Propane Assessment for Winter 1995 - 1996

by David Hinton & John Zyren*

Summary

Propane demand for the 1995-1996 heating season (defined as October 1995 through March 1996) is expected to return to more normal levels compared with weak demand during last winter's heating season. Propane demand during the 1994-1995 heating season saw lower-than-normal heating demand, due to exceptionally mild winter temperatures, that was partially offset by unprecedented petrochemical feedstock demand. However, United States and regional inventories of propane appear adequate to meet expected demand this winter, assuming normal weather. As of September 30, 1995 (beginning of the heating season), United States inventories totaled 56.9 million barrels, more than 3 million barrels below the 60-million-barrel level considered by some industry observers as the minimum needed to meet demand without disruption. (Figure FE1) However, unexpected variations in winter severity and/or demand components can significantly

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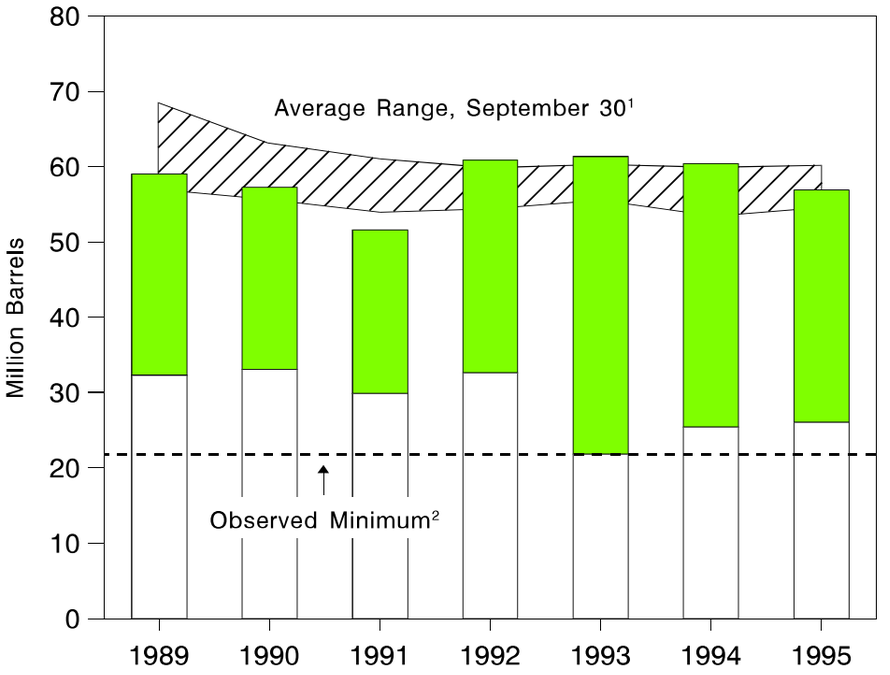
Figure FE1. U.S. Propane Stocks March 31 and September 30, 1989 - 1995



[1]Average level and width of average range based on 3 years of monthly data, January 1992 through December 1994. The significance of the "average range" is to provide a comparison of actual maximum inventory data for the years shown compared to an average range of maximum inventory data for the most recent 3-year period.

[2]The Observed Minimum for propane stocks is based on final monthly data for the last 36-month period and was 21.8 million barrels, occurring in March 1993. The significance of the Observed Minimum is to provide a comparison of actual minimum inventory data for the years shown compared to a historical minimum level of inventory data.

Sources: Data for 1989 through 1994, Energy Information Administration (EIA), *Petroleum Supply Annual 1989 through 1994*, DOE/EIA-0340(89-94), Volume 1, Table 2; data for January through July 1995, EIA, *Petroleum Supply Monthly 1995*, DOE/EIA-0109(95/03-09), Table 2; and data for August through September 1995, EIA, Form EIA-807 "Propane Telephone Survey."

