Responses to Stakeholder Questions and Comments on Draft Chapter 2 Flaring (December 2021)
Technology Innovation and Emissions Reduction Regulation

Item #	Page #	Chapter / Clause Section / Number / Table / Figure	Nature of the Comment	Stakeholder Comment/Question	AEP Response
1	2-3	2.2	Technical	Comment: The Stationary Combustion chapter indicates that flare pilots are to be treated like flares; however, the combustion efficiency for pilot gas is significantly higher than a typical flare vent gas. It more closely resembles the guidance given for incinerators and other devices that operate like boilers. Typically, pilot gas is not included in the flared gas when calculating flare efficiency for this reason, which can be seen in studies such as the EPA Flare Efficiency Study EPA-600/2-83-052. Using flare efficiencies derived while specifically excluding pilot gas for pilot gas would be a technical error. Recommendation: Clarification should be provided on the combustion efficiency to be used with flare pilots. The final bullet point on incinerators should be expanded to include flare pilots in the list of applicable equipment.	The recommendation is not adapted at this time. The approach of applying the same efficiency for flared and pilot/assistant gases is consistent with other flaring methods published (i.e. WCI, IPCC).
2	2-3	2.2	Editorial	Comment: The last paragraph, on sampling and measurement, does not have anything to do with the section it is in – combustion efficiency – and may contradict later sections that also discuss sampling and measurement. Recommendation: It is recommended that this paragraph be deleted.	Section revised.
3	2-4	2.3.1	Editorial	Question: Is the "Flaring emissions represent less than 1%" statement referring to emissions per flare/emission point or is does it refer to emissions in aggregate? i.e. if a facility had several flares, each less than 1% of TRE, but collectively the flaring emissions were >1% would that facility be allowed to use alternative methodologies for the flares or not? Recommendation: This bullet point is ambiguous. It is recommended that this statement clarify if the 1% is meant to be for each flaring air emission point.	Section updated to state that the total flaring emissions from all flaring sources representing less than 1% of a facility's total direct emissions do not count towards the facility's negligible emission sources under TIER.
4	2-10	2.3.3(2) Equation 2-2	Technical	Comment: This equation does not include all CO2 entrained in the flared gas. As it stands, only the combustion efficiency percentage (typically 98%) of the entrained CO2 would be included in the final total. The WCI guidance on flaring is a good reference and may be a good reference on this. Recommendation: A term, (1-CE_FL)*MF_CO2*V_FL,F, needs to be included in the equation to account for the entrained CO2 that is not combusted. This is analogous to how methane is being calculated and should be added to the CO2 equation. This is because entrained CO2 is not combusted, it merely passes through, and is a component of the carbon content and so a correction needs to be added for the "combusted" CO2.	Equation updated to include entrained CO_2 in the flared gas and such that the flaring efficiency does not apply to entrained CO_2.
5	2-10, 2-15	2.3.3(2) Equation 2-2, 2-4, 2.3.4(2) Equation 2-5, 2-6	Overarching	Comment: The AQM ver 2.1 Appendix B gives the molar weight of Carbon Dioxide as 44.0095g/mol, and the draft chapter uses a molar weight of 44.01g/mol throughout. Similarly, the molar weight in of Methane in Appendix B is 16.0425g/mol, but this chapter uses a molar weight of 16.04g/mol. Section C.11 of the AQM ver 2.1 states that "data and intermediate values shall not be rounded". The molar weights in this draft chapter are inconsistent with this statement. In addition, the values for constants need to be consistent within the AQM itself. Recommendation: It is recommended that all values of constants are the same throughout the entirety of the AQM to provide consistency, avoid premature rounding, and avoid assigning different constant values across different emission categories. It is also recommended for AEP to consider referring to Appendix B for the constants in the AQM chapters.	Updated to refer to Appendix B for molecular weights.
6	2-11		Editorial	Comment: The definition of MF_i,F has a typo. Recommendation: (kmol_CH4/kmol_flare gas) should be (kmol_i/kmol_flare gas)	Section revised.
7	2-12		Editorial	Comment: The molecular weight of methane, 16.04, is mistaken for Carbon Dioxide. Recommendation: The wording needs to be updated to the molecular weight of methane.	Section revised.

