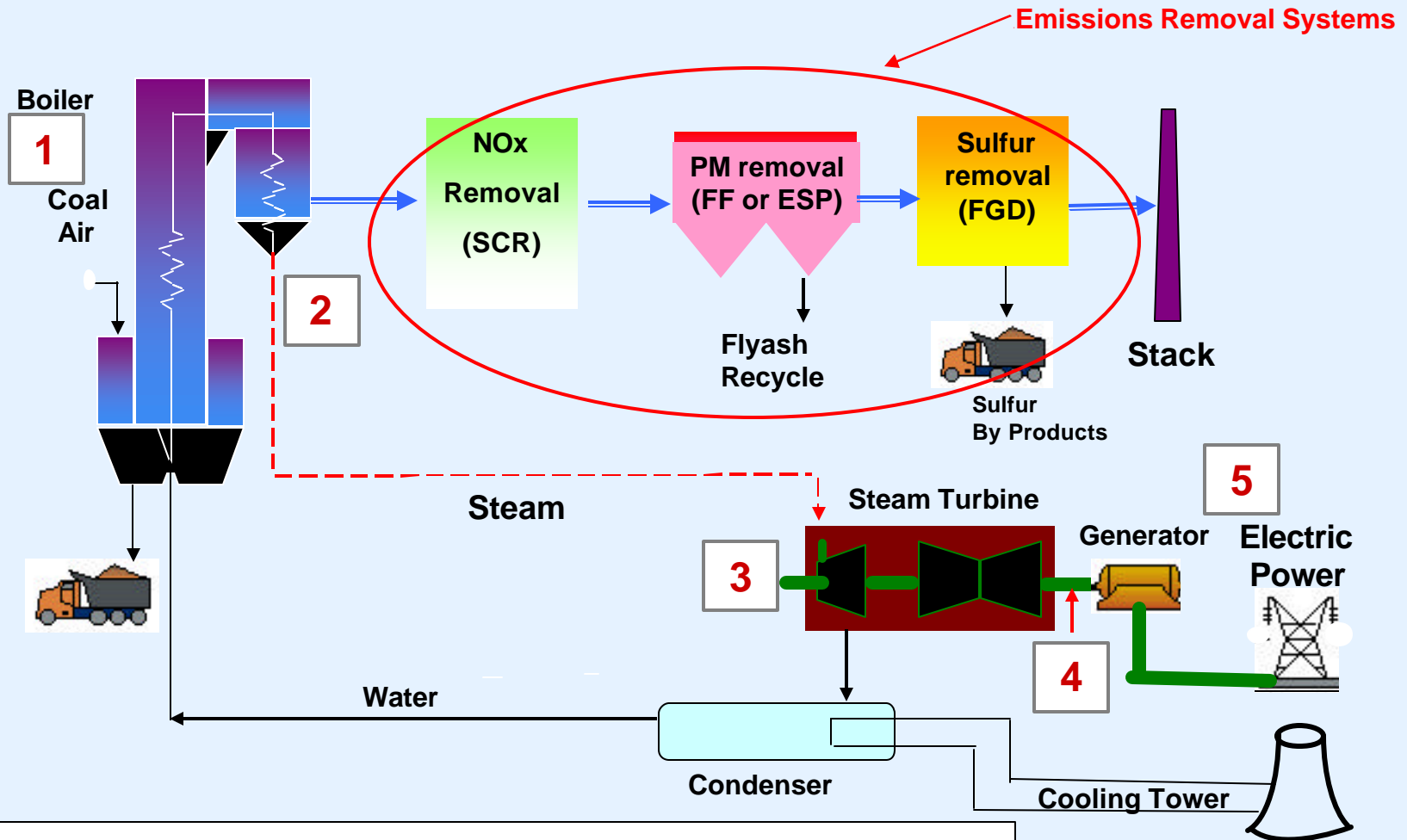


# Coal to Electricity: How It Works



# How Does a Pulverized Coal Plant with Emissions Removal Systems Work?



1. Air and coal enter boiler and burn
2. Heat converts water to steam
3. Steam turns blades of a turbine
4. Turbine shaft turns generator
5. Generator makes electricity

