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Natural Gas Productive Capacity for the Lower 48 States 1986 Through 1998

December 1997

Energy Information Administration
Office of Oil and Gas
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Washington, DC 20585

Preface

The *Natural Gas Productive Capacity for the Lower 48 States 1986 Through 1998* is the sixth in this series of reports prepared by the Energy Information Administration (EIA). The five previous reports were published in 1991, 1993, 1994, 1996, and 1997 {1,2,3,4,5} The EIA Dallas Field Office has prepared five earlier reports regarding natural gas productive capacity. These reports, *Gas Deliverability and Flow Capacity of Surveillance Fields*, reported deliverability and capacity data for selected gas fields in major gas-producing areas.{6,7,8,9,10} The data in the reports were based on gas-well back-pressure tests and estimates of gas-in-place for each field or reservoir. These reports use proven well testing theory, most of which has been employed by industry since 1936, when the Bureau of Mines first published *Monograph 7.*{11}

This publication is used by the Congress, Federal and State agencies, industry, and other interested parties to obtain accurate data of the lower 48 States' natural gas production history and wellhead productive capacity. Capacity projections from this report are used in EIA's *Short-Term Energy Outlook Quarterly Projections.* The report also contains a projection of lower 48 States' gas production requirements and wellhead productive capacity. These data are essential for the evaluation of the adequacy of future gas supplies, especially in periods of peak heating or cooling demand.

Total demand for natural gas in the United States is met by a combination of natural gas production, underground gas storage, imported gas, and supplemental gaseous fuels. This report examines the natural gas production element of the total gas demand. Domestic natural gas production supplies the majority of the natural gas demand requirements for the lower 48 States. The production requirement continues to increase while drilling has remained at low levels, a fact that this has raised some concern about the adequacy of future gas supplies, and gas producers' ability to meet periods of peak heating or cooling demand.

A history of natural gas production and natural gas productive capacity at the wellhead, along with a projection of the same, is shown in tables and figures. Data are compiled and presented for the lower 48 States, Texas, Louisiana, California, Kansas, New Mexico, Oklahoma, Gulf of Mexico Outer Continental Shelf (OCS), Southeast area, Rocky Mountain area, and an eighteen State area that includes the remaining gas producing States. The EIA generates projections based on historical gas-well drilling and production data from State, Federal, and private sources. In addition to conventional gas-well gas, coalbed gas and oil-well gas are also included. Also presented for each category are charts showing the number of gas-well completions by year and the percent of total wellhead productive capacity by age. Alaska is excluded from this report because Alaskan gas does not enter the lower 48 States pipeline system.

Appendix A contains the model abstract. Appendix B compares the results of previous productive capacity reports. Appendix C contains the calculations and a table of productive capacity per new gas-well completion. A glossary of terms used in this report is provided to assist readers in more fully understanding the data.

This annual gas capacity report was prepared by the Reserves and Production Division (located in Dallas,Texas), Office of Oil and Gas, Energy Information Administration. General information regarding preparation of the report may be obtained from Kenneth A. Vagts, Director of the Office of Oil and Gas (202/586--6401) or John H. Wood, Director of the Dallas Field Office (214/720-6150).

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Executive Summary

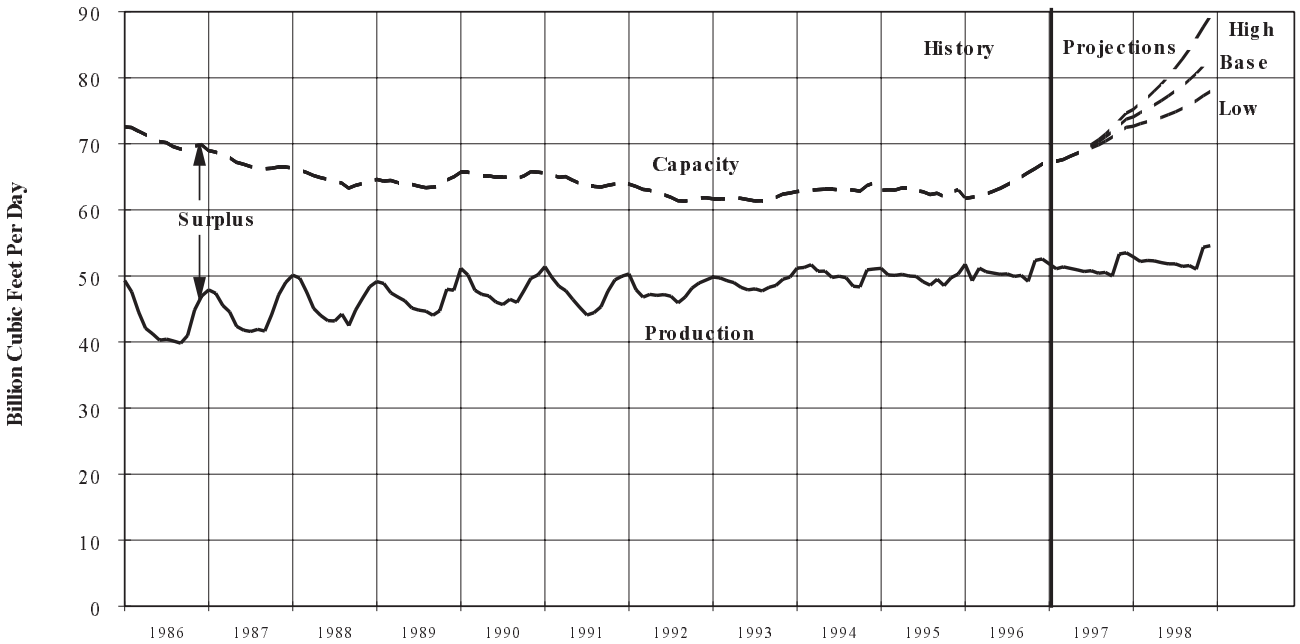
Natural gas productive capacity in the lower 48 States is expected to be adequate to meet monthly production requirements under normal weather conditions through 1998 for three drilling cases (Figure ES1). Capacity projections are shown for *low, base,* and *high* drilling cases associated with *low*, *base*, and *high* price scenarios from the Energy Information Administration *Short-Term Integrated Forecasting System, August 1997* (Table ES1). Exceptionally high peak-day or peak-week heating or cooling demand may exceed projected productive capacity, or production may be limited by other factors, such as pipeline availability. Wellhead productive capacity sets the upper limit on natural gas production. Nonetheless, the natural gas industry has developed methods to meet peak demand, such as deliveries from storage and peak-day shaving. These developments have been greatly promoted at the Federal level by the movements to lessen regulation by the Federal Energy Regulatory Commission. Increased reliance on market forces also encourages industry efficiency, as customers with fuel-switching capability consume other fuels in response to higher gas prices. Lastly, effective demand might be lowered by reducing service to customers that have interruptible contracts.

This is the sixth in the series of EIA reports on natural gas wellhead productive capacity in the lower 48 States. The series document a decline in gas productive capacity beginning in 1986 that was clearly reversed in 1996. Natural gas productive capacity is projected to increase in 1997 and 1998 for the *low*, *base*, and *high* drilling cases (Figure ES1). This increase in surplus capacity reflects mainly new discoveries in the Gulf of Mexico Outer Continental Shelf.

The major conclusions of this study are:

- Monthly wellhead productive capacity of dry gas will be adequate to meet production requirements in the *low, base*, and *high* cases through 1998.
- In fact, the surplus monthly productive capacity will be higher in December 1998 than in December 1996 for the *low, base,* and *high* cases.
- In particular, the largest gas producing area, the Gulf of Mexico Federal Offshore, is expected to meet its

Figure ES1. Lower 48 States Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacit Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP9 C102997.

historical market share of U.S. production and maintain a substantial surplus productive capacity.

- Beyond 1998, a sufficient number of new wells and/or imports must be added each year in order to ensure an adequate gas capacity and supply.

For decades the lower 48 States natural gas productive capacity has been adequate to meet production requirements. In the 1970's, the capacity surplus was small because of market structure (split between interstate and intrastate), increasing production requirements, and insufficient drilling. In the early 1980's lower production requirements, together with increased drilling and tight gas price incentives, led to a large surplus capacity. After 1986, this large surplus began to decline as requirements for gas increased, gas prices fell along with oil prices, and gas-well completions dropped sharply. In late December 1989, the decline in this surplus, accompanied by exceptionally high requirements and temporary weather-related production losses, led to concerns about the adequacy of productive capacity for natural gas. These concerns were moderated by the gas system's performance during the unusually severe winter weather in March 1993 and January 1994.

Monthly natural gas wellhead productive capacity estimates are for conventional and coalbed gas-well completions and oil-well completions in the lower 48 States. The different drilling levels assumed in three cases are functions of oil and gas prices and gas production requirements (Table ES1).

Beginning in 1987, coalbed gas production and capacity began a rapid increase. By the end of 1995, the coalbed gas capacity was over 5 percent of the total gas-well gas capacity. Coalbed gas capacity is projected to be over 4 percent of the total at the end of 1998.

The existence of a surplus wellhead productive capacity does not signify that the entire gas capacity could be produced and delivered. The ability of a well to deliver gas into a pipeline system (deliverability) is always equal to or less than wellhead productive capacity. Deliverability is that volume of gas that can be produced from a well, reservoir, or field during a given period of time against a certain wellhead back-pressure under actual reservoir conditions, taking into account restrictions imposed by pipeline capacity, gas plant capacity, contracts, or regulatory bodies.

At the end of 1995, deliverability into the lower-48 pipeline system was estimated to be 53 billion cubic feet per day of

Table ES1. Annual Wellhead Price, December Production, and December Productive Capacity of Gas, 1986, 1995, 1996, 1997, and 1998

Year/Case	Price (nominal dollars)	Production (billion cubic feet per day)	Productive Capacity (billion cubic feet per day)	Productive Capacity Surplus (billion cubic feet per day)	Productive Capacity Utilization (percent)
History					
1986	1.94	47.0	69.9	22.9	67.2
1995	1.55	50.3	63.0	12.7	79.8
1996	2.17	52.6	66.9	14.3	78.6
Projections					
1997/Low	2.00	53.5	72.5	19.0	73.8
1997/Base	2.30	53.5	73.7	20.2	72.6
1997/High	2.47	53.5	74.6	21.1	71.7
1998/Low	1.66	54.6	77.9	23.3	70.1
1998/Base	2.23	54.6	82.7	28.1	66.0
1998/High	2.63	54.6	89.3	34.7	61.1

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

dry gas, only 85 percent of the dry gas productive capacity at the wellhead. However, there is substantial uncertainty in this deliverability estimate. Should the surplus in wellhead productive capacity decline, more reliance would be placed on gas withdrawals from storage to meet peak heating and cooling demand. Gas storage requirements can be met by maintaining gas production that is closer to gas productive capacity throughout the year. This would lead to smaller seasonal variations in gas production.

1. Introduction

Natural gas demand in the lower 48 States has been increasing during the last few years. Natural gas-well drilling has remained at low levels during these same years. This has raised concern about the adequacy of future gas supplies, especially in periods of peak heating or cooling demand.

Total demand for natural gas in the United States is met by a combination of natural gas production, underground gas storage, imported gas, and supplemental gaseous fuels. Unpredictable market forces affect the number of new well completions and recompletions, which are related to drilling activity and rig efficiency. These forces include prices for oil and gas, imports, gas storage, regulatory changes, market dynamics, and total system deliverability.

This report addresses these concerns for the natural gas production element of total demand by presenting a historical analysis of the monthly productive capacity of natural gas at the wellhead for 1986 through 1996 and projecting productive capacity for 1997 and 1998. The impact of drilling, well completions, oil and gas price assumptions, and demand on gas productive capacity are integrated into the capacity projections as *low*, *base*, and *high* cases to account for the unpredictable market forces.

The *base* case reflects what would most likely occur if current market trends continue and drilling and production levels perform as they have in the past. The *high* case reflects an increase in the amount of drilling and favorable market conditions, while the *low* case reflects a decrease in drilling due to less favorable market conditions.

Assumptions used in the *Wellhead Productive Capacity Model* are summarized as follows:

- Wellhead gas productive capacity is a function of drilling, which adds new capacity, and production, which lowers existing capacity over time.
- The number of new gas-well completions is a function of drilling, which is influenced by oil and gas prices and production.
- Abandonment of individual conventional and coalbed gas-well completions is captured by decline functions for the group of wells included in a given vintage year for each area.
- Producing characteristics of new conventional and coalbed gas-well completions can be modeled from the characteristics of historical completions.
- Oil-well completions are currently producing at full capacity; therefore, the oil-well gas production rate equals oil-well gas capacity.
- U.S. gas production requirements are allocated to the lower 48 producing areas by month on the basis of 1995's production market share.

This report is based on of historical gas-well drilling and production data from State, Federal, and private sources. In addition to conventional gas-well gas, coalbed gas and oil-well gas are also included. Natural gas production from Alaska is excluded from this report because Alaskan gas does not enter the lower 48 States pipeline system.

For this report, monthly gas-well production data were as obtained on a per completion basis for 14 States and the Gulf of Mexico Outer Continental Shelf (OCS) from Dwight's EnergyData, Inc. (Dwight's). Dwight's data are not available for the entire lower 48 States. Production data on a State basis for the remaining States were obtained from EIA's *Natural Gas Monthly* reports, and the number of gas-well completions were obtained from the American Petroleum Institute (API) drilling statistics. Rig activity data for the Rig Model are obtained from Baker Hughes.

The method used to estimate natural gas productive capacity follows. Details of the methodology are found in previous reports { 1,2,3,4,5}.

By use of monthly gas-well production data, wells are grouped by vintage (the year a well first produced) for each State or area. A monthly peak production rate was selected each year for every vintage in each State or area. These data were input into the *Wellhead Productive Capacity Model* (Appendix A), where equation parameters were defined and a monthly productive capacity was estimated for each of the vintage years. Vintage-level capacities were summed to obtain the total capacities for each State or area. These were assumed to be the historical productive capacities. The model was used to project *low*, *base* and *high* case productive capacities for 1997 and 1998.

The projected gas production from the model was prorated by State and area on the basis of historical market share as follows. If scheduled gas-well gas production was less than gas-well gas productive capacity in a given State or area, the production required was set equal to the scheduled production. If the required scheduled gas-well gas production was greater than gas productive capacity in a given State or area, the production was set equal to productive capacity. When a State or area did not have adequate capacity to meet scheduled production, the unfilled capacity requirement was prorated to other States or areas that had surplus productive capacity. Surplus gas productive capacity occurs when the gas productive capacity is greater than and the scheduled gas production.

2. Gas Productive Capacity

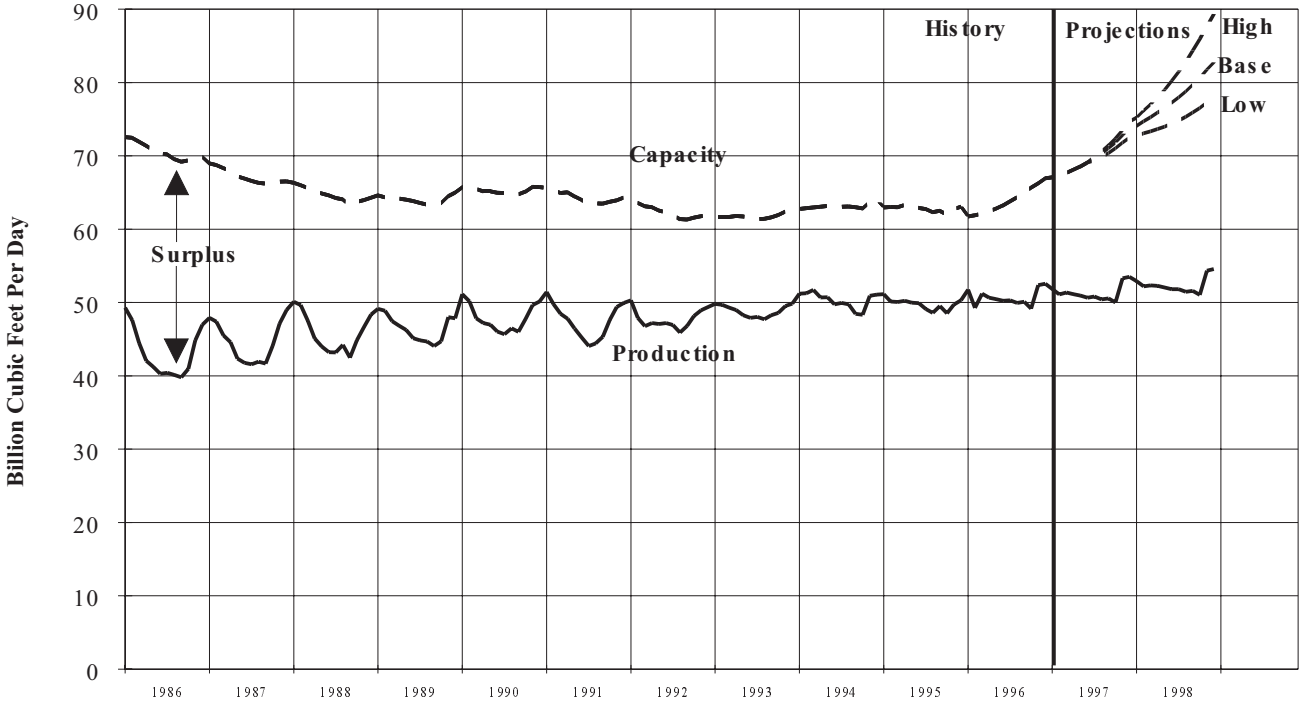
Gas Capacity to Meet Lower 48 States Requirements

The United States has sufficient dry gas productive capacity at the wellhead to meet forecast monthly production requirements through 1998 (Figure 1). Any potential shortfalls in States with low productive capacity could probably be met by transfers from those areas with a large surplus productive capacity, such as the Gulf of Mexico Outer Continental Shelf (OCS).

Dry gas is the type of gas generally transported by transmission systems and delivered to customers. *Gross gas* is the full stream volume, including all natural gas plant liquids and nonhydrocarbon gases but excluding lease condensate. In 1995, dry gas production represented 89 percent of the gross gas production in the lower 48 States (Figure 2).

For reporting and analysis, the lower 48 States were grouped into 10 separate producing States or areas on the basis of gas production volumes (Figure 3). Dry gas productive capacity was determined for each of these 10 areas. The quarterly gas production forecast in the Energy Information Administration (EIA), Short-Term Integrated Forecasting System, August 1997 {12} was used to determine the lower 48 States' production. This production was prorated into the 10 areas on the basis of their historical market shares. The quarterly production was further prorated into monthly data. If a given area could not meet its historical market share of production, the unmet production requirements were prorated to areas with surplus productive capacity. It was assumed that the pipeline facilities exist to transport this additional production from another supply area to its end market. Recent historical production patterns were used to allocate the projected lower-48 gas production requirements for 1997 and 1998 among States and areas (Figure 4).

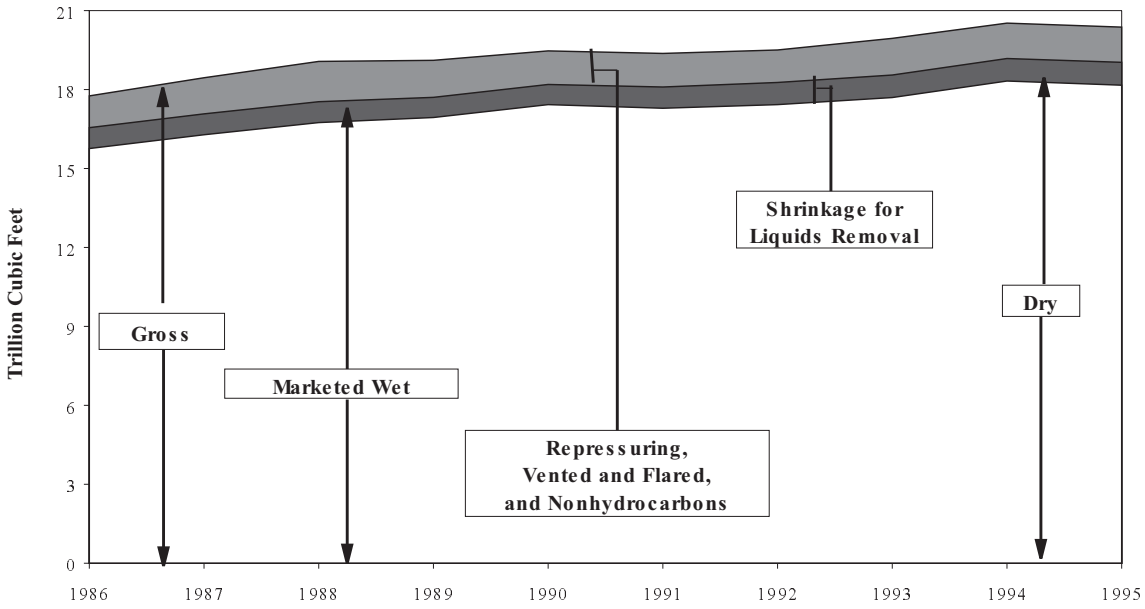
Figure 1. Lower 48 States Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.

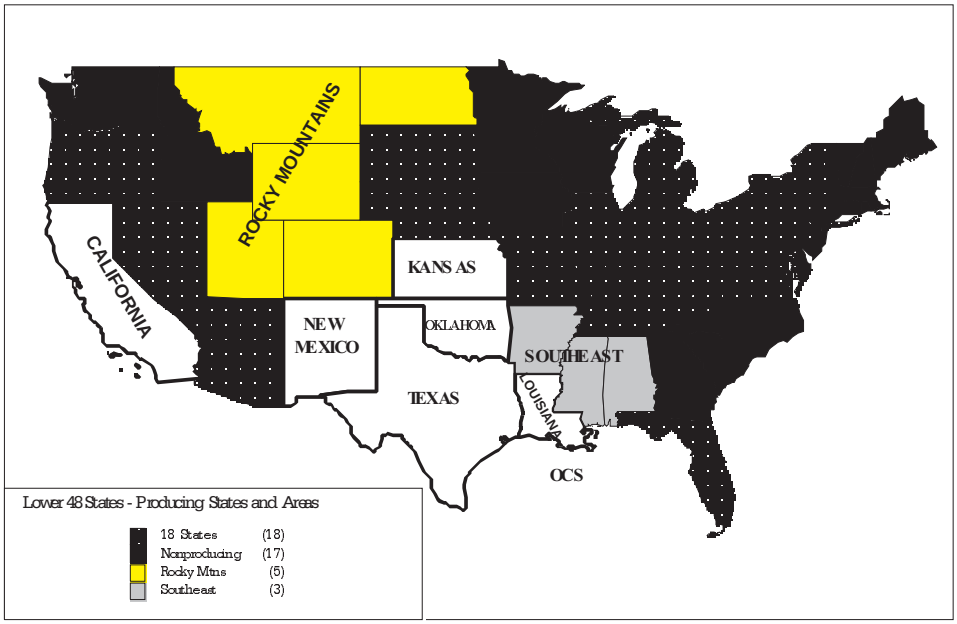
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Figure 2. Lower 48 States Natural Gas Production, 1986-1995



Source: Energy Information Administration, *Natural Gas Annual*, DOE/EIA-0131, 1986-1995.

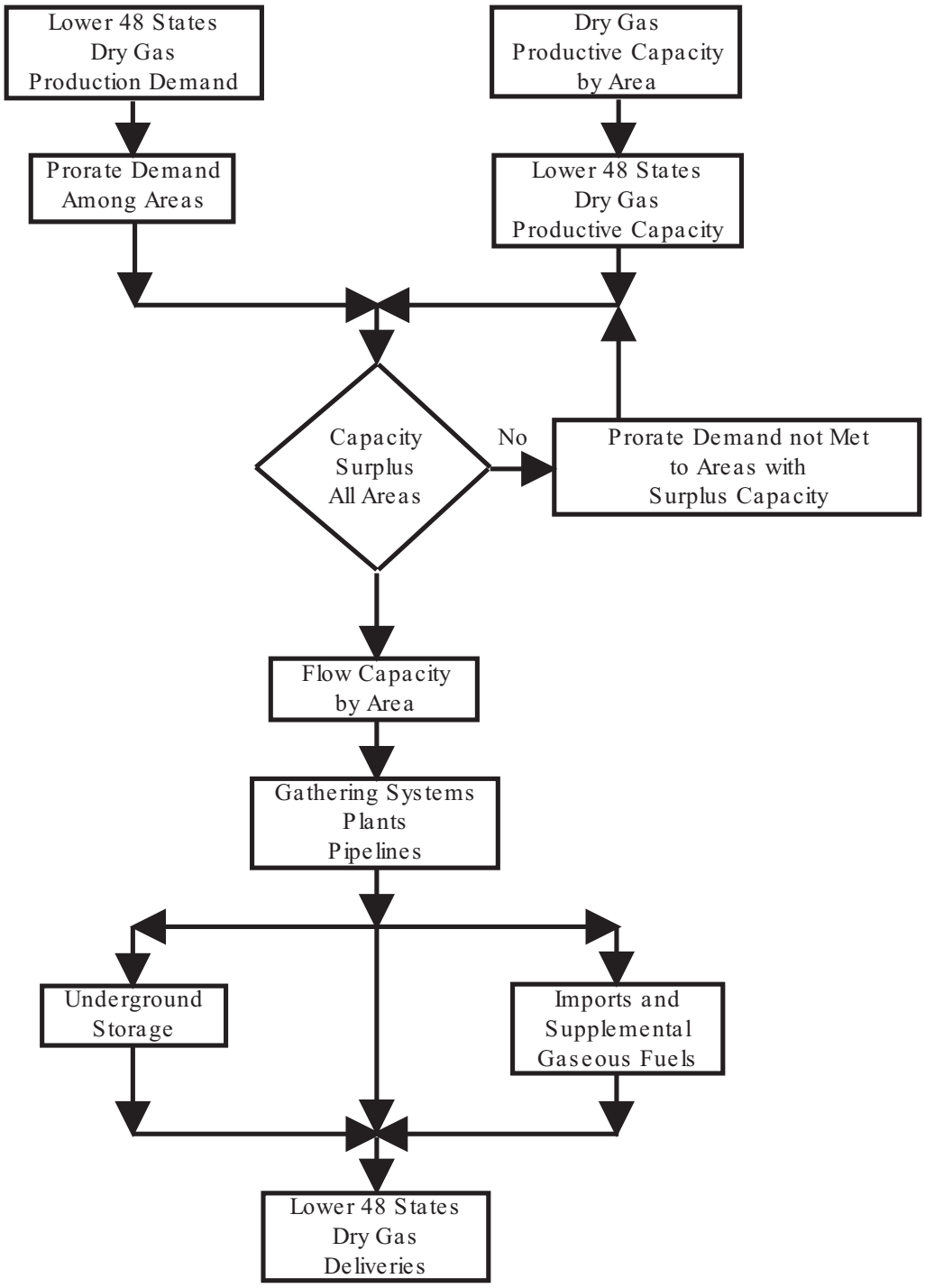
Figure 3. Lower 48 States - Producing States and Areas



Note: The 18 States are Arizona, Florida, Illinois, Indiana, Kentucky, Maryland, Michigan, Missouri, Nebraska, Nevada, New York, Ohio, Oregon, Pennsylvania, South Dakota, Tennessee, Virginia, and West Virginia. Non-producing States are Connecticut, Georgia, Delaware, Idaho, Iowa, Maine, Massachusetts, Minnesota, New Jersey, New Hampshire, North Carolina, Rhode Island, South Carolina, Vermont, Washington, and Wisconsin. Rocky Mountain States are Colorado, Montana, North Dakota, Utah, and Wyoming. Southeast States are Alabama, Arkansas, and Mississippi.

