ENSR | AECOM

Renewable Energy
The Gasification Option

Keys to Success





Three step process of Gasification:

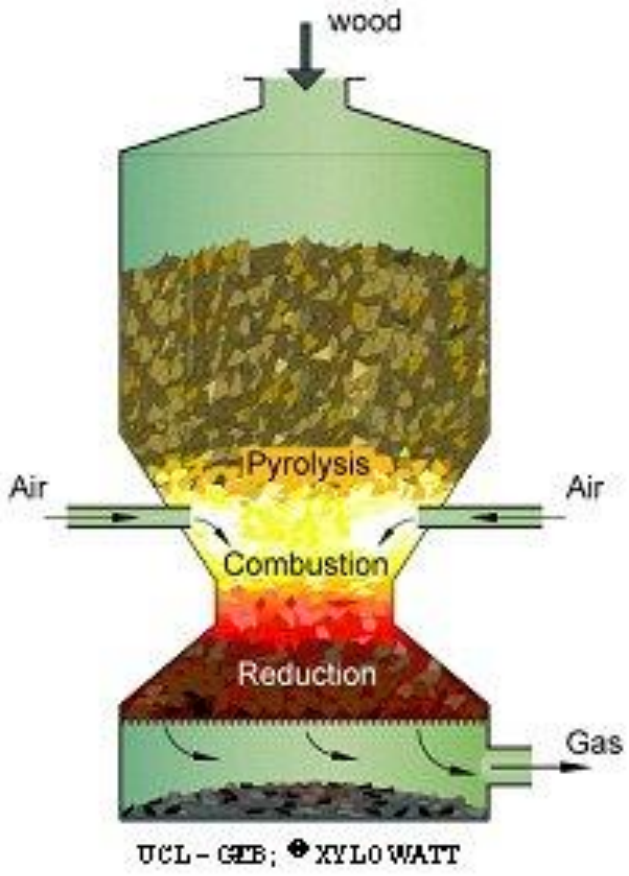


Illustration of Biomass Gasification

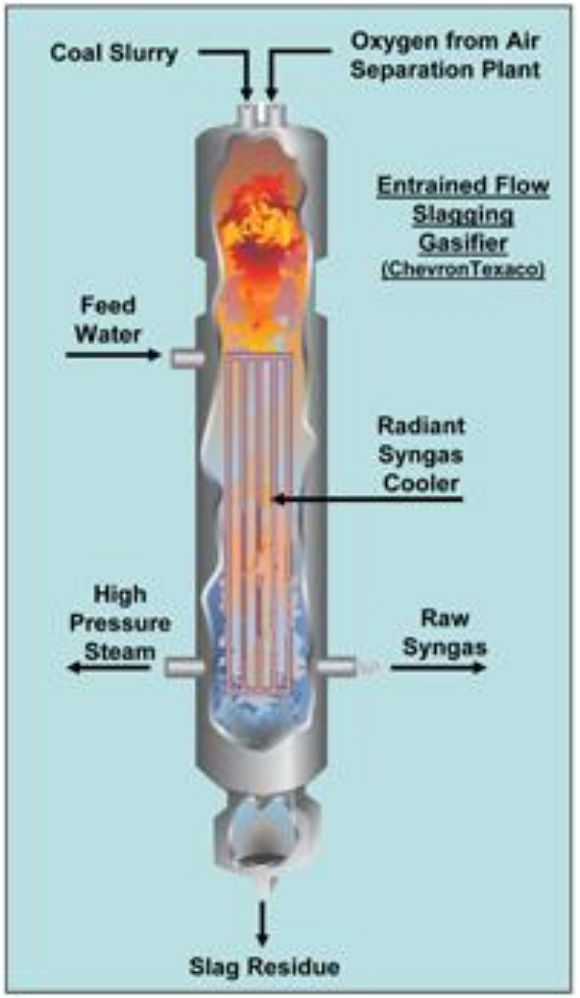
1. Pyrolysis
2. Combustion
3. Gasification (or Reduction)

* The process may vary slightly depending on specific inputs and outputs

Types of Gasifiers:

Modern gasification technologies generally fall into four categories depending upon the flow conditions in the gasifier:

1. Updraught or counter current
2. Downdraught or co-current
3. Entrained flow
4. Fluidized bed



Inputs and Outputs:

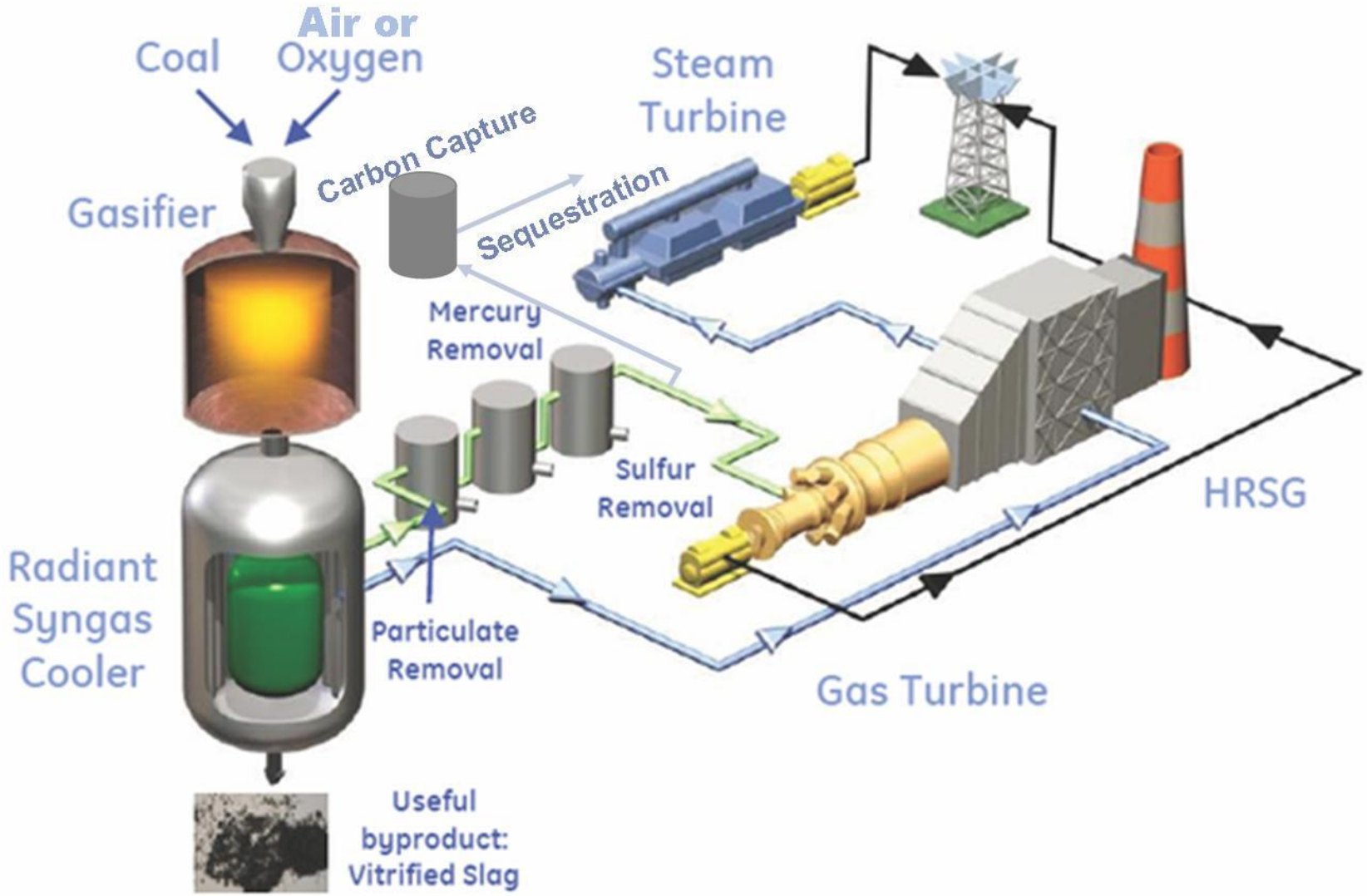
Common Inputs

- Municipal waste
- Scrap tires
- Coal
- Sewage sludge
- Biomass

Common outputs

- Syngas
- Power (in conjunction with engines or gas/steam turbines)
- Hydrogen (which can be used in fuel cells or in the H2 economy)
- F.T. fuels
- Ethanol and methanol through gas synthesis

IGCC Diagram:



IGCC in The U.S.

