity and growth in the demand for electric power will continue in the future. The second and increasingly important factor is the need to respond to rapid fluctuations in the electric power produced by variable wind generation. This increase in wind power is being driven primarily by state renewable power standards. The final societal need is to replace older coal-fired power plants to reduce emissions. Together, these factors will increase the regional nameplate natural gas capacity by at least 2,000 MW over the next decade.

The Interstate 5 (I-5) Corridor passes through both Portland, OR, and Seattle, WA, along with other major population centers. Running in close proximity to I-5 is the Williams Northwest Pipeline, a bi-directional natural gas pipeline. This is the only major pipeline serving Washington and Oregon west of the cascade mountain range. With the transition to greater reliance on natural gas-fired power plants underway, a key question for both direct gas providers and electric utility companies is whether the current I-5 Corridor natural gas delivery infrastructure is adequate to meet both the natural gas needs of the customers of local distribution companies and for electric power generators.

The gas infrastructure in the region was built to serve entities that contract for service, including local distribution companies, industrial end-users, and base load power generators (peaking electric power plants in the region have historically relied on oil as a backup fuel and have not usually subscribed to firm pipeline service). Although the Williams pipeline is fully subscribed for firm capacity, <u>the infrastructure is sufficient to meet current I-5 corridor demand.</u> The purpose of this paper is to provide an initial analysis to better understand the implications of greater interdependence between both the electric power and natural gas industries. Perhaps most importantly, this paper begins to examine if today's infrastructure is adequate to meet tomorrow's needs.

The analysis presented in this paper was designed to achieve a reconnaissance level understanding of the adequacy of the natural gas delivery infrastructure during a forecast period of high demand during the winter of 2015. Given the region's dependence on the Williams pipeline, could a capacity shortage result in direct use or electrical generation service interruption?

3. NGA Outlook Approach

The Northwest Gas Association publishes a yearly gas outlook. This report provides a peak day supply and demand balance for low, base and high gas demand forecasts for the next 10 years. The 2012 Northwest Gas Association Outlook is used as a starting point for this analysis.

The I-5 Corridor was chosen as the area of concern because it appears to be where natural gas supply problems are most likely to first appear. Due to the I-5 corridors high population density it has the greatest electricity and natural gas demand in the region. The combined high level of natural gas and electric power demand during peak winter days makes it a likely area of first concern.

Figure 1 is taken from the 2012 Gas Outlook and shows that if natural gas demand grows at the high or medium levels of the Gas Association's forecast there will be insufficient pipeline and storage capacity to meet a peak day in 2014-15 for the high case and 2017-18 in the base case. Under the base and high cases, peak day demand could exceed the region's infrastructure capacity within the forecast horizon. Given the long lead times (3 + years) to increase pipeline capacity, or to add significant quantities of storage, there could be natural gas supply problems in the I-5 corridor during the last half of this decade.

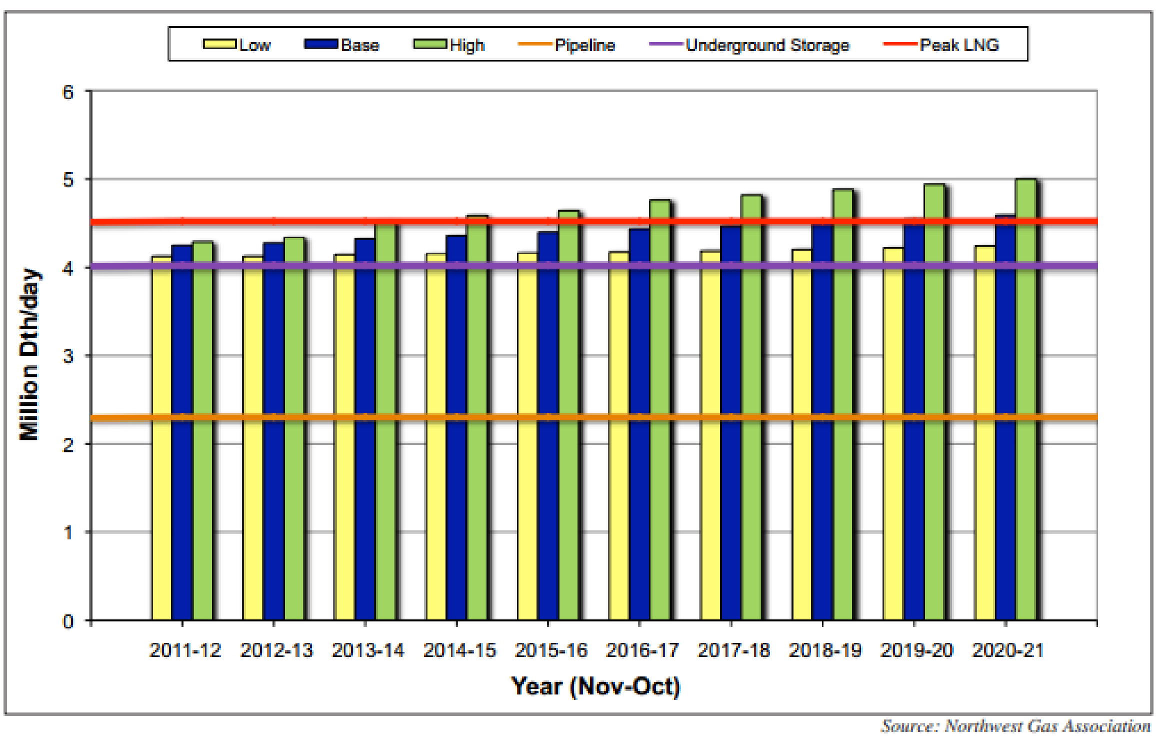
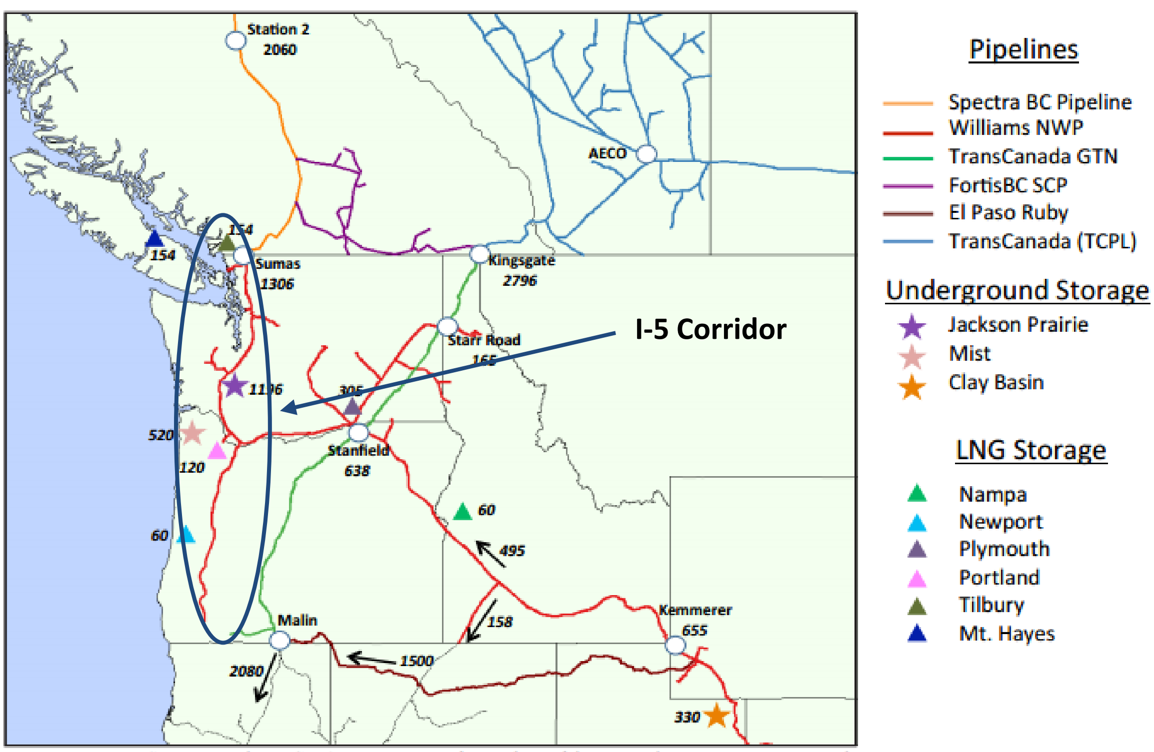


