# *Winter Fuels Outlook: 2000-2001*

## Introduction

***This winter--defined as the period from October 2000 to March 2001--is expected to bring with it significantly higher heating bills than those seen last winter. The main reasons for this outcome are: 1) expected space-heating fuels requirements larger than those of last winter, the warmest on record; 2) inventories of key heating fuels--especially heating oil--below normal and substantially below those of the outset of the winter of 1999-2000, and 3) crude-oil prices at relatively high levels. Because of the brisk recovery of Asian economies and continued robust growth in the U.S., neither the production increases announced by OPEC since last winter nor efforts by non-OPEC sources to increase output have been able to stem the increase in crude oil prices. Although they have declined somewhat since their recent peaks and are expected to continue to ease during the winter season, world oil prices are still expected to be the highest of any since the end of the Gulf War. As a result, retail energy fuel costs--already quite high by recent historical standards--will remain high amid tight supply conditions, posing increased risks of short-term price spikes similar to those of the previous winter. In contrast to the 1999-2000 winter season, natural-gas households are likely to see the largest year-over-year percentage increases in fuel bills of any heating fuel.***

## Overview

Heating fuel markets are expected to start the season with much higher prices and (generally) lower inventories than at this time last year. Moreover, the assumption of "normal" weather, which is almost 12 percent more severe in terms of heating degree-days than that of the previous winter--the warmest on record--is expected to raise demand for space-heating fuels. The resultant tight supply/demand balance substantially increases the risk of price run-ups if very cold weather patterns emerge, even if only temporarily. In contrast to those of previous winters, fuel market supplies cannot be described as adequate to ensure a high probability of supplies meeting the demands of a very cold winter without difficulty. High spot prices, reflecting the tight supplies, would be expected to engender "supply-side" responses, such as increased heating-oil supplies brought about by higher refinery utilization rates, distillate yields, and imports. Whether these responses would suffice to avoid sustained price run-ups in the event of very cold weather is not known at this time. Warmer-than-normal weather in the main heating regions of the United States would obviously ease demand pressures, but the probability of such an outcome is no more likely than that of a colder-than-normal winter.

The impact of a colder-than-normal winter on fuel prices and consumer bills has therefore become particularly difficult this year and subject to much higher uncertainty than in past years. A sustained cold-weather scenario for this winter could result in average upward price responses much larger than any downward price reactions to a very warm winter scenario. Current constraints on available supplies would tend to

hamper responses to cold weather, resulting in large price adjustments but limited additional supply, at least in the short term. Because the probability of a sustained cold winter is low, such a scenario should be viewed as unlikely but carries with it the potential for large upward price shocks. Short-term price spikes resulting from brief cold weather snaps, such as those that occurred during the first quarter of this year, are also possible.

## Heating Bills

Table WF01 below summarizes historical and base-case (normal weather) demand, total expenditure, and price projections for key heating fuels on a per-household basis. The calculations focus on particular regions of the country with respect to consumption and projected weather factors (i.e., changes in heating degree-days) but assume national average consumer prices for heating fuels normally presented in the *Short-Term Energy Outlook*. Thus, heating bill calculations are illustrative of the magnitude of the expected changes in fuel bills but are not necessarily indicative of the absolute expenditure levels to be anticipated by individual consumers.

**Table WF01. Illustrative Consumer Prices* and Expenditures** for Heating Fuels During the Winter**

| | 1997-1998 Actual | 1998-1999 Actual | 1999-2000 Actual | 2000-2001 Base Forecast |
|---|---|---|---|---|
| **Natural Gas (Midwest)** | | | | |
| Consumption (mcf) | 82.4 | 84.5 | 81.7 | 90.9 |
| Avg. Price ($/mcf) | 6.56 | 6.27 | 6.61 | 8.58 |
| Expenditures ($) | 541 | 530 | 540 | 780 |
| **Heating Oil (Northeast)** | | | | |
| Consumption (gals) | 636 | 650 | 644 | 693 |
| Avg. Price ($/gal) | 0.92 | 0.80 | 1.18 | 1.37 |
| Expenditures ($) | 585 | 520 | 760 | 949 |
| **Propane (Midwest)** | | | | |
| Consumption (gals) | 814 | 835 | 807 | 898 |
| Avg. Price ($/gal) | 0.94 | 0.85 | 1.02 | 1.16 |
| Expenditures ($) | 765 | 710 | 823 | 1,045 |

* National average prices.

** Based on typical per-household consumption by region.

As Table WF01 above shows, expenditures for this winter are likely to be up substantially from those of last winter as a result of both higher demand and prices. In our base case-projections, the expenditure increases for households are: 25 percent for heating oil and propane; and 44 percent for natural gas. In a reversal of price behavior last winter, gas-heated households are likely to experience much higher percentage increases than those consuming other fuels. Weather in the major gas-consuming regions was as much as 18 percent warmer than normal last year compared to 12 percent for the lower 48 states as a whole. Thus, under normal weather circumstances,

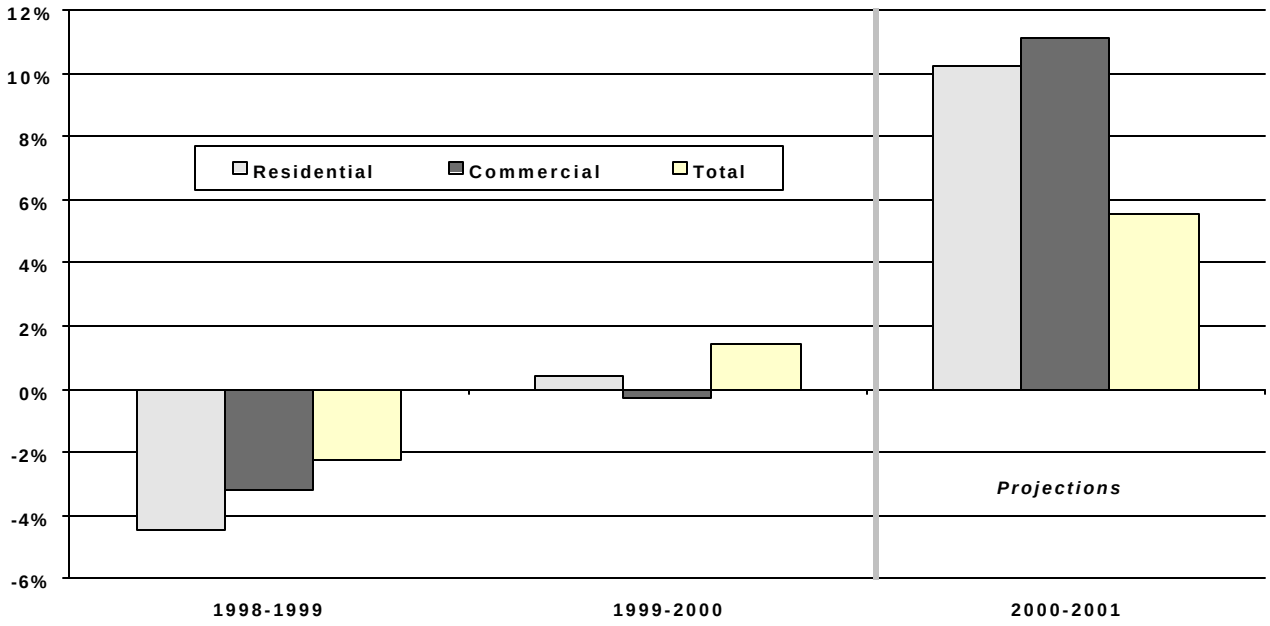
increases in per household gas consumption is expected to be relatively large. Also, since wellhead gas prices have been high most of the summer, substantial fuel cost adjustments for residential gas customers this winter are expected to be largely if not fully put in place by the nation's gas utilities. During the previous season, warmer-than-normal weather and lags in fuel cost adjustments mandated by regulations resulted in virtually no change in average expenditures for gas-heated households, compared to the 1998-99 winter heating season.