Source: Energy Information Administration, Office of Oil and Gas.

Figure 4. Lower 48 States Productive Capacity and Supply Schematic



Source: Energy Information Administration, Office of Oil and Gas.

Historical Data

Dry Gas Productive Capacity Trends

Historical monthly gas production and productive capacity for the lower 48 States for the months of January, June, and December are presented in Table 1.[1] January and December represent the typical peak winter months, and June represents a non-heating season.

Dry gas productive capacity in the lower 48 States substantially exceeded production throughout the 1980's. The lower 48 States' surplus capacity was more than 20 billion cubic feet per day through December 1986. However, gas capacity began declining in 1986 as drilling and new well completions rapidly declined. In 1996, surplus capacity was 14.4 billion cubic feet per day in December of that year.

The rapid decline in drilling and new well completions was caused by reduced natural gas prices. The wellhead price for natural gas shows a declining trend in 1986 and most of 1987 and then begins fluctuating seasonally after 1987 (Figure 5).

Gas Production

Total gross gas production (composed of gas-well and oil-well gas) from 1986 through 1995 is shown in Figure 6. Gas production from oil wells was stable over this time period, although oil production declined. Increases in producing gas-oil ratios roughly compensated for the declines in oil production. In 1995, gas production from oil wells was 16 percent of total gas production in the lower 48 States. If oil production declines in 1996, 1997, and 1998, as expected, gas production from oil wells will also decline if the producing gas-oil ratio stays at its 1995 level. The share of total gross production from gas wells increased from 79 percent in 1986 to 84 percent in 1995.

The dry natural gas production contribution from the major gas-producing States and areas is shown by Figure 7. The market share of production among States has been fairly stable from 1986 through 1995. The two largest gas-producing areas are the Gulf of Mexico OCS and Texas. Together these areas produce over one-half of the dry gas in the lower 48 States. The Gulf of Mexico has made the largest contribution to meeting major seasonal swings in demand. Other significant natural gas-producing States include Oklahoma, Louisiana, New Mexico, and Kansas. Chapter 3 reviews State and area gas production in detail.

Monthly gas production varies seasonally. Normally, production is highest in the months of January or February (because of high heating demand), substantially lower in June, and relatively higher in December. However, the minimum monthly production rate for a given year may fall in other months, such as September, when there is neither a large cooling nor heating demand.

Coalbed gas was treated separately in this report for New Mexico and the Southeast and Rocky Mountains areas (Figure 8). These are the three major coalbed gas-producing areas. Coalbed gas production was 5 percent of the lower-48 total gas produced in 1995.

Gas Prices

The average real wellhead value of natural gas peaked in 1983 at $3.75 (in constant 1995 dollars) per thousand cubic feet{13}, dropped sharply in 1986, and continued to decline to $1.76 per thousand cubic feet in 1991 (a 52 percent drop over eight years). The average price in 1995 is $1.55.{14} For comparison, real domestic crude oil prices dropped from $38.52 per barrel in 1983 to $14.62 in 1995, a 62 percent drop.{13} Given the lower prices and consequent decrease in drilling, it is understandable that wellhead productive capacity declined to values closer to gas production requirements from 1986 through 1995.

Projections

Dry Gas Productive Capacity and Production

EIA projects the natural gas wellhead productive capacity for the lower 48 States by using the *Wellhead Productive Capacity Model*. For a description of the model, see Appendix A. The model estimates the last year of historical production and productive capacity (because the data is still preliminary) and generates a 2-year projection of production and wellhead gas capacity. To account for unpredictable market forces and changing drilling activity levels, gas productive capacity projections are formulated for *low*, *base*, and *high* cases. The *base* case reflects what would most likely occur if current market trends continue and drilling and production levels continue to perform as they have performed in the past. The *high* case reflects an increase in the amount of drilling under more favorable market conditions, while the *low* case reflects a decrease under less favorable conditions. The model results are listed in Table 2.

In December 1996, the wellhead productive capacity of the lower 48 States was 66.9 billion cubic feet per day of dry natural gas. For the lower 48 States, the model projects the following:

- In the *low* case projection, dry gas productive capacity will increase 16 percent to 77.9 billion cubic feet per day in December 1998.

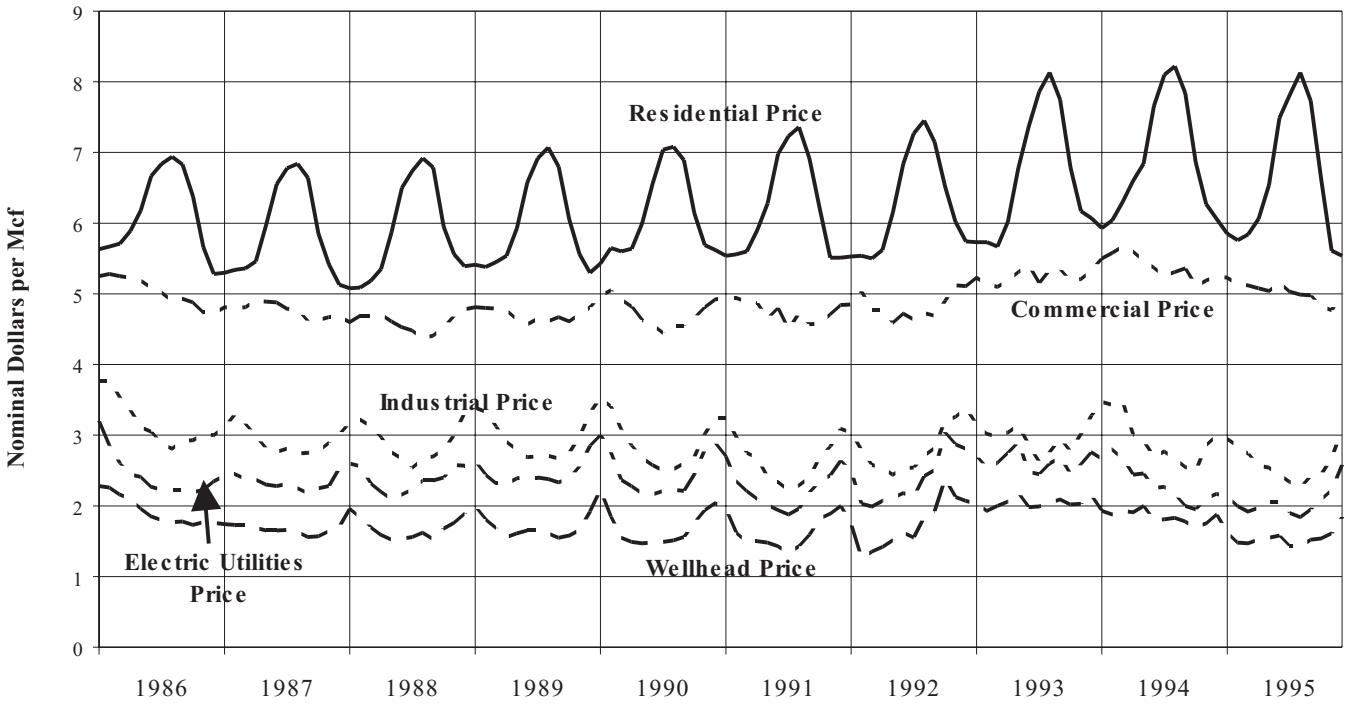
[1] Production and capacity for all 12 months can be obtained from the authors.

Table 1. Lower 48 States Dry Gas Production and Wellhead Productive Capacity, 1986-1996
(Billion Cubic Feet Per Day)

		Dry Gas Productive Capacity				
Month-Year	Dry Production	Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	49.3	62.7	9.8	72.6	23.3	67.9
Jun-86	40.3	61.3	9.0	70.3	30.0	57.3
Dec-86	47.0	61.1	8.8	69.9	22.9	67.2
Jan-87	47.9	60.0	9.0	69.0	21.1	69.4
Jun-87	41.8	58.1	8.8	66.9	25.1	62.5
Dec-87	49.0	57.8	8.7	66.5	17.5	73.7
Jan-88	50.1	57.5	8.8	66.3	16.2	75.6
Jun-88	43.2	55.8	8.8	64.6	21.4	66.9
Dec-88	48.4	55.7	8.5	64.3	15.9	75.3
Jan-89	49.1	55.8	8.8	64.6	15.5	76.0
Jun-89	45.1	55.4	8.4	63.8	18.7	70.7
Dec-89	47.8	57.1	7.9	65.0	17.2	73.5
Jan-90	51.1	57.0	8.7	65.7	14.6	77.8
Jun-90	46.0	56.6	8.4	65.0	19.0	70.8
Dec-90	50.1	57.3	8.4	65.7	15.6	76.3
Jan-91	51.4	57.2	8.4	65.6	14.2	78.4
Jun-91	45.2	55.7	8.3	64.0	18.8	70.6
Dec-91	49.9	56.0	8.3	64.3	14.4	77.6
Jan-92	50.3	55.3	8.6	63.9	13.6	78.7
Jun-92	47.2	53.9	8.4	62.3	15.1	75.8
Dec-92	49.4	53.6	8.2	61.9	12.5	79.8
Jan-93	49.8	53.5	8.1	61.7	11.9	80.7
Jun-93	47.9	53.5	8.1	61.6	13.7	77.8
Dec-93	49.8	54.6	7.9	62.6	12.8	79.6
Jan-94	51.2	54.7	8.0	62.8	11.6	81.5
Jun-94	49.8	55.2	7.9	63.1	13.3	78.9
Dec-94	51.1	56.1	8.0	64.1	13.0	79.7
Jan-95	51.1	55.2	7.8	63.0	11.9	81.1
Jun-95	49.9	55.1	7.8	62.9	13.0	79.3
Dec-95	50.3	55.3	7.7	63.0	12.7	79.8
Jan-96	51.8	54.0	7.7	61.7	9.9	84.0
Jun-96	50.2	55.6	7.7	63.3	13.1	79.3
Dec-96	52.6	59.1	7.8	66.9	14.3	78.6

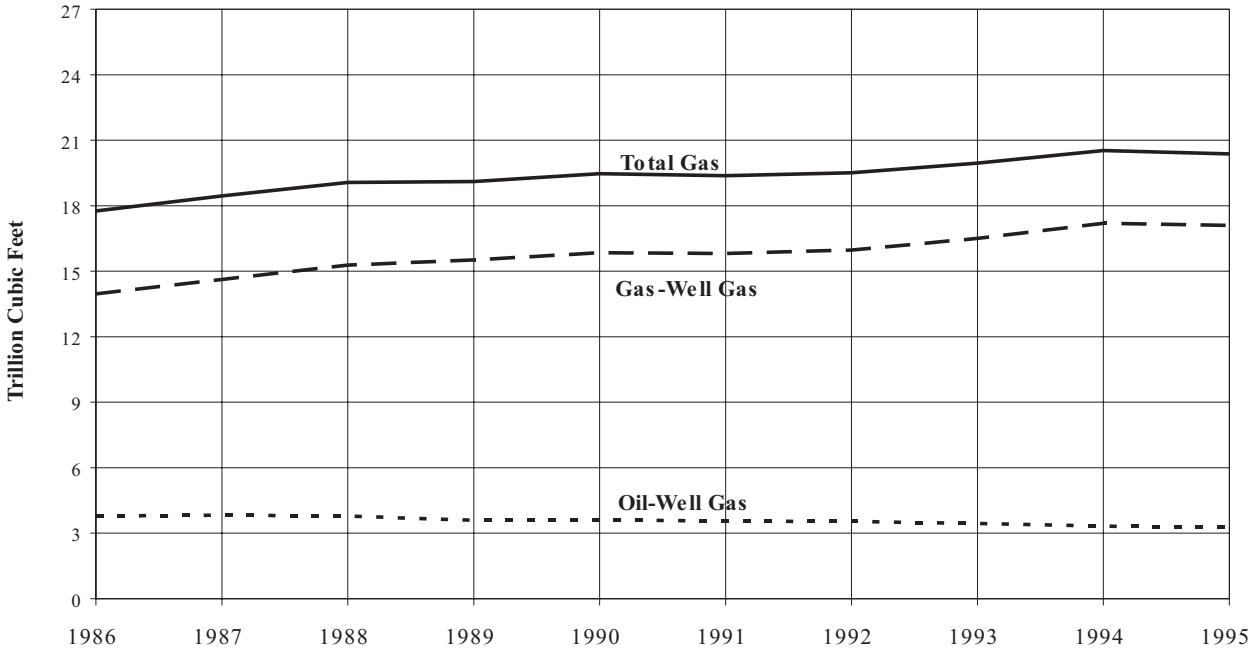
[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997.

Figure 5. Natural Gas Price by Category, 1986-1995



Source: Energy Information Administration, *Natural Gas Monthly*, DOE/EIA-0130(97/04)

Figure 6. Lower 48 States Gross Natural Gas Production by Type, 1986-1995



Source: Energy Information Administration, *Natural Gas Annual*, DOE/EIA-0131, 1986-1995

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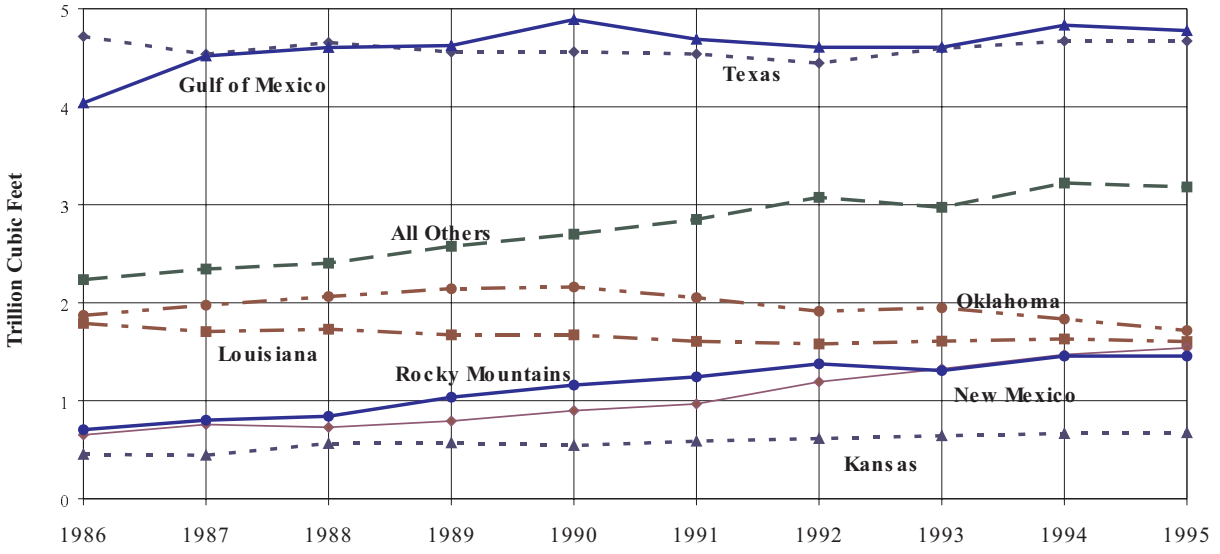
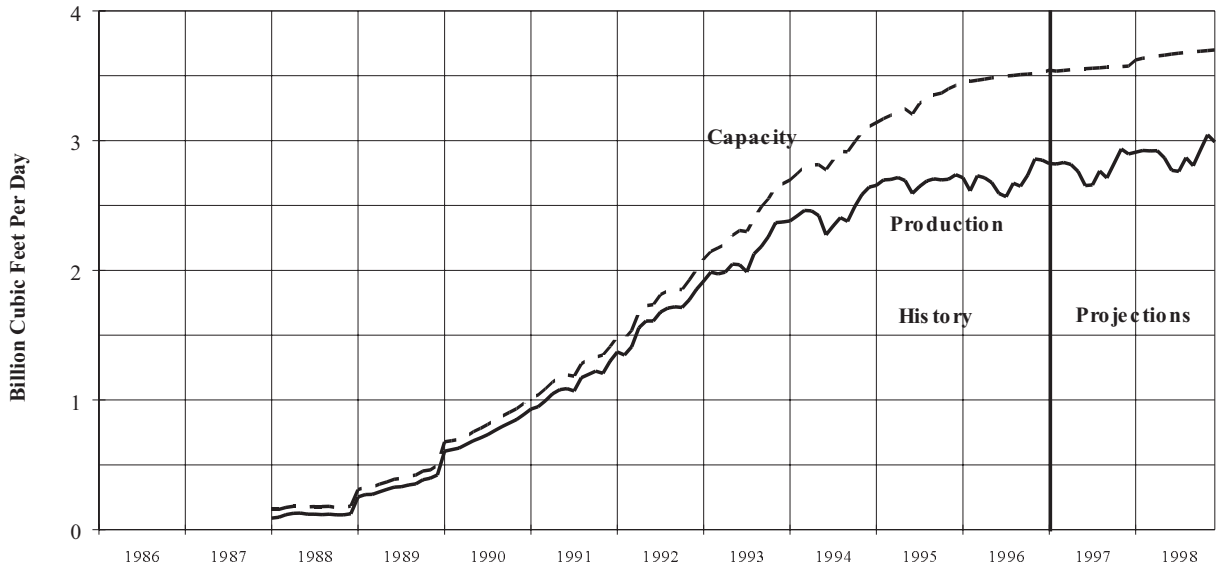
Figure 7. Dry Natural Gas Production from Lower 48 Producing States, 1986-1995



Note: State production for Texas and Louisiana does not include Gulf of Mexico OCS production

Sources: Energy Information Administration, *Natural Gas Annual*, DOE/EIA-0131, 1986-1995. Data for Texas, Louisiana, and Gulf of Mexico OCS are from Energy Information Administration, Office of Oil and Gas.

Figure 8. Lower 48 States Dry Coalbed Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 2. Lower 48 States Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998 (Billion Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
			Low Case Projection			
Jan-97	51.8	59.2	7.8	67.1	15.3	77.2
Jun-97	50.7	61.4	7.7	69.1	18.4	73.4
Dec-97	53.5	65.2	7.3	72.5	19.0	73.8
Jan-98	52.9	65.4	7.3	72.7	19.8	72.8
Jun-98	51.8	67.3	7.1	74.4	22.6	69.6
Dec-98	54.6	71.0	7.0	77.9	23.3	70.1
			Base Case Projection			
Jan-97	51.8	59.2	7.8	67.1	15.3	77.2
Jun-97	50.7	61.4	7.7	69.1	18.4	73.4
Dec-97	53.5	66.1	7.6	73.7	20.2	72.6
Jan-98	52.9	66.4	7.6	74.1	21.2	71.4
Jun-98	51.8	69.7	7.6	77.3	25.5	67.0
Dec-98	54.6	75.3	7.5	82.7	28.1	66.0
			High Case Projection			
Jan-97	51.8	59.2	7.8	67.1	15.3	77.2
Jun-97	50.7	61.4	7.7	69.1	18.4	73.4
Dec-97	53.5	66.7	7.9	74.6	21.1	71.7
Jan-98	52.9	67.3	7.9	75.2	22.3	70.3
Jun-98	51.8	72.3	7.9	80.2	28.4	64.6
Dec-98	54.6	81.4	8.0	89.3	34.7	61.1

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

- In the *base* case projection, productive capacity will increase 24 percent to 82.7 billion cubic feet per day in December 1998.
- In the *high* case, productive capacity increases 33 percent from the December 1996 level, reaching 87.3 billion cubic feet per day in December 1998.

For surplus capacity in the lower 48 States:

- In the *low* case, the surplus capacity increases from 14.4 billion cubic feet per day in December 1996 to 23.3 billion cubic feet per day in December 1998.
- In the *base* case, surplus capacity increases to 28.2 billion cubic feet per day in December 1998.
- In the *high* case, the surplus capacity increases to 34.8 billion cubic feet per day in December 1998.

Gas productive capacity should be adequate to meet the projected monthly gas production requirements of the lower 48 States through December 1998, even in the *low* case.

New Well Completions

Gas productive capacity is increased by new gas-well completions. If there had been no new gas-well completions projected after 1995, the surplus capacity would have gone from 14.4 billion cubic feet per day in December 1996 to zero by December 1997. With no new completions, productive capacity would not have been adequate to meet the forecast production requirements. Gas-well completions must be added continuously to sustain an adequate productive capacity.

To project gas productive capacity, a projection of new gas-well completions is required. The projection of new well completions is based on a projection of rigs running and an estimate of completions per rig. Forecasts of the total drilling rigs were obtained from the EIA Drilling Rig Model. This model generates monthly rig counts on the basis of oil and gas revenues which are derived from production and price data appearing in the EIA's *Short Term Energy Outlook* (STEO). The Drilling Rig Model was described in previous reports{1,2,3,4,5}.

Gas-well completions added for the 2-year period 1997 through 1998 are estimated to be 34,939 for the *low* case, 39,342 for the *base* case, and 46,039 for the *high* case (Figure 9). The larger number of completions yields a dry gas productive capacity for the *high* case in December 1998 that is 89.3 billion cubic feet per day, (Table 2) or 8 percent higher than the 82.7 billion cubic feet per day in the *base* case. Gas production requirements were assumed to be the same in both cases. A new gas-well completion is estimated to add about one million cubic feet per day of capacity (Appendix C).

For the *low*, *base*, and *high* cases, the corresponding gas-well completions were estimated primarily as a function of gas price and production. The 1998 gas prices for the three cases were respectively $1.66, $2.23, and $2.63 per thousand cubic feet, as shown in the Short-Term Integrated Forecasting System, August 1997{12}. The actual gas prices were $1.55 per thousand cubic feet in 1995{14} and $2.17 in 1996{12}.

The newer gas-well completions contribute most of the productive capacity in the lower 48 States. Wells less than three years old contributed 49 percent of the productive capacity in the lower 48 States in December 1996. Wells less than 2 years old provided 40 percent, while wells completed that year provided 28 percent (Figure 10).

Gas Productive Capacity Issues

Demand

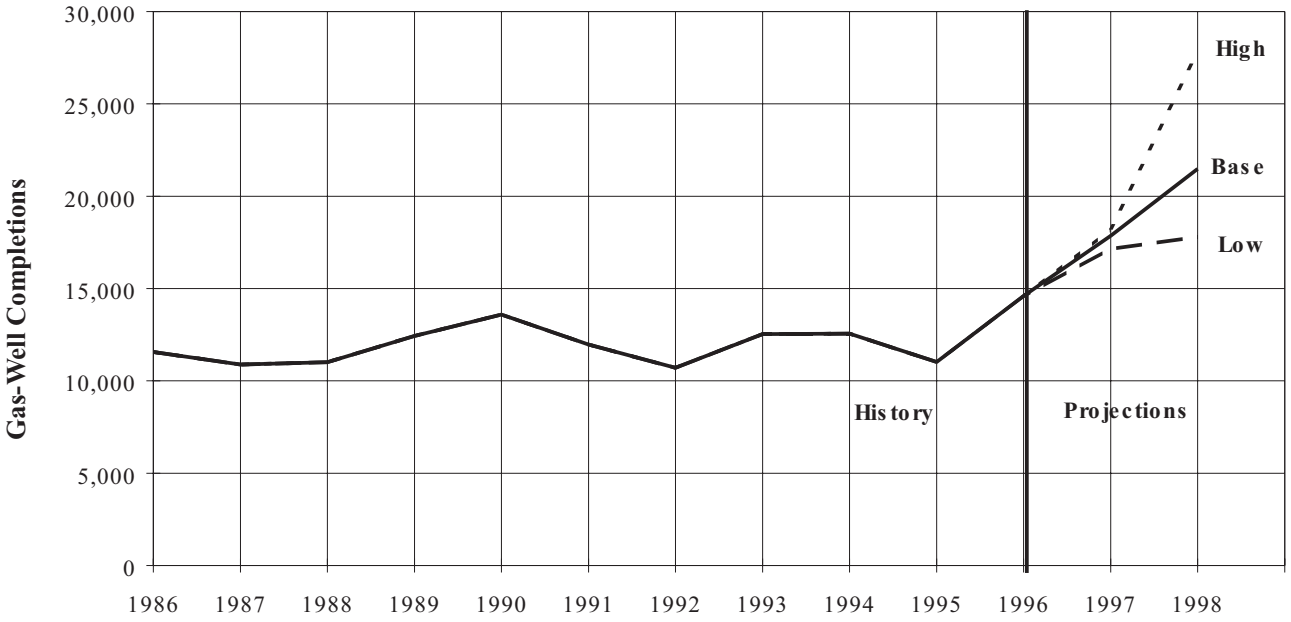
Peak-day demand may be twice the annual average-day demand. Peak-day demand usually occurs in December, January, or February during very cold weather. The cold weather, while increasing gas demand, may also decrease potential supply because of weather-related production and transportation problems.[2]

Peak-day demand cannot be met by increasing gas production at the wellhead and should not be expected to be met by production in the future. To better serve its customers, the natural gas industry has developed methods to meet peak demand, such as delivery from gas storage facilities and peak shaving facilities.

It could be argued that in periods of high gas demand, price increases at the wellhead could both increase supply quantities and decrease consumption until they balance. Over a sufficient period of time this is true. However, in the very short term (days), average wellhead prices are relatively unresponsive to demand, although, commercial, industrial, and electric utility gas prices normally increase during periods of high seasonal demand (Figure 5). The vast majority of gas is covered by 30-day or longer contracts. Therefore, if there is a sudden large increase in gas demand, there is not an accompanying sudden, large increase in the average price of gas at the wellhead. However, small volumes of gas may sell at very high prices on the spot market.

[2]For more information about this subject see Energy Information Administration, Service Report SR/OG/91-01 and Oil and Gas Journal, March 5, 1990, pp.17-20.

