BRITISH COLUMBIA | Ministry of Environment and Climate Change Strategy

Methane emissions from the oil and gas sector

First Nations Climate Initiative
Information Sharing Sessions

December 19, 2019

Outline

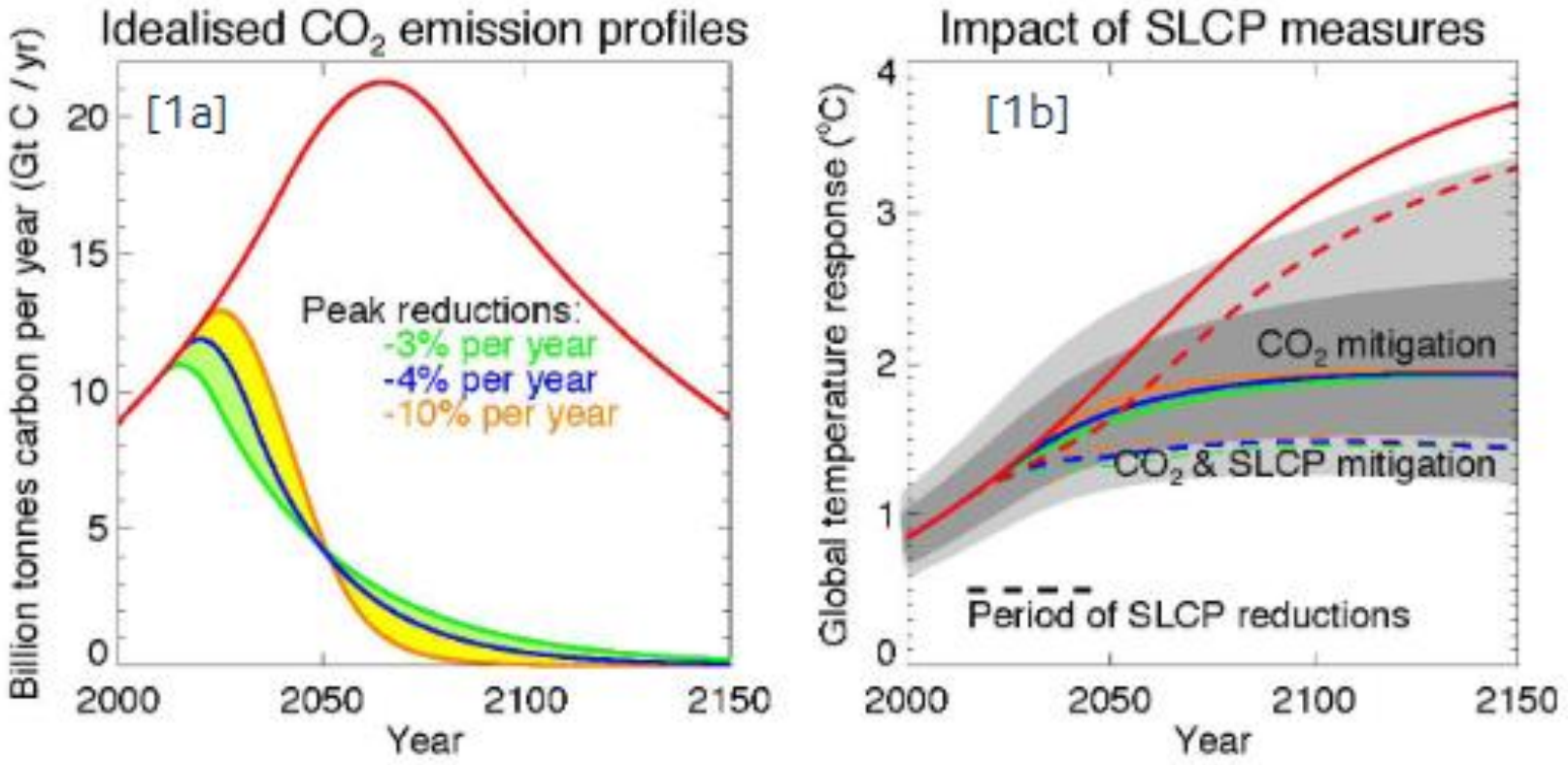
- Why is methane important?
- GHG emissions in B.C.
  - Inventories and methodologies
  - Estimation uncertainty
- Provincial and federal methane regulatory approaches
- Completed and upcoming research

Why is methane important?

- Methane is a potent greenhouse gas (GHG)
  - It is estimated to be responsible for about 25 per cent of human-caused global warming*
- Methane emissions make up about 14 percent of B.C.'s total GHG emissions
- The oil and gas sector is estimated to be the second largest contributor to methane emissions in B.C. (after waste)
  - Estimated to be the largest contributor to methane emissions in Canada