Figure 1 – Northwest Gas Association Peak Day Forecast

Natural gas utilities design distribution systems to accommodate extreme but still possible weather conditions (peak or design days). Figure 1 aggregates the design day of natural gas utilities located in the I-5 Corridor and southwestern British Columbia and compares them against currently available capacity and storage. For a list of direct service customers in the I-5 Corridor, please see the appendix.

A few notes are in order concerning Figure 1. While the probability of design days occurring in every system across the region on the same day ("coincidental peak day") is small, the possibility of very cold weather occurring simultaneously along the I-5 Corridor is reasonably high. Furthermore, Figure 1 assumes that existing capacity in the region is operating at 100 percent deliverability. Typically peaking power plants with alternate fuels available will not be served with natural gas during times of peak natural gas demand and are not included in Figure 1.

Figure 2 is also taken from the 2012 Gas Outlook report. The figure shows pipeline infrastructure currently serving the Northwest. The available natural gas storage sites, underground and liquefied natural gas, are also shown. It is important to note that much of the I-5 Corridor is served by only by the Williams Northwest Pipeline. This single dependency makes the delivery network more fragile than if there were multiple redundant pipelines providing support if a problem occurs on a critical gas delivery facility.



Source: Northwest Gas Association - Numbers indicate delivery or takeaway capacities in MDth.

Figure 2 – Natural Gas Pipelines and Storage Facilities in the Northwest

Storage plays an important role in meeting natural gas demand during peak winter days. The figure above shows the region's two primary storage facilities at Jackson Prairie, WA, and Mist, OR. These support peak demand in the I-5 corridor by providing an additional supply of natural gas, although their ability to store gas is limited. There are also liquefied natural gas (LNG) storage facilities shown on the map. But it should be noted that it can take many months to fill an LNG storage facility and only a few days to deplete one.

The following, Table 1, shows a more detailed breakdown of the base case forecast for natural gas by sector and the available sources of supply. These estimates are for a peak winter day in the I-5 Corridor.

Northwest Gas Association
2012 Natural Gas Outlook
I-5 Corridor Peak Day Demand/Supply Balance (Dth/day) - Base Case

