



Onion Power – Potential Production of Biofuels from Onions and Other Vegetables

Gary L. Hawkins, Ph.D.

University of Georgia

Biological and Agricultural Engineering Department

2010 SERFVC

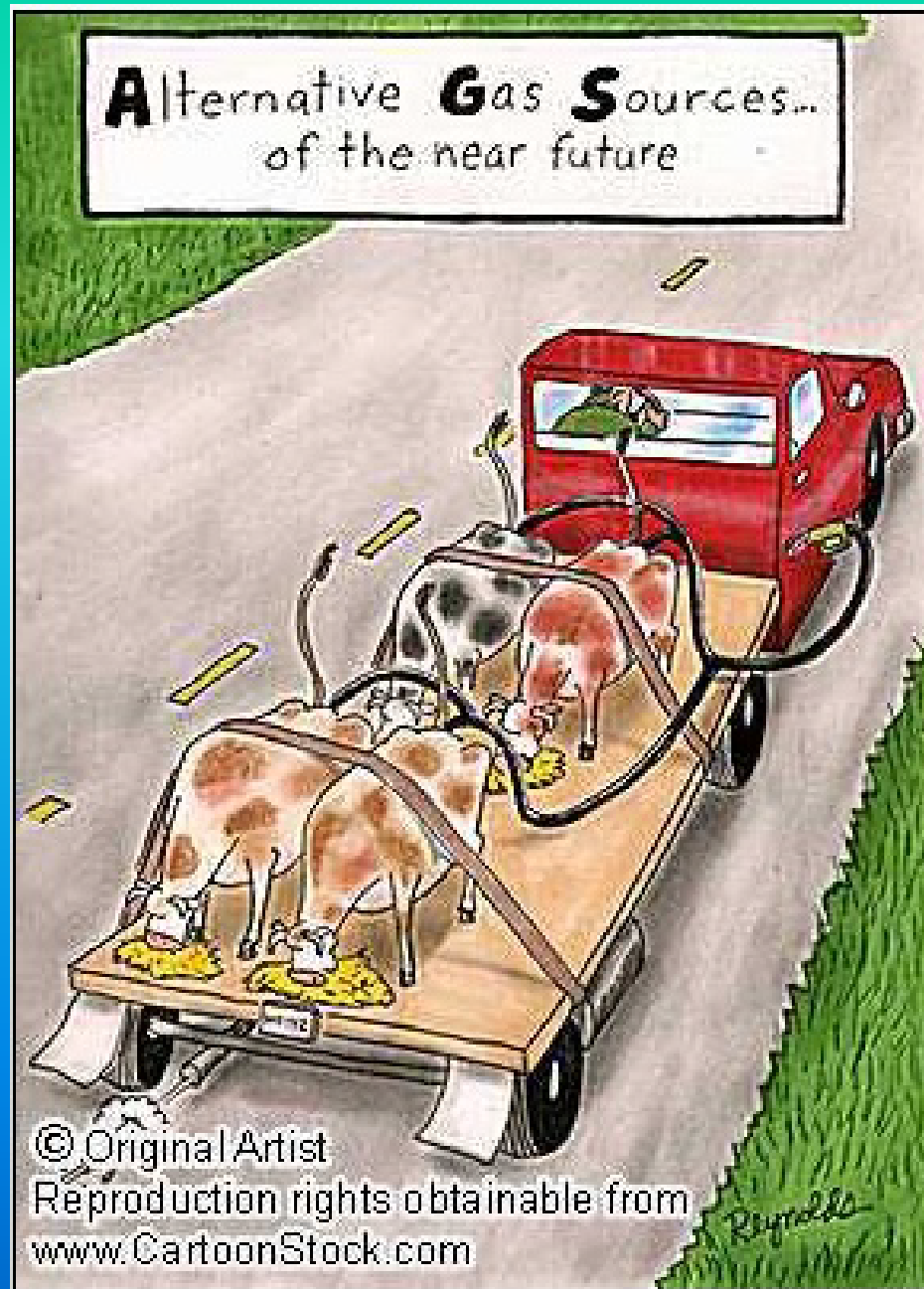
Savannah, GA

Jan 8, 2010



Alternative Energy at The University of Georgia

As we look for new and different ways to get energy this cartoon makes the point well.



Why Vegetable Waste?

