

3.6 Methodology for Estimating CH₄ and CO₂ Emissions from Natural Gas Systems

For the public review draft, this annex contains tables presenting methane emissions (in kt CH₄), activity data, average emission factors (in kg CH₄/unit) for the full 1990-2015 time series, and a short description of data sources and methods for each source, also in tabular format. Previous GHG Inventory annexes included the most recent year of information on activity data and average emission factors, and text describing data sources and methods for activity data and emission factors. EPA is seeking stakeholder feedback on the presentation of information in this format versus the previous annex discussion text. For information on CO₂ emissions, which have not been updated in this public review draft, please see the annexes of the 2016 GHG Inventory (1990-2014).

Natural Gas Systems Emissions, kt CH₄

Segment/Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Production													
Potential Emissions	2925.2	3038.3	3025.0	3099.4	3179.8	3176.3	3296.9	3365.2	3421.2	3546.5	3560.6	3816.2	3783.9
GasSTAR Reductions	0.0	0.0	0.0	8.9	28.3	44.1	85.1	95.9	121.0	138.5	144.0	163.8	169.4
Regulatory Reductions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.4	16.2	14.9	14.6
Net Emissions	2925.2	3038.3	3025.0	3090.4	3151.5	3132.1	3211.8	3269.2	3300.2	3391.7	3400.4	3637.6	3599.9
Normal Fugitives													
Gas Wells													
Non-associated Gas Wells (less fractured wells)	12.4	12.9	13.5	13.6	14.0	14.0	14.6	14.7	15.3	15.7	15.6	16.4	16.5
Gas Wells with Hydraulic Fracturing	7.6	8.7	9.2	9.8	10.6	11.1	11.7	12.1	12.7	13.5	15.0	17.3	19.0
Well Pad Equipment													
Heaters	12.7	13.2	13.8	14.4	15.0	15.3	16.2	16.2	16.9	17.0	17.0	17.9	18.3
Separators	40.9	42.4	44.7	46.0	49.1	50.3	53.4	54.6	58.0	61.6	65.8	72.5	77.2
Dehydrators	14.0	14.9	15.4	15.4	15.3	15.4	15.2	15.0	14.5	14.2	13.9	13.0	12.6
Meters/Piping	42.8	44.4	46.6	48.3	50.1	51.3	53.8	54.3	55.7	56.5	57.6	60.9	62.6
Compressors	33.2	34.4	35.7	38.6	40.6	41.7	45.5	45.5	49.0	48.0	47.5	51.5	52.8
Gathering and Boosting													
Gathering and Boosting Stations	956.9	961.0	975.5	992.7	1013.9	1019.2	1011.7	1012.8	1027.4	1137.4	1061.0	1079.6	1069.5
Pipeline Leaks	88.3	93.6	96.4	98.8	102.2	104.3	108.8	109.9	113.1	115.2	118.0	124.6	127.8
Vented and Combusted													
Drilling, Well Completion, and Well Workover													
Gas Well Completions without Hydraulic Fracturing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Gas Well Workovers without Hydraulic Fracturing	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Hydraulic Fracturing Completions and Workovers that vent	144.3	145.9	114.1	140.3	140.9	130.2	162.9	217.9	194.4	187.2	259.9	312.1	262.9
Flared Hydraulic Fracturing Completions and Workovers	2.1	2.2	1.7	2.1	2.1	1.9	2.4	3.2	2.9	2.8	3.8	4.9	4.3
Hydraulic Fracturing Completions and Workovers with RECs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.8
Hydraulic Fracturing Completions and Workovers with RECs that flare	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0
Well Drilling	0.7	0.6	0.5	0.7	0.6	0.5	0.6	0.7	0.7	0.7	1.0	1.3	1.0
Produced Water from Coal Bed Methane													
Powder River	0.04	0.1	0.5	0.5	0.8	1.5	1.6	3.7	6.0	12.6	31.4	44.2	51.0
Black Warrior	2.7	3.6	4.8	5.7	6.1	6.3	6.4	6.5	6.6	6.7	6.8	7.3	7.8
Normal Operations													
Pneumatic Device Vents	568.9	602.1	602.3	619.4	656.4	653.2	719.4	732.6	773.7	777.9	777.4	896.9	905.7
Chemical Injection Pumps	30.6	31.3	31.5	35.2	39.5	40.3	47.4	49.5	55.6	57.2	58.4	71.2	74.1
Kimray Pumps	163.4	183.1	184.9	183.3	180.3	180.4	175.5	172.0	166.8	163.6	161.7	148.4	145.4
Dehydrator Vents	50.9	57.1	57.6	57.2	56.2	56.2	54.7	53.6	52.0	51.0	50.4	46.3	45.3
Condensate Tank Vents													
Large Tanks w/Flares	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7
Large Tanks w/VRU	0.0	0.004	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.1	0.1
Large Tanks w/o Control	6.0	6.5	6.3	6.4	6.5	6.4	6.6	6.6	6.7	6.7	6.7	7.1	7.1
Small Tanks w/Flares	0.0	0.004	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.05	0.1	0.1	0.1
Small Tanks w/o Flares	14.3	15.6	15.3	15.6	16.0	16.0	16.7	16.9	17.4	17.5	17.7	19.1	19.5
Malfunctioning Separator Dump Valves	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.1	0.1	0.1	0.1	0.1

Natural Gas Systems Emissions, kt CH₄

Segment/Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Compressor Exhaust Vented													
Gas Engines	116.6	120.8	125.6	128.5	133.6	137.9	143.7	146.1	151.2	155.8	162.1	172.5	179.3
Liquids Unloading													
Liquids Unloading - Vent Using Plungers	0.0	3.3	6.6	10.2	14.0	17.6	22.2	26.4	31.3	35.9	40.7	48.7	54.5
Liquids Unloading - Vent Without Using Plungers	372.3	393.4	372.1	364.6	357.9	343.3	340.6	327.8	319.9	305.1	290.0	292.7	276.9
Blowdowns													
Vessel BD	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5
Pipeline BD	1.4	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.8	1.9	2.0	2.0
Compressor BD	1.3	1.3	1.4	1.5	1.6	1.6	1.8	1.8	1.9	1.9	1.8	2.0	2.0
Compressor Starts	2.9	3.0	3.1	3.3	3.5	3.6	3.9	3.9	4.2	4.1	4.1	4.5	4.6
G&B Station Episodic Events	94.9	95.3	96.8	98.5	100.6	101.1	100.3	100.5	101.9	112.8	105.2	107.1	106.1
Upsets													
Pressure Relief Valves	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5
Mishaps	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.1
Offshore													
Shallow water Gas Platforms (GoM and Pacific)	134.8	137.5	138.2	137.8	140.9	142.6	145.1	145.2	149.2	148.8	150.2	153.5	153.9
Deepwater Gas Platforms (GoM and Pacific)	6.2	6.2	7.0	7.1	7.5	8.7	9.6	10.5	11.3	14.2	15.1	16.1	17.8
Processing													
Net Emissions	853.2	842.8	848.2	821.4	799.5	735.3	673.0	649.1	588.6	590.0	576.7	550.7	547.5
Fugitives, Vented, and Combusted													
Plant Total Emissions	633.9	627.4	631.9	602.8	578.0	515.9	455.6	429.4	371.2	367.3	350.6	322.8	314.6
Plant Fugitives	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Reciprocating Compressors	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Centrifugal Compressors (wet seals)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Centrifugal Compressors (dry seals)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Flares	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Dehydrators	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Compressor Exhaust													
Gas Engines	137.1	135.9	137.0	140.9	144.8	148.7	152.6	156.5	160.4	164.3	168.2	172.1	176.0
Gas Turbines	3.9	3.8	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
AGR Vents	16.5	15.9	15.9	15.7	15.7	14.6	13.5	13.3	12.1	12.6	12.7	12.4	12.8
Pneumatic Devices	2.4	2.3	2.3	2.3	2.3	2.1	2.0	2.0	1.8	1.8	1.9	1.8	1.9
Routine Maintenance													
Blowdowns/Venting	59.5	57.4	57.2	55.8	54.8	50.1	45.4	44.0	39.2	40.1	39.6	37.8	38.4
Transmission and Storage													
Potential Emissions	2342.6	2371.7	2375.3	2327.7	2281.2	2229.4	2170.5	2124.6	2069.8	2015.6	1978.9	1907.7	1877.8
GasSTAR Reductions	0.0	0.0	0.0	53.5	77.6	101.7	82.8	127.4	183.1	213.0	255.1	330.7	351.4
Net Emissions	2342.6	2371.7	2375.3	2274.2	2203.6	2127.8	2087.6	1997.1	1886.7	1802.6	1723.8	1577.0	1526.3
Fugitives													
Pipeline Leaks	3.2	3.2	3.2	3.2	3.3	3.2	3.1	3.2	3.3	3.2	3.3	3.2	3.3
Compressor Stations (Transmission)													
Station Total Emissions	1098.4	1105.6	1096.6	1061.2	1026.1	991.4	957.2	923.3	889.9	856.9	824.3	792.2	760.4
Station + Compressor Fugitive Emissions	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Reciprocating Compressor	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Centrifugal Compressor (wet seals)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Centrifugal Compressor (dry seals)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Compressor Stations (Storage)													

Natural Gas Systems Emissions, kt CH₄

Segment/Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Station Total Emissions	245.6	254.8	262.3	254.1	246.0	238.0	230.2	222.4	214.7	207.1	199.7	192.3	185.0
Station + Compressor Fugitive Emissions	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Reciprocating Compressor	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Wells (Storage)	13.6	14.1	14.5	15.3	15.0	15.0	16.2	15.4	14.0	14.6	15.4	14.7	15.1
M&R (Trans. Co. Interconnect)	72.8	73.3	72.7	73.1	75.2	74.0	71.0	73.4	75.5	73.8	74.5	72.3	75.5
M&R (Farm Taps + Direct Sales)	16.9	17.0	16.9	17.0	17.5	17.2	16.5	17.0	17.5	17.1	17.3	16.8	17.5
Vented and Combusted													
Normal Operation													
Dehydrator vents (Transmission)	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.8
Dehydrator vents (Storage)	4.2	4.4	4.5	4.8	4.7	4.7	5.0	4.8	4.4	4.5	4.8	4.6	4.7
Compressor Exhaust													
Engines (Transmission)	176.9	180.5	186.7	191.8	196.1	204.9	208.6	209.8	205.3	206.7	215.3	205.2	212.3
Turbines (Transmission)	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Engines (Storage)	21.3	22.1	22.8	24.0	23.5	23.5	25.4	24.2	21.9	22.9	24.2	23.1	23.7
Turbines (Storage)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Generators (Engines)	8.7	8.8	9.1	9.4	9.6	10.0	10.2	10.3	10.0	10.1	10.5	10.0	10.4
Generators (Turbines)	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Pneumatic Devices Trans + Stor													
Pneumatic Devices Transmission	213.1	214.5	212.7	199.7	187.1	174.9	163.0	151.5	140.4	129.6	119.2	109.2	99.6
(High Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
(Intermittent Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
(Low Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Pneumatic Devices Storage	44.4	46.1	47.5	46.9	46.2	45.5	44.8	44.0	43.1	42.1	41.1	40.1	39.0
(High Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
(Intermittent Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
(Low Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Routine Maintenance/Upsets													
Pipeline venting	178.0	179.1	177.7	178.8	183.8	181.0	173.5	179.4	184.5	180.5	182.2	176.8	184.7
Station venting Trans + Storage													
Station Venting Transmission	145.5	146.4	145.3	144.2	143.1	142.0	140.9	139.8	138.7	137.6	136.5	135.4	134.3
Station Venting Storage	30.3	31.5	32.4	32.1	31.8	31.6	31.3	31.0	30.7	30.4	30.2	29.9	29.6
LNG Storage													
LNG Stations	9.2	9.3	9.5	9.6	9.7	9.8	9.9	10.0	10.1	10.2	10.3	10.4	10.5
LNG Reciprocating Compressors	34.5	34.9	35.4	35.8	36.2	36.7	37.1	37.5	38.0	38.4	38.8	39.3	39.7
LNG Centrifugal Compressors	11.8	11.9	12.1	12.2	12.4	12.5	12.7	12.9	13.0	13.2	13.3	13.5	13.6
LNG Compressor Exhaust													
LNG Engines	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.7	2.7	2.7
LNG Turbines	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
LNG Station venting	5.1	5.2	5.2	5.3	5.4	5.4	5.5	5.5	5.6	5.7	5.7	5.8	5.8
LNG Import Terminals													
LNG Stations	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3
LNG Reciprocating Compressors	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.5
LNG Centrifugal Compressors	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4
LNG Compressor Exhaust													
LNG Engines	1.7	1.3	1.0	1.7	1.1	0.5	0.9	1.6	1.8	3.2	4.4	4.7	4.5
LNG Turbines	0.01	0.01	0.005	0.01	0.01	0.002	0.005	0.01	0.01	0.02	0.03	0.03	0.03
LNG Station venting	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2

Natural Gas Systems Emissions, kt CH₄

Segment/Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Distribution													
Potential Emissions	1740.7	1714.8	1670.8	1652.0	1665.0	1536.4	1448.4	1406.2	1356.5	1275.7	1218.8	1169.0	1110.7
GasSTAR Reductions	0.0	0.0	0.0	20.5	25.2	19.7	23.9	30.3	26.0	32.9	29.9	36.9	155.5
Net Emissions	1740.7	1714.8	1670.8	1631.5	1639.8	1516.7	1424.5	1375.9	1330.6	1242.8	1188.9	1132.1	955.2
Normal Fugitives													
Pipeline Leaks													
Mains - Cast Iron	268.0	258.2	243.3	239.3	246.3	205.2	199.6	179.8	167.1	152.7	140.9	131.4	117.1
Mains - Unprotected steel	231.2	218.2	211.4	204.2	197.4	180.9	164.2	156.9	149.4	140.1	131.8	124.0	113.9
Mains - Protected steel	27.5	28.0	27.7	29.4	32.1	32.7	32.5	35.6	34.4	33.5	35.3	36.6	37.9
Mains - Plastic	59.4	48.8	51.0	53.5	58.0	58.5	55.0	61.8	56.0	54.5	55.1	56.9	56.2
Services - Unprotected steel	250.0	235.9	233.8	220.4	201.3	183.8	167.0	157.1	147.4	149.7	142.3	131.4	120.0
Services Protected steel	67.2	79.1	67.1	65.3	68.4	64.4	55.0	58.5	50.5	48.0	44.9	43.0	40.7
Services - Plastic	3.4	3.5	3.7	4.2	4.7	5.0	5.2	5.9	5.9	6.0	6.8	7.2	7.7
Services - Copper	7.8	8.0	7.7	7.9	7.7	7.1	7.4	7.7	7.2	7.1	7.0	6.8	6.7
Meter/Regulator (City Gates)													
M&R >300	140.6	141.8	139.6	139.4	142.6	131.9	123.9	119.1	116.7	105.5	98.9	93.5	88.2
M&R 100-300	272.8	275.2	270.9	270.4	276.4	255.4	239.9	230.3	225.6	203.6	190.7	180.1	169.6
M&R <100	6.6	6.6	6.5	6.9	7.4	7.2	7.2	7.4	7.7	7.5	7.6	7.8	8.1
Reg >300	138.4	139.6	137.5	137.0	139.7	128.9	120.7	115.6	112.9	101.6	94.8	89.0	83.4
R-Vault >300	0.7	0.7	0.6	0.7	0.7	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5
Reg 100-300	104.7	105.7	104.0	103.6	105.6	97.3	91.1	87.2	85.0	76.4	71.2	66.7	62.4
R-Vault 100-300	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Reg 40-100	8.1	8.1	8.0	8.4	9.0	8.8	8.7	8.9	9.3	9.0	9.1	9.3	9.6
R-Vault 40-100	0.6	0.6	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.7
Reg <40	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Customer Meters													
Residential	58.4	59.8	60.6	61.2	62.3	63.5	64.7	65.8	67.1	68.3	69.5	70.7	71.8
Commercial/Industry	43.4	44.5	45.0	45.5	46.1	47.2	48.0	48.6	51.3	51.0	50.9	50.7	51.3
Vented													
Routine Maintenance													
Pressure Relief Valve Releases	0.9	0.9	0.9	0.9	1.0	1.0	0.9	1.0	1.0	1.0	1.0	1.1	1.1
Pipeline Blowdown	3.0	3.1	3.0	3.2	3.4	3.3	3.3	3.4	3.6	3.5	3.5	3.6	3.7
Upsets													
Mishaps (Dig-ins)	47.4	47.8	47.0	49.4	53.3	52.1	51.9	53.1	55.7	54.0	54.8	56.3	58.2