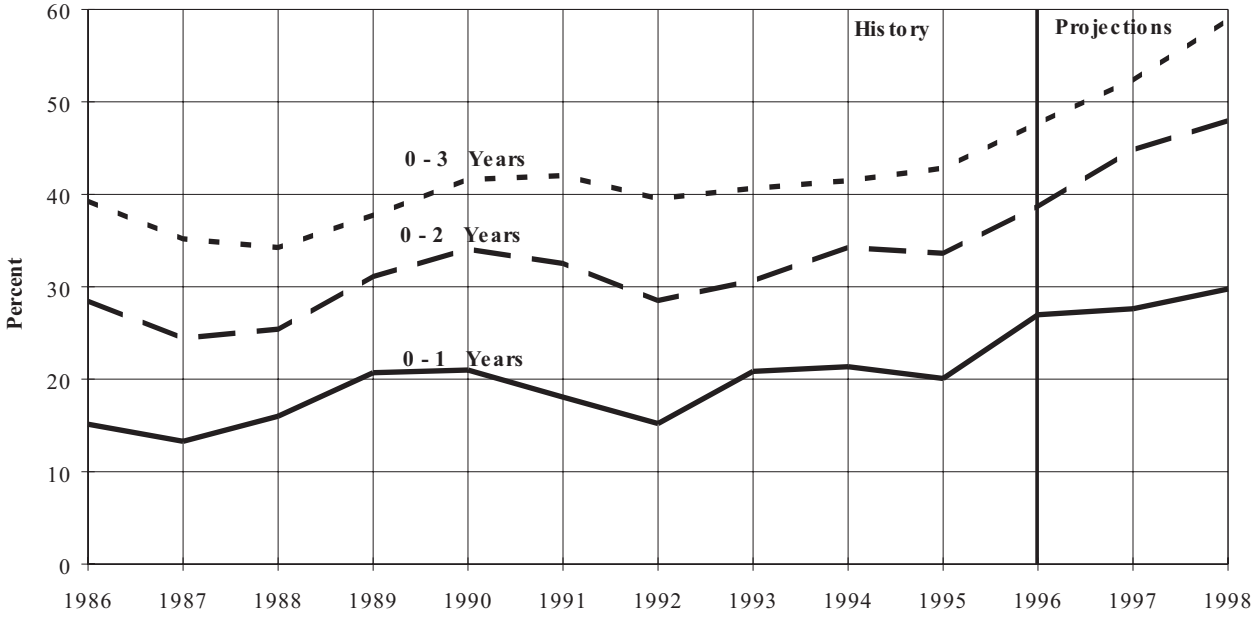
Figure 9. Lower 48 States Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on EIA's Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Figure 10. Percent of Total Wellhead Productive Capacity of Lower 48 States Gas Wells (Minus the 18 States Group) by Well Age, 1986-1998 (Base Case)



Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Effective gas demand in peak periods is typically lowered by reducing deliveries to customers with interruptible contracts or by customers with fuel-switching capability responding to higher gas prices by switching to another fuel. A price increase would have little impact on reducing residential gas requirements. It is residential heating or cooling demand that is most likely to have a sudden upward surge related to weather. Residential consumers used 5.2 times as much gas in December 1994 as they did in August 1994 and 6.6 times as much gas in December 1995 as they did in August 1995.{15}

Because cost-of-service pricing lowers the unit cost of gas during periods when large volumes are being delivered, the residential cost of gas per thousand cubic feet actually drops in December, while the wellhead price of gas increases.{15} Figure 5 shows the relationship of wellhead price to residential, commercial, industrial, and electric utility prices for 1986 through 1995. Therefore, small increases in the average price of natural gas at the wellhead do not effectively dampen weather-related residential gas requirements in the short term.

Deliverability

The existence of a high gas productive capacity at the wellhead does not mean that it could actually be produced and delivered. Deliverability is always equal to or less than wellhead productive capacity. Deliverability takes into account restrictions imposed by pipeline capacity, contract, or regulatory bodies. Even with a large surplus dry gas productive capacity, there can be Short-Term regional gas supply problems.

In order to meet peak-month or peak-day demand, the pipeline system must also have adequate deliverability to the final destination. Pipeline systems must have adequate diameters, properly spaced compressors, and adequate interconnections between pipelines. Gas pipeline systems must be optimized to transport gas efficiently from any well to wherever in the lower 48 States where the need might arise.

Productive capacity and deliverability can be compared by using the data collected by the Natural Gas Supply Association (NGSA) in its NGSA Survey on 1995 Natural Gas Field Deliveries & Productive Capacity.{16} The data on connected gas-well capacity as of January 1, 1996, which is equivalent to deliverability into the pipeline system, were collected on an operator basis for seven lower-48 regions. The survey covered 83 percent of the production for the Offshore Gulf Coast, the highest for any region in the survey. The ratio of the NGSA 1995 connected gas field capacity to the annual 1995 field deliveries was 1.07. In other words, deliverability was 7 percent higher than annual production. The equivalent deliverability for all Offshore Gulf Coast operators was 15 billion cubic feet per day if the NGSA surveyed operators are representative of all operators in this region.

For the month of January 1996, it was estimated that 85 percent of the productive capacity at the wellhead could be delivered into the pipeline system. This was obtained by dividing the January 1996 deliverability of 53 billion cubic feet per day (determined by scaling up the NGSA connected-gas-well capacity){16} by the January 1996 dry productive capacity at the wellhead of 62 million cubic feet per day.

During the 1980's and most recently with FERC Order 636 in 1992, major changes have occurred in regulations, contracts, interconnections between trunklines, access to transportation, and markets. These changes have introduced a much greater degree of flexibility and responsiveness in the natural gas industry. This flexibility makes it likely that a higher percentage of the productive capacity can be delivered. More gas can get from where it is produced to where it is needed. However, in some cases, pipeline capacity may limit gas deliverability.

Weather's Effect on Deliverability

One problem that is associated with the handling of natural gas is the phenomenon of a production line or well “freezing up.” This problem occurs when water vapor and hydrocarbon vapors combine to form snow-like substances, called hydrates. Under suitable pressure conditions, hydrates may be formed at temperatures well above the freezing point of water. One of the problems in handling natural gas is the prevention of the formation of hydrates and their removal once formed.

Interruptions in regional supply can cause a peak production requirement in other areas. For example, storms in the Gulf of Mexico have damaged producing sites and abruptly shut in wells. Needed gas was supplied to consumers from other areas or from storage during part of this time.

Gas Storage

Gas storage is a vital part of the natural gas industry. Stored gas provides a source for reliable deliveries during periods of heavy demand. Storage also enables greater system efficiency by allowing more stable production and transmission flows.

Sufficient dry gas productive capacity will exist during the years 1997 through 1998 to increase the underground natural gas storage inventory needed. Gas storage requirements can be met by maintaining gas production closer to gas productive-capacity throughout the year. Increased use of storage reduces the need for excess productive capacity, thus promoting improved economic efficiency in production.

Imports

Imports have become an increasingly important part of the domestic gas supply picture. Reliance on imported gas has more than doubled in less than a decade. In 1986, net imports made up 4 percent (689 billion cubic feet) of the total gas demand requirements. In 1995, net imports supplied 12 percent (2,687 billion cubic feet) of the total gas demand requirements.

3. Producing Areas

This section of the report details the natural gas wellhead productive capacity by State or area where Dwight's gas-well gas production data are available. From these data, individual studies are made for each of six States: California, Kansas, Louisiana, New Mexico, Oklahoma, Texas, and the Gulf of Mexico Federal Offshore Outer Continental Shelf (OCS).

The remaining Dwight's data are combined into 3 groups of States (Figure 3). Five states are grouped together as *Rocky Mountains*: Colorado, Montana, North Dakota, Utah, and Wyoming. Three states are combined as the *Southeast* group, consisting of Alabama, Arkansas, and Mississippi. The third group is made up of *18 States*: 3 States with Dwight's data–Michigan, Nebraska, and South Dakota and 15–Arizona, Florida, Illinois, Indiana, Kentucky, Maryland, Missouri, Nevada, New York, Ohio, Oregon, Pennsylvania, Tennessee, Virginia, and West Virginia- for which no Dwight's data are available.

Each State or group of States has its own unique, initially scheduled monthly gas production rate for January 1996 set to the same values for the *low, base*, and *high* cases. However, the actual production rate in an area will be less than its initially scheduled production rate if its scheduled production rate exceeds its gas productive capacity. Scheduled gas production is the production demand for the United States taken from the Energy Information Administration's Short-Term Integrated Forecasting System, August 1997, {12} and prorated among the States and areas.

For each State or area where the scheduled production exceeds the gas productive capacity, the deficit capacity (the negative difference between capacity and scheduled production) is rescheduled to States and areas with surplus capacity. The production for these deficit capacity States will be greater in the *base* and *high* cases because there will be more well completions. The larger number of well completions adds more capacity and reduces or eliminates the deficit capacity.

For States or areas where the scheduled production does not exceed capacity, the surplus capacity (the positive difference between capacity and scheduled production) is used to replace the deficit capacity of the States and areas with deficit capacities. For these surplus capacity States, the production rate will be highest in the *low* case because there is a larger deficit capacity to make up.

Gulf of Mexico OCS

The Gulf of Mexico OCS is a prolific natural gas producer with large seasonal variations in producing rate. In 1995, more than a quarter of the lower 48 States' dry gas production came from this area. Mobile Block 823 producing 81 Bcf, was the largest OCS natural gas producer in 1995. Garden Banks 236 was the second largest producer making 76 Bcf, and Matagorda Island 623, the third largest producer, producing 70 Bcf.

Surplus capacity was adequate from 1986 through 1996. Future projections show increases for the *low*, *base*, and *high* cases.

Figure 11 shows the dry gas production rate and wellhead productive capacity from 1986 through 1996, with projections through 1998. The January, June, and December historical production rates and capacities are presented in Table 3. Dry gas production and wellhead productive capacity projections are shown by Table 4.

Figure 12 shows the number of gas-well completions added during each year from 1986 through 1996 and projected through 1998. There is an increase in the Gulf of Mexico completions for 1997 and 1998.

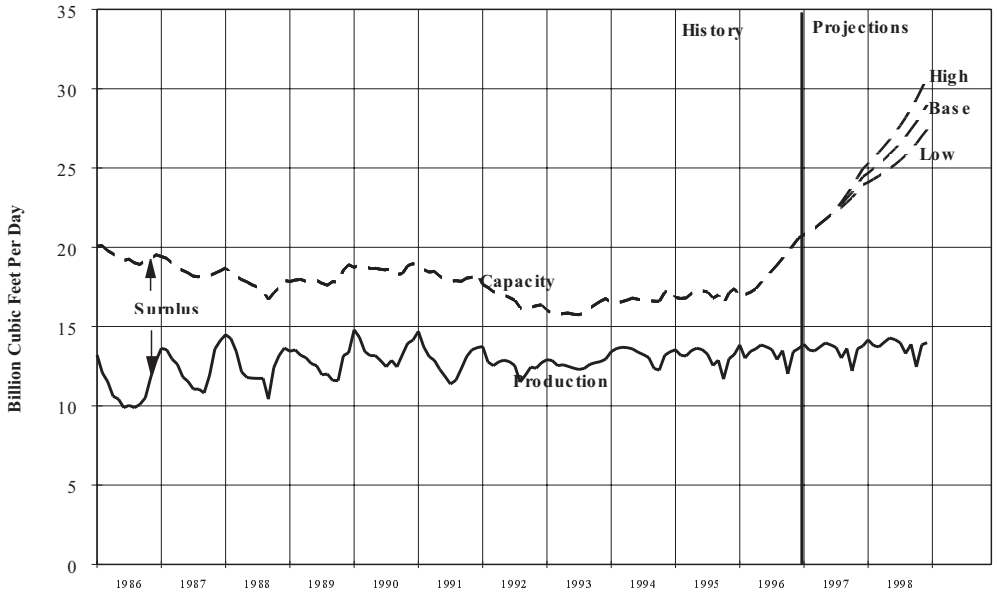
The initial flow rate per well completion for the Gulf of Mexico is about eight million cubic feet per day (Appendix C). Most reservoirs in the Gulf of Mexico have high permeabilities and are water-drive reservoirs. This means that the reservoir can sustain a high flow rate throughout most of its producing life. However, the recovery efficiency is generally less than the recovery efficiency for reservoirs with other types of drive mechanisms.

Figure 13 shows the percent of the Gulf of Mexico OCS gas-well productive capacity in December of each year by age of the well. gas-well completions that have been producing for less than one year contributed from 18 to 44 percent of the productive capacity from 1986 through 1996.

The gap between the capacity and production curves begins to widen in 1996 and continues through 1997. Several deep water projects are scheduled to commence production in 1997 and 1998.

The OCS area provides surplus capacity to meet major seasonal swings in the lower 48 States gas requirements. The future for this area to meet this role looks bright, especially if successful deep water projects continue to add adequate gas-well completions.

Figure 11. Gulf of Mexico OCS Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 3. Gulf of Mexico OCS Dry Gas Production and Wellhead Productive Capacity, 1986-1996
(Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	13,210	18,478	1,585	20,063	6,853	65.8
Jun-86	9,878	17,706	1,460	19,166	9,288	51.5
Dec-86	12,845	18,038	1,489	19,527	6,682	65.8
Jan-87	13,624	18,006	1,416	19,422	5,798	70.1
Jun-87	11,534	17,068	1,317	18,385	6,851	62.7
Dec-87	14,118	17,264	1,252	18,516	4,398	76.2
Jan-88	14,481	17,446	1,254	18,700	4,219	77.4
Jun-88	11,747	16,319	1,309	17,628	5,881	66.6
Dec-88	13,654	16,607	1,314	17,921	4,267	76.2
Jan-89	13,441	16,557	1,286	17,843	4,402	75.3
Jun-89	12,535	16,690	1,224	17,914	5,379	70.0
Dec-89	13,346	17,825	1,085	18,910	5,564	70.6
Jan-90	14,792	17,516	1,220	18,736	3,944	78.9
Jun-90	12,831	17,420	1,184	18,604	5,773	69.0
Dec-90	14,144	17,730	1,228	18,958	4,814	74.6
Jan-91	14,698	17,554	1,301	18,855	4,157	78.0
Jun-91	11,845	16,645	1,314	17,959	6,114	66.0
Dec-91	13,676	16,917	1,434	18,351	4,675	74.5
Jan-92	13,746	16,344	1,325	17,669	3,923	77.8
Jun-92	12,786	15,546	1,297	16,843	4,057	75.9
Dec-92	12,717	15,134	1,233	16,367	3,650	77.7
Jan-93	12,919	14,677	1,353	16,030	3,111	80.6
Jun-93	12,376	14,395	1,377	15,772	3,396	78.5
Dec-93	12,948	15,397	1,378	16,775	3,827	77.2
Jan-94	13,414	14,989	1,538	16,527	3,113	81.2
Jun-94	13,388	15,180	1,548	16,728	3,340	80.0
Dec-94	13,409	15,709	1,632	17,341	3,932	77.3
Jan-95	13,530	15,266	1,575	16,841	3,311	80.3
Jun-95	13,551	15,595	1,662	17,257	3,706	78.5
Dec-95	13,233	15,704	1,692	17,396	4,163	76.1
Jan-96	13,843	15,150	1,718	16,868	3,025	82.1
Jun-96	13,718	16,431	1,698	18,129	4,411	75.7
Dec-96	13,614	18,691	1,889	20,580	6,966	66.2

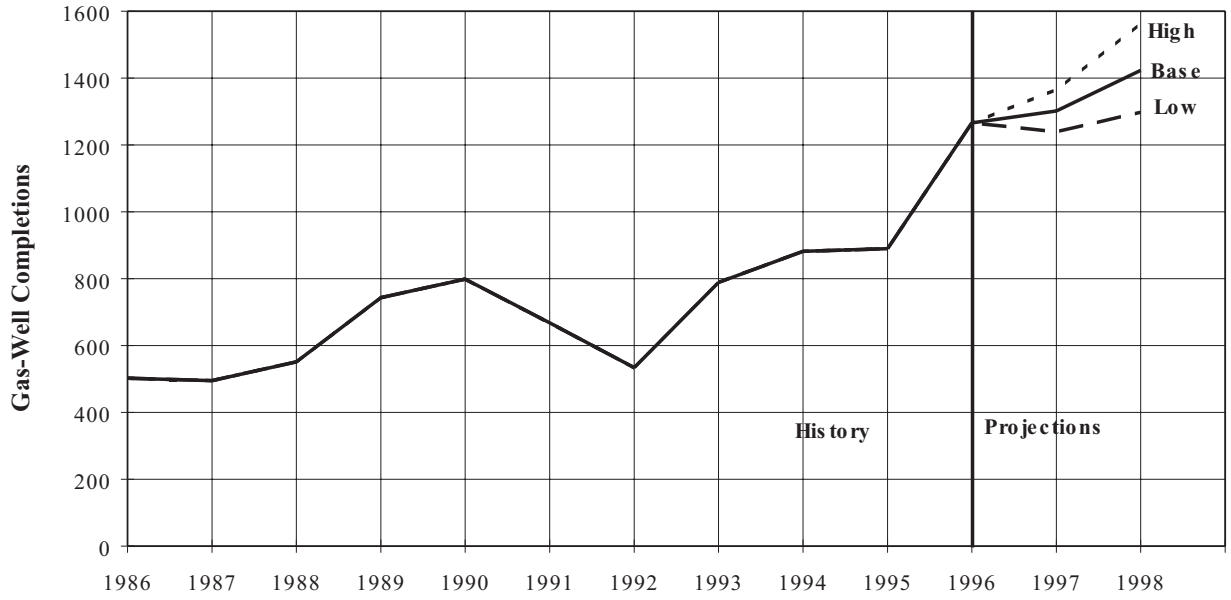
[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997.

Table 4. Gulf of Mexico OCS Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998 (Billion Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity: Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
		Low Case Projections				
Jan-97	13,874	18,889	1,916	20,805	6,931	66.7
Jun-97	13,848	20,135	1,902	22,037	8,189	62.8
Dec-97	13,806	22,045	1,889	23,934	10,128	57.7
Jan-98	14,176	22,210	1,889	24,099	9,923	58.8
Jun-98	14,177	23,315	1,907	25,222	11,045	56.2
Dec-98	14,032	25,553	1,874	27,427	13,395	51.2
		Base Case Projections				
Jan-97	13,874	18,889	1,916	20,805	6,931	66.7
Jun-97	13,848	20,135	1,902	22,037	8,189	62.8
Dec-97	13,773	22,510	1,939	24,449	10,676	56.3
Jan-98	14,169	22,738	1,943	24,681	10,512	57.4
Jun-98	14,174	24,251	1,965	26,216	12,042	54.1
Dec-98	13,983	27,021	1,955	28,976	14,993	48.3
		High Case Projections				
Jan-97	13,874	18,889	1,916	20,805	6,931	66.7
Jun-97	13,848	20,135	1,902	22,037	8,189	62.8
Dec-97	13,753	22,969	1,992	24,961	11,208	55.1
Jan-98	14,162	23,274	2,001	25,275	11,113	56.0
Jun-98	14,174	25,189	2,025	27,214	13,040	52.1
Dec-98	13,969	28,619	2,040	30,659	16,690	45.6

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

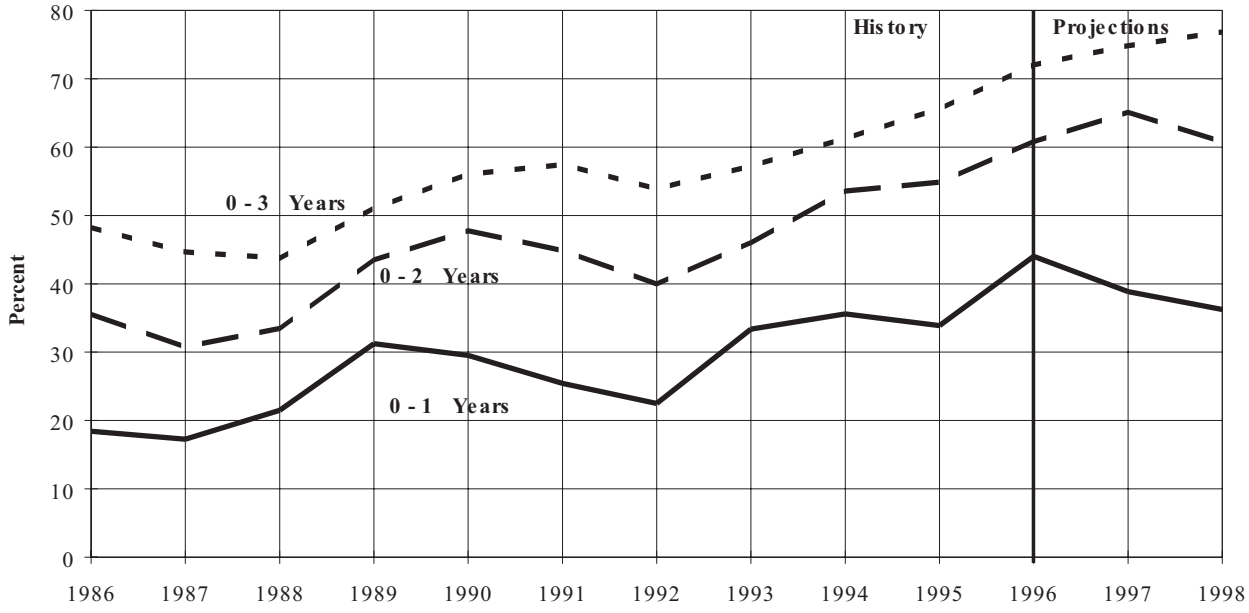
Figure 12. Gulf of Mexico OCS Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Figure 13. Percent of Total Wellhead Productive Capacity of Gulf of Mexico OCS Gas Wells by Well Age, 1986-1998 (Base Case)



Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Texas (Excluding Gulf of Mexico OCS)

Texas gas production amounted to over a quarter of the lower 48 States dry gas production in 1995. Gas-producing zones range from high permeability, water-drive formations to low permeability "Tight Gas" reservoirs. The three largest gas-producing areas in 1995 in the State were the Giddings (234 Bcf) the Carthage (189 Bcf), and the Panhandle West (154 Bcf) fields.

Figure 14 shows the dry gas production rate and wellhead productive capacity from 1986 through 1996, with projections through 1998. The January, June, and December production rates and capacities are presented in Tables 5 and 6. Productive capacity began a very pronounced downturn beginning in 1986. After 1986, surplus capacity began to diminish (Figure 14). Consequently, capacity utilization began to increase after 1986 (Table 5). The surplus capacity is projected to increase in 1997 and 1998. Compared with the OCS, surplus capacities have not shown large increases in June. This reflects the fact that production requirements for Texas gas are less seasonal than for the Gulf of Mexico OCS.

Figure 15 shows the number of producing gas-well completions added during each year from 1986 through 1998. The number of gas-well completions are projected to increase through 1998.

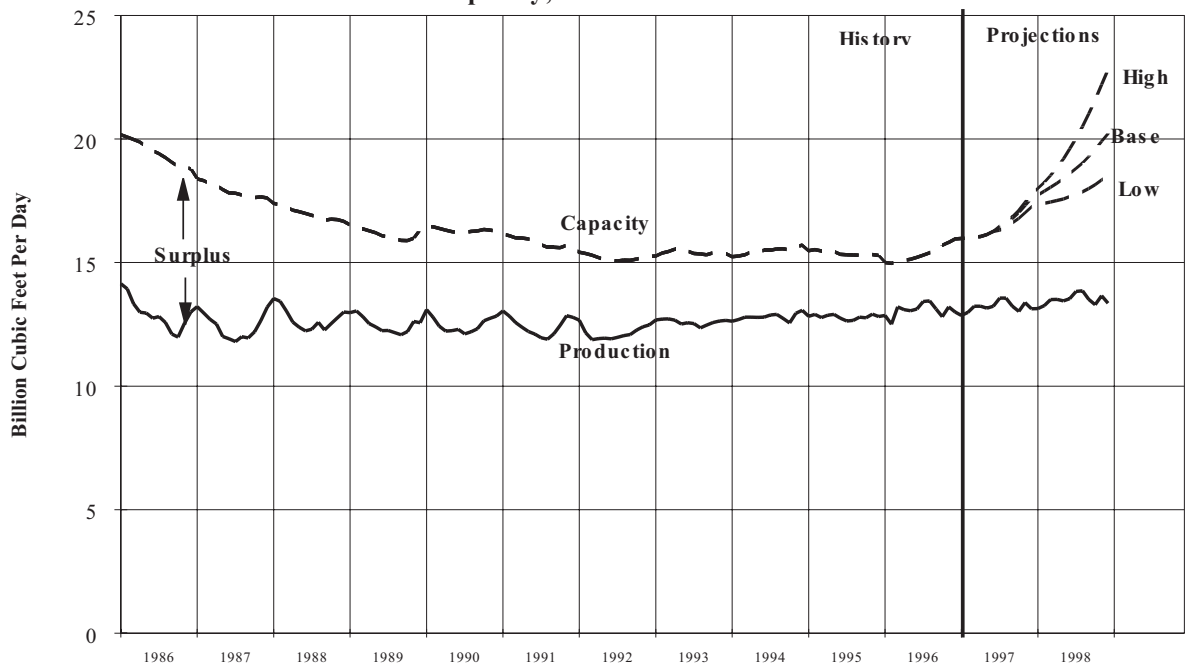
Initial flow rates for Texas wells range from high to relatively low. The average initial flow rate per well in Texas has been about one million cubic feet per day for the last few years (Table C1).

Figure 16 shows the percent of the Texas gas-well gas productive capacity for each year by age of well. Well completions that have been producing gas for less than one year contributed 30 percent of the gas-well gas productive capacity in 1996.

Figure 17 shows a comparison of the maximum daily rate monthly determined by the Texas Railroad Commission (TRC) and the gross gas-well gas productive capacity estimated in this study. The magnitude of the maximum daily rate as determined by TRC from the G-10 tests is higher than the productive capacity estimated in this report.

Operators of Texas gas wells are required to make a production test of each gas well semi-annually and report the test on Form G-10 unless the well is exempt from testing.

