Food and Fuel: Turning Food Waste to Biogas

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The problem

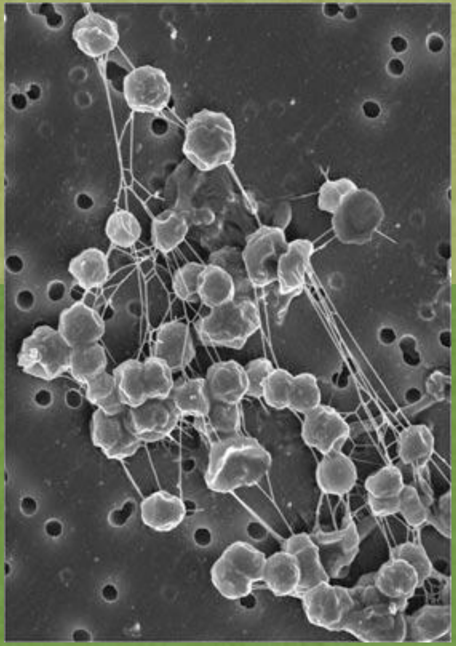
- Global climate change
- Decline in fossil fuels
- Unsustainable waste disposal
- Using biofuels from energy crops inflates food prices and increases deforestation
  - Ex. Soybeans in Brazil

One solution: Biogas

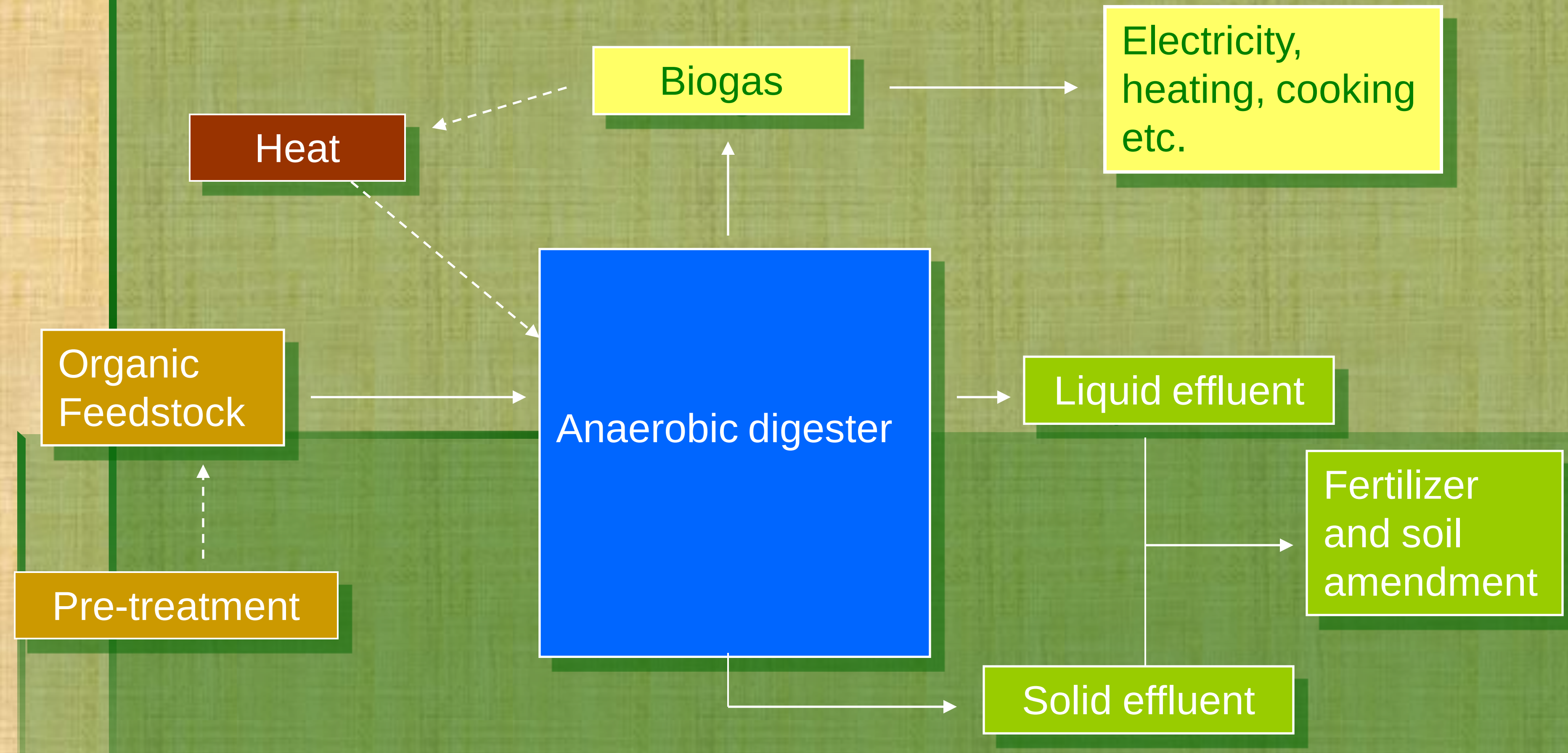
- Gaseous by-product from anaerobic digestion of organic material
- Driven by bacteria
- Relatively fast process
- Sustainable alternative to natural gas

