**CGE Greenhouse Gas Inventory Workshop**

Name: .

**Energy Sector – Fugitive Emissions**

1. What is the most important factor for determining the amount of methane emissions from coal mines?
   * + - 1. Age of the mine
         2. Type of coal

(c) Type of mine

1. Geographic region
2. What segment of a natural gas system is most likely to exhibit the greatest natural gas losses per unit of throughput?
   1. Exploration
   2. Production and processing
   3. Transmission
   4. Distribution
3. Which facility category is least likely to be a noteworthy source of fugitive methane emissions?
4. Heavy oil wells
5. Single-well oil batteries
6. Group oil batteries
7. Oil pipeline terminals
8. Which part of the oil industry is most likely to be the dominant source of greenhouse gas emissions from fugitive equipment leaks (assuming there are no imports):
9. Exploration
10. Production
11. Transport
12. Refining/storage
13. Distribution of oil products
14. Which part of the oil industry is least likely to have any greenhouse gas methane emissions from fugitive equipment leaks:
15. Exploration
16. Production
17. Transport
18. Refining/storage
19. Distribution of oil products
20. Which part of the oil industry is most likely to have significant greenhouse gas emissions from venting and flaring:
21. Exploration
22. Production
23. Transport
24. Refining/storage
25. Distribution of oil products
26. The natural gas produced in association with crude oil may be:
27. Used for on-site process needs
28. Re-injected into the producing formation to maintain reservoir pressure
29. Vented or flared
30. Collected into a gas-gathering system
31. Lost to the atmosphere due to equipment leaks
32. Used to produce electric power for use on site and sale into the electric utility grid
33. All of the above
34. (a)–(d) and (f)
35. (a)–(e)
36. Which part of the natural gas industry is least likely to flare waste gas volumes:
37. Exploration
38. Production/processing
39. Transmission
40. Distribution
41. Which post-mining activity is most likely to produce fugitive methane emissions:
42. Screening
43. Transport
44. Loading/unloading
45. Crushing
46. Combustion
47. Which of the following is not a valid contribution to fugitive emissions from coal mining and handling:
48. Release of gas from the coal seam
49. Release of gas from the strata above
50. Release of gas from the strata below
51. Flaring/venting of methane from mine degassing wells
52. Leakage from a coal-bed methane production system
53. (c), (d) and (e)
54. (d) and (e)
55. Which of the following is not true:
56. Petroleum refineries are not normally noteworthy sources of fugitive greenhouse gas emissions due to equipment leaks
57. All produced natural gas is processed before going to market
58. All countries that have natural gas distribution systems have natural gas production
59. Countries that have oil refineries do not necessarily have oil production
60. Which of the following statements is false:
    1. Large facilities are the major contributors of fugitive emissions on both oil and natural gas systems
    2. Storage tanks are likely to be significant sources of methane emissions at production facilities
    3. Casing gas venting from heavy oil wells is potentially a major source of methane emissions
    4. Waste gas is normally only flared if it is highly toxic or odorous, otherwise it is vented
61. Which of the following statements is false:
62. Any countries that have a natural gas system, oil production or petroleum refining should be reporting vented and flared volumes
63. Any gas processing plants that have gas sweetening units will probably have raw CO2 emissions
64. All gas processing plants use natural gas as the supply medium for gas-operated instruments
65. Any plants that process sour natural gas probably have raw CO2 emissions
66. None of the above
67. Which of the following statements is false:
68. Sour waste gas is more apt to be flared than vented
69. Shallow wells are less likely to produce sour natural gas than deep wells
70. Petroleum refineries tend to contribute more methane emissions from fugitive equipment leaks than do upstream field facilities
71. An important consideration in evaluating the amount of emissions from gas distribution systems is the amount of cast iron pipeline
72. None of the above
73. Storage tanks at pipeline terminals are normally sources of:
74. Working losses
75. Breathing (or standing) losses
76. Flashing losses
77. Fugitive equipment leaks
78. All of the above
79. (a) and (b) only
80. (a), (b) and (c) only
81. (a), (b) and (d) only
82. Emissions from fugitive equipment leaks are typically unaffected by:
83. Type of component
84. Type of service
85. Industry sector
86. Age of facility
87. Toxicity or economic value of the process fluid
88. None of the above
89. Which of the following is not normally a source of venting emissions:
90. Heavy oil wells
91. Natural gas wells
92. Use of natural gas as the supply medium for gas-operated equipment
93. Natural gas compressor stations
94. Which of the following is not a source of fugitive emissions:
95. Process sewers
96. Tailings ponds
97. API separators
98. Emergency vents
99. Produced water tanks
100. Underground coal fires
101. None of the above

