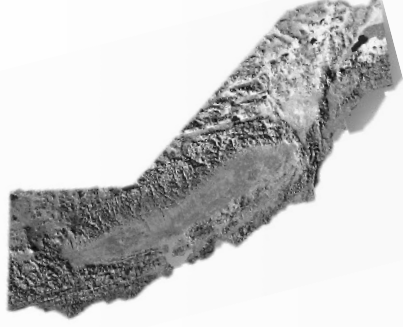


Verifier Accreditation Training for Mandatory GHG Reporting

General Verification
Course 1.2 - Stationary Fuel Combustion



Verifier Accreditation Training for Mandatory Greenhouse Gas Reporting

Course 1: General Verification

- 1.1 Verification Context, Principles, and Program Overview
- **1.2 Stationary Fuel Combustion and Sorbent Sources**
- 1.3 Accuracy and Product Data
- 1.4 Electricity Generating Units and Cogeneration

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Course 1.2 Stationary Fuel Combustion (SFC) and Sorbent Sources (MRR §95115)

- Overview
 - SFC Applicability: source categories, reporting thresholds, covered emissions
 - Aggregation of SFC units
 - Comparing §95115 requirements to US EPA's 40 CFR 98, Subpart C
 - Verifying correct methods to calculate GHG emissions
- Verifying combustion emissions
- Verifying sorbent emissions
- Verifying biomethane and biomass CO₂ emissions

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Entities Subject to §95115 - Reporting Thresholds

Entities are required to report when any of these criteria are met:

- Stationary combustion + process emissions
 - ≥ 10,000 MT CO₂e (§95101(b)(2))
 - Oil and gas production facilities include emissions from portable equipment and flares when calculating reporting threshold
- “All-in” categories of reporting entities (§95101(a)(1)(A))

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Entities Subject to §95115 - Source Categories

- Source categories that must report regardless of emissions levels (§95101(a)(1)(A)):
 - Electricity generation units subject to 40 CFR Part 75
 - Cement production
 - Lime manufacturing
 - Nitric acid production
 - Petroleum refineries
 - Geologic sequestration of carbon dioxide

Entities Subject to §95115 - Source Categories

- Source categories that must report when combustion and process emissions exceed 10,000 MT CO₂e annually (§95101(a)(1)(B)):
 - Stationary fuel combustion
 - Electricity generating units not subject to 40 CFR Part 75
 - Glass production
 - Hydrogen production
 - Iron and steel production
 - Pulp and paper manufacturing
 - Petroleum and natural gas systems;

Entities Subject to §95115 - Source Categories

- Non-industrial facilities only report combustion emissions
 - Universities, hospitals, military bases, large government buildings (boilers, electricity generation units, cogeneration)
 - Electricity generating units (EGUs) and cogeneration may have additional requirements under §95112, discussed in Course 1.4
- Industrial facilities may have combustion and process emissions, for example:
 - Glass production¹
 - Cement plants¹
 - Electricity generating units with wet flue gas desulfurization system

¹ Process emissions specialty required

Entities Subject to §95115 - GHGs to Report

- CO₂ from fossil fuel combustion
- CO₂ from biomass-derived fuel combustion
 - Exempt and non-exempt biomass
- CH₄ and N₂O from fossil and biomass fuel combustion
- CO₂ sorbent emissions

MRR generally references calculation methods in Subpart C

Entities Subject to §95115(h): Aggregation of SFC Units

- Small units: units may be aggregated if (40 CFR § 98.36(c)(1))*:
 - Units have a max heat input of ≤250 MMBtu/hr
 - Units are not required or elect to use Tier 4 method
 - Units use the same tier for any common fuels combusted
- Common stack: Units have a monitored common stack using a CEMS (40 CFR §98.36(c)(2))
- Common pipe: Units share a common liquid or gaseous fuel pipe (>250 MMBtu/hr is acceptable) (40 CFR 98.36(c)(3))*
 - Verify the reporter accounted for any fuel diverted from those units
 - Verify correct tier is used
- Combined large and small units: Common liquid or gaseous fuel is shared between large units and small combustions sources (40 CFR §98.36(c)(4))*
 - Verify reporter complies with 98.36(c)(4)(i) - (iii)

*Units must be from the same source category

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California MRR and US EPA 40 CFR Part 98

- Both the federal government and the State of California require GHG reporting
- MRR is structured to incorporate US EPA rule (40 CFR Part 98, Subpart C) by reference
- Key distinctions between MRR and Part 98 will be discussed

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Introduction to 40 CFR Part 98, Subpart C (1 of 2)

- Four Tiers (methods) for calculating CO₂ based on
 - Unit Size
 - Fuel Type
 - Other Factors
- CH₄ and N₂O are calculated depending on CO₂ Tier using
 - Measured therms or MMBtu and default EF or
 - Measured fuel mass or volume and either
 - Default EF and default HHV or
 - Default EF and measured HHV
- MRR specifies a particular version of Subpart C* (§95100(c)) – only the specified version may be used
- Verifiers must confirm they are using the version posted on CARB's website and not an older or newer version

