

Onion waste, once a liability, is now an asset at Gill's Onions

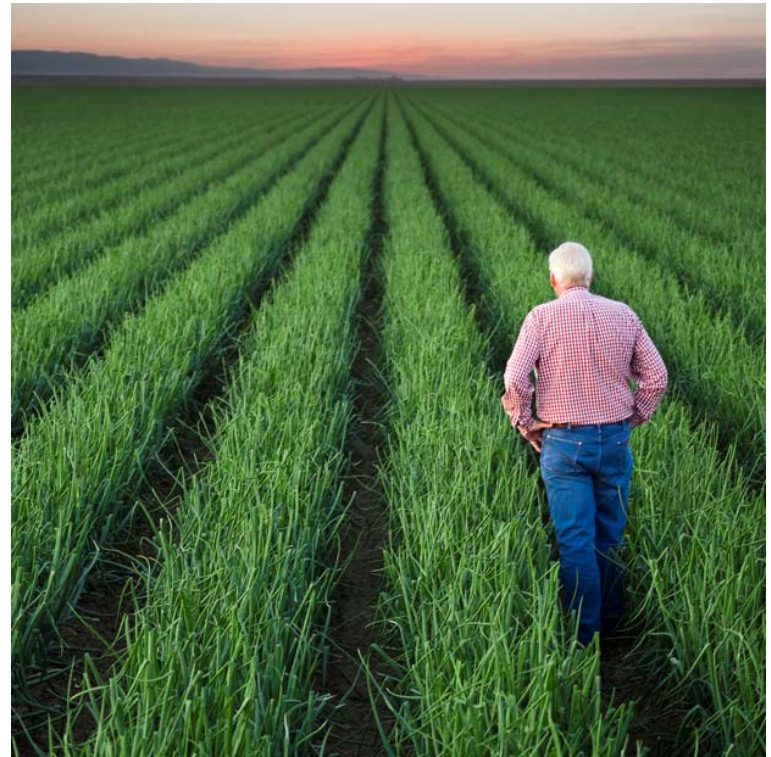
A \$10.8 million project—utilizing biogas and fuel cells—is converting onion waste into renewable energy and cattle feed



WASTE NOT. WANT NOT.

Gills Onions is a family owned and operated onion grower and processor with the largest fresh onion processing plant in the world

- Started as a processing partnership with La Victoria Salsa in 1983
- Gill's now has over 15,000 acres of farmland, 300,000 sf of processing and warehousing, and 600-plus employees



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“Necessity is the Mother of Invention” - Plato

- Gill’s processes about 1,000,000 lbs of onions, and creates about 300,000 pounds of onion waste each day
- Waste disposal could be a show-stopper
- Gill’s base electrical demand is 600 KW
- Waste = Energy = Electricity
- Solution: Waste & Energy Goals Unite



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When an onion is peeled, 35-40% is lost.



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Previous waste management involved hauling, composting and spreading the waste onto fields

- Not a viable long-term solution
- Leads to odor, run-off, disease, pest issues...
- Handling and disposal costs exceeds \$500,000 a year



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Anaerobic Digestion was chosen to convert the onion waste into Methane Gas

- Study conducted with the University of California, Davis
- Waste juice found to be highly digestible with excellent biogas yields
- 75% of the waste is extracted as juice
- Remaining 25% is a fibrous solid, which is compressed into an excellent cattle feed



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The Juice Extraction Process

- Lime is added to waste, which is macerated and squeezed through a screw press, yielding about 50% juice
- Press cake is sent through a second disintegrator, for further size reduction, yielding an additional 25% juice
- 30,000 gallons of juice and 20 tons of onion cake are produced per day
- Juice is high in simple sugars



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Juice is Held in an Equalization Tank before being Fed to the Digester to Generate Biogas

- 70,000 gallon Equalization Tank with Mixers and Process control—equalizes flows, and starts acidification of the juice
- After two days in tank fed to Upflow Anaerobic Sludge Blanket (UASB) reactor
- UASB Reactor - tight footprint, i.e. requires less space and shorter retention times
- Bacteria starts biodegrading the sugars in the juice to form biogas
- Biogas exits the top of reactor, and degassed sludge acts to mix the reactor (eliminating the need for mechanical mixing)



