

# Verifier Accreditation Training for Mandatory Greenhouse Gas Reporting

General Verification  
Course 1.2 - Stationary Fuel Combustion  
and Sorbent Sources

California Environmental Protection Agency

 **Air Resources Board**



# 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 & Product Data

1.4 Electricity Generating Units & Cogeneration

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# Course 1.2 Handout

- Handout 1.2.1 Minimal Allowable Methods (Tiers)

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

## 1. Overview

- SFC Applicability: who reports
- GHG reporting requirements: what is reported & aggregation of SFC units
- Comparing § 95115 to EPA's 40 CFR 98, Subpart C
- Verifying correct methods to calculate GHG emissions

## 2. Verifying combustion emissions

## 3. Verifying sorbent emissions

## 4. Verifying biomethane and biomass CO<sub>2</sub> emissions

# Entities Subject to § 95115 - Reporting (1 of 2)

Subject to reporting requirements when any of these criteria are met:

1. Stationary combustion + process emissions  
≥ 10,000 MTCO<sub>2</sub>e ( § 95101(b)(2))
2. Only stationary combustion emissions sources  
≥ 10,000 MTCO<sub>2</sub>e AND  
aggregate maximum rated heat input capacity of the  
SFC units is ≥ 12 MMBtu/hr ( § 95101(b)(3))

# Entities Subject to § 95115 - Reporting (2 of 2)

Subject to reporting requirements when any of these criteria are met:

3. Oil and gas production facilities have additional trigger: when all emissions, including portable drill rigs,  $\geq 25,000$  MT CO<sub>2</sub>e ( § 95101(e))
4. Cap-and-Trade Program “opt-in” covered entities
5. “All-in” categories of reporting entities ( § 95101(a)(1)(A))

# Entities Subject to § 95115 - Types of Reporting Entities

- Non-industrial, only SFC sources
  - Universities, hospitals, military bases, large government buildings (boilers, electricity generation units, cogeneration)
- Industrial facilities may have SFC and process emissions, for example
  - Glass production<sup>1</sup>
  - Cement plants<sup>1</sup>
  - Electricity generating units with wet flue gas desulfurization system

<sup>1</sup> Process emissions specialty is taught in Course 4

# US EPA (Part 98) and California ARB (MRR)

- 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
- Important differences between MRR and Part 98 will be discussed

# GHG Reporting Requirements for SFC and Sorbent Sources § 95115

MRR generally references calculations from 40 CFR Part 98, Subpart C

- CO<sub>2</sub> from fossil fuel combustion
- CO<sub>2</sub> from biomass-derived fuel combustion
  - Exempt and non-exempt biomass
- CH<sub>4</sub> and N<sub>2</sub>O from fossil and biomass fuel combustion
- CO<sub>2</sub> sorbent emissions

# Aggregation of SFC Units

## Compliance with § 95115(h) (1 of 2)

### Verify

- All units aggregated under 40 CFR 98.36(c)(1)
  - Are each 250 MMBtu/hr or less
  - Use the same tier for any common fuels combusted
- Units associated with different U.S. EPA subparts are not aggregated together, except when they have a monitored common stack using a CEMS (40 CFR 98.36(c)(2))
- Appropriate tier used when units share a common liquid or gaseous fuel pipe and some units are >250 MMBtu/hr (40 CFR 98.36(c)(3))

# Aggregation of SFC Units

## Compliance with § 95115(h) (2 of 2)

- Aggregated units using a common fuel pipe (40 CFR 98.36(c)(3)):
  - Verify the reporter accounted for any fuel diverted from those units
- Reporter attributing GHG emissions from a shared fuel supply to only “large” units (40 CFR 98.36(c)(4))
  - Verify reporter complies with 98.36(c)(4)(i) - (iii)

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

- Four Tiers (methods) for calculating CO<sub>2</sub> based on
  - Unit Size
  - Fuel Type
  - Other Factors
- CH<sub>4</sub> and N<sub>2</sub>O are calculated depending on CO<sub>2</sub> 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<sup>1</sup>  
( § 95100(c))
- Verifiers should confirm they are using the version posted on ARB's website and not an older or newer version.

