

**METHANE EMISSIONS FROM  
THE NATURAL GAS INDUSTRY  
VOLUME 2: TECHNICAL REPORT**

**FINAL REPORT**

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### **3.0 METHODS**

This section characterizes the natural gas industry and describes in general terms the methods used to define and extrapolate emissions for all source types or categories that comprise the industry.

#### **3.1 Emission Source Characterization**

The first step for estimating methane emissions from the U.S. natural gas industry is to identify and characterize each emission source within the industry, so that all significant sources are included. To fully characterize the industry, sources were defined by equipment type, mode of operation, and type of emissions.

While this section draws a general picture of the industry, it is not intended to be a definitive picture of any company or of the industry regarding specific operational practices and procedures. Rather, it is intended to define the general industry equipment practices and procedures used in 1992, the base year of the program, that could lead to measurable emissions of methane. Details that were useful for determining methane emissions are contained in specific reports (see Table 2-1).

##### **3.1.1 General Industry Description**

The natural gas industry uses wells to produce natural gas existing in underground formations, then processes, compresses, and transports the gas to the customer. Transportation and distribution of natural gas involve interstate and intrastate pipeline transportation, storage, and finally distribution of the gas by local distribution pipeline networks.

The generally accepted segments of the natural gas industry are:

- 1) Production
- 2) Processing
- 3) Transmission/storage
- 4) Distribution

Each of these segments is shown in the flow chart for the industry in Figure 3-1. Some of the major equipment in each segment is shown in Table 3-1. Each segment is described in more detail in the following subsections.

This project set specific boundaries for each segment of the industry that specify what equipment is included in the study. The guideline used for setting the boundaries was to include only the equipment in each segment that is required for marketing natural gas. For example, oil production equipment is excluded if it is used to produce oil and not natural gas. Similarly, gas processing equipment associated with the fractionation of propane, butane, and natural gas liquids are excluded from consideration. In distribution, all equipment up to and including the customer's meter are included. End-user emissions are not included in this estimate.

Each industry segment is described in more detail in the following subsections:

### **Production Segment Description**

The production segment is comprised of gas and oil wells and the surface equipment required to produce gas. The well includes the holes drilled through subsurface rock to reach the producing formation and the subsurface equipment such as casing and tubing pipe. Gas and oil surface equipment can include separators, heaters, heater-treaters, tanks, dehydrators, compressors, pumps, and pipelines.

