



**SOUTHERN STAR**

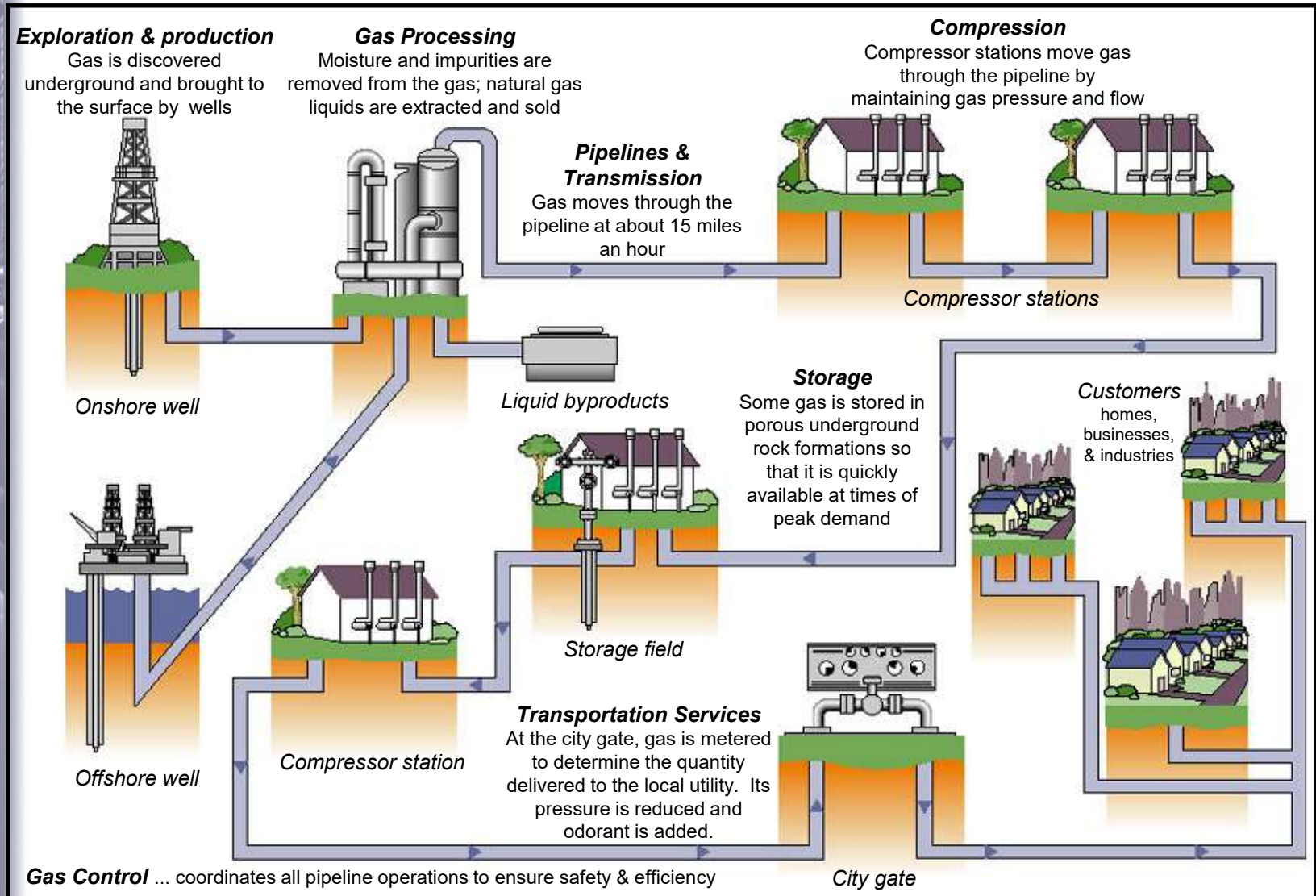
CENTRAL GAS PIPELINE

# Wellhead to Burnertip

*The path of natural gas*

## Wellhead to Burnertip

In the following slides we will follow gas as it travels “from wellhead to burnertip,” from its discovery underground to its final use by consumers:

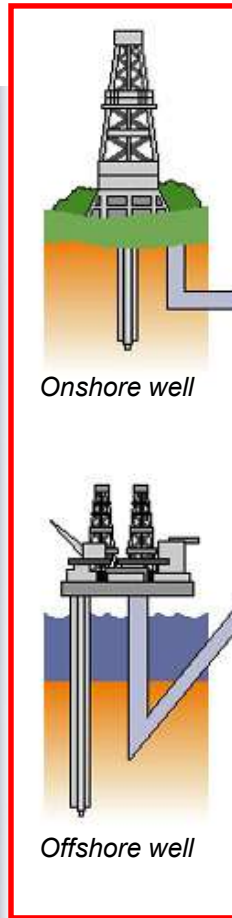


# Exploration & Production

Finding the gas &  
getting it out of the ground

## Wellhead to Burnertip

**Exploration & production**  
Gas is discovered underground and brought to the surface by wells

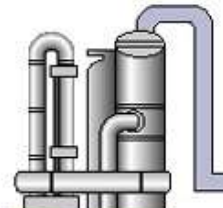


Onshore well

Offshore well

### Gas Processing

Moisture and impurities are removed from the gas; natural gas liquids are extracted and sold

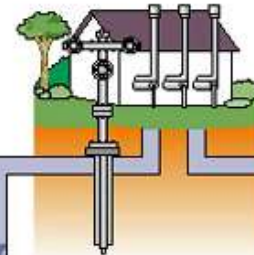


### Pipelines & Transmission

Gas moves through the pipeline at about 15 miles an hour



Liquid byproducts



Storage field

### Transportation Services

At the city gate, gas is metered to determine the quantity delivered to the local utility. Its pressure is reduced and odorant is added.

### Compression

Compressor stations move gas through the pipeline by maintaining gas pressure and flow



Compressor stations

### Storage

Some gas is stored in porous underground rock formations so that it is quickly available at times of peak demand