Figure 14. Texas (Excluding Gulf of Mexico OCS) Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 5. Texas (Excluding Gulf of Mexico OCS) Dry Gas Production and Wellhead Productive Capacity, 1986-1996 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	14,148	16,666	3,509	20,175	6,027	70.1
Jun-86	12,749	16,258	3,267	19,525	6,776	65.3
Dec-86	13,007	15,640	3,146	18,786	5,779	69.2
Jan-87	13,217	15,247	3,140	18,387	5,170	71.9
Jun-87	11,918	14,795	3,033	17,828	5,910	66.8
Dec-87	13,196	14,588	3,025	17,613	4,417	74.9
Jan-88	13,542	14,248	3,150	17,398	3,856	77.8
Jun-88	12,234	13,913	3,074	16,987	4,753	72.0
Dec-88	13,000	13,679	2,993	16,672	3,672	78.0
Jan-89	12,969	13,459	3,080	16,539	3,570	78.4
Jun-89	12,247	13,131	2,954	16,085	3,838	76.1
Dec-89	12,564	13,502	2,833	16,335	3,771	76.9
Jan-90	13,095	13,459	2,963	16,422	3,327	79.7
Jun-90	12,292	13,324	2,888	16,212	3,920	75.8
Dec-90	12,836	13,290	2,982	16,272	3,436	78.9
Jan-91	13,040	13,207	2,951	16,158	3,118	80.7
Jun-91	12,105	13,021	2,839	15,860	3,755	76.3
Dec-91	12,778	12,787	2,809	15,596	2,818	81.9
Jan-92	12,668	12,492	2,926	15,418	2,750	82.2
Jun-92	11,913	12,255	2,826	15,081	3,168	79.0
Dec-92	12,476	12,440	2,811	15,251	2,775	81.8
Jan-93	12,675	12,227	3,038	15,265	2,590	83.0
Jun-93	12,562	12,521	2,945	15,466	2,904	81.2
Dec-93	12,657	12,458	2,900	15,358	2,701	82.4
Jan-94	12,627	12,389	2,851	15,240	2,613	82.9
Jun-94	12,794	12,751	2,751	15,502	2,708	82.5
Dec-94	13,067	12,997	2,712	15,709	2,642	83.2
Jan-95	12,824	12,817	2,664	15,481	2,657	82.8
Jun-95	12,749	12,773	2,559	15,332	2,583	83.2
Dec-95	12,814	12,744	2,544	15,288	2,474	83.8
Jan-96	12,859	12,463	2,537	15,000	2,141	85.7
Jun-96	13,121	12,718	2,491	15,209	2,088	86.3
Dec-96	13,002	13,484	2,475	15,959	2,957	81.5

[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.

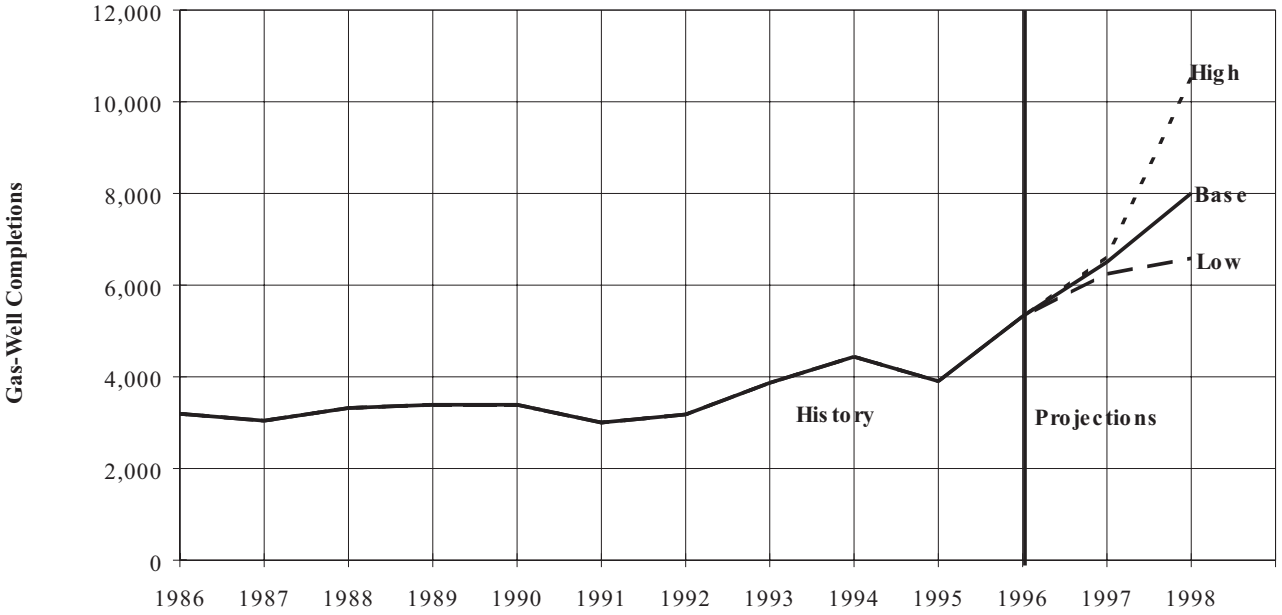
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997.

Table 6. Texas (Excluding Gulf of Mexico OCS) Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity: Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Low Case Projection						
Jan-97	12,859	13,508	2,464	15,972	3,113	80.5
Jun-97	13,232	13,839	2,423	16,262	3,030	81.4
Dec-97	13,160	15,004	2,245	17,249	4,089	76.3
Jan-98	13,146	15,101	2,232	17,333	4,187	75.8
Jun-98	13,542	15,502	2,168	17,670	4,128	76.6
Dec-98	13,405	16,417	2,100	18,517	5,112	72.4
Base Case Projections						
Jan-97	12,859	13,508	2,464	15,972	3,113	80.5
Jun-97	13,232	13,839	2,423	16,262	3,030	81.4
Dec-97	13,129	15,231	2,361	17,592	4,463	74.6
Jan-98	13,139	15,387	2,353	17,740	4,601	74.1
Jun-98	13,539	16,287	2,315	18,602	5,063	72.8
Dec-98	13,358	17,945	2,277	20,222	6,864	66.1
High Case Projections						
Jan-97	12,859	13,508	2,464	15,972	3,113	80.5
Jun-97	13,232	13,839	2,423	16,262	3,030	81.4
Dec-97	13,110	15,322	2,465	17,787	4,677	73.7
Jan-98	13,133	15,542	2,461	18,003	4,870	72.9
Jun-98	13,539	17,149	2,451	19,600	6,061	69.1
Dec-98	13,345	20,359	2,449	22,808	9,463	58.5

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

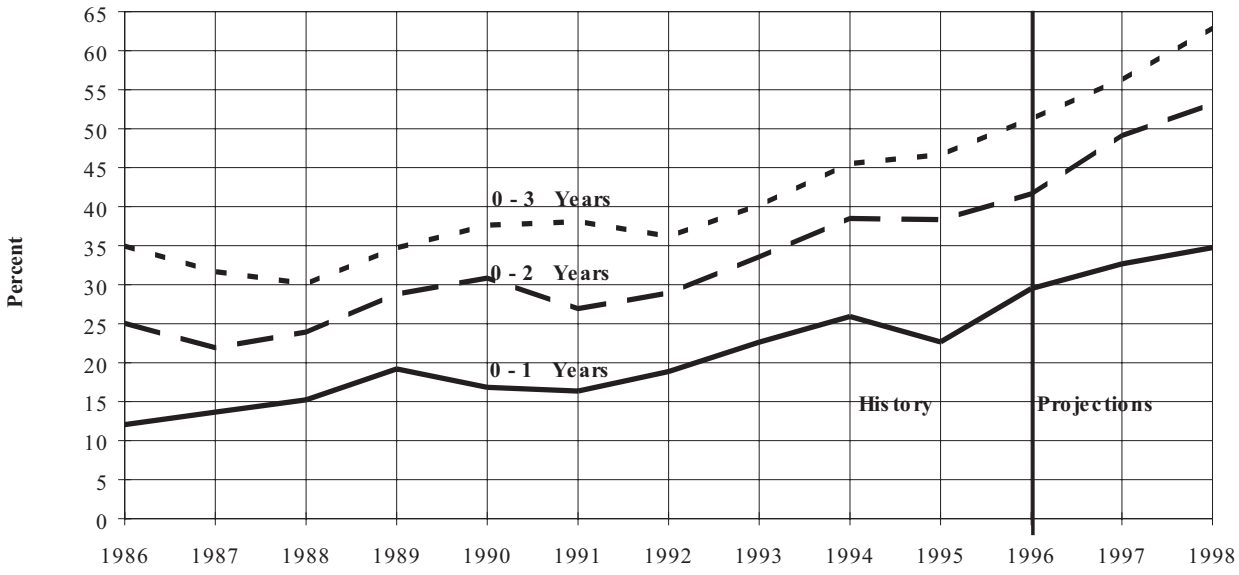
Figure 15. Texas (Excluding Gulf of Mexico OCS) Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

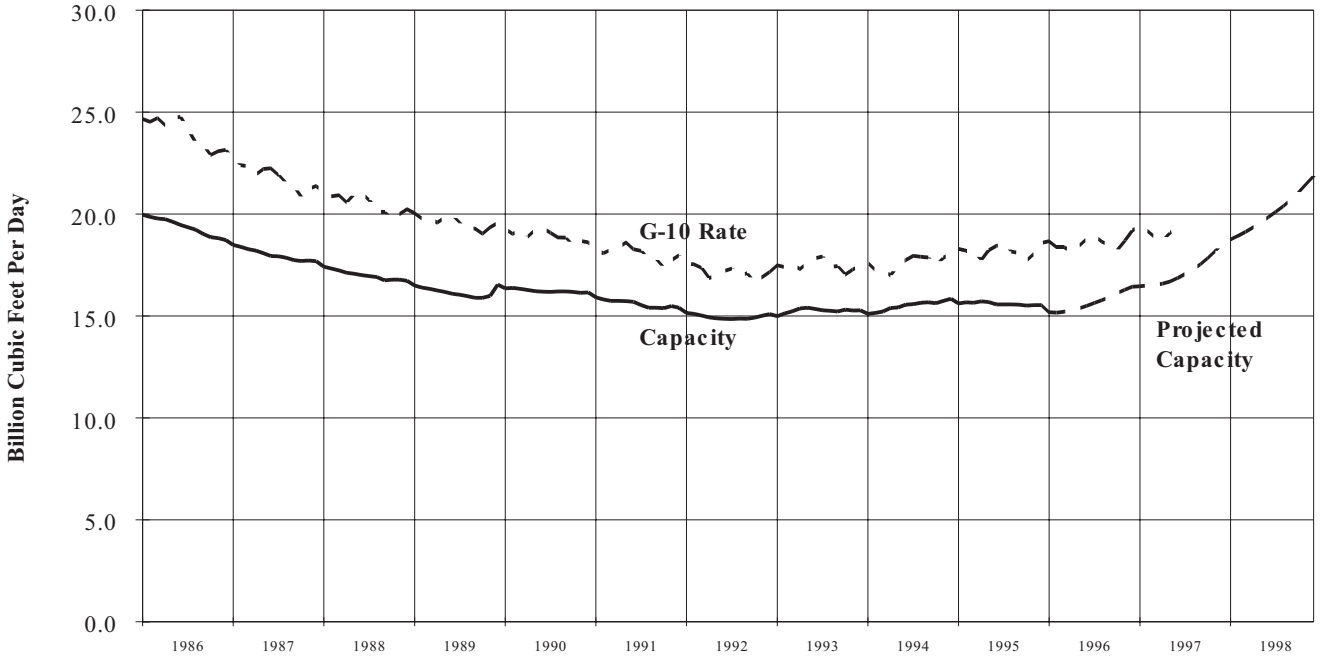
Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Figure 16. Percent of Total Wellhead Productive Capacity of Texas (Excluding Gulf of Mexico OCS) Gas Wells by Well Age, 1986-1998 (Base Case)



Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Figure 17. Texas (Excluding Gulf of Mexico OCS) Monthly Gross Gas-Well Gas Productive Capacity and G-10 Rate, 1986-1998



Note: Capacity projection plotted for base case only.

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Railroad Commission of Texas. Projections: Model GASCAP94 C102997.

All gas wells producing less than 100 thousand cubic feet per day are automatically exempt. Each month, the TRC determines statewide gas well deliverability by summing the latest available G-10 test rates. However, the TRC does not necessarily expect that this deliverability (sum of G-10 test rates) can be achieved. This is true for the following reasons:

The daily rate reported on a Form G-10 is of 72 hours duration, and that rate cannot be sustained for a month by most gas-well completions.

If all gas-well completions were produced at the daily rate shown on a G-10, increased back-pressures would result, prohibiting gas from many wells from getting into the pipeline system.

The daily rates reported on the form G-10 reflects the ability of gas-well completions to produce at the time they are tested. However, each TRC deliverability estimate (sum of latest G-10 tests) contains well test data that may be as much as five or more months old.

Capacity estimated in this report is the daily rate that can be sustained for a month. Rates reported on the G-10 tests are required to be sustainable for only 72 hours.

Both, however, exhibit a similar downward trend. Capacity is projected to increase during 1997 and 1998. Data from the G-10 tests are plotted through June 1997.

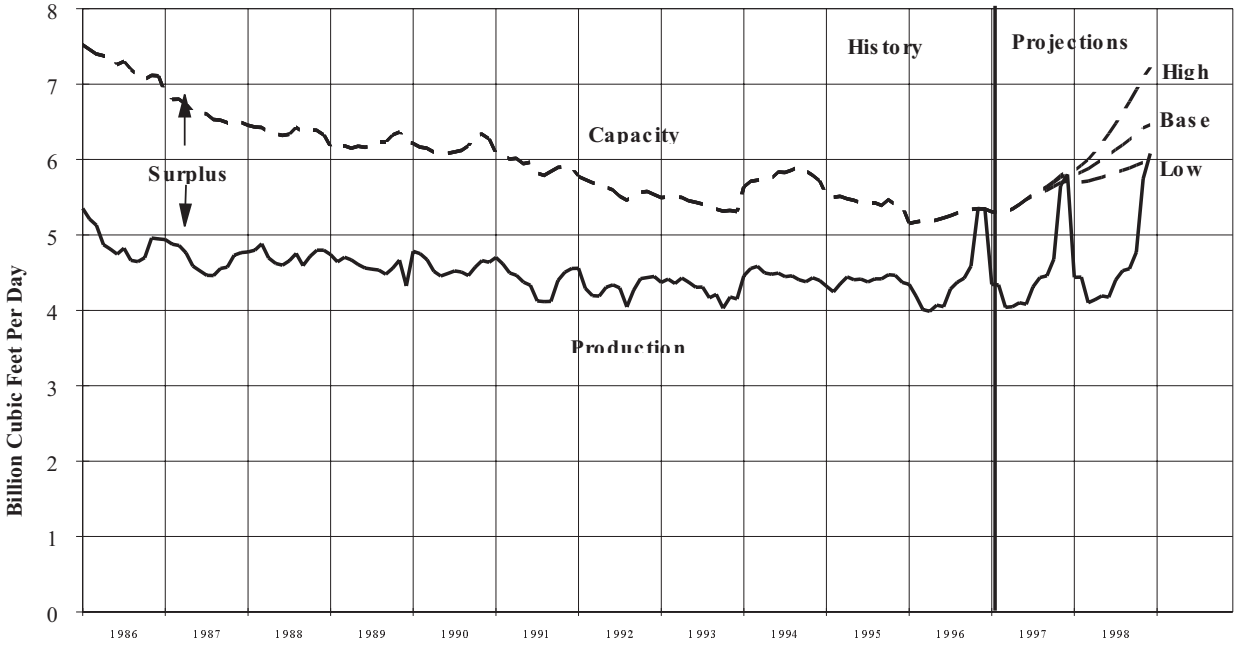
Louisiana (Excluding Gulf of Mexico OCS)

Louisiana has been a large producer of natural gas for many years. Gas produced comes from high permeability, water-drive, deep and sometimes over-pressured formations on the Gulf Coast as well as from low permeability and relatively shallow reservoirs in North Louisiana. In 1995, the three fields producing the largest volume of natural gas in the State were the Fresh Water Bayou (70 Bcf), Chalkey (51 Bcf), and Lake Arthur South (51 Bcf) fields, according to Dwight's data. In 1995, almost 9 percent of the total dry gas produced in the lower 48 States came from Louisiana.{14}

The following pages include Tables 7 and 8 and Figures 18 through 20, which provide historical and projected production and productive capacity, gas-well completions added, and percent of capacity by well age. These data exclude the OCS.

Production and productive capacity are equal with no surplus in November and December 1996. There is no surplus in December 1997 for any of the three cases. In December 1998, there is no surplus for the low case. The production is plotted for the base case only in Figure 18.

Figure 18. Louisiana (Excluding Gulf of Mexico OCS) Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 7. Louisiana (Excluding Gulf of Mexico OCS) Dry Gas Production and Wellhead Productive Capacity, 1986-1996 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	5,350	6,939	585	7,524	2,174	71.1
Jun-86	4,746	6,722	538	7,260	2,514	65.4
Dec-86	4,946	6,530	579	7,109	2,163	69.6
Jan-87	4,939	6,297	583	6,880	1,941	71.8
Jun-87	4,524	6,056	570	6,626	2,102	68.3
Dec-87	4,764	5,920	573	6,493	1,729	73.4
Jan-88	4,773	5,886	569	6,455	1,682	73.9
Jun-88	4,598	5,773	546	6,319	1,721	72.8
Dec-88	4,798	5,789	540	6,329	1,531	75.8
Jan-89	4,738	5,667	502	6,169	1,431	76.8
Jun-89	4,562	5,680	483	6,163	1,601	74.0
Dec-89	4,322	5,810	420	6,230	1,908	69.4
Jan-90	4,782	5,774	440	6,214	1,432	77.0
Jun-90	4,488	5,650	432	6,082	1,594	73.8
Dec-90	4,637	5,832	443	6,275	1,638	73.9
Jan-91	4,701	5,660	419	6,079	1,378	77.3
Jun-91	4,333	5,549	415	5,964	1,631	72.7
Dec-91	4,554	5,473	422	5,895	1,341	77.3
Jan-92	4,559	5,263	512	5,775	1,216	78.9
Jun-92	4,339	5,093	504	5,597	1,258	77.5
Dec-92	4,450	5,037	497	5,534	1,084	80.4
Jan-93	4,369	5,097	398	5,495	1,126	79.5
Jun-93	4,306	5,032	402	5,434	1,128	79.2
Dec-93	4,151	4,935	376	5,311	1,160	78.2
Jan-94	4,459	5,160	479	5,639	1,180	79.1
Jun-94	4,493	5,364	470	5,834	1,341	77.0
Dec-94	4,397	5,246	473	5,719	1,322	76.9
Jan-95	4,320	5,128	391	5,519	1,199	78.3
Jun-95	4,414	5,010	417	5,427	1,013	81.3
Dec-95	4,371	4,955	431	5,386	1,015	81.2
Jan-96	4,343	4,771	381	5,152	809	84.3
Jun-96	4,049	4,811	415	5,226	1,177	77.5
Dec-96	5,346	4,930	416	5,346	0	100.0

[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.

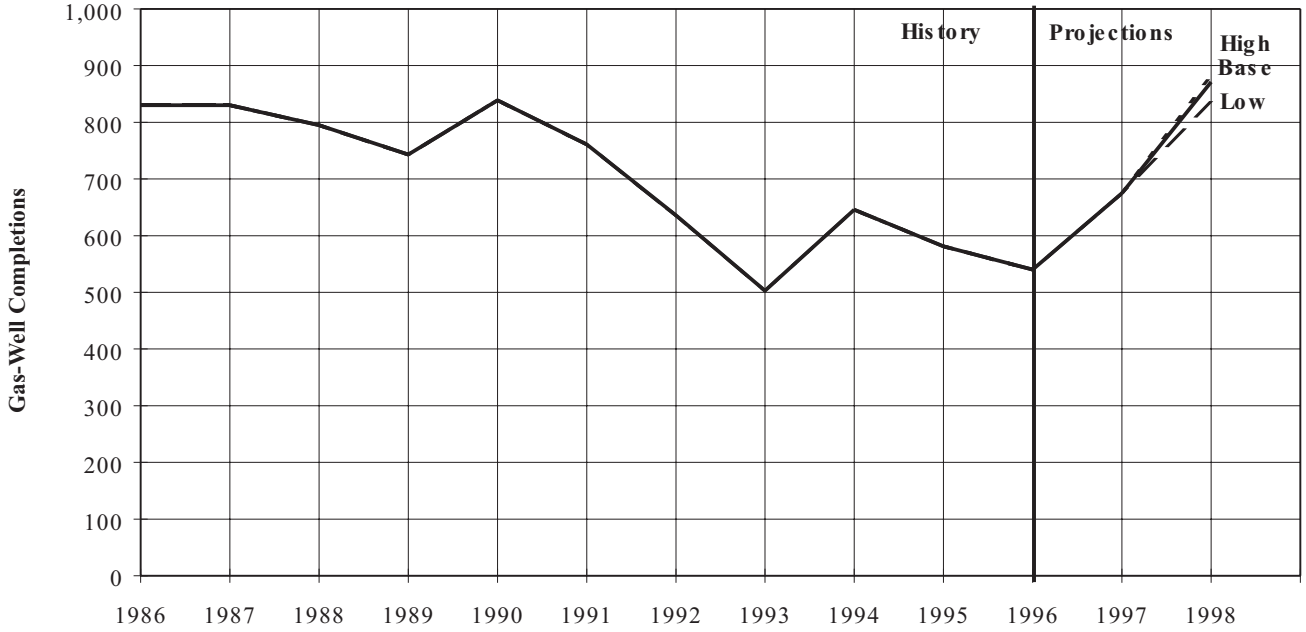
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997.

Table 8. Louisiana (Excluding Gulf of Mexico OCS) Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity: Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Low Case Projection						
Jan-97	4,343	4,894	414	5,308	965	81.8
Jun-97	4,080	5,061	410	5,471	1,391	74.6
Dec-97	5,714	5,331	383	5,714	0	100.0
Jan-98	4,440	5,306	381	5,687	1,247	78.1
Jun-98	4,175	5,423	373	5,796	1,621	72.0
Dec-98	5,964	5,600	364	5,964	0	100.0
Base Case Projection						
Jan-97	4,343	4,894	414	5,308	965	81.8
Jun-97	4,080	5,061	410	5,471	1,391	74.6
Dec-97	5,802	5,399	403	5,802	0	100.0
Jan-98	4,438	5,392	402	5,794	1,356	76.6
Jun-98	4,174	5,668	398	6,066	1,892	68.8
Dec-98	6,081	6,066	395	6,461	380	94.1
High Case Projection						
Jan-97	4,343	4,894	414	5,308	965	81.8
Jun-97	4,080	5,061	410	5,471	1,391	74.6
Dec-97	5,844	5,423	421	5,844	0	100.0
Jan-98	4,436	5,433	420	5,853	1,417	75.8
Jun-98	4,174	5,922	422	6,344	2,170	65.8
Dec-98	6,075	6,795	425	7,220	1,145	84.1

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

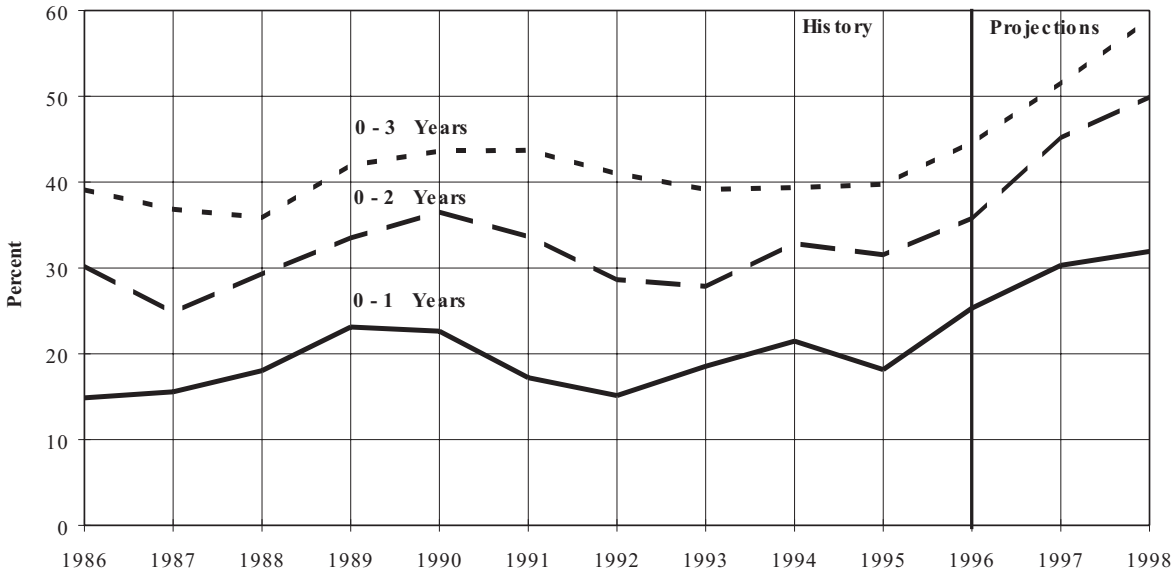
Figure 19. Louisiana (Excluding Gulf of Mexico OCS) Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102297.

Figure 20. Percent of Total Wellhead Productive Capacity of Louisiana (Excluding Gulf Mexico OCS) Gas Wells by Well Age, 1986-1998 (Base Case)



Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

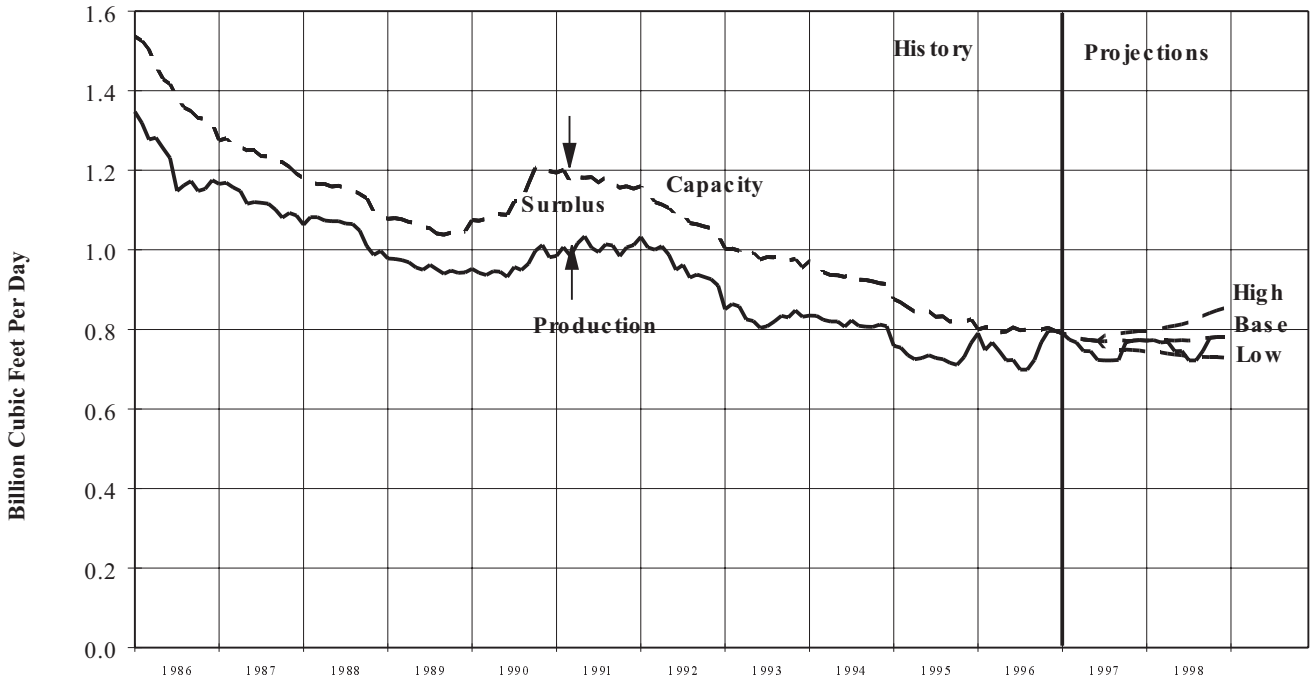
California (Including Pacific OCS)

California is a net importer of natural gas. All California gas produced is used within the State. In 1995, two-thirds of the total gas produced in California and the Pacific OCS was oil-well gas.{14}

In 1994, Elk Hills and Coalingas East Extension oil fields were the two largest producers of natural gas. The two largest gas fields were Rio Vista and Pitas Point; the latter is in the Pacific OCS. This information was obtained from the California Department of Conservation.