Responses to Stakeholder Questions and Comments on Draft Chapter 2 Flaring (December 2021)
Technology Innovation and Emissions Reduction Regulation

Item #	Page #	Chapter / Clause Section / Number / Table / Figure	Nature of the Comment	Stakeholder Comment/Question	AEP Response
8	2-13	"For emergency flaring, the volume of the flare gas may be estimated…"	Editorial	Comment: This clause refers to methodologies that can be used for "emergency flaring". Non-routine flaring during maintenance is often done with temporary flares that are unassisted and have minimal instrumentation. Recommendation: It is recommended that the wording of "emergency flaring" be changed to "non-routine flaring". Non-routine flaring can then use engineering estimates or calculations, such as mass balances, in place of metering and gas analysis since that level of instrumentation is nonstandard for temporary installations. In addition, Section 2.3.1. Introduction defines "[n]on-routine flaring", so updating the wording on page 2-13 maintains consistency in the document.	Section revised.
	2-13	"For a flare gas stream where the volume is not measured […]"	Editorial	Question: Does this clause apply to routine flaring? In the other words, would using a venting model for a stream count towards having measured volumes, per the earlier requirement to measure at least 60% of the streams going to a flare of routine flaring? Recommendation: It is recommended that AEP provide clarification on this statement.	This method has been moved under the routine flaring section of the "Data Requirement" section. However, it is noted that it can be used for non-routine flaring. The volume and gas compositions quantified using methodologies from the Chapter 4 may be included in the 60% measured volume and gas composition requirement.
10	2-14	2.3.3 last bullet point	Editorial	Comment: The previous bullet points indicate that all streams do not need to be measured and can be estimated. This final bullet point that flare gas volume and composition must be measured would contradict those. Recommendation: It is recommended that clarification be provided, as the aforementioned statements appear to contradict each other.	The flare gas measurement requirement has been moved under the routine flaring in the "Data Requirement" section.
11	2-14 -2-16	2.3.3 - 2.3.4	Technical	Comment: 2.3.3 discusses how flare pilots are to be handled, 2.3.4 does not. As written, it implies that a flare that has pilots would not be able to use method 2.3.4 as the pilot gas is not combined with the flare header prior to flaring and is instead used to operate the pilots; thereby, resulting in two emissions streams resulting in emissions, and not one. This would include most large flares at many facilities that have online analyzers on the flare header, which presumably is exactly the type of equipment this whole section was written for. Recommendation: It is recommended that clarification be added to page 2-16 on how to include flare pilots for these flares. Per previous recommendation, it is also recommended that flare pilot combustion efficiency be evaluated.	Method 2-3 is updated to calculate the emissions from the flaring of pilot gas separately from the combined flare gas.
12	2-15	2.3.4(2) Equation 2-4	Technical	Comment: This equation does not include all CO2 entrained in the flared gas. As it stands, only the combustion efficiency percentage (typically 98%) of the entrained CO2 would be included in the final total. The WCI guidance on flaring is a good reference and may be a good reference on this. Recommendation: A term, (1-CE_FL)*MF_CO2*V_FL,F, needs to be included in the equation to account for the entrained CO2 that is not combusted. This is analogous to how methane is being calculated and should be added to the CO2 equation. This is because entrained CO2 is not combusted, it merely passes through, and is a component of the carbon content and so a correction needs to be added for the "uncombusted" CO2.	Equation updated to include entrained CO_2 in the flared gas and such that the flaring efficiency does not apply to entrained CO_2.

Responses to Stakeholder Questions and Comments on Draft Chapter 2 Flaring (December 2021)
Technology Innovation and Emissions Reduction Regulation