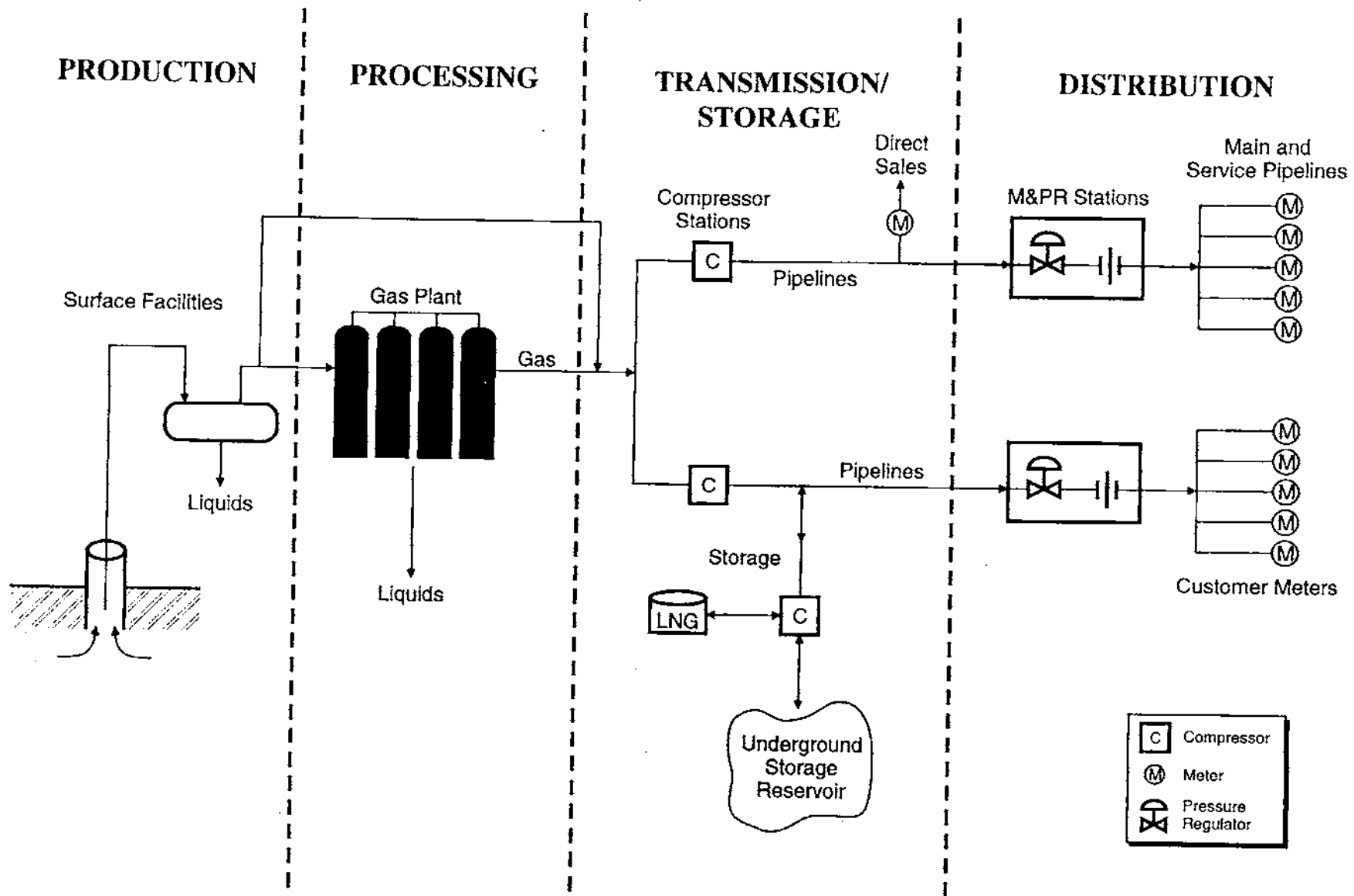


Figure 3-1. Gas Industry Flow Chart

**TABLE 3-1. INDUSTRY CHARACTERIZATION**

Segment	Facilities	Equipment at the Facility
Production	Well Sites, Central Gathering Facilities	Wellheads, Separators, Pneumatic Devices, Chemical Injection Pumps, Dehydrators, Compressors, Heaters, Meters, Pipelines
Processing	Gas Plants	Vessels, Dehydrators, Compressors, Acid Gas Removal (AGR) Units, Heaters, Pneumatic Devices
Transmission	Transmission Pipeline Networks, Compressor Stations, Meter and Pressure Regulating Stations	Vessels, Compressors, Pipelines, Meters/Pressure Regulators, Pneumatic Devices
Storage	Underground Injection/Withdrawal Facilities, and Liquefied Natural Gas (LNG) Facilities	Wellheads, Vessels, Compressors, Dehydrators, Heaters, Pneumatic Devices
Distribution	Main and Service Pipeline Networks, Meter and Pressure Regulating Stations	Pipelines, Meters and Pressure Regulators, Pneumatic Devices, Customer Meters

The definition for gas industry production equipment excludes equipment associated with oil production. Also, unmarketed natural gas, such as that produced by oil wells that vent gas or that reinject gas for gas lift circulation only, are not considered part of the natural gas industry. Figure 3-2 shows the general equipment found in the oil and gas production segment, as well as the boundaries between gas and oil production equipment used by this study.

The boundary between oil and gas equipment shown in Figure 3-2 affects the gas industry emissions estimate since it excludes some high emission rate production equipment associated with oil production. An accounting of total production segment emissions, or just oil industry emissions, will have to include the oil industry equipment excluded from this study (such as some pneumatics, some chemical injection pumps, and oil tanks).

