

## Week 1 Task 1:

Identify emission sources for any 3 industrial chemical processes

### 1. The Born-Haber Process (Ammonia Synthesis)

- **Process Emissions:**
  - **Steam Methane Reforming (SMR):** To get the hydrogen needed for ammonia, natural gas(Methane) is reacted with steam. This chemical reaction strips carbon from the methane, releasing it as high-purity CO<sub>2</sub>. This is a "point source" emission.
- **Energy-Related Emissions:**
  - **Primary Reformer Furnaces:** The SMR reaction requires temperatures around 800°C. Natural gas is burned in furnaces to provide this heat, creating CO<sub>2</sub>.
  - **Compressors:** The actual synthesis of ammonia happens at high pressures (150-250 bar). The compressors used to reach these pressures are usually steam-driven or gas-powered, adding to the energy footprint.

### 2. Petroleum Refining

- **Major Emission Sources:**
  - **Process Heaters & Boilers:** These burn "refinery fuel gas" (a byproduct of the refining process) to heat crude oil for distillation. This is the largest source of CO<sub>2</sub> in a refinery.
  - **Fluid Catalytic Cracking (FCC):** To break heavy oils into gasoline, a catalyst is used. Over time, coke (pure carbon) builds up on the catalyst. This coke is burned off in a regenerator, releasing a steady stream of CO<sub>2</sub>.
  - **Flaring & Venting:** Excess gases are burned and flared, which releases CO<sub>2</sub>.

### 3. Plastic Production (Polymerization)

- **Major Emission Sources:**
  - **Steam Cracking:** This is the most energy-intensive step. Feedstocks like Ethane or Naphtha are heated to >800°C in furnaces to break them into Ethylene. The fuel burned to reach these temperatures is a massive CO<sub>2</sub> source.
  - **Polymerization Reactors:** Converting Ethylene gas into solid Polyethylene pellets requires precise temperature control and high-power stirrers/extruders. The electricity used for these machines constitutes Indirect Emissions.

Week 1 Task 3:

Component	Value	Source
<b>Activity</b>	Steam Generation (Chemical Plant)	Industrial Boiler Benchmark
<b>Fuel Used</b>	Natural Gas	Process
<b>Consumption</b>	847,552 SCF/Day	Conversion from 24,000 m <sup>3</sup>
<b>Emission Factor</b>	0.0544 Kg CO <sub>2</sub> /SCF	<b>US EPA 2025 GHG Hub</b>
<b>Total Emissions</b>	<b>46,106.8Kg CO<sub>2</sub></b>	Calculated