- Georgia alone produces over 860 million pounds of fruits and vegetables annually.
- Some farmers or companies even bring in vegetables from other states and countries in the “off-season” for Georgia to repack here, and
- Some estimates are that 5-8% of harvested fruit and vegetables are discarded at the packing plant due to various reasons





Alternative Energy at The University of Georgia

Waste Disposal

- A necessary part of harvesting and repacking onions or other vegetables and fruits



Problems of this waste materials

- The degraded waste is:
 - Typically in liquid form
 - High strength (as measured by COD)
 - A potential water quality problem

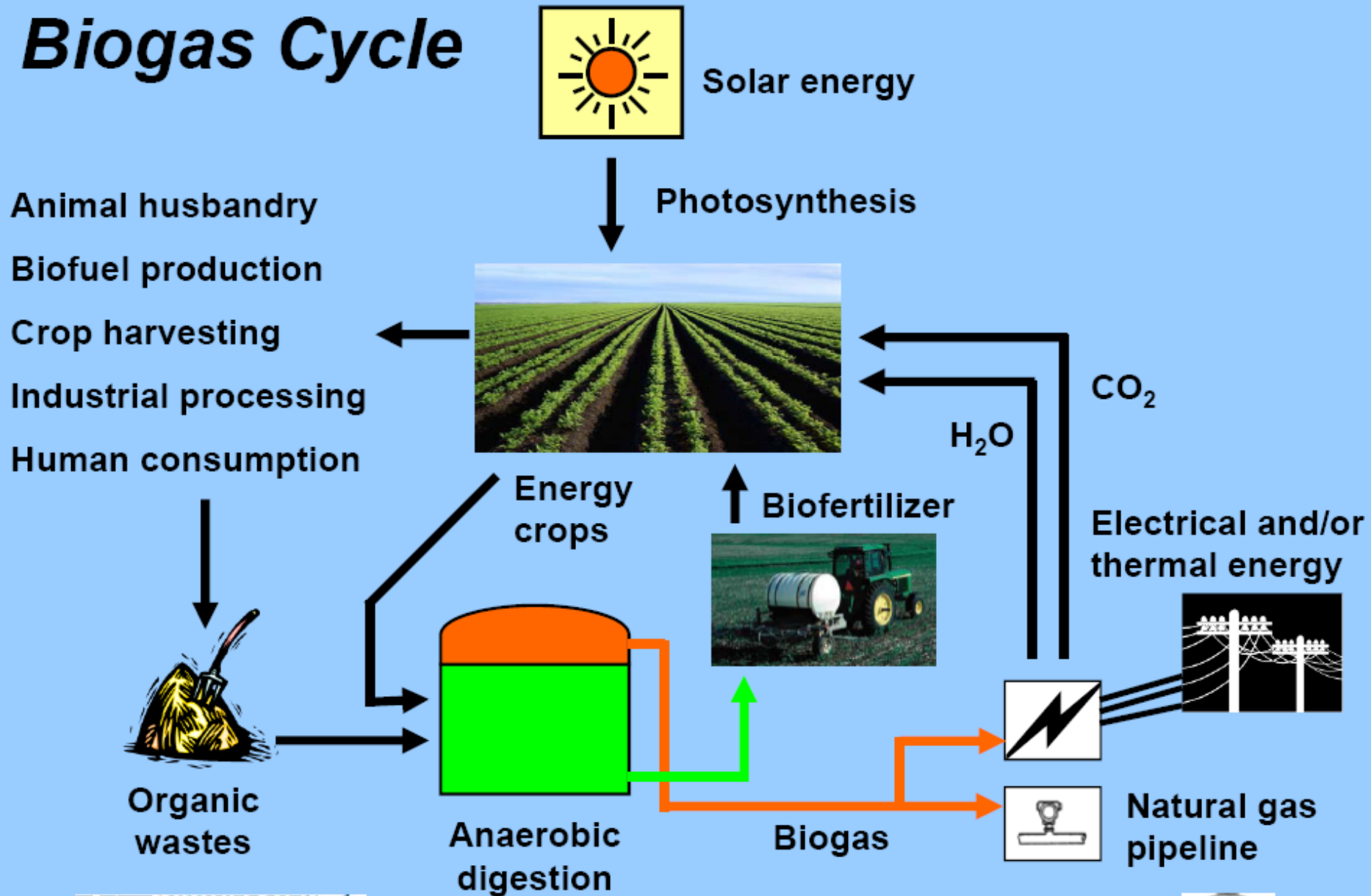


Solution?

