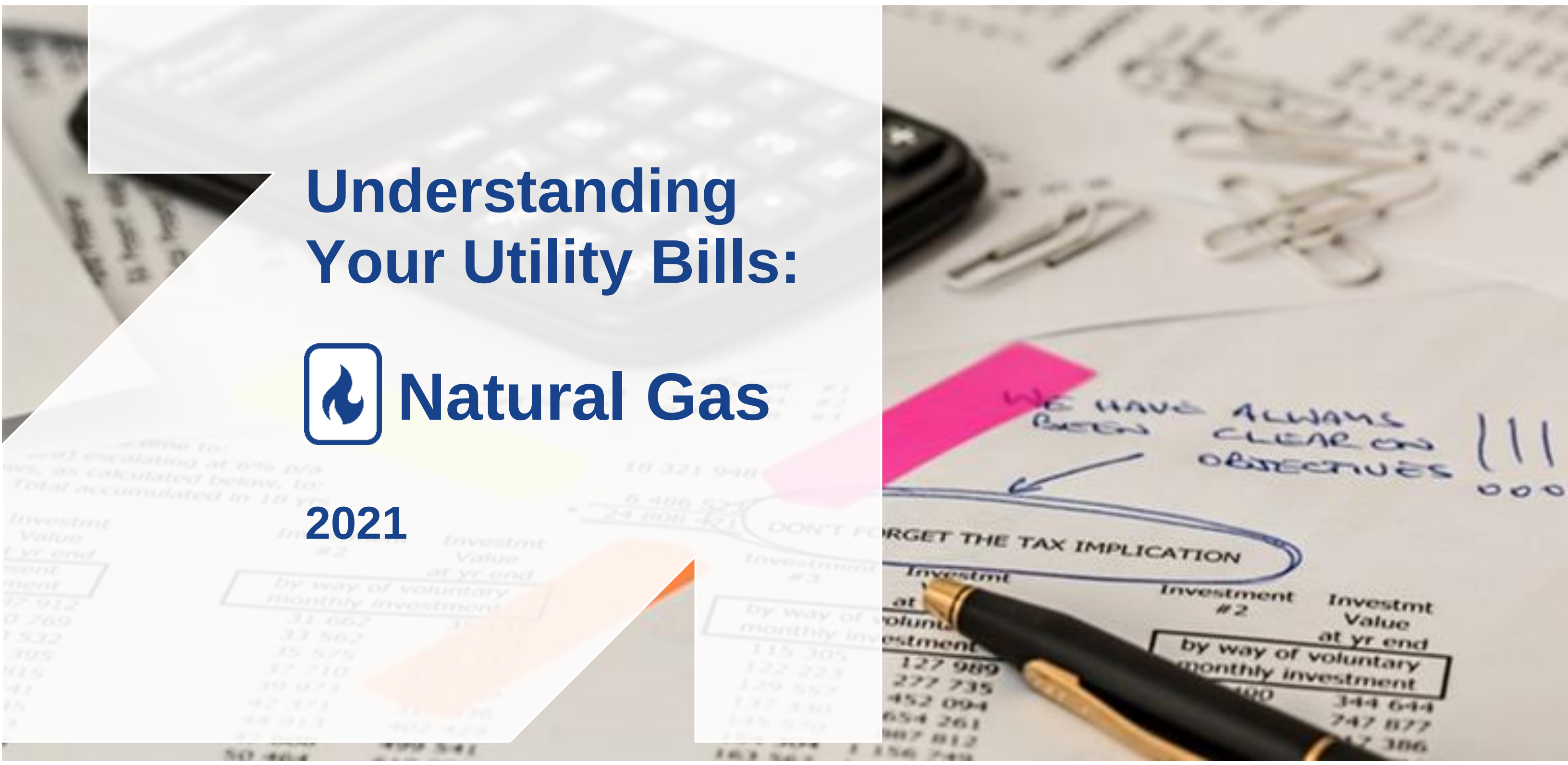
Better Plants®
U.S. DEPARTMENT OF ENERGY



Understanding Your Utility Bills: Natural Gas

2021

ORNL/SPR-2021/1832

Authors and Acknowledgements

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Preface

The US Department of Energy's (DOE's) Better Buildings, Better Plants Program (Better Plants) is a voluntary energy efficiency leadership initiative for US manufacturers and water/wastewater entities. The program encourages organizations to commit to reducing the energy intensity of their US operations over a 10-year period, typically by 25%. Companies joining Better Plants are recognized by DOE for their leadership in implementing energy efficiency practices and for reducing their energy intensity. Better Plants Partners are assigned to a Technical Account Manager, who can help companies establish energy intensity baselines, develop energy management plans, and identify key resources and incentives from DOE, other federal agencies, states, utilities, and other organizations that can enable them to reach their goals.

Better Plants Partners are expected to report their progress to DOE once a year. This involves establishing an energy intensity baseline upon joining the program, and then tracking their progress over time. *Understanding Your Utility Bills: Natural Gas* is intended to help companies meet the program's reporting requirements by helping them to learn about and analyze their natural gas bills. Data collected from utility bills can be used with the DOE Energy Performance Indicator software tool to establish an energy baseline and track progress over time.

This guidance document is applicable to companies participating at either the program or challenge level. Although this guide is intended primarily to assist companies participating in Better Plants, the methodologies and guidance within the document are applicable to any organization interested in understanding their natural gas bills.

For more information on the Better Plants Program, please visit:
betterbuildingssolutioncenter.energy.gov/better-plants

For more information on the Better Plants Challenge Program, please visit:
https://betterbuildingssolutioncenter.energy.gov/better-plants/better-plants-challenge

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Definition of Terms

The following definitions apply to the Better Buildings, Better Plants Program. Certain terms may have different definitions in other methodologies or contexts.

Block rate	A utility pricing structure in which the cost of natural gas varies in steps based on the amount consumed.
BTU factor	A factor that links the gas volume delivered to the energy consumed. This factor is usually listed in the gas invoice when consumption is reported in volume units. This represents the average heat content of the supplied gas.
Calendarization	The process of allocating energy usage and costs to standardized billing months.
Consumption	The total amount of natural gas that a facility consumes over a given period. Usually measured in MMBtu, decatherms, therms, CCF or MCF.
Conventional gas	Natural gas found on land or in the ocean bed that can be extracted through traditional drilling and pumping methods.
Declining block rate	A rate structure in which the cost per unit of NG declines with increasing consumption.
Declining rate	A utility pricing structure in which the cost of natural gas varies in steps based on the amount consumed and the per unit charge reduces for higher consumption.
Demand	The rate at which a facility consumes natural gas, usually measured in daily or hourly delivered natural gas (MCF or MMBtu).
Deregulated market	A utility market in which gas supply and distribution have been separated. In a deregulated market, a facility can choose among several natural gas suppliers, and the local utility will distribute it to the facility.
Firm service	A type of service offered to customers under different schedules or contracts that anticipates no outages or interruptions outside very limited circumstances.
Flat rate	A utility pricing structure in which the cost of natural gas remains constant for all amounts of consumption.
Fracking	A process of extracting natural gas from shale and other types of sedimentary rock formations by forcing water, chemicals, and sand down a well under high pressure.
Hedging option	A rate schedule option that enables mitigation of price increase risk.
Henry Hub	A market hub for natural gas located in Louisiana.
Interruptible service	A low-priority service offered to customers under different schedules or contracts that can anticipate and permit interruption on short notice.
Inverted rate	A utility pricing structure in which the cost of natural gas varies in steps based on the amount consumed and the per-unit charge increases for higher consumption.
Load factor	The ratio of per-day average gas volume to the maximum of per-day gas volume in a billing period or annual basis. High load factor signifies base-loaded systems with lesser variability whereas low load factor indicates systems with higher variation.
Local distribution company	Otherwise called utility companies, these take natural gas from the city gate and deliver it to consumers.

Market hub	Market hub is a physical transfer point where different natural gas pipelines merge. This is where depending on the services offered natural gas contracts are bought and sold.
Marketers	Otherwise called independent suppliers, these are third party entities from whom consumers can buy gas instead of buying gas from producers or local distribution companies.
Ratchet charge/clause	A feature of industrial natural gas rate structures whereby a minimum billed demand is set based on a seasonal average or seasonal peak demand.
Rate schedule	A set of rate structures offered by a utility to customers based on their type and size (i.e., residential, commercial, and industrial).
Rate structure	A collection of charges assessed by a utility for providing natural gas service as seen on the utility bill, e.g., large general service (LGS), medium general service. A rate structure can have different charges that directly relate to consumption and some that are independent of consumption (e.g., meter fee).
Regulated market	A market in which gas suppliers and utility distributors are predetermined by the geographical location. In a regulated market, a facility can only purchase natural gas from a local utility company and their supplier.
Riders	Adjustments or additional charges / credits to be used in existing rate structures. Riders often specify charges related to regulatory requirements or additional costs.
Significant energy users	Industrial equipment that consumes large portion of natural gas in a manufacturing facility. SEU's can be used to double check usage on utility bills.
Transportation service	A service provided by a pipeline company for moving the gas from a receipt point to a delivery point as per contract between the shipper and the consumer.
Unconventional gas	Otherwise called shale gas, this is gas found in tight spaces and extracted using a technique called as fracking

Definition of Abbreviations

The following section outlines the meaning of the abbreviations used in this document as related to the natural gas industry. Certain terms may have different definitions in other methodologies or contexts.

EI	Energy intensity
EnPI	Energy Performance Indicator
FERC	Federal Energy Regulatory Commission
FFI	Fine Factories Inc.
HDD	Heating Degree Days
LDC	Local Distribution Company
MDFQ	Maximum Daily Firm Quantity
MDQ	Maximum Daily Quantity
NG	Natural Gas
NOAA	National Oceanographic and Atmospheric Administration
NYMEX	New York Mercantile Exchange
NYMEX_HH	New York Mercantile Exchange Henry Hub
TAM	Technical Account Manager

1. Using This Guide

Analyzing natural gas (NG) bills can sometimes pose unique problems. Depending on your utility company, your bills can be very long and detailed or short, with just a few totals listed. Different charges can appear each month with no apparent explanation of why or how they are calculated. Learning to read your utility bills and understand why your utility charges different fees is critical in maximizing your cost savings through energy efficiency.

As a partner in the US Department of Energy's (DOE's) Better Buildings, Better Plants (Better Plants) Program you are required to submit an annual report to DOE. Reporting requires establishing an ***energy intensity (EI)*** baseline within one year of joining the program. The first step in creating a baseline is collecting and analyzing several years of utility data. Historical data from your NG bills can identify trends and help to find the best baseline year for your company. Utility data will also be used to document your progress in the Better Plants Program, with the ultimate goal of achieving your EI improvement target and receiving recognition from DOE.

This document provides guidance on the basics of understanding NG bills (Figure 1). Section 2 provides an overview of how NG is produced, transported, and delivered. Knowing how the transportation network works is key to understanding how you can have more than one bill for NG and how deregulation affects NG markets. Section 3 provides an overview of the different types of charges on your bills for NG usage and transportation. Section 4 discusses different rate structures your utilities might offer. Section 5 reviews simple energy and cost-saving opportunities that you can identify by analyzing your bills. Finally, Section 6 provides a detailed example of how the concepts discussed in this guidance can be applied to a set of NG bills.

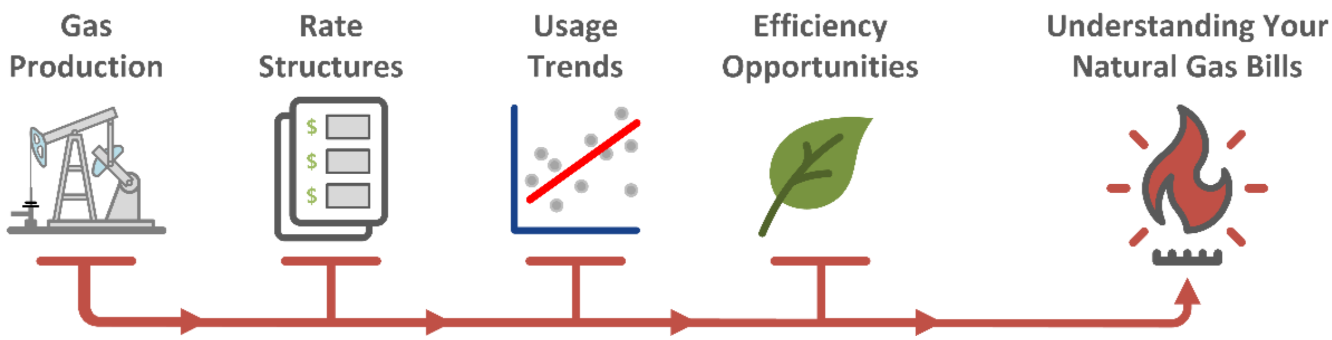


Figure 1: Key pieces needed to fully understand your NG bills.

This guidance is meant to cover topics that appear on most industrial NG bills. However, each utility is different and certain charges may be unique to your region. Utilities also experiment with new and innovative rate structures to encourage further energy efficiency investment. Please work with your Better Plants Technical Account Manager (TAM) with any questions you might have about your bills or charges that might not be discussed in this document.

2. Natural Gas

As a fossil fuel NG is a colorless and odorless gas in its natural state and is one of cleanest burning hydrocarbons. The largest component of raw extracted NG is methane, which is composed of four hydrogen atoms and one carbon atom (CH_4). When burned, NG produces carbon dioxide (CO_2), water vapor, and very small amounts of nitrogen oxides (NO_X). Although all fossil fuels impact the environment, NG is considered cleaner than coal and oil because it generates fewer harmful emissions and byproducts. Combustion of coal and diesel produces 80% and 38% more CO_2 respectively per unit energy[1] compared to NG. The factors that contribute to the popularity of NG in the US manufacturing sector include ease of availability, clean burning properties, market deregulation, and increased domestic production.

2.1 Origin and Migration of Natural Gas

The origin of NG dates back millions of years to the remains of plants and animals built up in thick layers on the earth's surface and ocean floors. Over time, these remains were covered by layers of sand, silt, and rock. Heat and pressure transformed some of this carbon- and hydrogen-rich material into coal, oil, and NG. Once the gas is formed, it tends to migrate through the pores, fractures, and fissures in the sediment and rocks. Some of the gas seeps through and makes it to the surface (conventional NG or conventional non-associated gas), while other gas molecules are trapped in formations of shale, sandstone, and sedimentary rock (unconventional, shale, or tight gas). NG found with deposits of crude oil is known as conventional associated gas and when found with deposits of coal is known as coalbed methane. Figure 2 shows the geology of the types of available NG resources.[2]

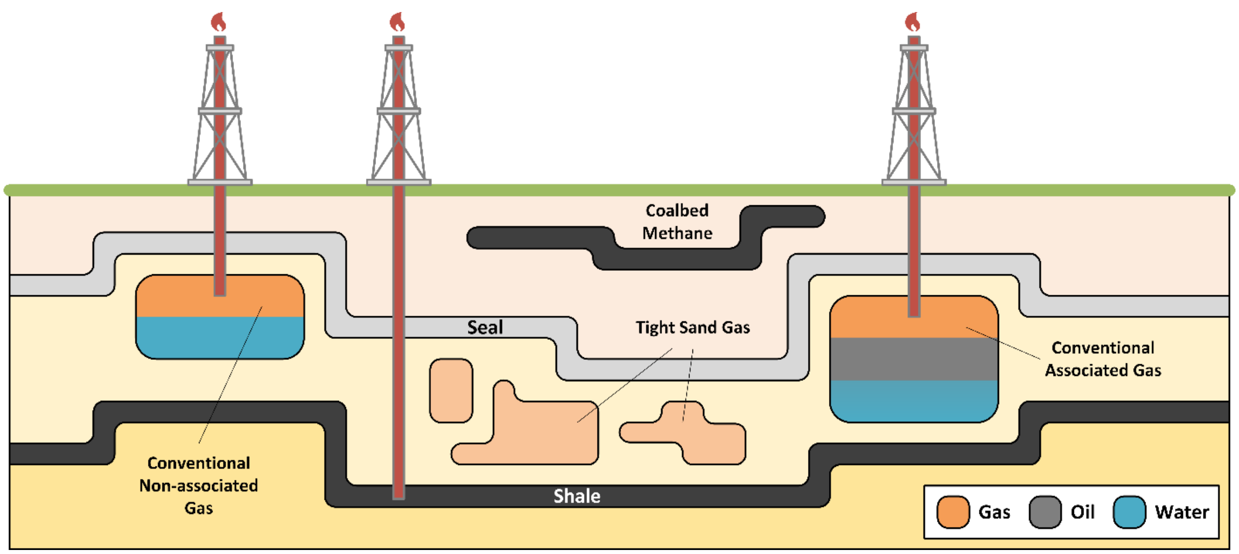


Figure 2: Geology of natural gas resources.[2]

2.2 Natural Gas Production and Delivery

NG deposits are found by seismic surveys conducted on land and in the ocean. Production starts by drilling wells into NG-bearing formations and extracting the gas to the surface. Conventional NG is easier to extract and flows

[1] (EIA) US Energy Information Administration, 'Environment: Carbon Dioxide Emissions Coefficients', 2016 <https://www.eia.gov/environment/emissions/co2_vol_mass.php> [accessed 12 April 2021].