Unless otherwise referenced, data in this article are taken from the following: *Petroleum Supply Monthly*, July 1995, DOE/EIA-0109 (95/09); *Petroleum Supply Annual 1994*, DOE/EIA-0340, Volumes 1 and 2 and predecessor reports; *Petroleum Marketing Annual*, July 1994, DOE/EIA-0487 (94); *Winter Fuels Report*, Week Ending October 6, 1995, DOE/EIA-0538 (95/96-1), and predecessor reports; and *Short-Term Energy Outlook*, DOE/EIA-0202 (95/3Q) and predecessor reports. All data through 1994 are considered final and are not subject to further revision.

Table FE1. Average[1] Propane Supply and Price
(Million Barrels per Day Except Where Noted)

Category	Winter 1992-1993	Winter 1993-1994	Winter 1994-1995
Production	0.96	0.93	0.99
Imports	0.09	0.12	0.12
Stocks Change	0.21	0.20	0.19
Total Propane Supply[2]	1.27	1.25	1.31
Residential Propane Prices (Cents per Gallon)	91.8	88.8	87.0

[1]Averages are calculated using monthly data for the winter heating season months October through March.
[2]Total propane supply is equal to domestic production, imports, and stock change, as reported in various issues of *Petroleum Supply Annual*, DOE/EIA-0340, Table 2. Total propane supply overstates product supplied due to the exclusion of exports and refinery inputs.
Sources: Energy Information Administration, *Petroleum Supply Annual 1994*, DOE/EIA-0240(94), Volume 2, and predecessor reports; and *Winter Fuels Report*, Week Ending: October 6, 1995, DOE/EIA-0538 (95/96-1), Table 8, and predecessor reports.
Note: Totals may not equal sum of components due to independent rounding.

alter the projections and the likelihood of the scenarios discussed in this assessment.

Based on pre-season inventory levels, and assuming normal weather and typical crop-drying demand, U.S. propane stocks are expected to decline gradually over the course of the heating season, ending at about 25 million barrels on March 31, 1996. This projection represents a stock draw of 32 million barrels, less than that seen in the last three seasons, but slightly more than the 5-year average. Given the same conditions, average residential prices would be expected to rise from about 88 cents per gallon in September to a peak of approximately 97 cents in January, before falling to end the season at about 87 cents.

The most significant determinant of winter propane demand is the severity of winter weather. Under two hypothetical alternative scenarios, each including 10-percent-colder-than-normal weather, but spread differently over the 6-month period, supplies remain adequate throughout the heating season. Although inventories would decline more rapidly and end at significantly lower levels under these scenarios, price impacts would be moderate, with peak prices only about 1 cent higher, and slower price declines late in the season, to ending prices about 2 to 6 cents higher.

Evaluating the accuracy of last year's assessment of propane supplies, based on the same three scenarios, the "Base Assessment" scenario[1] was the closest to actual weather conditions during the 1994-1995 winter heating season. In this scenario, average winter weather occurred throughout the Nation and the heating season, with primary stocks ending at approximately 32 million barrels. Comparatively, last winter's actual temperatures were moderately warmer than normal throughout the United States. However, a large stock draw in October 1994 , due to strong petrochemical feedstock demand for propane, dropped inventories below the expected path, where they remained throughout the season, ending at about 26 million barrels at the end of March. Residential price increases were much less than anticipated early in the season, but also fell less rapidly, ending the heating season at 88 cents per gallon compared with a projected price of 84 cents per gallon.

This article reviews the major components of propane supply and demand in the United States and their status entering the 1995-1996 heating season. Other influences on prices are also discussed. Finally, a base case and two adverse scenarios are described for the heating season assessment, focusing on inventory levels and residential prices.

Supply

Demand for propane is met from domestic production, inventory withdrawals, and imports. While domestic production accounts for the largest share of propane supply, inventory withdrawals and imports are also important sources of supply, particularly during peak demand periods in the heating season (Table FE1). Over the last 3 years, domestic production from natural gas processing facilities and refineries has averaged about three-fourths share of U.S. supply of propane during the winter heating season. During this same period, inventory drawdowns and imports, which provided the remainder of U.S. propane supply, accounted for shares of 16 percent and 9 percent, respectively.

