GREEN RICE

Generating Revenue from Electrical Energy Naturally to Reduce the Impact of Crop Emissions

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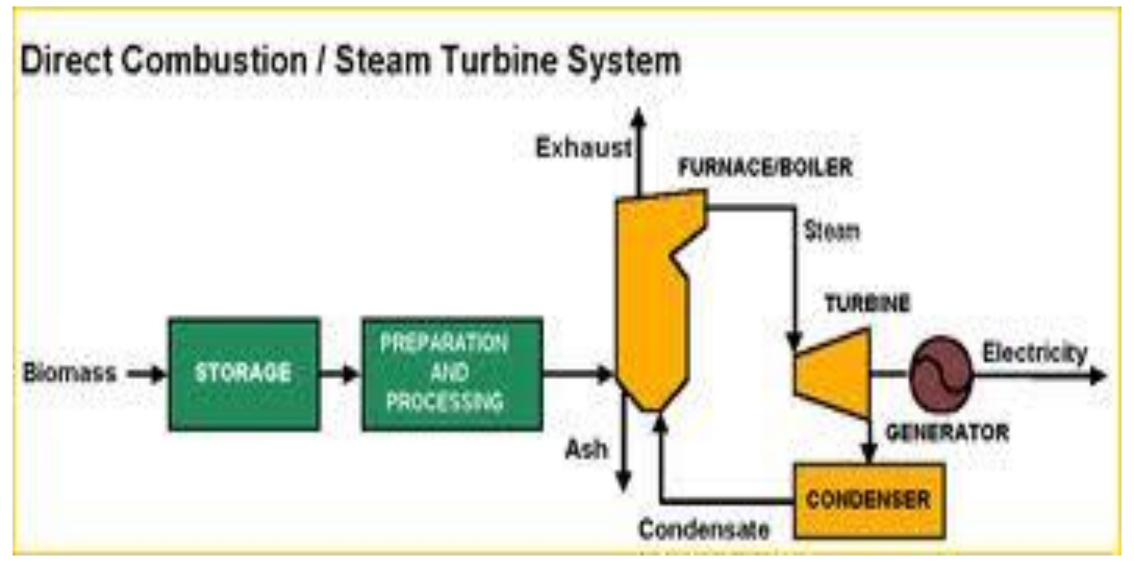
Introduction

Finding ways to generate energy in a sustainable fashion is the major problem facing our generation. We envision that in the future some of the solutions to this problem will come from small-scale hybrid systems that work synergistically with local resources to optimize the capture and usage of energy available in the area. Rice husks are an underutilized byproduct of rice production, and contain a high quantity of silica. We propose a hybrid system that combines the combustion of rice husks to generate 1 MW of electricity with a photobioreactor that will sequester the resultant CO2. The rice husk ash can then be further processed to create a high-value silica product. This system takes into consideration both the economic and environmental implications of energy production.

Combustion Chamber

- Burn 6 tons/hr, 24 hours/day
- Produce 1 MW electricity
- Fluidized Bed Design[3] to produce a more uniform heat transfer

