

Greenhouse Gas Reporting Program

XML Reporting Instructions for Inputs Verifier Tool (IVT) Subpart X - Petrochemical Production

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/rulemaking-notice-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 Verifier Tool. The Inputs Verifier Tool 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). 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:

<http://www.ccdsupport.com/confluence/display/help/Inputs+Verifier+Tool+and+the+XML+Reporting+Method?src=search>. 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.

The e-GGRT help website also provides support for understanding screen errors that users see if the IVT xml is rejected: <http://www.ccdsupport.com/confluence/display/help/IVT+XML+Acceptance+Criteria>. At this link, the user will find information on schema conformance, facility id / reporting year mismatch, and unit / feedstock match failure messaging.

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.

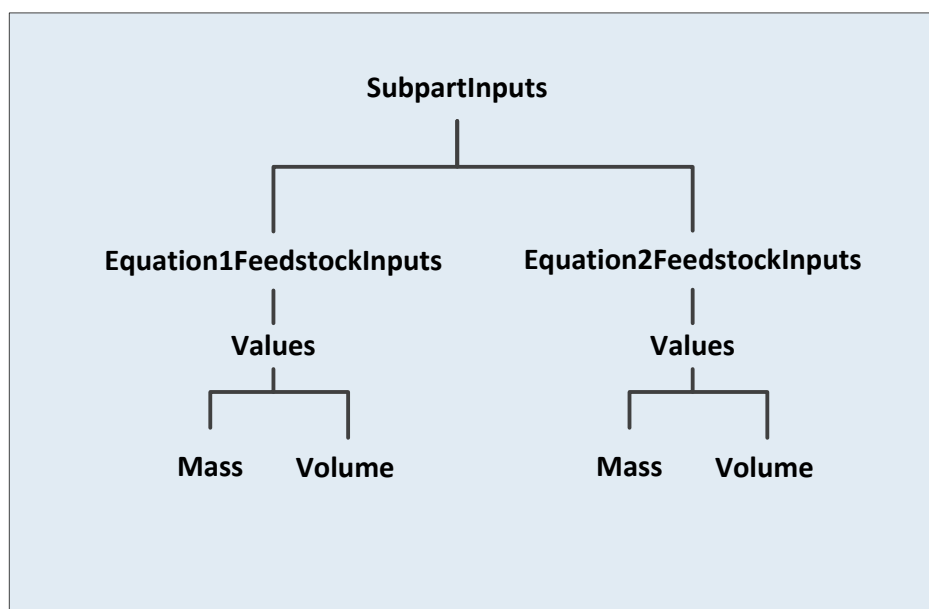
If a data element does not contain a value, then a single empty tag name may be used. An empty tag has a slash placed after the element's name <FacilitySiteIdentifier/>. **Note:** If you do not intend to upload a value for a particular data element, then it is recommended that you do not include the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

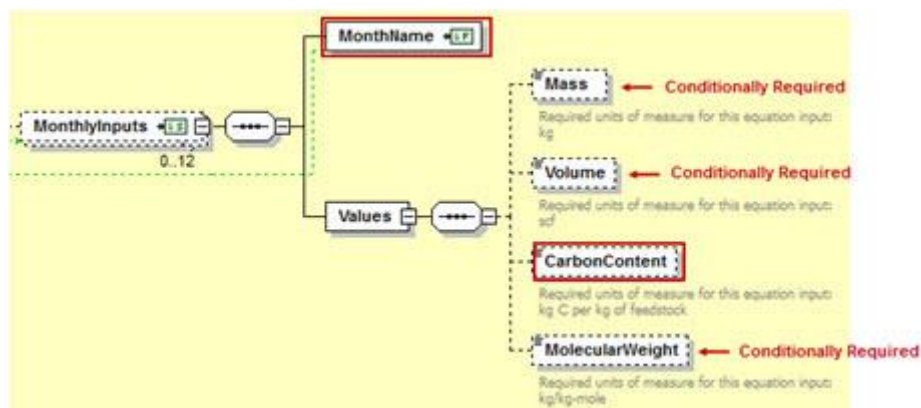


Table 2
Monthly Inputs Type Data Element Definitions

Data Element Name	Description
MonthlyInputs	Parent Element: A collection of data elements containing the monthly inputs for units using gaseous feedstock.
Month Name	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 reporting requirements for Subpart X feedstock and product data submitted through the IVT for petrochemical production units using non-CEMS (mass balance) calculation methodology. The subpart X IVT does not apply to petrochemical production units using either the CEMS or optional ethylene combustion calculation methodologies. However, the flare emissions associated with these petrochemical production unit(s) may be required to use IVT, depending on the specific equation(s) used to calculate flare emissions. See the subpart Y IVT XML instructions for flares for additional information. Similarly, an ethylene unit using the optional ethylene combustion methodology may be required to use the subpart C IVT for combustion unit(s) burning ethylene process off-gas and so should refer to the subpart C IVT XML instructions. Note that subpart C reporters have the option, for each configuration, to either use the IVT or report equation inputs to EPA through e-GGRT.

III. IVT Submittals for Subpart X – Petrochemical Production

This section provides a description of how to upload the inputs data for the Subpart X IVT using the XML schema. In accordance with 40 CFR 98.243, facilities must calculate the annual CO₂ emissions from each petrochemical production process unit using one of three methodologies: (1) CEMS, (2) mass balance, or (3) optional ethylene combustion methodology. Facilities must upload both feedstock and product inputs for units that use the mass balance calculation methodology.

1.0 Facility Inputs

Prior to compiling the inputs data for each type of fuel or feedstock, the general facility data should be defined. These data elements are described below in Table 3 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="SX Industries"
  <SubpartInputs>
    <SubpartXInputs>