[2] US DOE US Energy Information Administration (EIA), 'Natural Gas Explained - Basics, Data and Statistics' <https://www.eia.gov/energyexplained/natural-gas/> [accessed 26 January 2021].

easily up through wells to the surface, whereas unconventional NG, which is trapped in tight spots, is extracted by a method called hydraulic fracturing or fracking. Fracking is the process of extracting NG from shale and other types of sedimentary rock formations by forcing water, chemicals, and sand down a well under high pressure. The high pressure produces a fracture network in the formation that allows the NG inside dense formations to be extracted at the surface. Horizontal drilling is used for NG extraction when shale source runs horizontally. The exploration of the shale gas deposits with the introduction of these new drilling techniques have opened up tremendous new resources in the United States and made NG supply abundant.

Raw NG extracted from oil and gas wells is called "wet NG" because, along with methane, it contains water vapor and other compounds such as ethane, propane, butane, isobutane, and natural gasoline, usually referred to as liquid petroleum gases (LPG) or natural gas liquids (NGL). In addition, raw NG may also contain non-hydrocarbons such as sulfur, helium, nitrogen, and carbon dioxide. Water vapor, non-hydrocarbons, and NGLs are removed and separated from raw NG in a gas processing facility that produces pipeline-quality or consumer-grade dry NG. After processing, the dry NG is transported in pipelines directly to consumers, usually large users, or to local distribution companies (LDCs), which handle delivery to specific customers (residential, commercial, and industrial). NG extracted from coal deposits (coalbed methane) has sufficient quality to go directly into transmission pipelines without any processing or treatment. Figure 3 illustrates the production and delivery infrastructure network to take NG from origin to the customer.

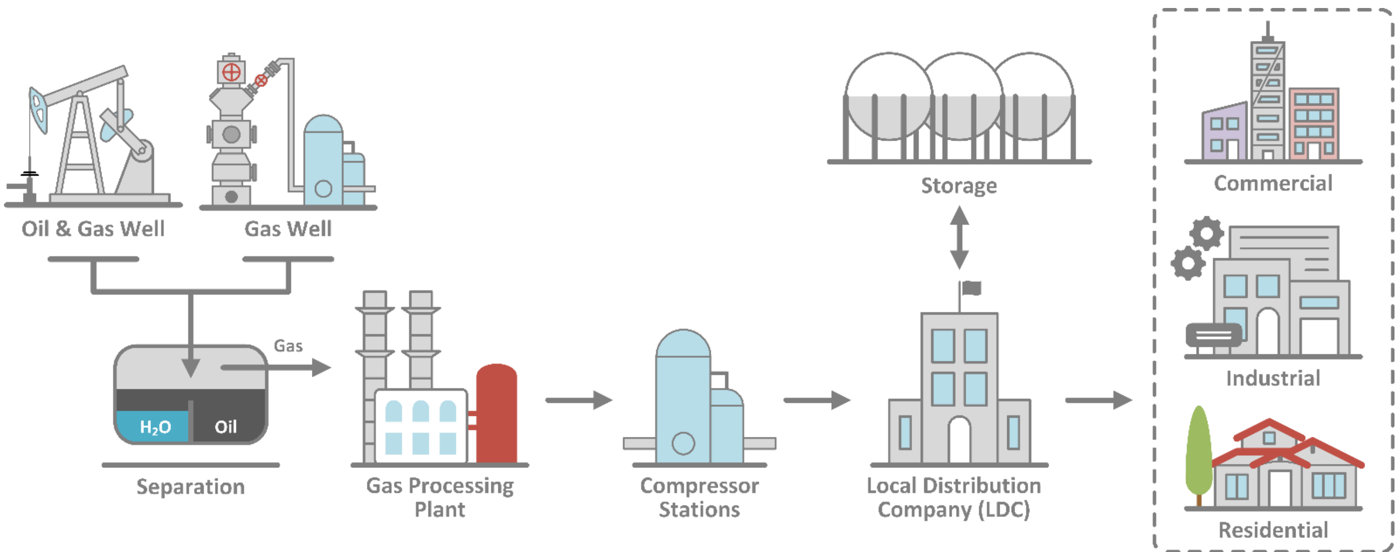


Figure 3: Natural gas production and delivery.

NG in the United States is delivered to consumers almost exclusively through networks of pipelines consisting of large, medium, and small-sized pipes. NG is transported through three main systems:

- **Gathering systems**: These field pipelines that gather the raw NG produced from individual wellheads to a central processing facility or to a central point (market center) for pickup by transmission pipelines.
- **Transmission systems**: Transmission pipelines utilize compressor stations located every 50 to 100 miles along the line to move NG from market centers to city-gates for delivery to the LDC or large consumers. These pipelines are referred to as long-haul pipelines because they move NG over long distances. They can either be an interstate pipeline transporting gas across state lines or intrastate pipeline transporting within the state where the gas was produced. Large consumers typically get NG directly from these transmission pipelines through sales networks known as marketers.

- **Distribution systems**: These are the LDCs that deliver NG from city gates to consumers. LDCs usually serve residential, commercial, and small industrial customers. Large consumers can get their gas directly from transmission pipelines, but some large users may still receive gas through an LDC.

2.3 Natural Gas Regulations and Market

The NG industry has undergone a major transformation from being federally regulated to a strong open market industry today. The Natural Gas Act in the mid-1930s enabled the government to control the NG pricing from wellhead to point of use. Although the government-regulated market was simple and ensured stable prices, it also caused shortages in supply with low gas prices hampering US market growth. Although there was a high consumer demand for NG, producers had no incentive to produce and supply NG because of the low pricing structure.

The Natural Gas Policy Act of 1978 and the 1992 Federal Energy Regulatory Commission (FERC) Order 636 called for federal deregulation of the NG market and changed the whole landscape of NG industry. Prior to deregulation, the route to get NG to consumers was simple and straightforward. Producers sold NG to interstate pipeline companies, which then sold it to LDCs or directly to consumers. Under deregulation, buying and selling of NG occurs at all levels: wellhead gas prices respond to market forces, pipelines are only transporters and no longer sell NG as a commodity (unbundling), and the market is open to anyone who wants to buy and sell gas. Even with deregulation, however, FERC and other state agencies are still involved in economic regulation of transmission and distribution of NG. This means that the transmission and distribution rates charged by both pipelines and LDCs are still regulated in some form.

Deregulation also increased the complexity of how NG was sold between suppliers and buyers. Several participants got involved at the wholesale level and market hubs and marketers grew in importance.

A ***market hub*** is a central point where NG is bought and sold. Gathering pipelines bring NG to the market hub from where the transmission lines pick it up for delivery to a customer, an LDC, or even another market hub. There are several market hubs in different locations in the United States, the most popular and well-known being the Henry Hub in Louisiana.

Marketers, also known as ***independent suppliers***, buy gas alongside LDCs in an open market and sell it for a profit. Marketers handle many services, including buying NG from the market, handling transportation, storage, and other services as required or requested by consumers.

Figure 4 illustrates how NG transactions take place at different levels as it makes its way from the fields where it is produced to the consumers. The transaction chain can be as short as producers selling gas directly to consumers with transportation handled by either party. However, LDCs and marketers generally buy the gas in an open market and sell it to consumers. Marketers can sell gas directly to consumers or to an LDC that either makes delivery or sells the gas to the consumers. Small consumers such as residential, commercial, or even small industrial facilities purchase gas from the LDC. Large consumers such as large industrial facilities or utilities frequently purchase the gas directly from producers or through marketers, who can be affiliated with a production company. Marketers were given access to competitively priced NG from producers by state regulators beginning in the early 1980s.[3]

[3] US Government Accountability Office (GAO), ‘Energy Deregulation: Status of Natural Gas Customer Choice Programs’, RCED-99-30, 1998 <https://www.gao.gov/products/RCED-99-30> [accessed 26 January 2021].

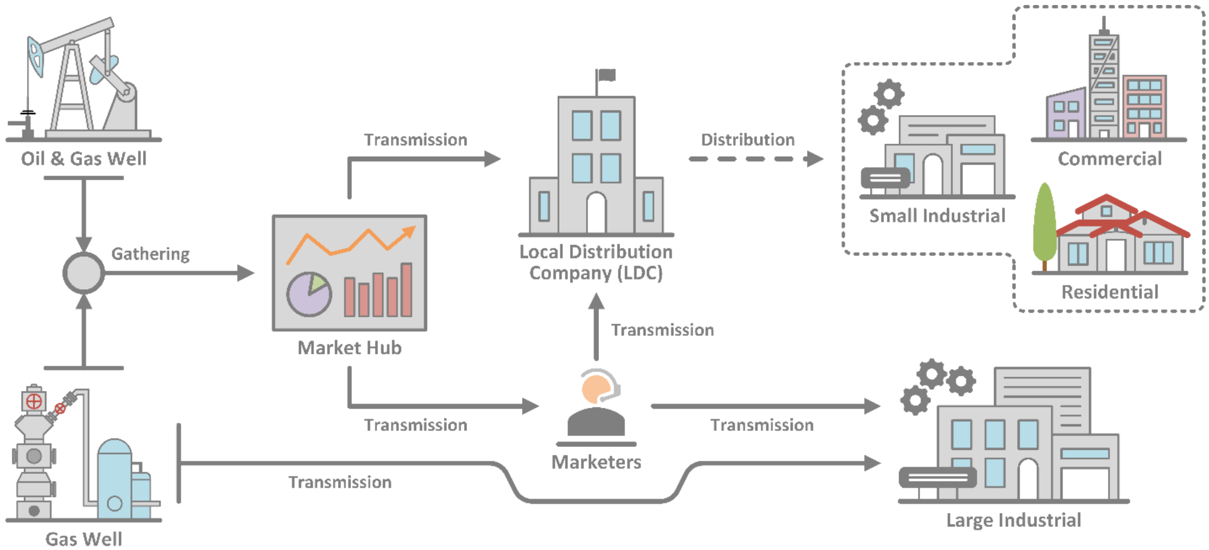


Figure 4: Natural Gas market.

In today's market, location of your facility will play a significant role in your options for purchasing NG. If you are in a regulated gas market (states shaded in gray in Figure 5), you must buy NG from an LDC who will supply the gas to your facility including transportation and delivery services.[4] In deregulated states or states that supports retail choice programs (states shaded in blue in Figure 5), you will have flexibility to buy gas from any source, and transportation will be supplied by pipelines, including the LDC who delivers the gas as transporters only. Figure 5 represents participants in the residential NG customer choice program but is applicable to all users within the state.[5, 6] The participation rate and states adopting these programs are constantly changing, so the information shown in Figure 5 may not be up to date.

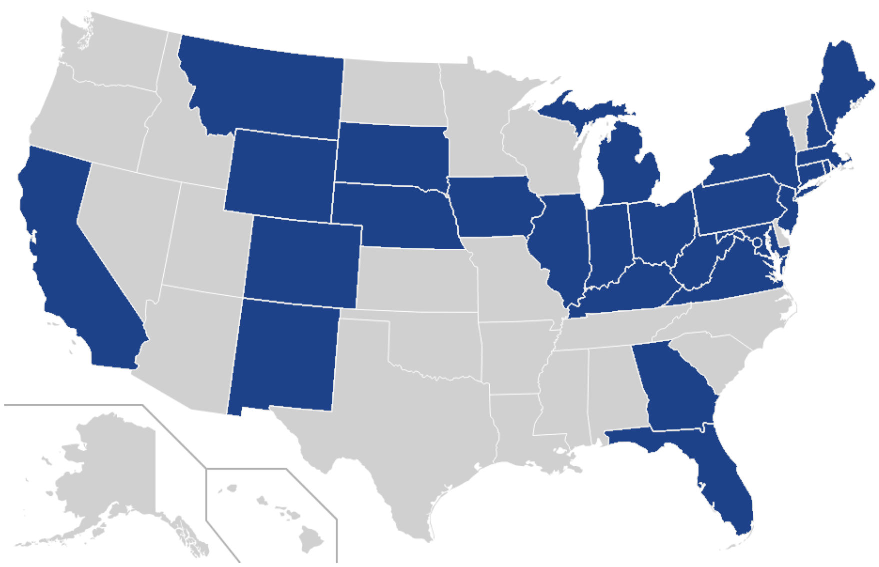


Figure 5: Deregulated (blue) and regulated (gray) natural gas market.

[4] Carol Freedenthal, 'Natural Gas Purchasing', in *Energy Management Handbook. 8th Edition* (Fairmont Press, 2013), pp. 519–53.

[5] Electric Choice, 'Deregulated Energy States & Markets', 2020 <https://www.electricchoice.com/map-deregulated-energy-markets/> [accessed 25 January 2021].

[6] US Energy Information Administration (EIA), 'Number of Natural Gas Customers Participating in Customer Choice Programs Is Increasing - Today in Energy' <https://www.eia.gov/todayinenergy/detail.php?id=19031> [accessed 26 January 2021].

2.4 Procurement : Pricing and Contracts

A thorough knowledge of the industry is essential in purchasing NG. The change in industry toward deregulation has made the purchasing process very complex for the average NG buyer. Though the purpose of this document is not to focus on NG procurement, this section provides basic information on some common pricing options offered by marketers to consumers.

New York Mercantile Exchange plus Basis Contract

The New York Mercantile Exchange (NYMEX) plus basis contract has two pricing components: NYMEX and basis. NYMEX is the commodity portion of your NG. Gas is traded every business day on the NYMEX and prices are set by the Henry Hub in southern Louisiana. The basis is the cost for delivering your NG from a trading point such as the Henry Hub to your local delivery point such as an LDC. The basis cost can be an additional charge or discount to the NYMEX price. The basis reflects the difference between the price of gas at Henry Hub and the price of gas at your regional delivery point.

With this option, the basis cost is locked at a fixed rate while the commodity portion floats monthly (NYMEX price is determined monthly). Consumers who anticipate declining or fluctuating market prices favor this option since they can ride the market until they see a benefit to lock in on a low NYMEX rate by converting to fixed pricing at any time during their contract period.

$$Contract\ Price = NYMEX\ Floating\ Price\ \left(\frac{\$}{Mcf}\right) + Fixed\ Basis\ \left(\frac{\$}{Mcf}\right)$$

Index Price

Index pricing is similar to NYMEX pricing except that it is determined based on the trading point closest to the consumer, not just the Henry Hub. It is determined monthly and is usually stated as a published index. Index prices also include a basis charge that captures the price differential between the index point and the point of delivery.

With index pricing, both the commodity and basis costs are allowed to float with the market. Monthly bills vary based on both consumption and the market rate. Similar to NYMEX, the index price option offers great flexibility to take advantage of market lows until prices start rising and it is cheaper to lock-in on a fixed price. Index pricing is for customers with a higher degree of risk tolerance who can afford to let their NG price fluctuate with the market to realize most cost savings possible.

$$Contract\ Price = Floating\ Index\ Price\ \left(\frac{\$}{Mcf}\right) + Floating\ Basis\ \left(\frac{\$}{Mcf}\right)$$

Fixed Price

Fixed pricing enables consumers to lock in a set rate for their NG supply. With fixed pricing, both the commodity and the basis costs are fixed and combined into one common price for the contract period. Monthly bills vary based on the consumption only, but the gas rate remains constant regardless of what happens in the market. Fixed price is considered a low-risk option and for customers who prefer cost certainty but choosing fixed cost certainty may not always be the best option. Fixed price cannot tap into the potential of taking advantage of market pricing during periods of low demand. NG prices go up and down, so in a down market, customers might be losing out on market dips that can result in substantial savings.

$$Fixed\ Contract\ Price = Fixed\ NYMEX\ \text{or}\ Commodity\ Price\ \left(\frac{\$}{Mcf}\right) + Fixed\ Basis\ \left(\frac{\$}{Mcf}\right)$$

2.4.1 Number of Invoices

The number of invoices you receive and the charges in the invoices change depending on how and from whom you get the gas. If you purchase your NG directly from an LDC, you should expect to receive a single bill that includes charges for gas purchasing, pipeline transportation, and local delivery. Likewise, you will receive a single bill if you purchase gas directly from a marketer. If you purchase gas from a marketer but delivery is managed by your LDC, you should expect two separate bills: one for gas purchase from the marketer and one from your LDC for delivery of the gas. Large industrial users in deregulated markets can often have 3 separate invoices: one for gas purchasing, pipeline transportation, and local delivery.

