Customer and Gas Demand Forecast

System Total Temperature-Adjusted Dth Sales and Throughput Comparison – 2015-2016 IRP and Actual Results

On a weather-normalized basis, Questar Gas' natural gas sales through the twelve months ending December 2015 totaled 111.3 MMDth. The Company projected a total of 113.1 MMDth in last year's IRP for the same time period. Customers adjusted their consumption behavior in response to the abnormally high temperatures during a record-setting warm heating season bringing temperature-adjusted usage below the projected level. Average usage per system-wide General Service (GS) customer on an annual basis was 106.2 Dth. The 2015-2016 IRP had projected an average of 108.7 Dth. Temperature-adjusted system throughput (sales and transportation) was 188.5 MMDth through the twelve months ending December 2015 compared to last year's IRP forecast of 197.0 MMDth for the same period. About 60% of the variance occurred in the electric generation sector where usage was notably lower than the prior year. Remaining variance is attributable to lower overall consumption during a warm heating season.

Temperature-Adjusted Dth Sales and Throughput Summary – 2016-2017 IRP Year

The 2015-2016 IRP year is projected to finish at 112.3 MMDth of temperature-adjusted system sales demand. The sales demand for the 2016-2017 IRP year is forecasted to be 111.6 MMDth. The reduction in total sales demand from the prior 2015-2016 IRP year is the result of approximately 2 MMDth in annual demand shifting from sales to transportation; nearly 140 GS, FS and IS customers will move to transportation service in July of 2016. Steady growth in the GS class is forecasted to bring demand to 122.7 MMDth for the 2025-2026 IRP year (see Exhibit 3.10).

The 2016-2017 IRP sales forecast of 111.6 MMDth will be the denominator used in the calculation of the percentage of sales supplied by cost-of-service production per the Trail Unit Settlement Stipulation. The numerator will be the actual cost-of-service quantity as reported at the wellhead.

The forecast projects GS customer growth from 1.02 million customers in the 2016-2017 IRP year to more than 1.2 million GS customers by the end of the 2025-2026 IRP year (see Exhibit 3.1). The Company projects that the annual Utah GS usage per customer will be 103.4 Dth in the 2016-2017 IRP year and decline to 93.0 Dth by end of the 2025-2026 IRP year (see Exhibit 3.2). Annual Wyoming GS usage per customer is projected to be 135.4 Dth in the 2016-2017 IRP year and decline to 116.9 by the end of the 2025-2026 IRP year (see Exhibit 3.5).

The Company projects annual usage per Utah residential customer to be 78.6 in the 2016-2017 IRP year and decline to 69.4 Dth (see Exhibit 3.3) by the end of the 2025-2026 IRP year. The Company projects the average annual usage per Utah GS commercial customer to be 442.0 Dth in the 2016-2017 IRP year and 424.2 Dth by the end of the 2025-2026 IRP year (see Exhibit 3.4). The Company projects annual usage per Wyoming residential customer to be at 92.8 Dth in the 2016-2017 IRP year and 82.9 Dth by the end of the 2025-2026 IRP year (see Exhibit 3.6). The Company projects annual usage per Wyoming GS commercial customer to be 484.8 Dth in the 2016-2017 IRP year and 399.1 Dth by the end of the 2025-2026 IRP year (see Exhibit 3.7).

The Company expects system total throughput in this year's forecast to increase from 191.6 MMDth during the 2016-2017 IRP year to 204.0 MMDth by end of the 2025-2026 IRP year (see Exhibit 3.10).

Residential Usage and Customer Additions

This year the Company expects the rate of customer growth to continue its upward momentum as healthy economics and in-migration lead to increased housing demand. GS demand in both the residential and commercial classes will continue to grow as a result. Non-GS commercial and industrial consumption will continue to grow modestly.

Utah

Utah residential GS customer additions through the twelve months ending December 2015 totaled 27,165, including the addition of approximately 6,500 customers from the acquisition of the Eagle Mountain system in Utah County in February of 2015. The Company projects about 21,000 additions by the end of the 2015-2016 IRP year. Expectations of sustained momentum in housing construction lead to a forecast of about 19,000 residential additions in the 2016-2017 IRP year and 20,000 in the 2017-2018 IRP year. The slight decline in forecasted additions relative to the 2015-2016 IRP year stands on an expectation of slightly fewer multi-unit dwellings being constructed over the next couple of years.

Actual temperature-adjusted residential usage per customer for the twelve months ending December 2015 was 79.95 Dth. The Company projects an average of 78.55 for the 2016-2017 IRP year. The overall downward trend in average consumption is expected to continue through the 2025-2026 IRP year as the pace of new dwelling construction increases and energy efficiency programs continue to incentivize greater efficiency (see Exhibit 3.3).

The Company uses both statistical and deterministic end-use modeling approaches to analyze and forecast residential gas demand. The end-use model estimates consumption for space heating, water heating, and other gas appliance use based on appliance efficiency and housing characteristics. The model incorporates estimates of housing characteristics, natural gas appliance saturation by efficiency rating throughout the residential customer base, customer growth projections, and projected changes in economic variables that affect use per customer such as the average residential gas bill and household income.

The model also addressed the effects on use per customer from the Company's energy-efficiency programs based on past and projected participation. The Company also employs statistical time series analysis, both univariate and multivariate, to estimate systematic variation of demand over time based on history and to the effects of commodity price and long-term trend on residential demand. The Company uses Microsoft Excel to conduct the end-use modeling, and SAS Enterprise Time Series 13.1 for the statistical time series modeling.

Wyoming

During the twelve months ending December 2015, Wyoming residential customer additions totaled 84, reflecting the continuation of a slowdown in housing construction in the service area that began in the spring and summer months of 2014. The Company expects a modest increase in housing demand in the service area and forecasts about 227 additions in the 2016-2017 IRP year and 259 in the 2017-2018 IRP year.

