Better Plants®
U.S. DEPARTMENT OF ENERGY

August 27th, 2025
Oak Ridge, TN

Week 4: Natural Gas Billing

Utility Bill Analysis

Virtual InPLT

Christopher Price, ORNL

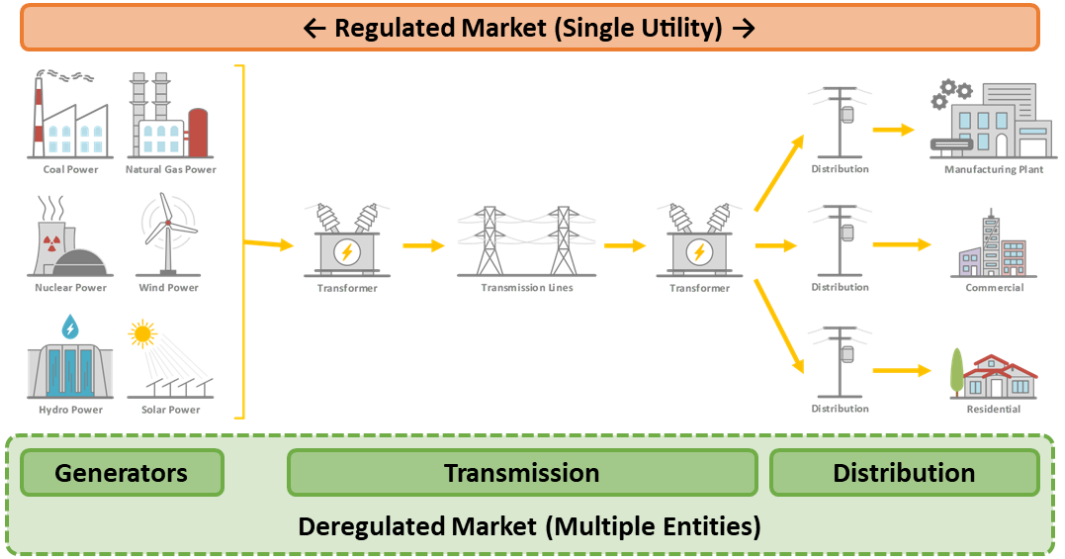
U.S. DEPARTMENT OF ENERGY

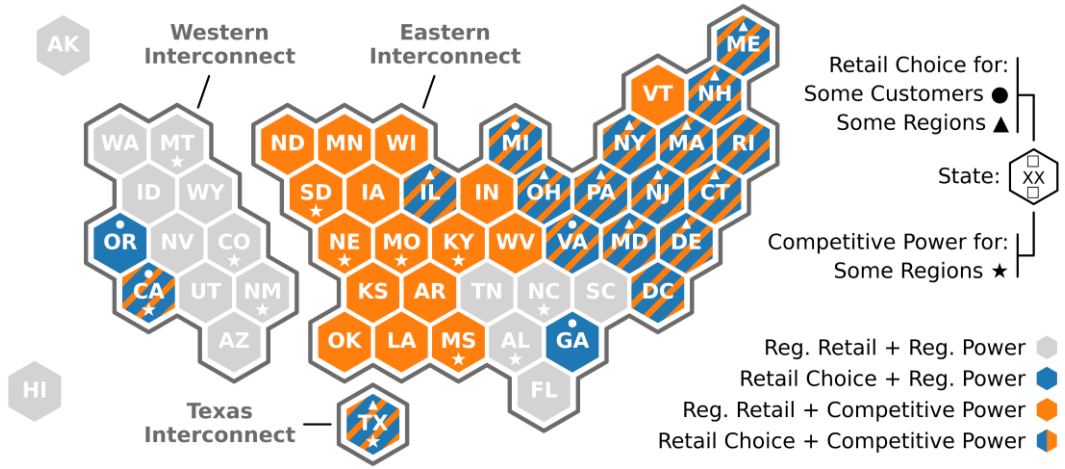
Weeks 1-3 Review:

Electricity rate tariffs, consumption, demand, power factor, interval data, billing, and VERIFI

Power Generation and Deregulation

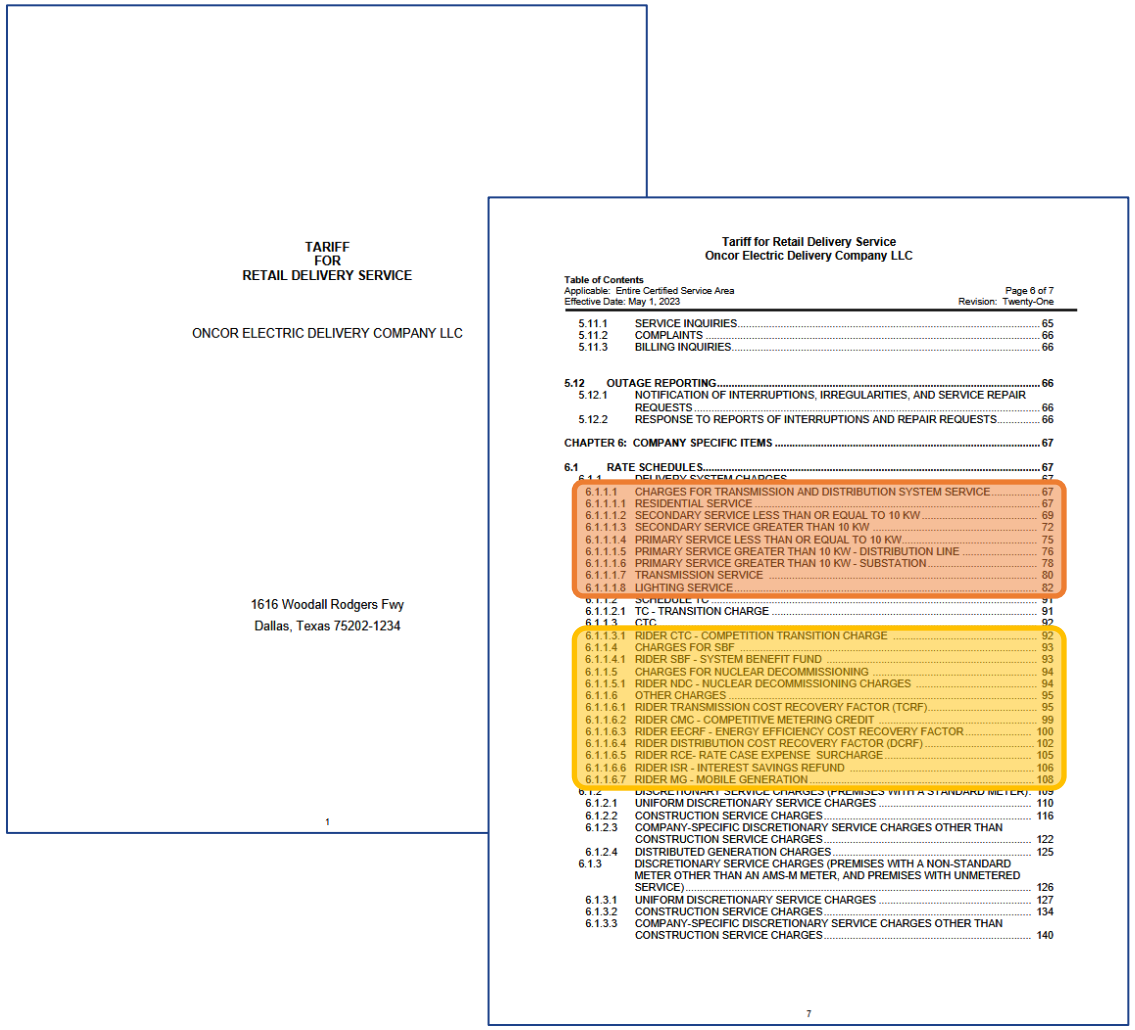
- Deregulation of electricity has happened in 15 states + DC
- Provides more choices for who provides your power
- Competition is designed to drive down prices but does come with some additional risk
- Can have separate bills for transmission, delivery, and generation of your power





What is a rate tariff?

- A rate tariff is your specific pricing structure that sets the terms of your utility contract
- You can usually find your rate tariff with an internet search or by asking your utility to provide it
- Rate tariffs are complicated legal documents, but you can work through them!
- Being on the right rate tariff is extremely important to avoid unnecessary energy charges



TARIFF
FOR
RETAIL DELIVERY SERVICE

ONCOR ELECTRIC DELIVERY COMPANY LLC

1616 Woodall Rodgers Fwy
Dallas, Texas 75202-1234

1

Tariff for Retail Delivery Service
Oncor Electric Delivery Company LLC

Table of Contents
Applicable: Entire Certified Service Area — Page 6 of 7
Effective Date: May 1, 2023 — Revision: Twenty-One

7

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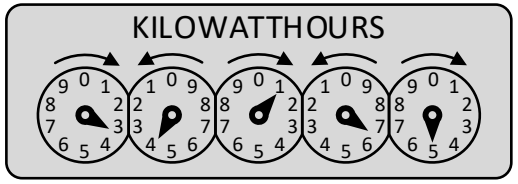
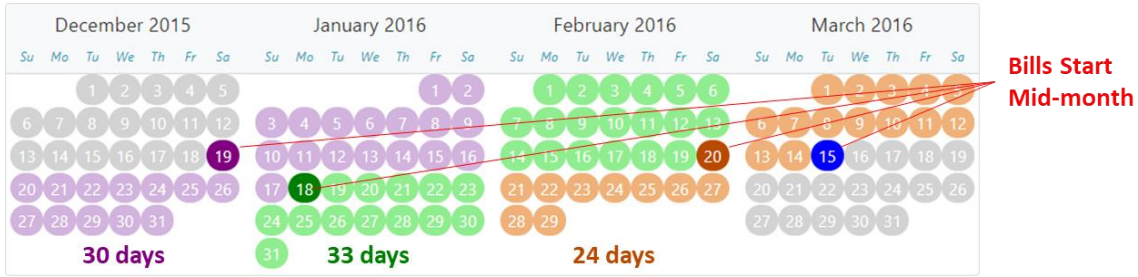
Electricity Consumption (kWh) Charges

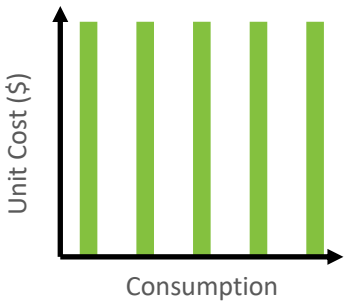
- Consumption (usage) is the total amount of electricity you use during a billing period
- Consumption is measured in kWh which is 1 kW of power sustained for 1 hour
- Consumption depends on your usage *and* your billing period
- Calendarization normalizes for inconsistent billing periods
- Your rate tariff sets the structure for your consumption charges



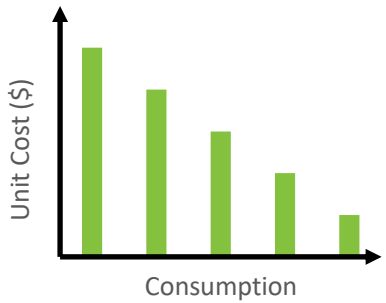
= 34,165 kWh



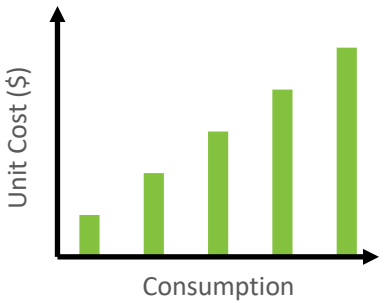
Uniform Rate



Decreasing Block Rate

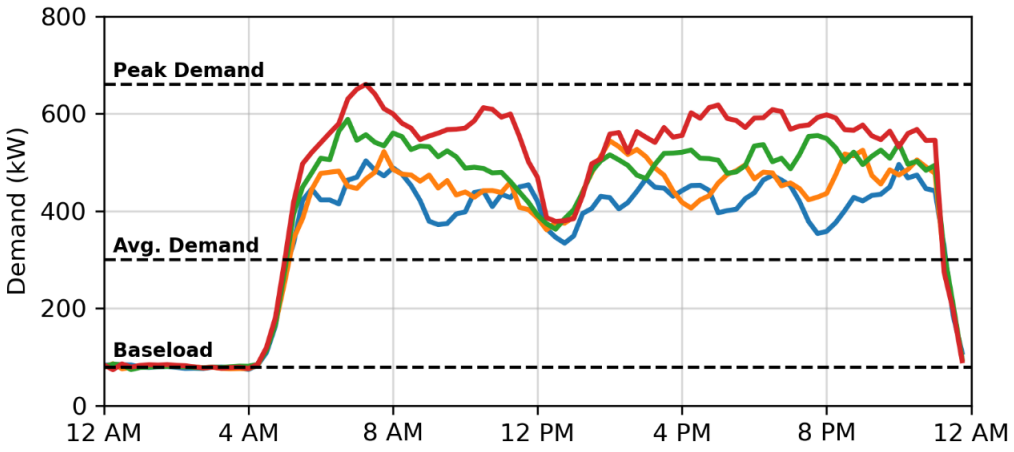


Increasing Block Rate



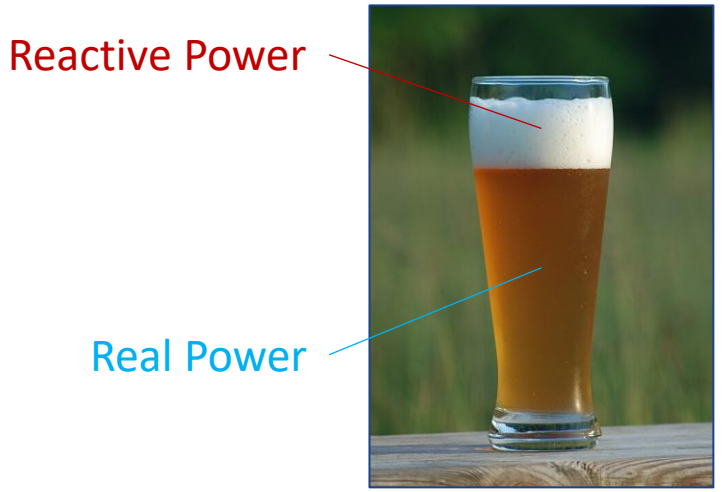
What is Electrical Demand?

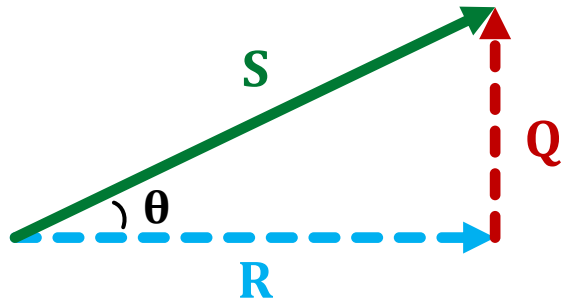
- Electrical demand is the average electricity used over a specified time window
- Measured in kW or kVA depending on your rate tariff
- Demand can be measured using block, lagged, or rolling intervals
- There are many kinds of demand including average, baseload, peak, and coincident peak
- Your utility bills based on your ***peak demand***!
- ***Billed demand*** is an adjustment to your peak demand



What is Power Factor?

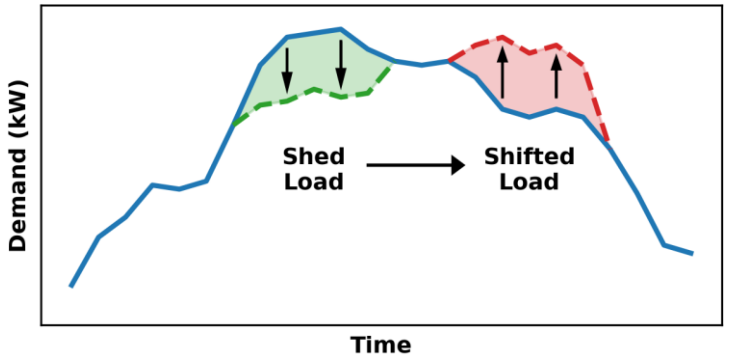
- PF is a number between 0.0 and 1.0
- Utilities penalize consumers for having low PF
- There are two types of power:
  1) Real Power (R) – Does actual work!
  2) Reactive Power (Q) – Does no work!
- Real and reactive power are related through the PF triangle
- Low PF means your utility must deliver extra Apparent Power (S)
- Can correct poor PF with capacitor banks

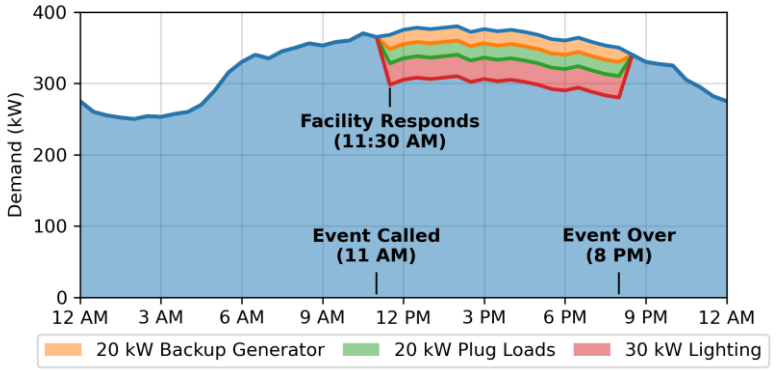




Basics of demand management

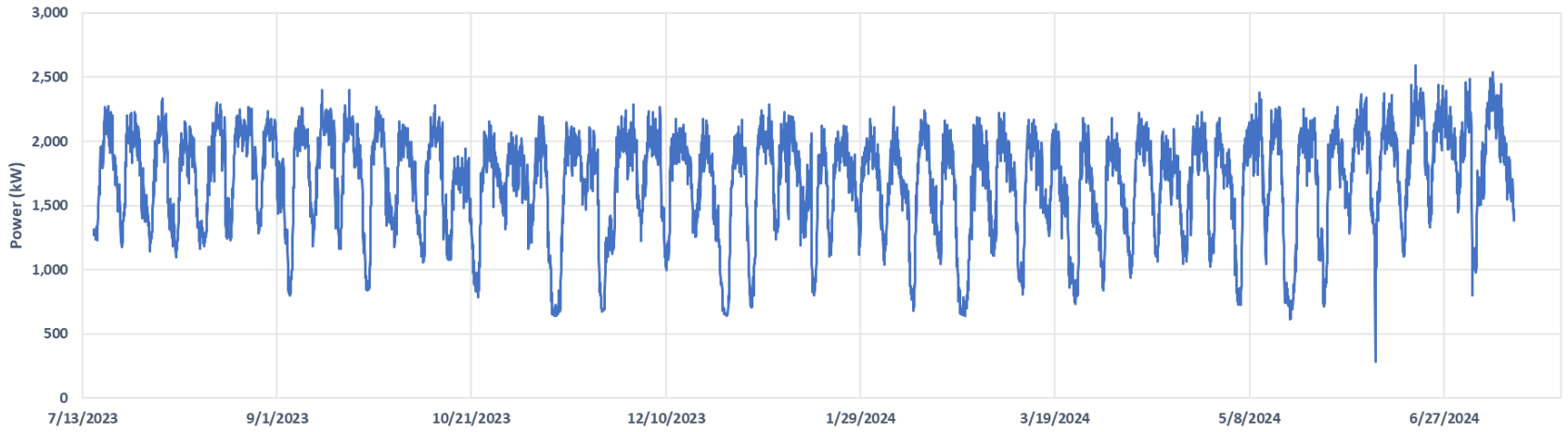
- There are two main demand management strategies
  1) Load Shedding
  2) Load Shifting
- Many utilities offer demand response programs to incentivize load shedding during high grid stress
- Often you can get paid for participating in a demand response program, even if you are not actually called on to shed load!