* http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/subpart_c_rule_part98.pdf

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Introduction to 40 CFR Part 98, Subpart C (2 of 2)

Tier 1: Default EF and default HHV or measured therms
(40 CFR § 98.33(a)(1))

$$CO_2 = 1 \times 10^{-3} * F_{fuel} * HHV * EF \quad (\text{Eq. C-1})$$

Tier 2: Default EF and annual weighted average HHV
(40 CFR § 98.33(a)(2))

$$CO_2 = 1 \times 10^{-3} * F_{fuel} * HHV * EF \quad (\text{Eq. C-2a})$$

Tier 3: Average carbon content and molecular weight
(40 CFR § 98.33(a)(3))

$$CO_2 = \frac{44}{12} * F_{fuel} * CC * \frac{MW}{MTC} * 0.001 \quad (\text{Eq. C-5})$$

Tier 4: CO₂ CEMS
(40 CFR § 98.33(a)(4))

$$CO_2 = 5.18 \times 10^{-7} * C_{CO_2} * Q \quad (\text{Eq. C-6})$$

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Key distinctions between MRR & Subpart C (1 of 2)

- Reporting threshold:
10,000 MT CO₂e (MRR) vs. 25,000 MT CO₂e (EPA)
- MRR uses same methods as Subpart C but:
 - MRR requires the use of higher tiers than Subpart C for some fuel and equipment size combinations
 - MRR requires reporting of GHG emissions from ALL fuels
 - For fuels not listed in Table C-1, Subpart C only requires units >250 MMBtu/hr and fuels ≥ 10% of annual heat input to report GHGs
 - For fuel providing <10% of heat input to a unit ≤250 MMBtu/hr, MRR reporter may use any method allowed by 40 CFR §98.33(b)

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Key distinctions between MRR & Subpart C (2 of 2)

- MRR reporters:
 - Required to report GHG emissions from pilot lights if operated ≥300 hours/year
 - May use a site-specific source test for CH₄ and N₂O, whereas Subpart C only allows default CH₄ and N₂O emission factors
 - May use monthly fuel analysis instead of quarterly flue gas analysis in determining biomass fraction for partially biogenic fuels other than MSW (for example, tires)
 - Must use global warming potentials (GWP) from the Fourth Assessment (AR4)
 - Most recent EPA Part 98 uses Fourth Assessment (AR4)

Updated from 2020 training. See errata.

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Verifying Correct Methods (1 of 2)

- Verify reporter is using correct method according to §95115 for each fuel type and unit size
 - See Handout #1.2.1 for a table of minimal allowable methods based on unit size and fuel type and a decision tree diagram
- Reporting entities may always use a higher tier than the minimum required by the regulation
- Method should be consistent with previous year unless reporters follow and document change of methodology requirements (§95103(m))
 - Review GHG Monitoring Plan and previous emissions data report (EDR) to confirm acceptable methods

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Verifying Correct Methods (2 of 2)

- If reporter is using §95115(c)(3), which allows use of any tier for the emissions calculation if:
 - Emissions are *de minimis* under §95103(i); or
 - Fuel provides <10% heat input to unit with a maximum heat capacity of ≤ 250 MMBtu/hr
 - Unless prohibited by 40 CFR §98.33(b)
- Then verify (as applicable):
 - Emissions are *de minimis*
 - Does reporter have records and calculations supporting fuel and unit size limits?
 - Method selected for calculating GHG emissions is allowed for that fuel and unit size by 40 CFR §98.33(b)?^{1,16}

Course 1-2: Stationary Fuel Combustion

- Overview
- **Verifying combustion emissions**
 - **CO₂ Emissions**
 - **Tiers 1-3**
 - Tier 4
 - Part 75
 - CH₄ and N₂O Emissions
 - Verifying sorbent emissions
 - Verifying biomethane and biomass CO₂ emissions

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Types of Evidence for Verifying CO₂

- GHG Monitoring Plan
- Fuel consumption data
- Measured data and measurement methodologies
 - High heat value (HHV)
 - Carbon content
 - Molecular weight
- Evidence of accuracy of meters and monitors
 - Calibration records
 - Linearity checks and other quality assurance procedures
- Missing data procedures and records

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Verifying Fuel Consumption

- Evidence to request
 - Fuel consumption records by fuel type
 - Methodology and supporting data used to reconstruct or replace missing data
- How to examine evidence
 - Examine fuel consumption records for completeness and accuracy
 - Confirm missing data procedures were followed:
 - Demonstrate reasonable efforts to capture 100% fuel consumption data; follow procedures in §95129(d)

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Verifying Tier 1 Reports

- $CO_2 = 1 \times 10^{-3} * \text{Fuel} * \text{HHV} * \text{EF}$ (Eq. C-1)
- Confirm
 - Fuel consumption records
 - Correct default HHV values were used
 - Correct CO₂ emission factors were used
 - Your calculation matches the reporter's calculations
 - Missing data procedures were followed (Course 1.3)
 - Demonstrate reasonable efforts to capture 100% fuel consumption and HHV
 - Follow applicable procedures in §95129(c) and (d)