<sup>1</sup>[http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/subpart\\_c\\_rule\\_part98.pdf](http://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/subpart_c_rule_part98.pdf)

# 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))

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

- **Tier 2:** default EF and annual weighted average HHV  
(40 CFR 98.33(a)(2))

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

- **Tier 3:** average carbon contents and molecular weights  
(40 CFR 98.33(a)(3))

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

- **Tier 4:** CEMS (40 CFR 98.33(a)(4))

– CO<sub>2</sub> CEMS

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

# Comparing § 95115 to Subpart C (1 of 2)

- Reporting threshold  
10,000 MT CO<sub>2</sub>e (MRR) vs. 25,000 MT CO<sub>2</sub>e (EPA)
- MRR uses same methods as Subpart C but:
  - Higher minimum tiers than Subpart C for some fuel and equipment size combinations
  - ARB requires reporting of GHG emissions from **ALL** fuels
    - Subpart C only requires units >250 MMBtu/hr and fuels ≥ 10% of annual heat input to report GHGs from fuels not listed in its Table C-1
  - 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)

# Comparing § 95115 to Subpart C (2 of 2)

## Under § 95115

- Report GHG from pilot lights if operated  $\geq 300$  hours/year
- May use a site-specific source test for  $\text{CH}_4$  and  $\text{N}_2\text{O}$ , whereas Subpart C only allows default  $\text{CH}_4$  and  $\text{N}_2\text{O}$  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)

# Verifying Correct Methods (1 of 2)

- Verify reporter is using correct method according to § 95115 for each fuel type and SFC 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 EDR's to confirm acceptable methods

# Verifying Correct Methods (2 of 2)

- If reporter is using § 95115(c)(3) provision, which allows use of any of the tiers for the emissions calculation if
  - fuels <10% heat input to unit, and
  - unit is  $\leq 250$  MMBtu/hr
- ...Then verify all are true
  - Does reporter have records and calculations supporting the 10% heat input determination?
  - Is method selected for calculating GHG emissions allowed for that fuel and unit size by 40 CFR 98.33(b)?

# Questions and ARB Comments

## 1. Overview

## 2. Verifying combustion emissions

- **CO<sub>2</sub> Emissions**
  - **Tiers 1-3**
  - Tier 4
  - O<sub>2</sub> Monitors
  - Part 75
- N<sub>2</sub>O and CH<sub>4</sub> Emissions

## 3. Verifying sorbent emissions

## 4. Verifying biomethane and biomass CO<sub>2</sub> emissions

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# Types of Evidence for Verifying CO<sub>2</sub>

- 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 used

# 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)

# Verifying Tier 1 Reports

- $CO_2 = 1 \times 10^{-3} * Fuel * HHV * EF$  (Eq. C-1)
- Confirm
  - Fuel consumption records
  - Correct default HHV values were used
  - Correct CO<sub>2</sub> 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)

# Verifying Tier 2 Reports (1 of 2)

- $CO_2 = 1 \times 10^{-3} * Fuel * HHV * EF$  (Eq. C-2a)
- Confirm
  - Fuel consumption records
  - Correct measured HHV values were used
  - Correct CO<sub>2</sub> emission factors were used
  - Correct input into Cal e-GGRT
  - Your calculation matches the reporter's calculations

# Verifying Tier 2 Reports (2 of 2)

Evidence to request when municipal solid waste facility uses steam production to calculate CO<sub>2</sub>

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

- 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)
  - Should be a constant: Confirm appropriate source documentation
- Use of correct fuel-specific default CO<sub>2</sub> emission factor, from Table C-1 (kg CO<sub>2</sub>/MMBtu)

# Verifying Tier 3 Reports

- More complicated methodology; higher risk of error
- Three different formulae, depending upon type of fuel: solid, liquid, gaseous
- CO<sub>2</sub> emissions calculated from fuel consumption, carbon content (CC) and, for gaseous fuels, molecular weight (MW)
- Daily sampling of CC and MW required

# Verifying Tier 3 Reports: Evidence to Request (1 of 2)

Confirmation of measurement accuracy for 40 CFR 98.3(i) 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)

# Verifying Tier 3 Reports: Evidence to Request (2 of 2)

- 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)

# Evaluating Tier 3 Evidence (1 of 2)

- 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?
- Where was the sampling location(s)?
- Gaseous fuels
  - Did reporter use correct MVC for standard conditions (temperature) at which fuel volume was measured?

# Evaluating Tier 3 Evidence (2 of 2)

- Premixed blend fuels
  - Does reporter have records of data and calcs used for annual weighted average CC and MW (if appropriate)
- Do verifier-calculated emissions using fuel consumption, measured CC and (for gaseous fuels) MW and appropriate MVC match those reported?