## Natural Gas

### Demand

Total natural gas demand is expected to average 71.2 billion cubic feet (bcf) per day, up 4.1 bcf per day (6.1 percent) over the level recorded last winter. Contributing to the growth in winter demand is an increase in gas space-heating customers (about 1 percent). The bulk of the winter-derived increase, however, stems from the assumption of normal weather. Milder weather last winter in the lower 48 states resulted in gas-weighted heating degree-days almost 12 percent warmer than normal, with several Midwestern areas recording weather as much as 18 percent warmer than normal. As a result, consumption this winter in residential and commercial markets is expected to average 21.0 and 12.5 bcf per day, respectively, up 10.5 percent and 10.6 percent from the previous winter's consumption (Figure WF1).

**Figure WF1. U.S. Winter Natural Gas Demand**
(Year-to-Year Percent Change)




### Supply

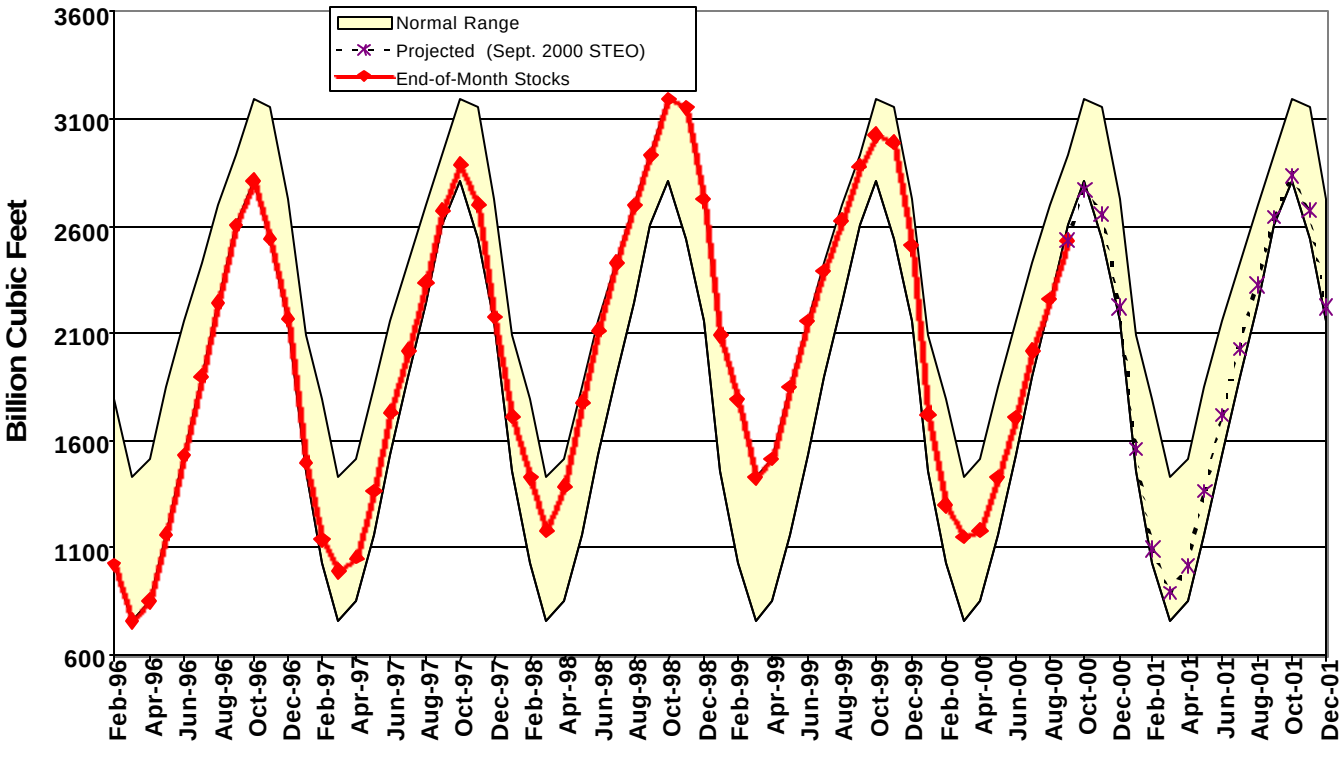
Domestic natural gas production is expected to average 51.8 bcf per day during the heating season, up slightly from the 50.7 bcf per day during the previous winter. Drilling

activity for both oil and gas had dropped sharply in 1999 in reaction to the 1998 decline in the price of oil and natural gas. The rig count in 1999 averaged 625 compared to the previous high of 943 in 1997. But exploration activity accounts have increased sharply in 2000 along with the rise in the price of crude oil and natural gas. By mid-September, the rig count reached 1012, with 816, or 80 percent, of the rigs dedicated to gas exploration. But because of the lead time needed for production to respond to exploration activity, increases in production are expected to provide little of the projected demand increase for this winter.

Storage plays a critical role in meeting increased winter demand. Working gas inventories at the beginning of the heating-season (October 1) are estimated at 2,530 bcf, 227 bcf below the 5-year (1995-1999) average of 2,757 bcf (Figure WF2). The region most dependent on inventories is the East Consuming region, which contains 56 percent of available capacity. It accounts for 1,610 bcf., 107 bcf below the 5-year regional average. The region is estimated to have filled almost 88 percent its active storage capacity. Stocks in the West Consuming region, which contains 15 percent of active capacity, are estimated at 300 bcf, which is 57 bcf below the 5-year regional average. That region is estimated to have filled 60 percent of its working gas storage capacity. The Producing region, estimated at 620 bcf, is 85 bcf below the 5-year average. Because storage activity in this region is oriented of production operations and summer power-generation requirements, it does not serve as a prime source to satisfy heating-season demand. Most storage facilities are expected to continue to add to stocks in October, which have averaged 160 bcf in the previous 5 years.

