



Hydrogen production from Biomass

(High Temperature Steam Gasification)

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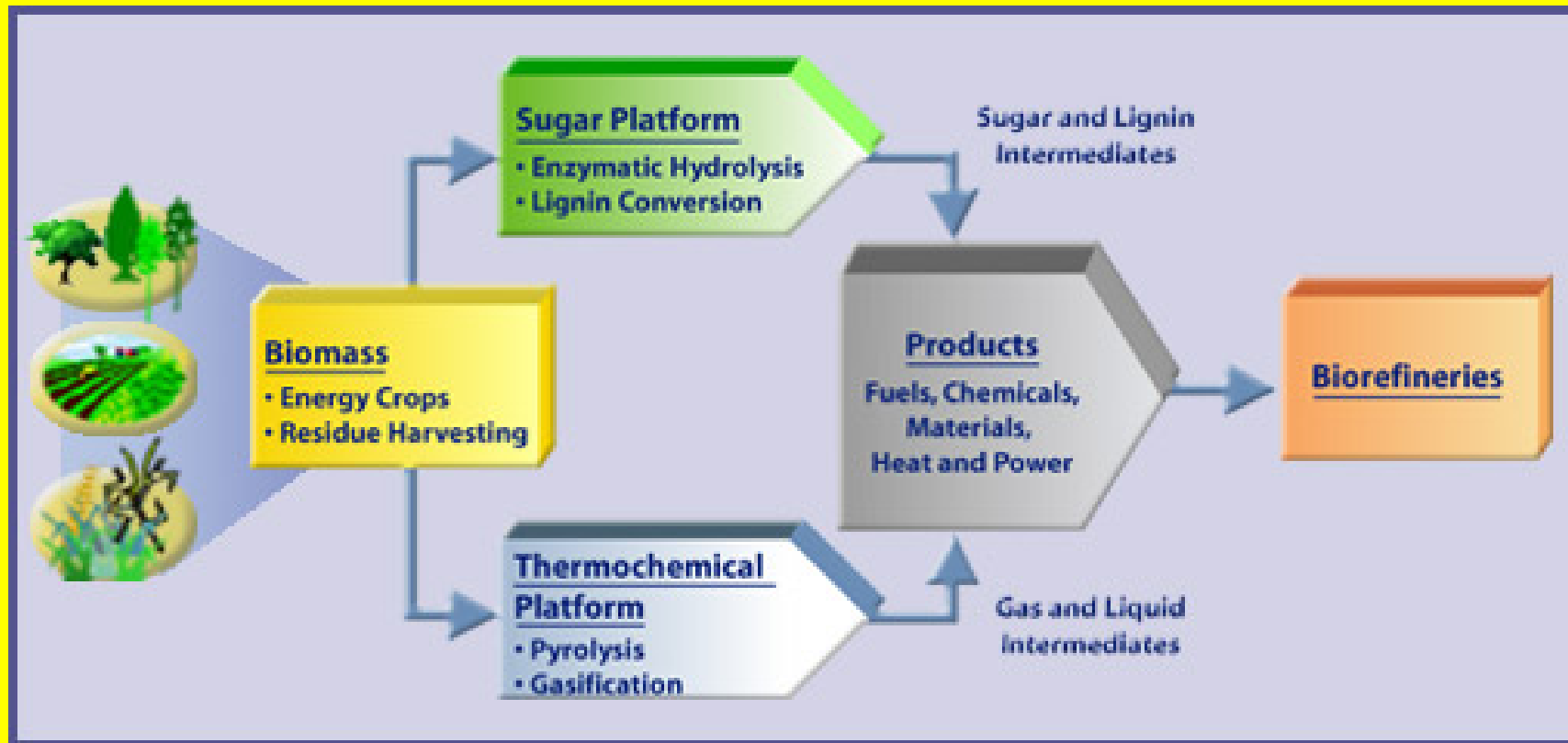
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Biomass Program Research Strategy



Program works closely with the [U.S. Department of Agriculture](#) and other government programs (NBI)



Motivation for Steam Gasification

- **Hydrogen Production:**

Biomass waste, such as, paper, wood chips or rice straw can be utilized to produce clean hydrogen fuel for use in fuel cells, engines, propulsion and many other applications

- **Reduced Emissions:**

Biomass is CO₂ neutral.