2.5 Forecasting Gas Usage

In addition to choosing the best pricing option for your business, another important aspect of NG procurement is understanding how gas consumption is handled in your contract. Forecasting exact gas usage is practically impossible, so it is critical to understand how any excess or unused gas is priced in your contract. You may underestimate your consumption and end up ordering gas, or you may overestimate usage and sell the excess gas (ordered gas that you did not consume) back to the supplier. Regardless of whether you under- or overestimate your usage, any difference will affect your bills. Suppliers will usually charge a higher rate for the extra gas that you purchase and pay a lower rate for any unused gas sold back to them depending on your supply contract. Therefore, setting these prices in your NG contract is vital.[7] Once these rates are determined, you can make informed decisions on how much gas you want to prebuy from your supplier.

2.6 Connecting Natural Gas Markets with Bills

With a general idea of how NG is procured and delivered to your facilities, understanding the charges on NG invoices becomes easier. Having basic knowledge on NG exploration, production, distribution, markets, and procurements will help to understand why different charges appear on your bills. The following sections will work through these charges and other important parts of your NG bills. Sections 3, 4, and 5 discuss common charges on your utility bills, typical rate structures, and opportunities for cost savings based on analyzing your bills. Simple analysis can sometimes lead to substantial cost savings by identifying opportunities to avoid unnecessary charges. Careful analysis of monthly consumption patterns may also identify energy projects that may save NG energy consumption as well.

[7] Blake Baxter, 'Natural Gas Contracts 101: Avoiding Common Mistakes', *Wisconsin Association of School Boards*, September 2016, pp. 20–22.

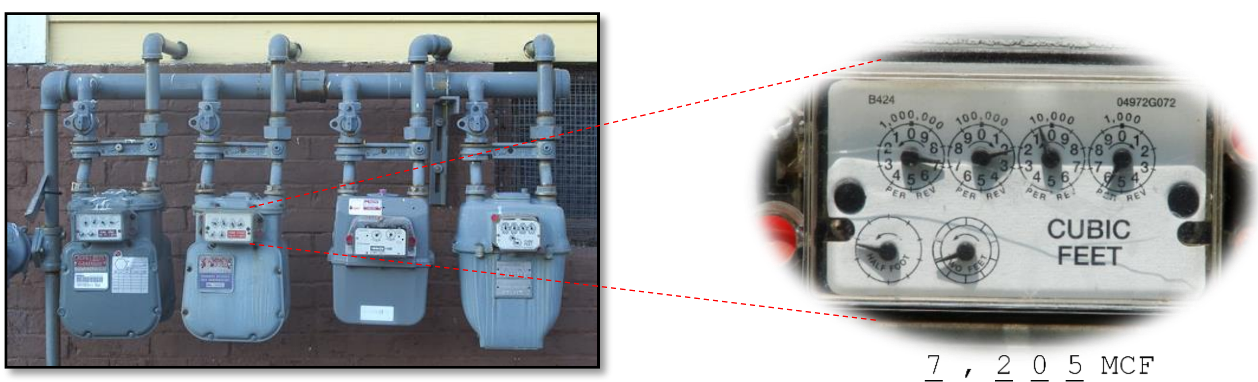
3. Natural Gas Bills and How to Read Them

The first step in understanding your utility bills is to determine what kinds of energy you use at your plant (e.g., electricity, gas, solar). Accounting for each energy stream being consumed in your facility is essential in reducing your usage.

This section focuses on your NG bills and the key information that you can learn about your facility by collecting and analyzing them. Finding bills from the past several years is helpful to understand NG usage in the past and how it is being used currently. Looking for trends and patterns or anomalies in your bills is a great resource for finding cost savings and identifying possible efficiency projects that reduce NG cost and usage. You may need to work with your accounting department or NG supplier company to track down old bills if you do not have them on hand.

3.1 Natural Gas Meters

NG meter installations vary widely across the United States, but most will look similar to the setup in Figure 6. Utilities employ different kinds of meters depending on type of facility, magnitude of usage, cost, NG supply pressure, the presence of particulate matter in the gas, availability of space for installation, maintenance, service access, and so on. The most common types of NG meters installed are the diaphragm type meter, rotary positive displacement meter, orifice meter, and turbine meter.[8] Sometimes, multiple meters are billed on a single invoice. In some instances, two or more sections of same facility may have separate meters that are assessed on different invoices. There can be advantages, disadvantages, and reasons for using each type of meter. In most cases, utilities decide the type and specifications of the installed meter as per established policy. Therefore, a detailed discussion on advantages and disadvantages of meter types is out of scope for this document's purpose but can be easily found in numerous resources on NG measurement.



(a) Typical Installation of Diaphragm Natural Gas Meters

(b) Analog Meter Readout

Figure 6: (left) Typical diaphragm natural gas meter installation and (right) analog meter readout.

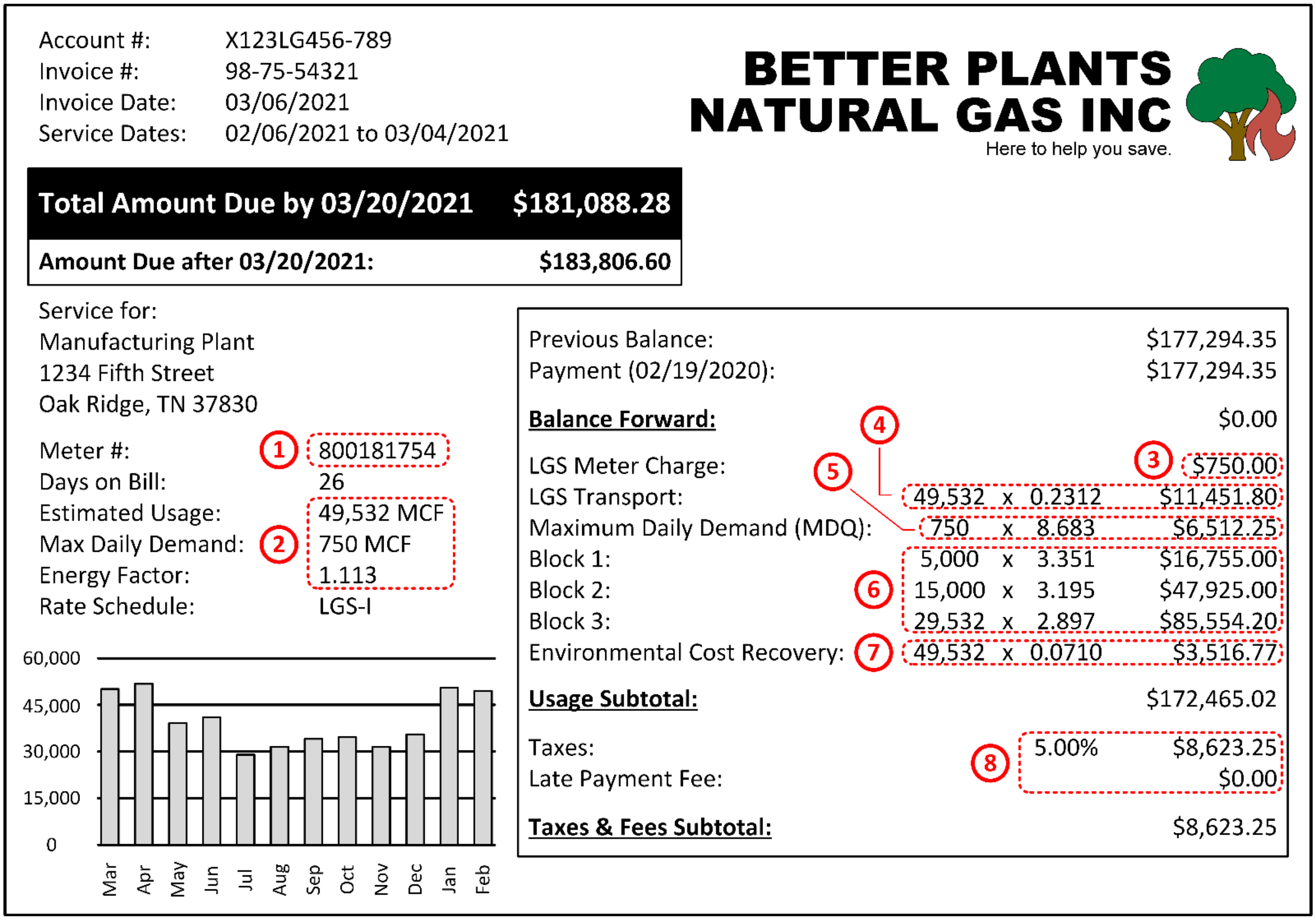
The reported gas volume is at normal temperature and pressure conditions, i.e., 60°F and 14.73 psia, adjusted using corrections by Charles's law, Boyle's law, and/or compressibility factor.[9] The installed meters are usually equipped with attachments that can compensate for temperature and pressure. In case the meter is not equipped with compensatory equipment, average temperature measurement for the billing period is used to adjust the gas volume.

[8] Liji Huang, 'City Natural Gas Metering', *Natural Gas—Extraction to End Use; Gupta, SB, Ed.; InTech: Rijeka, Croatia*, 2012, 181–208.

[9] Paul R. Ludtke, *Natural Gas Handbook* (National Bureau of Standards, Boulder, CO (USA). Chemical Engineering Science Division, 1986).

3.2 Understanding Natural Gas Bills

After you have collected a few gas bills, you can begin to analyze them. This can often be a tedious process because utility bills can be complex along with some unusual abbreviations and industry jargon. Some common things to look out for on your bills are the gas usage volume, measurement units, BTU (energy) factor, usage and transportation charges, penalties, other riders, taxes, and fees (Figure 7). In addition to the usage and cost information, other important components in the bills include account number, meter readings, number of days in the period, historical gas usage, and average temperature during the billing period.



Account #:	X123LG456-789
Invoice #:	98-75-54321
Invoice Date:	03/06/2021
Service Dates:	02/06/2021 to 03/04/2021

BETTER PLANTS NATURAL GAS INC
Here to help you save.

Total Amount Due by 03/20/2021	**$181,088.28**
Amount Due after 03/20/2021:	**$183,806.60**

Service for:
Manufacturing Plant
1234 Fifth Street
Oak Ridge, TN 37830

Meter #:	(1)	800181754
Days on Bill:		26
Estimated Usage:	(2)	49,532 MCF
Max Daily Demand:		750 MCF
Energy Factor:		1.113
Rate Schedule:		LGS-I

Previous Balance:					$177,294.35
Payment (02/19/2020):					$177,294.35
Balance Forward:					$0.00
LGS Meter Charge:	(3)				$750.00
LGS Transport:	(4)	49,532	x	0.2312	$11,451.80
Maximum Daily Demand (MDQ):	(5)	750	x	8.683	$6,512.25
Block 1:	(6)	5,000	x	3.351	$16,755.00
Block 2:		15,000	x	3.195	$47,925.00
Block 3:		29,532	x	2.897	$85,554.20
Environmental Cost Recovery:	(7)	49,532	x	0.0710	$3,516.77
Usage Subtotal:					$172,465.02
Taxes:	(8)			5.00%	$8,623.25
Late Payment Fee:					$0.00
Taxes & Fees Subtotal:					$8,623.25

Figure 7: : Example NG utility bill with key information highlighted: (1) meter number, (2) NG usage and energy factor (3) customer charge, (4) transportation charge, (5) maximum daily transportation fixed demand (6) usage charges, (7) riders, and (8) taxes, fees, and penalties.

A general description and explanation of these aspects of NG bills is given in the following section. Understanding what these charges mean and why they are assessed on your bills is key to avoiding or reducing their impact on your NG bills.

3.3 Typical Charges

Each utility company is different and so are the charges on the bills assessed by them. Utility companies have different rate schedules depending on the type of customer and anticipated consumption, and each rate has multiple cost components. However, a few general cost components appear on most NG bills. The objective of this section is to provide you a general idea of these common cost components. Consult with your NG provider or work with your TAM to understand any unique components that appear on your bills.

Customer Charge

A customer charge is a fixed charge that is seen on every invoice independent of NG consumption for the billing period. This is the fee that the utility company charges for providing utility and account management services. This charge also helps utility company pay for customer service associated with the account. These fees are generally unavoidable and can vary significantly depending on type of service (e.g., small commercial service, large industrial service). Customer fees can also sometimes be called a service charge, account fee, or metering fee.

Commodity Charge/Gas Cost Recovery

A commodity charge is the cost of NG consumed at your facility. Some bills may list commodity charges as gas cost, gas cost recovery charge, or purchased gas cost. The cost may be dependent on long-/short-term contracts or daily "real-time" market prices. The commodity charge is calculated based on your rate structure and your meter reading. Most bills will include a brief calculation showing how the charge is determined. Commodity cost is usually the largest portion of your gas bills, so a thorough understanding of this charge is essential for understanding cost impact of efficiency opportunities. See Section 4 for different rate schedules used to calculate commodity charges.

Units of Measurement and BTU Factor

As discussed, utility companies use different kinds of meters for NG measurement based on policy and conditions at a given site. These meters measure usage by volume in units such as hundred cubic feet (HCF or CCF) or thousand cubic feet (MCF).[10] The gas consumption charges are then assessed based on the reported volume units of gas. However, sometimes the rates are specified in energy units such as therms (Th), dekatherms (10 therms [Dth]), or million British thermal units (MMBtu) instead of volume.

The heating value of the gas supplied will vary continually because of changes in the composition of NG. The gas supplied consists of mostly methane with varying proportions of ethane, other hydrocarbons, and synthetic gas depending on the gas supply situation at any given time. The normal range of heating value will be from 920 to 1,100 Btu per cubic foot of gas.

This variation is accounted by the utility companies by using an average factor to covert the measured volume units into energy units. This factor is known as the ***BTU factor*** on your energy bills. It represents the average heating value of supplied NG over billing period. The volume and energy equivalencies for NG are given below. The BTU factor is assumed to be 1 (i.e., 1,000 BTU/CF of NG).

1 CF	=	0.01 CCF	=	0.01 MCF	≡	1,000 Btu	=	0.001 MMBtu	=	0.001 Dth	=	0.01 Th
100 CF	=	1 CCF	=	0.1 MCF	≡	100,000 Btu	=	0.1 MMBtu	=	0.1 Dth	=	1 Th
1,000 CF	=	10 CCF	=	1 MCF	≡	1,000,000 Btu	=	1 MMBtu	=	1 Dth	=	10 Th

Demand Charge – Maximum Daily Quantity/Maximum Daily Firm Quantity/Highest Monthly Average Daily

Though not common for all customers, some large industrial facilities may see a charge for demand of NG. Demand is the rate at which NG is delivered to the facility. The rate is measured on a predetermined interval of time, typically per day, but sometimes monthly or hourly variations are also seen. Because the pipelines must be sized

[10] As a standard, utility companies always report the gas volume at 14.73 psia and 60°F (520°R).

appropriately to accommodate for the NG demand, utility companies have to invest in infrastructure for it. Proper sizing also ensures reliability of NG supply for customers. The demand charge portion of your NG bill is used to pay for these projects. The demand charge is assessed on maximum rate of NG supply during the billing period.

Utilities can charge for NG demand in numerous variations and a few of them are discussed here. One way utility companies assess demand charge is the maximum daily quantity (MDQ), which establishes the maximum NG quantity consumed by a customer in continuous 24 hour period (demand). The customer is charged based on MDQ and it contributes to the minimum charge for the facility per billing period. In a firm rate schedule variation, demand charge is assessed as maximum daily firm[11] quantity (MDFQ), which determines the maximum NG quantity the utility is responsible to supply regardless of external market conditions. In another variation, there may be a seasonal ratchet demand clause in the rate schedule, where monthly demand is charged based on established peak for the winter season. Example 1 shows a demand calculation using highest monthly average daily (HMAD) strategy.

Example 1: Demand calculation

A manufacturing plant's utility measures its NG demand daily. The utility company bases the monthly demand charge on HMAD NG demand.

