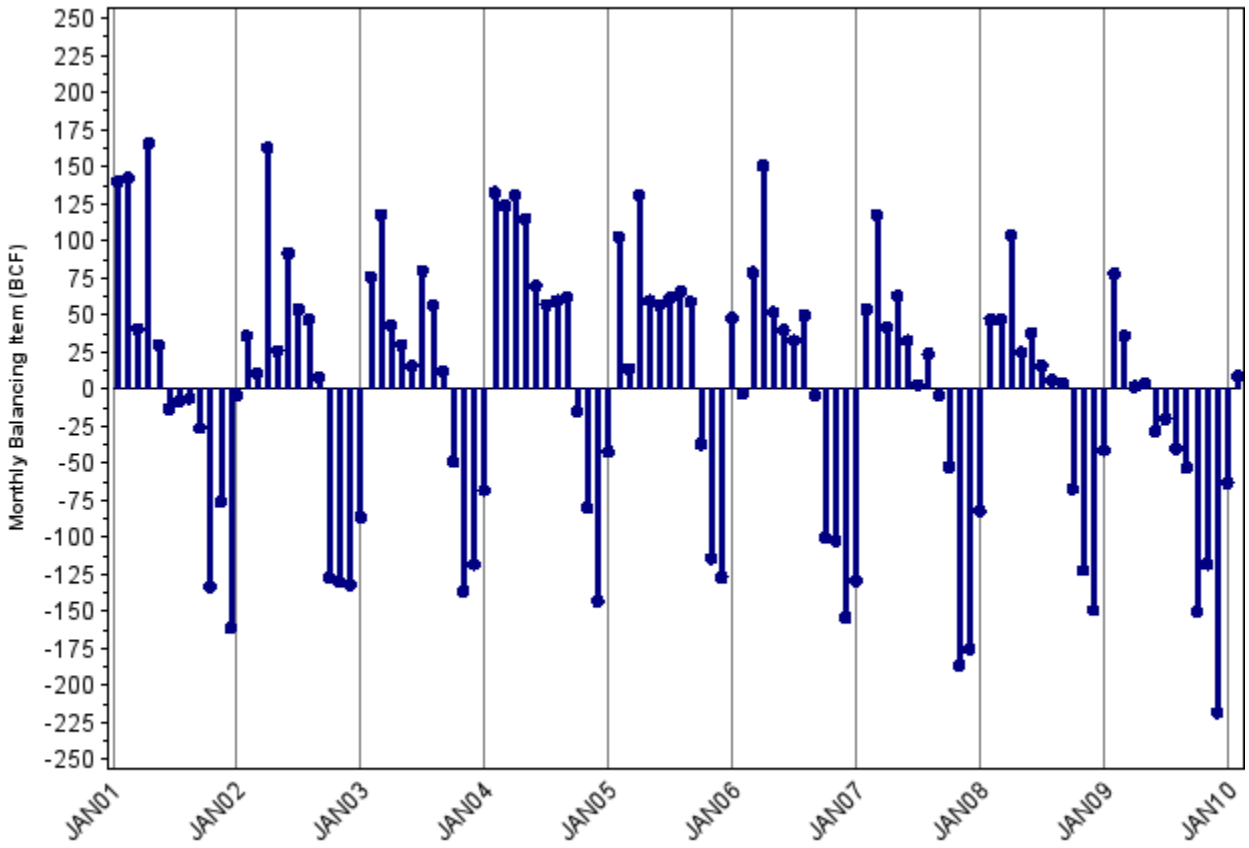
Seasonality in the Natural Gas Balancing Item: Historical Trends and Corrective Measures

This special report examines an underlying cause of the seasonal pattern in the balancing item published in the *Natural Gas Monthly*. Research finds that a significant portion of data collected on EIA's primary monthly natural gas consumption survey reflects billing data that does not strictly coincide with the actual calendar month, which creates an aggregate-level discrepancy with EIA's other natural gas supply and disposition data series. This discrepancy is especially observable during the fall and spring as one transitions into and out of the winter heating season. The report also outlines improved data collection and estimation procedures that will be implemented later this year to more closely align reported and actual calendar month consumption. This discussion will be helpful to users of EIA's volumetric natural gas data. Questions about this report should be directed to Andy Hoegh at **andrew.hoegh@eia.doe.gov** or (202) 586-9502.