- Manage waste not as a waste product, but the feedstock in a process that can produce total needed or partial energy needed for packing facility
- Effluent water and sludge can be used as a soil amendment



Biogas Cycle



Objectives


- The objectives are:
 - Measure chemical and physical parameters of Fruit and Vegetable Waste (FVW)
 - Operate anaerobic digesters on FVW to determine bio-gas production
 - Determine optimum feed rate and solids content for FVW



Objectives

- The objectives are:
 - Co-digest with animal waste to determine the above objectives
 - Build a pilot or full scale digester for use in producing methane gas





Measuring Chemical and Physical Parameters

- The fruits and vegetable waste are analyzed for:
 - Moisture Content
 - Volatile Solids
 - Chemical Oxygen Demand (COD)
 - Brix (suspended solids content)





Sample



Process



Grind
(bell pepper)



Dry for
Moisture
Content



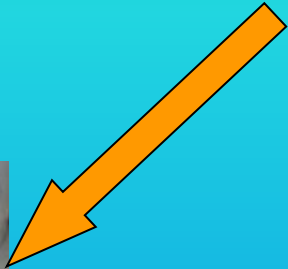
(onions)



Ash for
Volatile Solids
Content



(onions)



Blend to get juice
(bell pepper)



Squeeze for COD
measurements
(bell pepper)