The following pages include Tables 9 and 10 and Figures 21 through 23, which provide historical and projected production and productive capacity, gas-well completions added, and percent of capacity by well age. These data include the OCS. Production and productive capacity are equal, with no surplus for December 1996. There is no surplus for January 1997, October 1997 through June 1998, and September 1998 through December 1998 for the low case. For the base case, there is no surplus for January 1997, October 1997 through February 1998, and October 1998 through December 1998. For the high case, there is no surplus for January 1997, and November 1997 through January 1998.

Figure 21. California (Including Pacific OCS) Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 9. California (Including Pacific OCS) Dry Gas Production and Wellhead Productive Capacity, 1986-1996 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	1,347	762	775	1,537	190	87.6
Jun-86	1,231	683	734	1,417	186	86.9
Dec-86	1,175	616	703	1,319	144	89.1
Jan-87	1,166	579	696	1,275	109	91.5
Jun-87	1,120	536	714	1,250	130	89.6
Dec-87	1,086	485	707	1,192	106	91.1
Jan-88	1,063	485	695	1,180	117	90.1
Jun-88	1,072	469	692	1,161	89	92.3
Dec-88	997	431	655	1,086	89	91.8
Jan-89	978	419	659	1,078	100	90.7
Jun-89	950	399	658	1,057	107	89.9
Dec-89	943	399	648	1,047	104	90.1
Jan-90	952	423	652	1,075	123	88.6
Jun-90	932	450	638	1,088	156	85.7
Dec-90	981	561	637	1,198	217	81.9
Jan-91	985	569	625	1,194	209	82.5
Jun-91	1,005	555	628	1,183	178	85.0
Dec-91	1,012	519	635	1,154	142	87.7
Jan-92	1,032	528	632	1,160	128	89.0
Jun-92	950	457	630	1,087	137	87.4
Dec-92	910	408	628	1,036	126	87.8
Jan-93	851	428	575	1,003	152	84.8
Jun-93	804	397	579	976	172	82.4
Dec-93	832	368	588	956	124	87.0
Jan-94	835	398	574	972	137	85.9
Jun-94	807	356	576	932	125	86.6
Dec-94	808	313	601	914	106	88.4
Jan-95	759	326	550	876	117	86.6
Jun-95	735	288	558	846	111	86.9
Dec-95	766	264	561	825	59	92.8
Jan-96	790	251	549	800	10	98.8
Jun-96	723	251	554	805	82	89.8
Dec-96	796	259	537	796	0	100.0

[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.

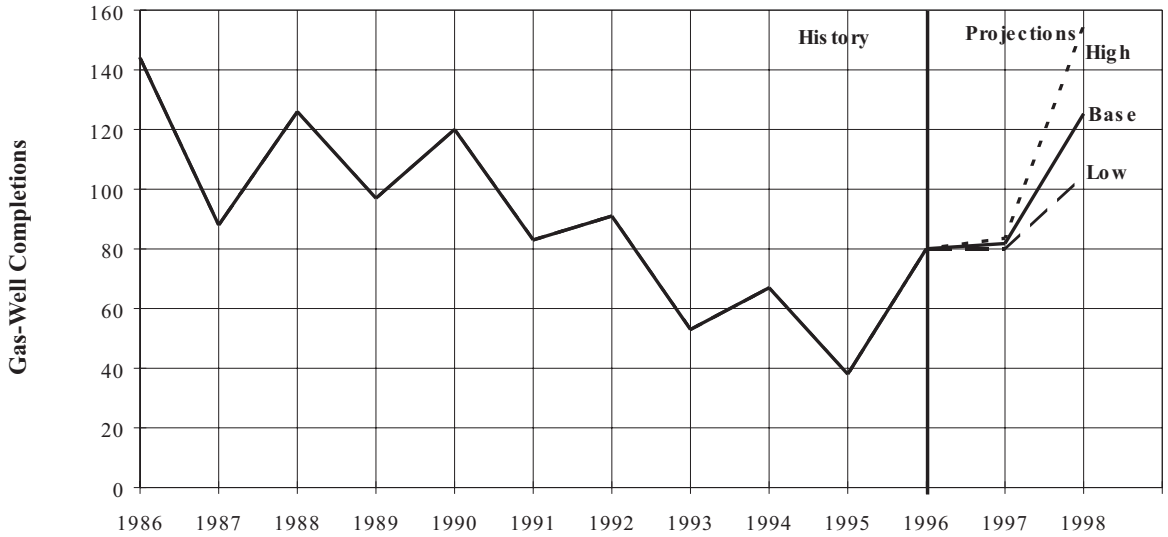
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997.

Table 10. California (Including Pacific OCS) Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
			Low Case Projection			
Jan-97	790	255	535	790	0	100.0
Jun-97	723	241	530	771	48	93.8
Dec-97	747	249	498	747	0	100.0
Jan-98	744	249	495	744	0	100.0
Jun-98	735	250	485	735	0	100.0
Dec-98	729	255	474	729	0	100.0
			Base Case Projection			
Jan-97	790	255	535	790	0	100.0
Jun-97	723	241	530	771	48	93.8
Dec-97	773	253	520	773	0	100.0
Jan-98	772	253	519	772	0	100.0
Jun-98	746	259	514	773	27	96.5
Dec-98	781	272	509	781	0	100.0
			High Case Projection			
Jan-97	790	255	535	790	0	100.0
Jun-97	723	241	530	771	48	93.8
Dec-97	796	255	541	796	0	100.0
Jan-98	796	256	540	796	0	100.0
Jun-98	746	273	540	813	67	91.8
Dec-98	835	310	543	853	18	97.9

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

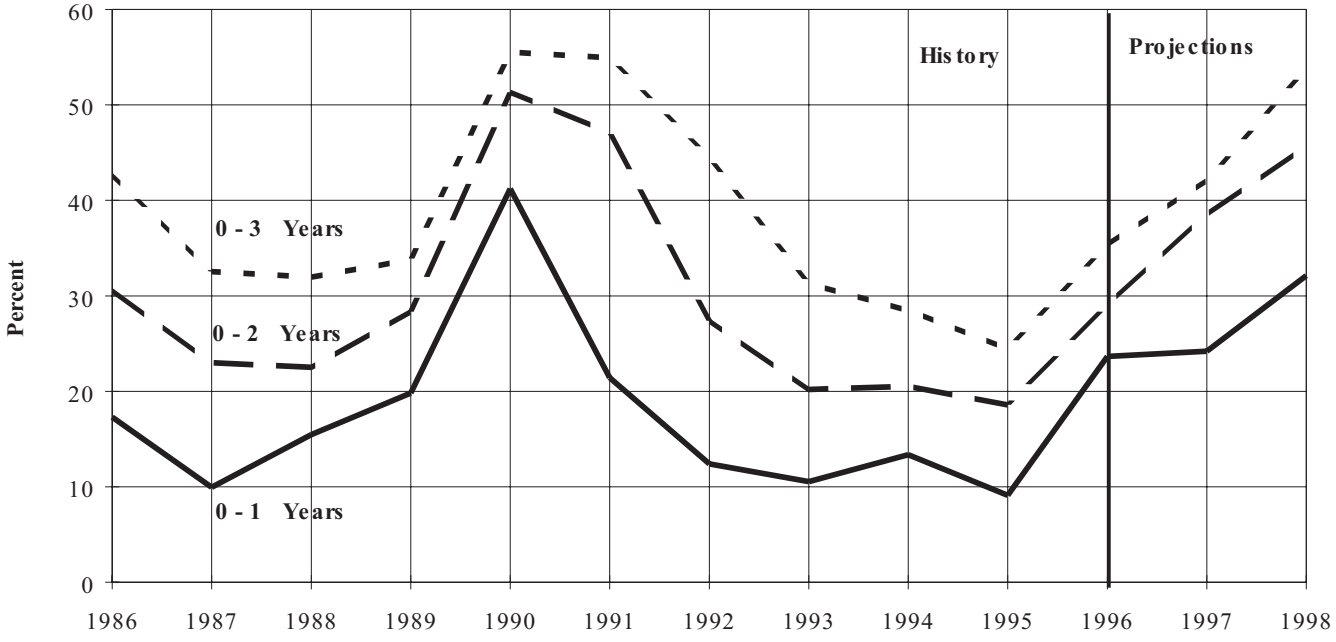
Figure 22. California (Including Pacific OCS) Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Figure 23. Percent of Total Wellhead Productive Capacity of California (Including Pacific OCS) Gas Wells by Well Age, 1986-1998 (Base Case)



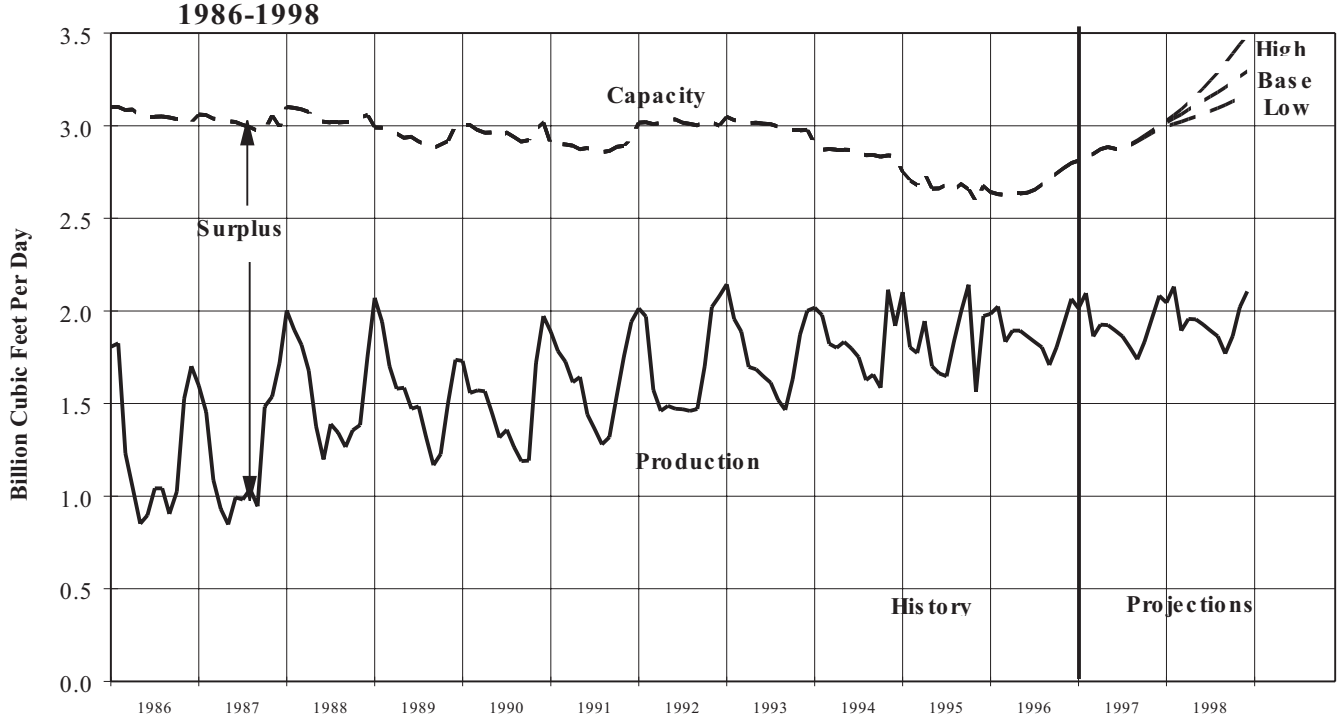
Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Kansas

In 1995 over half the gas produced in the State of Kansas came from the giant Hugoton field. Hugoton field 1995 production of 517 billion cubic feet of gas was almost 23 percent more than in 1994. This information was obtained from Dwight's. Hugoton field occupies almost all of the western half of Kansas and extends south into Oklahoma and the northern part of the Texas Panhandle. Production from this field generally comes from low permeability sandy carbonate reservoir rocks.

The following pages include Tables 11, 12, and Figures 24 through 26. These data provide historical and projected production and productive capacity, gas-well completions added, and percent of capacity by well age.

Figure 24. Kansas Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 11. Kansas Dry Gas Production and Wellhead Productive Capacity Projections, 1986-1996
(Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	1,806	2,813	287	3,100	1,294	58.3
Jun-86	897	2,803	245	3,048	2,151	29.4
Dec-86	1,702	2,791	226	3,017	1,315	56.4
Jan-87	1,597	2,809	251	3,060	1,463	52.2
Jun-87	994	2,768	252	3,020	2,026	32.9
Dec-87	1,720	2,745	248	2,993	1,273	57.5
Jan-88	2,002	2,820	281	3,101	1,099	64.6
Jun-88	1,198	2,720	302	3,022	1,824	39.6
Dec-88	1,753	2,778	279	3,057	1,304	57.3
Jan-89	2,071	2,742	248	2,990	919	69.3
Jun-89	1,472	2,696	244	2,940	1,468	50.1
Dec-89	1,736	2,784	218	3,002	1,266	57.8
Jan-90	1,730	2,727	279	3,006	1,276	57.6
Jun-90	1,317	2,665	275	2,940	1,623	44.8
Dec-90	1,972	2,750	268	3,018	1,046	65.3
Jan-91	1,888	2,698	200	2,898	1,010	65.1
Jun-91	1,441	2,678	202	2,880	1,439	50.0
Dec-91	1,941	2,740	193	2,933	992	66.2
Jan-92	2,014	2,801	215	3,016	1,002	66.8
Jun-92	1,472	2,829	205	3,034	1,562	48.5
Dec-92	2,080	2,801	200	3,001	921	69.3
Jan-93	2,144	2,841	207	3,048	904	70.3
Jun-93	1,647	2,791	220	3,011	1,364	54.7
Dec-93	2,001	2,774	204	2,978	977	67.2
Jan-94	2,018	2,681	216	2,897	879	69.7
Jun-94	1,798	2,647	222	2,869	1,071	62.7
Dec-94	1,920	2,619	216	2,835	915	67.7
Jan-95	2,102	2,521	229	2,750	648	76.4
Jun-95	1,663	2,437	225	2,662	999	62.5
Dec-95	1,973	2,469	206	2,675	702	73.8
Jan-96	1,984	2,435	207	2,642	658	75.1
Jun-96	1,863	2,427	211	2,638	775	70.6
Dec-96	2,066	2,581	217	2,798	732	73.8

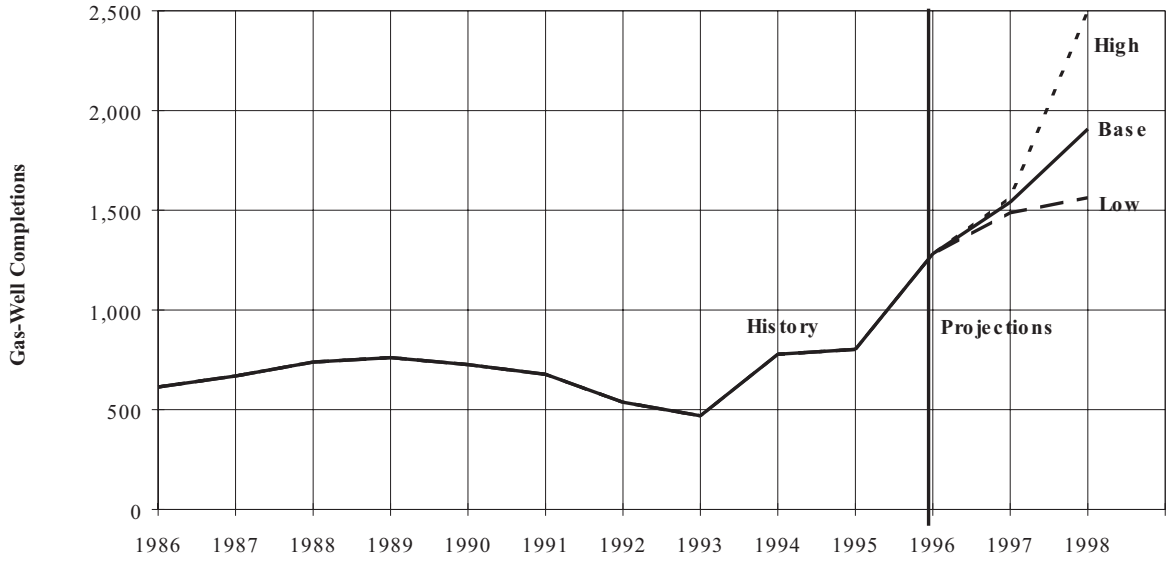
[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.;

Table 12. Kansas Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998
(Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
			Low Case Projection			
Jan-97	2,014	2,595	216	2,811	797	71.6
Jun-97	1,894	2,663	212	2,875	981	65.9
Dec-97	2,087	2,787	196	2,983	896	70.0
Jan-98	2,046	2,801	195	2,996	950	68.3
Jun-98	1,926	2,875	189	3,064	1,138	62.9
Dec-98	2,113	2,982	183	3,165	1,052	66.8
			Base Case Projection			
Jan-97	2,014	2,595	216	2,811	797	71.6
Jun-97	1,894	2,663	212	2,875	981	65.9
Dec-97	2,082	2,793	206	2,999	917	69.4
Jan-98	2,045	2,811	206	3,017	972	67.8
Jun-98	1,926	2,933	202	3,135	1,209	61.4
Dec-98	2,106	3,094	199	3,293	1,187	64.0
			High Case Projection			
Jan-97	2,014	2,595	216	2,811	797	71.6
Jun-97	1,894	2,663	212	2,875	981	65.9
Dec-97	2,079	2,787	216	3,003	924	69.2
Jan-98	2,044	2,813	215	3,028	984	67.5
Jun-98	1,926	2,988	214	3,202	1,276	60.1
Dec-98	2,104	3,274	214	3,488	1,384	60.3

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

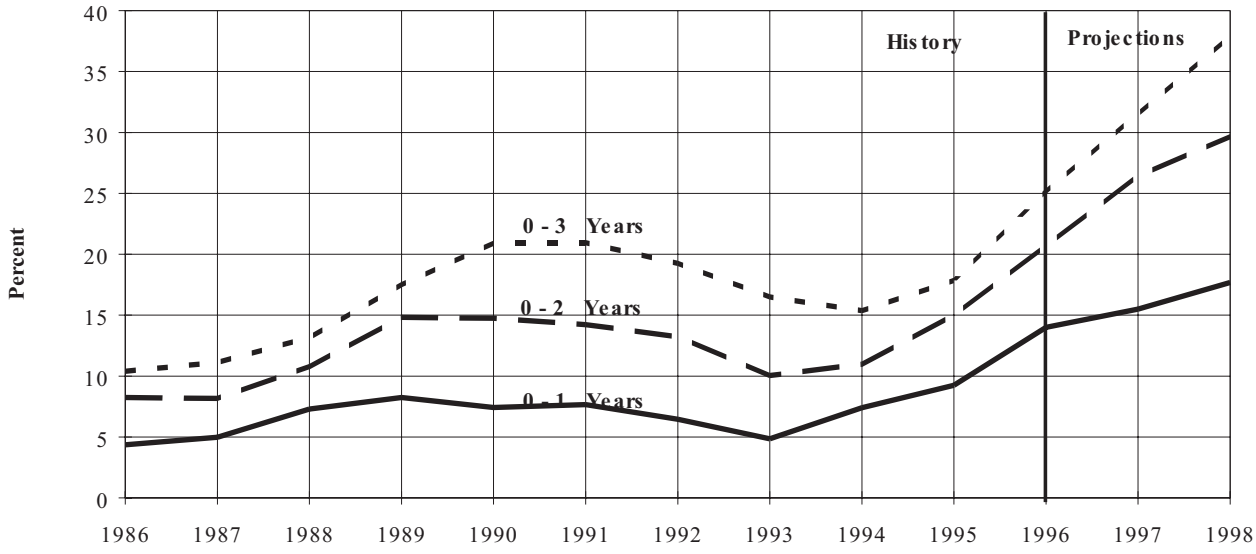
Figure 25. Kansas Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Figure 26. Percent of Total Wellhead Productive Capacity of Kansas Gas Wells by Well Age, 1986-1998 (Base Case)



Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

New Mexico

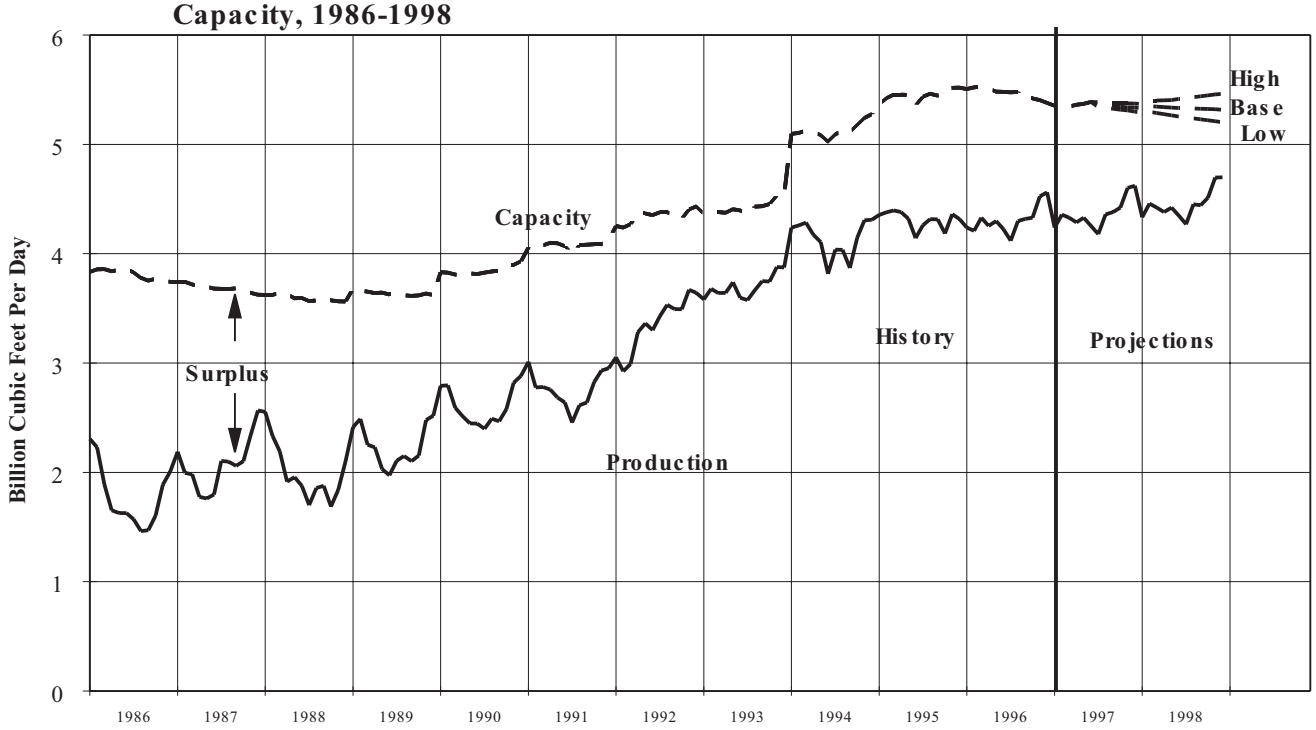
Most of this State's natural gas is produced from fields in northwestern New Mexico from the San Juan Basin. Practically all of the oil-well gas produced comes from the Permian Basin of southeast New Mexico.

Basin field of the San Juan Basin, the largest gas field in the State, produced 667 billion cubic feet of mixed gas-well conventional and coalbed gas during 1995. This was a decrease of 36 billion cubic feet over the amount produced in 1994. New Mexico has been an area of intense drilling for coalbed gas since 1989. Coalbed gas production from this field increased 217 percent from 1990 through 1994.

Coalbed gas produced in New Mexico was about 15 percent of the State's total dry gas producted in 1990, 23 percent in 1991, 31 percent in 1992, 36 percent in 1993, 39 percent in 1994, and 41 percent in 1995.{13} Coalbed gas-well completions were treated separately from the conventional gas-well completions in this report. Coalbed gas wells have an increasing rate of production the first few years of their lives. After reaching their peak production rates, coalbed gas wells are predicted to have very low decline rates and therefore very long lives. Coalbed gas capacity has shown an increase in the last few years. (Figure 28).

The following pages include Tables 13, 14, and Figures 27 through 30, which provide historical and projected production and productive capacity, gas-well completions added, and percent of capacity by well age.

Figure 27. New Mexico Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 13. New Mexico Dry Gas Production and Wellhead Productive Capacity, 1986-1996
(Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	2,307	3,259	574	3,833	1,526	60.2
Jun-86	1,627	3,310	551	3,861	2,234	42.1
Dec-86	2,005	3,222	521	3,743	1,738	53.6
Jan-87	2,189	3,208	536	3,744	1,555	58.5
Jun-87	1,798	3,155	525	3,680	1,882	48.9
Dec-87	2,567	3,085	539	3,624	1,057	70.8
Jan-88	2,553	3,098	524	3,622	1,069	70.5
Jun-88	1,876	3,083	512	3,595	1,719	52.2
Dec-88	2,100	3,059	503	3,562	1,462	59.0
Jan-89	2,414	3,179	501	3,680	1,266	65.6
Jun-89	1,974	3,155	472	3,627	1,653	54.4
Dec-89	2,519	3,165	458	3,623	1,104	69.5
Jan-90	2,791	3,322	508	3,830	1,039	72.9
Jun-90	2,445	3,322	491	3,813	1,368	64.1
Dec-90	2,881	3,426	504	3,930	1,049	73.3
Jan-91	3,010	3,506	551	4,057	1,047	74.2
Jun-91	2,640	3,531	539	4,070	1,430	64.9
Dec-91	2,952	3,581	547	4,128	1,176	71.5
Jan-92	3,051	3,692	563	4,255	1,204	71.7
Jun-92	3,301	3,789	564	4,353	1,052	75.8
Dec-92	3,642	3,880	553	4,433	791	82.2
Jan-93	3,583	3,801	565	4,366	783	82.1
Jun-93	3,596	3,839	556	4,395	799	81.8
Dec-93	3,875	3,959	571	4,530	655	85.5
Jan-94	4,239	4,556	539	5,095	856	83.2
Jun-94	3,815	4,540	487	5,027	1,212	75.9
Dec-94	4,310	4,761	515	5,276	966	81.7
Jan-95	4,354	4,758	611	5,369	1,015	81.1
Jun-95	4,143	4,737	620	5,357	1,214	77.3
Dec-95	4,316	4,904	615	5,519	1,203	78.2
Jan-96	4,239	4,891	615	5,506	1,267	77.0
Jun-96	4,224	4,875	605	5,480	1,256	77.1
Dec-96	4,561	4,774	606	5,380	819	84.8

[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.