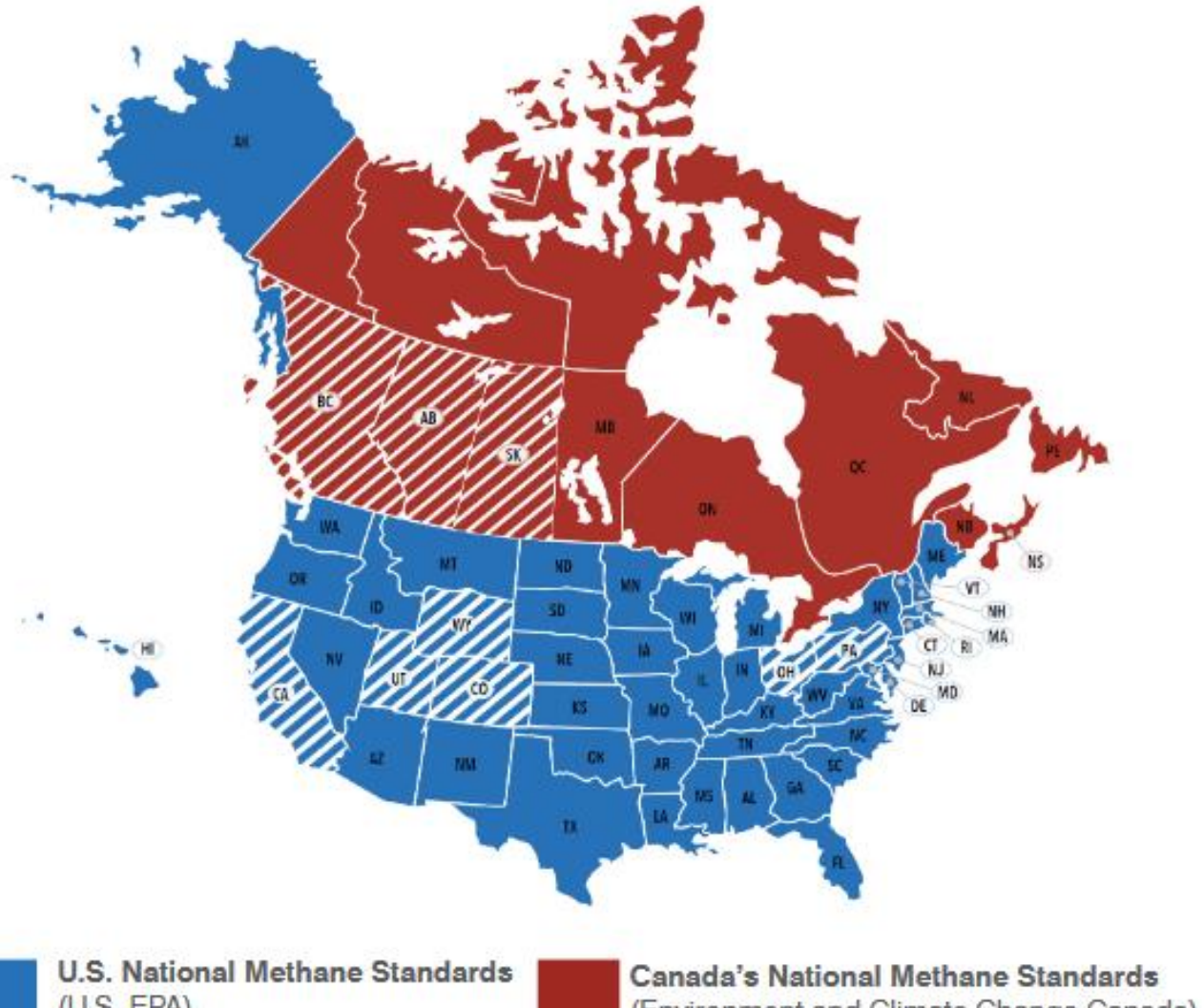
* EDF calculation based on IPCC AR5 WGI Chapter 8.

Why is methane important?



Immediate mitigation of Short-Lived Climate Pollutants (SLCPs) could reduce – by about half a degree Celsius – the amount of global climate warming we experience between now and 2050.

Why is methane important?



Note that in August 2019, the EPA proposed rolling back the US federal methane rules which are not reflected in this map.

B.C. GHG emissions inventory

- Industrial operators emitting over 10,000 tonnes CO_2e per year report under the *Greenhouse Gas Industrial Reporting and Control Act*
  - Lower reporting threshold than most jurisdictions (Canada has lowered threshold to B.C.'s this year)
- Provincial GHG Inventory is published on a two-year delay using national and provincial data sources
- Bottom-up approach follows international standards (based on IPCC guidance) with methodologies initially developed through the Western Climate Initiative (California, Ontario, Quebec, etc.)

Reported GHG emissions

- An **emission factor** attempts to relate the quantity of a pollutant released to the atmosphere with an activity or operation

Example for pneumatic pumps from upstream oil and gas (from Final Essential Requirements for Mandatory Reporting – Amended for Canadian Harmonization, 2012)

