Gas Well Decline

- Gas wells decline in volume and pressure as produced
- As the pressure declines so does the volume of gas being produced into the market pipeline.
  - Decline curves plot rate versus time
(after Considine et al., 2011)
Compression

**Purpose:**

- Well field development compressor stations clean, treat, and pressurize natural gas for safe and efficient transport
- Compression will increase or stabilize the pressure into transmission pipelines
- Main transmission systems are typically between 18” and 36” in diameter and run for long interstate distances to local distribution systems
- Friction and geographic elevation differences slow the gas and reduce the pressure over distance
- To ensure that the natural gas flowing through any one pipeline remains pressurized, compression of this natural gas is required periodically along the pipe, usually 40-100 mile intervals.
Compressor Station Components:

- **Station Yard Piping** - Station yard piping moves natural gas between the pipeline and compressor station.
- **Filter Separators / Scrubbers** - Filter separators or scrubbers remove any solids or liquids from the natural gas that enters the compressor station.
- **Compressor Units** - The compressor station runs compressor units sufficient to re-pressurize the volume of gas flowing through the pipeline.
- **Gas Cooling System** - When natural gas is compressed, its pressure and temperature increase. The gas may be cooled before returning to the pipeline to protect the pipeline’s inner coating and increase its transmission efficiency.
Compression Station Components continued:

- **Lube Oil System** - Compressor units have lube oil systems to lubricate, cool and protect the moving parts.
- **Mufflers (Exhaust Silencers)** - Mufflers decrease the volume level of compressor units.
- **Fuel Gas System** - Compressor units are fueled by natural gas from the pipeline or by large electric motors.
- **Backup Generators** - Backup generators in case of an electrical outage.
As the natural gas enters the compressor station, it is compressed by either a turbine, motor, or engine:

- **Turbine compressors**
  - Natural gas powered
  - The turbine serves to operate a centrifugal compressor, which contains a type of fan that compresses and pumps the natural gas through the pipeline

- **Electric compressors**
  - Electric motor turns the same type of centrifugal compressor; Quiet
  - Requires a reliable source of electricity; Does not require natural gas

- **Reciprocating natural gas engines (positive displacement)**
  - Engines resemble a very large automobile engine and are powered by natural gas from the pipeline
  - The combustion of the natural gas powers pistons on the outside of the engine, which serves to compress the natural gas
Compression

How Many Compressors expected?

- The number of compressors in a general area will vary based on the amount of gas produced from nearby wells, the size of the pipeline and the distance the gas has to travel to the nearest pipeline market.
- Currently 9 compressors have been constructed for unconventional development, 3 pending construction.
- Anticipate between 100 – 200 compressor stations on state forest lands.
- Compressors can either be used at the wellhead (distributed) or at a central location (centralized) along the pipeline.
Compression

- Distributed Compression
  - Gas wells on any pad are fed into a single compressor on the pad site and discharged to a gathering system at high to medium pressures and fed down the line to the market point on the main transmission system.
  - The advantage of this system is that all the compressors are smaller, less expensive, and operating pressures may be adjusted over time as the well pressures continue to fall, but the discharge pressure may be kept at a steady level.
  - The main disadvantage is the large number of compressors that would be needed for the typical Marcellus gas field.
Compression

• Centralized Compression
  – Gas wells on any pad are fed into a single low pressure or high pressure line and fed to a large centrally located compressor that may service multiple drill pads and tens of wells at one time.
  – The advantage of this system is far fewer compressors, which results in much lower maintenance costs over time. Although the compressors are expensive to purchase and install, the central location in large buildings lends itself to better control of the gas system to maintain a steady delivery gas volume without major control issues.
  – The main disadvantage to the operator is the expense of the large compressors.
  – Other disadvantages to land use include large footprint and noise.
Compression
Compression
Compression