COSMOS
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40 C.F.R. § 98.93

Calculating GHG emissions.

(a) You must calculate total annual emissions of each fluorinated GHG emitted by electronics manufacturing production processes from each fab (as defined in § 98.98) at your facility, including each input gas and each by-product gas. You must use either default gas utilization rates and by-product formations rates according to the procedures in paragraph (a)(1), (a)(2), or (a)(6) of this section, as appropriate, or the stack test method according to paragraph (i) of this section, to calculate emissions of each input gas and each by-product gas.

(1) If you manufacture semiconductors, you must adhere to the procedures in paragraphs (a)(1)(i) through (iii) of this section. You must calculate annual emissions of each input gas and of each by-product gas using Equations I-6 and I-7 of this subpart, respectively. If your fab uses less than 50 kg of a fluorinated GHG in one reporting year, you may calculate emissions as equal to your fab's annual consumption for that specific gas as calculated in Equation I-11 of this subpart, plus any by-product emissions of that gas calculated under paragraph (a) of this section.

$$\mathrm{Processtype}E_i = \sum_{j=1}^{N} E_{ij} \qquad \text{(Eq. I-6)}$$

Where:

ProcesstypeE_i = Annual emissions of input gas i from the process type on a fab basis (metric tons). E_{ij} = Annual emissions of input gas i from process sub-type or process type j as calculated in Equation I-8 of this subpart (metric tons). N = The total number of process sub-types j that depends on the electronics manufacturing fab and emission calculation methodology. If E_{ij} is calculated for a process type j in Equation I-8 of this subpart, N = 1.i = Input gas. j = Process sub-type or process type.

$$\mathrm{Processtype}BE_k = \sum_{j=1}^{N}\sum_{i} BE_{ijk} \qquad \text{(Eq. I-7)}$$

Where:

ProcesstypeBE_k = Annual emissions of by-product gas k from the processes type on a fab basis (metric tons). BE_{ijk} = Annual emissions of by-product gas k formed from input gas i used for process sub-type or process type j as calculated in Equation I-9 of this subpart (metric tons). N = The total number of process sub-types j that depends on the electronics manufacturing fab and emission calculation methodology. If BE_{ijk} is calculated for a process type j in Equation I-9 of this subpart, N = 1. i = Input gas. j = Process sub-type, or process type. k = By-product gas.

(i) You must calculate annual fab-level emissions of each fluorinated GHG used for the plasma etching/wafer cleaning process type using default utilization and by-product formation rates as shown in Table I-3 or I-4 of this subpart, and by using Equations I-8 and I-9 of this subpart.

$$E_{ij} = C_{ij} * (1 - U_{ij}) * \left(1 - (a_{ij} * d_{ij} * UT_{ij})\right) * 0.001 \quad \text{(Eq. I-8)}$$

Where:

E_{ij} = Annual emissions of input gas i from process sub-type or process type j, on a fab basis (metric tons). C_{ij} = Amount of input gas i consumed for process sub-type or process type j, as calculated in Equation I-13 of this subpart, on a fab basis (kg). U_{ij} = Process utilization rate for input gas i for process sub-type or process type j (expressed as a decimal fraction). a_{ij} = Fraction of input gas i used in process sub-type or process type j with abatement systems, on a fab basis (expressed as a decimal fraction). d_{ij} = Fraction of input gas i destroyed or removed in abatement systems connected to process tools where process sub-type, or process type j is used, on a fab basis (expressed as a decimal fraction). This is zero unless the facility adheres to the requirements in § 98.94(f). UT_{ij} = The average uptime factor of all abatement systems connected to process tools in the fab using input gas i in process sub-type or process type j, as calculated in Equation I-15 of this subpart, on a fab basis (expressed as a decimal fraction). 0.001 = Conversion factor from kg to metric tons. i = Input gas. j = Process sub-type or process type.

$$BE_{ijk} = B_{ijk} * C_{ij} * \left(1 - \left(a_{ij} * d_{jk} * UT_{ijk}\right)\right) * 0.001 \quad \text{(Eq. I-9)}$$

Where:

