Potential for Natural Gas Energy Savings in the Southwest

Tom Rooney and Richard Spellman, GDS Associates, Inc.
Jeff Burks and Steve Bean, Public Service of New Mexico

ABSTRACT

This paper presents estimates of the technical and maximum achievable cost effective potential for natural gas savings from energy efficiency measures in Utah and New Mexico over the period from 2004 through 2014 based on two independent studies[1]. The results of the studies showed that there is a significant natural gas savings potential in these two Southwest states for the implementation of long-lasting, cost effective natural gas energy efficiency measures. This paper will present and compare the detailed sector-level results of the studies, including: 1) efficiency supply curves; 2) natural gas savings potential broken down by measure and end-use category; and 3) benefit/cost ratios. In addition, the paper will describe the methodologies used in estimating savings potential for each sector (residential, commercial, industrial). The unique challenges presented in each of the two studies related to the availability, and relative scarcity of certain market and end-use data will be presented and compared to illustrate the possible methods available for other organizations considering similar efficiency potential studies. Finally, the paper will discuss the valuable lessons learned through the process of completing these comprehensive studies. The paper will also include comparisons of the two studies' results to other recently completed natural gas efficiency potential studies, and will discuss how the findings of these studies have been used by decision-makers in both States.

Introduction

This paper presents the results of two independent studies that were commissioned to estimate the potential for natural gas energy efficiency in Utah (GDS 2004) and New Mexico (GDS 2005). The specific regions addressed in the studies included the service areas of the project sponsors, Questar Gas in Utah and Public Service Company of New Mexico (PNM). For each study there was a stakeholder group who selected the project consultant and provided oversight on the studies. The groups were the Utah Gas DSM Advisory Group and the New Mexico Governor's Energy Efficiency Task Force. Both studies were conducted by GDS Associates, Inc. with support from Quantum Consulting on the Utah assessment. Additional input that was instrumental in completing the studies was provided by the staff of Questar Gas, the Utah Energy Office, PNM, and the Southwest Energy Efficiency Project (SWEEP).

Before getting into the details of the potential studies, it will be useful to briefly review some general characteristics of Questar Gas and PNM. Table 1 provides a summary of the two companies' operating statistics as well as some components of the each study.

---

[1]The Utah study estimated savings potential over the ten year period from 2004-2013 and the New Mexico study covered 2005-2014.

Table 1. Summary of Questar Gas and PNM

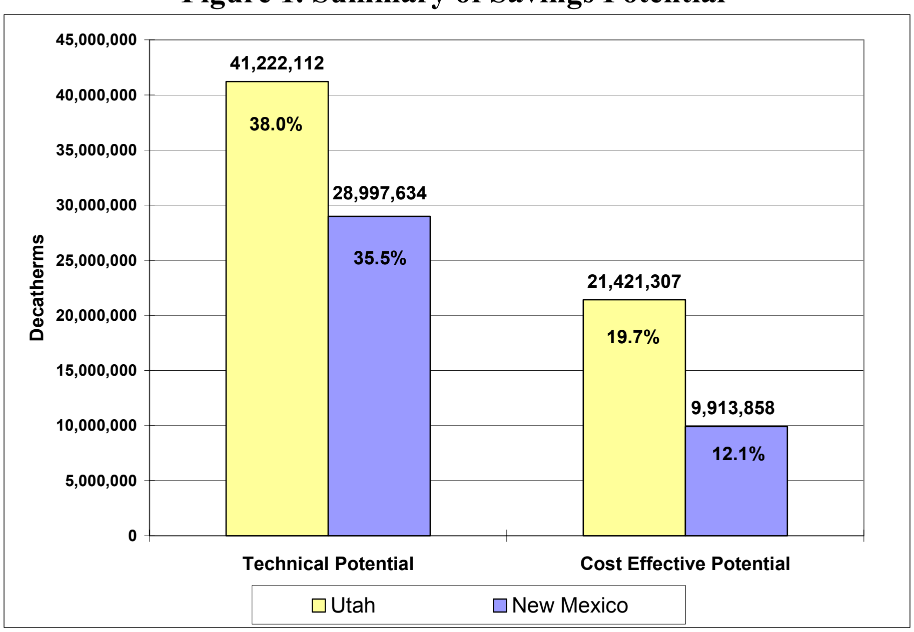
Company Specifics & Project Details	Questar Gas	PNM
Efficiency Potential Study Period	2004 - 2013	2005 - 2014
Sectors Included in Study	Res, Com	Res, Com, Ind
DSM Programs In-Place Prior to Study	No	Industrial Only
Total Annual Gas Sales in Final Year of Study (Dth)	108,500,000	81,696,072
No. of Climate Zones Analyzed (Avg. HDD)	1 (5,570)	3 (4,187)
Est. Annual 10-Year Load Growth %	0.9%	1.7%
Load Growth after Max Ach. Cost Effective Savings	-1.3%	0.4%
Load Growth after Technical Potential Savings	-3.9%	-2.69