### Customers

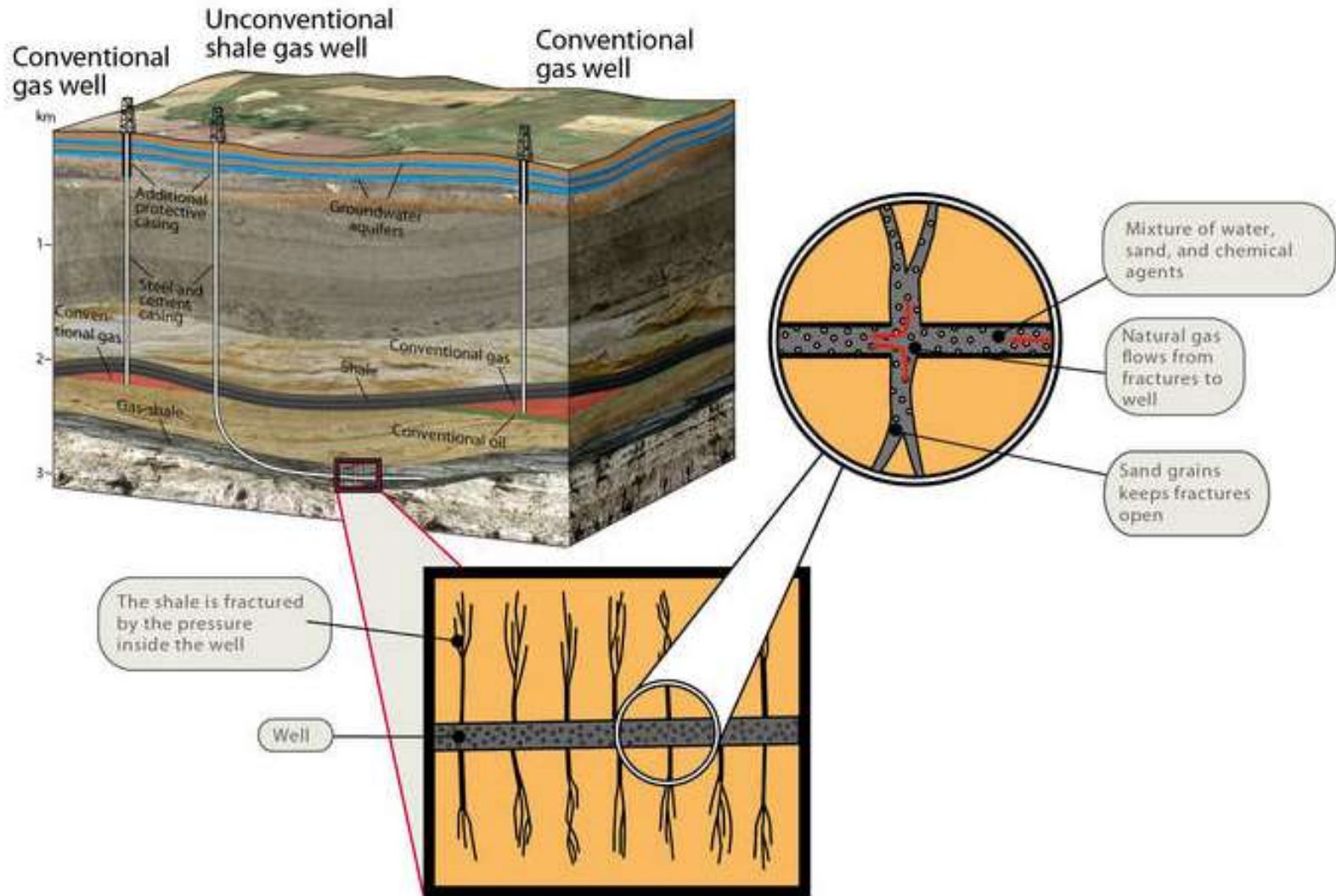
homes, businesses, & industries



City gate

Where and how is gas found? How is it made accessible?

# Exploration: Where is gas found?



Shale Gas is natural gas that is present in shale rocks. Throughout the world, different types of sedimentary rock contain natural gas deposits, for example sandstones, limestone's or shale's. Sandstone rocks often have high permeability, which means that the tiny pores within the rock are well connected and gas can flow easily through the rock. In contrast, shale rocks usually have very low permeability, making gas production more complex and costly.

# Gas Conditioning (a.k.a. Processing or midstream)

Converting wellhead gas to  
“pipeline quality” gas

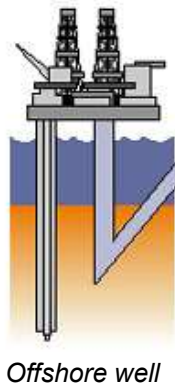
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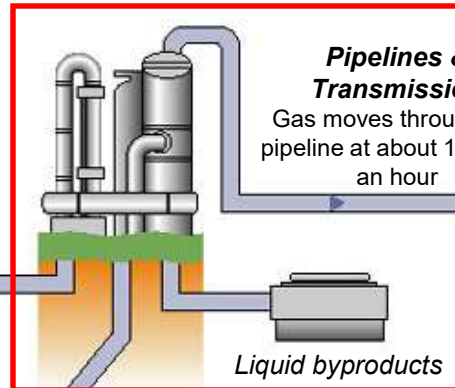
Onshore well



Offshore well

### Gas Processing

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Liquid byproducts

### Pipelines & Transmission

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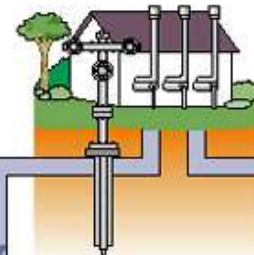
Compressor stations move gas through the pipeline by maintaining gas pressure and flow



Compressor stations

### Storage

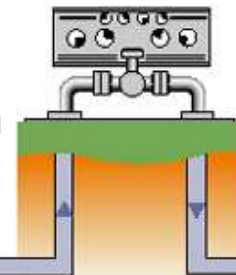
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Storage field