Importance of microbes

- Four classes of bacteria:
  - Hydrolytic
  - Acidogenic
  - Acetagenic
  - Methanogenic
- Each class needed for biogas production



The biogas process



Designs of Anaerobic digesters

Experimental-sized digesters, Gainesville, FL

Designs of Anaerobic digesters

"Bag digester", Costa Rica

Small scale digester, rural India

Designs of Anaerobic digesters

Covered Lagoon, Tulare, CA

Corn sillage digester, Neumunster, Germany

Designs of Anaerobic digesters

Lübek mechanical biological treatment plant, Germany

Mechanical biological treatment plant, Tel Aviv, Israel

Designs of Anaerobic digesters

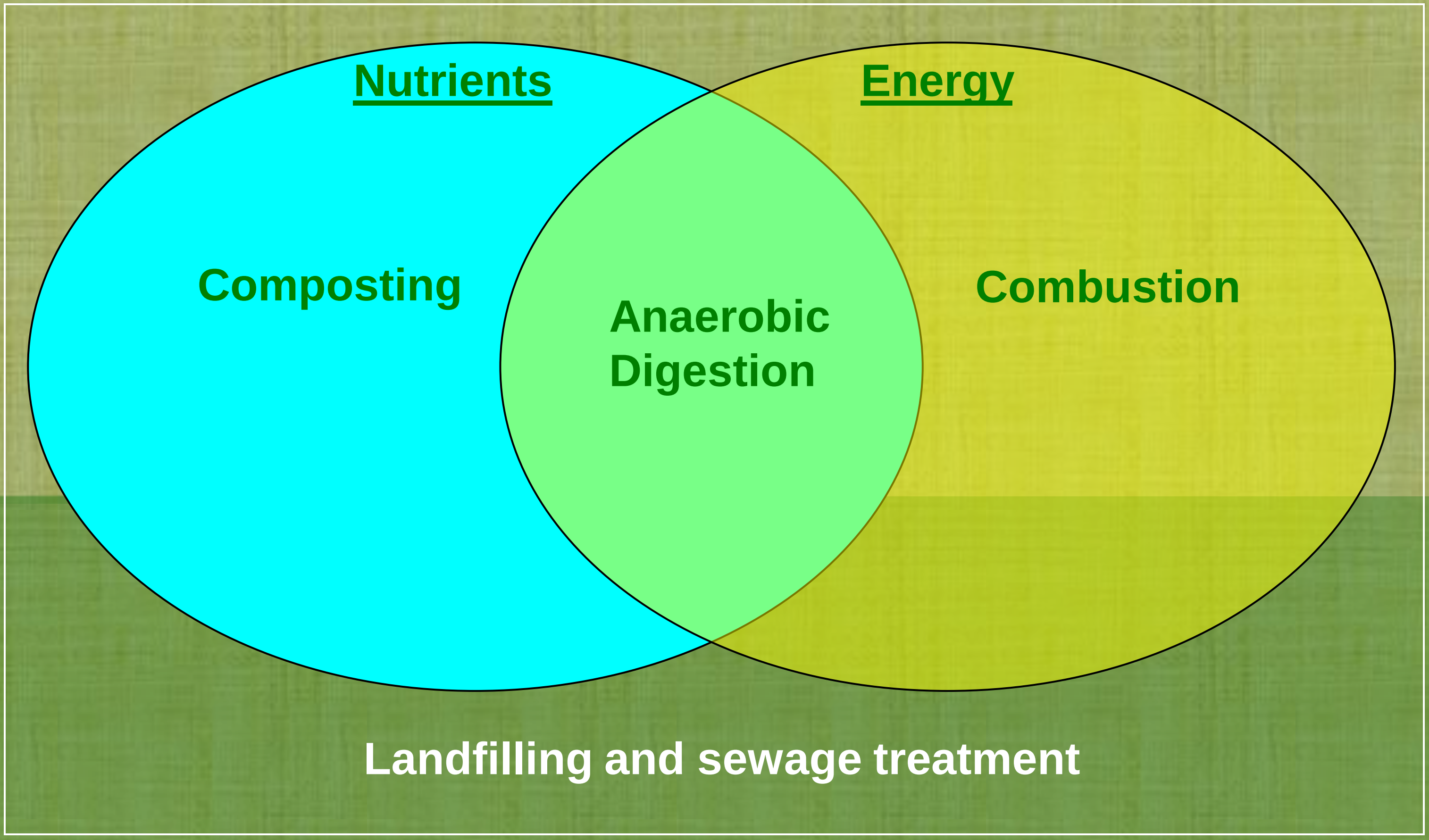
Reading Sewage Treatment Works, Reading, United Kingdom