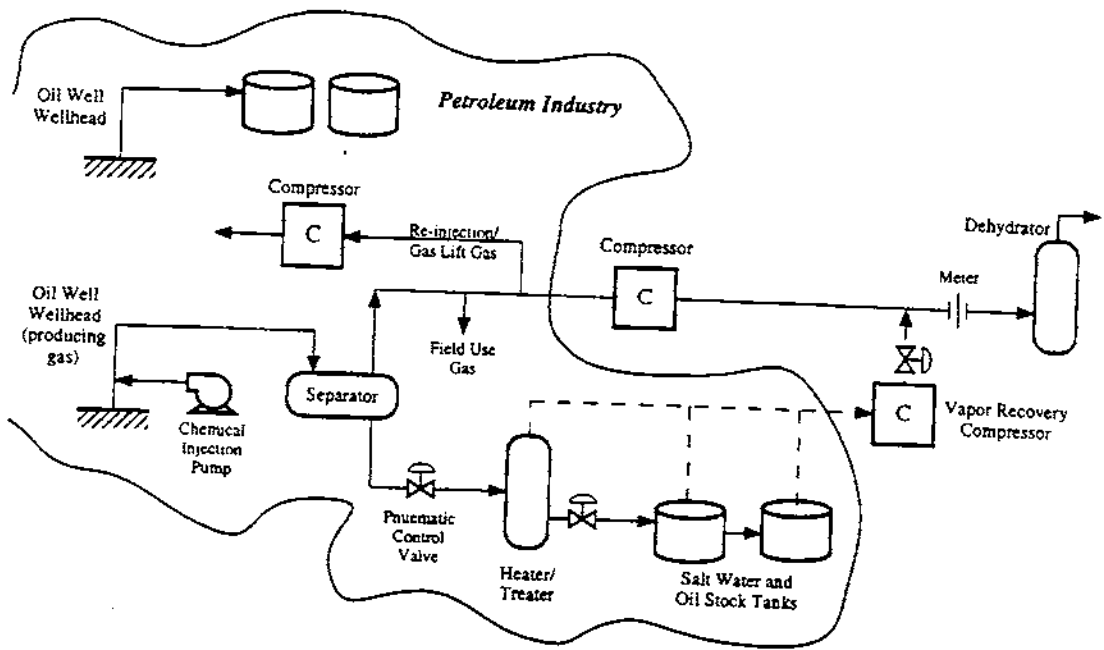
### **Gas Processing Segment Description**

Natural gas processing plants recover high value liquid products from the gas stream and maintain the quality (i.e., content and heating value) of the gas stream. The liquid products include natural gasoline, butane, propane, and in some cases, ethane. The products are removed by compression and cooling or by absorption.

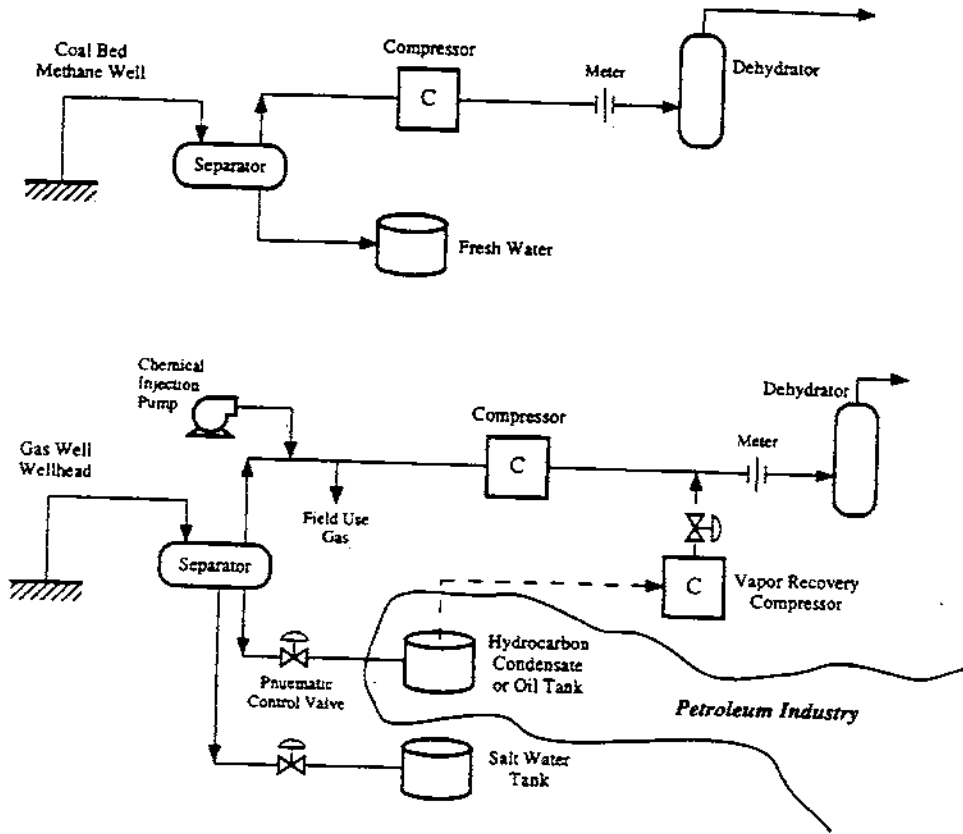
A gas plant may have fractionation towers and stabilization towers to further purify the individual components of the product stream. The back end of the gas plant, such as the fractionation train, is excluded from the gas industry definition since its function is to purify and market liquid products. Also, the back end of the gas plant has negligible methane emissions since the liquids handled have little methane content.

