

Greenhouse Gas Reporting Program

XML Reporting Instructions: Inputs Verifier Tool (IVT) Subpart C - General Stationary Fuel Combustion

United States Environmental Protection Agency
Climate Change Division
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These instructions explain how to upload the required data for the applicable regulations. Owners and operators of units should refer to the applicable regulations for information about what data are required to be uploaded.

The EPA eliminated the reporting requirements for certain data elements used as inputs to emission equations for direct emitters.

See <https://www.epa.gov/ghgreporting/confidential-business-information-ghg-reporting>. Reporting of these data elements was previously deferred until March 31, 2015. In accordance with the rule, many of these inputs to equations must be entered into the Inputs Verification Tool (IVT). IVT performs electronic verification on the entered inputs to emission equations and uses the entered inputs to calculate the emissions. IVT does not retain the entered inputs (i.e., the inputs are not reporting requirements under Part 98). The EPA will not have access to the entered inputs either during the time of entry or any time thereafter.

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I. Introduction

The U.S. Environmental Protection Agency's (EPA's) electronic greenhouse gas reporting tool (e-GGRT) extensible markup language (XML) Reporting Schema contains all of the data elements needed to comply with the Greenhouse Gas Reporting Program (GHGRP) beginning with the reporting year (RY) 2010.

Beginning with RY 2014, e-GGRT uses two separate schemas: one schema defines requirements for reporting data elements through e-GGRT, and the other defines requirements for uploading certain equation inputs to the Inputs Verifier Tool (IVT). These instructions specifically relate to the equation inputs uploaded to IVT. IVT will perform electronic verification on the entered inputs to emission equations and use the entered inputs to calculate the emission equation results. IVT will not retain the entered inputs (i.e., the inputs are not reporting requirements under Part 98); instead, IVT will conduct certain checks at the time of data entry and generate a verification summary. The EPA will not have access to the entered inputs either during the time of entry or any time thereafter.

The XML schemas define expected data elements and attributes, allowable data formats for each data element, and the hierarchical structure and sequence in which data elements must appear in the XML file. Similar to an architectural blueprint that describes the structural design of a house, an XML schema describes the structural design of an XML file. In some cases, it also defines which elements are optional and which are required and the maximum number of occurrences allowed for each element.

II. E-GGRT IVT XML Overview

The e-GGRT IVT XML schema is made up of a root data element and complex and simple data elements. A simple element is a single piece of data. A complex element is a group of simple elements which are logically grouped together. The root data element is the base of the XML schema.

The schema's structure can be thought of as a family tree. The elements are related to each other in parent-child relationships. The root element is the parent element of the entire schema. Complex elements are children of the root element, and complex elements can also be children of other complex elements.

All IVT XML files submitted to e-GGRT must be well formed and will be accepted only if they conform to the current version of the e-GGRT IVT XML schema.

An XML upload must only contain data for a single facility. All data for a facility must be uploaded in a single complete file and must include all required inputs for all of the relevant direct emitter subparts applicable to the facility. It is not possible to upload a subset of any portion of a facility's input data to add, delete, correct or update. The entire report must be re-uploaded to make any modification at all. Each subsequent upload for the same facility replaces all of the previously uploaded data.

The e-GGRT IVT XML schema includes information about the units of measure and allowable values for the data elements. For rules regarding the unit of measure or allowable values for a specific data element, please refer to the appropriate Schema Excerpts and Data Element Definitions tables in Part III of these instructions.

The e-GGRT IVT XML schema is available for download at the e-GGRT help website: <https://www.ccdsupport.com/confluence/display/help/XML+Reporting+Instructions>. By clicking the Inputs Verifier Tool XML Schema link, you can download a zip file containing subpart-specific IVT schemas and a schema with summary content that is relevant for all IVT XML files.

Table 1
Using Numbers in IVT XML Uploads

Number Format	Description
Rounding	Non-emissions quantitative data uploaded by the user (e.g., a monthly HHV sample result, a monthly feedstock quantity, etc.) will not need to be rounded.
Percentages	If a value must be expressed as a percentage, then the number should be within the range of 0 to 100 (percent), e.g., 85.5% should be expressed as 85.5.
Fractions	If a value must be expressed as a decimal fraction, then the number should be within the range of 0 to 1, e.g., 1/4 should be expressed as 0.25. Leading zeroes are optional.

Key XML Terms

- **XML:** A markup language for documents containing structured information. The XML specification defines a standard way to add markup to documents. Its primary purpose is to facilitate the sharing of structured data across different information systems, particularly via the internet.
- **XML Schema:** An XML schema describes the structure of an XML document. The schema also defines the set of rules to which the XML document must conform in order to be considered "valid".
- **XML file:** A file containing data organized into a structured document using XML markup.
- **Data Element:** An XML data element is used for storing and classifying data in an XML file. Opening and closing tags represent the start and end of a data element. An opening tag looks like <elementName>, while a closing tag has a slash that is placed before the element's name </elementName>. The following example shows how to identify the facility's identification number: <FacilitySiteIdentifier>23222</FacilitySiteIdentifier>. The information shaded in blue represents the data element's value.

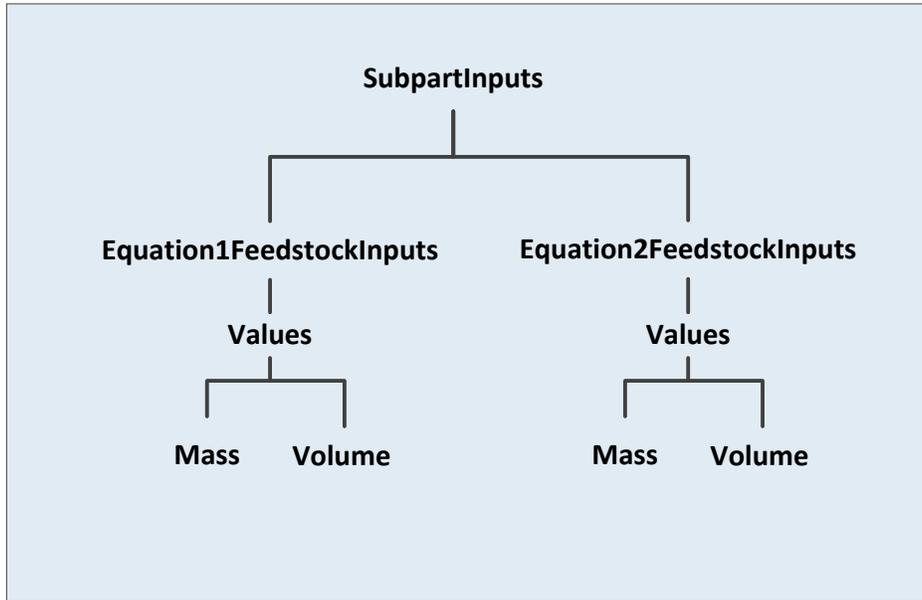
If a data element does not contain a value, then a single empty tag name may be used. An empty tag has a slash placed after the element's name <FacilitySiteIdentifier/>. **Note:** If you do not intend to upload a value for a particular data element, then it is recommended that you do not include the data element in the XML file.

- **Attribute:** An XML attribute contains additional information about a specific data element. An attribute for a data element is placed within the opening tag. The syntax for including an attribute in an element is <elementName attributeName="value">. For example, <TotalCH4CombustionEmissionsmassUOM="Metric Tons">.
- **Root/Parent/Child Element:** The schema's structure can be thought of as a family tree. At the top of the tree is some early ancestor and at the bottom of the tree are the latest children. With a tree structure you can see which children belong to which parents and many other relationships.

XML data elements are sometimes referenced in terms of how they relate to each other, e.g.,

parent-child relationships, within the schema's tree structure, also known as hierarchy. The top of the XML tree is considered the root – it is the parent to all data elements within the schema. In the example below, “Facility Identifier” is the root, and just like in many other family trees, there is more than one item with the same name (e.g., “Unit Name”). The easiest way to distinguish these items is by referencing them in terms of their parent-child relationships, e.g., Equation2FeedstockInputs/Values vs. Equation1FeedstockInputs/Values.

Figure 1
Example of an XML Tree



This document provides a step-by-step description of how to temporarily upload data into IVT using the XML schema. Please note the following:

- **Unit names, feedstock names, and product names uploaded via the IVT XML file must match the unit names, feedstock names, and product names within the corresponding e-GGRT Annual Emissions Report exactly.** In most cases, units of measure do not need to be included in the IVT XML file, because they are associated automatically in e-GGRT. Detail on units of measure are provided in the schema diagram excerpts and the data elements definition tables.
- **The Annual Report XML file must be uploaded before uploading the IVT XML file.** IVT XML data for multiple subparts may be combined in one file. Correction of inaccurate data within either the IVT XML or the Annual Report XML files will, in most cases, require reporters to re-upload both files.
- **The inputs data in the IVT XML file do not persist within e-GGRT if the user logs out, closes the browser, or if the user's session times out due to an extended period of inactivity; they must be saved on a local drive and must be re-uploaded each time the record is opened and viewed within e-GGRT.**

- **Non-applicable data elements should not be included in the facility's XML file.** The schema contains many data elements, some of which may not be applicable to XML reporters in general or to a particular situation. If a data element is not referenced in the instructions (definition tables), then **do not** include it in the facility's XML file.
- **Data elements must be ordered as defined by the schema.** The figures and tables in this document depict the specific sequence in which data elements must be arranged in the facility's IVT XML file in order to produce a well-formed XML file.
- **Enumerations are case sensitive.** Many data elements have a defined set of allowable values, also known as enumerations. Values for enumerations must be entered exactly as they are defined within the schema (including punctuation marks) in order to be accepted by schema validation. See the data definition tables for a complete list of enumerations.
- **Schema diagrams depict the hierarchy (or tree structure).** The primary purpose of the schema diagrams is to indicate the sequence in which data elements must appear within the facility's IVT XML file and to identify the data elements that are required (must be uploaded) and conditionally required (see last bullet). Required data elements are boxed in red and conditionally required data elements are noted.
- **Definition tables provide details for required and conditionally required data elements.** The tables are designed to provide unique instructions for reporting a given data element, including the list of enumerations and required units of measure, if defined.
- **Some data elements are conditionally required.** Data elements which are conditionally required are noted in the schema diagrams and the data element definitions tables. If your facility meets the condition specified for the data element, then the data element is required and you must include it in the facility's IVT XML file. If your facility does not meet the condition specified for the data element, then **do not** include the data element in the facility's IVT XML file. If a parent element is not required, then **do not** include any of its child data elements in the facility's IVT XML file.

The following sample schema diagram and data elements definition table depict the bulleted items discussed above.

Figure 2
Monthly Inputs Type Schema Diagram

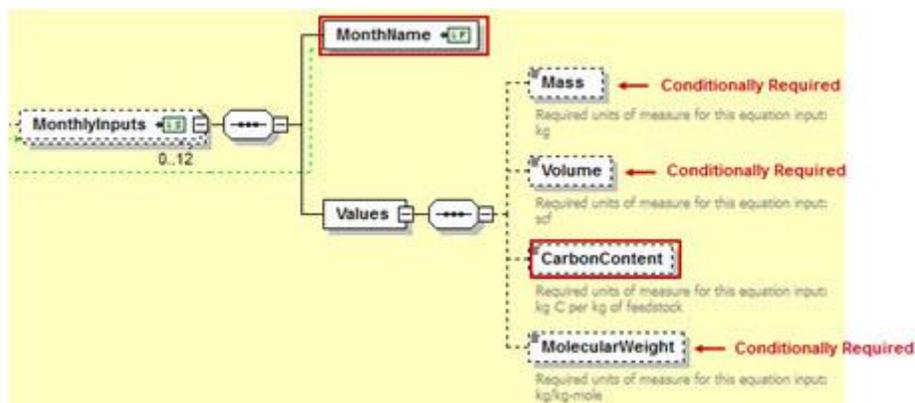


Table 2
Monthly Inputs Type Data Element Definitions

Data Element Name	Description
MonthlyInputs	Parent Element: A collection of data elements containing the monthly inputs for units using gaseous feedstock.
MonthName	An indication of the applicable month for which data are being uploaded (e.g., “January”).
Values	Parent Element: A collection of data elements containing the monthly inputs for units using gaseous feedstock.
Mass	The quantity of the gaseous fuel or feedstock consumed during the month (kg). Conditionally Required: This data element is only required if the gaseous fuel or feedstock is measured in mass units of measure.
Volume	The quantity of the gaseous fuel or feedstock consumed during the month (scf). Conditionally Required: This data element is only required if the gaseous fuel or feedstock is measured in volumetric units of measure.
CarbonContent	The average carbon content of the gaseous fuel or feedstock for the specified month (kg carbon per kg fuel or feedstock).
MolecularWeight	The average molecular weight of the gaseous fuel or feedstock for the specified month (kg per kg-mole). Conditionally Required: This data element is only required if the gaseous fuel or feedstock is measured in volumetric units of measure.

Section III provides details on the XML schema and requirements for Subpart C fuels inputs data uploaded through the IVT for stationary combustion units.

III. Summary of Changes

No substantive changes were made to the Subpart C XML reporting instructions for Reporting year 2016.

Please note that example screen images and XML examples sourced from or labelled with a prior reporting year are accurate for Reporting Year 2016.

