

Report No. S4

Natural Gas National Totals

1. Definition of the Commodity Flow Data Gap

1.1. General Description

Natural gas is composed primarily of methane but can also include ethane, propane, butane and pentane. In its purest form, such as the natural gas delivered to homes, it is almost pure methane. Methane is a molecule made up of one carbon atom and four hydrogen atoms, and is referred to as CH₄.

Delivering natural gas is an enormous enterprise. Natural gas is transported to consumers through more than 300,000 miles of transmission pipelines with the help of vast storage reservoirs and thousands of compressors. This gas is sold to marketers, large commercial and industrial consumers, and distribution companies for delivery to consumers over a network of more than 1.1 million miles of local distribution pipelines.

The Commodity Flow Survey (CFS) does not cover oil and gas extraction industries within NAICS code 211 and, thus, natural gas is out-of-scope.

1.2. Commodities involved in the data gap

1.2.1. SCTG codes

Unlike other energy producing commodities (coal, crude petroleum, gasoline, fuel oil, and aviation turbine fuel), natural gas does not have a unique designated SCTG code. Instead, natural gas and liquefied natural gas (LNG) are classified with all other gaseous hydrocarbons in a gaseous state (excluding chemically pure) under the SCTG code 19330, or within liquefied gaseous hydrocarbons not elsewhere classified (excluding chemically pure) under the SCTG code 19329. That is, at the 2-digit level, natural gas is included in SCTG 19.

1.2.2. STCC codes

Under STCC coding, natural gas is included in code 13 - Crude Petroleum, Natural Gas, or Gasoline.

1.3. Establishments involved in the data gap

1.3.1. NAICS codes

211 - Oil and Gas Extraction

486 - Pipeline Transportation

Both NAICS categories were excluded from the CFS 2002 sampling frame. This is an out-of-scope data gap for CFS.

1.3.2. NAICS-SIC conversion issues

There are no major NAICS-SIC conversion issues for this data gap. Natural gas is an out-of-scope commodity for the CFS.

2. Importance of the Data Gap

2.1. Value and tonnage as a share of national shipments

Table 1 contains a national summary of Natural Gas movement estimates described in this report. FAF estimates show that about 65 trillion cubic feet of inter-state Natural Gas were delivered in 2002. This is equivalent to about 1.2 billion tons shown in Table 1. In addition, FAF estimates non-local, intra-state movement of natural gas at about 22 trillion cubic feet, out of which about 11 trillion cubic feet were delivered to distributors for local distribution. The equivalent tonnages for these are also shown in Table 1. In total, FAF estimates total national Natural Gas deliveries at about 2 billion tons in 2002. These estimates were based on the EIA Annual Report of Natural and Supplemental Gas Supply and Disposition (EIA-176) database containing state level data collected from natural and synthetic gas producers, processors, distributors, storage operators, and pipeline operators.

Table 1: National Summary of Natural Gas Movement Estimates

	Tons	Ton-Miles	Value
	(Thousands)	(Millions)	(Million \$)
Inter-State	1,226,448	294,348	378,973
Non-local Intra-State	449,765	44,976	138,977
Local Intra-State	222,836	6,685	68,856
Total	1,899,049	346,009	586,806

It should be noted that the amount of natural gas movements across state lines and U.S. border boundaries is much higher than the amount of natural gas consumed during 2002. According to the revised number published in the *Natural Gas Annual 2003*, total consumption of natural gas is estimated at 23,018 billion cubic feet (equivalent to approximately 520 million tons). The higher total of natural gas movements is due to transshipments among pipeline companies. Considering that the 2002 CFS (SCTG 19) captured less than 450 million tons with a value of \$82 billion, natural gas shipments are a significant data gap.