Appleton Wastewater Treatment Plant, Appleton, Wisconsin

Benefits of biogas

- Can produce energy from almost any type of organic waste
- Carbon neutral
- Not reliant on energy crops
- Effluent used as an organic fertilizer
- Can be scaled large or small

Benefits of biogas



Possible uses of biogas

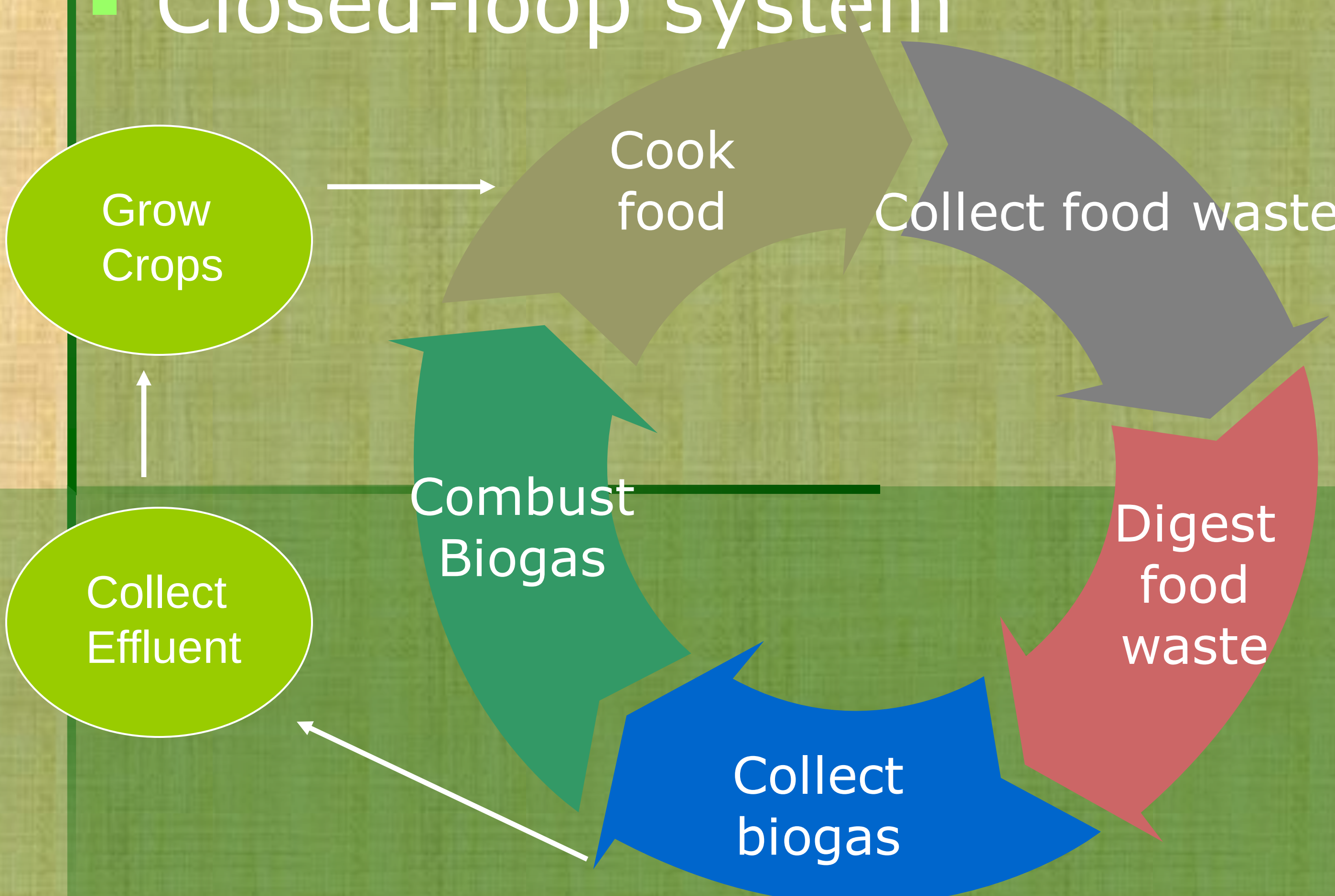
- Cooking
- Heating water/air
- Gas lighting
- Electricity generation
- Transportation
- Hydrogen fuel cells

Why food waste?

- 96 billion pounds/year in the US or 12% of the municipal waste stream
- Highly visible in community
- Relatively untapped market
- Avoids problems with energy crops

Why food waste?