IV. IVT Submittals for Subpart C – Fuel Combustion Units

This section provides a description of how to upload the inputs data for the Subpart C IVT using the XML schema. In accordance with 40 CFR 98.33, facilities must calculate their annual CO₂, CH₄, and N₂O emissions from each fuel in each combustion unit using the appropriate tier calculation methodology.

1.0 Facility Inputs

Prior to compiling the inputs data for each type of fuel, the general facility data should be defined. These data elements are described below in Table 4 and the XML file format is illustrated in Excerpt 1.

Table 3
Facility Input Details Data Element Definitions

Data Element Name	Description
Facility Inputs – name	Specify the registered name of the facility
Facility Inputs – id	Specify the 6-digit facility ID
Facility Inputs – Reporting Year	Specify the reporting year
Facility Inputs – Last Update Date	Specify the date associated with the most recent file update.

Excerpt 1 illustrates a portion of the XML file that can be used for the Facility Inputs data described above. See Appendix A for an example of a complete XML file that can be submitted through the IVT.

XML Excerpt 1
Facility Inputs Information Details

```
<FacilityInputs lastUpdateDate="2014-08-11" reportingYear="2014" id="544768" name="SP Industries">
  <SubpartInputs>
    <SubpartCInputs>

      --- insert XML for Subpart C Unit data per instructions that follow ---

    </SubpartCInputs>
  </SubpartInputs>
</FacilityInputs>
```

2.0 Subpart C Inputs

The inputs data for Subpart C facilities can be submitted for one or more of the tier 1 through 3 CO₂ calculation methodologies and the paired CH₄ and N₂O calculation methodology outlined in §98.33. The required inputs data are unique to each equation. Inputs must be uploaded for each relevant fuel type used in each combustion unit. Data elements showing C1C8, C1aC8, and C1bC8 are based on Equations C-1, C-1a and C-1b respectively, and pertain to units using the Tier 1 calculation methodology for CO₂ and Equation C-8 to calculate CH₄ and N₂O emissions. Data elements showing C2aC9 and C2cC9 are based on Equations C-2a and C-2c respectively, which pertain to units using the Tier 2 calculation methodology for CO₂ and either Equation C-9a or C-9b to calculate CH₄ and N₂O emissions. Data elements showing C3C8, C4C8, and C5C8 pertain to units using solid, liquid, and gaseous fuel types, respectively, and the Tier 3 calculation methodology for CO₂ and Equation C-8 to calculate CH₄ and N₂O emissions. Inputs uploaded under Tier 1, Tier 2 or Tier 3 IVT equations listed above are used to calculate CO₂, CH₄ and N₂O emissions. Equation C-10 pertains to the calculation of CH₄ and N₂O for units that calculate CO₂ emissions using either the Tier 4 methodology or the alternative part 75 methodology described in §98.33(a)(5). Equation C-10 inputs were undeferred beginning in RY2012 for units using the alternative part 75 calculation methodology and so is only part of the IVT for units using the Tier 4 calculation methodology for CO₂.

Subpart C Inputs (High-Level)

The schema is organized by Subpart C unit and then by Subpart C equation. Figure 3 below shows the high level structure of the Subpart C IVT schema and Table 5 provides detailed data element descriptions.

**Figure 3
Subpart C Inputs Type High-Level Schema Structure**

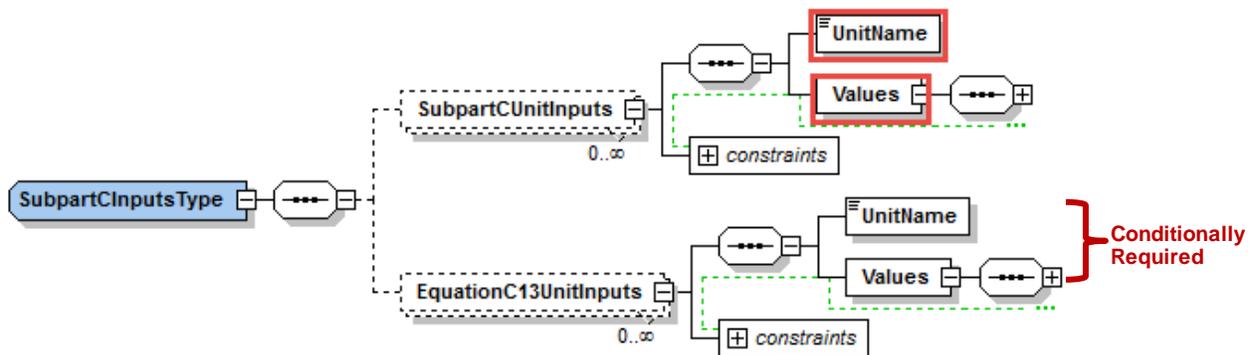


Table 4
Data Element Definitions for Subpart C Inputs Type (High Level)

Data Element Name	Description
SubpartCInputsType	Parent Element: A collection of data elements containing the inputs for Subpart C units
SubpartCUnitInputs	Parent Element: A collection of data elements containing the unit name and the emission calculation equation inputs
UnitName	The name of the unit for which inputs are being uploaded. <u>Important:</u> The unit name must match EXACTLY the unit name in the facility's annual emissions report to e-GGRT.
Values	Parent Element: A collection of data elements describing inputs for the named Subpart C unit.
EquationC13UnitInputs	Parent Element: (Conditionally Required) A collection of data elements containing the unit name and the emission calculation equation inputs
UnitName	The name of the unit for which inputs are being uploaded. <u>Important:</u> The unit name must match EXACTLY the unit name in the facility's annual emissions report to e-GGRT.
Values	Parent Element: A collection of data elements describing inputs for the named Subpart C unit.

Following from the high-level schema discussed above, the XML structure for unit input values must follow the order shown in the schema structure. The order of Subpart C equations required by the schema is displayed in Figure 4 and Table 6 provides data element descriptions.

Figure 4
Subpart C Inputs Type High-Level Schema Structure Showing Required Equation Order

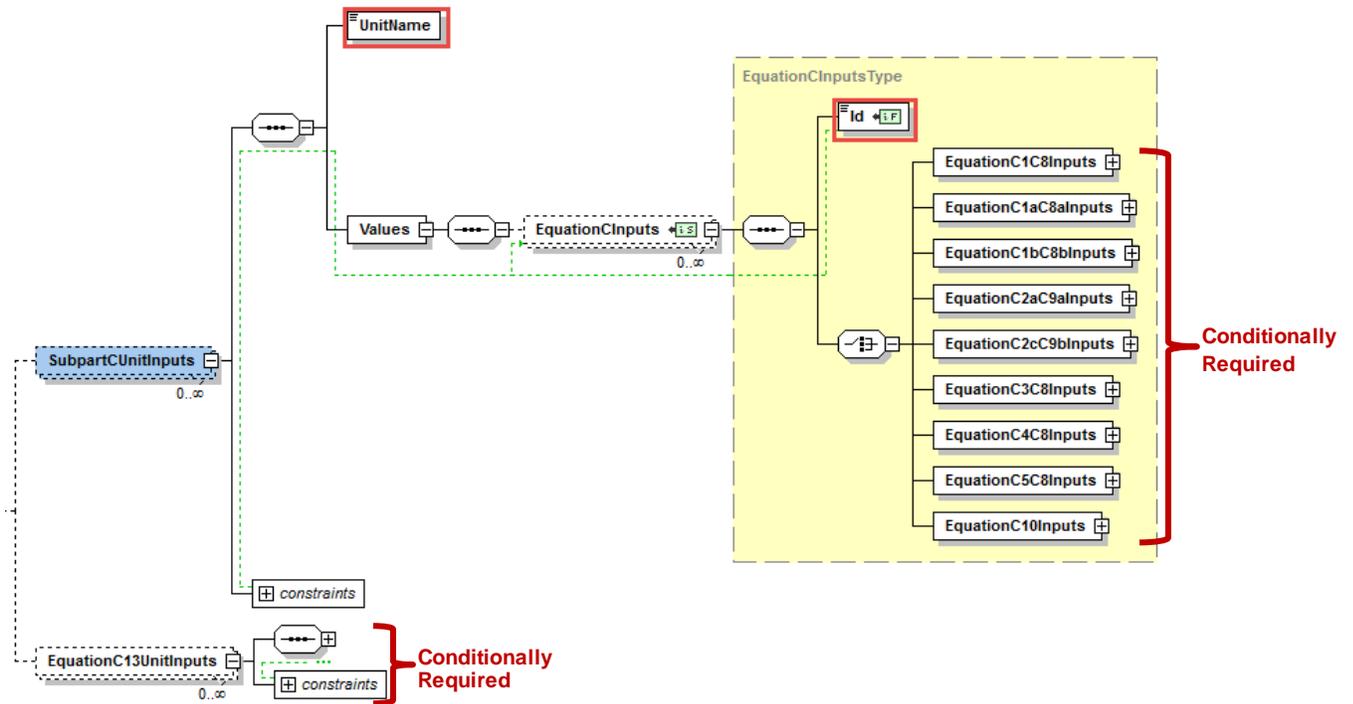


Table 5
Data Element Definitions for Subpart C Inputs Type

Data Element Name	Description
SubpartCInputsType	Parent Element: A collection of data elements containing the inputs for Subpart C units
SubpartCUnitInputs	Parent Element: A collection of data elements containing the unit name and the emission calculation equation inputs
UnitName	The name of the unit for which inputs are being uploaded. Important: The unit name must match EXACTLY the unit name in the facility’s annual emissions report to e-GGRT.
Values	Parent Element: A collection of data elements describing inputs for the UnitName.
EquationCInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.

Data Element Name	Description
Equation****Inputs	Parent Element: The collection of data elements containing fuel quantity and other inputs associated with the specific Subpart C Inputs equation. Equation inputs must be reported in the order shown in the schema. Conditionally Required: This parent data element is only required if the specific Subpart C Inputs equation is used.
EquationC13UnitInputs	Parent Element: The collection of data elements containing fuel quantity and other inputs associated with the specific Subpart C Inputs equation. Equation inputs must be reported in the order shown in the schema. Conditionally Required: This parent data element is only required if the specific Subpart C Inputs equation is used.

2.1 Inputs for Units Using Tier 1 Calculation Methodology

If a unit calculates emissions using the Tier 1 calculation methodology, inputs are quantified using Equation C-1, C-1a, or C-1b, depending on the type of fuel consumed and the units by which consumption is expressed.

2.1.1 All Fuels in Table C-1, Except Natural Gas from Billing Records where Consumption is Expressed in Therms and Million Btu (Equation C-1)

Quantify the input (i.e., fuel usage) required by Equation C-1 [§98.33(a)(1)(i)] when using the Tier 1 calculation methodology, unless natural gas billing records are used to quantify fuel usage and gas consumption is expressed in units of therms (see Section 2.1.2) or million Btu (see Section 2.1.3). The inputs will be used to calculate CO₂, CH₄ and N₂O annual emissions using equations C-1 and C-8; therefore the data element for the inputs schema is named “EquationC1C8InputsType.” Following the formula and list of variables, the corresponding XML schema is illustrated in Figure 5 and data elements are described in Table 7. If a Tier 1 unit uses multiple fuels (other than natural gas from billing records expressed in therms or million Btu), the XML must complete a full in-and-out path, beginning and ending with the EquationCInputs data element, for each fuel.

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

Where:

CO₂ = Annual CO₂ mass emissions for the specific fuel type (metric tons).

Fuel = Mass or volume of fuel combusted per year, from company records as defined in §98.6 (express mass in short tons for solid fuel, volume in standard cubic feet for gaseous fuel, and volume in gallons for liquid fuel).

HHV = Default high heat value of the fuel, from Table C-1 of this subpart (mmBtu per mass or mmBtu per volume, as applicable).

EF = Fuel-specific default CO₂ emission factor, from Table C-1 of this subpart (kg CO₂/mmBtu).

1 × 10⁻³ = Conversion factor from kilograms to metric tons.