Introduction

The monthly natural gas balancing item, which reflects the difference between consumption and supply at the national level,[1] is a significant metric for gauging the comprehensiveness and quality of EIA's volumetric data as presented in the *Natural Gas Monthly* (NGM). A negative balancing item is the result of supply that is greater than consumption. A positive balancing item is indicative of consumption that exceeds supply. Historically, the balancing item has exhibited a consistent seasonal pattern, with considerable spikes evident at certain times during the year. In the fall, reported supply exceeds reported demand and the balancing item trends significantly negative. In spring the opposite occurs, as reported demand exceeds reported supply, resulting in a substantial positive balancing item. This phenomenon is depicted in Figure 1. Other factors contribute to the monthly imbalance, but the seasonal aspect warrants particular attention because it has had a significant and systematic effect over the years.

Figure 1.Monthly Natural Gas Balancing Item, 2001-2010



Source: U.S. Energy Information Administration.

Underlying Seasonality

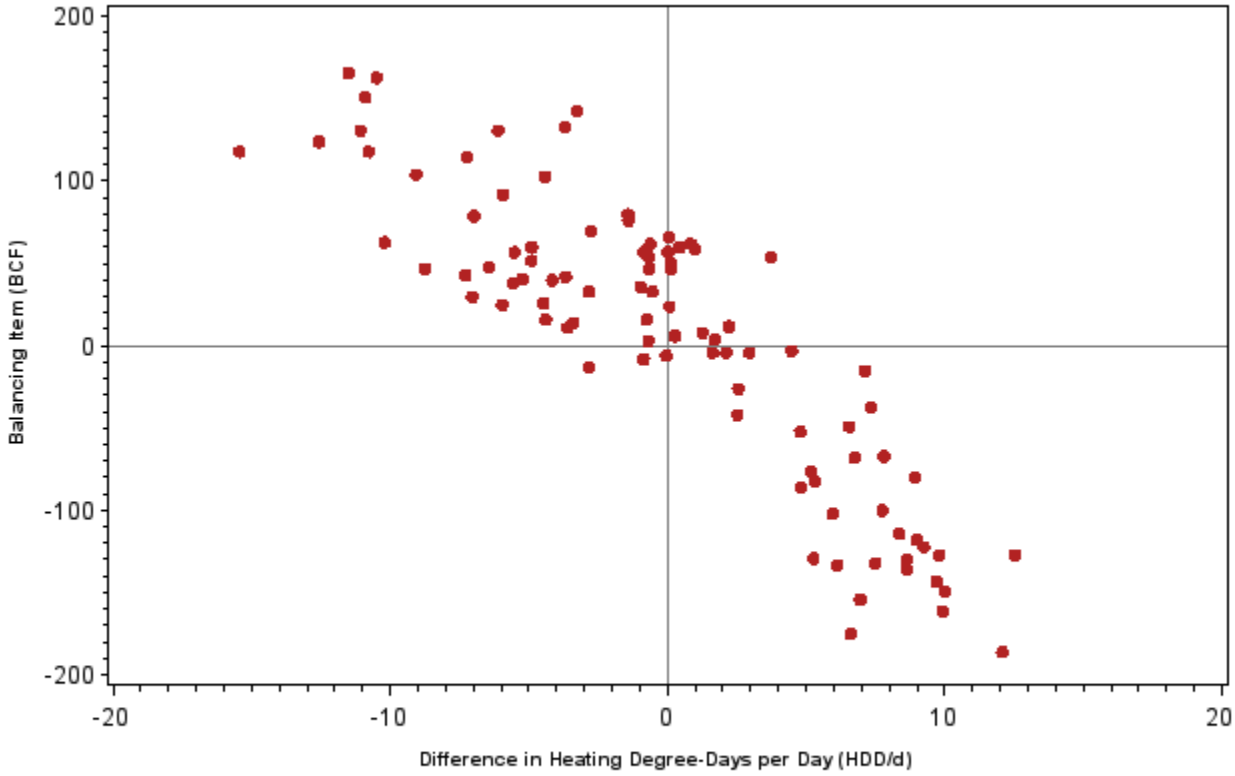
The discernible pattern in Figure 1 suggests a flaw in the data collection process behind the *NGM*. Research conducted via site visits to several respondents that file Form EIA-857, "Monthly Report of Natural Gas Purchases and Deliveries," EIA's primary monthly natural gas consumption survey, indicates that many local distribution companies (LDCs)[2] are reporting end-use deliveries to residential and commercial customers on a lag. That is, they are providing data corresponding to their billing cycles rather than to the actual calendar month being sought by EIA. This in turn creates a disconnect between supply and demand patterns at the published aggregate level, as estimated supply precedes estimated demand going into and out of the heating season each year.