The front end of the gas plant often contains dehydration facilities, wet gas compression, and the absorption or compression and refrigeration process. All natural gas processing plants are considered part of the natural gas industry, and methane emissions from these facilities are included in this study.

**Oil Wells**



**Gas Wells**



**Figure 3-2. Gas Industry Boundaries**

## **Transmission and Storage Segment Description**

The transmission segment moves the natural gas from the gas plant or directly from field production to local distribution companies (LDCs). Gas is often transported across many states, such as from the Gulf Coast to the Eastern seaboard of the United States. The transmission segment consists of large diameter pipeline, compressor stations, and metering facilities. All of these facilities and all of the equipment they contain are considered part of the natural gas industry.

Transmission compressor stations usually consist of piping manifolds, reciprocating engines or gas turbines, reciprocating or centrifugal compressors, and generators, as shown in Figure 3-3. Dehydrators may be included but are not typically present because of upstream gas drying. Some transmission compressor stations may also include metering facilities.

Transmission companies also have metering and regulating stations (M&PR) where they exchange gas with other transmission companies, or where they deliver gas to LDCs or industrial customers. These stations may contain heaters, small dehydrators, and odorant addition equipment.

Most storage facilities exist to store natural gas produced during off-peak times (usually summer) so that gas can be produced and delivered during peak demand. Storage facilities are often located close to consumption centers so that cross-country transmission pipelines do not have to be sized for peak demand. Storage facilities can be below or above ground. Above-ground facilities are liquefied natural gas (LNG) facilities that liquefy the gas by supercooling and then storing the liquid phase methane in above ground, heavily insulated storage tanks. Below-ground facilities compress and store the gas (in vapor phase) in one of several formations: 1) spent gas production fields, 2) aquifers, or 3) salt caverns. Below-ground storage is the predominant means of gas storage.