The supply of propane from domestic production has shown phenomenal growth during 1995. Through July 1995, domestic production was up by 7.2 percent compared with the same period last year. This contrasts sharply with recent year growth rates which have averaged less than 3 percent a year since 1990. Both natural gas plants and refineries reported higher production volumes during 1995, although most of the year-to-date 1995 increase was attributed to higher production at refineries. Moreover, gas plant production and refinery production are now roughly equivalent, in contrast to prior

[1] Energy Information Administration, *Winter Fuels Report*, Week Ending October 21, 1994, DOE/EIA-0538 (94/95-3) "Propane Assessment for Winter 1994-1995."

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The supply of propane from domestic production has shown phenomenal growth during 1995. Through July 1995, domestic production was up by 7.2 percent compared with the same period last year. This contrasts sharply with recent year growth rates which have averaged less than 3 percent a year since 1990. Both natural gas plants and refineries reported higher production volumes during 1995, although most of the year-to-date 1995 increase was attributed to higher production at refineries. Moreover, gas plant production and refinery production are now roughly equivalent, in contrast to prior

[1] Energy Information Administration, *Winter Fuels Report*, Week Ending October 21, 1994, DOE/EIA-0538 (94/95-3) "Propane Assessment for Winter 1994-1995."

years when gas plant production was dominant. The increase in refinery production of propane was primarily attributable to higher crude runs at refineries in association with the increase in production of some products such as motor gasoline. Since propane is essentially a byproduct of other refinery operations, higher refinery production of products such as motor gasoline promotes higher production of propane. The modest increase in gas plant production of propane was partly attributable to the practice away from ethane rejection[2] that occurred during 1994.

Inventory withdrawals[3] provide the second largest source of propane during the winter. Because demand is strongest during the winter heating season, primary stockholders build up their inventories during the spring and summer months as a source of supplemental supply. Although peak inventory levels have varied over the years, industry observers generally look for 60 million barrels at the start of the heating season as the minimum needed to meet demand without disruption. As of September 30, 1995, U.S. inventories stood at an estimated 56.9 million barrels, a level that was well within the average range of the last 3 years.

Inventory withdrawals totaled more than 34 million barrels during the 1994-1995 heating season, or about 15 percent of total propane supply. Both the level of inventory withdrawals and their share of total propane supply were slightly above their average ranges compared with recent years despite winter weather that was the third mildest this century. Nonetheless, inventories finished the heating season at 26.1 million barrels by the end of March 1995, a level within the average range of recent years and the highest end-of-March level since 1992. Conversely, U.S. stocks of propane were built up at an above average 30.9 million barrels between April and September 30, 1995, despite downward pressure exerted by unprecedented petrochemical feedstock demand and lackluster waterborne imports. However, the 1995 stockbuild contrasted sharply from prior years because most of the build occurred relatively late in the build cycle. This situation was cause for concern during the spring and early summer months when stocks trailed historical norms by as much as 5 million barrels. However, strong stockbuilds during July and August moved U.S. inventories within the normal range which eased industry concerns over low stock levels.

The smallest component of U.S. supply of propane is from imports.[4] Imports provide a vital source of supply when consumption rates exceed the rates of available supplies of propane from domestic production and inventories. Moreover, imports provide an important source for incremental supplies during the stockbuilding period, which typically lasts from April to September. Imports accounted for 9 percent of total propane supply during the 1994-1995 heating season, about average compared with recent years. During the first 7 months of 1995, propane imports averaged 94 thousand barrels per day, down nearly 18 percent from the same period last year. The 1995 decline in imports was the result of low demand, due to the mild winter and high domestic production, which partially offset the need for additional imports.

Imports of propane are primarily of two origins, Canada and waterborne supplies from offshore countries such as Algeria, Saudi Arabia, Venezuela, Norway, and the United Kingdom.[5] The leading exporter of propane to the United States is Canada, since the country consumes only about half of its supply of propane and generally exports the remainder to the United States.