DEMAND (Region/Sector)	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
BC Lower Main & Van. Island (I-5 Corridor)	**1,390,697**	**1,394,682**	**1,398,704**	**1,403,089**	**[illegible],407,033**	**1,411,212**	**1,415,607**	**1,420,226**	**1,425,077**	**1,430,170**
Residential	591,542	591,632	591,687	592,061	591,932	591,860	591,824	591,825	591,864	591,944
Commercial (Firm Sales & Transport)	415,393	419,288	423,2[illegible]5	427,266	[illegible]31,339	435,590	440,021	444,639	449,450	454,464
Industrial (Firm Sales & Transport)	122,164	122,164	122,1[illegible]4	122,164	[illegible]2,164	122,164	122,164	122,164	122,164	122,164
Power Generation	261,598	261,598	261,[illegible]98	261,598	2[illegible]1,598	261,598	261,598	261,598	261,598	261,598
W. Washington (I-5 Corridor)	**1,867,894**	**1,889,431**	**1,928,[illegible]46**	**1,954,088**	**1,97[illegible],489**	**2,001,204**	**2,023,206**	**2,045,533**	**2,068,517**	**2,092,775**
Residential	803,403	817,799	835,499	852,773	86[illegible],432	885,765	901,883	918,203	934,750	951,932
Commercial (Firm Sales & Transport)	329,329	336,011	344,931	353,900	362,062	368,939	375,328	381,846	388,784	396,342
Industrial (Firm Sales & Transport)	276,814	277,272	289,468	289,066	288,647	288,150	287,646	287,135	286,633	286,152
Power Generation	458,349	458,349	45[illegible],349	458,349	458,349	458,349	458,349	458,349	458,349	458,349
W. Oregon (I-5 Corridor)	**986,444**	**989,505**	**99[illegible],347**	**1,001,952**	**1,009,[illegible]83**	**1,018,909**	**1,029,421**	**1,040,886**	**1,052,789**	**1,064,859**
Residential	573,984	576,808	58[illegible],517	588,251	595,[illegible]14	605,235	615,250	625,657	635,969	646,432
Commercial (Firm Sales & Transport)	288,886	287,492	28[illegible],741	286,719	286,[illegible]47	286,491	287,005	288,081	289,668	291,272
Industrial (Firm Sales & Transport)	36,574	38,206	[illegible]9,090	39,981	40,[illegible]22	40,183	40,166	40,148	40,151	40,155
Power Generation	87,000	87,000	[illegible]7,000	87,000	87,[illegible]00	87,000	87,000	87,000	87,000	87,000
Total Peak (Design) Day Demand	4,245,035	4,273,619	4,3[illegible]1,297	4,359,128	4,394,[illegible]05	4,431,325	4,468,234	4,506,645	4,546,383	4,587,804
SUPPLY										
Pipeline Interconnects	**2,304,060**	**2,304,061**	**2,3[illegible]4,062**	**2,304,063**	**2,304,[illegible]64**	**2,304,065**	**2,304,066**	**2,304,067**	**2,304,068**	**2,304,069**
Max north flow on NWP @ Gorge	**551,000**	**551,001**	**5[illegible]1,002**	**551,003**	**551,[illegible]04**	**551,005**	**551,006**	**551,007**	**551,008**	**551,009**
Huntingdon/Sumas	**1,753,060**	**1,753,060**	**1,7[illegible]3,060**	**1,753,060**	**1,753,[illegible]60**	**1,753,060**	**1,753,060**	**1,753,060**	**1,753,060**	**1,753,060**
T-South to Huntingdon	1,753,060	1,753,060	1,7[illegible]3,060	1,753,060	1,753,[illegible]60	1,753,060	1,753,060	1,753,060	1,753,060	1,753,060
Underground Storage	**1,716,000**	**1,716,000**	**1,71[illegible],000**	**1,716,000**	**1,716,[illegible]00**	**1,716,000**	**1,716,000**	**1,716,000**	**1,716,000**	**1,716,000**
Jackson Prairie (NWP from JP)	1,196,000	1,196,000	1,19[illegible],000	1,196,000	1,196,000	1,196,000	1,196,000	1,196,000	1,196,000	1,196,000
Mist Storage (NWN)	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000	520,000
Peak LNG	**501,508**	**501,508**	**501,508**	**501,508**	**501,508**	**501,508**	**501,508**	**501,508**	**501,508**	**501,508**
Newport/Portland LNG (NWN)	180,000	180,000	180,000	180,000	18[illegible],000	180,000	180,000	180,000	180,000	180,000
Gig Harbor Satellite LNG (PSE)	3,000	3,000	3,[illegible]00	3,000	[illegible],000	3,000	3,000	3,000	3,000	3,000
Swarr Stn Propane (PSE)	10,000	10,000	10,0[illegible]0	10,000	[illegible]0,000	10,000	10,000	10,000	10,000	10,000
Tilbury LNG (FortisBC)	155,466	155,466	155,4[illegible]6	155,466	[illegible]5,466	155,466	155,466	155,466	155,466	155,466
Mt. Hayes LNG (FortisBC)	153,042	153,042	153,04[illegible]	153,042	[illegible]53,042	153,042	153,042	153,042	153,042	153,042
Total Supply	**4,521,568**	**4,521,569**	**4,521,570**	**4,521,571**	**[illegible],521,572**	**4,521,573**	**4,521,574**	**4,521,575**	**4,521,576**	**4,521,577**
Supply Surplus/(Shortfall)	276,533	247,950	200,272	162,442	126,866	90,247	53,340	14,930	(24,808)	(66,227)

Table 1 – 2012 Gas Outlook Demand and Supply Data

The 2012 Gas Outlook identifies a potential shortfall in the ability to meet projected gas demands in the I-5. However, this analysis does not represent the uncertain nature of electric power plant operations. Demand for natural gas needed for electric power generation is difficult to predict because it responds to many uncertainties. Electric power generation must respond to fluctuations in customer demands during an extreme weather events, hydropower generation can be limited due to poor water conditions at hydropower plants and like all machines power generators are subject to unanticipated failures. Additionally, some electric power plants have the ability to switch to alternative fuels such as oil but this is limited by physical storage of oil on site and environmental limitations. The highly uncertain nature of electric power loads and generation make it a challenge to properly evaluate potential interactions between the natural gas and electric power systems that could potentially cause problems with natural gas supply and delivery.

4. Natural Gas Use for Electric Power Generation in the I-5 Corridor

The 2012 Gas Outlook supply/demand balance assumes the level of gas for power generation shown in Table 1. This includes some plants operating at maximum levels and other plants operating off of backup fuel. To better understand the potential for electric power generators to consume natural gas during peak periods of natural gas demand it was necessary to simulate electric power operations during 2015.

The following analysis utilized a regional power production cost model and focused on operations for every hour of 2015. The model is a detailed production cost simulation model that can evaluate the impact of possible sources of uncertainty caused by major variables such as weather, hydropower production and wholesale power market prices. To help understand the range of possible outcomes this analysis was conducted over 500 simulated future operating scenarios. Unlike the 2012 Gas Outlook report, this analysis does not take fuel switching into account.

The results provide a range of natural gas for power generation that can be compared with the assumptions used in the 2012 Gas Outlook. Figure 3 shows the results of the analysis for a peak day in January 2015 for all electric power generation in the I-5 Corridor. Figure 3 also relies on the estimates of "direct use" and total supply from the 2012 Gas Outlook. This shows that the total gas demand is roughly in balance with the total gas supply including full use of storage facilities as is shown in Figure 3.