Known: NG consumption readings for February 2020

Calculate: Peak demand

Day	MCF	Day	MCF	Day	MCF	Day	MCF	Day	MCF
Feb 1	1,678	**Feb 7**	1,499	**Feb 13**	1,550	**Feb 19**	1,650	**Feb 25**	1,591
Feb 2	1,639	**Feb 8**	1,573	**Feb 14**	1,442	**Feb 20**	1,210	**Feb 26**	1,613
Feb 3	1,615	**Feb 9**	1,681	**Feb 15**	1,414	**Feb 21**	1,654	**Feb 27**	1,457
Feb 4	1,614	**Feb 10**	1,693	**Feb 16**	1,423	**Feb 22**	1,562	**Feb 28**	1,590
Feb 5	1,592	**Feb 11**	1,690	**Feb 17**	1,561	**Feb 23**	1,585	**Feb 29**	1,375
Feb 6	1,639	**Feb 12**	1,653	**Feb 18**	1,793	**Feb 24**	1,579	—	—

Because demand is assessed based on the highest daily demand and we know the daily consumption from the utility, HMAD for February 2020 is simply the maximum daily consumption value:

$$\text{Demand for Feb 2020} = \text{maximum}(1678{,}1639, \dots, 1375)\ \text{MCF} = 1{,}793\ \text{MCF on Feb } 18, 2020$$

Transportation Charge/Delivery Charge

All the NG pipelines are regulated by FERC. These pipelines transport NG from where it is available to the region, large industrial customer, or LDC where it is needed. These pipeline companies charge for the service they provide, which is the transportation or delivery fee on your NG bills. The transportation charges are usually directly related to the volume of NG delivered to the facility. Therefore, as the facility becomes more efficient, the transportation charge also reduces with the commodity charge.

Distribution Charge

Once the NG arrives in your local region, it is distributed to your meter by an LDC. This charge can be combined with the transportation charge depending on the utility company and pipeline company.

[11] Note: Interruptible and firm service and rates are discussed in more details in Section 4.

Storage Charge

NG usage fluctuates daily and seasonally for many reasons, including weather, industrial production, and market demand. Despite this variation, NG mining and transport is relatively constant. To accommodate for this mismatch in production and demand, NG is stored in large underground storage facilities or smaller-volume tanks aboveground. This ensures that sufficient gas is available when it is needed. Utility companies recoup storage costs by adding an additional charge to your gas bills. The storage charge is based on the portion of supplied NG that was kept in storage.

Other Charges

Besides these main charges, a few other charges may appear on your bill. These charges may be independent of the NG consumption, or some of them can be just a fraction of the total charge, like the sales tax, but it can add up and sometimes can denote a considerable portion of the bill. The charges are levied because of local/state laws and regulations or policies of the utility company. Some of these charges may be referred to as ***riders*** in the rate structure document from the utility.

The ***environmental surcharge*** *and* ***energy efficiency program surcharge*** are addon charges that the local utilities have chosen to apply to the bills to promote reduction of the NG use, to improve environmental performance and energy efficiency. These charges are sometimes used to pay for utility companies' incentive programs that offer rebates for approved energy efficiency projects. The ***distribution integrity management program surcharge*** denotes a charge on the bill for maintenance and enhancement of the NG distribution network.

Taxes and Late Payment Fees

Taxes are assessed as a percentage of all costs incurred on the bill. Depending on local and state regulations, manufacturing customers may receive tax rebates and exemptions. This is discussed in detail in Section 5. If tax is assessed on your bill, these charges are typically unavoidable and are assessed in accordance with local laws and regulations. The late payment fees are charged by utility companies if the due invoices are unpaid beyond a designated date. These are assessed to recoup the time value of money and can range from 0.5% to 2.0% of the total cost. The ***late and returned payment penalties*** are almost always avoidable. A good accounting practice is to always pay the due amount on time because the late fees can add up over time.

To summarize, utility companies can apply variations of rates and charges to recover their cost from customers. Because of the high variability among utility companies, generalizing all the charges is difficult, but looking up the rate schedule document from your supplier and distributor will be helpful in understanding what each category of charge means for your bill.

3.4 Calculating Gas Cost

The ultimate goal of understanding all the charges on the energy bill is to be able to determine the actual cost of gas for your facility. Determining this cost is much easier when you know how to classify and categorize charges on the NG bill. There are many ways to calculate your gas cost. The energy content of the NG delivered to your facility varies with time and source. This means that the same volume (cubic feet) of NG will have different heating value. Therefore, calculating NG cost on the basis of energy content is preferable. The easiest and most commonly used method is to calculate the ***average gas cost*** in US dollars per million British thermal units. In this method, you examine the total NG energy consumption vs. total invoice paid to utility company each month.

$$Average\ Gas\ Cost\ = \frac{Total\ Billed\ Cost\ (\$)}{Total\ Gas\ Energy\ Consumed\ (MMBtu)} = \frac{Total\ Billed\ Cost\ (\$)}{Gas\ Volume\ \times BTU\ Factor}$$

The main advantage of calculating the average gas cost is simplicity of analysis. It does not require digging into specific rate structures or classifying specific charges as fixed or variable costs. However, the simplicity has a tradeoff with accuracy. The average gas cost can yield ballpark results for large consumers with low or no fixed costs. The error tends to increase for smaller gas users who have larger portions of their bills in fixed costs. Accuracy is also affected with more complex rate structures (e.g., rate schedule with multiple rate blocks or rate schedules that charge transportation based on NG demand in addition to NG usage and so on).

Another way to calculate your NG cost is by using the ***marginal gas cost*** method. Marginal cost is the cost of purchasing one extra unit of energy above current consumption. For an energy saving project marginal gas cost is also the cost of buying the last energy unit. This is the true cost that will be saved if an energy efficiency project is implemented. This approach provides more accurate quantification of gas cost but can be tedious if there are different supplier and distributor companies and if complex rate structures are involved. To estimate marginal cost, list and group every charge based on usage, demand, and fixed costs. If your bills use a block rate structure (see Section 4.2), use the rate from the highest block of gas usage reached. With marginal costs, you can estimate savings from 1 MMBtu or MCF of usage. In the situation in which the NG supplier and distributor are different entities, similar principles of separating costs on their basis (fixed or variable based on NG consumption) should be used for both gas invoice and distribution invoice. Marginal cost calculation requires a deep understanding of your rate structure and provides a better estimate of your actual NG costs and savings potential. Example 2 demonstrates the gas cost calculations.

Example 2: Marginal cost of NG

Consider the following monthly bill for a wood processing company. The company consumes significant amount of NG for process heating use and is on LGS-I rate schedule.

Natural Gas Invoice						
Rate Schedule	LGS-I					
Previous meter	510498	Invoice Date		12/5/2018		
Current meter	556170	Meter Read Date		11/30/2018		
Difference	45672	Days on Bill		30		
Usage Nov 2018	**45672**	**Payment Due Date**		**12/19/2018**		
BTU Factor	1.112					
Category	Description	Units	Rate/MCF		Cost	
Customer charge	Meter charge	1	$	767.390	$	767.39
Demand charge	MDFQ	445	$	8.683	$	3,863.94
Commodity charge	Block 1 (≤10,000)	10,000	$	5.351	$	53,510.00
	Block 2 (>10k,≤30k)	20,000	$	4.895	$	97,900.00
	Block 3 (>30,000)	15,672	$	4.179	$	65,493.29
Environmental		45,672	$	0.021	$	959.11
			Total		**$**	**222,493.73**
			Taxes (4.39%)		$	9,767.47
			Grand total		**$**	**232,261.20**

Known: Charges listed on bill for November 2018

Example 2 continued on next page…

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…Example 2 continued from previous page

Calculate: (1) Average cost of NG and (2) marginal cost of NG for November 2018.

1. Average cost of NG, C_{AVG}

$$C_{AVG} = \frac{Grand\ Total}{Gas\ Volume \times BTU\ Factor} = \frac{\$232{,}261.20}{45{,}672 \times 1.112} = \$4.57/MMBtu$$

2. Marginal cost of NG energy, C_{MRG}, is the cost of purchase of the last MMBtu. Since the gas usage in the invoice above is 45,672 MCF, we can obtain C_{MRG} by calculating the difference in the cost of 45,671 MCF using the rate structure in above invoice and subtracting it from the actual cost for 45,672 MCF. As the steps will be similar, while calculating cost for 45,671 MCF, the customer charge, and demand charge, the first two blocks of commodity charge will have the same cost. The commodity charge for third block of usage, environmental surcharge, and taxes will be different and hence shown in the numerator in following formula:

$$C_{MRG} = \frac{\Delta\ Gas\ Cost}{\Delta\ MCF \times BTU\ Factor} = \frac{[(65{,}493.29 + 959.11) - (65{,}489.109 + 959.091)] \times [1 + 0.0439]}{(45{,}672 - 45{,}671) \times 1.112}$$

$$C_{MRG} = \$3.94/MMBtu$$

If you want to calculate the financial impact of an NG equipment expansion or efficiency project, marginal rate calculation is useful. Marginal rate calculation is highly dependent on rate structure. Block rates are usually designed such that the last block is usually where a significant part of the usage tends to fall (i.e., block 3 in Example 2). Let's consider a scenario where we are evaluating energy savings project. If the saved energy completely falls in the third block, you can proceed as illustrated in Example 2. If the calculated energy saving would fall in the third block and then partially in the second block, the weighted average of the rates for the third and second blocks should be used.

For instance, if the facility in Example 2 saved 10,000 MCF of gas, then the savings will fall only under block 3, so the marginal cost used should be \$3.94/MMBtu. However, if the facility saved 20,000 MCF, then the savings will fall under block 3 and partially under block 2, so a weighted average between those two blocks should be used to calculate marginal cost as shown:

$$C_{MRG} = \frac{(Wt. Average\ \text{of}\ Commodity\ Charge\ in\ Block\ 3\&2 + Environmental\ Charge) \times (1 + Tax\ Rate)}{BTU\ Factor}$$

Weighted average of commodity charge in block 3 and block 2 can be calculated as shown below and substituted in the above equation to calculate the marginal rate.

$$Weighted\ Average = \frac{Amt\ in\ Block\ 3\ \times\ Block\ 3\ rate\ +\ Remaining\ amt\ in\ Block\ 2\ \times\ Block\ 2\ Rate}{(Amt\ in\ Block\ 3 + Remaining\ amt\ in\ Block\ 2)}$$

$$C_{MRG} = \frac{\left(\left(\frac{15{,}672 \times \$4.179) + ((20{,}000 - 15{,}672) \times \$4.895)}{20{,}000}\right) + \$0.021\right) \times (1 + 0.0439)}{1.112} = \$4.08/MMBtu$$

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3.5 Calendarization

As you examine each month's utility bills, take note of how many days are on each invoice. Sometimes, number of days on each bill can vary significantly. Depending on when your meters are read, some billing periods can have fewer than 25 days, whereas others can be close to 35. When comparing between years, months, or with other utilities such as electricity and water, having consistent billing periods is essential.

Adjusting NG data to normalize for billing periods is known as ***calendarization***. While beyond the scope of this document, standard practice is to divide monthly consumption by the number of billing days and allocate to each month an appropriate number of days from each bill. More information on calendarization and baselining your electricity consumption can be found in the Better Plants Energy Intensity Baselining and Tracking Guidance 2020.[12]

[12] Christopher Price, Sachin Nimbalkar, and Thomas Wenning, *Energy Intensity Baselining and Tracking Guidance* (United States: Oak Ridge National Lab, Oak Ridge, TN, 22 August 2020) <https://www.osti.gov/biblio/1649123> [accessed 5 February 2021].

4. Common Rate Schedules and Rate Structures

The previous section provided a basic understanding of how to read your NG bills, where all the charges are, and what different terminology means. However, to fully understand your bills, you need to understand why and how charges are calculated. Utility companies utilize different mechanisms to recoup their costs from customers. A typical utility will have a collection of pricing policies for different customers called a ***rate schedule***. Large manufacturing operations will have significantly different consumption patterns and quantities than a residential customer or even a large commercial building. Therefore, different rate schedules are offered for industrial, commercial, and residential customers.

Each rate structure is usually further segmented by size, service type provided, and anticipated demand. A number of different pricing structures are offered based on these classifications (e.g., small industrial, large general service, large commercial). These sets of pricing structures are called ***rate structures***. Examples for rate schedules and rate structures are discussed in this section.

Often, the NG supplier and transportation company are different for manufacturing facilities. This increases the complexity of NG billing analysis as the customers receive two invoices. Supplier and transportation price structures are often different and can cause confusion. Information about rate schedules and rate structures follows.

4.1 Gas Commodity Rate Schedules/Service Types

This section reviews a few common pricing strategies for NG purchasing. Different customers have different requirements, so utilities will recoup their costs differently through the pricing structure.

Size-Based and Industrial/Commercial Service

The service types offered by utility companies are usually based on the requirements and characteristics of the customer. Retail or office buildings are commercial spaces and have unique consumption characteristics that are similar to each other, but they are significantly different from industrial customers. Quantity needed and day-to-day variability are two main characteristics on which these rate schedules are based. Utility companies pass on volume discounts to high-quantity users. Higher variability in the usage adds uncertainty for utilities on daily volumes sold. The classification based on size and type reduces this uncertainty and helps utility companies plan better. The industrial and commercial service types get further sub-divided into general service, large industrial, small and medium industrial, and other rate schedules.

Firm and Interruptible Schedules

These schedules are available regardless of the class of service. Firm service is offered to customers that need a reliable and continuous supply of NG at all times. Contracts for industrial customers will usually specify special conditions under which there could be disruption in service such as a natural calamity or a residential demand surge during an emergency. Firm service may only be available during specified periods or seasons. The advantage of this rate schedule is that it cannot be interrupted during adverse conditions not specified in your contract. The rates are called ***firm rates*** and come at a premium over the market price.

Interruptible service is a low-priority service offered under special rate schedules or contracts to customers that can anticipate and permit interruption in gas supply on a short notice when a surge occurs in NG market demand. Priority is given to firm service customers in exchange for lower gas costs. The rates are called ***interruptible rates*** and offer a discount from the market price.

Off-Peak Schedule

Off-peak service is similar to interruptible service in that it is available during certain periods in an annual cycle. It is made available to customers who experience higher demand during periods of low overall market demand. This service with off-peak rates may not be available to all customers.

High Load Factor Based Schedule

Load factor is the ratio of average daily NG requirement to the maximum daily NG requirement in the year. A high load factor signifies constant demand for NG and low variability in consumption. If NG usage is for seasonal demand (e.g., comfort heating or seasonal production) the resulting annual load factor is often low. High load factor schedules are offered to industrial customers that intend to drive baseload processes with supplied NG without much variation. This allows the NG suppliers and transporters to plan better for anticipated demand. Figure 8 shows NG load cycles for gas suppliers due to different consumption patterns. Demand spikes usually occur twice per year, once in summer months when electricity generation increases to meet air conditioning demand, and once in the winter for heating demand.

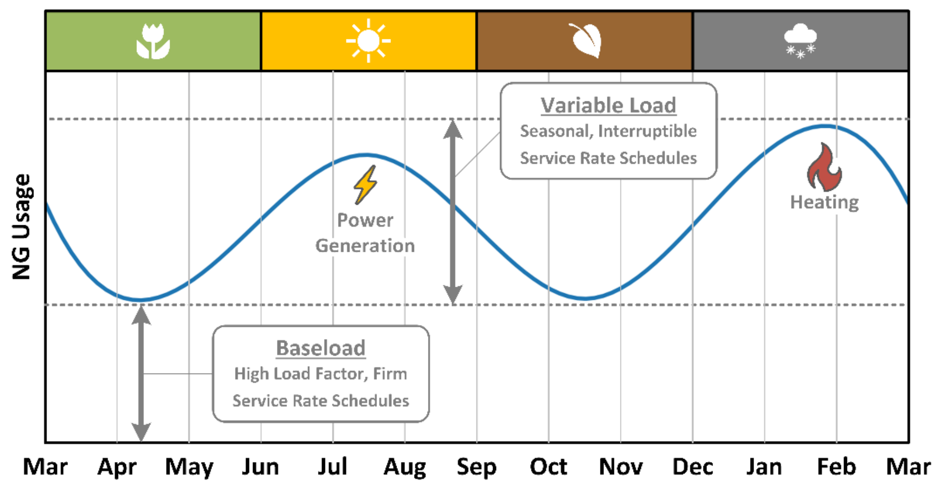


Figure 8: Representation of NG load cycles and contributing rate schedules.[13]

Hedging Option

A ***hedging option*** is provided to large industrial customers with high NG demand when an LDC has excess delivery capacity over firm service customers. This option offers risk protection to the customer from NG price increase due to market demand fluctuation. To benefit from this option, LDCs may impose certain requirements including having an available alternative fuel source that can offset NG demand in case of a shortage. When NG cost is increasing, you can hedge your exposure through futures contract for a fixed price. If the market price ends up higher as expected, the futures contract is executed, and NG can be bought at the fixed price. There is a risk of under delivery or over delivery which are charged based on established rates through negotiated contracts or standard rate schedules.