### Transportation Services

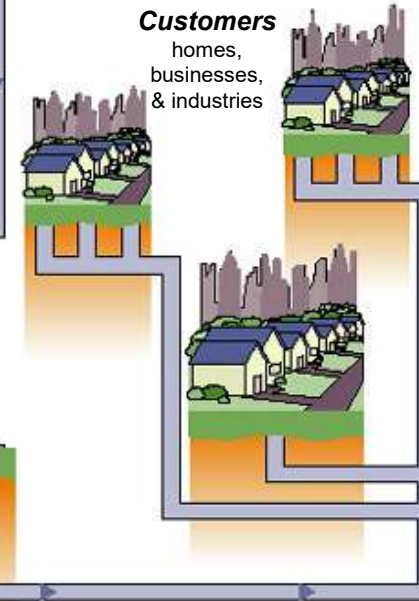
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City gate

### Customers

homes, businesses, & industries



What are the components of natural gas? Why and how is gas conditioned? Why is gas odorized?

# Components of wellhead gas

- Wellhead gas has no “typical” composition
- It may include:
  - hydrocarbon gases:  
methane, ethane, propane, butane
  - acid gases:  
carbon dioxide, hydrogen sulfide
  - inorganic gases:  
nitrogen, oxygen, helium
  - salt water
  - crude oil
- Gas quality is an ever growing concern across the pipeline industry as producers improve technology to extract new sources of gas.
- Natural gas is odorless. Companies add mercaptan.

# Pipelines and Transmission

Transportation of natural gas  
through pipelines from production  
areas to market areas

## Wellhead to Burnertip

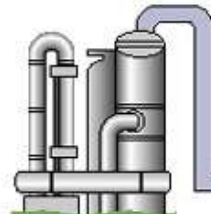
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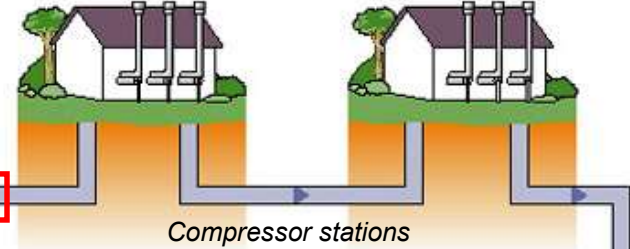
Moisture and impurities are removed from the gas; natural gas liquids are extracted and sold



**Pipelines & Transmission**  
Gas moves through the pipeline at about 15 miles an hour

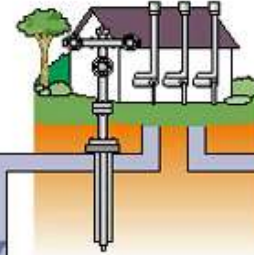
### Compression

Compressor stations move gas through the pipeline by maintaining gas pressure and flow



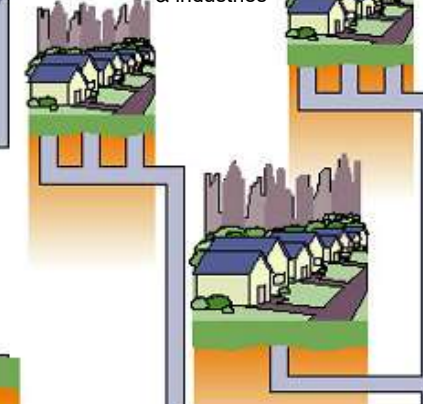
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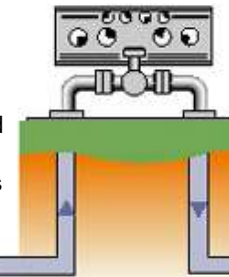
### Customers

