Venting and Flaring of Associated Gas

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MAP Session # 8
Oct. 11, 2019
Key Points

• Large volumes of waste and air pollution
• Economic, not technological problem
• Alternatives to flaring available, but will be underused absent standards
• ND/BLM 2016 approaches establish capture rate goals, allow industry compliance flexibility
• Standards only work if clear and straightforward
Scale of emissions and waste

NM Reported Venting and Flaring Volumes (2016-2019)

- Vented + Flared
- Flared
- Vented

Volume (mcf)
Scale of emissions and waste – overall

• Total gas production reported as vented or flared -- C-115s likely produce substantial underestimate (see https://www.ngdc.noaa.gov/eog/viirs/download_global_flare.html)

<table>
<thead>
<tr>
<th></th>
<th>Vented</th>
<th>Flared</th>
<th>Vented + Flared</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019 Q2</td>
<td>724,641</td>
<td>8,319,266</td>
<td>9,043,907</td>
</tr>
<tr>
<td>2019 Q1</td>
<td>711,939</td>
<td>8,472,053</td>
<td>9,183,992</td>
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<tr>
<td>2018 Q4</td>
<td>613,390</td>
<td>11,499,805</td>
<td>12,113,195</td>
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<tr>
<td>2018 Q3</td>
<td>638,211</td>
<td>8,775,299</td>
<td>9,413,510</td>
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<td>2018 Q2</td>
<td>880,210</td>
<td>7,828,529</td>
<td>8,708,739</td>
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<tr>
<td>2018 Q1</td>
<td>983,923</td>
<td>5,317,869</td>
<td>6,301,792</td>
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<td>2017 Q4</td>
<td>544,849</td>
<td>4,418,534</td>
<td>4,963,383</td>
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<td>2017 Q3</td>
<td>486,144</td>
<td>3,689,663</td>
<td>4,175,807</td>
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<td>2017 Q2</td>
<td>669,194</td>
<td>3,774,982</td>
<td>4,444,176</td>
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<td>2017 Q1</td>
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<td>3,002,997</td>
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<td>2016 Q4</td>
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<td>4,886,637</td>
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<td>2016 Q3</td>
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<td>2016 Q2</td>
<td>1,020,546</td>
<td>5,702,331</td>
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<td>2016 Q1</td>
<td>1,361,619</td>
<td>5,919,156</td>
<td>7,280,775</td>
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## Scale of emissions and waste – associated gas

<table>
<thead>
<tr>
<th>Table 2</th>
<th>% of oil well gas production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vented</td>
</tr>
<tr>
<td>2019 Q2</td>
<td>0.3%</td>
</tr>
<tr>
<td>2019 Q1</td>
<td>0.3%</td>
</tr>
<tr>
<td>2018 Q4</td>
<td>0.3%</td>
</tr>
<tr>
<td>2018 Q3</td>
<td>0.4%</td>
</tr>
<tr>
<td>2018 Q2</td>
<td>0.5%</td>
</tr>
<tr>
<td>2018 Q1</td>
<td>0.6%</td>
</tr>
<tr>
<td>2017 Q4</td>
<td>0.4%</td>
</tr>
<tr>
<td>2017 Q3</td>
<td>0.4%</td>
</tr>
<tr>
<td>2017 Q2</td>
<td>0.5%</td>
</tr>
<tr>
<td>2017 Q1</td>
<td>0.3%</td>
</tr>
<tr>
<td>2016 Q4</td>
<td>0.4%</td>
</tr>
<tr>
<td>2016 Q3</td>
<td>0.4%</td>
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<tr>
<td>2016 Q2</td>
<td>0.8%</td>
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<tr>
<td>2016 Q1</td>
<td>1.1%</td>
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</table>
Drivers of associated gas venting and flaring

• Most associated gas flaring connected/near gathering systems

• Gas production volumes, timing, and location not aligned with gathering lines/processing plant capacities
  • Oil production drives well development decisions
  • Time lag between production increases and takeaway capacity expansions

• In most situations, operators are able to flare vs. vent
Alternatives available to reduce v/f

• Develop wells in alignment with gas gathering and processing capacity
• Alternative capture approaches providing flexibility to operators:
  • Natural gas liquids
  • CNG trucking
  • On-site electricity production – local loads or grid
  • Reinjection for EOR
• Alternative means of disposal
  • Reinjection for storage
Alternatives – Align well development with gathering capacity

• Oil and gas producers know how to get products to market
• Little economic incentive to invest in gas capture where greater returns from investment in additional oil production
• Gas capture planning would help, but not sufficient
Alternatives – NGL stripping

• Portable, modular, scaleable
• Best for rich gas
• Reduces flare by 5% to 21%
• Low cost
• E.g., http://gtuit.com/ngl-recovery/
  http://vortextools.com/ngl-recovery/
  https://www.pioneerenergy.com/products#flarecatcher
Alternatives – CNG trucking

