Venting and Flaring of Associated Gas

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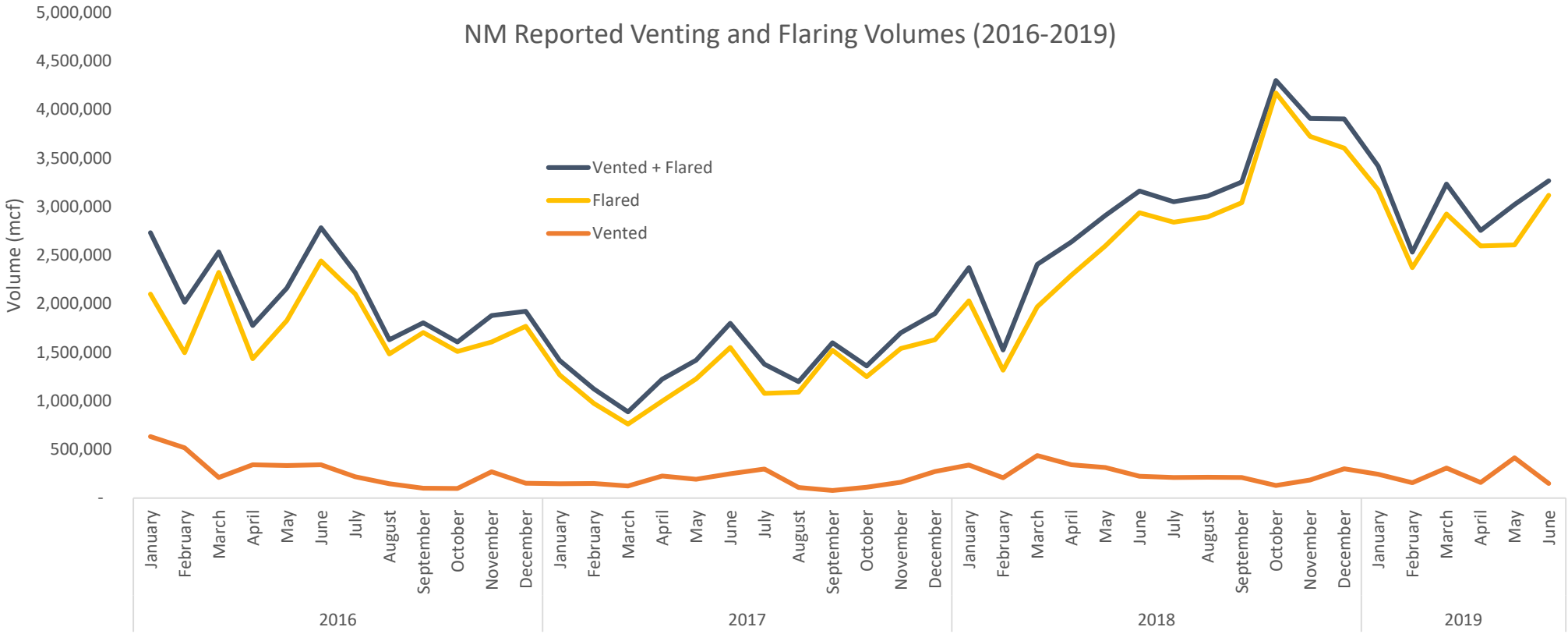
Key Points

- 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



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 1	Total Reported Volume (mcf)		
	Vented	Flared	Vented + Flared
2019 Q2	724,641	8,319,266	9,043,907
2019 Q1	711,939	8,472,053	9,183,992
2018 Q4	613,390	11,499,805	12,113,195
2018 Q3	638,211	8,775,299	9,413,510
2018 Q2	880,210	7,828,529	8,708,739
2018 Q1	983,923	5,317,869	6,301,792
2017 Q4	544,849	4,418,534	4,963,383
2017 Q3	486,144	3,689,663	4,175,807
2017 Q2	669,194	3,774,982	4,444,176
2017 Q1	423,251	3,002,997	3,426,248
2016 Q4	521,433	4,886,637	5,408,070
2016 Q3	466,377	5,290,614	5,756,991
2016 Q2	1,020,546	5,702,331	6,722,877
2016 Q1	1,361,619	5,919,156	7,280,775

Scale of emissions and waste – associated gas

Table 2	% of oil well gas production		
	Vented	Flared	Vented + Flared
2019 Q2	0.3%	3.6%	3.9%
2019 Q1	0.3%	4.1%	4.5%
2018 Q4	0.3%	5.9%	6.2%
2018 Q3	0.4%	4.9%	5.2%
2018 Q2	0.5%	4.6%	5.1%
2018 Q1	0.6%	3.5%	4.2%
2017 Q4	0.4%	3.0%	3.4%
2017 Q3	0.4%	2.7%	3.0%
2017 Q2	0.5%	2.8%	3.3%
2017 Q1	0.3%	2.3%	2.6%
2016 Q4	0.4%	3.8%	4.2%
2016 Q3	0.4%	4.0%	4.3%
2016 Q2	0.8%	4.3%	5.1%
2016 Q1	1.1%	4.9%	6.0%

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

Alternatives – Electricity generation for grid

- Needs larger supply of gas from multiple wellheads
- Best with dry gas
- Requires location near grid
- E.g., http://www.blaiseenergy.com/solutions.html

Alternatives – Reinjection for EOR/storage

- EOR common in conventional oil production
- Alaska prohibition on venting/flaring → 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

Operator Anonymized	2018 Q1	2018 Q2	2018 Q3	2018 Q4	2019 Q1	2019 Q2	Total
1	0%	0%	16%	51%	40%	11%	**25%**
2	22%	42%	25%	28%	18%	21%	**24%**
3	29%	12%	11%	17%	15%	6%	**14%**
4	12%	12%	14%	13%	11%	14%	**12%**
5	4%	7%	14%	7%	12%	24%	**10%**
6	3%	4%	12%	25%	14%	9%	**10%**
7	6%	8%	8%	9%	4%	3%	**6%**
8	0%	0%	10%	0%	6%	7%	**5%**
9	4%	8%	4%	4%	3%	5%	**5%**
10	4%	9%	2%	3%	3%	4%	**5%**

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 CO_2 over 20 year period
- VOCs – ozone formation; pulmonary and cardiovascular harms
- Air toxics – carcinogenic, reproductive harms

Flaring

- CO_2 – climate
- NOx – ozone formation; pulmonary and cardiovascular harms
- Methane – potent GHG, estimated 86x CO_2 over 20 year period
- Particulate – pulmonary and cardiovascular harms
- SO_2 – from hydrogen sulfide gas flaring

Eddy County. Credit: Current Argus