The average annual usage per residential customer in Wyoming was 89.60 Dth in calendar year 2015, a decline of 3.68 Dth over the year prior. The Company expects a slight increase in the average during the 2016-2017 IRP year and then a continuation of the long-term downward trend perpetuated by greater appliance and housing shell efficiencies. The projected average in the 2016-2017 IRP year is 92.79. And a sustained decline brings the average to 82.88 in the 2025-2026 IRP year (see Exhibit 3.6).

Small Commercial Usage and Customer Additions

Utah

Temperature-adjusted Utah GS commercial usage per customer for the twelve months ended December 2015 was 448.91 Dth. This year's forecast reflects a continuation of a general downward trend with an average of 441.99 Dth by the end of the 2016-2017 IRP year and 439.76 in the 2017-2018 IRP year (see Exhibit 3.4).

Utah GS commercial customer additions are projected to increase along with the residential level. The Company forecasts approximately 1,100 additions through the 2016-2017 IRP year and about 1,300 in the 2017-2018 IRP year.

Wyoming

Usage among commercial GS customers in Wyoming for the twelve months ended December 2015 averaged 490.37 Dth. The Company projects an average of 484.78 by the end of the 2016-2017 IRP year and 473.46 during the 2017-2018 IRP year. The average is expected to continue its general decline through the forecast period.

The forecast projects about 30 additions in the 2016-2017 IRP year, and about the same amount in the 2017-2018 IRP year.

Large Commercial, Industrial and Electric Generation Gas Demand

As shown in Exhibit 3.8, annual gas demand among large commercial and industrial customers is steady with modest year-over-year increases. The Company expects demand to grow from 49.6 MMDth in the 2016-2017 IRP year to 52 MMDth in the 2025-2026 IRP year.

Annual demand among electric generation customers decreased over the prior year by about 5 MMDth in 2015. Much of the total demand is used for peaking load generation and can vary considerably over time making accurate forecasting difficult. However, the overall demand increase resulting from the Lake Side expansion appears to have stabilized. The forecast projects a leveling off of electric generation demand at the current level of about 36 MMDth per year.

Firm Customer Design-Day Gas Demand

The design-day peak demand forecast is based on a one-in-twenty year (five occurrences in 100 years) weather event. More specifically, the design-day firm customer peak demand projection is based on a theoretical day when the mean temperature is –5 degrees Fahrenheit at the Salt Lake Airport weather station and corresponding design-day temperatures are seen coincidentally across the Company's service territory.

Wind speed, temperature and prior-day demand are significant factors in the prediction of daily gas sendout during the winter heating season. Note that the design-day demand projection distinguishes between firm sales and firm transportation demand for gas supply and system capacity planning purposes.

As shown in Exhibit 3.9, the firm sales and firm transportation sendout for the heating seasons of 2010-2011 through 2015-2016 show actual firm sendout for the coldest day in each season. Design-day conditions did not occur during those time periods. The firm sales design-day gas supply projection for the 2016-2017 heating season is 1.316 MMDth and grows to 1.452 MMDth in the winter of 2025-2026.

Periods of Interruption

The Company estimates that under peak conditions approximately 37,000 Dth could be curtailed across the system (34,000 Dth of interruptible transportation and 3,000 Dth of interruptible sales).

Questar Gas' Utah Natural Gas Tariff No. 400 (Tariff) states, "At times there may be a need for interruption on an isolated portion of the Company's system." In 2009, the Company performed an analysis to determine if isolation of certain system segments could alleviate pressure concerns while limiting the impact on customers that are neither affected by nor can affect pressures on that segment. The Company determined that it could effectively manage interruptions through Interruption Zones, which it updates on an annual basis. The Company is continually working to improve its interruption processes to ensure the reliability of service.

Source Data

Where available, the Company has obtained economic, demographic and other data from state and local sources such as the University of Utah (Bureau of Economic and Business Research) and the Utah Governor's Office of Planning and Budget. When current local data were not available, the Company used nationally recognized sources such as the U.S. Energy Information Administration, the U.S. Census Bureau, IHS Global Insight and Moody's Analytics.

The Utah and Wyoming Economic Outlook

Table 3.1 and Table 3.2 below show the recent history and the current economic outlook for Utah and Wyoming:

Table 3.1: Summary of Utah Economy
Annual Percentage Change

Description	2010 – 2015	2015 - 2016	2015 - 2020	2015 – 2023
Population	1.6%	1.9%	1.9%	1.9%
Personal Income	5.3%	5.0%	5.9%	5.9%
Construction Employment	5.0%	9.6%	7.2%	6.1%
Manufacturing Employment	2.4%	1.8%	1.1%	0.9%
Non-Manufacturing Employment	3.2%	2.5%	2.3%	2.2%
Total Employment	3.1%	2.4%	2.2%	2.1%
Average Housing Starts	13,823	19,270	22,758	24,408

Source: Spring 2016 Long-term Forecasts by IHS Global Insight

Table 3.2: Summary of Wyoming Economy
Annual Percentage Change

Description	2010 – 2015	2015 - 2016	2015 - 2020	2015 – 2023
Population	0.8%	0.5%	0.5%	0.5%
Personal Income	5.1%	2.1%	4.4%	4.5%
Construction Employment	1.2%	3.1%	2.3%	1.7%
Manufacturing Employment	2.5%	-0.5%	0.4%	0.5%
Non-Manufacturing Employment	0.7%	-0.7%	0.6%	0.7%
Total Employment	0.8%	-0.7%	0.6%	0.7%
Average Housing Starts	2,041	1,818	2,004	2,055

Source: Spring 2016 Long-term Forecasts by IHS Global Insight

The U.S. Economic Outlook

Table 3.3 is a review of recent history and Table 3.4 shows the consensus economic outlook:

Table 3.3: **U.S. MACROECONOMIC FORECAST**
Source: IHS GLOBAL INSIGHT Review of the U.S. Economy – April 2016

						Forecast	
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Real Gross Domestic Product 1/	2.5	1.6	2.2	1.5	2.4	2.4	2.1
GDP Price Index - Chain Wt. 1/	1.2	2.1	1.8	1.6	1.6	1.0	1.5
CPIU 1/	1.6	3.1	2.1	1.5	1.6	0.1	1.0
Real Disposable Income 1/	1.0	2.5	3.1	-1.4	2.7	3.4	2.8
Pre-tax Profits 1/	25.0	4.0	10.0	2.0	1.7	-3.1	1.8
Unemployment Rate 3/	9.6	8.9	8.1	7.4	6.2	5.3	4.8
Housing Starts 4/	0.6	0.6	0.8	0.9	1.0	1.2	1.2
3-month Treasury Bills 3/	0.1	0.1	0.1	0.1	0.03	0.1	0.5
30-Year Fixed Mortgage Rate 3/	4.7	4.5	3.7	4.0	4.2	3.9	3.9
Trade Balance 2/	-442	-460	-450	-377	-390	-484	-418
Vehicle Sales – Total 4/	11.6	12.7	14.4	15.5	16.4	17.3	17.8
Real Non-Res Fixed Investment 1/	2.5	7.7	9.0	3.0	6.2	2.8	1.2
Industrial Production 1/	5.5	2.9	2.8	1.9	2.9	0.3	-0.8

1/ Annual Rate of Change (Percent)
2/ Billions of 1996 chained dollars
3/ Percent
4/ Million Units

Table 3.4: Long-term U.S. Economic Outlook
Source: IHS GLOBAL INSIGHT Review of the U.S. Economy – April 2016

	2017	2018	2019	2020	2021	2022	2023
Real Gross Domestic Product 1/	2.8	2.7	2.4	2.4	2.4	2.4	2.3
GDP Price Index - Chain Wt. 1/	2.0	2.1	2.0	2.1	2.1	2.1	2.0
CPIU 1/	2.2	2.6	2.6	2.6	2.6	2.5	2.5
Real Disposable Income 1/	3.2	3.3	3.0	2.5	2.4	2.4	2.2
Pre-tax Profits 1/	3.6	2.7	3.0	3.4	2.5	3.1	1.1
Unemployment Rate 3/	4.7	4.7	4.9	4.9	4.9	4.8	4.7
Housing Starts 4/	1.4	1.5	1.5	1.6	1.6	1.7	1.7
3-month Treasury Bills 3/	1.4	2.3	2.8	2.8	2.8	2.8	2.8
30-Year Fixed Mortgage Rate 3/	4.4	5.1	5.7	5.7	5.7	5.7	5.7
Trade Balance 2/	-417	-519	-570	-600	-641	-694	-769
Vehicle Sales - Total 4/	18.2	18.1	17.7	17.3	17.1	17.0	17.0
Real Non-Res Fixed Investment 1/	5.4	5.3	4.5	4.1	4.1	4.0	3.8
Industrial Production 1/	2.8	3.4	2.6	2.8	2.5	2.4	2.2

1/ Annual Rate of Change (Percent)
2/ Billions of 1996 chained dollars
3/ Percent
4/ Million Units

Alternatives to Natural Gas

Questar Gas customers have alternatives to using natural gas for virtually every application. Some energy applications are dominated by another fuel (cooking, clothes drying) while others are dominated by natural gas (space and water heating). A material shift in customer preference would affect future demand and load profiles. While considering alternatives one must consider full fuel-cycle efficiency.

Full Fuel-Cycle Efficiency

Natural gas remains the most efficient and least expensive form of energy for use in space heating, water heating, cooking and clothes drying applications. This is particularly evident when natural gas is compared to electricity through a full fuel-cycle analysis. Full fuel-cycle analysis looks at the journey of different forms of energy, and their associated losses, from the point of production to the point at which the customer receives and uses the energy. Figure 3.1 shows that for each 100 MMBtu of natural gas extracted, 92 MMBtu are delivered to the customer for direct use. Conversely, for each 100 MMBtu of other energy sources extracted for conversion to electricity, 32 MMBtu are ultimately delivered to the customer for direct use. In other words, converting any fuel source into electricity to power comparable electric end-use products only maintains 32% of usable energy.