• Portable, scaleable
• Works with all gas compositions
• Most cost-effective within 20-25 miles of processing plant with available capacity
• Reduces flare by 91%-98%
Alternatives – Electricity generation for local use

• Conventional reciprocating engine or gas turbine
• Scaleable, modular, low/negative cost
• Can reduce flare 18% to 22% depending on site energy demand
• Best with dry gas (can combine with NGL stripping)
• See, e.g., [http://www.blaiseenergy.com/solutions.html](http://www.blaiseenergy.com/solutions.html)
Alternatives – Electricity generation for grid

- Needs larger supply of gas from multiple wellheads
- Best with dry gas
- Requires location near grid
Alternatives – Reinjection for EOR/storage

- EOR common in conventional oil production
- Alaska prohibition on venting/flaring $\rightarrow$ widespread reinjection
- Reinjection starting to be used in tight oil plays
  - At least 5 companies using in TX
- Benefits in Eagle Ford – 30-70% gain in oil output from older wells
- Results vary by formation
% flared/vented varies across operators

- 10 of top 20 oil producers -- less than 5% of production V/F
- 10 of top 20 oil producers -- 5% to 25% of production V/F

2018-2019 top oil producers ranked by percent V/F

<table>
<thead>
<tr>
<th>Operator Anonymized</th>
<th>2018 Q1</th>
<th>2018 Q2</th>
<th>2018 Q3</th>
<th>2018 Q4</th>
<th>2019 Q1</th>
<th>2019 Q2</th>
<th>Total</th>
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<tbody>
<tr>
<td>1</td>
<td>0%</td>
<td>0%</td>
<td>16%</td>
<td>51%</td>
<td>40%</td>
<td>11%</td>
<td>25%</td>
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<tr>
<td>2</td>
<td>22%</td>
<td>42%</td>
<td>25%</td>
<td>28%</td>
<td>18%</td>
<td>21%</td>
<td>24%</td>
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<tr>
<td>3</td>
<td>29%</td>
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<td>14%</td>
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<tr>
<td>4</td>
<td>12%</td>
<td>12%</td>
<td>14%</td>
<td>13%</td>
<td>11%</td>
<td>14%</td>
<td>12%</td>
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<tr>
<td>5</td>
<td>4%</td>
<td>7%</td>
<td>14%</td>
<td>7%</td>
<td>12%</td>
<td>24%</td>
<td>10%</td>
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<td>6</td>
<td>3%</td>
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<td>12%</td>
<td>25%</td>
<td>14%</td>
<td>9%</td>
<td>10%</td>
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<td>7</td>
<td>6%</td>
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<td>8%</td>
<td>9%</td>
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<td>8</td>
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<td>9%</td>
<td>2%</td>
<td>3%</td>
<td>3%</td>
<td>4%</td>
<td>5%</td>
</tr>
</tbody>
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Economic problem, not a technology problem

• Variety of factors and circumstances lead to decision to flare
• Operators in best position to decide how to reduce flaring
• Classic market failure – requires regulatory fix
• BLM and ND approaches provide goals, allow operator flexibility
North Dakota approach

ND Industrial Commission Order 24665 (2014)

• Set minimum gas capture rates for covered production
  • 74% Oct. 1, 2014
  • Gradual increase to 88% now
  • 91% beginning Nov. 1, 2020

• Substantial and expanded volumes of gas excluded from calculation
  • Complex; administrative burden

• Flaring fell initially, then rose

• As of 3/19, chronic failure to meet capture targets

• Virtually no consequences for failure to meet targets
BLM approach in 2016 rule

• Initially proposed average monthly volume limits by well
• Industry commenters preferred ND approach
• Final rule set minimum capture percentages:
  • 85% in 2018
  • 90% in 2020
  • 95% in 2023
  • 98% in 2026
• In lieu of multiple exemptions, subtract a set volume of flaring/well/month that falls over time:
  • 3,600 Mcf/well beginning in 2019
  • Gradually declined to 750 Mcf/well from 2025 on
• Compliance flexibility – calculate on a lease-by-lease, county-by-county, or state-wide basis
• National applicability (esp. ND) drove less stringent numbers
Air pollution from venting and flaring

**Venting**
- Methane – potent GHG, estimated 86x CO₂ over 20 year period
- VOCs – ozone formation; pulmonary and cardiovascular harms
- Air toxics – carcinogenic, reproductive harms

**Flaring**
- CO₂ – climate
- NOx – ozone formation; pulmonary and cardiovascular harms
- Methane – potent GHG, estimated 86x CO₂ over 20 year period
- Particulate – pulmonary and cardiovascular harms
- SO₂ – from hydrogen sulfide gas flaring

Eddy County. Credit: Current Argus