Today, we will:

- Discuss some more terminology related to the study of air pollution
- Begin a discussion of EFs (Emission Factors) – how to estimate emissions

Emission Factors (EFs)

Emission factors are a quick and dirty way to estimate emissions of air pollutants from various activities or manufacturing processes.

Definition of **Emission Factor**: $$EF = \frac{\text{mass of contaminent emitted}}{\text{mass of raw material used or product produced}}$$

- Typical units are kg/Mg, but sometimes other units like mg/cigarette (for a particular product), kg/m^2 (for evaporation of liquid solvents), kg/mile (for auto emissions), etc.
- EPA publishes EFs in document AP-42, so EFs are often called "**AP-42 Emission Factors**".
- Sometimes EF is called **Emission Index**, **EI**, particularly for fuel combustion and power production.
- See EPA website www.epa.gov/ttn/chief.
- **CHIEF** = ClearingHouse for Inventories and Emission Factors.
- EFs are "ballpark" estimates for "back of the envelope" calculations – typically good to only one or two significant digits.
- EFs are listed for ***uncontrolled emissions*** (no APCS used), but sometimes also list emissions with some APCS used (**APCS = Air Pollution Control System**).

Example, Open Hearth Furnace (OHF) for steel production.

Source	Units	Emission Factor		EMISSION FACTOR RATING	Particle Size Data
Open hearth furnace					
Melting and refining	kg/Mg (lb/ton) steel				
Uncontrolled		10.55	(21.1)	D	Yes
Controlled by ESP		0.14	(0.28)	D	Yes
Roof monitor		0.084	(0.168)	C	

Example, Basic Oxygen Furnace (BOF) for steel production.

Basic oxygen furnace (BOF)					
Top blown furnace melting and refining	kg/Mg (lb/ton) steel				
Uncontrolled		14.25	(28.5)	B	
Controlled by open hood venter to:					
ESP		0.065	(0.13)	A	
Scrubber		0.045	(0.09)	B	

Example: Emission Factors

Given: A steel mill has an open hearth furnace with which it does melting and refining. The furnace refines about 8 tons of steel per hour on average.

To do: Estimate the uncontrolled emission rate of particles in kg/hr.

Solution: First we look up the EF of particle emissions in an open hearth furnace:
EF = 10.55 kg/Mg.

Example: EFs and APCS (Air Pollution Control System)

Given: A steel plant produces 820 Mg of steel per day using a basic oxygen furnace (BOF). Fumes are cleaned with an electrostatic precipitator and a scrubber before going up the stack. Measurements of the stack exhaust show that 32 kg of particulate matter are emitted per day.

To do: Calculate the overall efficiency of the APCS as a percentage (to 3 digits).

Solution: First we look up the EF of particle emissions in a BOF: EF = 14.25 kg/Mg.