The lag in consumption data is a direct result of LDC business practices. Typically, LDCs read a separate grouping of residential and commercial customer meters on each business day during a calendar month. In order to submit Form EIA-857, a number of respondent LDCs sum the usage data from the meters read *during* the calendar month and submit this total to EIA. In cases where meters are read near the end of the report month, usage somewhat aligns with the actual calendar month. However, meters read early in the month contain data more representative of the prior month's usage. On average, about half the billing volume is used during the report month with the other half used in the month preceding the report month.

Because residential and commercial customers utilize natural gas primarily for space heating, weather patterns drive demand in these sectors. It is during the spring and fall transitional periods that supply and demand become incrementally disjointed in the *NGM*, due in large part to the effects of lag reporting. As noted above, this phenomenon primarily affects the residential and commercial sectors.

The relationship between the balancing item and the month-to-month heating degree-day[3] differential — or change in HDD over the course of a month — serves to illustrate the seasonal impact of lag reporting (Figure 2). As shown in the figure, when heating degree-day differential is positive, the prior month was warmer than the report month, suggesting under-reporting of consumption and in turn a negative balancing item. Negative heating degree-day differential correlates to a colder prior month, suggesting over-reported consumption and a resultant positive balancing item. Furthermore, a regression analysis performed on the same dataset shows that the difference in heating degree-days accounts for nearly 80 percent of the total variability in the balancing item.[4]

Figure 2. Balancing Item vs. Difference in Heating Degree-Days per Day, 2001-2008



Source: U.S. Energy Information Administration, National Oceanic and Atmospheric Administration.

HDD = 65 - mean daily temperature

It is worth noting that variation in the balancing item is not universally attributable to lag reporting. The *NGM* relies on additional sources apart from the EIA-857 to cover the remaining segments of the natural gas industry, including production, imports and exports, underground storage, and electric power consumption.[5] These data are currently being reviewed as part of an ongoing effort to identify and rectify other causes of balancing item behavior outside of the seasonal phenomenon.[6] Nevertheless, improvements in calendar

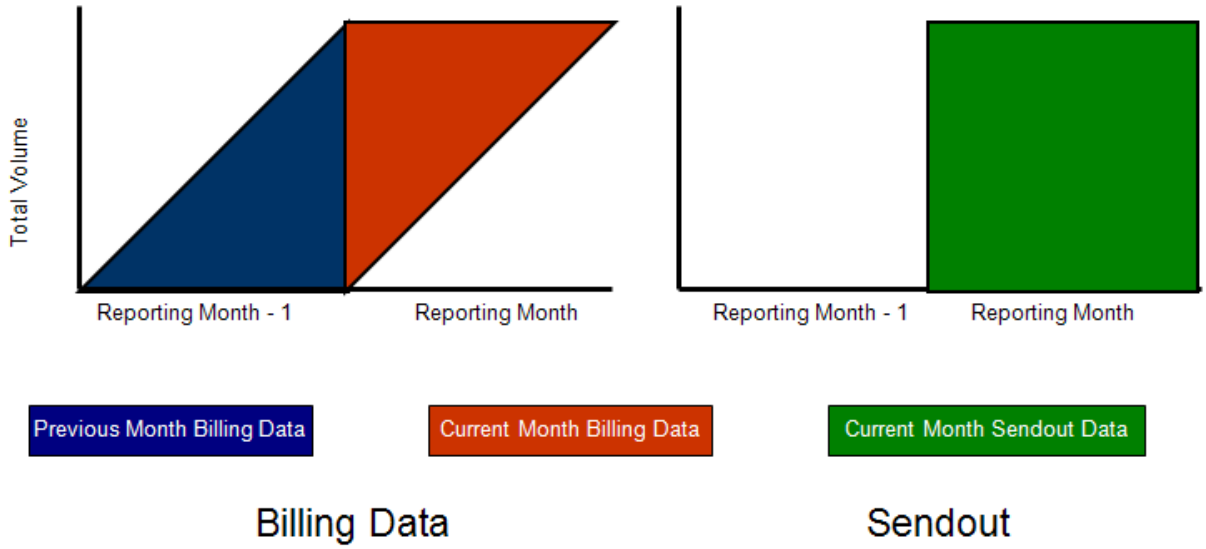
month consumption data would provide a more accurate, synchronous snapshot of gas markets in the United States.