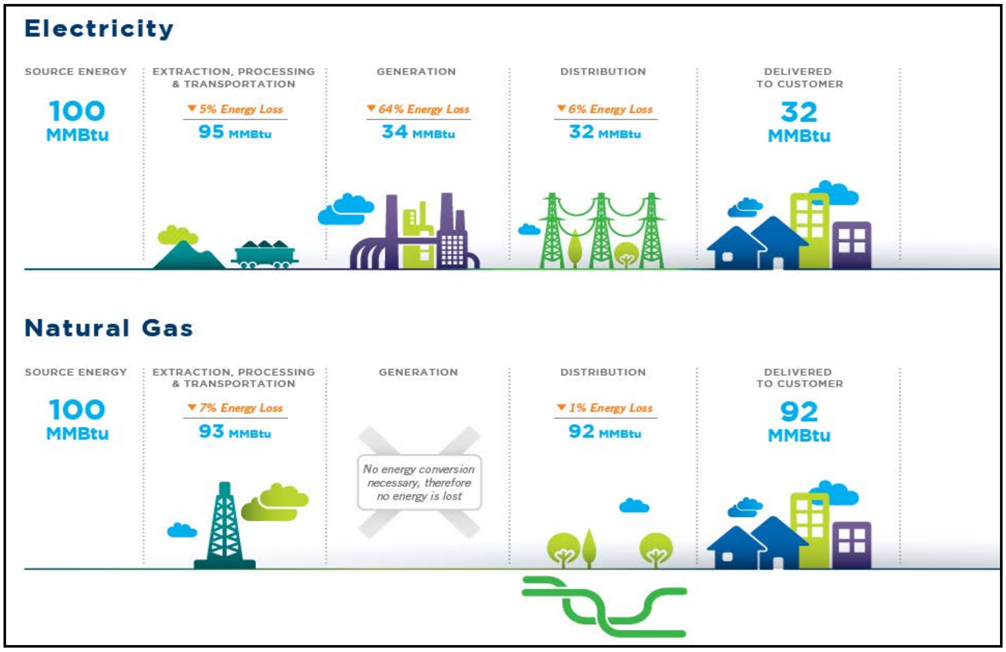

Figure 3.1 – Full Fuel-Cycle Analysis
(Source: American Gas Association 2014 Playbook)

A recent American Gas Association (AGA) study focused on the cost-to-operate differential between natural gas and electric appliances. The study used 2014 average utility rates and compared natural gas and electric water heaters of similar efficiency and size. The findings of the study show that a .62 energy factor (EF) natural gas water heater is nearly $300 less expensive to operate annually than an electric storage water heater ranging between .945 and .951 EF. Additionally, the study found that the direct use of natural gas in typical home appliances resulted in 28% less energy consumption than a similar home with all electric appliances.

The lower energy consumption and fuel-cycle efficiency of natural gas not only equates to lower customer bills but also significantly lower greenhouse gas emissions.

Figure 3.2 shows the full fuel-cycle greenhouse gas emissions (in metric tons) of a typical U.S. household generated from various forms of energy.

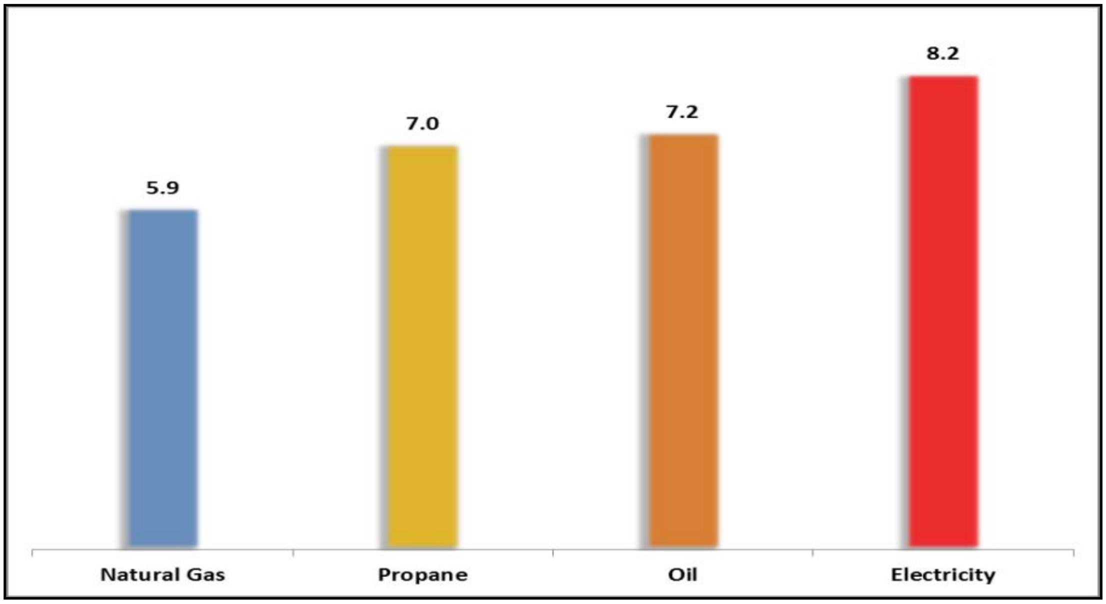

Figure 3.2 – Full Fuel-Cycle Greenhouse Gas Emissions
(Source: American Gas Association 2014 Playbook)

Solar

Although solar penetration is a significant issue for electric utilities, Questar Gas does not currently anticipate that solar-powered space or water heat will have a significant impact in the Company's natural gas service territory. However, as solar panels become more affordable with lower material cost and continued federal and state tax credits, their application will become more prevalent in the residential and commercial markets.

The Company will continue to monitor this issue and participate in studies with the Gas Technology Institute (GTI) and others and will report any impacts on the service territory in future IRPs.

Heat Pumps

In the 2015-2016 IRP, the Utah Commission ordered the Company to provide information and perform a study on potential regulatory issues related to heat pumps.

In the Customer and Gas Demand Forecast section of the 2015-2016 IRP, the Company provided a brief discussion on technologies that have the potential to substantially reduce demand for natural gas space and water heat while also not decreasing the Company's cost to serve such customers. Technologies, known as heat pumps, use the ambient air (air source) or geothermal (ground source) sources to create space and water heat for both residential and commercial applications. Traditional air and ground source heat pumps use electricity to power the generation of heat. In addition to traditional systems, a new absorption heat pump has begun to expand from traditional commercial applications to residential products. Absorption heat pumps replace electricity with natural gas or some other fuel source in order to power the system. As popular as heat pumps have become, all of the different applications face common challenges.

In this section the Company will provide the results of the Commission-ordered study by (1) providing an overview of how the different types of heat pumps work, (2) exploring the operating temperature issues related to heat pumps, (3) discussing common uses and challenges associated with the technology, (4) explaining the potential impact of heat pumps on peak demand and (5) discussing potential cost recovery and cross subsidy issues associated with heat pump customers.