Natural Gas Systems Emissions, kt CH₄

Segment/Source	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Production													
Potential Emissions	3915.5	3996.9	4149.3	4350.8	4418.7	4650.3	4475.2	4494.2	4590.9	4678.6	4665.0	4752.8	4709.7
GasSTAR Reductions	204.4	230.0	251.7	257.3	280.8	317.8	351.9	400.2	437.7	430.8	456.3	486.5	524.1
Regulatory Reductions	13.5	12.9	12.0	10.7	10.1	8.4	8.0	7.5	7.2	7.2	7.1	7.2	7.0
Net Emissions	3697.7	3754.1	3885.7	4082.8	4127.8	4324.1	4115.4	4086.5	4145.9	4240.6	4201.6	4259.1	4178.6
Normal Fugitives													
Gas Wells													
Non-associated Gas Wells (less fractured wells)	16.6	17.2	17.2	17.7	18.1	18.8	18.7	18.5	18.4	18.1	17.7	17.6	17.4
Gas Wells with Hydraulic Fracturing	20.8	22.4	24.7	27.2	30.2	32.6	33.6	34.0	34.9	34.9	34.3	34.4	34.0
Well Pad Equipment													
Heaters	18.8	19.4	20.0	20.7	21.1	22.1	22.4	22.9	23.1	23.0	22.6	22.5	22.1
Separators	82.3	89.0	95.1	103.1	110.1	118.2	120.6	121.3	122.9	122.5	119.9	118.1	116.8
Dehydrators	11.9	11.0	10.3	9.2	8.2	6.8	6.4	6.3	6.0	6.0	5.9	5.9	5.8
Meters/Piping	64.7	67.0	69.6	72.7	74.9	78.7	79.4	80.4	81.2	80.9	79.3	78.7	77.5
Compressors	54.8	56.6	58.8	61.5	62.6	67.0	67.9	70.9	71.7	71.3	70.1	70.9	69.0
Gathering and Boosting													
Gathering and Boosting Stations	1087.4	1086.3	1107.2	1164.7	1230.7	1331.0	1363.9	1431.8	1584.0	1697.0	1730.2	1877.9	1968.2
Pipeline Leaks	131.6	138.1	143.5	150.8	158.1	166.6	168.4	169.6	171.6	170.9	168.4	168.4	166.0
Vented and Combusted													
Drilling, Well Completion, and Well Workover													
Gas Well Completions without Hydraulic Fracturing	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Gas Well Workovers without Hydraulic Fracturing	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Hydraulic Fracturing Completions and Workovers that vent	299.9	324.3	376.1	393.2	358.5	356.2	211.5	192.9	168.6	120.6	79.4	75.8	5.1
Flared Hydraulic Fracturing Completions and Workovers	5.2	5.9	7.3	8.2	8.0	8.6	5.5	5.5	6.7	3.6	3.4	2.7	1.7
Hydraulic Fracturing Completions and Workovers with RECs	3.2	5.0	7.6	10.2	11.7	14.3	10.4	11.5	12.8	8.9	9.8	5.8	10.8
Hydraulic Fracturing Completions and Workovers with RECs that flare	1.8	2.7	4.2	5.7	6.5	7.9	5.7	6.3	7.1	10.1	10.7	15.7	9.0
Well Drilling	1.2	1.4	1.6	1.9	1.9	1.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Produced Water from Coal Bed Methane													
Powder River	50.4	48.1	50.0	61.1	62.1	64.7	54.0	50.6	47.2	47.0	47.3	47.6	48.1
Black Warrior	8.5	9.2	9.9	10.5	11.1	11.7	12.1	12.3	12.6	12.8	12.8	12.8	12.8
Normal Operations													
Pneumatic Device Vents	961.0	994.7	1041.1	1112.0	1129.7	1215.5	1192.2	1177.7	1148.6	1169.8	1180.6	1110.7	1065.2
Chemical Injection Pumps	81.9	87.8	95.3	105.9	111.1	124.8	127.0	130.8	132.3	131.8	129.8	130.3	126.8
Kimray Pumps	134.8	128.6	120.0	106.7	100.6	83.5	79.5	75.3	72.4	72.1	70.9	71.6	69.7
Dehydrator Vents	42.0	40.1	37.4	33.3	31.4	26.0	24.8	23.5	22.6	22.5	22.1	22.3	21.7
Condensate Tank Vents													
Large Tanks w/Flares	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Large Tanks w/VRU	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Large Tanks w/o Control	7.3	7.4	7.6	7.9	8.0	8.4	8.3	8.2	8.0	8.0	7.9	7.9	7.7
Small Tanks w/Flares	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Small Tanks w/o Flares	20.3	21.0	21.9	23.1	23.7	25.2	25.4	25.6	25.7	25.6	25.2	25.3	24.6
Malfunctioning Separator Dump Valves	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Natural Gas Systems Emissions, kt CH₄

Segment/Source	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Compressor Exhaust Vented													
Gas Engines	188.1	200.2	210.3	224.7	236.9	251.6	256.1	257.0	259.7	257.8	252.8	250.2	248.6
Liquids Unloading													
Liquids Unloading - Vent Using Plungers	62.1	69.8	78.5	89.2	98.3	111.6	119.6	128.0	136.1	126.4	114.2	117.0	126.0
Liquids Unloading - Vent Without Using Plungers	266.3	251.9	237.2	223.6	202.0	184.3	154.4	123.7	91.5	101.0	110.5	108.5	92.4
Blowdowns													
Vessel BD	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.6
Pipeline BD	2.1	2.2	2.3	2.4	2.5	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.6
Compressor BD	2.1	2.2	2.3	2.4	2.4	2.6	2.6	2.7	2.8	2.8	2.7	2.7	2.7
Compressor Starts	4.7	4.9	5.1	5.3	5.4	5.8	5.9	6.1	6.2	6.2	6.1	6.1	6.0
G&B Station Episodic Events	107.9	107.7	109.8	115.5	122.1	132.0	135.3	142.0	157.1	168.3	171.6	186.3	195.2
Upsets													
Pressure Relief Valves	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Mishaps	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.4
Offshore													
Shallow water Gas Platforms (GoM and Pacific)	153.4	150.6	149.3	149.0	141.6	138.8	129.1	123.5	123.5	123.5	123.5	123.5	123.5
Deepwater Gas Platforms (GoM and Pacific)	18.8	20.4	24.1	27.4	24.9	25.7	26.4	27.1	27.1	27.1	27.1	27.1	27.1
Processing													
Net Emissions	521.7	504.8	486.0	472.9	458.5	444.0	428.8	415.0	405.4	405.5	434.4	445.6	444.8
Fugitives, Vented, and Combusted													
Plant Total Emissions	287.2	267.3	245.8	229.1	211.4	193.5	175.0	157.5	143.2	143.3	153.2	157.1	156.3
Plant Fugitives	NE	NE	NE	NE	NE	NE	NE	NE	14.6	14.6	15.7	16.1	16.1
Reciprocating Compressors	NE	NE	NE	NE	NE	NE	NE	NE	64.4	64.4	69.1	70.9	70.9
Centrifugal Compressors (wet seals)	NE	NE	NE	NE	NE	NE	NE	NE	22.1	22.4	22.8	23.1	21.4
Centrifugal Compressors (dry seals)	NE	NE	NE	NE	NE	NE	NE	NE	7.0	6.8	7.9	8.3	9.2
Flares	NE	NE	NE	NE	NE	NE	NE	NE	19.8	19.8	21.2	21.8	21.8
Dehydrators	NE	NE	NE	NE	NE	NE	NE	NE	15.4	15.4	16.5	16.9	16.9
Compressor Exhaust													
Gas Engines	179.9	183.7	187.6	191.5	195.4	199.3	203.2	207.1	211.0	211.0	226.3	232.2	232.2
Gas Turbines	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	4.2	4.3	4.3
AGR Vents	12.4	12.4	12.3	12.4	12.4	12.5	12.5	12.7	13.1	13.1	14.1	14.5	14.5
Pneumatic Devices	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9	2.1	2.1	2.1
Routine Maintenance													
Blowdowns/Venting	36.6	35.7	34.6	34.1	33.6	33.0	32.3	31.9	32.3	32.3	34.6	35.5	35.5
Transmission and Storage													
Potential Emissions	1827.5	1781.4	1726.0	1673.1	1647.6	1608.8	1564.7	1533.2	1493.9	1491.8	1563.4	1617.0	1687.6
GasSTAR Reductions	353.4	409.9	496.2	458.3	435.3	437.7	379.0	433.2	341.9	375.4	331.8	335.0	338.2
Net Emissions	1474.1	1371.5	1229.8	1214.8	1212.3	1171.1	1185.7	1100.0	1151.9	1116.4	1231.6	1282.0	1349.4
Fugitives													
Pipeline Leaks	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Compressor Stations (Transmission)													
Station Total Emissions	729.0	698.1	667.6	637.5	607.8	578.5	549.7	521.2	493.2	496.0	536.0	574.3	572.4
Station + Compressor Fugitive Emissions	NE	NE	NE	NE	NE	NE	NE	NE	94.8	101.6	109.7	117.6	117.4
Reciprocating Compressor	NE	NE	NE	NE	NE	NE	NE	NE	301.6	293.7	317.2	340.0	339.4
Centrifugal Compressor (wet seals)	NE	NE	NE	NE	NE	NE	NE	NE	47.1	51.1	55.9	59.2	57.0
Centrifugal Compressor (dry seals)	NE	NE	NE	NE	NE	NE	NE	NE	49.7	49.7	53.2	57.5	58.7
Compressor Stations (Storage)													

Natural Gas Systems Emissions, kt CH₄

Segment/Source	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Station Total Emissions	177.9	170.8	163.9	159.8	153.2	151.0	146.0	140.9	136.5	131.0	131.6	131.6	129.0
Station + Compressor Fugitive Emissions	NE	NE	NE	NE	NE	NE	NE	NE	NE	25.1	25.3	25.3	24.8
Reciprocating Compressor	NE	NE	NE	NE	NE	NE	NE	NE	NE	105.8	106.4	106.4	104.2
Wells (Storage)	15.7	15.0	14.9	13.5	14.6	15.1	14.8	14.8	14.6	12.8	15.1	15.7	92.6
M&R (Trans. Co. Interconnect)	75.2	75.5	74.9	74.9	75.1	75.6	75.9	76.0	76.1	75.6	75.5	75.3	75.1
M&R (Farm Taps + Direct Sales)	17.5	17.5	17.4	17.4	17.4	17.6	17.6	17.6	17.7	17.6	17.5	17.5	17.4
Vented and Combusted													
Normal Operation													
Dehydrator vents (Transmission)	1.8	1.8	1.8	1.8	1.8	1.8	1.7	1.7	1.7	1.8	2.0	2.1	2.1
Dehydrator vents (Storage)	4.9	4.7	4.6	4.2	4.5	4.7	4.6	4.6	4.5	4.0	4.7	4.9	4.4
Compressor Exhaust													
Engines (Transmission)	205.6	206.6	203.1	200.1	213.2	214.8	211.4	222.3	225.9	235.6	241.3	245.4	252.0
Turbines (Transmission)	1.2	1.2	1.2	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4
Engines (Storage)	24.6	23.6	23.4	21.2	22.9	23.7	23.2	23.2	22.9	20.1	23.8	24.7	22.4
Turbines (Storage)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Generators (Engines)	10.1	10.1	9.9	9.8	10.4	10.5	10.3	10.9	11.1	11.5	11.8	12.0	12.3
Generators (Turbines)	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Pneumatic Devices Trans + Stor													
Pneumatic Devices Transmission	90.4	81.5	73.0	64.9	57.2	49.8	42.8	36.2	30.0	21.5	26.6	27.8	29.6
(High Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	19.5	10.0	11.9	12.1	14.6
(Intermittent Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	10.0	10.8	13.9	14.9	14.1
(Low Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	0.5	0.6	0.7	0.8	0.8
Pneumatic Devices Storage	37.8	36.6	35.3	33.9	32.5	31.0	29.5	27.9	26.3	26.0	30.1	29.4	22.5
(High Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	22.7	21.7	25.0	23.9	16.2
(Intermittent Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	3.2	3.8	4.5	5.0	5.8
(Low Bleed)	NE	NE	NE	NE	NE	NE	NE	NE	0.4	0.4	0.6	0.5	0.4
Routine Maintenance/Upsets													
Pipeline venting	183.8	184.7	183.2	183.1	183.5	184.8	185.7	185.8	186.0	184.9	184.6	184.0	183.6
Station venting Trans + Storage													
Station Venting Transmission	133.2	132.1	131.0	129.9	128.8	127.7	126.6	125.5	124.4	133.2	143.9	154.3	154.0
Station Venting Storage	29.3	29.0	28.8	29.0	28.8	29.4	29.4	29.5	29.7	29.7	29.9	29.9	29.3
LNG Storage													
LNG Stations	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6
LNG Reciprocating Compressors	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1
LNG Centrifugal Compressors	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
LNG Compressor Exhaust													
LNG Engines	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
LNG Turbines	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
LNG Station venting	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
LNG Import Terminals													
LNG Stations	0.4	0.4	0.4	0.4	0.4	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2
LNG Reciprocating Compressors	2.0	2.0	2.0	2.0	2.0	5.0	5.6	5.6	5.6	5.6	5.6	5.6	5.6
LNG Centrifugal Compressors	0.5	0.5	0.5	0.5	0.5	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4
LNG Compressor Exhaust													
LNG Engines	9.8	12.6	12.2	11.3	14.8	6.9	8.8	8.4	6.9	3.6	2.1	1.4	2.0
LNG Turbines	0.1	0.1	0.1	0.1	0.1	0.04	0.1	0.05	0.04	0.02	0.01	0.01	0.01
LNG Station venting	0.2	0.2	0.2	0.2	0.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6

Natural Gas Systems Emissions, kt CH₄

Segment/Source	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Distribution													
Potential Emissions	1023.5	981.8	931.9	881.1	726.8	681.7	620.2	554.1	502.1	496.0	489.9	487.3	480.3
GasSTAR Reductions	123.2	110.5	48.3	62.7	56.3	50.3	63.9	54.5	58.0	45.1	40.5	40.8	41.2
Net Emissions	900.2	871.2	883.6	818.3	670.5	631.4	556.3	499.6	444.1	450.8	449.4	446.4	439.1
Normal Fugitives													
Pipeline Leaks													
Mains - Cast Iron	107.1	98.5	88.9	79.8	71.0	62.6	54.1	46.3	39.0	37.5	35.8	34.0	32.1
Mains - Unprotected steel	103.1	100.5	91.3	86.2	80.1	74.7	67.4	62.6	56.0	54.9	52.2	50.4	48.1
Mains - Protected steel	39.1	41.3	41.6	42.7	43.5	44.3	45.3	46.3	47.3	47.2	47.1	47.1	46.9
Mains - Plastic	49.1	48.1	44.8	41.7	37.9	33.3	28.8	23.8	18.7	19.1	19.5	19.9	20.4
Services - Unprotected steel	107.4	102.0	111.6	109.2	100.1	94.1	85.7	65.3	60.0	56.7	53.2	49.7	47.8
Services Protected steel	37.6	37.9	32.4	29.6	27.4	25.5	23.5	21.5	19.8	19.4	19.1	18.9	18.6
Services - Plastic	8.0	8.6	9.1	9.6	10.1	10.5	10.9	11.2	11.7	11.9	12.1	12.3	12.5
Services - Copper	6.7	7.0	6.1	6.1	6.0	5.6	5.3	5.3	5.2	4.9	4.8	4.6	4.4
Meter/Regulator (City Gates)													
M&R >300	78.6	72.3	64.9	57.9	31.6	26.7	20.2	14.4	8.5	8.2	8.4	8.9	8.6
M&R 100-300	150.9	138.4	123.9	110.1	59.7	50.1	37.4	25.9	14.4	13.9	14.2	15.2	14.6
M&R <100	8.0	8.2	8.3	8.6	5.6	5.8	5.6	5.6	5.6	5.4	5.6	5.9	5.7
Reg >300	73.6	66.9	59.3	51.9	27.5	22.4	15.8	9.8	3.8	3.6	3.7	4.0	3.8
R-Vault >300	0.4	0.4	0.4	0.4	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2
Reg 100-300	54.9	49.8	43.9	38.2	20.1	16.1	11.1	6.5	1.9	1.8	1.9	2.0	1.9
R-Vault 100-300	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.6
Reg 40-100	9.4	9.6	9.8	10.0	6.5	6.7	6.5	6.5	6.5	6.2	6.4	6.8	6.5
R-Vault 40-100	1.8	1.9	2.0	2.2	1.5	1.6	1.6	1.7	1.3	1.3	1.0	1.0	0.4
Reg <40	0.5	0.5	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Customer Meters													
Residential	72.7	73.5	75.0	75.6	76.6	76.9	77.2	77.4	77.9	78.4	78.9	79.4	79.4
Commercial/Industry	52.2	52.1	52.6	53.2	53.6	55.2	53.8	53.5	53.6	54.0	54.2	54.6	54.6
Vented													
Routine Maintenance													
Pressure Relief Valve Releases	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Pipeline Blowdown	3.7	3.8	3.9	4.0	4.0	4.1	4.1	4.1	4.2	4.2	4.2	4.3	4.3
Upsets													
Mishaps (Dig-ins)	57.3	59.0	60.1	61.9	62.0	63.5	63.9	64.4	65.0	65.5	65.8	66.4	67.1