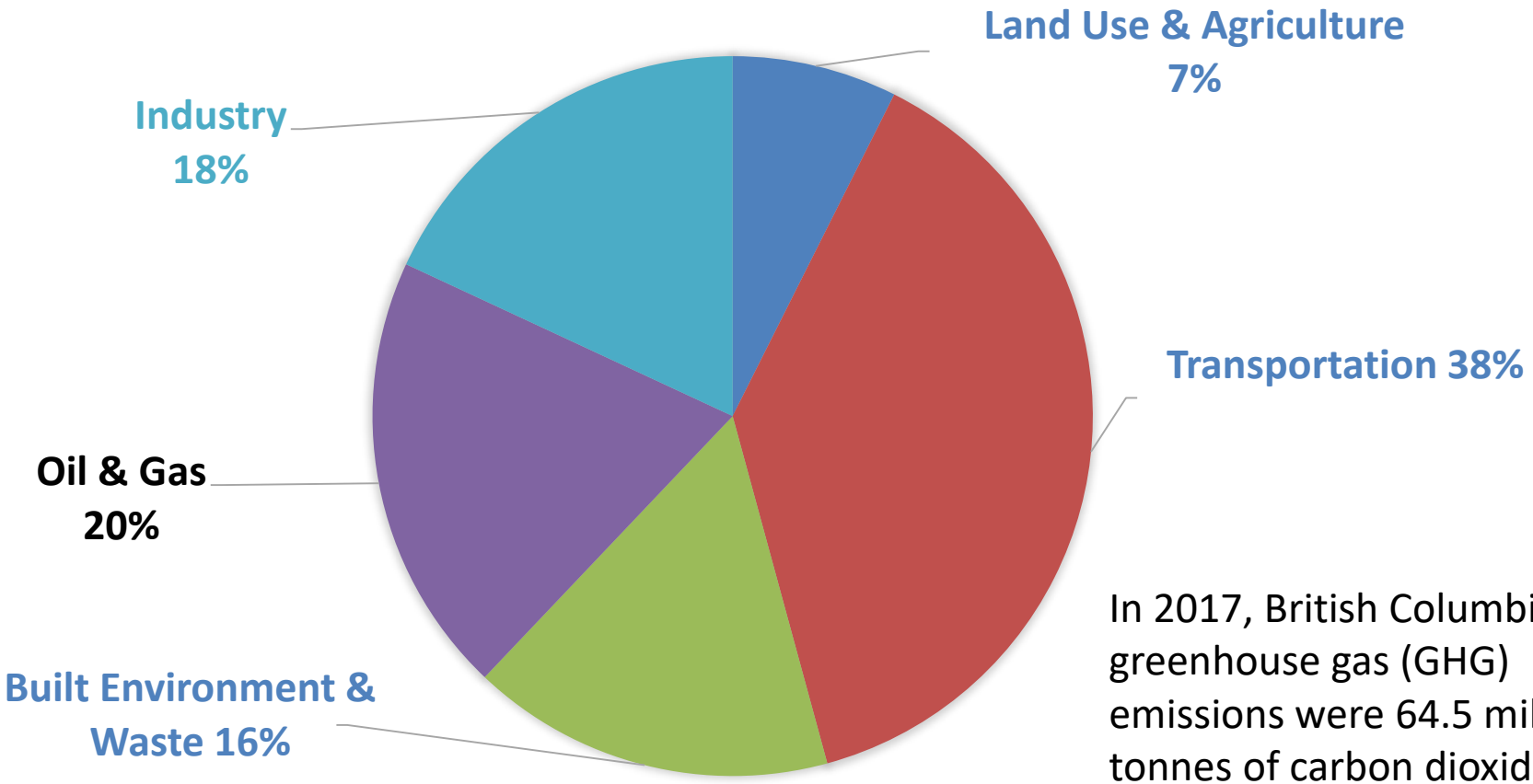
$$E_s = EF_j \times Q_j$$

Equation 360-3

Where:

E_s	=	Annual natural gas volumetric emissions (Sm^3/y).
EF_j	=	Natural gas-driven pneumatic pump gas emission factor expressed in "emission per volume of liquid pumped at operating pressure" as provided by the manufacturer for pump *j* (Sm^3/liter).
Q_j	=	Volume of liquid pumped annually by pump *j* (liters/y).

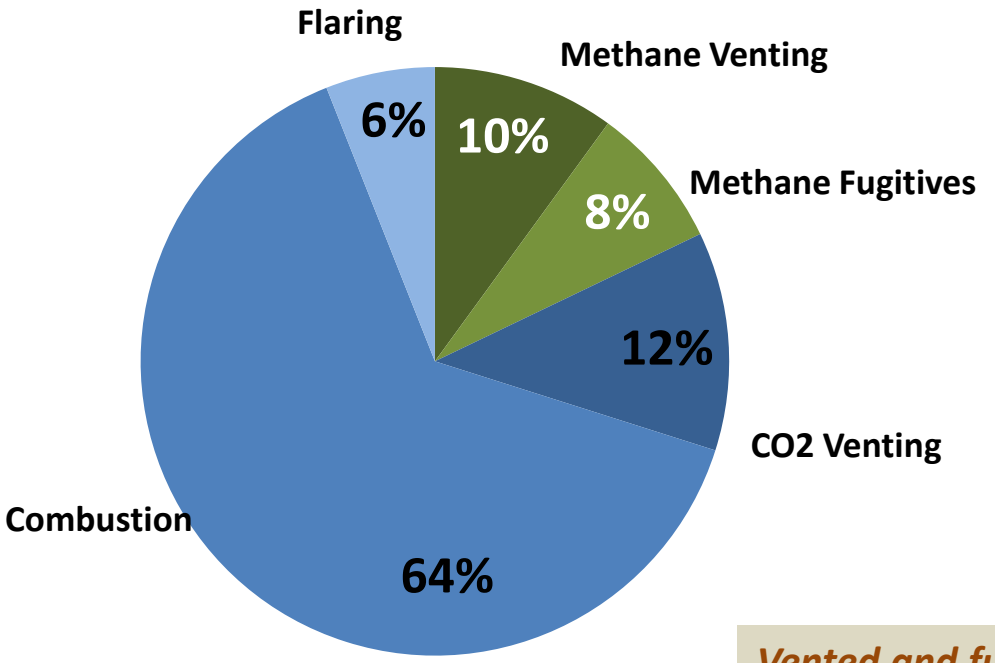
B.C.'s Provincial GHG Inventory



In 2017, British Columbia's greenhouse gas (GHG) emissions were 64.5 million tonnes of carbon dioxide equivalent (Mt CO_2e).

Upstream GHG Emissions Data by Type

Oil and Gas Sector GHG Emissions Breakdown by Source:
9.1 million tonnes CO_2e in 2017



Key Sources:

CH4 Venting: High Bleed Controllers, Gas Driven Pumps

CH4 Fugitive: Equipment Leaks

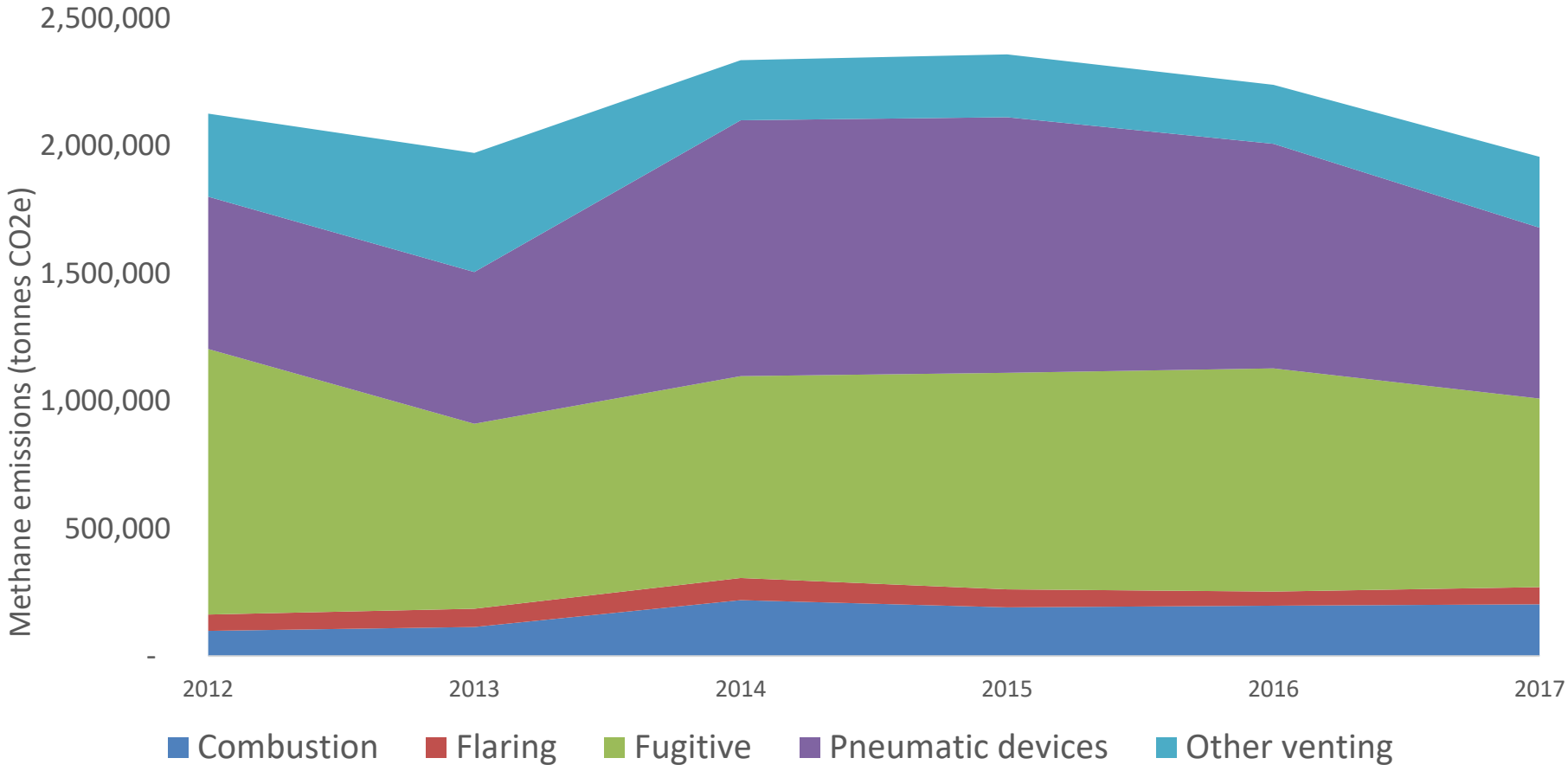
CO2 Venting: Acid Gas Removal

Combustion:
Compressors, Boilers, line heaters

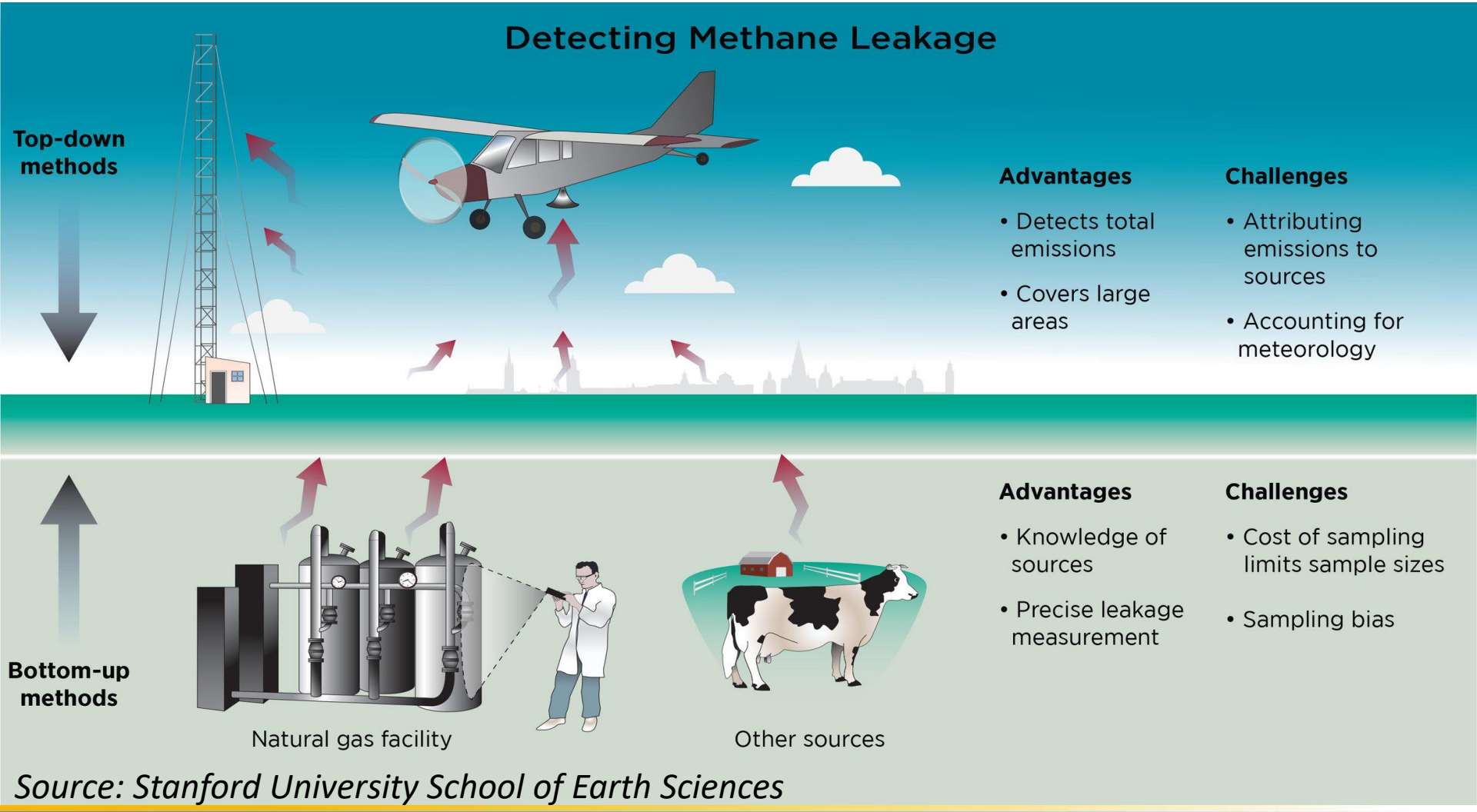
Flaring:
Well testing, flare stacks

Vented and fugitive methane emissions represent ~ 18% of reported GHG emissions from the natural gas and oil sector.