Figure 5
Equation C1C8 Inputs Type Schema Diagram (Tier 1)

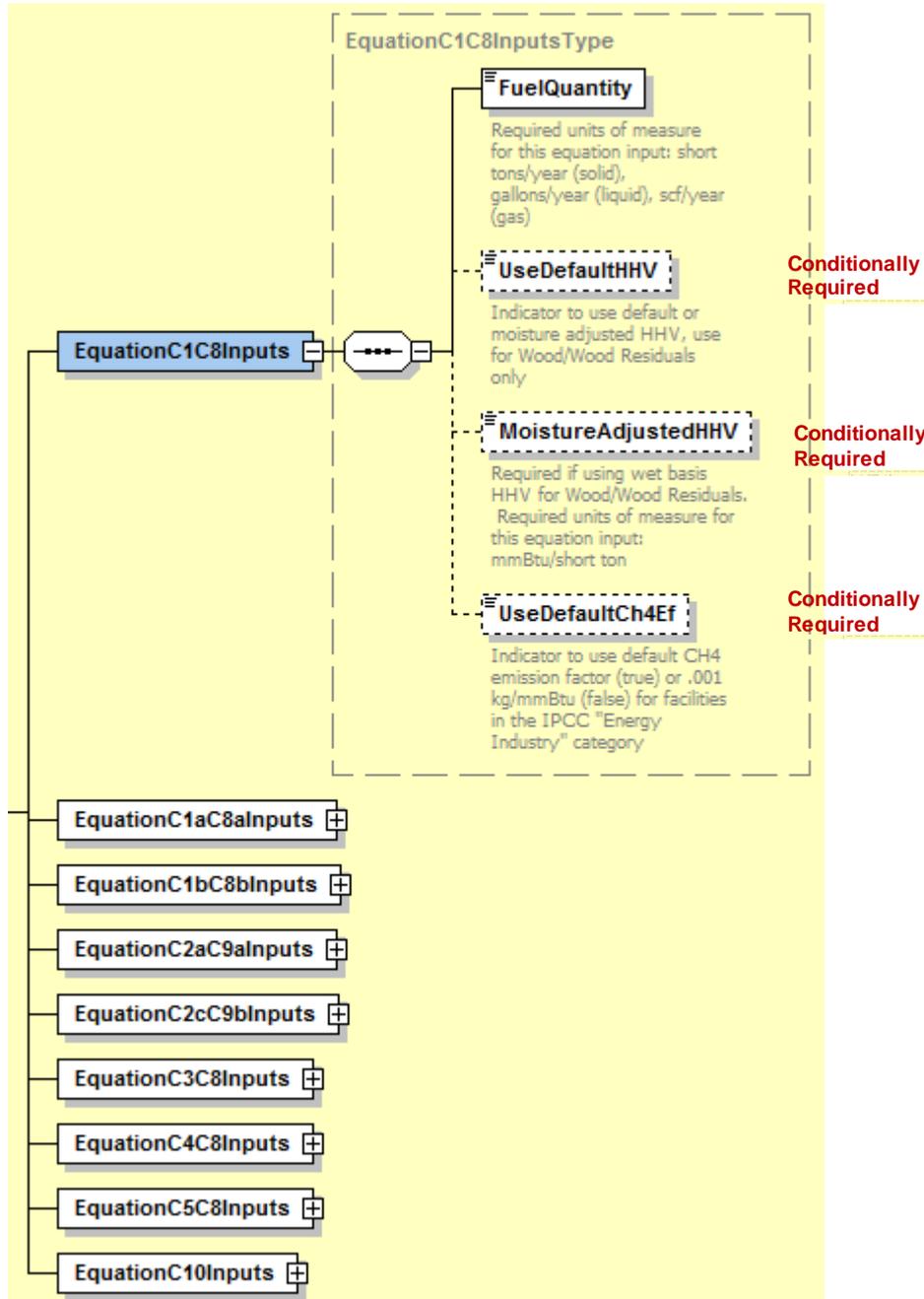


Table 6
Equation C1C8 Inputs Type Data Element Definitions

Data Element Name	Description
EquationCInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.
EquationC1C8Inputs	Parent Element: The data element containing the fuel quantity input Conditionally Required: This parent data element is required only if Equation C-1 is used.
FuelQuantity	Specify the mass or volume of fuel combusted from company records as defined in §98.6. Express mass in short tons for solid fuel, volume in standard cubic feet for gaseous fuel, and volume in gallons for liquid fuel.
UseDefaultCh4Ef	Conditionally Required: For facilities in the IPCC “Energy Industry” category, indicate “True” if using the default CH4 emission factor or “False” if using .001 kg/mmBtu.
UseDefaultHHV	Conditionally Required: For facilities that combust wood and/or wood residuals, indicate “True” if using a moisture adjusted HHV or “False” if using the default HHV from Table C-1.
MoistureAdjustedHighHeat Value	Specify the moisture adjusted HHV used in Equation C-1 in units of mmBtu/short ton. Conditionally Required: This data element is required only for facilities that combust wood and/or wood residuals and UseDefaultHHV = false.

Excerpt 2 illustrates a portion of the XML file that would be used to upload the Equation C1C8 inputs. See Appendix A for an example of a complete XML file that can be submitted through the IVT for Subpart C Inputs.

XML Excerpt 2
Equation C1C8 Information Details

```
<EquationCInputs>
  <Id>18092</Id>
  <EquationC1C8Inputs>
    <FuelQuantity>5555</FuelQuantity>
    <UseDefaultCh4Ef>True</UseDefaultCh4Ef>
  <EquationC1C8Inputs>
</EquationCInputs>
<EquationCInputs>
  <Id>18093</Id>
  <EquationC1C8Inputs>
    <FuelQuantity>3333</FuelQuantity>
    <UseDefaultCh4Ef>True</UseDefaultCh4Ef>
  <EquationC1C8Inputs>
</EquationCInputs>
<EquationCInputs>
  <Id>18094</Id>
  <EquationC1C8Inputs>
    <FuelQuantity>1111</FuelQuantity>
    <UseDefaultCh4Ef>True</UseDefaultCh4Ef>
    <UseDefaultHHV>false</UseDefaultHHV>
    <MoistureAdjustedHHV>18.5</MoistureAdjustedHHV>
  <EquationC1C8Inputs>
</EquationCInputs>
<EquationCInputs>
  <Id>18095</Id>
  <EquationC1C8Inputs>
    <FuelQuantity>3222</FuelQuantity>
    <UseDefaultCh4Ef>false</UseDefaultCh4Ef>
    <UseDefaultHHV>True</UseDefaultHHV>
  <EquationC1C8Inputs>
</EquationCInputs>
```

2.1.2 Natural Gas from Billing Records in Therms (Equation C-1a)

If natural gas consumption is obtained from billing records and fuel usage is expressed in therms, quantify the input (i.e., natural gas usage) required by Equation C-1a [§98.33(a)(1)(ii)] for units using the Tier 1 calculation methodology. The inputs will be used to calculate CO₂, CH₄ and N₂O annual emissions using equations C-1a and C-8a; therefore the data element for the inputs schema is named “EquationC1aC8aInputsType.” As indicated below, the fuel quantity must be expressed in therms. Following the formula and list of variables, the corresponding XML schema is illustrated in Figure 5 and data elements are described in Table 8.

$$CO_2 = 1 \times 10^{-3} [0.1 * Gas * EF] \quad (\text{Eq. C-1a})$$

Where:

- CO₂ = Annual CO₂ mass emissions from natural gas combustion (metric tons).
- Gas = Annual natural gas usage, from billing records (therms).
- EF = Fuel-specific default CO₂ emission factor for natural gas, from Table C-1 of this subpart (kg CO₂/mmBtu).
- 0.1 = Conversion factor from therms to mmBtu
- 1 × 10⁻³ = Conversion factor from kilograms to metric tons.

**Figure 6
Equation C1aC8a Inputs Type Schema Diagram (Tier 1)**

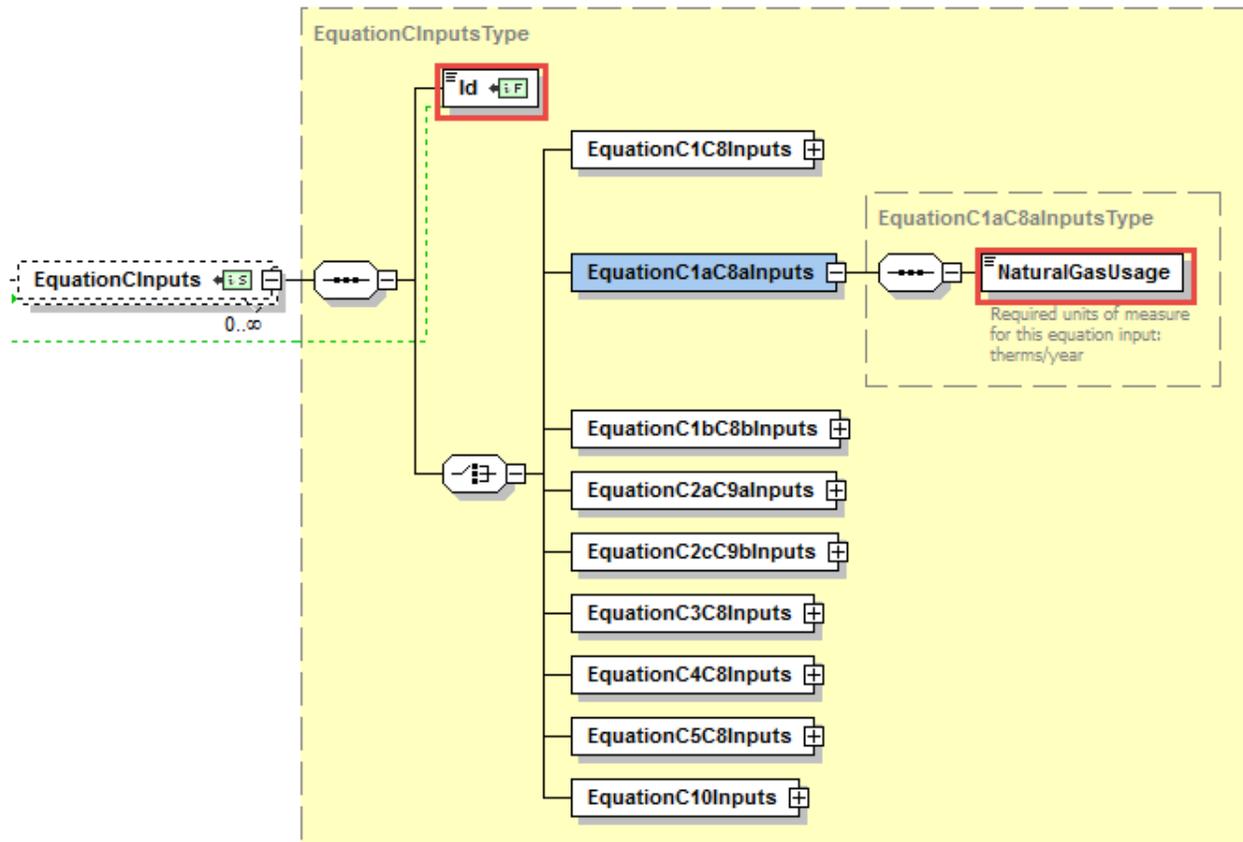


Table 7
Equation C1aC8a Inputs Type Data Element Definitions

Data Element Name	Description
EquationCInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.
EquationC1aC8aInputs	Parent Element: The data element containing the natural gas usage input Conditionally Required: This parent data element is required only if Equation C-1a is used.
NaturalGas Usage	Specify the natural gas usage from billing records in therms.

Excerpt 3 illustrates a portion of the XML file that would be used to upload the Equation C1aC8a inputs. See Appendix A for an example of a complete XML file that can be submitted through the IVT for Subpart C Inputs.

XML Excerpt 3
Equation C1aC8a Information Details

```

<EquationCInputs>
  <Id>18095</Id>
  <EquationC1aC8aInputs>
    ..... <NaturalGasUsage>2222</NaturalGasUsage>
  </EquationC1aC8aInputs>
</EquationCInputs>

```

2.1.3 Natural Gas from Billing Records in Million Btu (Equation C-1b)

If natural gas consumption is obtained from billing records and fuel usage is expressed in million Btu, quantify the input (i.e., natural gas usage) required by Equation C-1b [§98.33(a)(1)(iii)] for units using Tier 1 calculation methodology. As indicated below, the fuel quantity must be expressed in mmBtu. The inputs will be used to calculate CO₂, CH₄ and N₂O annual emissions using equations C-1b and C-8b; therefore the data element for the inputs schema is named “EquationC1bC8bInputsType.” Following the formula and list of variables, the corresponding XML schema is illustrated in Figure 7 and data elements are described in Table 9.

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

Where:

- CO₂ = Annual CO₂ mass emissions from natural gas combustion (metric tons).
- Gas = Annual natural gas usage, from billing records (mmBtu).
- EF = Fuel-specific default CO₂ emission factor for natural gas, from Table C-1 of this subpart (kg CO₂/mmBtu).
- 1 × 10⁻³ = Conversion factor from kilograms to metric tons.