Air Source Heat Pumps

The technology employed by air source heat pumps has been in use for many years in the form of air conditioners, refrigerators, and freezers. In these applications, the pump (Figure 3.3) moves heat to an external environment (condenser) and replaces it with cool air (evaporator).

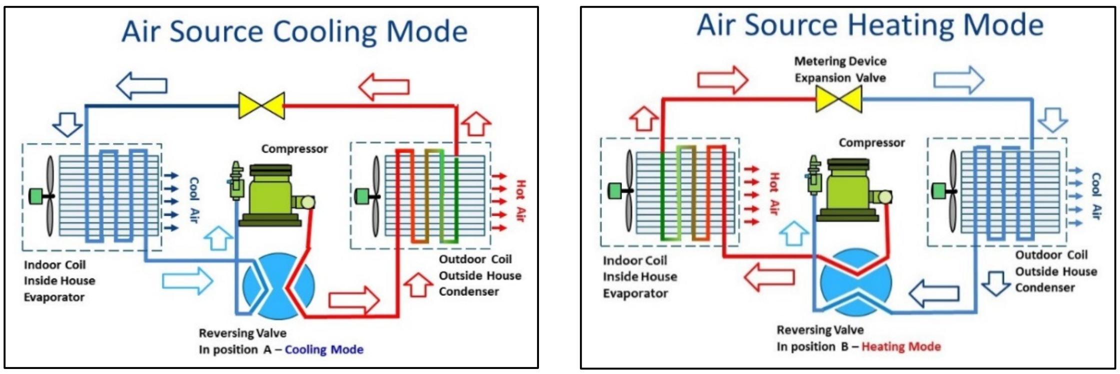

Figure 3.3 - Air Source Heat Pump Cooling & Heating Modes
(Source: Energy Solutions Center)

Air source heat pumps used in space and water heating applications operate in the opposite direction, drawing heat from an external environment (condenser) and transferring it into the conditioned space or water heating tank (evaporator). A simple example of how an air source system works would be the everyday can of compressed air which is used to dust keyboards and other office electronics. As air is released and pressure in the spray can drops, the temperature also drops and the can becomes cold to the touch. Conversely, if air were to be compressed, the spray can would feel hot as the pressure in the can increased.

Air source heat pumps have different operating requirements than traditional space and water heating systems. For space heating, the use of programmable thermostats is not recommended as shorter run periods will decrease efficiency and may degrade the useful life of the system. Air source space heating systems can also develop problems if filters are not changed regularly, if ducts are leaky, if system airflow is low or if refrigerant is incorrectly charged.

Cool winter temperatures, such as those experienced in Utah, create additional air source heat pump operating issues. As temperatures fall, it becomes more likely that a heat pump will not be able to raise a home's internal temperature to a comfortable level. As a result, heat pumps in the Company's service territory require a backup heat source such as a natural gas furnace or an auxiliary heating element. These heating elements use electricity to inefficiently heat wires that look and act much like the heating wires in a toaster. For air source heat pump water heaters, which draw heat from inside the building envelope, the system either switches to electricity as the temperature drops or ejects the cold air byproduct (if operating in heat pump mode) into the conditioned space. Heat pump efficiency and operating temperature issues are discussed in greater detail later in this section.

Ground Source Heat Pumps

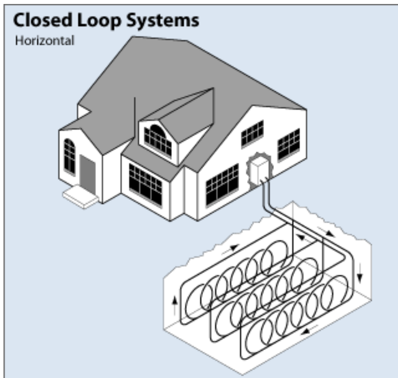

Figure 3.4 - Closed loop ground source heat pump (Source: USDOE)

Ground source heat pumps, also referred to as geothermal or water source heat pumps, have also been in use for a number of years. These systems use the constant temperature of the earth/ground water as the exchange medium instead of ambient air. This allows the system to reach higher levels of efficiency than air source heat pumps. One recent study found that the performance of ground source pumps was 34% better than the similarly-sized air source seasonal heat performance of systems.

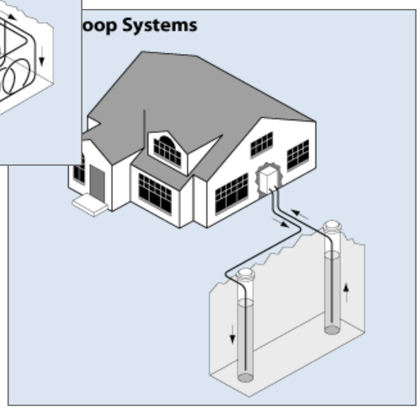

Figure 3.5 – Open-loop ground source heat pump (Source: USDOE)

As with any heat pump, ground source heat pumps are able to provide heating and cooling for both residential and commercial applications. Additionally, these systems are capable of supplying hot water. Some ground source systems are available with two-speed compressors and variable fans for more comfort and energy savings. Relative to air source heat pumps, they are quieter, last longer, need little maintenance, and do not depend on the temperature of the outside air.

The main types of ground source heat pumps used in Utah are classified as either closed or open-loop systems. Most closed-loop systems (Figure 3.4) circulate an antifreeze solution through a closed-loop - usually made of ¾ inch plastic tubing - that is buried in the ground, below the frost line. A heat exchanger transfers heat between the refrigerant in the heat pump and the antifreeze solution in the closed loop. The loop can be in a horizontal, vertical, or pond/lake configuration.

Open-loop systems (Figure 3.5) use well or surface body water as the heat exchange fluid. Once it has circulated through the system, the water is returned to the ground through the same well, through a recharge well, or is discharged as waste water above ground.