Upstream methane emissions sources



Estimation methods for methane leakage



Source: Stanford University School of Earth Sciences

Uncertainty in bottom-up methods

- "Super emitters" have been observed in numerous studies across jurisdictions:
  - Pneumatic Controllers: 13% of devices account for 88% of emissions. (Allen et al., 2014)
  - Gathering stations: 30% of facilities account for 80% of emissions. (Mitchell et al., 2015)
  - Transmission and storage: 5% of facilities account for >30% of emissions. (Zimmerle et al., 2015)

"We conclude that the occurrence of abnormal process conditions (for example, malfunctions upstream of the point of emissions; equipment issues) cause additional emissions that explain the gap between component-based and site-based emissions."[1]

1: "Super-emitters in natural gas infrastructure are caused by abnormal process conditions", D Zavala-Araiza et. al, Nature communications, 2017

Estimates vary across jurisdictions

Field	Survey method	Estimated rate (t/h)	Estimated rate (m^3/d/location)	Source
Uintah, UT	Airborne	55	325	Karion et al, 2014
Lloydminster, AB	Airborne	22	290	Johnson et al, 2017
Barnett, TX	Airborne	60	121	Karion et al, 2015
Bakken, ND	Airborne	28	96	Peischl et al, 2016
Marcellus, PA	Airborne	20	91	Barklay et al, 2017
Montney, BC	Truck		34-37	Atherton et al, 2017
DJ Basin, CO	Airborne	19	27	Petron et al, 2014
Red Deer, AB	Airborne	2	26	Johnson et al, 2017

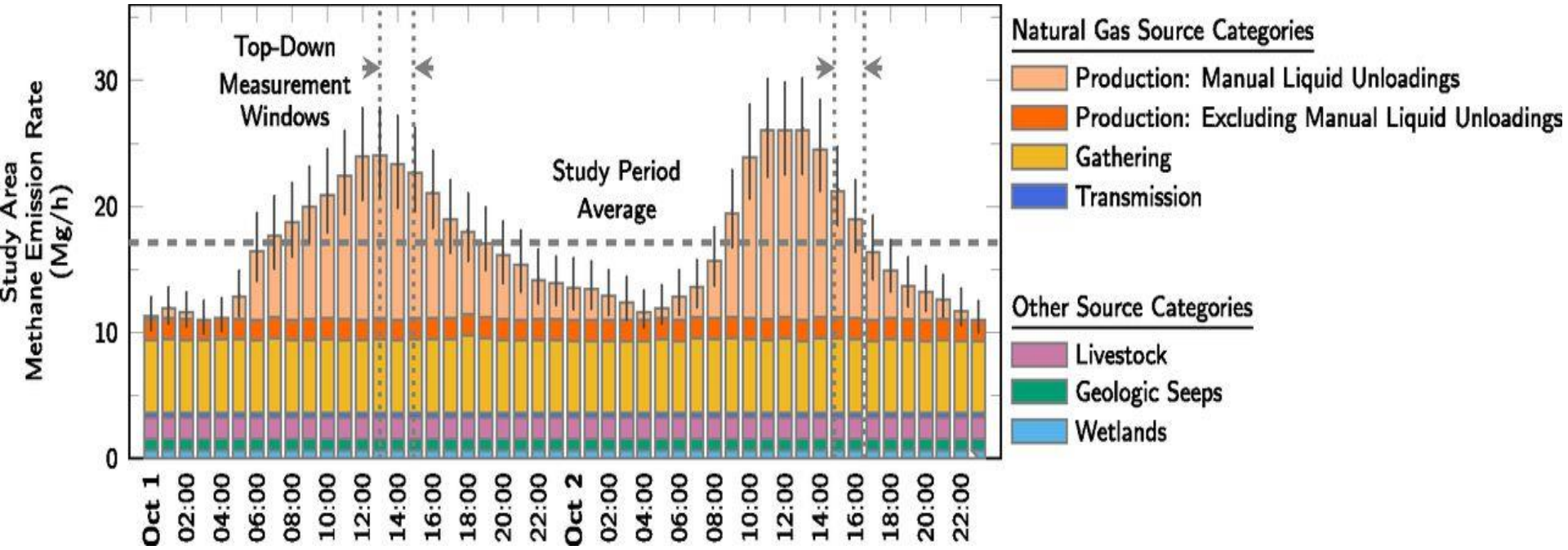
Results represent estimates developed when field campaigns took place and while they can provide an indicative 'snapshot' of emissions, they should not be considered conclusive comparisons.

Uncertainty in top-down methods

- Temporal Variations in Methane Emissions from an Unconventional Well Site (Johnson et al, 2019):
  - "Our data shows that even for a single site, a snapshot in time could significantly over-predict (3×) or under-predict (16×) methane emissions as compared to a long-term temporal average."

- Temporal variability largely explains top-down/bottom-up difference in methane emission estimates from a natural gas production region (Vaughn et al, 2018):
  - "We show that episodic venting from manual liquid unloadings, which occur at a small fraction of natural gas well pads, drives a factor-of-two temporal variation in the basin-scale emission rate of a US dry shale gas play. The midafternoon peak emission rate aligns with the sampling time of all regional aircraft emission studies, which target well-mixed boundary layer conditions present in the afternoon."
  - "Our results demonstrate that direct comparison of emission estimates from methods covering widely different timescales can be misleading."

Uncertainty in top-down methods



Temporal variability largely explains top-down/bottom-up difference in methane emission estimates from a natural gas production region (Vaughn et al, 2018)

Questions?