Addressing the Problem

EIA staff made site visits to a set of EIA-857 respondents who together accounted for nearly a third of total U.S. residential and commercial deliveries of natural gas. These visits provided important insights into industry recordkeeping practices and available data resources. In discussing reporting methodologies, for example, it was learned that along with the billing cycle data that form the basis for many EIA-857 submissions, total system sendout[7] is another widely available element. This number, which is generally available on a calendar month basis, captures natural gas going into the distribution system without specifying the end-use sector for which it is intended. By aligning the various available data sources in Figure 3, a representation of LDC reporting practices and methodologies can be visualized.

The graphic on the left illustrates lag effect inherent in companies reporting calendar month usage from meters read during the month. A billing cycle customer grouping with meters read on the first of the month would consist of data largely from the month prior to the report month. In the diagram this is represented by a horizontal slice from the bottom layer of the parallelogram. Similarly, a group with meters read on the final day of the month would represent a horizontal slice from the top layer of the figure, with nearly all of the usage falling in the report month. Alternatively, the graphic on the right, sendout data would provide a more accurate measure of calendar month use; however, the end-use sector of the natural gas can not be precisely determined by this measure alone.

Figure 3. Available Data



Source: U.S. Energy Information Administration.

While discussions with select LDCs revealed that not all are reporting billing cycle (i.e., lagged) data on the EIA-857, evidence suggests that the proportion who do is significant. The total percentage of residential and commercial volume reported in this manner is perhaps on the order of 70 percent. Over the course of these site visits, two other general

reporting methods were indicated apart from straight billing cycle data: use of an estimation technique, e.g., sample meters or heating degree-day-based models, or the allocation of the sendout volume proportional to the billing cycle usage. This latter method forms the basis of a proposed solution going forward.

New Methodology

EIA's goal in identifying an alternate data collection and estimation protocol is to more precisely align monthly consumption estimates with the other aspects of natural gas supply and disposition such that all data correspond to a calendar month timeframe. From discussions with several LDCs, it became apparent that the total sendout volume was the most expedient means of achieving a meaningful improvement in the published estimates for two major reasons:

- It represents an accurate calendar month measurement of total end-use deliveries.
- The number is already available from other business processes. Therefore collection results in a minimal increase in reporting burden.

In March 2010, EIA was granted Office of Management and Budget (OMB) approval to add a line item for total sendout to Form EIA-857 (Figure 4). This change, along with refinement of the instructions to clearly instruct that unadjusted billing cycle data be reported on lines 3 through 12 will provide the basis for better consumption estimates using an approach, detailed here, that consistently accounts for the lag between sendout and billing data for all respondents.

Figure 4. Updated EIA-857

PART 3. NATURAL GAS PURCHASES AND DELIVERIES TO CONSUMERS				
			Volume (Mcf @ 14.73 psia-60°F)	Cost (Including taxes)
Purchased Gas Received in Distribution Service Area (City Gate)	1			
Total sendout of gas owned and not owned (may not be total of lines 3-12 due to billing cycles)	2			
Deliveries of natural gas that you **do own** to end-use consumers within the report State:		Number of Customers	Volume (Mcf @ 14.73 psia-60°F)	Revenue (Including taxes)
Residential	3			
Commercial	4			
Industrial	5			
Electric Power	6			
Other (not included in above categories) _____ (Specify Type)	7			

Source: U.S. Energy Information Administration.

At the respondent level, sendout data will become the new basis for total consumption. The majority of the natural gas in the electric power and industrial sectors is transported by LDCs and pipelines on behalf of third party suppliers. Meters for these customers are generally read daily or at the end of the calendar month so that usage corresponds to the actual calendar month, and in turn, the third party supplier's nomination cycle. Thus, the timeliness of these sectors allows their totals to be subtracted from the total sendout, with the remaining volume, (minus a small amount estimated for distribution use and/or loss), attributable to the residential and commercial sectors. The residential and commercial sector shares of the combined residential and commercial sendout will be determined by the proportion of use from the most recent billing data reported on lines 3 through 12 on the

form. For example, if the residential sector accounted for 60 percent of the total residential and commercial volume, the residential sector would receive 60 percent of the remaining sendout volume. The end result of this adjustment is that the sector totals sum to the sendout volume, which reflects actual monthly consumption.