Ground source heat pumps can be used in more extreme climates than air source systems because of the stability of earth/ground water temperatures. Even on the coldest days of the year, ground source systems can perform at efficiency levels as high as 400% without requiring a backup heat source. Owner satisfaction with ground source heat pumps is also usually high. These systems however are not without challenges. Ground source systems are costly to purchase and maintain. A recent study performed by the Company found costs for ground source systems in Utah average between $30,000 and $60,000 for residential applications and $1 million or more for commercial systems. System prices vary due to factors such as size, soil composition, system type (e.g. vertical or horizontal closed loop, open loop) and the percentage of space heating being provided by the ground source heat pump. Because of these costs, payback periods on ground source systems are 15 years or more when compared to the common natural gas furnace and water heater.

Ground source systems typically require large amounts of land to install. For example, a horizontally installed closed loop ground source heat pump might need three loops of 400 to 600 ft long plastic tubing in order to produce 36,000 Btu per hour of heat. While open-loop ground source heat pumps take up less land, they do require an adequate supply of clean ground water. In addition, open-loop systems must deal with potential aquifer and well contamination issues. Because of these water issues some jurisdictions throughout the country have banned open-loop systems.

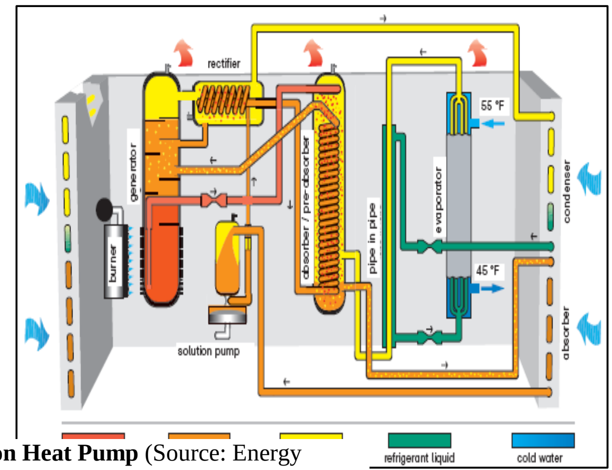

Figure 3.6 - Absorption Heat Pump (Source: Energy Solutions Center)

Absorption Heat Pumps

Absorption heat pumps (Figure 3.6) are essentially air source heat pumps powered not by electricity, but by natural gas or some other fuel source. Because natural gas is the most common fuel source for absorption heat pumps, they are also referred to as gas-fired heat pumps. Residential absorption heat pumps use an ammonia-water absorption cycle to provide heating and cooling. As in a standard heat pump, the refrigerant (in this case, ammonia) is condensed in one coil to release its heat; its pressure is then reduced and the refrigerant is evaporated to absorb heat. If the system absorbs heat from the interior of your home, it provides cooling; if it releases heat to the interior of your home, it provides heating.

The difference between absorption heat pumps and traditional air-source heat pumps is that the evaporated ammonia is not pumped up in pressure in a compressor, but is instead absorbed into water. A relatively low-power pump can then pump the solution up to a higher pressure. The problem then is removing the ammonia from the water, and that's where the heat source comes in. The heat essentially boils the ammonia out of the water, starting the cycle again.

Although currently used in industrial or commercial settings, absorption heat pumps are on the verge of commercial availability for large residential (4,000 square feet or bigger) homes. One such unit which is presently under development has shown the ability to provide 85,000 Btu per hour in heating mode and 3.5 tons of air conditioning in cooling mode while reducing overall energy usage by 30% to 50%. Initial equipment costs for this system are estimated to be $5,500. The Company will continue to monitor the development of absorption heat pumps and report to the Energy Efficiency Advisory Group on this technology as additional information becomes available.

Heat Pump Efficiency & Operating Temperatures

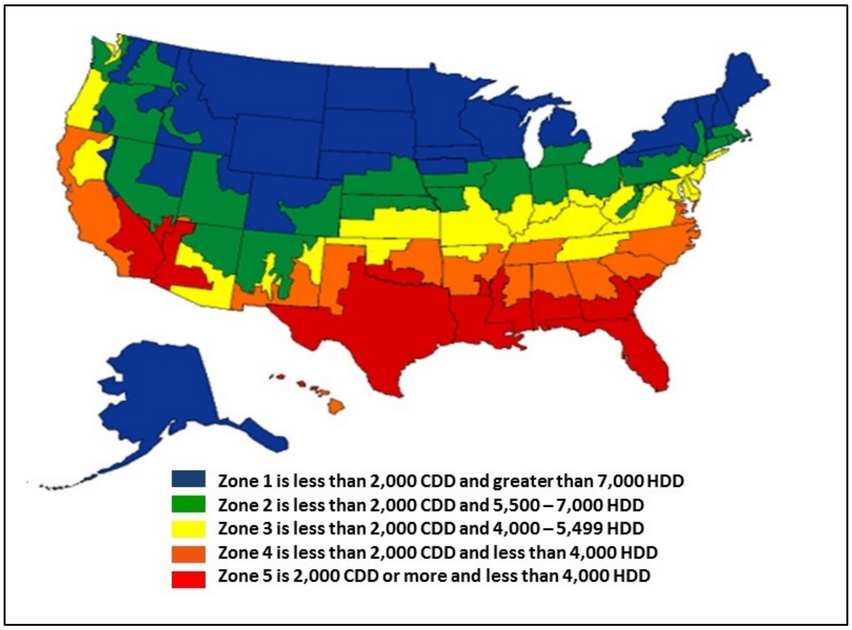

Figure 3.7 - HDD in the United States by climate zone (Source: Energy Solutions Center)

Heat pumps can operate at higher levels of efficiency than traditional space and water heating systems because heat pumps move heat rather than creating it through combustion. The measure of performance and efficiency for heat pumps is known as the Heating Seasonal Performance Factor (HSPF). HSPF is defined as the ratio of Btu heat output over the heating season to watt-hours of electricity used over the same time period. Put another way, HSPF is a measure of the number of Btus delivered over the heating season divided by the amount of electricity required to power the heat pump. As an example, a heat pump using 1 Btu to operate but producing an average of 3 Btu's of output over the heating season is rated as having a HSPF of 3. To put that in traditional energy efficiency terminology, a system with an HSPF rating of 3 would be described as being 300% efficient.