Natural Gas Systems Activity Data

Segment/Source	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PRODUCTION														
Gas Wells														
Total active gas wells	wells	214,220	236,309	233,861	240,169	247,709	250,284	262,382	267,600	277,786	282,974	288,491	314,108	322,508
Non-associated Gas Wells (less fractured wells)	wells	154,370	160,430	160,406	161,839	164,222	165,217	169,363	171,529	177,281	178,281	175,191	187,823	189,280
Gas Wells with Hydraulic Fracturing	wells	59,850	75,879	73,455	78,330	83,487	85,067	93,019	96,071	100,505	104,693	113,300	126,285	133,228
Well Pad Equipment														
Heaters	heaters	53,218	54,303	54,658	56,968	58,866	58,804	62,568	63,375	66,152	66,145	65,697	71,783	72,661
Separators	separators	124,287	139,368	137,307	141,740	147,430	150,005	158,858	162,870	170,885	175,167	179,975	199,024	205,838
Dehydrators	dehydrators	29,866	32,946	32,605	32,139	31,393	31,112	29,921	29,431	28,442	27,952	27,618	25,418	24,901
Meters/Piping	meters	197,710	201,836	202,256	211,528	219,287	220,384	235,588	240,555	250,031	251,718	252,316	279,939	284,882
Compressors	compressors	18,870	19,161	19,141	20,325	21,018	21,248	22,767	22,857	24,529	24,098	23,856	26,061	26,688
Gathering and Boosting														
Gathering and Boosting Stations	stations	2,565	2,576	2,615	2,661	2,718	2,732	2,712	2,715	2,754	3,049	2,844	2,894	2,867
Pipeline Leaks	miles	248,854	258,955	257,999	261,282	266,634	268,330	275,267	278,910	286,582	292,374	299,304	317,257	325,851
Drilling, Well Completion, and Well Workover														
Gas Well Completions without Hydraulic Fracturing	completions/year	366	404	400	411	424	428	449	458	475	484	493	537	552
Gas Well Workovers without Hydraulic Fracturing	workovers/year	6,715	6,979	6,978	7,040	7,144	7,187	7,367	7,462	7,712	7,755	7,621	8,170	8,234
Hydraulic Fracturing Completions and Workovers that vent	completions and workovers/year	3,920	3,962	3,097	3,811	3,827	3,534	4,424	5,917	5,278	5,083	7,058	8,475	7,138
Flared Hydraulic Fracturing Completions and Workovers	completions and workovers/year	436	440	344	423	425	393	492	657	586	565	784	989	877
Hydraulic Fracturing Completions and Workovers with RECs	completions and workovers/year	0	0	0	0	0	0	0	0	0	0	0	313	554
Hydraulic Fracturing Completions and Workovers with RECs that flare	completions and workovers/year	0	0	0	0	0	0	0	0	0	0	0	115	204
Well Drilling	wells	15,096	13,066	10,887	13,047	12,232	10,465	11,498	14,473	14,507	14,564	19,863	25,350	20,041
Normal Operations														
Pneumatic Device Vents	controllers	225,085	238,242	238,308	257,298	279,626	285,576	322,996	338,038	367,144	379,978	391,157	465,353	485,025
Pneumatic Device Vents - Low Bleed (LB)	controllers	0	0	0	8,995	14,664	19,968	28,230	35,454	44,924	53,137	61,538	81,345	93,262
Pneumatic Device Vents - High Bleed (HB)	controllers	78,780	83,385	83,408	83,526	87,227	85,460	92,561	92,584	95,898	94,430	92,246	103,840	102,077
Pneumatic Device Vents - Intermittent Bleed (IB)	controllers	146,306	154,857	154,900	164,777	177,735	180,147	202,205	210,000	226,322	232,412	237,374	280,168	289,687
Chemical Injection Pumps	active pumps	17,524	17,955	18,077	20,333	22,938	23,570	27,963	29,386	33,255	34,436	35,369	43,440	45,586
Kimray Pumps	MMscf/yr	8,741,661	9,643,045	9,543,150	9,406,778	9,188,460	9,106,182	8,757,621	8,614,202	8,324,647	8,181,253	8,083,478	7,439,576	7,288,448

Natural Gas Systems Activity Data

Segment/Source	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Dehydrator Vents	MMscf/yr	9,811,067	10,822,722	10,710,606	10,557,551	10,312,525	10,220,182	9,828,980	9,668,016	9,343,038	9,182,102	9,072,366	8,349,692	8,180,077
Condensate Tank Vents														
Large Tanks w/Flares	tanks	9,430	10,487	10,462	10,831	11,259	11,466	12,114	12,451	13,025	13,369	13,733	15,065	15,584
Large Tanks w/VRU	tanks	0	103	204	314	432	546	686	817	969	1,111	1,258	1,507	1,688
Large Tanks w/o Control	tanks	9,430	10,215	9,923	10,000	10,117	10,024	10,300	10,292	10,463	10,434	10,408	11,083	11,123
Small Tanks w/Flares	tanks	0	575	1,137	1,752	2,409	3,043	3,828	4,555	5,404	6,193	7,015	8,402	9,411
Small Tanks w/o Flares	tanks	67,607	74,003	72,668	74,044	75,766	75,945	78,978	79,898	82,264	83,112	84,031	90,729	92,371
Malfunctioning Separator Dump Valves	tanks	18,861	20,805	20,590	21,145	21,809	22,036	23,101	23,560	24,457	24,914	25,400	27,655	28,394
Compressor Exhaust Vented														
Gas Engines	MMHPhr	26,830	27,346	27,460	27,709	28,357	28,771	29,421	29,927	30,982	31,949	33,268	35,481	36,930
Liquids Unloading														
Liquids Unloading - Vent Using Plungers	venting wells	0	1,164	2,303	3,548	4,879	6,162	7,752	9,223	10,942	12,540	14,205	17,013	19,056
Liquids Unloading - Vent Without Using Plungers	venting wells	120,499	127,319	120,453	118,006	115,835	111,103	110,250	106,096	103,546	98,768	93,851	94,735	89,619
Blowdowns														
Vessel Blowdowns	vessels	207,371	226,617	224,570	230,847	237,689	239,920	251,347	255,675	265,479	269,264	273,289	296,225	303,401
Pipeline Blowdowns	miles (gathering)	248,854	258,955	257,999	261,282	266,634	268,330	275,267	278,910	286,582	292,374	299,304	317,257	325,851
Compressor Blowdowns	compressors	18,870	19,161	19,141	20,325	21,018	21,248	22,767	22,857	24,529	24,098	23,856	26,061	26,688
Compressor Starts	compressors	18,870	19,161	19,141	20,325	21,018	21,248	22,767	22,857	24,529	24,098	23,856	26,061	26,688
G&B Station Episodic Events	stations	2,565	2,576	2,615	2,661	2,718	2,732	2,712	2,715	2,754	3,049	2,844	2,894	2,867
Upsets														
Pressure Relief Valves	PRV	484,975	534,982	529,440	543,721	560,791	566,620	594,009	605,822	628,882	640,627	653,117	711,112	730,129
Mishaps	miles	62,214	64,740	64,500	65,321	66,659	67,083	68,818	69,728	71,646	73,094	74,827	79,315	81,463
Produced Water from Coal Bed Methane														
Black Warrior	wells	1,300	1,704	2,230	2,581	2,706	2,731	2,768	2,774	2,838	2,873	2,928	3,143	3,357
Powder River	gal produced water	24,833,340	76,253,310	253,637,580	258,413,526	395,441,592	731,194,212	850,452,960	1,895,693,394	3,032,900,388	6,429,856,860	15,783,545,946	21,506,423,610	24,318,956,382
Offshore														
Shallow water Gas Platforms (GoM and Pacific)	Shallow water gas platforms	2,155	2,198	2,209	2,202	2,252	2,280	2,319	2,321	2,385	2,378	2,401	2,453	2,461
Deepwater Gas Platforms (GoM and Pacific)	Deep water gas platforms	9	9	11	11	11	13	15	16	17	22	23	24	27
GAS PROCESSING PLANTS														
Fugitives, Vented, and Combusted														
Plant Total Emissions	plants	761	734	732	726	725	675	623	615	558	581	585	570	590
Plant Fugitives	plants	761	734	732	726	725	675	623	615	558	581	585	570	590
Reciprocating Compressors	compressors	4,128	4,094	4,126	4,095	4,091	3,811	3,520	3,477	3,156	3,288	3,313	3,230	3,345
Centrifugal Compressors (wet seals)	compressors	665	660	665	651	641	589	535	520	465	476	472	452	459
Centrifugal Compressors (dry seals)	compressors	0	0	0	13	26	37	46	57	62	76	88	97	113
Flares	plants	761	734	732	726	725	675	623	615	558	581	585	570	590
Dehydrators	plants	761	734	732	726	725	675	623	615	558	581	585	570	590
Compressor Exhaust														
Gas Engines	MMHPhr	29,660	29,410	29,642	30,485	31,327	32,170	33,012	33,854	34,697	35,539	36,382	37,224	38,066

Natural Gas Systems Activity Data

Segment/Source	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Gas Turbines	MMHPhr	35,169	34,872	35,147	35,159	35,171	35,183	35,195	35,207	35,218	35,230	35,242	35,254	35,266
AGR Vents	AGR units	386	372	371	368	367	342	316	312	283	294	296	289	299
Pneumatic Devices	gas plants	761	734	732	726	725	675	623	615	558	581	585	570	590
Routine Maintenance														
Blowdowns/Venting	gas plants	761	734	732	726	725	675	623	615	558	581	585	570	590
TRANSMISSION AND STORAGE														
Fugitives														
Pipeline Leaks	miles	291,925	293,862	291,468	293,263	301,545	296,947	284,672	294,370	302,709	296,059	298,957	289,994	302,999
Compressor Stations (Transmission)														
Station	stations	1,733	1,744	1,730	1,717	1,704	1,691	1,678	1,665	1,652	1,639	1,626	1,613	1,600
Reciprocating Compressor	compressors	6,967	7,013	6,956	6,834	6,712	6,591	6,469	6,347	6,225	6,103	5,981	5,859	5,737
Centrifugal Compressor (total)	compressors	699	703	698	757	816	875	934	993	1,052	1,111	1,171	1,230	1,289
Centrifugal Compressor (wet seals)	compressors	699	703	698	697	697	697	697	696	696	696	695	695	695
Centrifugal Compressor (dry seals)	compressors	0	0	0	59	119	178	238	297	356	416	475	535	594
Compressor Stations (Storage)														
Station	stations	361	375	386	383	379	376	373	369	366	363	359	356	353
Reciprocating Compressor	compressors	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Wells (Storage)	wells	16,853	17,483	17,999	19,021	18,604	18,614	20,115	19,126	17,347	18,136	19,174	18,311	18,762
M&R (Trans. Co. Interconnect)	stations	2,599	2,616	2,595	2,611	2,684	2,643	2,534	2,620	2,695	2,635	2,661	2,581	2,697
M&R (Farm Taps + Direct Sales)	stations	77,053	77,564	76,932	77,406	79,592	78,378	75,139	77,698	79,899	78,144	78,909	76,543	79,976
Vented and Combusted														
Normal Operation														
Dehydrator vents (Transmission)	MMscf/yr	1,104,607	1,111,937	1,102,878	1,094,549	1,086,220	1,077,891	1,069,563	1,061,234	1,052,905	1,044,576	1,036,247	1,027,918	1,019,589
Dehydrator vents (Storage)	MMscf/yr	1,872,608	1,942,686	2,000,001	2,113,594	2,067,223	2,068,338	2,235,115	2,125,248	1,927,597	2,015,185	2,130,538	2,034,659	2,084,756
Compressor Exhaust														
Engines (Transmission)	MMHPhr	38,275	39,050	40,380	41,501	42,414	44,330	45,133	45,389	44,408	44,726	46,578	44,393	45,927
Turbines (Transmission)	MMHPhr	9,133	9,318	9,635	9,903	10,120	10,577	10,769	10,830	10,596	10,672	11,114	10,593	10,959
Engines (Storage)	MMHPhr	4,608	4,781	4,922	5,202	5,087	5,090	5,501	5,230	4,744	4,959	5,243	5,007	5,131
Turbines (Storage)	MMHPhr	1,619	1,679	1,729	1,827	1,787	1,788	1,932	1,837	1,666	1,742	1,842	1,759	1,802
Generators (Engines)	MMHPhr	1,873	1,911	1,976	2,031	2,076	2,169	2,209	2,221	2,173	2,189	2,279	2,172	2,247
Generators (Turbines)	MMHPhr	22	23	23	24	24	26	26	26	26	26	27	26	27
Pneumatic Devices Transmission and Storage														
Pneumatic Devices Transmission	devices	68,210	68,662	68,103	66,592	65,080	63,569	62,058	60,547	59,035	57,524	56,013	54,501	52,990
Pneumatic Devices Transmission (high bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Natural Gas Systems Activity Data

Segment/Source	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Pneumatic Devices Transmission (intermittent bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Pneumatic Devices Transmission (low bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Pneumatic Devices Storage	devices	14,226	14,759	15,194	15,495	15,797	16,098	16,400	16,701	17,002	17,304	17,605	17,907	18,208
Pneumatic Devices Storage (high bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Pneumatic Devices Storage (intermittent bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Pneumatic Devices Storage (low bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Routine Maintenance/Upsets														
Pipeline venting	miles	291,925	293,862	291,468	293,263	301,545	296,947	284,672	294,370	302,709	296,059	298,957	289,994	302,999
Station venting Transmission and Storage														
Station Venting Transmission	compressor stations	1,733	1,744	1,730	1,717	1,704	1,691	1,678	1,665	1,652	1,639	1,626	1,613	1,600
Station Venting Storage	compressor stations	361	375	386	383	379	376	373	369	366	363	359	356	353
LNG Storage														
LNG Stations	stations	61	62	63	63	64	65	65	66	67	67	68	69	70
LNG Reciprocating Compressors	compressors	232	235	238	241	244	247	250	253	256	259	262	265	268
LNG Centrifugal Compressors	compressors	55	56	56	57	58	58	59	60	61	61	62	63	63
LNG Compressor Exhaust														
LNG Engines	MMHPHr	561	562	564	565	567	568	569	571	572	574	575	576	578
LNG Turbines	MMHPHr	110	110	110	110	111	111	111	112	112	112	112	113	113
LNG Station venting	stations	61	62	63	63	64	65	65	66	67	67	68	69	70
LNG Import Terminals														
LNG Stations	stations	1	1	1	1	1	1	1	1	1	1	1	2	2
LNG Reciprocating Compressors	compressors	7	7	7	7	7	7	7	7	7	7	7	10	10
LNG Centrifugal Compressors	compressors	1	1	1	1	1	1	1	1	1	1	1	2	2
LNG Compressor Exhaust														
LNG Engines	MMHPHr	375	291	208	365	239	105	196	349	381	698	954	1,016	978
LNG Turbines	MMHPHr	86	65	44	83	52	18	41	79	87	167	230	243	233
LNG Station venting	stations	1	1	1	1	1	1	1	1	1	1	1	2	2
DISTRIBUTION														
Normal Fugitives														
Pipeline Leaks														
Mains - Cast Iron	miles	58,292	56,158	52,917	54,190	58,148	50,625	51,542	48,699	47,587	45,865	44,750	44,283	42,025
Mains - Unprotected steel	miles	108,941	102,816	99,619	99,335	99,224	94,058	88,412	87,650	86,639	84,534	82,800	81,291	78,119
Mains - Protected steel	miles	465,538	473,727	469,106	481,702	509,301	503,288	484,526	515,575	484,963	459,298	471,510	475,329	480,982
Mains - Plastic	miles	311,386	255,681	267,283	293,547	333,689	353,735	350,699	416,896	400,627	415,210	449,425	498,234	532,499

