A Comparative Assessment of Alberta's Oil and Gas Methane Emissions Under the ECCC rules and AER'S Draft Directive 060

(1/2/2020 correction)

We conducted our analysis based on emissions estimates and models provided directly by Environment and Climate Change Canada (ECCC). ECCC has models of the upstream conventional oil and gas system that can be used to estimate baseline emissions and reductions from various regulations.

The Emissions Analysis Model (EAM) allows users to calculate emissions (GHG and CH_4) by province, source, and site type for the years 2000-2035. It makes its emissions estimates based on detailed engineering estimates and facility measurements. The model projects emissions in future years based on the most recent production projections from the National Energy Board (NEB). It presents emissions in two scenarios: 1) "Uncontrolled," or baseline, and 2) "Controlled," or emissions expected after the implementation of the ECCC regulation.

We used the EAM to estimate emissions for the following categories:

- Fugitives/Leaks
- Pneumatics
- Well Completions
- Compressors

For these sources, we used the model's output of 2025 Alberta baseline emissions (uncontrolled) and emissions with ECCC regulations (controlled). By subtracting 2025 emissions in the controlled scenario from emissions for the same year in the uncontrolled scenario, we estimate the quantity of emissions abatement in Alberta due to the ECCC regulations. We then used the EAM to model Alberta emissions under rules proposed by the Alberta Energy Regulator (AER) in Draft Directive 060 ("DD 060").

For emissions from venting in Alberta, a separate model — based on Petrinex data — is used. This model allows the user to calculate what historical (2013-2017) provincial emissions would have been under various site venting limits, given the historical site-by-site venting data. Thus, for each year between 2013 and 2017, we calculated the abatement percentage that would have been achieved by the DD 060 venting limits (separately for new and existing sites). Then, we projected uncontrolled emissions to 2025 based on based on 2017 NEB projection data for Conventional Light and Conventional Heavy production in Alberta. And, we applied the average 2013-2017 abatement percentages to these uncontrolled emissions.

For the certain sources (Oil sands, refining, and "Other upstream conventional"), neither the ECCC regulations nor AER Draft Directive 060 would reduce emissions. Therefore, in our modeling, we only used baseline emissions provided directly by ECCC; no reductions were associated with these sources.

Below we describe specifics of how we modeled emissions under DD 060:

Fugitives/Leak Detection and Repair (LDAR)

- DD 060 would require triannual instrument-based surveys for gas plants and compressor stations with <0.01 mol/kmol H_2S. To be conservative, we assumed that all Alberta gas plants and compressor stations are surveyed three times per year, which may lead to an overestimation of reductions from the AER rule.
- DD 060 would require a single annual instrument-based surveys for all batteries.
- DD 060 would only require a single annual audio, visual, or olfactory (AVO) inspection for well sites – no instrument-based survey is required for these sites under DD 060. We assume that AVO inspections will not achieve any reductions over the baseline case, because we believe that most operators already carry out these types of checks. Methane and most raw natural gas are invisible and have not odor, so these types of checks are generally ineffective. Therefore, we assign a 0% abatement percentage to emissions from sites with this requirement.
- For sites with three instrument-based inspections per year, we assume that leak/fugitive emissions are reduced by 70%. For sites with one instrument-based inspection per year, we assume that these emissions are reduced by 40%. These emissions reductions are based on generally accepted abatement percentages for various LDAR inspection frequencies.[1] The abatement percentage of 70% for triannual inspections is also consistent with the results of EAM for ECCC's rules.
- The EAM presents emissions for nine different site types. The following table lists the inspection frequency and emissions abatement percentage we applied to the uncontrolled emissions from each site type, reflecting the interpretations of DD 060 described above:

EAM Site Type	Inspections per year	Leak abatement percentage
Gas Plant	3	70%
Compressor Station	3	70%
Admin Battery - Satellite	1	40%
Gas Multi Effluent Battery	1	40%
Multi-Well Group Battery	1	40%
Multi-Well Pro-rated Battery	1	40%

[1] E.g. U.S. Environmental Protection Agency. Regulatory Impact Analysis of the Final Emission Standards for New and Modified Sources in the Oil and Natural Gas Sector. May 2016. Pg 3-18, Available at: https://www.regulations.gov/document?D=EPA-HQ-OAR-2010-0505-7630.
Cost-Benefit Analysis for Proposed Revisions to Colorado Air Quality Control Commission (AQCC) Regulations No. 3 and 7, CDPHE, February 7, 2014. Pg. 27. Available at: https://www.regulations.gov/document?D=EPA-HQ-OAR-2010-0505-7573.