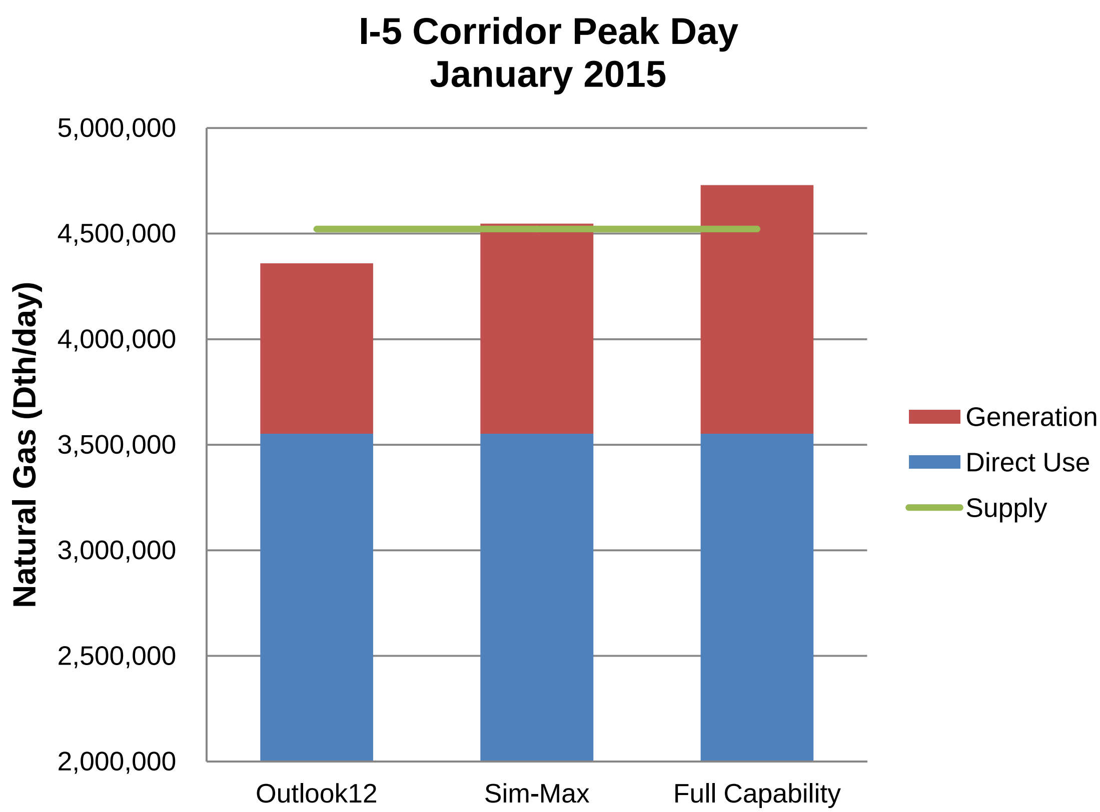


Figure 3 – Simulated Maximum Demand for Natural Gas for Electric Power Generation Combined with Direct Use of Gas (coincidental peak day)

Table 2 contains a list of power plants that are in the I-5 corridor. These plants were chosen to provide an aggregate picture of the demand for natural gas during peak periods in the winter of 2015. The natural gas to supply these plants must be delivered by the same natural gas infrastructure that serves all other users in the I-5 corridor. The combination of direct use and fuel for electric power generation for a peak day is compared to the total gas infrastructure delivery capability available in the I-5 corridor and as reported in the 2012 Gas Outlook. This analysis presents what might be a reasonable "worst case" scenario for a coincidental peak day.

			Natural Gas (Dth/day)			
			Outlook '12			
Project	Owner	Nameplate MW	Peak Day	Non-Coincident Maximum	Coincident Maximum	Full Capability
BC Lower Mainline & Vancouver Island						
Burrard	BC Hydro	950	218,946	237,204	218,599	218,946
Vancouver Island	IPP to BC Hydro	254	42,652	44,152	39,519	42,652
			261,598	**281,356**	**258,118**	**261,598**
W. Oregon (I-5)						
Alden Bailey	Clatskanie PUD	11	-	623	311	3,326
Beaver	Portland General Electric	586	-	101,532	60,074	161,791
Beaver 8	Portland General Electric	25		1,582	1,242	6,762
Port Westward	Portland General Electric	415	87,000	67,519	67,519	67,728
		1,037	**87,000**	**171,256**	**129,146**	**239,608**
W. Washington (I-5)						
Big Hanaford	TransAlta	248	30,000	46,923	46,923	42,854
Chehalis Generating Facility	PacifiCorp	517	90,000	91,946	88,115	86,856
Encogen	Puget Sound Energy	159	39,020	37,879	30,303	35,283
Frederickson Generation Station	EPCOR Power L.P./PSE	258	-	45,595	45,595	43,858
Fredonia 1 & 2	Puget Sound Energy	208	-	35,364	25,181	69,738
Fredonia 3 & 4	Puget Sound Energy	108	-	20,676	18,092	27,442
Fredrickson 1 & 2	Puget Sound Energy	149	46,654	10,041	6,301	59,417
Goldendale	Puget Sound Energy	261	48,998	42,841	42,691	43,817
Grays Harbor (Satsop)	Invenergy	650	-	109,661	108,387	109,200
March Point 1	March Point Cogen	80	15,345	11,502	11,502	16,320
March Point 2	March Point Cogen	60	15,345	9,515	9,515	16,344
Mint Farm Energy Center	Wayzata Investment Part	305	51,321	54,413	54,142	52,623
River Road Generating Project	Clark Public Utilities	248	48,000	42,067	42,067	43,152
Sumas Energy	Puget Sound Energy	121	25,919	36,348	19,670	24,286
Tenaska	Tenaska	245	47,746	54,843	54,843	48,098
Whitehorn #2 & 3	Puget Sound Energy	149	-	7,045	4,583	54,685
		3,765	**458,348**	**656,658**	**607,908**	**773,973**
Total		**4,802**	**806,946**	**1,109,270**	**995,172**	**1,275,179**

Table 2 – Natural Gas Use by Electric Power Generation in the I-5 Corridor

Figure 4 shows the modeled use of natural gas for power production for each month in 2015 based on this analysis. This chart shows the average monthly consumption of natural gas and the peak hourly demand to fuel the power plants in the I-5 Corridor. For a point of comparison, the 2012 Gas Outlook estimated peak "direct use" of natural gas in the I-5 Corridor is shown for the month of January.