- The United States has many combined cycle plants in operation across the country
  - The El Dorado refinery (Kansas)
    - Began its cogeneration processes in 1996
    - Uses primarily petcoke and wastes as fuel
    - Generates power and steam through Entrained-flow gsification
  - Wabash River Coal Gasification Repowering Project (Indiana)
    - one of Cleanest Coal/Petcoke Fired Power Plants in the World
    - 1997-set the record of the longest operating run of the gasifier to date

Advantages of Gasification:

- has a higher efficiency than incineration
- feedstock flexibility
- near-zero emissions
- lessen over-reliance on fuel imports
- easy integration with other technologies for advanced power generation
- syngas produced can be converted into many valuable products (i.e.-electricity, steam, liquid fuels, basic chemicals, and hydrogen)
- with IGCCs much less cooling water is required

Drawbacks to Gasification:

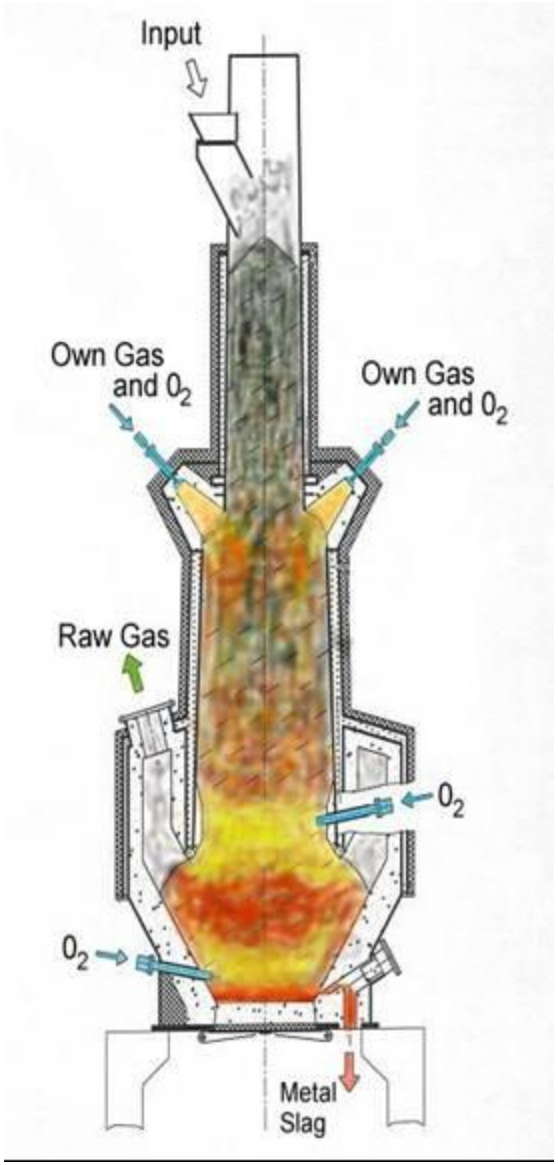
- the ash generated can cause a variety of problems particularly in up or downdraught gasifiers
- technology to remove the toxins fromm the gas produced does not exist on a commercial scale
- pollutants such as SOx and NOx are released during combustion of most feedstock
- some plants have not been able to stay up to the standards predicted during the permitting process
- high capital and operating costs relative to competing alternatives
- not economical to transport the gas produced by such facilities over long distances so the power generation equipment must be sited with the gasification facilities

Permitting Issues Associated with IGCC:

- IGCC Permitting Issues fall into the basic categories of:
  - air permitting
    - NSPS, BACT Analysis, PSD/Visibility Modeling, PM2.5 Non-Attainment
  - wastewater permitting
    - Effluent Guidelines Applicability, NPDES permitting (water intake and discharging)
  - landfill permitting
    - Geotechnical Evaluations, Environmental/Archeological Studies
  - USACE permitting
    - Environmental/Archeological Studies, Section 10 and 404, 401 Water Quality Certifications
  - NEPA permitting
    - Applicability and Environmental Assessment/Impact Studies
  - State permitting
    - varies by state and it is usually hard to predict what extra permitting measures must be taken

Renewable Feedstocks

With the recent push for renewables, many countries are finding that the gasification of biomass, biosolids, sewage sludge, and biosludge provide an almost perfect solution to the environmental shortages we now face.



High Temperature Conversion of Waste