Natural Gas Systems Activity Data

Segment/Source	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total Pipeline Miles	miles	944,157	888,382	888,925	928,774	1,000,362	1,001,706	975,179	1,068,820	1,019,816	1,004,907	1,048,485	1,099,137	1,133,625
Services - Unprotected steel	services	7,633,526	7,201,784	7,138,563	6,933,064	6,529,108	6,151,653	5,775,613	5,619,584	5,463,253	5,751,250	5,675,520	5,449,653	5,186,134
Services Protected steel	services	19,781,581	23,276,047	19,742,086	19,843,107	21,520,667	21,002,455	18,593,770	20,557,061	18,478,344	18,310,719	17,855,560	17,911,402	17,778,463
Services - Plastic	services	18,879,865	19,509,092	20,692,674	22,630,182	25,112,436	26,044,545	26,187,536	29,460,189	28,629,388	28,796,952	31,795,871	32,706,753	34,547,274
Services - Copper	services	1,588,111	1,636,252	1,568,685	1,608,674	1,577,809	1,445,380	1,519,625	1,570,346	1,464,019	1,458,518	1,434,091	1,393,987	1,364,545
Total Services	services	47,883,083	51,623,175	49,142,008	51,015,027	54,740,020	54,644,033	52,076,544	57,207,180	54,035,004	54,317,439	56,761,042	57,461,795	58,876,416
Meter/Regulator (City Gates)														
M&R >300	stations	4,635	4,676	4,603	4,832	5,210	5,094	5,078	5,196	5,447	5,287	5,357	5,508	5,692
M&R 100-300	stations	16,913	17,063	16,798	17,635	19,014	18,591	18,531	18,963	19,879	19,294	19,550	20,099	20,771
M&R <100	stations	9,040	9,120	8,978	9,426	10,163	9,937	9,905	10,136	10,625	10,313	10,449	10,743	11,102
Reg >300	stations	5,067	5,112	5,032	5,283	5,697	5,570	5,552	5,681	5,955	5,780	5,857	6,021	6,223
R-Vault >300	stations	2,976	3,002	2,956	3,103	3,346	3,271	3,260	3,337	3,498	3,395	3,440	3,536	3,655
Reg 100-300	stations	15,329	15,464	15,224	15,983	17,233	16,849	16,795	17,186	18,016	17,486	17,718	18,216	18,825
R-Vault 100-300	stations	6,887	6,948	6,840	7,181	7,742	7,570	7,545	7,721	8,094	7,856	7,960	8,184	8,458
Reg 40-100	stations	45,999	46,406	45,685	47,962	51,714	50,563	50,399	51,574	54,064	52,474	53,169	54,664	56,492
R-Vault 40-100	stations	40,792	41,152	40,513	42,532	45,860	44,839	44,693	45,735	47,944	46,534	47,150	48,476	50,097
Reg <40	stations	19,505	19,677	19,372	20,337	21,928	21,440	21,371	21,869	22,925	22,251	22,545	23,179	23,954
Customer Meters														
Residential	outdoor meters	39,214,235	40,165,941	40,730,299	41,127,972	41,840,912	42,633,446	43,430,787	44,184,847	45,085,084	45,874,915	46,682,526	47,499,264	48,213,748
Commercial/Industry	meters	4,454,621	4,573,781	4,619,315	4,674,572	4,736,845	4,845,898	4,926,276	4,996,264	5,270,688	5,238,520	5,231,069	5,213,472	5,270,299
Vented														
Routine Maintenance														
Pressure Relief Valve Releases	mile main	944,157	888,382	888,925	928,774	1,000,362	1,001,706	975,179	1,068,820	1,019,816	1,004,907	1,048,485	1,099,137	1,133,625
Pipeline Blowdown	miles	1,546,955	1,560,633	1,536,382	1,612,973	1,739,152	1,700,449	1,694,925	1,734,443	1,818,184	1,764,724	1,788,100	1,838,359	1,899,845
Upsets														
Mishaps (Dig-ins)	miles	1,546,955	1,560,633	1,536,382	1,612,973	1,739,152	1,700,449	1,694,925	1,734,443	1,818,184	1,764,724	1,788,100	1,838,359	1,899,845

Natural Gas Systems Activity Data

Segment/Source	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
PRODUCTION														
Gas Wells														
Total active gas wells	wells	339,191	353,870	371,385	395,471	410,434	440,090	446,667	454,294	459,948	457,984	450,997	452,870	440,496
Non-associated Gas Wells (less fractured wells)	wells	195,286	201,642	202,639	210,931	214,518	223,740	222,999	222,044	221,828	217,932	213,301	211,772	208,000
Gas Wells with Hydraulic Fracturing	wells	143,905	152,228	168,746	184,540	195,916	216,350	223,668	232,250	238,120	240,052	237,696	241,098	232,496
Well Pad Equipment														
Heaters	heaters	75,924	76,876	79,878	83,641	83,893	89,737	90,560	93,922	94,942	94,537	93,095	93,481	90,927
Separators	separators	218,777	231,359	244,992	264,240	277,200	300,286	305,815	310,795	315,118	313,773	308,986	310,269	301,792
Dehydrators	dehydrators	23,444	22,030	20,579	18,343	16,897	14,022	13,407	12,772	12,248	12,196	12,010	12,060	11,730
Meters/Piping	meters	300,073	306,732	321,723	341,040	345,891	373,328	377,342	389,254	394,384	392,700	386,709	388,315	377,705
Compressors	compressors	28,096	28,675	29,888	31,381	31,424	33,585	34,164	35,713	36,005	35,852	35,305	35,451	34,483
Gathering and Boosting														
Gathering and Boosting Stations	stations	2,915	2,912	2,968	3,122	3,299	3,568	3,656	3,838	4,246	4,549	4,638	5,034	5,276
Pipeline Leaks	miles	338,565	352,292	366,424	385,417	400,403	421,760	427,409	431,254	435,449	433,382	427,071	425,855	419,777
Drilling, Well Completion, and Well Workover														
Gas Well Completions without Hydraulic Fracturing	completions/year	580	605	635	676	702	753	764	777	787	783	771	775	753
Gas Well Workovers without Hydraulic Fracturing	workovers/year	8,495	8,771	8,815	9,175	9,332	9,733	9,700	9,659	9,650	9,480	9,279	9,212	9,048
Hydraulic Fracturing Completions and Workovers that vent	completions and workovers/year	8,145	8,807	10,213	10,679	9,735	9,672	5,743	5,238	4,577	3,274	2,155	2,057	139
Flared Hydraulic Fracturing Completions and Workovers	completions and workovers/year	1,057	1,211	1,493	1,667	1,629	1,745	1,124	1,120	1,374	743	695	559	341
Hydraulic Fracturing Completions and Workovers with RECs	completions and workovers/year	1,002	1,531	2,359	3,160	3,604	4,411	3,196	3,538	3,943	2,749	3,035	1,803	3,323
Hydraulic Fracturing Completions and Workovers with RECs that flare	completions and workovers/year	369	563	868	1,162	1,326	1,622	1,175	1,301	1,450	2,074	2,188	3,224	1,847
Well Drilling	wells	23,582	27,180	31,969	36,536	36,255	35,824	20,266	18,837	18,837	18,837	18,837	18,837	18,837
Normal Operations														
Pneumatic Device Vents	controllers	531,728	569,234	617,007	683,286	720,781	806,385	823,665	848,876	865,304	861,609	848,464	851,988	828,709
Pneumatic Device Vents - Low Bleed (LB)	controllers	111,537	129,354	150,996	179,160	201,591	239,629	259,161	281,932	302,514	258,588	172,959	205,677	197,063
Pneumatic Device Vents - High Bleed (HB)	controllers	105,160	105,356	106,371	109,130	105,975	108,331	100,203	92,502	83,315	71,494	40,950	30,219	22,628
Pneumatic Device Vents - Intermittent Bleed (IB)	controllers	315,031	334,523	359,640	394,996	413,216	458,425	464,300	474,442	479,475	531,527	634,555	616,091	609,018
Chemical Injection Pumps	active pumps	50,722	54,789	59,884	67,040	70,850	80,217	82,210	85,318	87,004	86,633	85,311	85,666	83,325
Kimray Pumps	MMscf/yr	6,861,991	6,448,003	6,023,394	5,368,959	4,945,742	4,104,039	3,924,165	3,738,319	3,585,016	3,569,707	3,515,248	3,529,847	3,433,399

Natural Gas Systems Activity Data

Segment/Source	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Dehydrator Vents	MMscf/yr	7,701,449	7,236,816	6,760,262	6,025,768	5,550,776	4,606,104	4,404,225	4,195,644	4,023,587	4,006,406	3,945,284	3,961,669	3,853,422
Condensate Tank Vents														
Large Tanks w/Flares	tanks	16,511	17,353	18,344	19,676	20,567	22,211	22,703	23,253	23,708	23,606	23,246	23,343	22,705
Large Tanks w/VRU	tanks	1,923	2,160	2,429	2,759	3,043	3,454	3,701	3,962	4,212	4,194	4,130	4,147	4,034
Large Tanks w/o Control	tanks	11,429	11,643	11,924	12,383	12,526	13,081	12,922	12,782	12,576	12,522	12,331	12,382	12,044
Small Tanks w/Flares	tanks	10,723	12,047	13,547	15,387	16,967	19,263	20,637	22,094	23,488	23,388	23,031	23,126	22,495
Small Tanks w/o Flares	tanks	96,324	99,632	103,660	109,421	112,563	119,627	120,328	121,278	121,669	121,150	119,301	119,797	116,523
Malfunctioning Separator Dump Valves	tanks	29,863	31,156	32,698	34,818	36,136	38,747	39,326	39,997	40,495	40,322	39,707	39,872	38,782
Compressor Exhaust Vented														
Gas Engines	MMHPhr	38,759	41,235	43,337	46,252	49,043	52,040	53,020	53,192	53,791	53,299	52,221	51,749	51,489
Liquids Unloading														
Liquids Unloading - Vent Using Plungers	venting wells	21,712	24,394	27,430	31,156	34,355	39,005	41,787	44,737	47,559	44,170	39,906	40,885	44,026
Liquids Unloading - Vent Without Using Plungers	venting wells	86,209	81,547	76,775	72,374	65,377	59,663	49,960	40,038	29,627	32,687	35,778	35,114	29,896
Blowdowns														
Vessel Blowdowns	vessels	318,145	330,264	345,448	366,224	377,991	404,045	409,782	417,489	422,309	420,506	414,091	415,810	404,449
Pipeline Blowdowns	miles (gathering)	338,565	352,292	366,424	385,417	400,403	421,760	427,409	431,254	435,449	433,382	427,071	425,855	419,777
Compressor Blowdowns	compressors	28,096	28,675	29,888	31,381	31,424	33,585	34,164	35,713	36,005	35,852	35,305	35,451	34,483
Compressor Starts	compressors	28,096	28,675	29,888	31,381	31,424	33,585	34,164	35,713	36,005	35,852	35,305	35,451	34,483
G&B Station Episodic Events	stations	2,915	2,912	2,968	3,122	3,299	3,568	3,656	3,838	4,246	4,549	4,638	5,034	5,276
Upsets														
Pressure Relief Valves	PRV	767,898	801,129	840,782	895,310	929,185	996,324	1,011,213	1,028,480	1,041,280	1,036,834	1,021,016	1,025,256	997,243
Mishaps	miles	84,642	88,073	91,608	96,355	100,101	105,441	106,853	107,814	108,864	108,346	106,769	106,465	104,946
Produced Water from Coal Bed Methane														
Black Warrior	wells	3,669	3,963	4,246	4,493	4,764	5,026	5,191	5,296	5,462	5,517	5,480	5,480	5,480
Powder River	gal produced water	23,791,158, 888	22,599,925, 656	23,421,598, 326	28,423,070, 466	27,554,638, 356	28,802,976, 384	23,883,321, 966	22,368,432, 828	20,596,530, 150	20,596,530, 150	20,596,530, 150	20,596,530, 150	20,596,530, 150
Offshore														
Shallow water Gas Platforms (GoM and Pacific)	Shallow water gas platforms	2,451	2,407	2,387	2,382	2,264	2,218	2,064	1,973	1,973	1,973	1,973	1,973	1,973
Deepwater Gas Platforms (GoM and Pacific)	Deep water gas platforms	29	31	37	42	38	39	40	41	41	41	41	41	41
GAS PROCESSING PLANTS														
Fugitives, Vented, and Combusted														
Plant Total Emissions	plants	574	572	566	571	574	577	579	585	606	606	650	667	667
Plant Fugitives	plants	574	572	566	571	574	577	579	585	606	606	650	667	667
Reciprocating Compressors	compressors	3,257	3,247	3,215	3,245	3,264	3,283	3,297	3,333	3,454	3,454	3,705	3,802	3,802
Centrifugal Compressors (wet seals)	compressors	438	429	416	411	404	397	390	384	388	394	401	407	377
Centrifugal Compressors (dry seals)	compressors	121	133	143	156	169	183	196	211	232	226	265	275	306
Flares	plants	574	572	566	571	574	577	579	585	606	606	650	667	667
Dehydrators	plants	574	572	566	571	574	577	579	585	606	606	650	667	667
Compressor Exhaust														
Gas Engines	MMHPhr	38,909	39,751	40,593	41,436	42,278	43,121	43,963	44,805	45,648	45,648	48,962	50,243	50,243

Natural Gas Systems Activity Data

Segment/Source	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Gas Turbines	MMHPhr	35,277	35,289	35,301	35,313	35,325	35,337	35,348	35,360	35,372	35,372	37,940	38,933	38,933
AGR Vents	AGR units	291	290	287	289	291	292	293	296	307	307	325	338	338
Pneumatic Devices	gas plants	574	572	566	571	574	577	579	585	606	606	650	667	667
Routine Maintenance														
Blowdowns/Venting	gas plants	574	572	566	571	574	577	579	585	606	606	650	667	667
TRANSMISSION AND STORAGE														
Fugitives														
Pipeline Leaks	miles	301,493	303,001	300,468	300,324	301,066	303,181	304,573	304,805	305,057	303,341	302,827	301,834	301,257
Compressor Stations (Transmission)														
Station	stations	1,586	1,573	1,560	1,547	1,534	1,521	1,508	1,495	1,482	1,587	1,714	1,837	1,834
Reciprocating Compressor	compressors	5,615	5,493	5,371	5,249	5,128	5,006	4,884	4,762	4,640	4,518	4,880	5,231	5,221
Centrifugal Compressor (total)	compressors	1,348	1,407	1,466	1,525	1,584	1,644	1,703	1,762	1,821	1,880	2,031	2,177	2,173
Centrifugal Compressor (wet seals)	compressors	695	694	694	694	693	693	693	693	692	751	822	871	838
Centrifugal Compressor (dry seals)	compressors	653	713	772	832	891	950	1,010	1,069	1,129	1,129	1,209	1,306	1,334
Compressor Stations (Storage)														
Station	stations	349	346	343	345	343	350	351	352	354	354	356	356	349
Reciprocating Compressor	compressors	NE	NE	NE	NE	NE	NE	NE	NE	NE	1,512	1,520	1,520	1,489
Wells (Storage)	wells	19,493	18,685	18,524	16,765	18,122	18,774	18,340	18,352	18,091	15,926	18,793	19,522	17,692
M&R (Trans. Co. Interconnect)	stations	2,684	2,697	2,675	2,673	2,680	2,699	2,711	2,713	2,716	2,700	2,696	2,687	2,682
M&R (Farm Taps + Direct Sales)	stations	79,578	79,976	79,308	79,270	79,466	80,024	80,391	80,453	80,519	80,066	79,930	79,668	79,516
Vented and Combusted														
Normal Operation														
Dehydrator vents (Transmission)	MMscf/yr	1,011,260	1,002,931	994,603	986,274	977,945	969,616	961,287	952,958	944,629	1,011,611	1,092,718	1,171,250	1,169,007
Dehydrator vents (Storage)	MMscf/yr	2,166,006	2,076,218	2,058,299	1,862,860	2,013,619	2,086,113	2,037,926	2,039,205	2,010,208	1,769,699	2,088,245	2,169,267	1,965,859
Compressor Exhaust														
Engines (Transmission)	MMHPhr	44,469	44,693	43,938	43,287	46,121	46,466	45,733	48,083	48,861	50,979	52,211	53,085	54,509
Turbines (Transmission)	MMHPhr	10,611	10,664	10,484	10,329	11,005	11,087	10,912	11,473	11,659	12,164	12,458	12,667	13,006
Engines (Storage)	MMHPhr	5,331	5,110	5,065	4,584	4,956	5,134	5,015	5,018	4,947	4,355	5,139	5,339	4,838
Turbines (Storage)	MMHPhr	1,873	1,795	1,779	1,610	1,741	1,803	1,762	1,763	1,738	1,530	1,805	1,875	1,699
Generators (Engines)	MMHPhr	2,176	2,187	2,150	2,118	2,257	2,274	2,238	2,353	2,391	2,495	2,555	2,598	2,667
Generators (Turbines)	MMHPhr	26	26	25	25	27	27	26	28	28	29	30	31	31
Pneumatic Devices Transmission and Storage														
Pneumatic Devices Transmission	devices	51,479	49,968	48,456	46,945	45,434	43,923	42,411	40,900	39,389	38,490	41,951	47,140	47,069
Pneumatic Devices Transmission (high bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	7,755	3,860	4,076	4,129	5,220
Pneumatic Devices Transmission (intermittent bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	29,367	31,581	34,859	39,216	38,217