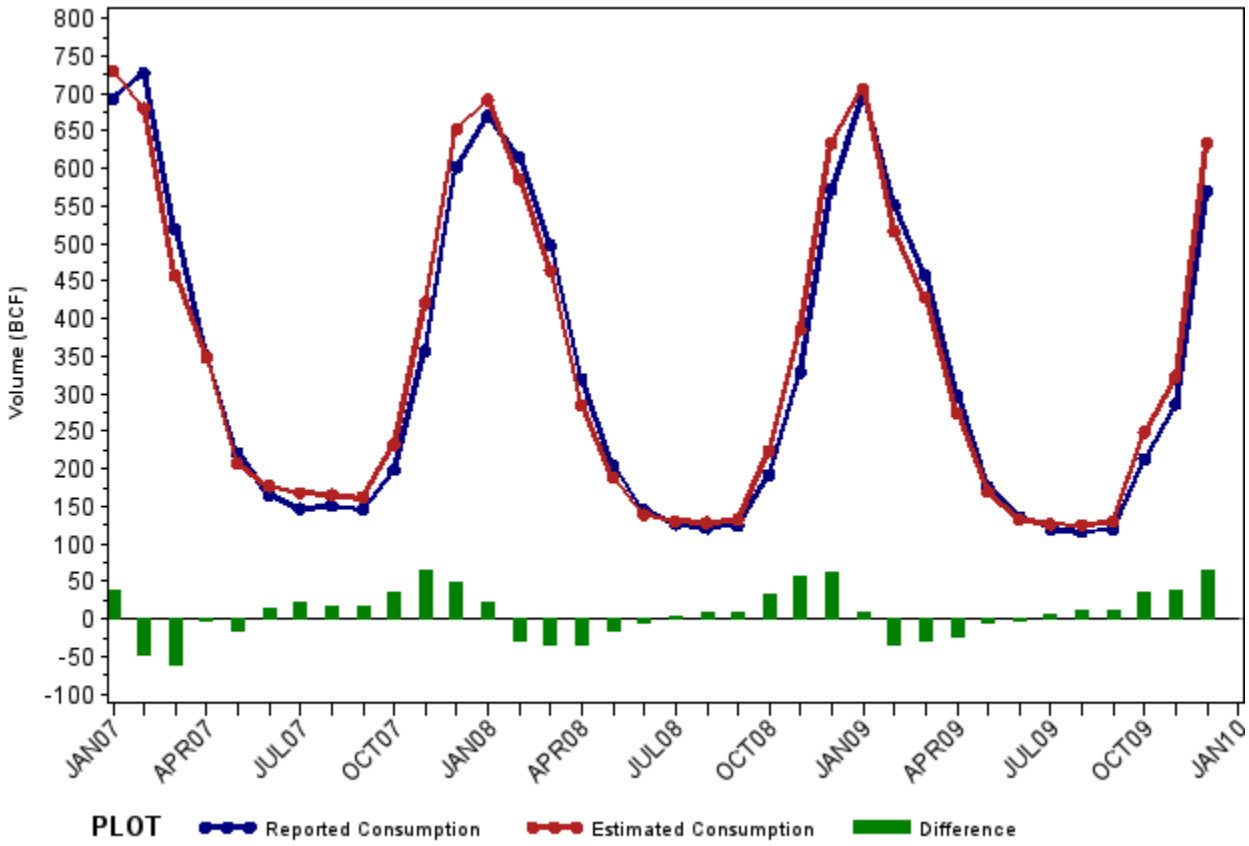
As Figure 3 depicts, the use of sendout volumes will enable EIA's consumption data to correspond more closely to the calendar month and, in turn, EIA's other supply and disposition series. This will not only mitigate the seasonal aspect of the balancing item, it will also create a uniform data reporting scheme across all EIA-857 survey respondents.