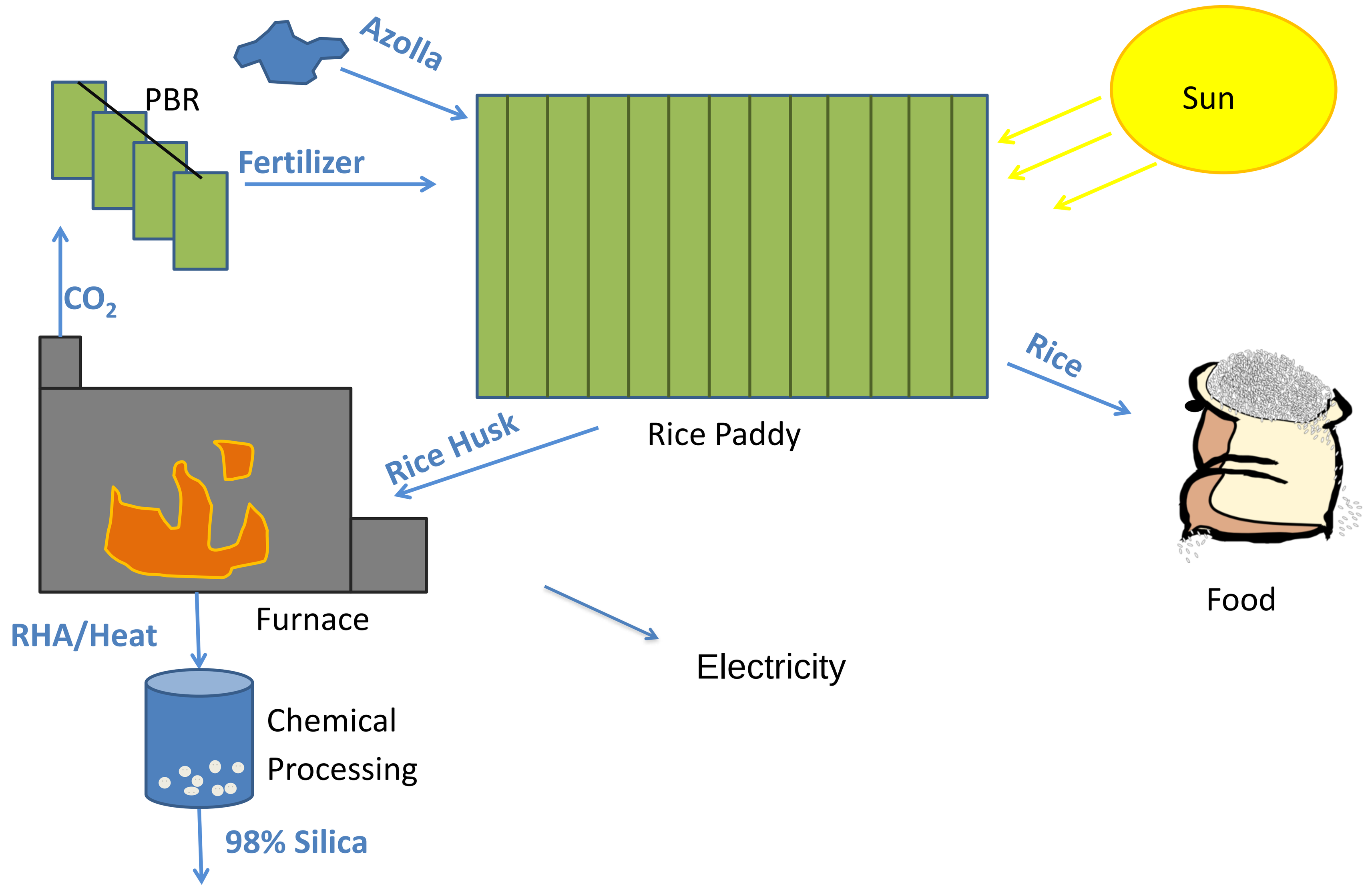


Rice Husk Ash (RHA)

- After the rice hulls[1] are burnt, the resulting ash (RHA) is composed of about 95% silica.
- Sodium hydroxide can be introduced to the ash while boiling followed by neutralization with acid to promote the formation of a silica-gel.
- Depending on the drying method a higher value product (mesoporous, xerogel, aerogel) of a purity >98% can be obtained.
- Products obtained can be used in filtration, insulation, filler for cement and steel production.

Sustainability

- Producing electricity via rice husk combustion at this scale would cost approximately $.34/kWh, compared to $.11/kWh in the area we studied. With renewable energy subsidies, the approach could be cost-competitive, and the system has additional economic and environmental benefits that should be included in an overall cost assessment.
- In addition to providing a renewable source of electricity, our system would produce a marketable commodity (xerogel) which has many applications, including insulation for increasing the energy efficiency of buildings.
- Using our hybrid system would avoid the need for approximately 399,000 tons of carbon dioxide emissions elsewhere, which would be required to produce the same amount of electricity with fossil fuels. Excess electricity could be sold and would help offset the capital costs of the system.
- Depositing the anabaena produced by the photobioreactor on the rice fields would reduce the need for fertilizer, indirectly reducing carbon emissions further since fertilizer production is very energy-intensive.



Photobioreactor (PBR)

- The photobioreactor[4] in this design serves the dual purpose of sequestering carbon dioxide and producing a valued product.
- Growing either algae or cyanobacteria have been shown to be able to consume up to 90% of the carbon dioxide in flue gas, drastically reducing the greenhouse gas impact of the biomass combustion chamber, while simultaneously stimulating growth.
- Algae and cyanobacteria have been looked at for a variety of value products. For the purpose of this conceptual design we apply the use of a nitrogen fixing bacterium *anabaena* to be applied back to the rice paddies to reduce the use of chemical fertilizers. The production of nitrogen fertilizers uses fossil fuels; therefore, reducing their use also further reduces greenhouse gas emissions.

- Azolla[2] is an aquatic fern that forms a symbiotic relationship with *anabaena azollae*, which fixes atmospheric nitrogen. It is a native plant to California, grows readily in fresh water in a range of climates, and quickly doubles its biomass every 2 to 3 weeks.

References

[1] http://www.zeomal.com/

[2] https://es.wikipedia.org/wiki/Archivo:Azolla_caroliniana0.jpg

[3] http://energyfromwasteandwood.weebly.com/technologies.html

[4] http://asulightworks.com/blog/azcati-update-plastic-film-vs-acrylic-photobioreactors