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Verifying Tier 2 Reports (1 of 2)

$$\text{CO}_2 = 1 \times 10^{-3} * \text{Fuel} * \text{HHV} * \text{EF} \quad (\text{Eq. C-2a})$$

- Confirm
 - Fuel consumption records
 - Correct measured HHV values were used
 - Correct CO₂ emission factors were used
 - Correct input into Cal e-GGRT
 - Your calculation matches the reporter's calculations

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Verifying Tier 2 Reports (2 of 2)

$$\text{CO}_2 = 1 \times 10^{-3} \text{ Steam} * \text{B} * \text{EF} \quad (\text{Eq. C-2c})$$

- Documentation to request when municipal solid waste facility uses steam production to calculate CO₂
 - Total mass of steam generated during the reporting year (lb steam)
 - Confirm device accuracy and appropriateness of calculation
 - Ratio of the boiler's maximum rated heat input capacity to its design rated steam output capacity (MMBtu/lb steam) (B)
 - Should be a constant: Confirm appropriate source documentation
 - Use of correct fuel-specific default CO₂ emission factor, from Table C-1 (kg CO₂/MMBtu)

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Verifying Tier 3 Reports (1 of 3)

- More complicated methodology; higher risk of error
- Three different formulae, depending upon type of fuel: solid, liquid, gaseous
- CO₂ emissions calculated from fuel consumption, carbon content (CC) and, for gaseous fuels, molecular weight (MW)
- CC and MW is required to be sampled based on fuel type per 40 CFR §98.34(b)(3)(ii)

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Verifying Tier 3 Reports (2 of 3)

- Confirmation of measurement accuracy for 40 CFR §98.3(j) and §95103(k) where applicable
 - Solid fuels - may use "company records" but must still be +/-5% accurate
 - Liquid and gaseous fuels
 - Calibrated fuel meter
 - Fuel billing (revenue) meter
 - For liquid fuels, tank drop measure using consensus-based standard (e.g., ASTM, API, ASME)

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Verifying Tier 3 Reports (3 of 3)

- Carbon content (CC) for each fuel
 - Measured at the frequency specified in §95115(f), and by methods specified in 40 CFR §98.34(b)(3)
- For gaseous fuels
 - Molecular weight (MW) measured at the frequency specified in §95115(f), and by methods in 40 CFR §98.34(b)(3) and the temperature-dependent molar volume conversion (MVC) factor used
- For pre-mixed blended fuels
 - Data to calculate the blend's annual average value of CC and MW, if appropriate, as in 40 CFR 98.34(b)(3)(v)

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Evaluating Tier 3 Evidence

- Does reporter have records of
 - Fuel consumption?
 - CC?
 - And for gaseous fuels, MW determination?
- Were CC and MW measured using correct methods at correct frequency and was the annual weighted average calculated correctly?
- Where was the sampling location(s)?
- Gaseous fuels
 - Did reporter use correct MVC for standard conditions (temperature) at which fuel volume was measured?

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Sample Calculations

- CO₂ Emissions from a SFC Source Group Participation Exercise 1-2.1
- Scenario
 - Fuel: Natural gas (primary fuel for a boiler)
 - HHV: 1.035×10^{-3} MMBtu/scf (measured)
 - Consumption: 500,000,000 scf

What are CO₂ emissions?

- A. 27,437,850 MT CO₂/yr
- B. 27,438 MT CO₂/yr
- C. 27,252 MT CO₂/yr

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Sample Calculations - Solution

- Scenario
 - Fuel: Natural gas (primary fuel for a boiler)
 - HHV: 1.035×10^{-3} MMBtu/scf (measured)
 - Consumption: 500,000,000 scf
- The correct answer is B:
 - CO₂ EF from Table C-1 is 53.02 kg CO₂/MMBtu
 - Use eq. C-2a: CO₂ = $1 \times 10^{-3} \times \text{Fuel} \times \text{HHV} \times \text{EF}$
 - $(1 \times 10^{-3} \text{ MT/kg}) \times (5 \times 10^8 \text{ scf}) \times (1.035 \times 10^{-3} \text{ MMBtu/scf}) \times (53.02 \text{ kg CO}_2/\text{MMBtu}) = 27,438 \text{ MT CO}_2$

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- Overview
- **Verifying combustion emissions**
 - **CO₂ Emissions**
 - Tiers 1-3
 - **Tier 4**
 - Part 75
 - CH₄ and N₂O Emissions
 - Verifying sorbent emissions
 - Verifying biomethane and biomass CO₂ emissions

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Continuous Emissions Monitoring System (CEMS)

- Collects hot stack gasses to directly measure [CO₂]
- Fuel usage is reported to CARB, but is NOT used for CO₂ emissions calculations
- Direct compliance instrument for air district rules
 - Primarily for NOx and CO limits