Overall technical potential natural gas savings estimates from the two studies were similar but there was considerably more cost effective natural gas savings potential found in the State of Utah. Table 2 and Figure 1 present the results of the two studies. As will be shown later in this paper, the cost effective savings from the residential sector make up the majority of the difference among the two studies.

Table 2. Summary of Savings Potential for Each Study

Natural Gas Energy Efficiency Savings Estimates (Dth) For a Ten Year Program Period		
	Utah	**New Mexico**
Technical Potential	41,222,112	28,997,634
% of Gas Sales	*38.0%*	*35.5%*
Max. Achievable Cost Effective Potential	21,421,307	9,913,858
% of Gas Sales	*19.7%*	*12.1%*

Figure 1. Summary of Savings Potential



Methodologies for Estimating Efficiency Potential in Each Sector

This section describes the methodologies that were used to estimate the levels of natural gas energy savings in decatherms (Dth) for the two studies.

GDS developed estimates of the technical potential, the maximum achievable potential, and the maximum achievable cost effective potential for natural gas energy efficiency opportunities for the residential and commercial in the Questar and PNM service territories, as well as the industrial sector for PNM. The GDS analysis incorporated the following methods and information:

- An assumption of 80% as the maximum achievable market penetration for all sectors;
- Inclusion of retrofit and market driven measures for all sectors; and
- Analysis of approximately 25 residential measures and 40 commercial measures across 8 unique commercial market segments (e.g., office, retail, lodging).

The **technical potential** for natural gas energy efficiency was based upon calculations that assume one hundred percent penetration of all energy efficiency measures analyzed in applications where they were deemed to be technically feasible from an engineering perspective.

The **maximum achievable potential** for natural gas energy efficiency 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.

The third level of energy efficiency examined is the **maximum achievable cost effective potential**. The calculation of the cost effective maximum achievable potential is based, as the term implies, on the assumption that energy efficiency measures or bundled measures will only be included in natural gas efficiency programs when it is cost effective to do so. All cost effectiveness calculations for natural gas energy efficiency measures and programs were done using the Total Resource Cost (TRC) Test as calculated by a publicly available spreadsheet model that operates in Excel and that has been approved by regulators in several states.

Limitations of the Studies

The limitations on the accuracy of the data included in both studies were centered on the same challenges, as included in the list below.

- **Energy use intensity:** The energy use intensities by end use provided by Questar in Utah for each of the commercial SIC codes were found to be anomalous in several instances and PNM was not able to provide end use data. Therefore, the energy use intensities by end use were developed by the GDS Team for each of the commercial building types and climate zones based on Energy-10 simulations, PG&E survey data, McGraw Hill survey data, and data from other studies. In most instances, end use percentages were developed from a blend of all of the data sources.
- **Measure costs:** Estimates of measure costs were developed using several sources. For the residential sector, in-depth interview surveys were conducted with local contractors and weatherization professionals to get estimates of the remaining potential for insulation

and weatherization services, and to get up-to-date cost estimates for these measures. For the commercial sector, the RS Means construction cost estimating data for Utah and New Mexico was used as well as natural gas savings potential studies recently conducted in California and Iowa, and other sources compiled for the studies. While the sources used offer reasonable values for the measure costs, GDS was unable (within the budget for these projects) to gather extensive cost data specific to Utah and New Mexico for every energy efficiency measure. Incremental costs for energy efficient new construction were based upon data from several sources, including the regional ENERGY STAR Homes program, data provided by SWEEP, and the commercial Savings By Design program as well as other specific case studies.

