Methane

Introduction

The NSW Environment Protection Authority (EPA) is the lead regulator for coal seam gas (CSG) activities in NSW. Along with legislative requirements, each CSG facility in NSW holds an Environment Protection Licence (EPL) issued by the EPA that sets out legally enforceable, site-specific conditions and controls, which holders must comply with in order to prevent and minimise pollution and safeguard the environment. This includes controls to protect air quality.

The main component of CSG is methane. Although methane is a naturally occurring gas present in the earth's atmosphere, it is also a greenhouse gas and can be hazardous in high concentrations, so it is important that methane emitted from industry sources is minimised and monitored.

This fact sheet contains an introduction to methane and the EPA's regulation of methane air emissions from CSG facilities.

What is methane?

Methane is a component of the earth's atmosphere and is present at low concentrations. We inhale methane along with other atmospheric gases such as nitrogen and oxygen when we breathe.

At room temperature and pressure, methane is an odourless and colourless flammable gas. It is composed of carbon and hydrogen and has the chemical formula CH_4.

Methane is the main component of natural gas and CSG. It is one of several gases including carbon dioxide, nitrous oxide and fluorinated gases that are greenhouse gases. Greenhouse gases trap heat in the earth's atmosphere, which ultimately leads to global climate change.

Methane's Global Warming Potential (GWP) is currently estimated as approximately 28 times higher than carbon dioxide over a 100 year timeframe.

How is methane formed?

Methane can be formed from man-made and natural processes, including biological and geological processes.

Geological processes

Methane is the major component of natural gas, which is formed when natural organic matter is compressed under the earth at very high pressure and temperatures, typically over tens of millions of years. This methane is typically trapped deep underground.

Biological processes

Methane is also formed when microorganisms chemically break down organic matter. This type of methane creation normally takes place at or near the earth's surface (such as in landfills and wetlands) and consequently can be lost to the atmosphere.

Methane is also produced as a by-product of the digestive processes of ruminant animals such as cattle, sheep and goats.

Coal seam methane is formed by either biological or geological processes. The methane produced is adsorbed into the solid matrix of the coal and is stored in coal cleats, fractures and other openings.

Where is methane emitted?

Emissions of methane can occur naturally at geological outlets known as seeps or vents. These outlets occur as a result of natural pathways in the earth's geological formations and may change over time as a result of activities and processes, including tectonic shifts (earthquakes). These seeps and vents occur at ground level and on the ocean floor.

Methane can also be emitted from a number of industrial activities, for example, leaks from pressurised equipment, venting of natural gas from activities such as coal mines and surface emissions from sewage waste water treatment ponds. These unintended, or uncontrolled emissions are known as fugitive emissions.

