The Maximum Achievable Cost Effective Potential for Gas DSM in Utah for the Questar Gas Company Service Area

Final Report

Prepared for the Utah Natural Gas DSM Advisory Group

June 2004

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Table of Contents

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This final report provides valuable and up-to-date natural gas energy efficiency potential information for decision-makers in the State of Utah, and it will also be useful to natural gas energy efficiency program designers and implementers in other States who need a template for their own energy efficiency potential studies. This report includes a thorough and up-to-date assessment of the impacts that DSM measures and programs can have on natural gas use in Utah, the economic costs and benefits of such natural gas DSM programs, the rate impacts of such programs, and the environmental benefits of the maximum achievable cost effective DSM programs identified by this study.

Richard F. Spellman, Vice President
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June 2004

1.0 EXECUTIVE SUMMARY – UTAH GAS DSM POTENTIAL

This study estimates the maximum achievable cost effective potential for gas Demand-Side Management (DSM) for residential and commercial customers in the geographic region of Utah served by the Questar Gas Company. Energy-efficiency opportunities typically are physical, long-lasting changes to buildings and equipment that result in decreased energy use while maintaining the same or improved levels of energy service. This study shows that there is significant savings potential in Utah for implementation of additional and long-lasting gas energy-efficiency measures. Capturing the maximum achievable cost effective potential for energy efficiency in Utah would reduce natural gas energy use by **20 percent** (21.4 million decatherms) by 2013, resulting in much slower growth in gas load from 2004 through 2013. The net present savings to Questar's residential and commercial customers for service-area wide implementation of cost effective gas DSM programs is over **$1.5 billion** in 2004 dollars.[1]

This report provides an assessment of the cost effectiveness of the DSM measures included in the maximum achievable cost effective potential portfolio using the tests and general methodology contained in the latest version of the California Standard Practices Manual. Benefit/cost results are presented for the Total Resource Cost (TRC) Test, the Participant Test, the Utility Cost Test and the Rate Impact Measure (RIM) Test.

1.1 Types of Savings Potential Analyzed

The definitions used in this study for energy efficiency potential estimates are the following:

- **Technical potential** is defined in this study as the complete penetration of all measures analyzed in applications where they were deemed technically feasible from an engineering perspective.

- **Maximum achievable potential** is defined as the maximum penetration of an efficient measure that would be adopted given unlimited funding, and by determining the maximum market penetration that can be achieved with a concerted, sustained campaign involving highly aggressive programs and market intervention over the next decade.[2] The term

[1] The gas DSM potential savings estimates and the Total Resource savings provided in this report are based upon the best and most recent gas load forecasts, natural gas avoided costs, appliance saturation data, economic forecasts, data on DSM measure costs and savings, and DSM measure lives available to GDS at the time of this study. GDS worked closely with staff of Questar Gas Company and the Utah Energy Office to ensure that all input assumptions for this study were up-to-date and applicable to the State of Utah. The $1.5 billion in total resource savings includes savings of natural gas, electricity and water.

[2] This definition is consistent with the standard practice used in other recent maximum achievable potential studies in other states, such as California and Connecticut. GDS Associates has used this definition in this study in order to develop a credible estimate of the remaining amount of cost

"maximum" refers to efficiency measure penetration, and means that the GDS Team has based our estimates of gas DSM potential on the maximum realistic penetration that can be achieved by 2013. The term "maximum" does not apply to other factors used in developing these estimates, such as measure costs, measure energy savings or measure lives.

- **Maximum achievable cost effective potential** is defined as the potential for maximum penetration of energy efficient measures that are cost effective according to the Total Resource Cost test, and would be adopted given unlimited funding, and by determining the maximum market penetration that can be achieved with a concerted, sustained campaign involving highly aggressive programs and market interventions.

The main outputs of this study are summary data tables and graphs reporting the total cumulative maximum achievable cost effective potential for gas DSM over the ten-year period, and the annual incremental achievable potential and cumulative potential, by year, for 2004 through 2013.

This study makes use of over 30 existing studies conducted throughout the US on the potential savings and penetration of natural gas energy efficiency measures. These other existing studies provided an extensive foundation for estimates of energy savings potential in existing residential and commercial facilities served by Questar Gas in Utah.

1.2 Key Findings

If all energy efficiency measures analyzed in this study were implemented immediately where technically feasible, we estimate that overall natural gas cumulative annual savings for Questar Gas in Utah would be 41.2 million decatherms (Dth) by 2013 (a **38%** reduction in the projected 2013 sales forecast for natural gas sales in Utah). More realistically, if all measures that are cost effective were implemented, and consumer acceptance trends and the timing of equipment replacements in the market are factored in, the maximum achievable cost effective potential natural gas savings would amount to 21.4 million decatherms (a **20%** reduction in the projected 2013 sales forecast for natural gas sales in Utah).

Table 1-1 on the next page provides a comparison of the estimates of the natural gas savings, percent savings, and gas sales growth rate for the State of Utah for the maximum achievable cost effective potential savings scenario and the maximum technical potential savings scenario. For this table, GDS provided

effective gas DSM potential in Utah. The term "unlimited funding" refers to the base case assumption where no limits are placed on funding, and it is assumed that highly aggressive programs are pursued for ten years. GDS has included in this Executive Summary in Table 1-3 a solid estimate of the Total Resource Costs required to achieve the maximum achievable cost effective gas DSM potential.

data for the midpoint of the study period (2008), and the final year of the study period (2013). Annual data for Table 1 for 2004 to 2013 are provided in Appendix E of this report.

Table 1-2, also on the next page, provides cumulative annual decatherm savings for each year from 2004 to 2013 for the maximum achievable cost effective gas DSM potential for the service area in Utah.

Table 1-1 Natural Gas Technical and Maximum Achievable Cost Effective Potential in Utah

		Base Case Gas Sales Forecast for Utah		Maximum Achievable Cost-Effective Savings Potential			Technical Potential		
Region	Year	Dth	Avg. Annual Load Growth	Dth Savings	% of Load in Year	Avg. Annual Load Growth	Dth Savings	% of Load in Year	Load Growth
Statewide	2008	104,000,000	0.90%	13,806,786	13.30%	-1.70%	25,511,844	24.50%	-3.00%
	2013	108,500,000	0.90%	21,421,307	19.70%	-1.30%	41,222,112	38.00%	-3.90%

Table 1-2 Cumulative Annual Decatherm Savings – Questar Service Area in Utah - 2004 to 2013

		Residential Gas Savings		Commercial Gas Savings				
Year	Load Forecast (Dth)	Dth	Percent of Total	Dth	Percent of Total	Total Dth Savings	Net Forecast (Dth)	Percent Savings
2004	99,700,000	1,106,289	80.90%	261,809	19.10%	1,368,098	98,331,902	1.40%
2005	100,700,000	3,529,472	82.40%	754,790	17.60%	4,284,261	96,415,739	4.30%
2006	101,700,000	6,611,102	82.90%	1,363,356	17.10%	7,974,458	93,725,542	7.80%
2007	102,800,000	9,692,732	83.10%	1,971,923	16.90%	11,664,655	91,135,345	11.30%
2008	104,000,000	11,457,468	83.00%	2,349,318	17.00%	13,806,786	90,193,214	13.30%
2009	105,100,000	13,222,204	82.90%	2,726,713	17.10%	15,948,917	89,151,083	15.20%
2010	106,300,000	14,328,493	82.70%	2,988,522	17.30%	17,317,014	88,982,986	16.30%
2011	107,100,000	15,434,781	82.60%	3,250,331	17.40%	18,685,112	88,414,888	17.40%
2012	107,900,000	16,541,070	82.50%	3,512,140	17.50%	20,053,210	87,846,790	18.60%
2013	108,500,000	17,647,358	82.40%	3,773,949	17.60%	21,421,307	87,078,693	19.70%
Annual Growth	0.90%						-1.30%	

1.3 Future Program Investment Scenarios

Achieving the maximum achievable cost effective energy efficiency savings by 2013 will require programmatic support. Programmatic support includes financial incentives to customers, marketing, administration, planning, and program evaluation activities provided to ensure the delivery of energy efficiency products and services to consumers. Costs for programmatic support are included in the benefit/cost analyses presented in this report.

As shown in Table 1-1, the statewide maximum achievable cost effective gas DSM savings is 21.4 million Dth in 2013. With implementation of the maximum achievable cost-effective gas energy efficiency potential, we estimate that growth in statewide gas demand could be cut from about .9% per year to -1.3% per year.

GDS estimates that Utah gas utility costs for gas DSM program planning, administration, marketing, reporting and evaluation ("other program costs") will be approximately 30% of efficiency measure incremental costs in the maximum achievable cost effective DSM potential scenario.

1.4 Present Value of Savings and Costs (in millions of 2004 $)

The results of this study demonstrate that cost effective gas energy-efficiency resources can play a significantly expanded role in Utah's energy resource mix over the next decade.[3] Table 1-3 below shows the present value[4] of benefits and costs associated with implementing the maximum achievable cost-effective potential energy savings in the State of Utah. The Total Resource Cost Test net present savings to Questar's residential and commercial customers in Utah for statewide implementation of programs are over **<u>$1.5 billion</u>** in 2004 dollars.

The Total Resource Cost benefit/cost ratio for the maximum achievable cost effective potential savings scenario is **<u>2.39</u>**. In addition, every gas DSM program that the GDS Team is recommending to the Utah Gas DSM Advisory Group is cost effective according to the TRC Test.

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[3] It is clear that natural gas DSM programs can play a significantly expanded role in Utah. The gas DSM potential estimates and Total Resource savings provided in this report are based upon the best and most recent natural gas load forecasts, appliance saturation data, economic forecasts, data on DSM measure costs and savings, and DSM measure lives available to GDS at the time of this study. All input assumptions and data have been thoroughly reviewed over a six-month period by GDS, staff of the Utah Energy Office, staff of Questar Gas Company, and staff of the Southwest Energy Efficiency Project. GDS has conducted extra research to ensure that data for DSM measure costs and savings are applicable to the State of Utah. For example, GDS conducted in-depth interviews with several weatherization service providers in Salt Lake City to ensure that data on residential weatherization DSM measure costs, savings and market potential were accurate. In addition, GDS used home and building energy analysis simulation models (REM/Rate, Energy 10) to ensure the validity of energy savings estimates for the State of Utah.

[4] The term "present value" refers to a mathematical technique used to convert a future stream of dollars into their equivalent value in today's dollars.

Table 1-3 provides the Total Resource Cost (TRC) Test benefit/cost ratio calculations for the overall maximum achievable cost effective portfolio of energy efficiency measures, and the benefit/cost ratio by major market sector. The Total Resource Cost (TRC) Test is a standard benefit-cost test used by many of the public utilities commissions in the US and other organizations to compare the value of the avoided natural gas costs to the costs of energy-efficiency measures and program activities necessary to deliver them. Table 1-3 summarizes the benefit/cost ratios for the maximum achievable cost effective scenario for the residential and commercial sectors for four tests:

- Total Resource Cost Test
- Utility Cost Test
- Participant Cost Test
- Rate Impact Measure Test

The present value of TRC costs in 2004 dollars to achieve the maximum achievable cost effective potential savings is $1.088 billion. It is important to note that the TRC benefits presented in Table 1-3 include the natural gas, electricity and water savings achieved due to the implementation of gas DSM measures. To achieve the net present value savings of $1.5 billion, Questar would need to incur costs for program design, program administration, marketing, data base development, program reporting, and program evaluation. The GDS Team worked with Questar staff to develop budgets for each program for these administrative, marketing and evaluation activities. These costs are included in the cost figures shown in Table 1-3 in the “Cost” column. Appendices A and B provide the annual budget for each natural gas DSM program for the maximum achievable cost effective potential scenario.

TABLE 1-3 BENEFIT COST RATIO TESTS

TOTAL RESOURCE COST TEST

FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Total Resource Benefits, Costs, and Net Benefits			
	Present Value		PV of Net	Benefit-Cost
	Benefit	Cost	Benefits	Ratio
Commercial Sector	$227,743,350	$100,914,338	$126,829,012	2.26
Residential Sector	$2,369,367,929	$986,723,672	$1,382,644,257	2.40
All Sectors	$2,597,111,280	$1,087,638,010	$1,509,473,270	2.39

UTILITY COST TEST

FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Total Resource Benefits, Costs, and Net Benefits			
	Present Value		PV of Net	Benefit-Cost
	Benefit	Cost	Benefits	Ratio
Commercial Sector	$204,741,345	$46,575,848	$158,165,496	4.40
Residential Sector	$2,102,946,384	$392,439,704	$1,710,506,680	5.36
All Sectors	$2,307,687,729	$439,015,552	$1,868,672,176	5.26

PARTICIPANT COST TEST

FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Total Resource Benefits, Costs, and Net Benefits			
	Present Value		PV of Net	Benefit-Cost
	Benefit	Cost	Benefits	Ratio
Commercial Sector	$252,928,880	$54,338,490	$198,590,390	4.65
Residential Sector	$2,312,573,781	$312,170,954	$2,000,402,826	7.41
All Sectors	$2,565,502,660	$366,509,444	$2,198,993,216	7.00

RATE IMPACT MEASURE TEST

FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Total Resource Benefits, Costs, and Net Benefits			
	Present Value		PV of Net	Benefit-Cost
	Benefit	Cost	Benefits	Ratio
Commercial Sector	$204,741,345	$253,736,546	($48,995,202)	0.81
Residential Sector	$1,647,734,422	$2,705,013,485	($1,057,279,063)	0.61
All Sectors	$1,852,475,767	$2,958,750,031	($1,106,274,264)	0.63

Notes:

Benefit/cost ratios were calculated using version 10 of the "NSTAR" model, and using Questar estimates of the avoided costs for natural gas.
The initial retail natural gas rates were based on Questar average 2003 rates.
The future growth in retail electric rates were based on the EIA Electric Power Annual, 2002.
Retail water rates were based on data obtained from the Salt Lake City Water Department.

1.5 Definition of the Total Resource Cost Test

The Total Resource Cost Test measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs.[5]

The test is applicable to conservation, load management, and fuel substitution programs. For fuel substitution programs, the test measures the net effect of the impacts from the fuel not chosen versus the impacts from the fuel that is chosen as a result of the program. TRC test results for fuel substitution programs should be viewed as a measure of the economic efficiency implications of the total energy supply system (gas and electric).

A variant on the TRC test is the Societal Test. The Societal Test differs from the TRC test in that it includes the effects of externalities (e.g., environmental, national security), excludes tax credit benefits, and uses a different (societal) discount rate.

Benefits and Costs: The TRC test represents the combination of the effects of a program on both the customers participating and those not participating in a program. In a sense, it is the summation of the benefit and cost terms in the Participant and the Ratepayer Impact Measure tests, where the revenue (bill) change and the incentive terms intuitively cancel (except for the differences in net and gross savings).

The benefits calculated in the Total Resource Cost Test include the avoided natural gas supply costs for the periods when there is a gas load reduction. The avoided supply costs are calculated using net program savings, savings net of changes in energy use that would have happened in the absence of the program. For fuel substitution programs, benefits include the avoided device costs and avoided supply costs for the energy using equipment not chosen by the program participant. Also included in the benefits are any electric and/or water avoided costs based on net savings due to the influence of the program. Table 1-4 includes a breakout of the total TRC benefits, as presented in Table 1-3, associated with gas, electricity, and water.

[5] California Public Utilities Commission, California Standard Practice Manual, Economic Analysis of Demand-Side Management Programs and Projects, October 2001, page 18.

Table 1-4: Components of TRC Benefits for Gas DSM

	Present Value of Program Benefits by Source			
	Gas Savings Benefits	Electric Savings Benefits	Water Savings Benefits	Total Gas, Electric and Water Savings Benefits (TRC Benefits)
Commercial Sector	$204,741,345	$22,963,932	$38,073	$227,743,350
Residential Sector	$1,497,940,384	$673,843,331	$197,584,215	$2,369,367,929
All Sectors	$1,702,681,728	$696,807,264	$197,622,288	$2,597,111,280

Notes:
Gas avoided costs were provided by Questar on February 20, 2004.
Electric avoided costs are based on Pacificorp rate schedule 37, Rates for Avoided Cost Purchases from Qualifying Facilities, filed November 8, 2001.
Water avoided costs were estimated based on data obtained from the Salt Lake City Water Department.

The costs in this test are the program costs paid by the utility and the participants plus any increase in supply costs for periods in which load is increased. Thus all equipment costs, installation, operation and maintenance, cost of removal (less salvage value), and administration costs, no matter who pays for them, are included in this test. Any tax credits are considered a reduction to costs in this test.

Complete definitions of all of the benefit/cost tests presented in this report are provided in Appendix F.

1.6 Sensitivity Analyses

At the February 19, 2004 meeting of the Utah Gas DSM Advisory Group, the Group decided to examine the sensitivity of the study results to key assumptions relating to future market penetration of gas DSM measures and future avoided costs of natural gas. This final report includes in Appendix D the results of the following sensitivity analyses:

- Natural gas avoided costs starting at $1.50 per decatherm higher and lower in 2004 than in the base case.
- Long-term market penetration for gas energy efficiency measures in the maximum achievable potential scenario of 25% and 50% of the total market.

2.0 INTRODUCTION

The main objective of this technical potential assessment is to assess and evaluate the potential for achievable and cost-effective natural gas Demand-Side Management (DSM) measures opportunities for residential and commercial customers in the Utah service territory of Questar Gas Company (QGC). The main outputs of this study include the following deliverables:

- A concise, fully documented report on the work performed and the results of the analysis of opportunities for achievable, cost effective natural gas DSM in QGC's Utah service territory
- An overview of the impacts that gas DSM measures and programs will have on natural gas use
- A summary of the economic costs and benefits of DSM program design and implementation
- A summary of the revenue impacts to QGC
- An assessment of the environmental impacts and other non energy benefits of the maximum achievable cost effective gas DSM options developed in this study

2.1 Summary of Approach

Maximum Achievable Potential: GDS first developed estimates of the maximum achievable potential for natural gas DSM opportunities for the residential and commercial sectors[6] in Questar Gas Company's service territory in the State of Utah. The GDS analysis utilized the following models and information:

(1) an existing GDS Associates gas DSM potential spreadsheet model[7];
(2) detailed information relating to the current and potential saturation of natural gas efficiency measures in the State of Utah; and
(3) available data on natural gas energy efficiency measure costs, energy savings, and useful lives.

The maximum achievable potential for gas DSM in Utah was estimated by determining the maximum penetration of an efficient measure that would be adopted given unlimited funding, and by determining the maximum market penetration that can be achieved with a concerted, sustained campaign involving highly aggressive programs and market intervention. This estimate provides a measure of the maximum amount of natural gas energy that could be saved if most or every household and business in Utah retrofitted their existing standard efficiency gas equipment with high efficiency gas technologies and installed the high efficiency measure in all new construction applications, failed equipment

[6] The portion of the industrial sector in the Questar service area that purchases its own gas is not included in this scope of work.
[7] This GDS Excel spreadsheet model operates on a PC platform using the MS windows operating system, is documented, and can be followed by a technician with expertise. GDS has provided this model to the study sponsors as a deliverable of this project.

replacement and major renovation applications, regardless of cost or other considerations.

Maximum Achievable Cost Effective Potential: Calculation of the cost effective maximum achievable potential is based, as the term implies, on the assumption that energy efficiency measures/bundles will only be included in Statewide natural gas efficiency programs when it is cost effective to do so. The GDS team followed the cost effectiveness screening guidelines in the scope of work for this project provided to GDS by the Utah Natural Gas DSM Advisory Group to determine the cost effective achievable potential for gas DSM.[8] As an added benefit for this Study, the GDS Team also developed natural gas DSM supply curves for each sector. Once the maximum achievable potential was calculated by customer class (i.e., residential and commercial sectors), the GDS Team sorted efficiency measures by cost in data tables in the form of a conservation supply curve.

All cost effectiveness analyses for natural gas DSM measures and programs were done using Version 10 of the NSTAR benefit/cost model, a model developed by a major electric and gas utility in Massachusetts. This model is publicly available, operates in Excel, and has been approved by regulators in many States.

2.2 Report Organization

The remainder of this report is organized as follows:

- Section 3 - Natural Gas Usage in Utah – Overview of Questar Sales Forecast
- Section 4 - Methodology for Determining Energy Savings Potential
- Section 5 - Natural Gas DSM Potential – Residential Sector
- Section 6 - Natural Gas DSM Potential – Commercial Sector
- Section 7 - Residential Gas DSM Programs for Utah
- Section 8 - Commercial Gas DSM Programs for Utah
- Section 9 - Co-Benefits of Gas DSM Programs
- Section 10 - Cost Recovery and Shareholder Incentive Mechanisms
- Section 11 – Summary of Findings

[8] The statement of work issued to GDS in November 2003 stated that GDS shall "provide a preliminary evaluation of the cost effectiveness of these DSM measures and programs using the tests and general methodology for natural gas utilities contained in the "California Standard Practices Manual".

3.0 CHARACTERIZATION OF NATURAL GAS USAGE IN THE QGC SERVICE TERRITORY

3.1 Introduction

Using the data provided by the Utah Gas DSM Advisory Group and Questar Gas Company, the GDS Team has developed a characterization of natural gas usage and the customer base in the QGC Utah service territory. GDS has collected existing data and the latest Questar natural gas demand forecast for Utah[9] to develop the description of how natural gas is used and how usage is expected to change over the next decade. Types of data collected for the QGC service area include the following:

- natural gas demand sales forecasts for Utah
- historical sales and/or deliveries of natural gas by residential, commercial and industrial sectors
- number of customers by class of service (residential, commercial, industrial)
- projections of future natural gas sales by customer class
- information on future expansion of the QGC gas distribution network over the study period
- Utah demographic and economic information expected to affect gas use,
- usage per customer data
- gas appliance saturation data
- square footage of commercial space

Questar provided the GDS Team with the latest available data on gas sales, deliveries, sales by end use, number of customers by class of service, load forecasts, etc.

3.2 Summary of Total Gas Sales Forecast

Questar's May 1, 2003 Integrated Resource Plan is the source of the natural gas forecast for the Questar service area in Utah used in this study. The May 2003 IRP states that system gas sales are projected to increase from 98.3 million decatherms in 2003 to 108.5 million decatherms in 2013. The 2002 IRP projected faster growth in sales for the same period. Slower growth is projected in the 2003 IRP due to a lower forecast of General Service (GS) gas usage per customer and fewer customer additions each year. Table 3-1 below shows the demand forecast for natural gas in the Questar service area by class of service. The base case forecast included in the May 2003 IRP projects that total natural gas system Dth sales will increase at one percent a year from 2003 to 2013. The market sector with the fastest growing sales is the commercial sector (1.4% sales growth a

[9] Questar provided GDS with the May 2003 natural gas sales forecast for its Utah service territory included on page 20 of the 2003 Questar IRP document.

year). Table 3-2 shows that the residential sector will continue to account for 63% of Questar's gas sales through 2013.

TABLE 3-1 NATURAL GAS DEMAND FORECAST BY CLASS OF SERVICE 2003 TO 2013 - BASE CASE FROM MAY 2003 QUESTAR IRP

Year	Residential (Dth in Millions)	Commercial (Dth in Millions)	Industrial (Dth in Millions)	Total Dth in (Millions)	Total Sales - Annual % Change
2003	62.7	29.4	6.2	98.3	NA
2004	63.5	29.9	6.3	99.7	1.4%
2005	63.9	30.5	6.3	100.7	1.0%
2006	64.4	30.9	6.4	101.7	1.0%
2007	65.1	31.3	6.4	102.8	1.1%
2008	65.8	31.7	6.5	104.0	1.2%
2009	66.4	32.1	6.6	105.1	1.1%
2010	67.1	32.5	6.7	106.3	1.1%
2011	67.4	33.0	6.7	107.1	0.8%
2012	67.7	33.4	6.8	107.9	0.7%
2013	67.9	33.8	6.8	108.5	0.6%
Average Annual Compound Growth Rate	0.8%	1.4%	1.0%	1.0%	NA

TABLE 3-2 SECTOR SALES AS A PERCENT OF TOTAL SALES 2003 TO 2013 - BASE CASE FROM MAY 2003 QUESTAR IRP

Year	Residential (Dth in Millions)	Commercial (Dth in Millions)	Industrial (Dth in Millions)	Total Dth in (Millions)
2003	63.8%	29.95%	6.27%	100.0%
2004	63.7%	30.04%	6.27%	100.0%
2005	63.5%	30.27%	6.27%	100.0%
2006	63.3%	30.41%	6.27%	100.0%
2007	63.3%	30.40%	6.27%	100.0%
2008	63.3%	30.46%	6.27%	100.0%
2009	63.2%	30.55%	6.27%	100.0%
2010	63.1%	30.61%	6.27%	100.0%
2011	62.9%	30.80%	6.27%	100.0%
2012	62.7%	30.99%	6.27%	100.0%
2013	62.6%	31.15%	6.27%	100.0%

3.3 Forecast of System Throughput

System throughput in the 2003 IRP sales forecast increases from 143.7 decatherms in 2003 to 172.6 million decatherms in 2012. The 2002 IRP forecast projected system throughput growing from 141.6 million decatherms to 149.0 decatherms for the same period. The transportation portion of these forecasts largely comprises industrial type end-use customers. Questar uses a forecast of Industrial Production from Global Insights to drive its industrial sales forecast. Because the Global Insight's forecast of Industrial Production increased significantly from the 2002 forecast to the 2003 forecast, the Questar forecast of gas sales to transportation customers increased significantly.

3.4 Residential Gas Sales Forecast in Utah

Table 3-3 presents the residential natural gas sales forecast by end use and the residential customer forecast. Residential sales are forecast to increase at an average rate of .8% a year for the period 2003 to 2013, the slowest growth rate of any market sector. The fastest growing residential end use in the forecast is secondary appliances (3.8% growth a year) followed by cooking (3.2% growth a year). It is very important to note that Questar is forecasting that space-heating sales in the residential sector will decline from 37.6 million Dth in 2003 down to 37.2 million Dth in 2013, even though the total number of residential customers is expected to increase by over 200,000 customers by 2013. Figures 3-1 and 3-2 provide graphs of the forecast of total annual residential gas sales and residential gas customers in the Questar service area in Utah for the period 2004 to 2013.

**TABLE 3-3 FORECAST OF RESIDENTIAL SALES BY END USE
2003 TO 2013 - BASE CASE FROM MAY 2003 QUESTAR IRP**

Year	Forecast of Residential Customers	Secondary Appliances (Dth in Millions)	Cooking (Dth in Millions)	Clothes Drying (Dth in Millions)	Space Heat (Dth in Millions)	Water Heat (Dth in Millions)	Total Residential Dth in (Millions)
2003	680,349	4.6	1.2	1.0	37.6	18.3	62.7
2004	702,009	4.8	1.2	1.0	37.8	18.6	63.5
2005	724,902	5.0	1.3	1.0	37.7	18.8	63.9
2006	745,114	5.3	1.3	1.1	37.6	19.1	64.4
2007	766,648	5.5	1.4	1.1	37.8	19.4	65.1
2008	786,362	5.7	1.4	1.1	37.9	19.7	65.8
2009	806,583	5.9	1.5	1.2	38.0	19.9	66.4
2010	826,279	6.1	1.5	1.2	38.1	20.2	67.1
2011	845,937	6.3	1.6	1.2	37.9	20.5	67.4
2012	865,538	6.5	1.6	1.3	37.6	20.8	67.7
2013	885,611	6.7	1.6	1.3	37.3	21.1	67.9
Average Annual Compound Growth Rate	2.7%	3.8%	3.2%	2.6%	-0.1%	1.4%	0.8%

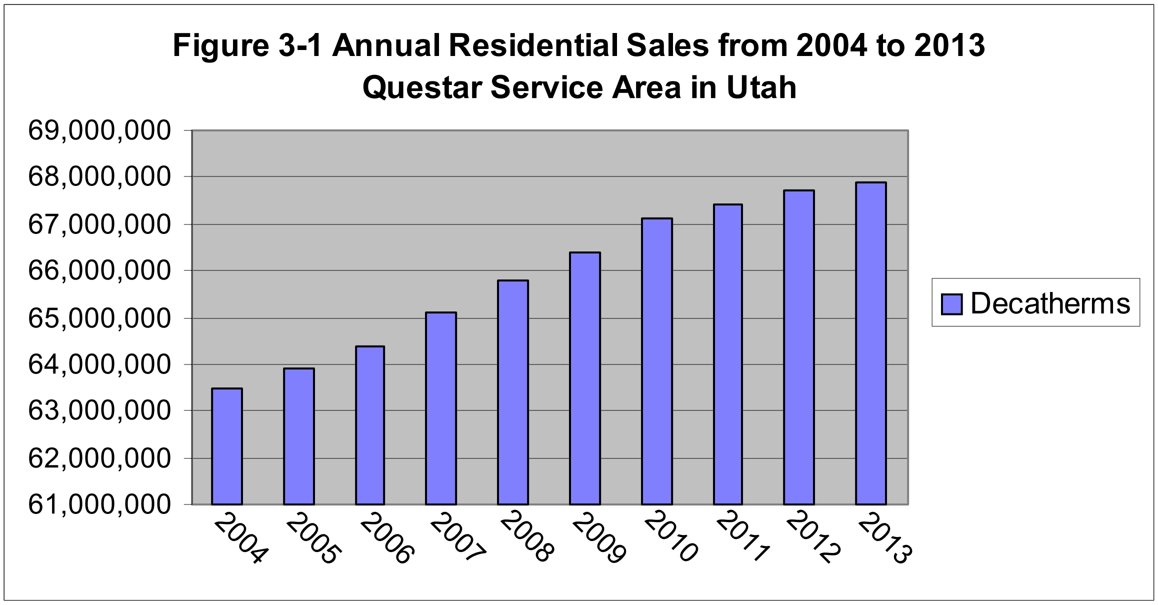


Figure 3-1 Annual Residential Sales from 2004 to 2013
Questar Service Area in Utah
69,000,000
68,000,000
67,000,000
66,000,000
65,000,000
64,000,000
63,000,000
62,000,000
61,000,000
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Decatherms

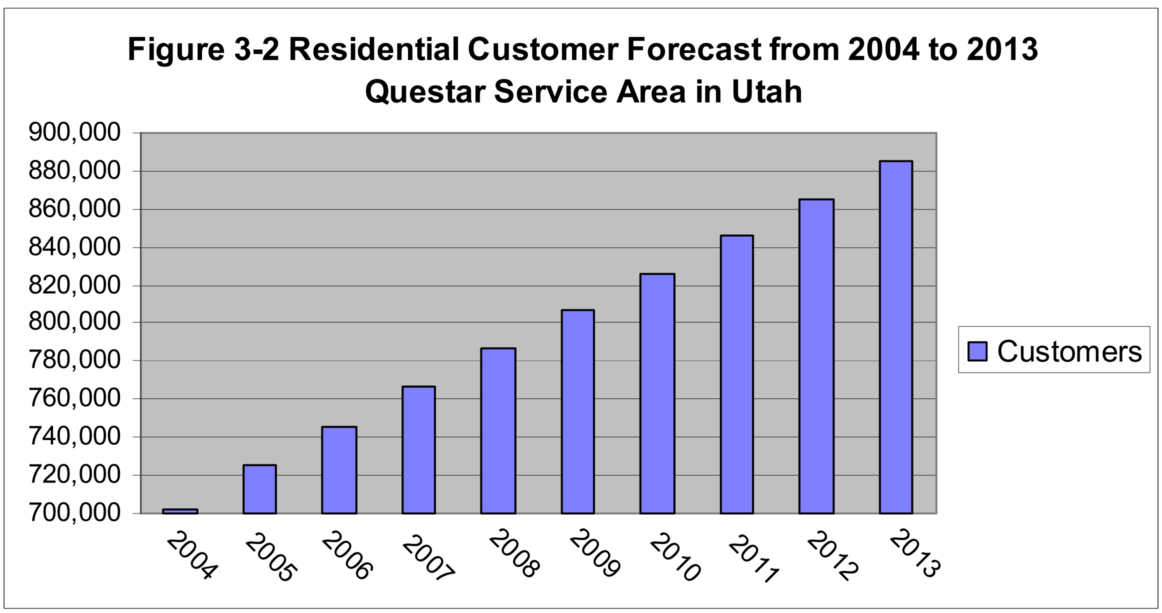


Figure 3-2 Residential Customer Forecast from 2004 to 2013
Questar Service Area in Utah
900,000
880,000
860,000
840,000
820,000
800,000
780,000
760,000
740,000
720,000
700,000
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Customers

3.5 Residential Usage per Appliance Forecast

Table 3-4 and Figures 3-3 to 3-6 show the forecasts of residential annual gas use per appliance by end use. It is very important to note that gas use per appliance is forecast to decline for **four of the five** residential end uses.

**TABLE 3-4 FORECAST OF ANNUAL GAS USE PER APPLIANCE
2003 TO 2013 - BASE CASE FROM MAY 2003 QUESTAR IRP**

Year	Secondary Appliances - Dth	Cooking - Dth	Clothes Drying - Dth	Space Heating - Dth	Water Heating - Dth
2004	12.4983	6.2937	4.8540	53.8351	27.6868
2005	12.4984	6.1813	4.7670	52.0653	27.1252
2006	12.5468	6.1149	4.7157	50.4795	26.7741
2007	12.5699	6.0404	4.6580	49.2778	26.3957
2008	12.6145	5.9894	4.6184	48.1525	26.1201
2009	12.6205	5.9240	4.5676	47.0509	25.7780
2010	12.6397	5.8715	4.5266	46.1120	25.4909
2011	12.6536	5.8212	4.4873	44.7516	25.2176
2012	12.6834	5.7791	4.4548	43.3990	24.9865
2013	12.6696	5.7211	4.4100	42.0644	24.6940
Average Annual Compound Growth Rate	0.2%	-1.1%	-1.1%	-2.7%	-1.3%

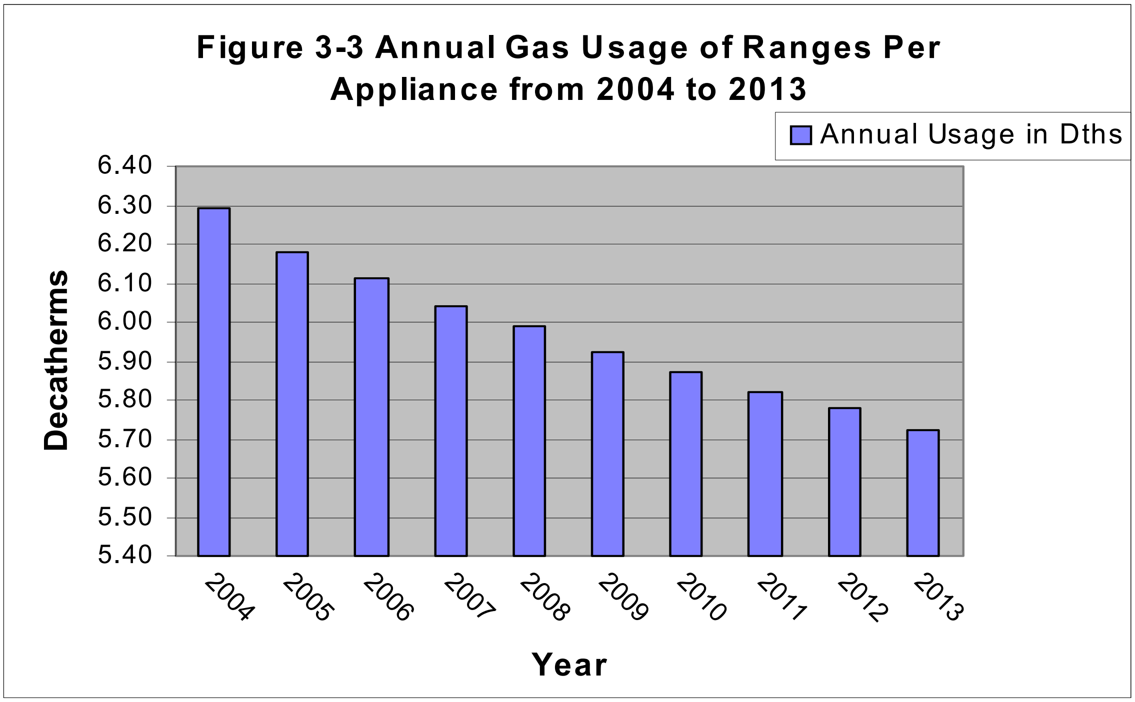


Figure 3-3 Annual Gas Usage of Ranges Per Appliance from 2004 to 2013
Annual Usage in Dths
Decatherms
6.40
6.30
6.20
6.10
6.00
5.90
5.80
5.70
5.60
5.50
5.40
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Year

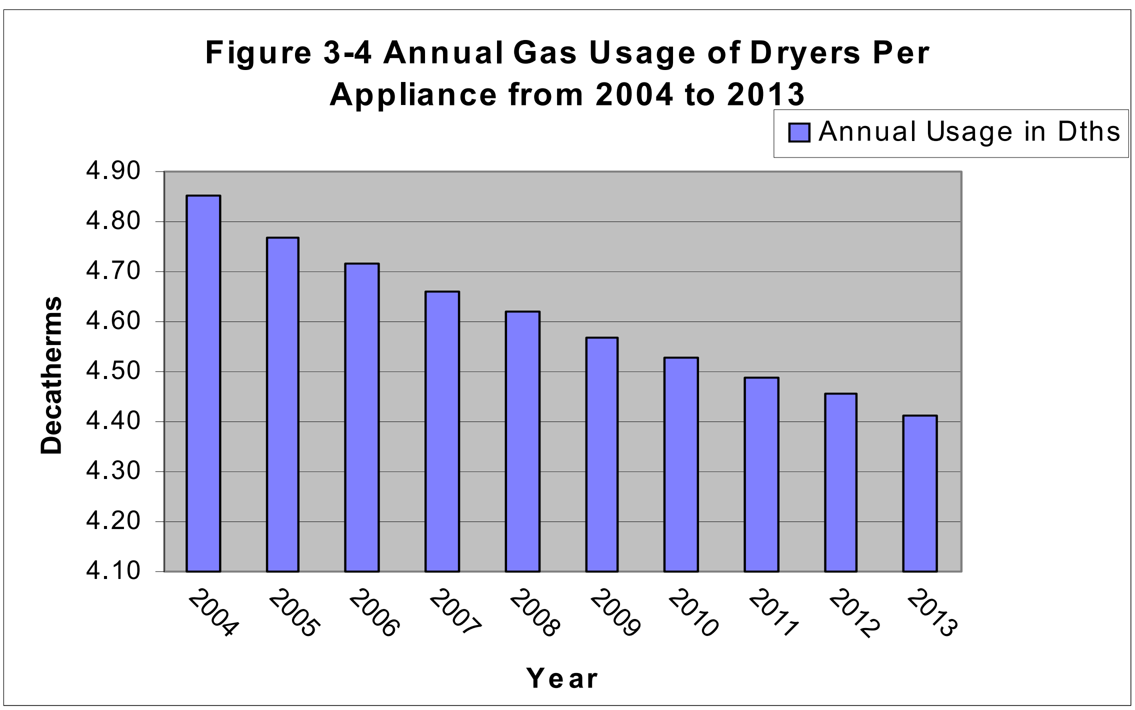


Figure 3-4 Annual Gas Usage of Dryers Per Appliance from 2004 to 2013
Annual Usage in Dths
Decatherms
4.90
4.80
4.70
4.60
4.50
4.40
4.30
4.20
4.10
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Year

Figure 3-5 Annual Gas Usage of Space Heating Per Appliance from 2004 to 2013

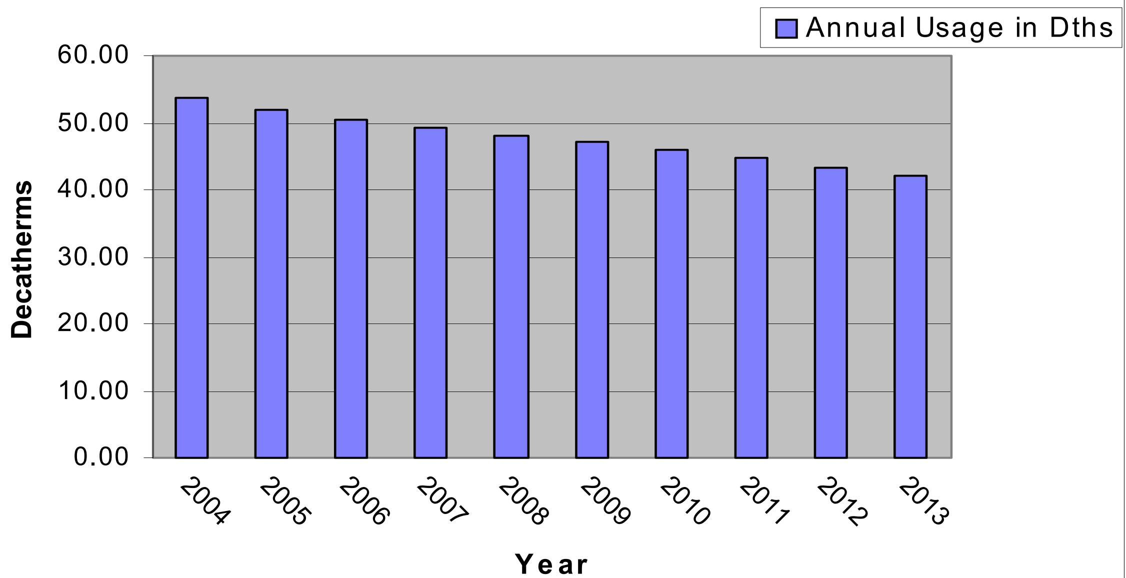
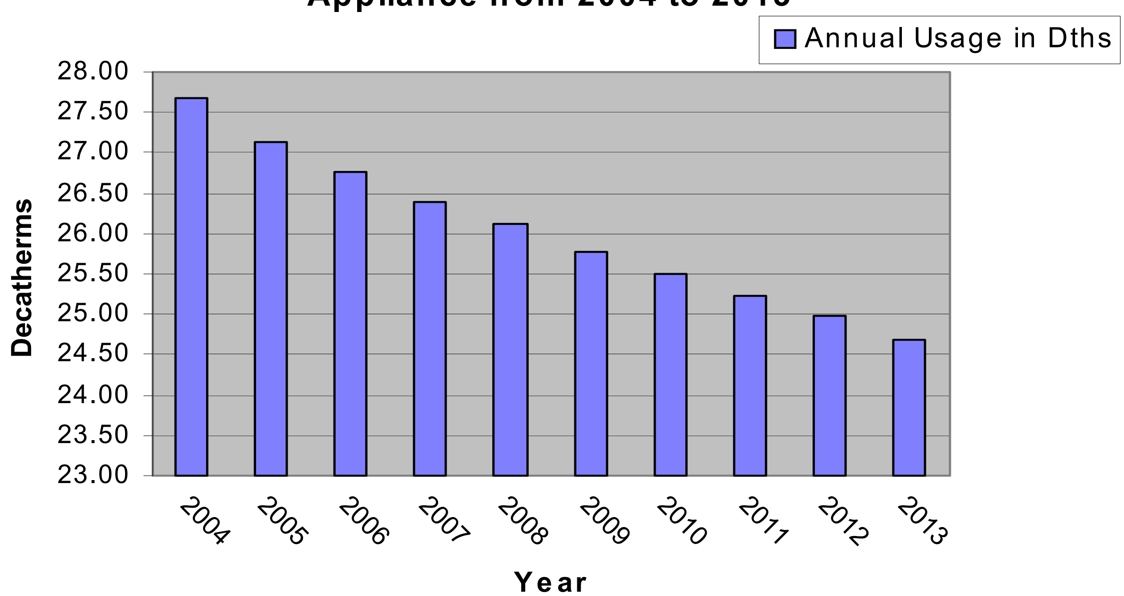


Figure 3-6 Annual Gas Usage of Water Heaters Per Appliance from 2004 to 2013



Figures 3-7 and 3-8 show a breakdown of the residential sales forecast for 2004 and 2013 by end use. In 2004, the gas space heating end use represents the largest market segment in the residential sector (59% share of residential sales), and gas water heating is the second largest market segment (29% of residential sales). Thus these are the market segments likely having the most potential for gas DSM savings.