During the first 7 months of 1995, Canadian imports totaled 64 million barrels, relatively unchanged from the same period last year. However, Canada accounted for nearly 68 percent of all propane imports through July 1995, up from about 55 percent during the first 7 months of 1994. Although Canadian inventories of specification[6] propane were down about 8 percent as of September 1, 1995, compared with the same period a year earlier, Canadian imports are expected to remain an important source for incremental supplies of propane throughout the 1995-1996 heating season.

Non-Canadian imports are waterborne supplies mostly from countries in the Persian Gulf, North Africa, the North Sea, and South America. The most significant development this year has been the sharp drop in the volume of waterborne imports of propane compared with 1994. Through July 1995, waterborne imports measured 30 million barrels, down 40 percent compared with the same period last year. Part of the decline in overall imports can be attributed to strong domestic production and a mild winter, which combined to reduce the need for additional imports during 1995. However, the decline in waterborne imports reflects in part the virtual absence of imports from Saudi Arabia during 1995, due to its shift away from a crude oil based pricing policy.

Regionally, propane inventories as of September 30, 1995, are either within or above their respective normal ranges for this time of year. East Coast (PAD District I) propane markets, particularly the Northeast, are most susceptible to supply

[2]"Ethane rejection" generally occurs when natural gas prices are high in relation to natural gas liquids (NGL) prices and gas plant operators, in order to maximize their profit margins, leave (reject) the ethane in the natural gas stream. However, ethane rejection also lowers the content of the NGL stream which is reflected in lower propane production from gas plant operations.

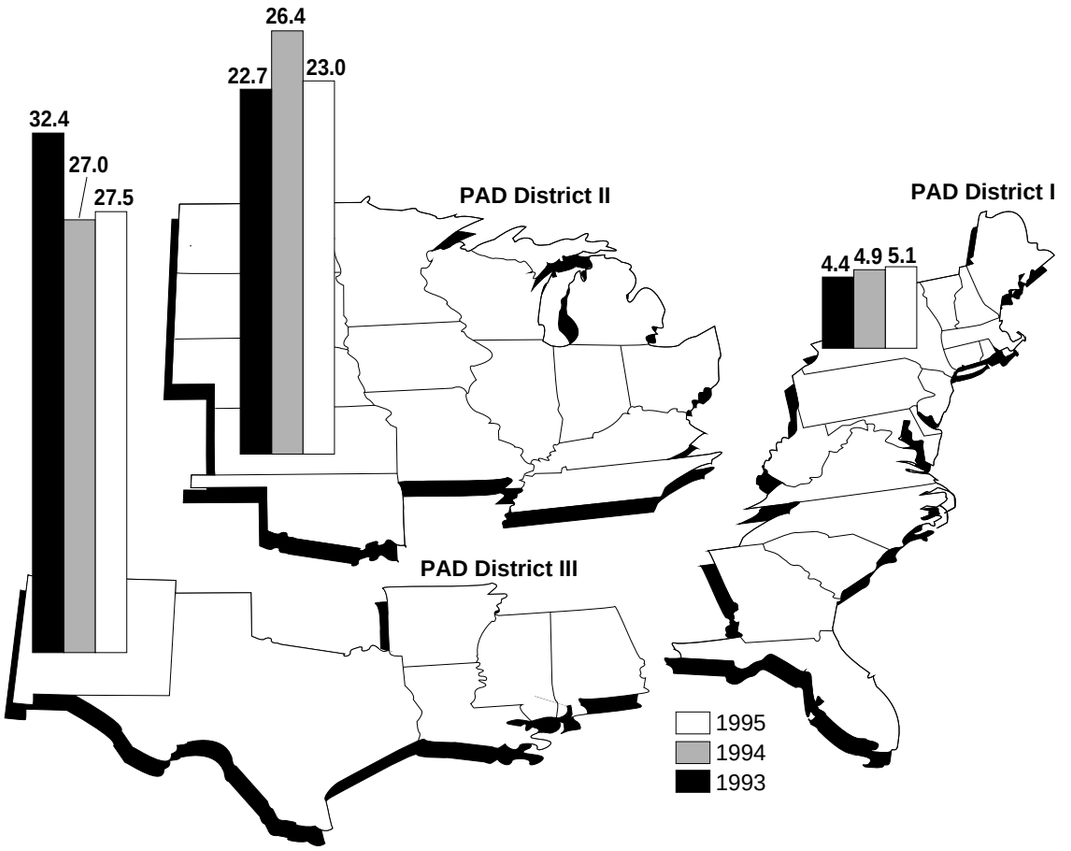
[3]"Inventory withdrawals" is the same as "Stock Change" as reported in the *Petroleum Supply Annual*, DOE/EIA-0340, Table 2.