Tillage
Pays Everyone



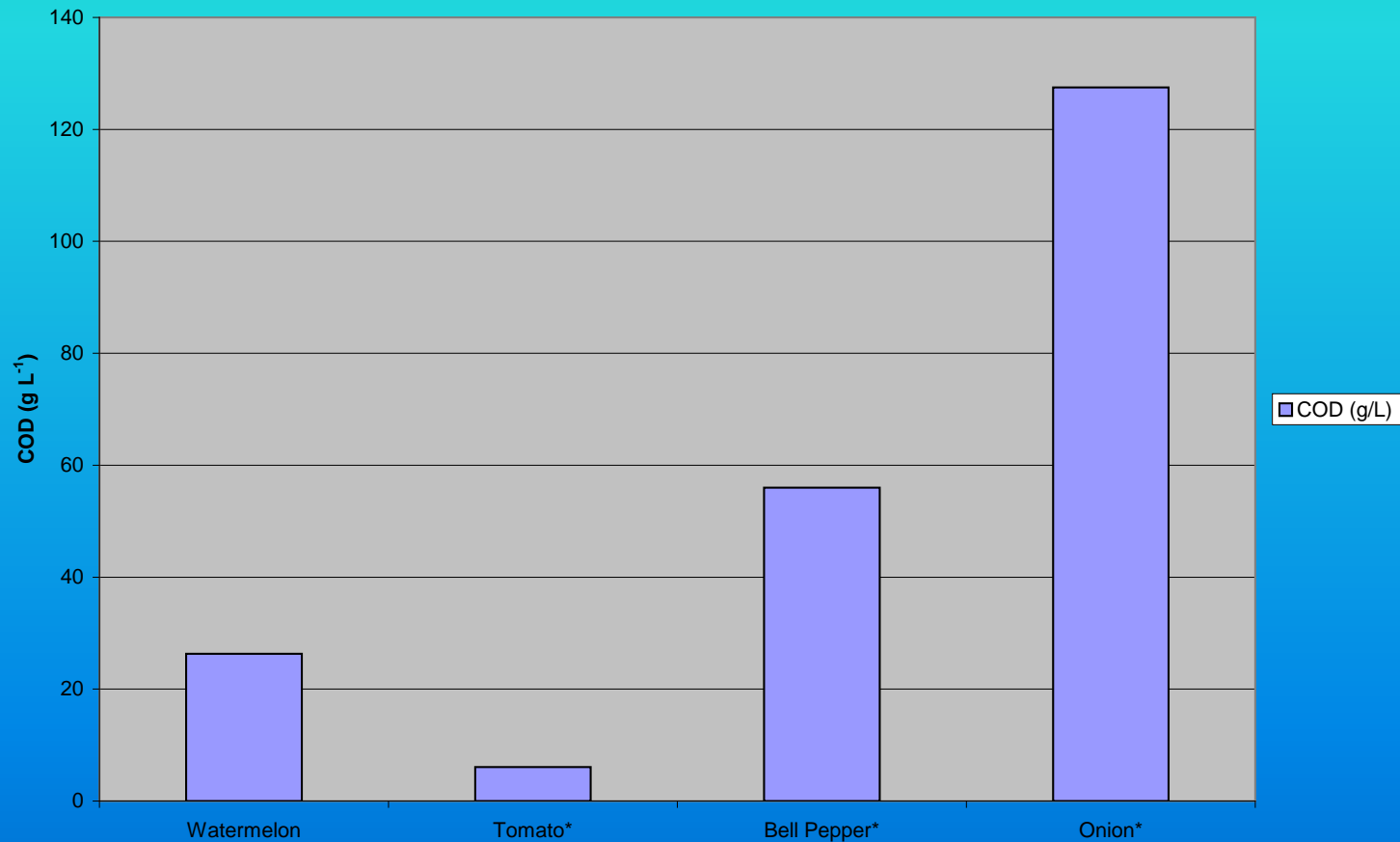
TEAM CONSERVATION TILLAGE

Conserv
Tillage P
Every

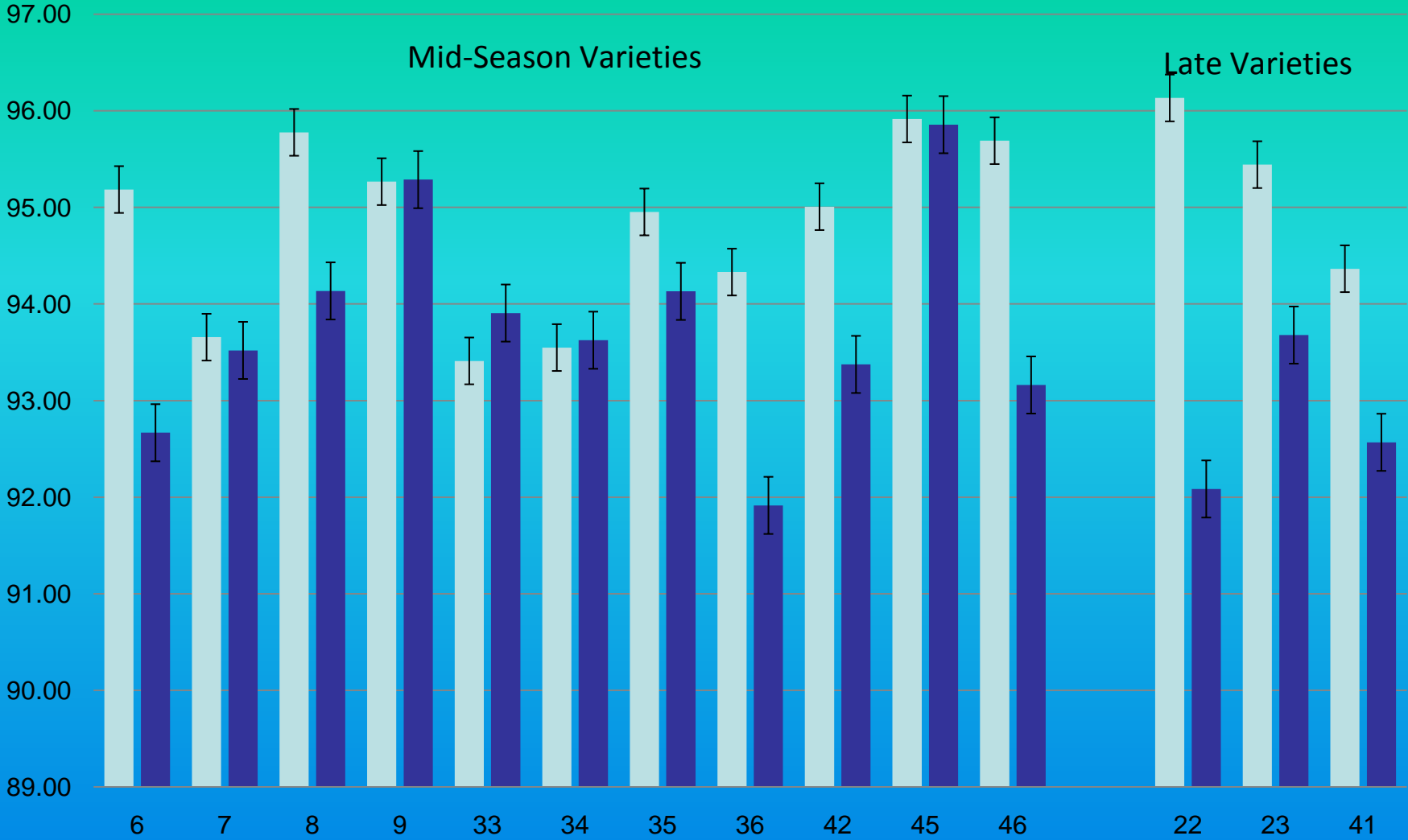


Chemical Characteristics

Average COD of selected fruits and vegetables