- Closed-loop system



Sources of food waste

- Restaurants
- Grocery stores
- Food processing plants
- Home kitchens

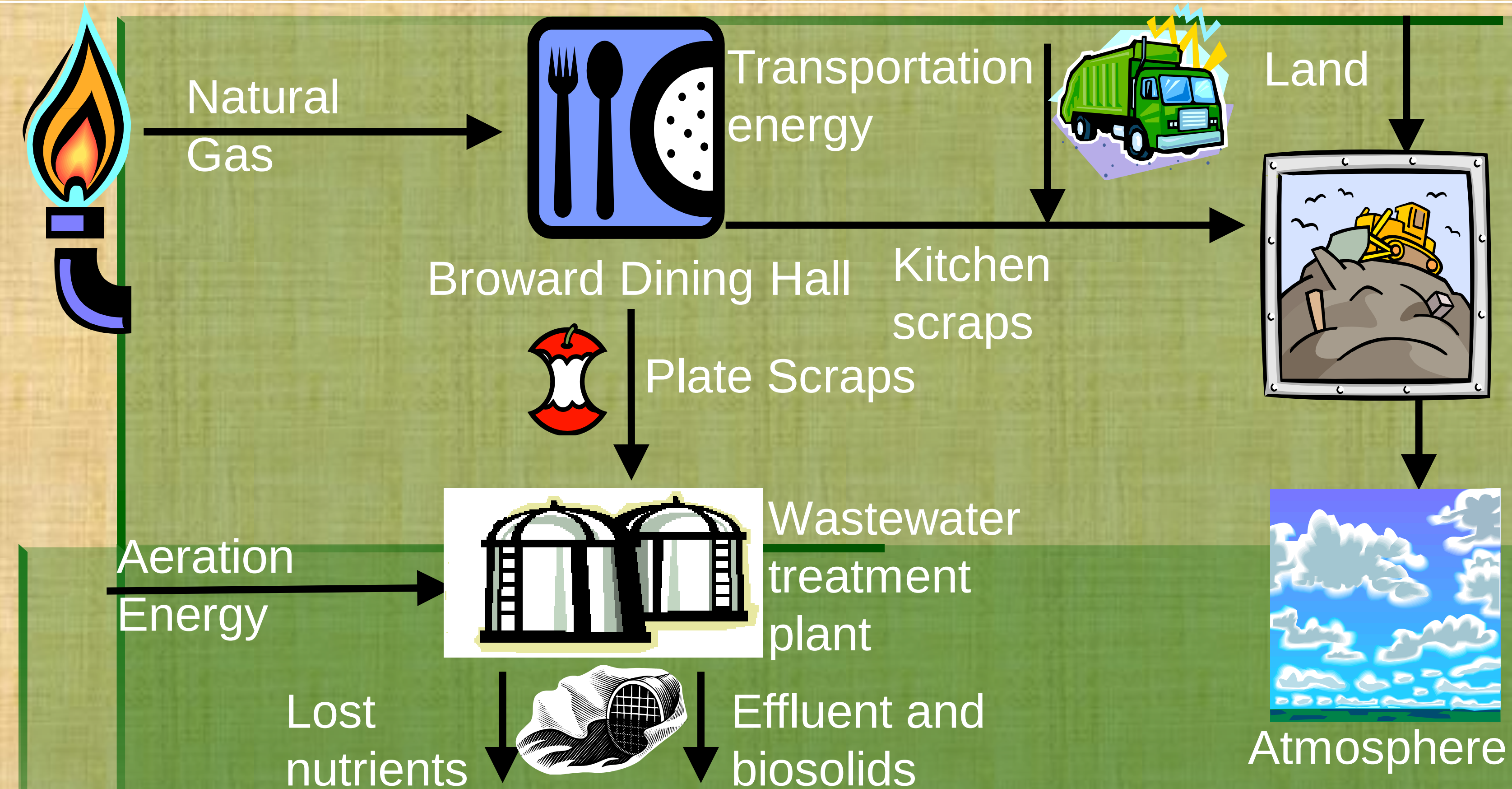
Case study: Broward Dining Hall

- One of two on-campus dining halls
- Almost 2,000 customers per day
- Two waste streams
  - Plate Scraps – wastewater plant
  - Prep Waste - landfill

Problems with current waste disposal

Landfilling - Prep Waste	Sewage treatment - Plate Scraps
• Transportation energy	• Requires water for flushing
• Methane to atmosphere	• Energy wasted on cooking
• Land requirement	• Energy demand at treatment plant
• Aesthetics	• Loss of nutrients in biosolids
• Lock-up nutrients	• Transportation of biosolids