[4] Gross imports, rather than net imports, are used in assessing the adequacy of propane supply data due to the relatively small volumes of exports which are mostly destined for Mexico.

[5]Propane imports by country of origin are derived from Form EIA-814.

[6]The National Energy Board of Canada reports propane inventories as "specification" grade (pure propane) and "mix" grade (propane mixed with ethane and/or butane).

Figure FE2. Propane Stocks of Major Petroleum Administration for Defense (PAD) Districts, September 30, 1993-1995



Sources: Energy Information Administration (EIA), *Petroleum Supply Annual 1994*, DOE/EIA-0340(94)/2, Volume 2, and predecessor reports; and *Winter Fuels Report, Week Ending*: October 6, 1995, DOE/EIA-0538 (95/96-1).

disruptions because of its end-of-the-pipeline location, limited refinery production, and its reliance on waterborne imports for supplemental supplies. Because of these drawbacks, East Coast markets have the lowest concentration of residential households using propane as their main heating fuel. As of the end of September, East Coast inventories of propane stood at 5.1 million barrels, about 3 percent higher than the year earlier and above its average range for this time of year (Figure FE2). Propane stocks at the East Coast, including the Northeast, are expected to be adequate for this winter.

Because of their close proximity to the major supply centers, Midwest propane markets are less vulnerable to supply disruptions than are East Coast markets. However, the Midwest region contains the highest concentration of residential heating customers of any region. Midwest stocks, at 23.0 million barrels as of September 30, were below last years level at this time but were well within the normal range of recent year's. Assuming brisk pre-buy activity by residential/commercial users and normal weather, no major supply disruptions or transportation problems are anticipated in the Midwest region during the upcoming winter heating season.

The Gulf Coast region produces far in excess of the region's demand for propane and contains the vast majority of the Nation's propane storage capacity. The region also contains the highest concentration of petrochemical plants in the United States. Petrochemical plants are the largest consumers of propane. Consequently, the Gulf Coast region is considered the Nation's primary supply hub. As of September 30, Gulf Coast stocks were 27.5 million barrels, about 2 percent above last year's level at this time and were within the normal range for this time of year.

Demand

Propane markets have continued to show steady growth throughout much of the 1990's. Between 1990 and 1994, propane demand averaged a growth rate of more than 4 percent per year. Through July 1995, propane demand was up by more than 6 percent over the same period last year despite low heating demand due to mild winter temperatures.

The primary factors that affect propane demand in the United States are crude oil and natural gas prices, macroeconomic

growth, and weather. Propane enjoys a wide variety of end use markets, including residential/commercial, industrial, petrochemical, agricultural, transportation, and utility. The percentage breakdown of propane demand by consuming sectors includes: residential/commercial (33 percent), petrochemical (42 percent), agricultural (9 percent), and industrial, utility and other end use sectors (16 percent).[7]

Residential/commercial markets consume propane for space heating, water heating, cooking, and clothes drying. Because of the predominance of space heating requirements, compared with other end-uses, residential/commercial demand for propane is concentrated during the winter months. Furthermore, the primary space heating customers are located in the Northeast (PAD District I) and the Midwest regions (PAD District II). For this reason, residential/commercial demand for propane is extremely weather-dependent. Although severe weather in prior years has caused supply problems, increased use of residential/commercial storage capacity can be very effective in minimizing the potential for propane market disruptions. Vulnerability to disruptions could be reduced significantly by increased use of the "keep full" contract (customer is refilled on a regular basis), rather than the traditional "cash basis" contract (customer is refilled upon request).