Natural Gas Systems Activity Data

Segment/Source	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Pneumatic Devices Transmission (low bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	2,267	3,049	3,017	3,795	3,633
Pneumatic Devices Storage	devices	18,509	18,811	19,112	19,414	19,715	20,016	20,318	20,619	20,921	20,150	21,332	23,964	23,093
Pneumatic Devices Storage (high bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	9,058	7,493	7,602	8,379	6,870
Pneumatic Devices Storage (intermittent bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	10,056	10,484	11,176	13,482	14,076
Pneumatic Devices Storage (low bleed)	devices	NE	NE	NE	NE	NE	NE	NE	NE	1,807	2,173	2,555	2,103	2,147
Routine Maintenance/Upsets														
Pipeline venting	miles	301,493	303,001	300,468	300,324	301,066	303,181	304,573	304,805	305,057	303,341	302,827	301,834	301,257
Station venting Transmission and Storage														
Station Venting Transmission	compressor stations	1,586	1,573	1,560	1,547	1,534	1,521	1,508	1,495	1,482	1,587	1,714	1,837	1,834
Station Venting Storage	compressor stations	349	346	343	345	343	350	351	352	354	354	356	356	349
LNG Storage														
LNG Stations	stations	70	70	70	70	70	70	70	70	70	70	70	70	70
LNG Reciprocating Compressors	compressors	270	270	270	270	270	270	270	270	270	270	270	270	270
LNG Centrifugal Compressors	compressors	64	64	64	64	64	64	64	64	64	64	64	64	64
LNG Compressor Exhaust														
LNG Engines	MMHPhr	579	579	579	579	579	579	579	579	579	579	579	579	579
LNG Turbines	MMHPhr	113	113	113	113	113	113	113	113	113	113	113	113	113
LNG Station venting	stations	70	70	70	70	70	70	70	70	70	70	70	70	70
LNG Import Terminals														
LNG Stations	stations	3	3	3	3	3	7	8	8	8	8	8	8	8
LNG Reciprocating Compressors	compressors	14	14	14	14	14	34	37	37	37	37	37	37	37
LNG Centrifugal Compressors	compressors	2	2	2	2	2	6	7	7	7	7	7	7	7
LNG Compressor Exhaust														
LNG Engines	MMHPhr	2,127	2,720	2,635	2,441	3,204	1,496	1,904	1,819	1,484	774	457	303	435
LNG Turbines	MMHPhr	516	665	643	595	786	358	461	439	356	178	99	60	93
LNG Station venting	stations	3	3	3	3	3	7	8	8	8	8	8	8	8
DISTRIBUTION														
Normal Fugitives														
Pipeline Leaks														
Mains - Cast Iron	miles	41,091	40,605	39,645	38,704	37,720	36,813	35,623	34,592	33,669	32,406	30,904	29,359	27,770
Mains - Unprotected steel	miles	74,042	75,801	72,458	72,286	71,065	70,434	67,758	67,443	64,981	63,703	60,619	58,520	55,863
Mains - Protected steel	miles	483,782	498,978	490,156	491,331	489,541	487,687	488,352	488,756	488,863	487,688	486,850	486,530	484,749
Mains - Plastic	miles	505,768	542,841	560,301	582,931	602,770	612,648	626,415	637,427	649,826	662,020	675,166	690,291	706,594
Total Pipeline Miles	miles	1,104,683	1,158,225	1,162,560	1,185,252	1,201,096	1,207,582	1,218,148	1,228,218	1,237,339	1,245,817	1,253,539	1,264,700	1,274,976
Services - Unprotected steel	services	4,840,347	4,809,606	5,507,356	5,658,533	5,457,880	5,415,333	5,221,143	4,226,682	4,142,891	3,917,081	3,669,003	3,432,641	3,297,457
Services Protected steel	services	17,258,710	18,283,248	16,529,118	16,027,531	15,781,496	15,672,810	15,470,934	15,324,950	15,276,929	14,954,949	14,757,332	14,593,093	14,330,139

Natural Gas Systems Activity Data

Segment/Source	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Services - Plastic	services	35,071,961	37,261,819	38,549,089	39,944,585	41,130,155	42,020,192	42,719,579	43,452,685	44,301,673	45,178,843	46,162,568	46,762,321	47,517,936
Services - Copper	services	1,366,377	1,422,685	1,247,011	1,247,236	1,229,031	1,146,843	1,086,696	1,078,351	1,056,628	1,009,288	973,107	935,595	895,398
Total Services	services	58,537,395	61,777,358	61,832,574	62,877,885	63,598,562	64,255,178	64,498,352	64,082,668	64,778,121	65,060,161	65,562,010	65,723,650	66,040,930
Meter/Regulator (City Gates)														
M&R >300	stations	5,611	5,769	5,879	6,059	3,914	4,055	3,961	3,964	3,972	3,827	3,919	4,172	4,026
M&R 100-300	stations	20,475	21,055	21,455	22,112	14,283	14,797	14,456	14,465	14,495	13,967	14,303	15,224	14,692
M&R <100	stations	10,944	11,254	11,468	11,819	7,634	7,909	7,727	7,731	7,748	7,465	7,645	8,137	7,853
Reg >300	stations	6,134	6,308	6,428	6,625	4,279	4,433	4,331	4,333	4,343	4,184	4,285	4,561	4,402
R-Vault >300	stations	3,603	3,705	3,775	3,891	2,513	2,604	2,543	2,545	1,860	1,812	1,489	1,513	4,328
Reg 100-300	stations	18,557	19,082	19,445	20,040	12,945	13,411	13,101	13,109	13,137	12,658	12,963	13,798	13,316
R-Vault 100-300	stations	8,337	8,573	8,736	9,004	5,816	6,025	5,886	5,890	4,304	4,194	3,446	3,500	12,060
Reg 40-100	stations	55,687	57,262	58,351	60,139	38,846	40,245	39,315	39,340	39,423	37,985	38,900	41,406	39,958
R-Vault 40-100	stations	49,382	50,780	51,745	53,330	34,448	35,689	34,864	34,886	25,494	24,840	20,410	20,733	8,144
Reg <40	stations	23,613	24,281	24,742	25,500	16,472	17,065	16,671	16,681	16,716	16,107	16,495	17,557	16,943
Customer Meters														
Residential	outdoor meters	48,833,119	49,393,447	50,371,424	50,803,342	51,469,799	51,671,973	51,818,178	51,979,221	52,304,183	52,645,217	52,991,569	53,339,363	53,339,363
Commercial/Industry	meters	5,357,691	5,349,007	5,404,251	5,467,209	5,507,074	5,669,379	5,529,956	5,494,306	5,509,118	5,545,769	5,564,810	5,611,121	5,611,121
Vented														
Routine Maintenance														
Pressure Relief Valve Releases	mile main	1,104,683	1,158,225	1,162,560	1,185,252	1,201,096	1,207,582	1,218,148	1,228,218	1,237,339	1,245,817	1,253,539	1,264,700	1,274,976
Pipeline Blowdown	miles	1,872,748	1,925,748	1,962,351	2,022,474	2,025,731	2,075,191	2,086,689	2,102,366	2,121,105	2,137,769	2,149,598	2,169,156	2,190,825
Upsets														
Mishaps (Dig-ins)	miles	1,872,748	1,925,748	1,962,351	2,022,474	2,025,731	2,075,191	2,086,689	2,102,366	2,121,105	2,137,769	2,149,598	2,169,156	2,190,825

Natural Gas Systems Emission Factors

Segment/Source	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
PRODUCTION														
Normal Fugitives														
Gas Wells														
Non-associated Gas Wells (less fractured wells)	kg/well	80.2	80.6	84.1	83.8	85.3	84.9	86.4	86.0	86.5	88.3	89.3	87.5	87.0
Gas Wells with Hydraulic Fracturing	kg/well	126.4	115.1	124.8	125.3	126.5	130.9	125.4	125.8	126.4	128.7	132.3	136.7	143.0
Well Pad Equipment														
Heaters	kg/heater	238.2	242.6	252.7	253.0	254.9	260.8	259.1	256.3	256.2	256.4	259.4	249.2	251.3
Separators	kg/separator	328.8	304.6	325.3	324.4	332.9	335.2	336.0	335.4	339.6	351.8	365.6	364.5	374.9
Dehydrators	kg/dehydrator	469.8	452.5	470.9	480.6	488.6	494.5	508.9	509.0	510.9	507.5	502.3	510.2	507.3
Meters/Piping	kg/meter	216.6	219.9	230.6	228.4	228.5	233.0	228.2	225.9	222.9	224.3	228.3	217.7	219.8
Compressors	kg/compressor	1,758.6	1,793.7	1,862.8	1,897.6	1,930.9	1,964.8	1,999.7	1,991.5	1,999.3	1,992.8	1,990.4	1,976.8	1,977.1
Gathering and Boosting														
Gathering and Boosting Stations	kg/station	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7
Pipeline Leaks	kg/mile	354.9	361.6	373.7	378.3	383.2	388.8	395.2	394.2	394.8	394.2	394.1	392.7	392.3
Vented and Combusted														
Drilling, Well Completion, and Well Workover														
Gas Well Completions without Hydraulic Fracturing	kg/completion	13.8	14.0	14.3	14.4	14.5	14.6	14.8	14.7	14.7	14.7	14.7	14.7	14.6
Gas Well Workovers without Hydraulic Fracturing	kg/workover	46.8	47.2	48.2	48.5	48.8	49.2	49.6	49.4	49.6	49.5	49.5	49.4	49.4
Hydraulic Fracturing Completions and Workovers that vent	kg/(compl. & workover)	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7
Flared Hydraulic Fracturing Completions and Workovers	kg/(compl. & workover)	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8
Hydraulic Fracturing Completions and Workovers with RECs	kg/(compl. & workover)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3,241.5	3,241.5
Hydraulic Fracturing Completions and Workovers with RECs that flare	kg/(compl. & workover)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4,876.9	4,876.9
Well Drilling	kg/well	47.9	48.7	49.7	50.0	50.3	50.7	51.3	51.0	51.2	51.1	51.1	50.9	50.9
Produced Water from Coal Bed Methane														
Powder River	kg/gal produced water	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Black Warrior	kg/well	2,095.7	2,104.2	2,172.1	2,209.1	2,248.6	2,288.9	2,328.1	2,327.5	2,327.7	2,328.3	2,328.4	2,328.1	2,327.2
Normal Operations														
Pneumatic Device Vents	kg/controller	2,527.3	2,527.3	2,527.3	2,407.3	2,347.3	2,287.3	2,227.3	2,167.3	2,107.3	2,047.3	1,987.4	1,927.4	1,867.4
Chemical Injection Pumps	kg/pump	1,743.4	1,743.4	1,743.4	1,731.7	1,720.0	1,708.3	1,696.6	1,684.9	1,673.2	1,661.5	1,649.8	1,638.1	1,626.4
Kimray Pumps	kg/MMscf	18.7	19.0	19.4	19.5	19.6	19.8	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Dehydrator Vents	kg/MMscf	5.2	5.3	5.4	5.4	5.5	5.5	5.6	5.5	5.6	5.6	5.6	5.5	5.5
Condensate Tank Vents														
Large Tanks w/Flares	kg/tank	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2
Large Tanks w/VRU	kg/tank	NA	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2
Large Tanks w/o Control	kg/tank	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4
Small Tanks w/Flares	kg/tank	NA	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Small Tanks w/o Flares	kg/tank	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9
Malfunctioning Separator Dump Valves	kg/tank	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Compressor Exhaust Vented														

Natural Gas Systems Emission Factors

Segment/Source	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Gas Engines	kg/MMHPhr	4,346.6	4,415.8	4,574.1	4,638.6	4,712.0	4,791.9	4,882.6	4,880.7	4,879.8	4,877.4	4,871.9	4,861.8	4,855.0
Liquids Unloading														
Liquids Unloading - Vent Using Plungers	kg/well	NA	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8
Liquids Unloading - Vent Without Using Plungers	kg/well	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5
Blowdowns														
Vessel BD	kg/vessel	1.5	1.5	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Pipeline BD	kg/mile	5.7	5.8	6.0	6.0	6.1	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.2
Compressor BD	kg/compressor	67.9	69.3	71.9	73.3	74.6	75.9	77.2	76.9	77.2	77.0	76.9	76.3	76.3
Compressor Starts	kg/compressor	151.9	155.0	160.9	163.9	166.8	169.7	172.8	172.0	172.7	172.2	172.0	170.8	170.8
G&B Station Episodic Events	kg/station	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0
Upsets														
Pressure Relief Valves	kg/PRV	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Mishaps	kg/mile	12.2	12.5	12.9	13.0	13.2	13.4	13.6	13.6	13.6	13.6	13.6	13.5	13.5
Offshore														
Shallow water Gas Platforms (GoM and Pacific)	kg/platform	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1
Deepwater Gas Platforms (GoM and Pacific)	kg/platform	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7
GAS PROCESSING PLANTS														
Fugitives, Vented, and Combusted														
Plant Total Emissions	kg/plant	832,939.8	854,738.4	863,251.2	830,252.8	797,254.5	764,256.1	731,257.8	698,259.4	665,261.1	632,262.7	599,264.3	566,266.0	533,267.6
Plant Fugitives	kg/plant	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reciprocating Compressors	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Centrifugal Compressors (wet seals)	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Centrifugal Compressors (dry seals)	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Flares	kg/plant	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dehydrators	kg/plant	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Compressor Exhaust														
Gas Engines	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
Gas Turbines	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
AGR Vents	kg/AGR	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9
Pneumatic Devices	kg/plant	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5
Routine Maintenance														
Blowdowns/Venting	kg/plant	78,195.6	78,195.6	78,195.6	76,881.1	75,566.5	74,252.0	72,937.4	71,622.9	70,308.3	68,993.8	67,679.2	66,364.7	65,050.2
TRANSMISSION AND STORAGE														
Fugitives														
Pipeline Leaks	kg/mile	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Compressor Stations (Transmission)														
Station Total Emissions	kg/station	633,830.4	633,830.4	633,830.4	617,986.3	602,142.1	586,298.0	570,453.9	554,609.7	538,765.6	522,921.5	507,077.4	491,233.2	475,389.1
Station + Compressor Fugitive Emissions	kg/station	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reciprocating Compressor	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Centrifugal Compressor (wet seals)	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Centrifugal Compressor (dry seals)	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Compressor Stations (Storage)														
Station Total Emissions	kg/station	679,538.6	679,538.6	679,538.6	664,051.5	648,564.5	633,077.4	617,590.4	602,103.3	586,616.2	571,129.2	555,642.1	540,155.0	524,668.0

Natural Gas Systems Emission Factors

Segment/Source	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Station + Compressor Fugitive Emissions	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reciprocating Compressor	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wells (Storage)	kg/well	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9
M&R (Trans. Co. Interconnect)	kg/station	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1
M&R (Farm Taps + Direct Sales)	kg/station	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3
Vented and Combusted														
Normal Operation														
Dehydrator vents (Transmission)	kg/MMscf	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Dehydrator vents (Storage)	kg/MMscf	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Compressor Exhaust														
Engines (Transmission)	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
Turbines (Transmission)	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
Engines (Storage)	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
Turbines (Storage)	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
Generators (Engines)	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
Generators (Turbines)	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
Pneumatic Devices Trans + Stor														
Pneumatic Devices Transmission	kg/controller	3,123.9	3,123.9	3,123.9	2,999.5	2,875.2	2,750.8	2,626.4	2,502.0	2,377.6	2,253.3	2,128.9	2,004.5	1,880.1
(High Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
(Intermittent Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
(Low Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pneumatic Devices Storage	kg/controller	3,123.9	3,123.9	3,123.9	3,025.5	2,927.2	2,828.8	2,730.4	2,632.0	2,533.7	2,435.3	2,336.9	2,238.5	2,140.2
(High Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
(Intermittent Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
(Low Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Routine Maintenance/Upsets														
Pipeline venting	kg/mile	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6
Station venting Trans + Storage														
Station Venting Transmission	kg/station	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3
Station Venting Storage	kg/station	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3
LNG Storage														
LNG Stations	kg/station	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1
LNG Reciprocating Compressors	kg/compressor	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4
LNG Centrifugal Compressors	kg/compressor	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1
LNG Compressor Exhaust														
LNG Engines	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
LNG Turbines	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
LNG Station venting	kg/station	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3
LNG Import Terminals														
LNG Stations	kg/station	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1
LNG Reciprocating Compressors	kg/compressor	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4
LNG Centrifugal Compressors	kg/compressor	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1
LNG Compressor Exhaust														
LNG Engines	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
LNG Turbines	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
LNG Station venting	kg/station	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3

