

TABLE 6.3 (UPDATED)
INFORMATION SOURCES NECESSARY FOR COMPLETING THE TIERED EMISSIONS ESTIMATING METHODS FOR GASEOUS FCs FOR ELECTRONICS MANUFACTURING

Note: The names of the variables have been simplified for the purpose of Table 6.3; please refer to the equations in each tiered methodology for the complete definitions of the variables and their units.

Legend: (Me) = measured; (Mo) = modelled (calculated but no equation specified in this chapter); (D) = default factors from guidance; (C) = calculated using an equation in this chapter.

* These variables are applicable to both sampling period and total year.

	Variables	Tier 1	Tier 2			Tier 3	
			2a	2b	2c	3a	3b
Production	Annual production	P (Me/Mo)					
	Fraction of PV manufacture that uses FC gases	F_{PV} (Me/Mo)					
	$\delta = 1$ when applied to PV industry and zero when applied to either semiconductor or TFT-Display industries, dimensionless	δ (D)					
	Total number of tools that use gas i to run process type p (e.g., chamber cleaning processes)		$n_{i,p}, n_{k,i,p}$ (Me)	$n_{i,p}, n_{k,i,p}$ (Me)	$n_{i,p}, n_{k,i,p}$ (Me)	$n_{i,p}, n_{k,i,p}$ (Me)	$n_{i,p}, n_{k,i,p}$ (Me)
	Number of tools that use gas i to run process type p and that are equipped with suitable emissions control technologies		$n_{i,p,a}, n_{k,i,p,a}$ (Me)	$n_{i,p,a}, n_{k,i,p,a}$ (Me)	$n_{i,p,a}, n_{k,i,p,a}$ (Me)	$n_{i,p,a}, n_{k,i,p,a}$ (Me)	$n_{i,p,a}, n_{k,i,p,a}$ (Me)
	Total number of tools that use gas i to run reference process type q (e.g., etch and/or wafer cleaning (EWC) processes)		$m_{i,q}, m_{k,i,q}$ (Me)	$m_{i,q}, m_{k,i,q}$ (Me)			$m_{i,q}, m_{k,i,q}$ (Me)
	Number of tools that use gas i to run reference process type q and that are equipped with suitable emissions control technologies		$m_{i,q,a}, m_{k,i,q,a}$ (Me)	$m_{i,q,a}, m_{k,i,q,a}$ (Me)			$m_{i,q,a}, m_{k,i,q,a}$ (Me)
Process Gas Entering Tool	Annual consumption of gas		C_i (C)	C_i (C)	$C_{i,p}$ (C)	$C_{i,p}$ (C)	$C_{i,f}$ (Me/Mo)
	Inventory of input gas stored in containers at the beginning of the reporting year		IB_i (Me)	IB_i (Me)	IB_i (Me)	IB_i (Me)	IB_i (Me)
	Inventory of input gas stored in containers at the end of the reporting year		IE_i (Me)	IE_i (Me)	IE_i (Me)	IE_i (Me)	IE_i (Me)
	Acquisitions of input gas during the year		A_i (Me)	A_i (Me)	A_i (Me)	A_i (Me)	A_i (Me)
	Transfers of input gas		T_i (C)	T_i (C)	T_i (C)	T_i (C)	T_i (C)
	Heel factor		$h_{i,c}$ (D/Me)	$h_{i,c}$ (D/Me)	$h_{i,c}$ (D/Me)	$h_{i,c}$ (D/Me)	$h_{i,c}$ (D/Me)
	Number of containers		$N_{i,c}$ (Me)	$N_{i,c}$ (Me)	$N_{i,c}$ (Me)	$N_{i,c}$ (Me)	$N_{i,c}$ (Me)
	Full capacity of containers		$F_{i,c}$ (Me)	$F_{i,c}$ (Me)	$F_{i,c}$ (Me)	$F_{i,c}$ (Me)	$F_{i,c}$ (Me)
	Total number of container types		M (Me)	M (Me)	M (Me)	M (Me)	M (Me)
	Apportioning factor		$\Phi_{i,p}$ (Me/Mo)	$\Phi_{i,p}$ (Me/Mo)	$\Phi_{i,p}$ (Me/Mo)	$\Phi_{i,p}$ (Me/Mo)	