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Verifying Tier 4 (CEMS) Reports (1 of 3)

- Verifier must collect information on
 - Hourly CEMS concentration, flow and calculated CO₂ mass
 - Records of dates and results of CEMS certifications and quality assurance procedures
 - Methodology and supporting data used to reconstruct or replace missing data
- **Observation is key here**
 - Visit CEMS “shack”, discuss outputs with CEMS technician
 - Visit control room to identify how data is recorded
 - Locate data transmitters and all meters on the site
 - Ask for a live demonstration and output from the Data Acquisition and Handling System

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Verifying Tier 4 (CEMS) Reports (2 of 3)

- Evidence to request
 - CEMS Certifications
 - Records of dates
 - Results of:
 - Certifications
 - Quality assurance Procedures including
 - Linearity checks
 - Cylinder gas audits
 - Relative accuracy test audit
- Information should be included in the reporter’s GHG Monitoring Plan

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Verifying Tier 4 (CEMS) Reports (3 of 3)

- Evidence to request
 - Fuel consumption
 - Solid fuels may use “company” records
 - Liquid and gaseous fuels - calibrated fuel meter meeting 40 CFR §98.3(i), or tank drop measure
 - Fuel consumption records do not need to meet measurement accuracy requirements for CO₂
 - Information to understand the CO₂ mass calculation, especially moisture correction

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Evaluating Tier 4 Evidence (1 of 2)

- Verifier must check actual (daily) CEMS data to “recalculate” data as required by regulation
 - Sample the CEMS data produced through the DAHS
 - Ask the operator to query the data while you are on site
- Calculate CO₂ emissions using Tier 1 to cross-check
 - Calculated CO₂ emissions should be in general agreement with CO₂ emissions measured by CEMS, but some difference is expected

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Evaluating Tier 4 Evidence (2 of 2)

- Determine whether the CEMS certifications and quality assurance procedures conform with the requirements in:
 - 40 CFR Part 60
 - 40 CFR Part 75
 - Or the relevant air district program under which the CEMS is operated
- Ensure CEMS missing data procedures have been followed

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- Overview
- **Verifying combustion emissions**
 - **CO₂ Emissions**
 - Tiers 1-3
 - Tier 4
 - **Part 75**
 - **CH₄ and N₂O Emissions**
- Verifying sorbent emissions
- Verifying biomethane and biomass CO₂ emissions

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Verifying CO₂ Emissions - 40 CFR Part 75

- Developed as part of U.S. EPA's Acid Rain Program
 - Data available on public website
- Regulates EGUs (Electricity Generating Units)
- Requires continuous monitoring and reporting of, among other gases, CO₂ mass emissions and reporting of heat input
- First cap-and-trade program - SO₂
- Includes
 - Monitoring Provisions
 - Operation and Maintenance Requirements
 - Missing Data Substitution Procedures
 - Record Keeping and Reporting Requirements
- Useful tool: **US EPA's Plain English Guide to the Part 75**

http://www.epa.gov/airmarkets/emissions/docs/plain_english_guide_par75_final_rule.pdf 37

Verifying CO₂ Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (1 of 6)

- Where Part 75 estimates are not based on measured concentrations of CO₂
- Allowed under 40 CFR §75.10(3)(ii): Appendix G
- Based on measured heat content of the fuel and amount of fuel combusted (and sorbent where applicable)
- Operator calculates daily, quarterly and annual CO₂ mass emissions

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Verifying CO₂ Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (2 of 6)

Text of 40 CFR §75.13(b)

Determination of CO₂ emissions using appendix G to this part. If the owner or operator chooses to use the appendix G method, then the owner or operator shall follow the procedures in appendix G to this part for estimating daily CO₂ mass emissions based on the measured carbon content of the fuel and the amount of fuel combusted.

For units with wet flue gas desulfurization systems or other add-on emissions controls generating CO₂, the owner or operator shall use the procedures in appendix G to this part to estimate both combustion-related emissions based on the measured carbon content of the fuel and the amount of fuel combusted and sorbent-related emissions based on the amount of sorbent injected.

The owner or operator shall calculate daily, quarterly, and annual CO₂ mass emissions (in tons) in accordance with the procedures in appendix G to this part.

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Verifying CO₂ Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (3 of 6)

- Appendix G provides two basic methods for determining CO₂ emissions:
 - Daily CO₂ emissions are calculated from company records of fuel usage and the results of periodic fuel sampling and analysis (to determine the % carbon in the fuel); or
 - Hourly CO₂ emissions are calculated using heat input rate measurements made with certified Appendix D fuel flow meters together with fuel-specific, carbon-based "F-factors".