During this heating season, withdrawals are expected to be 9.2 bcf per day, slightly less than last year's average of 9.5 bcf per day. Due to a lower level of working gas at the beginning of this heating season, end-of-season stocks of working gas are projected to be 857 bcf compared to 1,150 last year. This would be the lowest level since the 750 bcf level reached in March, 1996.

**Figure WF2. Working Gas in Storage**



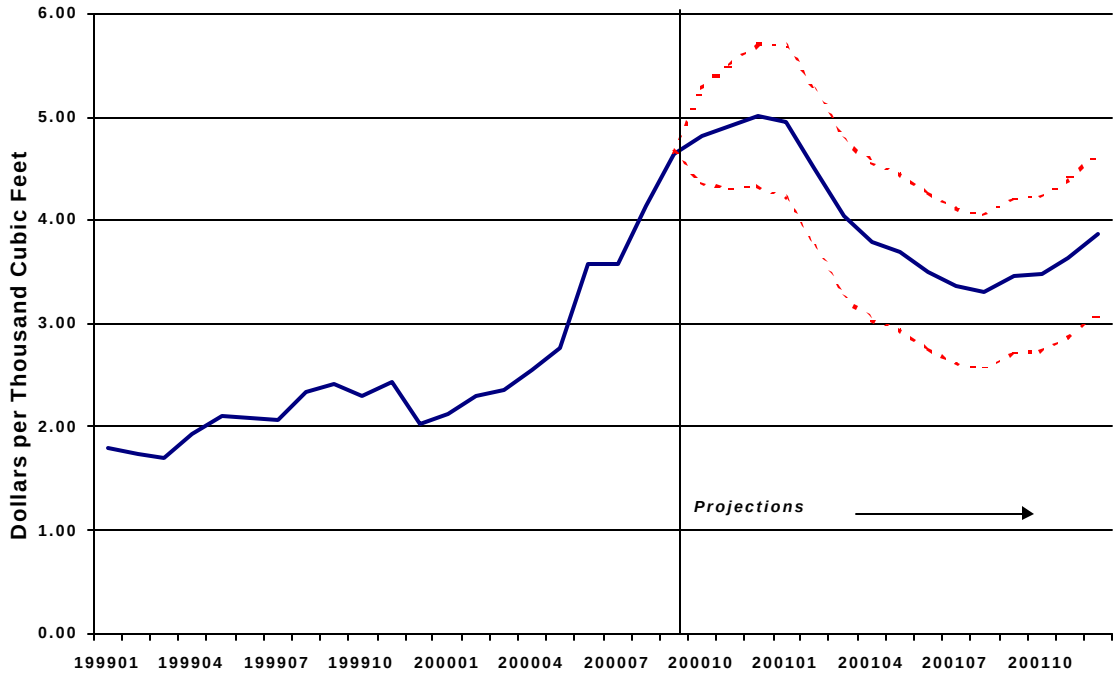
Natural gas net imports are expected to average 10.2 bcf per day, or 14 percent of demand, compared to last year's 9.6 bcf per day, or 12 percent of demand. During the winter months, net imports are about 10 percent higher than flows during the rest of the year and usually increase to full pipeline capacity. That capacity is scheduled to increase at the end of 2000 when the Alliance Pipeline will begin carrying gas from western Canada to the Midwest. Assuming that it will take several months before Alliance reaches its full capacity of 1.3 bcf per day, that pipeline may not fully contribute to advancing new gas supplies until the heating season is nearly over. Even if Alliance is near capacity at mid winter, it is likely that a substantial portion of the volumes contracted for delivery on the system will have been de-contracted from other systems, particularly TransCanada Pipeline System. Thus it is an important question as to just how significant Alliance will be with respect to net new supply from Canada.

## Prices

Average spot prices for natural gas are estimated to have averaged between $4.90 and $5.00 per thousand cubic feet (mcf) in September, nearly double the price from one year ago (Figure WF3). Average natural gas wellhead prices (which reflect some short and longer-term contract prices) are projected to post an average of $4.48 per mcf this winter, also almost double the average recorded during the 1999-2000 season. Several factors account for this sharp increase, including: below-average stock levels resulting from lagging domestic production in the face of increasing demand from the strong U.S. economy (despite increases in drilling activity); increases in summer power-generation demand, which helped constrain inventory accumulations to half their normal rate; the influence of the rise in crude-oil prices on fuel switching and, hence, prices; and inventories of other winter fuels (notably heating oil) also being below average. It should be noted that mild winter weather as well as higher inventories depressed wellhead prices during the previous heating season, making the difference between the two years especially large.

Prices paid by residential consumers are also expected to move up sharply, averaging $8.58 per mcf, up 29.5 percent from last winter's average of $6.61. This is the largest percentage increase of the major space-heating fuels to the residential sector. Consumers could see higher or lower prices during the winter, depending on whether abnormally cold or warm conditions develop.

**Figure WF3. Natural Gas Spot Prices: Base Case and 95% Confidence Interval**




## Heating Oil

### Demand

The base-case winter distillate fuel requirement is projected to be 3.88 million barrels per day, 130,000 barrels per day, or 3.3 percent, above last winter. The expectation of normal winter weather in the Northeast, the principal region for heating oil, would bring about an 8 percent increase in heating degree-days in that region and a corresponding increase in heating oil demand. Meanwhile, adding to the overall expected increases in distillate demand, growth in transportation-related demand is expected to continue at a strong pace.

