

Biomass Energy:

Harvesting Waste Power

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Overview

■ **Biomass Intro.**




- What is it Biomass
- Sources of Energy

■ **Generatio**

- Extraction Methods
- US Biomass Plants
- US Energy Consumption
- Efficiency
- Cost Comparison

■ **The Environment**

- Affects on the Environment
- Trade-offs
- Potential Implementation

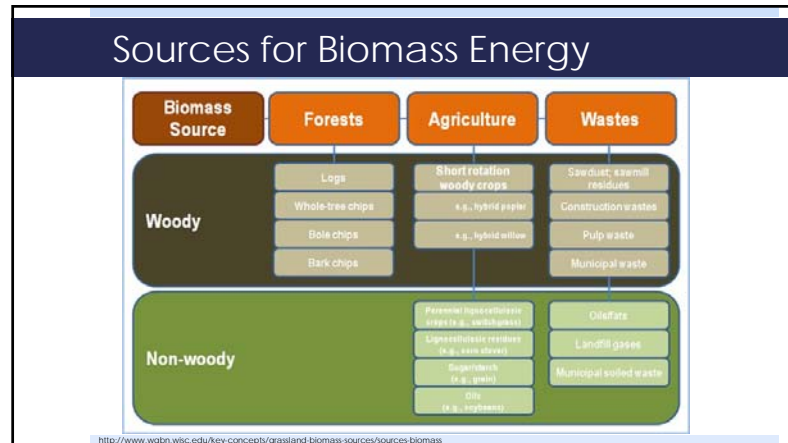




Biomass Introduction

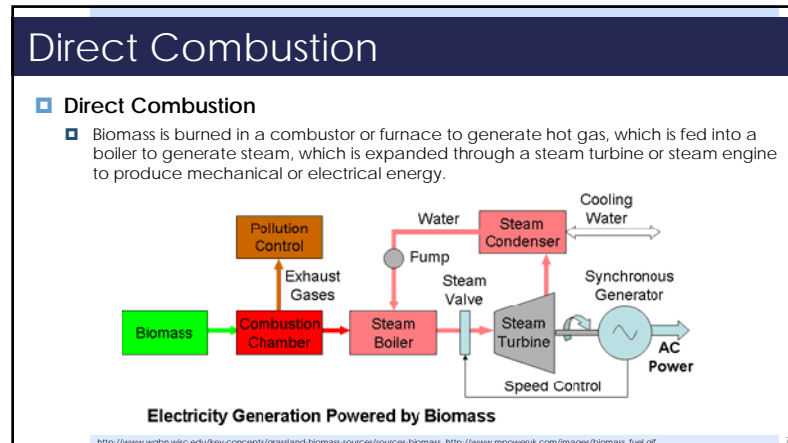
What is Biomass?

- **Biomass:** *recently living organisms*
 - Biological material (solids, liquids, and gases) derived from living organisms, from the wastes, and or the byproducts of human activities
- **Biomass Energy:** *energy obtained from biomass*
 - Generated electricity with less harmful environmental impacts than energy from traditional fossil fuels.
- **Fossil Fuels:** *partially decomposed ancient organisms*
 - Fuels formed by natural processes such as anaerobic decomposition of buried dead organisms

http://www.biomassenergyportal.org.uk/portal/page?_pageid=7615049&_dad=portal

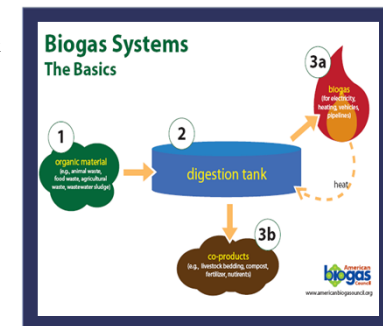


Power Generation



Anaerobic Digestion

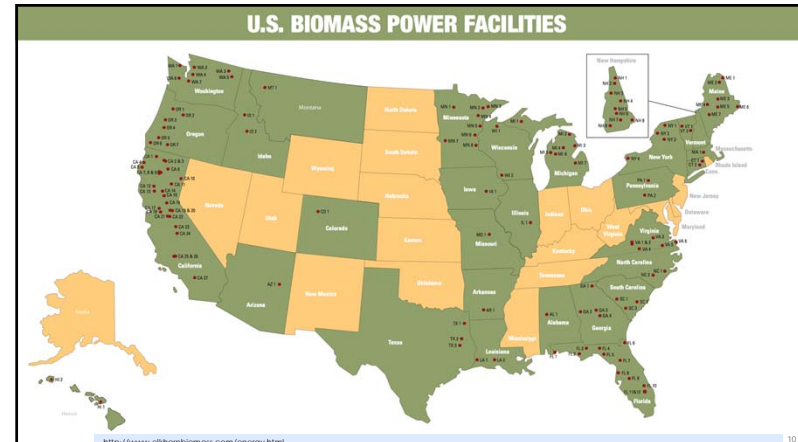
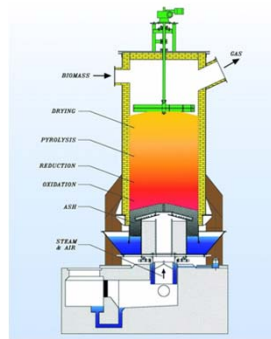
- Anaerobic digestion**
 - Process where micro-organisms break down biomass waste
 - Process produces biogas (60% CH₄ & 40% CO₂)
 - Biogas can be further refined to produce bio methane.