Using great circle distances between state geographic centroids and distances to points of entry or exit, for imports and exports, respectively, it can be estimated that interstate movements of natural gas and movements across U. S. borders generated at least 346 billion ton-miles in 2002. These movements of natural gas pass through approximately 191 thousand miles of interstate transmission natural gas pipelines. This is about 11 percent of the total ton-miles reported in the CFS 2002 (approximately 3 trillion ton-miles) for all commodities. In fact, the 2002 CFS reported only about 93 billion ton-miles for the 2-digit SCTG code 19.

2.2. Value and tonnage as a share for individual modes

Pipelines carried 100 percent of interstate natural gas movements and natural gas movements across U.S. borders in 2002. As a result, this is a significant data gap for movements by pipelines. The CFS 2002 reported that more than 650 million tons of goods moved by pipeline. The total tonnage of natural gas shipments estimated under this study is over twice the CFS-captured amount for pipelines.

2.3. Geographic concentration: Dispersed versus concentrated, local versus long distance

Interstate movements as well as imports/exports of natural gas shipments are expected to be transported long-distances to various locations in the United States. The estimated average length of movement is approximately 182 miles based on our estimation.

2.4. Importance to international trade

U.S. consumption of natural gas is increasing and is forecasted to continue. Natural gas demand is projected to grow by nearly 40 percent by 2025, to over 31 trillion cubic feet in 2025¹. U.S. production of natural gas is significantly less than the total U.S. consumption. Historically, natural gas imports – mostly from Canada via pipeline – have made up this deficit.

¹ *Annual Energy Outlook 2005 with Projections to 2025*, DOE/EIA-0383(2005), January, 2005.
<http://www.eia.doe.gov/oiaf/aeo/index.html>.

Liquefied natural gas (LNG) imports represent an increasingly important part of the natural gas supply picture in the United States. LNG takes up much less space than gaseous natural gas, allowing it to be shipped much more efficiently from global production regions.

According to the EIA, the United States imported 4.0 trillion cubic feet and exported 0.5 trillion cubic feet of natural gas in 2002. Most of the current imports/exports are with Canada and Mexico via pipelines. Among the 4.0 trillion cubic feet of imports, 0.23 trillion cubic feet of natural gas is in the form of LNG. LNG imports are expected to increase at an average annual rate of 15.8 percent, to levels of 4.80 trillion cubic feet of natural gas by 2025. LNG that is imported to the United States from countries other than Canada and Mexico comes via ocean tanker. The majority of U.S. LNG is from Trinidad and Tobago, Qatar, and Algeria. The United States also receives shipments from Nigeria, Oman, Australia, Indonesia, and the United Arab Emirates. On the exports side, Japan and Mexico are the two countries receiving LNG from the United States.

3. Data Sources

3.1. Coverage in CFS

The CFS does not include the natural gas industry; thus natural gas is out-of-scope. On the other hand, CFS does capture some of SCTG code 19 – Coal and petroleum products, not elsewhere classified so natural gas can also be treated as an under-count of in-scope CFS commodities.

3.2. Coverage in other data sources

Natural gas movements, including imports and exports, are collected by EIA/DOE. Information related to interstate natural gas movements and international trade movements across U.S. borders is found in Table 12 of the *Natural Gas Annual*. Other related information such as natural gas points of entry and exit related to imports and exports (Tables 10 and 11), price information at different stages of the production process, and transportation, and the consumer sector (numerous tables) are found in the same publication. The natural gas volume to weight conversion factor is based on information in Table C1 in the *International Energy Annual* by EIA/DOE.

Note that the Federal Energy Regulatory Commission (FERC) also collects financial and operation data through FERC Forms 2 and 2A for major and non-major natural gas pipeline companies. The information collected is summarized by the *Oil & Gas Journal* and published annually in a special issue, *Pipeline Economics*, during August/September. Because of regulatory authority, FERC's estimates of natural gas movements (32,158,450 million cubic feet) are far less than the reported natural gas movements (69,046,332 million cubic feet) in Table 12 of the *Natural Gas Annual*.