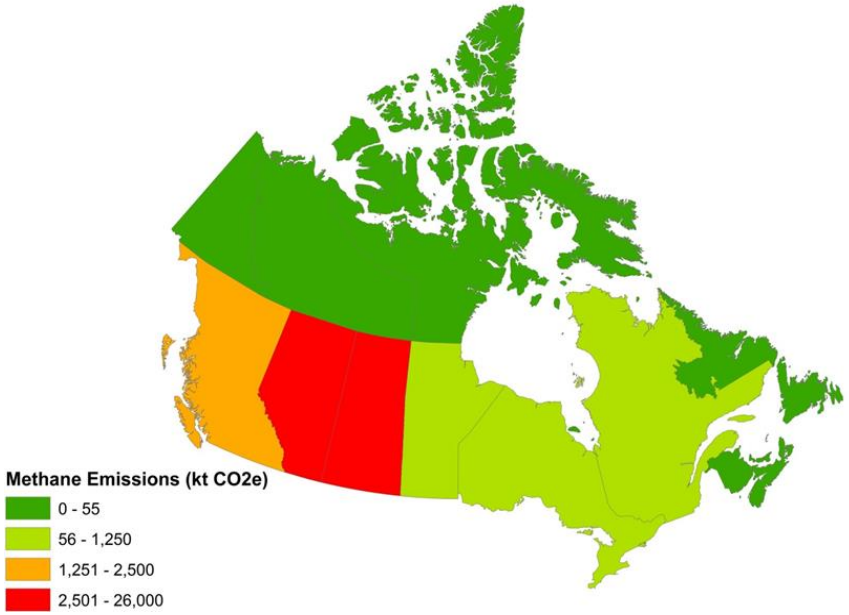
Provincial activities timeline

- 2010 – Carbon offset protocol for Oil and Gas Emission Reduction Projects
- 2016 – Climate Leadership Plan
  - Commitment to reduce emissions from existing infrastructure by 45 per cent by 2025
- 2016 – Clean Infrastructure Royalty Credit Program (CIRCP), currently the Clean Growth Infrastructure Royalty Program
- 2016-2018 – Provincial regulatory development
- 2018 – CleanBC
  - Confirmed regulatory approach and additional research

Federal Regulations

- In 2016, Canada committed to a 40-45 per cent below 2012 levels by 2025
- Limits to methane emissions outlined in federal regulation (April 2018) in 5 key areas:

1. Fugitive equipment leaks
2. Venting
3. Pneumatic devices
4. Compressors
5. Well completions



- Would require corrective actions (equipment repairs, gas combustion and gas conservation)
- Would utilize existing provincial reporting structures when possible, such as production accounting systems

Provincial approach

- December 2018, in CleanBC, the Province confirmed a policy approach to reduce methane emissions from upstream oil and gas operations by 45%
- January 2019, the OGC announced new regulations. The amendments to the Drilling and Production Regulation are effective Jan. 1, 2020.
- March 2019, the Government of Canada published (as a draft) *An Agreement on the Equivalency of Federal and British Columbia Regulations Respecting the Release of Methane from the Upstream Oil and Gas Sector in British Columbia*.
- June 2019, a (draft proposed) *Order Declaring that the Provisions of the Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector) Do Not Apply in British Columbia* and an accompanying Regulatory Impact Analysis Statement were published.

Comparison of ECCC/B.C. requirements

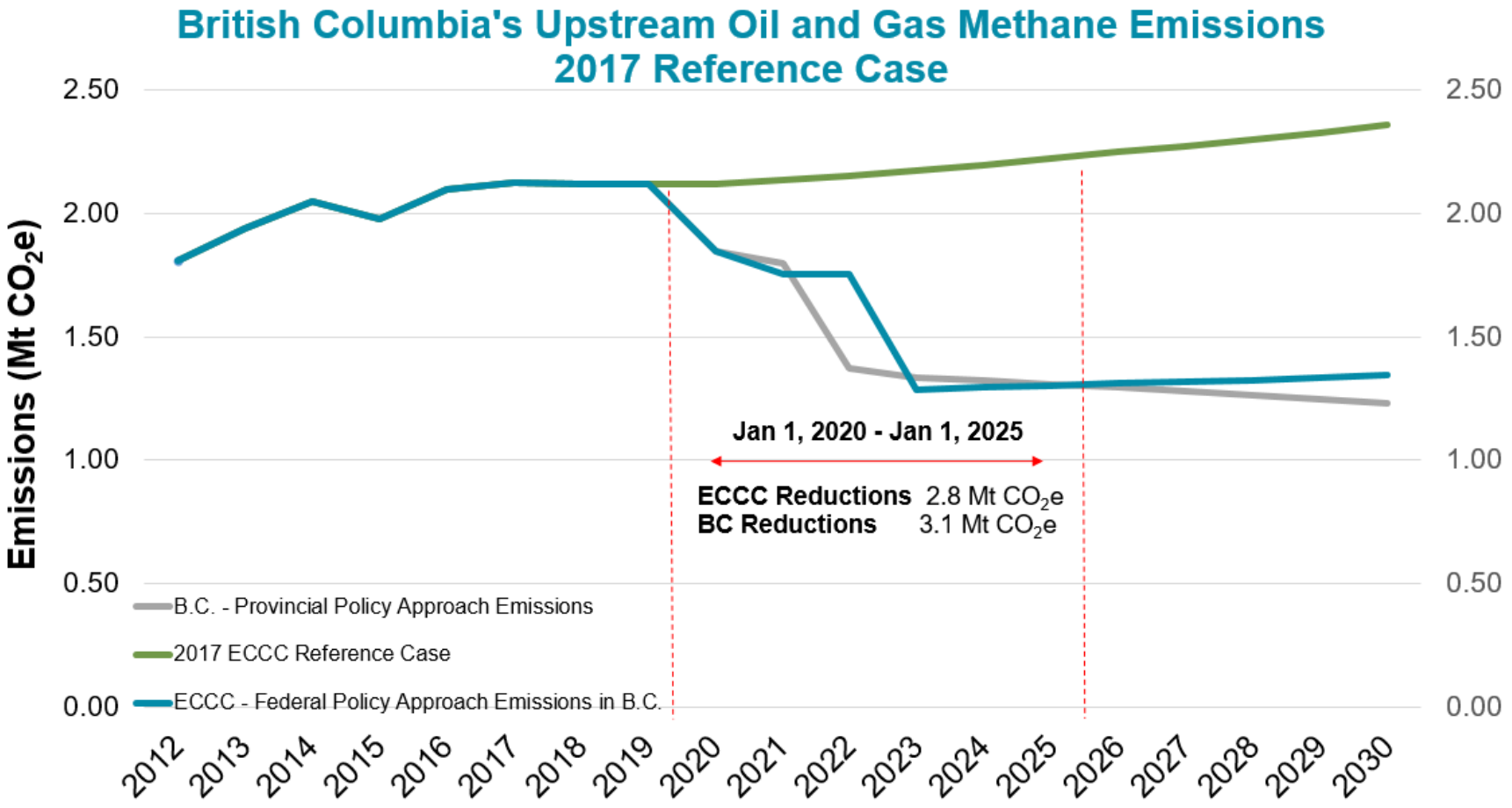
Requirement	ECCC	BC
Venting limit	**Limit to 1,250m^3 per month**	Limit to 1,250m^3 per month (new) Limit to 9,000m^3 per month (existing)
Pneumatic devices	Retrofit to low-bleed	**Requires non-emitting devices (new)** Retrofit to low-bleed (existing)
Centrifugal compressors	Limit to less than 8.4m^3 per hour (new) Limit to less than 20.4m^3 per hour (existing)	**Limit to less than 3.4m^3 per hour (new)** **Limit to less than 10.2m^3 per hour (existing)**
Reciprocating compressors	Limit to 0.06m^3 per hour per throw (new) Limit to 1.38m^3 per hour per throw (existing)	Control all new compressors Limit to 0.83m^3 per hour per throw (existing) Fleet average approach
LDAR	**3x per year at all facilities except single well sites**	3x per year at gas plants, compressor stations, multiwell batteries, single well batteries 1x per year at shale and tight wells
Surface casing vent flows		**Limit to 100m^3 per day**
Dehydrator venting		**Must not exceed 68 kg per day (new)** **Must not exceed 138 kg per day (existing)**