The petrochemical industry constitutes the largest market for propane and is primarily concentrated on the Gulf Coast region (PAD District III). Petrochemical plants use propane primarily as a feedstock in the manufacture of plastics and chemicals. Moreover, propane competes with other feedstocks on the basis of price and availability.

Petrochemical feedstock demand for propane has grown significantly over the past several years. Through September 1995, petrochemical feedstock consumption of propane averaged 361 thousand barrels per day. For 1993 and 1994, feedstock consumption of propane averaged 284 thousand barrels per day and 327 thousand barrels per day, respectively.[8] Most of this growth has been in response to continued strong domestic demand for petrochemical products, recent capacity expansions at petrochemical plants, and the low dollar exchange rates with foreign currencies that have contributed to support a strong export market for U.S. chemical products abroad. If these market trends continue into the heating season and adverse weather patterns are experienced over the major space heating regions of the Nation, the potential risk for spot shortages and/or supply disruptions is greater. However, recent market activity suggests a softening of demand for petrochemical feedstock use for propane which, over the course of the heating season, may ease some of the downward pressure on inventories in the Gulf Coast region.

Agricultural demand for propane accounts for the smallest market share of propane. Typical applications include crop drying, flame weeding, tobacco curing, defoliation, poultry brooding, frost protection, and use as a fuel to power farm equipment and irrigation pumps. Agricultural sector demand is primarily concentrated in the Midwest States of Iowa, Illinois, Nebraska, Minnesota, and Ohio (PAD District II) and is usually heaviest between late summer and early winter. The major component of agricultural sector demand is for crop drying, which can vary greatly from year to year depending on crop size, moisture content, and weather. Although small in comparison to other end use markets, agricultural demand has caused minor supply problems in past years. Generally, a combination of factors needs to occur for this to happen, such as during the fall of 1992 when heavy rains produced a near record corn crop that was both extremely wet and later than usual. These conditions caused the crop drying season to overlap the beginning of the residential heating season which caused stocks in the Midwest region to be drawn down much faster than normal.

United States corn production in 1995 is projected at 7.8 billion bushels according to the U.S. Department of Agriculture's latest 1995 forecast.[9] This level is 22 percent below last year's record 10.1 billion bushels and reflects a 10-percent drop in planted acreage and an expected 9-percent drop in yield.[10] With PAD District II inventories of propane at above average levels for this time of year, and assuming normal weather through the harvest season, crop drying demand is not expected to impact the heating fuels market this winter.

Prices

Market prices for propane are influenced by many factors, including prices for crude oil, natural gas, and competing products, and the propane supply/demand balance. In the United States, the benchmark prices for propane throughout the industry are the daily spot market quotations at Mont Belvieu, Texas, and Conway, Kansas, and the NYMEX futures prices, also for delivery at Mont Belvieu. Mont Belvieu is a storage and distribution hub for the Gulf Coast area, especially serving the petrochemical industry, while Conway serves the same function in the mid-continent area. Both centers are connected to the pipeline networks serving residential and commercial markets throughout the eastern United States. However, limited pipeline capacity between the two centers sometimes leads to price disparities during high-demand periods.

[7] American Petroleum Institute, Sales of Natural Gas Liquids and Liquefied Refinery Gases, October 1994, Table 4. pp. 6 and 7.

[8] The Current U.S. Butadiene Situation and Steam Cracker Operations, Hodson & Company Inc., Houston, Texas, September 1995 Newsletter, Volume XIX, Number 8; and predecessor issues.

[9] *Crop Production Report*, National Agricultural Statistics Service, U.S. Department of Agriculture, CrPr 2-2(9-95), p. A-4.

[10] *Agricultural Outlook*, Economic Research Service, U.S. Department of Agriculture, September 1995, AO-222, p. 4.