3.3. Data quality

The tonnage and value of natural gas movements across state lines and U.S. border boundaries are based on EIA published reports. These data did not require assumptions to arrive at national numbers. Thus, the data quality for the tonnage and value of natural gas moved across state lines and U.S. border boundaries is as good as those of the data source.

Ton-mile information for natural gas moved across state lines and U.S. border boundaries is estimated based on the distance between state-centroids and the distance to points of entry/exit for imports/exports.

3.4. Other issues

There are essentially three major types of natural gas pipelines along the transportation logistic: the gathering system, the transmission system, and the distribution system.

The gathering system consists of low pressure, small diameter pipelines that transport raw natural gas from the wellhead to the processing plant. The transmission natural gas pipeline network transports processed natural gas from processing plants in producing regions to those areas with high natural gas demands, particularly large, populated urban areas. Local distribution companies typically transport natural gas from delivery points (city gates) along transmission (interstate and intrastate) pipelines through thousands of miles of small-diameter distribution pipe and deliver it to individual end users.

Current estimates of natural gas tonnage, value, and ton-mile includes interstate, non-local intrastate and local intrastate portions of the transmission pipeline networks. The interstate portion of the transmission system, similar to the interstates highway network for truck freight, carries the major nationwide natural gas supplies to meet the demands of metropolitan areas. Therefore, the interstate portion is by far the largest.

4. Estimation Methods

4.1. General description of alternative methods

Table 12 of the *Natural Gas Annual* provides state-to-state movements of natural gas, as well as imports and exports. Points of entry and exit and the amount of natural gas imported and exported are also provided in this publication. State level production, supply, disposition, consumption, and delivery to consumption sectors are also given in this annual report.

The *Natural Gas Annual* can be supplemented by company level information as reported on Form EIA-176 (provided in the EIA-176 Query System). The EIA-176 Query System is a personal computer-based query system. It provides a method to extract company level data collected on Form EIA-176. There are pre-selected data queries, which allow the user to select and run the most often-used queries, as well as the ability to create customized queries. Form EIA-176 collects data on the consumption of natural gas by major end-use category, demand, and price by state. Data collected by EIA also includes the origin of natural gas supplies and the disposition of natural gas on a state basis. Respondents of EIA-176 include natural and synthetic gas producers, processors, distributors, storage operators, and pipeline operators.

Based on this information, both a national level total and regional flows of natural gas can be generated. Methodologies for estimating the national total and regional flows are briefly described in the following sections.

4.2. Method for estimating national totals

Estimating the national total of interstate movements of natural gas is relatively straight forward. For tonnage, a volume to weight conversion factor (48,700 cubic feet per metric ton) is used to convert the national totals to weight.

Composite natural gas export prices are used to estimate value – i.e. via “delivered to consumer” price. The composite transmission pipeline natural gas “delivered to consumers” price is based on the city gate and the quantities and prices in Table 1 of the *Natural Gas Annual*. Note that consumption quantity and price for the residential sector is not included in this composite price calculation. The composite export price is developed in a similar way based on information found in Table 11 of the *Natural Gas Annual*. The total value is then estimated by applying the quantities of natural gas moved and exported from Table 12, *Natural Gas Annual* to composite prices for domestic deliveries (including imports and exports).

The estimation process for ton-miles is more involved. For each state-to-state natural gas movement a great-circle distance between state centroids is calculated. Furthermore, points of entry and exit for imports and exports and off-shore locations in the Gulf of Mexico are geographically identified. Distances for imports and exports, as well as from off-shore locations, are also calculated. Consequently, ton-miles are estimated by the product of the state-to-state movement quantity and distance and then summed to the national total.

4.3. Expected quality of the estimates

Estimated FAF regional natural gas movements will be based on state-level information published by EIA. Thus, the quality of the FAF regional flows is inherited from EIA’s state-level published information.

5. Implications for the Scope and Content of the 2007 CFS

Since state-level natural gas movements are collected by the EIA on a continuous basis, no duplication of effort by the CFS is necessary.

6. Other Issues

None.