- **Measure savings**. GDS used the Energy-10 Model to estimate commercial sector natural gas savings due to implementation of natural gas energy efficiency measures. While actual measure savings will vary based on site specific conditions, the savings estimates used in the studies represent savings levels for typical installations. The most difficult end use for which to determine typical savings was commercial 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.

Energy Efficiency Supply Curves

A key element in the approach used in the studies was the use of energy efficiency supply curves. 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. An energy efficiency supply curve is designed to avoid the double counting of energy savings across measures by accounting for interactions between measures. In addition, it is independent of prices and provides a simplified framework to compare the costs of efficiency with the costs of energy supply technologies.

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 where 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, where 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.

Technical natural gas energy efficiency potential was calculated in two steps. In the first step, all measures were treated independently; that is, the savings of each measure were not reduced 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. Based on the results of this first step, the measures are then ranked from most to least cost effective in the supply curve. For measures that interact with one another, their relative cost effectiveness will change when "stacked" in the supply curve and in some cases may result in a measure being removed from the analysis due to it no longer being cost effective. For example, if a measure such as an efficient furnace is found to be more cost effective than ENERGY STAR® windows, the resulting level of savings associated with windows will be reduced as the furnace will come first in the supply curve and will effectively reduce the available "pool" of natural gas that is available to be saved.

Figure 2 and Figure 3 present the commercial sector energy efficiency supply curves associated with the cost effective savings potential. As shown in the curves, 10% of the commercial energy efficiency potential can be achieved for less than $0.75 per therm. In New Mexico, approximately 8% of the commercial sector cost effective savings would be realized at the $0.75 per therm level.

Figure 2. Cost Effective Supply Curve for Utah Commercial Sector

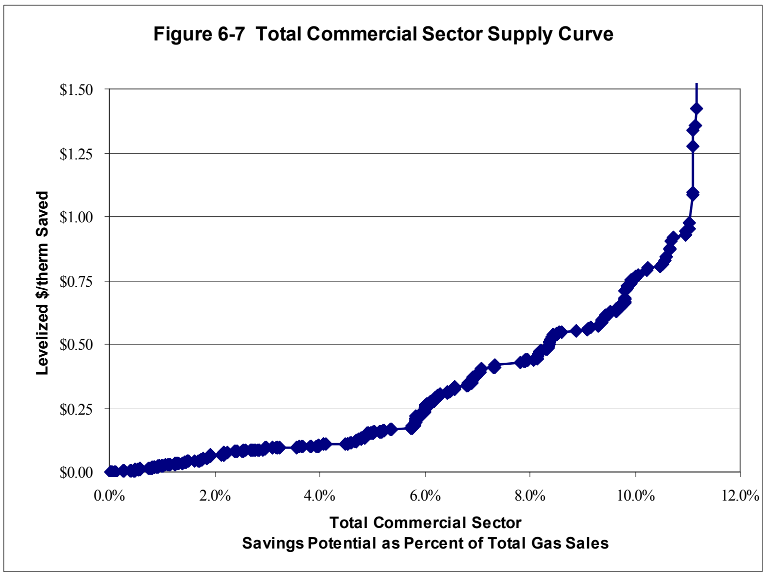
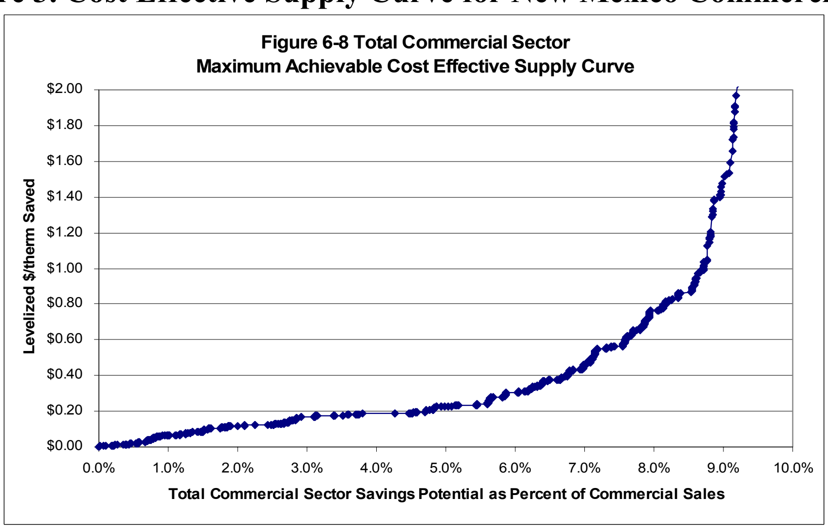