# Sample Calculations of CO<sub>2</sub> Emissions from a SFC Source

## Group Participation Exercise 1-2.1

- Scenario
  - Fuel: Natural gas (primary fuel for a boiler)
  - HHV:  $1.035 \times 10^{-3}$  MMBtu/scf (measured)
  - Consumption: 500,000,000 scf
- What are CO<sub>2</sub> emissions?
  - A. 27,437,850 MT CO<sub>2</sub>/yr
  - B. 27,438 MT CO<sub>2</sub>/yr
  - C. 27,252 MT CO<sub>2</sub>/yr

# Sample Calculations of CO<sub>2</sub> Emissions from a SFC Source

## Group Participation Exercise 1-2.1 Solution

- Scenario
  - Fuel: Natural gas (primary fuel for a boiler)
  - HHV:  $1.035 \times 10^{-3}$  MMBtu/scf (measured)
  - Consumption: 500,000,000 scf

The correct answer is B:

CO<sub>2</sub> EF from Table C-1 is 53.02 kg CO<sub>2</sub>/MMBtu

Use eq. C-2a: CO<sub>2</sub> =  $1 \times 10^{-3}$  x Fuel x HHV x EF:

$1 \times 10^{-3}$  MT/kg x  $5 \times 10^8$  scf x  $1.035 \times 10^{-3}$  MMBtu/scf x 53.02 kg CO<sub>2</sub>/MMBtu =

**27,438 MT CO<sub>2</sub>**

# Questions and ARB Comments

## 1. Overview

## 2. Verifying combustion emissions

- **CO<sub>2</sub> Emissions**
  - Tiers 1-3
  - **Tier 4**
  - O<sub>2</sub> Monitors
  - Part 75
- N<sub>2</sub>O and CH<sub>4</sub> Emissions

## 3. Verifying sorbent emissions

## 4. Verifying biomethane and biomass CO<sub>2</sub> emissions

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

- Verifier must collect information on
  - Hourly CEMS concentration, flow and calculated CO<sub>2</sub> mass
  - Records of dates and results of CEMS certifications and quality assurance procedures
  - Methodology and supporting data used to reconstruct or replace missing data (more on missing data in course 1.3)
- 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 Handling System

# 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

# 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), fuel billing meter or tank drop measure
- Fuel consumption records do not need to meet measurement accuracy requirements unless used to report (non-de minimis) CH<sub>4</sub> and N<sub>2</sub>O ( § 95115(g))

# Evaluating Tier 4 Evidence (1 of 2)

- Calculate CO<sub>2</sub> emissions using Tier 1 to cross-check
  - Calculated CO<sub>2</sub> emissions should be in general agreement with CO<sub>2</sub> emissions measured by CEMS, but some difference is expected
- Verifier must check actual daily CEMS data to “re-calculate” 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

# Evaluating Tier 4 Evidence (2 of 2)

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

# Questions and ARB Comments

## 1. Overview

## 2. Verifying combustion emissions

- **CO<sub>2</sub> Emissions**
  - Tiers 1-3
  - Tier 4
  - **O<sub>2</sub> Monitors**
  - **Part 75**
- **N<sub>2</sub>O and CH<sub>4</sub> Emissions**

## 3. Verifying sorbent emissions

## 4. Verifying biomethane and biomass CO<sub>2</sub> emissions

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# Verifying CO<sub>2</sub> Emissions Calculated Using O<sub>2</sub> Monitors (1 of 2)

## Evidence to request

- Records of dates and results of CEMS certifications and quality assurance procedures
- Methodology and supporting data used to reconstruct or replace missing data



# Verifying CO<sub>2</sub> Emissions - Calculated Using O<sub>2</sub> Monitors (2 of 2)

## How to evaluate evidence

- Check that O<sub>2</sub> monitoring requirements in 40 CFR 75.13 were followed
- Determine whether the CEMS certifications and quality assurance procedures conform with requirements in 40 CFR 75
- Confirm ARB missing data procedures were followed
- Procedures in Part 75 for O<sub>2</sub> concentration, stack gas flow rate, fuel flow rate, high heat value, and fuel carbon content



# Verifying CO<sub>2</sub> 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, CO<sub>2</sub> mass emissions and reporting of heat input
- First cap-and-trade program – SO<sub>2</sub>
- 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](http://www.epa.gov/airmarkets/emissions/docs/plain_english_guide_par75_final_rule.pdf)

# Verifying CO<sub>2</sub> 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 CO<sub>2</sub>
- Allowed under 75.10(3)(ii): Appendix G
- Based on measured content of the fuel and amount of fuel combusted (and sorbent where applicable)
- Operator calculates daily, quarterly and annual CO<sub>2</sub> mass emissions

# Verifying CO<sub>2</sub> Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR 75.13(b) (2 of 6)

Appendix G provides two basic methods for determining CO<sub>2</sub> emissions:

1. Daily CO<sub>2</sub> 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
2. Hourly CO<sub>2</sub> emissions are calculated using heat input rate measurements made with certified Appendix D fuel flow meters together with fuel-specific, carbon-based “F-factors”.