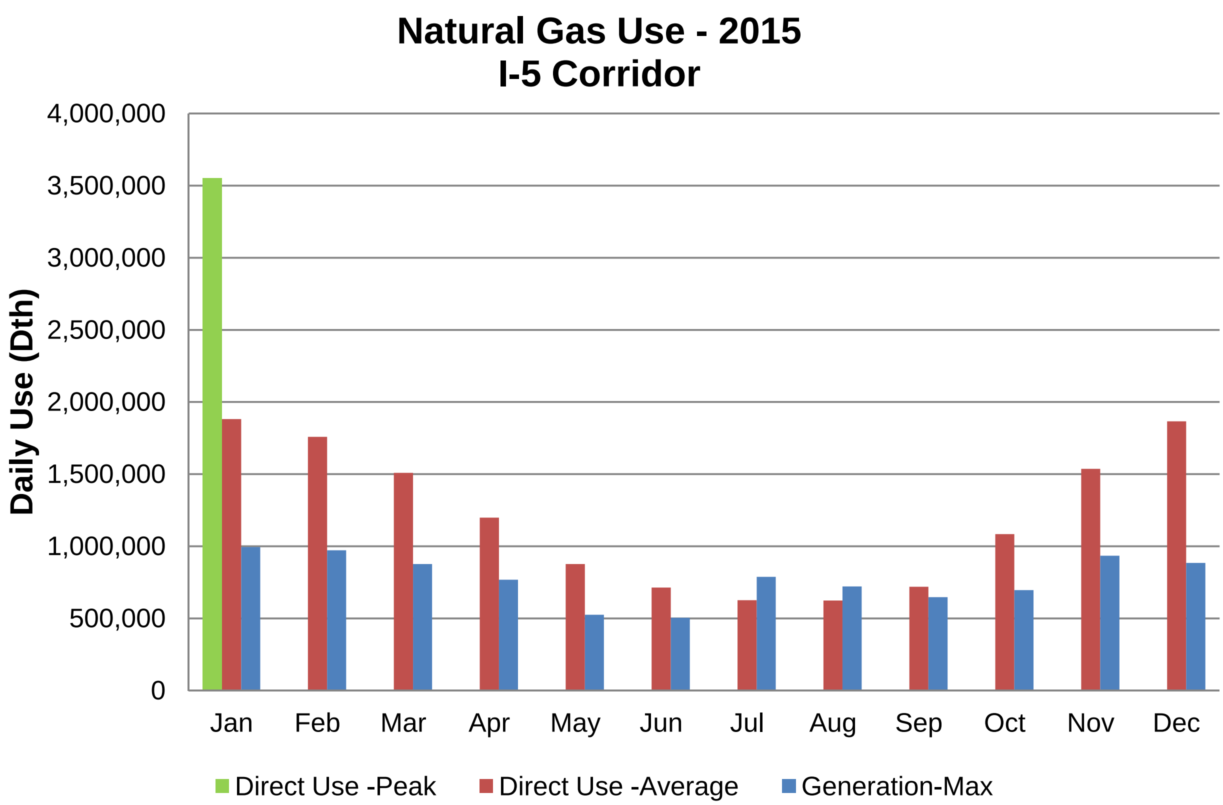


Figure 4 – Natural Gas Use for Power Generation by Month

However, the analysis provides additional detail about how electric power plants are likely to operate across the peak day. The simulated hourly operation of the Northwest natural gas power plants indicates that individual plants are not likely to operate flat for 24 hours. Rather, they typically ramp up their generation from low levels in the morning to higher levels in the afternoon and evening. Examples from the simulation of winter and summer days have been examined to explore the range of natural gas demand throughout the day. The implications of power plant ramping on pipeline and storage operations needs to be further examined.

Figure 5 illustrates the simulated operations of all natural gas fired power plants in the I-5 Corridor. The graph contains example operations for both a summer and winter day (note that these are not peak days). The pattern for both days is similar due to the typical shape of electric power demand throughout the day. Demand for electricity begins at its lowest in the period near midnight and then begins to climb when the work day starts and peaks in the late afternoon/early evening. This pattern is observable in Figure 5 and shows that demand for natural gas mirrors the demand for electric power over the day. The implications of gas demand changing from approximately 5,000 dekatherms (Dth) per hour to over 30,000 Dth per hour needs to be investigated with pipeline operators.