Natural Gas Systems Emission Factors

Segment/Source	Units	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
DISTRIBUTION														
Normal Fugitives														
Pipeline Leaks														
Mains - Cast Iron	kg/mile	4,597.4	4,597.4	4,597.4	4,416.3	4,235.2	4,054.2	3,873.1	3,692.1	3,511.0	3,330.0	3,148.9	2,967.8	2,786.8
Mains - Unprotected steel	kg/mile	2,122.3	2,122.3	2,122.3	2,055.9	1,989.5	1,923.2	1,856.8	1,790.4	1,724.1	1,657.7	1,591.3	1,525.0	1,458.6
Mains - Protected steel	kg/mile	59.1	59.1	59.1	61.1	63.0	65.0	67.0	69.0	71.0	73.0	74.9	76.9	78.9
Mains - Plastic	kg/mile	190.9	190.9	190.9	182.3	173.8	165.3	156.8	148.2	139.7	131.2	122.6	114.1	105.6
Services - Unprotected steel	kg/service	32.8	32.8	32.8	31.8	30.8	29.9	28.9	27.9	27.0	26.0	25.1	24.1	23.1
Services Protected steel	kg/service	3.4	3.4	3.4	3.3	3.2	3.1	3.0	2.8	2.7	2.6	2.5	2.4	2.3
Services - Plastic	kg/service	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Services - Copper	kg/service	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Meter/Regulator (City Gates)														
M&R >300	kg/station	30,335.4	30,335.4	30,335.4	28,851.6	27,367.8	25,883.9	24,400.1	22,916.3	21,432.5	19,948.6	18,464.8	16,981.0	15,497.2
M&R 100-300	kg/station	16,129.4	16,129.4	16,129.4	15,332.9	14,536.4	13,739.8	12,943.3	12,146.8	11,350.3	10,553.7	9,757.2	8,960.7	8,164.2
M&R <100	kg/station	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2
Reg >300	kg/station	27,315.4	27,315.4	27,315.4	25,923.5	24,531.5	23,139.6	21,747.7	20,355.8	18,963.9	17,571.9	16,180.0	14,788.1	13,396.2
R-Vault >300	kg/station	219.3	219.3	219.3	210.5	201.6	192.7	183.8	174.9	166.1	157.2	148.3	139.4	130.5
Reg 100-300	kg/station	6,833.1	6,833.1	6,833.1	6,481.0	6,128.9	5,776.8	5,424.7	5,072.6	4,720.5	4,368.5	4,016.4	3,664.3	3,312.2
R-Vault 100-300	kg/station	30.4	30.4	30.4	31.4	32.5	33.6	34.6	35.7	36.8	37.8	38.9	40.0	41.0
Reg 40-100	kg/station	175.5	175.5	175.5	174.8	174.2	173.6	173.0	172.4	171.7	171.1	170.5	169.9	169.3
R-Vault 40-100	kg/station	14.6	14.6	14.6	16.5	18.4	20.3	22.2	24.1	26.0	27.9	29.8	31.7	33.6
Reg <40	kg/station	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
Customer Meters														
Residential	kg/meter	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Commercial/Industry	kg/meter	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
Vented														
Routine Maintenance														
Pressure Relief Valve Releases	kg/mile	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Pipeline Blowdown	kg/mile	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Upsets														
Mishaps (Dig-ins)	kg/mile	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6

Natural Gas Systems Emission Factors

Segment/Source	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
PRODUCTION														
Normal Fugitives														
<i>Gas Wells</i>														
Non-associated Gas Wells (less fractured wells)	kg/well	84.9	85.4	85.1	84.1	84.6	84.0	83.9	83.2	83.2	83.1	83.0	83.1	83.9
Gas Wells with Hydraulic Fracturing	kg/well	144.3	147.2	146.3	147.6	153.9	150.7	150.1	146.6	146.4	145.2	144.5	142.7	146.1
<i>Well Pad Equipment</i>														
Heaters	kg/heater	247.5	251.8	249.8	247.3	251.8	246.8	247.2	243.8	243.3	243.3	242.4	240.4	242.9
Separators	kg/separator	376.2	384.5	388.3	390.2	397.1	393.7	394.2	390.2	390.0	390.3	388.1	380.5	387.2
Dehydrators	kg/dehydrator	506.9	500.5	500.7	499.1	484.2	486.4	480.4	493.2	493.8	492.6	491.0	487.4	494.5
Meters/Piping	kg/meter	215.5	218.4	216.3	213.2	216.7	210.7	210.5	206.5	205.9	205.9	205.1	202.8	205.2
Compressors	kg/compressor	1,951.3	1,973.5	1,967.9	1,960.3	1,992.1	1,994.4	1,987.6	1,984.5	1,990.5	1,988.8	1,985.9	1,999.5	2,001.1
<i>Gathering and Boosting</i>														
Gathering and Boosting Stations	kg/station	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7	373,048.7
Pipeline Leaks	kg/mile	388.6	392.1	391.7	391.3	394.8	395.1	394.1	393.3	394.1	394.3	394.3	395.5	395.4
Vented and Combusted														
<i>Drilling, Well Completion, and Well Workover</i>														
Gas Well Completions without Hydraulic Fracturing	kg/completion	14.4	14.6	14.6	14.6	14.9	14.9	14.8	14.8	14.9	14.8	14.8	14.9	14.9
Gas Well Workovers without Hydraulic Fracturing	kg/workover	48.5	49.4	49.4	49.3	50.5	50.5	50.3	50.1	50.3	50.1	50.0	50.4	50.5
Hydraulic Fracturing Completions and Workovers that vent	kg/(compl. & workover)	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7	36,824.7
Flared Hydraulic Fracturing Completions and Workovers	kg/(compl. & workover)	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8	4,906.8
Hydraulic Fracturing Completions and Workovers with RECs	kg/(compl. & workover)	3,241.5	3,241.5	3,241.5	3,241.5	3,241.5	3,241.5	3,241.5	3,241.5	3,241.5	3,241.5	3,241.5	3,241.5	3,241.5
Hydraulic Fracturing Completions and Workovers with RECs that flare	kg/(compl. & workover)	4,876.9	4,876.9	4,876.9	4,876.9	4,876.9	4,876.9	4,876.9	4,876.9	4,876.9	4,876.9	4,876.9	4,876.9	4,876.9
Well Drilling	kg/well	50.0	50.9	50.9	50.7	51.9	52.0	51.8	51.6	51.8	51.8	51.7	52.0	52.1
<i>Produced Water from Coal Bed Methane</i>														
Powder River	kg/gal produced water	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Black Warrior	kg/well	2,327.0	2,326.6	2,326.5	2,326.5	2,327.5	2,325.3	2,323.5	2,319.7	2,316.1	2,315.8	2,333.8	2,334.0	2,333.2
Normal Operations														
Pneumatic Device Vents	kg/controller	1,807.4	1,747.4	1,687.4	1,627.4	1,567.4	1,507.4	1,447.4	1,387.4	1,327.4	1,357.7	1,391.5	1,303.6	1,285.4
Chemical Injection Pumps	kg/pump	1,614.7	1,603.0	1,591.3	1,579.6	1,568.0	1,556.3	1,544.6	1,532.9	1,521.2	1,521.2	1,521.2	1,521.2	1,521.2

Natural Gas Systems Emission Factors

Segment/Source	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Kimray Pumps	kg/MMscf	19.6	19.9	19.9	19.9	20.3	20.3	20.3	20.2	20.2	20.2	20.2	20.3	20.3
Dehydrator Vents	kg/MMscf	5.5	5.5	5.5	5.5	5.7	5.7	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Condensate Tank Vents														
Large Tanks w/Flares	kg/tank	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2	43.2
Large Tanks w/VRU	kg/tank	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2
Large Tanks w/o Control	kg/tank	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4	639.4
Small Tanks w/Flares	kg/tank	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6
Small Tanks w/o Flares	kg/tank	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9	210.9
Malfunctioning Separator Dump Valves	kg/tank	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1
Compressor Exhaust Vented														
Gas Engines	kg/MMHPHr	4,853.7	4,854.0	4,852.9	4,858.2	4,831.4	4,834.9	4,830.6	4,830.7	4,828.4	4,836.7	4,841.3	4,835.3	4,828.8
Well Clean Ups														
Well Clean Ups (LP Gas Wells) - Vent Using Plungers	kg/well	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8	2,861.8
Well Clean Ups (LP Gas Wells) - Vent Without Using Plungers	kg/well	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5	3,089.5
Blowdowns														
Vessel BD	kg/vessel	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Pipeline BD	kg/mile	6.2	6.2	6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
Compressor BD	kg/compressor	75.4	76.2	76.0	75.7	76.9	77.0	76.8	76.6	76.9	76.8	76.7	77.2	77.3
Compressor Starts	kg/compressor	168.6	170.5	170.0	169.4	172.1	172.3	171.7	171.4	172.0	171.8	171.6	172.7	172.9
G&B Station Episodic Events	kg/station	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0	37,000.0
Upsets														
Pressure Relief Valves	kg/PRV	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Mishaps	kg/mile	13.4	13.5	13.5	13.5	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
Offshore														
Shallow water Gas Platforms (GoM and Pacific)	kg/platform	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1	62,559.1
Deepwater Gas Platforms (GoM and Pacific)	kg/platform	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7	659,657.7
GAS PROCESSING PLANTS														
Fugitives, Vented, and Combusted														
Plant Total Emissions	kg/plant	500,269.3	467,270.9	434,272.6	401,274.2	368,275.9	335,277.5	302,279.1	269,280.8	236,282.4	236,536.2	235,631.5	235,476.4	234,261.3
Plant Fugitives	kg/plant	NA	NA	NA	NA	NA	NA	NA	NA	24,134.2	24,134.2	24,134.2	24,134.2	24,134.2
Reciprocating Compressors	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	18,646.9	18,646.9	18,646.9	18,646.9	18,646.9
Centrifugal Compressors (wet seals)	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	56,827.6	56,827.6	56,827.6	56,827.6	56,827.6
Centrifugal Compressors (dry seals)	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	29,985.5	29,985.5	29,985.5	29,985.5	29,985.5
Flares	kg/plant	NA	NA	NA	NA	NA	NA	NA	NA	32,634.3	32,634.3	32,634.3	32,634.3	32,634.3

Natural Gas Systems Emission Factors

Segment/Source	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Dehydrators	kg/plant	NA	NA	NA	NA	NA	NA	NA	NA	25,335.6	25,335.6	25,335.6	25,335.6	25,335.6
Compressor Exhaust														
Gas Engines	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
Gas Turbines	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
AGR Vents	kg/AGR	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	42,762.9	43,295.8	42,762.9	42,762.9
Pneumatic Devices	kg/plant	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5	3,172.5
Routine Maintenance														
Blowdowns/Venting	kg/plant	63,735.6	62,421.1	61,106.5	59,792.0	58,477.4	57,162.9	55,848.3	54,533.8	53,219.3	53,219.3	53,219.3	53,219.3	53,219.3
TRANSMISSION AND STORAGE														
Fugitives														
Pipeline Leaks	kg/mile	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Compressor Stations (Transmission)														
Station Total Emissions	kg/station	459,545.0	443,700.8	427,856.7	412,012.6	396,168.4	380,324.3	364,480.2	348,636.1	332,791.9	312,527.5	312,680.3	312,543.2	312,138.5
Station + Compressor Fugitive Emissions	kg/station	NA	NA	NA	NA	NA	NA	NA	NA	64,000.0	64,000.0	64,000.0	64,000.0	64,000.0
Reciprocating Compressor	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	65,000.0	65,000.0	65,000.0	65,000.0	65,000.0
Centrifugal Compressor (wet seals)	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	68,000.0	68,000.0	68,000.0	68,000.0	68,000.0
Centrifugal Compressor (dry seals)	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	44,000.0	44,000.0	44,000.0	44,000.0	44,000.0
Compressor Stations (Storage)														
Station Total Emissions	kg/station	509,180.9	493,693.9	478,206.8	462,719.7	447,232.7	431,745.6	416,258.5	400,771.5	385,284.4	369,797.4	369,797.4	369,797.4	369,797.4
Station + Compressor Fugitive Emissions	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	NA	71,000.0	71,000.0	71,000.0	71,000.0
Reciprocating Compressor	kg/compressor	NA	NA	NA	NA	NA	NA	NA	NA	NA	70,000.0	70,000.0	70,000.0	70,000.0
Wells (Storage)	kg/well	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9	804.9	5,233.5
M&R (Trans. Co. Interconnect)	kg/station	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1	28,007.1
M&R (Farm Taps + Direct Sales)	kg/station	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3	219.3
Vented and Combusted														
Normal Operation														
Dehydrator vents (Transmission)	kg/MMscf	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Dehydrator vents (Storage)	kg/MMscf	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Compressor Exhaust														
Engines (Transmission)	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
Turbines (Transmission)	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
Engines (Storage)	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
Turbines (Storage)	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
Generators (Engines)	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
Generators (Turbines)	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
Pneumatic Devices Trans + Stor														

Natural Gas Systems Emission Factors

Segment/Source	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Pneumatic Devices Transmission	kg/controller	1,755.7	1,631.4	1,507.0	1,382.6	1,258.2	1,133.8	1,009.5	885.1	760.7	559.0	633.3	589.6	628.4
(High Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	2,516.7	2,599.8	2,927.1	2,926.9	2,802.7
(Intermittent Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	338.8	343.5	399.4	379.7	370.0
(Low Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	219.2	207.5	236.8	215.6	221.9
Pneumatic Devices Storage	kg/controller	2,041.8	1,943.4	1,845.0	1,746.7	1,648.3	1,549.9	1,451.5	1,353.2	1,254.8	1,290.1	1,410.0	1,225.4	972.6
(High Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	2,504.7	2,900.2	3,282.4	2,850.2	2,359.2
(Intermittent Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	319.5	365.6	405.1	372.4	415.2
(Low Bleed)	kg/controller	NA	NA	NA	NA	NA	NA	NA	NA	194.7	197.8	234.1	219.8	190.6
Routine Maintenance/Upsets														
Pipeline venting	kg/mile	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6	609.6
Station venting Trans + Storage														
Station Venting Transmission	kg/station	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3
Station Venting Storage	kg/station	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3
LNG Storage														
LNG Stations	kg/station	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1
LNG Reciprocating Compressors	kg/compressor	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4
LNG Centrifugal Compressors	kg/compressor	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1
LNG Compressor Exhaust														
LNG Engines	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
LNG Turbines	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
LNG Station venting	kg/station	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3
LNG Import Terminals														
LNG Stations	kg/station	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1	151,192.1
LNG Reciprocating Compressors	kg/compressor	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4	148,443.4
LNG Centrifugal Compressors	kg/compressor	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1	214,925.1
LNG Compressor Exhaust														
LNG Engines	kg/MMHPhr	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4	4,622.4
LNG Turbines	kg/MMHPhr	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8	109.8
LNG Station venting	kg/station	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3	83,954.3
DISTRIBUTION														
Normal Fugitives														
Pipeline Leaks														
Mains - Cast Iron	kg/mile	2,605.7	2,424.7	2,243.6	2,062.6	1,881.5	1,700.4	1,519.4	1,338.3	1,157.3	1,157.3	1,157.3	1,157.3	1,157.3
Mains - Unprotected steel	kg/mile	1,392.2	1,325.9	1,259.5	1,193.1	1,126.8	1,060.4	994.1	927.7	861.3	861.3	861.3	861.3	861.3
Mains - Protected steel	kg/mile	80.9	82.9	84.8	86.8	88.8	90.8	92.8	94.8	96.7	96.7	96.7	96.7	96.7
Mains - Plastic	kg/mile	97.1	88.5	80.0	71.5	63.0	54.4	45.9	37.4	28.8	28.8	28.8	28.8	28.8

Natural Gas Systems Emission Factors

Segment/Source	Units	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Services - Unprotected steel	kg/service	22.2	21.2	20.3	19.3	18.3	17.4	16.4	15.4	14.5	14.5	14.5	14.5	14.5
Services Protected steel	kg/service	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.3	1.3	1.3
Services - Plastic	kg/service	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Services - Copper	kg/service	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Meter/Regulator (City Gates)														
M&R >300	kg/station	14,013.3	12,529.5	11,045.7	9,561.8	8,078.0	6,594.2	5,110.4	3,626.5	2,142.7	2,142.7	2,142.7	2,142.7	2,142.7
M&R 100-300	kg/station	7,367.6	6,571.1	5,774.6	4,978.1	4,181.5	3,385.0	2,588.5	1,792.0	995.4	995.4	995.4	995.4	995.4
M&R <100	kg/station	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2	727.2
Reg >300	kg/station	12,004.3	10,612.3	9,220.4	7,828.5	6,436.6	5,044.7	3,652.7	2,260.8	868.9	868.9	868.9	868.9	868.9
R-Vault >300	kg/station	121.7	112.8	103.9	95.0	86.1	77.3	68.4	59.5	50.6	50.6	50.6	50.6	50.6
Reg 100-300	kg/station	2,960.1	2,608.0	2,255.9	1,903.8	1,551.8	1,199.7	847.6	495.5	143.4	143.4	143.4	143.4	143.4
R-Vault 100-300	kg/station	42.1	43.2	44.2	45.3	46.4	47.4	48.5	49.5	50.6	50.6	50.6	50.6	50.6
Reg 40-100	kg/station	168.6	168.0	167.4	166.8	166.1	165.5	164.9	164.3	163.7	163.7	163.7	163.7	163.7
R-Vault 40-100	kg/station	35.4	37.3	39.2	41.1	43.0	44.9	46.8	48.7	50.6	50.6	50.6	50.6	50.6
Reg <40	kg/station	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
Customer Meters														
Residential	kg/meter	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Commercial/Industry	kg/meter	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7	9.7
Vented														
Routine Maintenance														
Pressure Relief Valve Releases	kg/mile	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Pipeline Blowdown	kg/mile	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Upsets														
Mishaps (Dig-ins)	kg/mile	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6