BE_{ijk} = Annual emissions of by-product gas k formed from input gas i from process sub-type or process type j, on a fab basis (metric tons). B_{ijk} = By-product formation rate of gas k created as a by-product per amount of input gas i (kg) consumed by process sub-type or process type j (kg). C_{ij} = Amount of input gas i consumed for process sub-type, or process type j, as calculated in Equation I-13 of this subpart, on a fab basis (kg). a_{ij} = Fraction of input gas i used for process sub-type, or process type j with abatement systems, on a fab basis (expressed as a decimal fraction). d_{jk} = Fraction of by-product gas k destroyed or removed in abatement systems connected to process tools where process sub-type, or process type j is used, on a fab basis (expressed as a decimal fraction). This is zero unless the facility adheres to the requirements in § 98.94(f). UT_{ijk} = The average uptime factor of all abatement systems connected to process tools in the fab emitting by-product gas k, formed from input gas i in process sub-type or process type j, on a fab basis (expressed as a decimal fraction). For this equation, UT_{ijk} is assumed to be equal to UT_{ij} as calculated in Equation I-15 of this subpart. 0.001 = Conversion factor from kg to metric tons. i = Input gas. j = Process sub-type or process type. k = By-product gas.

(ii) You must calculate annual fab-level emissions of each fluorinated GHG used for each of the process sub-types associated with the chamber cleaning process type, including in-situ plasma chamber clean, remote plasma chamber clean, and in-situ thermal chamber clean, using default utilization and by-product formation rates as shown in Table I-3 or I-4 of this subpart, and by using Equations I-8 and I-9 of this subpart.

(iii) If default values are not available for a particular input gas and process type or sub-type combination in Tables I-3 or I-4, you must follow the procedures in paragraph (a)(6) of this section.

(2) If you manufacture MEMS, LCDs, or PVs, you must calculate annual fab-level emissions of each fluorinated GHG used for the plasma etching and chamber cleaning process types using default utilization and by-product formation rates as shown in Table I-5, I-6, or I-7 of this subpart, as appropriate, and by using Equations I-8 and I-9 of this subpart. If default values are not available for a particular input gas and process type or sub-type combination in Tables I-5, I-6, or I-7, you must follow the procedures in paragraph (a)(6) of this section. If your fab uses less than 50 kg of a fluorinated GHG in one reporting year, you may calculate emissions as equal to your fab's annual consumption for that specific gas as calculated in Equation I-11 of this subpart, plus

any by-product emissions of that gas calculated under this paragraph (a).

(3)-(5) [Reserved]

(6) If you are required, or elect, to perform calculations using default emission factors for gas utilization and by-product formation rates according to the procedures in paragraphs (a)(1) or (a)(2) of this section, and default values are not available for a particular input gas and process type or sub-type combination in Tables I-3, I-4, I-5, I-6, or I-7, you must use the utilization and by-product formation rates of zero and use Equations I-8 and I-9 of this subpart.

(b) You must calculate annual fab-level N_2O emissions from all chemical vapor deposition processes and from the aggregate of all other electronics manufacturing production processes using Equation I-10 of this subpart and the methods in paragraphs (b)(1) and (2) of this section. If your fab uses less than 50 kg of N_2O in one reporting year, you may calculate fab emissions as equal to your fab's annual consumption for N_2O as calculated in Equation I-11 of this subpart.

$$E(N_2O)_j = C_{N_2O,j} \bullet \left(1 - U_{N_2O,j}\right) \bullet \left(1 - \left(a_{N_2O,j} \bullet d_{N_2O,j} \bullet UT_{N2O}\right)\right) \bullet 0.001 \qquad \text{(Eq. I-10)}$$

Where:

$E(N_2O)_j$ = Annual emissions of N_2O for N_2O-using process j, on a fab basis (metric tons). $C_{N2O,j}$ = Amount of N_2O consumed for N_2O-using process j, as calculated in Equation I-13 of this subpart and apportioned to N_2O process j, on a fab basis (kg). $U_{N2O,j}$ = Process utilization factor for N_2O-using process j (expressed as a decimal fraction) from Table I-8 of this subpart. $a_{N2O,j}$ = Fraction of N_2O used in N_2O-using process j with abatement systems, on a fab basis (expressed as a decimal fraction). $d_{N2O,j}$ = Fraction of N_2O for N_2O-using process j destroyed or removed in abatement systems connected to process tools where process j is used, on a fab basis (expressed as a decimal fraction). This is zero unless the facility adheres to the requirements in § 98.94(f). UT_{N2O} = The average uptime factor of all the abatement systems connected to process tools in the fab that use N_2O, as calculated in Equation I-15 of this subpart, on a fab basis (expressed as a decimal fraction). For purposes of calculating the abatement system uptime for N_2O using process tools, in Equation I-15 of this subpart, the only input gas i is N_2O, j is the N_2O using process, and p is the N_2O abatement system connected to the N_2O using tool. 0.001 = Conversion factor from kg to metric tons. j = Type of N_2O-using process, either chemical vapor deposition or all other N_2O-using manufacturing processes.