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Verifying CO₂ Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (4 of 6)

$$W_{CO_2} = \frac{(MW_c + MW_{O_2}) * WC}{2,000 MWC} \quad \text{Eq. G-1}$$

- W_{CO_2} = CO₂ emitted from combustion, tons/day
- MW_c = Molecular weight of carbon (12.0)
- MW_{O_2} = Molecular weight of oxygen (32.0)
- W_c = Carbon burned, lb/day, using fuel analysis and fuel feed rates

$$W_{CO_2} = \frac{F_c * H * U_f * MW_{CO_2}}{2,000} \quad \text{Eq. G-4}$$

- W_{CO_2} = CO₂ emitted from combustion, tons/hr
- MW_{CO_2} = Molecular weight of CO₂, 44.0 lb/lb-mole
- F_c = Carbon based F-factor, 1,040 scf/mmBtu for natural gas (see section 3.3.5 of appendix F)
- H = Hourly heat input in mmBtu (see section 5 of appendix F)
- U_f = 1/385 scf CO₂/lb-mole at 14.7 psia and 68 °F

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Verifying CO₂ Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (5 of 6)

- Evidence to request for natural gas
 - Hourly fuel flow rates from company records
 - Measured high heating value (HHV/GCV) from fuel sampling
 - Determine the carbon content of each fuel sample
 - The carbon-based F factor (F_c) (i.e., ratio of CO₂ generated to the calorific value of the fuel combusted)
 - Methodology and supporting data used to reconstruct or replace missing data

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Verifying CO₂ Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR §75.13(b) (6 of 6)

Confirm:

- Appropriate fuel flow used
- Records and methodologies for HHV/gross calorific value (GCV) determinations
- Heat input appropriately calculated per Appendix F to Part 75, Section 5.5 (conversion procedures)
- Correct F_c factors were used for specific fuel
- Missing data procedures were followed
 - 40 CFR §75 for CO₂ concentration, stack gas flow rate, fuel flow rate, high heating value, and fuel content (in particular Appendix G, Section 5)

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CH₄ and N₂O Emissions (1 of 2)

Emissions calculated using procedures in 40 CFR §98.33(c)

$$\begin{aligned} CH_4 \text{ or } N_2O &= 0.001 * F_{fuel} * HHV * EF && \text{(Eq. C-8 for all fuels)} \\ CH_4 \text{ or } N_2O &= 0.001 * F_{fuel} * EF && \text{(Eq. C-8b for NG reported in MMBtu)} \end{aligned}$$

If 789,000 MMBtu of natural gas is combusted...

- CH₄ = 0.001 MT/kg * 789,000 MMBtu * 0.001 kg/MMBtu
- N₂O = 0.001 MT/kg * 789,000 MMBtu * 0.0001 kg/MMBtu
- CO₂ = 0.001 MT/kg * 789,000 MMBtu * 53.02 kg/MMBtu (Eq. C-1b)

$$\begin{aligned} \text{Total CO}_2e &= CO_2 + [CH_4 * 25] + [N_2O * 298] \\ &= 41,832.8 + [0.79 * 25] + [0.079 * 298] = 41,876 \text{ MT} \end{aligned}$$

← GWPs

Updated from 2020 training. See errata.

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CH₄ and N₂O Emissions (2 of 2)

- Did reporter:
 - Use same values for fuel consumption as for calculating CO₂ emissions under Tiers 1 or 3?
 - Use same values for fuel consumption and HHV, or for steam production, under Tier 2?
 - Have values for total annual heat input for units using Tier 4? What is the source of those values?
- How to evaluate evidence
 - Were the EFs from Table C-2 used for the correct fuel, unless facility used source-specific EFs?
 - For blended fuels, were emissions calculated for each individual fuel separately using procedures in 40 CFR §98.33(c)?
 - Do verifier calculated emissions match reported emissions? ⁴⁵

- Overview
- Verifying combustion emissions
 - CO₂ Emissions
 - Tiers 1-3
 - Tier 4
 - Part 75
 - CH₄ and N₂O Emissions
- **Verifying sorbent emissions**
- Verifying biomethane and biomass CO₂ emissions

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CO₂ Emissions from Sorbent: Equation and Inputs

$$CO_2 = 0.91 * S * R * \left(\frac{MW_{CO_2}}{MW_S} \right) \quad (\text{Eq. C-11})$$

- CO₂ = CO₂ emitted from sorbent for the reporting year (MT)
- 0.91 = Conversion factor from short tons to metric tons
- S = Limestone or other sorbent used in the reporting year, from company records (short tons)
- R = The number of moles of CO₂ released upon capture of one mole of the acid gas species being removed (R = 1.00 when the sorbent is CaCO₃ and the targeted acid gas species is SO₂)
- [CaCO_{3(s)} + SO_{2(g)} → CaSO_{3(s)} + CO_{2(g)}]
- MW_{CO₂} = Molecular weight of carbon dioxide (44)
- MW_S = Molecular weight of sorbent (100 if calcium carbonate) ⁴⁷

