

Thermal Conversion of Biomass

(Combustion, Gasification, Pyrolysis)

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Renewable Energy Roundtable

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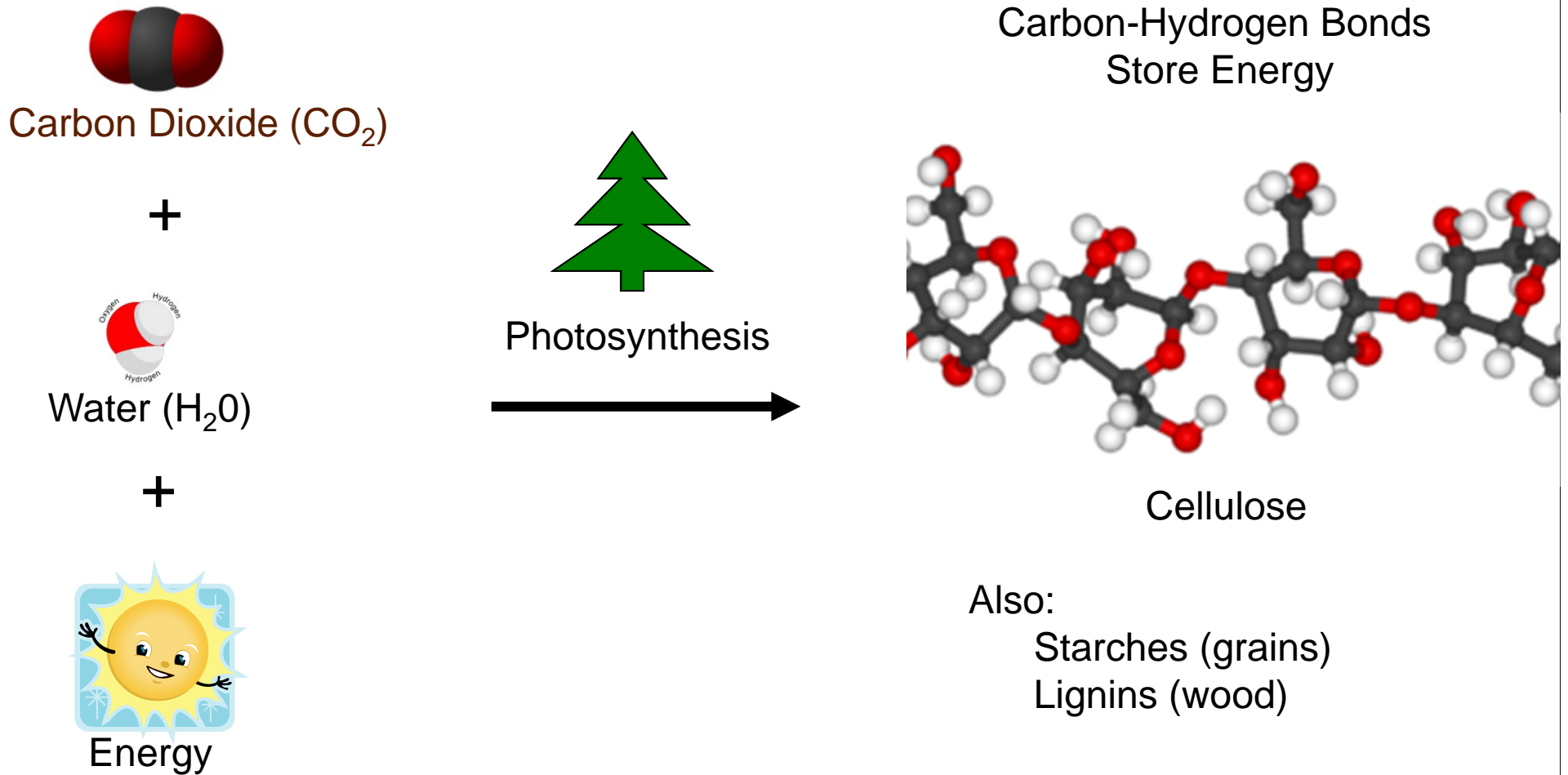
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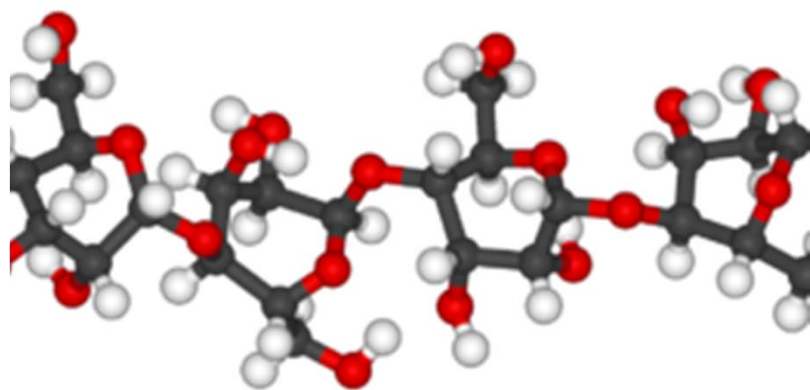
Making Biomass Energy