      --- insert XML for Subpart X Process Unit Inputs

    </SubpartXInputs>
  </SubpartInputs>
</FacilityInputs>
```

2.0 Subpart X Inputs

For each petrochemical process unit, the mass balance methodology of §98.243(c) is used if either the total emissions from process vents and emissions from combustion of process off-gas are not routed to stacks that are monitored with CEMS (except flare stacks) to measure CO₂ emissions, or, if the facility chooses not to use the optional ethylene combustion methodology at §98.243(d). Both feedstock inputs and product inputs must be uploaded.

The schema is organized by Subpart X process unit and then by Subpart X equation. Separate equations are used, depending on whether inputs are for a gaseous, liquid, or solid product or feedstock.

Subpart X Inputs (High-Level)

Inputs for Subpart X are organized by Subpart X process unit. The XML structure requires that all inputs determined by Subpart X equations must follow process unit identification. Figure 3 shows the high level structure of the Subpart X IVT schema, and Table 4 provides detailed data element descriptions.

Figure 3
Subpart X Inputs Type High-Level Schema Structure

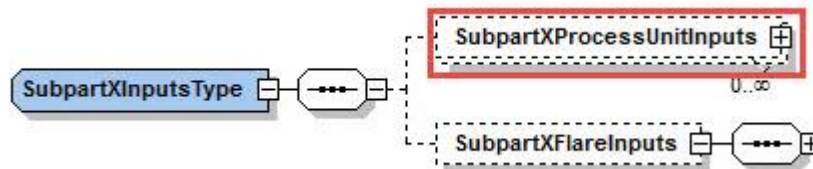


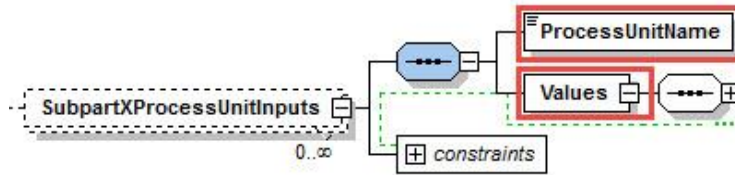
Table 4
Data Element Definitions for Subpart X Inputs Type (High Level)

Data Element Name	Description
SubpartXInputsType	Parent Element: A collection of data elements containing the process unit inputs for Subpart X
SubpartXProcessUnitInputs	Parent Element: A collection of data elements containing the process unit name and the emission calculation equation inputs.

Subpart X Process Unit Inputs (High-Level)

In the following figure and table, high level Subpart X Process Unit Inputs are shown and defined.

**Figure 4
Subpart X Process Unit Inputs High-Level Schema Structure**



**Table 5
Data Element Definitions for Subpart X Process Unit Inputs (High Level)**

Data Element Name	Description
SubpartXProcessUnitInputs	Parent Element: A collection of data elements containing the process unit name and the emission calculation equation inputs.
ProcessUnitName	The name of the process unit for which inputs are being uploaded. Important: The process unit name must match EXACTLY the process unit name in the facility’s annual emissions report to e-GGRT.
Values	Parent Element: A collection of data elements describing inputs for Subpart X process units.

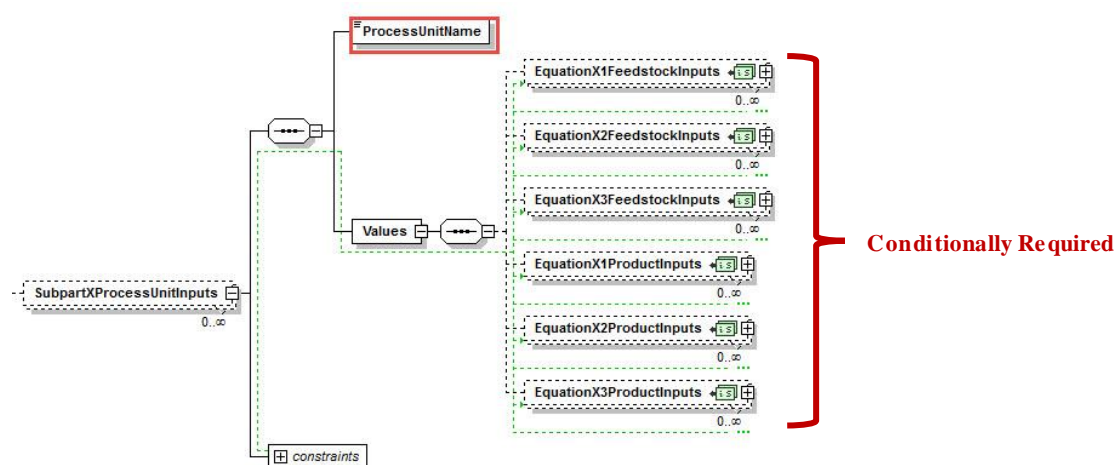
**XML Excerpt 2
Subpart X Process Unit High Level**

```

- <SubpartXInputs>
  - <SubpartXProcessUnitInputs>
    <ProcessUnitName>TEST MASS1</ProcessUnitName>
    - <Values>
    