What is demand interval data?

- Digitally captured electrical load measurements
- Time increments more granular than bills (e.g., 15-minutes)
- Question to ask before analyzing interval data...
  - Do you need to aggregate meters?
  - How does your rate tariff set your demand interval?
  - Are the units the same as your bills?

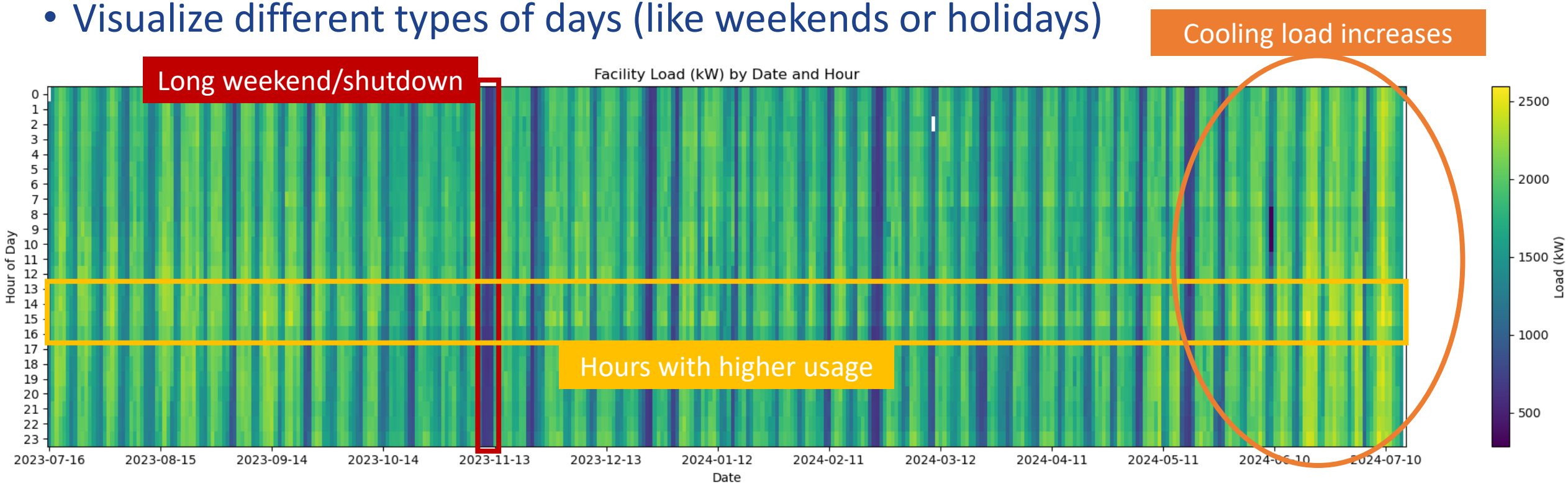


Analyzing demand data is all about visuals

Analysis: Display the whole year by color

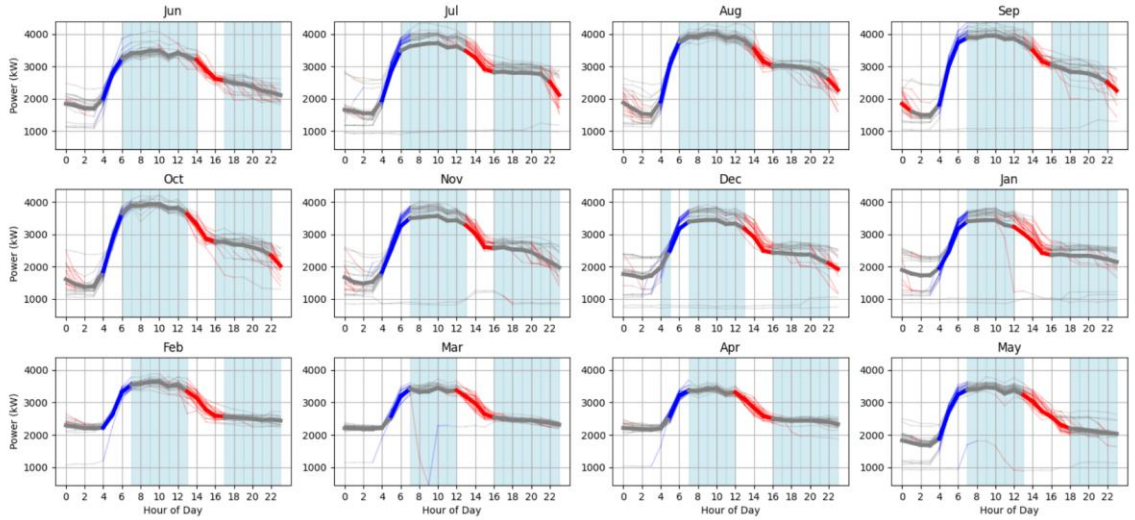
Actions to take:

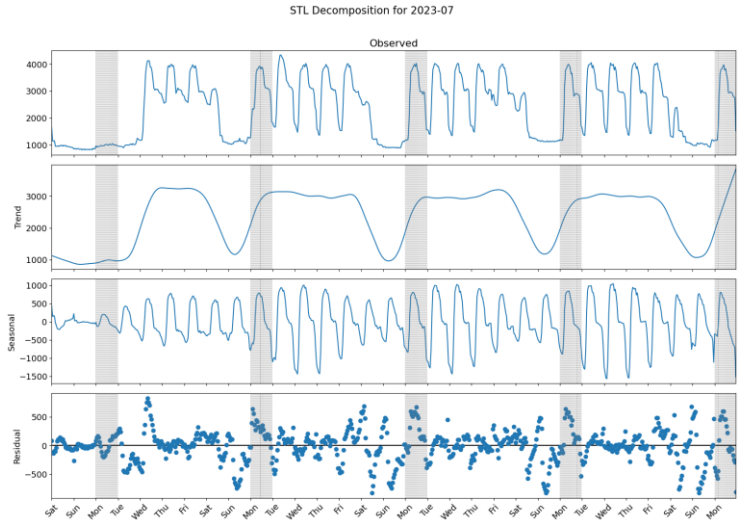
- Identify certain hours that have patterns
- Visualize different types of days (like weekends or holidays)



Key Takeaways from Interval Data Visualization

- Interval data cannot be properly used without informative visualizations
- Integrating interval data with production data can be useful when determining large energy consumers at a facility
- Successful data analysis will lead to informed observations and conversation on the production floor
- Large seasonal trends indicate needs to analyze cooling systems
- Verify the numbers on your bills. Utilities make mistakes





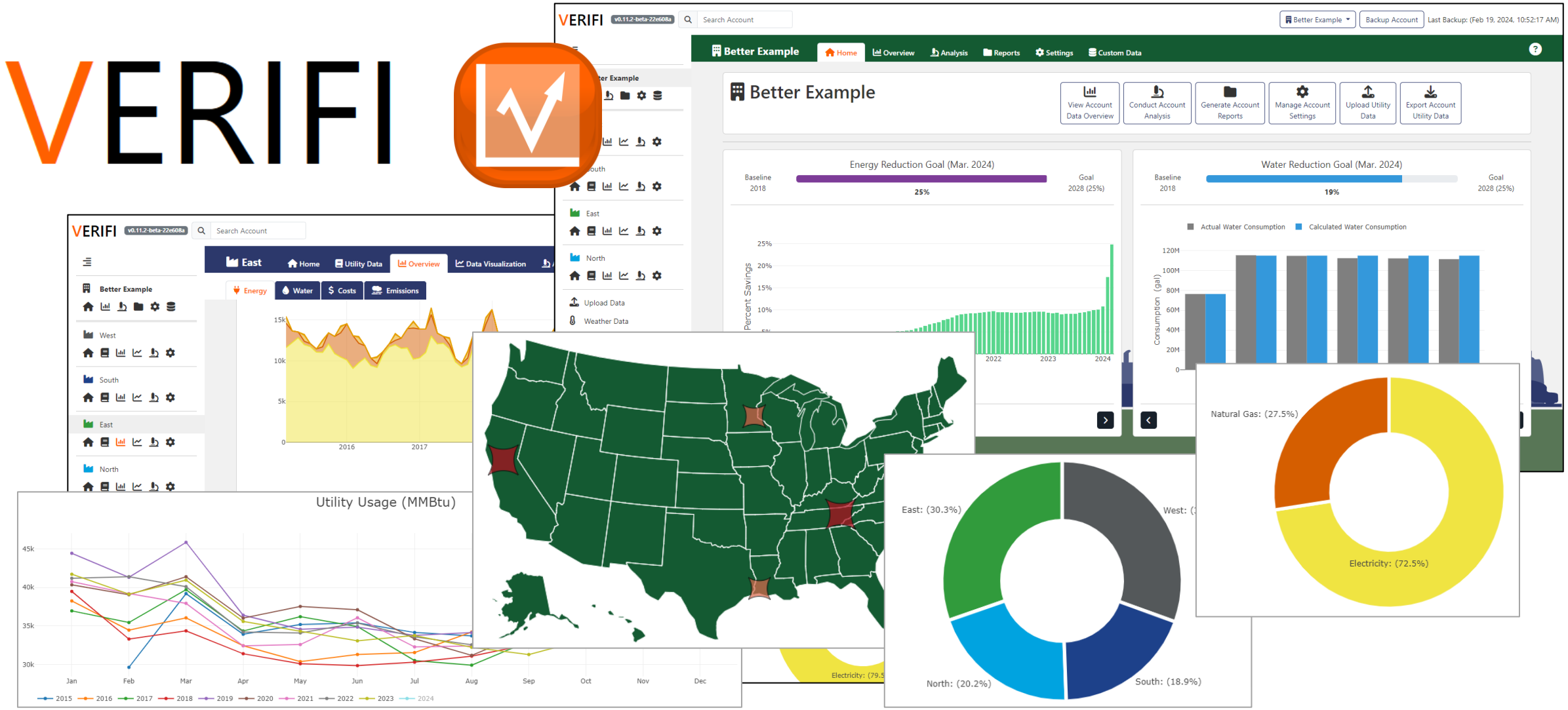
Cost of Electricity

- **Blended Cost** lumps consumption, demand, fixed, and other charges into a single $/kWh rate
  - Simple but cannot be used to estimate demand reduction opportunities

- **Marginal Cost** is the cost of purchasing or saving the next/last unit of electricity on your bills
  - Separate costs for consumption and demand
  - Requires a deeper knowledge of your rate structure
  - Need to be careful with block rates!

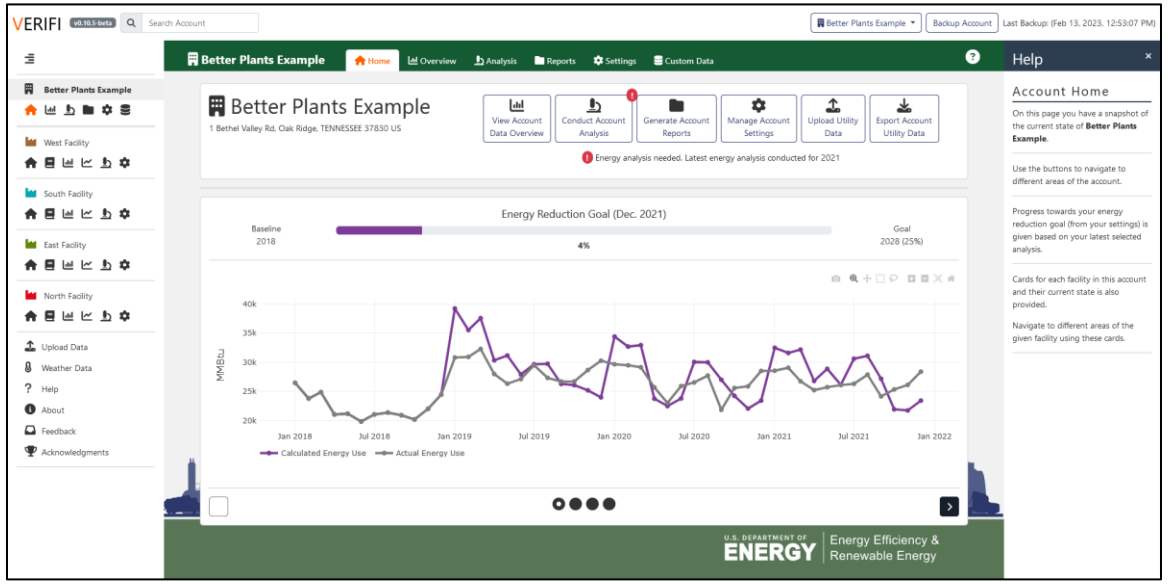
- Which cost to use will depends on the type of analysis or project!

VERIFI for Utility Bill Analysis



Opportunities for Electricity Cost and Energy Savings

- Demand Management
- Power Factor Correction
- Recreating Your Bills
- State Sales Tax Exemptions
- Avoiding Late Fees
- Tracking Energy Consumption
- Production/Load Factor Analysis

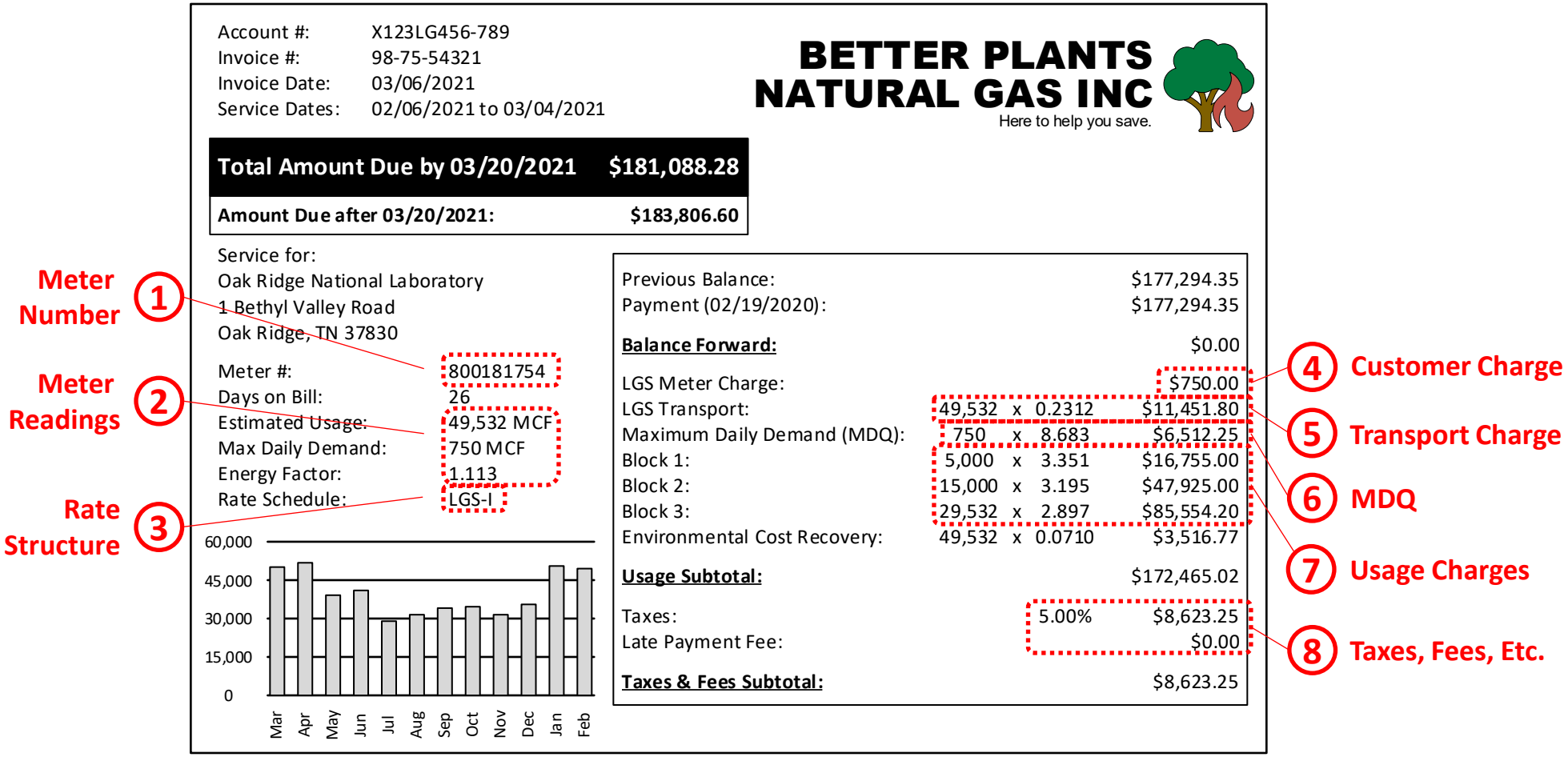


New VERIFI Tool can help track your utility usage!
Beta Testing Version now available to try!
https://verifi.ornl.gov

Utility Bill Analysis V-InPLT Agenda

- Week 1 – Markets, Tariffs, and Consumption
- Week 2 – Demand, Power Factor, and Load Factors
- Week 3 – Interval Data, Demand Management, and Costs
- **Week 4 – Natural Gas Bills Analysis**
- Week 5 – Water Bills Analysis
- Week 6 – Review and Partner Cast Studies

Key Components to your NG Bills



Week 3 Homework:

Common questions, demand management, initial findings

Week 3 Homework Questions

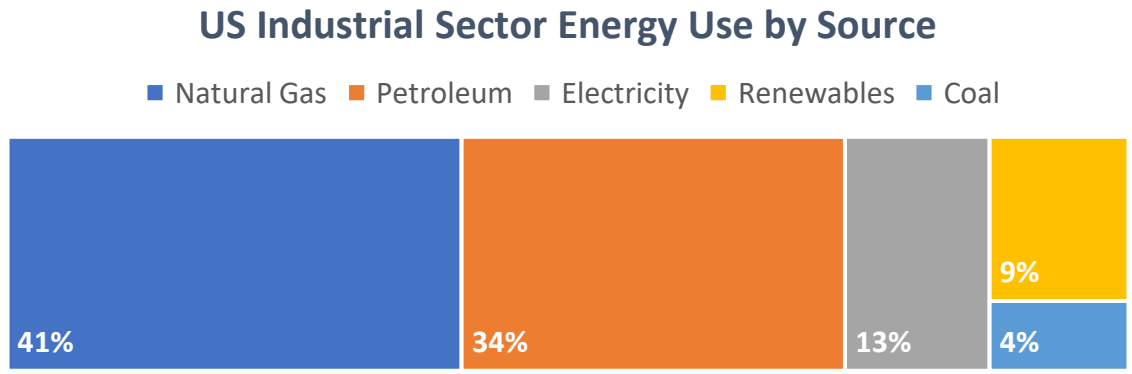
- Calculate your blended and marginal costs of electricity
- Do a VERIFI analysis on electricity data collected so far
- Analyze demand interval data for trends and opportunities

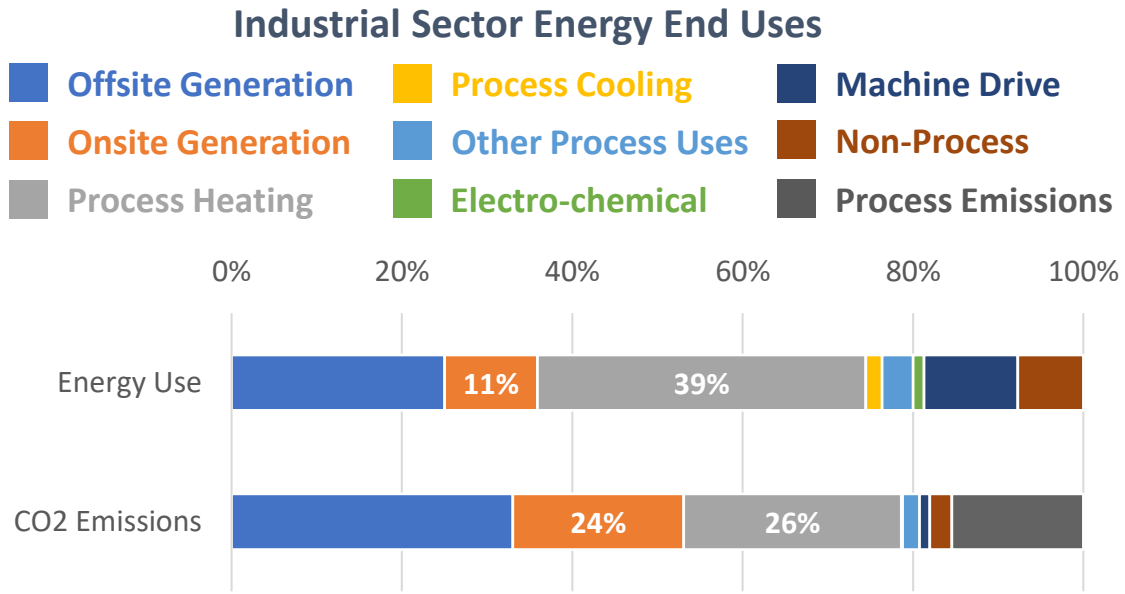
Natural Gas Production, Distribution, and Markets

Industrial Energy Use Profile

Natural Gas…

- Is the largest energy source for the US industrial sector
- Primarily used for process heating which is the single largest end use in the industrial sector
- Is also used for onsite energy generation (i.e., CHP) which also makes natural gas the largest source of emissions in the industrial sector
- The US industrial sector is projected to grow 30% by 2050





What is Natural Gas?

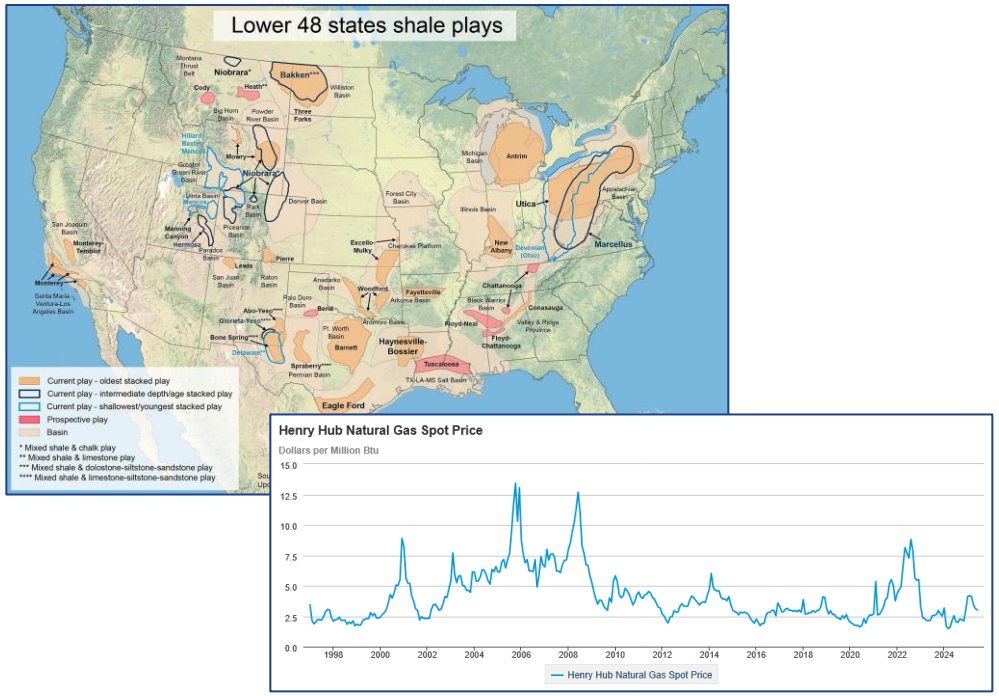
- Natural gas is a fossil fuel that contains many different products
  - Up to 90% methane (CH_4) but also contains small amounts of other hydrocarbons including ethane, propane, butane, and other gases
- Natural gas is a relatively clean-burning fossil fuel
  - Burning coal releases sulfur dioxide, carbon dioxide, nitrogen oxide, heavy metals, particulates, and ash
  - Natural gas releases lower amounts of all these pollutants

1 MMBtu Coal: 94.63 kg CO_2 + 11 g CH_4 × 28 + 1.6 g N_2O × 265 = 95.4 kg CO_2e

1 MMBtu NG: 53.06 kg CO_2 + 1.0 g CH_4 × 28 + 0.1 g N_2O × 265 = 56.1 kg CO_2e

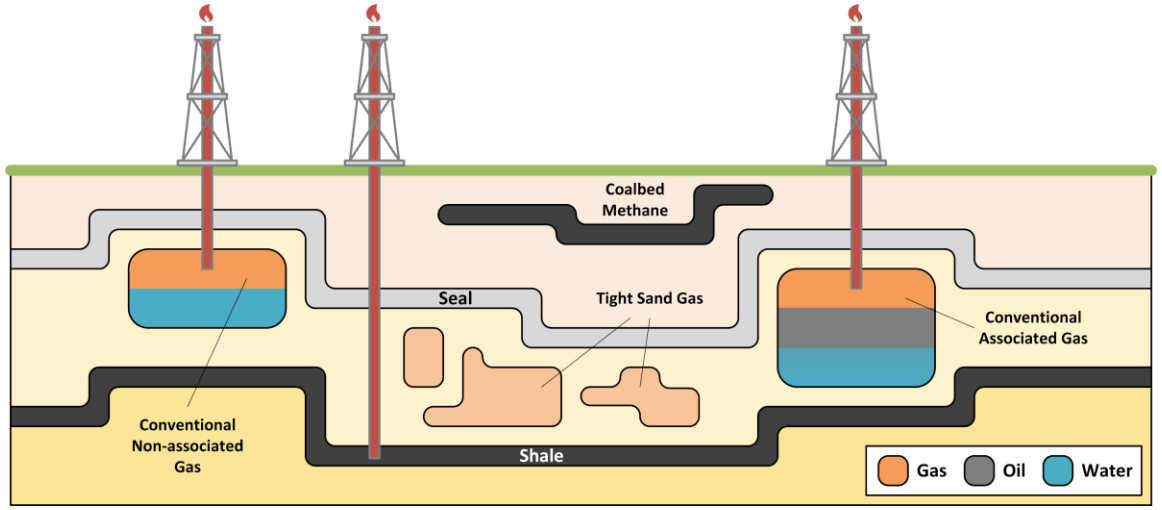
Why Natural Gas?

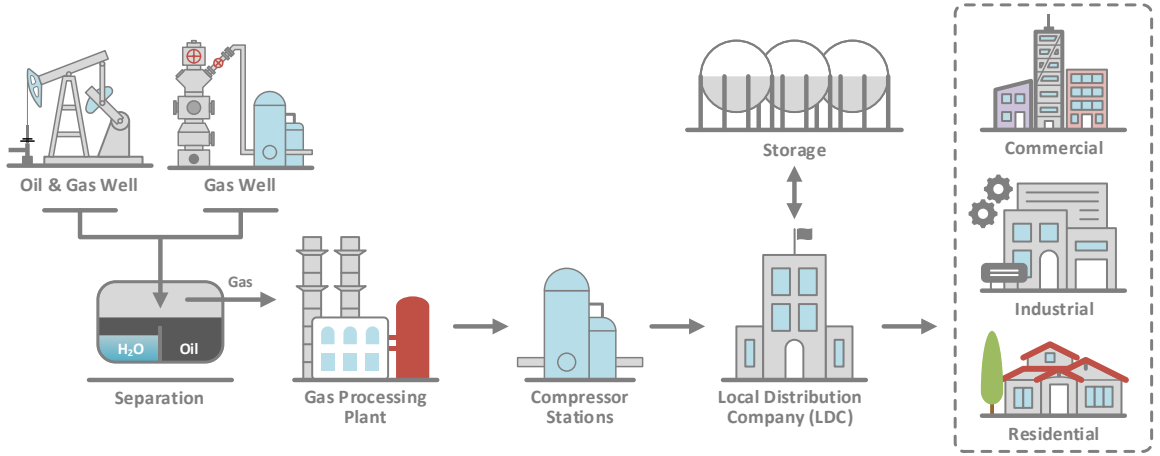
- Natural gas is widely available in the US
  - The US has the fourth largest proven reserve of natural gas in the world
  - At the current rate of production, the US has enough gas for 80+ years
- Natural gas is relatively energy dense
  - Wood: 8,850 Btu/lb
  - Coal: 12,425 Btu/lb
  - NG: 22,450 Btu/lb
- Natural gas has gotten cheaper
  - 2004: $5.89/MMBtu
  - 2014: $4.37/MMBtu
  - 2024: $2.19/MMBtu



Where Does Natural Gas Come From?

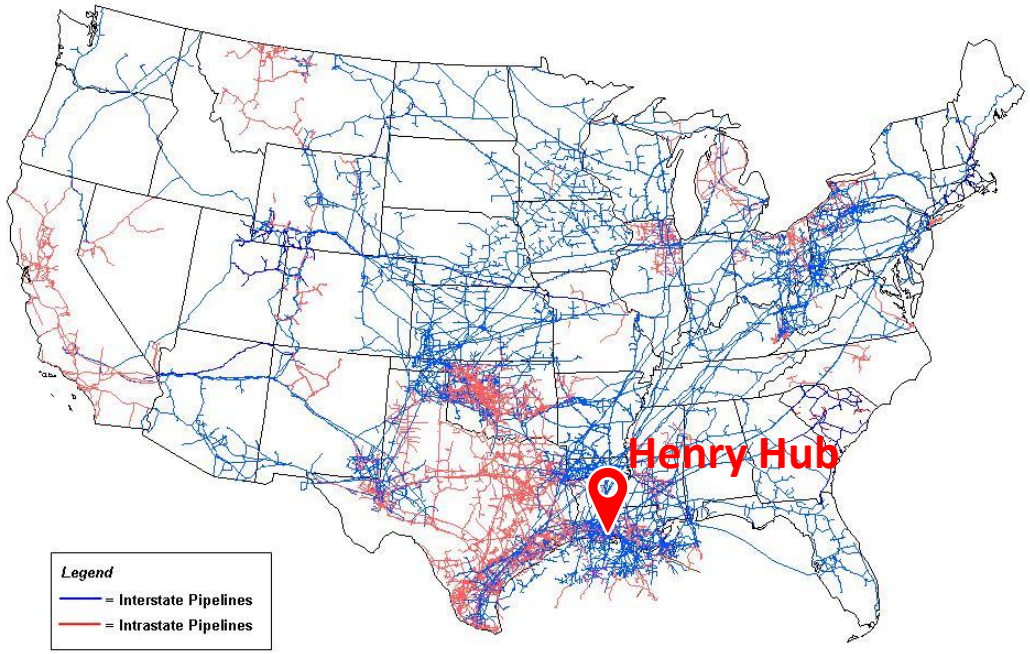
- Natural gas is formed from the anaerobic decay of dead plants and animals under high heat and pressure
- Once formed, natural gas tends to migrate through pores and fissures in sediment and rocks
- Conventional NG makes it to the surface while unconventional NG is trapped in shale and other rock
- Raw NG must be processed to remove water vapor and other compounds
- Processed NG is compressed and transported to customers through network of pipelines





How Does Natural Gas Get to Me?

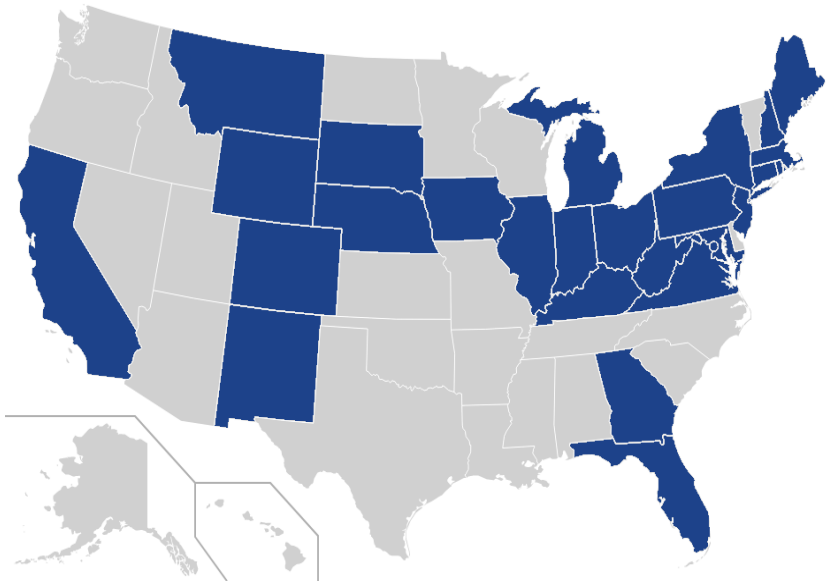
- The US has more than 3 million miles of pipeline
- **Hubs** are points in the pipeline network where many networks cross and transfers between networks can occur
  - Also serve as convenient locations for establishing the price of gas
  - The Henry Hub in Erath, LA is the most influential hub in the US
  - There are more than 20 major natural gas hubs in the US
- **Citygates** are points where local distribution companies receive gas from the pipeline
  - Typically located outside of major metropolitan centers
  - Another convenient location for establishing the price of natural gas



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System

What is Natural Gas Deregulation?

- In a **Regulated Gas Market**, a single utility manages all steps from purchasing through final delivery of your natural gas
- In a **Deregulated Gas Market**, prices are no longer set by a single utility which separates purchasing from gas delivery transactions
- Deregulation is meant to:
  - Equalize supply and demand
  - Lower energy costs through competition
- 1978 NG Policy Act and 1992 Federal Energy Regulatory Commission led to the deregulation of NG markets

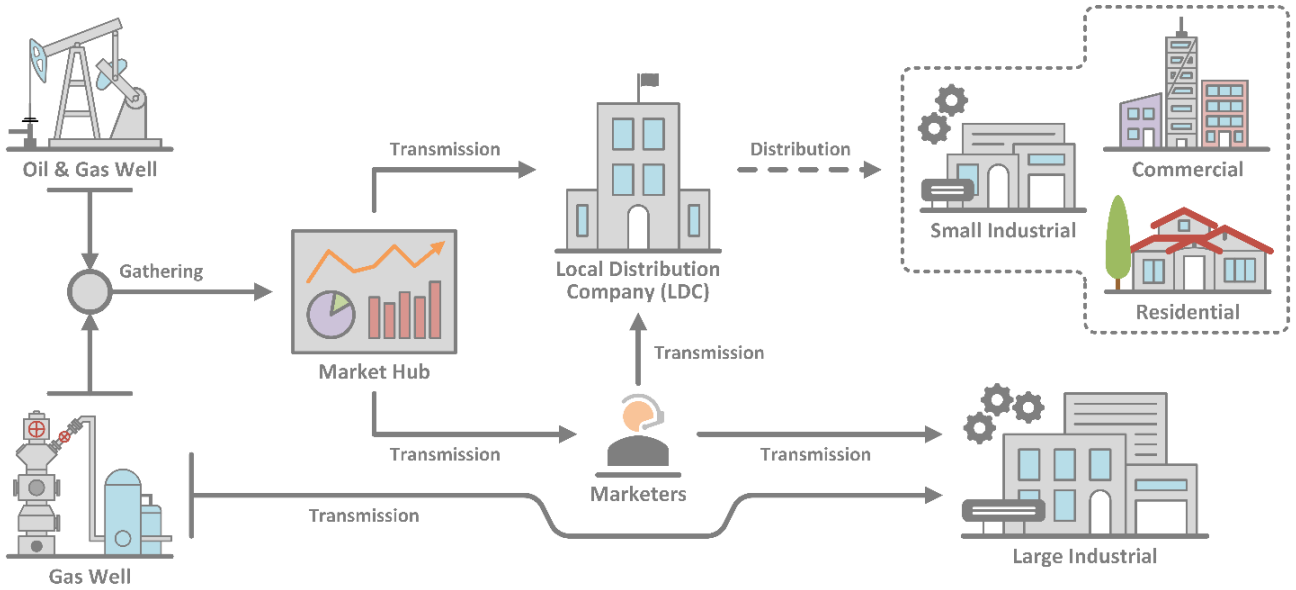


Source: electricchoice.com

Who Can I Buy Gas From?