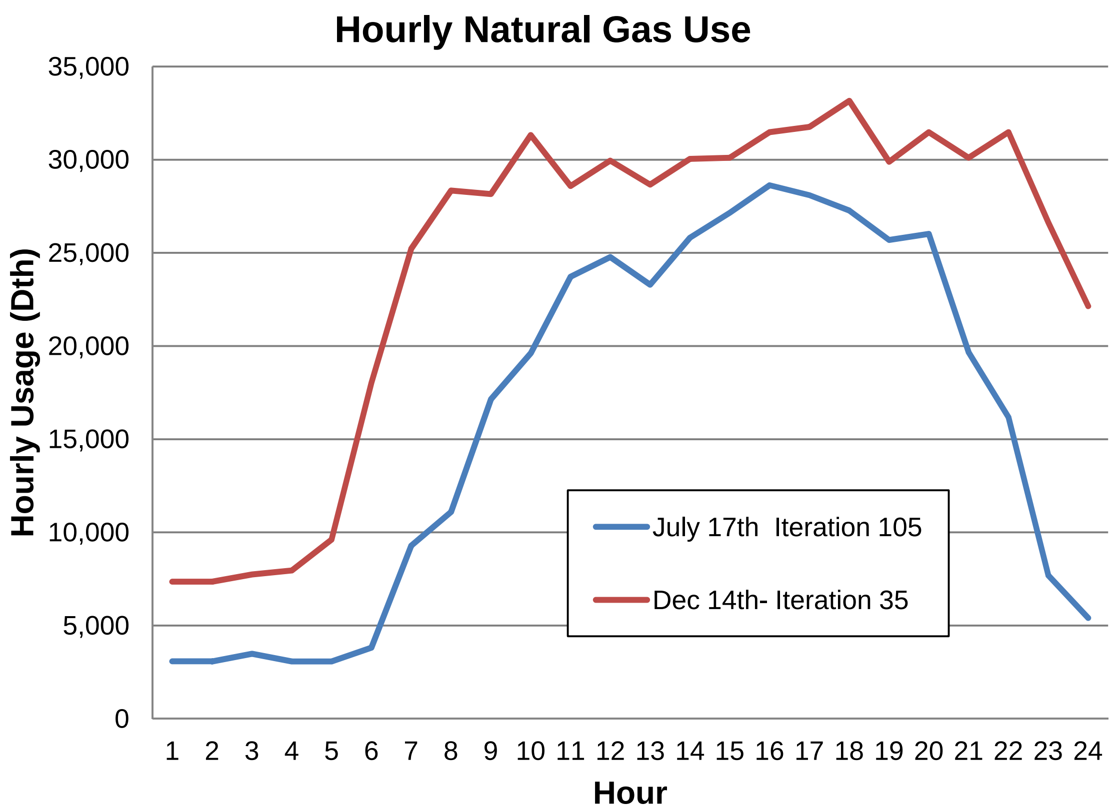


Figure 5 – Hourly Gas Demand for Electric Power Generation

It is not clear how much flexibility the existing pipeline infrastructure has to meet rapidly changing demands from electric power plants. However, Figure 6 illustrates estimates of the rate of change in gas plant demands for natural gas that resulted from these studies. This figure shows that over an 8 hour period gas demand could increase by over 20,000 Dth via demand ramping up or fall almost 30,000 Dth. Please note that these swings are not hourly – rather they show the difference between period X and the period eight hours earlier. These swings on natural gas demand need to be evaluated to determine what impacts this could have on pipeline and storage operations.

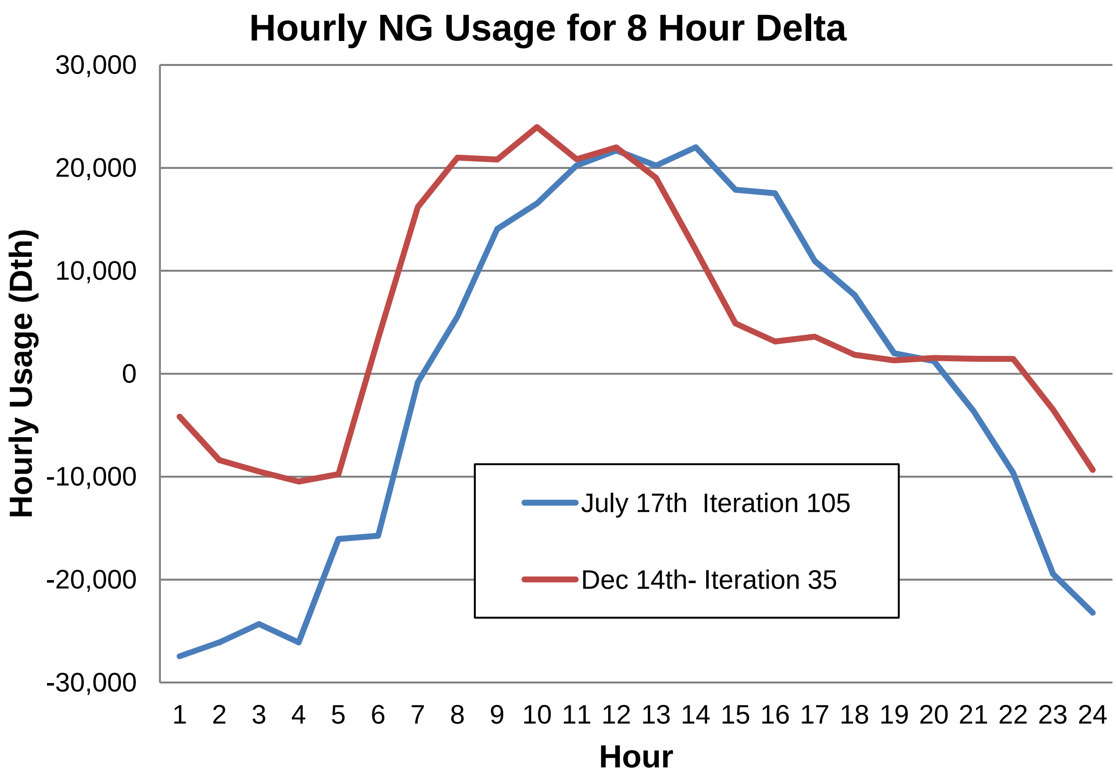


Figure 6 – Rate of Change in Natural Gas Demand for Power Generation, 8 hour delta

Figure 7 provides an estimate of the total gas demand for electric power generation over the peak day in both winter and summer. This figure shows that daily demand for gas is higher and more linear in winter months.