```

Following from the high-level schema discussed above, the XML structure for process unit feedstock and product input values must follow the order shown in the schema structure. For each process unit, the XML must first include feedstock inputs, followed by product inputs. For example, all Equation X-1 feedstock inputs for the process unit must be included before any Equation X-2 feedstock inputs are added; similarly, all Equation X-1, Equation X-2, and Equation X-3 feedstock inputs must be included before any product inputs are added. The order of Subpart X equations required by the schema is displayed as Figure 5.

Figure 5
Subpart X Process Unit Inputs Schema Structure Showing Required Equation Order



Detailed instructions for preparing XML for each Subpart X process unit are provided in the sections below. The sections are presented in schema order; inputs by Subpart X equation are provided in Sections 2.1 – 2.6.

2.1 Process Unit Gaseous Feedstock Inputs – Equation X-1 [§98.243(c)(5)(i)]

For gaseous feedstocks, monthly inputs data are required for Equation X-1. The feedstock quantity can be provided in terms of either mass or volume. The formula and list of variables for Equation X-1 are shown below. The corresponding XML schema diagram for feedstock inputs is illustrated in Figure 6. Data element definitions are included in Table 6. Sample XML excerpts are also provided.

$$C_i = \sum_{n=1}^{12} \left[\sum_{i=1}^j \left[(F_{i,n}) \cdot (CC_{i,n}) \cdot \frac{(MW_i)_{i,n}}{MVC} - (P_{i,n}) \cdot (CC_{i,n}) \cdot \frac{(MW_p)_{i,n}}{MVC} \right] \right] \quad (\text{Eq. X-1})$$

Where:

C_i = Annual net contribution to calculated emissions from carbon (C) in gaseous materials, including streams containing CO₂ recovered for sale or use in another process (kg/yr).

$(F_{i,n})$ = Volume or mass of gaseous feedstock i introduced in month "n" (scf or kg). If you measure mass, the term $(MW_i)/MVC$ is replaced with "1".

$(CC_{i,n})$ = Average carbon content of the gaseous feedstock i for month "n" (kg C per kg of feedstock).

$(MW_i)_n$ = Molecular weight of gaseous feedstock i in month "n" (kg/kg-mole).

MVC = Molar volume conversion factor (849.5 scf per kg-mole at 68 °F and 14.7 pounds per square inch absolute or 836.6 scf/kg-mole at 60 °F and 14.7 pounds per square inch absolute).

$(P_{i,n})$ = Volume or mass of gaseous product i produced in month "n" (scf or kg). If you measure mass, the term $(MW_p)/MVC$ is replaced with "1".

$(CC_{i,n})$ = Average carbon content of gaseous product i, including streams containing CO₂ recovered for sale or use in another process, for month "n" (kg C per kg of product).

$(MW_p)_n$ = Molecular weight of gaseous product i in month "n" (kg/kg-mole).

j = Number of feedstocks.

k = Number of products.

Figure 6
Gaseous Feedstock IVT Inputs Schema Diagram (Equation X-1)

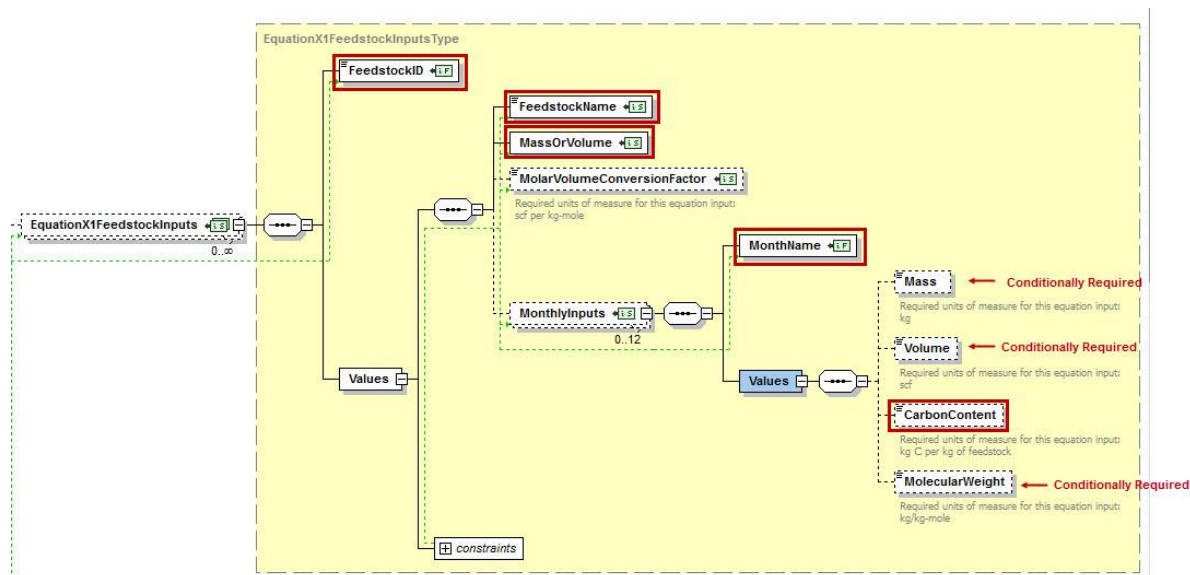


Table 6
Equation X-1 Data Element Definitions for Feedstock IVT Inputs

Data Element Name	Description
EquationX1FeedstockInputs	<p>Parent Element: A collection of data elements containing the inputs required for units using gaseous feedstock (see §98.243(c)(5)(i)).</p> <p>Conditionally Required: These data elements are required only if the production unit uses gaseous feedstock.</p>
FeedstockID	Provide a unique identifier for the feedstock (e.g., “1”).
Values	Parent Element: A collection of data elements in terms of mass or volume for units using gaseous feedstock (see §98.243(c)(5)(i)).
FeedstockName	<p>Provide the name of the feedstock for which inputs are being uploaded.</p> <p>Important: The feedstock name must match EXACTLY the feedstock name in the facility’s annual emissions report to e-GGRT.</p>
MassorVolume	Specify how the gaseous feedstock quantity is measured: Mass or Volume.
MonthlyInputs	Parent Element: A collection of data elements containing the monthly inputs for units using gaseous feedstock (see §98.243(c)(5)(i)).
Month Name	Specify 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 (see §98.243(c)(5)(i)).
Mass	<p>Provide the quantity of the gaseous feedstock consumed during the month (kg).</p> <p>Conditionally Required: This data element is only required if the gaseous feedstock is measured in mass units of measure.</p>
Volume	<p>Provide the quantity of the gaseous feedstock consumed during the month (scf).</p> <p>Conditionally Required: This data element is only required if the gaseous feedstock is measured in volumetric units of measure.</p>
CarbonContent	Provide the average carbon content of the gaseous feedstock for the specified month (kg carbon per kg feedstock).
MolecularWeight	<p>Provide the average molecular weight of the gaseous feedstock for the specified month (kg per kg-mole).</p> <p>Conditionally Required: This data element is required only if the gaseous feedstock is measured in volumetric units of measure.</p>

Excerpts 3 and 4 below illustrate a portion of the XML file that can be used to upload gaseous feedstock inputs data to the IVT in terms of mass or volume, respectively. Data for January and February are shown. Data for March through December would be uploaded in a similar format. See Appendix A for an

example of a complete XML file that can be submitted through the IVT for gaseous feedstock measured in terms of mass and volume.

XML Excerpt 3 Example for Gaseous Feedstock (Mass) – Equation X-1 IVT Inputs

```
- <EquationX1FeedstockInputs>
  <FeedstockID>1</FeedstockID>
  - <Values>
    <FeedstockName>Natural gas</FeedstockName>
    <MassOrVolume>Mass</MassOrVolume>
    - <MonthlyInputs>
      <MonthName>January</MonthName>
      - <Values>
        <Mass>10</Mass>
        <CarbonContent>0.4</CarbonContent>
      </Values>
    </MonthlyInputs>
    - <MonthlyInputs>
      <MonthName>February</MonthName>
      - <Values>
        <Mass>10</Mass>
        <CarbonContent>0.4</CarbonContent>
      </Values>
  </Values>
</EquationX1FeedstockInputs>
```

XML Excerpt 4 Example for Gaseous Feedstock (Volume) – Equation X-1 IVT Inputs