Hydrogen does not produce hydrocarbons, CO, and greenhouse gases

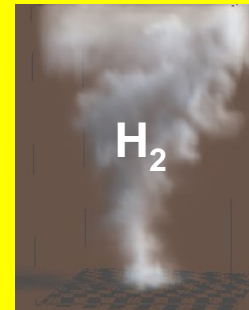
- **Mass Reduction of Waste:**

Thermal destruction of biomass and wastes provide 80-99% mass reduction thus minimizing the problem of waste disposal and its effect on the environment



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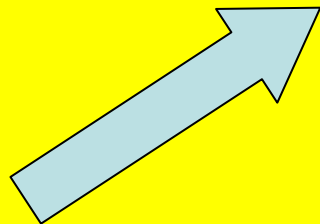
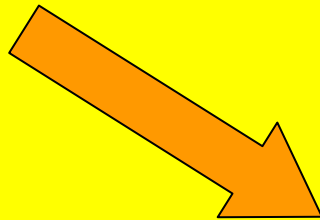
Biomass to Gas Conversion

- Thermal heating with or without air or O₂
- Low temperature pyrolysis (former city gas)
- Starved air burning
- Low temp. gasification
- High temperature gasification
- Ultra-high temperature steam gasification



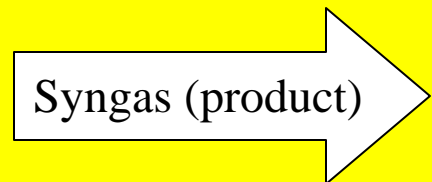
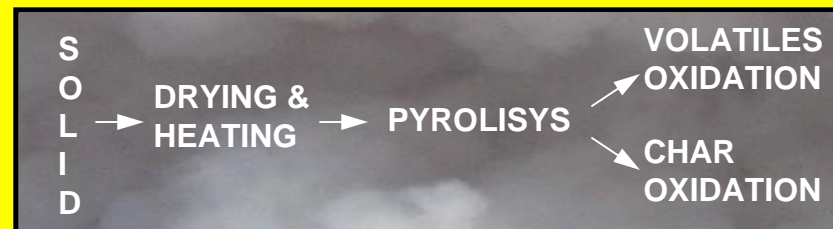
Schematic of Steam Gasification

Feedstock (biomass, MSW, coal ...)



Steam (gasifying agent)

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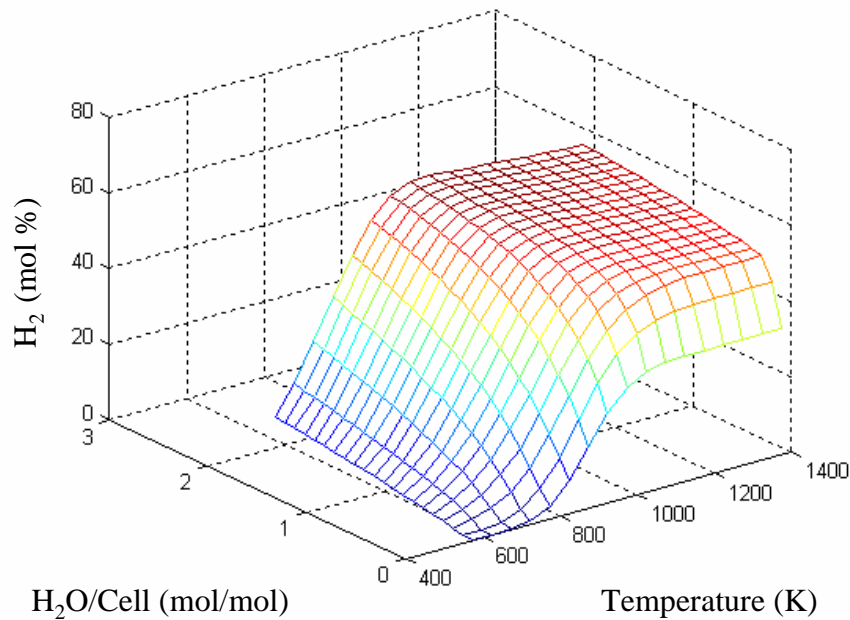


Syngas (product)