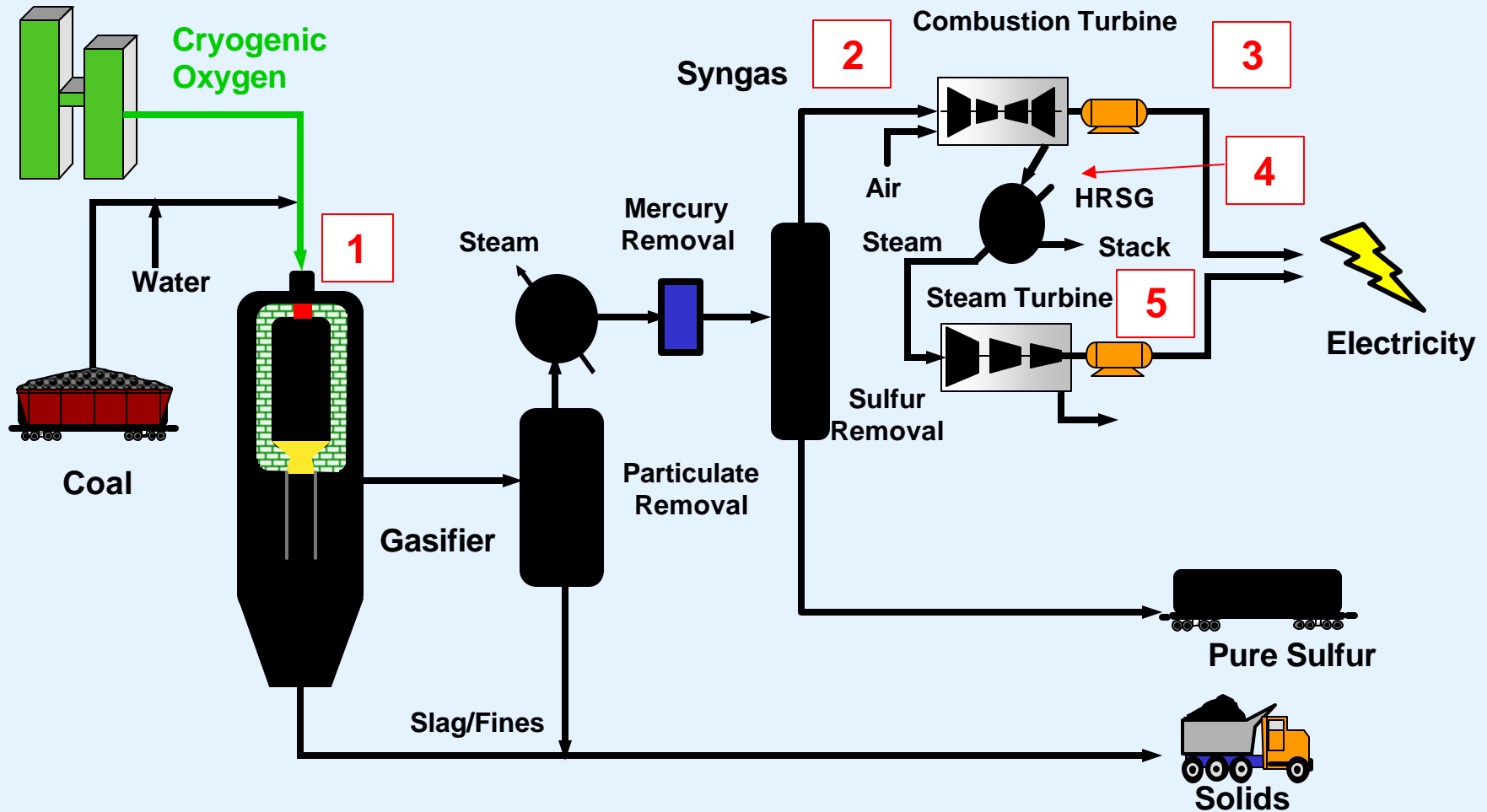
# Pulverized Coal Combustion

- In pulverized coal combustion, coal is crushed to a powder and blown into a boiler with air where it is combusted in burners. This provides the heat that is used to produce superheated steam to drive turbines and generate electricity.
- Nearly all of the world's coal-fired electricity is produced using pulverized coal combustion systems.
- Installing emissions control equipment can reduce emissions from pulverized coal units.

# Advanced Pulverized Coal Combustion

- The average thermal efficiency of U.S. power plants has increased from 5% in 1900, to around 35% currently.
- New conventional pulverized coal plants can achieve between 37% and 40% efficiency, depending on the coal type used and the location of the plant.
- Advanced plants are starting to use specially developed high strength alloy steels, which enable the use of supercritical and ultra-supercritical steam (high pressures and temperatures necessary to achieve the higher combustion efficiencies) that permit plants to achieve, depending on location, efficiencies higher than 40%.
- Application of new advanced materials to pulverized coal power plants (without carbon capture) could enable efficiencies of between 50% and 55% to be achieved in the future. This results in corresponding reductions in CO<sub>2</sub> emissions as less fuel is used per unit of electricity generated.

# How Does An IGCC Power Plant Work?



1. Gasifier converts coal, oxygen & steam to syngas
2. Cleaned syngas ( $\text{SO}_x$ , Hg, PM removed) is burned
3. Combustion gases expand in gas turbine, generates power

4. Waster heat generates steam (HRSG)
5. Steam expands in steam turbine, generates more power

# IGCC – How It Works

- Coal gasification reacts coal with steam and controlled amounts of air or oxygen under high temperatures and pressures in a gasifier. The heat and pressure break apart the chemical bonds in the coal's molecular structure, setting into motion chemical reactions with the steam and oxygen to form a gaseous mixture, called a synthesis gas (or syngas) made up primarily of carbon monoxide and hydrogen, which is then combusted in a turbine to generate electricity.
- The syngas can be “cleaned up” prior to its combustion in a turbine, meaning the  $\text{SO}_2$  and  $\text{NO}_x$  can be removed from the gas and disposed of prior to combustion.
- The Integrated Coal Gasification Combined Cycle (IGCC) IGCC system has two basic components: (1) a gas turbine burns the cleaned up syngas to produce electricity; and (2) exhaust heat from the gas turbine is recovered to produce steam to power traditional high efficiency steam turbines.