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	Variables	Tier 1	Tier 2			Tier 3	
			2a	2b	2c	3a	3b
Process	Emission Factor	EF_i (D)					
	Use rate of gas		U_i (D)	U_i (D)	$U_{i,p}$ (D)	$U_{i,p}$ (Me)	
	Byproduct emission factor		$B_{k,i}$ (D)	$B_{k,i}$ (D)	$B_{k,i,p}$ (D)	$B_{k,i,p}$ (Me)	
Downstream Emissions Control	Destruction Removal Efficiency (DRE)		d_i, d_k (D)	d_i, d_k (D)	d_i, d_k (D)	d_i, d_k (D/Me)	d_i, d_k (D/Me)
	Overall reduction of emissions		$D_i, D_{k,i}$ (C)	$D_i, D_{k,i}$ (C)	$D_{i,p}, D_{k,i,p}$ (C)	$D_{i,p}, D_{k,i,p}$ (C)	
	Mass fraction of F_2 in process exhaust gas that is converted into CF_4 by direct reaction with hydrocarbon fuel in a combustion emissions control system.		AB_{i,CF_4} (D)	AB_{i,CF_4} (D)	AB_{i,CF_4} (D)	AB_{i,CF_4} (D)	
	Ratio of emissions control systems certified not to form CF_4 within emissions control systems to the total number of emissions control systems in the facility		η (Me)	η (Me)	η_p (Me)	η_p (Me)	
	Ratio of uncontrolled emissions per-tool from tools running weighted process types p (e.g., chamber cleaning processes) to uncontrolled emissions per-tool from process tools running reference process types q (e.g., EWC processes)		$\gamma_{i,p}, \gamma_{k,i,p}$ (D)	$\gamma_{i,p}, \gamma_{k,i,p}$ (D)			$\gamma_{i,p}, \gamma_{k,i,p}$ (D)
	Estimate of the fraction of gas exhausted from process tools equipped with suitable emissions control technologies		$a_i, a_{k,i}$ (C)	$a_i, a_{k,i}$ (C)	$a_{i,p}, a_{k,i,p}$ (C)	$a_{i,p}, a_{k,i,p}$ (C)	$a_{i,f}, a_{k,i,f}$ (C)
	Uptime factor of emissions control systems		UT (C)	UT (C)	UT_p (C)	UT_p (C)	UT_f (C)*
	Total time that emissions control system connected to process tool(s) in the plant is not in operational mode when at least one of the manufacturing tools connected to emissions control system is in operation		Td_n (Me)	Td_n (Me)	$Td_{n,p}$ (Me)	$Td_{n,p}$ (Me)	$Td_{n,f}$ (Me)*
	Total time during which emissions control system has at least one associated manufacturing tool in operation		TT_n (Me)	TT_n (Me)	$TT_{n,p}$ (Me)	$TT_{n,p}$ (Me)	$TT_{n,f}$ (Me)*

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Stack Test Specific	Flow rate of stack system during the sampling period						Q_s (Me)
	Molecular weight of gas						MW_i, MW_k (D)
	Standard molar volume of gas						SV (D)
	Average concentration of input gas in stack system during sampling						$X_{i,s,m}, X_{k,s,m}$ (Me)
	Length of time interval m in the FTIR sampling period						Δt_m (Me)
	Total number of time intervals m in sampling period						N (C)
	Consumption of input gas during the sampling period						Activity _{if} (Me)
Facility-specific emission factor						$EF_{i,f}, EF_{k,f}$ (C)	
Emissions	Emissions of FC gases or N ₂ O	$\{E_i\}_n$ (C)					
	Emissions of unreacted input gas		E_i (C)	E_i (C)	E_i (C)	E_i (C)	$EA_{i,f}, ES_{i,s}$ (C)
	Emissions of by-products		BPE_k (C)	BPE_k (C)	BPE_k (C)	BPE_k (C)	$EA_{k,f}, ES_{k,s}$ (C)
	Emissions of CF ₄ from hydrocarbon-fuel-based combustion emissions control systems		$EAB_{i,CF4}$ (C)	$EAB_{i,CF4}$ (C)	$EAB_{i,CF4}$ (C)	$EAB_{i,CF4}$ (C)	