Federal government assessment

Emissions Source	B.C. Regulatory Reductions	Federal Regulatory Reductions
Fugitive emissions	1.23	1.21
Pneumatic devices	1.36	0.98
Compressors	0.37	0.54
Routine venting	0.04	0.05
Glycol dehydrators	0.05	N/A
Surface casing vent flow	0.04	
Total (Jan. 1, 2020, to Jan. 1, 2025)	3.10	2.77
Total (Jan. 1, 2025, to Jan. 1, 2030)	4.97	4.77

Canada Gazette, Part I, Volume 153, Number 24, REGULATORY IMPACT ANALYSIS STATEMENT

Fed government assessment



Questions?

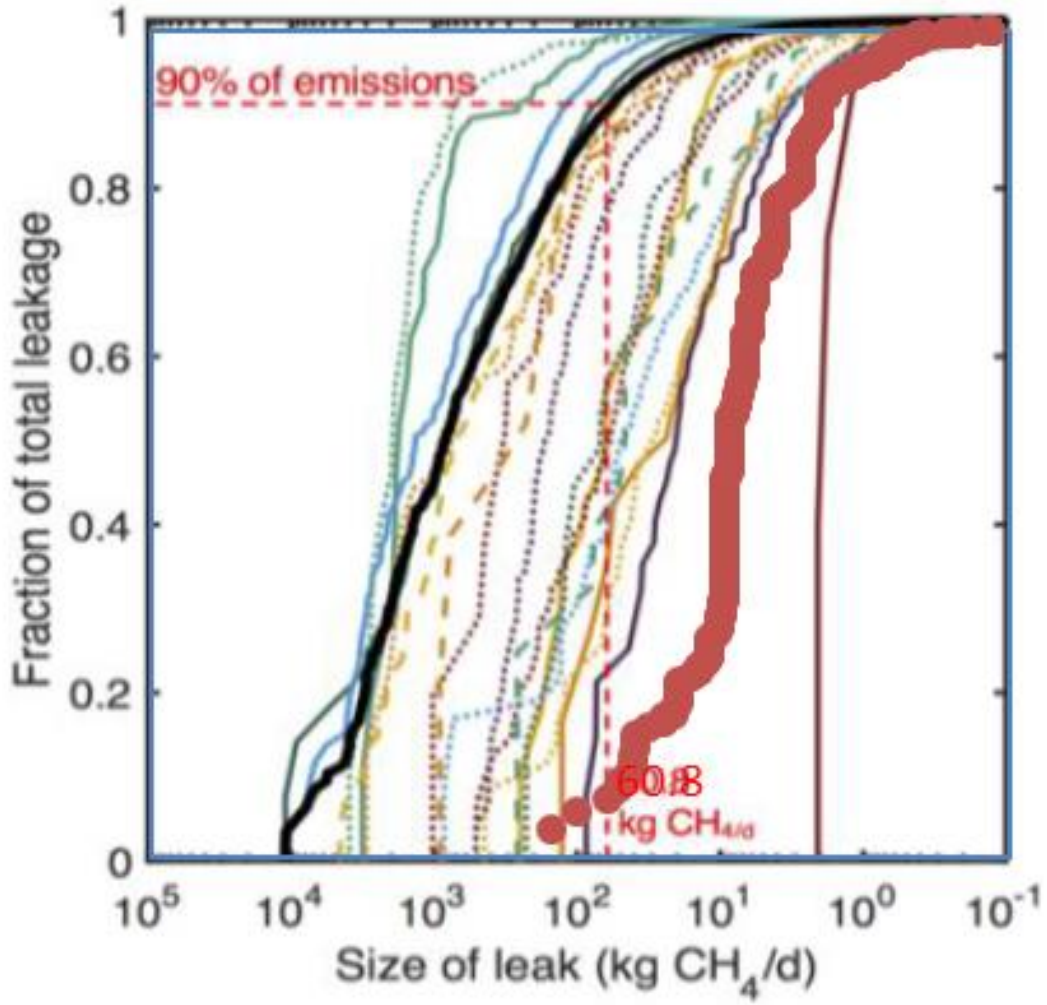
B.C. Methane Emissions Research

- B.C. Oil and Gas Methane Emissions Field Study (2018)
  - Jointly funded by B.C. and ECCC
  - The study gathered methane emissions data at 266 locations (wells and batteries)
  - Assessed against recent field studies in AB