Natural Gas Systems Activity Data Sources

Segment/Source	Units	Data Source/Method
PRODUCTION		
Gas Wells		
Total producing gas wells	wells	Total producing gas wells (DrillingInfo). See 2015 Well counts memo (https://www.epa.gov/sites/production/files/2015-12/documents/revision-data-source-well-counts-4-10-2015.pdf) and 2017 Production Segment memo (https://www.epa.gov/sites/production/files/2017-01/documents/2017_ghgi_ngpetro_revunderconsid-production_and_gb_1.10.17.pdf).
Non-associated Gas Wells (less fractured wells)	wells	Total non-associated gas wells (DrillingInfo) minus total gas wells with hydraulic fracturing (DrillingInfo).
Gas Wells with Hydraulic Fracturing	wells	Total gas wells with hydraulic fracturing (DrillingInfo).
Well Pad Equipment		
Heaters	heaters	1990-1992: [total producing gas wells] * [modified per well activity factor from Radian (1996)]. 2011-2015: [total producing gas wells] * [per well activity factor from subpart W]. 1993-2010: linear interpolation.
Separators	separators	1990-1992: [total producing gas wells] * [modified per well activity factor from Radian (1996)]. 2011-2015: [total producing gas wells] * [per well activity factor from subpart W]. 1993-2010: linear interpolation.
Dehydrators	dehydrators	1990-1992: [total producing gas wells] * [modified per well activity factor from Radian (1996)]. 2011-2015: [total producing gas wells] * [per well activity factor from subpart W]. 1993-2010: linear interpolation.
Meters/Piping	meters	1990-1992: [total producing gas wells] * [modified per well activity factor from Radian (1996)]. 2011-2015: [total producing gas wells] * [per well activity factor from subpart W]. 1993-2010: linear interpolation.
Compressors	compressors	1990-1992: [total producing gas wells] * [modified per well activity factor from Radian (1996)]. 2011-2015: [total producing gas wells] * [per well activity factor from subpart W]. 1993-2010: linear interpolation.
Gathering and Boosting		
Gathering and Boosting Stations	stations	[NEMS region marketed on-shore production (EIA)]/[2012 production rate per station (Marchese et al., 2015)]
Pipeline Leaks	miles	[total producing gas wells] * [per well activity factor from Radian (1996)] plus 82,600 miles of gathering pipeline owned by transmission company.
Drilling, Well Completion, and Well Workover		
Gas Well Completions without Hydraulic Fracturing	completions/year	# of completions for 2002 base year (400) scaled with drivers.
Gas Well Workovers without Hydraulic Fracturing	workovers/year	# of gas wells without hydraulic fracturing * fraction of wells requiring workovers (4.35%).
Hydraulic Fracturing Completions and Workovers that vent	completions and workovers/year	# of completions and workovers for hydraulically fractured wells (1990-2010 DrillingInfo, 2011-2015 GHGRP).
Flared Hydraulic Fracturing Completions and Workovers	completions and workovers/year	# of completions and workovers for hydraulically fractured wells (1990-2010 DrillingInfo, 2011-2015 GHGRP).
Hydraulic Fracturing Completions and Workovers with RECs	completions and workovers/year	# of completions and workovers for hydraulically fractured wells (1990-2010 DrillingInfo, 2011-2015 GHGRP).
Hydraulic Fracturing Completions and Workovers with RECs that flare	completions and workovers/year	# of completions and workovers for hydraulically fractured wells (1990-2010 DrillingInfo, 2011-2015 GHGRP).
Well Drilling	wells	1990-2010: # of total wells drilled * regional drivers. 2011-2015: 2010 values used as proxy.
Normal Operations		
Pneumatic Device Vents	controllers	1990-1992: [total producing gas wells] * [modified per well activity factor from Radian (1996)]. 2011-2015: [total producing gas wells] * [per well activity factor from subpart W]. 1993-2010: linear interpolation.
Pneumatic Device Vents - Low Bleed (LB)	controllers	[# of pneumatic device vents * device type fraction]. 1990-1992: high-bleed fraction = 0.35 (assumed), intermittent-bleed fraction = 0.65 (assumed), and low-bleed fraction = 0.00 (assumed). 2011-2015: device type fractions from subpart W. 1993-2010: linear interpolation.
Pneumatic Device Vents - High Bleed (HB)	controllers	[# of pneumatic device vents * device type fraction]. 1990-1992: high-bleed fraction = 0.35 (assumed), intermittent-bleed fraction = 0.65 (assumed), and low-bleed fraction = 0.00 (assumed). 2011-2015: device type fractions from subpart W. 1993-2010: linear interpolation.
Pneumatic Device Vents - Intermittent Bleed (IB)	controllers	[# of pneumatic device vents * device type fraction]. 1990-1992: high-bleed fraction = 0.35 (assumed), intermittent-bleed fraction = 0.65 (assumed), and low-bleed fraction = 0.00 (assumed). 2011-2015: device type fractions from subpart W. 1993-2010: linear interpolation.
Chemical Injection Pumps	active pumps	1990-1992: [total producing gas wells] * [modified per well activity factor from Radian (1996)]. 2011-2015: [total producing gas wells] * [per well activity factor from subpart W]. 1993-2010: linear interpolation.
Kimray Pumps	MMscf/yr	# of dehydrator vents * % of dehydrator output (Radian, 1999).

Natural Gas Systems Activity Data Sources

Segment/Source	Units	Data Source/Method
Dehydrator Vents	MMscf/yr	# of dehydrators * MMscf/yr-dehydator (Radian, 1999).
Condensate Tank Vents		
Large Tanks w/Flares	tanks	2011-2015: Count per well based on RY2015 GHGRP subpart W data. 1990-2010: Interpolation between zero controls assumed in 1990, to the activity factor assigned in 2011. Count per well applied to total producing gas wells.
Large Tanks w/VRU	tanks	2011-2015: Count per well based on RY2015 GHGRP subpart W data. 1990-2010: Interpolation between zero controls assumed in 1990, to the activity factor assigned in 2011. Count per well applied to total producing gas wells.
Large Tanks w/o Control	tanks	2011-2015: Count per well based on RY2015 GHGRP subpart W data. 1990-2010: Interpolation between zero controls assumed in 1990, to the activity factor assigned in 2011. Count per well applied to total producing gas wells.
Small Tanks w/Flares	tanks	2011-2015: Count per well based on RY2015 GHGRP subpart W data. 1990-2010: Interpolation between zero controls assumed in 1990, to the activity factor assigned in 2011. Count per well applied to total producing gas wells.
Small Tanks w/o Flares	tanks	2011-2015: Count per well based on RY2015 GHGRP subpart W data. 1990-2010: Interpolation between zero controls assumed in 1990, to the activity factor assigned in 2011. Count per well applied to total producing gas wells.
Malfunctioning Separator Dump Valves	Large tanks	Sum of Large Tanks w/Flares, Large Tanks w/VRU, Large Tanks w/o Control.
Compressor Exhaust Vented		
Gas Engines	MMHPhr	Base year 1992 estimate from GRI/EPA, Methane Emissions from the Natural Gas Industry (1996); scaled by total active gas well count
Liquids Unloading		
Liquids Unloading - Vent Using Plungers	venting wells	2011-2015: Population fraction based on year-specific GHGRP subpart W data. 1990-2010: Interpolation between 1990 assumed to have zero plunger lifts and 56.3% of wells requiring unloading (API-ANGA) to the activity factor assigned in 2011.
Liquids Unloading - Vent Without Using Plungers	venting wells	2011-2015: Population fraction based on year-specific GHGRP subpart W data. 1990-2010: Interpolation between 1990 assumed to have zero plunger lifts and 56.3% of wells requiring unloading (API-ANGA) to the activity factor assigned in 2011.
Blowdowns		
Vessel Blowdowns	vessels	[# of heaters] + [# of separators] + [# of dehydrators]
Pipeline Blowdowns	miles (gathering)	[total producing gas wells] * [per well activity factor from Radian (1996)] plus 82,600 miles of gathering pipeline owned by transmission company.
Compressor Blowdowns	compressors	1990-1992: [total producing gas wells] * [modified per well activity factor from Radian (1996)]. 2011-2015: [total producing gas wells] * [per well activity factor from subpart W]. 1993-2010: linear interpolation.
Compressor Starts	compressors	1990-1992: [total producing gas wells] * [modified per well activity factor from Radian (1996)]. 2011-2015: [total producing gas wells] * [per well activity factor from subpart W]. 1993-2010: linear interpolation.
G&B Station Episodic Events	stations	[NEMS region marketed on-shore production (EIA)]/[2012 production rate per station (Marchese et al., 2015)]
Upsets		
Pressure Relief Valves	PRV	Base year 1992 estimate from GRI/EPA, Methane Emissions from the Natural Gas Industry (1996); scaled by total active gas well count
Mishaps	miles	[total producing gas wells] * [per well activity factor from Radian (1996)] plus 82,600 miles of gathering pipeline owned by transmission company. Assumed 0.25 leaks per mile.
Produced Water from Coal Bed Methane		
Black Warrior	wells	Alabama State Oil and Gas Board
Powder River	gal produced water	Wyoming Oil and Gas Conservation Commission
Offshore		
Shallow water Gas Platforms (GoM and Pacific)	Shallow water gas platforms	1990-2010: [Number of oil & gas platforms * fraction of gas platforms - number of deep water gas platforms] (MMS). 2011-2015: 2010 data used as proxy.
Deepwater Gas Platforms (GoM and Pacific)	Deep water gas platforms	1990-2010: [# of deep water oil & gas platforms * fraction of gas platforms] (MMS). 2011-2015: 2010 data used as proxy.
GAS PROCESSING PLANTS		
Fugitives, Vented, and Combusted		
Plant Total Emissions	plants	Oil and Gas Journal, "Worldwide Gas Processing."
Plant Fugitives	plants	Oil and Gas Journal, "Worldwide Gas Processing."
Reciprocating Compressors	compressors	1990-1992: Base year 1992 estimate scaled by dry gas production (EIA). 2011-2015: Reciprocating compressors per plant based on RY2015 GHGRP subpart W data. 1993-2010: Number of compressors per plant linearly interpolated between 1992 and 2011 factors.

Natural Gas Systems Activity Data Sources

Segment/Source	Units	Data Source/Method
Centrifugal Compressors (wet seals)	compressors	1990-1992: Base year 1992 estimate scaled by dry gas production (EIA); assume all wet seals. 2011-2015: Centrifugal compressors per plant based on RY2015 GHGRP subpart W data; wet and dry seal fractions based on year-specific subpart W data. 1993-2010: Number of compressors per plant linearly interpolated between 1992 and 2011 factors; seal type fractions interpolated between 1992 and 2011 values.
Centrifugal Compressors (dry seals)	compressors	1990-1992: Base year 1992 estimate scaled by dry gas production (EIA); assume all wet seals. 2011-2015: Centrifugal compressors per plant based on RY2015 GHGRP subpart W data; wet and dry seal fractions based on year-specific subpart W data. 1993-2010: Number of compressors per plant linearly interpolated between 1992 and 2011 factors; seal type fractions interpolated between 1992 and 2011 values.
Flares	plants	Oil and Gas Journal, "Worldwide Gas Processing."
Dehydrators	plants	Oil and Gas Journal, "Worldwide Gas Processing."
Compressor Exhaust		
Gas Engines	MMHPHr	1990-1992: Base year 1992 estimate scaled by dry gas production (EIA). 2011-2015: MMhp-hr per plant based on RY2015 GHGRP subpart W data. 1993-2010: Linear interpolation between 1992 and 2011 values.
Gas Turbines	MMHPHr	1990-1992: Base year 1992 estimate scaled by dry gas production (EIA). 2011-2015: MMhp-hr per plant based on RY2015 GHGRP subpart W data. 1993-2010: Linear interpolation between 1992 and 2011 values.
AGR Vents	AGR units	Base year 1992 estimate from GRI/EPA, Methane Emissions from the Natural Gas Industry (1996); scaled by total plant count.
Pneumatic Devices	gas plants	Oil and Gas Journal, "Worldwide Gas Processing."
Routine Maintenance		
Blowdowns/Venting	gas plants	Oil and Gas Journal, "Worldwide Gas Processing."
TRANSMISSION AND STORAGE		
Fugitives		
Pipeline Leaks	miles	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (total transmission)
Compressor Stations (Transmission)		
Station	stations	1990-1992: Base year 1992 estimate scaled by transmission length (EIA). 2011-2015: [station count * subpart W station scaling factor (3.52)]. 1993-2010: linear interpolation.
Reciprocating Compressor	compressors	1990-1992: Base year 1992 estimate scaled by transmission length (EIA). 2012-2015: [station count for year N * 2012 reciprocating compressor count / 2012 station count]. 1993-2011: linear interpolation.
Centrifugal Compressor (total)	compressors	1990-1992: Calculated. 2012-2015: [station count for year N * 2012 total centrifugal compressor count / 2012 station count]. 1993-2011: linear interpolation.
Centrifugal Compressor (wet seals)	compressors	1990-1992: Base year 1992 estimate scaled by transmission length (EIA). 2011-2015: [total centrifugal compressors * wet seal fraction (subpart W)]. 1993-2010: linear interpolation
Centrifugal Compressor (dry seals)	compressors	1990-1992: Assumed to be 0 (zero). 2011-2015: [total centrifugal compressors * dry seal fraction (subpart W)]. 1993-2010: linear interpolation.
Compressor Stations (Storage)		
Station	stations	1990-1992: Base year 1992 estimate scaled by residential natural gas consumption driver. 2005-2015: [Storage fields (EIA) * stations per storage field]. 1993-2004: linear interpolation.
Reciprocating Compressor	compressors	1990-2011: Assumed to be 0 (zero). 2012-2015: [2012 compressor count * station count for year N / 2012 station count]
Wells (Storage)	wells	1992 base year value (17,999) scaled by residential natural gas consumption driver.
M&R (Trans. Co. Interconnect)	stations	1992 base year value (2,595) scaled by transmission pipeline length driver.
M&R (Farm Taps + Direct Sales)	stations	1992 base year value (76,932) scaled by transmission pipeline length driver.
Vented and Combusted		
Normal Operation		
Dehydrator vents (Transmission)	MMscf/yr	[Station count for year N * (dehydrators per station) * (throughput per dehydrator).
Dehydrator vents (Storage)	MMscf/yr	1992 base year value (2,000,001) scaled by residential natural gas consumption driver.
Compressor Exhaust		
Engines (Transmission)	MMHPHr	1992 base year value (40,380) scaled by total natural gas consumption driver.
Turbines (Transmission)	MMHPHr	1992 base year value (9,635) scaled by total natural gas consumption driver.
Engines (Storage)	MMHPHr	1992 base year value (4,922) scaled by residential natural gas consumption driver.
Turbines (Storage)	MMHPHr	1992 base year value (1,729) scaled by residential natural gas consumption driver.
Generators (Engines)	MMHPHr	1992 base year value (1,976) scaled by total natural gas consumption driver.
Generators (Turbines)	MMHPHr	1992 base year value (23) scaled by total natural gas consumption driver.