This option involves careful planning of operations and issuing timely energy consumption forecasts so that maximum benefits from the rate schedule can be obtained. Under-delivery occurs when LDC receipts are higher than the metered delivery volume, and on the other hand over-delivery occurs when LDC receipts are lower than

[13] Direct Energy, 'Energy Pricing 101: Breaking Down the Energy Price Tag' <https://business.directenergy.com/understanding-energy-pricing> [accessed 26 January 2021].

the metered delivery volume. In both cases, utility companies may impose additional tariffs on differential gas quantity. This option is a purchasing strategy and is very complex, so it is not discussed in detail here. For additional assistance, you can discuss it with your local utility. It may also be worthwhile to speak to your energy procurement team in your organization if this kind of strategy makes sense for your operation.

4.2 Gas Commodity Rate Structures

As discussed earlier, for higher certainty in NG demand, utilities classify their customers by rate schedules. Based on these characteristics, distinct price points will emerge that are economically practical for utilities and customers, (e.g., high load factor and high usage can get volume discounts). These price points can be translated into sets of rate structures. Rate structures may be designed to promote efficiency, improve demand profile, and so on, and are used to calculate your total bills. Some of the common rate structures are discussed here.

Flat Rates and Block Rates

Rates that remain constant regardless of consumption are called ***flat rates***. This is the most common NG pricing mechanism for small manufacturers. Flat rate structures are easier to analyze compared with other rate structures because they involve only one component in commodity charge.

Rates that change in steps based on how much NG is consumed are called ***block rates***. With block rates, your unit cost of gas is divided into distinct tiers based on usage. In a declining or decreasing block structure, the unit cost for consumption decreases as you consume more NG. In an inverted or increasing block structure, the unit cost of consumption increases as you use more gas.[14] Both declining and inverted structures reflect the relative cost for the utility to provide procure and distribute additional NG. Most utilities with block rates have at least two blocks that appear on your bills with labels such as “Block 1 Charge” and “Block 2 Charge.” Examples of flat and block rate structures are given in Table 1.

Table 1: Example flat and block rate structures

Rate type	Block	Cost	Total cost
Flat rate	Customer charge (F)	\$475	$C = F + 0.4851 \cdot V$
	All usage, per CCF (V)	\$0.4851	
Block rate (decreasing)*	Meter fee (F)	\$330	$C = F + 4.79 \cdot V_1 + 4.55 \cdot V_2 + 4.09 \cdot V_3$
	≤ 2,000 MCF (V_1)	\$4.79	
	> 2,000 MCF; ≤ 12,000 MCF (V_2)	\$4.55	
	> 12,000 MCF (V_3)	\$4.09	
Block rate (increasing)**	Meter fee (F)	\$330	$C = F + 4.35 \cdot V_1 + 4.79 \cdot V_2 + 5.99 \cdot V_3$
	≤ 7,000 MCF (V_1)	\$4.35	
	> 7,000 MCF; ≤ 10,000 MCF (V_2)	\$4.79	
	> 10,000 MCF (V_3)	\$5.99	

* Passes on the volume discount to consumers

** Discourages from higher consumption because of steep increases in rate

[14] National Association of Regulatory Utility Commissioners (NARUC), *Gas Distribution Rate Design Manual* (Washington, DC, USA, June 1989) <https://maxxwww.naruc.org/forms/store/ProductFormPublic/gas-distribution-rate-design-manual> [accessed 20 January 2021].

Seasonal (Summer/Winter) Rates

Seasonal rates may be put in place by a utility that experiences large fluctuations in the demand from one season to another. This may happen for manufacturing customers because of the seasonal nature of production activity or large seasonal heating load for comfort heating or process during winter months. Though less common, these rates are seen in seasonal manufacturing facilities under firm or interruptible rate schedules. These can be combinations of flat and block rate structures and are priced separately for winter and summer months. The definition of winter and summer months for your region is usually included in the rate schedule.

4.3 Transportation Rate Schedules and Rate Structures

Similar to gas commodity rate schedules and rate structures, NG transportation pipeline companies impose their own tariffs on consumers to recoup their costs. In deregulated states, you may see two separate commodity and transportation invoices whereas in regulated states, you will most likely see a single invoice with total costs. Generally, the service types and rate schedules you will come across for transportation service are very similar to commodity schedules. Major service types are based on customer type such as industrial or commercial and other factors such as interruptible or firm service requirement.

The most common transportation rate structure for large users is a block rate schedule. The block rate schedules work as described in Section 4.2. Most of the manufacturers will see at least two blocks billed on the gas transportation invoice. Flat rates are common for small and medium manufacturers but can sometimes be seen for large manufacturers, as well. An extra component frequently seen in transportation rate structures is an NG demand charge. Demand is determined as maximum daily quantity (MDQ), which is the maximum NG consumption during a consecutive 24 hour period during a billing month. There are a few different ways in which utilities charge for transportation demand. When there is ratchet clause in rate schedule, the NG demand is determined as a maximum demand in a predefined rolling window of billing periods (e.g., over winter months). The most commonly found ratcheting clause measures the highest MDQ during winter months and the demand is charged for the rest of the year irrespective of the monthly MDQ. If in the next winter lower MDQ is experienced, the demand ratchet is lowered for the next year. The winter months are specified in the contract.

The MDQ can also be negotiated as firm - maximum daily firm quantity (MDFQ). This is the maximum daily demand the utility company is obligated to provide unless there is an extreme emergency or natural calamity. This is the demand that will be charged by transportation company on the invoice. An example of a deregulated rate structure for a large general service is given in Table 2**Error! Reference source not found.**. Under this rate structure, the customer can choose this utility as their gas transporter and supplier. If the customer chooses a third party as their supplier, the supply service will not be charged.

Table 2: Example deregulated rate structure for a NG transporter and supplier[15]

LGS-industrial rate schedule component	Rate
Customer charge	$350.00/month
Daily demand metering	$19.32/month
Delivery charge	
– First 5,000 CCF*	$0.0155/CCF
– Over 5,000 CCF	$0.0057/CCF
CAM** charge	$0.046/CCF
Demand charge/MDQ*** (min MDQ = 82 CCF)	$1.1217/CCF MDQ
DIMP**** charge/MDQ	$0.0064/CCF MDQ
Decoupling credit	–$0.0035/CCF
Supply service	
– Sales services charge/MDQ	$0.4571/CCF MDQ

* CCF = 100 cubic feet

** CAM = Conservation Adjustment and Management Charge for financing of conservation projects

*** MDQ = Maximum Daily Quantity in CCF – calculated as maximum demand in 5 winter months, ≥ average of last 12 months calculated monthly

**** DIMP = Distribution Integrity Management Program charge

4.4 Other Rate Structures

Your NG utility may have other types of rate structure options available. As this section suggests, knowing your options for NG purchasing can be a key to saving money. Staying alert for any updates to your utility's rate schedule can help you to take advantage of innovative rate structures and save on future NG costs.

[15] Connecticut Natural Gas Corp, 'Pricing of Natural Gas: LGS Rate Schedule', *NG Rate Schedules*, 2021 <https://www.cngcorp.com/wps/wcm/connect/www.cngcorp.com-20629/d21d0071-1df2-4139-ac34-ac9f74b1ce79/06a-LGS+%28Large+General+Service%29.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE.Z18_J092I2G0NODI40A73GVBIB3O26-d21d0071-1df2-4139-ac34-ac9f74b1ce79-nnj7H6l> [accessed 26 January 2021].

5. Savings Opportunities in Natural Gas Bills

NG bills can initially seem straightforward when compared with your electricity bills. However, with deregulation in place, anyone can buy and sell NG in the market. Further adding complexity to the process, utility companies design rate structures that can be quite complex and make it difficult to analyze your NG bills. The previous sections provided you with information on how to read your bills and to understand various charges that you may encounter in your monthly invoice, and this section focuses on some basic actions you can take to reduce your costs. The following measures are not meant to be a complete list but an overview of different opportunities that are possible. Analyzing your bills and NG consumption is an ongoing endeavor and new opportunities arise all the time. Appendix A included at the end provides information on biogas / renewable natural gas generation opportunity for facilities that have organic waste.

5.1 Recreating Your Bills

Once you know your rate structure(s), you can double check charges on your bills. Every consumption and demand charge can be verified by using the line items in your rate structure and the meter readings from your bills. The goal is to balance the charges on the bills with your understanding of your rate structure(s). There are generally three possible outcomes.

1. **Matching calculation with the bills:** This is the ideal case; you have identified the correct rate structure(s) and the bills had no calculation errors.
2. **Incorrect rate structure:** Your estimated bill does not match your actual bill because you used the wrong rate structure. Understanding your rate structure(s) is key to avoiding unnecessary spending.
3. **Calculation error:** Your estimated and actual bills do not match because of an error on your bill. Catching failed meters, data entry issues, clerical errors, and so on can result in significant savings.

5.2 Avoiding Late Fees

Almost every company (including utilities) charges a late fee when a payment is overdue. The exact size of the fee varies, but some utilities can charge as much as 10% of the outstanding balance. When bills are not paid, your facility is effectively borrowing money at an extremely high annual percentage rate. For example, a late fee of just 5% has an effective annual percentage rate of 80%. Working with your billing department and your utility can help you avoid these fees. Simple things such as understanding if a payment must be postmarked or received by the due date can save a lot of money over time.

5.3 Tax Exemptions

When reviewing your utility bills, pay attention to any listed taxes. Many states allow manufacturing facilities to claim state sales tax exemption on their utility bills under certain conditions.[16] For example, Texas manufacturers can claim an exemption if they can prove that at least 50% of the energy on a given meter is used for production purposes, including manufacturing, processing, and refining. Administration (e.g., purchasing, maintenance, testing of raw materials) and distribution activities (e.g., storage, maintenance, prevention of product deterioration) are usually not included in exempt usage. A ***predominant use study*** from an independent third party is typically required to analyze the energy consumption of each piece of equipment on a meter and determine if it is exempt under state rules. A predominant use study report is also a great way of determining the ***significant energy uses*** in

[16] SM Engineering Co., 'State Sales Tax Exemptions for Manufacturers', *SM Engineering Co.* <https://www.smeng.com/manufacturing-sales-tax-exemptions/> [accessed 15 April 2021].

your facility, a valuable tool for targeting future energy efficiency initiatives. Savings will vary state by state depending on your tax rate, and some states will refund up to 24 months of back taxes after claiming the exemption. Example 3 demonstrates the use of sales tax exemption and resulting cost savings. Consult with your local utility to see if your state offers any tax exemptions for manufacturers.

Example 3: Sales tax exemption

Consider a plastic manufacturing facility here. The facility is located in a state that offers a sales tax exemption on eligible purchases for manufacturers as long as more than 50% of the plant's energy consumption is used for manufacturing activity. If a predominant use study confirms that more than 50% of purchased NG is used for manufacturing, estimate the tax exemption benefit assuming a 4% tax rate.

Known: NG purchase, distribution, delivery, environmental cost recovery charges, and Sales tax rate.

Calculate: Sales tax savings.

<u>NG charges:</u>

Tax exempt: Purchased gas charge ($57,750)

Non-exempt: Customer charge ($300), environmental cost recovery charge ($525), distribution delivery charge ($11,250)

<u>Cost savings:</u>

The only charge eligible for tax exemption is the purchase gas charge. Sales tax savings are therefore

$$Monthly\ Cost\ Savings = Tax\ Rate \times Total\ Eligible\ Charges = 0.04 \times \$57{,}750 = \$2{,}310$$
$$Projected\ Annual\ Cost\ Savings = 12 \times \$2{,}310 = \$27{,}720$$

5.4 Finding an Affordable Supplier in a Deregulated Market

One basic way to lower your NG bills is to shop around for another supplier/marketer. NG deregulation has opened the market for suppliers who offer competitive pricing to customers. If you are allowed to buy gas from an independent supplier, you may be able to take advantage of lower prices while still meeting your NG needs. Example 4 illustrates possible savings from such a project. Before switching suppliers there are a few steps you should take:

1. Contact your current NG supplier for details of your current NG rate structure, including contract length, pricing type (e.g., fixed, index), and NG rates.
2. Analyze your past 12 months of NG bills to determine your monthly and yearly gas consumption and costs. This will serve as a baseline for your cost analysis.
3. Shop around and get quotes from different suppliers in your area. Compare quotes, pricing options, and any miscellaneous fees that may apply.
4. Once you gather all the information, estimate your gas costs and pick the best supplier for your situation.

Example 4: Gas charges cost analysis

Consider a manufacturing facility whose average monthly NG consumption is 15,000 MCF. The company currently gets its gas from Supplier A at a contract rate of $3.85/MCF. A new Supplier B offers to supply NG at a contract rate of $3.70/MCF. The same LDC would deliver the NG, meaning that the distribution delivery charge ($0.75/MCF) and environmental recovery charge ($0.035/MCF) would remain the same. If the customer charge for Supplier A and Supplier B is $300 and $575, respectively, determine if switching suppliers will save the company money.

Example 4 continued on next page…

…Example 4 continued from previous page

Known: Average monthly NG consumption, Contract rates for Suppliers A and B, Charges for customer account, delivery, environmental recovery fee.

Calculate: NG costs for Suppliers A and B, potential savings by switching suppliers.

Charge	Supplier A	Supplier B
Customer charge	\$300	\$575
Purchased gas charge	$15{,}000\ MCF \times \$3.85/MCF = \$57{,}750$	$15{,}000\ MCF \times \$3.70/MCF = \$55{,}500$
Distribution delivery charge	$15{,}000\ MCF \times \$0.75/MCF = \$11{,}250$	
Environmental cost recovery charge	$15{,}000\ MCF \times \$0.035/MCF = \$525$	
Subtotal	**\$69,825**	**\$67,850**
Tax (4%)	\$2,793	\$2,714
Total	**\$72,618**	**\$70,564**

From the analysis in the table, the monthly and projected annual cost savings are

$$Monthly\ Cost\ Savings = Cost_A - Cost_B = \$72{,}618 - \$70{,}564 = \$2{,}054$$

$$Annual\ Projected\ Cost\ Savings = \$2{,}054 \times 12 = \$24{,}648$$

5.5 Consolidating Meters

Consolidation of NG meters can result in cost savings in your utility bills. Plants that use multiple NG meters can switch to fewer or single meter which puts the plant energy use into blocks with lower unit costs or rate schedule (\$/MCF). In addition, consolidating meters also eliminates service charges on multiple meters charges. This is illustrated in Example 5. There are limitations in consolidating meters depending upon the consumption, meter rating, and the size of the distribution pipes serving the meters, and so on.

Example 5: Consolidation of meters

Consider a small industrial facility with average monthly NG consumption of around 3,000 MCF measured with three individual meters. After thorough analysis, the utility company determined that the facility could consolidate 2 meters and the total number would go down to 2 meters. Using the rate structure below, calculate the cost savings from consolidating meters 1 and 2.

Customer charge	Block 1 (≤1,000 MCF)	Block 2 (>1,000 MCF)
\$214/meter/month	\$2.038/MCF	\$1.393/MCF

Known: Meter 1 consumption (800 MCF), meter 2 consumption (1,200 MCF), meter 3 consumption (1,000 MCF), NG rate structure.

Calculate: Cost savings from consolidating Meters 1 and 2.