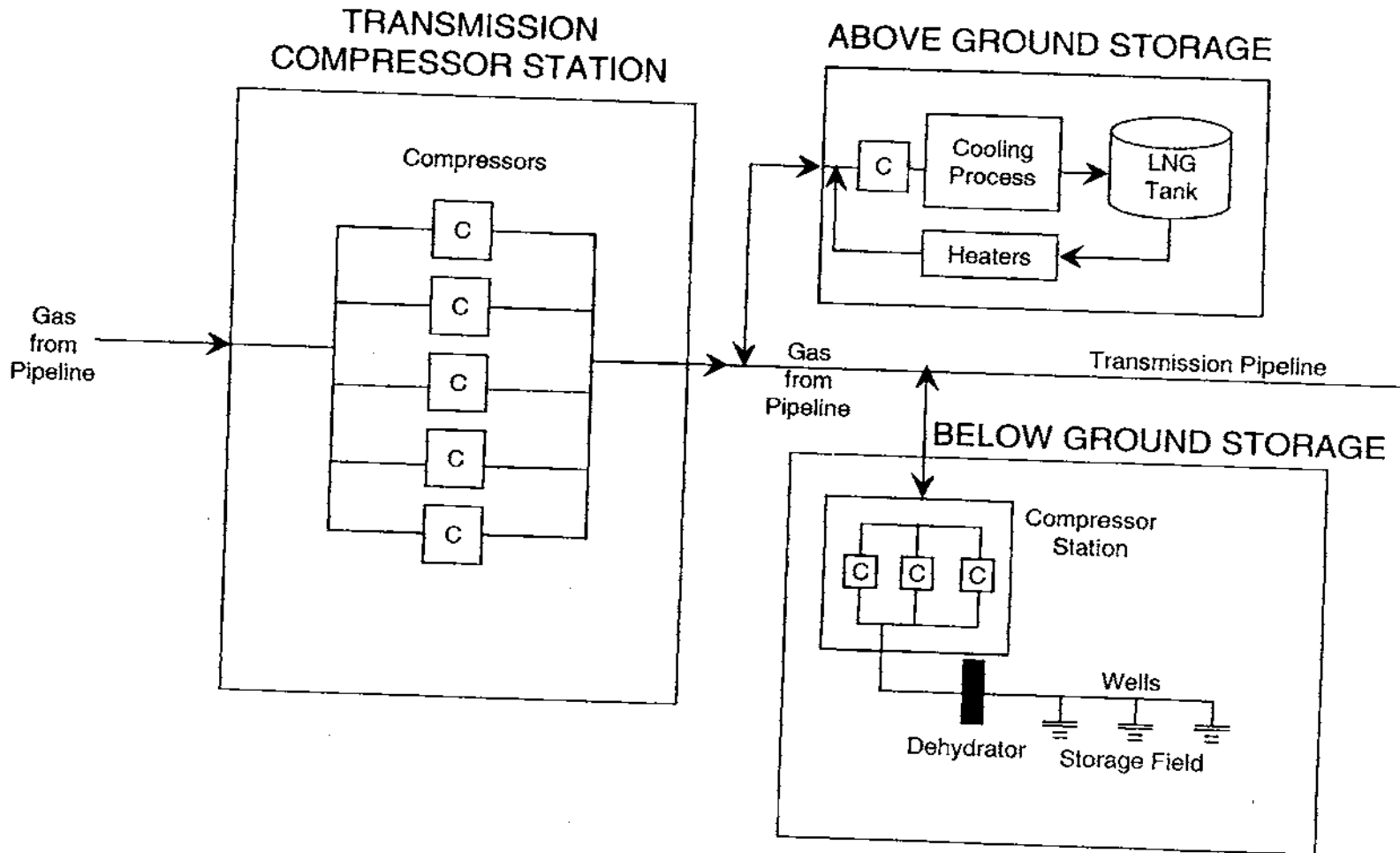


Figure 3-3. Transmission and Storage Stations

Most storage stations consist of a compressor station that is very similar to a transmission compression station (see Figure 3-3). Underground storage facilities also have storage field wells, and usually have dehydrators to remove water absorbed by the gas while underground. All storage equipment is included in boundaries of the natural gas industry defined by this project.

### **Distribution Segment Definition**

The distribution segment receives high pressure gas from transmission pipelines, reduces the pressure, and delivers the gas to residential, commercial, and industrial consumers. This segment includes pipelines (mains and services), M&PR stations and customer meters. All of these facilities are considered to be an integral part of the gas industry. Figure 3-4 shows a schematic of the distribution segment and the equipment that it includes.

#### **3.1.2 Operating Mode**

After identifying the major equipment (source types) in each industry segment, emissions from each source were identified by examining the *operating modes* of the equipment that may lead to emissions, and by associating one of three possible *types* of emissions from the source: fugitive emissions, vented emissions, or combustion emissions.

The cause of emissions is directly related to the operating mode of the equipment. Since more than one cause of emissions can be associated with a particular piece of equipment, it is important to identify the various operating modes in order to identify all emissions. In general, the operating modes are:

- Start-up;
- Normal operations;
- Maintenance;
- Upsets; and
- Mishaps.