



Waste-to-Energy

Renewable Energy for the 21st Century

U.S. Carbonaceous Feedstocks Readily Available for Conversion to Ethanol

Feedstock

Quantity

Solid Waste / Biomass

500 Million Tons of Municipal Solid Waste, Sewage Sludge, Agricultural Residues, Animal Wastes, Forestry Residues

Used Tires

300 Million Used Tires per Year

Recoverable Coal Reserves

267 Billion Tons
(more than a 300-year supply)



How Does It Work?

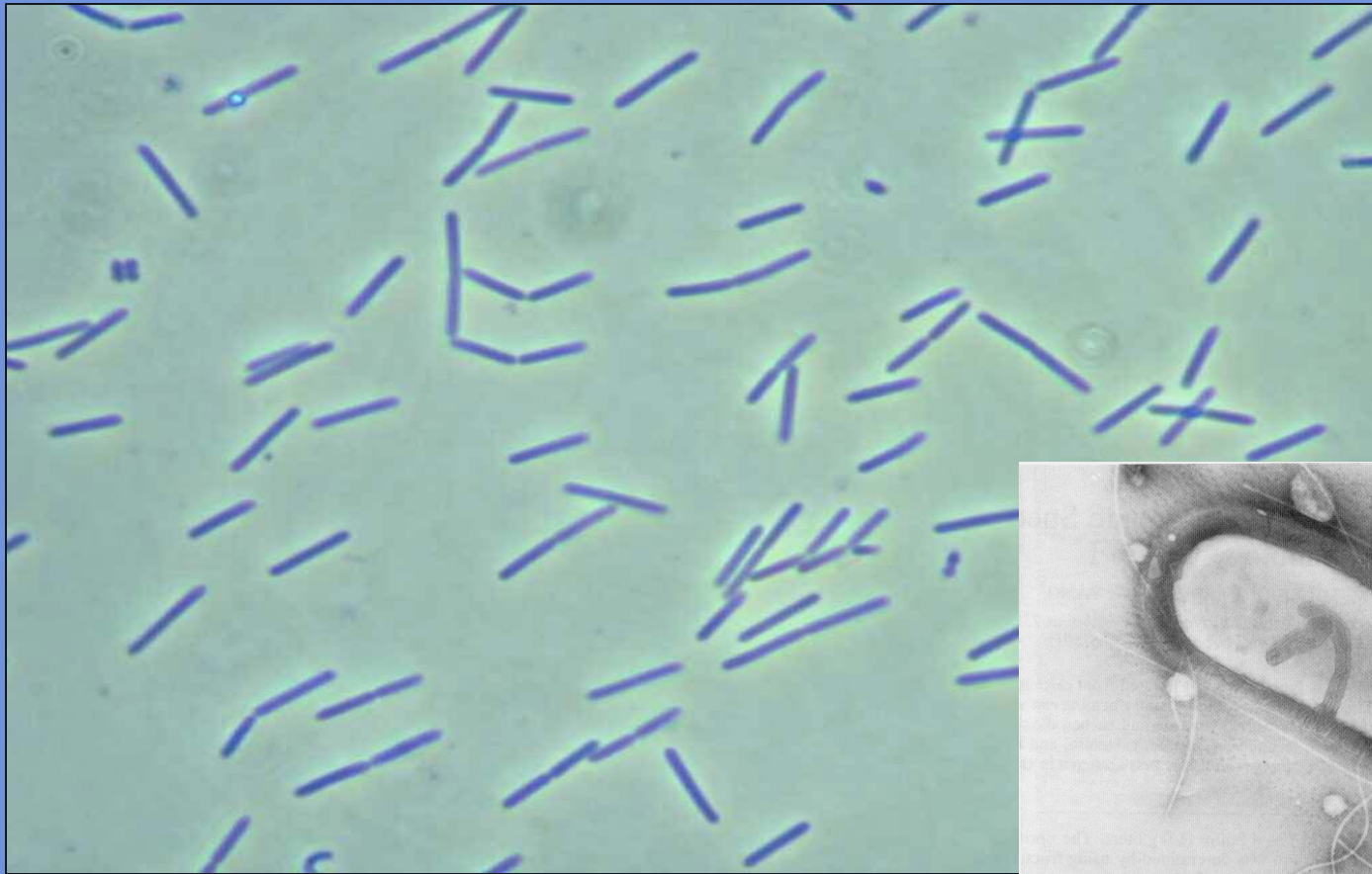
- The BRI technology thermally deconstructs the carbon molecules in organic feedstocks through an enclosed, oxygen-starved process (gasification).
- Then, in a reaction that takes two minutes or less, a patented bacterial culture reconstructs the resulting synthesis gases (CO, H₂ and CO₂) into ethanol, hydrogen and water.
- A final standard distillation process creates 99.5% pure fuel-grade ethanol.