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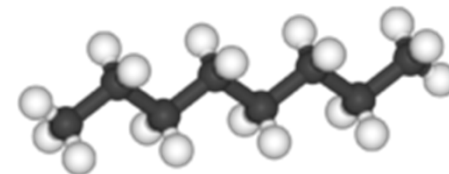


Converting Biomass Energy

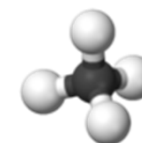
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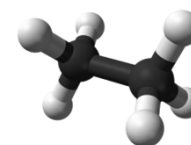
Cellulose
(or Starch, Lignin)



Octane



Methane



Ethane



Heat

Thermal Conversion of Energy

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- Can use all forms of carbon in biomass
 - Starch (easy to breakdown)
 - Cellulose and hemi-cellulose
 - Lignin (very tough to breakdown)
- Methods produces heat and more
- Specific technique depends on oxygen



Combustion

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- Oldest form of biomass energy conversion
- Used traditionally
 - Heat
 - Process Energy
 - Power Generation (via steam)
- Releases all chemical energy in biomass



Gasification

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- Converts biomass to vaporous gas
(like natural gas, not a liquid fuel)
- Energy is transferred to the gas and heat
- Concept is very simple

Biomass is heated with limited oxygen

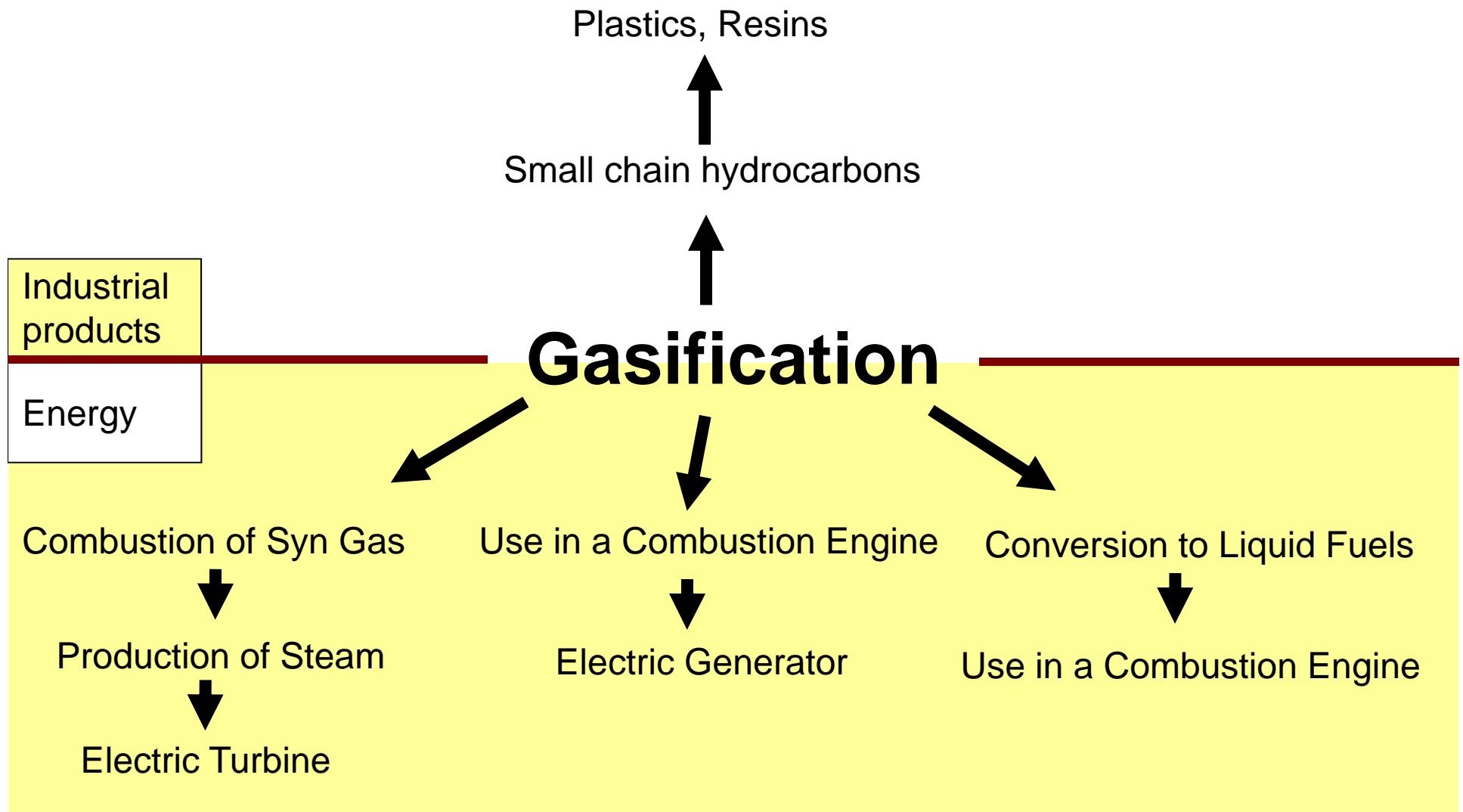
Typically 600-1000 °C

30% of the oxygen needed for full combustion



Converting Energy

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Pyrolysis

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- Converts biomass to liquid 'biocrude'
(tar-like mixture of hydrocarbons)
- Energy is transferred to the crude & heat
- Simple process

Biomass is heated with no oxygen

Typically 600-1000 °C



Thermochemical Summary

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	Combustion	Gasification	Pyrolysis
Cost	Low	Moderate	High
Scale	Small - large	Mid - large	Mid - Large*
Training/oper.	Easy	moderate	Skilled
Feedstocks	Clean	flexible	Flexible
Development	Well Developed	Developed	Research



Conversion Technology Efficiency

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	Ethanol	Combustion	Gasification	Pyrolysis
Liquid Fuel	Good		Possible	Good
Heat		Good	Good	Possible
Electricity		Good	Good	Moderate
Vaporous			Good	Moderate



Summary of Technologies

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- Combustion system produces HEAT very efficiently.
- Gasification systems are good for dealing with feedstock contaminants
- Pyrolysis shows promise for liquid fuels



Current State of Thermal Conversion

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- Combustion
 - Forest and RDF systems are running
 - Ag based systems are being piloted
- Gasification
 - Struggling to compete with natural gas prices
 - Technology for ag materials is not where it needs to be yet



Renewable Energy Partners

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