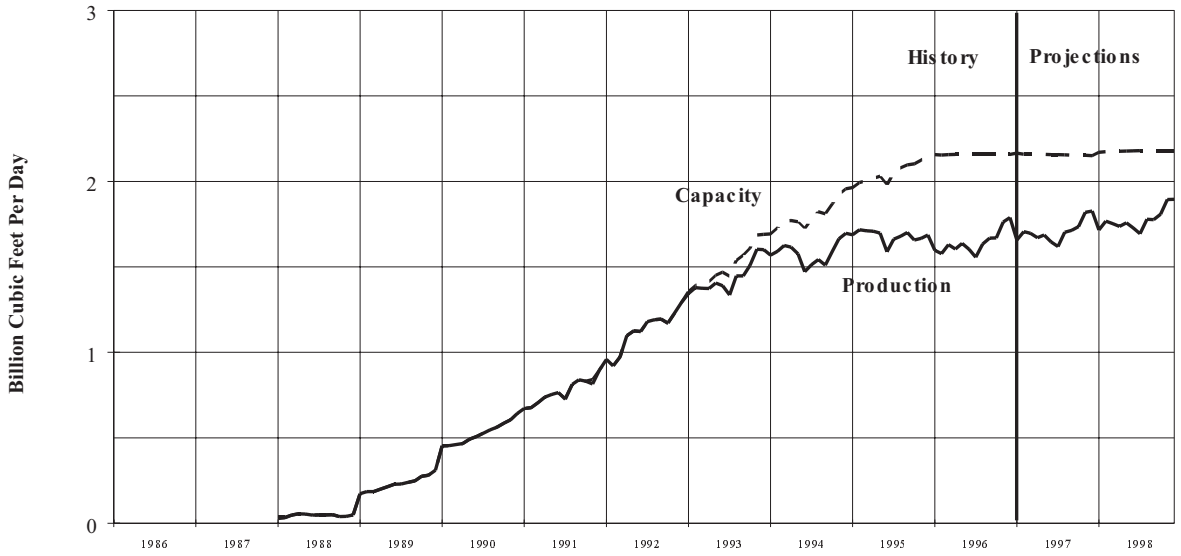
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997.

Table 14. New Mexico Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity: Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Low Case Projection						
Jan-97	4,239	4,750	604	5,354	1,115	79.2
Jun-97	4,255	4,792	597	5,389	1,134	79.0
Dec-97	4,632	4,745	556	5,301	669	87.4
Jan-98	4,335	4,733	553	5,286	951	82.0
Jun-98	4,350	4,715	540	5,255	905	82.8
Dec-98	4,714	4,676	526	5,202	488	90.6
Base Case Projection						
Jan-97	4,239	4,750	604	5,354	1,115	79.2
Jun-97	4,255	4,792	597	5,389	1,134	79.0
Dec-97	4,621	4,752	585	5,337	716	86.6
Jan-98	4,333	4,744	583	5,327	994	81.3
Jun-98	4,349	4,756	577	5,333	984	81.5
Dec-98	4,698	4,746	571	5,317	619	88.4
High Case Projection						
Jan-97	4,239	4,750	604	5,354	1,115	79.2
Jun-97	4,255	4,792	597	5,389	1,134	79.0
Dec-97	4,615	4,762	611	5,373	758	85.9
Jan-98	4,331	4,759	610	5,369	1,038	80.7
Jun-98	4,349	4,804	611	5,415	1,066	80.3
Dec-98	4,693	4,850	614	5,464	771	85.9

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

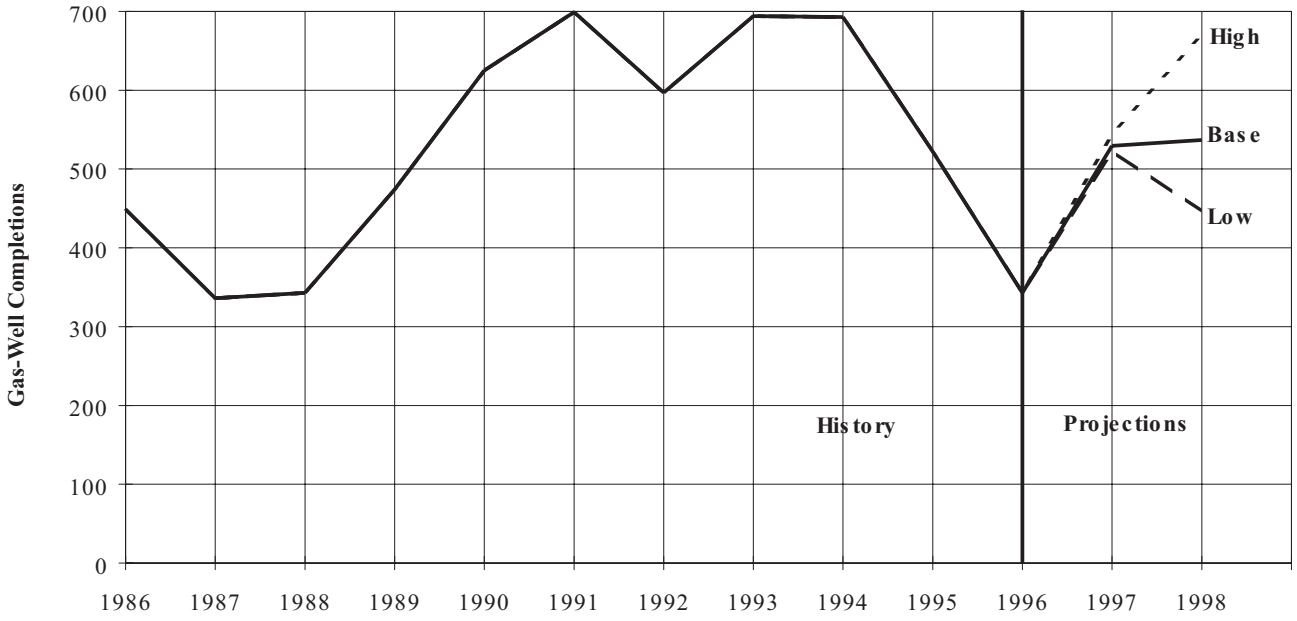
Figure 28. New Mexico Dry Coalbed Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

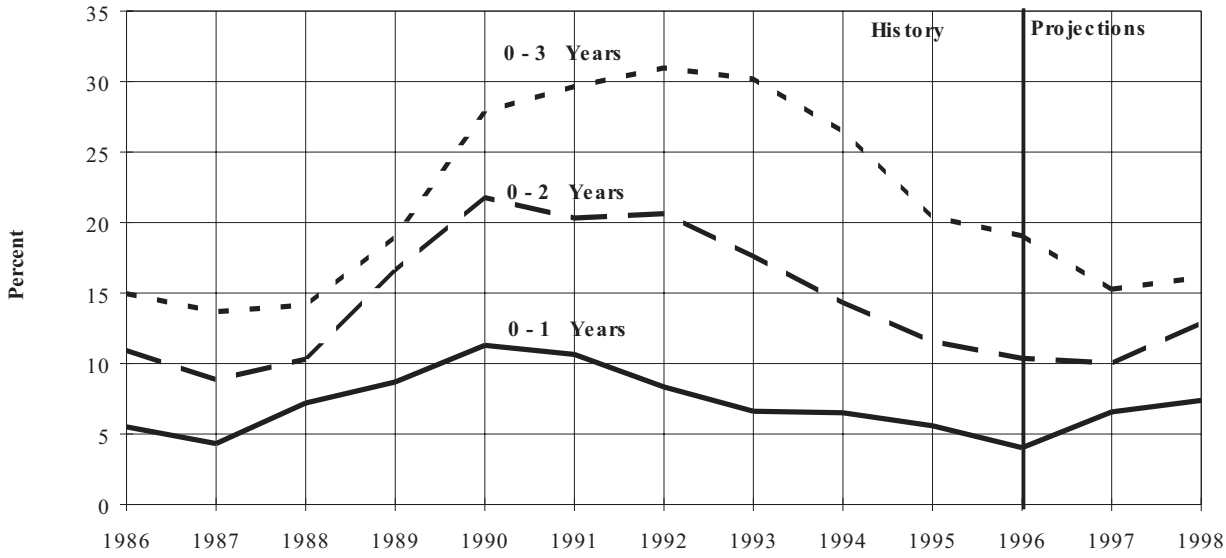
Figure 29. New Mexico Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Figure 30. Percent of Total Wellhead Productive Capacity of New Mexico Gas Wells by Well Age, 1986-1998 (Base Case)



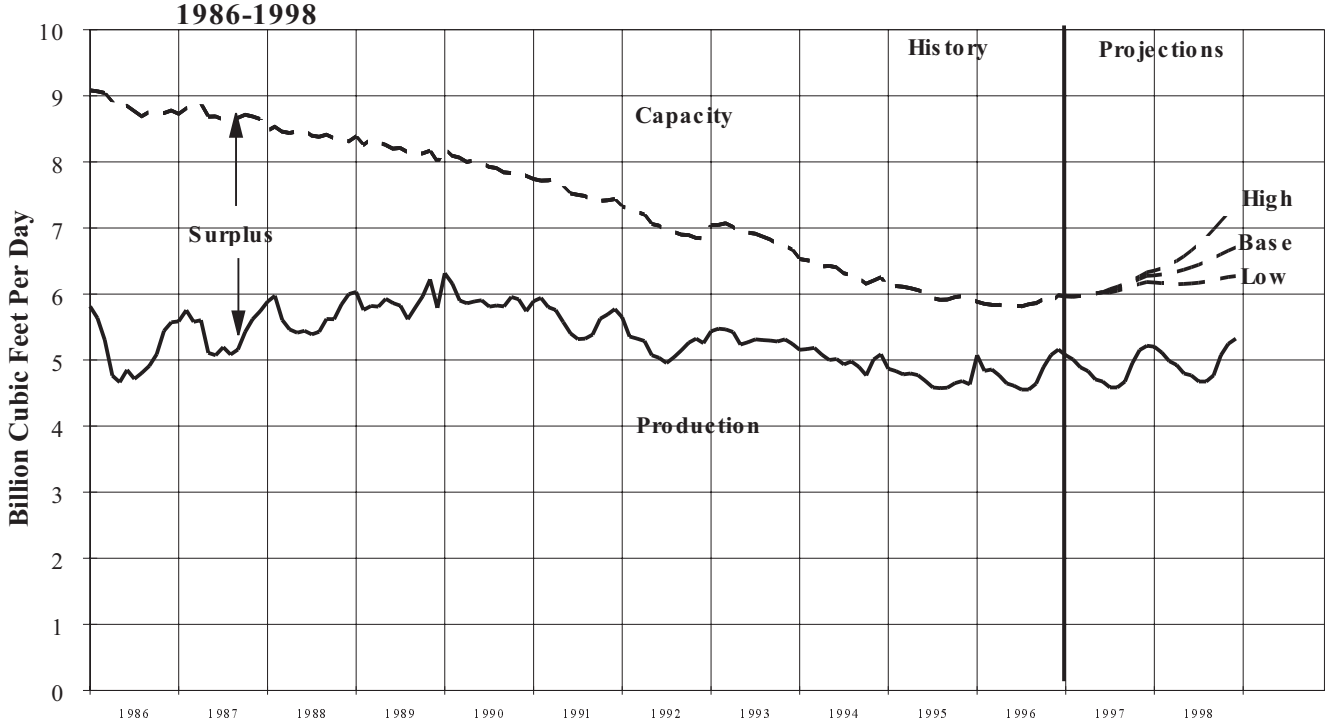
Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Oklahoma

Oklahoma is among the top three gas-producing States. There are numerous large and small gas fields scattered throughout western Oklahoma. Oil fields with large volumes of associated-dissolved gas are located generally in central Oklahoma. Dwight's EnergyData, Inc., indicates that, in 1995, the top two gas-producing areas were the Mocane-Laverne (94 Bcf) area and the Watonga-Chickasha Trend (82 Bcf). The Mocane-Laverne area, located in Northwest Oklahoma, consists of over 50 fields, and the Watonga-Chickasha Trend consists of more than 70 fields.

The following pages include Tables 15 and 16 and Figures 31 through 33, which provide historical and projected production and productive capacity, gas-well completions added, and percent of capacity by well age.

Figure 31. Oklahoma Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 15. Oklahoma Dry Gas Production and Wellhead Productive Capacity, 1986-1996
(Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	5,812	7,575	1,507	9,082	3,270	64.0
Jun-86	4,852	7,555	1,295	8,850	3,998	54.8
Dec-86	5,572	7,513	1,264	8,777	3,205	63.5
Jan-87	5,588	7,498	1,228	8,726	3,138	64.0
Jun-87	5,073	7,392	1,296	8,688	3,615	58.4
Dec-87	5,742	7,439	1,211	8,650	2,908	66.4
Jan-88	5,885	7,271	1,202	8,473	2,588	69.5
Jun-88	5,444	7,256	1,222	8,478	3,034	64.2
Dec-88	5,999	7,128	1,183	8,311	2,312	72.2
Jan-89	6,032	7,164	1,222	8,386	2,354	71.9
Jun-89	5,863	7,059	1,141	8,200	2,337	71.5
Dec-89	5,789	6,966	1,033	7,999	2,210	72.4
Jan-90	6,313	6,981	1,224	8,205	1,892	76.9
Jun-90	5,907	6,892	1,094	7,986	2,079	74.0
Dec-90	5,740	6,778	1,010	7,788	2,048	73.7
Jan-91	5,890	6,800	940	7,740	1,850	76.1
Jun-91	5,405	6,583	941	7,524	2,119	71.8
Dec-91	5,772	6,545	892	7,437	1,665	77.6
Jan-92	5,646	6,424	902	7,326	1,680	77.1
Jun-92	5,035	6,141	893	7,034	1,999	71.6
Dec-92	5,257	5,958	887	6,845	1,588	76.8
Jan-93	5,436	6,219	824	7,043	1,607	77.2
Jun-93	5,271	6,083	846	6,929	1,658	76.1
Dec-93	5,244	5,886	788	6,674	1,430	78.6
Jan-94	5,155	5,709	820	6,529	1,374	79.0
Jun-94	5,017	5,587	817	6,404	1,387	78.3
Dec-94	5,088	5,450	804	6,254	1,166	81.4
Jan-95	4,869	5,335	750	6,085	1,216	80.0
Jun-95	4,687	5,261	759	6,020	1,333	77.9
Dec-95	4,632	5,214	735	5,949	1,317	77.9
Jan-96	5,074	5,132	751	5,883	809	86.2
Jun-96	4,612	5,082	729	5,811	1,199	79.4
Dec-96	5,161	5,240	741	5,981	820	86.3

[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.

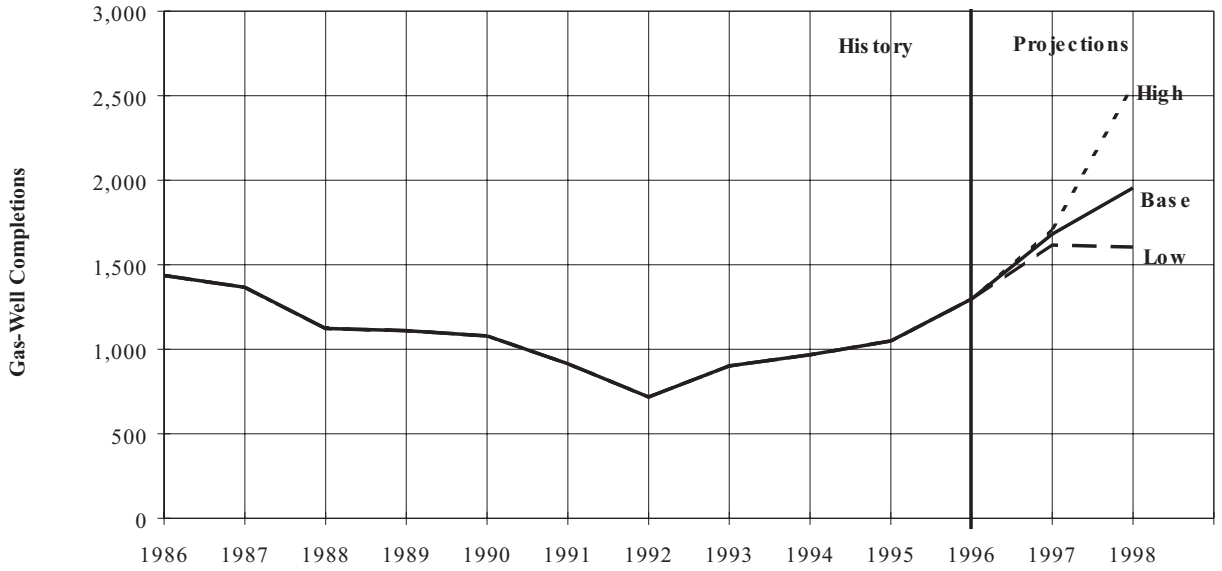
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997.

Table 16. Oklahoma Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity: Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
		Low Case Projection				
Jan-97	5,074	5,228	737	5,965	891	85.1
Jun-97	4,675	5,303	724	6,027	1,352	77.6
Dec-97	5,230	5,513	670	6,183	953	84.6
Jan-98	5,203	5,508	666	6,174	971	84.3
Jun-98	4,771	5,514	646	6,160	1,389	77.5
Dec-98	5,343	5,647	625	6,272	929	85.2
		Base Case Projection				
Jan-97	5,074	5,228	737	5,965	891	85.1
Jun-97	4,675	5,303	724	6,027	1,352	77.6
Dec-97	5,218	5,571	705	6,276	1,058	83.1
Jan-98	5,201	5,581	702	6,283	1,082	82.8
Jun-98	4,770	5,714	690	6,404	1,634	74.5
Dec-98	5,324	6,026	678	6,704	1,380	79.4
		High Case Projection				
Jan-97	5,074	5,228	737	5,965	891	85.1
Jun-97	4,675	5,303	724	6,027	1,352	77.6
Dec-97	5,210	5,593	736	6,329	1,119	82.3
Jan-98	5,198	5,619	735	6,354	1,156	81.8
Jun-98	4,770	5,928	731	6,659	1,889	71.6
Dec-98	5,319	6,614	729	7,343	2,024	72.4

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

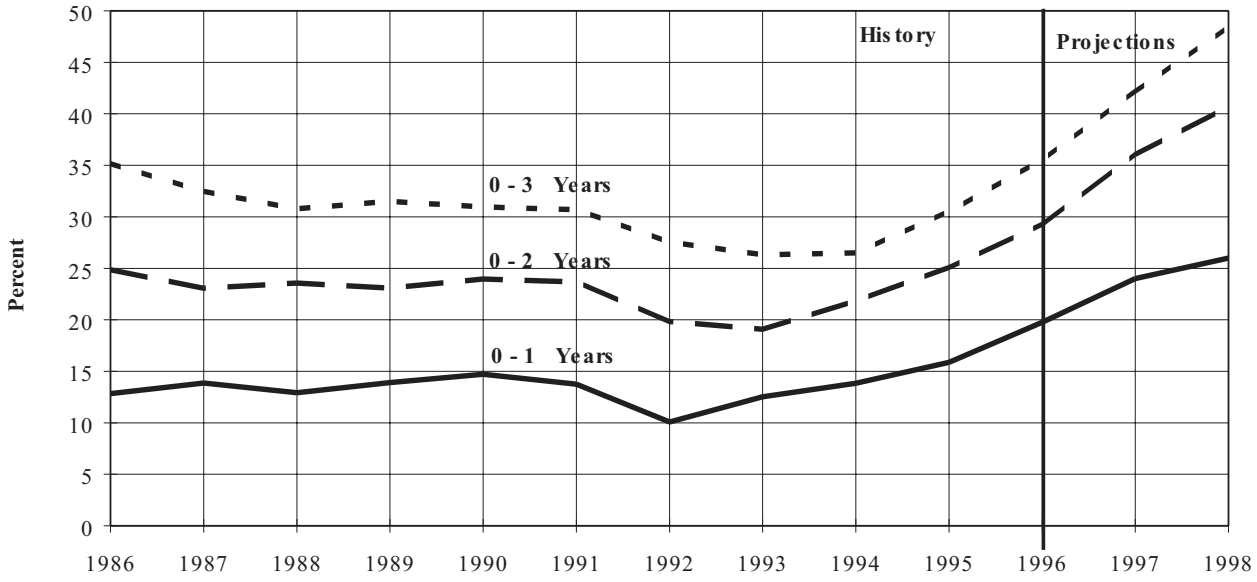
Figure 32. Oklahoma Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Figure 33. Percent of Total Wellhead Productive Capacity of Oklahoma Gas Wells by Well Age, 1986-1998 (Base Case)



Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

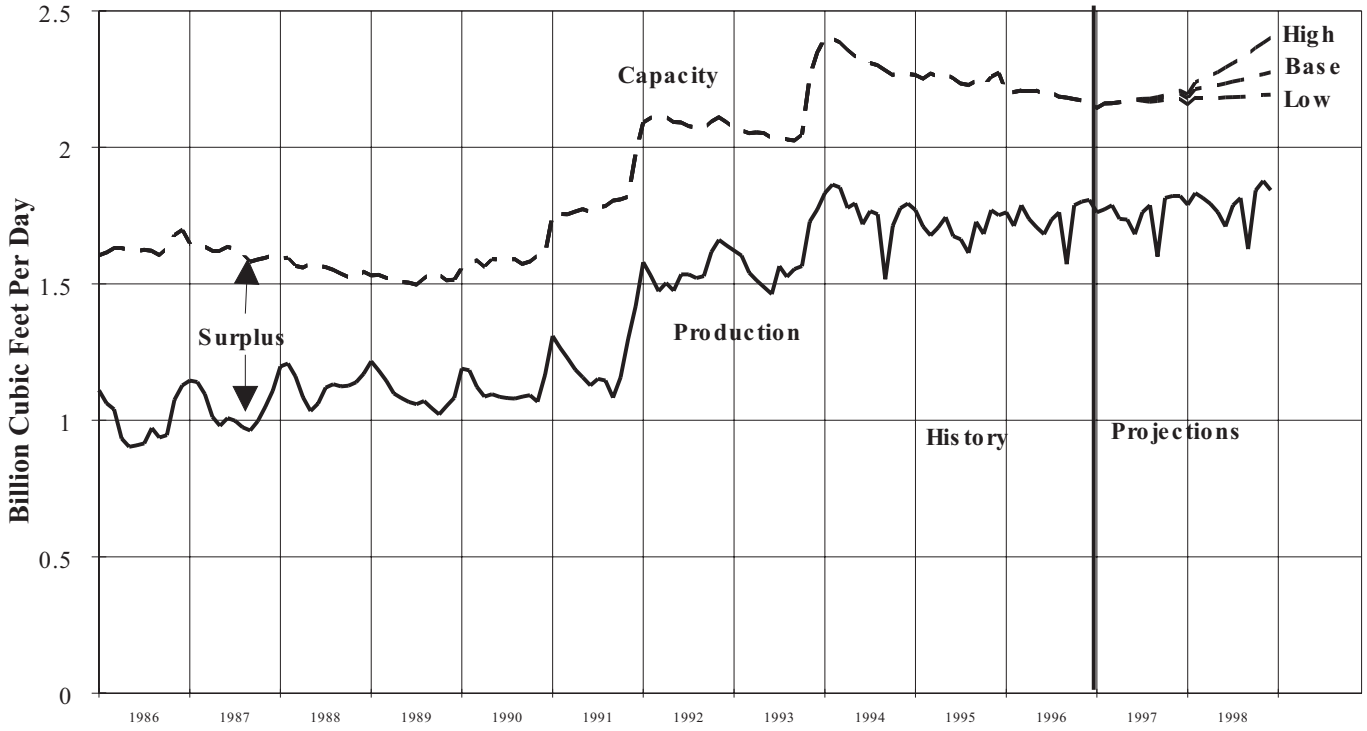
Southeast (Excluding Gulf of Mexico OCS)

The Southeast area includes the States of Arkansas, Mississippi, and Alabama (excluding Gulf of Mexico OCS). Production is from highly permeable deep formations on the Gulf Coast, as well as from low permeability and relatively shallow formations in Arkansas, northern Mississippi, and northern Alabama.

Coalbed gas production in Alabama was 35 percent of the State's total dry gas production in 1990, 47 percent in 1991, 35 percent in 1992, 37 percent in 1993, 28 percent in 1994, and 30 percent in 1995. {13} Coalbed gas-well completions in Alabama were treated separately from conventional gas-well completions in this report. Coalbed gas capacity continues to increase through 1998, (Figure 35).

The following pages include Tables 17 and 18 and Figures 34 through 37, which provide historical and projected production and productive capacity, gas-well completions added, and percent of capacity by well age.

Figure 34. Southeast (Excluding Gulf of Mexico OCS) Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 17. Southeast (Excluding Gulf of Mexico OCS) Dry Gas Production and Wellhead Productive Capacity, 1986-1996 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	1,110	1,458	146	1,604	494	69.2
Jun-86	908	1,483	137	1,620	712	56.0
Dec-86	1,128	1,567	131	1,698	570	66.4
Jan-87	1,146	1,519	128	1,647	501	69.6
Jun-87	1,008	1,505	130	1,635	627	61.7
Dec-87	1,109	1,477	127	1,604	495	69.1
Jan-88	1,197	1,470	124	1,594	397	75.1
Jun-88	1,062	1,444	121	1,565	503	67.9
Dec-88	1,171	1,425	119	1,544	373	75.8
Jan-89	1,216	1,405	126	1,531	315	79.4
Jun-89	1,067	1,377	127	1,504	437	70.9
Dec-89	1,082	1,400	115	1,515	433	71.4
Jan-90	1,189	1,450	109	1,559	370	76.3
Jun-90	1,086	1,479	110	1,589	503	68.3
Dec-90	1,167	1,496	112	1,608	441	72.6
Jan-91	1,309	1,661	94	1,755	446	74.6
Jun-91	1,128	1,671	92	1,763	635	64.0
Dec-91	1,419	1,882	93	1,975	556	71.8
Jan-92	1,579	1,935	156	2,091	512	75.5
Jun-92	1,535	1,939	152	2,091	556	73.4
Dec-92	1,641	1,944	149	2,093	452	78.4
Jan-93	1,622	1,921	150	2,071	449	78.3
Jun-93	1,462	1,894	141	2,035	573	71.8
Dec-93	1,773	2,207	141	2,348	575	75.5
Jan-94	1,833	2,278	124	2,402	569	76.3
Jun-94	1,718	2,208	120	2,328	610	73.8
Dec-94	1,794	2,151	118	2,269	475	79.1
Jan-95	1,770	2,149	116	2,265	495	78.1
Jun-95	1,675	2,141	113	2,254	579	74.3
Dec-95	1,751	2,155	118	2,273	522	77.0
Jan-96	1,762	2,084	115	2,199	437	80.1
Jun-96	1,682	2,086	110	2,196	514	76.6
Dec-96	1,808	2,062	105	2,167	359	83.4

[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.