```
- <EquationX1FeedstockInputs>
  <FeedstockID>1</FeedstockID>
  - <Values>
    <FeedstockName>Natural gas</FeedstockName>
    <MassOrVolume>Volume</MassOrVolume>
    <MolarVolumeConversionFactor>849.5</MolarVolumeConversionFactor>
    - <MonthlyInputs>
      <MonthName>January</MonthName>
      - <Values>
        <Volume>1000</Volume>
        <CarbonContent>0.4</CarbonContent>
        <MolecularWeight>10</MolecularWeight>
      </Values>
    </MonthlyInputs>
    - <MonthlyInputs>
      <MonthName>February</MonthName>
      - <Values>
        <Volume>1000</Volume>
        <CarbonContent>0.4</CarbonContent>
        <MolecularWeight>10</MolecularWeight>
      </Values>
  </Values>
</EquationX1FeedstockInputs>
```

2.2 Process Unit Liquid Feedstock Inputs - Equation X-2 [§98.243(c)(5)(ii)]

For liquid feedstocks, monthly inputs data are required for Equation X-2. The feedstock quantity can be provided in terms of either mass or volume. The formula and list of variables for Equation X-2 are shown below. The corresponding XML schema diagram for feedstock data is illustrated in Figure 7. Data element definitions are described in Table 7. Sample XML excerpts are also provided.

$$C_i = \sum_{n=1}^{12} \left[\sum_{j=1}^j \sum_{k=1}^k \left[(F_{ij})_{LN} * (CC_{ij})_{LN} - (P_{ik})_{LN} * (CC_{ik})_{LN} \right] \right] \quad (\text{Eq. X-2})$$

Where:

C = Annual net contribution to calculated emissions from carbon in liquid materials, including liquid organic wastes (kg/yr).

(F)_{ij} = Volume or mass of liquid feedstock i introduced in month "n" (gallons or kg).

(CC)_{ij} = Average carbon content of liquid feedstock i for month "n" (kg C per gallon or kg of feedstock).

(P)_{ik} = Volume or mass of liquid product i produced in month "n" (gallons or kg).

(CC)_{ik} = Average carbon content of liquid product i, including organic liquid wastes, for month "n" (kg C per gallon or kg of product).

j = Number of feedstocks.

k = Number of products.

**Figure 7
Liquid Feedstock IVT Inputs Schema Diagram (Equation X-2)**

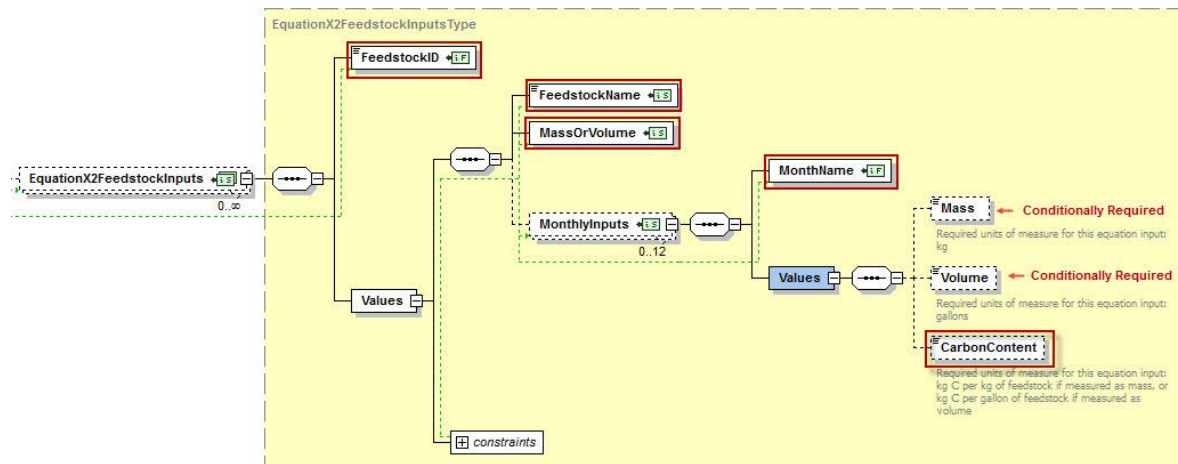


Table 7
Equation X-2 Data Element Definitions for Feedstock IVT Inputs

Data Element Name	Description
EquationX2FeedstockInputs	<p>Parent Element: A collection of data elements containing the inputs required for units using liquid feedstock (see §98.243(c)(5)(ii)).</p> <p>Conditionally Required: These data elements are required only if the production unit uses liquid feedstock.</p>
FeedstockID	Provide a unique identifier for the feedstock (e.g., “1”).
Values	<p>Parent Element: A collection of data elements in terms of mass or volume for units using liquid feedstock (see §98.243(c)(5)(ii)).</p>
FeedstockName	<p>Provide the name of the feedstock for which inputs are being uploaded.</p> <p>Important: The feedstock name must match EXACTLY the feedstock name in the facility’s annual emissions report to e-GGRT.</p>
MassorVolume	Specify how the liquid feedstock quantity is measured: Mass or Volume.
MonthlyInputs	<p>Parent Element: A collection of data elements containing the monthly inputs for units using liquid feedstock (see §98.243(c)(5)(ii)).</p>
Month Name	Specify the applicable month for which data are being uploaded (e.g., “January”).
Values	<p>Parent Element: A collection of data elements containing the monthly inputs for units using liquid feedstock (see §98.243(c)(5)(ii)).</p>
Mass	<p>Provide the quantity of the liquid feedstock consumed during the month (kg).</p> <p>Conditionally Required: This data element is only required if the liquid feedstock is measured in mass units of measure.</p>
Volume	<p>Provide the quantity of the liquid feedstock consumed during the month (scf).</p> <p>Conditionally Required: This data element is only required if the liquid feedstock is measured in volumetric units of measure.</p>
CarbonContent	Provide the average carbon content of the liquid feedstock for the specified month (kg carbon per gallon or kg feedstock).

Excerpts 5 and 6 below illustrate a portion of the XML file that can be used to upload liquid feedstock data to the IVT in terms of mass or volume, respectively. Data for January and February are shown. Data for March through December would be uploaded in a similar format. See Appendix A for an example of a complete XML file that can be submitted through the IVT for liquid feedstock measured in terms of mass and volume.

XML Excerpt 5
Example for Liquid Feedstock (Mass) – Equation X-2 IVT Inputs

```

- <EquationX2FeedstockInputs>
  <FeedstockID>1</FeedstockID>
  - <Values>
    <FeedstockName>Carbon Black Oil</FeedstockName>
    <MassOrVolume>Mass</MassOrVolume>
    - <MonthlyInputs>
      <MonthName>January</MonthName>
      - <Values>
        <Mass>10</Mass>
        <CarbonContent>0.4</CarbonContent>
      </Values>
    </MonthlyInputs>
    - <MonthlyInputs>
      <MonthName>February</MonthName>
      - <Values>
        <Mass>10</Mass>
        <CarbonContent>0.4</CarbonContent>
      </Values>
  </Values>
</EquationX2FeedstockInputs>

```

XML Excerpt 6
Example for Liquid Feedstock (Volume) – Equation X-2 IVT Inputs