Deregulation is complex but offers lots flexibility for buyers:

- Large gas customer can purchase gas directly from gas producers
- **Marketers** are third-parties who purchase gas and sell to consumers
- **Market Hubs** are central pricing points where NG is traded daily
- Consumers may receive multiple bills



Natural Gas Metering

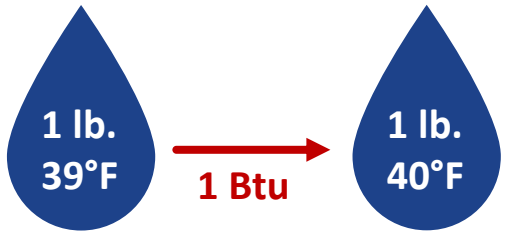
Natural Gas Consumption Charges

- Natural gas consumption or usage is the total amount of gas your facility uses in its operations
- Can be billed by volume or energy content of the gas
- Common units: CCF, MCF, M^3, therms, MMBtu, etc.
- Billed on a $/unit rate set by your tariff
- Can appear on multiple bills as gas cost, purchase cost, usage cost, commodity cost, etc.

https://commons.wikimedia.org/wiki/File:Gas_meter_2.jpg

Gas Bill Units Can Be Confusing!

- What is a Btu?



Definition:
Heat required to raise 1 lb of water by 1°F at its greatest density.

Example
Heat released by completely burning a wooden kitchen match

- Many utilities use **MMBtu** as their billing unit for heat content:

  1 MMBtu = 1,000,000 Btu

- Other utilities use **Therms** as their billing unit:

  1 MMBtu = 10 Therms

Utilities Can Also Bill By Volume

- Your meter measures gas usage by volume:
  - 1 CF = 1 Cubic Foot
  - 1 CCF = 100 Cubic Feet
  - 1 MCF = 1,000 Cubit Feet
- **BTU Factor** or **Energy Factor** is the heat value of the delivered gas
- BTU Factor will vary based on the gas mix and pressure in the pipeline

- Can usually find the BTU factor listed on your bills
- US Average is 1 MCF ≈ 1.038 MMBtu = 10.38 Therms

Natural Gas Meters

- A natural gas meter measures the total volume of gas that a facility uses during a billing cycle
- Gas meters are designed to measure gas volume under standard conditions of 0.25 psi and 60°F
- Meters are often installed downstream of pressure regulating devices
- The actual volume of natural gas delivered can, therefore, be estimated with Charles's Law:

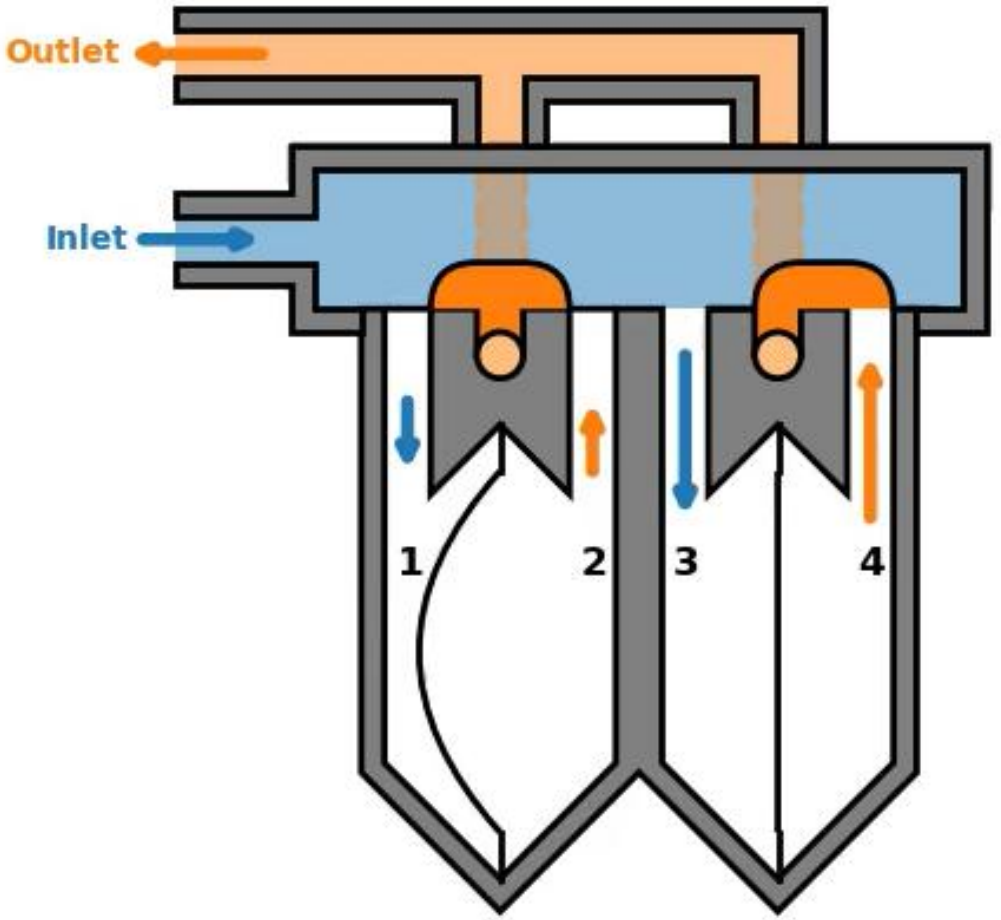
$$T_1/V_1 = T_2/V_2$$

- Meters can come with temperature compensating capabilities

https://commons.wikimedia.org/wiki/File:Seattle_-_gas_meters_for_floating_homes_on_Westlake_03.jpg

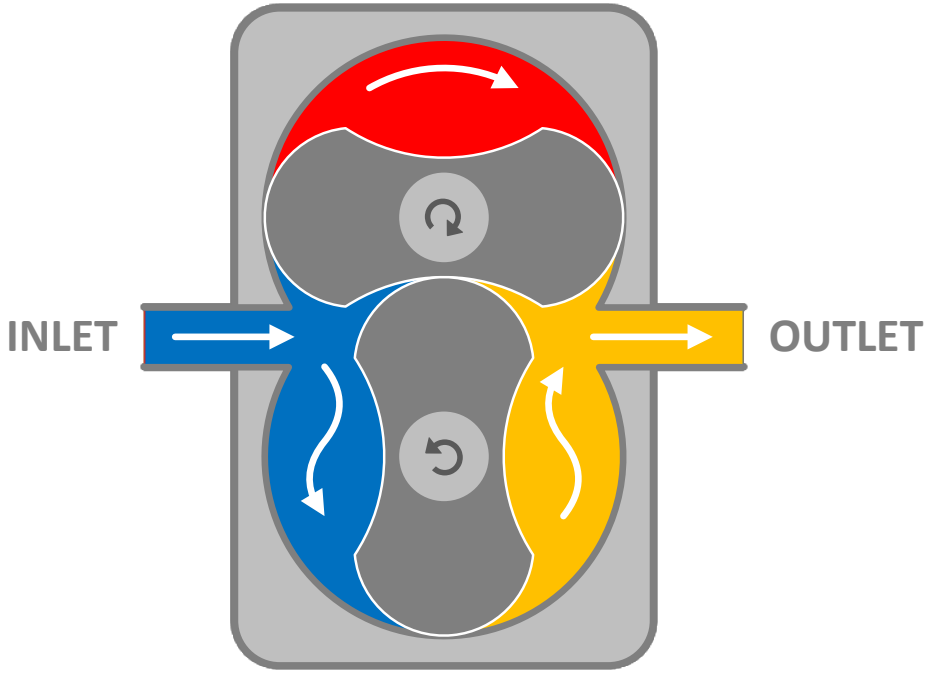
Diaphragm Meters

- A type of passive positive displacement meter
- Uses the pressure of natural gas to power the meter
- Divides flow into discrete volumes that can be counted by the meter
- Flexible walls between chambers move gas from the inlet to outlet
- The oscillations of the diaphragms spin the meter's register
- The diaphragm can suffer fatigue failure over time



Rotary meters

- Another common type of positive displacement meter
- Similar operating principal to a diaphragm meter
- Two gears move a fixed volume of gas from the inlet to the outlet of the meter with each rotation
- Rotation of the gears spins the meter register
- Convert volume to energy with the BTU factor



Corrections Are Common Feature of Gas Bills

- Gas bills are particularly susceptible to retroactive corrections
- The utility or seller can obtain a more accurate measurement of the heat content or volume of gas previously delivered
- Will update past usage and charges on later bills to account for the better information
- Can be credits or expenses on your current bill
- This can make gas bill particularly frustrating to deal with!

EXAMPLE:

August Bill (2025-07-28 to 2025-08-29)

Adjustment for Billing Period 2025-06-28 to 2025-07-27

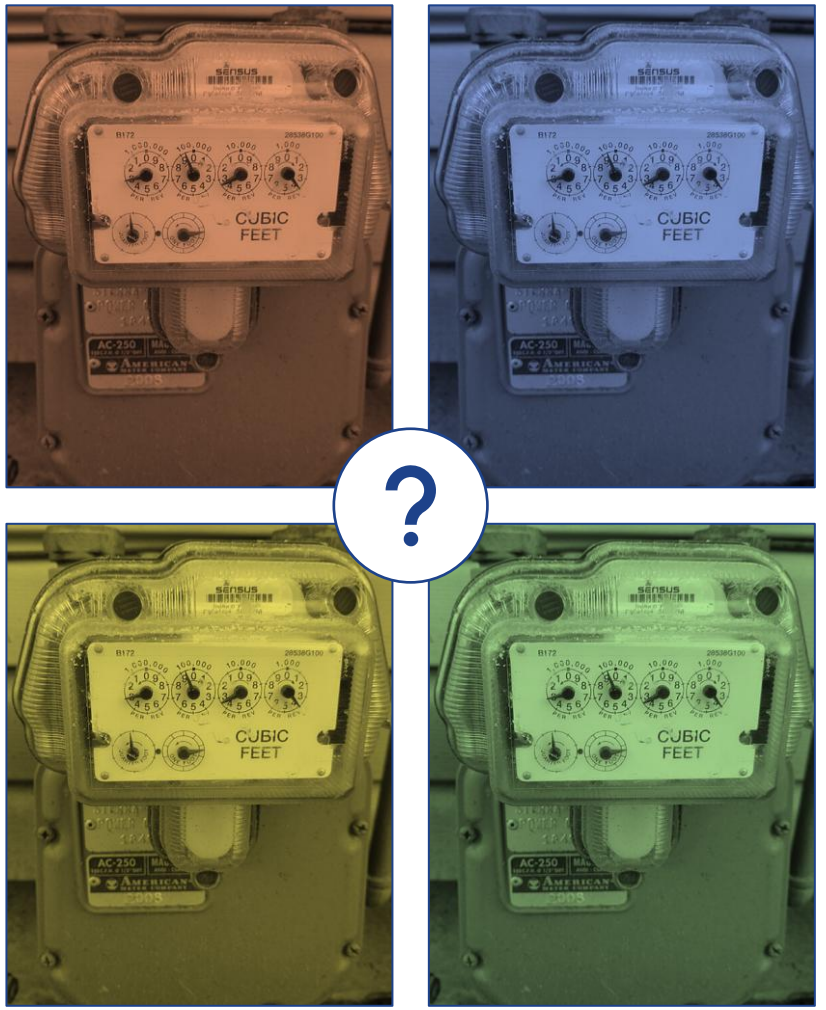
Usage:	34,820 Therms
Gas Cost:	-$417.84
Pipeline Fee:	-$104.46
Riders:	-$313.38
Taxes and Fees:	-$139.28

Adjustment for Billing Period 2025-05-29 to 2025-06-27

Usage:	31,870 Therms
Gas Cost:	$127.48
Pipeline Fee:	$31.87
Riders:	$95.61
Taxes and Fees:	$12.75

Which Meter Reading Do I Use?

- As discussed, deregulation means you can get upwards of three different bills for your natural gas
- Each bill will have its own meter reading, BTU Factor, billing period, etc.
- Each meter reading will have different conditions, meter types, gas mix, etc.
- Use meter reading from your LDC or utility as the “truth” because it will reflect the final gas delivery to your facility
- Purchased gas, pipeline distribution, and final delivery billing cycles may not align



https://commons.wikimedia.org/wiki/File:Gas_meter_2.jpg

How to Read a Gas Meter

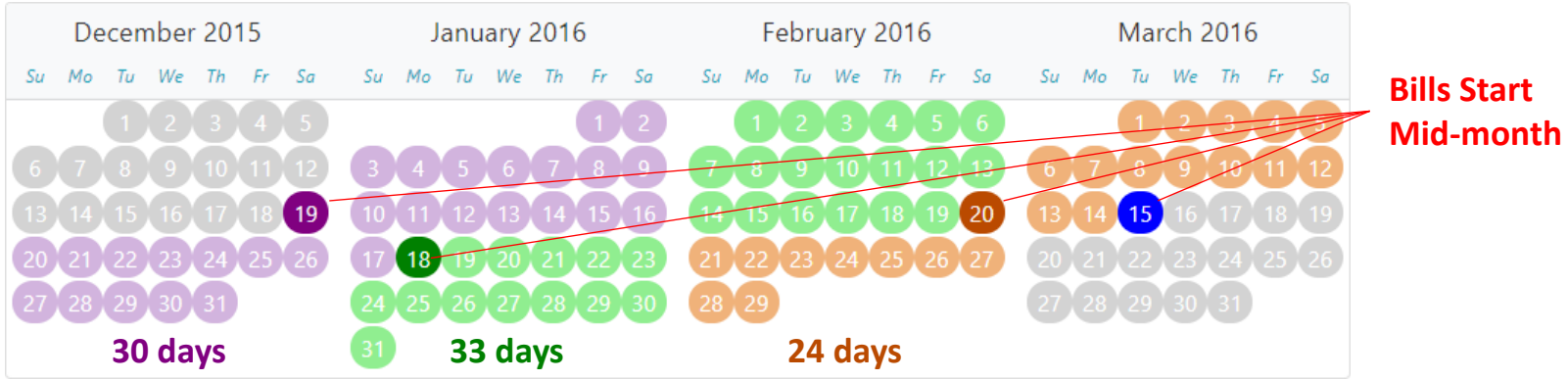
- Read analog dials from left to right:
  - If pointer is between numbers, choose lower number
  - If you're not sure, check the next dial on the right… is it greater than 0?
- Subtract previous from current reading to get usage

https://commons.wikimedia.org/wiki/File:Gas-Meter-1785.jpg

7 2 0 , 5 0 0 CCF

What is calendarization?

- Billing periods inherently depend on when the utility reads your gas meters each month



- Billing periods may be inconsistent and not align with production schedules or weather data
- ***Calendarization*** is the process of normalizing your water and other utility data for varying billing periods

How do you calendarize your data?

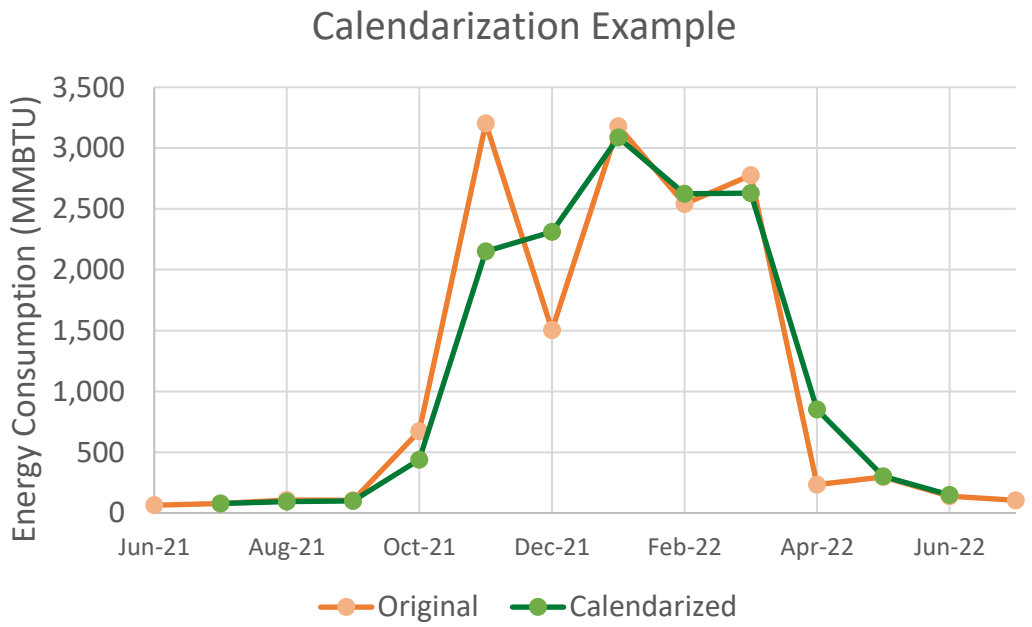
- Divide consumption by the number of days on the bill and allocate energy to the appropriate month.
- EXAMPLE: What is January's usage?

Read Date	Days on Bill	Usage (MMBTU)
1/11/2022	29	1,500
2/6/2022	26	3,250

$$11 \times \frac{1{,}500\ MMBTU}{29} = 570\ MMBTU$$

$$20 \times \frac{3{,}250\ MMBTU}{26} = 2{,}500\ MMBTU$$

January 2022 Usage = 3,070 MMBTU



Natural Gas Interval Data

Your Guest Presenter!

Dr. Miles Nevills
Postdoctoral Research Associate
Oak Ridge National Laboratory

PhD from Tennessee Tech University
BS from Tennessee Tech University

OAK RIDGE National Laboratory

Miles Nevills is a postdoctoral research associate and Technical Account Manager supporting the Better Plants program at Oak Ridge National Laboratory (ORNL). Previously during graduate studies, he worked with the Tennessee Technological University Industrial Assessment Center (TTU-IAC) on 40 energy audits of small to medium-sized manufacturers. Between 2020 - 2024, he assisted in the reduction of industrial energy usage by an implemented ~20,900,000 kWh/yr. Miles obtained his PhD in Mechanical Engineering and BS degree in Mechanical Engineering from Tennessee Technological University.

Natural Gas Interval Data – What is it?