Figure 3-7 Utah Gas Sales by Market Sector - 2004

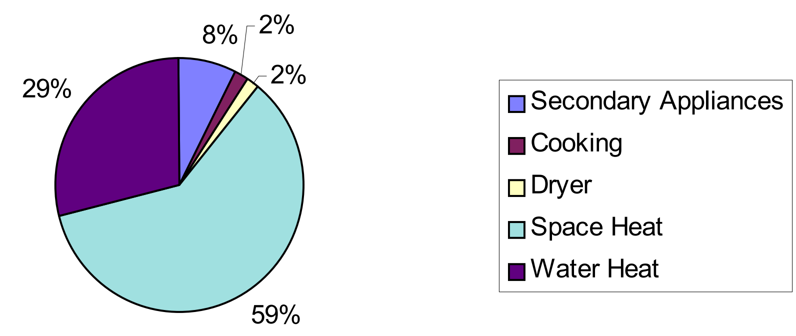
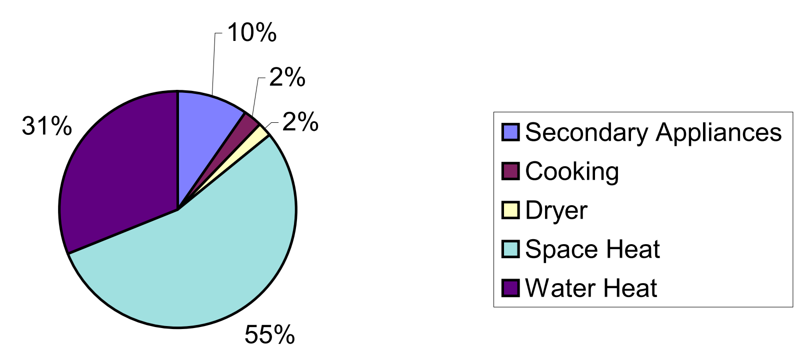


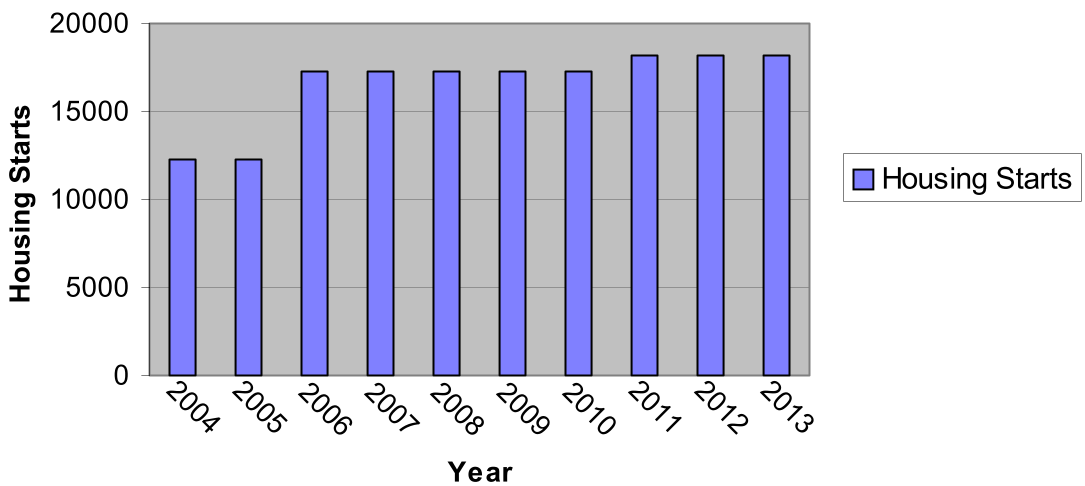
Figure 3-8 Utah Gas Sales by Market Sector - 2013



3.6 Forecast of Population and Housing Starts in Utah

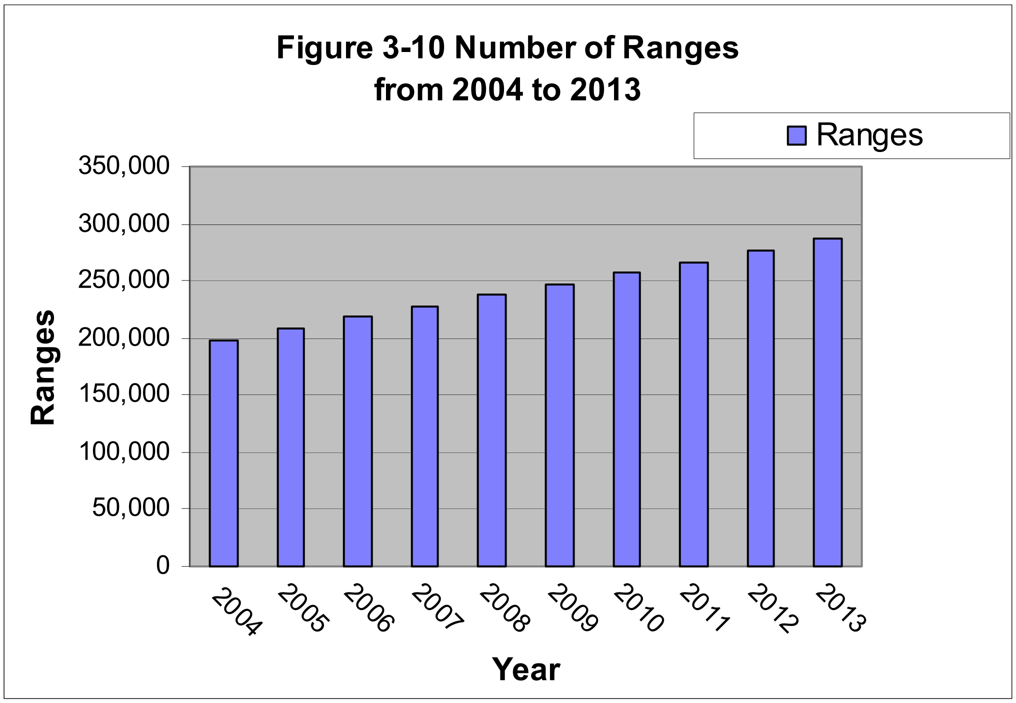
The population of Utah is projected to grow at 1.6% to 1.8% a year through 2012. In addition, a recent SWEEP report notes that there will be over 17,000 new single-family housing starts a year in Utah in every year from 2006 to 2013. Figure 3-9 below shows the forecast for single-family housing starts in the State.

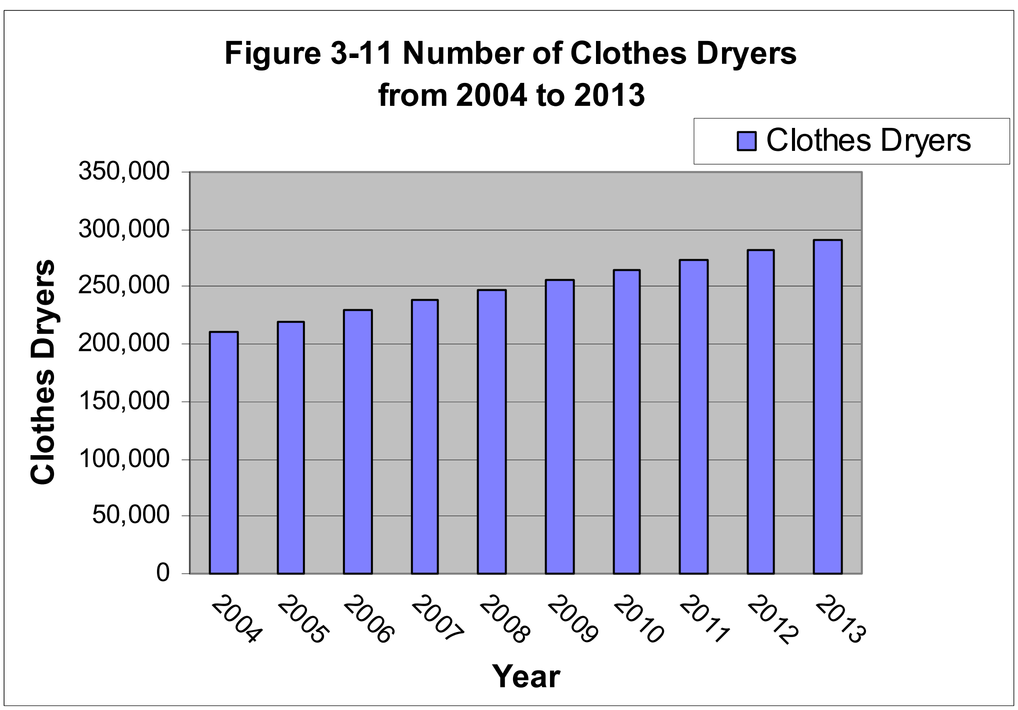
Figure 3-9 Forecast of Single Family Housing Starts in Utah from 2004 to 2013



3.7 Forecast of Number of Residential Gas Appliances

Figures 3-10 to 3-13 present graphs of the Questar forecasts for the number of residential gas appliances in Utah for the period 2004 to 2013.





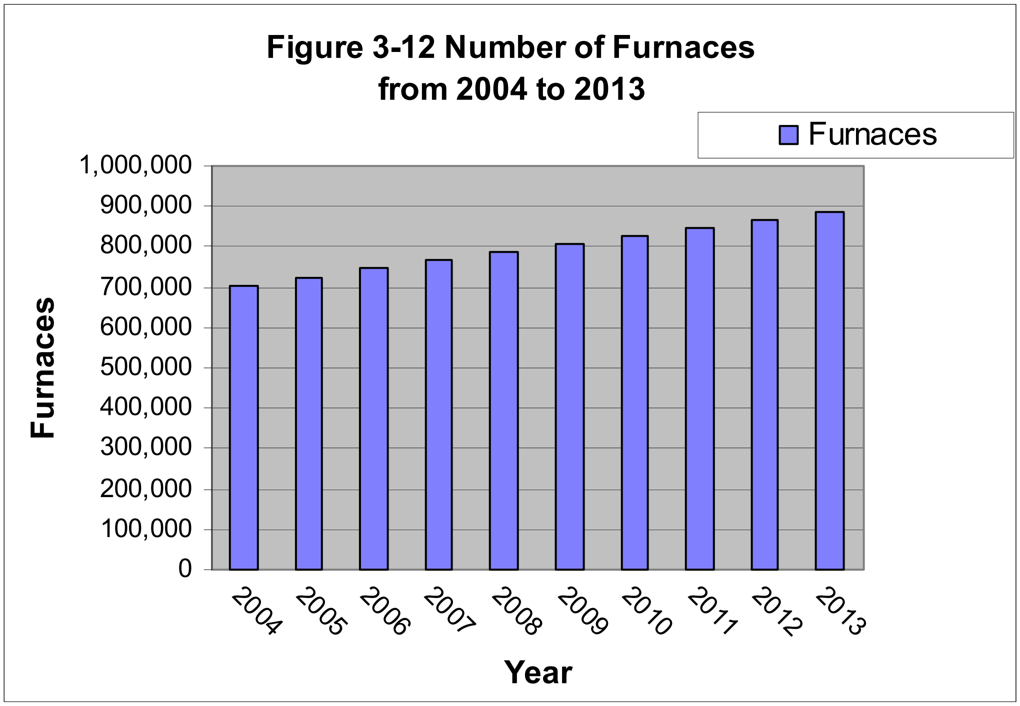


Figure 3-12 Number of Furnaces
from 2004 to 2013
Furnaces
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Furnaces
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Year

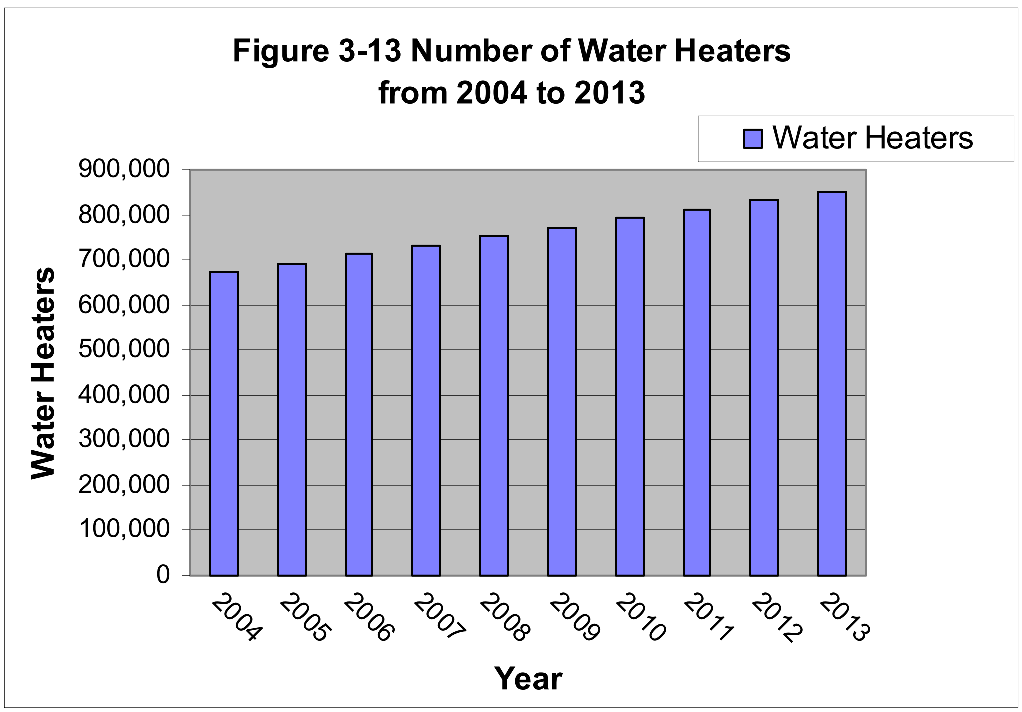


Figure 3-13 Number of Water Heaters
from 2004 to 2013
Water Heaters
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Water Heaters
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Year

3.8 Commercial Sector Gas Sales Forecast

As shown in Table 3-1, Commercial sector natural gas sales in Questar's Utah service area are forecast to increase at a 1.4 percent annual growth rate from 2004 to 2013. Table 3-5 and Table 3-6 below show the allocation of Questar commercial gas sales and customers to Commercial Markets for the period 2003 to 2013. The following figures provide an overview of the commercial sector sales forecast:

- Figure 3-14 shows a graph of this annual commercial gas sales (Dth) forecast.
- Figures 3-15 and 3-16 show a percentage breakdown of forecast commercial sector sales by market sector for 2004 and 2013.
- Figure 3-17 shows the forecast of the annual number of commercial customers from 2004 to 2013 (bar chart)
- Figures 3-18 to 3-24 shows the saturation forecasts for gas space heating, gas water heating, gas cooking, gas air conditioning, etc.

In order to estimate savings within the Commercial sector, it was necessary to further break down the gas sales forecast by end use (space heating, water heating, etc.) for each of the SIC code categories analyzed. In order to estimate this level of detail, GDS used the end use saturation values as shown in Figures 3-18 through 3-24 along with Questar's Energy Use Intensity (EUI) values for each end use in each segment of the Commercial sector.

TABLE 3-5 - ALLOCATION OF QUESTAR COMMERCIAL GAS SALES FORECAST FOR UTAH TO MARKET SEGMENTS

Year	Total Utah Gas Sales from 2003 IRP, page 20 (In millions of decatherms)	0	1	4	49	5	58	6	70	7	8	82	86	9	Total Commercial Gas Sales - Utah	% of Total Sales
2003	98.30	0.94	0.64	0.96	0.35	5.27	2.48	2.01	1.41	2.93	4.05	4.52	1.71	2.17	29.44	29.95%
2004	99.70	0.96	0.66	0.97	0.36	5.36	2.52	2.04	1.44	2.98	4.12	4.59	1.74	2.20	29.95	30.04%
2005	100.70	0.98	0.67	0.99	0.37	5.46	2.57	2.08	1.46	3.03	4.19	4.68	1.77	2.24	30.49	30.27%
2006	101.70	0.99	0.68	1.01	0.37	5.53	2.60	2.11	1.49	3.08	4.25	4.74	1.80	2.28	30.92	30.41%
2007	102.80	1.00	0.68	1.02	0.37	5.59	2.63	2.13	1.50	3.11	4.30	4.80	1.82	2.30	31.25	30.40%
2008	104.00	1.02	0.69	1.03	0.38	5.67	2.67	2.16	1.52	3.15	4.36	4.86	1.84	2.33	31.68	30.46%
2009	105.10	1.03	0.70	1.04	0.39	5.75	2.70	2.19	1.54	3.20	4.41	4.93	1.87	2.36	32.11	30.55%
2010	106.30	1.04	0.71	1.06	0.39	5.82	2.74	2.22	1.56	3.24	4.47	4.99	1.89	2.39	32.53	30.61%
2011	107.10	1.06	0.72	1.07	0.40	5.90	2.78	2.25	1.58	3.28	4.53	5.06	1.92	2.43	32.98	30.80%
2012	107.90	1.07	0.73	1.09	0.40	5.98	2.81	2.28	1.61	3.33	4.60	5.13	1.94	2.46	33.43	30.99%
2013	108.50	1.08	0.74	1.10	0.41	6.05	2.84	2.31	1.62	3.36	4.65	5.19	1.96	2.49	33.80	31.15%

Source: E-mail from Blake Smith of Questar Gas Company, dated January 28, 2004.

Key for SIC Codes

0 - Agriculture
1 - Construction
4 - Transportation, Warehouse Postal, Communications
49 - Electric Generation
5 - Retail Trade, including car sales
58 - Restaurants
6 - F, I.R.E.
70 - Hotels
7 - Service-Auto repair and amusement
9 - Public Administration - police, firemen
82 - Schools
86 - Churches
8 - Services- Primarily health

TABLE 3-6 -- ALLOCATION OF QUESTAR COMMERCIAL CUSTOMER FORECAST FOR UTAH TO COMMERCIAL MARKET SEGMENTS

Year	Year End Commercial & Industrial System Customers	0	1	4	49	5	58	6	70	7	8	82	86	9
2003	55,823	1,109	2,025	1,362	282	13,003	3,388	5,814	1,026	7,786	10,636	1,806	2,740	1,299
2004	57,227	1,139	2,079	1,399	290	13,352	3,479	5,970	1,054	7,995	10,922	1,855	2,814	1,334
2005	58,651	1,169	2,135	1,436	297	13,706	3,571	6,129	1,082	8,207	11,211	1,904	2,888	1,369
2006	60,075	1,199	2,190	1,473	305	14,061	3,664	6,287	1,109	8,419	11,501	1,953	2,963	1,405
2007	61,499	1,229	2,245	1,510	313	14,415	3,756	6,445	1,137	8,631	11,791	2,002	3,038	1,440
2008	62,924	1,260	2,300	1,547	320	14,769	3,848	6,604	1,165	8,844	12,081	2,051	3,112	1,475
2009	64,347	1,290	2,355	1,584	328	15,123	3,940	6,762	1,193	9,056	12,370	2,100	3,187	1,511
2010	65,771	1,320	2,410	1,621	336	15,477	4,033	6,920	1,221	9,268	12,660	2,150	3,261	1,546
2011	67,195	1,350	2,466	1,658	343	15,832	4,125	7,079	1,249	9,480	12,950	2,199	3,336	1,582
2012	68,619	1,380	2,521	1,695	351	16,186	4,217	7,237	1,277	9,692	13,239	2,248	3,411	1,617
2013	70,039	1,411	2,576	1,732	359	16,539	4,309	7,395	1,305	9,903	13,528	2,297	3,485	1,652

Figure 3-14
Annual Commercial Gas Sales Forecast (Dth)

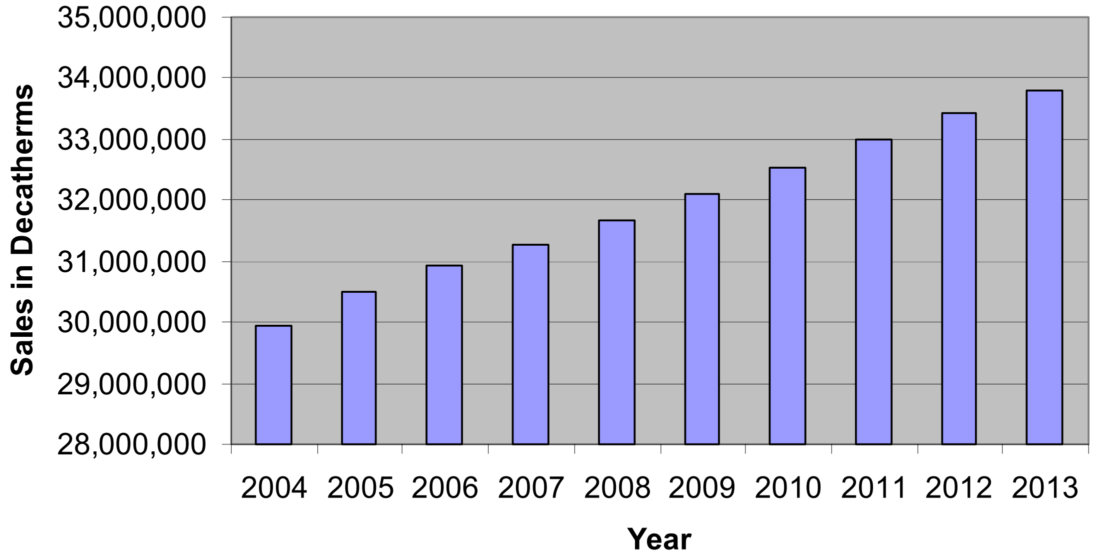
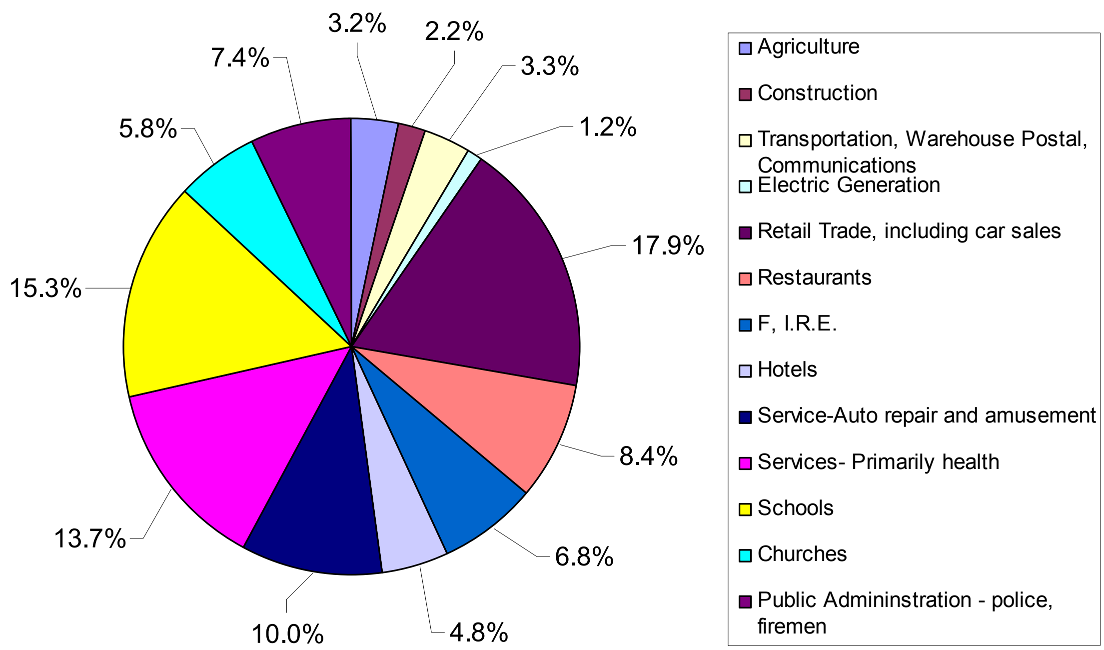


Figure 3-15 Utah Commercial Gas Sales by Market Sector - 2004



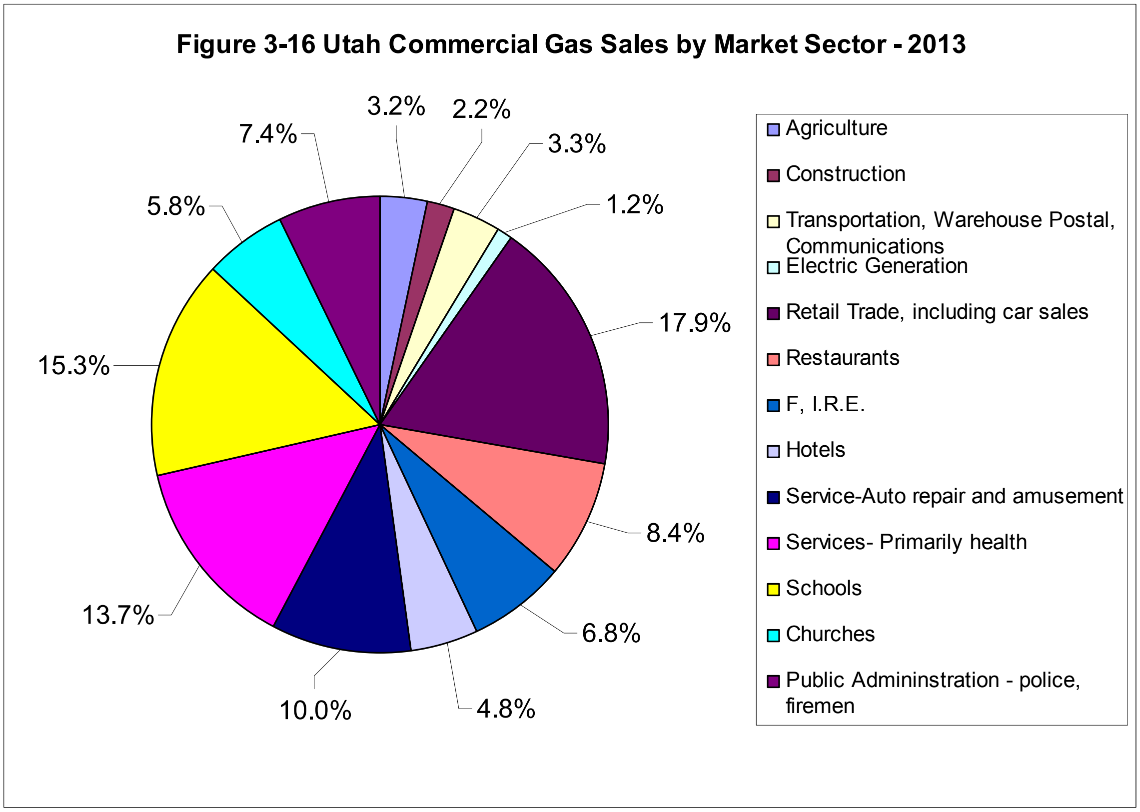


Figure 3-16 Utah Commercial Gas Sales by Market Sector - 2013
3.2%
2.2%
3.3%
1.2%
17.9%
8.4%
6.8%
4.8%
10.0%
13.7%
15.3%
5.8%
7.4%
Agriculture
Construction
Transportation, Warehouse Postal, Communications
Electric Generation
Retail Trade, including car sales
Restaurants
F, I.R.E.
Hotels
Service-Auto repair and amusement
Services- Primarily health
Schools
Churches
Public Admininstration - police, firemen

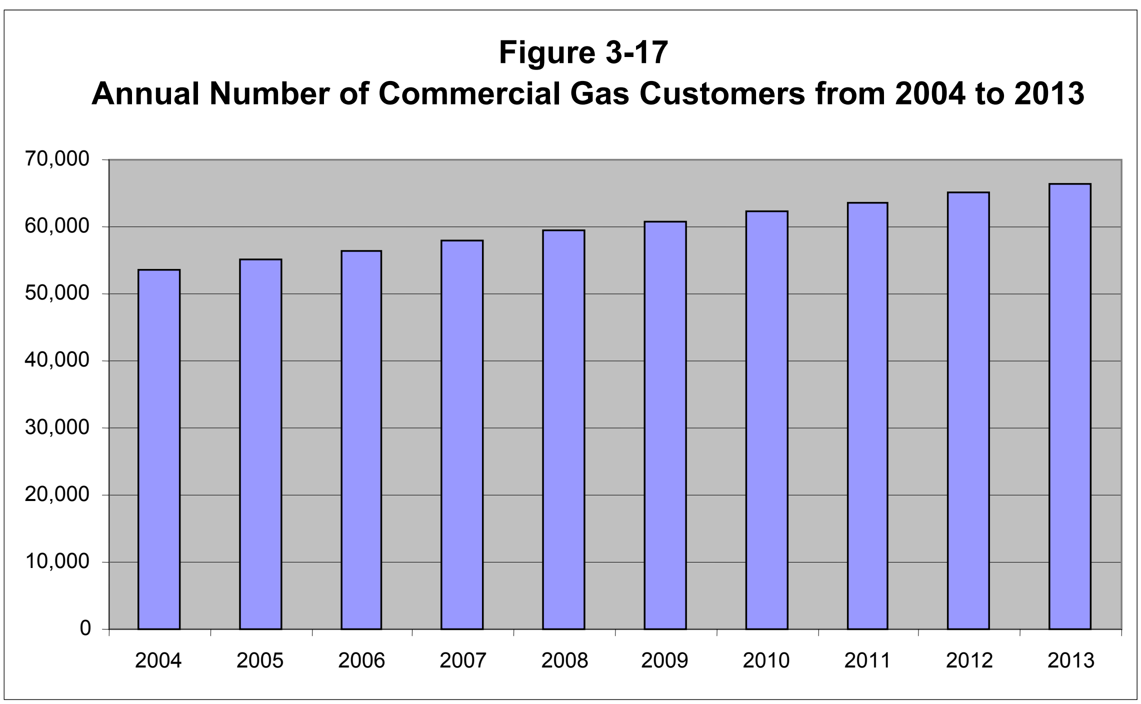


Figure 3-17
Annual Number of Commercial Gas Customers from 2004 to 2013
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

Figure 3-18
2003 Space Heat Saturation by Commercial Sector

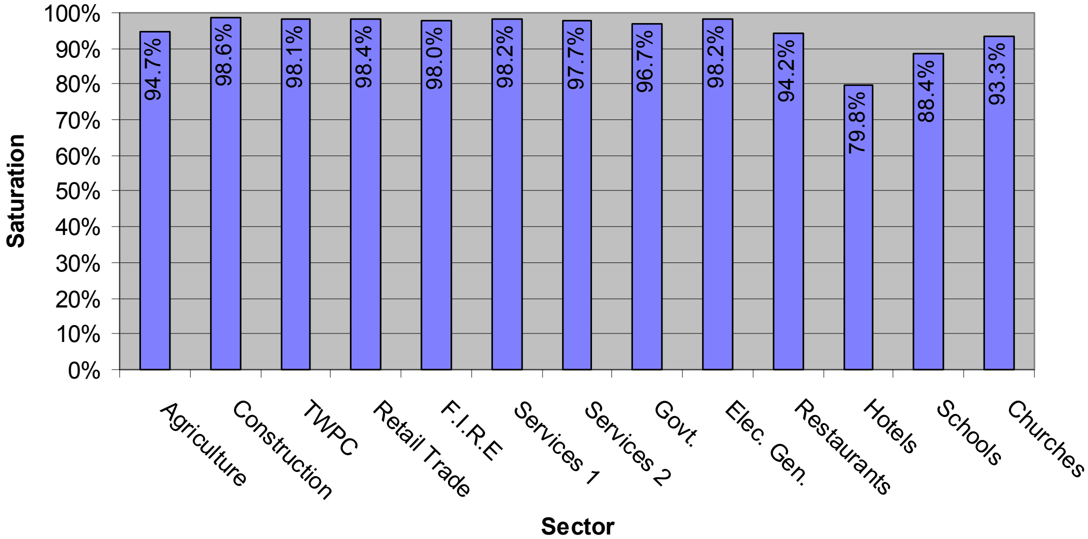
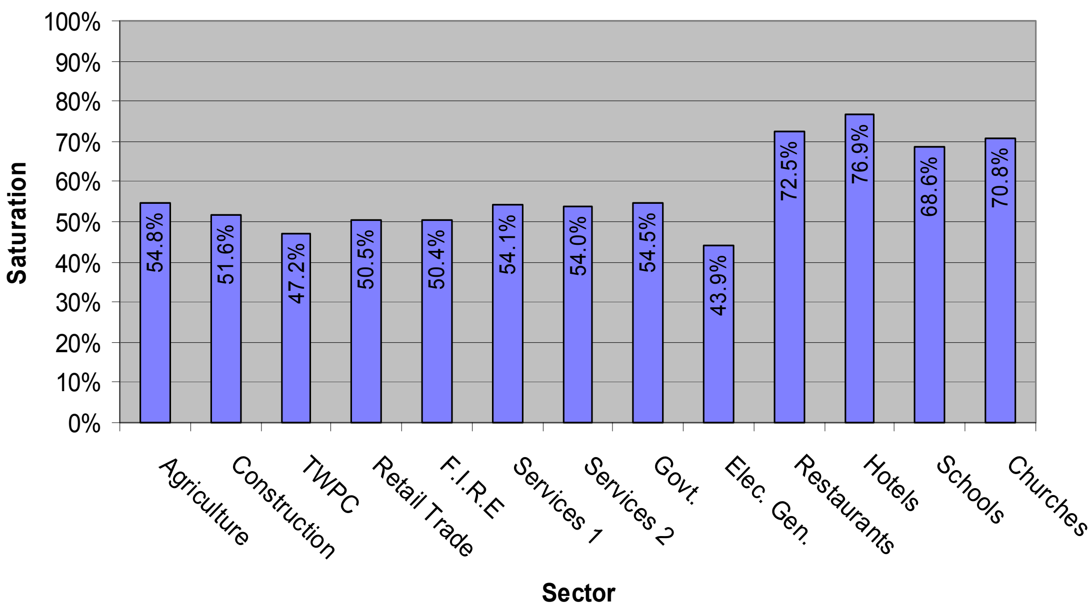