U.S. propane prices have been relatively stable throughout 1995, except for a brief spike in Conway prices at the beginning of March. Spot prices[11] at both Mont Belvieu and Conway have traded between 29 and 34 cents per gallon since the end of the 1994-1995 heating season. By contrast, West Texas Intermediate (WTI) crude oil prices climbed to over $20.50 per barrel in late April 1995, then fell to barely $17 in July, and began the heating season below $18. Spot prices for natural gas, the other major source of propane, have been well below last year's levels throughout 1995.

Assessment Scenarios

Starting from the known supply, demand, and price levels for propane at the beginning of the heating season, the expected conditions over the course of the season can be estimated based on assumptions about the variables that affect propane markets. For the purposes of this assessment, Scenario 1 (base assessment) assumes winter temperatures (as measured by heating degree-days)[12] equal to the historical (1961-1990) average, and all other non-weather-related demand and supply factors remaining at typical historical levels. In order to test the responsiveness of propane markets and supplies to various conditions, two alternative scenarios were considered. Scenario 2 (cold season) assumes uniformly colder temperatures (10 percent more heating degree-days) for the entire October through March heating season. Scenario 3 (cold winter) assumes a concentration of extreme winter temperatures (17 percent more heating degree-days) during the second half (January through March) of the heating season.

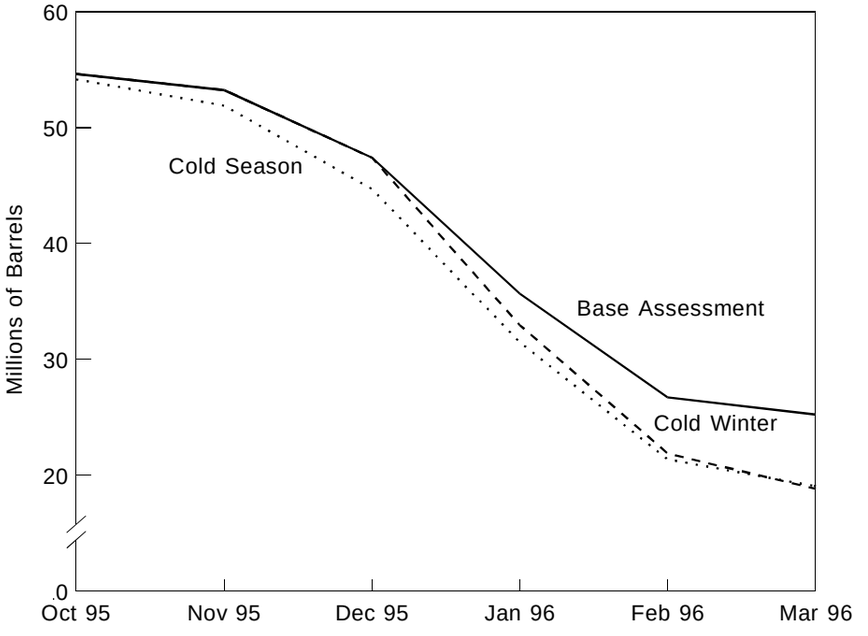
Based on current inventory levels and projected supply and demand, the expectation for the 1995-1996 winter heating season is for adequate supplies and moderate prices, given normal weather and the absence of any major supply problems. Although total U.S. inventories ended the previous heating season at a relatively low 26.1 million barrels, stocks had been rebuilt to a typical historical level of 56.9 million barrels by the end of September. Assuming average temperatures and typical crop drying demand, stocks are projected to gradually decline over the course of the season, reaching a level of about 25 million barrels by the end of March 1996[13] (Figure FE3). That ending level would be slightly below the last two winters', but above that reached in 1993. Under this projection, the total propane stockdraw over the heating season would be about 32 million barrels, near the average of the past 5 years. Residential prices would be expected to increase seasonally from about 88

[11]Spot prices quoted are from Reuters Information Services, Inc.

[12] Heating degree-days are the number of degrees that the daily average temperature falls below 65 degrees Fahrenheit.

[13]To evaluate the scenarios, the Propane Market Model (DOE/EIA-M055) was used to forecast the retail price and demand (product supplied) of propane. The model uses historical monthly data series covering the January 1989 through July 1994 time period, and also uses EIA forecasts of imported crude oil price for its projections. The model consists of a two-equation system estimated by ordinary least squares with correction for autocorrelation and a provision for the calculation of end-of-month stock levels.