**Energy Sector – Fugitive Emissions**

1. Answer: (c). The type of mine has the greatest impact on the amount of methane emissions that would be expected from coal mining. As indicated in Sections 1.7.2.2 and 1.7.2.3 of the Reference Manual of the Revised 1996 IPCC Guidelines, the difference in the rate of methane emissions from underground mining and surface mining is greater than the potential range of values for either type of mining. Methane emissions from underground mines are in the range of 10 to 25 m3/tonne of coal compared to values of 0.3 to 2.0 m3/tonne for surface mines.
2. Answer: (b). Specific natural gas losses are likely to be greater for natural gas production and processing than for the other listed segments. However, not all Parties will necessarily have each of these industry segments. Exploration activities can have large emission events but are generally brief in duration. Natural gas transmission facilities may have significant fugitive emissions due to their size, but overall, the amount of equipment and venting tends to be less per unit of throughput than for gas production and processing. Because gas distribution systems are operated at low pressures and carry odourized gas they tend to have relatively low emissions except where significant amounts of cast-iron piping are used.
3. Answer: (d). Of the listed types of facilities, oil pipeline terminals are least likely to be significant sources of fugitive methane emissions because crude oil contains only trace amounts of methane by the time it reaches the transmission pipeline system. Methane has a boiling point of –161.5º C at atmospheric pressure, so most of it quickly volatilizes when the oil is treated and first brought to stock tank conditions at the upstream production facilities.
4. Answer: (b). The production segment of the oil industry is most likely to be the dominant source of greenhouse gas emissions from fugitive equipment leaks. Crude oil only contains trace amounts of methane downstream of production facilities. The equipment used in oil exploration is only in service for relatively short periods of time, and collectively, is not as great as the amount of equipment in service at oil production facilities.
5. Answer: (e). The distribution of oil products is least likely to have methane emissions from fugitive equipment leaks. The distribution of oil products occurs downstream of petroleum refineries. The crude oil received by refineries contains only trace amounts of methane, and refined products produced there contain essentially no methane. The only fugitive methane emissions that might occur at refined-product distribution facilities are from leaking components in fuel gas services where natural gas is purchased for on-site use (e.g. for space heating).
6. Answer: (b). Assuming a Party has a balanced oil and gas industry, the production segment of the oil industry is most likely to be a significant source of venting and flaring. This is reflected in the Tier 1 emission factors presented in table 2.16 in section 2.7.1.2 of the IPCC good practice guidance.
7. Answer: (g). Natural gas produced in association with crude oil may be used for all of the listed purposes. Usually there is more associated gas produced than is needed to satisfy the on-site fuel requirements. Any gas that is not needed is either conserved, if it is economic to do so, or disposed of by venting or flaring. In both cases, some fugitive emissions from equipment leaks will occur.
8. Answer: (c). The gas transmission industry segment is least likely to flare waste gas volumes. In general, it is simpler and more economical for companies to vent rather than flare waste gas volumes (i.e. fewer safeguards and less land is needed for vent systems). Also, there can be more of a negative public reaction to flaring events (i.e. they tend to be noisier and more visible; the sight of a large open flame can be alarming to the public where they are unaccustomed to such events). Therefore, typical industry practice is to flare waste gas only if it contains toxic contaminants (e.g. hydrogen sulphide), is malodorous or if flaring is a regulatory requirement. The gas handled by transmission systems has normally been processed to remove all contaminants and has not been odourized. Distribution systems typically carry odourized natural gas, and exploration and production/processing applications can often involve odorous or toxic gases.