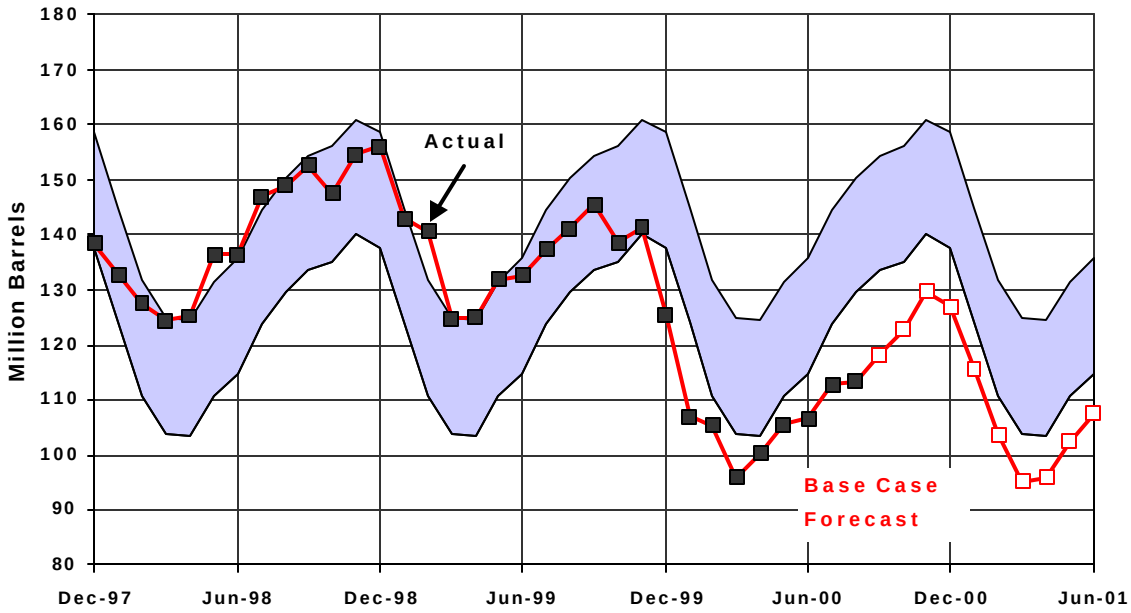
### Supply

The three sources of supply--domestic refinery production, net imports and primary stock withdrawals--should be adequate to meet the needs of a normal winter, assuming no extreme cold weather episodes or supply disruptions. As noted below, however, well above-normal spreads between distillate prices and crude oil costs are expected for the winter to help induce the necessary increment to supply to meet a normal or colder-than-normal winter in the United States. During this winter season, refinery production of distillate is projected to average 3.66 million barrels per day, up 270,000

barrels per day from the previous winter's production. That increase--more than twice that of total consumption—is expected to be brought about by three factors: 1) a 90,000 barrels-per-day increase in refinery capacity; 2) utilization rates averaging 91.8 percent compared to 89.2 percent last winter season (but still less than the 94.8 percent experienced during the 1997-98 winter season), and 3) an increase in average distillate yields to 23.7 percent from 22.9 percent last winter. Net imports are expected to average 110,000 barrels per day, or 2.8 percent of total winter requirements, slightly more than the 100,000 barrels-per-day average of the previous heating season. Maintaining this level of net imports is seen as achievable (in fact, much higher import levels have been seen in the past) but tight overall supplies elsewhere in the Atlantic Basin are likely to add to steep marginal acquisition costs.

Primary inventories of distillate at the beginning of this heating season are estimated at between 114 and 118 million barrels, down 15 percent to 18 percent from last year and below the normal range (Figure WF4). End-of-season (March 31) stocks are projected to be 95 million barrels, similar to the 96 million barrels per day available at the end of the previous heating season. That would be the lowest end-of-season stock level since the 89 million barrels recorded in March 1996. It should be noted that the projection excludes the newly created fuel oil reserve, projected to be 2 million barrels by early November. Not only are stock levels projected to be below the normal range for the entire winter season, but also the average stock withdrawal is therefore projected to be only 130,000 barrels-per-day--less than half that of the previous winter--due to the lower stock levels.

**Figure WF4. U.S. Distillate Fuel Stocks**



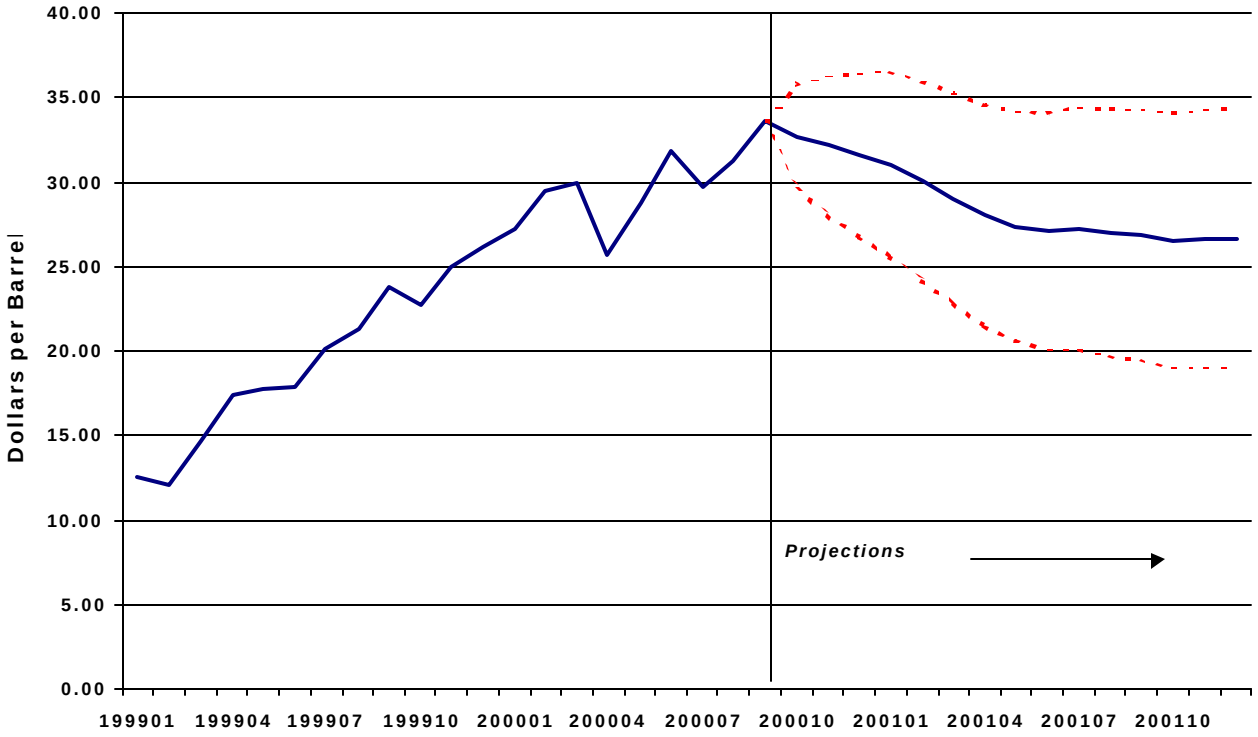

***NOTE: Colored Band is Normal Stock Range***

EIA estimates that average distillate stock levels this winter will be about 3 to 5 million barrels above where they would otherwise have been had the President not ordered a swap of 30 million barrels of oil from the Strategic Petroleum Reserve (SPR) this fall in exchange for future barrels (assumed here to be returned to the SPR during the second half of 2001). This assumes that the SPR release does not spur offsetting cutbacks from OPEC sources. The increment is small compared to total winter requirements but does improve the buffer against modest increases in demand above baseline levels and improves the likelihood that stocks will stay above the minimum levels seen in 1996 by season-end.