The EIA-857 reported electric power totals are used in the process of allocating sendout to the residential, commercial, and industrial sectors; however, EIA's official electric power consumption data are from a source other than the EIA-857.[8] In line with the current practice, the State-level electric power volume from the official source will be combined with the EIA-857 based residential, commercial, and industrial volumes to create State-level consumption totals. A final note of interest on the new procedure is that sector-level prices as published in the *NGM* would still correspond to the LDC billing cycles, as billing data represent the only source of an LDC's revenue stream.[9]

Effectiveness of Adjustment: An Example at the National Level

An example serves to illustrate the impact of the proposed methodology change. While estimating the precise effect at the national level is difficult, it is possible to follow a similar process using citygate volume data from the EIA-857 to extrapolate the hypothetical result (EIA currently collects citygate volumes for the purpose of calculating prices). For this analysis, criteria were set to filter out data that did not meet certain quality standards.[10] The estimated volumes based on using citygate volumes as a proxy for total sendout can be compared with volumes as currently reported (Figure 5). As expected, estimated consumption is lower than reported consumption during the spring, when the reported value contains data from the previous month that was likely cooler than the report month. Similarly, estimated consumption is higher than reported consumption during the fall, when the reported total contains data from the previous month that was likely warmer than the report month. The green bars at the bottom of the figure represent the difference between the estimated and reported volumes.

Figure 5. Reported Consumption vs. Estimated Consumption, 2007-2010

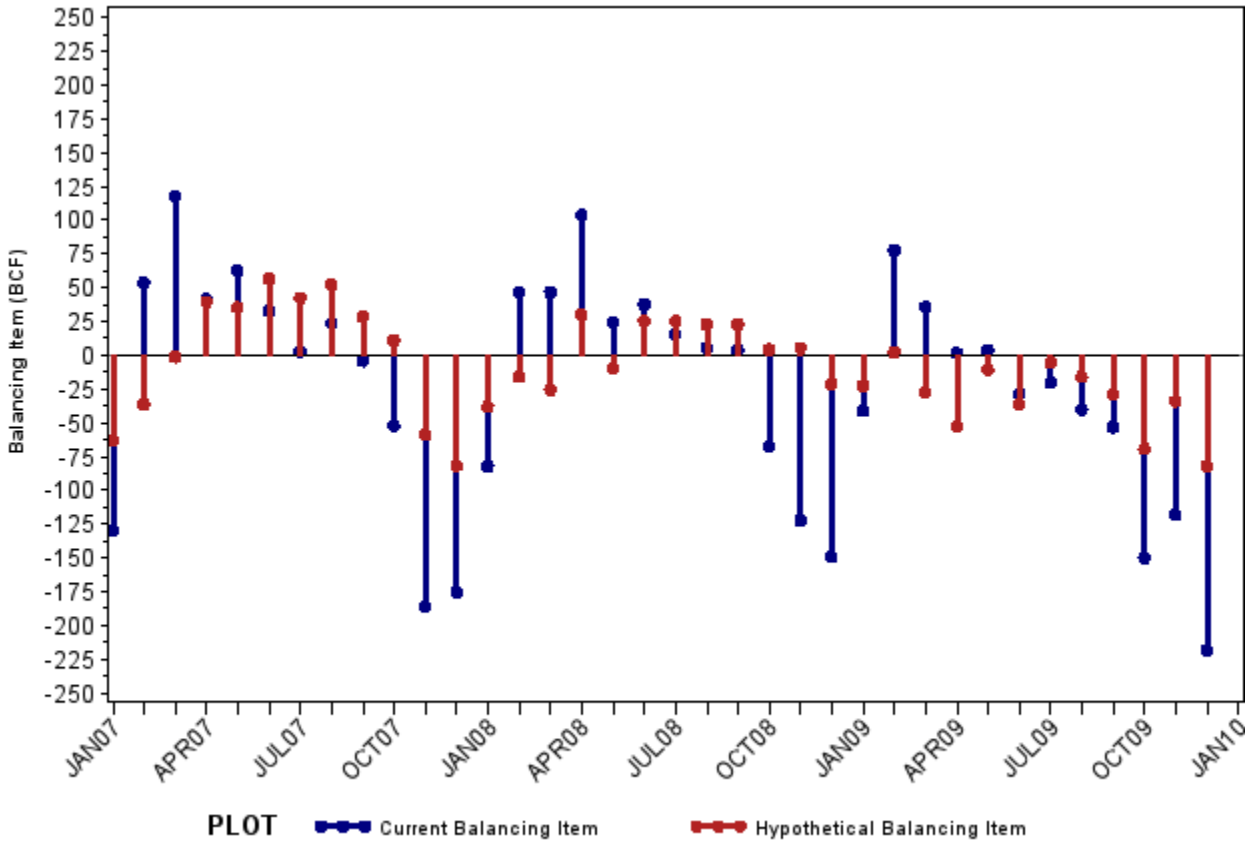


Source: U.S. Energy Information Administration.

