Brief description of source

Casinghead gas is gas that evolves off of crude oil when it flows into a lower pressure through well casing perforations and collects in the annular space between the casing and tubing in an oil well. This associated gas helps lift the produced oil up the tubing in a free-flowing oil well. However, in a mature oil well that has evolved much of the gas from the reservoir oil, it is necessary to pump the oil to the surface with a down-hole beam pump or electric submersible pump. In this case gas collecting in the casing can exert a back pressure decreasing a well's production and vapor locking the pump. Combined with the backpressure of an oil well's surface equipment, pressure from casinghead gas can severely restrict production. Casinghead gas pressure build-up must be addressed to maintain production. One of the methods to do this is to periodically or continuously vent the casinghead gas to the atmosphere at or near the wellhead. In other configurations, the casinghead gas is captured and re-routed to a vapor recovery unit (for on-site use or sales) or sent to the flare unit for combustion.

System boundaries

Methane that is vented to atmosphere (continuously or periodically) from the oil well casinghead is considered herein. Methane emissions from oil well casinghead that are captured and routed to tanks with new or existing VRU systems and routed to sales or for on-site use, i.e. not vented, are not to be reported. Methane emissions captured and routed to a flare or thermal oxidizer fall under the category Flaring (see *Flaring TGD*).

Guidance on materiality is presented in the *General Principles TGD.*

Level 3 Quantification Methodologies

Emission Factors

Accepted source-level emission factors, as defined in the *General Principles TGD,* or those prescribed by local regulation are considered as providing Level 3 estimates, provided they are specific for the source type. Partners are encouraged to use emission factors that best represent conditions and practices at their facilities and adjust the factors, where warranted, to more accurately estimate emissions given differences between the reference system on which the emission factor is based, and their systems.

The following reference provides an example emissions factor which can be used to quantify methane emissions at Level 3:

Emission factor - Oil well casinghead gas venting[1]	Unit
132,33[2]	Scf THC/component/hour

[1] Global Methane Initiative, Ecopetrol Eco-Efficiency Methane Emission Reduction Opportunities, 2012, Page 22

[2] https://www.api.org/~/media/Files/Policy/ESG/GHG/2021-API-GHG-Compendium-110921.pdf, Table 7-25, Surface Casing Vent Flow (SCVF)

Level 4 Quantification Methodologies

Direct measurement and Measurement-based Emission factor

Measurements (including continuous and periodic monitoring) or emission factors developed based on representative measured emissions are considered Level 4 emissions quantification. Measurements must be taken that represent the total flow and associated methane content of each gas stream that is vented to the atmosphere.

Level 4 emission factors should be based on measurements conducted on a representative sample. System configurations, environmental and operating conditions should be considered in determining 'like' systems that carry a common emission factor. Each system that is not 'like' will require determination of a separate emission factor for that system based on the appropriate measurement studies. For guidelines on the methodology to develop a statistically representative sample, please refer to the [Uncertainty and reconciliation guidance].

Determining the point where the casinghead gas is being vented is essential to take accurate measurements. Typically, an oil wellhead has a designated gas vent line for casinghead gas. Each wellhead setup is unique, however, and a wellhead could have multiple lines for venting casinghead gas. Partners can confirm the locations of all lines before measuring casinghead gas. Furthermore, viewing all gas lines with an infrared leak-imaging camera during venting of casinghead gas can help to identify potential fugitive leak emissions. Accepted equipment and techniques, as defined in the *General Principles TGD*, for determining gas flow are to be employed. Measurement techniques should not impose any significant back pressure on the vent as that will suppress venting. Following are examples of equipment that work well to quantify the gas flow from oil well casinghead gas venting, but the list is not exhaustive[3]:

- ePV Meter
- Hotwire anemometer
- Vane anemometer
- High volume sampler

The methodologies presented here give the flow rate for total gas, which is then converted to methane flow rate using the methane content of the gas. The methane flow rate is extrapolated over the entire year. The annual volume of methane emissions is calculated by multiplying the measured methane flow rate by the number of operating hours that the wells are vented.

Engineering calculations

Accepted engineering calculations, as defined in the *General Principles TGD,* that capture all relevant system vents, use measured activity data (i.e. flows and compositions) and consider all major physical and chemical processes relevant to the venting of methane from the oil well casinghead are considered Level 4 emissions quantification. Measured activity data can be continuous or based on a representative sample. For guidelines on the methodology to develop a statistically representative sample, please refer to the [Uncertainty and reconciliation guidance].

[3] More details on various detection and measurement equipment can be found at CCAC, Conduction Emissions Surveys, Including Emission Detection and Quantification Equipment – Appendix A of the OGMP Technical Guidance Document, 2017

For example, engineering calculation for oil well casinghead gas venting relies on a representative sample of reservoir oil: i.e., capture all gas and oil entering the well casing. From this sample a gas/oil ratio (GOR) can be taken. For mature wells, for example, Partners can use the estimated well's producing GOR (scf/bbl or scm/bbl) multiplied by the production rate of oil per year (bbl/year) and the methane content of the gas to estimate annual methane emissions[4]

$$I = GOR * T * MC$$

I = Annual total volumetric greenhouse gas (GHG) emissions at standard conditions from each storage tank (scm or scf)

GOR = Gas to Oil ratio (scm/bbl or scf/bbl)

T = Annual total oil (bbl/year).

MC = Methane content of the gas

If part or all of the gas is vented is routed to productive route or to sales, it can be deducted from the total and are not to be reported as methane emissions from oil well casinghead, as described in the *System Boundaries.*

[4] Greenhouse Gas Reporting Program. Subpart W – Petroleum and Natural Gas Systems. Section 98.234: Monitoring and QA/QC requirements, 40 CFR 98.234(b). http://www.ecfr.gov/cgi-bin/text-idx?SID=82b3acbd3d06d1ee2c38a34ba97f132b&mc=true&node=sp40.23.98.w&rgn=div6#se40.23.98_1234 .