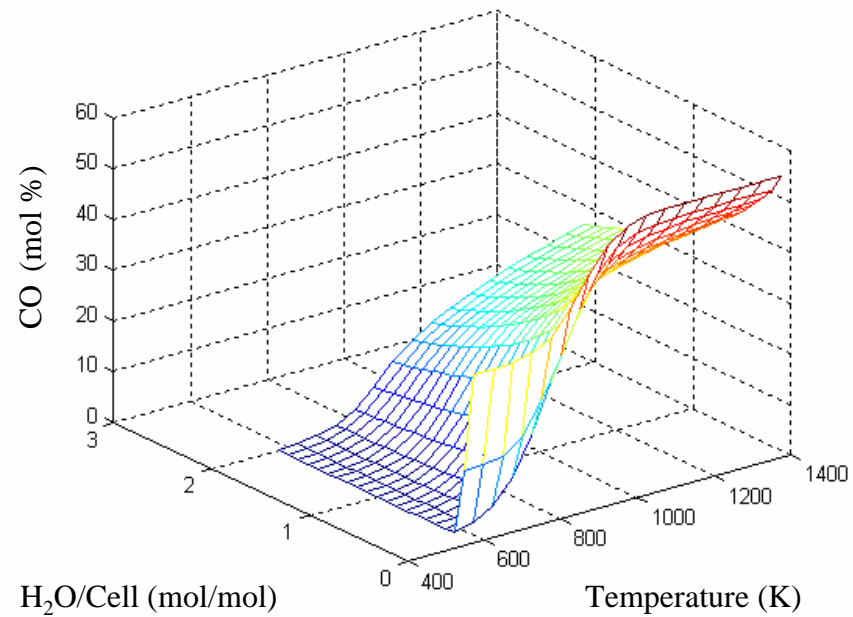


Numerical Simulation Results

Numerical simulations were done with the use of EQUIL – a part of Chemkin Collection package software. Cellulose ($C_6H_{10}O_5$) was the assumed biomass, since common waste largely consists of this compound (estimated 47%).



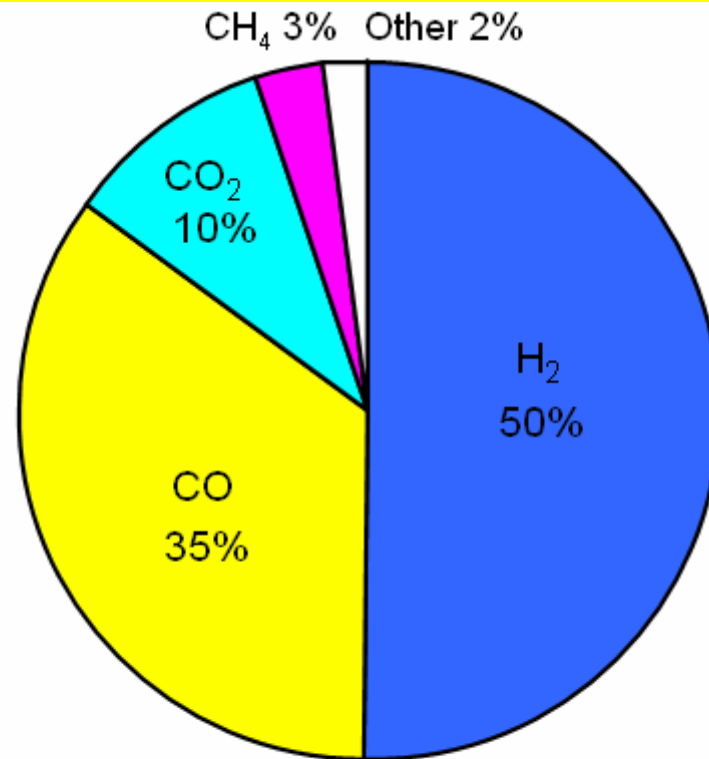
H₂ yield in a dry syngas (cellulose)



CO yield in a dry syngas (cellulose)



Hydrogen yield from Biomass



Temperature = 1100 °C
Steam/Feedstock = 9



Summary

- Great potential for the conversion of biomass and wastes to clean hydrogen-rich syngas
- Hydrogen can be separated out from syngas
- Process alleviates the production and emission of harmful pollutants
- None to negligible tars