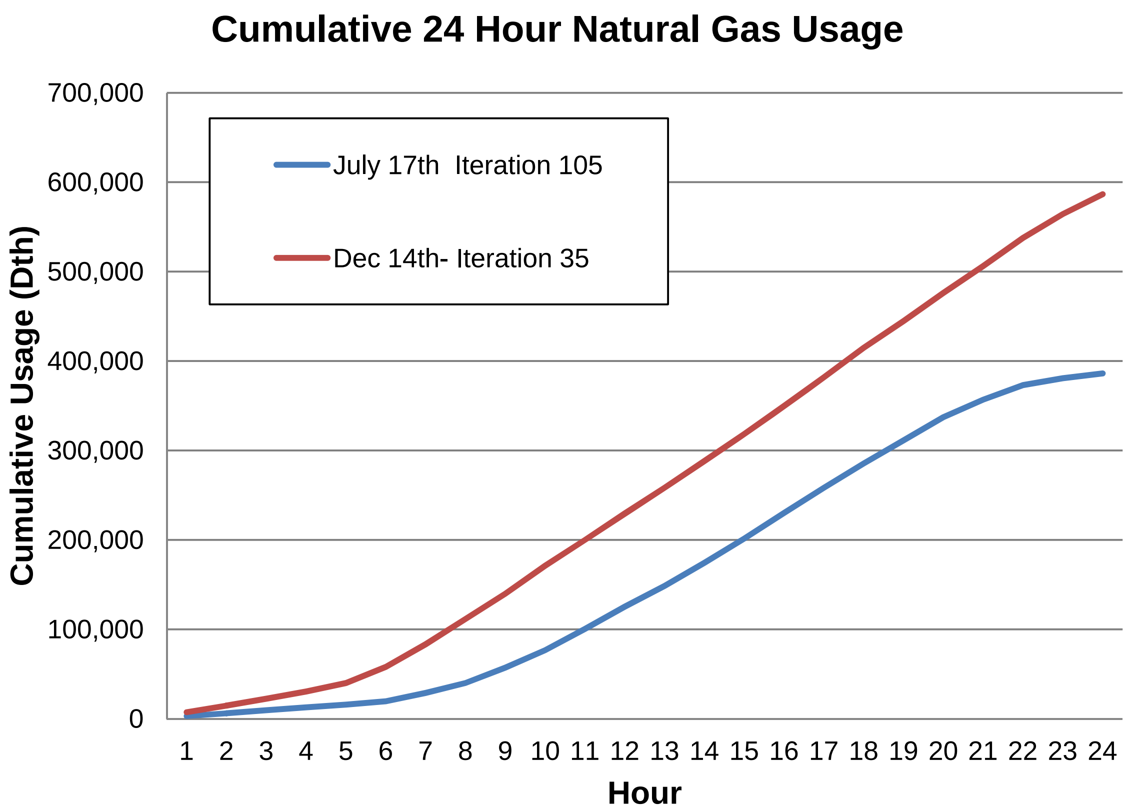


Figure 7 – Cumulative Example Day Natural Gas for Power Generation Use

The analysis conducted for I-5 power plant operations in 2015 was combined with estimates of direct use and available supply from the 2012 Gas Outlook report. The results of this combined analysis are shown in Table 3. The Outlook analysis estimated that 806,947 Dth of natural gas would be needed to meet power plant production needs during a peak winter day. However, the analysis estimated that the total demand for natural gas could reach 995,172 Dth. This is 23 percent higher demand than anticipated in the Outlook 2012 analysis and suggests that there would be a shortfall in gas deliveries that day of 25,782 Dth. It should be noted that scenarios exceeding the estimated maximum supply only occurred in 3 of 500 simulations and that there likely is enough backup fuel available to absorb a one day shortfall of 25,782 Dth. The absolute worst case would be a power demand that required all power plants in the I-5 Corridor to be operating using natural gas at the same time - this would result in a daily shortfall of 307,789 Dth, nearly 10 percent of the estimated direct use.

	Peak Day		
Dth	Outlook12	Simulation Maximum	Full Capability
Demand			
Direct Use	3,552,181	3,552,181	3,552,181
Generation	806,947	995,172	1,275,179
Total	**4,359,128**	**4,547,353**	**4,827,360**
Supply			
Pipeline	2,304,063	2,304,063	2,304,063
Storage	1,716,000	1,716,000	1,716,000
LNG-peak	501,508	501,508	501,508
Total	**4,521,571**	**4,521,571**	**4,521,571**
Surplus(Shorfall)	**162,443**	**(25,782)**	**(305,789)**

Table 3 – Peak Day Simulated Operations with 2012 Gas Outlook Direct Use and Supply

5. Next Steps

No definitive conclusions have been made from this analysis. However there are times in this simulated operation when the winter demand of gas for generation plus the expected direct use of gas exceeds the infrastructure's supply capability. These conditions require further study to better understand when electric power generation will be limited by natural gas supply and delivery capability or whether switching to alternative fuels can alleviate these problems.

Specifically, the following questions should be answered so that both the natural gas and electric power industries better understand physical limitations and points at which additional gas supplies and pipeline delivery capabilities will be needed.

- Will the existing gas infrastructure be adequate to meet the range of hourly demands from power generators? Low and high limits?
- Are there limits to the rate of change that the existing infrastructure can provide?
- What seasons of the year will pose the greatest challenges, given that direct use of gas varies dramatically from winter to summer and the seasonal nature of natural gas storage?
- What is the effect of backup fuel on these estimates and is there additional backup fuel needed?
- When will new pipeline and/or storage infrastructure be needed and how much should be added in what locations?
- What level of reliability should the gas transportation strive to achieve? 1 in 20 years, 1 in 100 years?