**Percent Volatile Solids for 2007 and 2008
Vidalia Onions**



Mid-Season Varieties

Late Varieties

Vidalia Onion Variety Numbers

■ %Volatile Solids 2007 ■ %Volatile Solids 2008



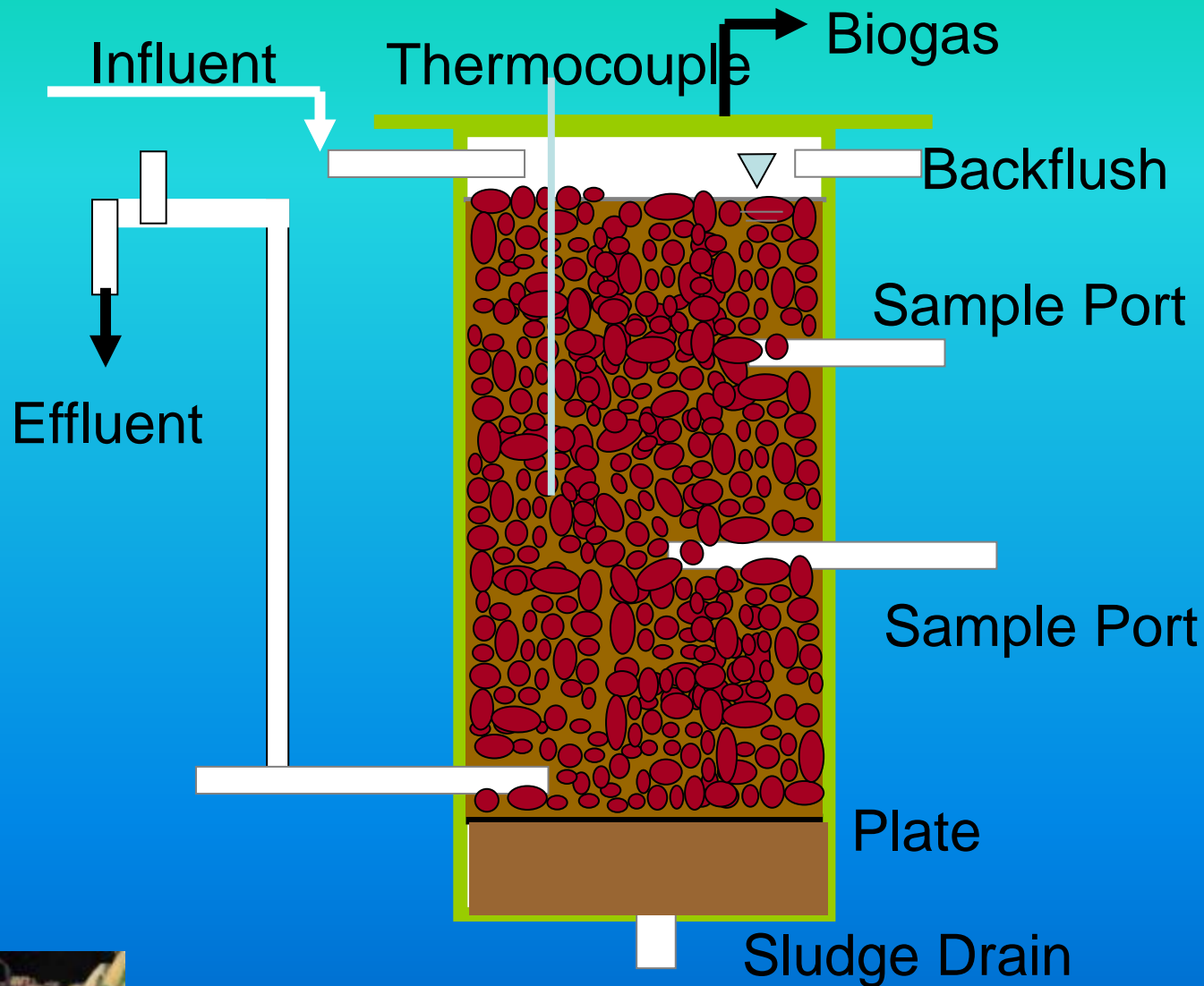
Alternative Energy at The University of Georgia