## Prices

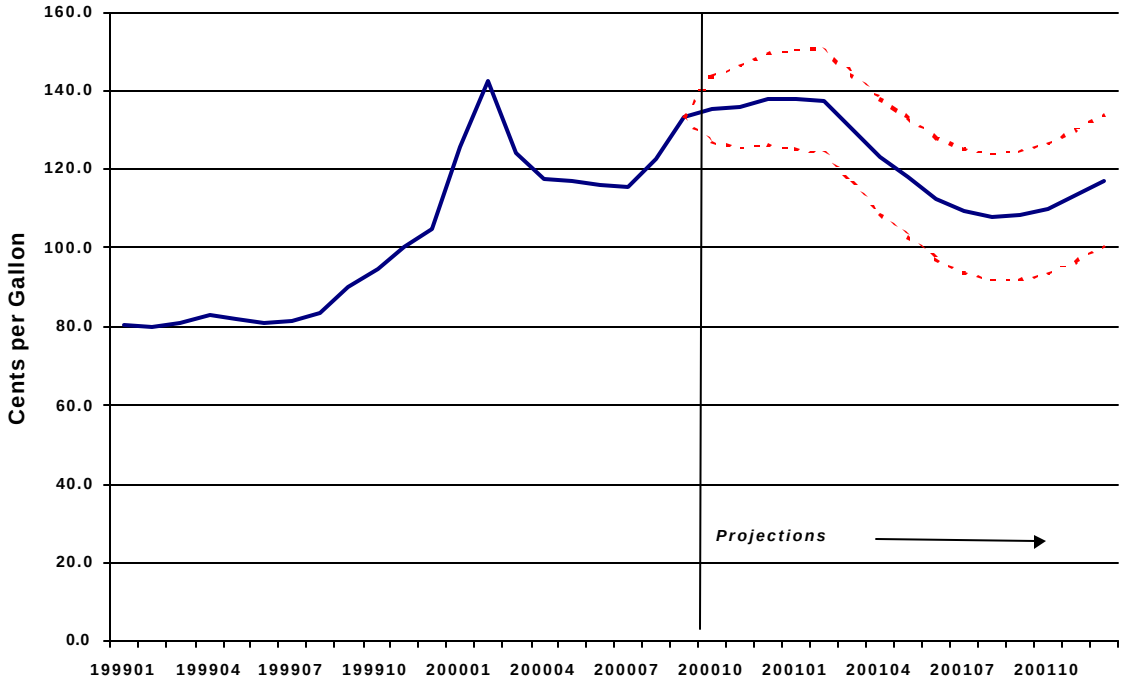
Crude oil costs to U.S. refineries are projected to average 65.2 cents per gallon ($27.62 per barrel), about 10 cents higher than the previous winter's average of 59.3 cents per gallon ($25.11 per barrel). But that projection is less than the peak of more than 80 cents per gallon observed last month. This projection partly reflects the recent decision to release 30 million barrels of crude oil from the Strategic Petroleum Reserve, and the assumption that OPEC increases production in accordance with recent annual quota revisions. Nevertheless, there remains much uncertainty about oil prices this winter, even with normal weather. In the case of very cold weather, we would expect crude oil prices to swing up toward the high end of the uncertainty band depicted in Figure WF5.

## Figure WF5. WTI Crude Oil Price: Base Case and 95% Confidence Interval




The combination of substantial rises in crude oil prices, lower inventories, and increased distillate demand is expected to result in higher and more volatile heating oil prices this winter. Residential heating oil prices are projected to average $1.37 per gallon this winter, compared to an average of $1.18 last winter (Figure WF6). But only 6 cents of that increase stems from crude oil costs. The remaining increase is related to increased refinery and distribution costs resulting from increased demand under anticipated supply constraints. This contrasts with last winter season's price behavior. The 33 cents-per-gallon rise in crude oil prices at that time accounted for almost all of the increase in wholesale and retail residential heating oil prices--38 cents and 36 cents per gallon, respectively. During that winter, demand, refinery utilization rates and distillate yields were depressed by warmer-than-normal weather, though we did experience a price runup in late January/early February in conjunction with a sharp cold spell.

**Figure WF6. Residential Heating Oil Prices: Base Case and 95% Confidence Interval**




## Propane

### Demand

U.S. demand for propane averaged 1.42 million barrels per day during the 1999-2000 winter heating season, more than 5 percent above the previous year's heating season. Strong petrochemical feedstock demand more than offset the impact of a warm winter. Although the U.S. economy remains fairly strong, available data indicate that year-to-date petrochemical feedstock demand has declined by 12 percent, reflecting a price-induced shift towards other petrochemical feedstocks and a slowdown in chemicals industry growth from last year's rapid pace. As a result, average year-to-date propane demand has averaged 1.20 million barrels per day, down more than 2 percent from the same period last year.

Propane demand for the remainder of 2000 is expected to be less than during the same period last year. But crop-drying demand this year could be higher than expected. The U.S. Department of Agriculture (USDA) is forecasting a record corn crop ever at nearly 10.4 billion bushels. If the moisture content of the corn is high, the impact of below-normal inventories in the Midwest could bring about some market volatility during the fourth quarter 2000, especially if the weather turns out to be colder than normal, pending the arrival of propane from other areas of the U.S.

Demand for the upcoming winter season is projected to average 1.42 million barrels per day, about level with that of the previous winter. Increases in space-heating demand brought about by a normal winter are largely offset by the projected declines in petrochemical demand brought about by both seasonal and price factors.