```

- <EquationX2FeedstockInputs>
  <FeedstockID>1</FeedstockID>
  - <Values>
    <FeedstockName>Carbon Black Oil</FeedstockName>
    <MassOrVolume>Volume</MassOrVolume>
    - <MonthlyInputs>
      <MonthName>January</MonthName>
      - <Values>
        <Volume>1000</Volume>
        <CarbonContent>0.4</CarbonContent>
      </Values>
    </MonthlyInputs>
    - <MonthlyInputs>
      <MonthName>February</MonthName>
      - <Values>
        <Volume>1000</Volume>
        <CarbonContent>0.4</CarbonContent>
      </Values>
  </Values>
</EquationX2FeedstockInputs>

```

Note: The code excerpt above is presented here to demonstrate the concept of reporting greenhouse gas quantity data.

2.3 Process Unit Solid Feedstock Inputs - Equation X-3 [40 CFR 98.243(c)(5)(iii)]

For solid feedstocks, monthly inputs data are required for Equation X-3. The formula and list of variables for Equation X-3 are shown below. The corresponding XML schema diagram for feedstock data is illustrated in Figure 8. Data element definitions are described in Table 8. Sample XML excerpts are also provided.

$$C_s = \sum_{n=1}^{12} \left\{ \sum_{i=1}^{j \text{ or } k} \left[(F_{sf})_{i,n} * (CC_{sf})_{i,n} - (P_{sp})_{i,n} * (CC_{sp})_{i,n} \right] \right\} \quad (\text{Eq. X-3})$$

Where:

C_s = Annual net contribution to calculated emissions from carbon in solid materials (kg/yr).

$(F_{sf})_i$ = Mass of solid feedstock i introduced in month "n" (kg).

$(CC_{sf})_i$ = Average carbon content of solid feedstock i for month "n" (kg C per kg of feedstock).

$(P_{sp})_i$ = Mass of solid product i produced in month "n" (kg).

$(CC_{sp})_i$ = Average carbon content of solid product i in month "n" (kg C per kg of product).

j = Number of feedstocks.

k = Number of products.

Figure 8
Solid Feedstock IVT Inputs Schema Diagram (Equation X-3)

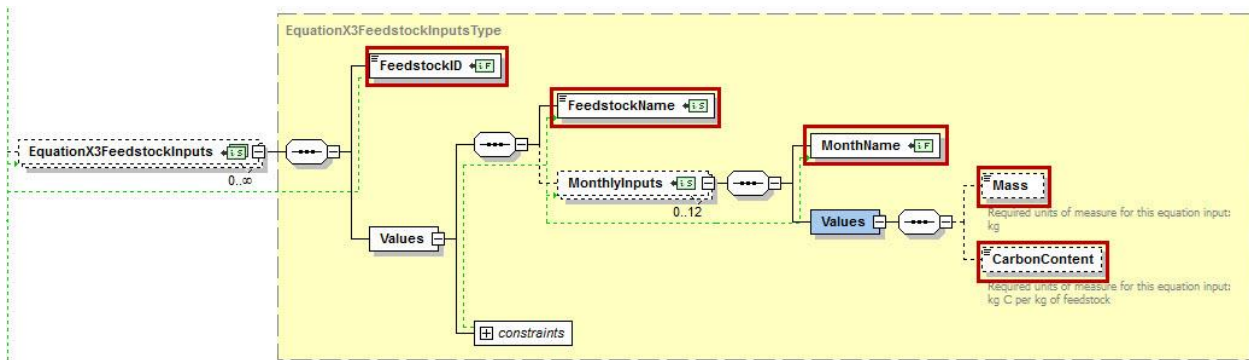


Table 8
Equation X-3 Data Element Definitions for Feedstock IVT Inputs

Data Element Name	Description
EquationX3FeedstockInputs	<p>Parent Element: A collection of data elements containing the inputs required for units using solid feedstock (see §98.243(c)(5)(iii)).</p> <p>Conditionally Required: These data elements are required only if the production unit uses solid feedstock.</p>
FeedstockID	Provide a unique identifier for the feedstock (e.g., “1”).
Values	Parent Element: A collection of data elements in terms of mass or volume for units using solid feedstock (see §98.243(c)(5)(iii)).
FeedstockName	<p>Provide the name of the feedstock for which inputs are being uploaded.</p> <p>Important: The feedstock name must match EXACTLY the feedstock name in the facility’s annual emissions report to e-GGRT.</p>
MonthlyInputs	Parent Element: A collection of data elements containing the monthly inputs for units using solid feedstock (see §98.243(c)(5)(iii)).
Month Name	Specify 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 solid feedstock (see §98.243(c)(5)(iii)).
Mass	Provide the quantity of the solid feedstock consumed during the month (kg).
CarbonContent	Provide the average carbon content of the solid feedstock for the specified month (kg carbon per kg feedstock).

Excerpt 7 below illustrates a portion of the XML file that can be used to upload solid feedstock data to the IVT in terms of mass. Data for January and February are shown. Data for March through December would be uploaded in a similar format. See Appendix A for an example of a complete XML file that can be submitted through the IVT for solid feedstock measured in terms of mass.

XML Excerpt 7
Example for Solid Feedstock (Mass) – Equation X-3 IVT Inputs