**Figure 7
Equation C1bC8b Inputs Type Schema Diagram (Tier 1)**

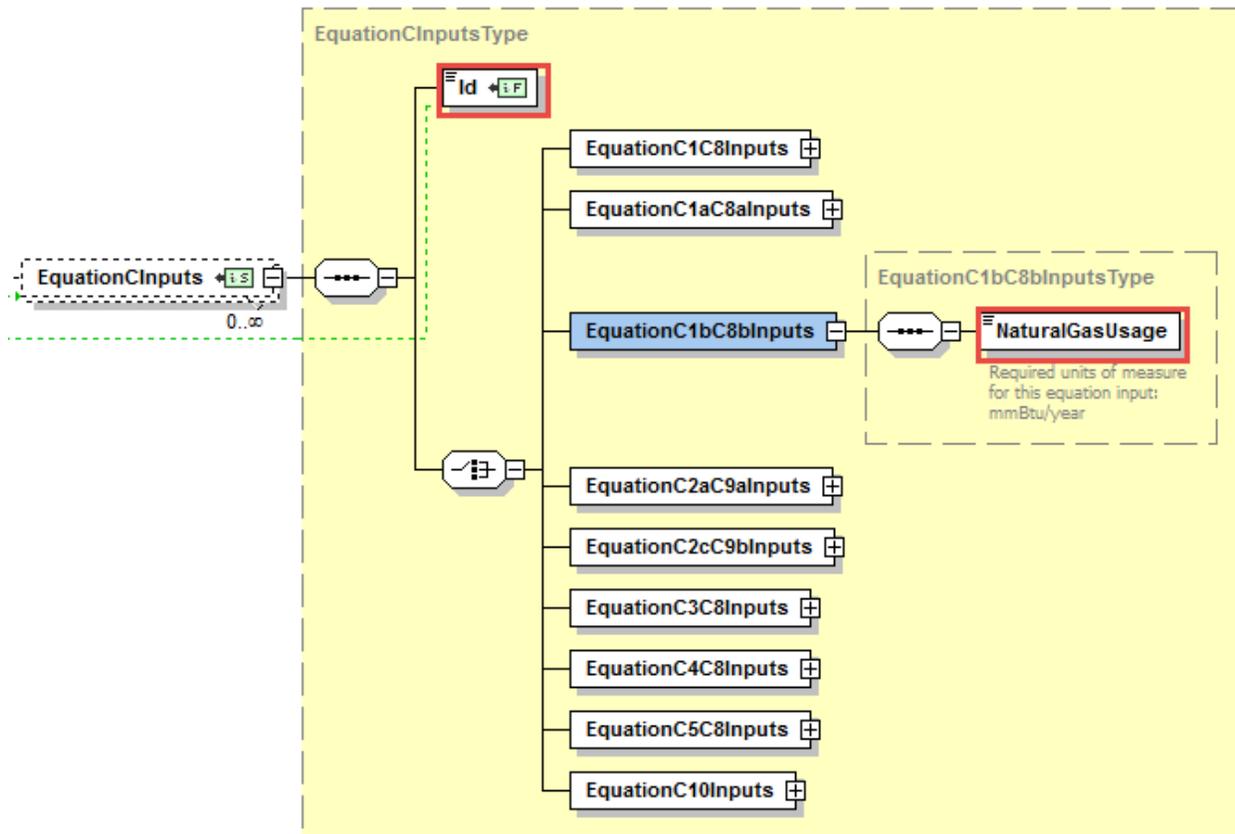


Table 8
Equation C1bC8b Inputs Type Data Element Definitions

Data Element Name	Description
EquationCInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.
EquationC1bC8bInputs	Parent Element: The data element containing the natural gas usage input Conditionally Required: This parent data element is required only if Equation C-1b is used.
NaturalGas Usage	Specify the natural gas usage from billing records in mmBtu.

Excerpt 4 illustrates a portion of the XML file that would be used to upload the Equation C1bC8b inputs. See Appendix A for an example of a complete XML file that can be submitted through the IVT for Subpart C Inputs.

XML Excerpt 4
Equation C1bC8b Information Details

```

<EquationCInputs>
  <Id>18096</Id>
  <EquationC1bC8bInputs>
    .....<NaturalGasUsage>4444</NaturalGasUsage>
  </EquationC1bC8bInputs>
</EquationCInputs>

```

2.2 Inputs for Units Using Tier 2 Calculation Methodology

If a unit calculates emissions using the Tier 2 calculation methodology, quantify the inputs required by Equation C-2a, unless the fuel is municipal solid waste (MSW) used for the production of steam. In that case, use Equation C-2c (see Section 2.2.2). Equation C-2c may also be used for any Table C-1 solid fuel combusted to produce steam.

2.2.1 All Fuels in Table C-1 Except Municipal Solid Waste used for the Production of Steam – (Equation C-2a)

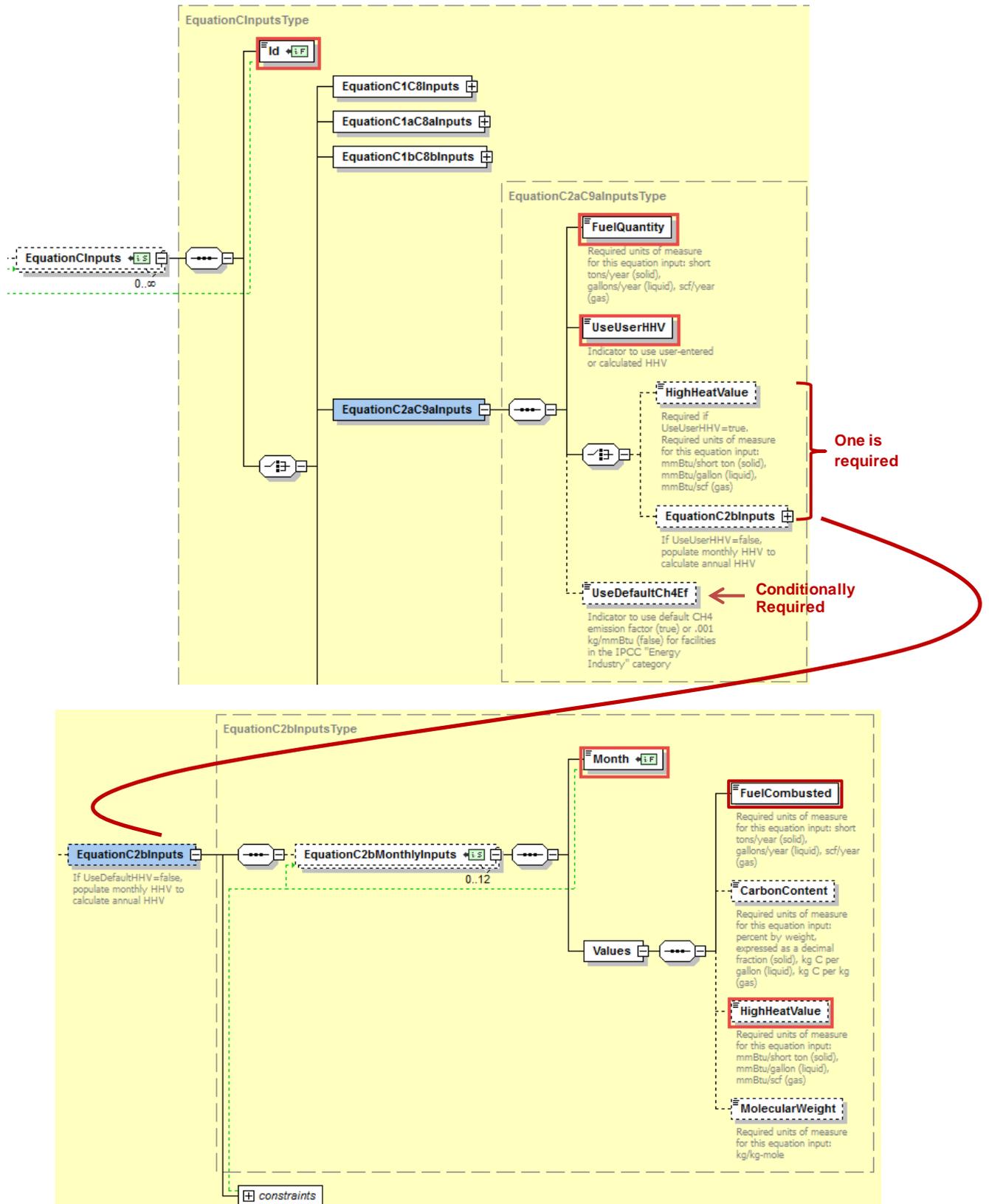
If fuel used by the unit is any fuel listed in Table C-1 of Subpart C other than MSW used for steam production, quantify the inputs required by Equation C-2a [§98.33(a)(2)]. As indicated below, the fuel usage can be provided in terms of either mass or volume. The inputs will be used to calculate CO₂, CH₄ and N₂O annual emissions using equations C-2a and C-9a; therefore the data element for the inputs schema is named “EquationC2aC9aInputsType.” Following the formula and list of variables, the corresponding XML schema are illustrated in Figure 8, and described in Table 10. If a Tier 2 unit uses multiple fuels, the XML must complete a full in-and-out path, beginning and ending with the EquationCInputs data element, for each fuel.

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

Where:

- CO₂ = Annual CO₂ mass emissions for a specific fuel type (metric tons).
- Fuel = Mass or volume of the fuel combusted during the year, from company records as defined in §98.6 (express mass in short tons for solid fuel, volume in standard cubic feet for gaseous fuel, and volume in gallons for liquid fuel).
- HHV = Annual average high heat value of the fuel (mmBtu per mass or volume). The average HHV shall be calculated according to the requirements of paragraph 98.33 (a)(2)(ii).
- EF = Fuel-specific default CO₂ emission factor, from Table C-1 of this subpart (kg CO₂/mmBtu).
- 1 × 10⁻³ = Conversion factor from kilograms to metric tons.

Figure 8
Equation C2aC9a Inputs Type Schema Diagram (Tier 2)



**Table 9
Equation C2aC9a Inputs Type Data Element Definitions**

Data Element Name	Description
EquationCInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.
EquationC2aC9aInputs	Parent Element: The collection of data elements containing the fuel quantity and high heat value inputs. Conditionally Required: This parent data element is required only if Equation C-2a is used.
Fuel Quantity	Specify the mass or volume of the fuel combusted during the year from company records as defined in §98.6. Express mass in short tons for solid fuel, volume in standard cubic feet for gaseous fuel, and volume in gallons for liquid fuel.
UseUserHHV	Indicate “False” if using Equation C-2b to calculate annual average HHV; otherwise indicate “True.”
HighHeat Value	Specify the arithmetic average HHV for all values for the year (including valid samples and substitute data values under §98.35). Required units of measure for this equation input are mmBtu/ton for solid fuel, mmBtu/gallon for liquid fuel, and mmBtu/scf for gaseous fuel. Conditionally Required: This data element is required only if UseUserHHV= True
EquationC2bInputs	Parent Element: The collection of data elements used to determine the weighted annual average high heat value of the fuel. Conditionally Required: These data elements are used if UseUserHHV= False. These data elements are required if the results of fuel sampling are received monthly or more frequently and the maximum rated heat input capacity of the unit is greater than or equal to 100 mmBtu/hour (or for a group of units containing at least one unit of that size). The user has the option to use Equation C-2b to quantify HHV regardless of sampling frequency for units with a maximum rated capacity less than 100 mmBtu/hour (or a group of such units).
EquationC2bMonthlyInputs	Parent Element: The collection of monthly data elements used to determine the annual average high heat value of the fuel.
Month	Specify the applicable month for which data are being uploaded (e.g., “January”).
Values	Parent Element: The collection of data elements describing fuel combusted and HHV for the specified month.
Fuel Combusted	Specify the mass or volume of the fuel combusted during the month from company records (using short tons for solid fuel, gallons for liquid fuel, and standard cubic feet for gaseous fuel)
CarbonContent	Not Required: Specify the carbon content of the fuel in percent by weight, expressed as a decimal fraction (solid), kg C per gallon (liquid) or kg C per kg (gas).

Data Element Name	Description
HighHeatValue	Specify the measured high heat value of the fuel for the month, which may be the arithmetic average of multiple determinations, or, if applicable, an appropriate substitute data value. (mmBtu/short ton if solid, mmBtu/gallon if liquid, mmBtu/scf if gas).
MolecularWeight	Not Required: Specify the molecular weight in kg/kg-mole.
UseDefaultCh4Ef	Conditionally Required: For facilities in the IPCC “Energy Industry” category, indicate “True” if using the default CH4 emission factor or “False” if using .001 kg/mmBtu.

Excerpts 5 and 6 illustrate portions of the XML file that can be used to upload Equation C2aC9a inputs with user-supplied HHV and annual average HHV, respectively. The XML excerpt for calculated annual average shows data for months January and February only; the pattern shown would be repeated for the remaining months. See Appendix A for an example of a complete XML file that can be submitted through the IVT for Subpart C Inputs.

XML Excerpt 5 Equation C2aC9a with User Entered HHV Information Details

```

<EquationInputs>
  <Id>18097</Id>
  <EquationC2aC9aInputs>
    <FuelQuantity>6666</FuelQuantity>
    <UseUserHHV>true</UseUserHHV>
    <HighHeatValue>45</HighHeatValue>
  </EquationC2aC9aInputs>
</EquationInputs>

```

XML Excerpt 6
Equation C2aC9a with Calculated Annual Average HHV Information Details

```

<EquationCInputs>
  <Id>18098</Id>
  <EquationC2aC9aInputs>
    <FuelQuantity>7777</FuelQuantity>
    <UseUserHHV>>false</UseUserHHV>
    <HighHeatValue>3</HighHeatValue>
  <EquationC2bInputs>
    <EquationC2bMonthlyInputs>
      <Month>January</Month>
      <Values>
        <FuelCombusted>2</FuelCombusted>
        <HighHeatValue>3</HighHeatValue>
      </Values>
    </EquationC2bMonthlyInputs>
    <EquationC2bMonthlyInputs>
      <Month>February</Month>
      <Values>
        <FuelCombusted>2</FuelCombusted>
        <HighHeatValue>3</HighHeatValue>
      </Values>
    </EquationC2bMonthlyInputs>
  </EquationC2bInputs>
</EquationCInputs>
  
```

2.2.2 Municipal Solid Waste or Solid Fuel Combustion to Produce Steam – (Equation C-2c)

For MSW used to generate steam, Equation C-2c will be used to calculate CO₂ emissions [§98.33(a)(2)]. It may also be used to calculate emissions when any Table C-1 solid fuel use used to produce steam. The inputs will be used to calculate CO₂, CH₄ and N₂O annual emissions using equations C-2c and C-9b; therefore the data element for the inputs schema is named “EquationC2cC9bInputsType.” Following the formula and list of variables, the corresponding XML data are illustrated in Figure 9 and described in Table 11. If a Tier 2 unit uses multiple fuels in the production of steam, the XML must complete a full in-and-out path, beginning and ending with the EquationCInputs data element, for each fuel.