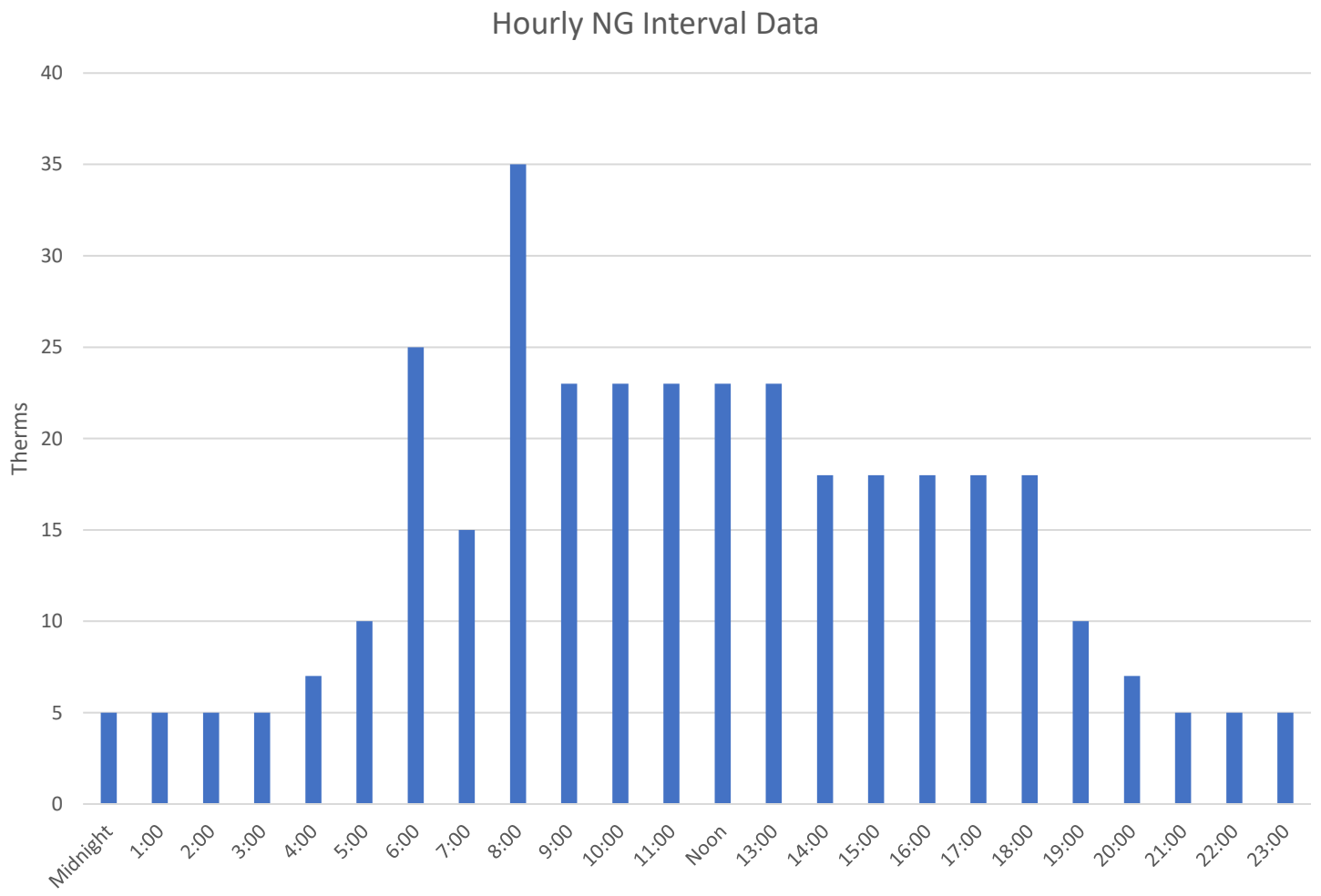
- Like electrical interval data, it's possible to collect natural gas consumption at 15-minute, 30-minute, or hourly intervals.

Why collect it?

- Interval data enables decision making based on the energy time-of-use
- This is more common in residential settings via home smart-meters
- This capability is also applicable in manufacturing industries

How would we use it?

- If we have appropriate equipment time-of-use, there's potential to inventory and characterize natural gas uses
- Though not as ideal as submetering, it can grant insight into individual processes



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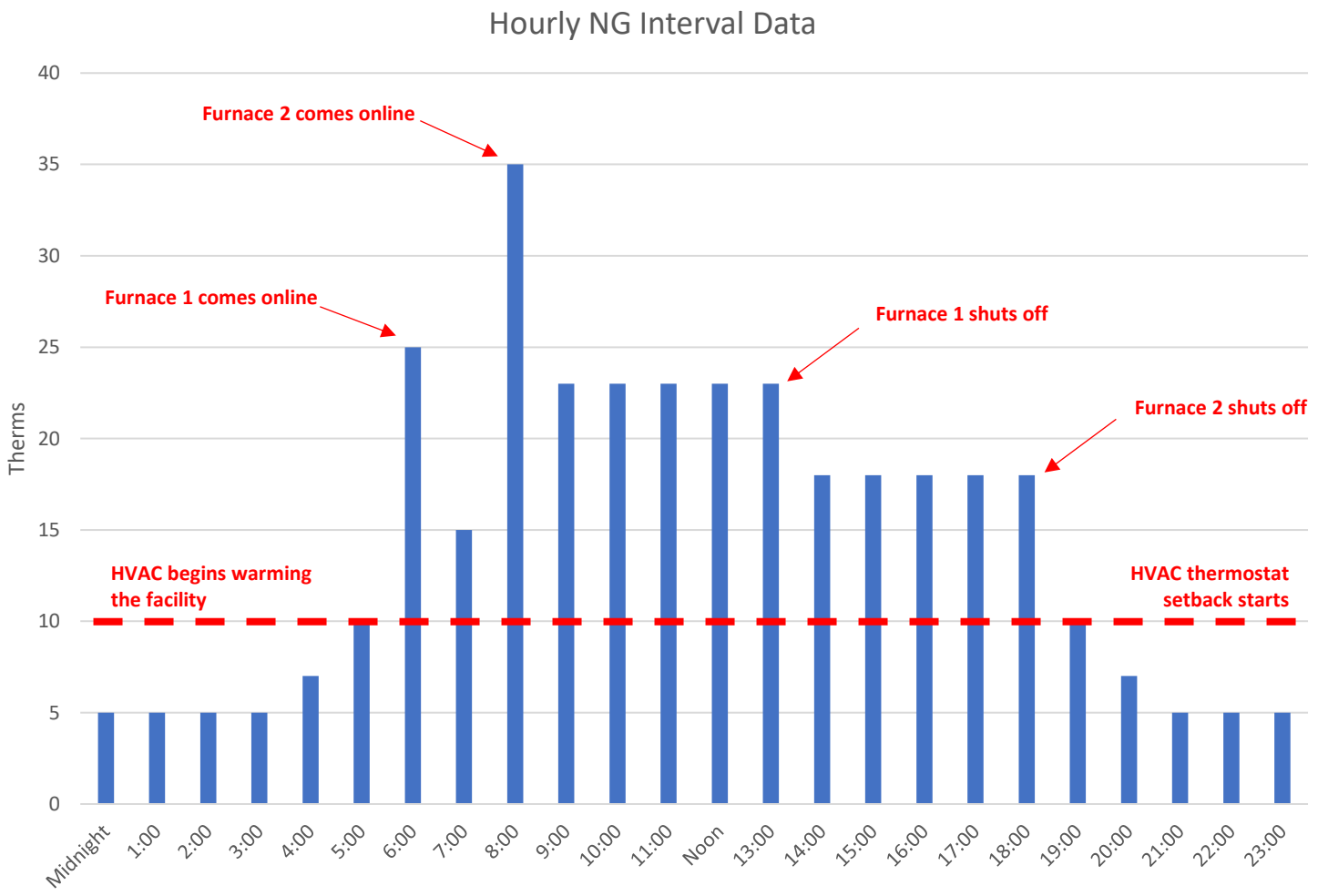
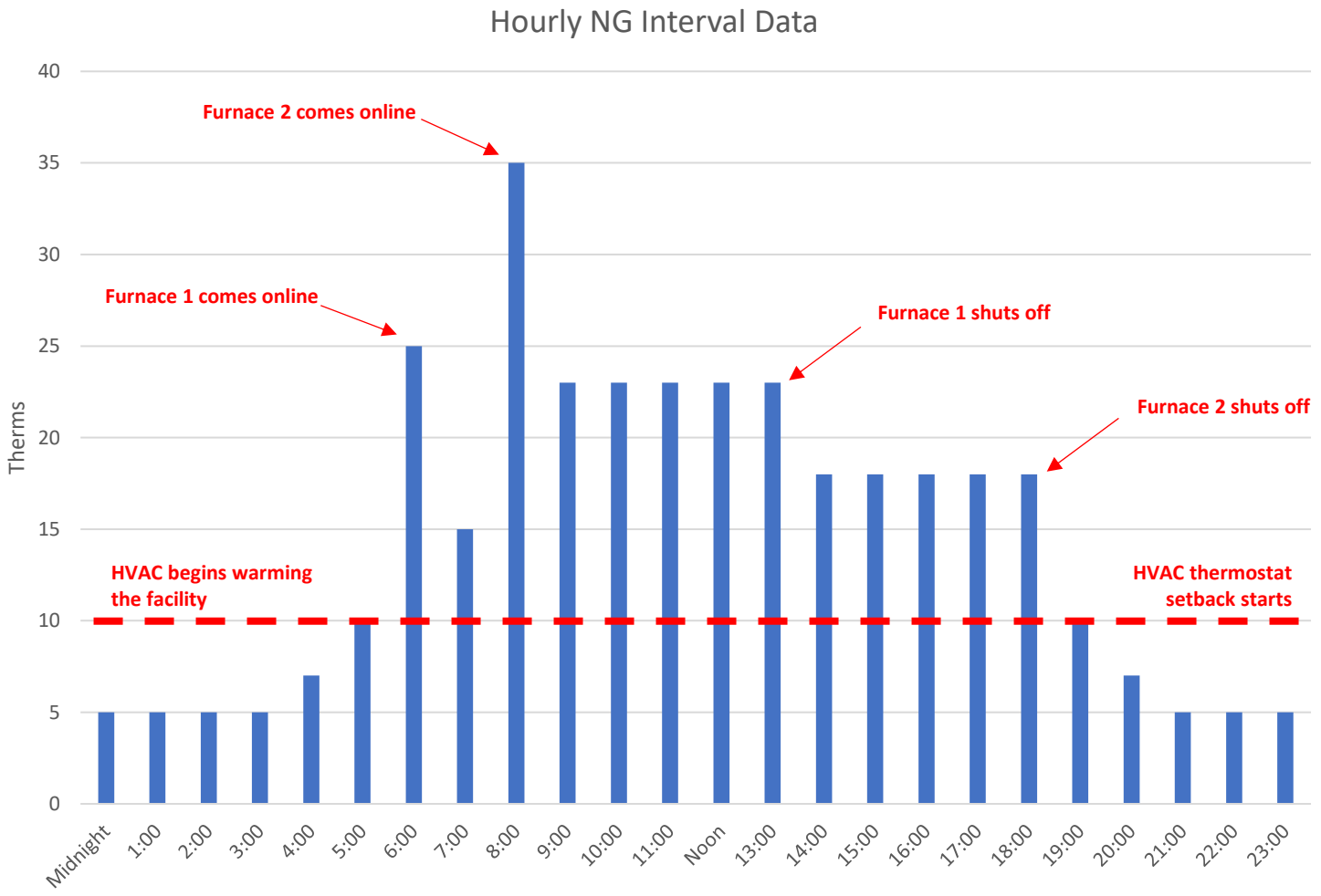


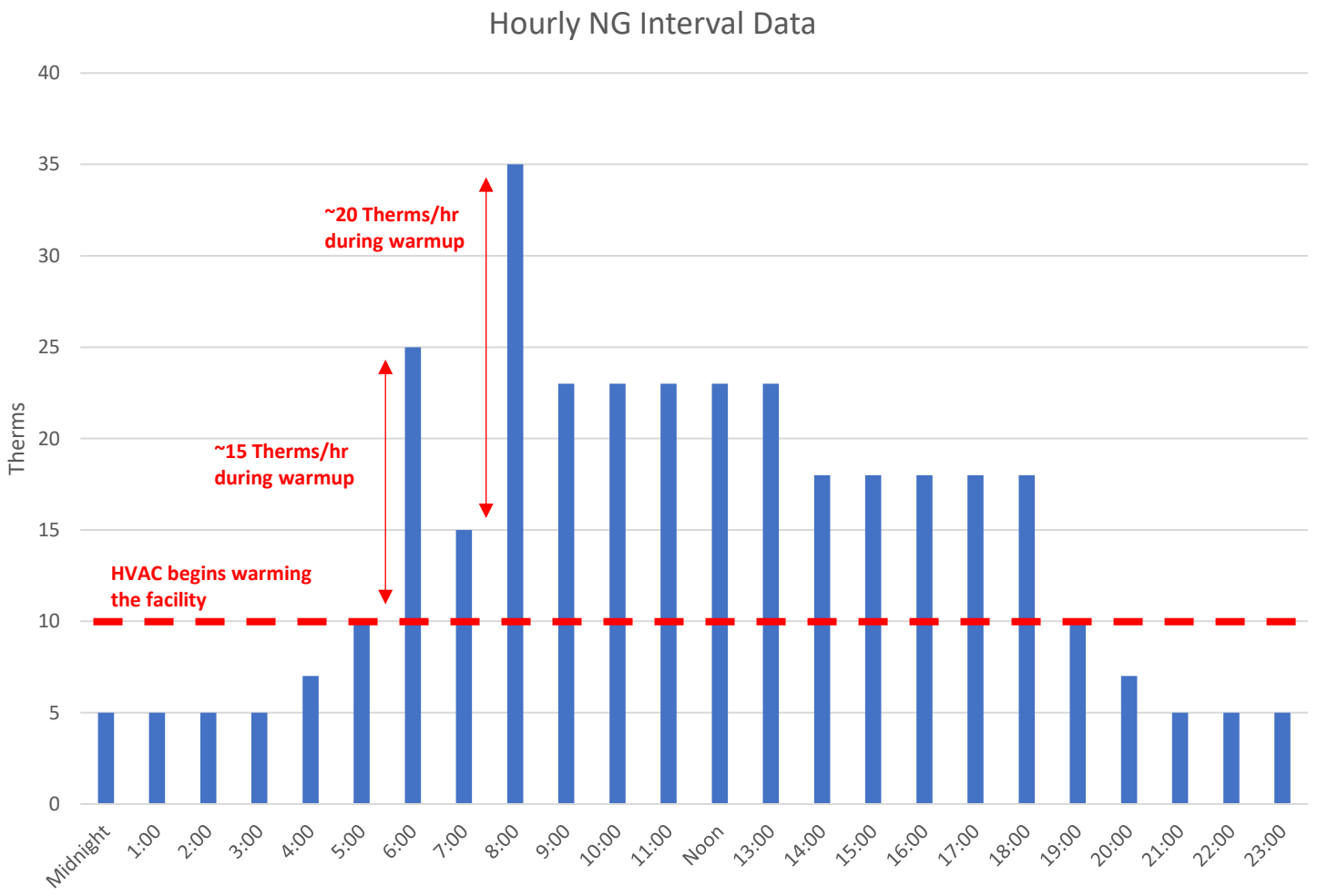
How would we use it?

- Here we've got an example plant running two furnaces to anneal some parts in batch processes.
- The furnace uses a great deal of fuel to reach setpoint and then drops to steady state.



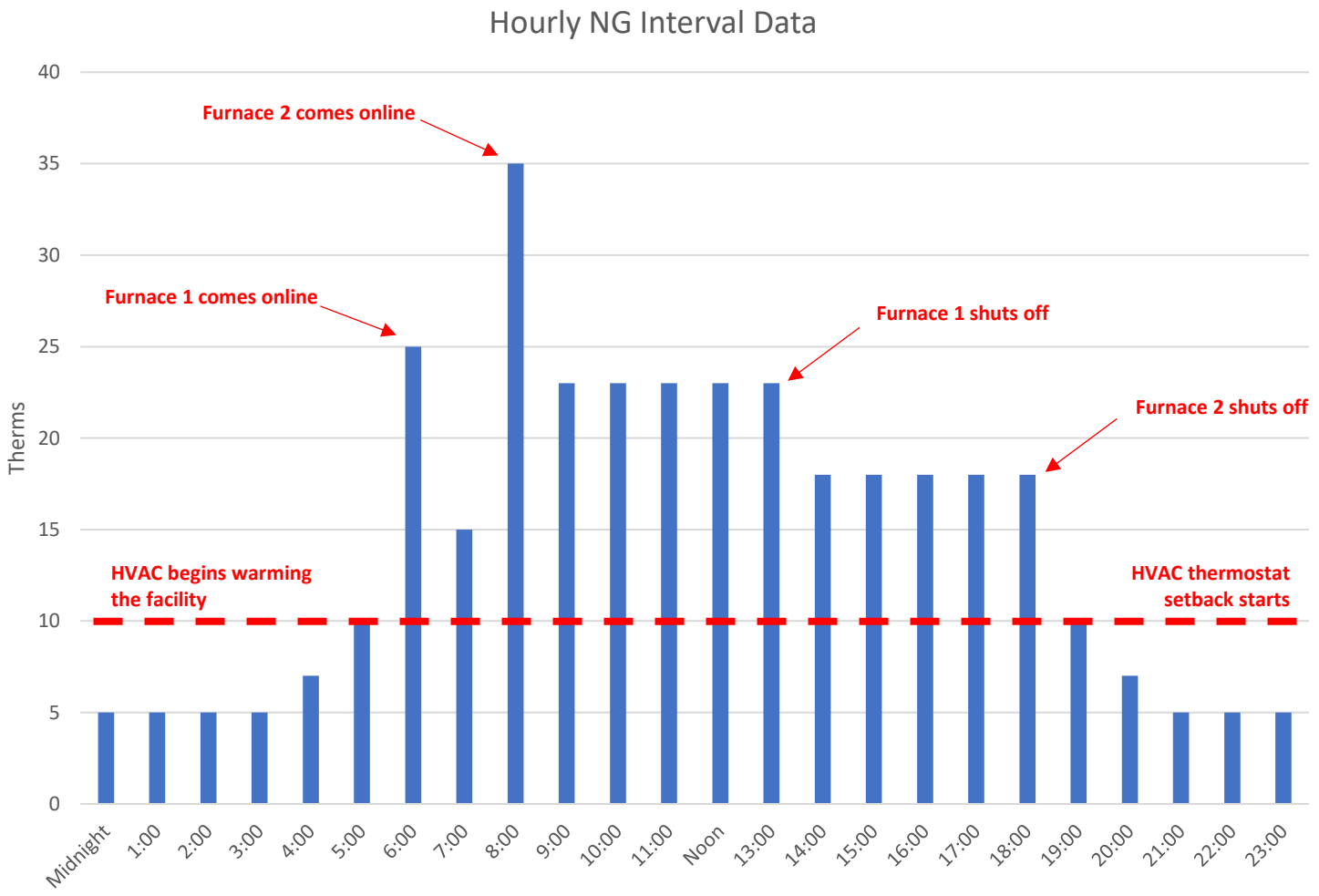
How would we use it?