The differences displayed in Figure 5 can be grossed up to provide a hypothetical change in monthly consumption at the national level, which is then applied to the balancing item (Figure 6). It is important to note that there are several assumptions[11] used to construct this hypothetical balancing item, and the results are intended merely to provide an approximation of the expected changes. Further, while citygate data are useful as a proxy in this analysis, they are not synonymous with total sendout, as citygate includes only natural gas that is owned by the LDCs and does not include natural gas for transportation to end users, which constitutes a significant share of total consumption.

In Figure 6, the navy lines represent the current balancing item, while the red lines represent the estimated balancing item after the effects of billing cycle data are accounted for. Although the results do not appear random, the seasonality has been largely removed. Randomness would not be the expected end result, as there are other places in the data where estimation procedures may lead to errors that would be expected to persist across months. Nonetheless, the average reduction of the balancing item in absolute terms is around 35 billion cubic feet per month.

Figure 6. Hypothetical Balancing Item, 2007-2010



Source: U.S. Energy Information Administration.

Implementation

EIA has developed an implementation timeline for the new data collection and estimation methodology. Under this plan, respondents to Form EIA-857 will receive official notification of the change along with updated forms and instructions by mid-summer 2010. The first month for which sendout data will be collected is August 2010. These forms will be due to EIA by September 30, 2010, meaning that the first published aggregates featuring the new methodology would appear in the October *NGM*. Thus the new methodology will be in place by fall of 2010, more closely aligning EIA's supply and consumption data heading into the next heating season.

While EIA recognizes that the proposed methodology will not fully eliminate the balancing item, it represents a practical measure to improve published data without substantially increasing the reporting burden of survey respondents. It is believed that the transition will yield a significant benefit to EIA's user community.

Footnotes:

[1]The balancing item is calculated as: Balancing Item = Total Consumption – (Dry Gas Production + Supplemental Gaseous Fuels + Net Imports + Net Storage Withdrawals).

[2]Local distribution company (LDC): A legal entity engaged primarily in the retail sale and/or delivery of natural gas through a distribution system that includes mainlines (that is, pipelines designed to carry large volumes of natural gas, usually located under roads or other major right-of-ways) and laterals (that is, pipelines of smaller diameter that connect the end user to the mainline). Since the restructuring of the natural gas industry, the sale of natural gas and/or delivery arrangements may be handled by other agents, such as producers, brokers, and marketers that are referred to as "non-LDC."

[3]Heating degree-days are calculated by the National Oceanic and Atmospheric Administration (NOAA). The calculation is 65 degrees minus the average daily temperature. Thus for a day with a high of 70 degrees and a low of 50 degrees, the heating degree-day total would be five (65-60=5).

[4]The t-statistic associated with the slope of the regression coefficient is 17.8, with a resultant R^2 of 0.78.

[5]Production estimates are derived from the EIA-914, “Monthly Natural Gas Production Report;” imports/exports data from the Department of Energy’s Office of Fossil Energy; storage data from the EIA-191M, “Monthly Underground Gas Storage Report;” and electric power consumption data from the EIA-923, “Power Plant Operations Report.”

[6]Recently, updated production estimates were published that resulted in a significant reduction in the magnitude of the balancing item during 2009.

[7]EIA collects a subset of sendout volume known as citygate. Citygate volumes only represent natural gas that the LDC owns, as LDCs also transport and deliver natural gas that they do not own. Citygate volumes are not published, but are used, along with citygate revenue, to calculate citygate prices.

[8]The EIA-857 collects deliveries of natural gas for electric power generation to ensure this consumption is not reported in other sectors. Official electric power totals are reported by power plants on the EIA-923.

[9]While alternate price estimation techniques were explored, it was determined that the uniform reporting of billing cycle volumes and revenues would yield the best prices at the sector level.

[10]Companies were excluded if the annual citygate volume is not within 10 percent of the annual sum of the sales volumes or a monthly citygate volume is twice the sum of the sales volumes.

[11]The coverage of the companies included in the analysis accounts for roughly 45 percent of the residential and commercial sectors. This total is grossed up to represent all residential and commercial use. The analysis assumes that companies not included in the analysis and transportation volumes behave in a similar manner.