B.C. Methane Emissions Research

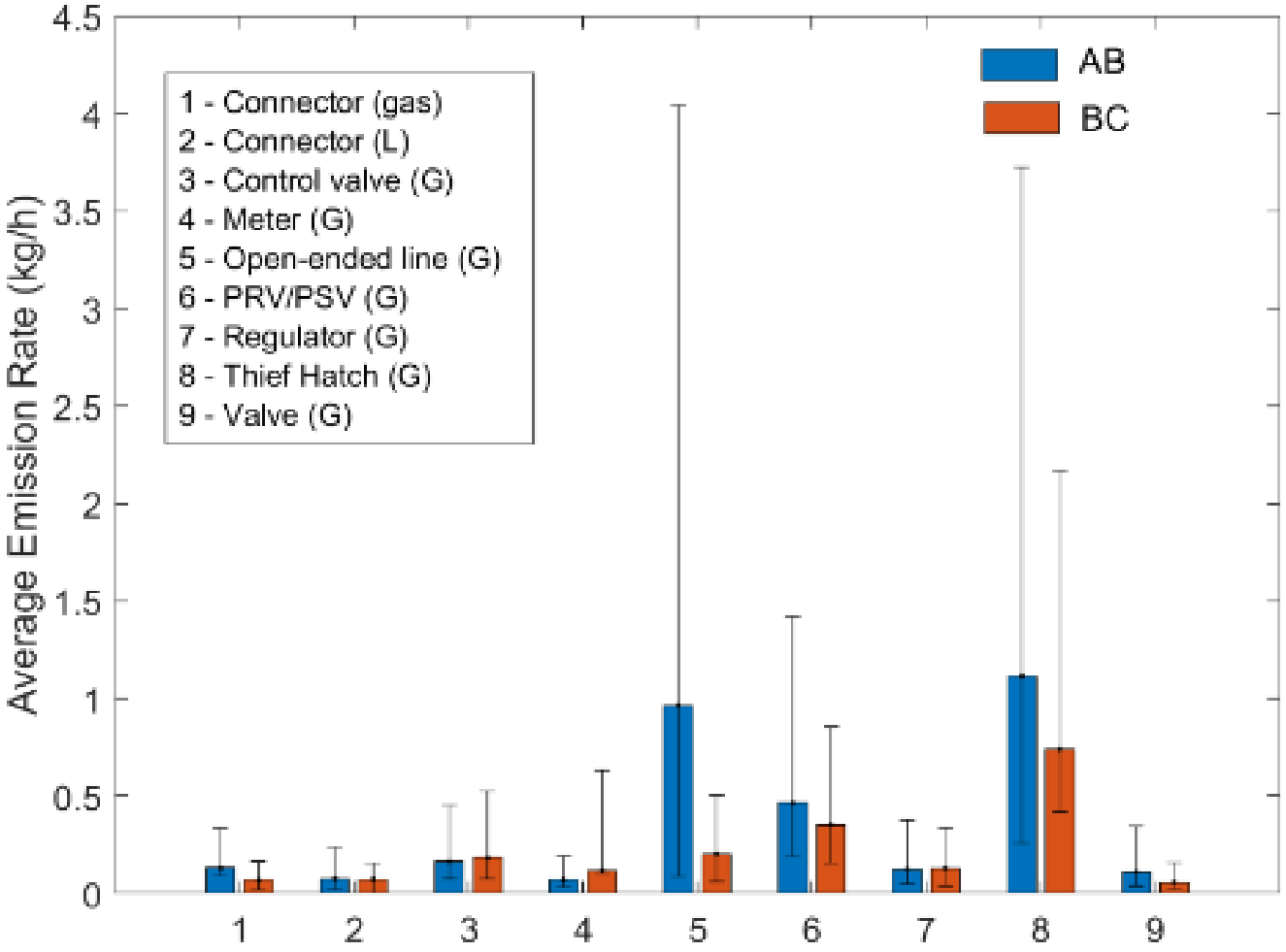
- Alignment with previous North American research
  - small number of sources were found to be responsible for a large portion of the methane releases
  - Specifically, 51% of emissions resulted from the top 8.7% of equipment fugitives

- The majority of sites (186 of 266 sites visited) had no vents or leaks detected (excluding pneumatics)
- Of all pneumatic or pneumatic-equivalent devices observed in the study, 65% were non-emitting; a recent pneumatic inventory in Alberta found <5% non-emitting
- Methane emissions from natural gas-driven pneumatic devices (66% of total) represent significant sources methane emissions at B.C. wells and batteries



Brandt et al. (2017) EST

B.C. field study results suggested that 90% of emissions resulted from sources greater than 2.18 kg CH_4 per day, significantly lower than those observed in the U.S. studies



Comparison of fugitive emissions between B.C. study (red) and Clearstone 2018 study in AB (blue)

B.C. Methane Emissions Research Collaborative (B.C. MERC)

- Created to focus research efforts toward managing and reducing the release of methane from oil and gas operations
- Purpose is to share funding, information and resources to improve research efficiencies and broaden scientific understanding of methane emission sources, detection and measurement methods, and emission reduction and control technologies that can be implemented by oil and gas operators.

- Comprised of:
  - Ministry of Environment and Climate Change Strategy; Ministry of Energy, Mines and Petroleum Resources; BC Oil and Gas Commission; Canadian Association of Petroleum Producers; Explorers and Producers Association of Canada, Geoscience BC, and; the Pembina Institute

B.C. MERC research

- Expect to initially advance research related to:
  - Top down, bottom up emissions inventory development (ongoing)
  - Fugitives and leak detection and repair (LDAR)
    - Assessment of the relative efficiency, cost, and effectiveness of equipment fugitive emissions detection and repair
    - Support the development of simulation model to assess new detection technologies
  - Storage Tanks (ongoing)
  - Compressor venting (ongoing)

B.C. MERC next steps

- Research plan (2019-2022) to be released early next year
- Projects will be completed with involvement of academic experts when applicable
- Data and information gained through research projects will be made publicly available
- Research will inform OGC review of the regulations by end of 2022

Questions?