- If we consider we know the load on the HVAC system, which we'll consider as constant during work here at 10 Therms/hr, we can separate out that HVAC load and be left with process loading.



How would we use it?

Time	HVAC (Therms/hr)	Furnace 1 (Therms/hr)	Furnace 2 (Therms/hr)
6 am	~10	~15	0
7 am	~10	~5	0
8 am	~10	~5	~20
9 am	~10	?	?
10 am	~10	?	?
11 am	~10	?	?
12 pm	~10	?	?
1 pm	~10	?	?
2 pm	~10	0	~8
3 pm	~10	0	~8
4 pm	~10	0	~8



How to collect it?

- Most industrial meters lack the capability to automatically log it, though some newer “smart meters” can.
- Additionally, the Diagnostic Equipment Loan Program is currently testing an add-on meter that may be capable of measuring the throughput of typical natural gas meters via Hall Effect.

Some Notes and Caveats

- Natural gas interval data metering is somewhat underexplored, so guidance for implementation and interpretation is limited.
- Significant time-of-use information is necessary for a plant's inventory of natural gas consumers if lacking in submetering.

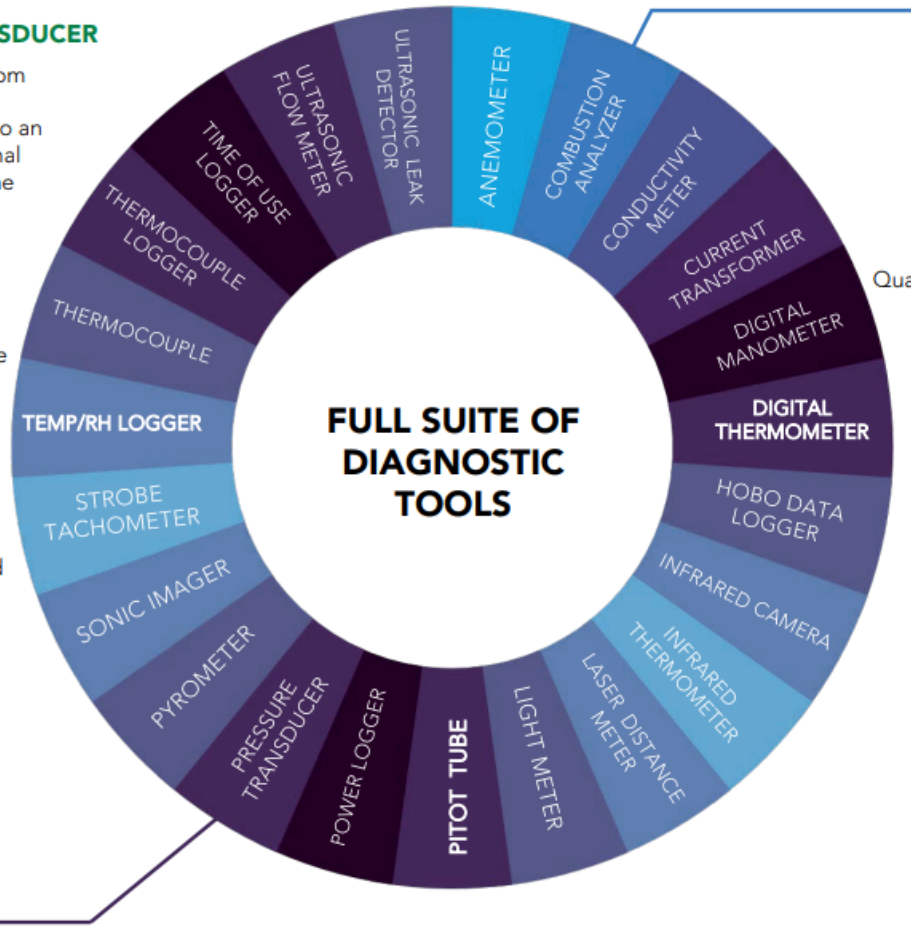
Technical Assistance: Diagnostic Equipment Program

PRESSURE TRANSDUCER

Converts pressure from compressed air and pumping systems into an analog electrical signal for recording, with the use of a data logger.

Why it matters:

Characterizing a compressed air system using pressure transducers and data loggers provides valuable insight into system performance over time. These instruments help identify imbalances between compressed air supply and demand, which enables users to identify and implement energy saving opportunities.



COMBUSTION ANALYZER

Quantifies excess oxygen in boiler/combustion process exhaust.

Why it matters:

When more air is present than is needed during boiler and combustion processes, heat is absorbed and exhausted. Quantifying excess oxygen helps reduce payment for heated air that is not being used.

You can borrow power meters and other diagnostic equipment from the Better Plants program!

Questions?

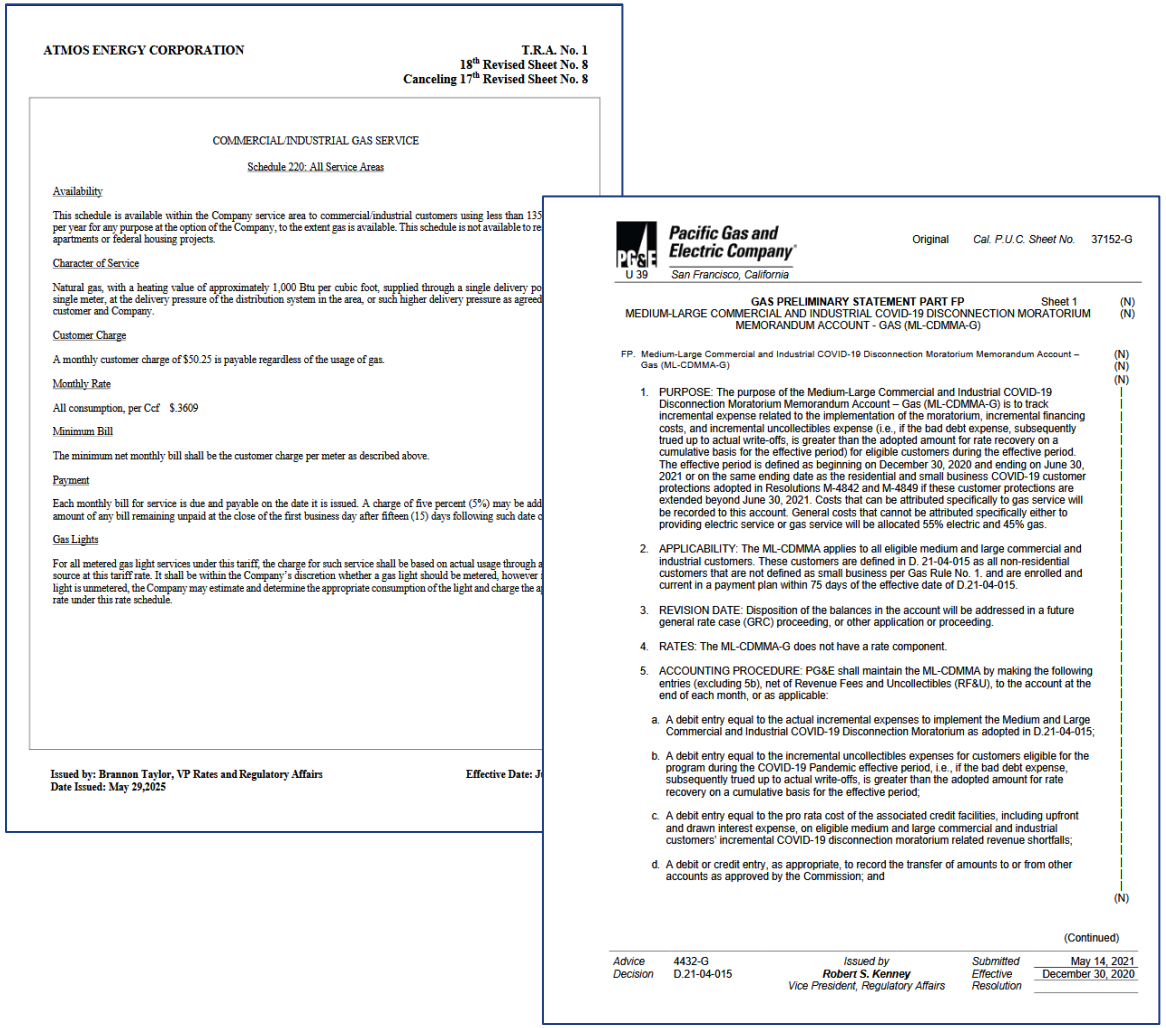
Natural Gas Tariffs

What are rate tariffs?

- ***Rate schedules*** are a collection of pricing structures offered by a utility for different kinds of natural gas service
- ***Rate Tariffs*** are a specific pricing structure that sets the terms of your commodity and transportation contracts
- Schedules and tariffs are generally considered public information
- You can usually find your specific rate tariffs by…
  - Doing an internet search for “<INSERT UTILITY NAME> rate tariff”
  - Calling your utility
- Often divided into (1) Commodity and (2) Transportation tariffs

Rate Tariff Documents Can Be Complicated

- Documents can be very long
- Don’t be intimidated! All the information you need to reconstruct your bills is in this document.
- There cane be several different kinds of tariffs available to large industrial manufacturers
- Each tariff may have 10+ riders that can apply to your service
- May be separate tariffs for supply and for sewer



ATMOS ENERGY CORPORATION

T.R.A. No. 1
18th Revised Sheet No. 8
Canceling 17th Revised Sheet No. 8

COMMERCIAL/INDUSTRIAL GAS SERVICE

Schedule 220: All Service Areas

Availability

This schedule is available within the Company service area to commercial/industrial customers using less than 135
per year for any purpose at the option of the Company, to the extent gas is available. This schedule is not available to re
apartments or federal housing projects.

Character of Service

Natural gas, with a heating value of approximately 1,000 Btu per cubic foot, supplied through a single delivery po
single meter, at the delivery pressure of the distribution system in the area, or such higher delivery pressure as agreed
customer and Company.

Customer Charge

A monthly customer charge of $50.25 is payable regardless of the usage of gas.

Monthly Rate

All consumption, per Ccf $.3609

Minimum Bill

The minimum net monthly bill shall be the customer charge per meter as described above.

Payment

Each monthly bill for service is due and payable on the date it is issued. A charge of five percent (5%) may be add
amount of any bill remaining unpaid at the close of the first business day after fifteen (15) days following such date c

Gas Lights

For all metered gas light services under this tariff, the charge for such service shall be based on actual usage through a
source at this tariff rate. It shall be within the Company's discretion whether a gas light should be metered, however
light is unmetered, the Company may estimate and determine the appropriate consumption of the light and charge the a
rate under this rate schedule.

Issued by: Brannon Taylor, VP Rates and Regulatory Affairs
Date Issued: May 29,2025

Effective Date: J

Pacific Gas and Electric Company
U 39 San Francisco, California

Original Cal. P.U.C. Sheet No. 37152-G

GAS PRELIMINARY STATEMENT PART FP Sheet 1 (N)
MEDIUM-LARGE COMMERCIAL AND INDUSTRIAL COVID-19 DISCONNECTION MORATORIUM (N)
MEMORANDUM ACCOUNT - GAS (ML-CDMMA-G)

FP. Medium-Large Commercial and Industrial COVID-19 Disconnection Moratorium Memorandum Account – Gas (ML-CDMMA-G) (N) (N) (N)

1. PURPOSE: The purpose of the Medium-Large Commercial and Industrial COVID-19 Disconnection Moratorium Memorandum Account – Gas (ML-CDMMA-G) is to track incremental expense related to the implementation of the moratorium, incremental financing costs, and incremental uncollectibles expense (i.e., if the bad debt expense, subsequently trued up to actual write-offs, is greater than the adopted amount for rate recovery on a cumulative basis for the effective period) for eligible customers during the effective period. The effective period is defined as beginning on December 30, 2020 and ending on June 30, 2021 or on the same ending date as the residential and small business COVID-19 customer protections adopted in Resolutions M-4842 and M-4849 if these customer protections are extended beyond June 30, 2021. Costs that can be attributed specifically to gas service will be recorded to this account. General costs that cannot be attributed specifically either to providing electric service or gas service will be allocated 55% electric and 45% gas.
2. APPLICABILITY: The ML-CDMMA applies to all eligible medium and large commercial and industrial customers. These customers are defined in D. 21-04-015 as all non-residential customers that are not defined as small business per Gas Rule No. 1. and are enrolled and current in a payment plan within 75 days of the effective date of D.21-04-015.
3. REVISION DATE: Disposition of the balances in the account will be addressed in a future general rate case (GRC) proceeding, or other application or proceeding.
4. RATES: The ML-CDMMA-G does not have a rate component.
5. ACCOUNTING PROCEDURE: PG&E shall maintain the ML-CDMMA by making the following entries (excluding 5b), net of Revenue Fees and Uncollectibles (RF&U), to the account at the end of each month, or as applicable:
   a. A debit entry equal to the actual incremental expenses to implement the Medium and Large Commercial and Industrial COVID-19 Disconnection Moratorium as adopted in D.21-04-015;
   b. A debit entry equal to the incremental uncollectibles expenses for customers eligible for the program during the COVID-19 Pandemic effective period, i.e., if the bad debt expense, subsequently trued up to actual write-offs, is greater than the adopted amount for rate recovery on a cumulative basis for the effective period;
   c. A debit entry equal to the pro rata cost of the associated credit facilities, including upfront and drawn interest expense, on eligible medium and large commercial and industrial customers' incremental COVID-19 disconnection moratorium related revenue shortfalls;
   d. A debit or credit entry, as appropriate, to record the transfer of amounts to or from other accounts as approved by the Commission; and (N)

(Continued)

Advice 4432-G
Decision D.21-04-015

Issued by
Robert S. Kenney
Vice President, Regulatory Affairs

Submitted May 14, 2021
Effective December 30, 2020
Resolution

Better Plants® U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF ENERGY

Size-based Service

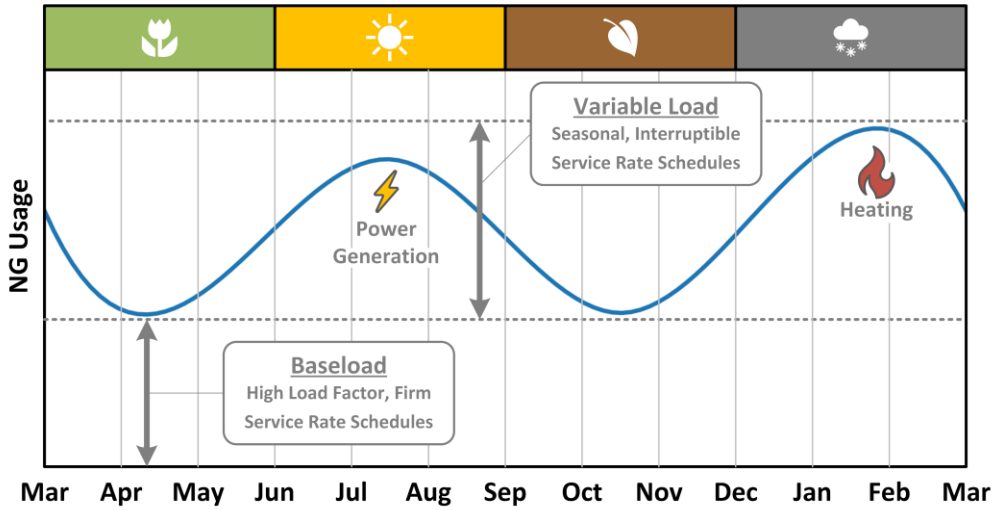
- Tariffs for industrial and commercial gas users will have different options and prices available depending on scale
- Larger service typically…
  - Has higher metering fees
  - Has cheaper base rates for gas
  - May have demand-based charges
- Can be listed as general service, large industrial, small and medium industrial, and other rate schedules.

Firm vs. Interruptible Service

- **Firm Service** guarantees a reliable and continuous supply of gas
  - Usually more expensive than market price
  - May still experience disruptions during exceptional events (natural calamities or extremely cold weather)
- **Interruptible Service** is a lower-priority supply of gas
  - Usually cheaper than market price
  - Good for customers that can tolerate their gas service being shut on/off
  - Production process has enough thermal inertial to span events or facility has alternate fuel sources stored on-site
- Selecting between these options depends on your risk tolerance!

