

# Aluminum Production

## Subpart F, Greenhouse Gas Reporting Program

### OVERVIEW

Subpart F of the Greenhouse Gas Reporting Program (GHGRP) (40 CFR 98.60 – 98.68) applies to any facility that contains an aluminum (Al) production process and meets the Subpart F source category definition. Some subparts have thresholds that determine applicability for reporting, and some do not. To decide whether your facility must report under this subpart, please refer to 40 CFR 98.61 and the GHGRP [Applicability Tool](#).

This Information Sheet is intended to help facilities reporting under Subpart F understand how the source category is defined, what greenhouse gases (GHGs) must be reported, how GHG emissions must be calculated and shared with EPA, and where to find more information.



## How is This Source Category Defined?

The aluminum (Al) production source category consists of facilities that manufacture primary Al using the Hall-Héroult manufacturing process. The primary Al manufacturing process consists of the following operations:

- Electrolysis in prebake and Söderberg cells.
- Anode baking for prebake cells.

This source category does not include experimental cells or research and development process units.



## What GHGs Must Be Reported?

Each Al production facility must report:

- Perfluoromethane (CF<sub>4</sub>) and perfluoroethane (C<sub>2</sub>F<sub>6</sub>) emissions from anode effects in all prebake and Söderberg electrolysis cells combined.
- Carbon dioxide (CO<sub>2</sub>) emissions from anode consumption during electrolysis in all prebake and Söderberg cells.
- All CO<sub>2</sub> emissions from onsite anode baking.

If multiple Greenhouse Gas Reporting Program (GHGRP) source categories are co-located at a facility, the facility may need to report greenhouse gas (GHG) emissions under a different subpart. For example, facilities must report CO<sub>2</sub>, nitrous oxide (N<sub>2</sub>O), and methane (CH<sub>4</sub>) emissions from each stationary combustion unit on site by following the requirements of Subpart C (General Stationary Fuel Combustion Sources), found at 40 CFR 98.30 – 98.38. Please refer to the relevant Information Sheet for a summary of the rule requirements for any other source categories located at the facility.



## How Must GHG Emissions Be Calculated?

Facilities must calculate GHG process emissions using the following methods:

- **CF<sub>4</sub> from anode effects.** Calculate annual CF<sub>4</sub> emissions based on the frequency and duration of

anode effects in the Al electrolytic reduction process for each prebake and Søderberg electrolysis cell using the following parameters:

- Anode effect minutes per cell-day (AEM/cell-day) calculated monthly.
- Al metal production calculated monthly.
- A slope coefficient relating  $\text{CF}_4$  emissions to AEM/cell-day and Al production. The slope coefficient is specific to each smelter. Smelters that have never measured the slope coefficient must measure it within one year of rule publication. Smelters that have measured it must re-measure it within three years of rule publication. Thereafter, all smelters must measure it at least once every 10 years, or whenever there is a major technological or process change. The slope coefficient must be measured in accordance with the protocol specified in the rule. Under certain conditions, high-efficiency smelters may use a default slope coefficient from Table F-1 in the rule.
- **$\text{C}_2\text{F}_6$  from anode effects.** Estimate annual  $\text{C}_2\text{F}_6$  emissions from anode effects from each prebake and Søderberg electrolysis cell using the estimated  $\text{CF}_4$  emissions and the mass ratio of  $\text{C}_2\text{F}_6$  to  $\text{CF}_4$  emissions, as determined during the same test during which the slope coefficient is determined.
- **Process  $\text{CO}_2$  emissions.** Reporters can elect to calculate and report process  $\text{CO}_2$  emissions from anode consumption during electrolysis and from anode baking by using one of two methods:
  - Installing and operating a continuous emission monitoring system (CEMS) and following the Tier 4 Calculation Methodology (in 40 CFR Part 98, Subpart C).
  - Using the calculation procedures specified below.
- **$\text{CO}_2$  emissions from anode consumption in prebake cells.** Estimate annual  $\text{CO}_2$  emissions at the facility level using a mass balance equation based on measurements of the following parameters:
  - Net prebaked anode consumption rate per metric ton of Al produced.
  - Ash and sulfur (S) contents of the anodes.
  - Total mass of Al produced per year for all prebake cells.
- **$\text{CO}_2$  emissions from Søderberg cells.** Estimate  $\text{CO}_2$  emissions from paste consumption in Søderberg cells using a mass balance equation at the facility level based on the following parameters:
  - Paste consumption rate per metric ton of Al produced and the annual mass of Al produced for all Søderberg cells.
  - Emissions of cyclohexane ( $\text{C}_6\text{H}_{12}$ )-soluble matter per metric ton of Al produced.
  - Binder content of the anode paste.
  - S, ash, and hydrogen ( $\text{H}_2$ ) contents of the coal tar pitch used as the binder in the anode paste.
  - S and ash contents of the calcined coke used in the anode paste.
  - Carbon (C) in the skimmed dust from the cell per metric ton of Al produced.
- **$\text{CO}_2$  emissions from anode baking of prebake cells.** Estimate  $\text{CO}_2$  emissions at the facility level separately from pitch volatiles and from bake furnace packing material.
  - To estimate  $\text{CO}_2$  emissions from the pitch volatiles, use a mass balance equation based on

the following parameters:

- Initial weight of the green anodes.
- Mass of H<sub>2</sub> in the green anodes.
- Mass of the baked anodes.
- Mass of waste tar collected.
- To estimate CO<sub>2</sub> emissions from bake furnace packing material, use a mass balance equation based on the following parameters:
  - Packing coke consumption rate per ton of baked anode production.
  - S and ash contents of the packing coke.

Facilities must also measure the smelter-specific values used to estimate CO<sub>2</sub> emissions from anode and paste consumption (e.g., S, ash, and H<sub>2</sub> contents), or use default values listed in the rule.

If process CO<sub>2</sub> emissions from anode consumption during electrolysis or anode baking are emitted through the same stack as a combustion unit or process equipment that uses a CEMS and follows the Tier 4 Calculation Methodology in the rule to report CO<sub>2</sub> emissions, then the CEMS must be used to measure and report combined CO<sub>2</sub> emissions from that stack, instead of using the calculation procedures specified above.

A checklist for data that must be monitored is available here: [Subpart F Monitoring Checklist](#).



## What Information Must Be Reported?

In addition to the information required by the General Provisions in Subpart A, found at 40 CFR 98.3(c), the following must be reported:

- Type of smelter technology used.
- The following perfluorocarbons (PFC)-specific information on an annual basis:
  - CF<sub>4</sub> and C<sub>2</sub>F<sub>6</sub> emissions from anode effects in all prebake and Söderberg electrolysis cells combined.
  - AEM/cell-day, anode effect frequency, anode effect duration, if estimating CF<sub>4</sub> emissions from anode effect duration.
  - Anode effect overvoltage factor, potline overvoltage, and current efficiency, if estimating CF<sub>4</sub> from overvoltage.
  - Smelter-specific slope coefficients (or overvoltage emission factors (EFs)) and the last date when the smelter-specific-slope coefficients (or overvoltage EFs) were measured, if estimating CF<sub>4</sub> emissions from overvoltage.
- Method used to measure the frequency and duration of anode effects (or overvoltage).
- The following CO<sub>2</sub>-specific information for prebake cells on an annual basis:
  - Anode consumption if using the method in 40 CFR 98.63(g).
  - CO<sub>2</sub> emissions from the smelter.
- The following CO<sub>2</sub>-specific information for Söderberg cells on an annual basis:
  - Paste consumption if using the method in 40 CFR 98.63(g).
  - CO<sub>2</sub> emissions from the smelter.
- Smelter-specific inputs to the CO<sub>2</sub> process equations (e.g., levels of S and ash) that were used in the calculation.



## What Records Must Be Maintained?

Reporters are required to retain records that pertain to their annual GHGRP report for at least three years after the date the report is submitted. Please see the [Subpart A Information Sheet](#) and 40 CFR 98.3(g) for general recordkeeping requirements. Specific recordkeeping requirements for Subpart F are listed at 40 CFR 98.67.



## When and How Must Reports Be Submitted?

Reporters must submit their annual GHGRP reports for the previous calendar year to the EPA by March 31<sup>st</sup>, unless the 31<sup>st</sup> falls on a Saturday, Sunday, or federal holiday, in which case reports are due on the next business day. Annual reports must be submitted electronically using the [electronic Greenhouse Gas Reporting Tool \(e-GGRT\)](#), the GHGRP's online reporting system.

Additional information on setting up user accounts, registering a facility, and submitting annual reports is available on the [GHGRP Help webpage](#).



## When Can a Facility Stop Reporting?

A facility may discontinue reporting under several scenarios, which are summarized in Subpart A (found at 40 CFR 98.2(i)) and the [Subpart A Information Sheet](#).



## For More Information

For additional information on Subpart F, please visit the [Subpart F webpage](#). For additional information on the GHGRP, please visit the [GHGRP website](#), which includes additional information sheets, [data](#) previously reported to the GHGRP, [training materials](#), and links to [FAQs](#). For questions that cannot be answered through the GHGRP website, please contact us at: [GHGreporting@epa.gov](mailto:GHGreporting@epa.gov).

*This Information Sheet is provided solely for informational purposes. It does not replace the need to read and comply with the regulatory text contained in the rule. Rather, it is intended to help reporting facilities and suppliers understand key provisions of the GHGRP. It does not provide legal advice; have a legally binding effect; or expressly or implicitly create, expand, or limit any legal rights, obligations, responsibilities, expectations, or benefits with regard to any person or entity.*