Figure 3. Cost Effective Supply Curve for New Mexico Commercial Sector



Comparison of Sector-Level Results

This section presents a detailed comparison of the results of the two studies for the residential and commercial sectors. The industrial sector is not included as it was only addressed in New Mexico study.

Residential Sector

In the residential sector, results from the two studies were noticeably different with New Mexico showing higher technical potential savings and Utah showing higher cost effective savings. Table 3 presents the estimated savings potential in the residential sector for each study.

Table 3. Residential Savings Summary

Residential Natural Gas Energy Efficiency Savings Estimates		
	Utah	**New Mexico**
Technical Potential	31,300,000	22,735,218
% of Gas Sales	*46.2%*	*61.8%*
Max. Achievable Cost Effective Potential	17,600,000	6,156,568
% of Gas Sales	*26.0%*	*16.7%*

The measure breakdown for each study helps to explain the differences in the savings as percent of gas sales. For the technical potential savings estimates, where the economics of the measures is not yet taken into account, Figure 3 shows the mix of measures in the two studies along with the corresponding percentage of total savings. The most influential measures in driving up the New Mexico estimates appear to be high efficiency water heating, ENERGY STAR Windows, high efficiency furnaces, and insulation and weatherization. For New Mexico, the water heating measure savings are primarily made up of solar water heating (38%) and instantaneous water heaters (58%). Neither of these technologies was considered in the Utah analysis, which explains the large difference in water heater savings in Figure 4.

For the cost effective level of savings, several of the major residential measures (i.e., furnaces, ENERGY STAR Homes, Low Income Package) were estimated to be more expensive on a per-therm-saved basis in New Mexico than in Utah. In each study, the cost estimates for each residential measure were based on information from local contractors and weatherization agencies, when possible, as well as other recently completed studies in other states. Figure 5 shows that for nearly all heating related measures, the cost of conserved energy is notably higher in the New Mexico study than in Utah.