# Verifying CO<sub>2</sub> Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR 75.13(b) (3 of 6)



Text of 75.13(b): *Determination of CO<sub>2</sub> 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 CO<sub>2</sub> 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 CO<sub>2</sub>, 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 CO<sub>2</sub> mass emissions (in tons) in accordance with the procedures in appendix G to this part.

# Verifying CO<sub>2</sub> Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR 75.13(b) (4 of 6)

$$W_{\text{CO}_2} = \frac{(MW_{\text{C}} + MW_{\text{O}_2}) \times W_{\text{C}}}{2,000 MW_{\text{C}}} \quad (\text{Eq. G-1})$$

$W_{\text{CO}_2}$  = CO<sub>2</sub> emitted from combustion, tons/day

$MW_{\text{C}}$  = Molecular weight of carbon (12.0)

$MW_{\text{O}_2}$  = Molecular weight of oxygen (32.0)

$W_{\text{C}}$  = Carbon burned, lb/day, determined using fuel  
sampling and analysis and fuel feed rates.

# Verifying CO<sub>2</sub> Combustion Emissions Calculated Using Fuel-based Methodology in 40 CFR 75.13(b) (5 of 6)

## Evidence to request

- Hourly fuel flow rates from company records
- Measured high heating value (HHV) from fuel sampling
- Determine the carbon content of each fuel sample
  - The carbon-based F factor ( $F_c$ ) (i.e., ratio of CO<sub>2</sub> generated to the calorific value of the fuel combusted)
- Methodology and supporting data used to reconstruct or replace missing data

# Verifying CO<sub>2</sub> 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
- Correct calculation
- Missing data procedures were followed
  - 40 CFR 75 for CO<sub>2</sub> concentration, stack gas flow rate, fuel flow rate, high heating value, and fuel content (in particular Appendix G to Part 75, Section 5)

# Verifying Emissions Data for CH<sub>4</sub> and N<sub>2</sub>O Emissions (1 of 2)

- Emissions calculated using procedures in 40 CFR 98.33(c)
- Review equations in Part 40 CFR 98.33(c)
- How to evaluate evidence: Did reporter
  - Use same values for fuel consumption as for calculating CO<sub>2</sub> 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?

# Verifying Emissions Data for CH<sub>4</sub> and N<sub>2</sub>O Emissions (2 of 2)

## 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?

# Questions and ARB Comments

## 1. Overview

## 2. Verifying combustion emissions

- CO<sub>2</sub> Emissions
  - Tiers 1-3
  - Tier 4
  - O<sub>2</sub> Monitors
  - Part 75
- N<sub>2</sub>O and CH<sub>4</sub> Emissions

## 3. Verifying sorbent emissions

## 4. Verifying biomethane and biomass CO<sub>2</sub> emissions

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# CO<sub>2</sub> Emissions from Sorbent:

## Equation and Inputs

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

- CO<sub>2</sub> = CO<sub>2</sub> emitted from sorbent for the reporting year (metric tons)
- S = Limestone or other sorbent used in the reporting year, from company records (short tons)
- R = The number of moles of CO<sub>2</sub> released upon capture of one mole of the acid gas species being removed (R = 1.00 when the sorbent is CaCO<sub>3</sub> and the targeted acid gas species is SO<sub>2</sub>)
- MW<sub>CO<sub>2</sub></sub> = Molecular weight of carbon dioxide (44)
- MW<sub>S</sub> = Molecular weight of sorbent (100 if calcium carbonate)
- 0.91 = Conversion factor from short tons to metric tons

# Verifying CO<sub>2</sub> 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 CO<sub>2</sub> released per mole of acid gas being removed
    - MWS, molecular weight of the sorbent

# 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

# 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

# Selecting the Correct Tier

## Group Participation Exercise 1.2.3

- A single-cycle peaking turbine (EGU) that burns kerosene-type jet fuel 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

# Selecting the Correct Tier

## Group Participation Exercise 1.2.3 Solution

- A single-cycle peaking turbine (EGU) that burns kerosene-type jet fuel 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

# 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
  - Confirm natural gas provider (should be IOU/POU, not third-party, contracted provider)
- Supplied natural gas values must be reported **even if the facility reports GHG emissions using data from internal meters**

# Questions and ARB Comments

1. Overview
2. Verifying combustion emissions
3. Verifying sorbent emissions
4. **Verifying biomethane and biomass CO<sub>2</sub> emissions**

# 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.
- “Biomethane” means biogas that has been processed and meets pipeline quality natural gas standards.