```
- <EquationX3FeedstockInputs>
  <FeedstockID>1</FeedstockID>
  - <Values>
    <FeedstockName>Coal</FeedstockName>
    - <MonthlyInputs>
      <MonthName>January</MonthName>
      - <Values>
        <Mass>10</Mass>
        <CarbonContent>0.4</CarbonContent>
      </Values>
    </MonthlyInputs>
    - <MonthlyInputs>
      <MonthName>February</MonthName>
      - <Values>
        <Mass>10</Mass>
        <CarbonContent>0.4</CarbonContent>
      </Values>
  </Values>
</EquationX3FeedstockInputs>
```

2.4 Process Unit Gaseous Product Inputs – Equation X-1 [§98.243(c)(5)(i)]

For gaseous products, monthly inputs data are required for Equation X-1. The product quantity can be provided in terms of either mass or volume. The formula and list of variables for Equation X-1 are shown below. The corresponding XML schema diagram for product inputs is illustrated in Figure 9. Data element definitions are included in Table 9. Sample XML excerpts are also provided.

$$C_i = \sum_{n=1}^{12} \left[\sum_{j=1}^j \left[(F_{ij})_{i,n} \cdot (CC_{ij})_{i,n} \cdot \frac{(MW_j)_{i,n}}{MVC} - (P_{ik})_{i,n} \cdot (CC_{ik})_{i,n} \cdot \frac{(MW_k)_{i,n}}{MVC} \right] \right] \quad (\text{Eq. X-1})$$

Where:

- C_i = Annual net contribution to calculated emissions from carbon (C) in gaseous materials, including streams containing CO₂ recovered for sale or use in another process (kg/yr).
- $(F_{ij})_{i,n}$ = Volume or mass of gaseous feedstock i introduced in month "n" (scf or kg). If you measure mass, the term (MW_j)/MVC is replaced with "1".
- $(CC_{ij})_{i,n}$ = Average carbon content of the gaseous feedstock i for month "n" (kg C per kg of feedstock).
- $(MW_j)_{i,n}$ = Molecular weight of gaseous feedstock i in month "n" (kg/kg-mole).
- MVC = Molar volume conversion factor (849.5 scf per kg-mole at 68 °F and 14.7 pounds per square inch absolute or 836.6 scf/kg-mole at 60 °F and 14.7 pounds per square inch absolute).
- $(P_{ik})_{i,n}$ = Volume or mass of gaseous product i produced in month "n" (scf or kg). If you measure mass, the term (MW_k)/MVC is replaced with "1".
- $(CC_{ik})_{i,n}$ = Average carbon content of gaseous product i, including streams containing CO₂ recovered for sale or use in another process, for month "n" (kg C per kg of product).
- $(MW_k)_{i,n}$ = Molecular weight of gaseous product i in month "n" (kg/kg-mole).
- j = Number of feedstocks.
- k = Number of products.

Figure 9
Gaseous Product IVT Inputs Schema Diagram (Equation X-1)

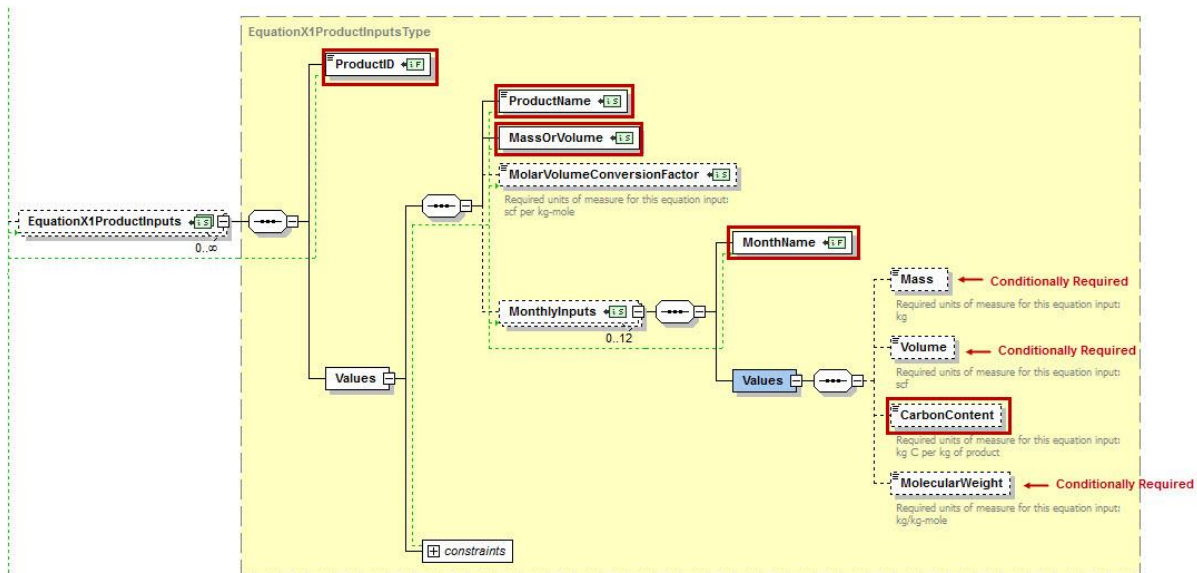


Table 9
Equation X-1 Data Element Definitions for Product IVT Inputs

Data Element Name	Description
EquationX1ProductInputs	<p>Parent Element: A collection of data elements containing the inputs required for units producing gaseous product (see §98.243(c)(5)(i)).</p> <p>Conditionally Required: These data elements are required only if the production unit produces gaseous product.</p>
ProductID	Provide a unique identifier for the product (e.g., “1”).
Values	Parent Element: A collection of data elements in terms of mass or volume for units producing gaseous product (see §98.243(c)(5)(i)).
ProductName	<p>Provide the name of the product for which inputs are being uploaded.</p> <p>Important: The product name must match EXACTLY the product name in the facility’s annual emissions report to e-GGRT.</p>
MassorVolume	Specify how the gaseous product quantity is measured: Mass or Volume.
MonthlyInputs	Parent Element: A collection of data elements containing the monthly inputs for units producing gaseous product (see §98.243(c)(5)(i)).
Month Name	Specify 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 producing gaseous product (see §98.243(c)(5)(i)).
Mass	<p>Provide the quantity of the gaseous product produced during the month (kg).</p> <p>Conditionally Required: This data element is only required if the gaseous product is measured in mass units of measure.</p>
Volume	<p>Provide the quantity of the gaseous product produced during the month (scf).</p> <p>Conditionally Required: This data element is only required if the gaseous product is measured in volumetric units of measure.</p>
CarbonContent	Provide the average carbon content of the gaseous product for the specified month (kg carbon per kg product).
MolecularWeight	<p>Provide the average molecular weight of the gaseous product for the specified month (kg per kg-mole).</p> <p>Conditionally Required: This data element is only required if the gaseous product is measured in volumetric units of measure.</p>

Excerpts 8 and 9 below illustrate a portion of the XML file that can be used to upload gaseous product inputs data to the IVT in terms of mass or volume, respectively. Data for January and February are shown. Data for March through December would be uploaded in a similar format. See Appendix A for an example of a complete XML file that can be submitted through the IVT for gaseous product measured in terms of mass and volume.

XML Excerpt 8
Example for Gaseous Product (Mass) – Equation X-1 IVT Inputs

```

- <EquationX1ProductInputs>
  <ProductID>1</ProductID>
  - <Values>
    <ProductName>Methanol</ProductName>
    <MassOrVolume>Mass</MassOrVolume>
    - <MonthlyInputs>
      <MonthName>January</MonthName>
      - <Values>
        <Mass>5</Mass>
        <CarbonContent>0.3</CarbonContent>
      </Values>
    </MonthlyInputs>
    - <MonthlyInputs>
      <MonthName>February</MonthName>
      - <Values>
        <Mass>5</Mass>
        <CarbonContent>0.3</CarbonContent>
      </Values>
  </Values>
</EquationX1ProductInputs>

```

XML Excerpt 9
Example for Gaseous Product (Volume) – Equation X-1 IVT Inputs