6. Appendices

I-5 Direct Use

	StudyDeliveryZone	Receiving Party	Pipeline Source
BC Lower Mainline and Van Island			
ResidSales I-5	BC L.Mainland	FortisBC	Spectra (SET)
FSales-Coml I-5	BC L.Mainland	FortisBC	SET
FSales-Indl I-5	BC L.Mainland	FortisBC	SET
IntSales-Coml I-5	BC L.Mainland	FortisBC	SET
IntSales-Indl I-5	BC L.Mainland	FortisBC	SET
Transport-Coml I-5	BC L.Mainland	FortisBC	SET
Transport-Indl I-5	BC L.Mainland	FortisBC	SET
IntTransport-Coml I-5	BC L.Mainland	FortisBC	SET
IntTransport-Indl I-5	BC L.Mainland	FortisBC	SET
ResidSales I-5	Vancouver Island	FortisBC	Lower Mainland (LML)
FSales-Coml I-5	Vancouver Island	FortisBC	LML
FSales-Indl I-5	Vancouver Island	FortisBC	LML
IntSales-Coml I-5	Vancouver Island	FortisBC	LML
IntSales-Indl I-5	Vancouver Island	FortisBC	LML
Transport-Coml I-5	Vancouver Island	FortisBC	LML
Transport-Indl I-5	Vancouver Island	FortisBC	LML
IntTransport-Coml I-5	Vancouver Island	FortisBC	LML
IntTransport-Indl I-5	Vancouver Island	FortisBC	LML
W. Washington			
ResidSales I-5	W.Wash	Other(Sumas)	SET
FSales-Coml I-5	W.Wash	Other(Sumas)	SET
FSales-Indl I-5	W.Wash	Other(Sumas)	SET
IntSales-Coml I-5	W.Wash	Other(Sumas)	SET
IntSales-Indl I-5	W.Wash	Other(Sumas)	SET
Transport-Coml I-5	W.Wash	Other(Sumas)	SET
Transport-Indl I-5	W.Wash	Other(Sumas)	SET
IntTransport-Coml I-5	W.Wash	Other(Sumas)	SET
IntTransport-Indl I-5	W.Wash	Other(Sumas)	SET
ResidSales I-5	W.Wash	Cascade	SET
FSales-Coml I-5	W.Wash	Cascade	SET
FSales-Indl I-5	W.Wash	Cascade	SET
IntSales-Coml I-5	W.Wash	Cascade	SET
IntSales-Indl I-5	W.Wash	Cascade	SET
Transport-Coml I-5	W.Wash	Cascade	SET
Transport-Indl I-5	W.Wash	Cascade	SET
IntTransport-Coml I-5	W.Wash	Cascade	SET
IntTransport-Indl I-5	W.Wash	Cascade	SET
ResidSales I-5	W.Wash	Cascade	Northwest Pipeline (NWP)
FSales-Coml I-5	W.Wash	Cascade	NWP
FSales-Indl I-5	W.Wash	Cascade	NWP
IntSales-Coml I-5	W.Wash	Cascade	NWP
IntSales-Indl I-5	W.Wash	Cascade	NWP
Transport-Coml I-5	W.Wash	Cascade	NWP
Transport-Indl I-5	W.Wash	Cascade	NWP

IntTransport-Coml I-5	W.Wash	Cascade	NWP
IntTransport-Indl I-5	W.Wash	Cascade	NWP
ResidSales I-5	W.Wash	PSE	NWP
FSales-Coml I-5	W.Wash	PSE	NWP
FSales-Indl I-5	W.Wash	PSE	NWP
IntSales-Coml I-5	W.Wash	PSE	NWP
IntSales-Indl I-5	W.Wash	PSE	NWP
Transport-Coml I-5	W.Wash	PSE	NWP
Transport-Indl I-5	W.Wash	PSE	NWP
IntTransport-Coml I-5	W.Wash	PSE	NWP
IntTransport-Indl I-5	W.Wash	PSE	NWP
ResidSales I-5	W.Wash	NWNat'l	NWP
FSales-Coml I-5	W.Wash	NWNat'l	NWP
FSales-Indl I-5	W.Wash	NWNat'l	NWP
IntSales-Coml I-5	W.Wash	NWNat'l	NWP
IntSales-Indl I-5	W.Wash	NWNat'l	NWP
Transport-Coml I-5	W.Wash	NWNat'l	NWP
Transport-Indl I-5	W.Wash	NWNat'l	NWP
IntTransport-Coml I-5	W.Wash	NWNat'l	NWP
IntTransport-Indl I-5	W.Wash	NWNat'l	NWP
ResidSales I-5	W.Wash	Buckley/Enumclaw	NWP
FSales-Coml I-5	W.Wash	NWP	NWP
FSales-Indl I-5	W.Wash	NWP	NWP
IntSales-Coml I-5	W.Wash	NWP	NWP
IntSales-Indl I-5	W.Wash	NWP	NWP
Transport-Coml I-5	W.Wash	NWP	NWP
Transport-Indl I-5	W.Wash	NWP	NWP
IntTransport-Coml I-5	W.Wash	NWP	NWP
IntTransport-Indl I-5	W.Wash	NWP	NWP
W. Oregon			
ResidSales I-5	W.Ore	NWNat'l	NWP
FSales-Coml I-5	W.Ore	NWNat'l	NWP
FSales-Indl I-5	W.Ore	NWNat'l	NWP
IntSales-Coml I-5	W.Ore	NWNat'l	NWP
IntSales-Indl I-5	W.Ore	NWNat'l	NWP
Transport-Coml I-5	W.Ore	NWNat'l	NWP
Transport-Indl I-5	W.Ore	NWNat'l	NWP
IntTransport-Coml I-5	W.Ore	NWNat'l	NWP
IntTransport-Indl I-5	W.Ore	NWNat'l	NWP
ResidSales I-5	W.Ore	NWP	NWP
FSales-Coml I-5	W.Ore	NWP	NWP
FSales-Indl I-5	W.Ore	NWP	NWP
IntSales-Coml I-5	W.Ore	NWP	NWP
IntSales-Indl I-5	W.Ore	NWP	NWP
Transport-Coml I-5	W.Ore	NWP	NWP
Transport-Indl I-5	W.Ore	NWP	NWP
IntTransport-Coml I-5	W.Ore	NWP	NWP
IntTransport-Indl I-5	W.Ore	NWP	NWP
ResidSales I-5	W.Ore	Avista	NWP
FSales-Coml I-5	W.Ore	Avista	NWP
FSales-Indl I-5	W.Ore	Avista	NWP
IntSales-Coml I-5	W.Ore	Avista	NWP
IntSales-Indl I-5	W.Ore	Avista	NWP
Transport-Coml I-5	W.Ore	Avista	NWP
Transport-Indl I-5	W.Ore	Avista	NWP
IntTransport-Coml I-5	W.Ore	Avista	NWP
IntTransport-Indl I-5	W.Ore	Avista	NWP