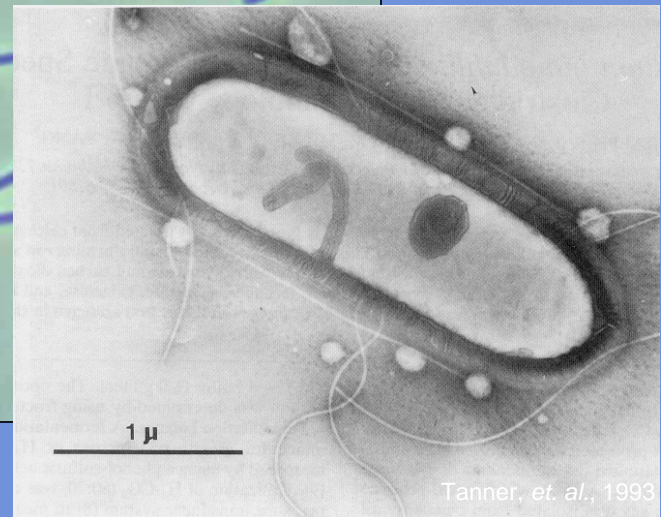
The Technology

- Can create electricity without combustion. Waste heat (generated during the cooling of the syngas) is used to create the high temperature steam that powers electric turbines.
- Its thermal decomposition step (gasification) does not create air emissions.
- The process consumes 95% of any carbon-based feedstock, leaving a final residue of non-hazardous ash.
- It yields 75-85 gallons of ethanol per dry ton of biomass (twice that amount from used tires or plastics).

Patented Bacteria Used for Production of Ethanol



Clostridium ljungdahlii





What is unique about the Technology?

- The entire process takes about two hours, whereas prior sugar fermentation technologies require 45-55 hours.
- Flexibility - its feedstocks can be blended so long as the moisture content averages less than 30%.
- Once up to temperature, the process requires no external energy and is continuous.
- It renders the current discussion about the energy efficiency of ethanol obsolete.



A Generation Beyond **Cellulosic Ethanol**

- Cellulosic processes will only be able to convert the 50% cellulosic portion of plant materials into sugars, and then to ethanol.
- The BRI process, right now converts the hemi-cellulose and lignin to ethanol, as well, 95-98% of plant material.
- Beyond this, the BRI process can convert to ethanol and electricity ANY carbon-based materials (i.e., organic wastes) and/or hydrocarbons.



The BRI Process

Friend of Corn Ethanol

Plants can be Collocated

- Increased farm revenue, both corn kernels and corn stover are used to produce ethanol.
- Low-cost electricity, steam provided to corn ethanol plant.
- Ethanol filtration, denaturing, storage, marketing, shipping, maintenance, administration can be shared.
- Lower average ethanol production cost.

Pilot Plant Facility



Biocatalytic Reactor





BRI Plants are modular, and therefore, scalable. A single module will:

- **Combine**
 - Two Complete Lines, each with capacity to process 125-150 tons of waste per day),
 - Two Biocatalytic Reactors, and
 - A final Filtration Step.
- **Process up to 100,000 tons of waste annually.**
- **Produce 6-8 million gallons of ethanol (depending upon the feedstock).**
- **Generate 5-6 MW of power (including marketable energy, in excess of what is required to run the plant).**

How the BRI technology will change the energy picture in America...



- Theoretically, it could produce ALL of the nation's liquid energy requirements from domestically-available feedstocks.
- Produce ethanol inexpensively (net of power sales and tipping fees, for 1/4 of the nation's current average retail cost of regular gasoline) even if federal and state ethanol subsidies were phased out.
- Provide communities with long-term, low-cost renewable electricity (green power) at 6-10 cents per kWh.



- **Enable every state in the nation to produce its own ethanol locally from materials that currently represent major disposal problems.**
- **Reduce the cost of ethanol distribution by producing and blending it locally.**
- **Provide a new revenue source for farmers without having to change their crops.**
- **Enable utilities to meet their mandates for the generation of green power.**

How the BRI technology can change waste disposal in America...



- Assist municipalities in reducing their waste transport expenses and other costs of waste disposal.
- It will reduce our dependence on landfills and could extend their useful lives by up to 80%.
- Eliminate the need for the agricultural land spreading of sewage sludge.
- Provide a constructive alternative to the open-field burning of agricultural residues and the disposal of animal wastes.



- Enable the industry to make productive use and profit from materials that have no further value for recycling.
- Keep recyclable materials here at home, rather than sending them abroad for processing.
- Create a new industry and jobs for America's work force...

**and do all of this while
contributing to an improved
environment!**



The concept that today's waste streams can become tomorrow's liquid and electric energy supersedes all other solutions in our quest for energy independence.

It is the paradigm for the 21st Century.



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