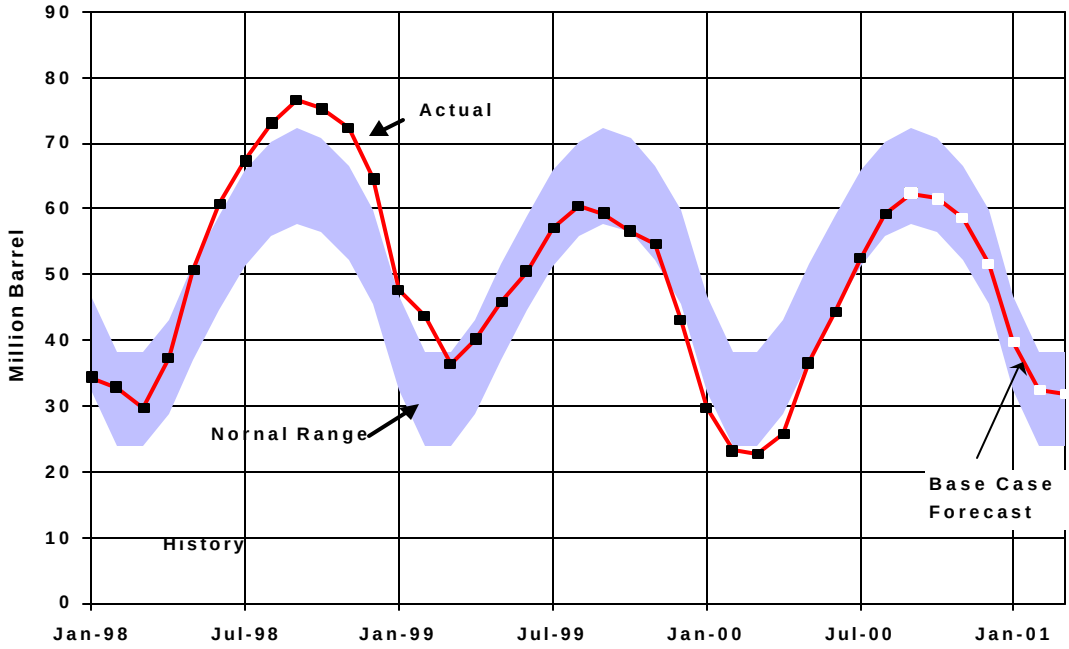
## Supply

On the basis of current inventory levels and projected supply and demand, the expectation for the 2000-2001 winter heating season is for adequate propane supplies with higher prices, assuming normal weather and the absence of any major supply disruptions.

Domestic propane production is the most important source of supply, accounting for about 80 percent of requirements during the heating season. For the first half of the year, propane production averaged 1.15 million barrels per day, up nearly 8 percent from the comparable period last year. Refineries, which accounted for most of the annual growth in propane production due to high refinery runs from strong gasoline production, are expected to remain the primary source during the winter season, assuming continued strong growth in the U.S. economy. In addition, high propane prices have provided incentive for gas processors to extract larger quantities of propane compared to last year.

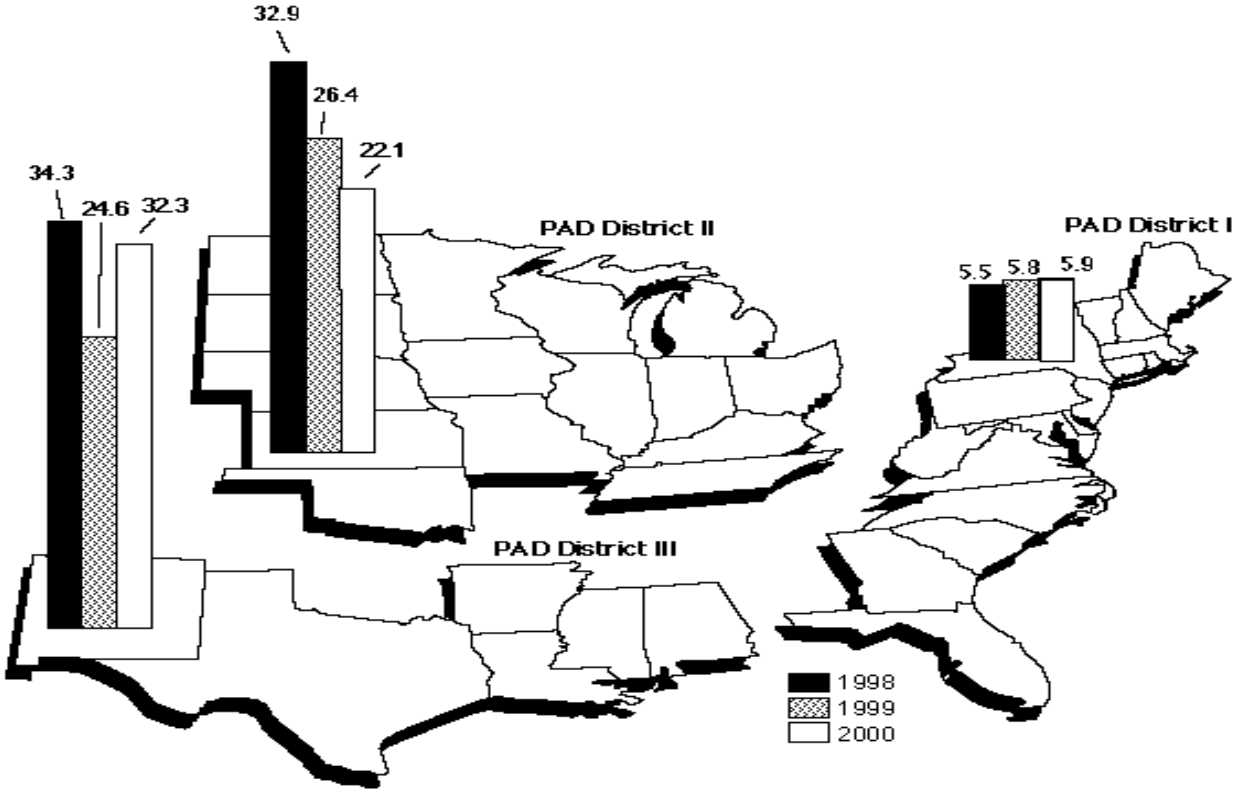
Primary propane inventory withdrawals provide the second largest source of propane during the winter season. Despite last winter's mild weather, U.S. propane inventories fell to 22.7 million barrels by the end of the heating season, 13.7 million barrels below that of the 1998-99 season. This caused concern among industry observers because of the overwhelming need to rebuild inventories to adequate levels by the start of the next heating season. However, last summer's strong stock build pushed inventories to an estimated 62.5 million barrels as of September 30, 2000, slightly above last year's levels. As a result, propane inventories are well within the normal range at the start of the heating season (Figure WF7). Under the base-case scenario, inventories are projected to gradually decline, reaching a level of 32.2 million barrels by the end of March 2001, or 4.2 million barrels higher than last year. Propane is the only major fuel whose end-of-season inventories are projected to he higher than those of the previous season.

## Figure WF7. U.S. Propane Stocks




Regional inventories remain mixed (Figure WF8). As of the beginning of the heating season, East Coast and Gulf Coast inventories were at the upper limit of their respective normal ranges, while inventories in the Midwest region continued to track substantially below the normal range. Below-normal inventories in the Midwest region may be cause for some concern due not only to the high concentration of heating demand in the region and but also the potential for larger-than-expected crop-drying demand.