High Load Factor Service

- Natural gas **Load Factor** is the ratio of the average daily gas usage to the maximum daily usage for the year
- High load factor (e.g., >60%) means gas usage is relatively constant and predictable throughout the year



- Utilities sometime offer reduced rates to industrial customers with large baseload processes and high load factor
- If natural gas usage is primarily driven by seasonal demand, your load factor is likely very low

Natural Gas Pricing and Contracts

- Pricing for physical natural gas has two primary components:
  - **Commodity Price:** The price of gas at a specific trading point
  - **Basis Cost:** Price differential between the point of sale and delivery
- The benchmark price of natural gas in the US is the Henry Hub in Erath, Louisiana
- Basis cost can be positive or negative depending on the relative cost of natural gas between hub and delivery
- Both the commodity price and basis cost can be fixed by your contract to hedge against price volatility

Natural Gas Pricing and Contracts

- NYMEX Price

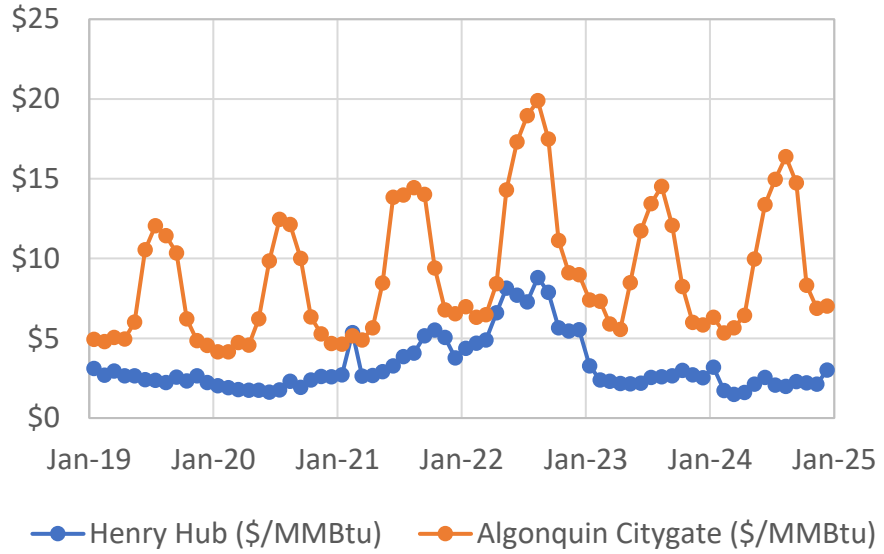
  Spot Henry Hub Price ± Fixed Basis

- Index Price

  Spot Hub Price ± Floating Basis

- Fixed Price

  Fixed Commodity Price ± Fixed Basis



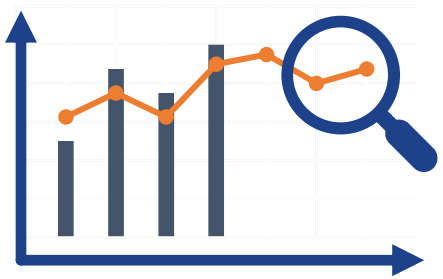
***Example:** NYMEX delivered to a Texas Citygate*

NYMEX = $3.01/MMBtu Texas Citygate = $2.83/MMBtu

Basis Cost = Texas Citygate – NYMEX = **–$0.18/MMBtu**

Forecasting Natural Gas Usage

- De-regulation has opened some gas markets to new suppliers that may offer more competitive pricing
- Using markets to find cheaper gas can generate large cost savings
- May have an option to **Pre-Buy** your natural gas at a cheaper rate
- Requires an accurate estimate your future gas usage:
  - Estimated natural gas is purchased at a base rate ($$)
  - ***Additional gas is more expensive*** ($$$) than the base rate if you underestimate your usage
  - ***Excess gas is sold back at a cheaper rate*** ($) than the base rate if you overestimate your usage



Natural Gas Storage Options

- Natural gas can be bought and stored ahead of time
- Gas can be stored in underground salt caverns, depleted oil and gas wells, or in aboveground storage tanks
- Utility companies can store gas on the customer's behalf and withdraw that gas when needed
- Charges will be based on the type of storage and amount of gas
- Different storage options can withdraw gas at different rates

https://commons.wikimedia.org/wiki/File:MiRO4.jpg

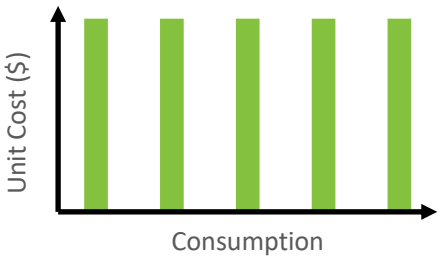
Hedging Options

- Utilities may offer large industrial customers **Hedging Options**
- Provides an opportunity to buy additional gas if the utility has excess capacity over their firm delivery requirements
- Customer has option to purchase the surplus gas at a reduced price
- Must either use the gas or pay for additional gas storage until used
- Provides further protection against future natural gas price volatility
- Requires careful planning of operations, accurate energy forecasts, and dedicated personnel for maximum benefit

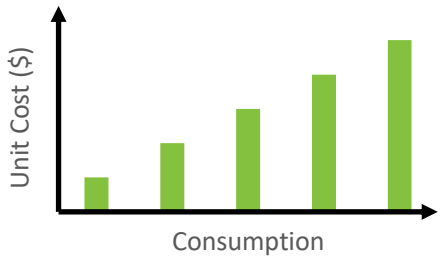
Block Rates

- The cost of natural gas changes based on how much gas you use
- Common block structures:

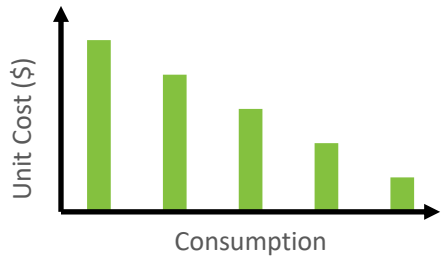
Uniform Rate



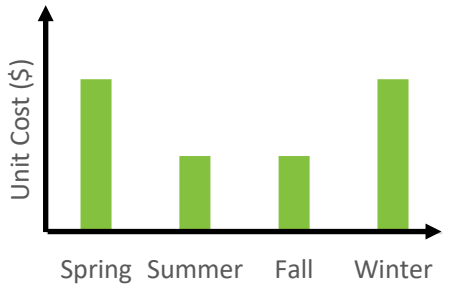
Increasing Block Rate



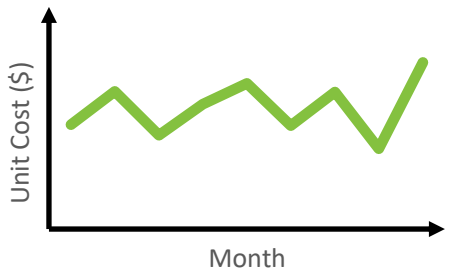
Decreasing Block Rate



Seasonal Rates



Floating Market Rates



- Example:

Block	Cap
First 7,000 MCF	$4.35/MCF
Next 13,000 MCF	$4.79/MCF
All Additional Usage	$5.99/MCF

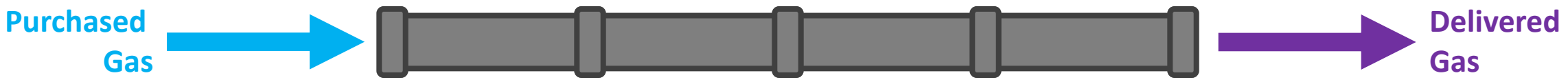
24,632 MCF of gas usage is:

7,000 MCF x $4.35/MCF = $30,450
13,000 MCF x $4.79/MCF = $62,270
4,632 MCF x $5.99/MCF = $27,746

$120,466

Pipeline Pricing

- Natural gas customers in deregulated states may get multiple bills
  - Commodity Bill(s) for the physical natural gas
  - Pipeline Bill(s) for transportation of your gas
  - LDC Bill for the final delivery of your gas
- Pipeline and LCD bills will have similar rate tariff structures
- Pipelines are physical objects with limited capacity
- Pipeline tariffs will charge you for portion of that capacity through **pipeline demand charges**



Natural Gas Demand Rates

- **Maximum Daily Firm Quantity (MDFQ)** is the quantity of guaranteed daily delivery the utility is obligated to provide
  - Delivery of gas if prioritized up to the MDFQ and is not usually subject to weather disruptions or supply constraints
  - This quantity is set based on your contract negotiations
- **Maximum Daily Quantity (MDQ)** is the maximum amount of gas delivered over 24 hours during a specific time window
  - MDQ is analogous to demand charges for electricity
  - Usually determined over a 36-month period
  - Can set your gas charges for a long time!

Optimum Rate Selection

- Energy usage characteristics shift over time
  - Operations change
  - Product mix change
  - Operating hour change
- It is a best practice to check if your operation qualifies for a better rate
- Understanding your usage, available rate structures, and billing is critical to evaluate your options

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

Other Natural Gas Charges

What Are All of These Additional Line Items?

- Several additional charges can appear on your bills
- **Riders** are additional charges that are not part of the base tariff
- Regulated by Public Utility (PUC) or Public Service (PSC) commissions
- Typically have very descriptive names because they are earmarked for specific programs, projects, etc.
- Can be calculated based on consumption OR fixed
- Can be credits or charges
- Your rate tariffs will list all riders with terms and conditions

Example Riders


Environmental Surcharge


Energy Efficiency Program Surcharge


Distribution System Management Surcharge


Fuel Cost Adjustment Surcharge


Storage Service Surcharge

Late Fees Are Just High Interest Loans!

- Every company (including your utility) charges late fees
- Late payment fees can be > 10% of the balance
- Late bills are the same as borrowing money from your utility… at an EXTREMELY HIGH interest rate
- Check if due date is “Mailed By” or “Received By”
- Consider a 5% Late Fee…

Nominal Annual Interest rate $(r) = \frac{5\%}{\text{month}} = \frac{60\%}{\text{year}}$

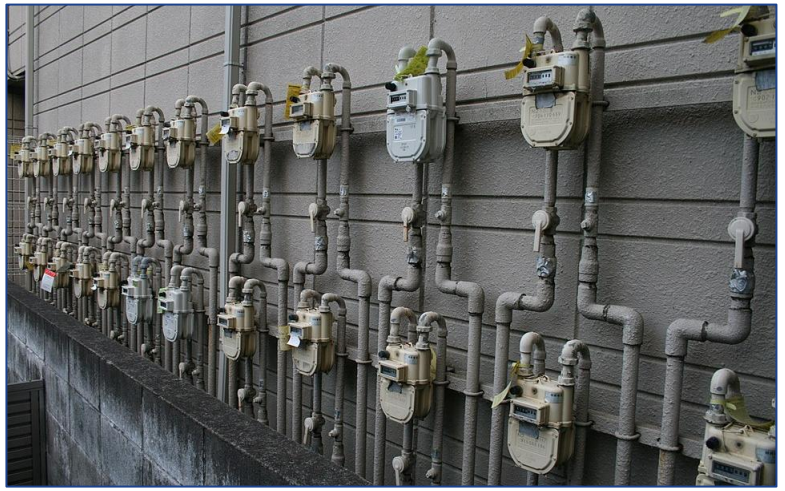
Compounding Frequency $(n) = 12$

→ Compound Interest $= \left(1 + \frac{r}{n}\right)^n - 1 =$ **80%!**

Meter Fees Can Add Up!

- **Fixed Charges** are built into the rate structure
- Amount stays the same each month
- Not related to your gas usage but to the natural gas service itself
- Common fixed fees include customer and metering fees
- Larger service typically has higher fixed fees
- Natural gas **metering fees** are usually high!
- Can be opportunities to consolidate gas meters and avoid duplicate metering fees

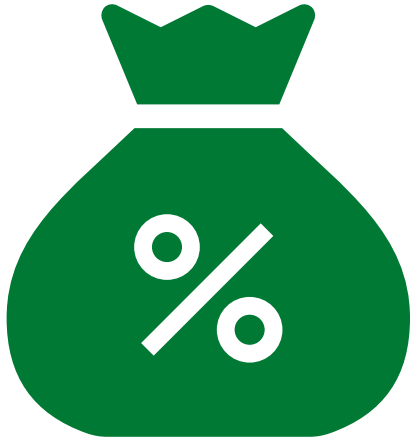
https://commons.wikimedia.org/wiki/File:Individual_gas_meters.jpg



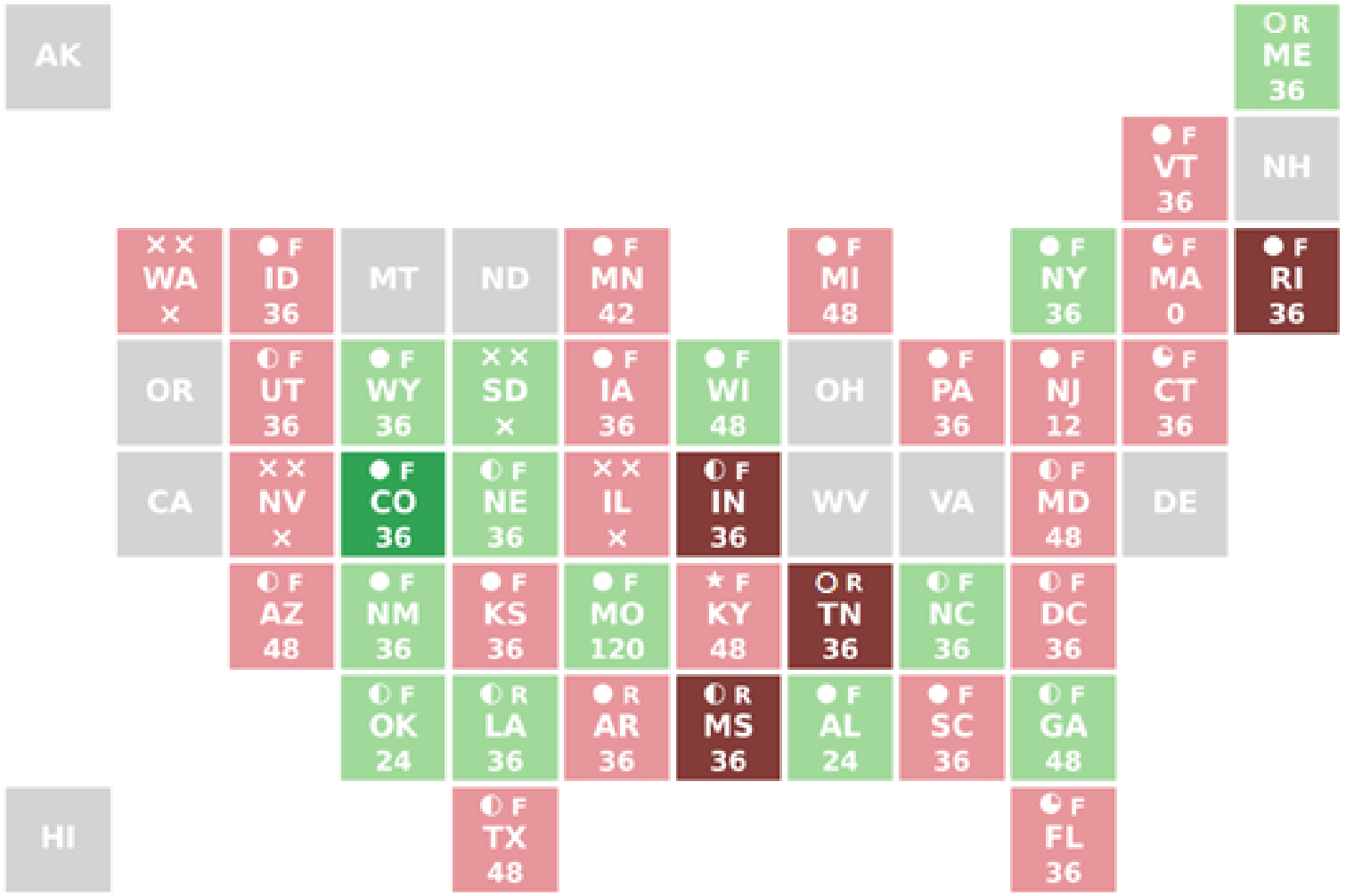
https://commons.wikimedia.org/wiki/File:Gas_meters_and_pipes_(2199570777).jpg

State Sales Tax Exemptions

- Nearly every state offers some kind of exemption for sales tax on utilities used for manufacturing
- This can be significant depending on your state and utility costs
- States will even let you reclaim previously paid sales tax!
  - Up to 48 months depending on statute of limitations
- Most states require a **Predominate Use Study**
  - Third party assessment to determine manufacturing energy usage
- Depending on the state, can receive up to 100% exemption for meters where >X% of energy is used towards manufacturing



Sales Tax Exemption



Exemption Threshold
- × No Exemption
- ○ Any Manufacturing
- ◐ 50% Manufacturing
- ◔ 75% Manufacturing
- ● Only Manufacturing
- ★ 3% Production Cost

XX
Rebate Window (months)

Exemption Type
- × No Exemption
- F Full Exemption
- R Reduced Rate

State Sales Tax
- No Utility Sales Tax
- Tax < 4.0%
- 4.0% ≤ Tax < 5.5%
- 5.5% ≤ Tax < 7.0%
- 7.0% ≤ Tax

Cost of Natural Gas Bills

Estimating Savings on Your Gas Bills

- There are many ways to estimate your cost of natural gas
- Different methods are appropriate for different situations
- **Blended** or **Average Cost** is the quickest and easiest way

$$\$_{blend} = \frac{\text{Total Natural Gas Costs}}{\text{Total Natural Gas Consumption}} \left[\frac{\$}{\text{MMBtu}}\right]$$

- Lumps together all commodity charges, transportation charges, and other charges into a single $/MMBtu rate
- Should average several months of bills for better accuracy
- Combine costs from all bills related to your gas consumption

Marginal Cost of Natural Gas

- A more accurate way to estimate savings on natural gas usage
- Represents the cost of purchasing or saving the last MMBtu of natural gas on your bills
- Requires a deeper understanding of your commodity, transport, and delivery rate structures
- Must identify all consumption charges from all natural gas bills

$$\$_{mrg} = \underbrace{\text{Gas Cost} + \text{Pooling Fee} + \text{Balancing Fee}}_{\text{Commodity Rate Tariff}} + \underbrace{\text{Pipeline Cost Factor} + \text{Transportation Fee}}_{\text{Pipeline Tariff}}$$

Example: Gas Cost from a Single Bill

Natural Gas Invoice			
Current Meter Reading	556,170	Invoice Date	12/5/2018
Previous Meter Reading	510,498	Meter Read Date	11/30/2018
Usage (MCF)	45,672	Days on Bill	30
BTU Factor	1.112	Payment Due	12/19/2018

Category	Description	Units	Rate/Unit	Cost
Customer Charge	Meter Fee	1	$767.390	$767.39
Demand Charge	MDFQ	445	$8.683	$3,863.94
Commodity Charge	Block 1 (≤10k)	10,000	$5.351	$53,510.00
	Block 2 (>10k, ≤30k)	20,000	$4.895	$97,900.00
	Block 3 (>30K)	15,672	$4.179	$65,493.29
Environmental	Regulatory Fee	45,672	$0.021	$959.11
			Total	$222,493.73
			Tax (4.39%)	$9,767.47
			Grand Total	**$232,261.20**

Average Gas Cost:

$$\$_{avg} = \frac{\$232{,}261.20}{45{,}672\ \text{MCF} \times 1.112} = \frac{\$\mathbf{4.57}}{\mathbf{MMBtu}}$$

Marginal Gas Cost:

The final MCF of gas only affects the third block!

Gas Cost (15,672 MCF)

$$(\$65{,}493.29 + \$959.11) \times 1.0439 = \$69{,}369.66$$

Gas Cost (15,671 MCF)

$$(\$65{,}489.11 + \$959.10) \times 1.0439 = \$69{,}365.29$$

$$\$_{mrg} = \frac{(\Delta\ \text{Gas Cost}\ (\$))}{\Delta\ \text{Gas Volume} \times \text{BTU Factor}}$$

$$= \frac{\$69{,}369.66 - \$69{,}365.29}{1\ \text{MCF} \times 1.112} = \frac{\$\mathbf{3.93}}{\mathbf{MMBtu}}$$

What about block rates?

