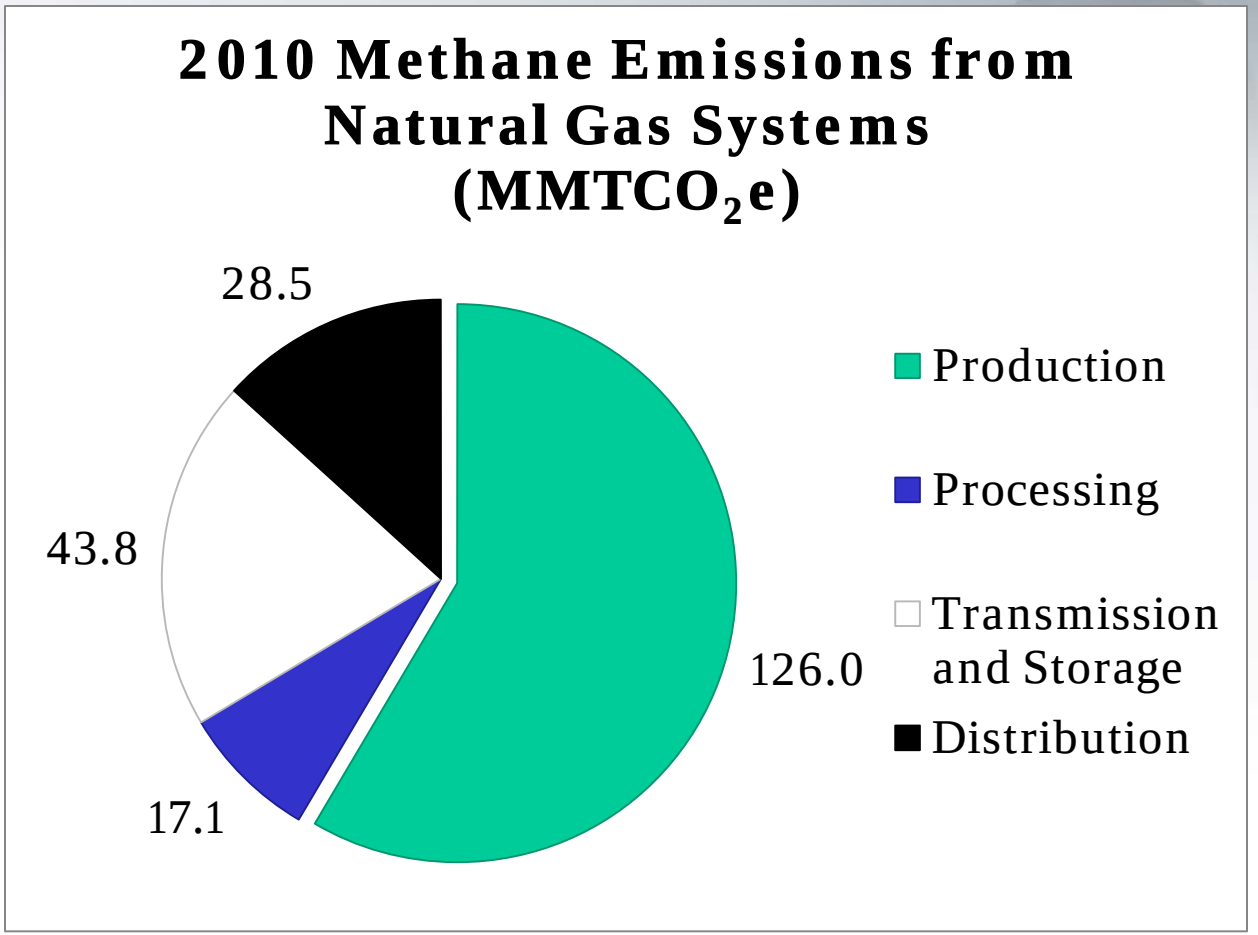
Natural Gas Production Sector Overview

September 13, 2012

Natural Gas Production

- 126.0 MMTCO2e
- 58.5% of total natural gas systems emissions



Background

Natural Gas Production – Sources including fugitives (e.g., gas wells, separation equipment, gathering compressors, etc.), drilling and well completions, well workovers, liquids unloading, condensate tanks, blowdowns, upsets, etc.