Figure 3-19
2003 Water Heat Saturation by Commercial Sector



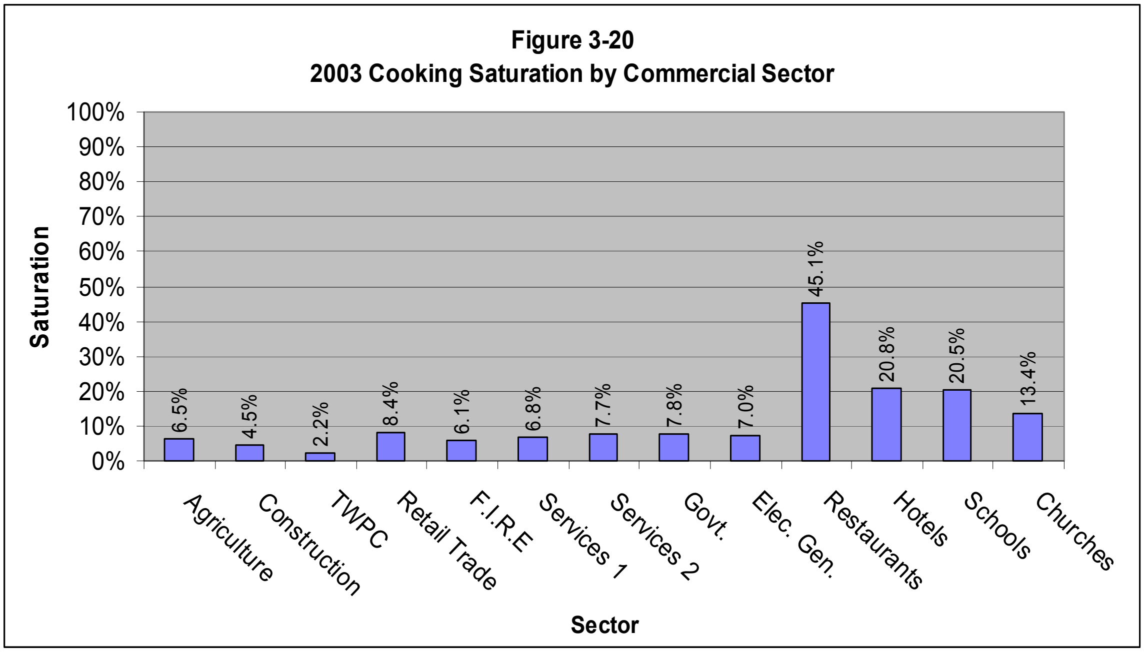


Figure 3-20
2003 Cooking Saturation by Commercial Sector
Saturation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
6.5%
4.5%
2.2%
8.4%
6.1%
6.8%
7.7%
7.8%
7.0%
45.1%
20.8%
20.5%
13.4%
Agriculture
Construction
TWPC
Retail Trade
F.I.R.E
Services 1
Services 2
Govt.
Elec. Gen.
Restaurants
Hotels
Schools
Churches
Sector

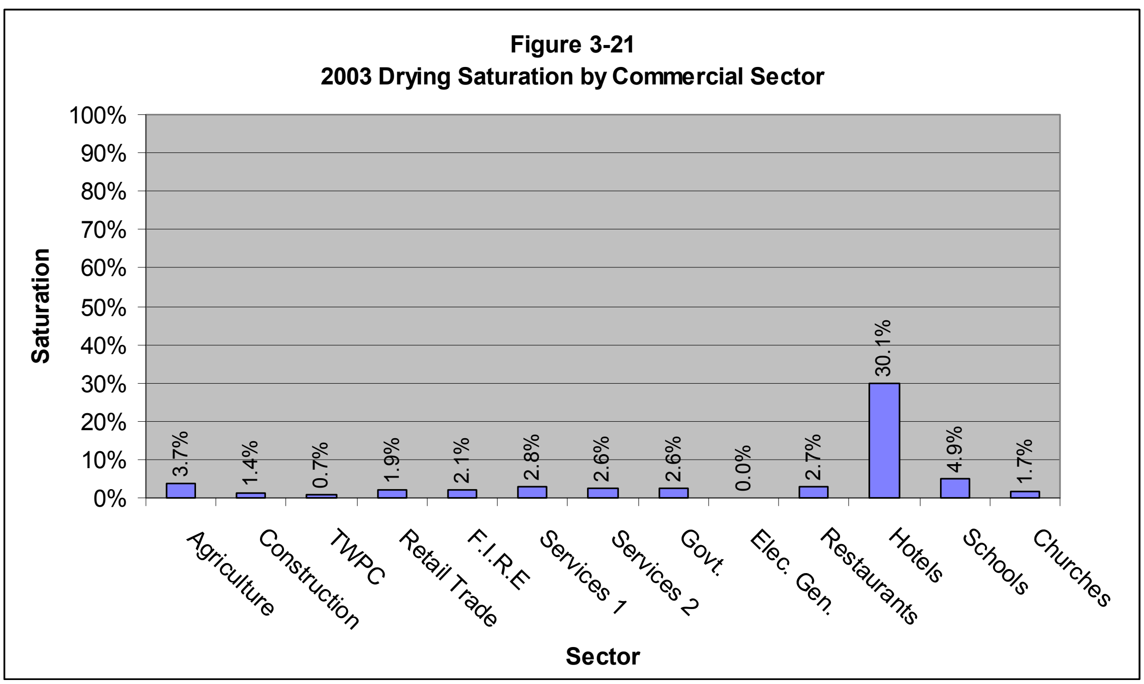


Figure 3-21
2003 Drying Saturation by Commercial Sector
Saturation
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
3.7%
1.4%
0.7%
1.9%
2.1%
2.8%
2.6%
2.6%
0.0%
2.7%
30.1%
4.9%
1.7%
Agriculture
Construction
TWPC
Retail Trade
F.I.R.E
Services 1
Services 2
Govt.
Elec. Gen.
Restaurants
Hotels
Schools
Churches
Sector

Figure 3-22
2003 Pool Heating Saturation by Commercial Sector

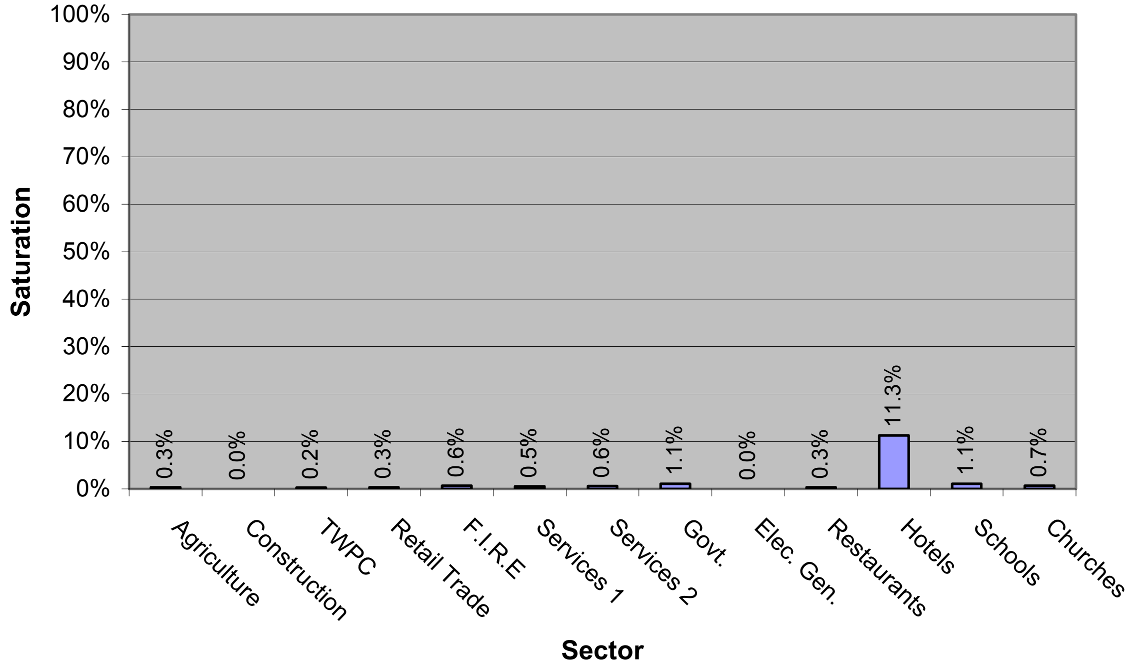


Figure 3-23
2003 Process Use Saturation by Commercial Sector

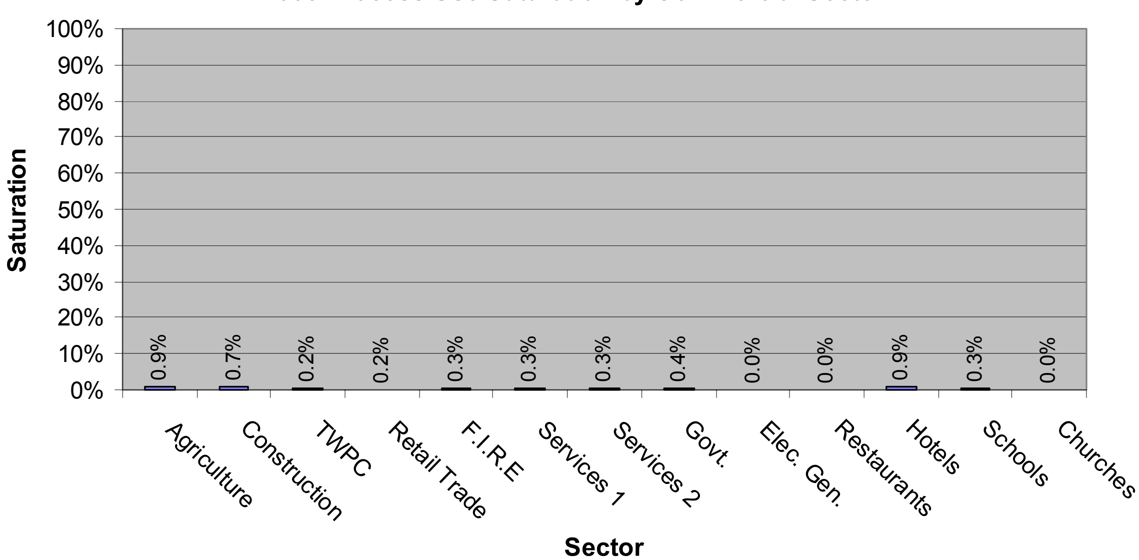
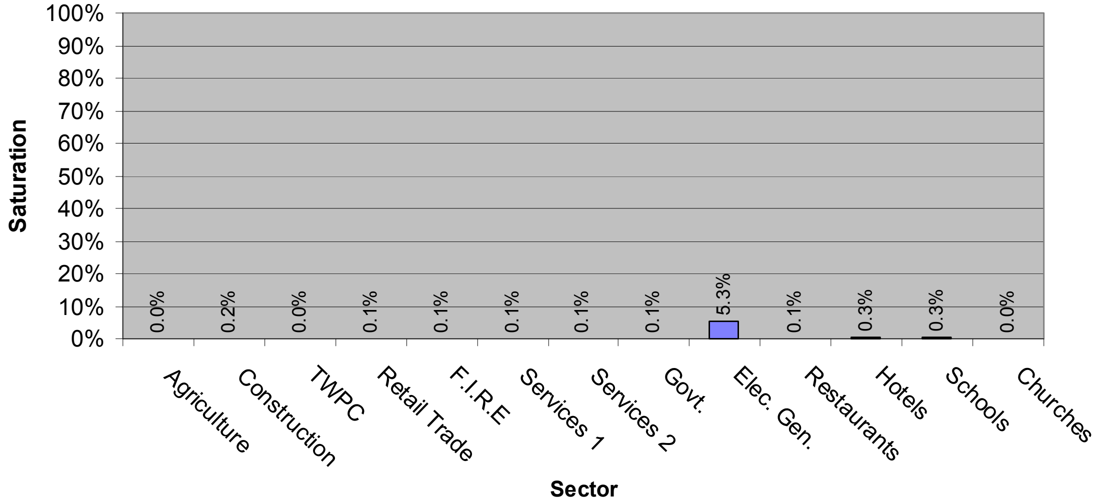


Figure 3-24
2003 Air Conditioning Saturation by Commercial Sector



4.0 METHODOLOGY USED TO ASSESS MAXIMUM ACHIEVABLE POTENTIAL

In this section, we give an overview of the approach and methodology used to complete this maximum achievable cost-effective potential study for residential and commercial gas DSM in Questar's Utah service territory.

Table 4-1
Roadmap of Approach for Estimating Gas DSM Potential in Utah

1	The first step in this study was to estimate technical potential. **Technical potential** is defined in this study as the complete penetration of all measures analyzed in applications where they were deemed technically feasible from an engineering perspective. The total technical potential for natural gas energy efficiency for each sector (residential and commercial sectors) was developed from estimates of the technical potential of individual energy efficiency measures applicable to each sector (energy efficient space heating, energy efficient water heating, etc.). For each energy efficiency measure included in this study, the GDS Team calculated the natural gas energy savings that could be captured if 100% of inefficient gas appliances and equipment were replaced instantaneously (where they are deemed to be technically feasible).
2	The second step in this study was to estimate maximum achievable efficiency potential. **Maximum achievable potential** is defined as the maximum penetration of an efficient measure that would be adopted given unlimited funding, and by determining the maximum market penetration that can be achieved with a concerted, sustained campaign involving highly aggressive programs and market intervention. The term "maximum" refers to efficiency measure penetration, and means that the GDS Team has based our estimates of efficiency potential on the maximum realistic penetration that can be achieved by 2013. The GDS Team reviewed maximum penetration forecasts from other recent technical potential studies, actual penetration experience for programs operated by energy efficiency organizations (NEEP, NYSERDA, NEEA, BPA, utilities, etc.), input from the Utah Gas DSM Advisory Group and penetration data from other sources (program evaluation reports, market progress reports, etc.) to estimate terminal penetration rates in 2013 for the maximum achievable scenario. Based on a thorough review of all of this information, the GDS Team selected a maximum achievable penetration rate of **80 percent** by 2013 for all sectors.
3	The third step in this study was to estimate the maximum achievable cost effective potential. **The maximum achievable cost effective potential** is defined as the potential for maximum penetration of energy efficient measures that are cost effective according to the Total Resource Cost test, and would be adopted given unlimited funding, and by determining the maximum market penetration that can be achieved with a concerted,

sustained campaign involving highly aggressive programs and market interventions. To develop the maximum achievable cost effective potential, the GDS Team only retained in the energy efficiency supply curves those gas DSM measures that were found to be cost effective (according to the Total Resource Cost Test) based on the individual measure cost effective analyses conducted in this Study. Energy efficiency measures that are not cost effective are excluded from the estimate of maximum achievable cost effective gas DSM potential.

4.1 Overview of Methodology

Energy efficiency measures can be a cost effective alternative to gas and electric energy supply options.[10] The objective of this study was to determine the maximum achievable cost-effective potential for residential and commercial gas DSM measures in Questar's Utah service territory over the ten-year period from 2004 through 2013. The main output of this study is summary data tables and graphs reporting the maximum achievable cost effective potential and cumulative annual potential, by year, for 2004 through 2013.

To develop estimates of the maximum achievable cost-effective potential for the residential and commercial sectors in Utah, this analysis utilized the following models and data:

(1) a GDS Associates energy efficiency potential supply curve spreadsheet model
(2) detailed information relating to the current and potential saturation of gas energy efficiency measures in the State of Utah
(3) available data on gas DSM measure costs, energy savings, operations and maintenance savings, and useful lives.

The methodology used in the determination of the potential for natural gas DSM in Questar's Utah residential and commercial sectors included the following steps:

1. Identification of data sources to be used in this study
2. Identification of measures to be included in the assessment
3. Determination of the characteristics of each measure including its incremental cost, energy savings, operations and maintenance savings, and useful life
4. Calculation of initial cost-effectiveness screening metrics (e.g., the total resource cost (TRC) benefit cost ratio, the utility cost test, the participant test and the rate impact measure test) and sorting of measures from least-cost of conserved energy to highest cost of conserved energy

[10] Note: In Utah we treat DSM as a supply option within the context of an IRP model along with all other supply options. The IRP model, given various costs and other input assumptions, chooses the least-cost alternative to meet the load requirements.

5. Collection and analysis of the baseline and forecasted characteristics of the natural gas market in Utah, including natural gas equipment saturation levels and consumption, by market segment and end use over the forecast period
6. Integration of measure characteristics and baseline data to produce estimates of cumulative costs and savings across all measures (supply curves)
7. Determination of the cumulative technical and maximum achievable potentials using supply curves.
8. Determination of the annual maximum achievable potential over the ten-year forecast period.

A key element in this approach is the use of energy-efficiency supply curves. Supply curves are a common tool in economics. In the 1970s, conservation supply curves were developed by energy analysts as a means of ranking energy conservation investments alongside investments in energy supply in order to assess the least cost approach to meeting energy service needs.

The advantage of using an energy-efficiency supply curve is that it provides a clear, easy-to-understand framework for summarizing a variety of complex information about energy efficiency technologies, their costs, and the potential for energy savings. Properly constructed, an energy-efficiency supply curve avoids the double counting of energy savings across measures by accounting for interactions between measures, is independent of prices, and also provides a simplified framework to compare the costs of efficiency with the costs of energy supply technologies.

This conservation supply curve approach also has certain limitations. In particular, the potential energy savings for a particular sector are dependent on the underlying gas load forecast for the sector as well as the measures that are listed and/or analyzed at a particular point in time. There may be additional energy efficiency measures or technologies that do not get included in an analysis, or the fraction of the market to which a measure applies may be miss-stated, so savings may be underestimated or overestimated. In addition, the costs of efficiency improvements (initial investment costs plus operation and maintenance costs) does not include all of the transaction costs for acquiring all the appropriate information needed to evaluate and choose an investment and there may be additional investment barriers as well that are not accounted for in the analysis. There are a number of other advantages and limitations of energy-efficiency supply curves (see, for example, Rufo 2003).[11]

[11] Rufo, Michael, 2003. *Attachment V – Developing Greenhouse Mitigation Supply Curves for In-State Sources*, *Climate Change Research Development and Demonstration Plan,* prepared for the California Energy Commission, Public Interest Energy Research Program, P500-03-025FAV, April. http://www.energy.ca.gov/pier/reports/500-03-025fs.html

The supply curve is typically built up across individual measures that are applied to specific base-case practices or technologies by market segment. Measures are sorted on a least-cost basis and total savings are calculated incrementally with respect to measures that precede them. Supply curves typically, but not always, end up reflecting diminishing returns, i.e., costs increase rapidly and savings decrease significantly at the end of the curve.

The cost dimension of most energy-efficiency supply curves is usually represented in dollars per unit of energy savings. Costs are usually annualized (often referred to as "levelized") in supply curves. For example, energy-efficiency supply curves usually present levelized costs per therm saved by multiplying the initial investment in an efficient technology or program by the "capital recovery rate" (CRR):

$$\mathrm{CRR} = \frac{d}{1-(1+d)^{-n}}$$

where *d* is the real discount rate and *n* is the number of years over which the investment is written off (i.e., amortized). Then the annualized cost of the measure is divided by the annual therm savings of the measure to obtain the levelized cost per unit of energy saved. This is the approach we are using in this study. Table 4-2 lists the discount and inflation rates provided by Questar Gas Company for this study.

Table 4-2 Assumptions for Discount and Inflation Rate for Utah Gas DSM Potential Study

Real Discount Rate (RDR)	4.09%
Inflation Rate (Long Term Future)	2.80%
Nominal Discount Rate (NDR)	7.00%

The levelized costs are calculated as follows:

Levelized Cost per Therm Saved = (Initial Cost x Capital Cost Recovery Factor)/Annual Energy Savings

The levelized cost per therm saved is useful because it allows simple comparison of the characteristics of natural gas energy efficiency with the characteristics of natural gas supply costs.

It is important to note that in an energy-efficiency supply curve, the measures are sorted by the relative cost of conserved energy: from least to most expensive. In addition, the energy consumption of the system being affected by the efficiency measures goes down as each measure is applied. As a result, the savings attributable to each subsequent measure decrease if the measures are interactive. Thus, in a typical energy-efficiency supply curve, the base-case end-use consumption is reduced with each unit of energy-efficiency that is acquired. Adjustments for measures that interact need to be performed where necessary.

The results are then ordered by levelized cost and the individual measure savings summed to produce the energy-efficiency potential for the entire sector.

In the following sections we discuss the sector-specific aspects of the approaches used in more detail.

4.2 Development of Technical Potential Estimates for Energy Efficiency Measures by 2013

The total technical potential for Questar's Utah residential and commercial sectors was developed from estimates of the technical potential of individual energy efficiency measures applicable to each sector (efficient space heating, efficient water heating, etc.). The general approach used in this study is identical to the approach used in other recent studies completed for the State of California.[12]

4.2.1 Residential Sector

Core Equation

The core equation used to calculate the natural gas energy efficiency technical potential for each individual efficiency measure, by market segment, is shown below in Table 4-3 below (using a residential example):

Table 4-3 – Core Equation

Technical Potential of Efficient Measure	=	Total Number of Residential Households in State of Utah	*	Base Case Equipment End Use Intensity (therms per home)	*	Base Case Factor	*	Remaining Factor	*	Convertible Factor	*	Savings Factor

where:

- **Number of Households** is the number of residential natural gas customers in the market segment.

- **Base-case equipment EUI** is the natural gas energy used per customer per year by each base-case technology in each market segment. This is the consumption of the gas energy-using equipment that the efficient technology replaces or affects. For example, if the efficient measure were a high efficiency gas furnace, the base EUI would be the annual therm use

[12] "California's Secret Energy Surplus: The Potential For Energy Efficiency – Final Report", Prepared for The Energy Foundation and The Hewlett Foundation, prepared by XENERGY Inc., September 23, 2002.

per household associated with space heating for a standard 80% efficiency non-condensing natural gas furnace.

- **Base Case factor** is the fraction of the end use natural gas energy that is applicable for the efficient technology in a given market segment. For example, for a residential high-efficiency heating technology, this would be the fraction of all residential gas customers that have gas space heating equipment.

- **Remaining factor** is the fraction of applicable dwelling units or floor space that has not yet been converted to the efficient gas DSM measure; that is, one minus the fraction of households or floor space that already have the energy-efficiency measure installed.

- **Convertible factor** is the fraction of the applicable dwelling units (or floor space) that is technically feasible for conversion to the efficient technology from an *engineering* perspective (e.g., it may not be possible to apply water pipe insulation in all homes due to access difficulties).

- **Savings factor** is the percentage reduction in natural gas energy consumption resulting from application of the efficient technology.

An example calculation for a high efficiency natural gas furnace in the residential sector using the core equation is shown in Table 4-4.

Table 4-4 – Sample Calculation Of Technical Potential For High Efficiency Condensing Natural Gas Furnace in 2004

Technical Potential of Efficient Measure (in therms)	=	Total Number of Residential Gas Customers in the Questar Service Area in Utah in 2004	*	Base Case Equipment End Use Intensity (therms per home for space heating)	*	Base Case Factor (Saturation of gas space heat in res. Sector)	*	Remaining Factor	*	Convertible Factor	*	Savings Factor
77,555,449	=	702,009	*	538	*	98.88%	*	52.7%	*	1.00	*	21.2%

Technical energy-efficiency potential is calculated in two steps. In the first step, all measures are treated *independently*; that is, the savings of each measure are not marginalized or otherwise adjusted for overlap between competing or synergistic measures. By treating measures independently, their relative economics are analyzed without making assumptions about the order or combinations in which they might be implemented in customer buildings. However, the total technical potential across measures cannot be estimated by summing the individual measure potentials directly because some savings would be double-counted. For example, the savings from a weatherization, such as low-e Energy Star windows, are partially dependent on other measures that affect the efficiency of the system being used to cool or heat the building, such as high-efficiency gas furnaces; the more efficient the gas furnace, the less energy saved from the low-e Energy Star windows.

4.2.2 Residential New Construction Sector

The supply curve estimates for the maximum achievable potential for the residential new construction sector in Utah are based on a technical analysis that SWEEP recently conducted for the Southwest. This study provides the incremental costs of the Energy Star® Homes Program, the useful life of measures, and the energy savings per home in Utah. This study also provides the baseline energy use for new homes likely to occur in the absence of the program. Further detail on these costs and savings is provided in Section 5.

4.2.3 Commercial Sector – Top Down Approach

A “top-down” approach was used to develop the technical potential estimates for the commercial sector. The main difference from using a bottom-up method is that data is displayed in terms of energy rather than square feet. It is important to note that square-foot based saturation assumptions cannot be applied to energy use values without taking into account differences in energy intensity (e.g., an area covered by a unit heater may represent 2 percent of floor space but a larger percent of space heating energy in the building because it is likely to be less efficient than the main heating plant).

In the top-down method, the core equation used to calculate the energy technical potential for each individual efficiency measure, by market segment, is calculated as shown below in Table 4-5.

Table 4-5 – Core Equation – Commercial Sector – Top Down Method

Technical Potential of Efficient Measure	=	Total End Use Dth (by segment)	*	Base Case Factor	*	Remaining Factor	*	Convertible Factor	*	Savings Factor

An example of how the core equation was used in the commercial sector is shown in Table 4-6 for the case of installing duct insulation in the office segment of the Questar service territory. Column 1 shows the Technical Potential savings value in Dth for installing duct insulation in existing buildings, which is calculated by multiplying the values in columns 2 through 6. Column 2 shows the total forecasted level of Dth sales for space heating in existing buildings of the Office segment, based on Questar's sales forecast and Questar's Energy Use Intensities (EUI) for end uses with commercial segments. The Base Case Factor in column 3 is then applied to this sales value in order to account for the amount of space heating sales that area associated with forced air heating systems. The 85% value shown in column 3 was estimated based on data from the 2003 PacifiCorp/Questar Commercial Energy Preferences Survey. The Remaining Factor in column 4 of 59% represents an estimate of the amount of ducts that are left to be insulated and is based on data from the 2003 California gas efficiency potential study.[13] Column 5 shows a 25% Convertible Factor which is also based on the California study. This low convertible factor indicates that only one quarter of the ducts that are not currently installed can be retrofitted due to accessibility and other factors. The Savings Factor in column 6 of 1.9% was estimated using the Energy-10 building simulation software.

Table 4-6
Example of Technical Potential Calculation – Duct Insulation in the Office Segment for Existing Buildings

1		2		3		4		5		6
Technical Potential of Efficient Measure	=	Total End Use Dth (by segment)	*	Base Case Factor	*	Remaining Factor	*	Convertible Factor	*	Savings Factor
2,486	=	1,030,975	*	85%	*	59%	*	25%	*	1.923%

Total measure costs in the top-down method can be calculated as a function of savings using costs per first-year therm saved as the basis. For the example above, if the cost per therm saved is $0.077 based on a cost of duct insulation of $33, then the total measure cost associated with the technical potential savings of 2,486 Decatherms can then calculated as:

24,860 therms X $0.077/therm = $1,914

The costs are then adjusted in the supply curve development phase to account for reductions in savings that occur through the measure stacking process.

<u>Measure-Level Detail</u>
The commercial measures included in the analysis had four basic characteristics, aside from the grouping by end use, that were considered in determining savings factor:

- *Weather dependent with significant variation by building type*
  Installation of an energy management system would fall into this category because buildings with occupancy schedule variations or areas serving

[13] California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study, Study ID #SW061, Prepared for Pacific Gas & Electric Company, Prepared by Mike Rufo and Fred Coito KEMA-XENERGY Inc., May 14, 2003.

different functions will likely see more savings from an EMS than buildings that do not. Hospitals and schools are usually excellent candidates, while warehouses are not. These measures needed to be modeled using software that can account for these differences as well as model energy use based on typical meteorological data for the area. In this case, the Energy-10 building energy use simulation software was used.

- *Weather dependent with little or no variation by building type*
  Installation of a high efficiency furnace or boiler would fall into this category. Absolute energy savings in terms of therms will vary by building type, but the savings percentage is primarily dependent on the increase in efficiency over the previous unit.

- *Non-weather dependent with significant variation by building type*
  Water heater tank insulation falls into this category because it will provide greater benefit in terms of savings percentage to buildings with little hot water consumption because hot water is more likely to be stored in the tank for extended periods. An engineering calculation was done to determine energy savings for this category of measures.

- *Non-weather dependent measures with little or no variation by building type*
  The savings factor for an efficient water heater is primarily dependent on efficiency increase and not water use, and will show relatively little weather dependency.

In order to determine whether a measure was cost effective, it was necessary to assign a square footage to each building type so that an absolute annual energy savings could be compared with an absolute cost of installation for the measure. Questar's most recent average customer square footage by SIC code was used as an estimate of square footage by building type.

In some cases, measures included in the database were only appropriate for large buildings or specific applications not found in all buildings. It was necessary to fairly assess the cost effectiveness of such measures even though they would not be found in the majority of buildings encountered. Two such measures were Boiler Stack Heat Exchangers (economizers) and Infrared Heaters.

Stack heat exchangers use heat that would otherwise be lost up the stack to preheat boiler feed-water or combustion air. These units typically save about 5% and typically only apply to larger boilers where more savings are possible. This measure would be ideal in a large hospital but would not be possible in a small clinic of just over 5,000 square feet, which represents the average size of Questar customers in the health care industry. In order to allow stack heat exchangers to be compared fairly to other measures, the cost of the measure was scaled down to match the size of the average building for the purposes for evaluating cost effectiveness. In this case, it was estimated that stack heat exchangers would not be feasible in buildings smaller than 15,000 square feet because the relatively high first cost of the heat exchanger (economizer) could not be recovered in a reasonable amount of time from savings achieved from a smaller boiler. We estimated that buildings smaller than 15,000 square feet would typically not be heated by boilers large enough to utilize economizers; because the average size of buildings in the health care sector is about 5,000 square feet, the cost was scaled down to one-third (5,000/15,000). In order to account for this measure having limited applicability in the health care sector, a base case factor of 13.8% was used because survey information indicates that only 13.8% of respondents in the commercial sector use boiler heat.

Infrared heaters present a similar challenge because they are most appropriate for areas experiencing frequent air changes such as garages and warehouses where ductless, hanging unit heaters (such as those manufactured by Reznor) are typically employed. While they might be present in a large office building with a parking garage, they would not likely be found in a 4,000 square foot building that represents the average for offices in Questar's service territory. The typical cost of two to four units that might be needed in a large garage would make them cost prohibitive based on the savings that would be associated with a small building, so this cost was scaled down to the cost of a single unit for the purposes of evaluating cost effectiveness. In the Office segment, it was estimated that only 1% of space heating gas use could be affected by infrared heaters.

4.2.4 Commercial New Construction Sector

For the supply curve estimates for the Commercial Sector, we developed a separate supply curve for the new construction market segment to capture the cost and savings associated with new construction energy efficiency measures. The supply curve equations are methodologically identical; however, the end-use consumption amounts are different, as are the range of measures.

Certain efficiency measures are more suited for existing buildings and were therefore removed from the new construction measure list for the purposes of determining new construction savings potential. The removed measures include:

- Ceiling Insulation - In the majority of cases, the level of ceiling insulation is expected to be adequate in new construction, and missing insulation would likely be discovered during commissioning.
- Double-Pane Low E Windows - Double-pane low-emissivity windows are expected to be found in most newly constructed buildings.
- Boiler Tune-Up - Clearly applicable only to existing buildings.
- EMS Installation - New buildings would be expected to have an energy management system if it is appropriate.
- EMS Optimization - Adjustments made under this category would likely be covered in commissioning of mechanical systems.

- Programmable Thermostats - Programmable Thermostats are expected to be found in most newly constructed buildings, where appropriate.
- Heating/Cooling Duct Cleaning - Clearly applicable only to existing buildings after some period of operation.
- Repair Malfunctioning Steam Traps - Primarily applicable to existing buildings after some period of operation. Traps failing at startup would be covered under building commissioning.
- Water Heater Tank Insulation - Primarily applicable to existing buildings with older water heaters that have inadequate levels of insulation.

The GDS Team constructed the commercial Existing and New Construction supply curves for the last year (2013) of the study period. In order to estimate the level of new construction activity in the commercial sector, the Questar load forecast of gas sales and customers was used. For each building type, the average gas use per commercial customer was calculated for 2013. The average gas use in 2013 was multiplied by the customer count in 2004 and 2013 and the difference in these values represented an estimate of the sales associated with new construction in the commercial sector. We feel that this offers a reasonable value for gas sales associated with new buildings.

4.3 Development of Maximum Achievable Potential Estimates for Energy Efficiency Measures by the Year 2013

The maximum achievable natural gas energy efficiency potential for Questar's Utah residential and commercial sectors is a subset of the technical potential estimates. The term "maximum" refers to efficiency measure penetration, and means that the GDS Team has based our estimates of efficiency potential on the maximum realistic penetration that can be achieved by 2013. The term "maximum" does not apply to other factors used in developing these estimates, such as measure costs, measure energy savings or measure lives.

The maximum achievable potential estimate for energy efficiency defines the upper limit of savings from market interventions. For each sector, the GDS Team developed the initial year (2004) and terminal year (2013) penetration rate that is likely to be achieved for groups of measures (space heating equipment, water heating equipment, etc.) by end use for the "naturally occurring scenario" and the "with aggressive programs and unlimited funding" scenario. The GDS Team reviewed maximum penetration forecasts from other recent technical potential studies, actual penetration experience for programs operated by energy efficiency organizations (NEEP, NYSERDA, NEEA, BPA, utilities, etc.), input from the Project Advisory Team and penetration data from other sources (program evaluation reports, market progress reports, etc.) to estimate terminal penetration rates in 2013 for the maximum achievable scenario. In addition, the GDS Team conducted a survey of nationally recognized energy efficiency experts requesting their estimate of the maximum achievable potential for the State of Utah assuming implementation of aggressive programs and unlimited funding. The terminal year (2013) penetration estimates used in this study for Questar were based on the information gathered through this process. Based on a thorough review of all of this information, the GDS Team selected a maximum achievable penetration rate of **80 percent** by 2013 for Questar's Utah residential and commercial sectors.

Listed below in Table 4-9 is a summary of the information provided by energy efficiency experts across the U.S. in response to a request from the GDS Team to provide their expert judgment and a response to the following question: "Based on your experience and knowledge, and given the assumptions of implementation of very aggressive energy efficiency programs for the next 10 years and **unlimited funding**, what **maximum** penetration do you believe could be achieved for energy efficiency measures by the end of the next decade (ten years from now)?"

Table 4-9 – Expert Input on Maximum Achievable Penetration Rate

#	Efficiency Expert	Maximum Achievable Penetration Estimate Given Assumptions of Aggressive Programs and Unlimited Funding
1	Dr. Kenneth Keating - BPA	70% of energy efficiency technical potential
2	Fred Gordon- Energy Trust of Oregon	85% of stock for existing markets, on average. For new construction, 85% of turnover of floor space.
3	Raphael Friedman – Pacific Gas and Electric Company	With unlimited funding, you probably could save similar amounts to those shown in the California energy efficiency potential studies. The California Energy Surplus Study used 80% as a maximum penetration rate.
4	Janet Brandt – Wisconsin Energy Conservation Corporation	100% of the growth in energy and demand
5	Ernst Worrell - LBL	The maximum penetration rate for energy efficiency measures should be around 80% or slightly more, given aggressive programs and unlimited funding.
6	Tom Eckman – Northwest Power Planning Council (NWPPC)	Historically, the Northwest Power Planning Council has assumed that "on average" 85% of the "cost-effective" and "technically feasible" efficiency potential is achievable over a 20 year planning horizon. The empirical basis for this assumption is the experience in the Hood River Conservation project where Residential Weatherization measures where install free of charge (100% incentives) to participants. In the Hood River project about 90% of the household that were eligible participated and they installed roughly 90% of the technically feasible

		measures. The project only lasted two years so the NWPPC assumed that after 18 more years they would get most of the rest of the feasible measures installed. Assuming that programs could pay up to the full cost of all but the most expensive measures (since some amount of money must be used for program administration) and still remain cost-effective, the Council believes that a similar fraction of commercial and industrial customers would accept such offers. Over the past twenty of more years there were two periods when the Pacific Northwest Utilities and BPA were aggressively pursuing efficiency. During these periods the region "ramped" up efficiency acquisitions from less than 20 average MW to over 130 average MW in three to four years. If utilities and BPA had maintained this level of acquisition over a ten-year period, the region would have achieved about 70% of the technically feasible and cost-effective efficiency potential identified in the Council's Plans covering those same years. I might add that this level was achieved without offering 100% rebates -- the average incentive is probably in the range of 30 to 50% of measure incremental cost.
7	Nick Hall - TecMarket Works	Market research in the area of the diffusion cycle, the adoption path and the steps associated with the decision process leads me to know, without any uncertainty, that we can achieve a 80% to 90% market potential if we are allowed to design and operate a program to do so.
8	Michael Rufo – Quantum Consulting	The California Energy Surplus Study used 80% as a maximum achievable penetration rate for energy efficiency measures. Utah should be able to achieve similar maximum penetration of efficiency measures assuming aggressive programs and unlimited funding.

4.3.1 Penetration Rates from Other Efficiency Potential Studies

As noted above, the GDS Team also reviewed maximum penetration rate assumptions used in other recently published energy efficiency potential studies. Table 4-10 below presents the information collected from these other studies. Finally, the GDS Team collected information on energy efficiency programs conducted during the past three decades where high penetration has been achieved. Examples of four such programs are listed below:

- In the State of Wisconsin, a gas DSM program to promote high efficiency gas furnaces attained a penetration rate of over 90%.[14]
- Electric water heater insulation programs – A paper presented at the Fourth National DSM Conference[15] by Richard Spellman of GDS found that residential electric water heater programs operated in New England by electric utilities had achieved very high penetration rates (70% to 80%) by 1989.
- Energy efficiency programs targeted at low-income customers of electric utilities have achieved very high penetration rates during the 1980's and 1990's.
- Residential weatherization and insulation programs implemented by electric and gas utilities in New England have achieved high participation rates.

[14] Hewitt, David.C., "The Elements of sustainability. Efficiency and Sustainability", paper presented at the 2000 ACEEE Summer Study on Energy Efficiency in Buildings. Washington: American Council on an Energy Efficient Economy. Pages. 6.179-6.190. The Wisconsin furnaces case study data can be found on pages 6.185-6.186.

[15] Spellman, Richard F., "Demand-Side Management Market Penetration: Modeling and Resource Planning Perspectives from Central Maine Power Company", presented at the Fourth National Conference on Utility DSM Programs, April 1989.

Table 4-10 - Maximum Achievable Penetration of Energy Efficiency Measures by 2012			
	Penetration Rates		
Data Source	2003	2012	**Notes**
Source: The Achievable Potential for Electric Efficiency Savings in Maine			
CFL Saturation	10.0%	55.0%	
Energy Star Refrigerators	30.0%	85.0%	
High Efficiency Freezers	30.0%	85.0%	
High Efficiency Clothes Washers	70.0%	95.0%	
High Efficiency Room Air Conditioner	50.0%	95.0%	
High Efficiency Dishwashers	30.0%	85.0%	
Source: Vermont Department of Public Service - Electric And Economic Impacts of Maximum Achievable Statewide Efficiency Savings			
New Home		95.0%	Percent of homes treated, page 8, savings in 10th year.
Retrofit Measures		70.0%	Percent of homes treated, page 8, savings in 10th year.
Product Sales		75.0%	Percent of homes treated, page 8, savings in 10th year.
Source: California's Secret Energy Surplus: The Potential for Energy Efficiency			
All sectors		80.0%	
Source: The New Mother Lode: The Potential for More Efficient Electricity Use in the Southeast			
New Buildings		80.0%	Analysis was performed over the 2003 - 2020 period
Existing Buildings		100.0%	100% achieved by 2010.