Example 5 continued on next page…

…Example 5 continued from previous page

Before consolidation:

Meter 1: $800\ Mcf \times \$2.038/MCF = \$1{,}630.40$

Meter 2: $1{,}000\ Mcf \times \$2.038/MCF + 200\ MCF \times \$1.393/MCF = \$2{,}316.60$

Meter 3: $1{,}000\ Mcf \times \$2.038 = \$2{,}038.00$

Customer charge: $3\ meters \times \$214/meter = \$642.00$

$$\begin{aligned} Cost_{before} &= Meter\ 1\ Charge + Meter\ 2\ Charge + Meter\ 3\ Charge + Customer\ Charge \\ &= \$1{,}630.40 + \$2{,}316.60 + \$2{,}038.00 + \$642 = \$6{,}627 \end{aligned}$$

After consolidation:

Meter 1 and 2: $1{,}000\ Mcf \times \$2.038 + 1{,}000 \times \$1.393 = \$3{,}431.00$

Meter 3: $1{,}000\ Mcf \times \$2.038 = \$2{,}038.00$

Customer charge: $2\ meters \times \$214/meter = \$428.00$

$$\begin{aligned} Cost_{after} &= Meter\ 1\text{–}2\ Charge + Meter\ 3\ Charge + Customer\ Charge \\ &= \$3{,}431.00 + \$2{,}038.00 + \$428 = \$5{,}897 \end{aligned}$$

Cost savings:

$$Monthly\ Cost\ Savings = Cost_{after} - Cost_{before} = \$6{,}627 - \$5{,}897 = \$730.00$$
$$Annual\ Projected\ Cost\ Savings = 12 \times \$730 = \$8{,}760.00$$

5.6 Choosing the Right Rate Structure

Rate schedules are publicly available information and can be easily accessed through your utility provider's website. Choosing the right rate structure from your rate schedule is extremely important in minimizing your NG bill. Most utilities will offer different rate structures in their schedules depending on the expected energy use of the meter. In general, manufacturing facilities will fall under a general service rate schedule. Depending on the expected use, your meter may be classified as a small, medium, or large general service. Each rate schedule will have its own pricing structure and rules for the allowable usage. An example rate structure for an industrial customer is given in Table 3. Your actual rate schedules will depend on your utility provider and might include additional charges, different costs and block rates, and other factors. Rate schedule units may vary depending on the utility preference. An illustration of how you could save cost by choosing right rate structure is shown in Example 6.

Table 3: Example rate structure for an industrial customer

Rate Schedule	Requirements	Rates
Small General Service	Less than 2,000 therms	Service Charge: $145/month Fixed distribution charge: $0.091202/therm Gas cost: $0.54936/therm
Medium General Service	2,000 therms to 50,000 therms	Service Charge: $300/month Fixed distribution charge: $0.044966/therm Gas cost: $0.54706/therm
Large General Service	Greater than 50,000 therms	Service Charge: $450/month Fixed distribution charge: $0.041131/therm Gas cost: $0.55016/therm

Example 6: Choosing the right rate structure

Consider a metal working company that recently added two heat treatment furnaces within the past year. Before the addition, the company consumed around 40,000 therms of NG per month. After the addition, the company consumes around 60,000 therms of NG per month. The facility has been in "Medium General Service" rate structure. Because of the addition of new furnaces, the facility can qualify for "Large General Service" rate structure. How much cost savings would the company realize by switching from the medium general service to large general service rate structure?

Rate schedule	Usage requirements	Rates
Medium general service	2,000–50,000 therms	Service charge: $300/month Fixed distribution charge: $0.044966/therm Gas cost: $0.54706/therm
Large general service	More than 50,000 therms	Service charge: $750/month Fixed distribution charge: $0.041131/therm Gas cost: $0.49706/therm

Known: Medium and large general service rate schedules, monthly energy consumption.

Calculate: Cost savings from switching from medium to large general service rate structure.

From the rate structure, the energy costs for medium general service are:

$$Cost_{mds} = Service\ Charge + Fixed\ Distribution\ Charge + Gas\ Cost$$

$$= \$300 + 60{,}000 \times 0.044966 + 60{,}000 \times 0.54706 = \$35{,}821.56$$

The energy costs for large general service are:

$$Cost_{lgs} = Service\ Charge + Fixed\ Distribution\ Charge + Gas\ Cost$$

$$= \$750 + 60{,}000 \times 0.041131 + 60{,}000 \times 0.49706 = \$\ 33{,}041.46$$

Cost savings are the difference between the medium and large general service energy costs:

$$Montly\ Cost\ Savings = Cost_{mgs} - Cost_{lgs} = \$35{,}821.56 - \$33{,}041.46 = \$2{,}780.10$$

$$Annual\ Projected\ Cost\ Savings = \$2{,}780.12 \times 12 = \$33{,}361.44$$

By switching rate structures, the company could save around $33,361.44 per year!

5.7 Credit Assurance

Large industrial customers with large anticipated monthly invoices (typically in the hundreds of thousands of dollars) are often required to make a deposit for a *credit assurance* when establishing a new utility account. This charge may appear on the first monthly invoice. Establishing a new utility account occurs when a manufacturing facility changes legal ownership or when a new facility is built. Credit assurances can apply to customers with no established history or low credit rating and are frequently an amount equal to the highest anticipated monthly bill. The credit assurance may be refundable after a certain period of steady payments are completed, or the utility may accept a *letter of credit* or *surety bond* in place of a cash deposit. Often, utilities will hold your cash deposit for the credit assurance indefinitely unless you are proactive and inquire about a refund or suitable alternative.

5.8 Demand Response Program Enrollment

A number of utility companies across United States have released NG demand response pilot programs recently through which incentives are offered for customers that can curtail their NG demand on a short notice (usually less than 48 hours). Although demand response programs are practiced in the electricity sector commonly, they are recently gaining popularity in the NG industry.[17] The utilities offer incentives if you can shift NG usage to a lower demand period from an anticipated peak demand period. If the gas companies can lower peak demands and evenly spread the demand curve (improved load factor), it can lower spending on the infrastructure upgrades. The utilities pass this benefit to customers by offering incentives.

Utilities usually require certain conditions to be met for you to qualify for these programs, such as requirement to be enrolled in firm service rate schedule, minimum curtailed NG volume, smart meter enabled to measure gas volume per hour. A key requirement of the program is to determine baseline NG load for the customer using established methodology[18]. Once the customer gets approved through an application for the program, the utility company notifies the customer ahead of a peak demand event and can ask for curtailment of full agreed upon NG volume or a portion of it. The utility pays the customer to offset their demand per event per unit volume. The peak demand events are supposed to be limited to a maximum in a month and in a year. If your process allows NG usage to be shifted to off peak demand time, such a demand response incentive program can bring significant savings in the overall NG cost for your facility.

5.9 Tracking Natural Gas Usage

As you review your NG bills, visualizing and tracking your NG data can be very helpful. Some companies have internal dashboards for their energy data, which makes the information easily shareable within the facility and with upper management. A lower tech solution is a spreadsheet that records NG usage over time and perhaps even includes a few key charts and statistics. Tracking your energy usage can help you detect anomalies and identify problems in a timely manner to prevent unnecessary usage or spending.

Energy usage at your facility will usually be highly dependent on production (e.g., more production means more NG usage). NG usage can also vary significantly with weather conditions, particularly when gas is used for space heating using furnaces or low-pressure steam. Heat loss from reactors, storage tanks, steam lines, boilers, process heaters, and so on is greater during winter months than summer months. Tracking NG usage can help identify poor or deteriorated insulation (mechanical and building envelope) or help identify process changes such as storing raw materials inside to avoid extra heating. Tracking and understanding how certain variables affect your usage can help you plan, prepare, and save on NG usage.

DOE has developed free software tools that can help you keep track of your energy and NG data. First, the Energy Footprint tool is a Microsoft Excel–based tool for collecting and tracking energy data. The Energy Footprint tool can track up to 20 types of energy streams (e.g., electricity, NG), as well as other variables that affect your energy usage, including weather, production, and operating hours. The Energy Footprint tool is also an excellent way to create a list of your significant energy users and balance their energy consumption with the meter readings on your bills.

DOE's Energy Performance Indicator (EnPI) tool is an Excel-based tool for analyzing and comparing energy usage between years. EnPI is the main tool that the Better Plants Program uses to track improvements in EI. The tool uses a regression-based approach to normalize for differences in energy consumption by accounting for variables such as production, weather, and humidity. The tool can also aggregate savings from multiple facilities into a corporate-level

[17] David Manowitz, 'Consolidated Edison Gets Approval for Natural Gas Demand Response Pilot Program - Today in Energy - U.S. Energy Information Administration (EIA)', 2018 <https://www.eia.gov/todayinenergy/detail.php?id=37412> [accessed 16 April 2021].

[18] Inc. Consolidated Edison, 'ConEdison : Smart Usage Rewards for Reducing Gas Demand', 2020 <https://www.coned.com/en/save-money/rebates-incentives-tax-credits/rebates-incentives-tax-credits-for-commercial-industrial-buildings-customers/smart-usage-rewards/smart-usage-rewards-for-reducing-gas-demand> [accessed 16 April 2021].

energy improvement metric. For more information on this type of analysis, please see the Energy Intensity Baselining and Tracking Guidance 2020.[12]

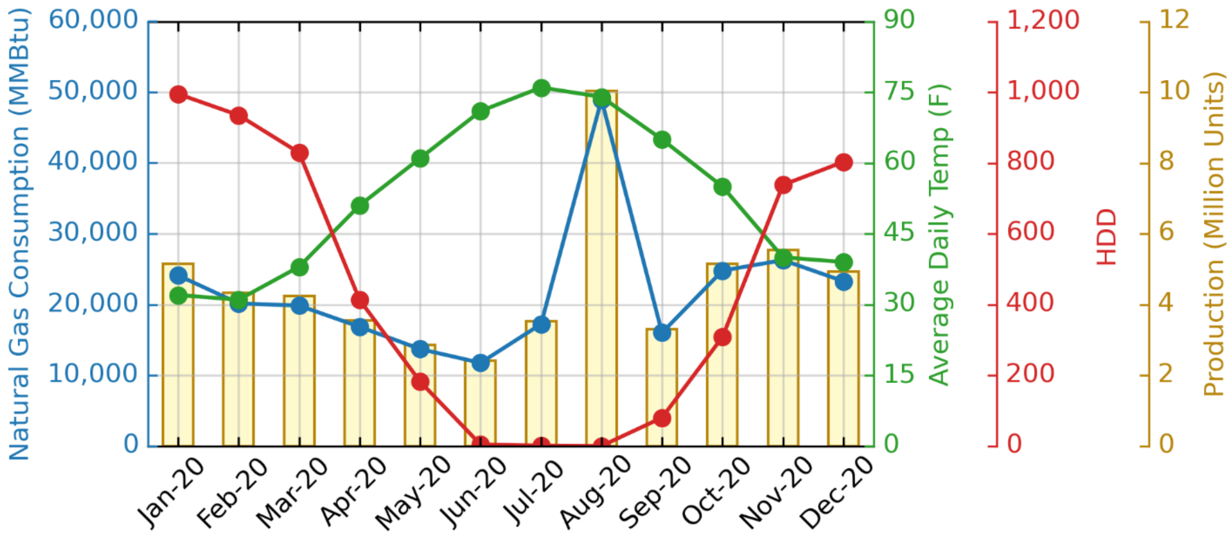


Figure 9: Tracking NG energy consumption (vertical axis color corresponds to plotted series color)

Figure 9 shows how monthly NG usage can be tracked at a manufacturing facility. The spike in NG usage in August 2020 could be quite puzzling in isolation. To understand the consumption patterns, the facility used data for daily average temperature (°F) and heating degree days (HDD) available from several weather services such as the National Oceanographic and Atmospheric Administration (NOAA). Although weather appears to explain some of variation in NG usage in colder months (January to April and October to December), the August peak is still unexplained. Obtaining and plotting production data, however, provides a much clearer picture. The spike in production volume in July and August caused significantly higher gas consumption. Both the Energy Footprint and EnPI tools can help you understand these relationships. For assistance in baselining your NG usage, please consult with your TAM.

6. Performing a Utility Bill Analysis: An Example

This section provides a detailed analysis of 12 months of example NG bill data. The example highlights key concepts discussed in this document. The numbers presented are fictitious and were fabricated based on real data to represent a real pattern. The appearance of specific NG transportation companies or gas suppliers is not an endorsement but is used to discuss actual NG rate structures. Your Better Plants TAM is available for any assistance you may need in understanding the analysis and can help you perform a similar analysis on your NG bills.

6.1 Rate Structure

Fine Factories, Inc. (FFI) has multiple manufacturing facilities located throughout United States, one of which is in Morgantown, West Virginia. Because West Virginia is a deregulated NG market, FFI has opted to use a national gas supplier (Shell Energy North America) and a separate LDC (Mountaineer Gas Company) for transportation. FFI gets two separate invoices each month, one from their supplier with commodity charges and one from their LDC for transportation costs.

FFI requires roughly 35,000 to 50,000 MMBtu of NG monthly for production and other support tasks such as space heating. This usage (i.e., >300,000 MCF per year and >150 MCF per day) puts FFI in the large general service rate structure for the LDC, which charges for daily metering, transportation, negotiated MDFQ, a storage balancing fee, and a base rate balancing fee on the monthly invoice. A summary of charges for the LDC rate structure is given in Table 4.

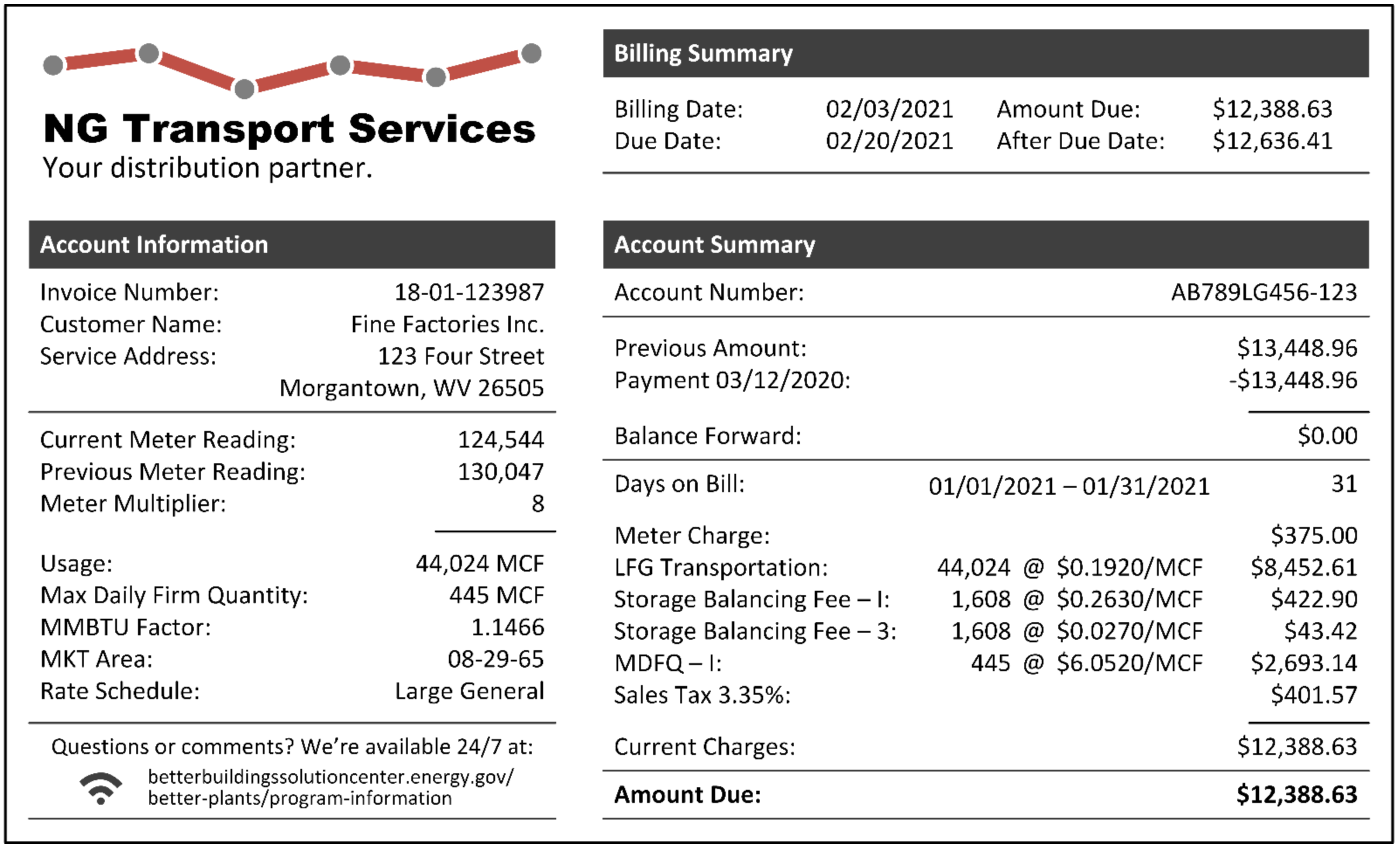
Table 4: LDC applicable rate schedule for FFI

Description	Rate	Unit	Charge type
Meter charge	$375	Per month	Fixed
Demand charge for MDFQ	$6.0520	Per MCF	Fixed demand
LGS total transportation	$0.1920	Per MCF	Variable consumption
Storage balancing fee - 1	$0.2630	Per MCF	Variable consumption
Base rate balancing fee - 3	$0.0270	Per MCF	Variable consumption
Other			
Delayed payment	2	%	Fee
Rate qualification			
Annual consumption	>300,000	MCF annually	
MDFQ	>150	MCF monthly	

FFI's gas commodity pricing from its NG supplier consists of three parts. Each month, FFI estimates the amount of baseload NG consumption that it expects its plant will use. FFI will procure this amount under fixed trigger (price type offered by supplier) at a fixed negotiated price of $4.515/MMBtu. The second part of the gas cost is buying a variable amount of gas from the NYMEX Henry Hub (NYMEX_HH) NG market at wholesale price. This is done on an ad hoc basis to fill in the remaining NG requirements. The price of gas on the hub varies each month and FFI has the option to switch to a fixed price at any point during the contract period to hedge against high NG costs. The final component of the gas cost is a settlement between what was bought from supplier and what was delivered by LDC to the facility. If FFI purchases more gas than it needs, the excess is resold to the supplier at a lower rate. If more gas was delivered than purchased, the remaining amount is added to the invoice at fair market price.