Current open-loop system



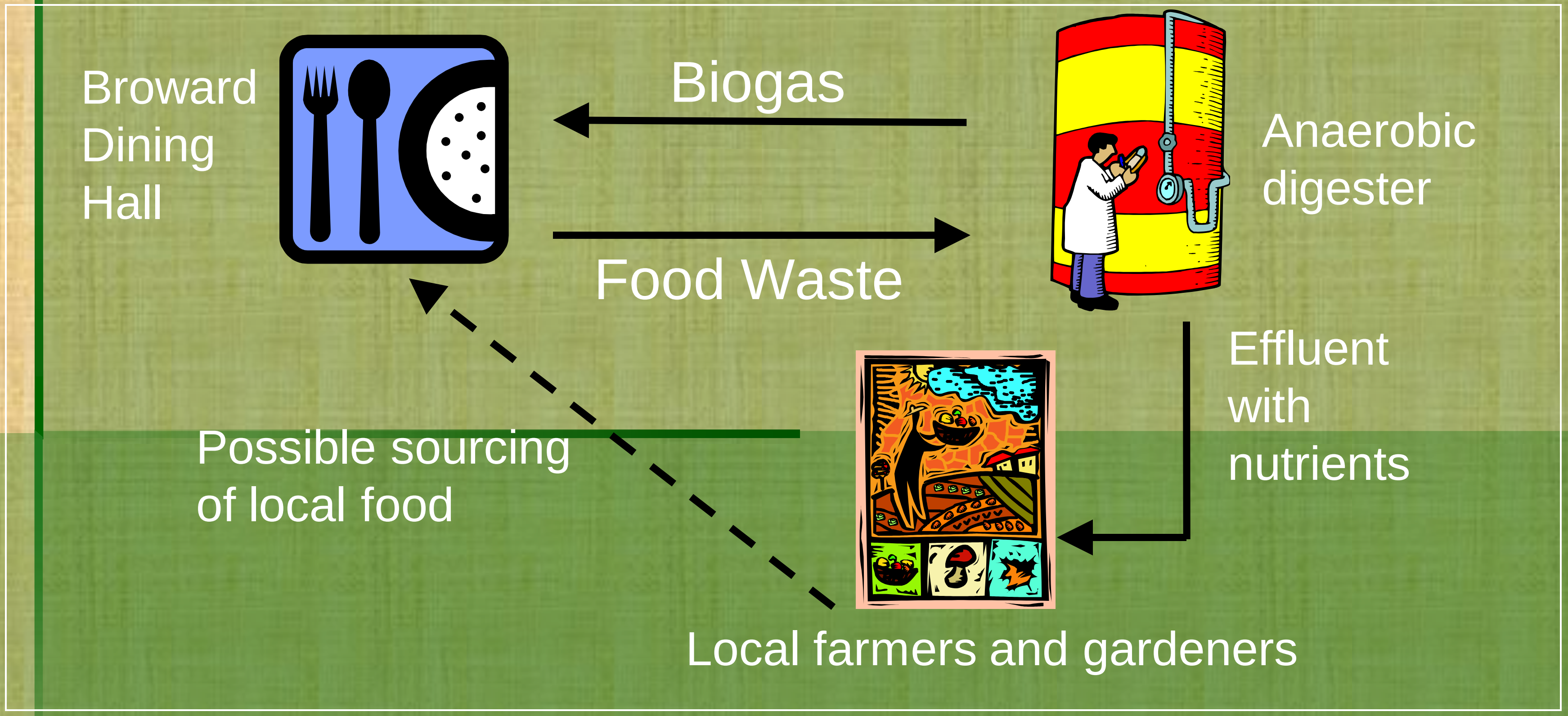
Method

- Waste audit conducted
- Food waste ground with paint mixer and blended
- Digester fed ~1 lb. per day
- Gas production, pH, and temp. read daily

Results

- ~600 lbs of food waste per day
- Could produce about 1500 ft^3 of biogas per day or 900 ft^3 natural gas equivalent
- Supplement cooking fuel
  - Low hydrogen sulfide
  - No need for clean-up

Proposed closed-loop “eco-dining”



Benefits to Dining Service

- Reduced landfilling costs
- Reduced energy costs
- Improved public image
- In-line with University's sustainability goals
- Pilot for biogas reactors at other dining halls

Benefits to the University

- Help meet zero waste goals
- Reduced demand on sewage treatment plant
- Reduced hauling costs of biosolids
- Improved public image
- Meet sustainability goals

Benefits to Community

- Benefits from spread of biogas technology
- Reduced carbon emissions
- Reduced negative consequences of current disposal system
- Effluent as an organic fertilizer

Conclusions

- Sustainable, closed-loop energy production and waste disposal
- One of many technologies for a sustainable energy future

Questions?