Figure 4. Comparison of Residential Technical Potential Savings by Measure

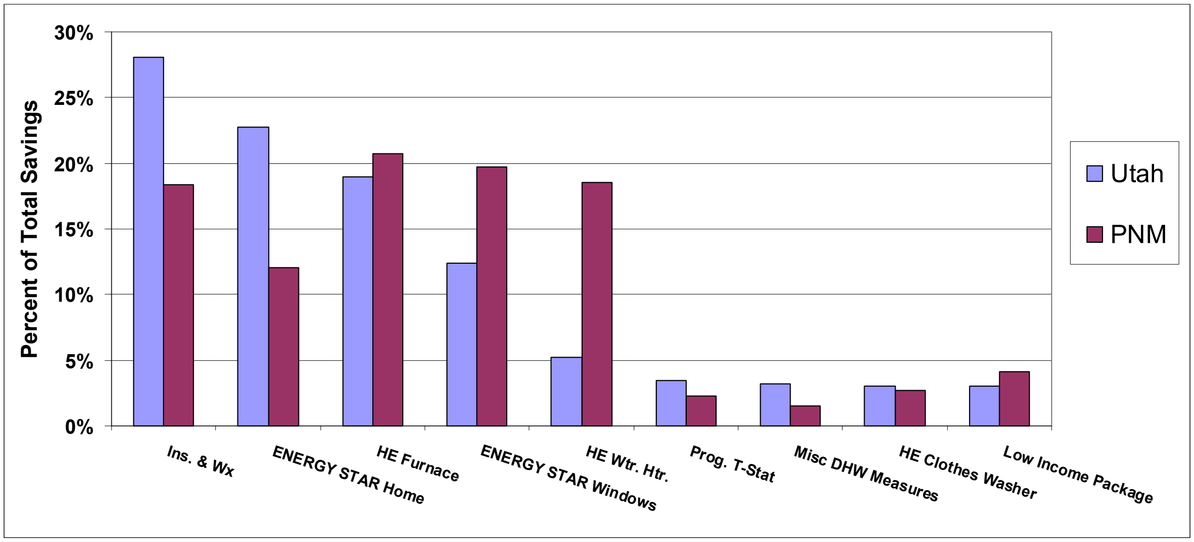
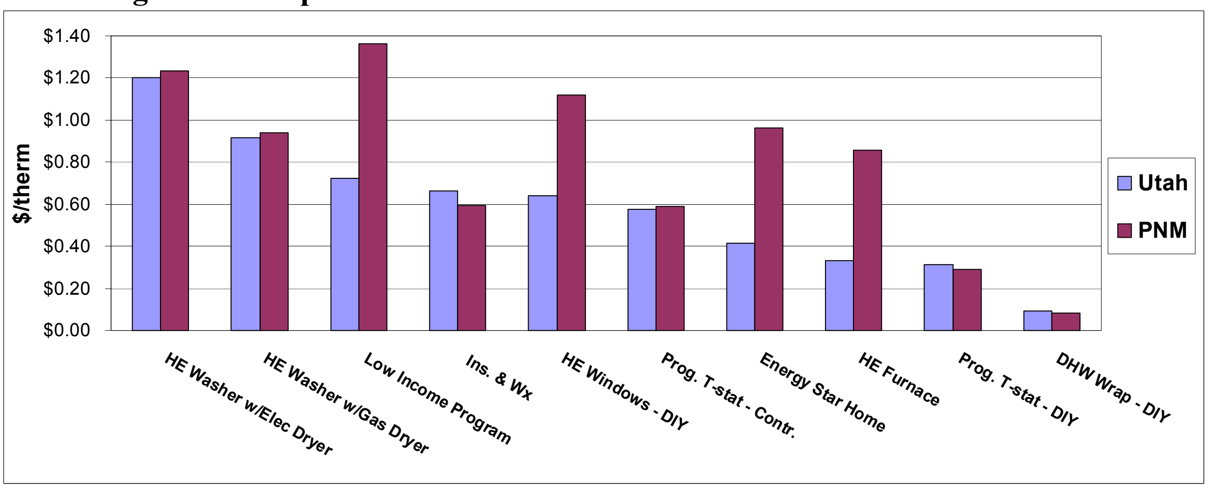


Figure 5. Comparison of Cost Per Therm Saved for Residential Measures



The difference in cost of conserved energy appears to be driven, in part, by the variation in climate between the two states. The Utah study based heating related savings estimates on the heating degree days (HDD) for Salt Lake City at 5,570 HDD. In New Mexico, three climate zones[2] were analyzed with a weighted average of 4,187 HDD, approximately 25% warmer than Utah. This would reduce the overall amount of total savings potential for heating related measures in New Mexico and as seen in Figure 4, increase the cost of conserved energy.

For non-heating measures in New Mexico, the high technical potential savings estimates associated with the solar and instantaneous water heating measures were completely lost due to the cost effectiveness screen as these measures were not found to be cost effective. These two measures alone accounted for 18% of the technical savings potential in New Mexico. The other major contributor to the large difference between the technical and cost effective savings

[2]The three climate zones were based on the HDD for Santa Fe at 5,549 HDD, Albuquerque at 3,893 HDD, and Roswell at 3,071 HDD.

potential in New Mexico was that high efficiency furnaces were found to be not cost effective, resulting in a reduction of 21% of the technical savings estimate.

