Methane emissions from the oil & gas and coal industries: Similarities and differences

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Mitigation of Methane Emissions from the Extractive Industries in Transition: Concrete Actions, Goals, and the Costs of the Process

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Methane emissions
Oil and gas operations vs coal

**Oil and gas CH₄ emissions**
- Emitted from all industry segments
- Majority of facilities assumed to emit some CH₄
- Oil and gas throughput does not necessarily equate to quantity of emissions
- Vented emissions (intentional) and leaks (unintentional)
- CH₄ emitted for safety, due to lack of infrastructure or no market
- Emission sources can be diffuse with emissions from millions of pieces of equipment
- Widely distributed across a large number of countries
- Includes onshore and offshore operations
- Includes large-scale events (e.g., well blowouts, storage leaks, pipeline ruptures)
- Emissions from plugged/abandoned wells may total 5-10% of onshore production emissions but there is significant uncertainty
- Significant CO₂ emissions from venting and combustion

**Coal mining CH₄ emissions**
- Emissions primarily from coal production
- Not all coal mines are gassy
- Coal production and emissions are not always directly related
- Vented emissions only, no leaks
- CH₄ is a byproduct of mining and emitted for safety
- Emission sources are concentrated into a small number of vent shafts, degasification system, vent pipes
- Generally limited to major mining countries
- Onshore operations only
- Nothing comparable to O&G major events – a major event would likely cause an explosion at the mine
- Abandoned mines believed to account for 10-20% of emissions from underground mines and abandoned mine methane (AMM) emissions are growing
- Very little CO₂ emissions
Onshore petroleum and natural gas exploration and production (E&P) segment

**US Greenhouse Gas Inventory (GHGI)**

- CH$_4$ emissions from
  - 47 sources at natural gas E&P operations
  - 40 sources at oil E&P operations

Sources include:
- drilling and completions
- associated gas venting
- pneumatic controllers and pumps
- liquids unloading
- storage tanks
- dehydrators
- leaks
- compressors
- well blowouts
- other sources
- uncombusted methane
- Other

**Enverus – Facility is defined as all onshore E&P operations at the basins level

Onshore E&P CH$_4$

- 96.6 MtCO$_2$e net emissions*
- (6.3) MtCO$_2$e reductions*
- ~9300 Facilities**

US GHGI Equipment Counts*

- 1,514,000 pneumatic devices
- 940,000 oil & gas wells
- 650,800 tanks
- 484,300 separators
- 350,300 meters of piping
- 153,000 heaters
- 123,800 pumps
- 52,100 gas engines
- 38,000 compressors
- 12,400 dehydrators
### Underground coal operations

![Diagram of underground coal operations](image)

**US CMM Statistics**

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Working surface mines</td>
<td>350</td>
</tr>
<tr>
<td>Gassy working UG mines</td>
<td>167</td>
</tr>
<tr>
<td>Gassy abandoned UG mines</td>
<td>532</td>
</tr>
<tr>
<td>MtCO(_2)e net emissions</td>
<td>53.4</td>
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<tr>
<td>MtCO(_2)e from UG mines</td>
<td>34.5</td>
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<tr>
<td>MtCO(_2)e from surface mines</td>
<td>6.4</td>
</tr>
<tr>
<td>MtCO(_2)e from post-mining</td>
<td>6.6</td>
</tr>
<tr>
<td>MtCO(_2)e from abandoned mines</td>
<td>5.9</td>
</tr>
<tr>
<td>MtCO(_2)e recovered and used from working UG mines</td>
<td>(15.7)</td>
</tr>
<tr>
<td>MtCO(_2)e recovered and used from abandoned mines</td>
<td>(2.6)</td>
</tr>
</tbody>
</table>

Monitoring, measurement of CH$_4$ emissions

Oil and gas operations vs coal

**Oil and gas CH$_4$ emissions**

- Due to large number of sources, monitoring/measurement often uses combination of:
  - Emission factors
  - Optical gas imaging and remote sensing
  - Flow meters and sensors
- Low emissions from individual sources collectively adds up to large emission totals
- Some large emission sources can produce significant emissions, e.g., Associated gas venting, Well blowouts.
- Concentration of large emitters among IOCs, NOCs, and major independents has allowed regulators and industry to develop standards such as the Oil and Gas Methane Partnership

**Coal mining CH$_4$ emissions**

- Common measurement methods
  - Flow meters and sensors, especially at working UG mines
  - Emission factors
  - Decline curve analysis and statistical analysis at abandoned mines
- Measurement is normal practice for safety
- More focus on remote sensing of methane emissions in recent years
- Major emitting companies in the global coal industry less concentrated than oil and gas
## Mitigation of CH₄ emissions
### Oil and gas operations vs coal

### Oil and gas CH₄ emissions
- O&G industry under significant scrutiny to reduce emissions
- Recovery of saleable product
- Mitigation actions within the normal competency of oil and gas facility operators
- Recovery and use of CH₄ requires
  - Market for the gas
  - Infrastructure such as sufficient pipeline capacity
- Economics are highly dependent on:
  - Price for natural gas
  - Incentives or carbon markets can help
- Flaring is used where recovery for sales is not possible
- Significant emission reductions are achievable, but 100% mitigation probably not possible: Upsets, Necessary blowdowns, Unintended events, Impossible to stop all leaks

### Coal mining CH₄ emissions
- More attention has turned to the coal industry in recent years
- CH₄ is a byproduct of mining; industry focused on safety first
- Mitigation actions are not normally within the core competency of owner/operators
- Recovery and use of coal mine methane (CMM) seen as a source of revenue or cost-savings for the mine
  - Predominant use of CMM worldwide is power generation, not gas sales
  - Requires access to markets but CMM can also be used on-site
- Economics are highly dependent on:
  - Price for power, natural gas, LNG, and/or coal
  - Incentives or carbon markets can help
- Mining industry in some countries has begun flaring unused CH₄ but historically this has not been a standard practice due to perceived safety concerns
- Ventilation Air Methane (VAM) remains largest source of coal mine emissions, but few projects worldwide due to technical challenges and need for sustained high carbon prices
- Significant emission reductions are achievable, but 100% mitigation is not possible: Technical limits of mitigation equipment, Need to ensure safety
Thank You

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