9. Answer: (d). Crushing or pulverizing coal is the post-mining activity most likely to produce fugitive methane emissions. The methane contained in coal when it leaves the mine is present largely as a free gas in the pores and void spaces of the coal (i.e. interstitial methane), although some methane is weakly adsorbed on the surface of the coal. Some of the coal-bound methane is gradually released to the atmosphere by molecular diffusion and some is released every time the coal is disturbed (i.e. moved or handled). Crushing or pulverizing coal causes rapid release of both the interstitial and adsorbed methane.
10. Answer: (e). Leakage from a coal-bed methane production system is not a valid source of fugitive emissions from coal mining and handling. The production of coal-bed methane into a gas-gathering system is part of the natural gas industry. Consequently, any leakage from the coal-bed methane production system should be reported under oil and gas systems rather than under coal mining.
11. Answer: (b). Not all produced natural gas is processed before going to market. Some produced natural gas may be of sufficient quality for immediate market consumption; although, normally it is necessary to at least compress and dehydrate the gas to meet sales gas specifications. Compression and dehydration alone are not deemed to constitute a gas processing plant. The distinguishing element of a gas processing plant is a process unit for hydrocarbon dew point control or extraction of heavier-than-methane hydrocarbon gas constituents; however, it may also have compression and treating units for removing contaminants such as water vapour, hydrogen sulphide, carbon dioxide and nitrogen, plus facilities for sulphur recovery and treating of hydrocarbon liquids.
12. Answer: (a). Large facilities are not necessarily the major contributors of fugitive emissions for either oil or natural gas systems. The upstream portion of the oil and gas industry, where most of the fugitive emissions occur, is usually characterized more by many smaller facilities and field installations rather than a few large facilities.
13. Answer: (c). Not all gas processing plants use natural gas as the supply medium for gas-operated devices (e.g. control loops, chemical injection pumps, automatic samplers). If total site-wide consumption requirements are large enough and electric power is available, it may be more economical to use compressed air as the supply medium. This is usually the case at larger gas plants (design capacity of more than 7 x 106m3/day) and most medium-sized gas plants (design capacity of 0.7 to 7 x 106m3/day).
14. Answer: (c). Petroleum refineries are not likely to contribute as much methane emissions from fugitive equipment leaks as the upstream field facilities. There are relatively few components in natural gas service at refineries, usually only the fuel gas system and the inlet piping to the hydrogen unit if one exists. All the crude oil and refined product streams would contain negligible or no methane. Additionally, there is likely to be much more equipment, and therefore more potential leakage points, associated with all the upstream facilities than at the refinery.
15. Answer: (h). Storage tanks at pipeline terminals are potential sources of working losses, breathing (or standing) losses and fugitive equipment leaks, but not flashing losses. Typical crude oil pipeline specifications preclude the receipt of flashing or boiling products at pipeline terminals. Moreover, the dissolved gas (i.e. solution gas) that would cause the product to boil should already have been released upon reaching stock tank conditions at the upstream production facilities.
16. Answer: (f). None of the above, since the average amount of emissions from fugitive equipment leaks correlates with each of the listed parameters.
17. Answer: (b). Some gas may be vented at oil wells where it is uneconomical to conserve; however, gas wells, by definition, are only produced if the gas can be conserved. Problems can still occur that would contribute to venting at gas wells (e.g. gas migration to the surface around the outside of the surface casing or surface-casing vent blows); however, most gas wells do not have such problems.
18. Answer: (g). Process sewers, tailings ponds and API separators are potential sources of fugitive methane emissions due to evaporation losses. Tailings ponds may also contribute carbon dioxide emissions due to aerobic decomposition of hydrocarbon residue contained in the tailings. Emergency vents may contribute methane emissions due to emergency relief episodes as well as leakage into the vent system. Produced water tanks may be a source of methane emissions if there is any gas carry-through to the storage tanks due to inefficient gas-liquid separation upstream or leakage past drain and blowdown valves connected to the tank inlet header. Underground coal fires may be a source of methane and carbon dioxide emissions, depending on how much air is available to support the fire.