Natural Gas Systems Activity Data Sources

Segment/Source	Units	Data Source/Method
Pneumatic Devices Transmission and Storage		
Pneumatic Devices Transmission	devices	1990-1992: Base year 1992 estimate scaled by transmission length driver. 2011-2015: [station count * subpart W controllers per station)]. 1993-2010: linear interpolation.
Pneumatic Devices Transmission (high bleed)	devices	1990-2010: Not estimated. 2011-2015: [# of transmission pneumatic devices * high bleed fraction (subpart W)].
Pneumatic Devices Transmission (intermittent bleed)	devices	1990-2010: Not estimated. 2011-2015: [# of transmission pneumatic devices * intermediate bleed fraction (subpart W)].
Pneumatic Devices Transmission (low bleed)	devices	1990-2010: Not estimated. 2011-2015: [# of transmission pneumatic devices * low bleed fraction (subpart W)].
Pneumatic Devices Storage	devices	1990-1992: [1992 device count * station count for year N / 1992 station count]; 2011-2015: [# of stations * subpart W controllers per station)]. 1993-2010: linear interpolation
Pneumatic Devices Storage (high bleed)	devices	1990-2010: Not estimated. 2011-2015: [# of storage pneumatic devices * high bleed fraction (subpart W)].
Pneumatic Devices Storage (intermittent bleed)	devices	1990-2010: Not estimated. 2011-2015: [# of storage pneumatic devices * intermediate bleed fraction (subpart W)].
Pneumatic Devices Storage (low bleed)	devices	1990-2010: Not estimated. 2011-2015: [# of storage pneumatic devices * low bleed fraction (subpart W)].
Routine Maintenance/Upsets		
Pipeline venting	miles	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (total transmission)
Station venting Transmission and Storage		
Station Venting Transmission	compressor stations	1990-1992: Base year 1992 estimate scaled by transmission length (EIA). 2011-2015: [station count * subpart W station scaling factor (3.52)]. 1993-2010: linear interpolation.
Station Venting Storage	compressor stations	1990-1992: Base year 1992 estimate scaled by residential natural gas consumption driver. 2005-2015: [Storage fields (EIA) * stations per storage field]. 1993-2004: linear interpolation.
LNG Storage		
LNG Stations	stations	EIA, US LNG Markets and Uses and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Reciprocating Compressors	compressors	EIA, US LNG Markets and Uses and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Centrifugal Compressors	compressors	EIA, US LNG Markets and Uses and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Compressor Exhaust		
LNG Engines	MMHPhr	EIA, US LNG Markets and Uses and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Turbines	MMHPhr	EIA, US LNG Markets and Uses and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Station venting	stations	EIA, US LNG Markets and Uses and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Import Terminals		
LNG Stations	stations	FERC, North American LNG Terminals and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Reciprocating Compressors	compressors	FERC, North American LNG Terminals and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Centrifugal Compressors	compressors	FERC, North American LNG Terminals and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Compressor Exhaust		
LNG Engines	MMHPhr	EIA, US LNG Markets and Uses; EIA, US Natural Gas Imports; and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Turbines	MMHPhr	EIA, US Natural Gas Imports and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
LNG Station venting	stations	FERC, North American LNG Terminals and ICF, Estimation of Activity Factors for the Natural Gas Exploration and Production Industry in the U.S (1996)
DISTRIBUTION		
Normal Fugitives		
Pipeline Leaks		
Mains - Cast Iron	miles	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (by pipeline material)
Mains - Unprotected steel	miles	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (by pipeline material)
Mains - Protected steel	miles	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (by pipeline material)
Mains - Plastic	miles	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (by pipeline material)

Natural Gas Systems Activity Data Sources

Segment/Source	Units	Data Source/Method
Total Pipeline Miles	miles	Calculated
Services - Unprotected steel	services	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (by pipeline material)
Services Protected steel	services	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (by pipeline material)
Services - Plastic	services	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (by pipeline material)
Services - Copper	services	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (by pipeline material)
Total Services	services	Calculated
Meter/Regulator (City Gates)		
M&R >300	stations	1990-2006: [Base year stations * (year N residential pipeline miles/base year residential pipeline miles)]. 2007-2010: [Base year stations * residential gas consumption driver]. 2011-2015: subpart W data.
M&R 100-300	stations	1990-2006: [Base year stations * (year N residential pipeline miles/base year residential pipeline miles)]. 2007-2010: [Base year stations * residential gas consumption driver]. 2011-2015: subpart W data.
M&R <100	stations	1990-2006: [Base year stations * (year N residential pipeline miles/base year residential pipeline miles)]. 2007-2010: [Base year stations * residential gas consumption driver]. 2011-2015: subpart W data.
Reg >300	stations	1990-2006: [Base year stations * (year N residential pipeline miles/base year residential pipeline miles)]. 2007-2010: [Base year stations * residential gas consumption driver]. 2011-2015: subpart W data.
R-Vault >300	stations	1990-2006: [Base year stations * (year N residential pipeline miles/base year residential pipeline miles)]. 2007-2010: [Base year stations * residential gas consumption driver]. 2011-2015: subpart W data.
Reg 100-300	stations	1990-2006: [Base year stations * (year N residential pipeline miles/base year residential pipeline miles)]. 2007-2010: [Base year stations * residential gas consumption driver]. 2011-2015: subpart W data.
R-Vault 100-300	stations	1990-2006: [Base year stations * (year N residential pipeline miles/base year residential pipeline miles)]. 2007-2010: [Base year stations * residential gas consumption driver]. 2011-2015: subpart W data.
Reg 40-100	stations	1990-2006: [Base year stations * (year N residential pipeline miles/base year residential pipeline miles)]. 2007-2010: [Base year stations * residential gas consumption driver]. 2011-2015: subpart W data.
R-Vault 40-100	stations	1990-2006: [Base year stations * (year N residential pipeline miles/base year residential pipeline miles)]. 2007-2010: [Base year stations * residential gas consumption driver]. 2011-2015: subpart W data.
Reg <40	stations	1990-2006: [Base year stations * (year N residential pipeline miles/base year residential pipeline miles)]. 2007-2010: [Base year stations * residential gas consumption driver]. 2011-2015: subpart W data.
Customer Meters		
Residential	outdoor meters	1990-2014: Energy Information Administration (EIA) - annual data (outdoor residential meters). 2015: 2014 data used as proxy.
Commercial/Industry	meters	1990-2014: Energy Information Administration (EIA) - annual data (commercial/industrial meters). 2015: 2014 data used as proxy.
Vented		
Routine Maintenance		
Pressure Relief Valve Releases	mile main	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (total pipeline miles)
Pipeline Blowdown	miles	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (gas distribution system)
Upsets		
Mishaps (Dig-ins)	miles	Pipeline and Hazardous Materials Safety Administration (PHMSA) - annual data (gas distribution system)

Natural Gas Systems Emission Factor Sources

Segment/Source	Units	Data Source/Method
PRODUCTION		
Normal Fugitives		
Gas Wells		
Non-associated Gas Wells (less fractured wells)	kg/well	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Gas Wells with Hydraulic Fracturing	kg/well	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Well Pad Equipment		
Heaters	kg/heater	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Separators	kg/separator	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Dehydrators	kg/dehydrator	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Meters/Piping	kg/meter	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Compressors	kg/compressor	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Gathering and Boosting		
Gathering and Boosting Stations	kg/station	Developed using Marchese et al., as documented in the ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revision to Gathering and Boosting Station Emissions" (April 2016)
Pipeline Leaks	kg/mile	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Vented and Combusted		
Drilling, Well Completion, and Well Workover		
Gas Well Completions without Hydraulic Fracturing	kg/completion	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Gas Well Workovers without Hydraulic Fracturing	kg/workover	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Hydraulic Fracturing Completions and Workovers that vent	kg/(compl. & workover)	Developed from RY2011-2013 GHGRP subpart W data, see February 2015 Public Review Memorandum: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013: Proposed Revision to Hydraulically Fractured Gas Well Completions and Workovers Estimate"
Flared Hydraulic Fracturing Completions and Workovers	kg/(compl. & workover)	Developed from RY2011-2013 GHGRP subpart W data, see February 2015 Public Review Memorandum: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013: Proposed Revision to Hydraulically Fractured Gas Well Completions and Workovers Estimate"
Hydraulic Fracturing Completions and Workovers with RECs	kg/(compl. & workover)	Developed from RY2011-2013 GHGRP subpart W data, see February 2015 Public Review Memorandum: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013: Proposed Revision to Hydraulically Fractured Gas Well Completions and Workovers Estimate"
Hydraulic Fracturing Completions and Workovers with RECs that flare	kg/(compl. & workover)	Developed from RY2011-2013 GHGRP subpart W data, see February 2015 Public Review Memorandum: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013: Proposed Revision to Hydraulically Fractured Gas Well Completions and Workovers Estimate"
Well Drilling	kg/well	Radian/API, Global Emissions of Methane Sources (1992)
Produced Water from Coal Bed Methane		
Powder River	kg/gal produced water	Wyoming Oil and Gas Conservation Commission
Black Warrior	kg/well	Alabama State Oil and Gas Board
Normal Operations		
Pneumatic Device Vents	kg/controller	Developed from RY2014 GHGRP subpart W data, see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas and Petroleum Production Emissions" (April 2016)
Chemical Injection Pumps	kg/pump	Developed from RY2014 GHGRP subpart W data, see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas and Petroleum Production Emissions" (April 2016)
Kimray Pumps	kg/MMscf	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Dehydrator Vents	kg/MMscf	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Condensate Tank Vents		
Large Tanks w/Flares	kg/tank	Developed from RY2015 GHGRP subpart W data
Large Tanks w/VRU	kg/tank	Developed from RY2015 GHGRP subpart W data
Large Tanks w/o Control	kg/tank	Developed from RY2015 GHGRP subpart W data
Small Tanks w/Flares	kg/tank	Developed from RY2015 GHGRP subpart W data
Small Tanks w/o Flares	kg/tank	Developed from RY2015 GHGRP subpart W data
Malfunctioning Separator Dump Valves	kg/tank	Developed from RY2015 GHGRP subpart W data

Natural Gas Systems Emission Factor Sources

Segment/Source	Units	Data Source/Method
Compressor Exhaust Vented		
Gas Engines	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Liquids Unloading		
Liquids Unloading - Vent Using Plungers	kg/well	Developed from RY2011-2015 GHGRP subpart W data
Liquids Unloading - Vent Without Using Plungers	kg/well	Developed from RY2011-2015 GHGRP subpart W data
Blowdowns		
Vessel BD	kg/vessel	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Pipeline BD	kg/mile	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Compressor BD	kg/compressor	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Compressor Starts	kg/compressor	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
G&B Station Episodic Events	kg/station	Developed using Marchese et al.
Upsets		
Pressure Relief Valves	kg/PRV	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Mishaps	kg/mile	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Offshore		
Shallow water Gas Platforms (GoM and Pacific)	kg/platform	See EPA memorandum: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013: Revision to Offshore Platform Emissions"
Deepwater Gas Platforms (GoM and Pacific)	kg/platform	See EPA memorandum: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2013: Revision to Offshore Platform Emissions"
GAS PROCESSING PLANTS		
Fugitives, Vented, and Combusted		
Plant Total Emissions	kg/plant	2011-2015: Developed from RY2015 GHGRP subpart W data. 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Plant Fugitives	kg/plant	2011-2015: Developed from RY2015 GHGRP subpart W data
Reciprocating Compressors	kg/compressor	2011-2015: Developed from RY2015 GHGRP subpart W data
Centrifugal Compressors (wet seals)	kg/compressor	2011-2015: Developed from RY2015 GHGRP subpart W data
Centrifugal Compressors (dry seals)	kg/compressor	2011-2015: Developed from RY2015 GHGRP subpart W data and previous GHGI factor for seal venting. See https://www.epa.gov/sites/production/files/2017-01/documents/2017_ghgi_ng_revision_under_consideration_-_gas_proc_1.17.pdf .
Flares	kg/plant	2011-2015: Developed from RY2015 GHGRP subpart W data
Dehydrators	kg/plant	2011-2015: Developed from RY2015 GHGRP subpart W data
Compressor Exhaust		
Gas Engines	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Gas Turbines	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
AGR Vents	kg/AGR	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Pneumatic Devices	kg/plant	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Routine Maintenance		
Blowdowns/Venting	kg/plant	2011-2015: Developed from RY2015 GHGRP subpart W data. 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
TRANSMISSION AND STORAGE		
Fugitives		
Pipeline Leaks	kg/mile	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Compressor Stations (Transmission)		
Station Total Emissions	kg/station	2011-2015: Developed using Zimmerle et al., see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Station + Compressor Fugitive Emissions	kg/station	2011-2015: Developed using Zimmerle et al., see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016)

Natural Gas Systems Emission Factor Sources

Segment/Source	Units	Data Source/Method
Reciprocating Compressor	kg/compressor	2011-2015: Developed using Zimmerle et al., see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016)
Centrifugal Compressor (wet seals)	kg/compressor	2011-2015: Developed using Zimmerle et al., see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016)
Centrifugal Compressor (dry seals)	kg/compressor	2011-2015: Developed using Zimmerle et al., see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016)
Compressor Stations (Storage)		
Station Total Emissions	kg/station	2011-2015: Developed using Zimmerle et al., see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Station + Compressor Fugitive Emissions	kg/compressor	2011-2015: Developed using Zimmerle et al., see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016)
Reciprocating Compressor	kg/compressor	2011-2015: Developed using Zimmerle et al., see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016)
Wells (Storage)	kg/well	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996), and CARB data on Aliso Canyon for 2015. See https://www.epa.gov/sites/production/files/2017-01/documents/memo_on_aliso_canyon_estimate_for_u.s._ghgi_1.10.17.pdf ,
M&R (Trans. Co. Interconnect)	kg/station	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
M&R (Farm Taps + Direct Sales)	kg/station	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Vented and Combusted		
Normal Operation		
Dehydrator vents (Transmission)	kg/MMscf	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Dehydrator vents (Storage)	kg/MMscf	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Compressor Exhaust		
Engines (Transmission)	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Turbines (Transmission)	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Engines (Storage)	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Turbines (Storage)	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Generators (Engines)	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Generators (Turbines)	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Pneumatic Devices Trans + Stor		
Pneumatic Devices Transmission	kg/controller	2011-2015: Developed from RY2011-2015 GHGRP subpart W data, see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
(High Bleed)	kg/controller	2011-2015: Developed from RY2011-2015 GHGRP subpart W data, see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016).
(Intermittent Bleed)	kg/controller	2011-2015: Developed from RY2011-2015 GHGRP subpart W data, see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016).
(Low Bleed)	kg/controller	2011-2015: Developed from RY2011-2015 GHGRP subpart W data, see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016).
Pneumatic Devices Storage	kg/controller	2011-2015: Developed from RY2011-2015 GHGRP subpart W data, see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
(High Bleed)	kg/controller	2011-2015: Developed from RY2011-2015 GHGRP subpart W data, see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016).
(Intermittent Bleed)	kg/controller	2011-2015: Developed from RY2011-2015 GHGRP subpart W data, see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016).
(Low Bleed)	kg/controller	2011-2015: Developed from RY2011-2015 GHGRP subpart W data, see ERG/EPA Memo: "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Transmission and Storage Emissions" (April 2016).

Natural Gas Systems Emission Factor Sources

Segment/Source	Units	Data Source/Method
Routine Maintenance/Upsets		
Pipeline venting	kg/mile	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Station venting Trans + Storage		
Station Venting Transmission	kg/station	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Station Venting Storage	kg/station	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Storage		
LNG Stations	kg/station	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Reciprocating Compressors	kg/compressor	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Centrifugal Compressors	kg/compressor	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Compressor Exhaust		
LNG Engines	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Turbines	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Station venting	kg/station	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Import Terminals		
LNG Stations	kg/station	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Reciprocating Compressors	kg/compressor	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Centrifugal Compressors	kg/compressor	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Compressor Exhaust		
LNG Engines	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Turbines	kg/MMHPhr	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
LNG Station venting	kg/station	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
DISTRIBUTION		
Normal Fugitives		
Pipeline Leaks		
Mains - Cast Iron	kg/mile	2011-2015: Developed using Lamb et al. and GRI, see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Mains - Unprotected steel	kg/mile	2011-2015: Developed using Lamb et al. and GRI, see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Mains - Protected steel	kg/mile	2011-2015: Developed using Lamb et al. and GRI, see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Mains - Plastic	kg/mile	2011-2015: Developed using Lamb et al. and GRI, see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Services - Unprotected steel	kg/service	2011-2015: Developed using Lamb et al. and GRI, see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Services Protected steel	kg/service	2011-2015: Developed using Lamb et al. and GRI, see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Services - Plastic	kg/service	2011-2015: Developed using Lamb et al. and GRI, see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Services - Copper	kg/service	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Meter/Regulator (City Gates)		

Natural Gas Systems Emission Factor Sources

Segment/Source	Units	Data Source/Method
M&R >300	kg/station	2011-2015: Developed using Lamb et al., see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
M&R 100-300	kg/station	2011-2015: Developed using Lamb et al., see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
M&R <100	kg/station	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Reg >300	kg/station	2011-2015: Developed using Lamb et al., see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
R-Vault >300	kg/station	2011-2015: Developed using Lamb et al., see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Reg 100-300	kg/station	2011-2015: Developed using Lamb et al., see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
R-Vault 100-300	kg/station	2011-2015: Developed using Lamb et al., see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Reg 40-100	kg/station	2011-2015: Developed using Lamb et al., see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
R-Vault 40-100	kg/station	2011-2015: Developed using Lamb et al., see ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016). 1990-1992: GRI/EPA, Methane Emissions from the Natural Gas Industry (1996). 1993-2010: based on linear interpolation from 1992 to 2011 value
Reg <40	kg/station	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Customer Meters		
Residential	kg/meter	GRI/EPA, GTI, and Clearstone. See ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016)
Commercial/Industry	kg/meter	GRI/EPA, GTI, and Clearstone. See ERG/EPA Memo "Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2014: Revisions to Natural Gas Distribution Emissions" (April 2016)
Vented		
Routine Maintenance		
Pressure Relief Valve Releases	kg/mile	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Pipeline Blowdown	kg/mile	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)
Upsets		
Mishaps (Dig-ins)	kg/mile	GRI/EPA, Methane Emissions from the Natural Gas Industry (1996)