Verifying CO₂ Emissions from Sorbent

- Evidence to request: Inputs and outputs used in Eq. C-11 in 40 CFR §98.33(d)
- How to evaluate evidence - Does the reporter have:
 - Company records supporting the reported type and annual amount of sorbent used?
 - Data or information supporting the values used in Eq. C-11?
 - R = moles of CO₂ released per mole of acid gas being removed
 - MW_S = molecular weight of the sorbent

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Selecting the Correct Tier
Group Participation Exercise 1.2.2

- A pipeline natural gas-fired boiler that is 300 MMBtu/hr maximum rated heat input; the consumption is measured in therms and obtained from billing records, and the unit has no CEMS.
- What is the minimum allowable reporting Tier?
 - A. Tier 1
 - B. Tier 2
 - C. Tier 3
 - D. Tier 4

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Selecting the Correct Tier
Group Participation Exercise 1.2.2 Solution

- A pipeline natural gas-fired boiler that is 300 MMBtu/hr maximum rated heat input; the consumption is measured in therms and obtained from billing records, and the unit has no CEMS.
- What is the minimum allowable reporting Tier?
 - A. Tier 1
 - B. Tier 2
 - C. Tier 3
 - D. Tier 4

Use Equation C-1a using Therms; **C-1 is not allowed** because heat input is >250 MMBtu/hr -- see §95115(c)(1).

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Selecting the Correct Tier
Group Participation Exercise 1.2.3

- A single-cycle peaking turbine (EGU) that combusts kerosene-type jet fuel with a heat input of 365 MMBtu/hr. The unit has no CEMS. What is the minimum tier?
 - A. Tier 1
 - B. Tier 2
 - C. Tier 3
 - D. Tier 4

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Selecting the Correct Tier
Group Participation Exercise 1.2.3 Solution

- A single-cycle peaking turbine (EGU) that combusts kerosene-type jet fuel with a heat input of 365 MMBtu/hr. The unit has no CEMS. What is the minimum tier?
 - A. Tier 1
 - B. Tier 2
 - C. Tier 3
 - D. Tier 4

- Jet fuel meets the definition of distillate fuel oil in §95102, so either Tier 1 or 2 may be used according to Table 2-3 at the end of §95115. However, Tier 1 is limited to units <250 MMBtu, so Tier 2 is the correct answer.

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Evaluating Additional Conformance Requirements §95131(b)(8)(F)

- Reporting entities that combust natural gas
 - Review natural gas bills
 - Confirm total amount reported in subpart A - compare with sum of gas combusted in Subpart C (or D)
 - Confirm natural gas provider -- should be gas utility company, not fuel “marketer”
- Purchased or acquired natural gas (MMBtu) must be reported even if the facility reports GHG emissions using data from internal meters

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- Overview
- Verifying combustion emissions
- Verifying sorbent emissions
- **Verifying biomethane and biomass CO₂ emissions**

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Biomass-Derived Fuels and Biomethane

- Biomass fuels are fuels that are derived from biomass products and byproducts, wastes, and residues from plants, animals, and microorganisms
 - Biomass fuels may be solid, liquid, or gaseous
- “Biomethane” means biogas that has been processed and meets pipeline quality natural gas standards

(Not all biogas is biomethane)

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Verifying Biomass-Derived Fuel Emissions §95103(j); §95131(i); C&T §95852.2(a)

- Why is it important?
- Who has to report?
- What are the reporting requirements for fuels?
- How to verify biomass-derived fuel combustion emissions?

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Importance of Biomass-derived Fuel Reporting

- Emissions from exempt biomass have no compliance obligation pursuant to Cap-and-Trade Regulation
 - Reporting and verification is still mandatory under MRR
- Financial incentive to report emissions as exempt
- MRR requires thorough demonstration that combusted fuel is biomass-derived fuel
- Responsibility for reporter to demonstrate conformance
- Verifier must take needed time to determine conformance, may include upstream entities

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Biomass-derived Fuel Combustion Emissions: Reporters

- Reporting entities emitting $\geq 10,000$ MT CO₂e (including CO₂ emissions from biomass-derived fuel) must report biomass derived-fuel combustion emissions (§95101(b)(4))
- Biomass-derived fuel emissions count toward the 25,000 MT CO₂e verification threshold (§95103(f))
- Emissions must be reported by fuel type unless using steam or CEMS-based methods (§95103(j))
- Emissions can be calculated using any tier

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Sources that Combust Biomass-derived Fuel

- Stationary combustion sources
 - Mainly concentrated in electricity generation to meet the Renewable Portfolio Standard requirements: solid biomass, biogas, and biomethane
- Transportation fuel
 - As an oxygenate and to reduce the carbon intensity of the fuel: ethanol and bio/renewable diesel (Course 2)
- Anaerobic digesters
 - Wastewater treatment plants and landfill gas collection systems are also a source of biogas, often combusted on-site

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Reporting Requirements for Biomass-derived Fuel: Solid Biomass §95103(j)(1)