4.3.2 Examples of US Efficiency Programs with High Market Penetration

The GDS Team reviewed data from a recent ACEEE publication[16] on exemplary market transformation (MT) energy efficiency programs. This ACEEE report provided several examples of MT programs where markets have been transformed or are almost transformed. Examples of such electric and natural gas energy efficiency programs that have achieved high penetration and participation in a relatively short period of time are the following:

Table 4-11 – Examples of Markets That Are Highly Transformed

1	Residential clothes washers
2	Residential appliances, including gas furnaces
3	Residential central air-conditioning equipment
4	Commercial packaged air conditioning
5	Commercial new construction
6	Exit signs
7	Builder Operator Training
8	Commercial Clothes Washers
9	Traffic Signals
10	Dry-type transformers

The GDS Team finds that the actual market penetration experience from electric and gas energy efficiency programs in other States is useful and pertinent information that can be used as a basis for developing long-term market penetration estimates for natural gas energy efficiency programs in Utah.

4.3.3 Lessons Learned from America's Leading Efficiency Programs

The GDS Team also reviewed program participation and penetration data included in ACEEE's March 2003 report on America's leading energy efficiency programs.[17] The information presented in this recent ACEEE report clearly demonstrates the wide range of high-quality energy efficiency programs that are being offered in various areas of the United States today. A common characteristic of the programs profiled in this ACEEE report is their success in reaching customers with their messages and changing behavior, whether regarding purchasing of new appliances, designing new office buildings, or operating existing buildings.

[16]Nadel, Steven; Thorne, Jennifer; Sachs, Harvey; Prindle, Bill; R Neal Elliott; "Market Transformation: Substantial Progress from a Decade of Work", published by the American Council for an Energy Efficient Economy, April 2003, Report Number A036.

[17] York, Dan; Kushler, Martin; "America's Best: Profiles of America's Leading Energy Efficiency Programs," published by the American Council for an Energy Efficient Economy, March 2003, Report Number U032.

4.3.4 Estimating Maximum Achievable Potential

To estimate the maximum achievable potential for each year of the forecast period, we first separated the forecasts of natural gas demand in Utah into existing and new construction. Existing construction is defined as the entire stock of buildings in place today. New construction is defined as the stock of buildings that is constructed over the 10 years of the forecast period. For new construction, energy-efficiency measures can be implemented when each new building is constructed, thus the rate of availability is a direct function of the rate of new construction. For existing building, determining the annual rate of availability of savings is more complex.

Energy-efficiency potential in the existing stock of buildings can be captured over time through two principal processes: 1) as equipment replacements are made normally in the market when a piece of equipment is at the end of its useful life (we refer to this as the "market-driven" case) and 2) at any time in the life of the equipment or building (which we refer to as the "retrofit" case). Market-driven measures are generally characterized by *incremental* measure costs and savings (e.g., the incremental costs and savings of a high-efficiency versus a standard efficiency natural gas furnace); whereas retrofit measures are generally characterized by full costs and savings (e.g., the full costs and savings associated with retrofitting ceiling insulation into an existing attic). A specialized retrofit case is often referred to as "early replacement". This refers to a piece of equipment whose replacement is accelerated by several years, as compared to the market-driven assumption, for the purpose of capturing energy savings earlier than they would otherwise occur. The actual rates of ramp-in used in this study for each of these types of measures is included in Table 4-12 at the end of this section.

For the market driven measures, it is assumed that existing equipment will be replaced with high efficiency equipment at the time a consumer is shopping for a new appliance or other energy using equipment, or if the consumer is in the process of building or remodeling. Using this assumption, equipment that needs to be replaced (replaced on burnout) in a given year is eligible to be upgraded to high efficiency equipment. For the retrofit measures, savings can theoretically be captured at any time; however, in practice it takes many years to retrofit an entire stock of buildings, even with the most aggressive of efficiency programs.

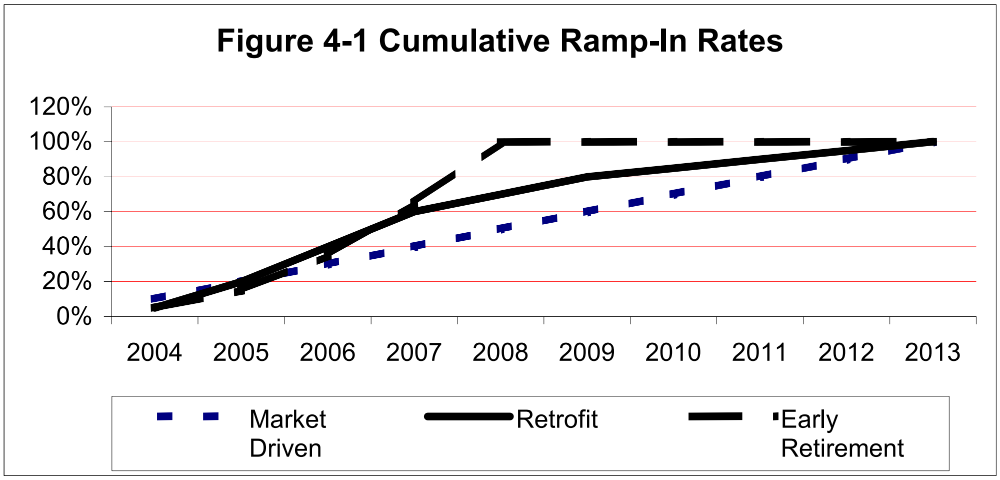
For the "market driven" maximum achievable potential, we calculate the rate at which savings are available as a function of the useful life of each piece of equipment. A simplified form of this function is the inverse of the useful life; thus, if the average life of a natural gas furnace is 20 years, their replacement is estimated to occur in the market-driven case at the rate of 1/20 per year. As noted above, retrofit measures are available for implementation by the entire eligible stock at any time; however, there are practical limits to reaching the entire stock of buildings over a short period of time. In this study, the annual rate of availability of retrofit measures assumes unlimited program funding and a concerted, sustained campaign involving highly aggressive programs and market interventions. For retrofit measures, it was assumed that installations over time would be faster than those done through the market-driven approach. After a short ramp-up period early, it was assumed that retrofit measures would be implemented aggressively in early-to-mid years of the next decade. The GDS team drew on its experience, input from additional national experts, and review of historic program accomplishments (for aggressive programs) over similar time periods (i.e., roughly 10 years) to develop annual rates of availability for the retrofit measures. The annual ramp-in rates that were used in this study for each of the three categories of measures are shown in Table 4-12. For market-driven and retrofit measures, the annual ramp-in rates are applied to the cumulative annual maximum achievable cost effective potential available in the year 2013 to obtain the year-by-year energy savings potential for the period 2004 to 2013. Figure 4-1 graphically illustrates the cumulative ramp-in rates over the ten-year period. By 2013, 100% of the available maximum achievable potential has been ramped-in.

Table 4-12 Annual Ramp-In Rates for Individual Energy Efficiency Measures

Year	Market Driven (1)	Retrofit (1)	Early Retirement
2004	10%	5%	5%
2005	10%	15%	10%
2006	10%	20%	20%
2007	10%	20%	30%
2008	10%	10%	35%
2009	10%	10%	0%
2010	10%	5%	0%
2011	10%	5%	0%
2012	10%	5%	0%
2013	10%	5%	0%

(1) For the market driven and retrofit ramp-in rates, it is important to note that these annual ramp-in rates are applied to the total maximum achievable cost effective potential that is available by 2013.

For purposes of providing Questar Gas Company with simplified DSM input assumptions for the Questar SEND OUT model, GDS used a flat 10% annual ramp-in rate. This was done because the SEND OUT Model can only accept as input a constant figure for annual program participation.



4.4 Development of Maximum Achievable Cost Effective Potential Estimates for Energy Efficiency

To develop the **maximum achievable cost effective potential** for natural gas DSM, the GDS Team only retained in the energy efficiency supply curves those measures that were found to be cost effective (according to the Total Resource Cost Test) based on the individual measure cost effective analyses conducted in this Study. Natural gas energy efficiency measures that are not cost effective are excluded from the estimate of maximum achievable cost effective energy efficiency potential.

4.5 Free-Ridership and Free-Driver Issues

Free-riders are defined as participants in an energy efficiency program who would have undertaken the energy-efficiency measure or improvement in the absence of a program or in the absence of a monetary incentive. Free drivers are those who adopt an energy efficient product or service because of the intervention, but are difficult to identify either because they do not collect an incentive or they do not remember or are not aware of exposure to the intervention.[18]

In this energy efficiency potential study, free-riders are addressed through the Questar natural gas sales forecast that was used by the GDS Team as the starting point of this technical analysis. Furthermore, GDS has not included the impact of free-drivers in this study.

The issue of free-ridership was discussed by the GDS Team with the Utah Gas DSM Advisory Group at the beginning of this study in late October 2003, and

[18] Pacific Gas and Electric Company, "A Framework for Planning and Assessing Publicly Funded Energy Efficiency Programs", Study ID PG&E-SW040, March 1, 2001.

again at the February 19, 2004 meeting of the Advisory Group. Early on in this study, the GDS Team requested that Questar provide estimates of naturally occurring energy efficiency (by major market sector) already included in the Questar gas sales forecast. Questar responded to the GDS Team that they could not break out from their official natural gas sales forecasts their estimates of naturally occurring energy efficiency. As a result, the GDS Team did not have any direct and explicit estimates from Questar of naturally occurring energy efficiency for the period 2004 to 2013.

Fortunately, Questar was able to provide data that allowed the GDS Team to develop a breakdown of an end use forecast by residential and commercial sector of gas sales in Utah for the period 2004 to 2013. This base case natural gas sales forecast ties to the total gas sales forecast in the May 2003 Questar IRP (page 20), and includes naturally occurring energy efficiency. This base case gas sales forecast (including naturally occurring energy efficiency) is described in detail in Section 3 of this Report. This gas sales forecast was the starting point in this study for all calculations of gas DSM potential.

In summary, free-riders are accounted for through the gas sales forecast used in this study. This gas sales forecast does include the impacts of naturally occurring energy efficiency (including impacts from vintaging of gas appliances, gas price impacts, and gas appliance efficiency standards). The GDS Team applied a number of factors to the base case gas sales forecast to determine potential energy efficiency savings by end use by sector for Utah. Because naturally occurring energy savings are already reflected in the gas sales forecast used in this study, these gas savings were not available to be saved again through the GDS energy efficiency supply curve analysis. GDS used this process to **ensure** that there could be no "double-counting" of energy efficiency savings. This technical methodology for accounting for free-riders is exactly consistent with the standard practice used in other recent technical potential studies, such as those conducted in California, Idaho and Connecticut.

4.6 Adjustments to Lifetime Savings for Early Retirement Measures

For early retirement energy efficiency measures, it was assumed that the measure would be replaced five years prior to reaching the end of its expected lifetime. Therefore, for the first five years, the savings associated with the measure reflects the large savings that result from replacing an old, relatively inefficient measure with a new energy-efficient model. For the remaining life of the measure, 20 years in the high efficiency natural gas furnace example, the energy savings associated with the measure reflects the incremental savings associated with installing an energy-efficient model rather than a new standard-efficient model. While there are more substantial savings available in the first five years, continued savings at a lower level are captured for the remainder of the measure lifetime.

5.0 RESIDENTIAL SECTOR GAS DSM POTENTIAL IN UTAH

This section of the report presents our estimates of natural gas technical and maximum achievable cost effective DSM potential for the existing and new construction market segments of the residential sector in the Questar service area. According to our analysis, there is still a large remaining potential for natural gas savings in Utah. Technical energy savings potential for the residential sector is estimated to be 31.3 million decatherms (Dth) by the year 2013, equivalent to **46.2** percent of forecast residential natural gas consumption in 2013). This is the maximum technical potential for gas DSM without consideration of cost effectiveness. The maximum achievable cost effective potential in the residential sector is **26.0%** of the residential gas sales forecast in 2013. Table 5-1 below presents a summary of the residential sector potential for gas DSM in Utah in the year 2013 by type of gas DSM measure.

Table 5-1 Maximum Achievable Cost Effective Potential for Gas DSM In Utah By 2013 Residential Sector

Measure #	Measure Description	Total Annual Therm Savings Maximum Technical Potential in 2013	Annual Maximum Achievable Cost Effective Therm Savings Potential in 2013
	Existing Construction Potential Savings		
1	**Programmable Thermostat - Single Family Homes - (Do-It Yourself)**	10,782,432	7,045,020
3	**Natural Gas Water Heater Blanket - (Do-It-Yourself Kit)**	10,011,800	7,067,153
4	**Energy Star Clothes Washer (Energy Factor=2.5) with electric dryer (49% of households in Utah)**	6,815,785	3,864,621
5	**Energy Star Clothes Washer (Energy Factor=2.5) with gas clothes dryer (20% of households in Utah)**	2,781,953	2,075,521
6	**Energy Star Windows - (Do-It Yourself)**	38,922,112	8,649,358
8	**Energy Star High Efficiency Gas Heating Equipment - Gas Furnace**	59,351,535	21,762,230
9	**Energy Star High Efficiency Water Heating Equipment**	16,262,483	8,432,399
10	**Residential Insulation and Weatherization Program**	87,874,630	54,921,644
11	**Low Income Program**	9,377,645	6,698,318
	New Construction Potential Savings		
12	**Energy Star Homes (new construction)**	71,208,068	55,957,320
Total Savings in 2013 (Therms)		313,388,443	176,473,583
Total Savings in 2013 (Dth)		31,338,844	17,647,358
Total Projected Residential Natural Gas Sales in 2013 (Dth)		67,900,000	67,900,000
Total Savings As A Percent of 2013 Gas Sales		46.2%	26.0%

5.1 Residential Sector Gas DSM Programs

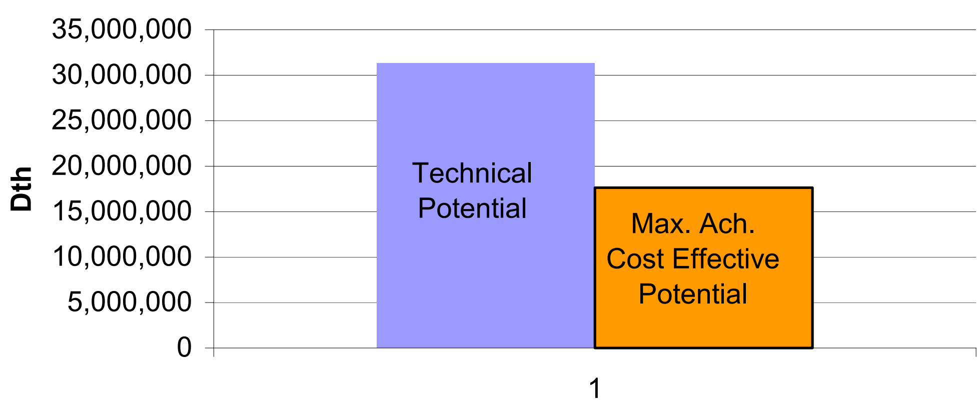
Twelve residential natural gas programs were included in the analysis for the residential sector. The set of gas DSM measures considered was pre-screened to only include those measures that are presently commercially available. Thus, emerging technologies were not included in the analysis. Table 5-1 lists the residential sector gas DSM programs included in the technical and maximum achievable cost effective potential analysis.

The technical and maximum achievable cost effective potential results are in the form of natural gas supply curves. Savings estimates are presented in both absolute and percentage terms. We based our analysis on Questar's May 2003 residential gas sales forecast for the years 2004 to 2013. Energy-efficiency measures were analyzed for the most important gas consuming end uses: space heating, water heating, and clothes washing.

5.2 Gas DSM Potential in the Residential Sector

This section presents gas DSM technical and maximum achievable cost effective potential estimates based upon the Questar residential sales forecast. In Figure 5-1 we present our estimates of total technical and maximum achievable cost effective potential for natural gas. Overall, technical energy savings potential in 2013 is estimated to be 31.3 million Dth, equivalent to 46.2 percent of total residential natural gas usage in 2013 (i.e., 31.3 million Dth Savings / 67.9 million Dth of base consumption). The maximum achievable cost effective potential is estimated to be 17.6 Mth, about 26.0 percent total base usage in 2013. A recent study completed in 2003 in California showed that the gas DSM technical potential in the residential sector for Southern California Gas (SCG) is 49 percent in the residential sector, and 43 percent for Pacific Gas & Electric (PG&E). Thus the 46 percent figure for the Questar service area in Utah is very similar to the residential technical potential estimates developed in the recent California Gas DSM Potential study.

Figure 5-1 - Technical Potential and Maximum Achievable Cost Effective Potential for Gas DSM In Utah in 2013 - Residential Sector



Gas DSM Technical Potential Savings by End Use and Measure

Estimates of natural gas savings technical potential for the residential sector are provided by end use in Figure 5-2 and Figure 5-3. Figure 5-2 provides a breakdown by efficiency measure of the technical potential savings in millions of decatherms. Figure 5-3 provides the percentage of the total technical potential savings provided by each measure type. Space heating energy efficiency measures represent the largest end-use savings potential. Water heating potential savings also represents a significant portion of the total technical potential savings.

Figure 5-2 Residential Sector Technical Potential Savings By Measure Type - Millions of Dth

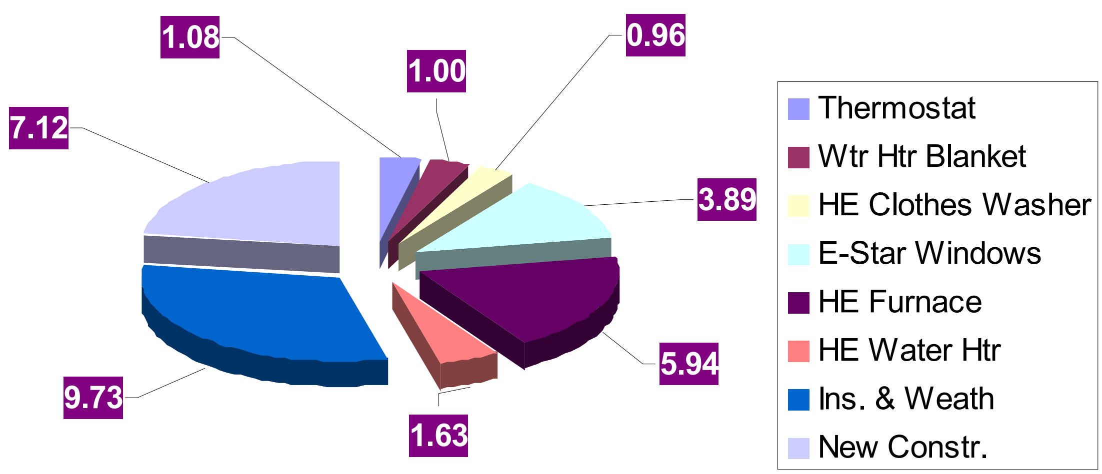
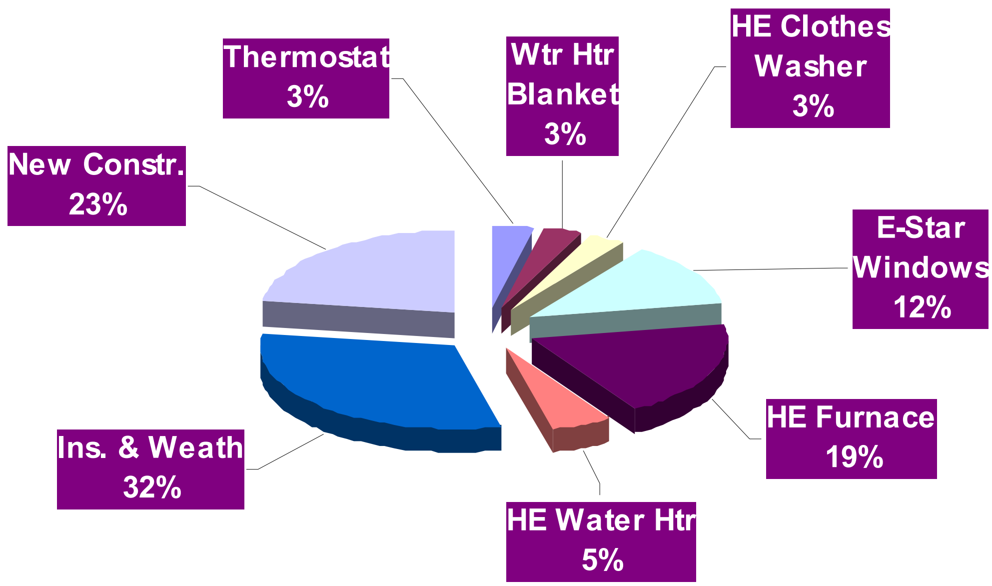


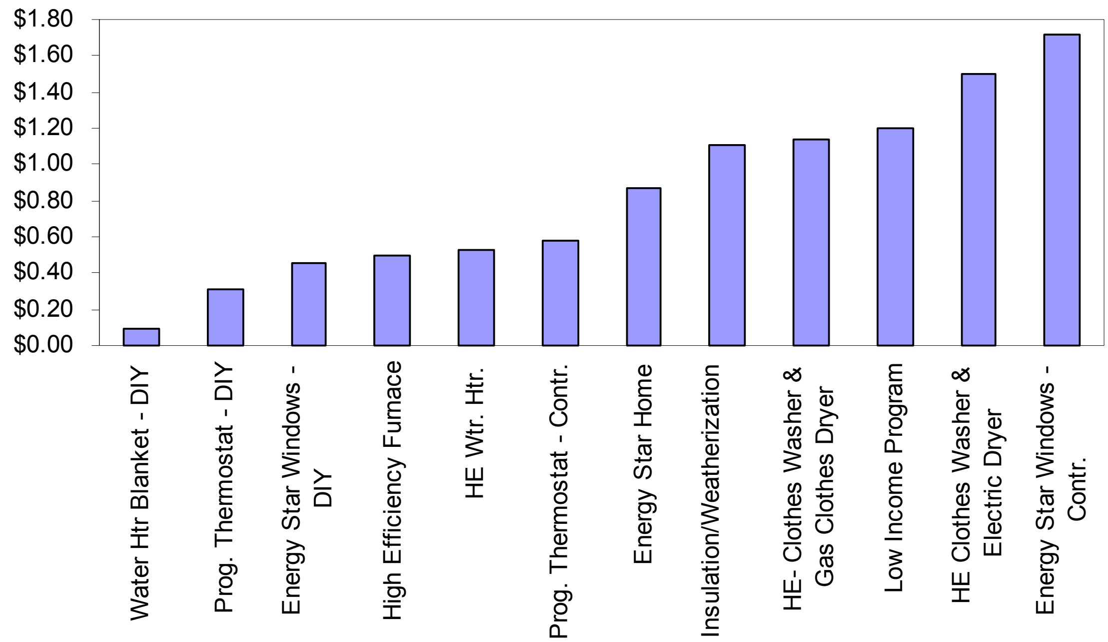
Figure 5-3 Residential Sector Technical Potential Savings By Measure Type - Percent of Total Savings



In terms of natural gas savings, insulation and weatherization measures hold the position as the measures with the largest potential at 32 percent of total technical potential in the year 2013. Energy Star Homes represent 23% of the technical potential savings, followed by high efficiency gas condensing furnaces at 19% of the total potential. The remaining measures together represent 26 percent of the total technical potential.

In Figure 5-4, we present the cost of conserved energy (CCE) for residential gas DSM measures included in this study. Note that the CCE figures shown below only include natural gas savings, and do not include savings of electricity or water.

Figure 5-4 - Cost of Conserved Energy - Residential Gas DSM Measures ($ Per Therm Saved)



The residential gas DSM supply curve is shown in Figure 5-5.

5.3 Benefit/Cost Ratios for Each Residential Program

Table 5-2 presents detailed information on the Total Resource Cost Test and the Utility Cost Test benefit/cost ratios for each residential program. The overall TRC benefit/cost ratio for the residential sector is 2.40 for the maximum achievable cost effective potential scenario, thus the overall portfolio of residential programs is cost effective according to the TRC test. It is important to note that each individual program is also cost effective according to the TRC benefit/cost test. Tables 5-3 to 5-6 present Total Resource Cost Test, the Utility Cost Test, the Participant Test and the Rate Impact Measure Test benefit/cost ratios for each program. The residential gas DSM supply curve is shown in Figure 5-5.

Figure 5-5 Residential Gas DSM Supply Curve for the State of Utah

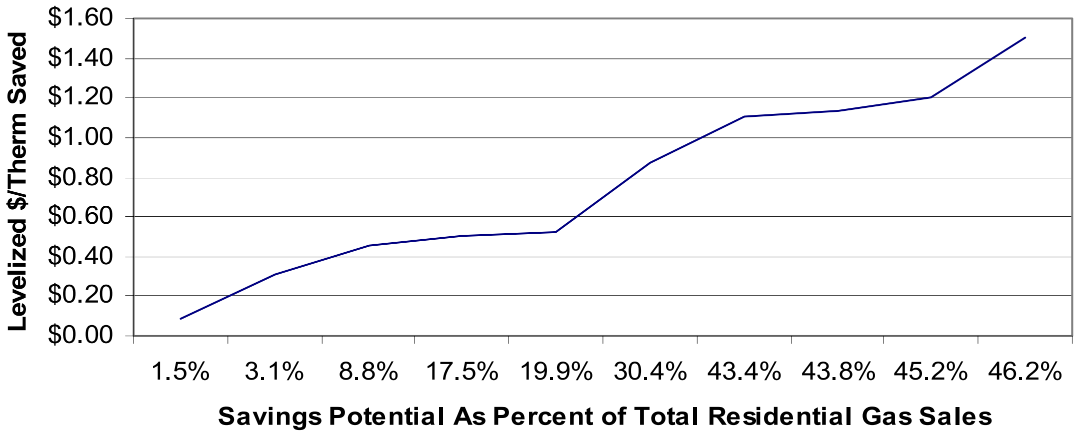


Table 5-2 - RESIDENTIAL SECTOR BENEFIT/COST RESULTS BY PROGRAM

10-Jun-04

Base Case	Total Resource				Electric Energy System				Gas Energy System				Electric & Gas Energy System			
Measure Name	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]
Sector Total	$2,369,367,929	$986,723,672	$1,382,644,257	2.40	$673,843,331	-	$673,843,331	-	$1,497,940,384	$521,183,352	$976,757,032	2.87	$2,171,783,715	$521,183,352	$1,650,600,363	4.17
Non-Measure		$7,860,477				$0				$7,860,477				$7,860,477		
Total Measure	$2,369,367,929	$978,863,195	$1,390,504,734	2.42	$673,843,331	-	$673,843,331	-	$1,497,940,384	$513,322,875	$984,617,509	2.92	$2,171,783,715	$513,322,875	$1,658,460,840	4.23
Programmable Thermostat - Single Family Homes Do-It-Yourself																
Program Total	$32,667,271	$13,675,519	$18,991,752	2.39	-	-	-	-	$29,697,519	$7,641,930	$22,055,589	3.89	$29,697,519	$7,641,930	$22,055,589	3.89
Natural Gas Water Heater Blanket (Do-It-Yourself kit)																
Program Total	$32,769,730	$4,499,297	$28,270,432	7.28	-	-	-	-	$29,790,663	$2,735,946	$27,054,717	10.89	$29,790,663	$2,735,946	$27,054,717	10.89
Energy Star CW (EF=2.5) w/ electric dryer																
Program Total	$80,256,567	$34,855,331	$45,401,236	2.30	$22,626,422	-	$22,626,422	-	$21,538,314	$18,904,783	$2,633,531	1.14	$44,164,736	$18,904,783	$25,259,953	2.34
Energy Star CW (EF=2.5) w/ gas dryer																
Program Total	$26,576,145	$14,616,050	$11,960,094	1.82	-	-	-	-	$11,567,244	$8,105,655	$3,461,589	1.43	$11,567,244	$8,105,655	$3,461,589	1.43
Energy Star Windows Do-It-Yourself																
Program Total	$137,470,452	$24,265,952	$113,204,500	5.67	$38,456,165	-	$38,456,165	-	$90,012,988	$13,378,958	$76,634,030	6.73	$128,469,153	$13,378,958	$115,090,195	9.60
Energy Star High Efficiency Gas Heating Equipment - Gas Furnace																
Program Total	$174,882,484	$173,657,077	$1,225,407	1.01	-	-	-	-	$158,984,076	$35,490,711	$123,493,366	4.48	$158,984,076	$35,490,711	$123,493,366	4.48
Energy Star High Efficiency Water Heating Equipment																
Program Total	$54,595,584	$27,494,015	$27,101,569	1.99	-	-	-	-	$49,632,349	$15,248,401	$34,383,948	3.25	$49,632,349	$15,248,401	$34,383,948	3.25
Residential Insulation and Weatherization Program																
Program Total	$735,209,770	$358,286,580	$376,923,189	2.05	$221,109,898	-	$221,109,898	-	$467,363,520	$191,505,231	$275,858,289	2.44	$688,473,418	$191,505,231	$496,968,186	3.60
Low Income Program																
Program Total	$89,693,928	$47,882,929	$41,810,999	1.87	$26,974,907	-	$26,974,907	-	$57,017,292	$56,904,224	$113,067	1.00	$83,992,199	$56,904,224	$27,087,975	1.48
Energy Star Homes																
Program Total	$1,005,245,999	$287,490,922	$717,755,078	3.50	$364,675,939	-	$364,675,939	-	$582,336,419	$171,267,513	$411,068,906	3.40	$947,012,358	$171,267,513	$775,744,845	5.53

The source of the natural gas avoided costs is an e-mail from Tom Yeager of Questar Gas Company, dated February 20, 2004. The source of the electric avoided costs is rate schedule 37 from PacifiCorp, Rates for Avoided Cost Purchases from Qualifying Facilities, filed November 8, 2001

Table 5-3 Total Resource Cost Test Benefit/Cost Ratios for Residential Programs

1	2	3	4	5	6
		Present Value of Savings	Present Value of Costs	Net Present Value Savings	B/C Ratio
Program #	Program Description				
1	Programmable Thermostat - Single Family Homes - Do-It Yourself	$32,667,271	$13,675,519	$18,991,752	2.39
2	Natural Gas Water Heater Blanket (Do-it-yourself kit) (2)	$32,769,730	$4,499,297	$28,270,432	7.28
3	Energy Star Clothes Washer (Energy Factor=2.5) with electric dryer (49% of households in Utah)	$80,256,567	$34,855,331	$45,401,236	2.30
4	Energy Star Clothes Washer (Energy Factor=2.5) with gas clothes dryer (20% of households in Utah)	$26,576,145	$14,616,050	$11,960,094	1.82
5	Energy Star Windows Do-It Yourself	$137,470,452	$24,265,952	$113,204,500	5.67
6	Energy Star High Efficiency Gas Heating Equipment - Gas Furnace	$174,882,484	$173,657,077	$1,225,407	1.01
7	Energy Star High Efficiency Water Heating Equipment	$54,595,584	$27,494,015	$27,101,569	1.99
8	Residential Insulation and Weatherization Program	$735,209,770	$358,286,580	$376,923,189	2.05
9	Low Income Program	$89,693,928	$47,882,929	$41,810,999	1.87
10	Energy Star Homes	$1,005,245,999	$287,490,922	$717,755,078	3.50
	Total Residential Sector	$2,369,367,929	$986,723,672	$1,382,644,257	2.40

Table 5-4: Utility Test Benefit/Cost Ratios for Residential Programs (Gas Utility Only)

1	2	3	4	5	6
		Present Value of Savings	Present Value of Costs	Net Present Value Savings	B/C Ratio
Program #	Program Description				
1	Programmable Thermostat - Single Family Homes - Do-It Yourself	$29,697,519	$7,641,930	$22,055,589	3.89
2	Natural Gas Water Heater Blanket (Do-it-yourself kit) (2)	$29,790,663	$2,735,946	$27,054,717	10.89
3	Energy Star Clothes Washer (Energy Factor=2.5) with electric dryer (49% of households in Utah)	$21,538,314	$18,904,783	$2,633,531	1.14
4	Energy Star Clothes Washer (Energy Factor=2.5) with gas clothes dryer (20% of households in Utah)	$11,567,244	$8,105,655	$3,461,589	1.43
5	Energy Star Windows Do-It Yourself	$90,012,988	$13,378,958	$76,634,030	6.73
6	Energy Star High Efficiency Gas Heating Equipment - Gas Furnace	$158,984,076	$35,490,711	$123,493,366	4.48
7	Energy Star High Efficiency Water Heating Equipment	$49,632,349	$15,248,401	$34,383,948	3.25
8	Residential Insulation and Weatherization Program	$467,363,520	$191,505,231	$275,858,289	2.44
9	Low Income Program	$57,017,292	$56,904,224	$113,067	1.00
10	Energy Star Homes	$582,336,419	$171,267,513	$411,068,906	3.40
	Total Residential Sector	$1,497,940,384	$521,183,352	$976,757,032	2.87

Table 5-5: Participant Test Benefit/Cost Ratios for Residential Programs

1	2	3	4	5	6
		Present Value of Savings	Present Value of Costs	Net Present Value Savings	B/C Ratio
Program #	Program Description				
1	Programmable Thermostat - Single Family Homes - Do-It Yourself	$37,369,069	$6,033,589	$31,335,480	6.19
2	Natural Gas Water Heater Blanket (Do-it-yourself kit) (2)	$37,486,274	$3,780,549	$33,705,725	9.92
3	Energy Star Clothes Washer (Energy Factor=2.5) with electric dryer (49% of households in Utah)	$75,168,480	$15,950,548	$59,217,932	4.71
4	Energy Star Clothes Washer (Energy Factor=2.5) with gas clothes dryer (20% of households in Utah)	$28,299,923	$6,510,396	$21,789,527	4.35
5	Energy Star Windows Do-It Yourself	$133,983,832	$10,886,994	$123,096,838	12.31
6	Energy Star High Efficiency Gas Heating Equipment - Gas Furnace	$196,734,987	$138,166,366	$58,568,620	1.42
7	Energy Star High Efficiency Water Heating Equipment	$61,888,639	$12,245,614	$49,643,025	5.05
8	Residential Insulation and Weatherization Program	$713,517,621	$166,781,349	$546,736,272	4.28
9	Low Income Program	$87,047,535	-	$87,047,535	0.00
10	Energy Star Homes	$941,077,421	$116,223,409	$824,854,012	8.10
	Total Residential Sector	$2,312,573,781	$476,578,813	$1,835,994,967	4.85

Table 5-6: Rate Impact Measure Test Benefit/Cost Ratios for Residential Programs

1	2	3	4	5	6
		Present Value of Savings	Present Value of Costs	Net Present Value Savings	B/C Ratio
Program #	Program Description				
1	Programmable Thermostat - Single Family Homes - Do-It Yourself	$32,667,271	$43,978,022	$(11,310,751)	0.74
2	Natural Gas Water Heater Blanket (Do-it-yourself kit) (2)	$32,769,730	$42,239,418	$(9,469,688)	0.78
3	Energy Star Clothes Washer (Energy Factor=2.5) with electric dryer (49% of households in Utah)	$23,692,145	$112,320,003	$(88,627,858)	0.21
4	Energy Star Clothes Washer (Energy Factor=2.5) with gas clothes dryer (20% of households in Utah)	$12,723,968	$43,853,190	$(31,129,222)	0.29
5	Energy Star Windows Do-It Yourself	$99,014,287	$144,871,939	$(45,857,652)	0.68
6	Energy Star High Efficiency Gas Heating Equipment - Gas Furnace	$174,882,484	$266,476,462	$(91,593,978)	0.66
7	Energy Star High Efficiency Water Heating Equipment	$54,595,584	$147,179,315	$(92,583,731)	0.37
8	Residential Insulation and Weatherization Program	$514,099,872	$784,274,442	$(270,174,570)	0.66
9	Low Income Program	$62,719,021	$143,951,760	$(81,232,739)	0.44
10	Energy Star Homes	$640,570,060	$975,868,934	$(335,298,874)	0.66
	Total Residential Sector	$1,647,734,422	$2,705,013,485	$(1,057,279,063)	0.61

6.0 COMMERCIAL SECTOR GAS DSM POTENTIAL IN UTAH

6.1 Introduction

This section of the report provides our estimates of technical and economic energy-efficiency potential for natural gas DSM measures for the commercial sector of the Questar service area. There are significant, still-available, untapped natural gas savings potential. Technical energy savings potential is estimated to be approximately 9,883,268 Dth, maximum achievable potential is estimated to be approximately 6,510,967 Dth and maximum achievable cost effective potential is estimated to be 3,773,950 Dth (or between 11.2 and 29.2 percent of expected commercial gas consumption in the year 2013). There is, however, uncertainty around these results. This section also discusses the actual program potential associated with these results.

The methodology used to develop these estimates is described in Section 4 of this report.

6.2 Efficiency Measures Examined

A total of 40 commercial natural gas measures were used in the analyses (21 space heating, 9 water heating, 6 cooking, 3 pool heating, and 1 drying). The complete set of measures considered was pre-screened to only include those measures that are presently commercially available. Table 6-1 lists the commercial gas DSM measures included in the technical potential analysis as well as the savings estimates used for the major commercial building types.

Table 6-1 Commercial Sector Energy Efficiency Measures

Space Heating	Savings Range
Ceiling Insulation	6%-15%
Double Pane Low Emissivity Windows	8%-22%
Duct Insulation Installed	1%-3%
Duct Leakage Repair	1%-7%
High Efficiency Furnace/Boiler	10%-11%
Boiler- Heating Pipe Insulation	1%-6%
Boiler Tune-Up	2%
EMS install	11%-22%
EMS Optimization	4%-11%
Stack Heat Exchanger	5%
Heat Recovery from Air to Air	7%-22%
Programmable Thermostats	7%-16%
Weatherization	10%-27%
Heating/cooling duct cleaning	1%-3%
Infrared heating	19%
Boiler Reset Controls	10%
Boiler O2 Trim Controls	2%
Boiler blowdown heat exchanger (steam)	4%
Repair malfunctioning steam traps	8%

Insulate steam lines/condensate tank	2%
Retrocommissioning	9%
Water Heating	
Eff Gas Water Heater System 95% Eff	20%
Instantaneous Water Heater <=200 MBTUH	10%
Circulation Pump Timeclocks	3%
Tank Insulation	6%-13%
Pipe Insulation	2%
Low Flow Showerheads	1%
Faucet Aerator	1%-3%
Solar DHW System Active	60%
High efficiency Clothes Washers	3%-7%
Cooking	
Efficient Infrared Griddle	2%-7%
Convection Oven	2%-14%
Infrared Conveyer Oven	4%-15%
Infrared Fryer	1%-15%
Power Burner Oven	1%-4%
Power Burner Fryer	1%-4%
Pool Heating	
High Efficiency Pool Heater, eff.=.97 320 kbtu	16%
Pool Cover	35%
Solar Pool Heater	35%
Clothes Drying	15%

Estimated annual savings vary for some of the measures based on the type of building. For example, water heater tank insulation would provide more benefit to buildings such as offices, where hot water use is low, than in restaurants, where hot water use is higher, because hot water is sitting in the tank for longer periods of time in low use buildings.