**Figure WF8. U.S. Propane Inventories by PAD District** (as of September 30)(million barrels)



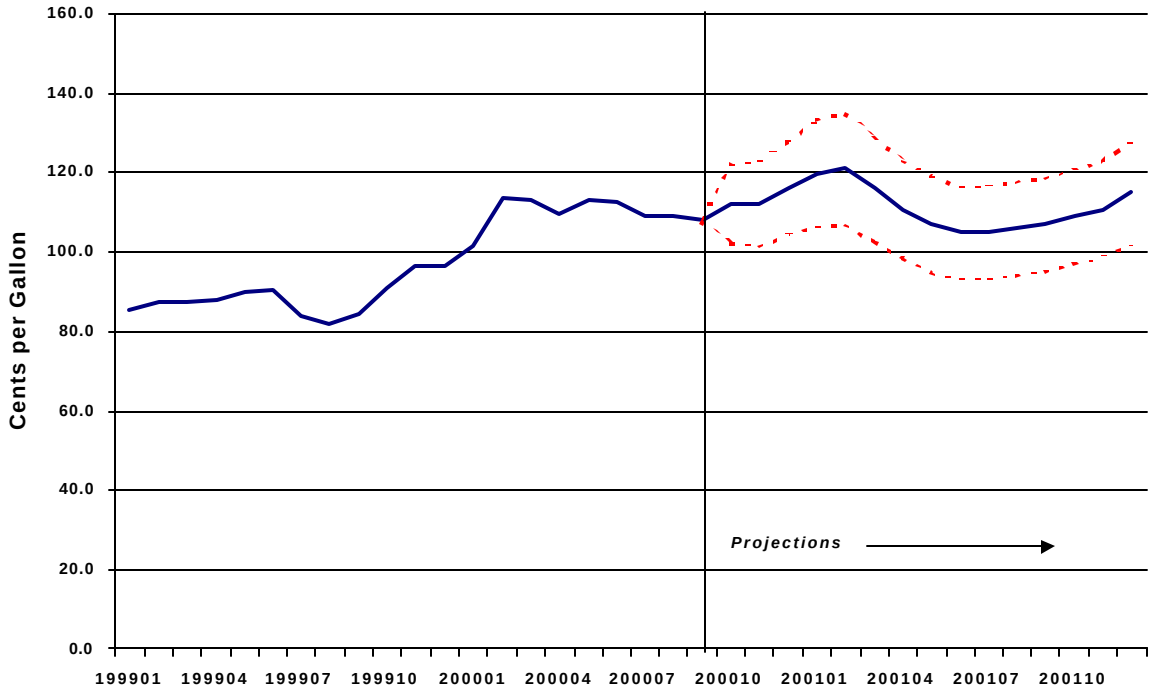

While small in volume, imports provide a crucial source of supply during periods when demand exceeds the available supplies from production and inventories. Propane imports are running slightly above this year compared with last year. Available data for this year indicate that propane imports averaged 125,000 barrels per day, up slightly from 118,000 barrels per day last year. However, the most dramatic shift in imports this year compared with last year was the drop in waterborne imports due to increased world demand for propane coupled with unfavorable economics of importing that product into the U.S. Gulf Coast. However, increases in Canadian imports have more than offset the decline in waterborne imports.

## Prices

The primary determinant of spot propane prices, as with most commodities, is the supply/demand balance, which can vary by region. These prices are also influenced by crude oil prices, natural gas prices, the prices of alternative petrochemical feedstocks, and intangible factors such as uncertainty about future supply/demand balances. Despite a strong stock build during the spring and summer months, spot propane prices increased significantly in response to the rise in crude oil prices and anticipated demand. Despite last winter's mild weather, propane inventories continued to track slightly below the normal range for most of the heating season, causing both wholesale and residential propane prices to remain relatively high.

For the upcoming winter season, propane prices are therefore expected to be substantially higher compared with last year. Under the base-case scenario, residential prices are expected to average $1.16 per gallon compared to $1.02 last winter (Figure WF9).

**Figure WF9. Residential Propane Prices: Base Case and 95% Confidence Interval**




## Extreme Weather Cases

In addition to the normal uncertainty surrounding the expected outcomes for key fuel volumes and prices, inferred from the inherent uncertainty of primary determinants (weather and economic growth for examples) as well as the basic stochastic nature of estimating relationships, we have considered demand and price responses under extreme (cold or warm) weather conditions. We have focused on the likely consequences of overall deviations (higher or lower) of 10 percent from normal weather, measured in terms of aggregate heating degree-days.

Based on winter season (October--March) heating degree-days over the period 1975 to 2000, we estimate that the probability of experiencing a winter in which overall degree-days (i.e. total heating degree-days over the winter) are either 10 percent above or below normal ranges of between 5 and 6 percent. But the distribution of the incremental degree-days can be far from even. To simplify the analysis, however, we assume that the 10-percent deviations in either direction are proportionally distributed over the winter based on the "normal" heating degree-day pattern. We did not investigate how this added assumption affects the probabilities associated with the event, but a more typical pattern is admittedly one that is at least somewhat uneven.

