

Charting a Course to Energy Independence

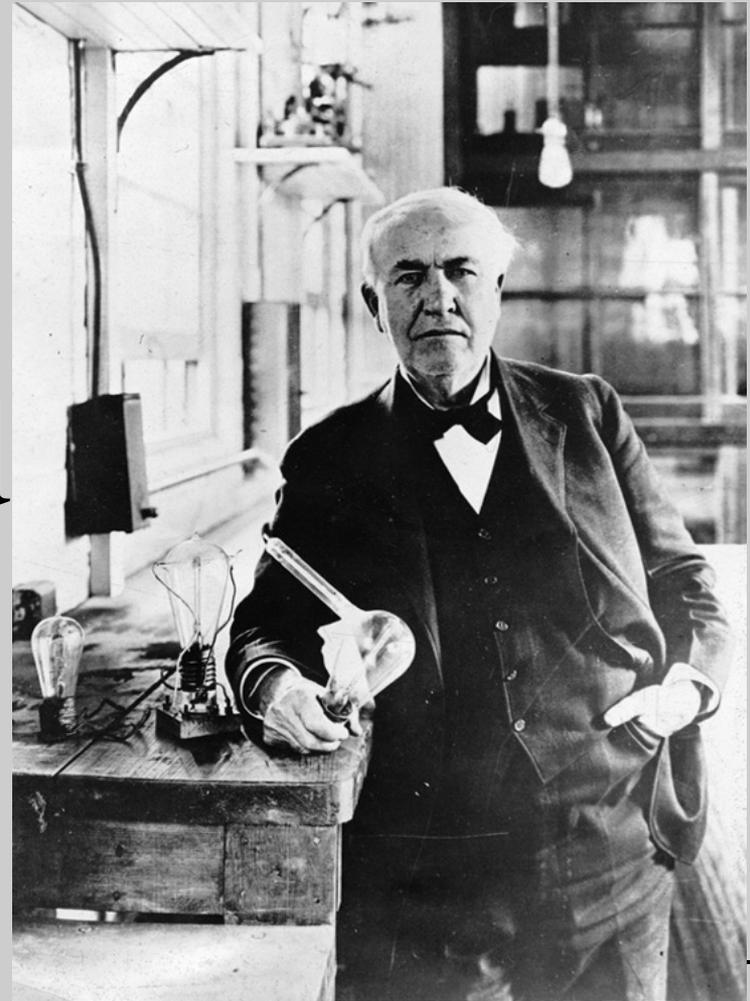
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Biomass Power and Heat

Overcoming challenges or
“So you want a
biomass fueled
plant?”





Why build a Biomass-fueled Plant?

- Laws requiring renewables
- Reduce fossil fuel consumption
- Cost Savings
- Carbon Offsets
- Cool Factor





Target audience

- Wood and crop residue fired systems less than
 - ☐ 5 MW thermal output
 - or
 - ☐ 17 million BTU/hour
 - or
 - 500 boiler horsepower
 - Too big for wood pellets and too small for coal



NREL Renewable Fuel Heat Plant



9 MBTU/hour district heating plant, 3600 tons woodchips/year



Successful projects have a long term **CHAMPION**



- ☐ A biomass plant is more hassle than a typical natural gas, fuel oil, or propane fueled facility.
 - Management must support extra labor and maintenance.
 - Supervisors have to be supportive and not bad mouth management's "bright idea"  or neglect maintenance.
 - Operators have to keep biomass plant on line and not let it fail to run an easier backup fossil fuel system.



Fuel Supply Assessment

- ☐ Fuel supply is the key to a Biomass project.
- ☐ Without a fuel supply there is no project.



Fuel Supply

Fossil fuels are easy.

☰ Supply chains reach around the world.



Just send a check and limitless natural gas flows to your facility.



Biomass- *Not so easy*

Unlike gas and oil, the U.S. has no biomass fuel commodity market.

- ☐ Each project has to find its own fuel supply.





Biomass Fuel Supply Assessment

- ☐ How much fuel does your plant need?
- ☐ Is it available?
- ☐ At what cost?
- ☐ Can you get it to your door?
 - For as long as you need fuel?
10 years? 30 years? Forever?



Biomass Fuel Supply



Sustainable wood fuel supply



Biomass Fuel Supply



Unsustainable wood fuel supply



Crop Residue Biomass Fuel



Crop residues are harvested every year.



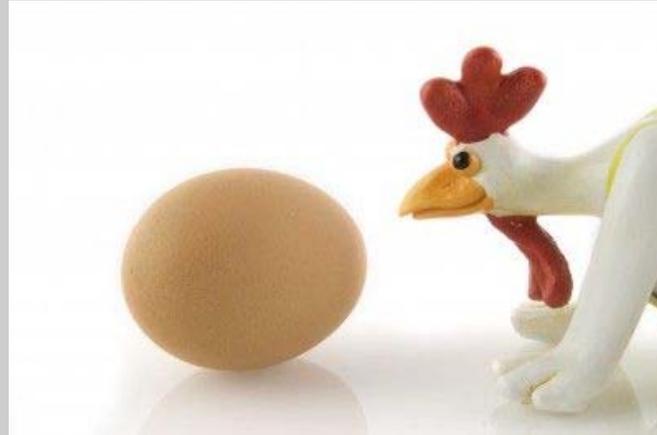
Fuel Supply Hurdles

Biomass fuel availability varies with region.

- ☐ The Rocky Mountains have abundant trees but few forest product industries.
 - Millions of acres of trees dying from pine beetles without a market.
- ☐ Great Plains have abundant crop residues but few trees.
- ☐ Southeast has trees and forest products industries.