Concerning avoided costs[3], the residential values used in the New Mexico study were approximately 44% higher than those used in Utah. This generally would be expected to increase the level of cost effective potential savings, but in this case the cost of conserved energy was too high even with higher avoided costs.

Commercial Sector

In the commercial sector, results from the two studies were quite different for the technical potential savings estimates but similar for the cost effective level of savings. As shown in Table 4, the Utah study resulted in considerably more savings than New Mexico for technical potential but for cost effective potential the two studies were very similar.

Table 4. Commercial Savings Summary

Commercial Natural Gas Energy Efficiency Savings Estimates		
	Utah	**New Mexico**
Technical Potential	9,883,268	5,252,416
% of Gas Sales	*29.2%*	*17.0%*
Max. Achievable Cost Effective Potential	3,773,950	2,949,102
% of Gas Sales	*11.2%*	*9.6%*

Table 5 presents the breakdown of the technical potential savings by major end use categories and indicates that the two studies have a very similar apportionment of savings across the end uses.

Table 5. Commercial Technical Potential Savings Estimates by End Use as a Percent of Total Savings

Technical Potential Savings Estimates

End Use	Utah	New Mexico
Space Heat	53%	51%
Water Heat	34%	35%
Cooking	9%	13%
Pool Heat	3%	1%
Drying	1%	0%

Table 6 presents the breakdown of the cost effective savings by major end use categories and shows that the apportionment of savings changed substantially after the measures went through the cost effectiveness screen.

As was witnessed in the residential sector, space heating measures were found to be more cost effective in Utah due to the relatively colder climate. Water heating measures were more cost effective in the New Mexico study which is likely due to differences in the estimates

[3]Avoided supply costs include the cost of the gas (the commodity cost) as well as costs avoided for natural gas transportation, natural gas storage and natural gas peak shaving. The avoided natural gas supply costs are those that would be avoided by the utility due to the implementation of a portfolio of energy efficiency programs.

Table 6. Commercial Cost Effective Savings Estimates by End Use as a Percent of Total Savings

Cost Effective Potential Savings Estimates

End Use	**Utah**	**New Mexico**
Space Heat	66%	49%
Water Heat	16%	39%
Cooking	12%	12%
Pool Heat	5%	0.3%
Drying	2%	0.1%

associated with the energy end use intensities for water heating in the various commercial market segments (e.g., office, retail, education) as well as variations in the estimated costs to install the energy efficient measures. As will be discussed in the Data Limitations section, accurate estimates of end use intensities for commercial water heating are difficult to find.

Present Value of Savings and Costs

Table 7 presents the overall level of total resource costs and benefits associated with each of the studies at the sector level. Underlying the values in Table 7 are a few major differences in assumptions. For the Utah study, administrative costs associated with marketing, implementing and evaluating energy efficiency programs were assumed to be 30% of the efficiency measure incremental costs. However, in New Mexico this administrative cost estimate was estimated to be 25% of measure incremental costs. This difference has to do with the lack of energy efficiency infrastructure in Utah. Although there was also limited energy efficiency program activity in New Mexico prior to the study, it was felt that 25% was sufficient to cover program implementation costs.

In addition to the difference in administrative program cost estimates, the avoided costs of natural gas were very different in the two studies. For the residential sector, the avoided costs used in New Mexico were 44% higher than those used in Utah. For the commercial sector, the New Mexico values were 30% higher than the Utah avoided costs. During the 2004 – 2005 time frame surrounding the two studies, there was extreme volatility in gas prices. At the time of the PNM study, in early 2005, the gas prices were climbing and it was very difficult to get consensus. Utah's lower prices were partially the result of the study being at the beginning of the large swings in gas prices. In addition, another consideration in the case of Questar is that 50% of there gas supply is cost of service gas from reserves that are owned by Questar's parent company but are credited to Utah ratepayers as part of a Utah Supreme Court case involving Questar's former exploration subsidiary Wexpro. This gas is delivered to Utah customers at cost.

