Pneumatic Equipment:
Opportunities for Mitigation

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Scale of Emissions

GHGRP data does not allow us to separate emissions from the NM portion of the Permian and San Juan Basins, and omits small operators / facilities

2017 EMISSIONS, TONNES METHANE Segment	High-bleed Pneumatic Devices	Intermittent Bleed Pneumatic Devices	Low-Bleed Pneumatic Devices	CONTROLLERS TOTAL	Pneumatic Pumps
Onshore natural gas transmission compression	**9**	**47**	**-**	**56**	
Onshore petroleum and natural gas gathering and boosting	**6,178**	**27,919**	**1,117**	**35,214**	**4,049**
430 - Permian Basin	4,994	23,018	600	28,612	3,634
580 - San Juan Basin	1,184	4,901	517	6,602	415
Onshore petroleum and natural gas production	**16,584**	**162,958**	**9,846**	**189,389**	**5,314**
430 - Permian Basin	12,310	71,145	2,541	85,996	4,397
580 - San Juan Basin	4,275	91,813	7,305	103,392	917
Underground natural gas storage		**6**		**6**	
Grand Total	**22,771**	**190,931**	**10,964**	**224,665**	**9,362**

Emissions per controller

Study Name	# PC Samples	Application	Duration of Measurement	Whole gas (avg ER) (scf/hr)
EDF/UTexas 2014	377	Well pads natural gas production, several U.S. basins	15 minutes	5.7
EPA – Thoma Utah Study 2016	80	Unitah Basin well pads, oil and gas production	1 hour or more	0.36
Oklahoma Independent Producers Association	680	Oil and gas production in Oklahoma	NA	1.05 (calc)
Prasino 2013	601	British Columbia oil and gas sites, measured high bleeds only	30 minutes	8.7 – 9.2
Luck et al 2019 (Gathering facilities) (data quality affected by meter problem)	72	US gathering facilities	76 hours (avg)	Low-bleed: 7.6 High-bleed: 19.3 Intermittent-bleed: 11.1 Overall: 10.9
Cap-On Energy BC Oil and Gas Methane Emissions Field Study (Data tables here)		British Columbia wellpads	Direct equip. cts. from 266 pads, with EFs calculated based on counts of specific models and recent measured EFs for each model	Emissions reported by controller function (irrespective of continuous-bleed / intermittent-bleed distinction. See figure below.

Studies carried out over the last ten years consistently find that a large portion of emissions from controllers come from improper operations / leaks / problems.

Real emissions cannot be calculated using manufacturer specs or emissions measured under ideal conditions

Mitigation approaches

Mitigation approaches:

- Replace high-bleed with low-bleed
- Inspect controllers
- Capture emissions & direct to process
- Replace with zero-bleed
  - Electric
  - Instrument (compressed) Air

Mitigation approaches

Mitigation approaches:

- **Replace high-bleed with low-bleed**

US rules have only applied this to continuous-bleed controllers, greatly limiting the benefits of these measures.
Exception: Wyoming

Canadian rules generally place a threshold of 6 scfh on all new controllers, intermittent-bleed and continuous-bleed

PROS:

VERY cost effective, VERY feasible

CONS:

Are low-bleeds really low-emitting?

Mitigation approaches

Mitigation approaches:

- Replace high-bleed with low-bleed
- **Inspect controllers**

California (requires measurement for grandfathered continuous-bleeds), Colorado

PROS:

Based on CO experience, appears to be helpful.

CONS:

Based on Luck et al, could not be expected to find all malfunctions.

Creates additional administrative burden

Mitigation approaches

Mitigation approaches:

- Replace high-bleed with low-bleed
- Inspect controllers
- **Capture emissions & direct to process**
  - Required for certain pumps (OOOOa), seen on permits for controllers in WY
  - Allowed by Canadian rules

Mitigation approaches

Mitigation approaches:

- Replace high-bleed with low-bleed
- Inspect controllers
- Capture emissions & direct to process
- **Replace with zero-bleed**
  - **Electric**
  - **Instrument (compressed) Air**

Required for new controllers / sites under AB / BC rules

Canadian zero-bleed standards

With lead time, provinces are requiring operators to move to zero bleeds

BC: all controllers at new sites after 1/1/21; retrofit existing large compressor stations by 1/1/22

AB: 90% of new controllers (at new and existing sites!) after 1/1/22

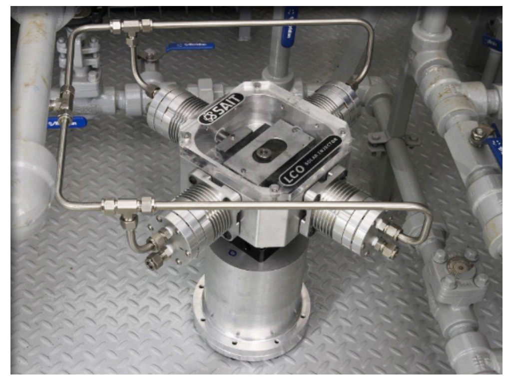
How will Canadian operators comply?

Solar-Electric systems

Retrofitted Separator with Bear Solar Electric Control System

http://www.calscan.net/products_bearcontrol.html

Off-grid air systems



Very low-power air compressor designed for solar

https://lcotechnologies.com/crossfire-compressor.html

Hybrid solar & gas generation system designed to provide air and power for sites

Number of Devices

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SEGMENT	High-bleed Pneumatic Devices	Intermittent Bleed Pneumatic Devices	Low-Bleed Pneumatic Devices	Controllers Total	Pneumatic pumps
Onshore natural gas transmission compression	**3**	**126**	**2**	**131**	
Onshore petroleum and natural gas gathering and boosting	**1,306**	**18,416**	**6,674**	**26,396**	**2,572**
430 - Permian Basin	1,080	15,982	4,272	21,334	2,293
580 - San Juan Basin	226	2,434	2,402	5,062	279
Onshore petroleum and natural gas production	**3,988**	**121,683**	**68,753**	**194,424**	**3,874**
430 - Permian Basin	3,115	67,470	24,268	94,853	3,322
580 - San Juan Basin	873	54,213	44,485	99,571	552
Underground natural gas storage		**15**		**15**	
Grand Total	**5,297**	**140,240**	**75,429**	**220,966**	**6,446**