## Table WF02. U.S. Winter Fuels Outlook: Base Case

| | History | | | Base Case | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1999-2000 | | | 2000-2001 | | | Percent Changed | | |
| | Q4 | Q1 | Winter | Q4 | Q1 | Winter | Q4 | Q1 | Winter |
| **Demand/Supply** | | | | | | | | | |
| Distillate Fuel (mill. barrels per day) | | | | | | | | | |
| Total Demand | **3.75** | **3.75** | **3.75** | 3.78 | 3.97 | *3.88* | *0.8%* | *5.9%* | *3.3%* |
| Refinery Output | **3.50** | **3.27** | **3.39** | 3.80 | 3.51 | *3.66* | *8.5%* | *7.3%* | *7.9%* |
| Net Stock Withdrawal | **0.22** | **0.32** | **0.27** | -0.10 | 0.35 | *0.13* | *-144.3%* | *9.4%* | *-53.0%* |
| Net Imports | **0.03** | **0.16** | **0.10** | 0.10 | 0.11 | *0.11* | *221.5%* | *-29.3%* | *11.3%* |
| Refinery Utilization (percent) | **91.1%** | **87.3%** | **89.2%** | 93.1% | 90.5% | *91.8%* | | | |
| Natural Gas (bill. cubic feet per day) | | | | | | | | | |
| Total Demand | **58.67** | **75.53** | **67.06** | 62.34 | 80.17 | *71.16* | *6.3%* | *6.1%* | *6.1%* |
| Production | **50.79** | **50.53** | **50.66** | 51.29 | 52.39 | *51.84* | *1.0%* | *3.7%* | *2.3%* |
| Net Stock Withdrawal | **4.08** | **14.93** | **9.48** | 3.60 | 14.91 | 9.19 | *-11.7%* | *-0.1%* | *-3.0%* |
| Net Imports | **9.55** | **9.59** | **9.57** | 9.97 | 10.51 | *10.23* | *4.3%* | *9.5%* | *6.9%* |
| **Propane** (mill. barrels per day) | | | | | | | | | |
| Total Demand | **1.42** | **1.43** | **1.42** | 1.38 | 1.47 | *1.42* | *-2.8%* | *2.8%* | *0.0%* |
| Net Stock Withdrawal | **0.18** | **0.22** | **0.20** | 0.12 | 0.22 | 0.17 | *-34.8%* | *-2.5%* | *-17.1%* |
| **Stocks** (ending period) | | | | | | | | | |
| Distillate Fuel (MMB) - Beg. [a] | **145** | **125** | **145** | 118 | 127 | *118* | *-18.7%* | *1.2%* | *-18.7%* |
| - End. [a] | **125** | **96** | **96** | 127 | 95 | *95* | *1.2%* | *-0.9%* | *-0.9%* |
| Working Gas (BCF) - Beg. [b] | **2884** | **2509** | **2884** | 2530 | 2199 | 2530 | *-12.3%* | *-12.4%* | *-12.3%* |
| - End. [b] | **2509** | **1150** | **1150** | 2199 | 857 | 857 | *-12.4%* | *-25.5%* | *-25.5%* |
| Propane (MMB) - Beg. [a] | **59.4** | **43.0** | **59.4** | 62.5 | 51.8 | *62.5* | *5.1%* | *20.4%* | *5.1%* |
| - End. [a] | **43.0** | **22.7** | **22.7** | 51.8 | 32.2 | *32.2* | *20.4%* | *41.8%* | *41.8%* |
| **Prices** | | | | | | | | | |
| Imported Crude Oil (c/g) [c] | **54.8** | **63.9** | **59.3** | 67.3 | 63.1 | *65.2* | *22.8%* | *-1.3%* | *10.0%* |
| Retail Heating Oil (c/g) | **101.3** | **130.5** | **118.1** | 137.8 | 135.9 | *136.7* | *36.0%* | *4.1%* | *15.8%* |
| Wellhead Gas ($/mcf) | **2.26** | **2.26** | **2.26** | 4.57 | 4.39 | *4.48* | *102.6%* | *94.5%* | *98.5%* |
| Resid. Gas ($/mcf) | **6.85** | **6.48** | **6.61** | 8.61 | 8.54 | *8.56* | *25.8%* | *31.7%* | *29.5%* |
| Resid. Propane (c/g) | **94.7** | **108.7** | **101.7** | 113.4 | 119.0 | *116.3* | *19.7%* | *9.5%* | *14.4%* |
| **Market Indicators** | | | | | | | | | |
| Manuf. Output (index, 1996=1.0) | **1.195** | **1.216** | **1.206** | 1.274 | 1.284 | *1.279* | *6.6%* | *5.6%* | *6.1%* |
| Northeast HDDs per day | **20.6** | **30.7** | **25.6** | 22.4 | 33.0 | 27.7 | *9.1%* | *7.6%* | *8.1%* |
| Gas-Weighted HDDs per day | **16.5** | **23.2** | **19.9** | 18.6 | 26.2 | 22.4 | *12.6%* | *12.5%* | *12.5%* |

[a]mmb = million barrels.
[b]bcf = billion cubic feet.
[c]Refiner acquisition cost (RAC) of imported crude oil.
[d]Percent changes have been adjusted for leap-year effects.
Notes: Minor discrepancies with other EIA published historical data are due to rounding. Historical data are printed in bold; forecasts are in italic. The forecasts were generated by simulation of the Short-Term Integrated Forecasting System. Sources: Historical data: Energy Information Administration, *Petroleum Supply Monthly*, DOE/EIA-0109; *Monthly Energy Review*, DOE/EIA-0035. Macroeconomic projections are based on DRI/McGraw-Hill Forecast CONTROL0900.

Over the last 25 years, only 3 winters even exhibited weather patterns that have led to all months deviating from normal in the *same direction* (1981-1982, 1990-1991, and 1999-2000). All of these winters were warmer than normal, the most significant overall deviation having been recorded last winter (10.7 percent warmer than normal). On the other hand, 2 winters in the last 25 were more than 10 percent colder than normal (1976-1977 and 1977-1978). Interestingly, the coldest winter relative to normal since then was the 1978-1979 winter, when heating degree-days exceeded normal by 8.2 percent. Lest one conclude that we have inadvertently overstated the probabilities here in view of the apparent concentration of colder periods in the early part of the sample period, we have made adjustments for warming trends that have been identified in mean temperatures by season in the United States. The difference in mean winter degree-day deviations from normal between the first half of the sample period and the second half of the sample period is not statistically significant.

This winter, with low heating oil stocks and relatively low natural gas in storage at the beginning of the season, we see an enhanced risk of significant upward price shocks under a scenario in which heating degree-days are 10 percent colder than normal. For propane, which starts the season with inventory levels near normal nationally (albeit still somewhat below normal in the Midwest region) the upward price risk is present but not as significant as the other heating fuels. We characterize the potential price variance for heating fuels under extreme weather conditions as asymmetrical between upward and downward risk, with a significantly higher absolute price response likely under extreme cold weather than under extremely warm conditions. The key results, which are expressed in percent changes, are summarized below:

Table WF03. Severe Weather Scenarios: Percent Deviations from Base Case

| | 10% Colder | 10% Warmer |
|---|---|---|
| **Natural Gas** | | |
| Demand | 2.6% | -3.8% |
| Residential Price | 10.5% | -4.6% |
| **Distillate Fuel Oil** | | |
| Demand | 1.8% | -2.6% |
| Residential Price | 30.0% | -15.4% |
| **Propane** | | |
| Demand | 2.6% | -2.8% |
| Residential Price | 5.5% | -3.5% |

Because propane supply appears to be adequate to satisfy demand without any obvious difficulty under most circumstances likely to arise this winter, we do not expect particularly large swings in propane prices relative to the base case this winter if weather is substantially colder or warmer than normal.

For natural gas and heating oil (or distillate fuel generally), a winter scenario this year which includes the assumption that weather is 10% colder than normal is likely to generate particularly strong upward price movements. Starting from relatively tight supply conditions in these markets, the ultimate volumetric supply response to such a demand shock would be expected to be small and the change in the market clearing price relatively large. We estimate that the potential ranges of price increases would extend to 30 percent higher residential heating oil prices and 10 percent higher residential gas prices above the base case under the colder-than-normal scenario. For the winter period itself, these constitute the outside ranges of cold weather-induced price shocks in our view.

In a 10 percent warmer-than-normal scenario, more of a volume response is possible on the supply side (i.e. refinery runs can be cut, spot purchases reduced) and market clearing can occur with smaller absolute price changes. In the warm weather case, we would expect key heating fuel prices to residential consumers to range 4 percent to 15 percent below base case levels, with the strongest relative price reaction to be evident in the Northeast heating oil market.