Digester Operation

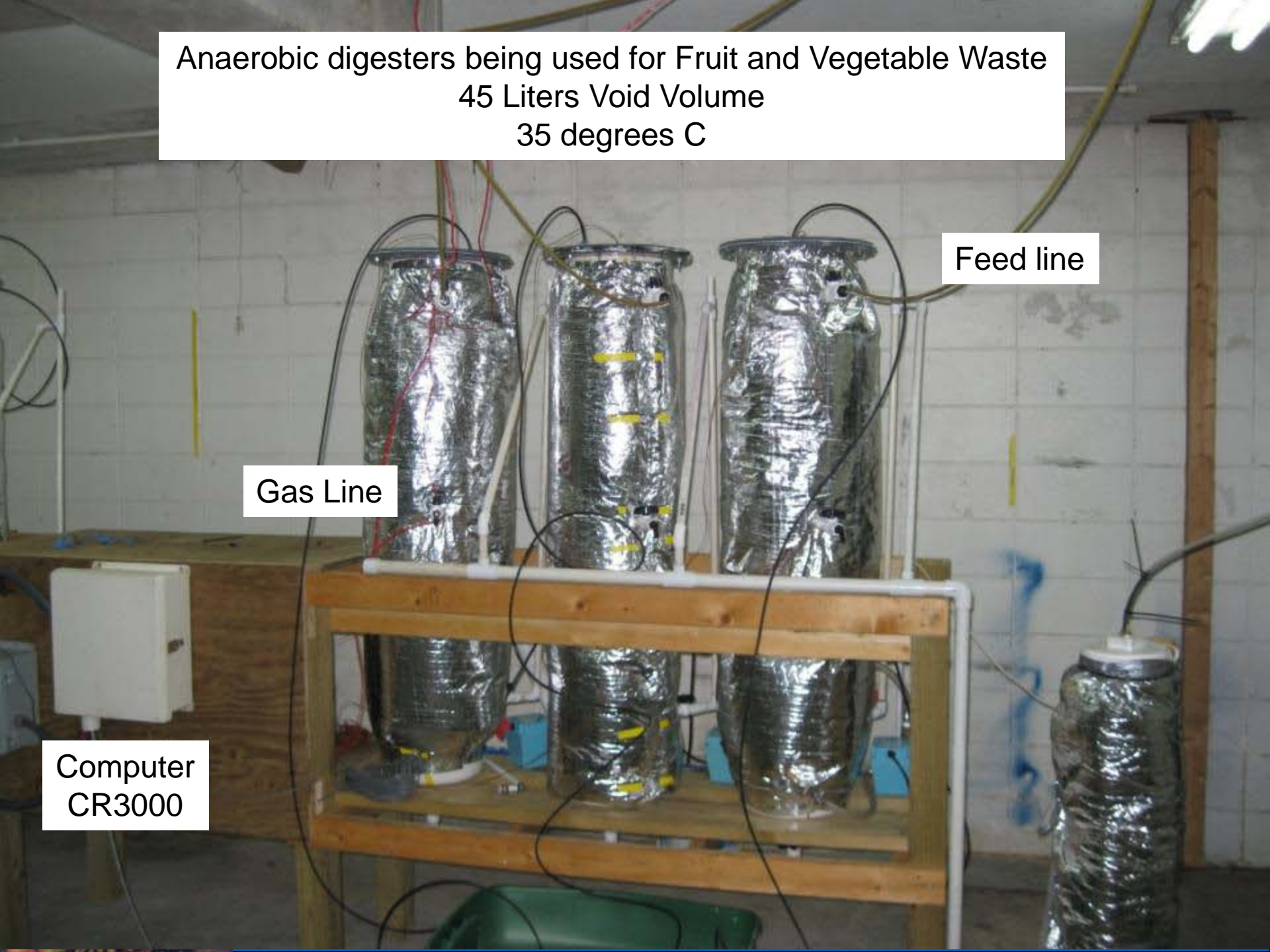
- The digesters are:
 - Anaerobic Filters
 - Each system is 90 L empty
 - Insulated and heated to approximately 35 degree C
 - Feeding, heating and biogas production amount controlled and monitored by datalogger



Downflow Anaerobic Filter



Anaerobic digesters being used for Fruit and Vegetable Waste
45 Liters Void Volume
35 degrees C