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

Where:

- CO₂ = Annual CO₂ mass emissions from MSW or solid fuel combustion (metric tons).
 Steam = Total mass of steam generated by MSW or solid fuel combustion during the reporting year (lb steam).
 B = Ratio of the boiler's maximum rated heat input capacity to its design rated steam output capacity (mmBtu/lb steam).
 EF = Fuel-specific default CO₂ emission factor, from Table C-1 of this subpart (kg CO₂/mmBtu).
 1 × 10⁻³ = Conversion factor from kilograms to metric tons.

Figure 9
Equation C2c9b Inputs Type Schema Diagram (Tier 2)

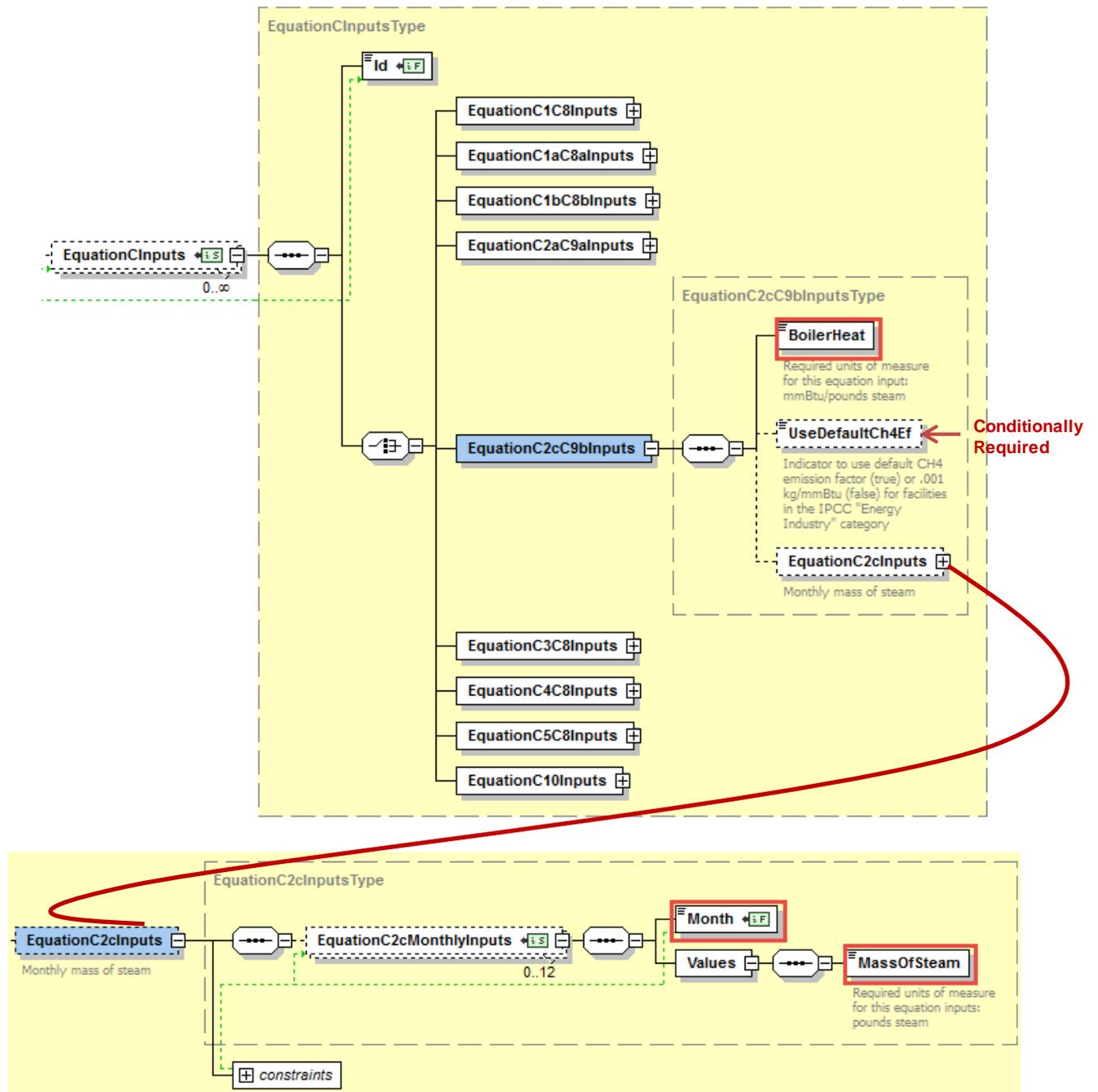


Table 10
Equation C2cC9 Inputs Type Data Element Definitions

Data Element Name	Description
EquationCInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.
EquationC2cC9bInputs	Parent Element: The collection of data elements necessary to determine inputs for MSW and other solid fuels used in steam generation. Conditionally Required: This parent data element is required only if Equation C-2c is used.
BoilerHeat	Specify the ratio of the boiler's maximum rated heat input capacity to its design rated steam output capacity (mmBtu/lb steam).
UseDefaultCh4Ef	Conditionally Required: For facilities in the IPCC "Energy Industry" category, indicate "True" if using the default CH4 emission factor or "False" if using .001 kg/mmBtu.
EquationC2cInputs	Parent Element: (Conditionally Required) If using Equation C-2c, a collection of monthly data elements to calculate mass of steam values.
EquationC2cMonthlyInputs	Parent Element: A collection of monthly data elements to calculate mass of steam values.
Month	Indicate the month for which the values will be specified.
Values	Parent Element: A collection of data elements for each month specified describing inputs for the named Subpart C unit.
MassOfSteam	Specify the total mass of steam generated by MSW or solid fuel combustion during the year (lb steam).

Excerpt 7 below illustrates a portion of the XML file that can be used to upload the Tier 2 MSW or other solid fuel inputs used to produce steam. See Appendix A for an example of a complete XML file that can be submitted through the IVT for Subpart C Inputs.

XML Excerpt 7 Equation C2cC9b Information Details

```

<EquationCInputs>
  <Id>18103</Id>
  <EquationC2cC9bInputs>
    <BoilerHeat>8</BoilerHeat>
    <UseDefaultCh4Ef>True</UseDefaultCh4Ef>
    <EquationC2cInputs>
      <EquationC2cMonthlyInputs>
        <Month>January</Month>
        <Values>
          <MassOfSteam>88</MassOfSteam>
        </Values>
      <EquationC2cMonthlyInputs>
      <EquationC2cMonthlyInputs>
        <Month>February</Month>
        <Values>
          <MassOfSteam>77</MassOfSteam>
        </Values>
      <EquationC2cMonthlyInputs>
    <EquationC2cInputs>
  </EquationC2cC9bInputs>
</EquationCInputs>

```

2.3 Inputs for Units Using Tier 3 Calculation Methodology

If a unit calculates emissions using the Tier 3 calculation methodology, use Equation C-3 for solid fuels, Equation C-4 for liquid fuels, and Equation C-5 for gaseous fuels.

2.3.1 Solid Fuel Inputs – (Equation C-3)

Equation C-3 is used to upload solid fuel inputs for units using Tier 3 calculation methodology [§98.33(a)(3)(i)]. The inputs will be used to calculate CO₂, CH₄ and N₂O annual emissions using equations C-3 and C-8; therefore the data element for the inputs schema is named “EquationC3C8InputsType.” As indicated below, the fuel usage can only be provided in terms of mass. Following the formula and list of variables, the corresponding XML data are illustrated in Figure 10 and described in Table 12. If a Tier 3 unit uses multiple solid fuels, the XML must complete a full in-and-out path, beginning and ending with the EquationCInputs data element, for each fuel.

$$\text{CO}_2 = \frac{44}{12} * \text{Fuel} * \text{CC} * 0.91 \quad (\text{Eq. C-3})$$

Where:

CO₂ = Annual CO₂ mass emissions from the combustion of the specific solid fuel (metric tons).

Fuel = Annual mass of the solid fuel combusted, from company records as defined in §98.6 (short tons).

CC = Annual average carbon content of the solid fuel (percent by weight, expressed as a decimal fraction, e.g., 95% = 0.95).
The annual average carbon content shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.

44/12 = Ratio of molecular weights, CO₂ to carbon.

0.91 = Conversion factor from short tons to metric tons.

Figure 10
Equation C3C8 Inputs Type Schema Diagram (Tier 3)

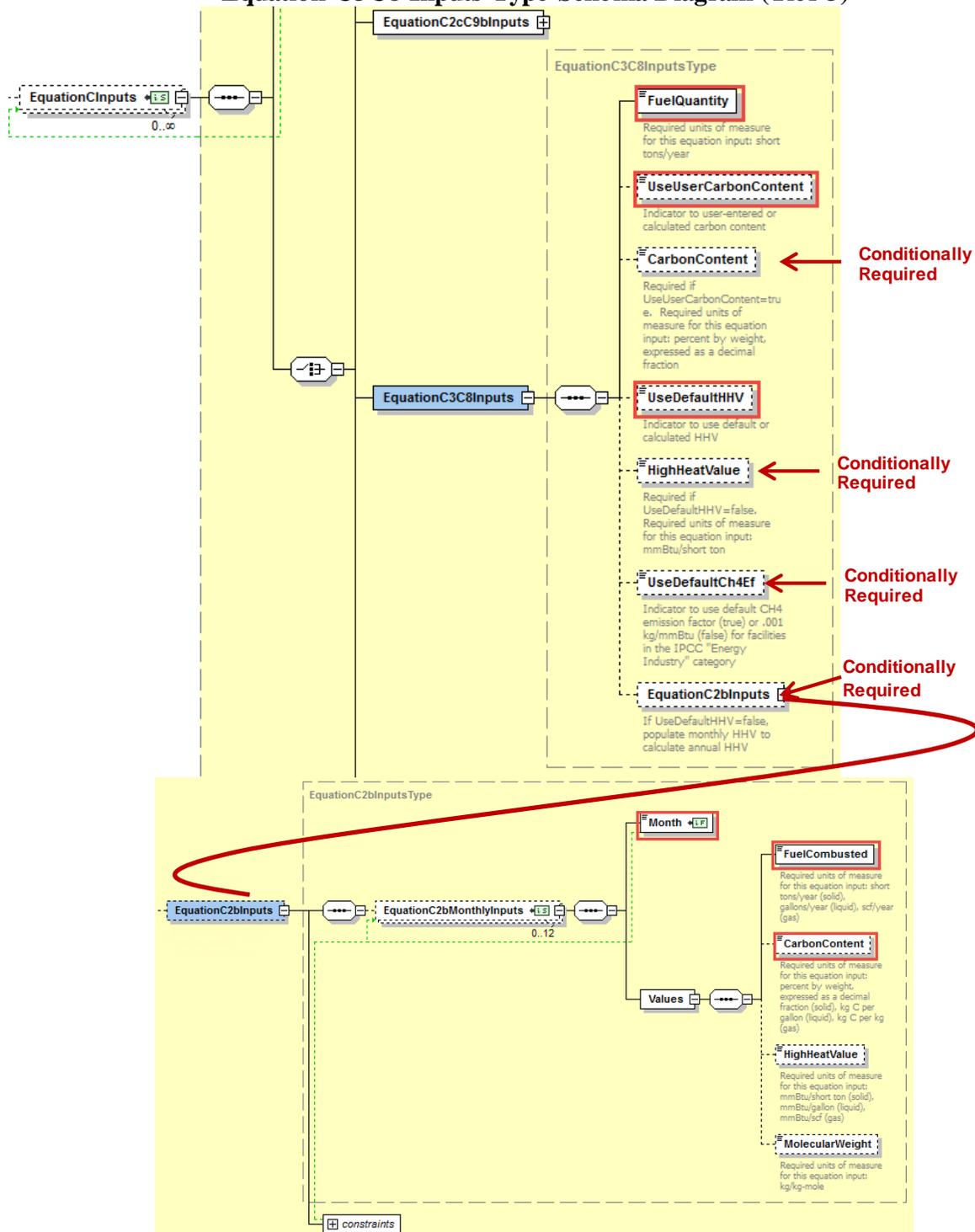


Table 11
Equation C3C8 Inputs Type Data Element Definitions

Data Element Name	Description
EquationCInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.
EquationC3C8Inputs	Parent Element: The collection of data elements necessary to determine solid fuel inputs for unit using Tier 3 calculation methodology. Conditionally Required: This parent data element is required only if Equation C-3 is used.
FuelQuantity	Specify the total mass of fuel consumed, in short tons per year.
UseUserCarbonContent	Indicate “True” if carbon content is user-entered or “False” if using Equation C-2b to calculate weighted annual average carbon content.
CarbonContent	Conditionally Required: Specify the carbon content (percent by weight, expressed as a decimal fraction) of the solid fuel consumed. Required if UseUserCarbonContent is user-entered “True”.
UseDefaultHHV	Indicate “False” if calculating annual average HHV; otherwise indicate “True.”
HighHeatValue	Conditionally Required: Required if UseDefaultHHV is false (in mmBtu per short ton).
UseDefaultCh4Ef	Conditionally Required: For facilities in the IPCC “Energy Industry” category, indicate “True” if using the default CH ₄ emission factor or “False” if using .001 kg/mmBtu.
EquationC2bInputs	Parent Element: The collection of data elements used to determine the weighted annual average carbon content of the fuel. Conditionally Required: These data elements are used if UseUserCarbonContent=False.
EquationC2bMonthlyInputs	Parent Element: The collection of monthly data elements used to determine the annual average carbon content of the fuel.
Month	Specify the applicable month for which data are being uploaded (e.g., “January”).
Values	Parent Element: The collection of data elements describing fuel combusted and carbon content for the specified month.
Fuel Combusted	Specify the mass of the fuel combusted during the month from company records (using short tons for solid fuel)
CarbonContent	Specify the carbon content of the fuel for the month in percent by weight, expressed as a decimal fraction (solid).