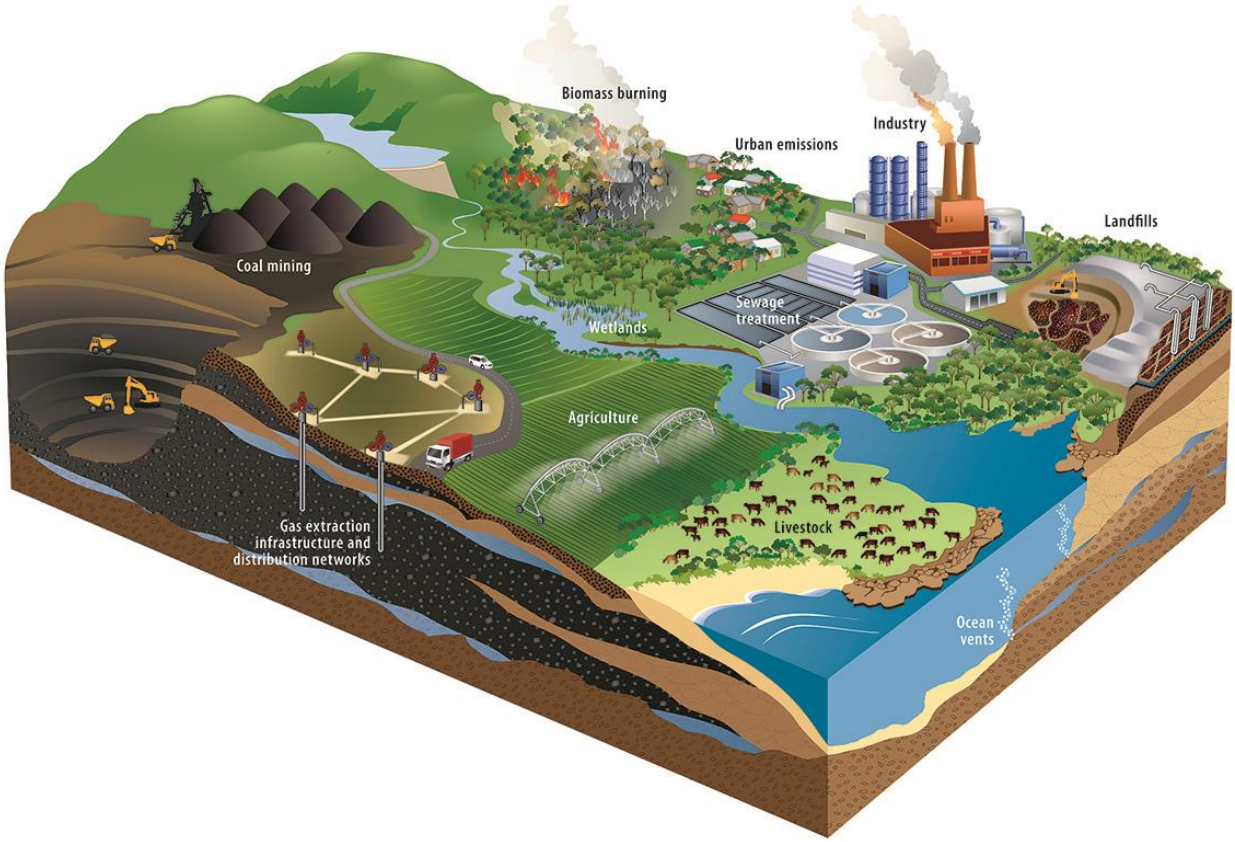

Illustration of common methane sources

What is methane used for?

Methane is used for a variety of purposes including industrial processes, heating and electricity generation. Methane is also an important feedstock in the chemical industry.

Before methane is distributed for commercial use, it is usually combined with trace amounts of pungent smelling gas to give the methane a detectable odour. This results in an obvious and simple means to detect gas leaks for safety purposes.

Extracted methane is typically processed, transported and sold, with much of the gas produced in Australia going overseas.

Methane concentrations in air

Parts per million (ppm) and parts per billion (ppb) are measures commonly used to describe small quantities such as the fractions of gases in air. These measures, typically by volume or mass, can be used to compare the ratio of methane or other greenhouse gases in the atmosphere.

A detection level of 1 ppbv of methane means there is 1 part of methane in 1 billion parts of a given amount of air by volume.

According to the World Meteorological Organization Global Atmosphere Watch Programme, recent (2013) measurement of methane levels from monitoring stations around the world show that the current average global background level of methane is 1824 ppb, with approximately 40% of methane being emitted by natural sources, and the other 60% from human activities, including intensive livestock farming.

Is methane hazardous?

Methane has not been found to have any adverse impact on human health at concentrations generally found in the environment.

Exposure to low levels of methane may cause dizziness, headaches or a general feeling of fatigue. These symptoms subside when exposure to methane has ended.

In high concentrations methane will displace oxygen, depriving the body of oxygen which may, in turn, pose an asphyxiation hazard. Symptoms may include agitation, slurred speech, nausea, vomiting and headaches.

There is currently no occupational exposure limit specified for methane in Australia, although it is a noted asphyxiant.