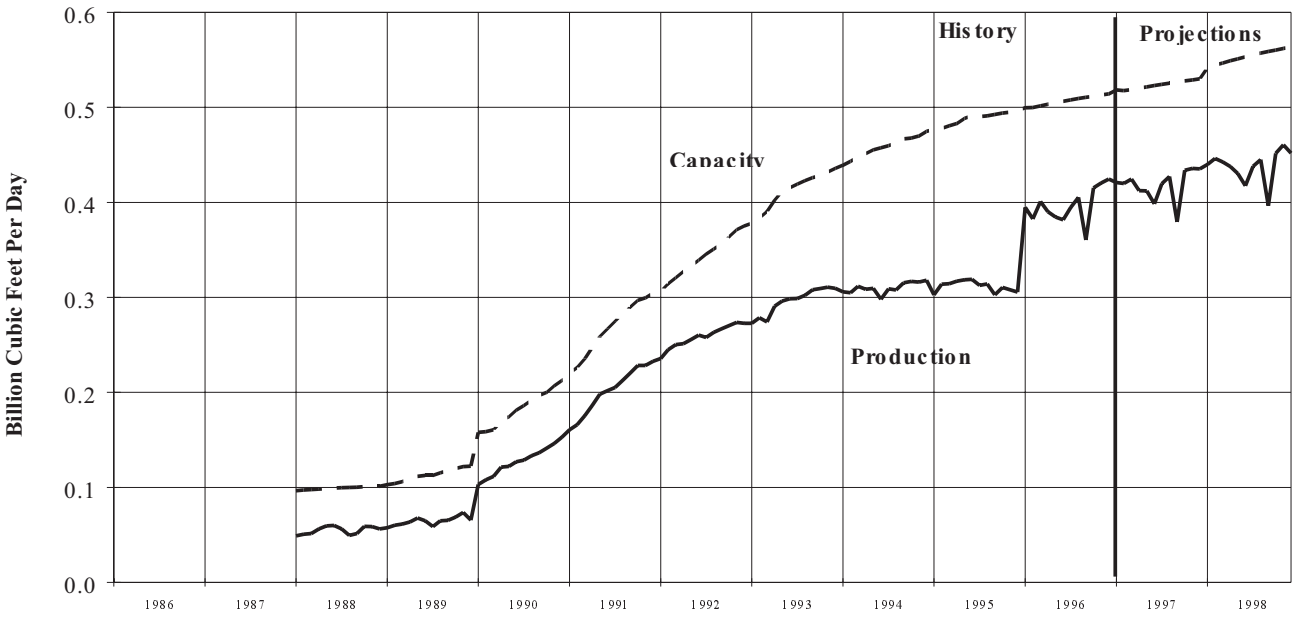
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997.

Table 18. Southeast (Excluding Gulf of Mexico OCS) Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity: Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Low Case Projection						
Jan-97	1,762	2,040	105	2,145	383	82.1
Jun-97	1,682	2,072	103	2,175	493	77.3
Dec-97	1,827	2,082	95	2,177	350	83.9
Jan-98	1,791	2,064	94	2,158	367	83.0
Jun-98	1,710	2,091	92	2,183	473	78.3
Dec-98	1,850	2,105	88	2,193	343	84.4
Base Case Projection						
Jan-97	1,762	2,040	105	2,145	383	82.1
Jun-97	1,682	2,072	103	2,175	493	77.3
Dec-97	1,822	2,097	100	2,197	375	82.9
Jan-98	1,790	2,081	100	2,181	391	82.1
Jun-98	1,710	2,136	98	2,234	524	76.5
Dec-98	1,843	2,179	96	2,275	432	81.0
High Case Projection						
Jan-97	1,762	2,040	105	2,145	383	82.1
Jun-97	1,682	2,072	103	2,175	493	77.3
Dec-97	1,820	2,104	104	2,208	388	82.4
Jan-98	1,789	2,091	104	2,195	406	81.5
Jun-98	1,710	2,190	103	2,293	583	74.6
Dec-98	1,842	2,299	103	2,402	560	76.7

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

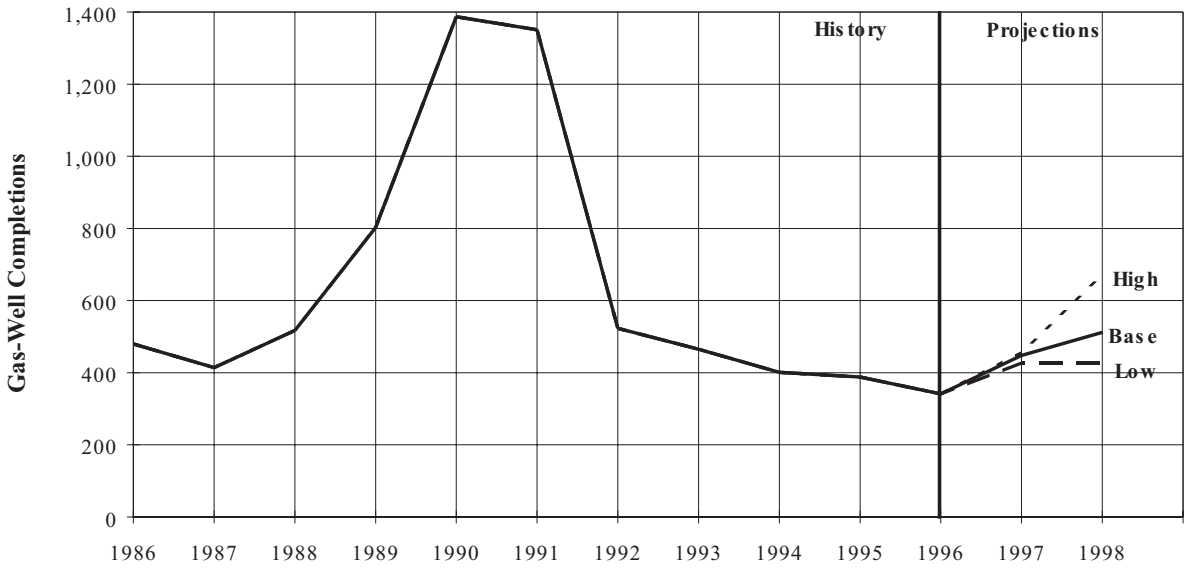
Figure 35. Southeast (Excluding Gulf of Mexico OCS) Dry Coalbed Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

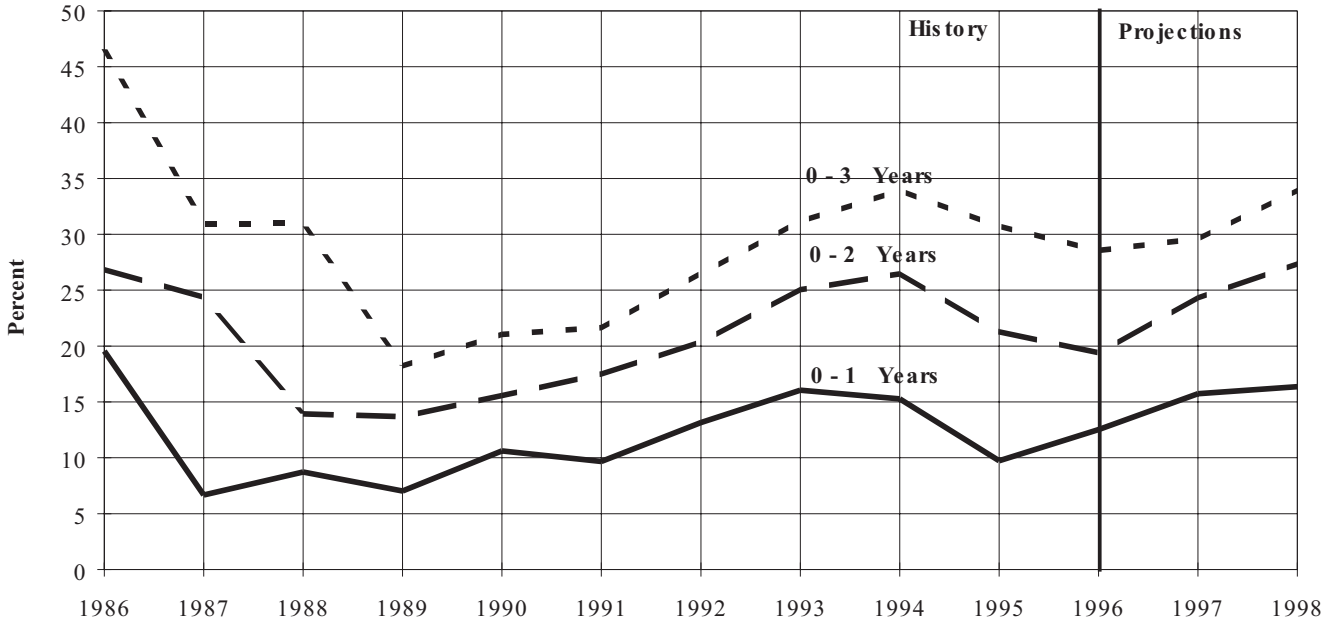
Figure 36. Southeast (Excluding Gulf of Mexico OCS) Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Figure 37. Percent of Total Wellhead Productive Capacity of Southeast (Excluding Gulf of Mexico) Gas Wells by Well Age, 1986-1998 (Base Case)



Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

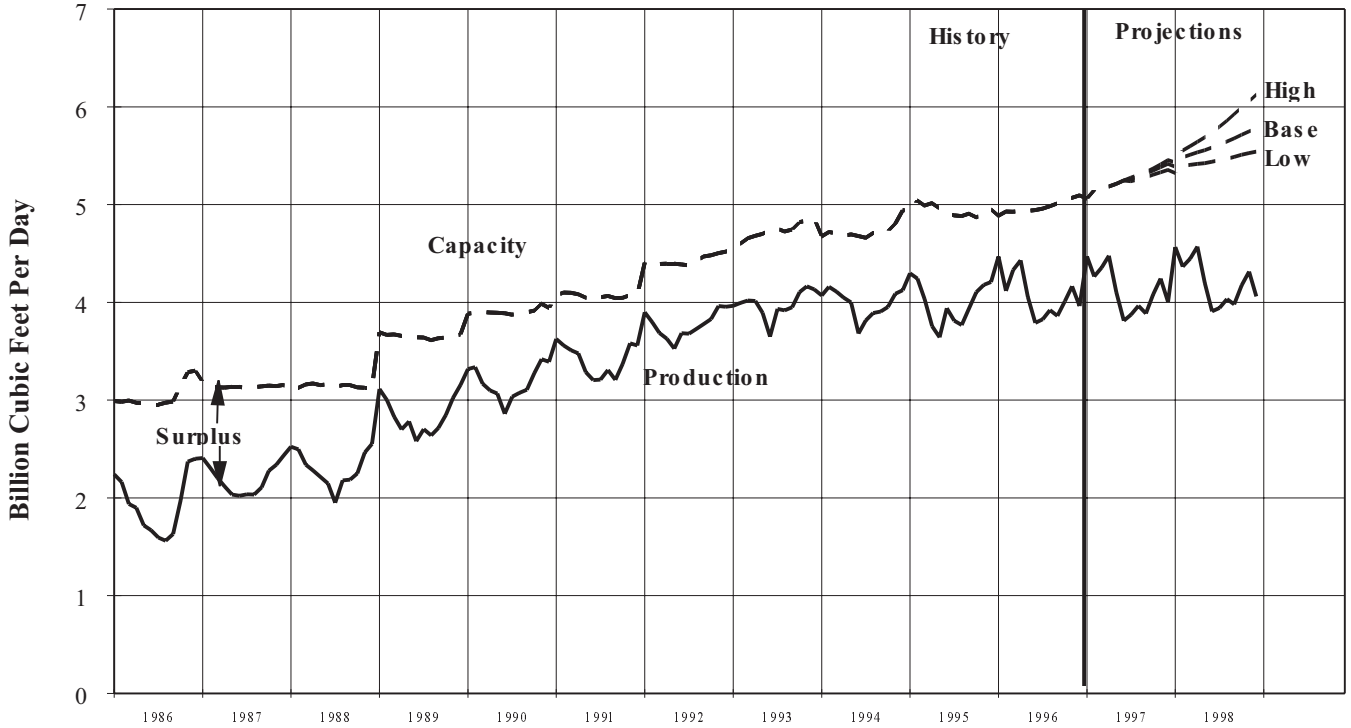
Rocky Mountains

The Rocky Mountains area includes Colorado, Montana, North Dakota, Utah, and Wyoming. The area is diverse and geologically complex, with many low permeability formations.

Coalbed gas produced in Colorado was about 11 percent of the State's total dry gas produced in 1990, 17 percent in 1991, 26 percent in 1992, 32 percent in 1993, and 40 percent in 1994, and 44 percent in 1995. {13} Coalbed gas-well completions in Colorado and Wyoming were treated separately from conventional gas-well completions in this report. Coalbed gas capacity has shown an increase in the last few years (Figure 39).

The following pages include Tables 19 and 20 and Figures 38 through 41, which provide historical and projected production and productive capacity, gas-well completions added, and percent of capacity by well age

Figure 38. Rocky Mountains Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history is based on Model GASCAP94 C102997 projections.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 19. Rocky Mountains Dry Gas Production and Wellhead Productive Capacity, 1986-1996
(Million Cubic Feet Per Day)

		Dry Gas Productive Capacity				
Month-Year	Dry Production	Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	2,241	2,342	650	2,992	751	74.9
Jun-86	1,671	2,354	600	2,954	1,283	56.6
Dec-86	2,400	2,738	562	3,300	900	72.7
Jan-87	2,408	2,395	785	3,180	772	75.7
Jun-87	2,022	2,374	761	3,135	1,113	64.5
Dec-87	2,436	2,393	763	3,156	720	77.2
Jan-88	2,524	2,303	802	3,105	581	81.3
Jun-88	2,147	2,357	804	3,161	1,014	67.9
Dec-88	2,553	2,372	754	3,126	573	81.7
Jan-89	3,115	2,786	909	3,695	580	84.3
Jun-89	2,579	2,769	873	3,642	1,063	70.8
Dec-89	3,155	2,810	861	3,671	516	85.9
Jan-90	3,319	2,823	1,061	3,884	565	85.5
Jun-90	2,861	2,843	1,045	3,888	1,027	73.6
Dec-90	3,391	2,929	1,015	3,944	553	86.0
Jan-91	3,625	2,969	1,102	4,071	446	89.0
Jun-91	3,206	2,951	1,077	4,028	822	79.6
Dec-91	3,559	3,030	1,048	4,078	519	87.3
Jan-92	3,899	3,326	1,080	4,406	507	88.5
Jun-92	3,685	3,337	1,051	4,388	703	84.0
Dec-92	3,955	3,510	1,009	4,519	564	87.5
Jan-93	3,965	3,790	765	4,555	590	87.0
Jun-93	3,649	3,973	770	4,743	1,094	76.9
Dec-93	4,131	4,119	736	4,855	724	85.1
Jan-94	4,071	4,029	646	4,675	604	87.1
Jun-94	3,682	4,044	634	4,678	996	78.7
Dec-94	4,124	4,327	617	4,944	820	83.4
Jan-95	4,298	4,337	598	4,935	637	87.1
Jun-95	3,940	4,330	583	4,913	973	80.2
Dec-95	4,209	4,382	571	4,953	744	85.0
Jan-96	4,470	4,329	559	4,888	418	91.4
Jun-96	3,790	4,389	554	4,943	1,153	76.7
Dec-96	3,963	4,539	556	5,095	1,132	77.8

[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.

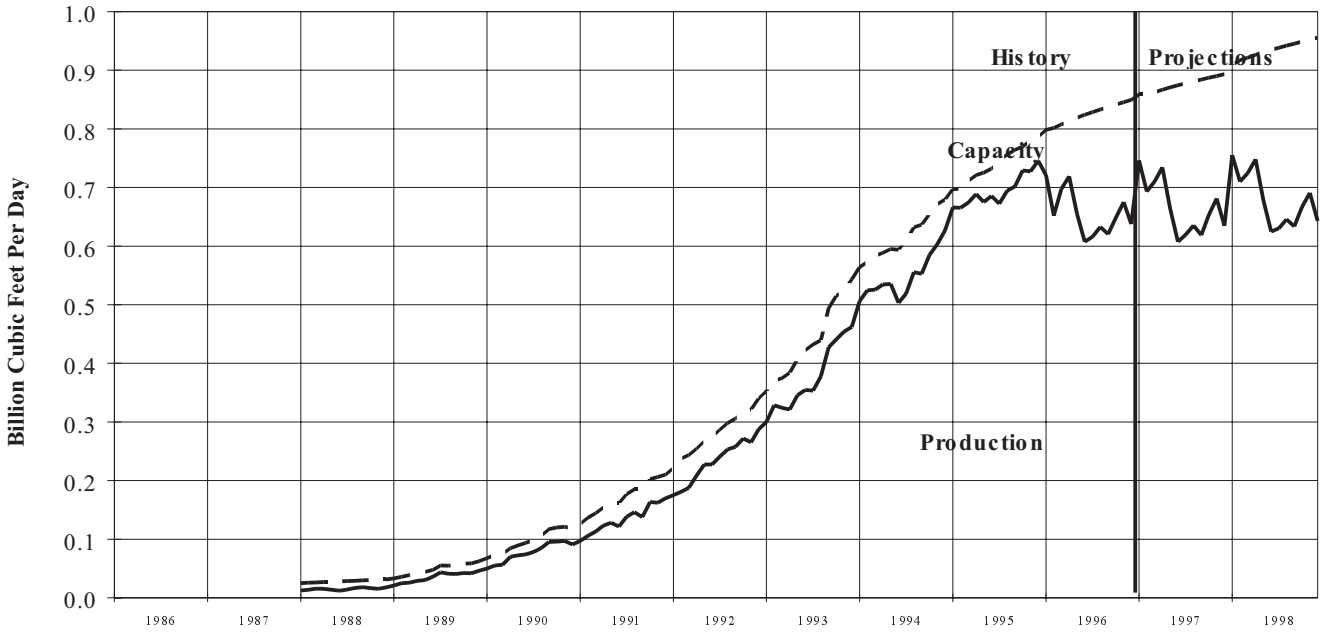
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997.

Table 20. Rocky Mountains Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
			Low Case Projection			
Jan-97	4,470	4,508	554	5,062	592	88.3
Jun-97	3,813	4,699	548	5,247	1,434	72.7
Dec-97	4,014	4,845	510	5,355	1,341	75.0
Jan-98	4,567	4,814	508	5,322	755	85.8
Jun-98	3,909	4,943	495	5,438	1,529	71.9
Dec-98	4,076	5,060	482	5,542	1,466	73.5
			Base Case Projection			
Jan-97	4,470	4,508	554	5,062	592	88.3
Jun-97	3,813	4,699	548	5,247	1,434	72.7
Dec-97	4,005	4,881	536	5,417	1,412	73.9
Jan-98	4,565	4,853	535	5,388	823	84.7
Jun-98	3,908	5,054	529	5,583	1,675	70.0
Dec-98	4,061	5,258	523	5,781	1,720	70.2
			High Case Projection			
Jan-97	4,470	4,508	554	5,062	592	88.3
Jun-97	3,813	4,699	548	5,247	1,434	72.7
Dec-97	3,999	4,895	560	5,455	1,456	73.3
Jan-98	4,563	4,873	559	5,432	869	84.0
Jun-98	3,908	5,181	560	5,741	1,833	68.1
Dec-98	4,057	5,562	562	6,124	2,067	66.2

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

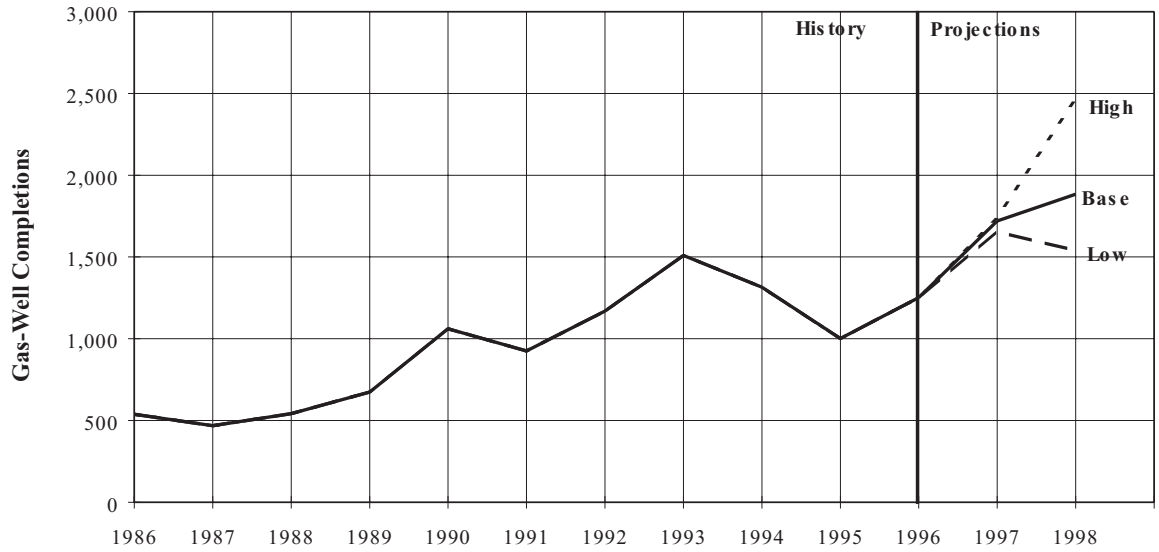
Figure 39. Rocky Mountains Dry Coalbed Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only.

Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

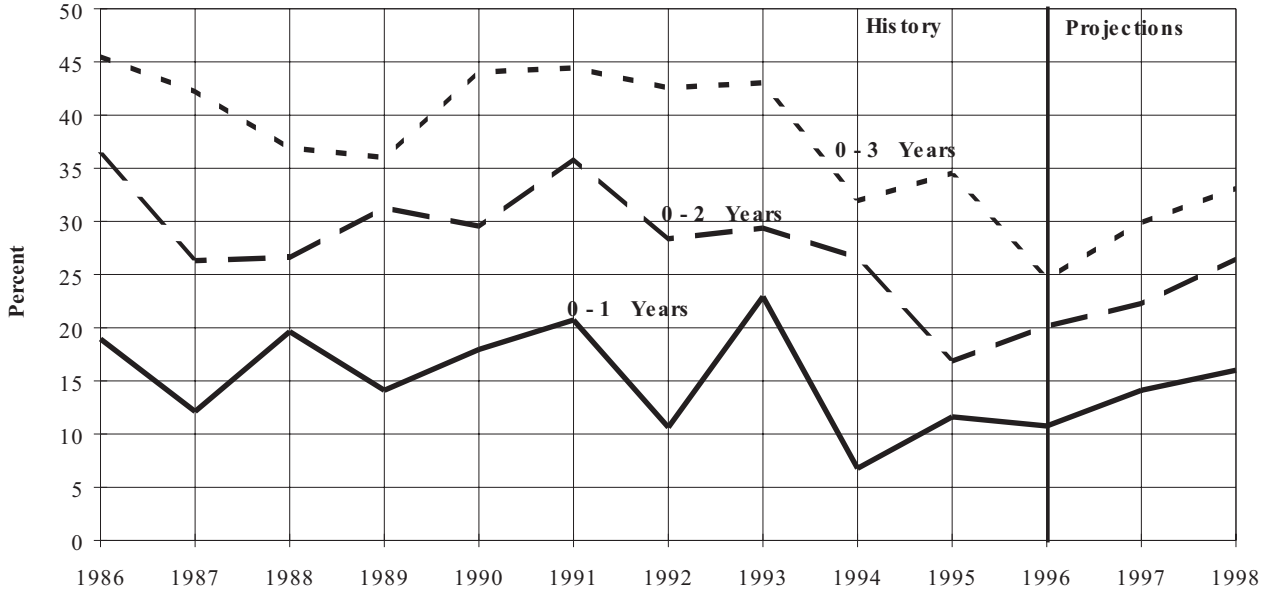
Figure 40. Rocky Mountains Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Figure 41. Percent of Total Wellhead Productive Capacity of Rocky Mountains Gas Wells by Well Age, 1986-1998 (Base Case)



Sources: History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc. Projections: Model GASCAP94 C102997.