Item #	Page #	Chapter / Clause Section / Number / Table / Figure	Nature of the Comment	Stakeholder Comment/Question	AEP Response
13	2-19	2.4.2 (3)	Editorial	Comment: The final bullet point directs facilities to use two different methodologies at the same time: 1) use the fuel gas type that best aligns with the flare gas; and 2) evaluate HHV falls between two values in the table to use the greater. Recommendation: It is recommended that clear guidance be provided. A proposed solution would be to clarify that the HHV requirement is for fuels, where there is no obvious entry in the table that best aligns with what is being flared. In other words, facilities would use the most appropriate fuel type, or, if there is no appropriate fuel type, use the fuel type with the most similar HHV.	The section is updated to provide further clarity.
14	2-4	Chapter 2 / Table 2-1	Overarching	Definitions of routine and non-routing flaring in AER Directive 60 are not applicable to refineries or mining operations.	The intention is to adapt this definition for all sectors in the flaring chapter.
16	2-13	Chapter 2/ Subsection 2.3.3 (3)	Technical	It is requested to remove the requirement in Method 2-2 that for routine flaring "the facility must have measured volumes and gas compositions for a minimum of 60% by volume of the total gas stream." For facilities where Directive 60 does not apply this requirement would necessitate installation and operation of additional measurement equipment for routine flaring. <REDACTED> is requesting to remove the mandatory minimum percentage for facilities that are not subject to Directive 60. Instead, allowing for those facilities to use engineering estimates, mass balance or manufacturing for up to 100% of the total flare gas stream.	The facility may submit a deviation request to the department with a reason for the deviation and proposed conservative methodology.
17	2-10	Chapter 2 / Equation 2-2 and equivalent	Editorial	Consistent use of molecular weight CO2 44.0095 g/mol instead of 44.01g/mol at stated in Chapter 2 Draft. Typo in equation (W FL,F instead of V FL,F).	Updated to refer to Appendix B for molecular weights.
18	2-12	Chapter 2/ Equation 2-4 and equivalent	Editorial	Consistent use of molecular weight CH4 16.0425 g/mol instead of 16.04 g/mol at stated in Chapter 2 Draft.	Updated to refer to Appendix B for molecular weights.
19	2-13	Chapter 2 / Section 2.3.3(3)	Technical	For multiple flare gas streams that are combined and flared as a single flare gas source, <REDACTED> is requesting the allowance of missing compositional data being backfilled by engineering judgement when operating conditions are known (known streams going to flare). The emission calculations using backfilled data based on engineering judgement will be more representative than using an available conservative datapoint or the calculated arithmetic mean as described in Section 17.5.2 of the TIER QM.	The facility may submit a deviation request to the department with a reason for the deviation and proposed conservative methodology.
20	2-10	2.3.3(2)	Technical	The manner in which Equations 2-2 and 2-2a are presented implies that the flaring combustion efficacy is also applied to CO2 contained in the flared gas. These equations should typeset in a manner which only applies the flaring combustion efficiency to hydrocarbons. For example: $CO_{2,flaring} = \sum_{F=1}^{N} \frac{V_{FL,F}}{MVC} \times CC_F \times 44.01 \times 0.001$ Equation 2-2 $CC_F = \sum_{i}^{I} (MF_{i,F} \times NC_{i,F} \times CE_{FL}) + MF_{i,CO2}$ Equation 2-2a	Equation updated to include entrained CO_2 in the flared gas and such that the flaring efficiency does not apply to entrained CO_2.
21	2-18	Table 2-4	Technical	N2O flaring emission factors adopted from WCI should be 0.0000952 g/MJ to ensure consistency with both the Alberta abd BC GHG reporting programs.	Emission factor updated.
22	2-12	2.3.3(2)	Editorial	The description of the terms of Equation 2-4 state the 16.04 is the molecular weight of CO2. This should be corrected to CH4.	Section revised.

Responses to Stakeholder Questions and Comments on Draft Chapter 2 Flaring (December 2021)
Technology Innovation and Emissions Reduction Regulation

Item #	Page #	Chapter / Clause Section / Number / Table / Figure	Nature of the Comment	Stakeholder Comment/Question	AEP Response
23	2-6	Table 2-2, Table 2-3	Technical	All measurement of flow for our petrochemical facility flares are collected in mass units of measure. It would be very helpful to compare Method 2-1 for suitability if the HHV was also mentioned in units with mass. Also the categories of gas types mentioned do not well represent any of the 'typical' flared gas streams we have at our site. Additional typical gas analyses will be sent to AEP to demonstrate this difference.	No updates to equations will be made at this time; however, please submit a deviation request to the department with a reason for the deviation and proposed conservative methodology. The department anticipates that the results of a mass based approach should be the same as a volume based approach.
24	2-10	Method 2-2	Technical	This method only allows measurement of flared gas in volume. As we have our measured flow for our facility built into our DCS and historian systems in mass and then integrated into our emissions management system with these units, a change to volume would require a lot of manual calculations and updates that seem unnecessary. If this method could be changed to incorporate both a mass and volume option that would alleviate this issue. We also convert the mass to energy so like Method 2-1, if there was a volume and energy option this would also allow use to use all of the current monitoring systems we have in place.	Refer to response for item 24.
25	Overall	Overall	Overarching	With the idea that CO2 is to be calculated assuming full carbon combustion, there is still a concern that we are overcounting CH4 and CO. Previously our carbon balance for CO2 removed CO and CH4 moles from the total. While we understand that applying a destruction efficiency to CH4 addresses some of this issue, this solution does not address CO since it is not a GHG. The concept that CO in the atmosphere would fairly quickly become CO2 is a reasonable assumption to make in the context of GHG reporting but it is mis-aligned with other reports such as a NPRI and AEIR. We suggest that the best way to resolve this issue would be to add CO to the TIER report and include the conversion to CO2 there, which preserves the transparency with other reports and maintains alignment with our reporting systems that strive for consistency in reported values whenever possible.	The department does not anticipate requesting facilities to report carbon monoxide as this is not a greenhouse gas and outside the scope of TIER. Where reasonable, alignments of regulations are sought; however, alignments are not always possible given that different regulations and programs have different purposes. In terms of the quantification methodologies under TIER, quantifying emissions from combustion assuming full combustion and adding methane is a standard approach applied across all sectors. The main purpose of this approach is to ensure conservatism in the emission calculations.
26	2-17	Method 2-4: N2O Default Emission Factor	Technical	As this is the only approved method for N2O, having the HHV in mass units as well as volume would prevent an additional calculation being required in order to determine which emission factors to use. We have variable gas types for our flares (none of which fit well in the prescribed categories) and the calculated HHV variability would need to be assessed to ensure we could pick an appropriate emission factor for each flare.	Refer to response for item 24.
27	2-3	2.2. Flare Combustion Efficiency "98.0% flare combustion efficiency for unassisted flares. These flares are typically found in remote oil and gas production operations.	Technical	Please explicitly add temporary flares to this list: Proposed text: 98.0% flare combustion efficiency for unassisted flares or temporary flares. Unassisted flares are typically found in remote oil and gas production operations. Temporary flares are sometimes used to dispose of finite quantities of gas at both large and small facilities.	The recommendation is not adapted at this time. If a temporary flare being used is categorized as an unassisted flare, the corresponding flare efficiency would apply.
28	2-3	2.3.1 Definition of routine and non-routine flaring	Technical	Please provide additional guidance or an example for classifying flares as non-routine, i.e. flaring which occurs intermittently and unpredictably less than 30% of the time can be considered non-routine.	Per Directive 60, non-routine flaring include: (1) Planned flaring associated with maintenance activities such as turnarounds, start ups, pipeline blowdowns, equipment depressurization, and well tests. In these cases, the facility has control of the timing and volume of flared gas. (2) Unplanned flaring occurs during emergency or upset conditions normally. In these cases, the facility does not have control over the timing or volume of flared gas. The definition does not specific percent timing for what is considered non-routine.