**(Not all biogas is biomethane.)**

# 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 fuels data?
- How to verify biomass-derived fuel combustion emissions?

# 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

# Biomass-derived Fuel Combustion Emissions: Reporters

- Reporting entities emitting  $\geq 10,000$  MT CO<sub>2</sub>e (including CO<sub>2</sub> emissions from biomass-derived fuel), AND having aggregate maximum heat input capacity of **12 MMBtu/hr** or greater, must report biomass derived-fuel combustion emissions (§ 95101(b)(4))
- Biomass-derived fuel emissions count toward the 25,000 MTCO<sub>2</sub>e verification threshold (§ 95103(f))
- Emissions must be reported by fuel type unless using steam or CEMS-based methods (§95103(j))

# Sources that Combust Biomass-derived Fuel

- SFC sources – same as for any other fuel
  - 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
  - At wastewater treatment plants and landfill gas collection systems are also a source of biogas, often combusted on-site
- Some use in oil production, refining, and other sectors, but these are fairly unique

# 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)(247))

# 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

# 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

# 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

# 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 § 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 have a compliance obligation pursuant to Cap-and-Trade Regulation (§)

# Biomass-derived Fuel Use Accuracy

## § 95103(k)

- Fuel use accuracy is not required if fuel is exempt and CH<sub>4</sub> and N<sub>2</sub>O are reported as *de minimis*
- Fuel use accuracy is required for biomass-derived fuels when
  - CO<sub>2</sub> emissions trigger compliance obligation because fuel is classified as **non-exempt** biomass-derived
  - CH<sub>4</sub> and N<sub>2</sub>O emissions are not classified as *de minimis*
- Emissions can be calculated using any tier

# 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 CO<sub>2</sub> 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 CO<sub>2</sub> emissions
- Does not apply to the combustion of MSW

## 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

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

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

# Verifying Biomass GHG Emissions (3 of 4)

Evidence to request and evaluate when CEMS are used

- Fossil fuel consumption and HHV must conform to Tier 2 data verification and missing data requirements
- Hourly average CO<sub>2</sub> 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 40 CFR 98.33(e)(1)(iii))

# 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 CO<sub>2</sub> emissions from tires)
  - Follow verification procedures for the applicable tier for the fuel as described for determining CO<sub>2</sub> 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)?

# Verifying Exempt Classification for Biogenic CO<sub>2</sub> Emissions

- Evidence to request
  - Annual and hourly heat input records
  - Purchase records, invoices, scheduling, etc.  
( § 95131(i)(1)(B)(2))
  - Biomass specific requirements( § 95131(i)(2))
- Evaluating evidence – 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

# 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)

# 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 (Per §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

# 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 (Per §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

# 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 § 95852.1.1
  - Invoices for purchase
  - Shipping reports
  - Allocation, balancing, and nomination reports
- Document your approach in a sampling plan

# Sample Calculations of CO<sub>2</sub> Emissions

## Group Participation Exercise 1.2.4

- Scenario
  - Fuel: Municipal Solid Waste
  - Steam generation:  $3 \times 10^9$  lb 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 CO<sub>2</sub> emissions?
  - A. 435,360 MT CO<sub>2</sub>/yr
  - B. 269,923 MT CO<sub>2</sub>/yr
  - C. 165,437 MT CO<sub>2</sub>/yr

# Sample Calculations of CO<sub>2</sub> Emissions

## Group Participation Exercise 1.2.4 Solution

The correct answer is C: **165,437 MT CO<sub>2</sub>/yr fossil based emissions**

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

$$\text{CO}_2 = 1 \times 10^{-3} \times B \times \text{Steam} \times \text{EF}$$

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

Step 2: Calculate biogenic CO<sub>2</sub> 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 CO<sub>2</sub> from total CO<sub>2</sub> to determine fossil-based emissions:

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

# Questions and ARB Comments

## Course 1: General Verification

### ***Complete:***

1.1 Verification Principles, Requirements, and Procedures

1.2 Stationary Fuel Combustion and Sorbent Sources

### ***Next:***

1.3 Accuracy & Product Data

1.4 Electricity Generating Units & Cogeneration

California Environmental Protection Agency

 **Air Resources Board**