6.2 Transportation and Distribution Bill

Figure 10 shows an invoice from FFI's LDC for transportation and delivery of consumed NG. The bill lists the current and previous gas meter readings, the current month's MCF consumption and MDFQ, the account balance, and a list of charges. The rate structure is easily available on the LDC website. Reading the transportation rate structure reveals a minimum annual energy and a MDFQ requirement.



NG Transport Services
Your distribution partner.

Account Information

Invoice Number:	18-01-123987
Customer Name:	Fine Factories Inc.
Service Address:	123 Four Street
	Morgantown, WV 26505
Current Meter Reading:	124,544
Previous Meter Reading:	130,047
Meter Multiplier:	8
Usage:	44,024 MCF
Max Daily Firm Quantity:	445 MCF
MMBTU Factor:	1.1466
MKT Area:	08-29-65
Rate Schedule:	Large General

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Billing Summary

Billing Date:	02/03/2021	Amount Due:	$12,388.63
Due Date:	02/20/2021	After Due Date:	$12,636.41

Account Summary

Account Number:		AB789LG456-123
Previous Amount:		$13,448.96
Payment 03/12/2020:		-$13,448.96
Balance Forward:		$0.00
Days on Bill:	01/01/2021 – 01/31/2021	31
Meter Charge:		$375.00
LFG Transportation:	44,024 @ $0.1920/MCF	$8,452.61
Storage Balancing Fee – I:	1,608 @ $0.2630/MCF	$422.90
Storage Balancing Fee – 3:	1,608 @ $0.0270/MCF	$43.42
MDFQ – I:	445 @ $6.0520/MCF	$2,693.14
Sales Tax 3.35%:		$401.57
Current Charges:		$12,388.63
Amount Due:		**$12,388.63**

Figure 10: LDC NG invoice (part I).

The bill in Figure 10 is for January despite the billing date being February 3. Billing period sometimes does not align exactly with a calendar month and can be different from the billing period(s) from the NG supplier. If the supplier and transportation billing periods are different (shifted by a few days or there are a different number of days on the bills), you should consider calendarizing your bills to synchronize your data. Using the billing data from Figure 10, the following analysis recreates each transportation charge listed charge on the example bill.

Meter Charge

There is a monthly fixed charge for metering on the LDC invoice, which is $375 per month.

Transportation Charge

The transportation charge is billed based on the NG delivered to the facility during the billing period. The transportation charges are calculated as

$$Transportation\ Charge = Total\ Gas\ Transported \times Transportation\ Rate$$
$$= 44{,}024\ MCF \times \$0.192/MCF = \$8{,}452.61$$ ✓

Balancing Charges

The transportation bill also lists two types of balancing charges: a storage balancing fee and a base rate balancing fee. These charges are based on the amount of NG that ended up being stored by the LDC. The LDC company calculates this by keeping track of the previous month's stored volume, nominated MCF, delivered MCF, and ending balance every month. For January, the stored volume was 1,608 MCF.

$$Storage\ Balancing\ Fee - I = Storage\ Volume \times Storage\ Balancing\ Rate$$
$$= 1{,}608\ MCF \times \$0.263/\mathrm{MCF} = \$422.90$$ ✓

The base rate balancing fee is another balancing fee, which is calculated as,

$$Base\ Rate\ Balancing\ Fee - 3 = Storage\ Volume \times Base\ Balancing\ Rate$$
$$= 1{,}608\ MCF \times \$0.0270/\mathrm{MCF} = \$43.42$$ ✓

Demand Charge

The company has MDFQ demand negotiated at 445 MCF per day. Therefore, the minimum monthly demand charge is calculated as,

$$Billed\ Demand\ Charge = MDFQ \times Demand\ Rate$$
$$= 445\ MCF \times \$6.052/MCF = \$2{,}693.14$$ ✓

Taxes

The LDC company assesses a 3.35% tax on the total charges. Tax calculated is,

$$Bill\ Subtotal = Meter\ Charge + Transportation\ Charge + Balancing\ Fee - I + Balancing\ Fee - 3 + Demand\ Charges\ (\mathrm{MDFQ} - \mathrm{I})$$
$$= \$375\ + \$8{,}452.61\ + \$422.90 + \$43.42 + \$2{,}693.14 = \$11{,}987.07$$

$$Sales\ Tax = Usage\ Subtotal \times Sales\ Tax\ Rate$$
$$= \$11{,}987.09 \times 3.35\% = \$401.57$$ ✓

Final Transportation Bill

The final bill is the sum of the usage subtotal and the sales tax. This result matches the amount due listed on the bill in Figure 10. This reconstruction illustrates how knowing the rate structure for the transportation component of NG billing can make it much easier to understand and replicate the charges on your bill.

$$Amount\ Due = Bill\ Subtotal + Sales\ Tax = \$11{,}987.09 + \$401.57 = \$12{,}388.64$$ ✓

6.3 Supplier Bill

FFI's gas supplier invoice shown in Figure 11 has three main charges as discussed in Section 6.1. The fixed trigger charge is the only rate that has the same cost per MMBtu each month. The other two rates (baseload and balancing) depend on the NG market and rate structure mutually agreed upon by the supplier and FFI.

NG Supply Services
Your gas, our priority.

Account #:	304865-1		Service Address
Invoice #:	01-2018-304865-1		Fine Factories Inc.
Invoice Date:	02/04/2021		123 Four Street
Due Date:	02/25/2021		Morgantown, WV 26505

Date Range	Deal	P/S	Trader	Price Type	Meter	MMBtu	Price	Amt Due
01/01-01/31	5096807-A	S	Baseload	NYMEX HH	5001250	14,890	$4.330	$ 64,473.70
01/01-01/31	5096890-B	S	Balancing	GDD ColGas	5001250	13,290	$2.783	$ 36,986.07
01/01-01/31	5096807-A	S	Baseload	Fixed Trigger	5001250	22,300	$4.515	$ 100,684.50
				Total Gas Sales:		50,480	----	$ 202,144.27
				Tax:			3.35%	$ 6,771.83
				Current Charges:				$ 208,916.10
				Amount Due:				**$ 208,916.10**

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Figure 11: Gas supplier company NG invoice (part II).

Similar to the transportation bill analysis, the following analysis recreates all the charges on the bill. The supply cost analysis is more straightforward but is still useful in double checking the amount due and the agreed upon rate structure. Gas consumption above the pre-bought baseload appears as the balancing consumption on the bill. If FFI had pre-bought more gas than required, the excess will appear as a credit (i.e., negative balancing consumption) on the invoice and the gas supplier will buy it back at a lower price.

The total gas sales charge is calculated by multiplying the purchased gas (measured in MMBtu) by the rate for each charge category. The total gas cost is therefore calculated as,

$$\begin{aligned} Total\ Gas\ Cost &= Fixed\ Trigger\ Cost + NYMEX\ HH\ Cost + Balancing\ Cost \\ &= 22{,}300\ MMBtu \times \frac{\$4.515}{MMBtu} + 14{,}890\ MMBtu \times \frac{\$4.33}{MMBtu} + 13{,}290\ MMBtu \times \frac{\$2.783}{MMBtu} \\ &= \$100{,}684.50 + \$64{,}473.70 + \$39{,}986.07 = \$202{,}144.27 \end{aligned} \quad ✓$$

The bill also lists a 3.35% sales tax based on the total gas cost. The tax is calculated as,

$$\begin{aligned} Tax &= Total\ Gas\ Sales \times Sales\ Tax\ Rate \\ &= \$202{,}144.27 \times 3.35\% = \$6{,}771.83 \end{aligned} \quad ✓$$

Final Gas Supplier Bill

The final bill is the sum of the gas cost and the sales tax. This result matches the amount due listed on the bill in Figure 11.

$$Amount\ Due = Total\ Gas\ Cost + Sales\ Tax = \$202{,}144.27 + \$6{,}771.83 = \$208{,}916.10 \quad ✓$$

An important point about the two bills in Figures 10 and 11 is how the LDC charges per delivered volume of gas (i.e., per MCF) while the supplier bills on energy content (MMBtu). After unit conversions, the delivered MCF and bought NG in MMBtu are equivalent in this case. However, in other cases it is a possibility that the quantities do not match. If the LDC and supplier quantities vary significantly you can resolve the errors by talking to your utility companies. Companies that report usage in MCF also report the energy content as the BTU factor as discussed in Section 3.3. To check the equivalence in this example, multiply the total MCF by the BTU factor listed on the invoice to get energy delivered in MMBtu. FFI's remaining bills for 2020 are similar to the two example bills shown above. Summarized data for 2020 are given in Tables 5 and 6.

Table 5: FFI NG supplier bill data

Category	Unit	Jan. 20	Feb. 20	Mar. 20	Apr. 20	May 20	Jun. 20	Jul. 20	Aug. 20	Sept. 20	Oct. 20	Nov. 20	Dec. 20
Fixed	MMBtu	22,300	29,750	0	29,750	21,610	49,590	30,010	34,090	34,110	38,990	31,010	32,990
	$	100,684.50	134,321.25	108,482.00	134,321.25	97,569.15	200,393.19	121,270.41	137,757.69	137,838.51	157,558.59	125,311.41	133,312.59
NYMEX_HH	MMBtu	14,890	19,830	49,310	19,840	14,410	—	—	—	—	—	—	—
	$	64,473.70	85,863.90	104,044.10	85,907.20	62,395.30	—	—	—	—	—	—	—
Balancing	MMBtu	13,290	424	2,510	-10,500	5,010	-22,990	1,510	0	0	-7,501	-900	2,490
	$	36,986.07	898.88	4,958.51	-24,307.50	12,033.02	-56,187.56	4,592.97	0.00	0.00	-21,233.08	-2,782.71	7,875.37
Tax	$	6,771.83	7,406.32	7,285.73	6,563.35	5,761.92	4,830.89	4,216.42	4,614.88	4,617.59	4,566.90	4,104.71	4,729.80
Late fee	$	0.00	0.00	0.00	0.00	2,024.84	0.00	1,490.37	1,300.80	0.00	0.00	0.00	1,266.33
Total	MMBtu	50,480	50,004	51,820	39,090	41,030	26,600	31,520	34,090	34,110	31,489	30,110	35,480
	$	208,916.10	228,490.35	224,770.34	204,509.14	177,759.38	150,526.88	131,380.60	142,372.57	142,456.10	140,892.41	126,633.41	147,376.94

Table 6: FFI NG transportation bill data

Category	Unit	Jan. 20	Feb. 20	Mar. 20	Apr. 20	May 20	Jun. 20	Jul. 20	Aug. 20	Sept. 20	Oct. 20	Nov. 20	Dec. 20
BTU factor	MMBtu / MCF	1.14665	1.03758	1.13578	1.26097	1.14927	1.01029	1.04506	1.19171	1.09135	1.26391	1.02238	1.08681
Storage balance -1	MCF	1,608	0	210	9,322	4,869	465	867	137	226	1,038	114	0
	$	422.90	0.00	55.23	2,451.69	1,280.55	122.30	228.02	36.03	59.44	272.99	29.98	0.00
Base rate balance -3	MCF	1,608	0	210	9,322	4,869	465	867	137	226	1,038	114	0
	$	43.42	0.00	5.67	251.69	131.46	12.56	23.41	3.70	6.10	28.03	3.08	0.00
Transport	MCF	44,024	48,193	45,625	31,000	35,701	26,329	30,161	28,606	31,255	24,914	29,451	32,646
	$	8,452.61	9,253.06	8,760.00	5,952.00	6,854.59	5,055.17	5,790.91	5,492.35	6,000.96	4,783.49	5,654.59	6,268.03
MDFQ	MCF	445	445	445	445	445	445	445	445	445	445	445	445
	$	2,693.14	2,693.14	2,693.14	2,693.14	2,693.14	2,693.14	2,693.14	2,693.14	2,693.14	2,693.14	2,693.14	2,693.14
Meter charge	$	375	375	375	375	375	375	375	375	375	375	375	375
Tax	$	401.57	412.76	398.28	392.74	379.71	276.65	305.20	288.11	306.01	273.11	293.32	312.76
Total	$	12,388.63	12,733.96	12,287.32	12,116.26	11,714.46	8,534.81	9,415.68	8,888.33	9,440.65	8,425.76	9,049.11	9,648.93

6.4 Cost of Natural Gas

To calculate FFI's annual average cost of NG, we can use the data in Tables 5 and 6. The average cost will be the total cost paid to the gas supplier and the LDC for delivery in 2020 divided by the total annual gas usage. The total cost paid to gas supplier for calendar year 2020 is $2,019,809.05, and the cost paid to LDC is $124,643.90. This excludes late fees because they will not be a regular occurrence.

$$Average\ cost\ of\ Natural\ Gas = \frac{Total\ Gas\ Supply\ Cost + Total\ Gas\ Transportation\ Cost}{Total\ Gas\ Energy}$$
$$= \frac{\$2{,}019{,}809.05 + \$124{,}643.90}{455{,}823} = \$4.705/MMBtu$$

The calculation of marginal cost of NG is more complex than average cost. Because the NG purchasing contract changed after June, we will focus this analysis on the later part of the year. In June, the facility negotiated a fixed cost contract with the gas supplier for a higher amount of NG. Some balancing is needed each month, which adds cost to the fixed negotiated rate of the NG. The balancing load is variable and is highly dependent on the forecasting strategy of the facility and associated error. It is reasonable to assume that similar forecasting error will persist in the future. Also, because the balancing price depends on the market conditions, we can assume that the average of the balancing price paid will be similar in future. This means that on an annual basis, a newly negotiated contract price and the average of the balancing purchases will be a good representation of additional NG supply cost.

$$Marginal\ NG\ Supply\ Cost = \frac{Gas\ Cost_{Jun} + \cdots + Gas\ Cost_{Dec}}{MMBtu_{Jun} + \cdots + MMBtu_{Dec}} = \frac{\$977{,}388.58}{233{,}399} = \$4.188/\text{MMBtu}$$

On the transportation side, the MDFQ demand charge and meter charge are unavoidable charges, so they can be excluded from the marginal cost calculation. The storage balance fee and the base rate balance fee are charged on the volume drawn from the LDC gas storage facility. This volume varies each month and depends on forecasting error and how much extra gas went to or was removed from storage. Forecasting error is small and integral part of forecasting process. This error is expected to be proportional to the volume bought (i.e., the higher the bill, the higher error), so an average of monthly storage balance fees per consumed gas volume can yield marginal cost for the storage balancing fee. The transportation cost is charged based on gas consumption and directly varies with volume. The costs given in the rate structure are on MCF basis for the transportation. These can be converted to MMBtu basis by using average BTU factor (calculated from Jun – Dec as 1.10164). Finally, tax will also need to be considered to calculate the marginal NG transportation cost.

$$Marginal\ NG\ Transportation\ Cost = \frac{\$Avg\ Storage\ Bal. -1 + \$Avg\ Base\ Rate\ Bal. -3 + Transport\ Cost}{BTU\ Factor}$$

$$\$Avg\ Storage\ Bal. -1 = \frac{(\$\ Storage\ Bal._{Jun} + \cdots + \$\ Storage\ Bal._{Dec})}{MCF_{Jun} + \cdots + MCF_{Dec}} = \frac{\$748.76}{203{,}362\ MCF} = \$0.00368/MCF$$

$$\$Avg\ Base\ Rate\ Bal. -3 = \frac{(\$Base\ Rate\ Bal._{Jun} + \cdots + \$Base\ Rate\ Bal._{Dec})}{MCF_{Jun} + \cdots + MCF_{Dec}} = \frac{\$76.87}{203{,}362\ MCF} = \$0.00038/MCF$$

$$Marginal\ NG\ Transportation\ Cost = \frac{(\$0.00368 + \$0.00038 + \$0.192)/Mcf}{1.10164\ MMBtu/MCF} = \$0.178/MMBtu$$

The total marginal cost of NG is the sum of the marginal supply and transportation costs:

$$Marginal\ Cost\ of\ Natural\ Gas = Marginal\ NG\ Supply\ Cost + Marginal\ NG\ Transportation\ Cost$$
$$= \$4.188/MMBtu + \$0.178/MMBtu\ = \$4.366/MMBtu$$

6.5 Analysis of Selected Opportunities for Savings

Similar to the discussion in Section 5, this section looks to identify applicable cost savings opportunities for FFI. The following analysis uses the billing and consumption data presented in Tables 5 and 6.