Comparison to Other Recently Completed Studies

Table 8 presents a comparison of the results of this study to other recent natural gas potential studies. As shown in Table 8, the technical potential natural gas savings level estimated in each of the studies is very similar. The cost effective level of natural gas savings is a little more varied as economic assumptions tend to differ more across states and utility companies.

Table 7. Present Value of Savings and Costs

Utah

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 Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost 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

New Mexico

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 Benefit	Present Value Cost	PV of Net Benefits	Benefit-Cost Ratio
Commercial Sector	$753,066,636	$471,059,313	$282,007,323	1.60
Residential Sector	$314,596,263	$120,558,500	$194,037,763	2.61
Industrial Sector	$40,669,895	$6,595,383	$34,074,512	6.17
All Sectors	$1,108,332,794	$598,213,196	$510,119,598	1.85

Table 8. Comparison of Recent Gas Savings Potential Studies

	California Study[1]	OR & WA[2] (20 year potential)	Utah Study	ACEEE U.S. Median[3] (4 Studies)	PNM Study All Sectors	PNM Study – Res. and Com. Sectors Only
Date of Study	**2003**	**2003**	**2004**	**2004**	**2005**	**2005**
Technical Potential	NA	40.0%	38.0%	41.0%	35.5%	39.7%
Residential	43% - 49%	NA	46.2%	48.0%	61.8%	--
Commercial	35.0%	NA	29.2%	20.0%	17.0%	--
Max. Ach. Cost Effective Potential After 10 Years	10.0%	9.0%	19.7%	9.0%	12.1%	12.9%
Residential	NA	NA	26.0%	9.0%	16.7%	--
Commercial	9.5%	NA	11.2%	8.0%	9.6%	--

References for Comparative Studies

1. Coito, Fred and Rufo, Michael. 2003. California Statewide Residential and Commercial Sector Energy Efficiency Potential Study - Final Reports Volume 1 of 2. Study ID #SW061 and SW063. Pacific Gas & Electric Company, San Francisco, California.
2. KEMA-Xenergy and Quantec. 2003. Assessment of Long Term Electricity and Natural Gas Conservation Potential in Puget Sound Energy Service Area 2003-2024. Puget Sound Energy.
3. Nadel, Steven, Monis Shipley, Anna, and Elliot, R. Neal. 2004. The Technical, Economic, and Achievable Potential for Energy Efficiency in the United States: A Meta-Analysis of Recent Studies. Proceedings of the ACEEE 2004 Summer Study on Energy Efficiency in Buildings.

A Tale of Two Utilities: How the Policy Landscape Influenced the Use of the Studies and Implementation of DSM Programs

The Questar Gas and PNM potential studies came at a time when there was increased stakeholder interest and policy support for utility-funded energy efficiency programs in Utah and New Mexico and throughout the western U.S. Both studies sought to identify the extent and nature of the energy efficiency potential in two utility service territories where the local gas distribution company had very limited experience with natural gas efficiency programs. However, the impetus and policy environment in which the studies were undertaken led to very different approaches in how Questar Gas and PNM used the results of the studies to support the development and implementation of utility-funded natural gas energy efficiency programs in the two states.

In Utah, the study was commissioned as a result of a December 2002 Utah Public Service Commission (Commission) Order approving a stipulated settlement between Questar Gas, and the Utah Energy Office, the Division of Public Utilities, and Committee of Consumer Services. The study was jointly funded by the Utah Energy Office and Questar Gas and undertaken to support a regulatory investigation of natural gas efficiency issues by the Natural Gas DSM Advisory Group (Advisory Group) established by the Utah Commission. The Advisory Group was charged by the Commission to undertake an energy efficiency potential study for Questar Gas's Utah service territory, evaluate what information was needed by Questar to incorporate energy efficiency programs in its annual Integrated Resource Plan ("IRP") filing and estimate the potential revenue impacts of the company implementing cost-effective energy efficiency programs identified in the potential study. The Advisory Group was further instructed to report its findings to the Commission by August 31, 2003.