```

- <EquationX1ProductInputs>
  <ProductID>1</ProductID>
  - <Values>
    <ProductName>Propylene</ProductName>
    <MassOrVolume>Volume</MassOrVolume>
    <MolarVolumeConversionFactor>849.5</MolarVolumeConversionFactor>
    - <MonthlyInputs>
      <MonthName>January</MonthName>
      - <Values>
        <Volume>500</Volume>
        <CarbonContent>0.3</CarbonContent>
        <MolecularWeight>5</MolecularWeight>
      </Values>
    </MonthlyInputs>
    - <MonthlyInputs>
      <MonthName>February</MonthName>
      - <Values>
        <Volume>500</Volume>
        <CarbonContent>0.3</CarbonContent>
        <MolecularWeight>5</MolecularWeight>
      </Values>
  </Values>
</EquationX1ProductInputs>

```

2.5 Process Unit Liquid Product Inputs - Equation X-2 [§98.243(c)(5)(ii)]

For liquid products, monthly inputs data are required for Equation X-2. The product quantity can be provided in terms of either mass or volume. The formula and list of variables for Equation X-2 are shown below. The corresponding XML schema diagram for product data is illustrated in Figure 10. Data element definitions are described in Table 10. Sample XML excerpts are also provided.

$$C_i = \sum_{n=1}^{12} \left[\sum_{i=1}^{j \times k} \left[(F_{i,n}) * (CC_{f,i}) - (P_{i,n}) * (CC_{p,i}) \right] \right] \quad (\text{Eq. X-2})$$

Where:

C = Annual net contribution to calculated emissions from carbon in liquid materials, including liquid organic wastes (kg/yr).

(F)_{i,n} = Volume or mass of liquid feedstock i introduced in month "n" (gallons or kg).

(CC)_{f,i} = Average carbon content of liquid feedstock i for month "n" (kg C per gallon or kg of feedstock).

(P)_{i,n} = Volume or mass of liquid product i produced in month "n" (gallons or kg).

(CC)_{p,i} = Average carbon content of liquid product i, including organic liquid wastes, for month "n" (kg C per gallon or kg of product).

j = Number of feedstocks.

k = Number of products.

**Figure 10
Liquid Product IVT Inputs Schema Diagram (Equation X-2)**

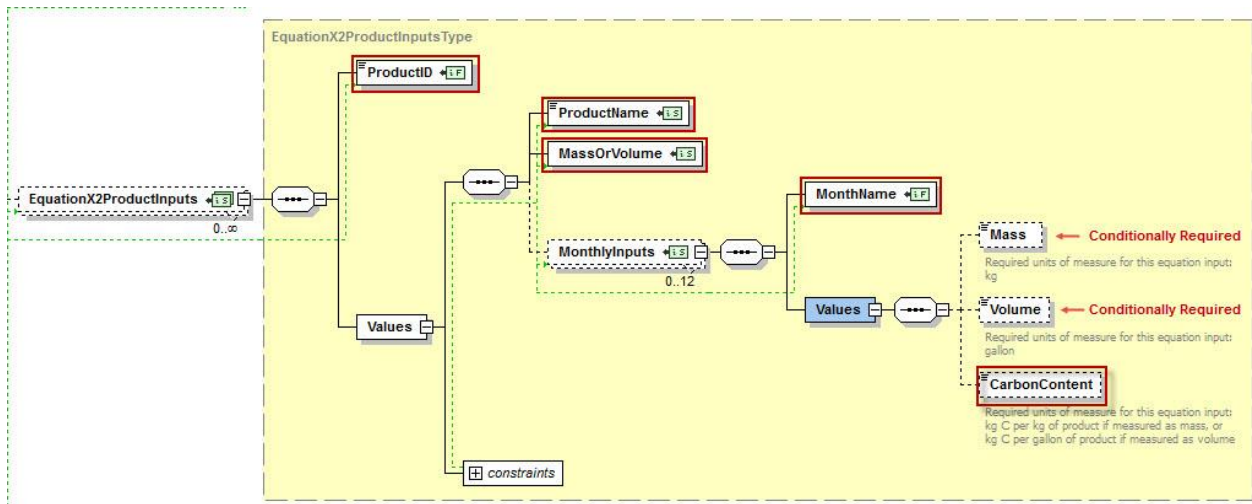


Table 10
Equation X-2 Data Element Definitions for Product IVT Inputs

Data Element Name	Description
EquationX2ProductInputs	<p>Parent Element: A collection of data elements containing the inputs required for units producing liquid product (see §98.243(c)(5)(ii)).</p> <p>Conditionally Required: These data elements are required only if the production unit produces liquid product.</p>
ProductID	Provide a unique identifier for the product (e.g., “1”).
Values	<p>Parent Element: A collection of data elements in terms of mass or volume for units producing liquid product (see §98.243(c)(5)(ii)).</p>
ProductName	<p>Provide the name of the product for which inputs are being uploaded.</p> <p>Important: The product name must match EXACTLY the product name in the facility’s annual emissions report to e-GGRT.</p>
MassorVolume	Specify how the liquid product quantity is measured: Mass or Volume.
MonthlyInputs	<p>Parent Element: A collection of data elements containing the monthly inputs for units producing liquid product (see §98.243(c)(5)(ii)).</p>
Month Name	Specify the applicable month for which data are being uploaded (e.g., “January”).
Values	<p>Parent Element: A collection of data elements containing the monthly inputs for units producing liquid product (see §98.243(c)(5)(ii)).</p>
Mass	<p>Provide the quantity of the liquid product produced during the month (kg).</p> <p>Conditionally Required: This data element is only required if the liquid product is measured in mass units of measure.</p>
Volume	<p>Provide the quantity of the liquid product produced during the month (scf).</p> <p>Conditionally Required: This data element is only required if the liquid product is measured in volumetric units of measure.</p>
CarbonContent	Provide the average carbon content of the liquid product for the specified month (kg carbon per gallons or kg product).

Excerpts 10 and 11 below illustrate a portion of the XML file that can be used to upload liquid product data to the IVT in terms of mass or volume, respectively. Data for January and February are shown. Data for March through December would be uploaded in a similar format. See Appendix A for an example of a complete XML file that can be submitted through the IVT for liquid product measured in terms of mass and volume.

XML Excerpt 10
Example for Liquid Product (Mass) – Equation X-2 IVT Inputs

```

- <EquationX2ProductInputs>
  <ProductID>1</ProductID>
  - <Values>
    <ProductName>Hydrogen Cyanide</ProductName>
    <MassOrVolume>Mass</MassOrVolume>
    - <MonthlyInputs>
      <MonthName>January</MonthName>
      - <Values>
        <Mass>5</Mass>
        <CarbonContent>0.3</CarbonContent>
      </Values>
    </MonthlyInputs>
    - <MonthlyInputs>
      <MonthName>February</MonthName>
      - <Values>
        <Mass>5</Mass>
        <CarbonContent>0.3</CarbonContent>
      </Values>
  </Values>
</EquationX2ProductInputs>

```

XML Excerpt 11
Example for Liquid Product (Volume) – Equation X-2 IVT Inputs