Figure FE3. Effect of Alternative Weather Scenarios on Propane Stock Assessment



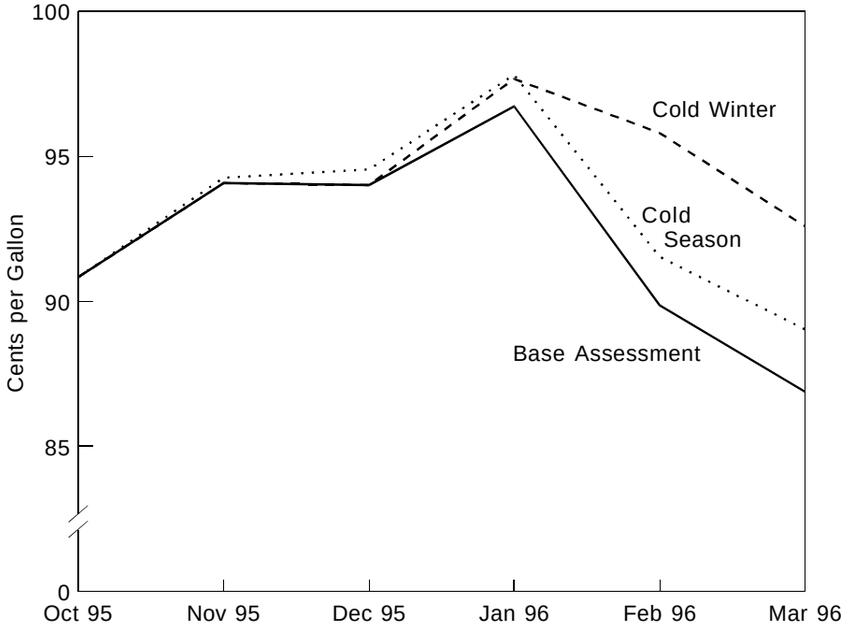
Sources: September 1995; Energy Information Administration, Form EIA-807, "Propane Telephone Survey", October 1995 - March 1996; Estimates derived from the Propane Market Model (DOE/EIA-M055).

cents per gallon in September to a peak of 97 cents in January, then fall to about 87 cents by the end of March (Figure FE4). These prices are significantly above those seen last winter, when temperatures were warmer-than-normal, due to the expected return to average levels.

If, instead of average temperatures, the weather is moderately colder (10 percent more heating degree-days) throughout the heating season and the Nation, propane supplies and prices in the United States would be significantly affected, but would remain adequate. Inventories would decline at a faster rate over the entire season, and would end March at about 19 million barrels, about 6 million barrels lower than with normal weather and slightly below the 1993 level. Residential propane prices would reach a peak only about 1 cent higher, at 98 cents in February, and would end the season about 2 cents higher, at 89 cents per gallon.

Under a different severe weather scenario, the colder weather is concentrated in a 3-month period, rather than spread evenly throughout the heating season. The 10-percent increase in heating degree-days for the season, applied entirely to the months of January through March (representing a 17-percent increase for those months), would actually result in a slightly lower end-of-season inventory level. U.S. propane stocks would be projected to end the season at under 19 million barrels, due to the shorter period of time available for production and imports to respond to the higher demand during the peak winter months. The impact of this scenario on residential prices would be more significant. With colder weather concentrated in the second half of the season, the projected result would be a slower decline and a higher season-ending price of nearly 93 cents per gallon.

Figure FE4. Effect of Alternative Weather Scenarios on Residential Propane Price Assessment



Sources: September 1995; Energy Information Administration, Forms EIA-782A, "Refiners'/Gas Plant Operators' Monthly Petroleum Product Sales Report", and EIA-782B, "Resellers'/Retailers' Monthly Petroleum Product Sales Report," October 1995 - March 1996; Estimates derived from the Propane Market Model (DOE/EIA-M055).