2012 Inventory Production Sector Emissions ($MMTCO_2e$)

	1990	1995	2000	2005	2010
Calculated Potential	88.9	101.0	126.4	141.0	185.9
Voluntary Reductions	+	-(1.6)	-(6.7)	-(29.9)	-(44.4)
Regulatory Reductions	-(0.2)	-(0.5)	-(6.4)	-(5.8)	-(15.4)
Net Emissions	89.0	98.9	113.3	105.2	126.0

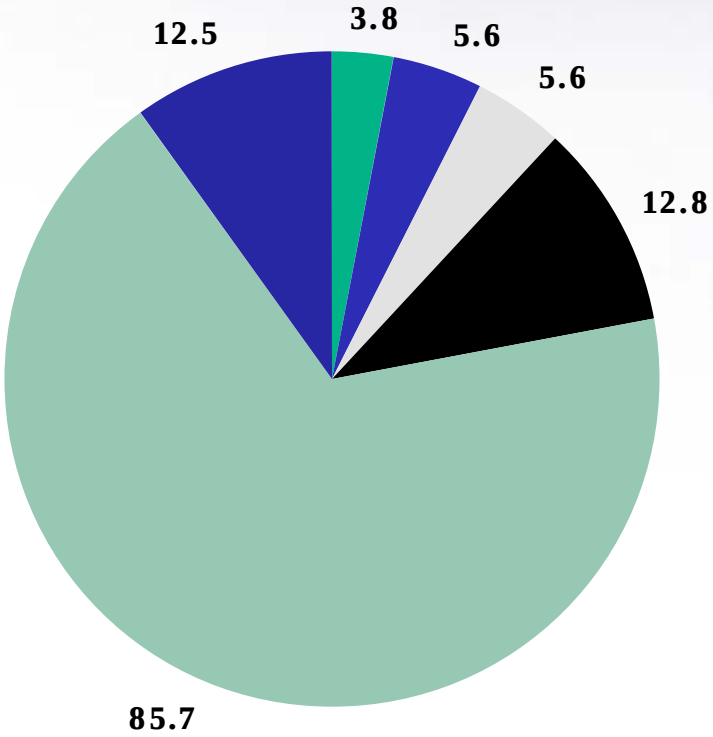
+ = Does not exceed 0.05 MMTCO2e

Production Emission Sources
Included in Inventory

Shallow water Gas Platforms (Gulf of Mexico and Pacific)	Pipeline Leaks – Gathering	Gas Well Completions with Hydraulic Fracturing
Deepwater Gas Platforms (Gulf of Mexico and Pacific)	Gas Well Completions without Hydraulic Fracturing	Gas Well Workovers with Hydraulic Fracturing
Non-associated Gas Wells (less fractured wells)	Gas Well Workovers without Hydraulic Fracturing	Liquids Unloading
Gas Wells with Hydraulic Fracturing	Well Drilling	Vessel – Blowdowns
Heaters – Field Separation Equipment	Pneumatic Device Vents	Pipeline – Blowdowns
Separators – Field Separation Equipment	Chemical Injection Pumps	Compressor – Blowdowns
Dehydrators – Field Separation Equipment	Kimray Pumps	Compressor Starts – Blowdowns
Meters/Piping – Field Separation Equipment	Dehydrator Vents	Pressure Relief Valves –Upsets
Small Reciprocating Compressors – Gathering	Condensate Tanks without Control Devices	Mishaps – Upsets
Large Reciprocating Compressors – Gathering	Condensate Tanks with Control Devices	Black Warrior – CBM Produced Water
Large Reciprocating Stations – Gathering	Gas Engines	Powder River – CBM Produced Water

Production Emission Sources

2010 Emissions from Natural Gas Production, (2012 Inventory) MMTCO2e



General Methodology Overview

Step 1. Calculate potential methane

- 1a – Activity Data
- 1b – Emission Factor

Step 2. Compile reductions data

- 2a – Voluntary Reductions Reported to GasStar
- 2b – Regulatory Reductions

Step 3. Calculate Net Emissions

Step 1. Calculate potential methane

Activity Data (AD) × Methane Emission Factor (EF) = Calculated potential

- Production Sector activity data and methane factors primarily from GRI/EPA (1996)
  - Exceptions – liquids unloading and hydraulically fractured well completions/workovers

Step 2. Compile Reductions Data

- Voluntary reductions activities in Production Sector include:
  - Install flash tank separators on glycol dehydrators
  - Identify and replace high-bleed pneumatic devices
  - Reduce methane emissions from compressor rod packing systems
  - Use of artificial lifts for liquids unloading
  - Reduced emissions completions at wells with hydraulic fracturing
- Regulatory reduction activities in Production Sector include:
  - State regulations requiring capture/combustion of gas from completions and workovers with hydraulic fracturing

Step 3. Calculate Net Emissions

Net Emissions = Calculated Potential – Reductions (Voluntary and Regulatory)

Example for 2010 Production Sector Emissions (2012 Inventory)

Potential Methane	Voluntary Reductions	Regulatory Reductions	Emissions (Tg CO_2e)
185.9	- 44.4	- 15.4	= 126.0