```

- <EquationX2ProductInputs>
  <ProductID>1</ProductID>
  - <Values>
    <ProductName>Hydrogen Cyanide</ProductName>
    <MassOrVolume>Volume</MassOrVolume>
    - <MonthlyInputs>
      <MonthName>January</MonthName>
      - <Values>
        <Volume>500</Volume>
        <CarbonContent>0.3</CarbonContent>
      </Values>
    </MonthlyInputs>
    - <MonthlyInputs>
      <MonthName>February</MonthName>
      - <Values>
        <Volume>500</Volume>
        <CarbonContent>0.3</CarbonContent>
      </Values>
  </Values>
</EquationX2ProductInputs>

```

Note: The code excerpt above is presented here to demonstrate the concept of reporting greenhouse gas quantity data.

2.6 Process Unit Solid Product Inputs - Equation X-3 [40 CFR 98.243(c)(5)(iii)]

For solid products, monthly inputs data are required for Equation X-3. The formula and list of variables for Equation X-3 are shown below. The corresponding XML schema diagram for product data is illustrated in Figure 11. Data element definitions are described in Table 11. Sample XML excerpts are also provided.

$$C_s = \sum_{n=1}^{12} \left\{ \sum_{i=1}^{j \text{ or } k} \left[(P_{sf})_{i,n} * (CC_{sf})_{i,n} - (P_{sp})_{i,n} * (CC_{sp})_{i,n} \right] \right\} \quad (\text{Eq. X-3})$$

Where:

C_s = Annual net contribution to calculated emissions from carbon in solid materials (kg/yr).

(F_s)_i = Mass of solid feedstock i introduced in month "n" (kg).

(CC_s)_i = Average carbon content of solid feedstock i for month "n" (kg C per kg of feedstock).

(P_s)_i = Mass of solid product i produced in month "n" (kg).

(CC_p)_i = Average carbon content of solid product i in month "n" (kg C per kg of product).

j = Number of feedstocks.

k = Number of products.

Figure 11
Solid Product IVT Inputs Schema Diagram (Equation X-3)

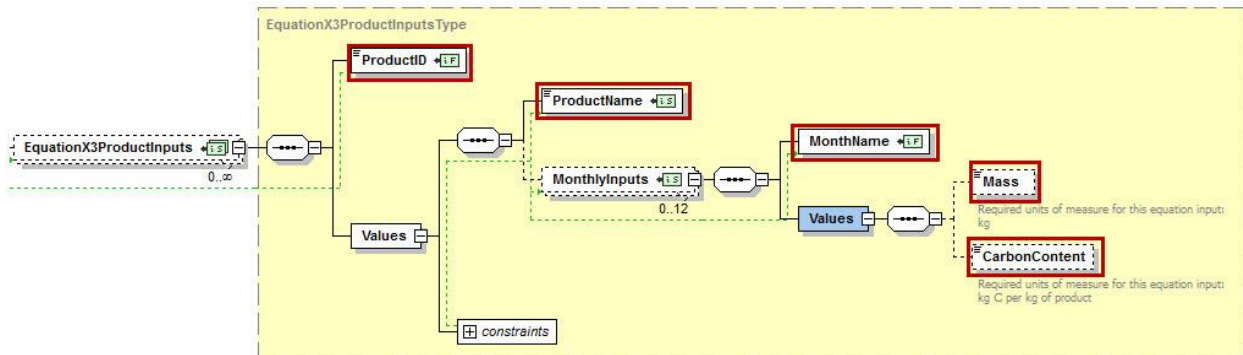


Table 11
Equation X-3 Data Element Definitions for Product IVT Inputs

Data Element Name	Description
EquationX3ProductInputs	<p>Parent Element: A collection of data elements containing the inputs required for units producing solid product (see §98.243(c)(5)(iii)).</p> <p>Conditionally Required: These data elements are required only if the production unit produces solid product.</p>
ProductID	Provide a unique identifier for the product (e.g., “1”).
Values	Parent Element: A collection of data elements in terms of mass or volume for units producing solid product (see §98.243(c)(5)(iii)).
ProductName	<p>Provide the name of the product for which inputs are being uploaded.</p> <p>Important: The product name must match EXACTLY the product name in the facility’s annual emissions report to e-GGRT.</p>
MonthlyInputs	Parent Element: A collection of data elements containing the monthly inputs for units producing solid product (see §98.243(c)(5)(iii)).
MonthName	Specify 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 producing solid product (see §98.243(c)(5)(iii)).
Mass	Provide the quantity of the solid product produced during the month (kg).
CarbonContent	Provide the average carbon content of the solid product for the specified month (kg carbon per kg product).

Excerpt 12 below illustrates a portion of the XML file that can be used to upload solid product data to the IVT in terms of mass. Data for January and February are shown. Data for March through December would be uploaded in a similar format. See Appendix A for an example of a complete XML file that can be submitted through the IVT for solid product measured in terms of mass.

XML Excerpt 12
Example for Solid Product (Mass) – Equation X-3 IVT Inputs

```
- <EquationX3ProductInputs>
  <ProductID>1</ProductID>
  - <Values>
    <ProductName>Carbon Black</ProductName>
    - <MonthlyInputs>
      <MonthName>January</MonthName>
      - <Values>
        <Mass>5</Mass>
        <CarbonContent>0.3</CarbonContent>
      </Values>
    </MonthlyInputs>
    - <MonthlyInputs>
      <MonthName>February</MonthName>
      - <Values>
        <Mass>5</Mass>
        <CarbonContent>0.3</CarbonContent>
      </Values>
  </Values>
</EquationX3ProductInputs>
```

IV. Appendix A: Sample XML Document for Subpart X IVT

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

```

<FacilityInputs name="Pearson Chemical Corporation" id="523757" reportingYear="2014" lastUpdateDate="2014-10-23T11:28:21.388-04:00">
  <SubpartInputs>
    <SubpartXInputs>
      <SubpartXProcessUnitInputs>
        <ProcessUnitName>X3 Inputs</ProcessUnitName>
        <Values>
          <EquationX3FeedstockInputs>
            <FeedstockID>1</FeedstockID>
            <Values>
              <FeedstockName>Coal</FeedstockName>
              <MonthlyInputs>
                <MonthName>January</MonthName>
                <Values>
                  <Mass>10</Mass>
                  <CarbonContent>0.4</CarbonContent>
                </Values>
              </MonthlyInputs>
              <MonthlyInputs>
                <MonthName>February</MonthName>
                <Values>
                  <Mass>10</Mass>
                  <CarbonContent>0.4</CarbonContent>
                </Values>
              </MonthlyInputs>
              <MonthlyInputs>
                <MonthName>March</MonthName>
                <Values>
                  <Mass>10</Mass>
                  <CarbonContent>0.4</CarbonContent>
                </Values>
              </MonthlyInputs>
              <MonthlyInputs>
                <MonthName>April</MonthName>
                <Values>
                  <Mass>10</Mass>
                  <CarbonContent>0.4</CarbonContent>
                </Values>
              </MonthlyInputs>
              <MonthlyInputs>
                <MonthName>May</MonthName>
                <Values>
                  <Mass>10</Mass>
                  <CarbonContent>0.4</CarbonContent>
                </Values>
              </MonthlyInputs>
              <MonthlyInputs>
                <MonthName>June</MonthName>
                <Values>
                  <Mass>10</Mass>

```

```

    <CarbonContent>0.4</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>July</MonthName>
  <Values>
    <Mass>10</Mass>
    <CarbonContent>0.4</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>August</MonthName>
  <Values>
    <Mass>10</Mass>
    <CarbonContent>0.4</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>September</MonthName>
  <Values>
    <Mass>10</Mass>
    <CarbonContent>0.4</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>October</MonthName>
  <Values>
    <Mass>10</Mass>
    <CarbonContent>0.4</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>November</MonthName>
  <Values>
    <Mass>10</Mass>
    <CarbonContent>0.4</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>December</MonthName>
  <Values>
    <Mass>10</Mass>
    <CarbonContent>0.4</CarbonContent>
  </Values>
</MonthlyInputs>
</Values>
</EquationX3FeedstockInputs>
<EquationX3ProductInputs>
  <ProductID>1</ProductID>
  <Values>
    <ProductName>Carbon Black</ProductName>
  <MonthlyInputs>
    <MonthName>January</MonthName>
    <Values>
      <Mass>5</Mass>
      <CarbonContent>0.3</CarbonContent>

```

```
</Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>February</MonthName>
  <Values>
    <Mass>5</Mass>
    <CarbonContent>0.3</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>March</MonthName>
  <Values>
    <Mass>5</Mass>
    <CarbonContent>0.3</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>April</MonthName>
  <Values>
    <Mass>5</Mass>
    <CarbonContent>0.3</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>May</MonthName>
  <Values>
    <Mass>5</Mass>
    <CarbonContent>0.3</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
  <MonthName>June</MonthName>
  <Values>
    <Mass>5</Mass>
    <CarbonContent>0.3</CarbonContent>
  </Values>
</MonthlyInputs>
<MonthlyInputs>
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