Gasification

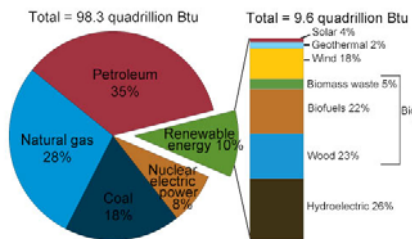
Gasification

- Process which produces a combustible gas mixture of carbon monoxide, hydrogen, carbon dioxide and methane.
- Gas can be upgraded to an ultra clean gas called syngas. Used to manufacture biomethane
- Biomethane can be injected into the national gas grid, or transport fuels such as hydrogen, ethanol, synthetic diesel or jet fuel.



US Energy Consumption

U.S. energy consumption by energy source, 2014



Note: Sum of components may not equal 100% as a result of independent rounding.

Source: U.S. Energy Information Administration, Monthly Energy Review, Table 1.3 and 10.1 (March 2015), preliminary data.



http://www.eia.gov/forecasts/weekly/energy_fuel.cfm

Energy Output and Efficiency

Average Thermal Energy Content by Fuel Type

| Fuel Type | Unit | Energy Output |
|-------------|--------------|-----------------------|
| Natural Gas | 1 cubic Foot | 1009 -1034 BTU |
| Crude Oil | 1 Gallon | 138,095 BTU |
| Crude Oil | 1 Barrel | 5.8 Million BTU |
| Gasoline | 1 Gallon | 125,000 BTU |
| Ethanol | 1 Gallon | 84,400 BTU |
| Coal | 1 Ton | 16.2 - 26 million BTU |
| Wood | 1 Ton | 18-24 million BTU |

<http://www.elkhornbiomass.com/energy.html>

Cost Comparison

- **Combustion and Gasification Facilities**
 - Estimated cost: 0.8 - 1.5 cents per kWh
- **Anaerobic Digestion in solid waste Combustion**
 - Estimated cost: 2.9-3.6 cents per kWh
- **Combined Cycle Facilities (Natural Gas)**
 - Estimated cost: 2.8 cents per kWh

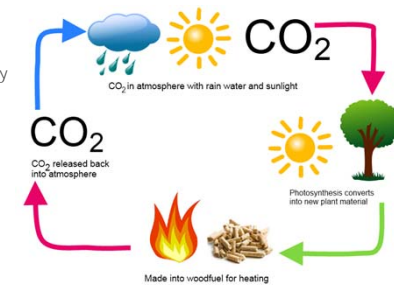


<http://www.oregon.gov/energy/renew/biomass/pages/cost.aspx> <http://www.wbdg.org/resources/biomasselectc.php>

It's Affect on The Environment

■ Biomass Power is Carbon Neutral

- As plants and trees grow they absorb carbon, when they die they release carbon
- When organic matter is used as a fuel, it is utilizing existing carbon, adding no new carbon to the atmosphere (Carbon Neutral)



http://www.visionco.com/biomass_vision_alternatives.php <http://www.p8biomass.com/cycle.html>

Trade offs

■ Advantages

- Possible solution for energy crisis in the future.
- Less pollution than oil and coal. Lower CO₂ emissions
- Negative GHG emissions due to avoidance of landfill disposal
- Uses biodegradable waste as fuel source(renewable source)
- Cheaper than fossil fuels

■ Disadvantages

- Emits very toxic gases and ash
- Requires lots of energy to collect, dry, and transport
- Can lead to deforestation, which can cause soil erosion and natural disasters.



Potential Implementation

■ The United States

- Harvesting all crops for energy currently under cultivation, will produce, at 100% conversion efficiency, the amount of energy equal to the annual usage in the US.
- At more realistic conversions, biomass maximum is about 30% at today's use rate

■ The World

- The amount of energy in the global biomass is about 8 times more than the amount of energy currently used globally.



Summary

- Wood is the most commonly used biomass
- About 80 biomass power plants operate in the US
- 50% of energy consumption in 2014 came from biomass
- Potential alternative but not feasible due to biomass conversion expenses



Questions ???