Emerging gas DSM technologies were not included in the analysis. Also, we did not include high efficiency dishwashers or electric to gas water heating conversion, items that were discussed during the kickoff meeting. High efficiency dishwashers are dishwashers that include a booster heater so the base water heating temperature can be lowered. We did not include them as a measure because, in our estimation, virtually all dishwashers in commercial applications utilize booster heaters. Electric to gas water heater conversion was not included because it results in electric savings rather than gas savings.

The measure analysis was segmented into nine commercial building types for the Questar service area. The technical and economic potential results are presented in aggregate and by end use in the form of natural gas supply curves. We provide estimates of savings in both absolute Dth and percentage terms, and we express percent savings in two ways:

1) percent of total commercial natural gas consumption; and
2) percent of energy addressed, as discussed in more detail below.

We base our technical and maximum achievable cost effective potential energy savings analysis on Questar's commercial gas sales forecast data for the period 2004 to 2013. Natural gas energy-efficiency measures are analyzed for the most important end uses. In particular, we have not included measures to address the miscellaneous end use, with the exception of commercial natural gas pool heating, and clothes drying, which together account for 83 percent of miscellaneous sales. The miscellaneous end-use category only represents about 3.5 percent of total commercial natural gas use in Utah. As a result, the end uses for which we have addressed efficiency measures account for approximately 99.4 percent of total commercial natural gas use, or about 27,600,000 Dth. We refer to the energy-efficiency estimates based on the major end uses as the base natural gas use addressed.

Table 6-2 shows the commercial segments as defined by Questar, along with the percentage of commercial sales that they are projected to account for in 2004.

Table 6-2 Commercial Segments

Building Type	**% of Commercial Sales**
F.I.R.E (Offices)	6.8%
Restaurant	8.4%
Retail & Auto Repair/Amusement	28.0%
Transportation, Warehouses, etc.	3.3%
Schools	15.3%
Services – Primarily Health	13.7%
Hotels	4.8%
Public Administration	7.4%
Churches	5.8%
Agriculture	3.2%
Electric Generation	1.2%
Construction	2.2%

Agriculture, electric generation, and construction were not included in the calculation of technical potential because the majority of the gas consumption in these building types would not be affected by the types of measures in typical commercial programs. In addition, the "Service-Auto Repair and Amusement" category was combined with retail for the purposes of this study.

6.3 Technical and Maximum Achievable Economic Potential

This section presents technical and economic potential estimates for the commercial sector for the year 2013.

Technical savings potential is estimated to be approximately 9,883,268 Dth, maximum achievable potential is estimated to be approximately 6,510,967 Dth and maximum achievable cost effective potential is estimated to be 3,773,950 Dth (or between 13.8 and 35.9 percent of expected commercial gas consumption in the year 2013). Figure 6-1 illustrates the three values along with the associated percent of gas sales in 2013.

Figure 6-1 Estimated Technical and Maximum Achievable Cost Effective Potential for Natural Gas in the Commercial Sector

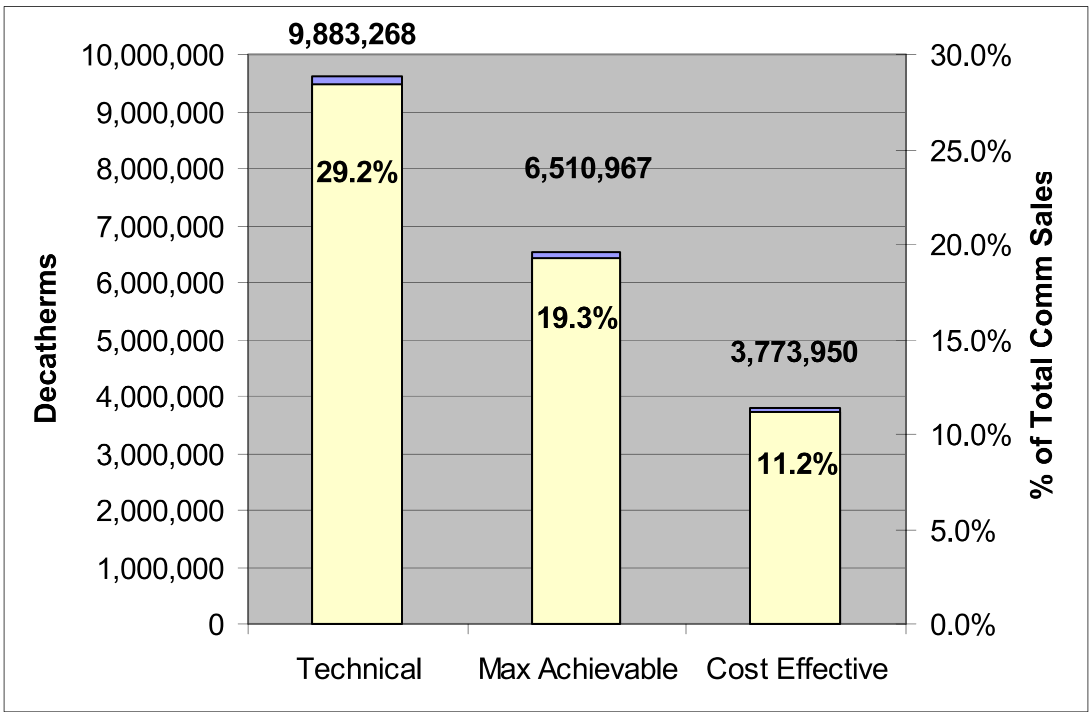


Figure 6-2 shows the percentage of total technical potential savings within each of the commercial end uses. Space heating accounts for the largest percentage of technical potential at 55%, with water heating second largest at 33%. Cooking, pool heating, and drying represent lesser potential at 12% combined.

Figure 6-2 Commercial Existing Buildings Gas Energy Savings Technical Potential

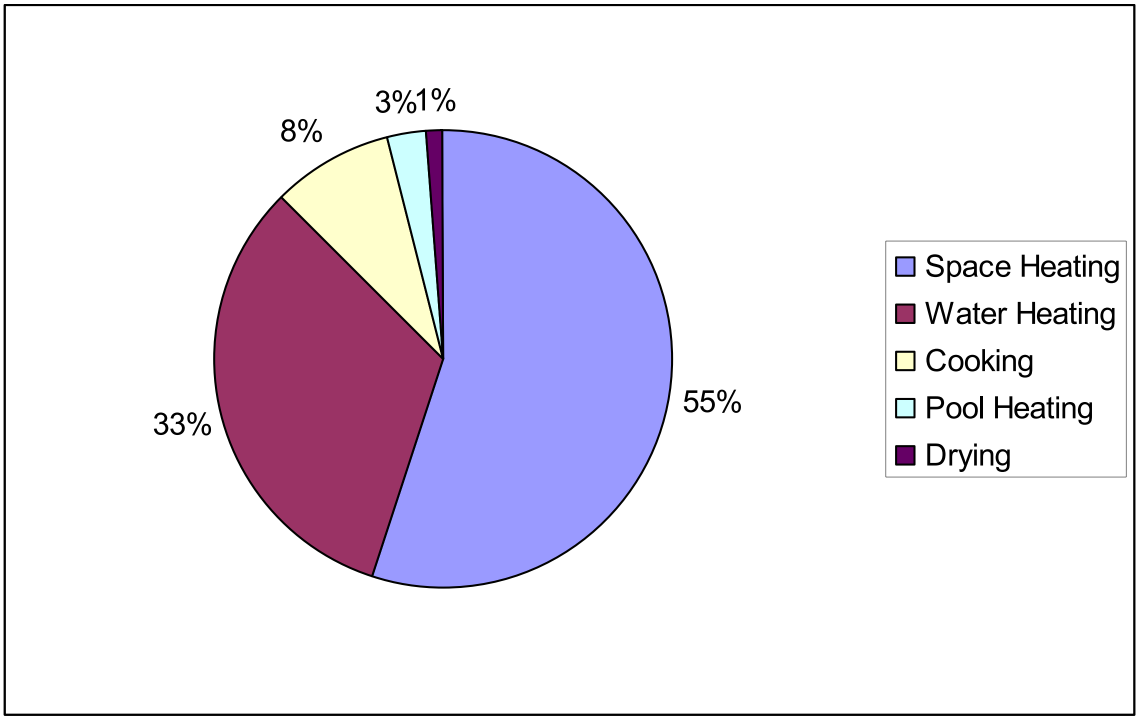


Figure 6-3 shows the percentage of total commercial new construction potential savings for each of the commercial end uses. Space heating accounts for the largest percentage of technical potential at 44% and water heating is nearly as large at 39%.

Figure 6-3 Commercial New Construction Gas Energy Savings Technical Potential

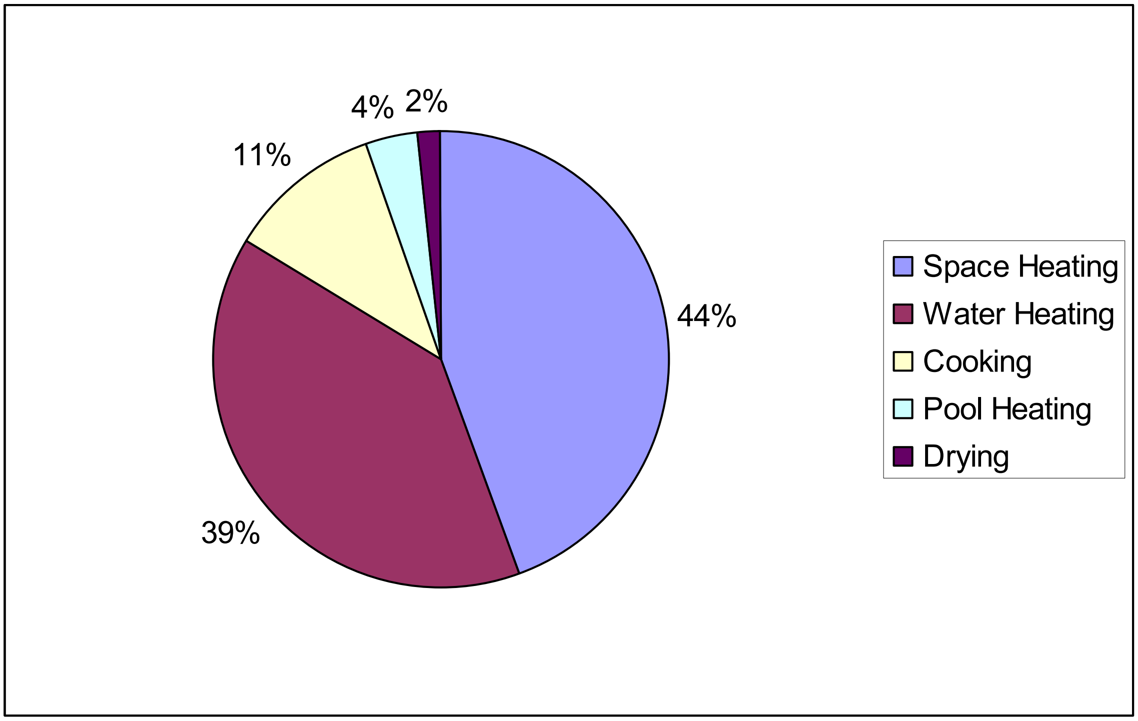
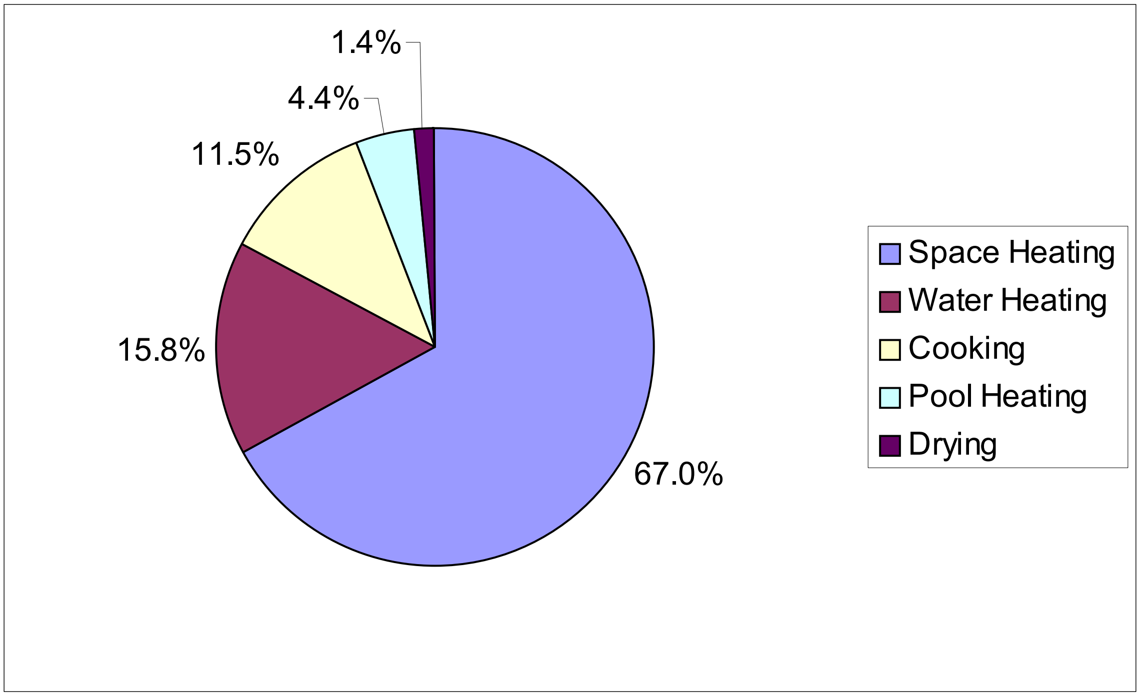


Figure 6-4 shows the percentage of total cost effective savings of each of the commercial end uses for existing buildings. Space heating accounts for the largest percentage of cost effective savings at 67%. Water heating represents 15.8% and cooking, pool heating, and drying represent a lesser potential at 17.3% combined.

Figure 6-4 Commercial Existing Buildings Gas Energy Savings Maximum Achievable Cost Effective Savings Potential



In Table 6-3, we present estimates of technical potential by end use in terms of energy saved in the year 2013 and in terms of percent of base end use energy consumption. Space heating is the end use with the largest technical potential at 4,598,388 Decatherms in existing buildings and 678,545 Decatherms in new construction.

Table 6-3 2013 Commercial Gas Technical Potential by End Use

End Use	Existing Buildings Savings Potential (Dth)	Savings Potential (% of Base Sales)	New Construction Savings Potential (Dth)	Savings Potential (% of Base Sales)
Space Heat	4,598,388	35.2%	678,545	21.8%
Water Heat	2,722,248	33.3%	596,619	30.6%
Cooking	706,773	24.6%	168,688	24.6%
Pool Heat	228,795	27.5%	54,607	27.5%
Drying	103,936	13.5%	24,807	13.5%

In Table 6-4, we present estimates of maximum achievable potential by end use in terms of energy saved in year 2013 and in terms of percent of base end use energy consumption. Space heating is the end use with the largest technical potential at 2,955,104 Decatherms in existing buildings and 446,366 Decatherms in new construction.

Table 6-4 2013 Commercial Gas Maximum Achievable Potential by End Use

End Use	Existing Buildings Savings Potential (Dth)	Savings Potential (% of Base Sales)	New Construction Savings Potential (Dth)	Savings Potential (% of Base Sales)
Space Heat	2,955,104	22.6%	446,249	14.3%
Water Heat	1,940,479	23.8%	418,281	21.5%
Cooking	376,946	13.1%	89,967	13.1%
Pool Heat	183,036	22.0%	43,686	22.0%
Drying	46,194	6.0%	11,025	6.0%

In Table 6-5, we present estimates of maximum achievable cost effective savings potential by end use in terms of energy saved in the year 2013 and in terms of percent of base end use energy consumption. Space heating is the end use with the largest technical potential at 2,201,795 Decatherms in existing buildings and 270,181 Decatherms in new construction.

Table 6-5 2013 Commercial Gas Maximum Achievable Cost Effective Savings by End Use

End Use	Existing Buildings Savings Potential (Dth)	Savings Potential (% of Base Sales)	New Construction Savings Potential (Dth)	Savings Potential (% of Base Sales)
Space Heat	2,201,795	16.9%	270,181	8.7%
Water Heat	518,236	6.3%	80,572	4.1%
Cooking	376,946	13.1%	89,967	13.1%
Pool Heat	144,537	17.4%	34,497	17.4%
Drying	46,194	6.0%	11,025	6.0%

Key Data Limitations Associated with Estimates of Commercial Gas Potential

- **Existing measure saturation estimates for energy efficient equipment**: We relied heavily on measure saturation information for high efficiency equipment within the commercial sector from the California potential study because we had very limited saturation data of this equipment for Utah. We reviewed the California data, and other sources, for reasonableness and made adjustments where necessary but this represents a key area of uncertainty in this study.

- **Energy use intensity:** The energy use intensities by end use provided by Questar for each of the commercial SIC codes were found to be anomalous in several instances. In some cases, the absolute magnitude of the energy intensity seemed unusually high or low compared with numbers generated by Energy-10 and with Department of Energy averages, which resulted in problems of relative magnitude between the end uses. For example, in the Retail segment, the energy use intensity for space heating was 0.027 Decatherms per square foot and for water heating was 0.052 Decatherms per square foot. This appeared to be very unusual, both because the magnitude of space heating intensity seemed very low, and because the magnitude of water heating intensity seemed very high (in absolute terms and relative to space heating); therefore, we used the energy intensities generated by Energy-10 for the Salt Lake City climate and the nationwide average water heating intensities from the Department of Energy for this analysis.

- **Measure costs:** Estimates of measure costs were developed using several sources, including gas savings potential studies recently conducted in California and Iowa, as well as many other sources compiled for this study. While the sources used offer reasonable values for the measure costs, GDS was unable (within the budget for this project) to gather cost data specific to Utah.

- **Measure savings**. While actual measure savings will vary based on site specific conditions, the savings estimates used in this analysis represent savings levels for typical installations. The most difficult end use for which to determine typical savings is water heating, due to the widely varying hot water consumption in the commercial sector. In order to improve the accuracy of the savings estimates associated with water heating, we "triangulated" savings values using several sources, along with standard engineering calculations.

- **Swimming Pool - Base consumption and measure saturation**. Few existing sources disaggregate pool gas consumption from the major gas end uses. Total base consumption for the population is estimated in this study by weighting up a prototypical pool's consumption based on the saturation of pools obtained from the Questar and PacifiCorp recent saturation studies. In addition, the fraction of pools for which pool covers are actively utilized is currently uncertain.

6.4 Energy-Efficiency Supply Curves

Our commercial sector energy-efficiency supply curves are shown in Figure 6-5, 6-6, and 6-7 for natural gas savings potential. The curve is shown in terms of savings as a percentage of total commercial sector natural gas consumption for: Existing Buildings (Figure 6-5), New Construction (Figure 6-6) and Total Commercial Sector (Figure 6-7). Note that our maximum achievable cost effective potential figures are based on measures that have passed the TRC test, as described in Section 4. Also note that our avoided-cost benefit values for the commercial sector primarily include natural gas savings benefits. Thus, our economic potential integrates the value of the savings potentials shown in the energy-efficiency supply curve figures.

Figure 6-5 Existing Commercial Building Supply Curve

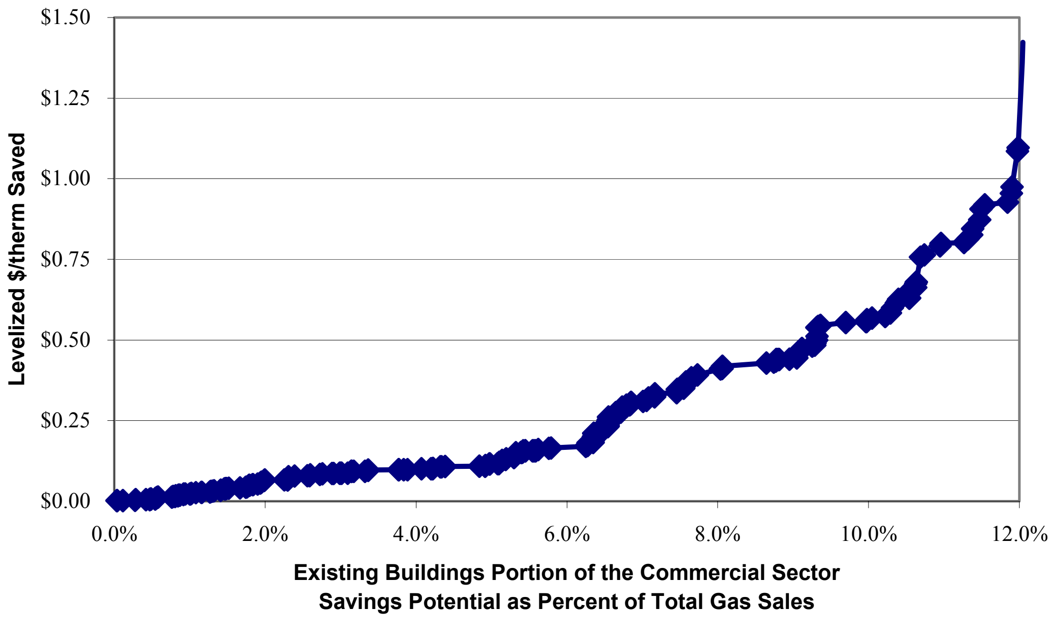


Figure 6-6 Commercial New Construction Supply Curve

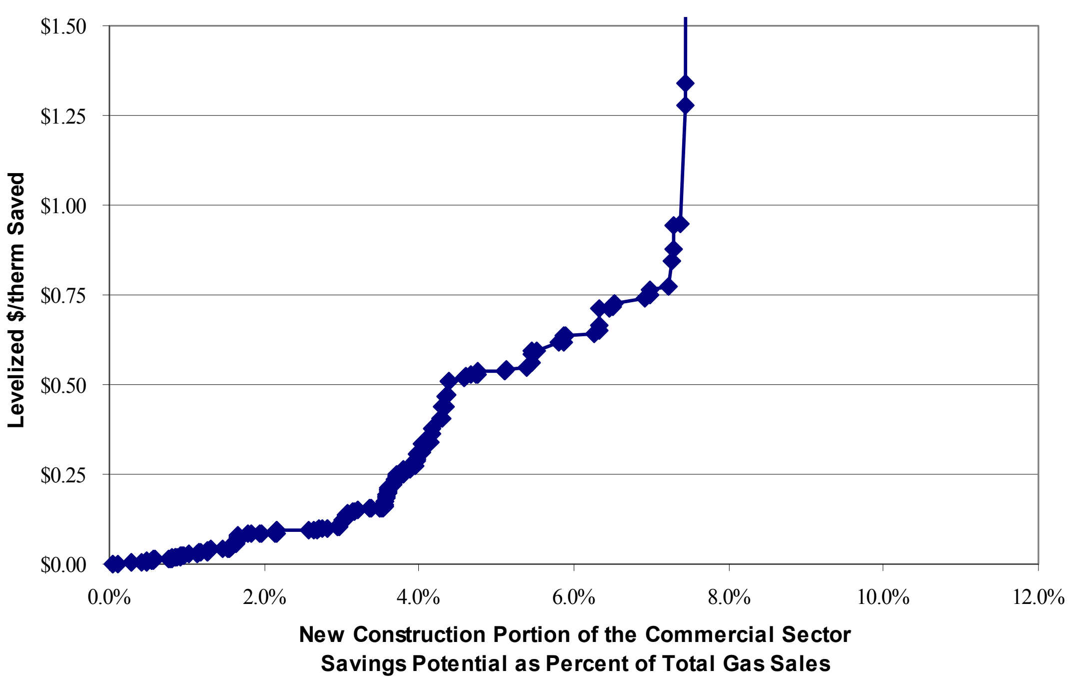
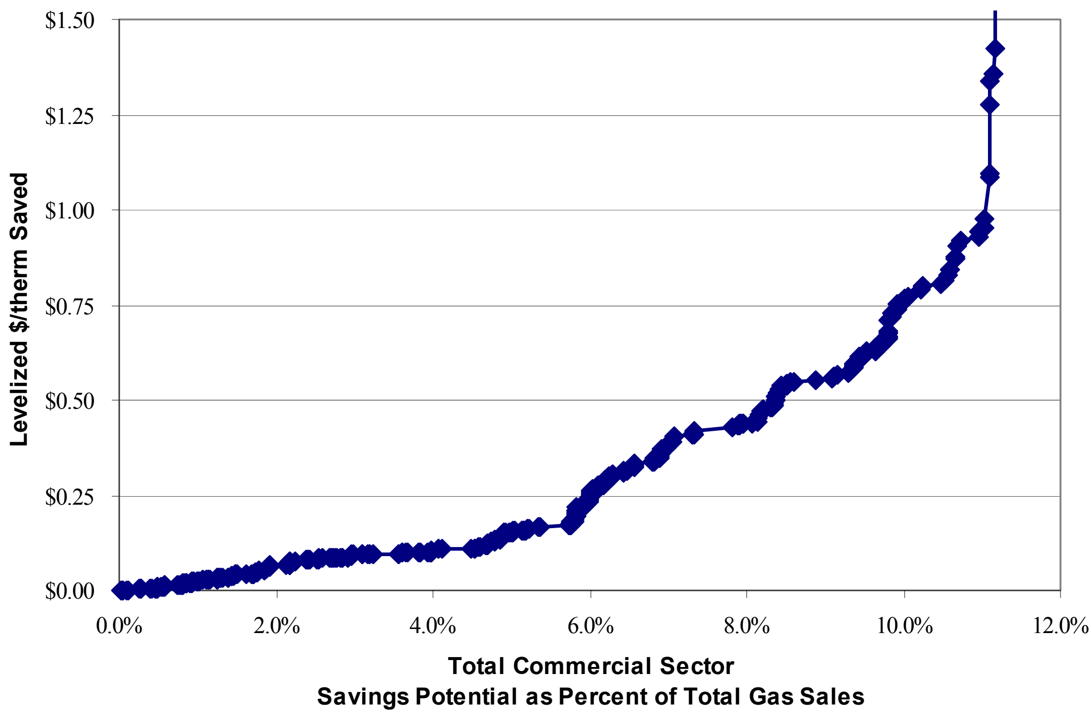


Figure 6-7 Total Commercial Sector Supply Curve



7.0 RESIDENTIAL SECTOR GAS DSM PROGRAMS IN UTAH

This section of the report provides further information on the specific, cost effective, gas DSM programs recommended by the GDS Team for consideration by the Utah Gas DSM Advisory Group.

7.1 Programmable Thermostat Program

Fifty-eight percent of residential gas space heating customers in Utah do not have programmable thermostats. The ENERGY STAR® Programmable Thermostat program is designed to provide a rebate for the purchase and installation of up to two ENERGY STAR® labeled programmable thermostats per household in Utah. Approximately 150 thermostat models currently meet ENERGY STAR® guidelines. To be ENERGY STAR® labeled, programmable thermostats must have the following features:

- Separate weekday and weekend programs, each with up to four customized temperature settings: two for occupied and in-use periods and two for energy saving periods when the house is unoccupied or at night.
- An advanced recovery feature that can be programmed to reach desired temperature at a specific time in a way to minimize system "on" time and auxiliary heat use.
- Ability to maintain room temperature within 2 degrees (F) of the desired temperature.
- A hold feature that allows users to temporarily override automatic settings without deleting programs. (For example, programming can be adjusted to maximize savings during a vacation or extended absence.)

This program can be promoted via bill inserts, gas company newsletters, the Company's Web site and radio, as well as through Residential Conservation Services ("RCS") program auditors (if applicable in Utah). In addition, an outreach program should be established with retailers such as The Home Depot® and Lowe's®. The outreach program should include training of the retailer's sales personnel regarding the rebate program and distributing program rebate forms at their stores within the Company's Utah service territory.

Under this proposed program, residential gas heating customers would be eligible for a $50 mail-in rebate on the purchase and installation of up to two ENERGY STAR® qualified or equivalent programmable thermostats, upon proof of purchase. Eligible thermostats may be installed by heating contractors, energy auditors or homeowners. Instant rebates offered by contractors could provide the Company assistance in promoting the thermostats and energy efficiency. In addition to mail-in rebates, instant rebates in the form of point-of-sale discounts could be available through heating contractors and energy auditors.

For this study of gas DSM potential in Utah, GDS evaluated research studies performed by other utilities and third-party sources on the cost effectiveness and energy savings of programmable thermostats. The evaluation of the research studies supported that programmable thermostats can be a significant source of energy savings.

Base Case: A non-programmable or manual thermostat
High Efficiency Case: Any ENERGY STAR rated programmable thermostat, which includes electromechanical, digital, hybrid, occupancy and light sensing.

7.2 Water Heater Blanket Program

Thirty-two percent of Questar's residential gas heating customers have an insulation blanket installed around the outside of their gas water heater. This program will provide a $14 rebate to existing residential gas water heating customers. There is a limited market for this program because new gas water heater efficiency standards went into effect in January 2004 that eliminate the need for an additional external insulation blanket on a new gas water heater.

Base Case: Water heater without an insulating blanket.
High Efficiency Case: Insulation blankets come in a standard size (48"x75") that should cover any common water heater holding up to 60 gallons of water. The blankets come in two thicknesses - the 2" thickness adds an extra R-6.7 rating's worth of insulation to a heater, and the 3" thickness adds an extra R-10. The analysis presented in this report uses an R-6.7 rated blanket, the R-10 rated blanket is meant for electric water heaters.

7.3 Energy Star Clothes Washers

Only three percent of Questar's residential customers have ENERGY STAR clothes washers. A recent SWEEP analysis reports that many utilities throughout the United States promote the purchase of Energy Star appliances by working with dealers to increase product availability, educating consumers, and in some cases providing rebates to consumers. The Consortium for Energy Efficiency (CEE) reports that utilities serving 74 million households had budgeted over $73 million for promoting Energy Star appliances in 2002 (CEE 2002).[19]

According to the SWEEP report, rebates can be important and cost-effective for high efficiency, Energy Star clothes washers. These units save a substantial amount of water as well as energy, and also have a first cost premium (on the order of $150-700 depending on the model) compared to standard clothes washers. Energy and water savings are on the order of 40-50% relative to the performance of standard-efficiency clothes washers. CEE has developed specifications for and maintains list of "Tier 1" and "Tier 2" Energy Star clothes washers (Tier 2 is superior in terms of energy factor). CEE is in the process of revising its tier structure and is adding two higher-end tiers in conjunction with

[19] Geller, Howard, "Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah", report prepared for the Utah Energy Office by the Southwest Energy Efficiency Project, October 2002.

DOE changing the clothes washer test procedure. Many utilities have used the CEE tier structure and provided incentives of $50-$75 for Tier 1 models and $75-$150 for Tier 2 models (CEE 2002). In some cases (e.g., in Austin and San Antonio, TX), the cost of the rebate is split between energy and water utilities.

CEE has published annual energy savings estimates for different water heater and dryer configurations under the old Tier structure, but not the new structure yet (they are working on this). The estimated electricity savings (kWh/yr), gas savings (therms/yr), and water savings (gallons/yr) for different configurations, along with SWEEP's estimates of the fraction of households with each configuration, are given in the following table (Foster 2002):

Table 7-1 – Estimated Savings from an Energy Star Clothes Washer in Utah

Configuration	Tier 1 savings (kWh/yr)	(therms/yr)	Tier 2 savings (kWh/yr)	(therms/yr)	Water savings (gal/yr)	% of households
CW, EWH, ED	420	0	475	0	5400	21 (1)
CW, EWH, GD	305	6	360	6	5400	0
CW, GWH, ED	115	16	115	19	5400	49
CW, GWH, GD	0	22	0	25	5400	20
No CW	--	--	--	--	--	10

(1) Assumes all households with electric water heaters (21%) also have electric dryers since the electric dryer penetration is 70% in Utah.

<u>Measure cost</u>: The SWEEP report states that the incremental cost for an Energy Star clothes washer varies from $150-$700 depending on the sophistication of the model. Manufacturers tend to sell more models with a lower first cost premium and costs are declining, so it would be reasonable to use an average first cost premium of $200 for the sake of analysis.

<u>Measure Lifetime</u>: The U.S. Department of Energy uses an average lifetime of 14 years for clothes washers.

<u>Program Cost</u>: Based on incentive levels around the country, SWEEP suggests an incentive of $50-100 per Energy Star clothes washer depending on efficiency level.

Base Case: Any clothes washer that does not meet the strict energy star guidelines set by the US Environmental Protection Agency and the Department of Energy.

High Efficiency Case: Front loading and top loading clothes washers that meet the Energy Star levels set at an energy factor of 2.5. Full-sized Energy Star qualified washers use 18-25 gallons of water per load, compare to the 40 gallons used by a standard machine.

7.4 Energy Star Windows Program

GDS estimates that only ten percent of existing homes in Utah have ENERGY STAR rated windows. The ENERGY STAR® Windows program can provide a rebate for the installation of high efficiency windows in new or existing residential structures. To receive a rebate, a participant must be a residential heating customer of Questar, the window(s) installed must carry the ENERGY STAR® label, and the window(s) installed must have a U-factor of .35 or less[20]. When applying for a rebate, it is recommended that the customer must send a rebate application that includes a dated sales receipt, or invoice for the purchase price, for the window(s) installed and a copy of the National Fenestration Rating Council ("NFRC") label(s) from the window(s) installed. To ensure that eligible equipment is installed properly, the first two installations per new contractor should be inspected, and the Company should consider random inspections of installations thereafter.

Program promotion should use an array of marketing methods, including gas company newsletters, the Company's Web site, bill inserts and radio. The Company should consider establishing an outreach program with retailers, The Home Depot® and Lowe's®, that includes training of their sales personnel regarding the Company's rebate program and supplying their stores within the Company's Utah service territory with program rebate applications.

Energy Star Windows
Energy Savings Assumptions:

- 2 story, 2000 square foot, frame house, in Salt Lake City.
- Average percentage of wall area for glazing in a 2000 square foot home is 14%.
- Number of existing windows in the base case home is 30
- Number of windows purchased per participant is 10

Base Case: Window #301 from RESFEN Model Window Library– W/V 1 Clear

- Width X Height – 2'X5'
- U-Factor[21] – 0.90
- SHGC[22] – 0.63

High Efficiency Case: Window #331 from RESFEN Model Window Library – W/V 2 SP Low-E

[20] U-Factor = Measurement of thermal conductivity. A lower U-factor indicates a higher level of window insulation.
[21] The lower the U-Factor the lower the amount of heat loss
[22] Solar Heat Gain Coefficient (heat gain rate)

- Width X Height – 2'X5'
- U Factor – 0.33
- SHGC – 0.40

7.5 High Efficiency Gas Space Heating Equipment

Twenty-five percent of Questar's residential customers with gas space heating equipment have a high efficiency gas furnace. The goals of a high efficiency gas space heating equipment program should include the following:

- Increasing residential customer awareness of high efficiency gas heating equipment.
- Providing training to trade allies such as plumbing and heating contractors.
- Increasing residential customer knowledge of where to obtain high efficiency heating products.
- Monitoring customer perception of the performance and reliability of high efficiency gas heating equipment and the savings achieved.

The program should be promoted through a variety of marketing methods including multiple direct mail campaigns, bill inserts, trade ally events, sponsorships and contractor job site visits. Program brochures, builder packets and rebate applications should be the primary marketing material utilized. The program can also be promoted via Questar's Web site, where consumers and contractors will have the opportunity to download program rebate applications, as well as learn about program announcements, updates, or changes.

Overall, a strong emphasis should be placed on working with builders and the contractors who install gas-heating equipment. Target markets for the program include both new construction and retrofit projects.

The program incentive should be a rebate available to residential heating customers' (builders and/or homeowners) worth up to $500, depending on the type of heating equipment installed. This rebate will encourage customers to choose a high efficiency model by offsetting a portion of the higher initial purchase cost of a high efficiency model versus a standard efficiency model

Energy Star High Efficiency Gas Heating Equipment - Gas Furnace
Base Case: Conventional gas furnace with standing pilot
High Efficiency Case: Condensing gas furnace, with efficiency greater than or equal to 90%.

7.6 Residential Weatherization and Insulation Program – Non Low Income

Thirty percent of homes in Utah already have adequate levels of insulation and air sealing measures. The Residential Weatherization and Insulation program can provide a rebate covering a portion (20% of cost is the recommended incentive) of the cost of installing weatherization and insulation measures in a residential heating customer's home. The maximum rebate available to a customer under this program should be no more than $750.

The GDS Team recommends that the following measures be eligible for a rebate under this program:

- attic insulation
- wall insulation
- basement/crawl space insulation
- rim joist insulation
- duct insulation
- heating system pipe insulation
- attic ventilation (in conjunction with attic insulation only)
- ductwork leakage testing
- ductwork leakage sealing
- air infiltration testing and air infiltration sealing

For a Questar residential customer to be eligible for a rebate, it is recommended that a Company pre-qualified contractor must complete all installed measures. Do-it-yourself work should not be allowed under the program. It is recommended that contractors wishing to become a pre-qualified contractor eligible to offer this program to the Company's heating customers should provide proof of the following:

- Registration as a Home Improvement Contractor (HIC) within the State of Utah. Registration must be in good standing.
- Proof of insurance at the Questar's corporate contractor partner specified minimum levels.

In addition, the Company should consider performing a background check on each contractor through the Utah Attorney General's office (through the Department of Professional Licensing and Consumer Protection) to verify a contractor's good standing, and to identify if there have been complaints or issues with a particular contractor.

Work completed under the program must meet all applicable state and local code requirements. It is anticipated that all measures installed will meet ENERGY STAR® guidelines, where applicable, and it should be the responsibility of the installing contractor to complete and submit all rebate applications with proper supporting documentation of work performed. For quality control purposes, newly approved contractors should have their first three jobs inspected, and approximately twenty percent of their jobs inspected thereafter. The inspection process should consist of a visual review of all work reported to be performed at a job site. Where applicable, the Company could utilize infrared scanning or related techniques to inspect a job site.

The program should be marketed to residential heating customers, home improvement contractors and weatherization contractors in Utah through home shows, direct mail promotions, newspaper advertising, bill inserts, the corporate Web site and radio. Potential participants could also be informed of their eligibility to participate in the program through the Residential Conservation Services program.

The program should include training for contractors once per year to increase awareness of new technologies and installation practices. Feedback should be gathered from participating contractors on technologies and practices they are interested in learning about.

7.7 Residential Weatherization and Insulation Program – Low Income

GDS estimates that 70 percent of low-income households need additional insulation and weatherization measures. The Residential Low-Income Weatherization and Insulation Program should target the households in Utah that fall into following categories:

- Federal or State assistance
- Utah Fuel Assistance Program
- Welfare or Social Security Income
- Disability programs and
- Those customers who fall between 200% of poverty and 60% of the median poverty level.

This program will offer weatherization and insulation services at no cost to low-income households in Utah.[23] The services to be provided will be the same as in the non-low income component of this program.