homes, businesses, & industries



### Transportation Services

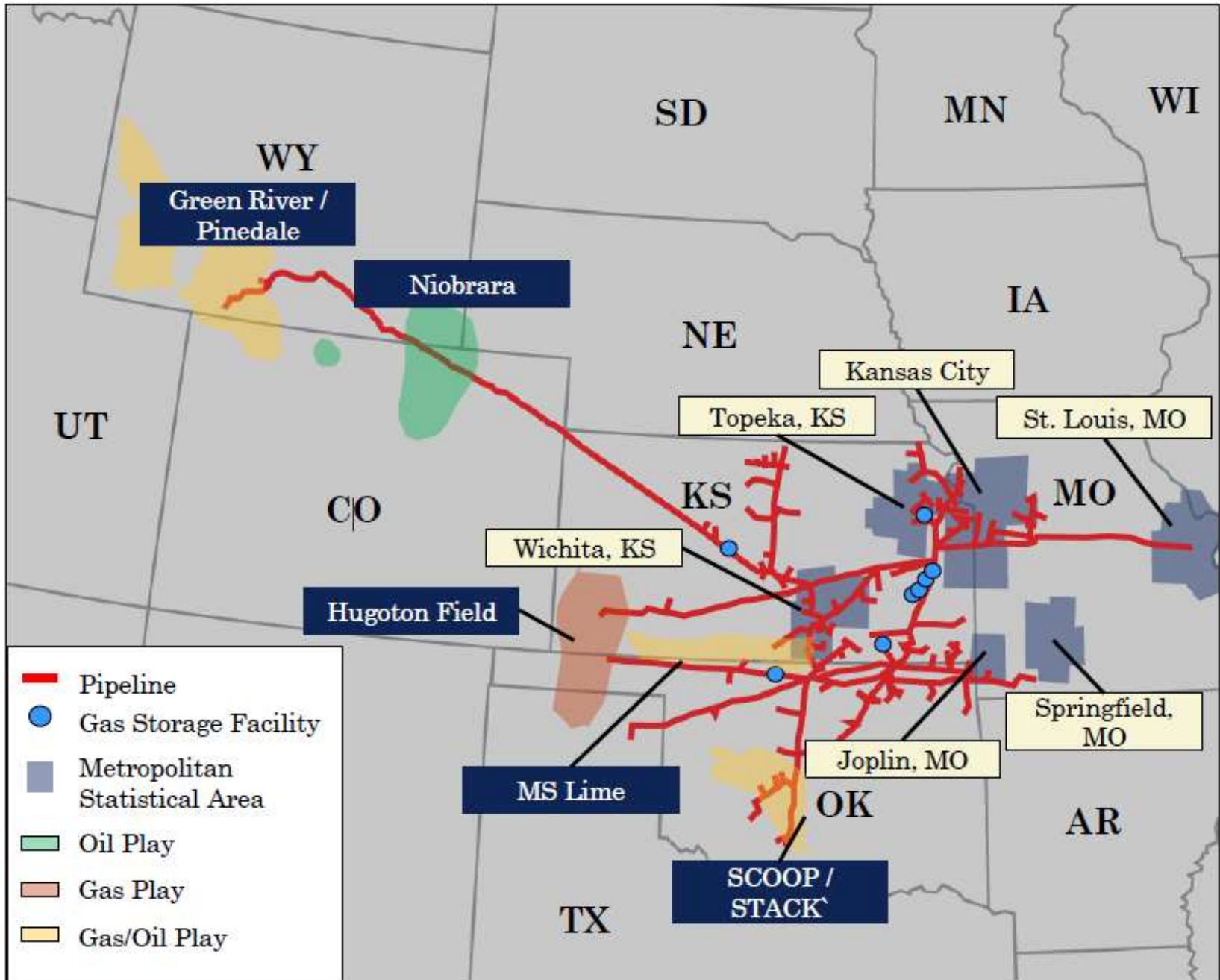
At the city gate, gas is metered to determine the quantity delivered to the local utility. Its pressure is reduced and odorant is added.



City gate

How is gas transported? What are some pipeline safety issues?

# Wellhead to Burnertip



# Protecting the pipeline

- Markers (AGM's) indicate the presence of a pipeline underground.
- Pipelines are regularly patrolled by air, truck, and on foot to monitor for problems.
- Right-of-way encroachments (such as digging to install utility lines) are managed very carefully to protect the line.
- *One-call systems* (811) inform the public of a centralized number to call before digging.
- Right of way is kept mowed & cleared.
- Sufficient coverage is maintained over the pipeline.
- Valves & other facilities are regularly inspected.
- Lines are cleaned and inspected with “pigs” propelled through the line with gas pressure.