- Identify if urban, agricultural, MSW, or forest-derived
 - Urban – pallets, construction waste, tree trimmings, mill residue, range land residues
 - Agricultural waste - as a result of agricultural activities such as crops, livestock, nurseries
 - MSW - solid phase waste discarded by households, commercial/retail entities, institutions (e.g., hospitals, prisons)
 - Forest derived - next slide
- If urban and agricultural biomass collected with MSW, then all identified as MSW (§95102(a))

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Reporting Requirements for Biomass-derived Fuel: Forest-derived Wood and Wood Waste §95103(j)(2)

- Forest clearing and cutting, where combusted material is not a waste product from other processes (like milling)
- Report by California Forest Practice Rule (CFPR) and National Environmental Protection Act (NEPA) identifier
- Report name, address, and contact information for supplier
- High Hazard Zone (HHZ) exemptions allow some forest-derived fuels to be exempt, even without a timber harvest plan – check Guidance

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Verifying Exempt Classification for Biomass: Solid and liquid fuels

- Contract review
 - Ensure proper classification and procurement timing
- Air district permit and inspection reports
 - For biomass-only plants, can give confidence that only biomass is burned
- Proper classification
 - Ensure material type has been classified consistent with definitions
 - Only need to meet forest-derived wood requirements if wood combusted is not a byproduct of other process, such as mill residue

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Verifying Exempt Classification for Biomass: Forest-derived wood

- Forest-derived wood and wood waste have additional requirements
 - Review forest product reporting form. Confirm that facility received wood from said companies
 - Confirm sample of listed companies had applicable permits or exemptions and were in compliance with those permits
 - Justify sample chosen in sampling plan

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Reporting Requirements for Biomass-derived Fuel: Non-exempt Biomass-derived Fuel §95103(j)(4)

- Biomass emissions are **non-exempt** if they:
 - Do not meet requirements of MRR and sections 95852.1.1 and 95852.2 of Cap-and-Trade Regulation, or
 - Cannot be verified according to the requirements of §95131(i)
- Non-exempt emissions are subject to the reporting requirements of §95103(k) and §95110-95158
 - Remember: Reporters subject to Cap-and-Trade have a compliance obligation on non-exempt emissions. Non-exempt biomass emissions must meet full fossil fuel accuracy and reporting tier requirements.

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Biomass-derived Fuel Use Accuracy §95103(k)

- Fuel use accuracy is required for biomass-derived fuels when
 - CO₂ emissions trigger compliance obligation because fuel is classified as non-exempt biomass-derived
- Reported fuel usage does not need to meet +/-5% accuracy threshold if fuel is exempt, and CH₄ and N₂O are reported as de minimis
- Exception: CH₄ and N₂O emissions **from biomass**, even if not classified as de minimis, do not need to meet +/-5% accuracy threshold

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Verifying Biomass GHG Emissions (1 of 4)

- For determinations using 40 CFR §98.33(e) when the biomass fraction is known and the fuel is not otherwise addressed by §95115(e)
 - Follow evidence and evaluation procedures for the applicable tier for the biomass fuel for calculating CO₂ emissions as if it were any other fuel
 - Note that pure, exempt biomass combustion can use any tier
 - If a biomass fuel is combusted with a fossil fuel in a unit monitored by a CEMS, follow the procedures in 40 CFR §98.33(e)(2) to calculate biogenic CO₂ emissions
 - Does not apply to the combustion of MSW

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Verifying Biomass GHG Emissions (2 of 4)

Evidence to request and evaluate when CEMS are used:

Inputs and outputs to Eq. C-12 to C-14 in 40 CFR Part 98, Subpart C

$$V_{CO_2h} = \frac{(\%CO_2)_h}{100} \times Q_h \times t_h \quad (\text{Eq. C-12})$$

$$\% \text{ Biogenic} = \frac{V_{bio}}{V_{total}} \quad (\text{Eq. C-14})$$

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Verifying Biomass GHG Emissions (3 of 4)

- Evidence to request and evaluate when CEMS are used
 - For CH₄ and N₂O, fuel consumption and HHV must conform to Tier 2 (see 40 CFR §98.33(c)(1))
 - Hourly average CO₂ concentration and stack flow rate data from CEMS must conform to Tier 4 data verification and missing data requirements
 - Fuel specific carbon based F-factors must comply with Appendix G to Part 75 (see §98.33(e)(1)(iii))

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Verifying Biomass GHG emissions (4 of 4)

- For determinations using 40 CFR §98.33(e) as specified in §95115(e)(1) for MSW, or other mixed fuels when biomass fraction is unknown (including when reporter elects to report biomass-derived CO₂ emissions from tires)
 - Follow verification procedures for the applicable tier for the fuel as described for determining CO₂ emissions
- For verification of the biomass-derived fraction
 - Review the sampling and analysis results of the flue gas or the fuel according to ASTM methods per 40 CFR §98.34(d)
 - Do the sampling and analysis conform to the ASTM methods and the frequency specified in 40 CFR §98.34(d)?