Feed line

Gas Line

Computer
CR3000

Magnetic Contactor



Tipping bucket
used for measuring
gas production

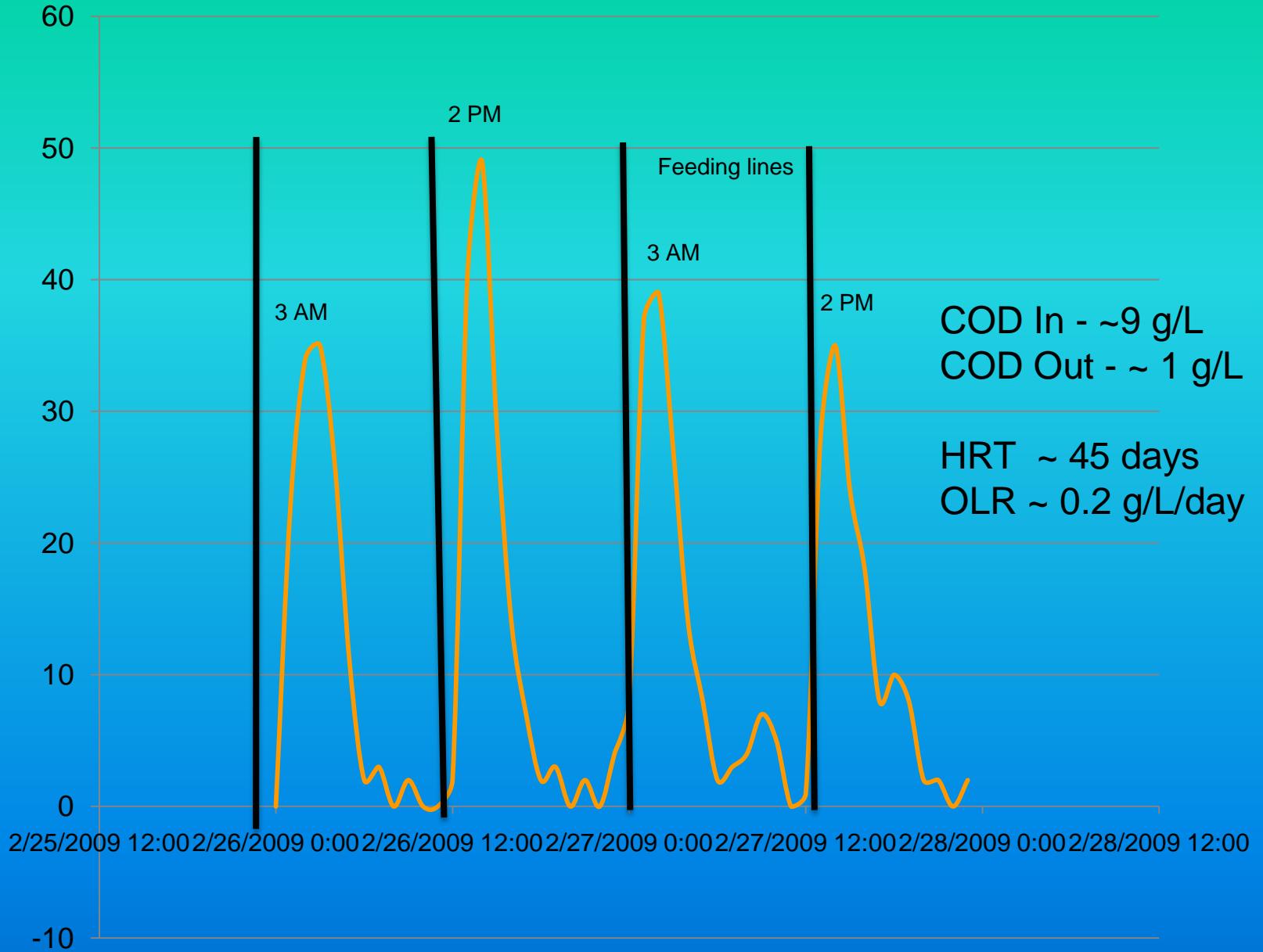


Alternative Energy at The University of Georgia

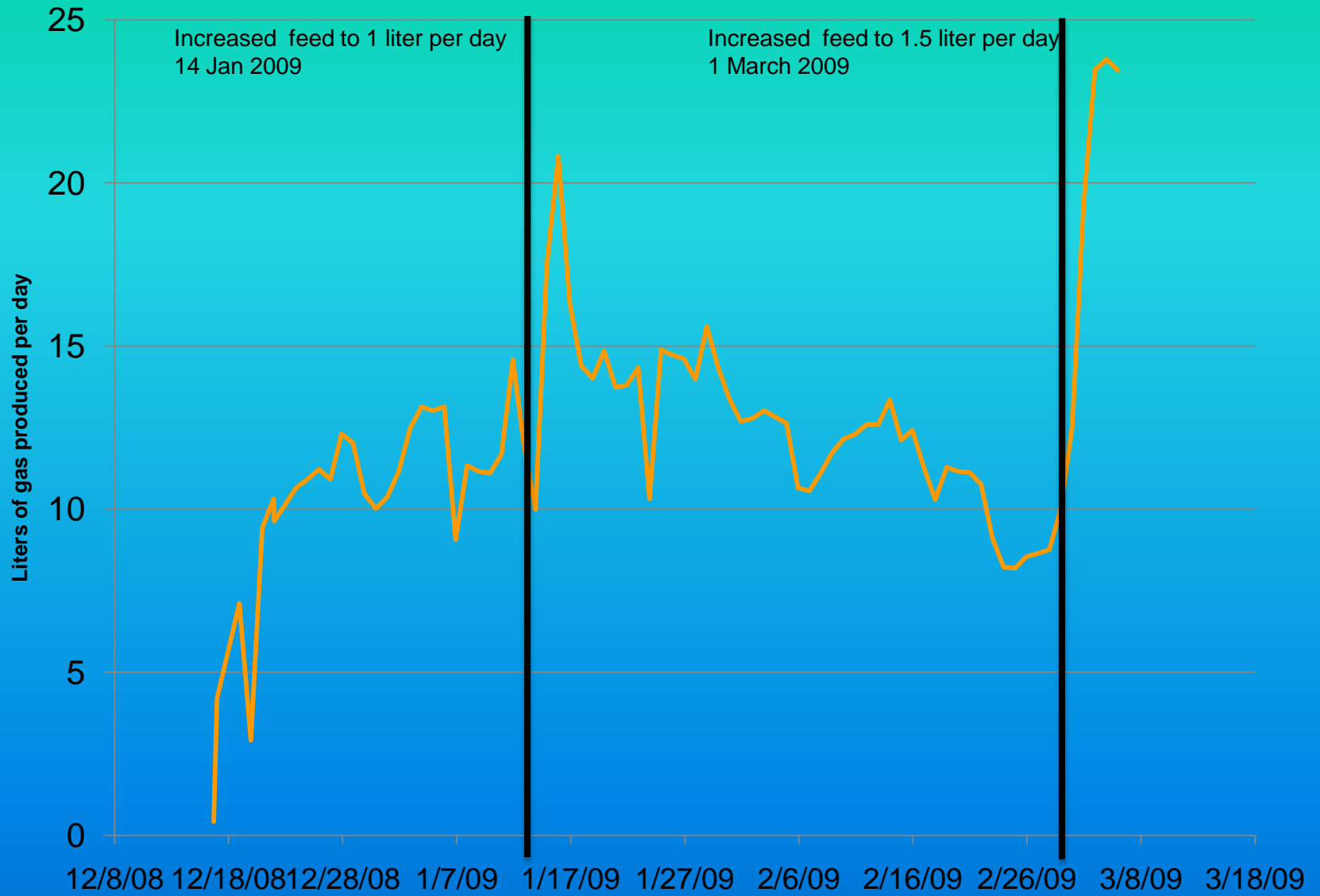
Current Operation

- Onion culls (juice fraction only) have been feed into anaerobic digesters since late November 2008
- Feed rates are 500 mL every 8 hours
- Temperature is controlled and gas is being measured





Digester 4 - 45 Liter Reactor



Summary

- Anaerobic digestion of fruit and vegetable waste can:
 - Reduce a potential source of water pollution
 - Provide a source of total or partial energy
 - Provide a soil amendment
- Work is continuing on determining methane yield and other parameters



So as we move forward with Bio-Energy research and looking for sources of “Green Energy” we may want to look at “Green” Peppers or the Georgia State Vegetable for future energy



Alternative **G**as **S**ources...
of the near future

Georgia **G**rown **F**uel



© Original Artist
Reproduction rights obtainable from
www.CartoonStock.com

Alternative Energy at The University of Georgia

Acknowledgement

- Georgia Department of Natural Resources Sustainability Division for support of the AgP2 Program
- USDA grant for Specialty Crop Research
 - NRCS CIG Grant





Questions?

Gary L. Hawkins, Ph.D.

University of Georgia

Biological and Agricultural Engineering

ghawkins@uga.edu

229-386-3914