7.8 Energy Star Homes Program

ENERGY STAR qualified homes are independently verified to be at least 30% more energy efficient than homes built to the 1993 national Model Energy Code or 15% more efficient than state energy code, whichever is more rigorous. These savings are based on heating, cooling, and hot water energy use and are typically achieved through a combination of:

- building envelope upgrades

[23] According to Michael Johnson of the State of Utah Weatherization Assistance Program, the maximum qualifying income for the U.S. Department of Energy Weatherization Assistance Program is 125% of the federal poverty level. The U.S. Health & Human Services LIHEAP program has a maximum qualifying level of 150% of the federal poverty level. The number of low income households in Utah is listed below for various levels of the federal poverty level:

100% of Poverty = 61,611 households
125% of Poverty = 78,702 households
150% of Poverty = 108,447 households

- high performance windows
- controlled air infiltration
- upgraded heating and air conditioning systems
- tight duct systems
- upgraded water-heating equipment

Any single-family or multi-family residential home that is three stories or less in height can qualify to receive the ENERGY STAR label. This includes traditional site-constructed homes as well as modular, systems-built (e.g., insulated concrete forms, structurally insulated panels), and HUD-code manufactured homes.

In a 2003 Report, SWEEP developed estimates of the costs and energy savings associated with building homes at various levels of energy efficiency for each State in the Southwest. SWEEP defined and modeled two generic home types, each of 1800 square feet. In Utah, the home was built with two stories and had both a basement and crawl space. A number of energy-relevant characteristics of each home were varied to produce homes reflective of common practice today (base), just-meets-code (IECC 2000) and best practice (ENERGY STAR +) levels of performance in the climates of the major cities in each of the six states.

In early February 2004, SWEEP staff sent GDS the Utah energy consumption and savings figures of the IECC 2000 Case versus the Low-Energy Case. The GDS Team used these energy savings per home calculations as the basis for the benefit/cost analysis of this program for Utah.

Table 7-2 – Annual Energy Star Home Savings (per home)

Case	Total MBtu	Gas MBtu	Gas Therms	Elec MBtu	Elec kWh
IECC 2000	118.2	82.3	823	35.9	10,533
Best Practice	62.5	33.1	331	29.4	8,623
Savings	55.7	49.2	492	6.5	1,910

7.9 High Efficiency Water Heating Equipment Program

GDS estimates that only 10 percent of Questar's residential gas water heating customers have a high efficiency gas water heater. This program will provide information and financial incentives for the installation of a high efficiency gas water heater. Similar to the Company's Residential High Efficiency Heating program, program goals should include:

- Increasing the demand for residential high efficiency natural gas water heaters
- Increasing residential customer and trade ally awareness of the benefits of high efficiency natural gas water heaters
- Providing training to trade allies such as plumbing and heating contractors
- Increasing residential customer knowledge of where to obtain high efficiency water-heating products

- Monitoring customer perception of the performance and reliability of high efficiency gas water heating equipment and the savings achieved.

Program marketing should consist of direct mail campaigns and outreach to contractors and builders, bill inserts to residential customers at seasonal intervals, attendance at trade ally training events, radio, and promotion via the Questar web site. While direct customer marketing can generate a portion of the leads for this program, a significant emphasis will be placed on meeting with heating and plumbing contractors at trade shows, training sessions, and job sites to encourage contractors to influence consumer purchasing behavior toward this type of product.

The program incentive should be a rebate to residential water heating customers who install high efficiency natural gas water heaters with a minimum Energy Factor ("EF") rating of .65. The minimum EF was selected after researching the current natural gas water heating equipment market. The existing minimum federal standard is an EF rating of .59 for a 40-gallon natural gas water heater. This standard officially took effect in January 2004.

8.0 COMMERCIAL SECTOR GAS DSM POTENTIAL IN UTAH

This section of the report provides further information on the specific, cost effective, commercial gas DSM programs recommended by the GDS Team for consideration by the Utah Gas DSM Advisory Group. The results of the benefit/cost tests for each commercial program are included in Tables 8-4, 8-5, and 8-6 at the end of this section.

8.1 High Efficiency Commercial Heating Program

The Commercial High Efficiency Heating program can offer financial incentives to commercial, industrial, governmental, institutional, non-profit, and multifamily facilities that install high efficiency gas space and water heating equipment. Table 8-1 below lists the gas technologies to be included in this program.

The Commercial High Efficiency Heating program can be promoted primarily to architects, engineers, equipment vendors, contractors, and other trade allies. Trade ally awareness can be promoted through direct mail, trade publications, newspapers, trade shows/seminars, field calls, and site visits.

The program's rebate schedule should apply to a variety of product types in a broad range of equipment sizes that are appropriate for the commercial market. There should be high efficiency rebates for small commercial customers and/or for localized heating in larger facilities. There should also be rebates for natural gas fired, low intensity infrared heaters. Rebates can be offered for high efficiency direct fired water heating equipment.

The Commercial High Efficiency Heating Program efficiency ratings for smaller heating equipment (up to 300,000 btuh input) are measured using AFUE ratings. Efficiency ratings for larger heating equipment, which exceeds the size ranges for AFUE, will be measured using a thermal efficiency or steady state rating. Qualifying water heating equipment will meet the .65 or greater Energy Factor rating in the case of residential sized equipment, or will exceed 90% thermal efficiency in the case of commercial sized equipment.

Table 8-1 - Commercial High Efficiency Heating Program Rebates

Product	Rating	Rebate
Furnaces (up to 150 kBtuh)	> 90% AFUE	$200
Infrared heaters (all sizes)	low intensity	$500
Direct fired water heaters (up to 75 gallons)	> or = .65 Energy Factor	$100
Direct fired water heaters (up to 100 kBtuh)	> 90% Thermal Efficiency	$250
Direct fired water heaters (over 100 kBtuh)	> 90% Thermal Efficiency	$400

8.2 Commercial Energy Efficiency Program

The Commercial Energy Efficiency Program is designed to provide support services and financial incentives to encourage Questar's commercial, industrial, governmental, and institutional customers to install energy efficient natural gas equipment. Customers can participate in one or more of the offerings shown in Table 8-2. Virtually any natural gas energy efficient technology or energy efficient system design that exceeds the minimum requirements of the Utah energy code, and that is not covered by another Company program offering, may be eligible for a rebate under this program. Participants in the program must be Company firm gas sales customers on a commercial tariff to be eligible. In addition, all services must be pre-approved by Questar and/or the administrative vendor prior to delivery or installation of product (s) or service(s).

Table 8-2 - Commercial Energy Efficiency Program Services
• Co-funding for Energy Auditing or Engineering Services
• Prescriptive rebates for insulation, windows, or basic HVAC controls
• Custom incentives for more sophisticated systems and controls

Customers may apply for program services or rebate incentives via a variety of trade ally channels including Company representatives, plumbing and heating contractors, engineering firms, energy service companies, or equipment vendors. After reviewing the customer's energy efficiency needs, the customer will be offered the appropriate program services. The following text describes the three categories of services for which a customer may be eligible.

Energy Audit and Engineering Services

Energy auditing services will be for Questar commercial and industrial customers intending to proceed with energy efficiency improvements but who require assistance estimating energy savings and rebate levels. Most participants in this category will likely be small to medium customers, or large customers with relatively simple energy efficiency projects. Customers will not be required to obtain an energy audit to proceed with prescriptive energy efficiency measures.

Engineering services will be used to evaluate more complex projects that involve technologies associated with mechanical and/or process equipment. These types of technologies may include boiler or chiller plant redesigns, heat recovery systems, digital energy management systems, or process efficiency improvement projects. GDS recommends to the Natural Gas DSM Advisory Group that Questar collaborate with electric utilities to promote electric savings opportunities as well as natural gas savings opportunities. Services provided under the program will include technical analysis and engineering support for medium to large customers who need assistance evaluating and/or designing complex projects. The Company will cost share these services with the customer. An administrative vendor can be retained to provide Engineering services to the customer under contract with the Company at negotiated rates to be established via the competitive bid process. Alternatively, the customer may select the engineering firm of their choice and receive co-funding from the Company up to 50% of the reasonable fees related to the efficiency project, not to exceed a $10,000 Company contribution.

Prescriptive Rebates

GDS recommends that prescriptive rebates be available for common commercial sector energy efficiency measures, including programmable thermostats, boiler reset controls, steam trap replacements, pipe and/or duct insulation, building shell (walls, roof, floor, crawlspace) insulation, and high efficiency windows. Prescriptive Rebates will be targeted primarily toward the small and medium sized multifamily, commercial, and industrial customers. GDS recommends that Questar rely primarily upon contractors and trade allies to locate candidate facilities and to install the eligible prescriptive measures. This effort should be supported by an extensive outreach and education effort to these trade allies, as well as promotions directed to the customers themselves. Energy audits will not be required for participation. However, pre-approval of the contractor's proposals and the available prescriptive rebate will be required. Customers can receive rebates for installed measures as indicated in Table 8-3.

Table 8-3 - Eligible Prescriptive Measures

Measure	Rebate Available
Programmable thermostats	$25.00 each, up to five units
Digital boiler reset control	$150.00 single stage; $250.00 multi-stage, up to two units
Steam trap replacements	$25.00 / replaced trap, up to 100 traps
Pipe or duct insulation; duct sealing	Up to 20% of project cost
Building shell insulation (roof, walls, floor)	Up to 20% of project cost
Premium efficiency windows	$0.50 / sq.ft. of window rough opening area with a maximum of 1,000 sq. ft.

Custom Incentives

Custom Incentives will be available for energy efficiency projects that demonstrate the use of natural gas more efficiently than typical industry practices, or more efficiently than the minimum building code requirements for the State of Utah. Incentives will be limited to no more than 50% of the eligible installed project costs. Questar will reduce the project and/or site maximum to $100,000 from $150,000. These changes and other limits that may be applied are part of an effort to maintain budget integrity.

Custom Incentives will be classified as either Level One or Level Two. Level One projects involve less complex technologies and/or highly cost effective technologies. For the first Program Year, GDS recommends that the Company use a custom incentive of $1.00 per first year of estimated therm savings. Examples of Level One projects are redesigns of HVAC systems, energy recovery ventilation, most heat recovery applications, building automation/energy management systems, and advanced technology burners and/or burner controls.

Level Two projects are more complex and/or represent underutilized technologies. For Level Two projects, the incentive should be $2.00 per first year of estimated therm savings. Applications qualifying for this incentive level will likely be projects larger in size that qualify for the maximum contribution. Incentives may not be applied toward normal maintenance costs, or for equipment disabling or abandonment without an energy efficient replacement.

8.3 Benefit/Cost Tests for the Commercial Programs

Tables 8-4, 8-5, and 8-6 present detailed information on the results of four major benefit cost tests for each of the commercial programs. The four tests are as follows:

1) Total Resource Cost (TRC) Test;
2) Utility Cost Test;
3) Participant Test;
4) Ratepayer Impact Measure (RIM) Test

The Commercial Energy Efficiency Program was separated into two programs, prescriptive and custom, for the purposes of conducting the benefit/cost tests. In addition to the results of each test for the commercial programs, Table 8-6 includes the results of the Total Resource Cost Test and the Utility System Test for each of the measures within the programs.

Table 8-4 - COMMERCIAL SECTOR BENEFIT/COST RESULTS BY PROGRAM

Outputs represent the cumulative NPV of the measures over their measure life, for measures installed during the study life.

PROGRAM SCREENING OUTPUTS
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	Total Resource				*Electric Energy System*				*Gas Energy System*				*Electric & Gas Energy System*			
	Present Value		PV of Net	Benefit-Cost	Present Value		PV of Net	Benefit-Cost	Present Value		PV of Net	Benefit-Cost	Present Value		PV of Net	Benefit-Cost
Measure Name	Benefit	Cost	Benefits	Ratio	Benefit	Cost	Benefits	Ratio	Benefit	Cost	Benefits	Ratio	Benefit	Cost	Benefits	Ratio
	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]
Commercial High Efficiency Heating																
Program Total	$41,022,283	$16,267,763	$24,754,520	2.52	-	-	-	-	$41,022,283	$5,222,274	$35,800,009	7.86	$41,022,283	$5,222,274	$35,800,009	7.86
Non-Measure		$756,577				$0				$756,577				$756,577		
Total Measure	$41,022,283	$15,511,186	$25,511,098	2.64	-	-	-	-	$41,022,283	$4,465,697	$36,556,586	9.19	$41,022,283	$4,465,697	$36,556,586	9.19
Commercial Energy Efficiency - Prescriptive																
Program Total	$131,802,255	$46,236,636	$85,565,619	2.85	$22,386,647	-	$22,386,647	-	$109,415,608	$22,245,626	$87,169,982	4.92	$131,802,255	$22,245,626	$109,556,629	5.92
Non-Measure		$3,236,469				$0				$3,236,469				$3,236,469		
Total Measure	$131,802,255	$43,000,167	$88,802,088	3.07	$22,386,647	-	$22,386,647	-	$109,415,608	$19,009,157	$90,406,451	5.76	$131,802,255	$19,009,157	$112,793,098	6.93
Commercial Energy Efficiency - Custom																
Program Total	$71,544,154	$63,237,063	$8,307,091	1.13	-	-	-	-	$71,544,154	$19,916,953	$51,627,201	3.59	$71,544,154	$19,916,953	$51,627,201	3.59
Non-Measure		$462,353				$0				$462,353				$462,353		
Total Measure	$71,544,154	$62,774,710	$8,769,444	1.14	-	-	-	-	$71,544,154	$19,454,600	$52,089,554	3.68	$71,544,154	$19,454,600	$52,089,554	3.68

Table 8-5 - COMMERCIAL SECTOR BENEFIT/COST RESULTS BY PROGRAM

Outputs represent the cumulative NPV of the measures over their measure life, for measures installed during the study life.

		Participant Test				*Ratepayer Impact Test*			
Measure Name	Program ID	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
High Efficiency Heating Program Total		$41,857,325	$11,045,489	$30,811,836	3.79	$41,022,283	$42,613,902	$(1,591,619)	0.96
Energy Efficiency - Prescriptive Program Total		$163,046,027	$23,991,010	$139,055,017	6.80	$109,415,608	$121,702,356	$(12,286,748)	0.90
Energy Efficiency - Custom Program Total		$85,117,646	$43,320,110	$41,797,536	1.96	$71,544,154	$85,579,999	$(14,035,845)	0.84

Note: The Commercial Programs include the major measures from the commercial sector but do not represent the entire commercial sector as analyzed in the technical potential calculations.
The source of the natural gas avoided costs is an e-mail from Tom Yeager of Questar Gas Company, dated February 20, 2004. The source of the electric avoided costs is rate schedule 37 from PacifiCorp, Rates for Avoided Cost Purchases from Qualifying Facilities, filed 11/8/01.

Table 8-6 - COMMERCIAL SECTOR TRC AND UTILITY TEST BENEFIT/COST RESULTS BY MEASURE

		Total Resource				Electric Energy System				Gas Energy System				Electric & Gas Energy System			
Measure Name	Program ID	Present Value Benefit	Cost	PV of Net Benefits	Benefit-Cost Ratio	Present Value Benefit	Cost	PV of Net Benefits	Benefit-Cost Ratio	Present Value Benefit	Cost	PV of Net Benefits	Benefit-Cost Ratio	Present Value Benefit	Cost	PV of Net Benefits	Benefit-Cost Ratio
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]
HE Furnace	A	$33,473,337	$8,218,109	$25,255,228	4.07	-	-	-	-	$33,473,337	$2,698,436	$30,774,901	12.40	$33,473,337	$2,698,436	$30,774,901	12.40
Infrared Heater	A	$2,331,355	$1,297,959	$1,033,397	1.80	-	-	-	-	$2,331,355	$497,883	$1,833,472	4.68	$2,331,355	$497,883	$1,833,472	4.68
HE Water Heater	A	$5,217,590	$5,995,118	$(777,527)	0.87	-	-	-	-	$5,217,590	$1,269,377	$3,948,213	4.11	$5,217,590	$1,269,377	$3,948,213	4.11
Programmable T-stats	B	$4,006,816	$442,671	$3,564,145	9.05	-	-	-	-	$4,006,816	$116,542	$3,890,273	34.38	$4,006,816	$116,542	$3,890,273	34.38
Boiler Reset Control	B	$1,498,265	$365,988	$1,132,278	4.09	-	-	-	-	$1,498,265	$96,354	$1,401,911	15.55	$1,498,265	$96,354	$1,401,911	15.55
Steam Trap Replacement	B	$222,291	$111,992	$110,299	1.98	-	-	-	-	$222,291	$48,177	$174,114	4.61	$222,291	$48,177	$174,114	4.61
Pipe / Duct Insulation	B	$6,722,278	$1,409,017	$5,313,260	4.77	-	-	-	-	$6,722,278	$364,126	$6,358,152	18.46	$6,722,278	$364,126	$6,358,152	18.46
Roof Insulation	B	$15,421,367	$15,504,697	$(83,330)	0.99	-	-	-	-	$15,421,367	$3,266,857	$12,154,510	4.72	$15,421,367	$3,266,857	$12,154,510	4.72
HE Windws	B	$63,751,956	$8,567,403	$55,184,553	7.44	-	-	-	-	$63,751,956	$5,670,000	$58,081,956	11.24	$63,751,956	$5,670,000	$58,081,956	11.24
Retrocomissioning	B	$40,179,282	$16,598,399	$23,580,883	2.42	$22,386,647	-	$22,386,647	-	$17,792,635	$9,447,100	$8,345,535	1.88	$40,179,282	$9,447,100	$30,732,182	4.25
Custom Projects	C	$71,544,154	$62,774,710	$8,769,444	1.14	-	-	-	-	$71,544,154	$19,454,600	$52,089,554	3.68	$71,544,154	$19,454,600	$52,089,554	3.68

Note: The Commercial Programs inlcude the major measures from the commercial sector but do not represent the entire commercial sector as analyzed in the technical potential calculations.
The source of the natural gas avoided costs is an e-mail from Tom Yeager of Questar Gas Company, dated February 20, 2004. The source of the electric avoided costs is rate schedule 37 from PacifiCorp, Rates for Avoided Cost Purchases from Qualifying Facilities, filed November 8, 2001.

9.0 NON-ENERGY BENEFITS OF GAS DSM PROGRAMS

Gas Demand-Side Management (DSM) Programs can provide a variety of non-energy benefits (NEB) to the State of Utah in addition to saving energy.[24] Implementing demand-side management programs in the State of Utah will save natural gas and will provide several other benefits to the State's economy.

Listed below are examples of non-energy benefits that will result from implementation of the natural gas energy efficiency measures included in the portfolio of gas DSM programs recommend by this study:

- Gas DSM programs can help reduce emissions of air pollutants[25] and greenhouse gases
  - Saving one therm of natural gas saves 11.7 lbs. of C02
  - Saving one therm of natural gas saves .01 lbs. of NOX
  - Saving one therm of natural gas saves .00006 lbs. of SO2
- Gas DSM programs can be more reliable than increasing the infrastructure of the natural gas pipeline system because gas DSM measures can be located in every home and business, and may not be as vulnerable to supply interruptions and price spikes
- Gas DSM can make homes and businesses more comfortable - less drafty, etc.
- Gas DSM programs can make businesses in Utah more efficient, and thus more competitive with businesses in other States and other countries
- Gas DSM can help homes and businesses reduce operating costs. As a result, there are economic multiplier effects, such as increased productivity and increased jobs. In the Wisconsin Focus on Energy Program, for example, the Program Evaluation contractor reports that 46 new full-time jobs are created in the State for every $1 million invested in energy efficiency programs.

9.1 Residential Sector Non Energy Benefits

Gas DSM projects installed in homes or businesses can be more reliable than investments in gas supply-side resources. Unlike gas pipelines, the location of gas DSM projects may not be as vulnerable to gas supply interruptions or spikes in the price of natural gas. Contractors or homeowners, depending on the complexity of the measure, can easily install the gas DSM measures. DSM measures are designed not only to save energy but also to improve the comfort of the occupant. Caulking, weather-stripping, insulation, ENERGY STAR windows, infiltration measures and high efficiency gas furnaces will reduce

[24] The New Mother Lode, The Potential for More Efficient Energy Use in the Southwest, A report Hewlett Foundation Energy Series, November 2002.

[25] The Wasatch Clean Air Coalition provided GDS with the following definitions or emissions: CO2 is the major green house gas; NOx contributes to ground level ozone, particulate matter, acid rain, visibility impairment and nitrogen deposition; and SO2 contributes visibility impairment, acid rain, and particulate matter.

household and business operating costs and will decrease infiltration and heat loss.

The following benefits of DSM programs have been noted in a recent evaluation report from the Wisconsin Focus on Energy Program[26]:

- Increased safety resulting from a reduction of gases emitted into the atmosphere, such as carbon monoxide.
- Fewer illnesses resulting from elimination of mold problems due to proper sealing, insulating and ventilation of a home
- Reduced repair and maintenance expense due to having newer, higher quality equipment
- Increased property values resulting from installation of new equipment

Non-energy benefits can play a key role for residential builders who promote energy efficiency in new home construction as seen in Wisconsin's Energy Star Home Program (WESH). Given that WESH homes are reported as selling at a higher price for 79 percent of homebuilders and the fact that 86 percent of homebuilders are more inclined to promote themselves as energy efficient builders, WESH homebuilders can view and market themselves as high-end homebuilders. WESH program implementers market the program by telling prospective homebuilders that they will be able to expand their business as a result of the WESH program. Also, given the frequency that comfort and safety improvements are cited as NEBs associated with both WESH and Home Performance with Energy Star Program (HWPES), emphasizing these two NEBs in program marketing efforts may help to increase program participation. In addition, increased durability and longevity of household equipment can be a selling point for the Wisconsin HPWES program, where 84 percent of contractors cite this as a NEB.[27]

9.2 Commercial Sector Non Energy Benefits

By utilizing gas demand-side management programs, businesses in Utah can become more efficient and lower their monthly utility bills. The energy and monetary savings from gas DSM programs can provide businesses with additional capital to invest in business infrastructure. Gas DSM programs can help businesses in Utah become more competitive with other businesses in the United States and in other countries. Implementing gas demand-side

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[26] State of Wisconsin Department of Administration Division of Energy, Focus on Energy Public Benefits Statewide Evaluation, Quarterly Summary Report: Contract Year 2, Second Quarter, March 31, 2003, Evaluation Contractor: PA Government Services Inc. Prepared by: Focus Evaluation Team.
[27] State of Wisconsin Department of Administration, Division of Energy, Focus on Energy Statewide Evaluation, Non-Energy Benefits Cross-Cutting Report, Year 1 Efforts, *Evaluation Contractor: PA Government Services Inc., Prepared by: Nick Hall, TecMarket Works, Oregon, Wisconsin Under Contract To PA Consulting,* January 20, 2003

management measures may also increase productivity and afford the business with the opportunity to add new jobs, further bolstering the economy in Utah.

Example Benefits from The Wisconsin Focus on Energy Business Programs:[28]

- Increased productivity
- Improvement in morale
- Reduced repair and maintenance costs
- Reduced waste
- Reduced defect or error rates

9.3 Societal Related Benefits

Economic impact

The spending of dollars to provide gas DSM programs creates jobs and increases the economic activity associated with local spending streams. As labor and material dollars are "turned-over" in the local economy, the people in that economy benefit.[29] In the Wisconsin Focus on Energy Program, for example, the Program Evaluation contractor reports that 46 new full-time jobs are created in the State for every $1 million invested in energy efficiency programs.

Environmental

Increased energy efficiency is in the public interest for environmental, economic and national security reasons. The production and use of energy causes a large portion of the nation's air pollution. Fossil fuel combustion and the resulting emissions can be harmful to public health in a variety of ways:

- harm to ecological systems, especially by increasing the acidity of rainfall and water bodies
- a major source of greenhouse gases causing climate change.

A reduction in energy consumption through greater efficiency of energy use is a means to reduce all emissions from burning fossil fuels, including NOx, SO2, and CO2.[30]

Cost-effective energy efficiency actions are beneficial to individual users by reducing consumer costs, and to the economy by increasing discretionary income. The implementation of energy efficiency measures can help consumers save money and can help reduce cash flow out of a region to pay for energy supplies. It is important to note that the national net import bill for energy

[28] Ibid.
[29] Beyond Energy Savings: A Review of the Non-Energy Benefits Estimated for Three Low-Income Programs, ACEEE Paper 326, *Nick Hall, TecMarket Works, Jeff Riggert, TecMarket Works,* From: 2002 ACEEE Summer Study Proceedings
[30] Energy Efficiency and Renewables Sources: A Primer, Prepared by the National Association of State Energy Officials Updated by Global Environment & Technology Foundation, October 2001.

(primarily petroleum) constituted $105 billion of the total national trade deficit of $370 billion in 2000.[31]

A recent American Council for An Energy Efficient Economy (ACEEE) analysis found that modestly reducing both natural gas and electricity consumption, and increasing the installation of renewable energy generation could dramatically affect natural gas price and availability. In just 12 months, nationwide efforts to expand energy efficiency and renewable energy could reduce wholesale natural gas prices by 20% and save consumers $15 billion/year in retail gas and electric power costs.[32] Efforts to increase energy efficiency and renewable energy in just one state or region are also found to have significant effects on natural gas prices both regionally and nationally. [33]

The evaluation and reporting of energy-program-induced NEBs is one of the fastest growing fields of energy program research. The primary reasons for this growth are:

1. The national movement toward public benefits funded energy programs, in which program costs are paid directly by energy consumers (instead of ratepayer-based or tax-based programs), has increased the need to document the range of benefits the public receives in exchange for those dollars. The central questions being asked by policy makers are: What is the public receiving in exchange for their public benefit dollar? Is this a good deal, or is the public better off spending the money they earn themselves? Because energy programs provide more than energy savings, good public policy and public value accounting requirements dictate the need to document the full range of benefits the public receives in exchange for their program contribution.

2. Several major evaluation studies have concluded that participants in energy programs often implement efficiency measures for reasons other than saving energy. For many participants, the energy savings are not seen as significant enough to make the change but instead, contribute to the total benefit package associated with the change. For many customers, the NEB is the primary reason for an energy efficient practice, and the value of the benefit to the customers can often be greater than the energy savings. Customers often view their energy savings as a low-priority by-product of the change, rather than the reason for the change. For example, a study of schools found that students in energy-efficient day-lit classrooms do significantly better than students in classrooms illuminated by artificial light. The value of the increased learning to the parent and to the government responsible for education can be priceless,

[31] IBID
[32] The ACEEE study notes how natural gas DSM programs can help reduce prices of natural gas. The base case forecast of natural gas avoided costs used in this study for Utah assumes that avoided costs of natural gas remain constant in real dollars over the study period (2004 to 2013).
[33] R. Neal Elliot, PH.D., P.E., et al., Natural Gas Price Effects of Energy Efficiency and Renewable Energy Practices and Policies, ACEEE, December 2003

just as the value of the increased learning to the child can contribute to a more productive life. Another study found that retail sales increase significantly in energy efficient stores lit by natural light. In this study, the energy efficient lighting system was worth a 30 to 40 percent increase in sales when controlled for other variables, dwarfing the benefits of the energy savings. In another study, researchers found that participants have improved levels of comfort and that the improved comfort is significantly more valuable to them than the energy savings. Other studies suggest that energy efficiency in the low-income sector produces healthier families, which reduces health care costs and the number of sick days among workers (a benefit to the employers). These and similar studies have focused attention on the importance of understanding a wider range of benefits associated with public energy programs.

3. Program managers have focused additional attention on the effect of NEBs in motivating customers to participate in their programs or to take action. Evaluators are being asked by program managers to provide expanded benefit information to improve the program's marketing and sales efforts. Program sales staff that do not understand the range of benefits associated with energy programs are at a disadvantage when approaching a potential participant. NEBs research can help improve the effectiveness of energy programs by demonstrating a wider range of benefits that can be used to increase participation and build program impacts.

4. Low-income energy efficiency programs are sometimes viewed as marginal programs from a cost-benefit perspective. That is, they may or may not be cost effective when life-cycle energy savings are compared to program costs. As a result, there is a move to expand program cost-effectiveness tests to incorporate a wider range of impacts. These cost-effectiveness tests have been labeled low-income public purpose tests because they examine benefits that impact society. California now uses a public purpose test for all their low-income programs in order to count more than just the energy savings.

The four factors listed above have focused considerable attention on evaluating the NEBs associated with public benefits energy efficiency programs. Taken together, the need to understand the full range of NEBs in the commercial, industrial, institutional, residential, and low-income markets is important for organizations implementing public benefits programs and for program managers and sales staff that are responsible for marketing such energy efficiency programs to the public For many participants in energy efficiency programs, the NEBs can be the single most important driving factor for participation, rather than a side benefit of that participation.[34]

[34] Id.

9.4 Job Creation Benefits of DSM Identified in SWEEP Report

The November 2002 Southwest Energy Efficiency Project "Mother Lode" report[35] determined that investing in electric energy efficiency measures can lower electricity bills for residents and businesses in the Southwest. This report notes that these lower energy bills, in turn, promote overall economic efficiency and create additional jobs. The High Efficiency Scenario included in the SWEEP report shows significant macroeconomic benefits for each of the states in the Southwest and the region as a whole. By 2020, SWEEP estimates that the efficiency investments and energy bill savings add more than $1.3 billion in new wage and salary income (in 2000 dollars) and support a net increase of 58,400 jobs for the Southwest region as a whole. These income and jobs gains reflect differences between a business-as-usual Base Scenario and a High Energy Efficiency Scenario. Although the job gains are distributed throughout much of the economy, several sectors, including services, retail trade, and government show the largest gains. Not surprisingly, the energy industries (electric and gas utilities, and coal mining) exhibit the largest losses.

The report found that a total job loss of 7,500 jobs is projected to occur in the region by 2020 in the High Efficiency Scenario, compared to a total job gain of about 66,000 jobs and a net increase of **58,400** jobs. Furthermore, the projected losses can be overcome if the energy industries recognize the new and expanding opportunities and transition to providing more efficiency-related products and services. In short, accelerating energy efficiency improvements can help to create a strong economic future in the southwest region.

9.5 Non Energy Benefits of Low Income Weatherization and Insulation Programs

GDS also conducted a literature search on the non-energy benefits of programs targeted at low-income households. The most comprehensive study of low-income program non-energy benefits was recently completed for five investor-owned utilities in California. The two documents listed below provide documentation of these non-energy benefits:

1. TecMRKT Works, Skumatz Economic Research Associates, and Megdal & Associates, Low-income Public Purpose Test, (The LIPPT), Final Report, Up-Dated for LIPPT Version 2.0, A Report Prepared for the RRM Working Group'sCost Effectiveness Committee, April 2001. This report provides a description of each non-energy benefit included in the KeySpan analysis of non-energy benefits, and provides the methodology for calculating the value of each category of non-energy benefits.

2. TecMRKT Works, Skumatz Economic Research Associates, and Megdal & Associates, User's Guide for California Utility's Low-Income Program

[35] Southwest Energy Efficiency Project, "The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest", November 2002, Section 4 of the report.

Cost Effectiveness Model, The Low-Income Public Purpose Test, Version 2.0, A Microsoft Excel Based Model, Prepared for The RRM Cost Effectiveness Subcommittee, May 25, 2001

Table 9-1 below provides examples of non-energy benefits that are applicable to weatherization and insulation programs targeted at low income customers.

Table 9-1

Summary of Low Income Program Non-Energy Benefits

Benefit Number in LIPPT Model	Name of Non Energy Benefit	Non-Energy Benefit Description
	Utility Perspective	
7A	Carrying cost on arrearages	Energy Efficiency Programs reduce customer bills, improving the likelihood that customers will be able to keep up with payments
7B	Lower bad debt write-offs	Makes energy bills more manageable for program participants, potentially reducing the bad debt for these customers
7C	Fewer shut-offs	As a result of the customers ability to pay their bills, a similar reduction in the number of customers with service disconnects is expected
7D	Fewer reconnects	As a result of the reduction in the number of shut-offs, the number of reconnects needed would also decline.
7E	Fewer notices	More affordable energy bills leads to more on-time payments and fewer notices from the utility
7F	Fewer customer calls	More affordable energy bills leads to more on-time payments and fewer customer calls
7H	Red'n in emergency gas service calls	
7J	Transmission and/or distribution savings (distribution only)	
	Societal Perspective	
8A	Economic impact	Estimate of economic impact to regional economy based upon using local labor for energy efficiency services instead of importing energy, and using bill savings being spent into local economy.
8B	Environmental benefits	Provides environmental benefits to the region and to society, particularly due to their role as a pollution abatement strategy. These include assisting in meeting Clean Air Act requirements, reduction in acid rain, and a variety of other benefits.

	Participant Perspective	
9B	Fewer Shutoffs	Providing customers with services and education that reduces energy use also helps customers reduce bills and presumably improves their payment record. As a result, participants experience fewer arrearages and are less likely to be disconnected.
9C	Fewer Calls to the utility	Without payment problems the customer is less likely to make calls to the utility concerning payments.
9D	Fewer reconnects	Reconnections are reduced in response to the lower shutoff numbers.
9H	Moving costs/mobility	High energy costs can make it difficult for residential customers to keep up with all of their household bills, including rent or mortgage payments. By keeping their bills down, this will reduce non-payment on living expenses
9I	Fewer Illnesses and lost days from work/school	Households with sufficient and continuous heating may experience changes in the number of colds and other illnesses per year
9K	Net Household Benefits from More Comfort, Less Noise, net of negatives	Weatherization of homes allows these homes to be kept warmer at lower costs, reduces drafts, and insulates them from noise and weather outside their homes.
9K	Net Household Benefits from Additional Hardship Benefits	The additional hardship benefits are those associated non-dollar benefits from reduced disconnects, reconnects, and bill collection, such as reduced stress as perceived and valued by participant.

10.0 GAS DSM SHAREHOLDER INCENTIVE MECHANISMS

This section of the report presents information collected by the GDS Team and ACEEE on gas DSM cost recovery and shareholder incentive mechanisms. (Note, Questar suggested that this section be moved earlier in the report, between sections 2 and 3, so that the reader of the report would understand that there is a cost to achieve the $834 million in savings. Rather than move this entire section, GDS has included in Appendices A and B of this report detailed information by program on projected annual costs to Questar for program design, implementation, rebates to program participants and marketing.)

10.1 December 2003 ACEEE Report Findings

The American Council for an Energy Efficiency Economy (ACEEE) recently completed a survey of gas DSM cost recovery and shareholder mechanisms. The title of this ACEEE Report is "Responding to the Natural Gas Crisis: America's Best Natural Gas Energy Efficiency Programs", published by ACEEE in December 2003. This section of the report summarizes the key information presented in this ACEEE report relating to gas DSM cost recovery and shareholder mechanisms.

Table 10-1 below presents summary data collected by ACEEE for eight states and one Canadian province regarding their legislative and regulatory framework for utility natural gas programs. ACEEE chose these nine jurisdictions because they were the leading areas identified in the ACEEE study in terms of utility natural gas energy efficiency efforts. Information is provided in the table regarding four categories of legislative/regulatory structure:

- whether there is a legal requirement in the state to provide natural gas energy efficiency programs;
- whether there is an approved program cost-recovery mechanism in place;
- whether there is a mechanism for the utility to earn shareholder incentives for good performance with its natural gas energy efficiency program; and
- whether there is a mechanism in place for utilities to recover "lost revenues" resulting from their natural gas energy efficiency programs.

ACEEE notes that the results presented in Table 10-1 reveal some significant patterns among these leading jurisdictions for natural gas energy efficiency. First, seven of the nine jurisdictions have some type of legal requirement for utility funding of natural gas energy efficiency programs, and the other two have strong regulatory encouragement for such programs. All nine jurisdictions have some type of explicit mechanism in place to assure cost-recovery for natural gas energy efficiency program expenditures.

These two key features (i.e., a legislative/regulatory requirement for funding and a mechanism for cost-recovery) have been characterized elsewhere (e.g., Kushler & Witte 2001) as crucial threshold conditions for significant utility energy efficiency efforts to occur, and the results of this study would seem to bear that out.

Beyond those minimum conditions, the observations regarding other regulatory mechanisms are somewhat mixed. Three of the nine jurisdictions have some type of utility shareholder incentive mechanism and two of those also have a lost revenue recovery mechanism (plus one other jurisdiction has a decoupling mechanism). While ACEEE notes that it received some good anecdotal feedback about the usefulness and desirability of those mechanisms, their presence in only a minority of these leading jurisdictions suggests that they are enhancements rather than minimum threshold conditions for achieving successful natural gas energy efficiency programs. (Nonetheless, ACEEE dos support the use of some incentive mechanism beyond simple cost-recovery as a way to help encourage maximum effectiveness on the part of the program administrator.)

Further details about the legislative/regulatory framework for natural gas energy efficiency programs in each of these nine jurisdictions are provided in Appendix A of the ACEEE report.

Table 10-1: Summary of Legislative and Regulatory Mechanisms for DSM Cost Recovery and Shareholder Mechanisms

State	Legal Requirement	Cost-Recovery	Shareholder Incentives	Lost-Revenue Recovery	Other Mechanisms
CA	Yes (required by statute)	Yes (gas public purpose surcharge)	No	No	Also a system benefit charge for low-income energy efficiency programs
MA	No (encouraged by regulators)	Yes ("conservation charges" approved in company-specific regulatory cases)	Yes (some gas utilities do have incentive mechanisms)	Yes (most utilities have some recovery mechanism)	Statue requires statewide energy audit program. Funded by small customer charge, administered by state.
MN	Yes (required by statute)	Yes (gas utilities required to spend 0.5% of revenues)	Yes (Commission approved mechanism)	No (used to, was replaced by incentive mechanism)	No
NJ	Yes (required by statute)	Yes ("societal benefits charge" on	No (used to; no current mechanism)	No (no current authorization,	No

		customer bills)		issue is under review)	
Ontario, Canada	Yes (Ontario Energy Board order)	Yes (included in rates, also has a "DSM Variance Account" to reconcile over-and under-spending on EE by utility)	Yes (one major utility has a shared savings mechanism (SSM) with + and – incentives)	Yes (a lost revenue adjustment mechanism)	No
OR	Yes (for residential gas space heat customers; for others, EE efforts are encouraged by PUC)	Yes (thru balancing accounts, but largest gas utility has a surcharge for EE with funds transferred to a state agency)	No	Yes (although now N/A for the largest gas utility, which has decoupling)	Utilities required by Statute to provide free energy audits and loans/rebates for residential gas space heat customers
WA	No (encouraged by regulators)	Yes (covered in Utility-specific regulatory orders)	No	No	Commission requires "least cost planning," comparing energy efficiency to gas purchasing options.
VT	Yes (required by statue and regulatory orders)	Yes (included in rates and reviewed in rate cases)	No	Yes (net lost revenues are eligible for recovery in rates cases)	The electricity energy "efficiency utility" in VT operates programs that also produce gas savings.
WI	Yes (required by statute)	Yes (certain funding amounts must be transferred by utilities to the state public benefits EE program)	N/A (programs are administered by a state agency)	No	Statue allows utility to spend more on EE, beyond the minimum it must send to the state, if it wishes.

10.2 GDS Survey of DSM Practices of Natural Gas Utilities

For this project, the GDS Team conducted a survey on gas DSM practices with twenty-nine North American gas utility companies. This survey was conducted by GDS in the late fall of 2003 on behalf of the Utah Gas DSM Advisory Group to determine the types of gas DSM and energy efficiency programs offered by selected gas utilities in North America, and to collect data on cost recovery and shareholder incentive mechanisms. The list of the utilities to be included in this survey was developed by the GDS Team and approved by the Utah Energy Office and Questar Gas Company. The survey was targeted at the natural gas utilities that are active members of the Consortium for Energy Efficiency (CEE) as well as natural gas utilities in several Western States.