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Verifying Exempt Classification for Biogenic CO₂ Emissions

- Request:
 - Annual and hourly heat input records
 - Purchase records, invoices, scheduling, etc. (§95131(i)(1)(B)(2))
 - Biomass specific requirements (§95131(i)(2))
- Confirm:
 - Heat input records
 - Purchase records, transportation records, chain of custody
 - Eligibility and other biomass-specific requirements are met
 - Use of correct emission factors
 - Correct calculation

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Verifying Biomass GHG Determinations: Mixtures of Natural Gas and Biomethane (1 of 2)

- “Biomethane” is biogas that meets pipeline quality natural gas standards (§95102(a))
- When using Tier 2:
 - Reporters calculate separate GHG emissions from biomethane and natural gas (per §95115(e)(3))
 - Biomethane emissions are calculated from contractual deliveries
 - Verifiers follow Tier 2 verification steps for inputs and outputs used in equation in §95115(e)(3)

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Verifying Biomass GHG Determinations: Mixtures of Natural Gas and Biomethane (2 of 2)

- Using Tier 4 or subject to 40 CFR §98, Subpart D
 - Reporters calculate GHG emissions from biomethane and assume the remainder are natural gas GHG emissions (§95115(e)(4))
 - Biomethane GHG emissions are calculated from contractual deliveries
 - Verifiers follow Tier 4 or Subpart D verification steps for the total GHG emissions from the mixture
 - Verifiers follow Tier 2 verification steps for the inputs and outputs used in the equation in §95115(e)(3) for the biomethane GHG emissions

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Verifying Biomass GHG Determinations: Mixtures of Natural Gas and Biogas

- Mixtures require either
 - Separate metering of each fuel, or
 - Solving by difference from total and other fuel (3 variables, 2 of them are known)
- When using Tier 3, Tier 4, or subject to Subpart D
 - Reporters use Tier 3 carbon content method to determine GHG emissions from biogas; the remainder are natural gas GHG emissions (§95115(e)(5))
 - Verifiers follow applicable Tier 3 or Tier 4 verification steps for the total GHG emissions from the mixture
 - Verifiers follow Tier 3 verification steps for the biogas GHG emissions if mixture contains “covered” emissions

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Reporting Requirements and Exemption for Biomethane §95103(j)(3)

- High risk - must review, even if small amount
- Reporting entity must report
 - Total biomethane consumption and exemption status
 - Name and address of biomethane vendor(s) and MMBtu delivered by each vendor
 - Name, address and facility type where biomethane is produced (§95103(j)(3))
- Must have documentation to demonstrate eligibility
 - Contract for actual biomethane, consistent with C&T §95852.1.1
 - Invoices for purchase
 - Shipping reports
 - Allocation, balancing, and nomination reports
- Document your approach in sampling plan
- Must be reported as non-exempt natural gas if reporter cannot provide evidence of applicability and accuracy

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Sample Calculations of CO₂ Emissions Group Participation Exercise 1.2.4

- Scenario
 - Fuel: Municipal Solid Waste
 - Steam generation: 3×10^9 lbs per year
 - B-ratio: 0.0016 MMBtu maximum rated heat input/lb of steam output capacity
 - Results of ASTM analysis of emissions: 62% of emissions are biogenic
- What are the annual fossil fuel CO₂ emissions?
 - A. 435,360 MT CO₂/yr
 - B. 269,923 MT CO₂/yr
 - C. 165,437 MT CO₂/yr

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Sample Calculations of CO₂ Emissions Group Participation Exercise 1.2.4 Solution

The correct answer is C: 165,437 MT CO₂/yr fossil based emissions

Step 1: Calculate total CO₂ emissions using Eq. C-2c, and correct CO₂ EF from Table C-1 of 90.7 kg CO₂/MMBtu :

$$\begin{aligned} \text{CO}_2 &= 1 \times 10^{-3} \times B \times \text{Steam} \times \text{EF} \\ 1 \times 10^{-3} \text{ MT/kg} \times 0.0016 \text{ MMBtu/lb} \times 3 \times 10^9 \text{ lb/yr} \times 90.7 \text{ kg CO}_2/\text{MMBtu} \\ &= 435,360 \text{ MT CO}_2/\text{yr} \end{aligned}$$

Step 2: Calculate biogenic CO₂ emissions:

$$435,360 \text{ MT CO}_2/\text{yr} \times 0.62 \text{ MT biogenic CO}_2/\text{MT total CO}_2 = 269,923 \text{ MT CO}_2/\text{yr}$$

Step 3: Subtract biogenic CO₂ from total CO₂ to determine fossil-based emissions:

$$435,360 \text{ MT CO}_2/\text{yr} - 269,923 \text{ MT CO}_2/\text{yr} = 165,437 \text{ MT CO}_2/\text{yr}$$

Course 1: General Verification

Complete:

- 1.1 Verification Principles, Requirements, and Procedures
- 1.2 Stationary Fuel Combustion and Sorbent Sources

Next:

- 1.3 Accuracy and Product Data
- 1.4 Electricity Generating Units and Cogeneration