In order to operate at higher levels of efficiency, air source heat pumps used in space heating applications require outside air temperatures to be above 30°F. For water heating applications, ambient air temperatures must be above 40°F. At temperatures below those levels, the heat pump's backup heat source would take over. Because of the temperature limitations, air source heat pumps have historically seen significant market uptake only in weather zones 4 and 5 (Figure 3.7) which typically have fewer than 4,000 heating degree days in a given year. For comparison, the Company's Utah service territory ranges between 2,864 (St. George) and 7,963 (Park City) heating degree days in a normal weather year. Additionally, according to the U.S. Census Bureau's 2015 estimate, 95% of Utah's population resides in areas which average 5,500 heating degree days or more in a normal weather year.

Data suggests that ground source heat pumps can function at very high levels of efficiency even when air temperatures are very low because the ground deeper than 20 ft maintains a nearly constant temperature of 50° to 60°F. The Company surveyed two of the largest ground source system installers in Utah while preparing the 2016 IRP. Feedback from both installers indicates that, because of ground temperature consistency, ground source systems in Utah can typically service 90-95% of a home's heating requirement in a normal year. However, both installers indicated that the performance of ground source systems is challenged when outside air temperatures drop below 15°F. System performance is further impacted if air temperatures stay at or below 15°F for extended periods of time. As a result, and in order to meet the remaining 5-10% of heating requirement, ground source-equipped homes are typically outfitted with either natural gas or electric-resistance backup heat.

The performance of ground source heat pumps is also highly dependent on the thermal properties of the soil into which they are installed. The thermal properties of sediment and rocks can strongly influence the heat exchange efficiency for ground source heat pumps. Soil moisture content is also an important component in optimal system operation. As moisture content increases in a particular geologic material, thermal conductivity also increases. As a result, ideal geological conditions are in wet clay loam while dry sand is considered the least desirable soil condition for ground source systems.

Effect on Peak Demand

The Company believes that air source heat pump technology would have an effect on peak-day customer usage only if customers were to choose electric-resistance as backup heat rather than a natural gas furnace. It appears that the use of electric-resistance backup heat is rare. The Company surveyed a few air source heat pump owners throughout the service territory and found that every respondent elected to use a natural gas furnace for backup heat. Assuming natural gas backup is the standard throughout Utah, the impact of air source heat pumps on peak-day usage would be minimal. Figure 3.8 shows the observed hourly temperatures in Salt Lake City on the highest sendout day of 2015. Above the red line indicates the outside air temperature at which space heating would be provided by the air source system and below the line indicates the temperatures at which space heating would be provided by the backup system. As is evident, on January 1, 2015 a customer with an air source space heating system would have spent the entire day on the backup heat source.

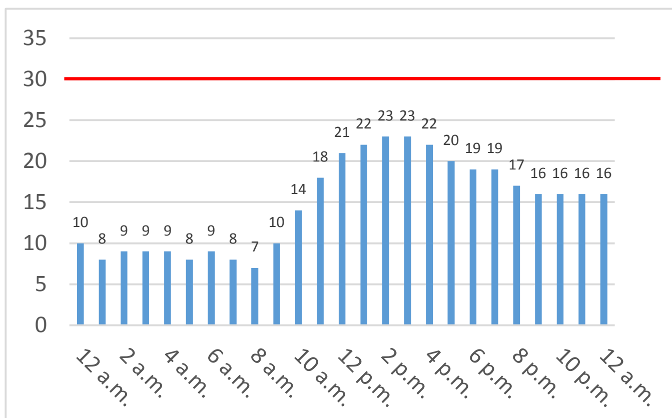

Figure 3.8 - Air source heat pump operation - January 1, 2015 (highest sendout day)

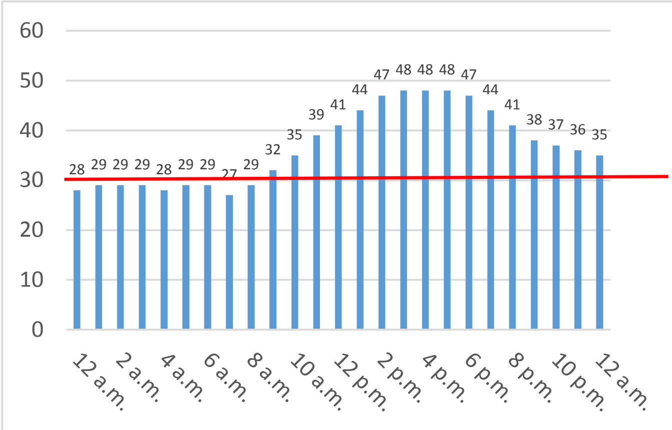

Figure 3.9 - Air source heat pump operation March 5, 2015

The greatest impact of space heating air source systems on natural gas usage would come in the shoulder months when low temperatures routinely rise above 30°F. For comparison, Figure 3.7 illustrates that an air source heat pump system would be the primary heat source between 9 a.m. and 11:59 p.m. on March 5, 2015. However, for the majority of peak usage time on that day (between 6 and 10 a.m.) heat would be provided by the backup system.