The primary hazard presented by methane is its flammability when sufficient quantities accumulate in a mixture with atmospheric oxygen. When methane concentrations are below 50,000 ppm the gas mixture is too ‘lean’ and there is insufficient methane for combustion. Above 150,000 ppm, the gas mixture is too ‘rich’ and insufficient oxygen exists for combustion. When methane is present at concentrations between the 50,000 and 150,000 ppm it has the ability to combust.

Methane monitoring in CSG operations

As methane is the principal component of natural gas and CSG it is important that methane emitted from gas extraction and related activities is carefully monitored to demonstrate that these operations are being carried out effectively without significant leakage. To ensure appropriate monitoring is conducted, the EPA requires EPL holders for gas activities to develop and implement a gas Leak Detection and Repair (LDAR) program for their operations.

LDAR programs focus on identifying any leaks from gas operations (including leaks from pumps, valves, pipelines and connections) by monitoring at regular intervals. LDAR programs also require that any leaks detected are repaired in a timely manner. In the case of CSG activities, the LDAR program is designed to detect and minimise methane leaks. Emission reductions from implementing an LDAR program reduce gas loss, increase safety, and minimise any exposure to the surrounding community.

EPA LDAR program requirements

EPA LDAR programs generally consist of five basic elements:

1. Identify components:

Requires the licensee to identify all components of its gas infrastructure to be monitored.

2. Leak classifications:

The EPA has determined the following three leak classification categories based on methane gas concentration:

- Category 1: 1,000 to 9,999ppm (less than 1% of air)
- Category 2: 10,000 to 49,999ppm (1% to less than 5%)
- Category 3: 50,000ppm or greater (5% or greater of air)

These categories are detailed within the EPL for the operations and the category defines the repair timeframe.

3. Monitor component:

The EPA LDAR program requires licensees to monitor for the detection of leaks in accordance with US EPA Reference Method 21 and US EPA Leak Detection and Repair - A Best Practices Guide.

4. Repair component:

The 'US EPA Leak Detection and Repair - A Best Practices Guide' provides guidance for LDAR repair programs. The guide states that repairs to leaking components should be done as soon as practicable, but not later than a specified number of calendar days after the leak is detected (usually five days for a first attempt at repair and 15 days for the final attempt at repair). The component is considered to be repaired only after it has been monitored and shown not to be leaking above the applicable leak category.

5. Records and reporting:

The EPA requires the licensee to submit a brief summary report on its LDAR program with the operation's Annual Return. The reporting requirement is detailed in the EPL.

The EPA LDAR program is continuously improving to provide a consistent best practice approach for identifying, classifying, repairing and reporting gas emissions.

Australia's domestic and global methane emissions reporting framework

The Australian Government's air policies and programs are implemented by the Department of the Environment. Programs funded under the Emissions Reduction Fund include projects such as the destruction of fugitive methane emissions by industry. In addition, the Department of the Environment tracks Australia's greenhouse gas emissions, including methane, through the Australian National Greenhouse Accounts.

In 2007, the National Greenhouse and Energy Reporting Scheme (NGERS) was introduced under the *National Greenhouse and Energy Reporting Act 2007*. This legislative reporting requirement provides data on greenhouse gas emissions, energy consumption and production in Australia, including emissions of fugitive methane from the oil, gas and coal mining industries, large scale landfills and sewage treatment facilities. The scheme is administered by the Clean Energy Regulator to provide a central point for the determination of Australia's contribution to global greenhouse gas emissions and is used as a tool to assist with making informed policy decisions around greenhouse gas emissions.

Australia is a member country of the Global Methane Initiative (GMI). The GMI notes that Australia was ranked 10th in the world for anthropogenic methane emissions in 2005. The GMI aims to provide incentives for business to engage in activities that will reduce methane emissions, and an avenue to engage in projects including methane abatement, recovery and use.

Environment Protection Authority
Website: www.epa.nsw.gov.au

ISBN 978-1-76039-206-2
EPA2015/0851
December 2015