Energy Tracking

Error! Reference source not found. Figure 12 **Error! Reference source not found.**shows monthly NG consumption in MMBtu, weather variables, and a breakdown of gas supply and transportation costs for FFI. Gas consumption and costs increase during the winter and then decrease considerably in the summer. After looking at this data, it seems worthwhile to investigate if the weather alone is driving this consumption. The consumption rises again at the end of summer. Then uncharacteristically, the consumption rises until September but dips in November even though it is colder than previous few months.

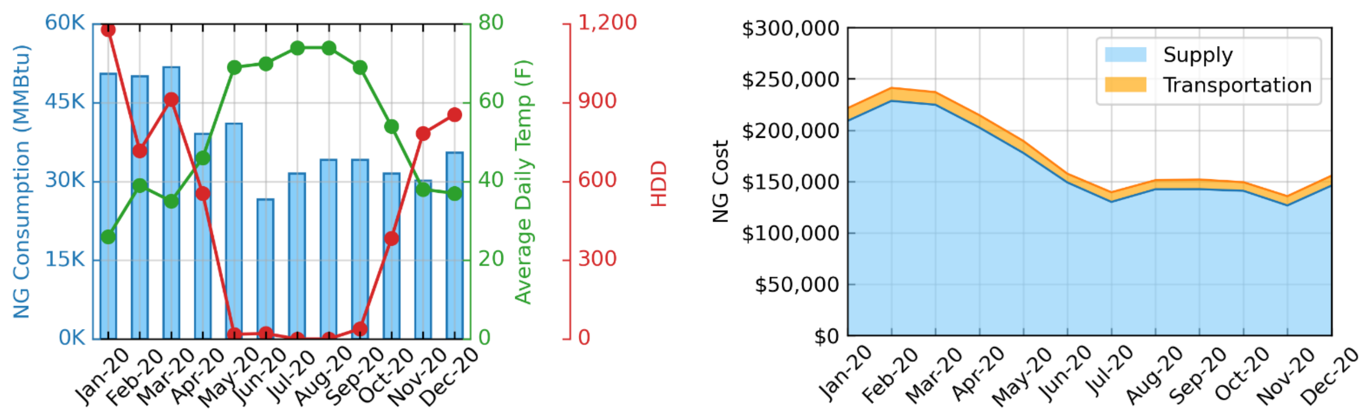

Figure 12: FFI's NG consumption compared with (left) average daily temperature and HDD (vertical axis color corresponds to series color) and (right) cost trends.

This can be further investigated by looking at the HDD data available from the NOAA or other weather services. The daily average temperature for each month and the HDD data with a 65°F base temperature was obtained for 2020 for the manufacturing plant location. These data are plotted along with NG consumption in Figure 12**Error! Reference source not found.**.

Initially, during the year as the temperature drops and HDD increase, the NG consumption is about the same with a slight increase in March. As the temperature increases and there was no longer a heating load due to weather, the NG consumption goes down, but there are fluctuations that seem unexplainable by weather alone. Typically, in a manufacturing plant, production levels are the biggest indicator of what the NG consumption would be for a given month, which seems to be the case here. Nevertheless, it may be a good exercise to further investigate how production relates to the NG consumption, which may lead to energy projects for the facility. There are certainly some cost saving opportunities on the bills, which are discussed below.

Sales Tax Exemption

The bill shown in Figure 11 shows a 3.35% state sales tax on the NG supply cost, which was also assessed for each month in 5. West Virginia allows manufacturers to claim a state sales tax exemption on purchases of tangible

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personal property and services that are directly used in manufacturing activities. After thorough energy use analysis, it was determined that FFI can claim sales tax on the supply cost of its NG and be refunded for up to 24 months of back taxes. Although the transportation costs are assessed the same 3.35% sales tax, transportation is not a tangible good and is therefore a non-exempt purchase. FFI can apply for and receive a state sales tax exemption on gas purchasing. The sales tax refund for 2020 for FFI would be,

$$Sales\ Tax\ Savings\ (2020) = Sales\ Tax_{Jan} + \cdots + Sales\ Tax_{Dec}$$
$$= \$65{,}470.35$$

Altogether, FFI stands to save more than $65,000 annually on their NG bills by claiming the tax exemption in the future. FFI can recover approximately $130,000 in back taxes (assuming similar NG expenditure) from the past two years. Many manufacturers overlook sales tax exemption on their utility bills. As this example demonstrates, refunds and exemptions can provide significant savings on your total NG expense. Work with your local utilities and billing department to assess if tax exemptions are available in your state for your facilities.

Avoiding Late Payment Fees

The data in 5 shows that FFI was assessed late payment fees in May, July, August, and December of 2020. Late payments are subject to a fee equal to 1% of the outstanding account balance. In all four cases, FFI mailed payment before the due date, but the payments were not received by the utility in time. Bills are received monthly and the balance that remains unpaid after the due date is subject to late payment fee. Working with its billing department and the utility, FFI updated its invoice payment procedures. By avoiding late payment fees, in 2020, FFI could have saved,

$$Late\ Fee\ Savings\ (2020) = Late\ Fee_{May} + Late\ Fee_{Jul} + Late\ Fee_{Aug} + Late\ Fee_{Dec}$$
$$= \$6{,}082.34$$

Although not assessed in 2020, FFI is also subject to a late payment fee on the transportation side. Paying bills on time not only helps FFI avoid late payment fees, but it also prevents supply and transportation interruptions.

Negotiating a Lower NG Rate Contract with a Utility Company

Under existing gas supply rate structure, FFI has the option to negotiate the NYMEX portion of its NG supply as a fixed pricing contract (baseload) anytime. As shown in Table 5, FFI switched to fixed pricing starting in June 2020 through the end of the year. FFI negotiated a fixed price as they had anticipated rising NG supply costs in the coming months. Before switching, the fixed cost was charged at $4.515/MMBtu and the remaining NYMEX portion was charged at $4.33/MMBtu. Since utility rates were trending upward, FFI decided to move all of its consumption into the fixed pricing portion. By renegotiating the fixed portion of their consumption, FFI lowered its fixed rate to $4.041/MMBtu for the remainder of the year.

Rate renegotiation is a cost saving opportunity that affects all of the NG consumption, so high savings are anticipated. From Table 5, FFI's average baseload consumption from January to May was 25,853 MMBtu. For savings estimates, this same average baseload consumption was used for the rest of the year. The remaining consumption that would have come from NYMEX_HH is estimated by subtracting the 25,853 (average baseload consumption) from the actual total consumption. For example, for June, the estimated NYMEX portion is 49,590 − 25,853 = 23,738 MMBtu. Balancing portion is not considered in the savings analysis because it is treated the same in both before and after scenarios. As shown in Table 7, FFI saved approximately $106,000 for the rest of the year by negotiating a favorable contract.

Table 7: Savings by switching from NYMEX to fixed pricing

Month CY2020	Category	Fixed	NYMEX_HH	Estimated cost	Actual cost	Savings
Jun	MMBtu	25,853	23,738	—	—	—
	$	$116,724.04	$102,783.38	$219,507.41	$200,393.19	$19,114.22
Jul	MMBtu	25,853	4,158	—	—	—
	$	$116,724.04	$18,001.98	$134,726.01	$121,270.41	$13,455.60
Aug	MMBtu	25,853	8,238	—	—	—
	$	$116,724.04	$35,668.38	$152,392.41	$137,757.69	$14,634.72
Sept	MMBtu	25,853	8,258	—	—	—
	$	$116,724.04	$35,754.98	$152,479.01	$137,838.51	$14,640.50
Oct	MMBtu	25,853	13,138	—	—	—
	$	$116,724.04	$56,885.38	$173,609.41	$157,558.59	$16,050.82
Nov	MMBtu	25,853	5,158	—	—	—
	$	$116,724.04	$22,331.98	$139,056.01	$125,311.41	$13,744.60
Dec	MMBtu	25,853	7,138	—	—	—
	$	$116,724.04	$30,905.38	$147,629.41	$133,312.59	$14,316.82
Total	**$**	**$817,068.26**	**$302,331.43**	**$1,119,399.69**	**$1,013,442.39**	**$105,957.30**

6.6 Summary

Altogether, the preliminary analysis of FFI's NG utility bill data in this section identified more than $175,000 in cost savings. Although most of these projects are purely cost-saving opportunities, the potential to identify NG consumption savings also exists. This analysis is directly applicable to other manufacturing facilities, although savings and opportunities might be different in your area. This, example illustrates how understanding and tracking your NG bills can help your company save energy and money. Please contact your TAM or the Better Plants Program if you have additional questions or would like help with analyzing your NG bills.

Appendix A: Selling Self-generated Gas

If you have facilities that produce excess anaerobically-generated biogas, you may have an opportunity to turn it into an additional revenue stream. Biogas produced by anaerobic digestion processes typically contains 45% to 65% methane depending on the type of waste source. This raw biogas can be converted into renewable natural gas (RNG) through advanced treatment and refinement that typically involves removal of moisture, siloxanes, sulfur, volatile organic compounds (VOCs), CO_2 as well as significant reduction of nitrogen and oxygen. Purified RNG has a methane content of 90% or higher and has the potential to be used as a drop-in substitute for fossil NG in many applications such as vehicle fuel, electricity generation, thermal use, and other industrial uses. Figure 13 illustrates production and delivery of RNG from anaerobic digestor.

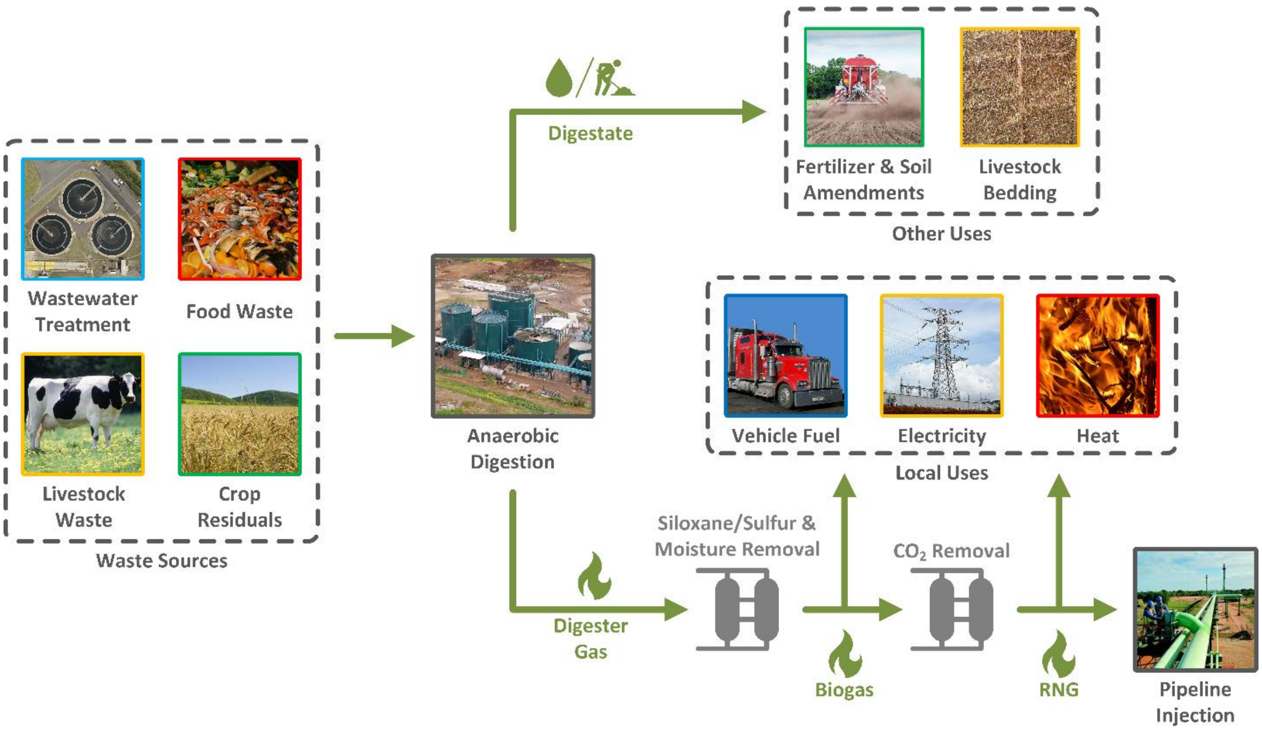

Figure 13: Production and delivery of biogas/renewable natural gas.

RNG can be used at the site or can be sold locally without needing complex infrastructure. Alternatively, it can also be sold to your local NG utility (pipeline injection). However, for injection into NG transmission and distribution pipelines, RNG must have a methane content of at least 96% to be accepted as pipeline quality gas. More details on these two options are discussed below.

Pipeline Injection

RNG injected into pipelines must meet specific requirements of the utility you are working with. As a producer you will usually be responsible for project development including producing, refining, and upgrading the gas to meet pipeline requirements. However, in some cases, third-party can be contracted for management of the operations. The LDC that owns and operates the pipeline system in your area will receive your RNG under a contractual agreement called as Gas Sales Agreement (GSA). The GSA will include multiple elements such as: project charges responsibility, delivery obligations, operation and maintenance requirements, gas measurement requirements, billing and payment terms. Pipeline injection projects can begin once the GSA is agreed upon and executed by both parties.

Pipeline injection projects can be expensive due to the complex infrastructure and processes required to deliver pipeline quality gas from your facility to the "point of receipt" of the receiving utility's pipeline extension. However, utility pipelines can distribute your RNG to a vast network and provides flexibility on how, when, and where the gas could be used. The Environmental Protection Agency (EPA) report[19] on RNG from Biogas provides key information on creation of RNG from biogas, main feedstocks and sources, operational projects, technologies used to upgrade biogas to RNG, and list of NG utility companies that accept RNG into their pipeline network.

Local Use

If you or other local users have gas demand for applications such as fueling fleet vehicles, generating electricity, or thermal use then utilizing self-generated biogas/RNG might be the most cost-effective option. Many onsite applications do not require fuel specifications to be as stringent as the requirement for RNG injected into NG pipelines and can use biogas or RNG of lower quality. In addition, using your self-generated gas onsite avoids the complication of building the infrastructure required for utility "interconnection" but reduces your need to purchase NG from your utility.

There are two main options for supplying excess RNG to a nearby facility. Depending on location, you may have the ability to build a dedicated pipeline that connects the two facilities. In this case, you would be responsible for project implementation, operation, and maintenance of the pipeline. If your facility is located far away from the receiving facility, then you also have the option of utilizing ground transportation. In this case, the RNG must be compressed for injection into a tube trailer truck and then decompressed at the point of use. Depending on your generation capacity and outside demand, you can employ more than one delivery option.

For Better Plant Program partners who need to track their energy usage, accounting for the use of RNG (or biogas) produced in the facility is possible in 3 ways – (a) treating the generated RNG/biogas energy as free energy (b) monitoring the energy content and volume of RNG/biogas stream, and (c) if the RNG/biogas is used to produce electricity – measuring the electrical generation and if possible, waste heat[20]. More details on accounting for RNG/biogas use can be found in *Energy Data Management Manual for the Wastewater Treatment Sector*.[20]

[19] US Environmental Protection Agency (EPA) - Landfill Methane Outreach Program (LMOP), *An Overview of Renewable Natural Gas from Biogas*, January 2021, p. 56 <https://www.epa.gov/sites/production/files/2021-02/documents/lmop_rng_document.pdf> [accessed 12 April 2021].

[20] US Dept of Energy (DOE) - EERE, *Energy Data Management Manual for the Wastewater Treatment Sector* (EERE Publication and Product Library, Washington, D.C. (United States), 1 December 2017) <https://doi.org/10.2172/1756504>.

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