Eighteen States

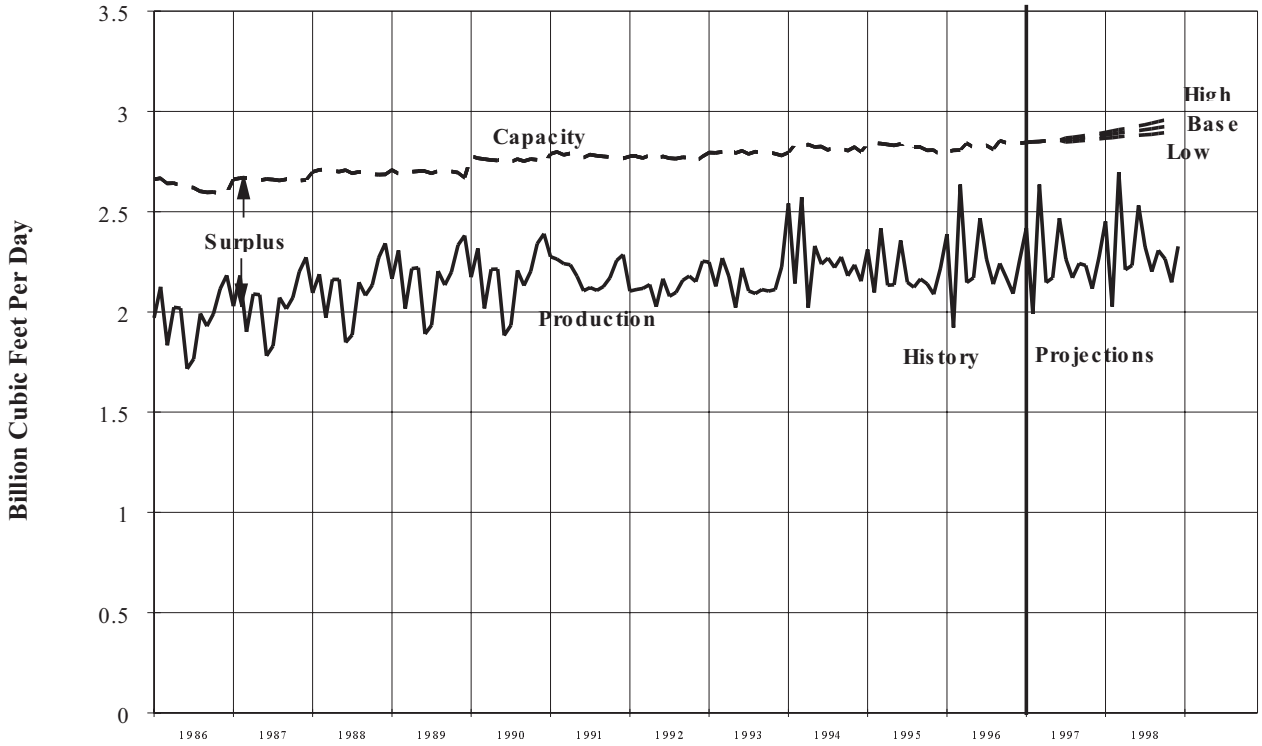
The remaining producing 18 States were considered as one group. The 18 States are:

- Arizona
- Florida
- Illinois
- Indiana
- Kentucky
- Maryland
- Michigan
- Missouri
- Nebraska
- Nevada
- New York
- Ohio
- Oregon
- Pennsylvania
- South Dakota
- Tennessee
- Virginia
- West Virginia.

Data are limited for this group of States, and only 3 of the 18 States are included in Dwight's: Nebraska, Oregon, and South Dakota. Production data are available from EIA for each of the 18 States but not by well completion.

The following pages include Tables 21 and 22 and Figures 42 and 43, which provide historical and projected production, productive capacity, and gas-well completions added.

Figure 42. Eighteen States Dry Gas Monthly Production Rate and Wellhead Productive Capacity, 1986-1998



Note: Production projection plotted for base case only. The 1996 estimated history based on Model GASCAP94 C102997 projections.

Sources: Production History: Energy Information Administration, Office of Oil and Gas and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997. Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997, and Model GASCAP94 C102997.

Table 21. Eighteen States Dry Gas Production and Wellhead Productive Capacity Projections, 1986-1996 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
Jan-86	1,970	2,448	213	2,661	691	74.0
Jun-86	1,716	2,423	201	2,624	908	65.4
Dec-86	2,182	2,402	189	2,591	409	84.2
Jan-87	2,029	2,443	218	2,661	632	76.2
Jun-87	1,781	2,441	221	2,662	881	66.9
Dec-87	2,272	2,439	219	2,658	386	85.5
Jan-88	2,095	2,484	214	2,698	603	77.7
Jun-88	1,848	2,480	227	2,707	859	68.3
Dec-88	2,341	2,479	207	2,686	345	87.2
Jan-89	2,166	2,471	237	2,708	542	80.0
Jun-89	1,890	2,474	228	2,702	812	69.9
Dec-89	2,381	2,476	194	2,670	289	89.2
Jan-90	2,173	2,514	264	2,778	605	78.2
Jun-90	1,883	2,513	239	2,752	869	68.4
Dec-90	2,390	2,513	226	2,739	349	87.3
Jan-91	2,275	2,535	253	2,788	513	81.6
Jun-91	2,105	2,531	239	2,770	665	76.0
Dec-91	2,285	2,521	244	2,765	480	82.6
Jan-92	2,104	2,521	255	2,776	672	75.8
Jun-92	2,166	2,515	260	2,775	609	78.1
Dec-92	2,253	2,518	257	2,775	522	81.2
Jan-93	2,248	2,529	266	2,795	547	80.4
Jun-93	2,219	2,535	269	2,804	585	79.1
Dec-93	2,225	2,528	252	2,780	555	80.0
Jan-94	2,541	2,533	262	2,795	254	90.9
Jun-94	2,238	2,524	301	2,825	587	79.2
Dec-94	2,153	2,523	276	2,799	646	76.9
Jan-95	2,311	2,523	317	2,840	529	81.4
Jun-95	2,356	2,519	318	2,837	481	83.0
Dec-95	2,218	2,511	273	2,784	566	79.7
Jan-96	2,387	2,514	283	2,797	410	85.3
Jun-96	2,467	2,528	292	2,820	353	87.5
Dec-96	2,257	2,552	289	2,841	584	79.4

[a]The 1996 estimated history is based on Model GASCAP94 C102997 projections and Baker Hughes rig counts.

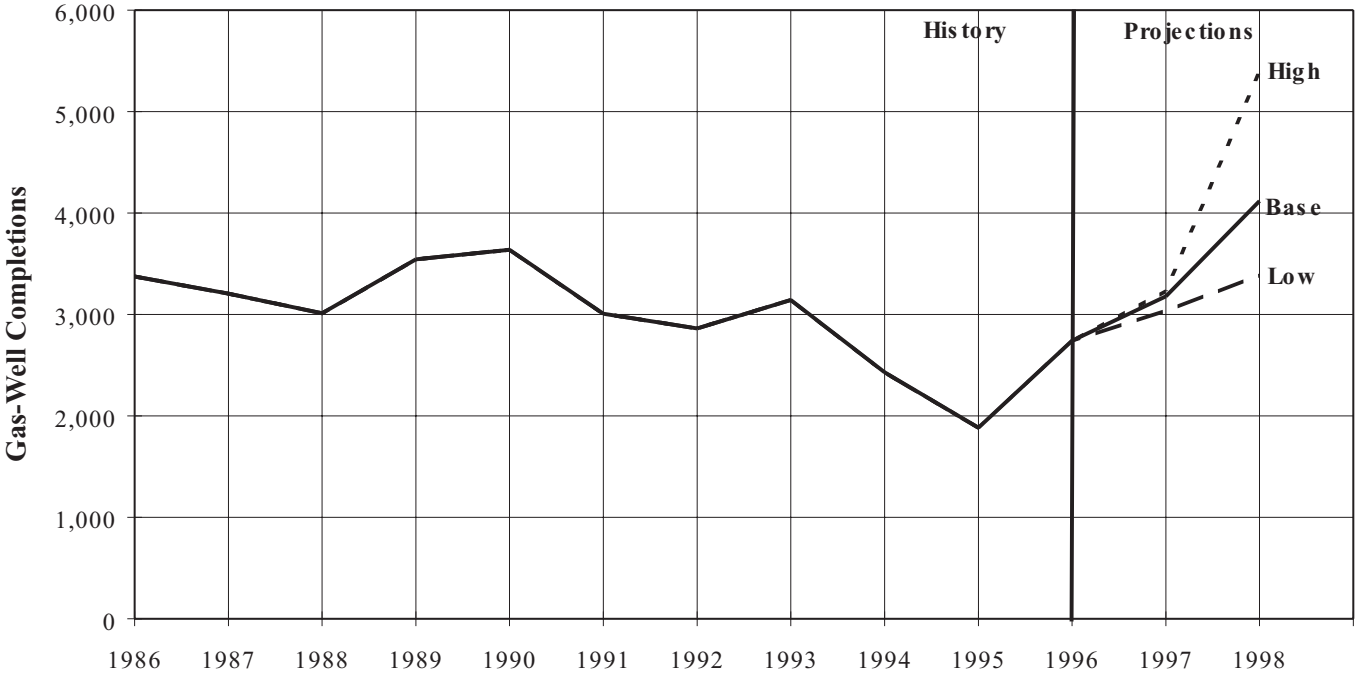
Sources: Production History: Energy Information Administration, Office of Oil and Gas; Dwight's Energydata, Inc.; and Model GASCAP94 C102997. Productive Capacity: Model GASCAP94 C102997.

Table 22. Eighteen States Dry Gas Production and Wellhead Productive Capacity Projections, 1997-1998 (Million Cubic Feet Per Day)

Month-Year	Dry Production	Dry Gas Productive Capacity				
		Gas-Well Gas	Oil-Well Gas	Total Gas	Total Surplus	Utilization (percent)
			Low Case Projection			
Jan-97	2,418	2,558	287	2,845	427	85.0
Jun-97	2,467	2,573	283	2,856	389	86.4
Dec-97	2,278	2,601	262	2,863	585	79.6
Jan-98	2,452	2,606	260	2,866	414	85.6
Jun-98	2,531	2,628	253	2,881	350	87.9
Dec-98	2,336	2,655	245	2,900	564	80.6
			Base Case Projection			
Jan-97	2,418	2,558	287	2,845	427	85.0
Jun-97	2,467	2,573	283	2,856	389	86.4
Dec-97	2,272	2,603	275	2,878	606	78.9
Jan-98	2,451	2,608	274	2,882	431	85.0
Jun-98	2,531	2,635	270	2,905	374	87.1
Dec-98	2,327	2,668	266	2,934	607	79.3
			High Case Projection			
Jan-97	2,418	2,558	287	2,845	427	85.0
Jun-97	2,467	2,573	283	2,856	389	86.4
Dec-97	2,269	2,602	288	2,890	621	78.5
Jan-98	2,450	2,609	287	2,896	446	84.6
Jun-98	2,531	2,642	286	2,928	397	86.4
Dec-98	2,325	2,688	286	2,974	649	78.2

Sources: Production Projections: Energy Information Administration, Short-Term Integrated Forecasting System, August 1997 and Model GASCAP C102997. Productive Capacity Projections: Model GASCAP94 C102997.

Figure 43. Eighteen States Gas-Well Completions Added During Year, 1986-1998



Note: The 1996 estimated history is based on Drilling Rig Model projections and Baker Hughes rig counts. Completions include recompletions in new producing zones.

Sources: History: Energy Information Administration, Office of Oil and Gas. Estimates of gas-well completions based on API well completion data. Projections: Model GASCAP94 C102997.

References

1. Energy Information Administration. *Natural Gas Productive Capacity for the Lower 48 States 1980 through 1991*. DOE/EIA-0542 (Washington, DC, January 24, 1991).

2. Energy Information Administration. *Natural Gas Productive Capacity for the Lower 48 States 1982 through 1993*. DOE/EIA-0542 (Washington, DC, March 10, 1993).

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13 Energy Information Administration, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves Annual Report*. DOE/EIA-0216 (Washington, DC, 1991, 1992, 1993, 1994 and 1995).

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15. Energy Information Administration. *Natural Gas Monthly.* DOE/EIA-0131 (Washington, DC, January 1986 through 1998).

16. Natural Gas Supply Association. *Natural Gas Supply Association Survey: Natural Gas Field Deliveries & Productive Capacity as of January 1, 1996* (Washington, DC, September 1996).

Appendix A

Model Abstract

Appendix A

Model Abstract

Name: Wellhead Gas Productive Capacity

Acronym: GASCAP

Description: GASCAP estimates the historical wellhead productive capacity of natural gas for the lower 48 States and projects the productive capacity for 3 years. *The Short-Term Energy Outlook* (STEO) output for *low*, *base*, and *high* cases is used to estimate the number of active rigs and oil and gas well completions. The projected oil production (which is assumed to be producing at capacity) is used to estimate the oil-well gas production using a constant gas-oil ratio. The gas demand is also taken from STEO. The difference between demand and oil-well gas production is assumed to be the gas-well gas demand and the production as long as capacity exceeds demand.

Purpose: GASCAP is used to project the natural gas wellhead productive capacity for the lower 48 States. It also allows quantification of the available productive capacity and the projected capacity under differing future scenarios.

Date of Last Model Update: 1996

Part of Another Model: No

References to Any Other Models: None

Documentation reference: *Wellhead Gas Productive Capacity Model* (GASCAP) Documentation DOE/EIA-M052, March 1995

Official Model Representatives:

- **Office**: Oil and Gas
- **Division:** Reserves and Production
- **Model Contacts**: John H. Wood, James N. Hicks, Hafeez Rahman, Velton T. Funk
- **Telephone:** 214-720-6150

Archive Media and Installation Guides: Cartridge tape available from NEIC for GASCAP94, for the report *Natural Gas Productive Capacity for the* Lower 48 States 1986 through 1998, DOE/EIA-0542(97/2).

Energy System Described: GASCAP measures and predicts wellhead natural gas productive capacity.

Coverage:

- **Geographic**: Lower-48 natural gas producing States
- **Time Unit/Frequency:** Evaluates 13 years of historical data and project productive capacity for 3 years.
- **Products**: Natural gas
- **Economic Sectors**: Not applicable

Modeling Features:

- **Model Structure**: The model consists of a series of Statistical Analysis System (SAS) procedures utilizing a modified rate of gas production versus cumulative gas production (Rate-cum) equation.
- **Modeling Techniques**: SAS, utilizing the least squares, nonlinear regression procedure (NLIN) with the Marquardt computational method, was used to fit hyperbolic equations to the data.
- **Special Features**: Estimates conventional and coalbed gas-well gas productive capacity separately.

Non--DOE Input Variables and Sources:

- Dwight's EnergyData Inc, Richardson, TX, Oil and Gas Reports
  - State monthly natural gas production by well
- Baker Hughes Incorporated
  - Number of active rotary rigs and number of active rotary gas rigs
- American Petroleum Institute
  - Drilling statistics monthly tapes

DOE Data Input Variables and Sources:

- ·*Natural Gas Annual*
  - Marketed gas production by State
  - Gross gas production by State
  - Oil-well gas production by State
- ·*Natural Gas Monthly*
  - Marketed production of natural gas by State
- *Short Term Energy Outlook*

- Dry gas production forecast
- Oil and gas price forecasts

- *Petroleum Supply Annual*
  - Crude oil production

Computing Environment:

Main Frame

- **Hardware**: IBM 3090E Model 400
- **Operating System:** MVS/XA
- **Languages:** FORTRAN / SAS / COBOL
- **Memory requirement:** 1500K
- **Storage requirement:** 1200 tracks of 3380 disk space
- **Estimated run time:** 4 hours CPU time

Personal Computer

- **Hardware**: Compaq Deskpro 386/20
- **Operating System:** MS DOS
- **Software:** LOTUS 123 / EXCEL / ARBITER / HARVARD GRAPHICS
- **Memory requirement:** 2000K
- **Storage requirement:** 10 Mb hard disk space
- **Estimated run time:** 1 hour

Independent Expert Reviews Conducted:

- Report of fingings and Recommendations
  Paul R. Carpenter, Ph.D.
  Brattle/IRI, Inc.
  26 June 1995
- Model Quality Audit
  Allied Technology Group, Inc.
  Prepared by QuanTech, Inc.
  29 February 1996

Appendix B

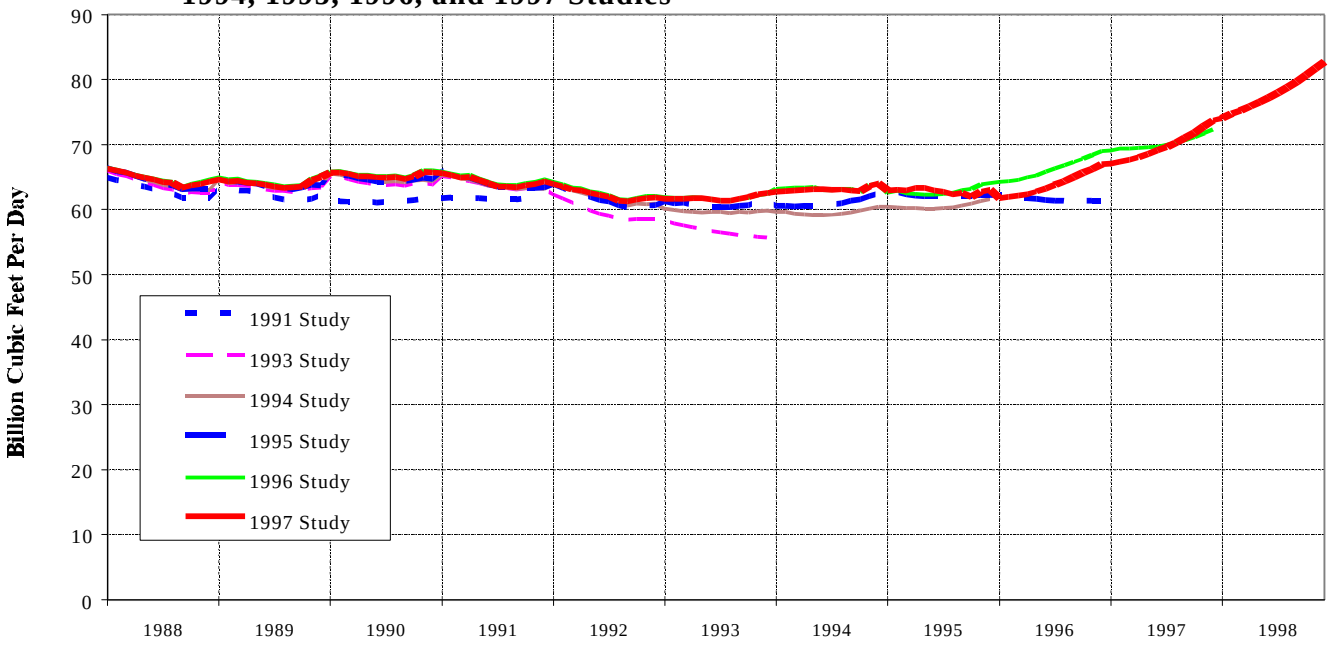
Comparison of Productive Capacity

Appendix B

Comparison of Productive Capacity

Comparisons of base case productive capacities for this and all previous studies were made (Figure B1). In nearly all instances, capacities for the last two studies were equal to or higher than those in earlier studies.

Figure B1. Comparisons of Base Case Dry Gas Productive Capacity for the 1991, 1993, 1994, 1995, 1996, and 1997 Studies



Note: Monthly capacity estimates are for base case.

Sources: 1991 Study: Energy Information Administration. *Natural Gas Productive Capacity for the Lower 48 States 1980 Through 1991* . DOE/EIA-0542(91) (Washington, DC January 24, 1991). 1993 Study: Energy Information Administration. *Natural Gas Productive Capacity for the Lower 48 States 1983 Through 1993* . DOE/EIA-0542(93) (Washington, DC March 10, 1993). 1994 Study: Energy Information Administration. *Natural Gas Productive Capacity for the Lower 48 States 1980 Through 1995* . DOE/EIA-0542(94) (Washington, DC July 14, 1994). 1995 Study: Energy Information Administration. *Natural Gas Productive Capacity for the Lower 48 States 1984 Through 1996* . DOE/EIA-0542(96) (Washington, DC February 9, 1996). 1996 Study: Energy Administration. *Natural Gas Productive Capacity for the Lower 48 States 1985 Through 1997.* DOE/EIA-0542(97) (Washington, DC

Appendix C

Dry Gas-Well Capacity per New Gas-Well Completions

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Dry Gas-Well Capacity per New Gas-Well Completion

Dry gas-well gas productive capacity of about one billion cubic feet per day is added per 1,000 new gas-well gas completions. This is the difference between the dry gas-well productive capacity change for the *high* case and the *base* case during 1998 divided by the difference in gas-well completions between the *high* and *base* case during 1998. For productive capacity, the period of change is from December 1997 to December 1998 (Table 2). The well completions for the *base* and *high* cases are those added during 1998 (Figure 9).

The calculation for 1998 follows:

$$\frac{(\textit{Difference in capacity change for the high and base case})}{(\textit{Difference in well completions for the high and base case})}$$

$$= \frac{(81.4\ {}^{Bcf}\!/_{day} - 66.7\ {}^{Bcf}\!/_{day}) - (75.3\ {}^{Bcf}\!/_{day} - 66.1\ {}^{Bcf}\!/_{day})}{27.9\ Thousand Completions - 21.5\ Thousand Completions)}$$

$$\approx 1\frac{{}^{Bcf}\!/_{day}}{1000\ Gas\text{-}well\ Completions}$$

$$\approx 1\frac{{}^{MMcf}\!/_{day}}{Gas\text{-}well\ Completion}\ .$$

The estimate of dry gas-well capacity per new gas-well completion depends on three parameters: initial flow rate (q_i); ultimate recovery (G_{ul}); and the decline exponent (B) (Table C1). These parameters are determined from nonlinear regression fits of the rate versus cumulative production relationship for hyperbolic declined.{5}

$$q = q_i \left(1 - \frac{G_p}{G_{ul}}\right)^B \ . \qquad \text{(C1)}$$

where

q= gas flow rate at capacity, million cubic feet per day

q_i= initial gas flow rate at capacity, million cubic feet per day

G_p= cumulative gas produced, million cubic feet

G_{ul}= ultimate gas recovery, million cubic feet

B= hyperbolic decline exponent.

Table C1. Average Initial Flow Rates, Ultimate Recovery, and Decline Exponent on a Conventional Gas-Well Completion Basis for 1992-1994

State/Area	q_i Initial Flow Rate (MMcf/day)	G_{ul} Ultimate Recovery (MMcf)	B Decline Exponent
Gulf of Mexico	7.5	4,386	1.2
Texas (Excluding Gulf of Mexico OCS)	1.0	1,009	2.2
Louisiana (Excluding Gulf of Mexico OCS)	2.1	1,886	1.9
California (Including Pacific OCS)	1.0	815	1.6
Kansas	0.4	953	2.7
New Mexico	0.6	1,179	2.9
Oklahoma	0.9	1,033	2.3
Southeast	1.2	2,408	2.4
Rocky Mountain	0.7	1,624	2.9

Note: Texas and Louisiana exclude Gulf of Mexico OCS; California includes Pacific OCS.
Source: Energy Information Administration, Model GASCAP94 C102997.

Glossary

Glossary

Annual Average-Day Demand: Annual demand divided by the number of days in the year.

Associated Gas: Natural gas, commonly known as gas-cap gas, which overlies and is in contact with crude oil in the reservoir.

Back-pressure: The pressure maintained on equipment or systems through which a fluid flows.

Bcf: Billion cubic feet of gas at a pressure base of 14.73 pounds per square inch absolute and a temperature base of 60 degrees Fahrenheit.

Coalbed Gas: Natural gas that is produced from coalbeds. Methane is the principal component. It is commonly referred to as coalbed methane.

Connected Field Capacity: The Natural Gas Supply Association's definition of Connected Field Capacity is "the *rate at which gas can be physically injected into the intrastate and interstate pipeline network, on a 30-day sustainable basis,"* under the best of operating conditions (i.e., excluding planned and unplanned downtime). Because the sustainable production rate of a gas field can be lower than that of the individual gas well, the connected capacity is defined on a field basis rather than on a well basis.

Connected field capacity also takes into account the capacity limitations imposed by gathering systems and natural gas processing plants. For example, if a group of wells can physically produce 100 MMcf/day of dry gas, but the gathering system can only transport 90 MMcf/day and the gas processing plant can only produce 70 MMcf/day of dry gas, then the connected field capacity is stated as 70 MMcf/day. The difference between the 100 MMcf/day well production potential and the 70 MMcf/day actually produced by the gas processing plant (i.e., 30 MMcf/day) is considered unconnected field capacity.

Gas productive capacity used to operate gas production and processing facilities was excluded from the survey's consideration.

Deficit Capacity: The negative difference between gas productive capacity and scheduled gas production.

Deliverability: The volume of natural gas that can be produced from a well, reservoir, or field during a given period of time against a certain wellhead back-pressure under actual reservoir conditions, taking into account restrictions imposed by pipeline capacity, contract, or regulatory bodies.

Demand: U.S. requirement for dry gas from all sources: production, storage withdrawals, supplemental gaseous fuels, and imports.

Dissolved Gas: Natural gas in solution in crude oil in the reservoir.

Dry Gas: Marketed gas less extraction loss.

Extraction Loss: The reduction in volume of natural gas resulting from the removal of natural gas liquid constituents at natural gas processing plants.

Flow String: The string of tubing or casing through which gas or oil flows to the surface.

Gas-Well Gas: Nonassociated or associated gas produced from well completions classified as gas-well completions by a regulatory body.

Gross Gas: Full well stream gas volume, including all natural gas plant liquids and nonhydrocarbon gases, but excluding lease condensate. Also includes amounts delivered as royalty payments or consumed in field operations.

G-10 Rate : Daily gas well production rate calculated as specified on the Railroad Commission of Texas Oil and Gas Division form G-10 and Rule 28.

Lease Condensate: A mixture consisting primarily of pentanes and heavier hydrocarbons which is recovered as a liquid from natural gas in lease or field separation facilities, exclusive of products recovered at natural gas processing plants or facilities.

Marketed Gas: Gross natural gas less gas used for repressuring, quantities vented and flared, and nonhydrocarbon gases removed in treating or processing operations. Includes all quantities of gas used in field and processing operations.

Mcf: Thousand cubic feet of gas at a pressure base of 14.73 pounds per square inch absolute and a temperature base of 60 degrees Fahrenheit.

MMcf: Million cubic feet of gas at a pressure base of 14.73 pounds per square inch absolute and a temperature base of 60 degrees Fahrenheit.

Nonassociated Gas: Free natural gas not in contact with crude oil in the reservoir.

OCS: Outer Continental Shelf.

Oil-Well Gas: Natural gas produced from well completions classified as oil-well completions by a regulatory body.

Peak-Day Demand: Highest daily demand that occurred on any one day during the year.

Peak-Month Average-Day Demand: Highest of the 12 monthly demands for the year divided by the number of days in the month.

Peak Shaving: Supplying fuel gas such as propane to a distribution system from an auxiliary source during periods of maximum demand, when the primary source is not adequate.

Plant Liquids: Those volumes of natural gas liquids recovered in natural gas processing plants.

Productive Capacity: The volume of natural gas that can be produced from a well, reservoir, or field during a given period of time against a certain wellhead back-pressure under actual reservoir conditions excluding restrictions imposed by pipeline capacity, contract, or regulatory bodies.

Productive Capacity at the Wellhead: The maximum gas production rate that can be sustained for a specific month at the gas-well. It changes over time and cumulatively is a function of gas production and drilling.

Surplus Capacity: The positive difference between gas productive capacity and scheduled gas production.

Tcf: Trillion cubic feet of gas at a pressure base of 14.73 pounds per square inch absolute and a temperature base of 60 degrees Fahrenheit.

Vintage Year: The year in which a well first goes on production.

Water-Drive Reservoir: A reservoir in which the rate of water intrusion into the pay substantially equals the volumetric net rate of oil and gas withdrawal.

Well: A hole made by drilling through strata.

Well Completion: A flow string in a well used to conduct fluids to the surface from one reservoir or zone. A producing well may contain one or more well completions.