Satellite Battery	1	40%
Single Well Battery	1	40%
Single Well Production site	0	0%

Pneumatic

- Existing pneumatic controllers: DD 060 would require existing high-bleed controllers to be replaced with low-bleed controllers (<0.17 m^3/h), with exceptions in cases where a low-bleed alternative "cannot fulfill the same function" as a high bleed device. Based on an analysis of the EAM data (the model provides a direct estimate of emissions from high-bleed controllers), we assumed a 68% reduction from high-bleed to low-bleed conversions. We assumed a 95% device retrofit rate, as DD 060 provides for exemptions in cases where a low vent alternative cannot fulfill the same function as a high bleed instrument.
- New pneumatic controllers: DD 060 would require zero bleed for new pneumatic controllers, starting in 2022, but allow up to 10% of the duty holder's total number of new pneumatic controllers to emit vent gas in any given year. For these remaining 10%, we assumed that they would emit an average amount of methane. We assume a 1.8% turnover rate (the median oil and gas production growth) to determine emissions from new sources starting in 2022.
- Existing pneumatic pumps: no reductions, since DD 060 does not include any measures for this source.
- New pneumatic pumps: AER rules require zero emissions for new pumps. We assume a 1.8% turnover rate starting in 2022.

Well Completions

- Since ECCC rules defer to provincial rules for well completions, we do not anticipate that there would be any difference between the ECCC rules and DD 060 for abatement from well completions. For both cases, reductions were calculated using the difference between "Uncontrolled" and "Controlled" emissions in EAM model.

Compressors

- Although structured differently, we anticipate that abatement from controllers would be approximately the same under ECCC rules and DD 060. As such, for both cases, reductions were calculated using the difference between "Uncontrolled" and "Controlled" emissions in EAM model.

Venting

- Production sites (except crude bitumen):
    - DD 060 would set a site venting limit of 3,000 m3/month for new sites, and 15,000 m3/month for existing sites. Based on our analysis of AB venting data from 2013 – 2017, we found that venting emissions (province-wide) from new sites would be reduced an average of 35% under 3,000 m3/month site limit, and

emissions from existing sites would be reduced an average of 15% under a 15,000 m3/month site limit.

	Abatement percentage					
Site Type	2013	2014	2015	2016	2017	Weighted Average
New	33%	32%	41%	42%	29%	35%
Existing	20%	18%	16%	10%	9%	15%

- Based on our analysis of venting data for 2013 – 2017, we found that an average of 14% of sites would be considered "new" each year. This is a higher turnover than we assumed for the pneumatics regulation, but it is consistent with the ECCC's historical estimates.

	2013	2014	2015	2016	2017	Weighted Average
Number of New Facilities	1,996	1,632	925	731	1,177	
Number of Existing Facilities	8,440	8,489	8,319	7,453	6,956	
Percent New	19%	16%	10%	9%	14%	14%

- For each year starting in 2022, we assumed that an 14% of emissions came from new sites and applied the 35% abatement percentage to these emissions. The portion of sites subject to the lower site limit compounds in the years after 2022. Then, we applied the 15% abatement percentage to the remaining emissions from existing sites.

- Crude bitumen:
  - DD 060 would impose a fleet average venting limit, for each operator, of 3,000 m3/mo.
  - Based on our analysis of annual venting data for 2017 from these facilities, our initial analysis suggested that the fleet venting limit would reduce venting from these wells, province-wide, by 10%. However, based on conversations with researchers at Carleton University, we believe a 10% reduction would be an underestimate of actual venting reductions. DD 060 requires operators to meet the fleet average venting limit on a monthly basis. A significant number of wells are operated less than an entire year, and many wells change ownership during the year. As a result of these factors, calculations of venting per well per month for a given operator are significantly too low if annual data is used. Carleton found that when they fully account for the requirement that operators comply with the limit on a monthly basis, 2017 venting from these wells would be reduced by 19% under the requirements of DD 060. NEB projections of production from AB crude bitumen in 2025 are similar to the 2017 production level. Therefore, we applied the 19% abatement from the monthly analysis by

Carleton, to the baseline projection of emissions from these wells in the ECCC model.

Other Upstream Conventional & Oil Sands and Refining-

- No regulation.

The below table presents the final emissions numbers for 2025 Alberta Methane Emissions (MMT CO2e, GWP = 87)

Emissions Source	Baseline Uncontrolled Emissions	Reductions with ECCC rules in Alberta		Reductions with AER rules in Alberta	
		Reductions	% reduction	Reductions	% reduction
Leaks	15.76	8.09	51%	6.16	39%
Pneumatics	25.34	15.54	61%	10.69	42%
Well Completions	0.19	0.00	0%	0.00	0%
Compressors	5.53	2.11	38%	2.11	38%
Venting	13.00	8.71	67%	3.03	23%
Other Upstream Conventional	11.14	0		0	
Oil Sands and Refining	23.66	0		0	
Total	94.62	36.46	36%	22.19	23%
2014 baseline	114.30		47%		36%