Data Element Name	Description
HighHeatValue	Not Required: Specify the measured high heat value of the fuel for the month (in mmBtu/short ton), which may be the arithmetic average of multiple determinations, or, if applicable, an appropriate substitute data value.
MolecularWeight	Not Required: Specify the molecular weight for the month in kg/kg-mole.

Excerpts 8 and 9 illustrates a portion of the XML file that can be used to upload Equation C3C8 inputs. The XML excerpt for calculated annual average shows data for months January and February only; the pattern shown would be repeated for the remaining months. See Appendix A for an example of a complete XML file that can be submitted through the IVT for Subpart C Inputs.

XML Excerpt 8 Equation C3C8 with Default Carbon Content Information Details

```

<EquationCInputs>
  <Id>18102</Id>
  <EquationC3C8Inputs>
    <FuelQuantity>9999</FuelQuantity>
    <UseUserCarbonContent>True</UseUserCarbonContent>
    <CarbonContent>0.33</CarbonContent>
    <UseDefaultHHV>True</UseDefaultHHV>
    <UseDefaultCh4Ef>True</UseDefaultCh4Ef>
  </EquationC3C8Inputs>
</EquationCInputs>
    
```

XML Excerpt 9 Equation C3C8 with Calculated Annual Average Carbon Content Information Details

```

<EquationCInputs>
  <Id>18102</Id>
  <EquationC3C8Inputs>
    <FuelQuantity>9999</FuelQuantity>
    <UseUserCarbonContent>False</UseUserCarbonContent>
    <UseDefaultHHV>True</UseDefaultHHV>
    <UseDefaultCh4Ef>True</UseDefaultCh4Ef>
    <EquationC2cInputs>
      <EquationC2bMonthlyInputs>
        <Month>January</Month>
        <Values>
          <FuelCombusted>100</FuelCombusted>
          <CarbonContent>0.33</CarbonContent>
        </Values>
      <EquationC2bMonthlyInputs>
      <EquationC2bMonthlyInputs>
        <Month>February</Month>
        <Values>
          <FuelCombusted>150</FuelCombusted>
          <CarbonContent>0.35</CarbonContent>
        </Values>
      <EquationC2bMonthlyInputs>
    </EquationC2cInputs>
  </EquationC3C8Inputs>
</EquationCInputs>
    
```

2.3.2 Liquid Fuel Inputs – (Equation C-4)

For liquid fuel types, Equation C-4 will be used to calculate CO₂ emissions [§98.33(a)(3)(ii)]. The inputs will be used to calculate CO₂, CH₄ and N₂O annual emissions using equations C-4 and C-8; therefore the data element for the inputs schema is named “EquationC4C8InputsType.” As indicated below, the fuel usage can only be provided in terms of volume. Following the formula and list of variables, the corresponding XML data are illustrated in Figure 11 and described in Table 13. If a Tier 3 unit uses multiple liquid fuels, the XML must complete a full in-and-out path, beginning and ending with the EquationCInputs data element, for each fuel.

$$\text{CO}_2 = \frac{44}{12} * \text{Fuel} * \text{CC} * 0.001 \quad (\text{Eq. C-4})$$

Where:

CO₂ = Annual CO₂ mass emissions from the combustion of the specific liquid fuel (metric tons).

Fuel = Annual volume of the liquid fuel combusted (gallons). The volume of fuel combusted must be measured directly, using fuel flow meters calibrated according to §98.3(i). Fuel billing meters may be used for this purpose. Tank drop measurements may also be used.

CC = Annual average carbon content of the liquid fuel (kg C per gallon of fuel). The annual average carbon content shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.

44/12 = Ratio of molecular weights, CO₂ to carbon.

0.001 = Conversion factor from kg to metric tons.

Figure 11
Equation C4C8 Inputs Type Schema Diagram (Tier 3)

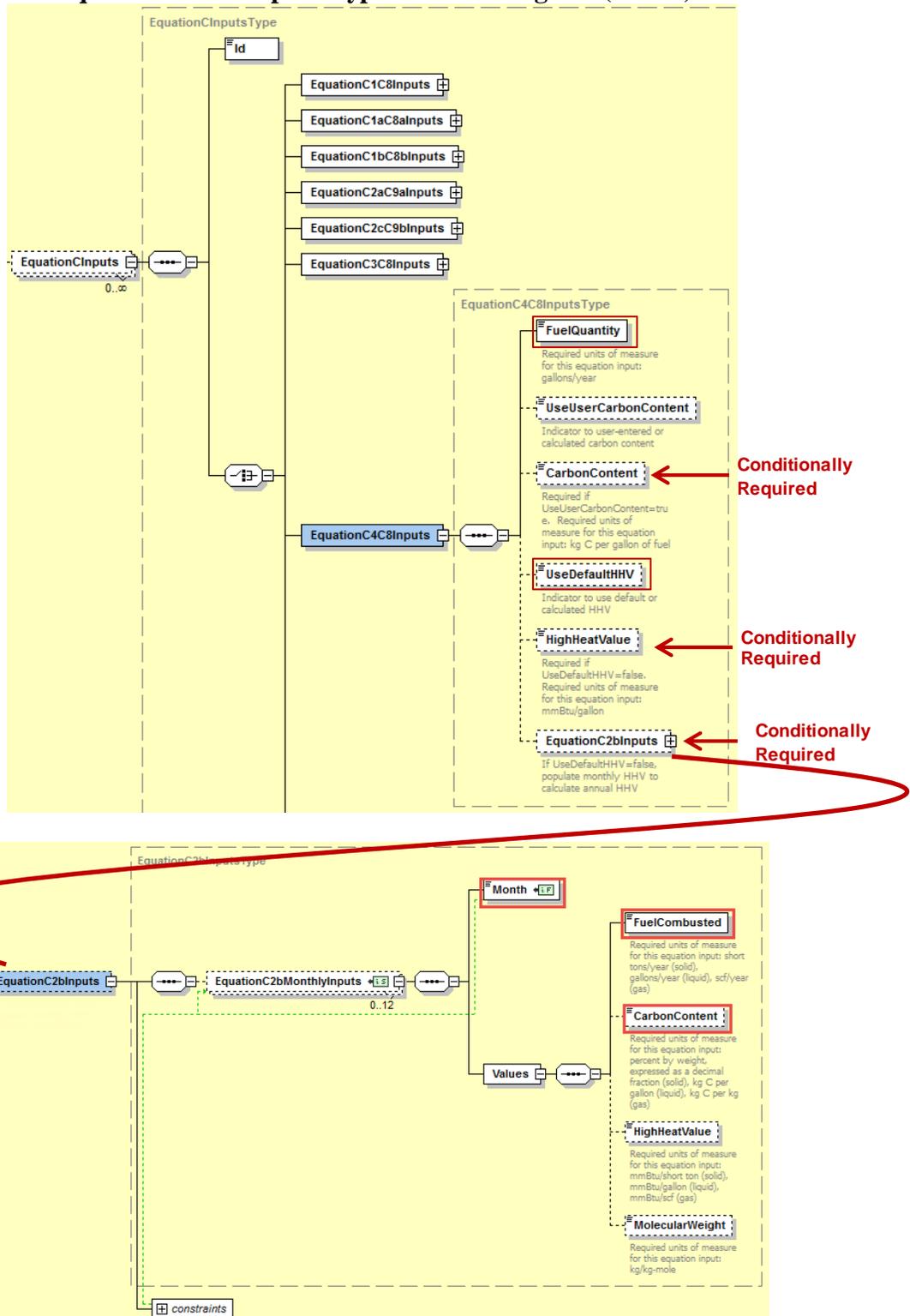


Table 12
Equation C4C8 Inputs Type Data Element Definitions

Data Element Name	Description
EquationCInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.
EquationC4C8Inputs	Parent Element: The collection of data elements necessary to determine liquid fuel inputs for unit using Tier 3 calculation methodology. Conditionally Required: This parent data element is required only if Equation C-4 is used.
FuelQuantity	Specify the total volume of fuel consumed, in gallons per year.
UseUserCarbonContent	Indicate “True” if using user-entered carbon content or “False” if using Equation C-2b to calculate weighted average carbon content.
CarbonContent	Specify the carbon content expressed in kg C per gallon of liquid fuel. Conditionally Required: Used if “UseUserCarbonContent” is “True.”
UseDefaultHHV	Indicate “False” if calculating annual average HHV; otherwise indicate “True.”
HighHeat Value	Conditionally Required: When using their own HHV (if UseDefaultHHV=False), reporters must provide the weighted average HighHeat Value based on Eq C-2b.
EquationC2bInputs	Parent Element: The collection of data elements used to determine the weighted annual average carbon content of the fuel. Conditionally Required: These data elements are used if UseDefaultCarbonContent=False.
EquationC2bMonthlyInputs	Parent Element: The collection of monthly data elements used to determine the annual average carbon content of the liquid fuel.
Month	Specify the applicable month for which data are being uploaded (e.g., “January”).
Values	Parent Element: The collection of data elements describing fuel combusted and carbon content for the specified month.
Fuel Combusted	Specify the volume of the fuel combusted during the month from company records (using gallons for liquid fuel.)
CarbonContent	Specify the carbon content of the fuel for the month in percent by weight, expressed in kg C per gallon for the liquid fuel.
HighHeatValue	Not Required: Specify the measured high heat value of the fuel for the month, which may be the arithmetic average of multiple determinations, or, if applicable, an appropriate substitute data value.
MolecularWeight	Not Required: Specify the molecular weight for the month in kg/kg-mole.

Excerpts 10 and 11 illustrate a portion of the XML file that can be used to upload Equation C4C8 inputs. The XML excerpt for calculated annual average shows data for months January and February only; the pattern shown would be repeated for the remaining months. See Appendix A for an example of a complete XML file that can be submitted through the IVT for Subpart C Inputs.

XML Excerpt 10
Equation C4C8 with Default Carbon Content Information Details

```

<EquationCInputs>
  <Id>18102</Id>
  <EquationC4C8Inputs>
    <FuelQuantity>9999</FuelQuantity>
    <UseUserCarbonContent>True</UseUserCarbonContent>
    <CarbonContent>0.33</CarbonContent>
    <UseDefaultHHV>True</UseDefaultHHV>
  </EquationC4C8Inputs>
</EquationCInputs>
    
```

XML Excerpt 11
Equation C4C8 with Calculated Annual Average Carbon Content Information Details

```

<EquationCInputs>
  <Id>18102</Id>
  <EquationC3C8Inputs>
    <FuelQuantity>9999</FuelQuantity>
    <UseUserCarbonContent>False</UseUserCarbonContent>
    <UseDefaultHHV>True</UseDefaultHHV>
    <HighHeatValue>898</HighHeatValue>
    <EquationC2cInputs>
      <EquationC2bMonthlyInputs>
        <Month>January</Month>
        <Values>
          <FuelCombusted>50</FuelCombusted>
          <CarbonContent>0.33</CarbonContent>
        </Values>
      <EquationC2bMonthlyInputs>
      <EquationC2bMonthlyInputs>
        <Month>February</Month>
        <Values>
          <FuelCombusted>40</FuelCombusted>
          <CarbonContent>0.35</CarbonContent>
        </Values>
      <EquationC2bMonthlyInputs>
    </EquationC2bInputs>
  </EquationC3C8Inputs>
</EquationCInputs>
    
```

2.3.3 Gaseous Fuel Inputs – (Equation C-5)

For gaseous fuel types, Equation C-5 will be used to calculate CO₂ emissions [§98.33(a)(3)(iii)]. The inputs will be used to calculate CO₂, CH₄ and N₂O annual emissions using equations C-5 and C-8; therefore the data element for the inputs schema is named “EquationC5C8InputsType.” As indicated below, the fuel usage can only be provided in terms of volume. Following the formula and list of variables, the corresponding XML data are illustrated in Figure 12 and described in Table 14. If a Tier 3 unit uses multiple gaseous fuels, the XML must complete a full in-and-out path, beginning and ending with the EquationCInputs data element, for each fuel.

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

Where:

CO₂ = Annual CO₂ mass emissions from combustion of the specific gaseous fuel (metric tons).