Responses to Stakeholder Questions and Comments on Draft Chapter 2 Flaring (December 2021)
Technology Innovation and Emissions Reduction Regulation

Item #	Page #	Chapter / Clause Section / Number / Table / Figure	Nature of the Comment	Stakeholder Comment/Question	AEP Response
29	2-4	Table 2-1 Flaring emissions represent less than 1% of the facility's total emissions	Technical	Please clarify whether this clause applies to specific flares (ie. If a facility has two flares, can both use alternative methods if each flare is below 1%, or does the 1% apply to the total flaring emissions; or if a facility has two flares, one of which is very small and one of which is well over the 1% threshold, can they apply alternate methods for the smaller of the two flares)	Section updated to state that the total flaring emissions from all flaring sources representing less than 1% of a facility's total direct emissions do not count towards the facility's negligible emission sources under TIER.
30	2-12	Equation 2-4 16.04 = Molecular weight of CO2 (kg/kmol)	Overarching	16.04 kg/kmol is the molecular weight of methane, not CO2. Additionally, the molecular weight selected for methane differs from the weight of 16.0425 kg/kmol in the AQM Table B-1. If the AQM specifies physical constants to significant figures, then for consistency it is essential that they be used throughout the published material. This inconsistency also applies to other molecular weights in the document.	Section updated.
31	2-13	Data requirements for routine flaring	Overarching	The data requirements for measuring flared volumes and compositions may require significant changes to operational procedures. We recommend ensuring that there be at least a year between publication of the requirements and the date when they take effect (ie. If the final flaring chapter were published Apr. 2021, the measurement requirements would not apply until Apr. 2022).	The flaring quantification methodologies will be mandatory for the 2021 reporting year. The Standard for Completing Greenhouse Gas Compliance and Forecasting Reports will be updated with this requirement.
32	2-13	Data requirements for routine flaring pilot and assistance gas: "For pilot or assistance gas used for flaring where the fuel type is known (ie. Propane, butane, sales gas, etc.), the facility may apply the gas composition of the fuel type listed in Table 2-2	Technical	Most large facilities already have natural gas composition either measured or provided by the supplier. Recommend allowing facilities to use measured compositions for natural gas to apply them to pilot gas. Proposed text: -For pilot or assistance gas used for flaring where the fuel time is known (i.e. natural gas, propane, butane, sales gas, etc.), the facility may apply measured gas compositions consistent with Table 17-1 of the AQM, or the default gas composition of the fuel type listed in Table 2-2.	Section updated. The recommendation is adapted to allow for measured compositions to be used for the pilot and/or assistance gas.
33	2-14	Data requirements for emergency flaring: 'For emergency flaring, the volume of the flare gas may be estimated using engineering estimates, fuel mass balance, manufacturer specifications and operating time	Overarching	On page 2-3, definitions are provided for routine and non-routine flaring. Some, but not all, non-routine flaring is emergency flaring. When specifying data requirements, they should apply to all non-routine flaring, not just emergency flaring. Proposed text: -For non-routine flaring, the volume of the flare gas may be estimated using engineering estimates, fuel mass balance, manufacturer specifications and operating time. Note, this item also applies to the data requirements on page 2-18.	Sections updated.