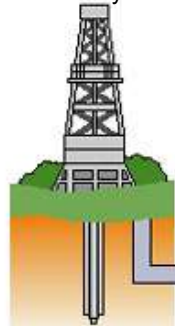
# Compressor Stations

Where the gas is compressed to  
push it along the pipeline

## Wellhead to Burnertip

### Exploration & production

Gas is discovered underground and brought to the surface by wells



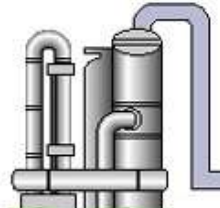
Onshore well



Offshore well

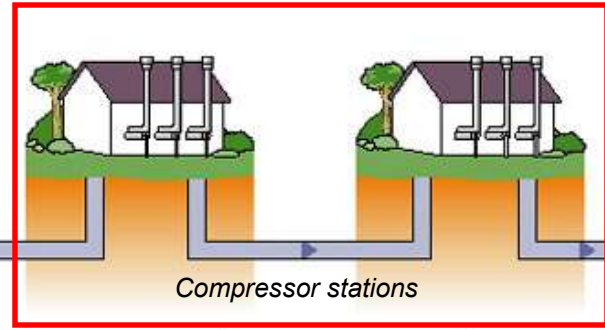
### Gas Processing

Moisture and impurities are removed from the gas; natural gas liquids are extracted and sold



### Pipelines & Transmission

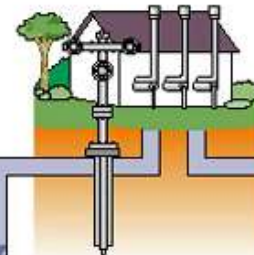
Gas moves through the pipeline at about 15 miles an hour



Compressor stations

### Storage

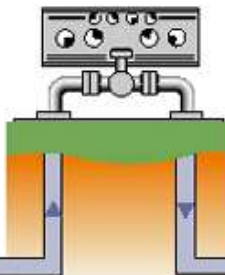
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Storage field

### Transportation Services

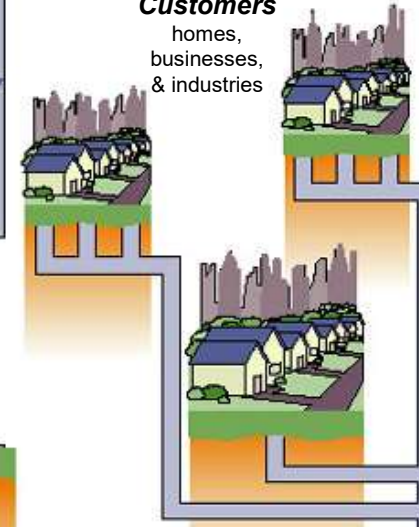
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City gate

### Customers

homes, businesses, & industries



City gate

**Compression**  
Compressor stations move gas through the pipeline by maintaining gas pressure and flow

How is gas moved through a pipeline? What do you find in a compressor station?

# What's in a station?

- Buildings to house compression equipment
- Piping to route the gas as needed
- Cathodic protection equipment
- *Traps* used for “launching” & “catching” pigs
- Overpressure protection devices
- *Scrubbers* that clean the gas before it enters the main units for compression



# Support/Control systems

A number of systems are critical for the proper operation of units:

- Cooling, Lubrication, and Air systems
- Emissions control equipment
- Shut down units that are operating outside safe limits
- Detect dangerous conditions - fires, presence of gas - and shut down units or the entire station as needed
- Monitor and automatically adjust station operations to assure efficiency