What if your consumption is in a different block every month?

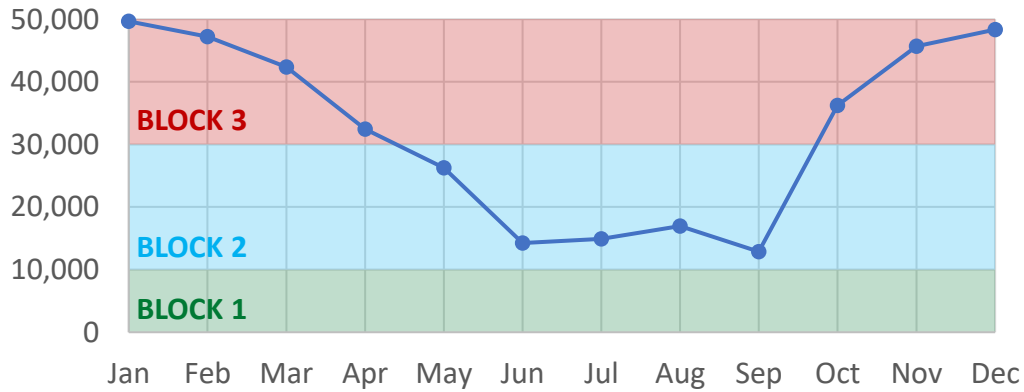
Let's look at an example:

- Block 2 Cost = $4.895/MCF
- Block 3 Cost = $4.179/MCF
- Company reaches Block 2 (5x)
- Company reaches Block 3 (7x)

$$\$_{C,mrg} = \frac{5}{12} \times \text{Block 2 Rate} + \frac{7}{12} \times \text{Block 3 Rate}$$

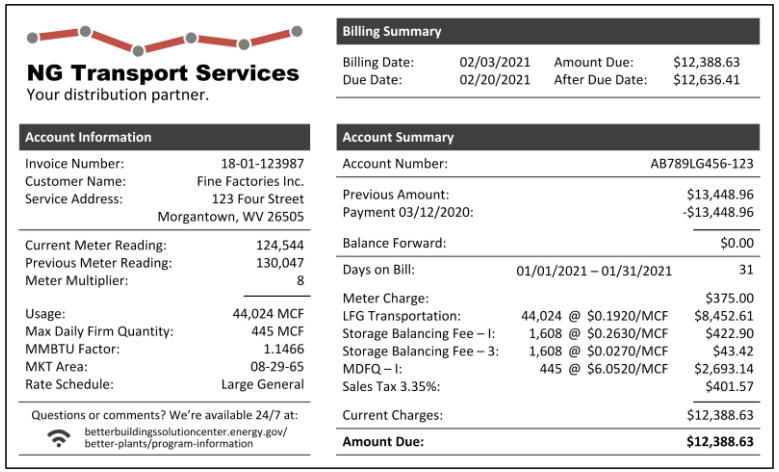
$$= \$4.477/\text{MCF}$$

Month	Block 1 (MCF)	Block 2 (MCF)	Block 3 (MCF)
January	10,000	20,000	19,657
February	10,000	20,000	17,234
March	10,000	20,000	12,345
April	10,000	20,000	2,453
May	10,000	16,235	0
June	10,000	4,234	0
July	10,000	4,897	0
August	10,000	6,975	0
September	10,000	12,874	0
October	10,000	20,000	6,243
November	10,000	20,000	15,672
December	10,000	20,000	18,364



Auditing Natural Gas Bills

- Fine Factories, Inc. (FFI) has a manufacturing facility in Morgantown, West Virginia
- WV is a deregulated natural gas market
- FFI contracts with Shell Energy North America for their natural gas supply
- FFI uses Mountaineer Gas Company as their natural gas transportation LDC
- FFI receives two separate bills each month form both companies for their natural gas usage



NG Transport Services
Your distribution partner.

Billing Summary

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

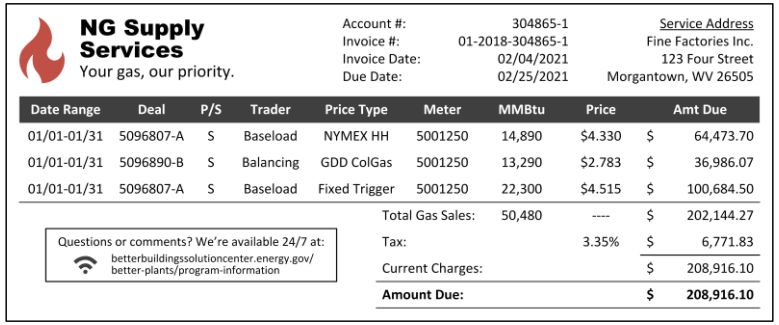
Account Information

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

Questions or comments? We're available 24/7 at:
betterbuildingssolutioncenter.energy.gov/better-plants/program-information

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**



NG Supply Services
Your gas, our priority.

Account #:	304865-1
Invoice #:	01-2018-304865-1
Invoice Date:	02/04/2021
Due Date:	02/25/2021

Service Address
Fine Factories Inc.
123 Four Street
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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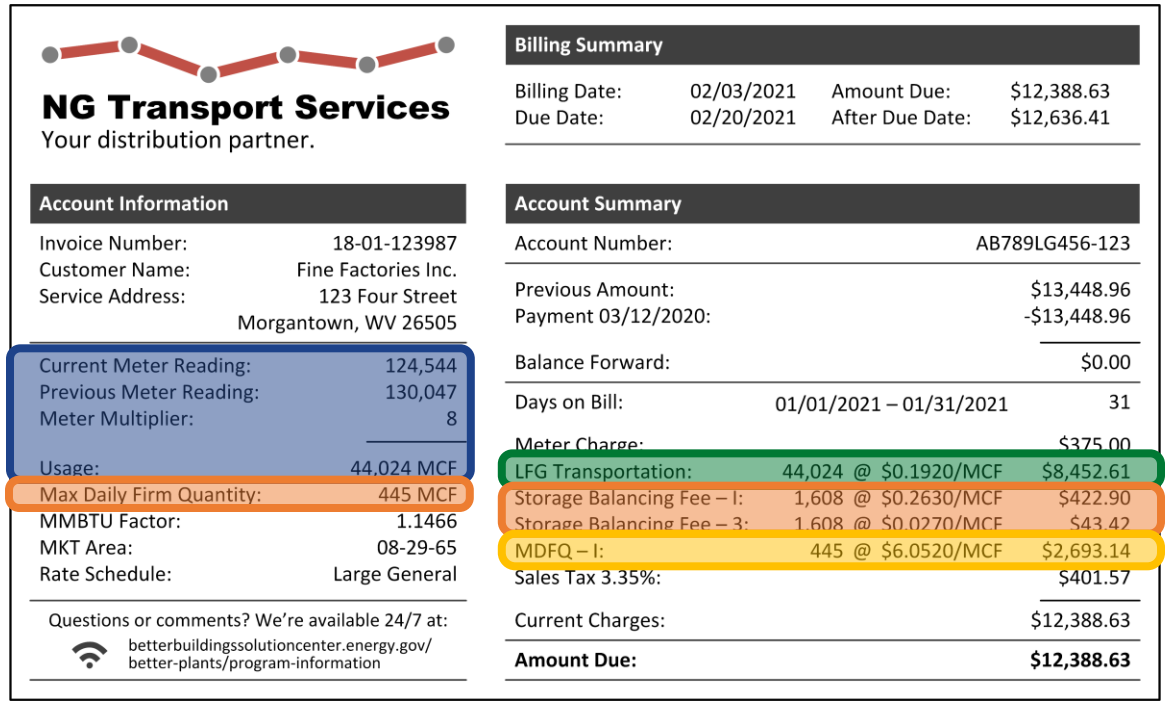
Transportation Bill



NG Transport Services
Your distribution partner.

Billing Summary

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

Account Information

Invoice Number:	18-01-123987
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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

Questions or comments? We're available 24/7 at:
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Account Summary

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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**

Meter Fee	$375	/Month
MDFQ	$6.052	/MCF
Transportation Fee	$0.192	/MCF
Storage Fee – 1	$0.263	/MCF
Storage Fee – 3	$0.027	/MCF

Usage:

(130,047 – 124,544) × 8 = 44,024 MCF

Transportation Fee:

44,024 MCF × $0.192/MCF = $8,452.61

Storage Fee (1,608 MCF):

1,608 MCF × $0.290 = $466.32

MDFQ:

445 MCF × $6.052/MCF = $2,693.14

Supplier Bill

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
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					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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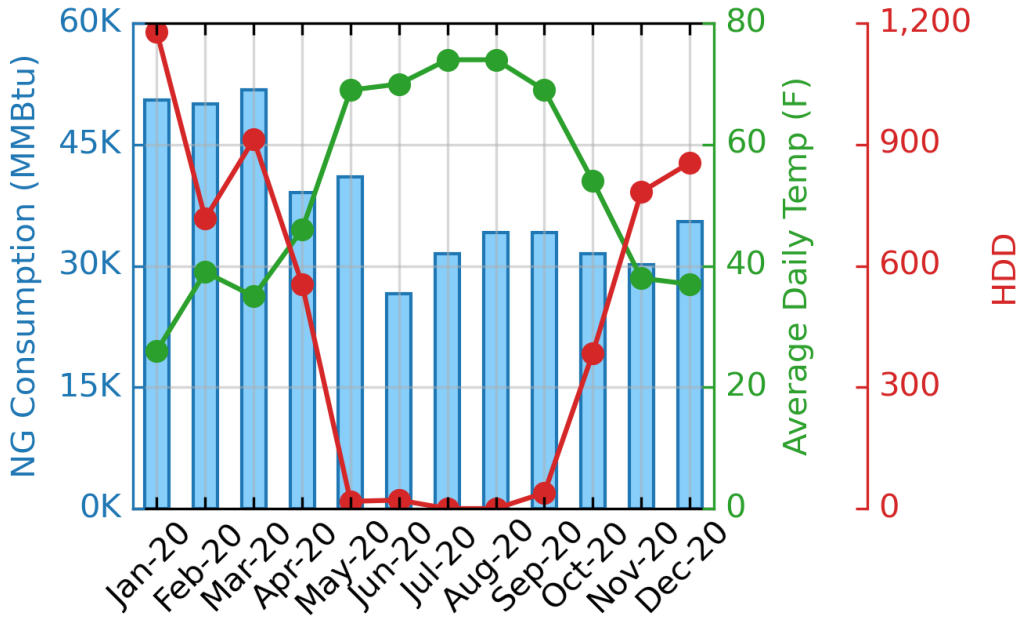
- Let's compare the meter reading for the transported gas:

$$44{,}024\ \text{MCF} \times 1.1466 = 50{,}478\ \text{MMBtu}$$

- Combining Gas and Transportation Costs:

$$\$_{avg} = \frac{\$12{,}388.63 + \$208{,}916.10}{50{,}480\ MMBtu} = \frac{\$4.384}{MMBtu}$$

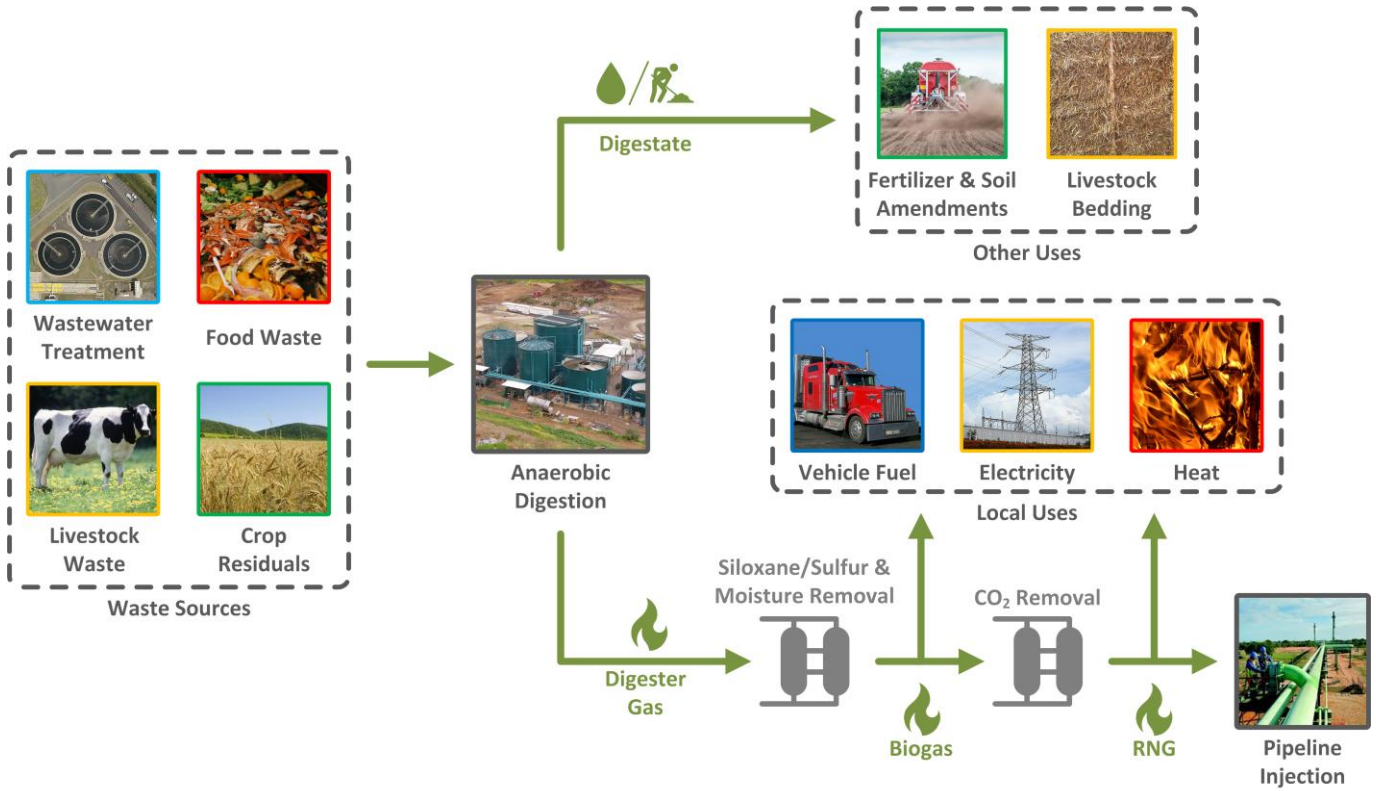


- To estimate the marginal cost of natural gas, need to investigate a year's work of bills!
- See ***Understanding Utility Bills: Natural Gas*** guidance document for more analysis

Renewable Natural Gas

What is Biogas?

- Biogas is produced from anaerobic digestion of organic matter
- Typically contains 45-65% methane depending on waste source
- Biogas can be converted to renewable natural gas by removing moisture, sulfur, CO_2, and volatile organic compounds (VOCs)



What Can I Do With Biogas?

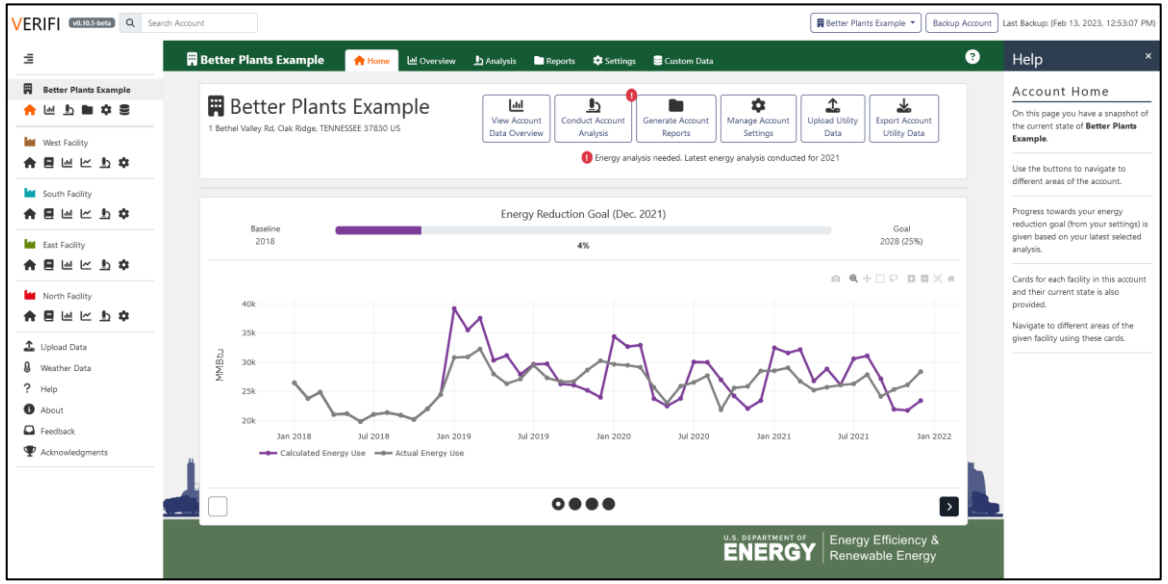
- Facilities that produce biogas may be able to supplement their utility-supplied natural gas with raw biogas
- Renewable natural gas can be used as a substitute for natural gas
- Biogas and renewable natural gas can be sold locally as an additional revenue stream
- High quality RNG can be injected into pipelines and sold to your LDC
- Biogas is a biogenic carbon source which is outside of Scope 1 carbon emissions

Summary and Closeout

What have we talked about today? Next time!

Opportunities for Natural Gas Cost Savings

- Purchasing contract negotiation
- Optimum rate structure selection
- Billing and accounting errors
- Tax Exemptions
- Avoiding Late Fees
- Tracking Energy Consumption
- Consolidating meters where feasible
- Credit assurance refunds
- Demand response program enrollment



New VERIFI Tool can help track your utility usage!
Beta Testing Version now available to try!
https://verifi.ornl.gov

Homework for Next Week

1) Find your natural gas rate tariffs (pipeline and final delivery).
2) Add natural gas data into VERIFI and do an analysis on your usage.
3) Determine your costs of natural gas (blended and marginal)

- If you have any questions, just email me! pricecr@ornl.gov
- Common questions and answers will be discussed at the beginning of next week's training

Next week!

- Water treatment and disposal process
- Types of water sources
- Water rate tariffs
- True cost of water
- Plant Water Profiler Tool and NEW Water Flows Tool
- Recreating a water bill
- Water analysis in VERIFI

Open Time for Questions