The Fuel chicken and egg problem.



- ❑ No biomass fuel supply industry because there's no demand.
- ❑ No demand because there's no supply chain.



Fuel is available. What's next?

Fuel Quality is paramount to
a successful project!





Fuel Quality



Fuel Quality affected by chip size, dirt, rocks, fines, needles, bark, tramp metal, construction debris, trash and moisture content.



Fuel Quality harmed in processing



Dirty raw material



Rocks and dirt picked up during handling



Fuel Quality improved by cleaning



Note amount of dirt compared to clean wood chips.



Fuel Storage

On site fuel storage is controlled by space, consumption, and availability.

- Keep more fuel on site if space allows
 - Maintain control of fuel
 - Mitigates delivery interruptions
- Covered storage to keep fuel dry is desirable
- Small plants should be able to run a long weekend without a fuel delivery



Fuel Storage



Outdoor fuel stockpile



Enclosed fuel storage



Fuel Storage



Indoor 40 ton fuel storage



Equipment and Fuel Quality



Screeener keeps out oversize chips.
Magnet catches steel and iron.

Higher quality, expensive fuel needs simpler equipment

Lower quality, cheaper fuel needs more flexible equipment.

Design for reliability.



Moisture Content

Wet fuel is costly

- Lower energy content per ton
- Lower combustion efficiency
- Less delivered energy per truckload increases freight costs
- Wet fuel may decompose, causing rot, mold, or even fires



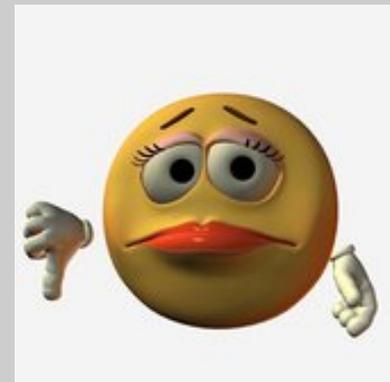
Buy Fuel, Not Water



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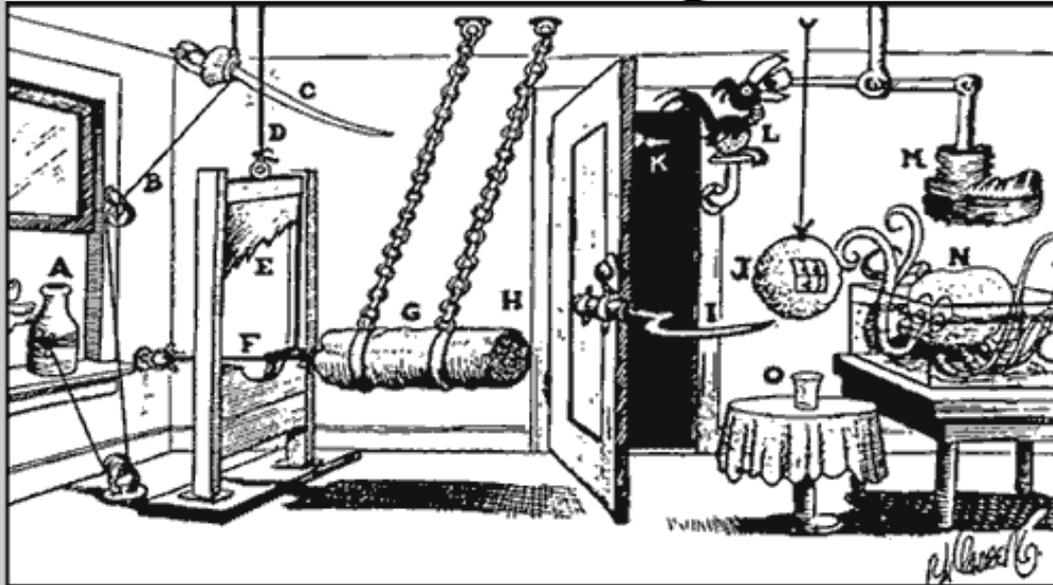
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Equipment Selection

☐ Don't buy Serial #1 unless you have the time, money, and perseverance for a Research & Development Project.





Equipment Performance

- ☐ Biomass fueled equipment can take longer to debug and commission.
 - All parties need to support lengthy startup period
 - ⊕ Expect the first operating season to be spent tuning machinery and operations.
 - ⊕ If everything works the first time you press  buy a Lottery ticket- it's your lucky day.



Test Equipment Performance

Make equipment performance verification part of the contract.

☐ Thermal / Electrical Output

☐ Fuel Efficiency

☐ Reliability





Waste Streams

Ash

- Biomass Ash contains soil nutrients
 - ⊕ Try to recycle to landscape mulch supplier

Slag and Clinkers

- Fused minerals can impair operations but are benign.



Slagging Problems in Combustion Chamber



Slag accumulation caused auger to melt in two.



Air Emissions

Air Emission rules vary by state and locality.

- Contact local air quality authority for rules governing your project.
- Established manufacturers have emissions data.



Controlling Air Emissions

Biomass combustion emits more fine particulates (PM10 and PM1) than natural gas.

- Control with multicyclone, baghouse, or scrubber to meet air emission rules.
- Normal operating plant will have low opacity or a clear stack.



Air Emission Equipment



Multicyclone



Baghouse



Opacity vs. water vapor

Opacity must be checked by a certified tester.

- Don't confuse water vapor with particulates



Opacity from pollution or water vapor?



Nuclear power plant cooling towers. Definitely water vapor.



If it was easy everyone would do it.

Questions?