# Storage

Storage of natural gas helps  
even out seasonal fluctuations  
in demand

## Wellhead to Burnertip

### Exploration & production

Gas is discovered underground and brought to the surface by wells



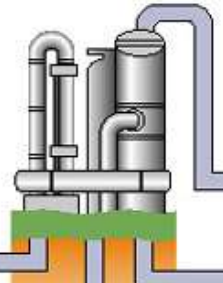
Onshore well



Offshore well

### Gas Processing

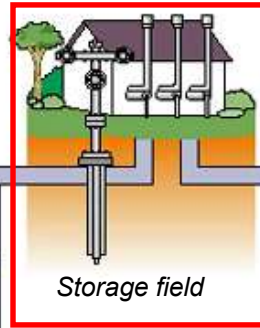
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### Pipelines & Transmission

Gas moves through the pipeline at about 15 miles an hour

Liquid byproducts



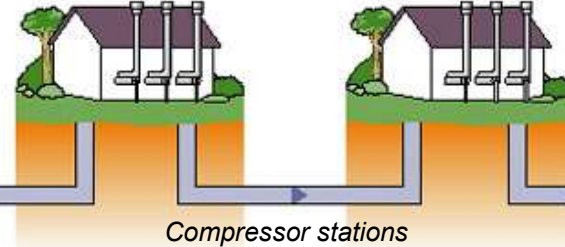
Storage field

### Transportation Services

At the city gate, gas is metered to determine the quantity delivered to the local utility. Its pressure is reduced and odorant is added.

### Compression

Compressor stations move gas through the pipeline by maintaining gas pressure and flow

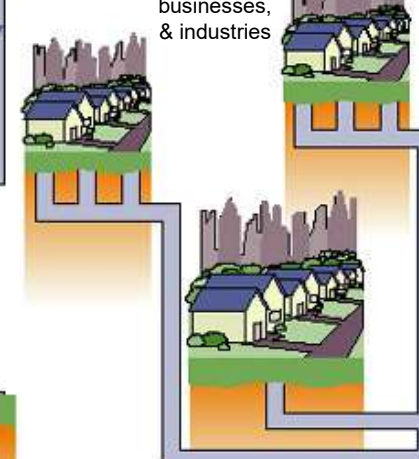


Compressor stations

**Storage**  
Some gas is stored in porous underground rock formations so that it is quickly available at times of peak demand

### Customers

homes, businesses, & industries



City gate

Why is storage needed?

# Why is storage needed?

- Demand for natural gas varies dramatically throughout the day & year because of its use in residential heating, power generation, and other processes.
- *Peak use periods* - times when gas use is at its maximum - make it hard to plan for the *throughput* (volume of gas carried) that is needed on a system at any given time.
- Stored gas can be used for *peak shaving*, the use of alternative sources of energy to supplement normal gas deliveries during peak use periods.

# Transportation Services

Transportation, capacity  
marketing, storage, contracts,  
administration, gas scheduling, &  
other pipeline services

## Wellhead to Burnertip

### Exploration & production

Gas is discovered underground and brought to the surface by wells



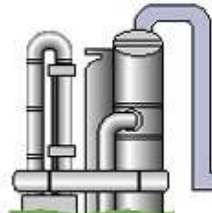
Onshore well



Offshore well

### Gas Processing

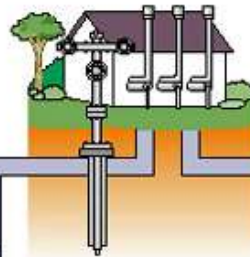
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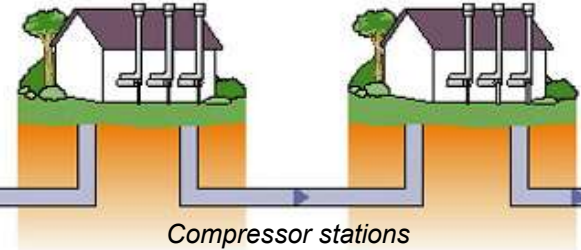
### Liquid byproducts