The primary goal for this study was to determine the following:

- The rationale for DSM programs. The survey examines why or why not DSM programs are offered by these twenty-nine gas utilities, and lists the reasons given by some gas companies for not offering gas DSM or energy efficiency programs. And for those gas utilities that do offer such DSM programs, the survey examines the methods for cost recovery of expenditures on the programs, and do these utilities have shareholder incentives.
- Descriptions of the programs each gas utility company offered. This includes detailed data collection on the number and types of programs offered, the average number of programs offered, the frequency that each program is offered, and descriptions of the gas DSM measures with relatively low and high dollar incentives.
- Which benefit/cost test is used the most.
- The availability of gas DSM technical potential studies, any documentation they might have regarding gas DSM, availability of program evaluation studies, and if each utility could send us copies of such information.

10.2.1 Rationale for DSM Programs

Of the thirty gas utility companies included on the list of companies to be surveyed, the GDS Team was able to obtain twenty-nine solid responses. Twenty-one out of the twenty-nine gas utility companies (72%) do offer some type of DSM program. The main reasons these utilities **do offer** DSM programs include the following:

- to meet requirements of regulatory agencies
- to provide customer service
- to help their customers save money
- to delay the need for further capital investments

The eight gas utility companies that **do not offer** DSM programs do not offer such programs for the following reasons:

- there are no regulatory requirements for them to conduct such programs

- they are concerned about lost revenues
- they are concerned about the difficulty of getting cost recovery for program expenditures
- there is no demand from their customers for such programs
- there are no Federal or State laws mandating that they conduct such programs

10.2.2 Cost Recovery And Shareholder Incentive Mechanisms

For those twenty-one gas utility companies that do offer gas DSM programs, there are different methods for cost recovery of the expenditures on the programs. Twelve out of the twenty-one gas utility companies receive recovery through their gas rates. Pacific Gas & Electric, Southwest Gas, South Jersey Gas, and Unitil (Fitchburg Gas & Electric) have a system benefits charge applied to every therm of gas sold. Xcel Energy-Minnesota recovers costs through a rider on their gas rates. Avista, New England Gas Company, Public Service Electric & Gas, and Southern California Gas were compensated in other forms.

Six companies were allowed to collect shareholder incentives. Most shareholder incentives were based on actual therm savings, program specific metrics, or benefit/cost metrics. Fourteen of the twenty-one companies offering programs were not allowed to collect any type of shareholder incentive.

10.2.3 DSM Programs Offered

There are many different gas DSM programs offered by the respondents to the survey. The twenty-one companies offering gas DSM programs are listed below in Table 10-2 along with the number of programs each offers to their customers.

From Table 10-2 we can see that the number of programs offered ranges from 1 to 20. The average number of programs offered by these twenty-one utilities is eight programs. Table 10-2 only includes the gas companies that currently offer gas DSM programs.

Table 10-2		
No.	**Company**	**Number of Gas DSM Programs Offered**
1	Enbridge Gas	20
2	Gaz Metropolitan	20
3	Puget Sound Energy	20
4	Xcel Energy – Minnesota	16
5	KeySpan Energy Delivery	14
6	Southern California Gas	13
7	Pacific Gas & Electric	12
8	MidAmerican Energy	9
9	Berkshire Gas	8
10	Vermont Gas Systems, Inc.	6
11	Bay State Gas	5
12	Public Service Electric & Gas	5
13	South Jersey Gas	5
14	Unitil (Fitchburg Gas & Electric)	5
15	Madison Gas & Electric	4
16	Avista	3
17	NW Natural	3
18	New England Gas Company	2
19	Northwestern Energy & Gas	2
20	Questar Gas Company	2
21	Intermountain Gas Company	1
	Average Number of Programs Offered Per Gas Utility (For those 21 gas utilities listed above)	8

10.2.4 Benefit/Cost Tests

The purpose of benefit/cost tests is to determine the cost effectiveness of a program. By far the most frequently used benefit/cost test is the Total Resource Cost (TRC) Test (11 mentions). Other frequently used benefit/cost include the Societal Test (five mentions), and the Utility Cost Test (five mentions).

10.2.5 Natural Gas Avoided Costs

Thirteen of the twenty-nine survey respondents do have a forecast of natural gas avoided costs, and most (10) of these forecasts are publicly available. It is very important to note that ***sixteen*** of the survey respondents agreed with the statement that "successful gas DSM programs or energy efficiency information programs can avoid gas distribution costs." In addition, the majority of the ten publicly available avoided cost forecasts do include avoided gas distribution system costs.

11.0 SUMMARY OF FINDINGS

In summary, the maximum achievable cost effective potential for gas DSM in Utah by 2013 is significant.[36] GDS estimates that the maximum achievable cost effective potential for gas DSM in Utah is twenty percent of the 2013 forecast of total gas sales. If all energy efficiency measures analyzed in this study were implemented immediately where technically feasible, we estimate that overall natural gas cumulative annual savings for this technical potential in Utah would be 41.2 million decatherms by 2013. If all measures that are cost effective were implemented, and consumer acceptance trends and the timing of equipment replacements in the market are factored in, the maximum achievable cost effective potential natural gas savings would amount to 21.4 million decatherms (a 20% reduction in the projected 2013 sales forecast for natural gas sales in Utah).

The results of this study demonstrate that cost effective gas energy-efficiency resources can play a significantly expanded role in Utah's energy resource mix over the next decade. Table 1-3 in the Executive Summary shows the present value of benefits and costs associated with implementing the maximum achievable potential energy savings in the State of Utah. The net present savings to citizens of the State of Utah for statewide implementation of programs are over **$1.5 billion** in 2004 dollars.

The Total Resource Cost benefit/cost ratio for the maximum achievable cost effective potential savings scenario is **2.39**. In addition, every gas DSM program that the GDS Team is recommending to the Utah Gas DSM Advisory Group is cost effective according to the TRC Test.

It is clear that natural gas DSM programs can play a significantly expanded role in Utah. The gas DSM potential estimates and Total Resource savings provided in this report are based upon the best and most recent natural gas load forecasts, appliance saturation data, economic forecasts, data on DSM measure costs and savings, and DSM measure lives available to GDS at the time of this study. All input assumptions and data have been thoroughly reviewed over a six-month period by GDS, staff of the Utah Energy Office, staff of Questar Gas Company, and staff of the Southwest Energy Efficiency Project. GDS has conducted extra research to ensure that data for DSM measure costs and savings are applicable to the State of Utah. For example, GDS conducted in-depth interviews with several weatherization service providers in Salt Lake City to ensure that data on DSM measure costs, savings and market potential were accurate. In addition, GDS used home and building energy analysis simulation models (REM/Rate, Energy 10) to ensure the validity of energy savings estimates and gas DSM potential estimates for the State of Utah.

[36] It is important to note that these savings apply to Questar's Utah residential and commercial customers. This was not a study done for all natural gas customers in the State of Utah, but rather it focused only on the Questar Gas service area, and it was limited in scope to residential and commercial customers.

APPENDIX A

Residential DSM Inputs

APPENDIX A - INPUT ASSUMPTIONS
RESIDENTIAL GAS DSM PROGRAMS

MAY 20, 2004

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Measure # from GDS Gas DSM Data Base	**Measure Description**	**Savings Units**	**Cost Units**	**Equipment Cost**	**Labor Cost**	**Total Installed Cost**	**Cost Type: Incremental = 0 Full = 1**	**Measure Life**	**Annual MMBTU Savings Per Unit Installed**	**Annual Therm Savings Per Unit Installed**	**Annual Amortized Cost Per Unit**	**Levelized Cost Per Therm Saved**	**Annual Gallons of water saved**	**Annual kWh savings**	**Gas End Use Affected**	**Implementation Type 1 = 1 Time 2 = ROB**
1	**Programmable Thermostat - Single Family Homes - Do-It Yourself**	Home	Unit	$58.80	$0.00	$58.80	1	10	2.692	26.92	$8.37	$0.3110	0	0	Space Heating	1
2	**Programmable Thermostat - Single Family Homes - Contr. Installled**	Home	Unit	$58.80	$50.00	$108.80	1	10	2.692	26.92	$15.49	$0.5754	0	0	Space Heating	1
3	**Natural Gas Water Heater Blanket (Do-it-yourself kit)**	Per water heater	Per water heater	$14.00	$0.00	$14.00	1	10	2.2	22	$1.99	$0.0906	0	0	Water Heating	1
4	**Energy Star Clothes Washer (Energy Factor=2.5) with electric dryer (49% of households in Utah)**	Per clothes washer	Per clothes washer	$200.00	$0.00[2]	$200.00	0	14	1.9 MMBTU savings for gas water heating	19	$28.48	$1.4987	5400	115	Gas water heater, electric clothes washer, electric clothes dryer	2
5	**Energy Star Clothes Washer (Energy Factor=2.5) with gas clothes dryer (20% of households in Utah)**	Per clothes washer	Per clothes washer	$200.00	$0.00	$200.00	0	14	2.5 MMBTU savings for gas water heating	25	$28.48	$1.1390	5400	0	Gas water heater,electric clothes washer, gas clothes dryer	2
6	**Energy Star Windows Do-It Yourself**	Per Home	Per home	$200.00	$0.00	$200.00	0	35	6.23	62.3	$28.48	$0.4571	0	165	Space Heating	2
7	**Energy Star Windows - Contractor Installed**	Per Home	Per home	$200.00	$550.00	$750.00	0	35	6.23	62.3	$106.78	$1.7140	0	165	Space Heating	2
8	**Energy Star High Efficiency Gas Heating Equipment - Gas Furnace**	Per furnace	Per furnace	$400.00	$0.00	$400.00	0	20	11.4	114	$56.95	$0.4996	0	0	Space Heating	2
9	**Energy Star High Efficiency Water Heating Equipment**	Per water heater	Per water heater	$100.00	$0.00	$100.00	0	15	2.7	27	$14.24	$0.5273	0	0	Water Heating	2
10	**Residential Insulation and Weatherization Program**	Home	Home	$687.50	$687.50	$1,375.00	1	25	17.75	177.5	$195.77	$1.1027	0	498	Space Heating	1
11	**Low Income Program**	Home	Home	$750.00	$750.00	$1,500.00	1	25	17.75	177.5	$213.57	$1.2032	0	498	Space Heating	1
12	**Energy Star Homes**	Home	Home	$3,000.00	$0.00	$3,000.00	0	35	49.2 mmbtu savings for gas space heating	492	$427.13	$0.8682	0	1910	Space Heating	1

APPENDIX A - INPUT ASSUMPTIONS
RESIDENTIAL GAS DSM PROGRAMS

MAY 20, 2004

1	2	18	19	20	21	22	23	24	25	26	27	28	29	30
Measure # from GDS Gas DSM Data Base	**Measure Description**	**Base Case Factor (Saturation)**	**Remaining Factor (In how many homes can this be installed)**	**Type of home where applicable**	**Number of applicable homes in 2004**	**Total Homes Remaining without measure**	**Maximum Number of new participants per year (80% penetration limit)[1]**	**Total annual MMBTU savings potential in 2004 if 100% penetration attained "overnight"**	**Total annual therm savings potential in 2004 if 100% penetration attained "overnight"**	**Total annual kWh savings potential in 2004**	**Total annual gallons of water savings potential in 2004**	**Annual Maximum Achievable Cost Effective Therm Savings Potential in 2013**	**Free-rider percentage**	**On-going annual O&M cost (+) or savings (-)**
1	**Programmable Thermostat - Single Family Homes - Do-It Yourself**	42.30%	57.7%	Homes in Utah with natural gas space heat	694,170	400,536	26,170	1,078,243	10,782,432	0	0	7,045,020	0%	$0.00
2	**Programmable Thermostat - Single Family Homes - Contr. Installled**	42.30%	57.7%	Homes in Utah with natural gas space heat	694,170	400,536	26,170	1,078,243	10,782,432	0	0	7,045,020	0%	$0.00
3	**Natural Gas Water Heater Blanket (Do-it-yourself kit)**	32.00%	68%	Homes in Utah with natural gas water heating	669,238	455,082	32,123	1,001,180	10,011,800	0	0	7,067,153	0%	$0.00
4	**Energy Star Clothes Washer (Energy Factor=2.5) with electric dryer (49% of households in Utah)**	3.00%	97%	Total Households in Utah in 2004 = 754,735 Households in Utah with clothes washers, a gas water heater and an electric clothes dryer (49%)	369,820	358,726	20,340	681,579	6,815,785	29,466,741	1,383,655,676	3,864,621	0%	$0.00
5	**Energy Star Clothes Washer (Energy Factor=2.5) with gas clothes dryer (20% of households in Utah)**	3.00%	97%	Total Households in Utah in 2004 = 754,735 Households in Utah with clothes washers, a gas water heater and an gas clothes dryer (20%)	150,947	146,419	8,302	278,195	2,781,953	0	564,757,419	2,075,521	0%	$0.00
6	**Energy Star Windows Do-It Yourself**	10.00%	90%	Homes in Utah with natural gas space heat	694,170	624,753	13,883	3,892,211	38,922,112	29,452,641	0	8,649,358	0%	$0.00
7	**Energy Star Windows - Contractor Installed**	10.00%	90%	Homes in Utah with natural gas space heat	694,170	624,753	13,883	3,892,211	38,922,112	29,452,641	0	8,649,358	0%	$0.00
8	**Energy Star High Efficiency Gas Heating Equipment - Gas Furnace**	25.00%	75%	Homes in Utah with natural gas furnaces	694,170	520,628	19,090	5,935,154	59,351,535	0	0	21,762,230	0%	$50.00
9	**Energy Star High Efficiency Water Heating Equipment**	10.00%	90%	Homes in Utah with natural gas water heating	669,238	602,314	31,231	1,626,248	16,262,483	0	0	8,432,399	0%	$0.00
10	**Residential Insulation and Weatherization Program**	30.00%	70%	Homes in Utah with natural gas space heat - excluding low income homes with natural gas space heat	694,170	494,957	30,935	8,787,463	87,874,630	15,405,530	0	54,921,644	0%	$0.00
11	**Low Income Program**	30.00%	70%	Low Income homes in Utah with natural gas space heat	75,474	52,832	3,774	937,764	9,377,645	1,879,303	0	6,698,318	0%	$0.00
12	**Energy Star Homes**	3.00%	97%	Total new homes built in Utah 2004 to 2013 = 147,707	147,707	143,276	11,373	7,120,807	71,208,068	273,656,759	0	55,957,320	0%	$0.00

APPENDIX A - SOURCES AND REFERENCES FOR RESIDENTIAL DSM INPUT ASSUMPTIONS
May 20, 2004

1	2	3	4	5	6	7
Measure # from GDS Gas DSM Data Base	**Measure Description**	**Source for MMBTU, Therm, kWh and Water savings**	**How savings numbers were calculated**	**Source for Useful Life**	**Source for Incremental Cost**	**Source for Saturation**
1	**Programmable Thermostat (.6) - Single Family Homes**	The average annual Dth usage of a home in Utah is 53.8 Dth. Programmable thermostats can save 5% of annual energy use, according to the California Statewide Residential Sector Energy Efficiency Potential Study, Volume 2, Appendix D, page 4-7.	The average annual Dth usage of a home in Utah is 53.8 Dth. The annual energy savings per participant was calculated by multiplying the annual usage per customer for space heating of 53.8 Dth times 5%.	Source: Honeywell Customer Service Center, phone call by Richard Spellman of GDS to Honeywell on 5/4/2000.	California Statewide Residential Sector Energy Efficiency Potential Study. Study ID #SW063. April 2003. Volume #2 Appendix D	2001 Pacificorp Survey. Question #5
3	**Natural Gas Water Heater Blanket (Do-it-yourself kit)**	California Statewide Residential Sector Energy Efficiency Potential Study. Study ID #SW063. April 2003. Volume #2 Appendix D	This information was obtained from a California Statewide Residential Sector Energy Efficiency Potential Study. Volue #2 Appendix D	Questar Gas Company	California Statewide Residential Sector Energy Efficiency Potential Study. Study ID #SW063. April 2003. Volume #2 Appendix D	2001 Pacificorp Survey Question #21
4	**Energy Star Clothes Washer (Energy Factor=2.5) with <u>electric dryer</u> (49% of households in Utah)**	Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah. October 17, 2002. Prepared for Utah by the Southwest Energy Efficiency Project (SWEEP) Page 2	All assumptions needed are provided in the SWEEP report that was sent to GDS by the Utah Energy Office. The title of the SWEEP report is "Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah"	Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah. October 17, 2002. Prepared for Utah by the Southwest Energy Efficiency Project (SWEEP) Page 4	Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah. October 17, 2002. Prepared for Utah by the Southwest Energy Efficiency Project (SWEEP) Page 4	Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah. October 17, 2002. Prepared for Utah by the Southwest Energy Efficiency Project (SWEEP) Page 5
5	**Energy Star Clothes Washer (Energy Factor=2.5) with <u>gas clothes dryer</u> (20% of households in Utah)**	Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah. October 17, 2002. Prepared for Utah by the Southwest Energy Efficiency Project (SWEEP) Page 5	All assumptions needed are provided in the SWEEP report that was sent to GDS by the Utah Energy Office. The title of the SWEEP report is "Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah"	Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah. October 17, 2002. Prepared for Utah by the Southwest Energy Efficiency Project (SWEEP) Page 5	Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah. October 17, 2002. Prepared for Utah by the Southwest Energy Efficiency Project (SWEEP) Page 5	Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah. October 17, 2002. Prepared for Utah by the Southwest Energy Efficiency Project (SWEEP) Page 5
6	**Energy Star Windows**	RESFEN Model Version 3.1: available at the Lawrence Berkeley Laboratory web site at http://windows.lbl.gov/software/resfen/resfen.html	For the base case, window # 301 was used. For the high efficiency case, window #331 was used. Estimates are based on an existing two story frame home of 2000 square feet, and heating and cooling degree days are based on Salt Lake City.	ACEEE report, "Selecting Targets for Market Transformation Programs, A National Analysis", August 1998, page 60	Baseline Characterization of the Residential Market for Energy Star Windows. The study was prepared for Northeast Energy Efficiency Partnerships by Quantec LLC and Nexus Market Research in October of 2002. Table V.10 on page V-11.	Utah Gas DSM Advisory Group
8	**Energy Star High Efficiency Gas Heating Equipment - Gas Furnace**	REM/Rate analysis conducted by Bruce Bennett of GDS on February 2, 2004	Savings were calculated by GDS by comparing the annual therm usage for the 2000 square foot base case home in Salt Lake City with a high efficiency Condensing Gas Furnace (92% efficiency) to a Conventional Gas Furnace (80% efficiency). The construction type used is the third scenario (R-38 ceiling, R-13 Walls and R-19 floors)	Questar Gas Company	GasNetworks Expert Knowledge	GAMA Data from Questar Response to GDS Data Request #1-5.4
9	**Energy Star High Efficiency Water Heating Equipment**	REM/Rate analysis conducted by Bruce Bennett of GDS Associates on January 14, 2004 for a high efficiency stand alone natural gas water heater.	REM/Rate Home Energy Use Simulation Model	California Statewide Residential Sector Energy Efficiency Potential Study. Study ID #SW063. April 2003. Volume #2 Appendix D	SEARS Water Heater Sales - based on quotes from salesperson on March 19, 2004 for standard efficiency natural gas water heater (EF = 0.59, model number = 33643) and high efficiency model (EF = 0.63, model number = 33144).	Utah Gas DSM Advisory Group
10	**Residential Insulation and Weatherization Program (R-11 to R-38)**	REM/Rate analysis conducted by Bruce Bennett of GDS Associates. January 2004	REM/Rate Home Energy Use Simulation Model	ACEEE	GDS survey of several Weatherization Contractors in the Salt Lake City area conducted by GDS Associates	Utah Gas DSM Advisory Group
11	**Low Income Program**	REM/Rate analysis conducted by Bruce Bennett. January 2004	REM/Rate Home Energy Use Simulation Model	ACEEE	Utah Gas DSM Advisory Group	Utah Gas DSM Advisory Group
12	**Energy Star Homes**	SWEEP Report, August 2003, "Increasing Energy Efficiency in New Buildings in the Southwest" Page 3-11	The August 2003 SWEEP Report shows the energy use (heating and cooling) per housing unit (when built to IEEC specifications) to be 118.2 MMBtus and the Energy Star homes use 62.5 MMBtus. This information was specific to Utah. Larry Kinney of SWEEP provided GDS with a breakdown of the total savings into gas and electric savings on February 3, 2004.	SWEEP Report, August 2003, "Increasing Energy Efficiency in New Buildings in the Southwest"	SWEEP Report, August 2003, "Increasing Energy Efficiency in New Buildings in the Southwest"	SWEEP Report, August 2003, "Increasing Energy Efficiency in New Buildings in the Southwest"

35000

Appendix A - DSM Inputs for Sendout Model - Base Case - May 20, 2004

	Description	SCENARIO A Programmable Thermostat (.6) - Single Family Homes	SCENARIO B Programmable Thermostat (.6) - Single Family Homes - Do-It Yourself	Natural Gas Water Heater Blanket (Do-it-yourself kit)	Energy Star Clothes Washer (Energy Factor=2.5) with electric dryer (49% of households in Utah)	Energy Star Clothes Washer (Energy Factor=2.5) with gas clothes dryer (20% of households in Utah)	SCENARIO A Energy Star Windows - Contactor Installed	SCENARIO B Energy Star Windows Do-It Yourself	Energy Star High Efficiency Gas Heating Equipment - High Efficiency Gas Furnace
	A	B	C	D	E	F	G	H	I
1	*Program Inputs*	0.747714286	0.747714286	0.9178	0.58114595	0.237202429	0.396657143	0.396657143	0.545428571
2	Number New Participants/Year (10% of remaining)	26,170	26,170	32,123	20,340	8,302	13,883	13,883	19,090
3	Dth Increase (Reduction)/Participant/Year	2.692	2.692	2.20	1.90	2.50	6.23	6.23	11.40
4									
5	Participant ongoing O&M Costs $/Participant/Year	0	0	0	0	0	0		$50.00
6	Utility Start-up Admin Cost $/Program First Year Only	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
7	Utility Fixed Cost (Administrative) $/Program/Year	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$70,000.00	$70,000.00	$60,000.00
8	Utility Fixed Cost (Mailer) $/Program/Year	$28,000.00	$28,000.00	$25,500.00	$12,500.00	$12,500.00	$40,000.00	$40,000.00	$87,500.00
9									
10	Installation Incentive - Utility to Participant $ - One time	$29.40	$29.40	$7.00	$100.00	$100.00	$100.00	$100.00	$200.00
11									
12	Participant Install Cost $ - One Time	$108.80	$58.80	$14.00	$200.00	$200.00	$750.00	$200.00	$400.00
13	Participant Net Cost $	$79.40	$29.40	$7.00	$100.00	$100.00	$650.00	$100.00	$200.00
14	Participant Savings - Electric Volume Reduction Kwh/Year	0	0	0	115	0	165	165	0
15	Participant Savings - Water Usage Reduction	0	0	0	5400	5400	0	0	0
16									
17	Free Rider Percent	0	0	0	0	0	0	0	0
18	DSM Device Life - Years	10	10	10	14	14	35	35	20
19									
20	*System Inputs*	Applies to Each of the Five Programs							
21	Gas Marginal Cost Rate	From Base Case Model Run							
22	Utility Base Revenue Rate $/Dth - First Year								
23	Electric Revenue Rate $/Kwh - First Year								
24									
25	Discount Rates - Percent								
26	Utility								
27	Participant								
28	Society								

	B	C	D	E	F	G	H	I
Total Annual Budget-Rebates	$769,398.00	$769,398.00	$224,861.00	$2,034,010.83	$830,208.50	$1,388,300.00	$1,388,300.00	$3,818,000.00
Utility Fixed Cost for Admin	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$70,000.00	$70,000.00	$60,000.00
Marketing	$28,000.00	$28,000.00	$25,500.00	$12,500.00	$12,500.00	$40,000.00	$40,000.00	$87,500.00
Total	$857,398.00	$857,398.00	$310,361.00	$2,106,510.83	$902,708.50	$1,498,300.00	$1,498,300.00	$3,965,500.00
Total Annual Budget for Maximum Achievable Cost Effective Potential Base Case Assuming 80% Market Penetration		$857,398.00	$310,361.00	$2,106,510.83	$902,708.50		$1,498,300.00	$3,965,500.00

Appendix A - DSM Inputs for Sendout
Model - Base Case - May 20, 2004

	Description	Energy Star High Efficiency Water Heating Equipment	Residential Insulation and Weatherization Program	Low Income Program (Weatherization and Insulation)	Energy Star Homes (for new homes only)	Totals
	A	J	K	L	M	
1	*Program Inputs*	0.892314286	0.883857143	0.10782	0.324942857	
2	Number New Participants/Year (10% of remaining)	31,231	30,935	3,774	11,373	
3	Dth Increase (Reduction)/Participant/Year	2.70	17.75	17.75	49.20	
4						
5	Participant ongoing O&M Costs $/Participant/Year	0	0	0	0	
6	Utility Start-up Admin Cost $/Program First Year Only	$0.00	$0.00	$0.00	$0.00	**$0.00**
7	Utility Fixed Cost (Administrative) $/Program/Year	$60,000.00	$20,000.00	$10,000.00	$60,000.00	**$650,000.00**
8	Utility Fixed Cost (Mailer) $/Program/Year	$87,500.00	$65,000.00	$25,000.00	$20,000.00	**$471,500.00**
9						
10	Installation Incentive - Utility to Participant $ - One time	$50.00	$687.50	$750.00	$1,500.00	
11						
12	Participant Install Cost $ - One Time	$100.00	$1,375.00	$1,500.00	$3,000.00	
13	Participant Net Cost $	$50.00	$687.50	$750.00	$1,500.00	
14	Participant Savings - Electric Volume Reduction Kwh/Year	0	498	498	1910	
15	Participant Savings - Water Usage Reduction	0	0	0	0	
16						
17	Free Rider Percent	0	0	0	0	
18	DSM Device Life - Years	15	25	25	35	
19						
20	*System Inputs*					
21	Gas Marginal Cost Rate					
22	Utility Base Revenue Rate $/Dth - First Year					
23	Electric Revenue Rate $/Kwh - First Year					
24						
25	Discount Rates - Percent					
26	Utility					
27	Participant					
28	Society					

Total Annual Budget-Rebates	$1,561,550.00	$21,267,812.50	$2,830,275.00	$17,059,500.00	$53,941,613.83
Utility Fixed Cost for Admin	$60,000.00	$20,000.00	$10,000.00	$60,000.00	$650,000.00
Marketing	$87,500.00	$65,000.00	$25,000.00	$20,000.00	$471,500.00
Total	$1,709,050.00	$21,352,812.50	$2,865,275.00	$17,139,500.00	$55,063,113.83
Total Annual Budget for Maximum Achievable Cost Effective Potential Base Case Assuming 80% Market Penetration	$1,709,050.00	$21,352,812.50	$2,865,275.00	$17,139,500.00	$52,707,415.83

APPENDIX B

Commercial Sector DSM Inputs

APPENDIX B - DSM DATA FOR QUESTAR FOR COMMERCIAL DSM PROGRAMS
COMMERCIAL MEASURES

1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Measure # from GDS Gas DSM Data Base	**Commercial Program**	**Measure Description**	**Savings Units**	**Cost Units**	**Total Installed Cost**	**Cost Type: Incremental = 0 Full = 1**	**Measure Life**	**Annual DecaTherm Savings Per Sq Ft**	**Average Commercial Building Size (sq ft)**	**Annual DecaTherm Savings Per Building**	**Annual Gallons of water saved**	**Annual kWh savings**	**Gas End Use Affected**	**Implementation Type 1 = 1 Time 2 = ROB**	**Base Case Factor of High Efficiency Measure (Saturation)**	**Remaining Factor (In how many buildings can this be installed)**	**Applicable Building Types**
105	***HE Heating***	**High Efficiency Furnace**	Dthms/sq ft	$/kBtu	$6.50	0	20	0.0060	5,100	30.5	0	0	Space Heating	2	5%	95.0%	All
116	***HE Heating***	**Infrared Heater**	Per Unit	Unit	$1,391.00	0	17	0.0064	5,100	32.4	0	0	Space Heating	2	50%	50.0%	Primarily Warehouse, Restaurant, Large Commercial
201	***HE Heating***	**High Efficiency Water Heater**	Per Unit	$/kBtu	$12.60	0	15	0.0031	5,100	15.7	0	0	Water Heating	2	53%	47%	All
113	***Com EE - Prescriptive***	**Programmable Thermostats**	Per Unit	$/unit	$100.00	1	12	0.0061	5,100	31.2	0	0	Space Heating	1	75%	25%	All
117	***Com EE - Prescriptive***	**Boiler Reset Control**	Per Unit	$/unit	$600.00	1	20	0.0056	5,100	28.5	0	0	Space Heating	1	70%	30%	All
120	***Com EE - Prescriptive***	**Steam Trap Replacements**	Dthms/sq ft	$/sq ft	$0.06	1	5	0.0045	5,100	22.8	0	0	Space Heating	1	50%	50%	All
103	***Com EE - Prescriptive***	**Pipe or Duct Insulation**	Per Linear ft	$/ln ft	$1.63	1	20	0.0009	5,100	4.5	0	0	Space Heating	1	41%	59%	All
101	***Com EE - Prescriptive***	**Building Shell Insulation (Roof)**	Dthms/sq ft	$/sq ft	$0.49	1	20	0.0057	5,100	28.8	0	0	Space Heating	1	66%	34%	All
102	***Com EE - Prescriptive***	**Premium Efficiency Windows**	Dthms/sq ft	$/sq ft of window	$0.68	0	35	0.0103	5,100	52.5	0	0	Space Heating	2	2%	98%	All
122	***Com EE - Prescriptive***	**Retrocommissioning**	Dthms/sq ft	$/sq ft	$0.17	1	7	0.0050	5,100	25.6	0	5610	Space Heating	1	0%	100%	All
NA	***Com EE - Custom***	**Custom Projects**	Dthms/sq ft	$/sq ft	$0.40	0	15	0.0114	5,100	58.1	0	0	Spc & Wtr Htng	2	20%	80%	All

Notes:

1. The calculation in Column 22 assumes that the maximum potential savings are attained over a ten-year period and that if existing standard efficiency units are replaced on burn-out then the maximum number of replacements per year is the reciprocal of the measure life. If the standard efficiency units are retrofitted prior to the end of their useful life, the maximum number of replacements per year is 10 which assumes a flat ramp-in over the 10 year period.

APPENDIX B - DSM DATA FOR QUESTAR FOR COMMERCIAI
COMMERCIAL MEASURES

1		2	18	19	20	21	22	23	24	25	26	27
Measure # from GDS Gas DSM Data Base	**Commercial Program**	**Measure Description**	**Total Number of Commercial Customers in 2004**	**Number of Commercial Customers with Applicable Gas End Use**	**Number of Applicable Commercial Customers**	**Total Remaining Commercial Customers without Measure**	**Maximum Number of New Participants per Year (80% penetration limit for the entire market)[1]**	**Total Annual DecaTherm Savings Potential in 2004 if 100% penetration attained "overnight"**	**Total Annual kWh Savings Potential in 2004**	**Total Annual Gallons of Water Savings Potential in 2004**	**Free-rider percentage**	**On-going annual O&M cost (+) or savings (-)**
105	*HE Heating*	**High Efficiency Furnace**	53,591	50,865	40,102	38,097	1,504	1,160,615	0	0	0%	$0.00
116	*HE Heating*	**Infrared Heater**	53,591	50,865	6,279	3,140	111	101,723	0	0	0%	$0.00
201	*HE Heating*	**High Efficiency Water Heater**	53,591	31,445	31,445	14,779	566	231,430	0	0	0%	$0.00
113	*Com EE - Prescriptive*	**Programmable Thermostats**	53,591	50,865	50,865	12,716	254	397,074	0	0	0%	$0.00
117	*Com EE - Prescriptive*	**Boiler Reset Control**	53,591	50,865	6,999	2,100	70	59,829	0	0	0%	$0.00
120	*Com EE - Prescriptive*	**Steam Trap Replacements**	53,591	50,865	1,400	700	42	15,954	0	0	0%	$0.00
103	*Com EE - Prescriptive*	**Pipe or Duct Insulation**	53,591	50,865	50,865	30,010	1,984	135,394	0	0	0%	$0.00
101	*Com EE - Prescriptive*	**Building Shell Insulation (Roof)**	53,591	50,865	50,865	17,294	712	498,603	0	0	0%	$0.00
102	*Com EE - Prescriptive*	**Premium Efficiency Windows**	53,591	50,865	50,865	49,848	1,134	2,616,528	0	0	0%	$0.00
122	*Com EE - Prescriptive*	**Retrocommissioning**	53,591	50,865	27,467	27,467	2,197	704,385	154,090,018	0	0%	$0.00
NA	*Com EE - Custom*	**Custom Projects**	53,591	50,865	50,865	40,692	2,035	2,364,652	0	0	0%	$0.00

Notes:

1. The calculation in Column 22 assumes that the maximum potential savings ε
standard efficiency units are replaced on burn-out then the maximum number o
life. If the standard efficiency units are retrofitted prior to the end of their useful
which assumes a flat ramp-in over the 10 year period.

1	2	3	4	5	6	7	8	9	10
Measure # from GDS Gas DSM Data Base	Measure Description	Source for Therm, kWh and Water savings	Source for Average Square Footage of Commercial Buildings	Method of Calculating Savings Values	Source for Useful Life	Source for Incremental Cost	Source for Saturation	Calculation of Applicable Number of Commercial Customers	Source for Rebates
105	**High Efficiency Furnace**- Assumes a 10% increase in AFUE.	Increase efficiency by 10% using Energy-10 simulation software	Pacific Gas & Electric Commercial Building Survey Report, 1999. Reported an average of 6,360 sq. ft. for all commercial buildings, this was rounded to 6,500 for use in this analysis.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database. 10%-11% savings applied to each building type's EUI value, weighted by 2004 gas sales.	CALIFORNIA STATEWIDE COMMERCIAL SECTOR NATURAL GAS ENERGY EFFICIENCY POTENTIAL STUDY, Study ID #SW061, Prepared for Pacific Gas & Electric Company, Prepared by Mike Rufo and Fred Coito KEMA-XENERGY Inc., May 14, 2003	CALIFORNIA STATEWIDE COMMERCIAL SECTOR NATURAL GAS ENERGY EFFICIENCY POTENTIAL STUDY, Study ID #SW061, Prepared for Pacific Gas & Electric Company, Prepared by Mike Rufo and Fred Coito KEMA-XENERGY Inc., May 14, 2003	CALIFORNIA STATEWIDE COMMERCIAL SECTOR NATURAL GAS ENERGY EFFICIENCY POTENTIAL STUDY, Study ID #SW061, Prepared for Pacific Gas & Electric Company, Prepared by Mike Rufo and Fred Coito KEMA-XENERGY Inc., May 14, 2003	The first step was to develop a sales weighted average of Questar's current space heating saturation to be used as a proxy for the entire sector (see Commercial Sales by Type tab). For high efficiency furnaces, this value was then multiplied by the number of commercial customers who have furnaces (78.8%) - based on results from Questar's 2003 Commercial Energy Preferences Survey.	Keyspan Energy, 2003
116	**Infrared Heater** - Radiant heat used to replace standard gas unit heater.	Massachusetts Market Transformation Scoping Study, Arthur D. Little, 1997. Reported value of 18.5% savings was checked through GDS calculations.	Same as above.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database. 18.5% savings applied to each building type's EUI value, weighted by 2004 gas sales.	Massachusetts Market Transformation Scoping Study, Arthur D. Little, 1997.	Massachusetts Market Transformation Scoping Study, Arthur D. Little, 1997.	50% saturation value is a GDS estimate based on a relatively low but increasing saturation of infrared heaters in the current market.	The first step was to develop a sales weighted average of Questar's current space heating saturation to be used as a proxy for the entire sector (see Commercial Sales by Type tab). For infrared heaters, this value was then multiplied by the Warehouse customer type plus 10% of all other customer types. This estimate of the infrared heating market was based on the 1997 Arthur D. Little Study.	Keyspan Energy, 2003
201	**High Efficiency Water Heater** - Assumes a stand-alone gas water of 100 kBtu with an thermal efficiency of 95% and a base efficiency of 76%.	GDS and Questar calculations using the CA Potential Study as a starting point.	Same as above.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database. 20% savings applied to each building type's EUI value, weighted by 2004 gas sales.	CALIFORNIA STATEWIDE COMMERCIAL SECTOR NATURAL GAS ENERGY EFFICIENCY POTENTIAL STUDY, Study ID #SW061, Prepared for Pacific Gas & Electric Company, Prepared by Mike Rufo and Fred Coito KEMA-XENERGY Inc., May 14, 2003	CALIFORNIA STATEWIDE COMMERCIAL SECTOR NATURAL GAS ENERGY EFFICIENCY POTENTIAL STUDY, Study ID #SW061, Prepared for Pacific Gas & Electric Company, Prepared by Mike Rufo and Fred Coito KEMA-XENERGY Inc., May 14, 2003	CALIFORNIA STATEWIDE COMMERCIAL SECTOR NATURAL GAS ENERGY EFFICIENCY POTENTIAL STUDY, Study ID #SW061, Prepared for Pacific Gas & Electric Company, Prepared by Mike Rufo and Fred Coito KEMA-XENERGY Inc., May 14, 2004	A sales weighted average of Questar's current water heating saturation was developed and used as a proxy for the entire sector (see Commercial Sales by Type tab).	Keyspan Energy, 2003
113	**Programmable Thermostats -** Assumes Setback from 70 to 66, 13 hours per day.	GDS estimate using Energy-10 building simulation software.	Same as above.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database. Range of 6% - 13% savings applied to each building type's EUI value, weighted by 2004 gas sales.	CA Potential Study	CA Potential Study.	GDS estimate based on market experience and discussions with Questar staff and other Utah energy professionals.	A sales weighted average of Questar's current space heating saturation was developed and used as a proxy for the entire sector (see Commercial Sales by Type tab).	Keyspan Energy, 2003
117	**Boiler Reset Control -** Outdoor temperature reset (reduces cycling)	Tekmar controls	Same as above.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database. 10% savings applied to each building type's EUI value, weighted by 2004 gas sales.	GDS estimate.	GDS estimate.	GDS estimate.	Using the sales weighted average of Questar's current space heating saturation and then multiplying this by the number of commercial customers who have boilers (13.8%) - based on results from Questar's 2003 Commercial Energy Preferences Survey.	Keyspan Energy, 2003
120	**Steam Trap Replacements**	Alliance to Save Energy, Technology Profile	Same as above.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database. 8% savings applied to each building type's EUI value, weighted by 2004 gas sales.	GDS estimate.	GDS estimate.	GDS estimate.	Using the value from above for customers with boilers, this was multiplied by 20% to estimate the number of boiler systems that generate steam.	Keyspan Energy, 2003
103	**Pipe or Duct Insulation -** Conduction to oudoor 5% to 4.5%.	GDS estimate using Energy-10 building simulation software.	Same as above.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database. 2% savings applied to each building type's EUI value, weighted by 2004 gas sales.	CA Potential Study	Assessment of Energy and Capacity Savings Potential in Iowa, Global Energy Partners and Quantec, LLC, July 2002	CA Potential Study.	A sales weighted average of Questar's current space heating saturation was developed and used as a proxy for the entire sector (see Commercial Sales by Type tab).	Keyspan Energy, 2003
101	**Building Shell Insulation (Roof) -** From R19 to R38.	GDS estimate using Energy-10 building simulation software.	Same as above.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database. Range of 6% - 15% savings applied to each building type's EUI value, weighted by 2004 gas sales.	CA Potential Study	CA Potential Study.	CA Potential Study.	A sales weighted average of Questar's current space heating saturation was developed and used as a proxy for the entire sector.	Keyspan Energy, 2003
102	**Premium Efficiency Windows -** Double pane (U=0.70) to double pane, low-e (U=0.29)	GDS estimate using Energy-10 building simulation software.	Same as above.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database. Range of 8% - 22% savings applied to each building type's EUI value, weighted by 2004 gas sales.	American Council for an Energy Efficient Economy (ACEEE), Selecting Targets for Market Transformation Programs: A National Analysis, 1998.	CA Potential Study.	CA Potential Study.	A sales weighted average of Questar's current space heating saturation was developed and used as a proxy for the entire sector.	Keyspan Energy, 2003
122	**Retrocommissioning -** This involves a comprehensive review and re-tuning of all major building systems.	Based on data from Mike Rufo on a CA Pilot, Excel Energy's Retro-Commissioning Program and the 1998 ACEEE Report	Same as above.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database. 9% savings applied to each building type's EUI value, weighted by 2004 gas sales.	American Council for an Energy Efficient Economy (ACEEE), Selecting Targets for Market Transformation Programs: A National Analysis, 1998.	Quantum Consulting via email from Mike Rufo concerning pilot program in CA. Verified against value in 1998 ACEEE Report.	GDS estimate.	A sales weighted average of Questar's current space heating saturation was developed and used as a proxy for the entire sector (see Commercial Sales by Type tab). This was then multiplied by 54% to estimate the number of buildings where retocommissioning is applicable. (The 54% value is from the 1998 ACEEE study.)	Keyspan Energy, 2003
NA	**Custom Projects -** Installation of various measures depending on building type.	GDS estimate based on a weighted average of selected measures for each building type.	Same as above.	Sales weighted average of all commercial building types' savings estimates from original GDS Commercial database, using a weighted group of measures for each building type. This was then applied to each building type's EUI value and weighted by 2004 gas sales.	GDS estimate based on the mix of measures included in the makeup of a "typical" custom project.	GDS estimate based on the mix of measures included in the makeup of a "typical" custom project.	GDS estimate.	A sales weighted average of Questar's current space heating saturation was developed and used as a proxy for the entire sector.	Keyspan Energy, 2003