Fuel = Annual volume of the gaseous fuel combusted (scf). The volume of fuel combusted must be measured directly, using fuel flow meters calibrated according to §98.3(i). Fuel billing meters may be used for this purpose.

CC = Annual average carbon content of the gaseous fuel (kg C per kg of fuel). The annual average carbon content shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.

MW = Annual average molecular weight of the gaseous fuel (kg/kg-mole). The annual average molecular weight shall be determined using the same procedures as specified for HHV in paragraph (a)(2)(ii) of this section.

MVC = Molar volume conversion factor at standard conditions, as defined in §98.6. Use 849.5 scf per kg mole if you select 68 °F as standard temperature and 836.6 scf per kg mole if you select 60 °F as standard temperature.

44/12 = Ratio of molecular weights, CO₂ to carbon.

0.001 = Conversion factor from kg to metric tons.

Figure 12
Equation C5C8 Inputs Type Schema Diagram (Tier 3)

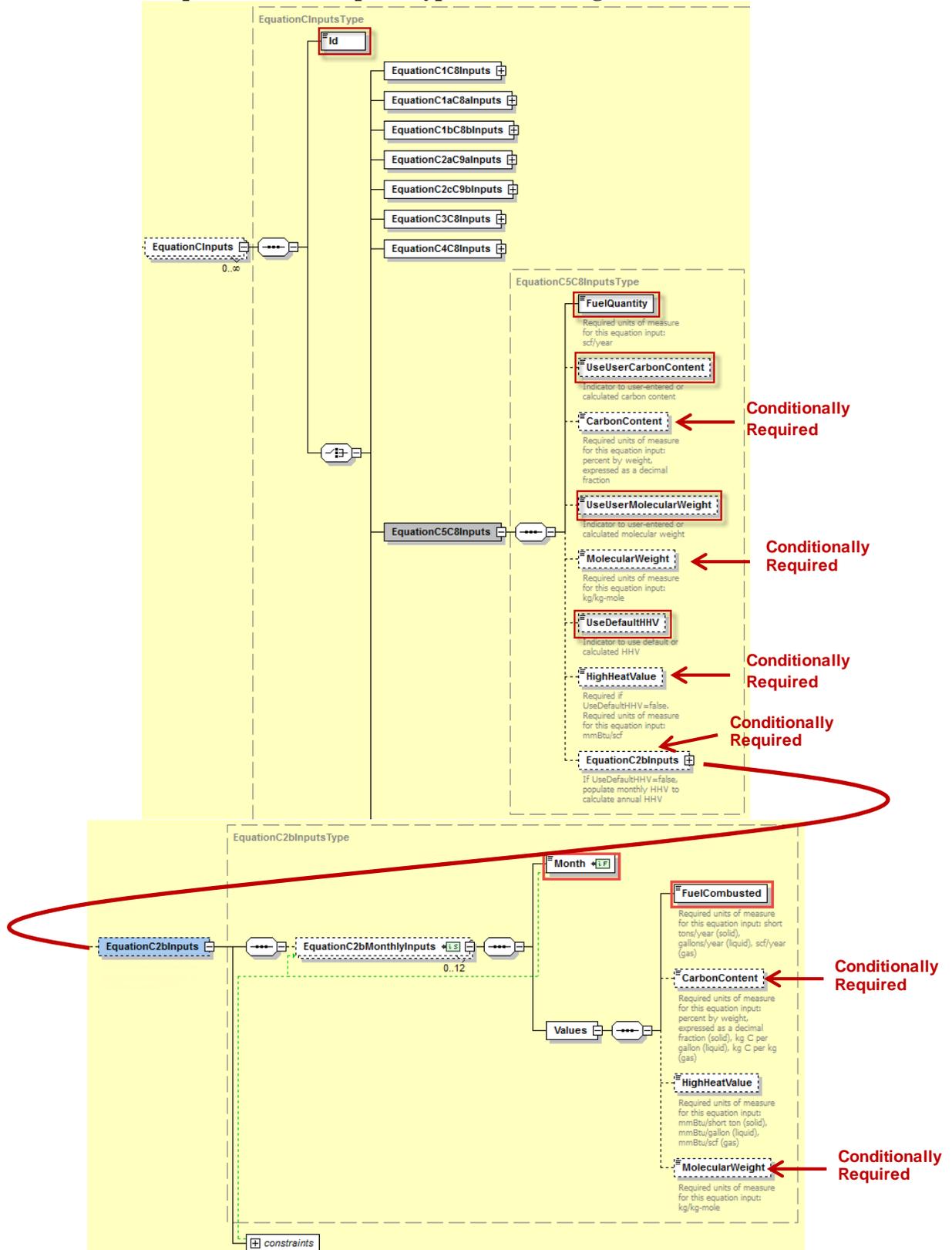


Table 13
Equation C5C8 Inputs Type Data Element Definitions

Data Element Name	Description
EquationCInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.
EquationC5C8Inputs	Parent Element: The collection of data elements necessary to determine gaseous fuel inputs for unit using Tier 3 calculation methodology. Conditionally Required: This parent data element is required only if Equation C-5 is used.
FuelQuantity	Specify the total volume of fuel consumed, in standard cubic feet per year.
UseUserCarbonContent	Indicate “True” if using user-entered carbon content or “False” if using Equation C-2b to calculate weighted annual average carbon content.
CarbonContent	Specify the carbon content of the gaseous fuel in kg C per kg of gaseous fuel Conditionally Required: Used if “UseUserCarbonContent” is “True.”
UseUserMolecularWeight	Indicate “True” if using user-entered molecular weight or “False” if using Equation C-2b to calculate weighted annual average molecular weight.
MolecularWeight	Specify the molecular weight for the fuel consumed, in kg/kg-mole. Conditionally Required: Used if “UseUserMolecularWeight” is “True.”
UseDefaultHHV	Indicate “False” if calculating annual average HHV; otherwise indicate “True.”
HighHeatValue	Conditionally Required: When using their own HHV (if UseDefaultHHV=False), reporters must provide the weighted average HighHeatValue based on Eq C-2b.
EquationC2bInputs	Parent Element: The collection of data elements used to determine the weighted annual average carbon content and/or molecular weight of the gaseous fuel. Conditionally Required: These data elements are used if UseDefaultCarbonContent=False and/or if UseUserMolecularWeight=False.
EquationC2bMonthlyInputs	Parent Element: The collection of monthly data elements used to determine the annual average carbon content and/or molecular weight of the fuel.
Month	Specify the applicable month for which data are being uploaded (e.g., “January”).
Values	Parent Element: The collection of data elements describing fuel combusted and carbon content and/or molecular weight for the specified month.

Data Element Name	Description
Fuel Combusted	Specify the volume of the fuel combusted during the month from company records (using short tons for solid fuel, gallons for liquid fuel, and standard cubic feet for gaseous fuel)
CarbonContent	Conditionally Required: If “UseUserCarbonContent” is “False, specify the carbon content of the fuel in kg C per kg for the gaseous fuel for each month.
HighHeatValue	Not Required: Specify the measured high heat value of the fuel for the month, which may be the arithmetic average of multiple determinations, or, if applicable, an appropriate substitute data value.
MolecularWeight	Conditionally Required: If “UseUserMolecularWeight” is “False”, specify the molecular weight for the month in kg/kg-mole for each month.

Excerpts 12 and 13 illustrate a portion of the XML file that can be used to upload Equation C-5 inputs. See Appendix A for an example of a complete XML file that can be submitted through the IVT for Subpart C Inputs.

XML Excerpt 12

Equation C5C8 with Default Carbon Content and Molecular Weight Information Details

```

<EquationCInputs>
  <Id>18102</Id>
  <EquationC5C8Inputs>
    <FuelQuantity>9999</FuelQuantity>
    <UseUserCarbonContent>True</UseUserCarbonContent>
    <CarbonContent>0.33</CarbonContent>
    <UseUserMolecularWeight>True</UseUserMolecularWeight>
    <MolecularWeight>22</MolecularWeight>
    <UseDefaultHHV>True</UseDefaultHHV>
  </EquationC5C8Inputs>
</EquationCInputs>
    
```

XML Excerpt 1
Equation C5C8 with Calculated Annual Average Carbon Content and Molecular Weight
Information Details

```

<EquationCInputs>
  <Id>18102</Id>
  <EquationC3C8Inputs>
    <FuelQuantity>9999</FuelQuantity>
    <UseUserCarbonContent>False</UseUserCarbonContent>
    <UseUserMolecularWeight>False</UseUserMolecularWeight>
    <UseDefaultHHV>True</UseDefaultHHV>
    <HighHeatValue>898</HighHeatValue>
    <EquationC2cInputs>
      <EquationC2bMonthlyInputs>
        <Month>January</Month>
        <Values>
          <FuelCombusted>1</FuelCombusted>
          <CarbonContent>0.33</CarbonContent>
          <MolecularWeight>2</MolecularWeight>
        </Values>
      <EquationC2bMonthlyInputs>
        <EquationC2bMonthlyInputs>
          <Month>February</Month>
          <Values>
            <FuelCombusted>2</FuelCombusted>
            <CarbonContent>0.35</CarbonContent>
            <MolecularWeight>2</MolecularWeight>
          </Values>
        <EquationC2bMonthlyInputs>
      </EquationC2bInputs>
    </EquationC2cInputs>
  </EquationC3C8Inputs>
</EquationCInputs>

```

2.4 Tier 4 Methodology Fuel Inputs for CH₄ and N₂O (Equation C-10)

If a unit uses the Tier 4 calculation methodology to quantify CO₂ mass emissions, quantify the input (i.e., cumulative annual heat input) required by Equation C-10 to calculate CH₄ and N₂O emissions [§98.33(c)(4)]. Following the formula and list of variables, the corresponding XML data are illustrated in Figure 13 and described in Table 15.

$$\text{CH}_4 \text{ or N}_2\text{O} = 0.001 * (\text{HI})_A * \text{EF} \quad (\text{Eq. C-10})$$

Where:

CH₄ or N₂O = Annual CH₄ or N₂O emissions from the combustion of a particular type of fuel (metric tons).

(HI)_A = Cumulative annual heat input from combustion of the fuel (mmBtu).

EF = Fuel-specific emission factor for CH₄ or N₂O, from Table C-2 of this section (kg CH₄ or N₂O per mmBtu).

.001 = Conversion factor from kg to metric tons.

Figure 13
Equation C-10 Inputs Type Schema Diagram

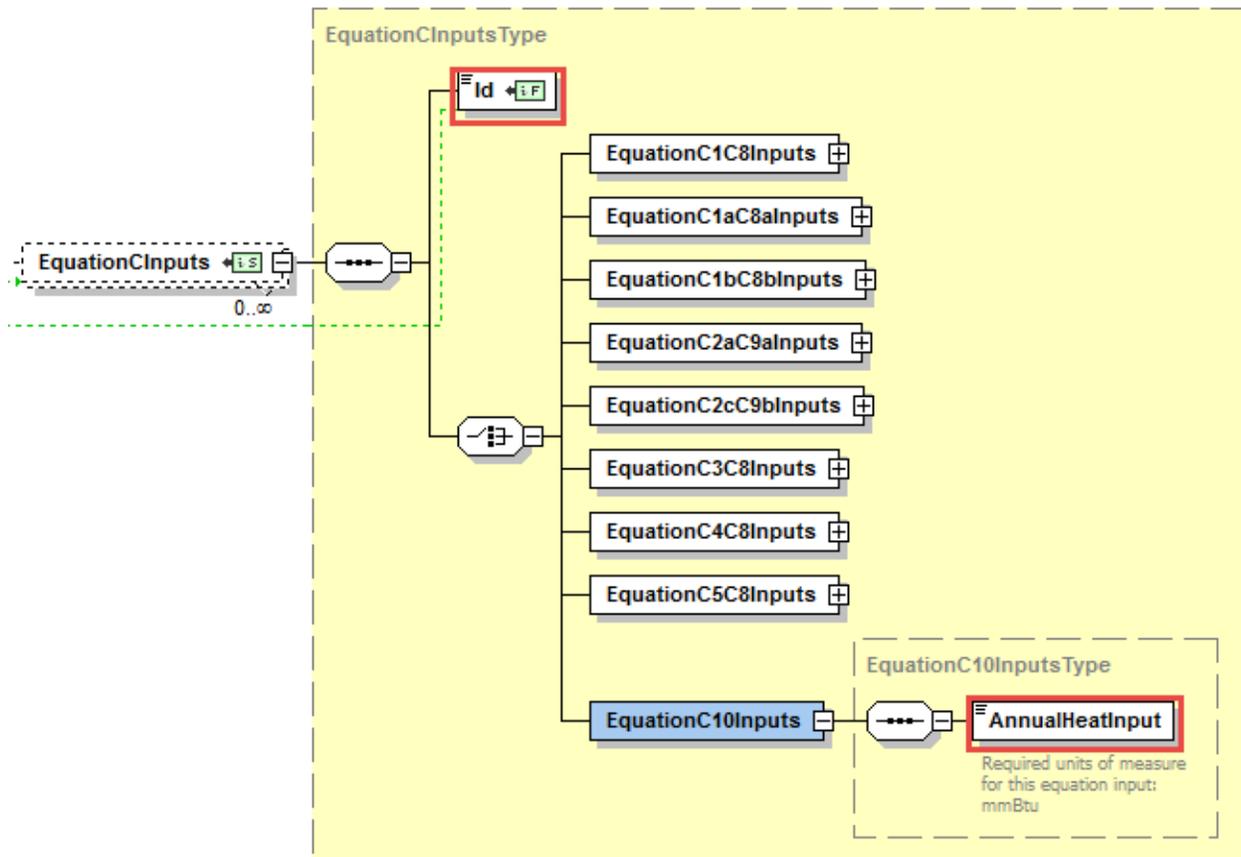


Table 14
Equation C-10 Inputs Type Data Element Definitions

Data Element Name	Description
EquationCInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.
EquationC10Inputs	Parent Element: A collection of data elements containing the annual heat input for units that calculate CO ₂ emissions using the Tier 4 calculation methodology.
AnnualHeatInput	Specify the annual heat input associated with the fuel consumed in the unit, expressed as mmBtu.