Storage field

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Compressor stations

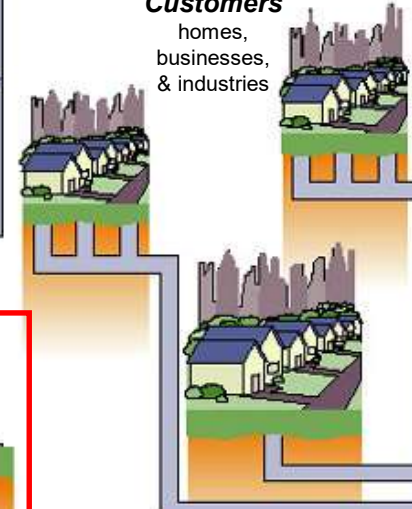
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### Customers

homes, businesses, & industries



City gate

What kinds of services do pipelines offer to their customers?  
How do we know how much gas a customer needs/uses?

Just like "UPS"



# Tariffs, contracts, & capacity

- A *tariff* is a document filed by a pipeline with FERC that outlines its:
  - services offered to customers
  - rate schedule (price list).
- Customers contract with the pipeline for the services they require, such as transportation or storage.
- In general customers are renting physical space on the pipeline; this is called *capacity*.

# CSI (Customer EBB)

The screenshot displays the Southern Star Customer EBB interface. On the left is a navigation menu with categories like Customer Activities, Informational Postings, Capacity, Gas Quality, Index of Customers, Locations, Notices, Posted Imbalances, Regulatory, Tariff, Transactional Reporting, Master Points, Electronic Forms, Service Request Forms, Other Postings, Gas Supplier Listing, SSCGP Home, Downloads, Search, Customer Activities, and Site Map. The main content area is divided into several sections:

- Capacity Map:** A map of the United States showing gas pipeline routes in various colors (red, blue, green, orange) across the Great Plains and Midwest regions.
- Deadlines:** A table showing gas flow schedules for different ID numbers (ID1, ID2, ID3) and time periods (Timely, Evening). Each entry includes status buttons for NOM, CON, and SCH.
- Weather:** A section providing current weather conditions for four locations: Springfield, MO (86°F, 88°/70°, 14% humidity); Oklahoma City, OK (92°F, 95°/71°, 0% humidity); Wichita, KS (88°F, 93°/67°, 57% humidity); and Kansas City, KS (86°F, 91°/70°, 44% humidity).
- Notices:** A list of critical and non-critical notices, including Force Majeure and Planned Service Outage events with their respective dates and descriptions.

This is how customers schedule their gas

# Measurement

The cash register  
of the natural gas industry

# What is measured?

- All natural gas transactions - rates, taxes, payments, reporting - are based on its:
  - volume
  - heating capacity, determined by the components in the gas; this is called its *thermal content* (Mcf vs. Dth or *Dekatherm*)
- Gas Quality continues to be an area of interest to end users (industrials, power plants, etc.)

# Wellhead to Burnertip



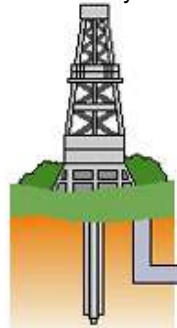
# Gas Control

The group that coordinates the flow of gas from receipt point to end user

## Wellhead to Burnertip

### Exploration & production

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Onshore well

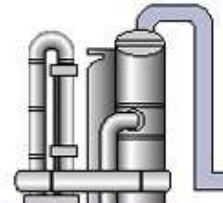


Offshore well

**Gas Control**  
... coordinates all pipeline operations to ensure safety & efficiency

### Gas Processing

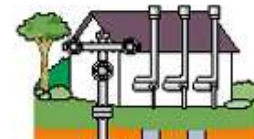
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Liquid byproducts

### Pipelines & Transmission

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Storage field

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homes, businesses, & industries

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City gate

What is Gas Control? How does this group ensure the safe and efficient operation of a pipeline?

# What is Gas Control?

- Gas Control coordinates the fined-tuned operations of the pipeline system. **24 / 7 / 365**
- Regardless of conditions, assure uninterrupted delivery of gas to customers:
  - In a safe manner
  - Reliably
    - in the required quantities
    - at the required pressure and quality
  - In the most efficient, economical way possible