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Process continued

- The 145,000-gallon UASB reactor is painted black to absorb heat from the sun and help warm the tank
- Retention time in the UASB reactor is typically 16-18 hours
- 50,000 gallons of granular sludge was provided by a St. Louis, Mo. Brewery
- the microbe population adjusted quickly, now eating everything we give them
- The Biogas is produced at a rate of 100-110 scfm and contains about 70 percent methane



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Fuel Cells become the most innovative, practical solution to generate electricity

- Biogas powers two 300-kW fuel cells, generating 0.6 MW of electricity.
- Satisfies 95% of Gill's base load requirements
- Meets goals for Air Quality, Zero Waste and Renewable Energy:
 - Virtually emissions-free
 - EPA Exempt
 - No air permit needed
 - Renewable (Biogas)
 - Ultra-Clean Energy Solution



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Fuel Cells become the most innovative, practical solution to fulfill our needs

- High fuel-to-electricity conversion rate: 47 - 50% efficiency
- Utilizing waste heat from fuel cells will push overall efficiency to 90%
- Elimination of 40,000 gallons diesel fuel to haul onion waste to fields
- AB 32 compliance - reduced GHG Emissions



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Challenges

- High Sulfur Content – remove impurities and moisture from biogas
- Two step process developed to achieve acceptable sulfur levels
- Variable gas generation – supplemented with some natural gas.
- Gas holder absorbs fluctuations, and opens the natural gas valve
- Permitting of new technology – no standards for reference
- Fire & Safety - extra alarms, liability waiver
- Financing – develop good economic models



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Fuel Cells help meet Gill's Waste & Energy Goals

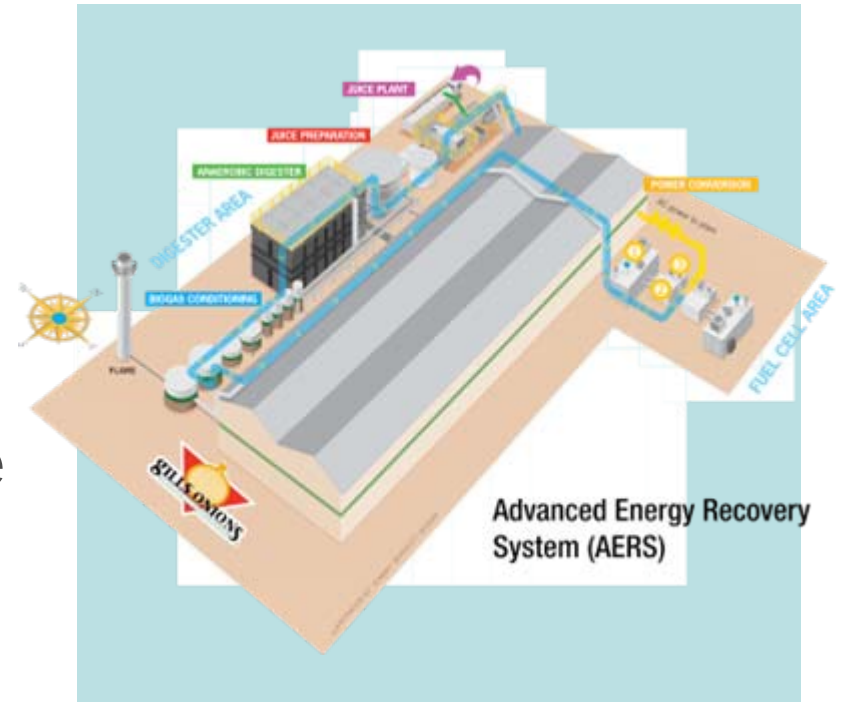
- Waste Reduction - Zero Waste by 2011
- Improve energy efficiency and reduce costs – food processing is third largest industrial energy user in CA
- GHG Emissions Reduction – Gill's is a Climate Registry Member and reports their verified annual GHG Emissions



WASTE NOT. WANT NOT.

Using Fuel Cells in the Advanced Energy Recovery System (AERS) makes good business sense

- Six-year payback on \$9.5 million project
- \$700,000 annual electricity savings
- \$500,000 annual savings by eliminating land application of waste



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Using Fuel Cells in the Advanced Energy Recovery System (AERS) makes good business sense

- \$499,000 grant from the California Energy Commission
- \$3,000 per kW in federal tax credits
- \$2.7 million in SGIP benefits
- Renewable Energy Credits
- GHG Credits



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Lessons in Success

- Be resourceful—find the BEST technology solution
- Understand feedstock and its variability
- Discover equipment limitations
- Integrate your business vision and growth opportunities into the design



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