Because air source water heaters draw air from inside the building envelope, they may be able to effectively operate in heat pump mode for the many cold winter days. However, the installation location of air source water heaters in the home poses different challenges to its effective operation. If the air source water heater is located in conditioned space (the area of the home that people live in), the heat pump will eject the cold air byproduct of its operation into rooms that the heating system is working to condition. Conversely, if the air source water heater is located in unconditioned space (within the building envelope but outside of the conditioned space), the heat pump will be drawing cold outside air in to fuel its operation thereby increasing the likelihood of greater electricity usage.

The Company believes that ground source heat pumps could potentially reduce not only total natural gas usage but also peak day usage as well. The Company spoke with one customer who installed a ground source heat pump in 2011. The customer reported that his usage had dropped by 98% by mid-2014. In 2015, the customer had completely eliminated his natural gas service. The Company believes that these results are repeatable but would require a shift from natural gas to electricity provided by either an electric utility or through solar panels. In the case of the surveyed customer, he opted to eliminate natural gas and meet his annual home heating needs through a combination of ground source heat pump and solar panels.

Evidence gathered by the Company suggests that while the scenario described above is possible, it is not currently probable. One of the surveyed installers estimated that roughly two thousand ground source systems were operating in Utah at the end of 2015. He also estimated that construction had slowed in recent years to the point that about 30 ground source systems were constructed annually in Utah. Additionally, he indicated that during his nine years in the ground source industry, only two customers had chosen electric service or solar panels over a natural gas backup system.

Cost Recovery and Cross Subsidy Issues

The Company studied the issues of cost recovery and cross subsidy as they relate to customers who choose heat pumps for space and water heating in combination with natural gas backup. The potential exists for heat pump owners to create cost recovery and cross subsidies by terminating the natural gas backup in the summer and then reinitiating service as winter approaches. However, the Company has found little evidence to suggest that this type of scenario is currently taking place. If cost recovery and cross subsidy problems were to arise in the future the Company will explore solutions. The Company will continue studying these issues and will report to the Commission in the future on any new findings.

Lost and Unaccounted For Gas

The Company calculates the portion of gas that is lost or unaccounted for using a moving three-year average of annual proportions that it derives by dividing the total of system receipts for the twelve-month period ending June 30 into the sum of Company use gas (accounts 810 and 812), loss from tear-outs, and volumes that are unaccounted for during the same period. The updated average is 0.53% and reflects meter-level compensation for temperature and elevation in the Utah service territory that began in August of 2010 and in the Wyoming service territory in October of 2012.

The current calculation for the most recent three years is included in Table 3.5.

Table 3.5 Questar Gas Estimated Use and Lost and Unaccounted for Gas Calculation

Three-Year Rolling Average (Dth)

Year	QGC Customer Sales	QGC Customer Transport.	Total Receipts	QGC Sales & Transportation	QGC Use Acct. 810&812	QGC Loss Due To Tearouts	QGC Lost & Unaccounted For Gas	Total Sales, Transport, Company Usage and L&U
2012-2013	112,150,529	61,127,867	173,278,396	172,597,050	233,285	23,882	424,178	173,278,396
2013-2014	110,269,241	75,077,263	185,346,504	184,385,320	231,141	18,561	711,482	185,346,504
2014-2015	95,655,542	77,559,159	173,214,701	172,029,397	192,616	29,117	963,572	173,214,701
Total	318,075,312	213,764,289	531,839,601	529,011,768	657,042	71,559	2,099,232	531,839,601

Lost-&-Unaccounted-For-Gas % 0.395%   Company Use and Lost-&-Unaccounted-For-Gas % 0.532%

Questar Gas takes the following steps to minimize the volume of lost or unaccounted for gas:

- **Temperature and Elevation Compensation**. In August of 2010 the Company began compensating for meter-level temperature and elevation in the computation of Dth in its Utah Service Territory, in accordance with the Utah Commission’s orders. It made the same change in the Wyoming service territory in October of 2012. As a result, the volume of lost and unaccounted for gas is lower.

- **Maintenance work on high pressure feeder lines.** When scheduled maintenance work requires the Company to blow down the feeder line, the Company allows the line to feed down to the lowest possible pressure before completely blowing it down. This minimizes the amount of gas that is blown down to the atmosphere. The Company records the pressure in order to calculate the amount of gas that it blows down.
- **Feeder line replacement project.** The feeder line replacement project replaces aging infrastructure to ensure the safety and reliability of the distribution system.
- **Hot tapping.** The Company utilizes hot taps when making branch connections on the feeder line system to eliminate the need to blow down sections of the feeder line. The hot tapping process allows this work to be completed while the line remains in service.
- **Excess flow valves.** The Company installs an excess flow valve on any new or replaced service line delivering up to 5,000 cf per hour. The excess flow valve is designed to limit the amount of gas lost in the event of the service line being severed (i.e. third party damage).
- **Leak survey and repair.** The Company regularly conducts leak surveys and performs system maintenance as required. The Company conducts additional leak surveys in Class 3 and Class 4 locations.
- **Response time to leak calls.** The Company continues to evaluate ways to reduce the response time to gas leak calls through efficiencies in how employees are dispatched to these gas leaks. The Company has implemented a Global Positioning System (GPS) to allow dispatchers the ability to dispatch personnel based on their geographic location with respect to the leak.
- **Leak detection equipment.** The Company utilizes advanced technologies for locating and identifying leaks. Examples include the remote methane leak detection (RMLD) and the Rover and SENSIT gas detector.
- **Research and Development.** The Company participated in a GTI study to identify factors for fugitive emissions from various types of facilities.
- **Innovative Design Methods at a Compressor Station.** Compressor station design includes the ability to feed the distribution system rather than blowing down the station piping.

Forecast Exhibits

The following charts summarize the 10-year customer and gas demand forecast. All charts contain temperature-adjusted data with forecast horizons summarized on an IRP-year basis. The Company has summarized forecasted data in IRP years (June 1 – May 31).