Excerpt 13 illustrates a portion of the XML file that can be used to upload Equation C-10 inputs. See Appendix A for an example of a complete XML file that can be submitted through the IVT for Subpart C Inputs.

XML Excerpt 13
Equation C-10 Information Details

```

<EquationCInputs>
  <Id>18105</Id>
  <EquationC10Inputs>
    ..... <AnnualHeatInput>67</AnnualHeatInput>
  </EquationC10Inputs>
</EquationCInputs>

```

2.5 Tier 4 Methodology Fuel Inputs (Equation C-13)

If a unit uses the Tier 4 calculation methodology to quantify CO₂ mass emissions, quantify the inputs required by Equation C-13 to calculate CO₂ emissions [§98.33(e)(2)]. Following the formula and list of variables, the corresponding XML data are illustrated in Figure 14 and described in Table 16.

$$V_{ff} = \frac{\text{Fuel} * F_c * \text{HHV}}{10^6} \quad (\text{Eq. C-13})$$

Where:

V_{ff} = Annual volume of CO₂ emitted from the combustion of a particular fossil fuel (scf).

Fuel = Total quantity of the fossil fuel combusted in the reporting year, from company records (lb for solid fuel, gallons for liquid fuel and scf for gaseous fuel).

F_c = Fuel-specific carbon based F-factor (scf CO₂/mmBtu).

HHV = High heat value of the fossil fuel, from fuel sampling and analysis (annual average value in Btu/lb for a solid fuel, Btu/gallon for a liquid fuel and Btu/scf for a gaseous fuel). The average HHV shall be calculated according to the requirements of paragraph 98.33 (a)(2)(ii).

10^6 = Conversion factor. Btu per mmBtu.

**Figure 14
Equation C-13 Inputs Type Schema Diagram**

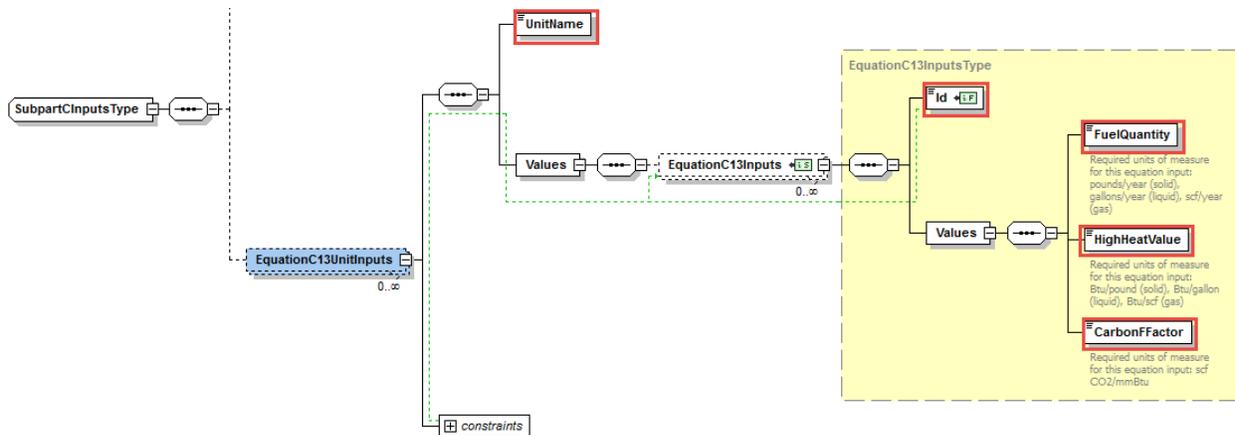


Table 15
Equation C-13 Inputs Type Data Element Definitions

Data Element Name	Description
EquationC13UnitInputs	Parent Element: A collection of data elements containing the relevant Subpart C equation inputs and unique IDs which identify distinct equation inputs.
UnitName	The name of the unit for which inputs are being uploaded. Important: The unit name must match EXACTLY the unit name in the facility's annual emissions report to e-GGRT.
Values	Parent Element: A collection of data elements describing inputs for the UnitName.
EquationC13Inputs	Parent Element A collection of data elements containing information for Equation C-13 for units that use Tier 4 Calculation Methodology.
Id	Specify a unique ID to associate with each set of fuel-specific inputs for the UnitName. Each distinct set of fuel-specific inputs will have its own ID. A unit will have more than one ID if it consumes more than one fuel.
Values	Parent Element: A collection of data elements describing inputs for the named Subpart C unit.
FuelQuantity	Indicate the total quantity of the fossil fuel combusted in the reporting year, from company records in pounds (solid), gallons (liquid), or scf (gas).
HighHeatValue	Indicate the high heat value of the fossil fuel, from fuel sampling and analysis in Btu/lb (solid), Btu/gallon (liquid) or Btu/scf (gas).
CarbonFFactor	Indicate the fuel-specific carbon based F-factor in scf CO ₂ /mmBtu..

Excerpt 15 illustrates a portion of the XML file that can be used to upload Equation C-13 inputs. See Appendix A for an example of a complete XML file that can be submitted through the IVT for Subpart C Inputs.

XML Excerpt 14 Equation C-13 Information Details

```
<SubpartCInputsType>
  <EquationC13UnitInputs>
    <UnitName>18102</UnitName>
    <Values>
      <EquationC13Inputs>
        <Id>18102</Id>
        <Values>
          <FuelQuantity>999</FuelQuantity>
          <HighHeatValue>3</HighHeatValue>
          <CarbonFFactor>.5</CarbonFFactor>
        </Values>
      </EquationC13Inputs>
    </Values>
  </EquationC13UnitInputs>
</SubpartCInputsType>
```

V. Appendix A: Sample XML Document for Subpart C IVT

[98.33(a)(1) – (3)]

Note: The data values below do not reflect an actual facility's data. Additional sample XML files with Subpart C IVT data are posted on the e-GGRT help site.

```

FacilityInputs name="Violet Test" id="557863" reportingYear="2014" lastUpdateDate="2015-03-06T16:28:19.413-05:00">
  <SubpartInputs>
    <SubpartCInputs>
      <SubpartCUnitInputs>
        <UnitName>GP- Violet 1</UnitName>
        <Values>
          <EquationCInputs>
            <Id>215061</Id>
            <EquationC4C8Inputs>
              <FuelQuantity>48</FuelQuantity>
              <UseUserCarbonContent>>false</UseUserCarbonContent>
              <CarbonContent>4</CarbonContent>
              <UseDefaultHHV>>false</UseDefaultHHV>
              <HighHeatValue>100</HighHeatValue>
            <EquationC2bInputs>
              <EquationC2bMonthlyInputs>
                <Month>January</Month>
                <Values>
                  <FuelCombusted>4</FuelCombusted>
                  <CarbonContent>4</CarbonContent>
                </Values>
              </EquationC2bMonthlyInputs>
              <EquationC2bMonthlyInputs>
                <Month>February</Month>
                <Values>
                  <FuelCombusted>4</FuelCombusted>
                  <CarbonContent>4</CarbonContent>
                </Values>
              </EquationC2bMonthlyInputs>
              <EquationC2bMonthlyInputs>
                <Month>March</Month>
                <Values>
                  <FuelCombusted>4</FuelCombusted>
                  <CarbonContent>4</CarbonContent>
                </Values>
              </EquationC2bMonthlyInputs>
              <EquationC2bMonthlyInputs>
                <Month>April</Month>
                <Values>
                  <FuelCombusted>4</FuelCombusted>
                  <CarbonContent>4</CarbonContent>
                </Values>
              </EquationC2bMonthlyInputs>
              <EquationC2bMonthlyInputs>
                <Month>May</Month>
                <Values>
                  <FuelCombusted>4</FuelCombusted>
                  <CarbonContent>4</CarbonContent>
                </Values>
              </EquationC2bMonthlyInputs>
              <EquationC2bMonthlyInputs>
                <Month>June</Month>
                <Values>

```

```

    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInput>
  <Month>July</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInput>
  <Month>August</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInput>
  <Month>September</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInput>
  <Month>October</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInput>
  <Month>November</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInput>
  <Month>December</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
</EquationC2bInputs>
</EquationC4C8Inputs>
</EquationCInputs>
<EquationCInputs>
  <Id>215062</Id>
  <EquationC4C8Inputs>
    <FuelQuantity>48</FuelQuantity>
    <UseUserCarbonContent>>false</UseUserCarbonContent>
    <CarbonContent>4</CarbonContent>
    <UseDefaultHHV>>false</UseDefaultHHV>
    <HighHeatValue>100</HighHeatValue>
  </EquationC2bInputs>
  <EquationC2bMonthlyInputs>
    <Month>January</Month>
    <Values>
      <FuelCombusted>4</FuelCombusted>

```

```

    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>February</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>March</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>April</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>May</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>June</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>July</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>August</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>September</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>October</Month>
  <Values>

```

```

    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInput>
  <Month>November</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInput>
  <Month>December</Month>
  <Values>
    <FuelCombusted>4</FuelCombusted>
    <CarbonContent>4</CarbonContent>
  </Values>
</EquationC2bMonthlyInputs>
</EquationC2bInput>
</EquationC4C8Inputs>
</EquationCInputs>
</Values>
</SubpartCUnitInputs>
<SubpartCUnitInputs>
  <UnitName>Violet Test 2</UnitName>
  <Values>
    <EquationCInputs>
      <Id>215089</Id>
      <EquationC1C8Inputs>
        <FuelQuantity>200</FuelQuantity>
      </EquationC1C8Inputs>
    </EquationCInputs>
  </Values>
</SubpartCUnitInputs>
<SubpartCUnitInputs>
  <UnitName>Violet Test 3</UnitName>
  <Values>
    <EquationCInputs>
      <Id>215109</Id>
      <EquationC2aC9aInputs>
        <FuelQuantity>0.6</FuelQuantity>
        <UseUserHHV>>false</UseUserHHV>
        <HighHeat Value>0.05</HighHeat Value>
      </EquationC2aC9aInputs>
      <EquationC2bInputs>
        <EquationC2bMonthlyInput>
          <Month>January</Month>
          <Values>
            <FuelCombusted>0.05</FuelCombusted>
            <HighHeat Value>0.05</HighHeat Value>
          </Values>
        </EquationC2bMonthlyInputs>
        <EquationC2bMonthlyInput>
          <Month>February</Month>
          <Values>
            <FuelCombusted>0.05</FuelCombusted>
            <HighHeat Value>0.05</HighHeat Value>
          </Values>
        </EquationC2bMonthlyInputs>
        <EquationC2bMonthlyInput>
          <Month>March</Month>
          <Values>
            <FuelCombusted>0.05</FuelCombusted>

```

```
<HighHeat Value>0.05</HighHeat Value>
</Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>April</Month>
  <Values>
    <FuelCombusted>0.05</FuelCombusted>
    <HighHeat Value>0.05</HighHeat Value>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>May</Month>
  <Values>
    <FuelCombusted>0.05</FuelCombusted>
    <HighHeat Value>0.05</HighHeat Value>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>June</Month>
  <Values>
    <FuelCombusted>0.05</FuelCombusted>
    <HighHeat Value>0.05</HighHeat Value>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>July</Month>
  <Values>
    <FuelCombusted>0.05</FuelCombusted>
    <HighHeat Value>0.05</HighHeat Value>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>August</Month>
  <Values>
    <FuelCombusted>0.05</FuelCombusted>
    <HighHeat Value>0.05</HighHeat Value>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>September</Month>
  <Values>
    <FuelCombusted>0.05</FuelCombusted>
    <HighHeat Value>0.05</HighHeat Value>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>October</Month>
  <Values>
    <FuelCombusted>0.05</FuelCombusted>
    <HighHeat Value>0.05</HighHeat Value>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>November</Month>
  <Values>
    <FuelCombusted>0.05</FuelCombusted>
    <HighHeat Value>0.05</HighHeat Value>
  </Values>
</EquationC2bMonthlyInputs>
<EquationC2bMonthlyInputs>
  <Month>December</Month>
  <Values>
```

```
<FuelCombusted>0.05</FuelCombusted>  
<HighHeat Value>0.05</HighHeat Value>  
</Values>  
</EquationC2bMonthlyInputs>  
</EquationC2bInputs>  
</EquationC2aC9aInputs>  
</EquationCInputs>  
</Values>  
</SubpartCUnitInputs>  
</SubpartCInputs>  
</SubpartInputs>  
</FacilityInputs>
```