Appendix B - Commercial DSM Inputs for Sendout Model

	Description	Commercial High Efficiency Heating Program - HE Furnaces	Commercial High Efficiency Heating Program - HE Infrared Heaters	Commercial High Efficiency Heating Program - HE Water Heaters	Programmable Thermostats	Boiler Reset Control	Steam Trap Replacements	Pipe or Duct Insulation	Building Shell Insulation (Roof)	Premium Efficiency Windows	Retro-Commissioning	Custom Projects	Totals
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	*Program Inputs*	0.03	0.00	0.01									
2	Number New Participants/Year (10% of remaining)	1,504	111	566	254	70	42	1,984	712	1,134	2,197	2,035	
3	Dth Increase (Reduction)/Participant/Year	30.46	32.400	15.66	31.23	28.49	22.80	4.51	28.83	52.49	25.64	58.11	
4													
5	Participant ongoing O&M Costs $/Participant/Year	0	0	0	0	0	0	0	0	0	0	0	
6	Utility Start-up Admin Cost $/Program First Year Only	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
7	Utility Fixed Cost (Administrative) $/Program/Year	$20,000	$20,000	$20,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	**$380,000**
8	Utility Fixed Cost (Marketing) $/Program/Year	$10,000	$10,000	$10,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	**$150,000**
9													
10	Installation Incentive - Utility to Participant $ - One time	$200	$500	$250	$50	$150	$125	$20	$500	$500	$430	$956	
11													
12	Participant Install Cost $ - One Time	$650.00	$1,391.00	$1,260.00	$200.00	$600.00	$306.00	$81.50	$2,499.00	$867.00	$867.00	$3,540.00	
13	Participant Net Cost $	$450.00	$891.00	$1,010.00	$150.00	$450.00	$181.00	$61.50	$1,999.00	$367.00	$437.00	$2,583.89	
14	Participant Savings - Electric Volume Reduction Kwh/Year	0	0	0	0	0	0	0	0	0	5610	0	
15	Participant Savings - Water Usage Reduction	0	0	0	0	0	0	0	0	0	0	0	
16													
17	Free Rider Percent	0	0	0	0	0	0	0	0	0	0	0	
18	DSM Device Life - Years	20	17	15	12	20	5	20	20	35	7	15	
19													
20	*System Inputs*	Applies to Each of the Five Programs											
21	Gas Marginal Cost Rate	From Base Case Model Run											
22	Utility Base Revenue Rate $/Dth - First Year												
23	Electric Revenue Rate $/Kwh - First Year												
24													
25	Discount Rates - Percent												
26	Utility												
27	Participant												
28	Society												

Total Annual Budget-Rebates	$300,764	$55,405	$141,501	$12,716	$10,499	$5,249	$39,675	$356,054	$566,780	$944,866	$1,945,299	**$4,378,807**
Utility Fixed Cost for Admin	$20,000	$20,000	$20,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	**$380,000**
Marketing	$10,000	$10,000	$10,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	**$150,000**
Total	$330,764	$85,405	$171,501	$67,716	$65,499	$60,249	$94,675	$411,054	$621,780	$999,866	$2,000,299	**$4,908,807**
Total Annual Budget for Maximum Achievable Cost Effective Potential Base Case Assuming 80% Market Penetration	$330,764	$85,405	$171,501	$67,716	$65,499	$60,249	$94,675	$411,054	$621,780	$999,866	$2,000,299	**$4,908,807**

APPENDIX C

Database of Data Sources

Appendix C - Database of Technical Potential Studies Recently Done in New England, New York, California, Southwest US

	STATE	Name of Technical Potential Study	Date Study Completed (Date on the final report)	Sponsoring Organization	Final Study Report Available to GDS in electronic or hard copy	Study Completed by Who (What Consultant)	Estimate of maximum technical potential for energy efficiency developed? (Yes or No)
1	Washington	Assessment of Long Term Electricity and Natural Gas Conservation Potential in Puget Sound Energy Service Area 2003-2024	August-03	Puget Sound Energy	Electronic	KEMA-Xenergy/Quantec	Yes
2	Iowa	Assessment of Energy and Capacity Savings Potential in Iowa, Volumes 1 and 2	July-02	Alliant Energy Aquila MidAmerican United Cities Gas IA Utility Association	Electronic	Global Energy Partners & Quantec	Yes
3	Wisconsin	WI Tech Potential	1994	Public Service Commission of Wisconsin	Electronic	Energy Center of WI	Yes
4	New York	Energy Efficiency and Renewable Energy Resource Develop Potential in New York State	2003	NYSERDA	Electronic	Optimal Energy	Yes
5	Minnesota	The Energy Conservation Potential for Retro-Commissioning in Xcel Energy's Minnesota Area	2003	Xcel Energy	Electronic	Summit Blue	Yes
6	California	California's Secret Energy Surplus: The Potential For Energy Efficiency - Final Report"	Sep-02	The Energy Foundation and The Hewlett Foundation		Xenergy, Inc.	
7	Arizona, Colorado, Nevada, New Mexico, Utah, Wyoming	The Mother Lode, The Potential for More Efficient Energy Use in the Southwest	Nov-02	Southwest Energy Efficiency Project (SWEEP)		SWEEP along with the American Council for an Energy-Efficient Economy, Robert Mowris and Associates, the Etc Group, Inc., and MRG & Associates	Yes

Appendix C - Database of Data Sources - Relevant Residential Sector Studies and Reports

Study #	Title of Document	Date of Publication	Number of Pages in Main Body of Report	Author or Consulting Firm	Organization Publishing the Report	Sector (Residential, Commercial, Industrial)	Type (Program Evaluation, Load Forecast, Market Research Study, Appliance Saturation Survey, Energy Efficiency Plan, etc.)	Market Segment or End Use Targeted by the Report	Report or Study Available to GDS Team in Electronic Format (Yes/No)?
1	California Statewide Residential Sector Energy Efficiency Potential Study (ID #SW063) Final Report; Volume 1	April-03	165	Coito, Fred; Rufo, Mike KEMA-XENERGY Inc.	Pacific Gas & Electric Company	Residential	Efficiency Potential	California	Yes/PDF
2	California Statewide Residential Sector Energy Efficiency Potential Study (ID #SW063) Final Report; Volume 2 (Appendices)	April-03	232	Coito, Fred; Rufo, Mike KEMA-XENERGY Inc.	Pacific Gas & Electric Company	Residential	Efficiency Potential	California	Yes/PDF
3	NJ Appliance/Window	March-01	125	RLW	GPU Energy, PSE&G, Conectiv, NJ NG, Elizabethtown Gas, So Jersey Gas, and Rockland Electric	Residential	Baseline	New Jersey	Yes/PDF
4	NJ Res HVAC	November-01	152	Xenergy, Inc	Xenergy and NJ Res HVAC Working Group	Residential	Baseline	New Jersey	Yes/PDF
5	NJ Statewide EE Market Assessment	August-99	77	Xenergy, Inc	Xenergy and NJ Utilities Working Group	All	Market Assessment	New Jersey	Yes/PDF
6	So Cal Gas EE Program Report	May-03	64	Sempra Energy/SoCal Gas	Sempra Energy/SoCal Gas	Residential	Annual Report	So. Cal.	Yes/PDF
7	So Cal Gas LI Program Report	May-03	24	Sempra Energy/SoCal Gas	Sempra Energy/SoCal Gas	Residential	Annual Report	So. Cal.	Yes/PDF
8	Natural Gas Price and Availability Effects of Aggressive Energy Efficiency and Renewable Energy Policies: A Methodology White Paper	December-03	98	Elliot, R; Shipley, A; Nadel, S; Brown, E	ACEEE	All	Whitepaper	National	Yes/PDF

Appendix C - Database of Data Sources - Relevant Residential Sector Studies and Reports									
Study #	Title of Document	Date of Publication	Number of Pages in Main Body of Report	Author or Consulting Firm	Organization Publishing the Report	Sector (Residential, Commercial, Industrial)	Type (Program Evaluation, Load Forecast, Market Research Study, Appliance Saturation Survey, Energy Efficiency Plan, etc.)	Market Segment or End Use Targeted by the Report	Report or Study Available to GDS Team in Electronic Format (Yes/No)?
9	Recent Trends in WI Residential Gas Use	August-99	76	Scott Pigg, Rich Hasselman	Energy Center of WI	Residential	Baseline	Wisconsin	Yes/PDF
10	Appliance Sales Tracking: 1999 Residential Survey	March-02	190	ODC	Energy Center of WI	Residential	Sales Tracking	Wisconsin	Yes/PDF
11	Energy Star Clothes Washer and Dishwasher Promotion and Incentives for Utah	Oct-02		Howard Geller	Utah Energy Office	Residential	Evaluation	Utah	

Appendix C - Database of Data Sources - Relevant Commercial Sector Studies and Reports

Study #	Title of Document	Date of Publication	Number of Pages in Main Body of Report	Author or Consulting Firm	Organization Publishing the Report	Sector (Residential, Commercial, Industrial)	Type (Program Evaluation, Load Forecast, Market Research Study, Appliance Saturation Survey, Energy Efficiency Plan, etc.)	Market Segment or End Use Targeted by the Report	Report or Study Available to GDS Team in Electronic Format (Yes/No)?
1	California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study (ID #SW061) Final Report Volume 1	July-03	90	Coito, Fred; Rufo, Mike KEMA-XENERGY Inc.	Pacific Gas & Electric Company	Commercial	Efficiency Potential	California	Yes/PDF
2	California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study (ID #SW061) Final Report Volume 2 (Appendices)	July-03	117	Coito, Fred; Rufo, Mike KEMA-XENERGY Inc.	Pacific Gas & Electric Company	Commercial	Efficiency Potential	California	Yes/PDF
3	NJ Electric & Gas Utilities: Comm EE Construction Baseline Study: Task 1 Final Report: On-Site Survey of New Construction & Renovation Projects	January-00	101	RLW	Atlantic, PSE&G, GPU	C/I	Baseline	NJ	Yes/PDF
4	NJ Electric & Gas Utilities: Comm EE Lighting and HVAC Baseline Study: Task II Report Decision-Maker Interviews	February-00	16	Roper Starch, RLW	Atlantic, PSE&G, GPU	C/I	Baseline	NJ	Yes/PDF
5	NJ Electric & Gas Utilities: Comm EE Lighting and HVAC Baseline Study Task III Report: Equipment Replacement and Remodeling Interviews	February-00	24	RLW	Atlantic, PSE&G, GPU	C/I	Baseline	NJ	Yes/PDF
6	MN Master Tech Assumptions	2003	10	MN Dept of Commerce	MN Dept of Commerce	C/I	B/C Assumptions	MN LG C/I	Yes/Excel
7	MN Commercial EE Boiler	November-03	6	Shawn White	Xcel Energy	Commercial	Program Assessment	MN	Yes/Word

Appendix C - Database of Data Sources - Relevant Industrial Sector Studies and Reports

Study #	Title of Document	Date of Publication	Number of Pages in Main Body of Report	Author or Consulting Firm	Organization Publishing the Report	Sector (Residential, Commercial, Industrial)	Type (Program Evaluation, Load Forecast, Market Research Study, Appliance Saturation Survey, Energy Efficiency Plan, etc.)	Market Segment or End Use Targeted by the Report	Report or Study Available to GDS Team in Electronic Format (Yes/No)?
1	MN Master Tech Assumptions	2003	10	MN Dept of Commerce	MN Dept of Commerce	C/I	B/C Assumptions	MN LG C/I	Yes

Appendix C - Database of Data Sources - Documents Supplied by Questar Gas

File #	Title of Document	Date of Publication	Number of Pages/Tabs in Main Body of Report	Author or Consulting Firm	Organization Publishing the Report	Sector (Residential, Commercial, Industrial)	Type (Program Evaluation, Load Forecast, Market Research Study, Appliance Saturation Survey, Energy Efficiency Plan, etc.)	Market Segment or End Use Targeted by the Report	Report or Study Available to GDS Team in Electronic Format?
1	Questar Gas Company Integrated Resource Plan Interim Update	May-98	36	Questar	Questar	All	Integrated Resource Plan	n/a	No
2	Questar Gas Company Integrated Resource Plan Interim Update	May-03	30	Questar	Questar	All	Integrated Resource Plan	n/a	No
3	UT Power Res Survey-Tabulation	2001	n/a	Questar	n/a	Res	Market Survey	Space Conditioning & Appliances	No
4	Questar/Pacificor Commercial Survey-Tabulation	2003	n/a	Questar	n/a	Comm	Market Survey	Space Conditioning & Appliances	No

Appendix C - Database of Data Sources - Other Documents Reviewed by GDS

File #	Title of Document	Date of Publication	Number of Pages/Tabs in Main Body of Report	Author or Consulting Firm	Organization Publishing the Report	Sector (Residential, Commercial, Industrial)	Type (Program Evaluation, Load Forecast, Market Research Study, Appliance Saturation Survey, Energy Efficiency Plan, etc.)	Market Segment or End Use Targeted by the Report	Report or Study Available to GDS Team in Electronic Format?
1	Impacts of Energy Efficiency and Renewable Energy on Natural Gas Markets-Final Report	December-03	98	Elliot, RN et al; and Petak, Kevin (Energy and Env Analysis, Inc.)	ACEEE	Wholesale	Program Market Impacts	Wholesale Market	PDF
2	NW Natural Avoided Costs (Exhibits from filing)	October-02	10	Dr. John Hansen	NW Natural	All	Avoided Costs	n/a	PDF
3	NW Natural 2000 IRP Exec Summary	July-02	16	NW Natural	NW Natural	All	IRP	n/a	PDF
4	NW Natural 1995 IRP Exec Summary	July-02	19	NW Natural	NW Natural	All	IRP	n/a	PDF
5	The Secret To Unleashing Natural Gas Utility Energy Efficiency Programs	July-02	12	Stephen Bicker, NW Natural/Ed Wisniewski, CEE	ACEEE	All	White Paper	n/a	PDF
6	NJ Clean Energy Annual Report	July-02	20	New Jersey Board of Public Utilities	NJ BPU	All	Annual Report	n/a	PDF
7	2001 DEER	August-01	309	Xenergy, Inc	Calif Energy Commission	All	Database of Energy Efficiency Measures	Varies	PDF
8	INPUTS TO BENCOST FOR GAS CIPS	2003	10	Steve Minder	MN Dept of Comm	C/I	Input Assumptions	Varies	PDF
9	America's Best: Profiles of America's Leading Energy Efficiency Programs	December-03	47 (plus 63 Indiv Prog Descriptions)	Dan York and Marti Kushler	ACEEE	All	Program Descriptions	Varies	PDF
10	A Framework for Planning and Assessing Publicly Funded Energy Efficiency	March-01	220	Frederick Sebold and Alan Fields (RER); Lisa Skumatz; Shel Feldman; Miriam Goldberg; Ken Keating; Jane Peters	PG&E	All	Program Design, Theory and Policy	Varies	PDF

Appendix C - Database of Data Sources - Other Documents Reviewed by GDS

File #	Title of Document	Date of Publication	Number of Pages/Tabs in Main Body of Report	Author or Consulting Firm	Organization Publishing the Report	Sector (Residential, Commercial, Industrial)	Type (Program Evaluation, Load Forecast, Market Research Study, Appliance Saturation Survey, Energy Efficiency Plan, etc.)	Market Segment or End Use Targeted by the Report	Report or Study Available to GDS Team in Electronic Format?
11	Increasing Energy Efficiency in New Buildings in the Southwest: Energy Codes and Best Practices	August-02	115	Kinney, Larry; Geller, Howard; Ruzzin, Mark	Southwest Energy Efficiency Project (SWEEP)	Res and Comm	Program Planning and Best Practices	Varies	PDF
12	A Market Assessment for Condensing Boilers in Commercial Heating Applications	2001	134	DeLima, Henry; Sachs, Harvey; Goldner, Fred	Consortium for Energy Efficiency	Comm	Market Assessment	Space Heating	PDF
13	Selecting Targets for Market Transformation Programs: A National Analysis	August-98	174	Suozzo, Margaret; Nadel, Steven	ACEEE	Res and Comm	Market Transformation Programs: Measures Analysis	Varies	PDF
14	Performance Guidelines for Instantaneous Water Heaters to Meet the Comfort Needs of the American Consumer	May-03	38 slides	Darrell, Paul, PhD	Battelle	Residential	Presentation	Water Heating	No
15	California Standard Practice Manual	Oct-01			CA PUC		Economic Analysis of Demand-Side Management Programs and Projects		
16	Attachment V-Developing Greenhouse Mitigation Supply Curves for In-State Sources, Climate Change Research Development and Demonstration Plan	Apr-03		Michael Rufo	CA Energy Commission		Public Interest Energy Research Program		
17	The Elements of Sustainability. Efficiency and Sustainability	2000		David C. Hewitt	ACEEE		Research Study	Buildings	
18	Demand-Side Management Market Penetration: Modeling and Resource Planning Perspectives from Central Maine Power Company	Apr-89		Richard F. Spellman			Market Research		

Appendix C - Database of Data Sources - Other Documents Reviewed by GDS

File #	Title of Document	Date of Publication	Number of Pages/Tabs in Main Body of Report	Author or Consulting Firm	Organization Publishing the Report	Sector (Residential, Commercial, Industrial)	Type (Program Evaluation, Load Forecast, Market Research Study, Appliance Saturation Survey, Energy Efficiency Plan, etc.)	Market Segment or End Use Targeted by the Report	Report or Study Available to GDS Team in Electronic Format?
19	Market Transformation: Substantial Progress from a Decade of Work	Apr-03		Nadel, Thorne, Sachs, Prindle, Elliott	ACEEE		Market Research		
20	Focus on Energy Public Benefits Statewide Evaluation, Quarterly Summary Report	Mar-03		Focus Evaluation Team	State of WI Department of Administration Division of Energy		Statewide Evaluation		
21	Focus on Energy Statewide Evaluation, Non-Energy Benefits Cross-Cutting Report	Jan-03		Nick Hall, TecMarket Works, PA Consulting	State of WI Department of Administration Division of Energy		Statewide Evaluation		
22	Beyond Energy Savings: A Review of the Non-Energy Benefits Estimated for Three Low-Income Programs	2002		Nick Hall & Jeff Riggert, TecMarket Works	ACEEE		Program Evaluation		
23	Energy Efficiency and Renewables Sources: A Primer	Oct-01		National Assoc. of State Energy Officials	Global Environment & Technology Foundation				

APPENDIX D

Sensitivity Analyses

APPENDIX D

UTAH NATURAL GAS TECHNICAL POTENTIAL STUDY
APPENDIX D - TABLE 1 - BASE CASE SCENARIO
BENEFIT COST RATIO TESTS
June 10, 2004

TABLE 1 - BENEFIT COST RATIO TESTS - BASE CASE

TOTAL RESOURCE COST TEST BY SECTOR
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Total Resource Benefits, Costs, and Net Benefits			
	Present Value		PV of	Benefit-
			Net	Cost
	Benefit	Cost	Benefits	Ratio
Commercial Sector	$227,743,350	$100,914,338	$126,829,012	2.26
Residential Sector	$2,369,367,929	$986,723,672	$1,382,644,257	2.40
All Sectors	$2,597,111,280	$1,087,638,010	$1,509,473,270	2.39

UTILITY COST TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Total Resource Benefits, Costs, and Net Benefits			
	Present Value		PV of	Benefit-
			Net	Cost
	Benefit	Cost	Benefits	Ratio
Commercial Sector	$204,741,345	$46,575,848	$158,165,496	4.40
Residential Sector	$2,102,946,384	$392,439,704	$1,710,506,680	5.36
All Sectors	$2,307,687,729	$439,015,552	$1,868,672,176	5.26

PARTICIPANT COST TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Total Resource Benefits, Costs, and Net Benefits			
	Present Value		PV of	Benefit-
			Net	Cost
	Benefit	Cost	Benefits	Ratio
Commercial Sector	$252,928,880	$54,338,490	$198,590,390	4.65
Residential Sector	$2,312,573,781	$312,170,954	$2,000,402,826	7.41
All Sectors	$2,565,502,660	$366,509,444	$2,198,993,216	7.00

RATEPAYER IMPACT TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Total Resource Benefits, Costs, and Net Benefits			
	Present Value		PV of	Benefit-
			Net	Cost
	Benefit	Cost	Benefits	Ratio
Commercial Sector	$204,741,345	$253,736,546	($48,995,202)	0.81
Residential Sector	$1,647,734,422	$2,705,013,485	($1,057,279,063)	0.61
All Sectors	$1,852,475,767	$2,958,750,031	($1,106,274,264)	0.63

References:

Values were calculated using version 10 of the "NSTAR" model, with Questar estimates of the avoided costs for natural gas.
Retail gas rates were based on Questar average 2003 rates.
Retail electric rates were based on the EIA Electric Power Annual, 2002.
Retail water rates were based on dicsussions with Salt Lake City Water Department.

APPENDIX D

UTAH NATURAL GAS TECHNICAL POTENTIAL STUDY
APPENDIX D - TABLE 2 - HIGH AVOIDED COST SENSITIVITY
BENEFIT COST RATIO TESTS

June 10, 2004

High Avoided Cost Sensitivity
TOTAL RESOURCE COST TEST BY SECTOR
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$284,411,208	$106,431,962	$177,979,246	2.67
Residential Sector	$1,911,303,313	$986,723,672	$924,579,641	1.94
All Sectors	$2,195,714,521	$1,093,155,634	$1,102,558,887	2.01

High Avoided Cost Sensitivity
UTILITY COST TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$261,409,203	$49,122,444	$212,286,758	5.32
Residential Sector	$1,863,513,137	$492,878,352	$1,370,634,785	3.78
All Sectors	$2,124,922,339	$542,000,796	$1,582,921,543	3.92

High Avoided Cost Sensitivity
PARTICIPANT COST TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$256,903,000	$57,309,518	$199,593,482	4.48
Residential Sector	$2,145,663,327	$493,845,320	$1,651,818,007	4.34
All Sectors	$2,402,566,327	$551,154,838	$1,851,411,489	4.36

High Avoided Cost Sensitivity
RATEPAYER IMPACT TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$261,409,203	$260,257,262	$1,151,940	1.00
Residential Sector	$1,497,940,384	$2,638,541,679	($1,140,601,295)	0.57
All Sectors	$1,759,349,586	$2,898,798,941	($1,139,449,355)	0.61

References:
Values were calculated using version 10 of the "NSTAR" model, with Questar estimates of the avoided costs for natural gas.
Retail gas rates were based on Questar average 2003 rates.
Retail electric rates were based on the EIA Electric Power Annual, 2002.
Retail water rates were based on dicsussions with Salt Lake City Water Department.

APPENDIX D

UTAH NATURAL GAS TECHNICAL POTENTIAL STUDY
APPENDIX D - TABLE 3 - LOW AVOIDED COST SCENARIO
BENEFIT COST RATIO TESTS

June 10, 2004

Low Avoided Cost Sensitivity
TOTAL RESOURCE COST TEST BY SECTOR
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$158,994,472	$75,186,549	$83,807,922	2.11
Residential Sector	$663,669,480	$406,897,086	$256,772,395	1.63
All Sectors	$822,663,952	$482,083,635	$340,580,317	1.71

Low Avoided Cost Sensitivity
UTILITY COST TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$135,992,466	$34,701,484	$101,290,982	3.92
Residential Sector	$615,879,304	$237,283,186	$378,596,119	2.60
All Sectors	$751,871,771	$271,984,670	$479,887,101	2.76

Low Avoided Cost Sensitivity
PARTICIPANT COST TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$233,391,285	$40,485,065	$192,906,220	5.76
Residential Sector	$1,224,839,134	$169,613,900	$1,055,225,234	7.22
All Sectors	$1,458,230,419	$210,098,965	$1,248,131,453	6.94

Low Avoided Cost Sensitivity
RATEPAYER IMPACT TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$135,992,466	$222,329,474	($86,337,008)	0.61
Residential Sector	$814,575,496	$1,462,122,319	($647,546,824)	0.56
All Sectors	$950,567,962	$1,684,451,794	($733,883,832)	0.56

References:
Values were calculated using version 10 of the "NSTAR" model, with Questar estimates of the avoided costs for natural gas.
Retail gas rates were based on Questar average 2003 rates.
Retail electric rates were based on the EIA Electric Power Annual, 2002.
Retail water rates were based on dicsussions with Salt Lake City Water Department.

APPENDIX D

UTAH NATURAL GAS TECHNICAL POTENTIAL STUDY
APPENDIX D - TABLE 4 - 50% PENETRATION RATE SENSITIVITY
BENEFIT COST RATIO TESTS

June 10, 2004

50% Penetration Rate Sensitivity
TOTAL RESOURCE COST TEST BY SECTOR
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$80,017,921	$38,196,688	$41,821,233	2.09
Residential Sector	$1,167,802,107	$698,454,674	$469,347,433	1.67
All Sectors	$1,247,820,028	$736,651,362	$511,168,666	1.69

50% Penetration Rate Sensitivity
UTILITY COST TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$68,516,919	$17,629,241	$50,887,678	3.89
Residential Sector	$1,035,119,193	$361,397,962	$673,721,231	2.86
All Sectors	$1,103,636,111	$379,027,203	$724,608,908	2.91

50% Penetration Rate Sensitivity
PARTICIPANT COST TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$103,595,395	$20,567,447	$83,027,948	5.04
Residential Sector	$1,608,943,484	$697,044,966	$911,898,519	2.31
All Sectors	$1,712,538,879	$717,612,413	$994,926,466	2.39

50% Penetration Rate Sensitivity
RATEPAYER IMPACT TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$68,516,919	$98,865,882	($30,348,964)	0.69
Residential Sector	$1,138,631,112	$1,970,341,446	($831,710,334)	0.58
All Sectors	$1,207,148,030	$2,069,207,328	($862,059,298)	0.58

References:
Values were calculated using version 10 of the "NSTAR" model, with Questar estimates of the avoided costs for natural gas.
Retail gas rates were based on Questar average 2003 rates.
Retail electric rates were based on the EIA Electric Power Annual, 2002.
Retail water rates were based on dicsussions with Salt Lake City Water Department.

UTAH NATURAL GAS TECHNICAL POTENTIAL STUDY
APPENDIX D - TABLE 5 - 25% PENETRATION RATE SCENARIO
BENEFIT COST RATIO TESTS

June 10, 2004

25% Penetration Rate Sensitivity
TOTAL RESOURCE COST TEST BY SECTOR
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value		PV of Net Benefits	Benefit-Cost Ratio
	Benefit	Cost		
Commercial Sector	$36,361,726	$17,035,285	$19,326,441	2.13
Residential Sector	$754,126,085	$468,787,680	$285,338,406	1.61
All Sectors	$790,487,811	$485,822,965	$304,664,847	1.63

25% Penetration Rate Sensitivity
UTILITY COST TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value		PV of Net Benefits	Benefit-Cost Ratio
	Benefit	Cost		
Commercial Sector	$30,841,245	$10,908,518	$19,932,727	2.83
Residential Sector	$673,156,786	$107,350,079	$565,806,707	6.27
All Sectors	$703,998,031	$118,258,597	$585,739,434	5.95

25% Penetration Rate Sensitivity
PARTICIPANT COST TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value		PV of Net Benefits	Benefit-Cost Ratio
	Benefit	Cost		
Commercial Sector	$40,263,959	$9,172,846	$31,091,114	4.39
Residential Sector	$740,472,464	$361,437,601	$379,034,864	2.05
All Sectors	$780,736,424	$370,610,446	$410,125,977	2.11

25% Penetration Rate Sensitivity
RATEPAYER IMPACT TEST
FOR MEASURES WITH A TRC BENEFIT COST RATIO OF GREATER THAN 1.0

	Benefits, Costs, and Net Benefits			
	Present Value		PV of Net Benefits	Benefit-Cost Ratio
	Benefit	Cost		
Commercial Sector	$30,841,245	$40,004,515	($9,163,271)	0.77
Residential Sector	$740,472,464	$847,822,544	($107,350,079)	0.87
All Sectors	$771,313,709	$887,827,059	($116,513,350)	0.87

References:
Values were calculated using version 10 of the "NSTAR" model, with Questar estimates of the avoided costs for natural gas.
Retail gas rates were based on Questar average 2003 rates.
Retail electric rates were based on the EIA Electric Power Annual, 2002.
Retail water rates were based on dicsussions with Salt Lake City Water Department.

APPENDIX E

Year by Year Technical and Maximum Achievable Potential

APPENDIX E

UTAH NATURAL GAS TECHNICAL POTENTIAL STUDY

Natural Gas Technical and Maximum Achievable Cost Effective Potential - Cumulative Dth Savings State Of Utah - 2004 to 2013						
	Technical Potential Savings			*Maximum Achievable Cost Effective Potential*		
Year	**Residential**	**Commercial**	**Total**	**Residential**	**Commercial**	**Total**
2004	2,187,612	709,402	2,897,014	1,106,289	261,809	1,368,098
2005	6,267,769	1,976,654	8,244,422	3,529,472	754,790	4,284,261
2006	11,294,199	3,522,829	14,817,028	6,611,102	1,363,356	7,974,458
2007	16,320,629	5,069,004	21,389,633	9,692,732	1,971,923	11,664,655
2008	19,454,514	6,057,331	25,511,844	11,457,468	2,349,318	13,806,786
2009	22,588,398	7,045,658	29,634,056	13,222,204	2,726,713	15,948,917
2010	24,776,010	7,755,060	32,531,070	14,328,493	2,988,522	17,317,014
2011	26,963,621	8,464,463	35,428,084	15,434,781	3,250,331	18,685,112
2012	29,151,233	9,173,865	38,325,098	16,541,070	3,512,140	20,053,210
2013	31,338,844	9,883,268	41,222,112	17,647,358	3,773,949	21,421,307

APPENDIX F

Definitions of Benefit-Cost Tests

The definitions of the benefit/cost tests used in this Utah gas DSM potential study were obtained from a publication of the California Public Utilities Commission (CPUC) titled "California Standard Practice Manual, Economic Analysis of Demand-Side Management Programs and Projects, October 2001." This manual is available on the public web site for the CPUC.[1]

1.0 Definition of the Total Resource Cost Test

The Total Resource Cost Test (TRC) measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs.[2]

The test is applicable to conservation, load management, and fuel substitution programs. For fuel substitution programs, the test measures the net effect of the impacts from the fuel not chosen versus the impacts from the fuel that is chosen as a result of the program. TRC test results for fuel substitution programs should be viewed as a measure of the economic efficiency implications of the total energy supply system (gas and electric).

A variant on the TRC test is the Societal Test. The Societal Test differs from the TRC test in that it includes the effects of externalities (e.g., environmental, national security), excludes tax credit benefits, and uses a different (societal) discount rate.

Benefits and Costs: The TRC test represents the combination of the effects of a program on both the customers participating and those not participating in a program. In a sense, it is the summation of the benefit and cost terms in the Participant and the Ratepayer Impact Measure tests, where the revenue (bill) change and the incentive terms intuitively cancel (except for the differences in net and gross savings).

The benefits calculated in the Total Resource Cost Test are the avoided natural gas supply costs for the periods when there is a gas load reduction. The avoided supply costs should be calculated using net program savings, savings net of changes in energy use that would have happened in the absence of the program. For fuel substitution programs, benefits include the avoided device costs and avoided supply costs for the energy using equipment not chosen by the program participant.

The costs in this test are the program costs paid by the utility and the participants plus any increase in supply costs for periods in which load is increased. Thus all equipment costs, installation, operation and maintenance, cost of removal (less salvage value), and administration costs, no matter who pays for them, are

[1] http://www.cpuc.ca.gov/static/industry/electric/energy+efficiency/rulemaking/resource5.doc
[2] California Public Utilities Commission, California Standard Practice Manual, Economic Analysis of Demand-Side Management Programs and Projects, October 2001, page 18.

included in this test. Any tax credits are considered a reduction to costs in this test.

2.0 Definition of the Participant Test

The Participant Test is the measure of the quantifiable benefits and costs to the customer due to participation in a program. Since many customers do not base their decision to participate in a program entirely on quantifiable variables, this test cannot be a complete measure of the benefits and costs of a program to a customer.

Benefits and Costs
The benefits of participation in a demand-side program include the reduction in the customer's utility bill(s), any incentive paid by the utility or other third parties, and any federal, state, or local tax credit received. The reductions to the utility bill(s) should be calculated using the actual retail rates that would have been charged for the energy service provided (electric demand or energy or gas). Savings estimates should be based on gross savings, as opposed to net energy savings[3].

In the case of fuel substitution programs, benefits to the participant also include the avoided capital and operating costs of the equipment/appliance not chosen. For load building programs, participant benefits include an increase in productivity and/or service, which is presumably equal to or greater than the productivity/ service without participating. The inclusion of these benefits is not required for this test, but if they are included then the societal test should also be performed.

The costs to a customer of program participation are all out-of-pocket expenses incurred as a result of participating in a program, plus any increases in the customer's utility bill(s). The out-of-pocket expenses include the cost of any equipment or materials purchased, including sales tax and installation; any ongoing operation and maintenance costs; any removal costs (less salvage value); and the value of the customer's time in arranging for the installation of the measure, if significant.

[3] Gross energy savings are considered to be the savings in energy and demand seen by the participant at the meter. These are the appropriate program impacts to calculate bill reductions for the Participant Test. Net savings are assumed to be the savings that are attributable to the program. That is, net savings are gross savings minus those changes in energy use and demand that would have happened even in the absence of the program. For fuel substitution and load building programs, gross-to-net considerations account for the impacts that would have occurred in the absence of the program.

3.0 Definition of the Ratepayer Impact Measure Test[4]

The Ratepayer Impact Measure (RIM) test measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program. Rates will go down if the change in revenues from the program is greater than the change in utility costs. Conversely, rates or bills will go up if revenues collected after program implementation are less than the total costs incurred by the utility in implementing the program. This test indicates the direction and magnitude of the expected change in customer bills or rate levels.

Benefits and Costs

The benefits calculated in the RIM test are the savings from avoided supply costs. These avoided costs include the reduction in transmission, distribution, generation, and capacity costs for periods when load has been reduced and the increase in revenues for any periods in which load has been increased. The avoided supply costs are a reduction in total costs or revenue requirements and are included for both fuels for a fuel substitution program. The increase in revenues are also included for both fuels for fuel substitution programs. Both the reductions in supply costs and the revenue increases should be calculated using net energy savings.

The costs for this test are the program costs incurred by the utility, *and/or other entities incurring costs and creating or administering the program,* the incentives paid to the participant, decreased revenues for any periods in which load has been decreased and increased supply costs for any periods when load has been increased. The utility program costs include initial and annual costs, such as the cost of equipment, operation and maintenance, installation, program administration, and customer dropout and removal of equipment (less salvage value). The decreases in revenues and the increases in the supply costs should be calculated for both fuels for fuel substitution programs using net savings.

4.0 Definition of the Program Administrator Cost Test (formerly the Utility Cost Test)

The Program Administrator Cost Test measures the net costs of a demand-side management program as a resource option based on the costs incurred by the program administrator (including incentive costs) and excluding any net costs incurred by the participant. The benefits are similar to the TRC benefits. Costs are defined more narrowly.

Benefits and Costs

The benefits for the Program Administrator Cost Test are the avoided supply

[4] The Ratepayer Impact Measure Test has previously been described under what was called the "Non-Participant Test." The Non-Participant Test has also been called the "Impact on Rate Levels Test."

costs of energy and demand, the reduction in transmission, distribution, generation, and capacity valued at marginal costs for the periods when there is a load reduction. The avoided supply costs should be calculated using net program savings, savings net of changes in energy use that would have happened in the absence of the program. For fuel substitution programs, benefits include the avoided supply costs for the energy-using equipment not chosen by the program participant only in the case of a combination utility where the utility provides both fuels.

The costs for the Program Administrator Cost Test are the program costs incurred by the administrator, the incentives paid to the customers, and the increased supply costs for the periods in which load is increased. Administrator program costs include initial and annual costs, such as the cost of utility equipment, operation and maintenance, installation, program administration, and customer dropout and removal of equipment (less salvage value). For fuel substitution programs, costs include the increased supply costs for the energy-using equipment chosen by the program participant only in the case of a combination utility, as above.

In this test, revenue shifts are viewed as a transfer payment between participants and all ratepayers. Though a shift in revenue affects rates, it does not affect revenue requirements, which are defined as the difference between the net marginal energy and capacity costs avoided and program costs. Thus, if NPVpa > 0 and NPVRIM < 0, the administrator’s overall total costs will decrease, although rates may increase because the sales base over which revenue requirements are spread has decreased.