In New Mexico the potential study was an initiative driven primarily by the local utility's interest in offering energy efficiency programs to its customers at a time when there was strong support from public policy makers and utility stakeholders for increased funding for energy efficiency programs.[4] PNM commissioned and funded GDS to undertake the potential study in order to evaluate the nature, and extent of cost-effective energy efficiency potential in its New Mexico service territory. PNM's intent was to use the results of the study and, in collaboration with a utility-formed advisory group, design and file natural gas energy efficiency programs for use during the 2005-2006 winter heating season. PNM began its potential study in December of 2004. Within 6 months GDS had completed the potential study and PNM had designed and filed for Commission approval of six new natural gas efficiency programs with a total program budget of $2.1 million. The New Mexico Public Regulation Commission (PRC) completed hearings and approved the PNM energy efficiency programs by December 2005, six months after they were filed.

[4] At the same time Governor's Richardson's created the Clean Energy Development Council and established the Energy Efficiency Task Force to develop a set of policy recommendations that would support increased investments in energy efficiency in New Mexico. The work of the Governor's Energy Efficiency Task Force resulted in the drafting and passage of the Efficient Use of Energy Act during the 2005 legislative session. The key elements of the Act included language that directs gas and electric utilities to implement cost-effective DSM programs, subject to Public Regulation Commission approval. It also caps utility investments in demand side management programs at 1.5 percent of customers' bills and authorizes costs for approved DSM programs to be recovered through a tariff rider.

Questar Gas and the other interested parties in Utah were more deliberate in their use of the natural gas efficiency potential study. The study was first used by the Commission's Advisory Group to establish and advise them of the existence of a substantial energy efficiency resource potential in Questar Gas's service territory. Second, the results were used to provide the necessary data inputs to the model Questar Gas would use to evaluate and compare the costs of demand side resources with supply side resources as part of its integrated resource planning process. The issue of cost recovery and the company's sensitivity to lost revenues was acknowledged by the Advisory Group as an important financial disincentive that created a barrier to Questar Gas pursuing energy efficiency programs. But in its final report the Advisory Group referred the issue back to the Utah Commission as an issue that needed to be resolved in a future rate proceeding.

In both states public policy support and resolution of cost recovery and financial disincentives were an important influence on how the potential studies were used and the pace of energy efficiency program development and implementation. The more accelerated schedule in New Mexico was the result of collaboration and support of commissioners and staff of New Mexico PRC, the environmental and clean energy community, low income advocates, the state's largest industrial consumer group, Governor Richardson's Office and the New Mexico legislature in resolving the cost recovery and financial disincentive issues that discouraged PNM from investing in energy efficiency programs. These issues were in large measure resolved with the passage of the Efficient Use of Energy Act. This provided PNM with enough certainty to continue to pursue of new gas efficiency programs under a fairly aggressive schedule.

The more deliberate approach in Utah reflected a more cautious utility and stakeholder group who chose to pursue resolution of the cost recovery and financial disincentives issues through a more lengthy regulatory stakeholder and work group process rather than the Utah Legislature. Three years of regulatory study and investigation eventually resulted in Questar Gas filing a Joint Application for approval of a Conservation Enabling Tariff and a $1.3 million DSM pilot program in January, 2006.[5] Even then the Joint Application recommended that another task force be created to use the "GDS study as a guide" to evaluate and select new demand side management programs for Questar Gas to file with the Utah Commission in a future proceeding.

References

GDS Associates, Inc., May 2005. Maximum Achievable Cost Effective Potential for Natural Gas Energy Efficiency in the PNM Territory, Final Report.

GDS Associates, Inc., June 2004. The Maximum Achievable Cost Effective Potential for Gas DSM in Utah for the Questar Gas Company Service Area, Final Report.

[5]Joint Application of Questar Gas Company, the Division of Public Utilities and Utah Clean Energy for the Approval of the Conservation Enabling Tariff Adjustment Option and Accounting Orders. Docket No. 05-057-T01, January 23, 2006.