

Biogas and Renewable Carbon

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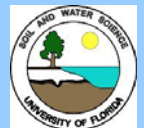
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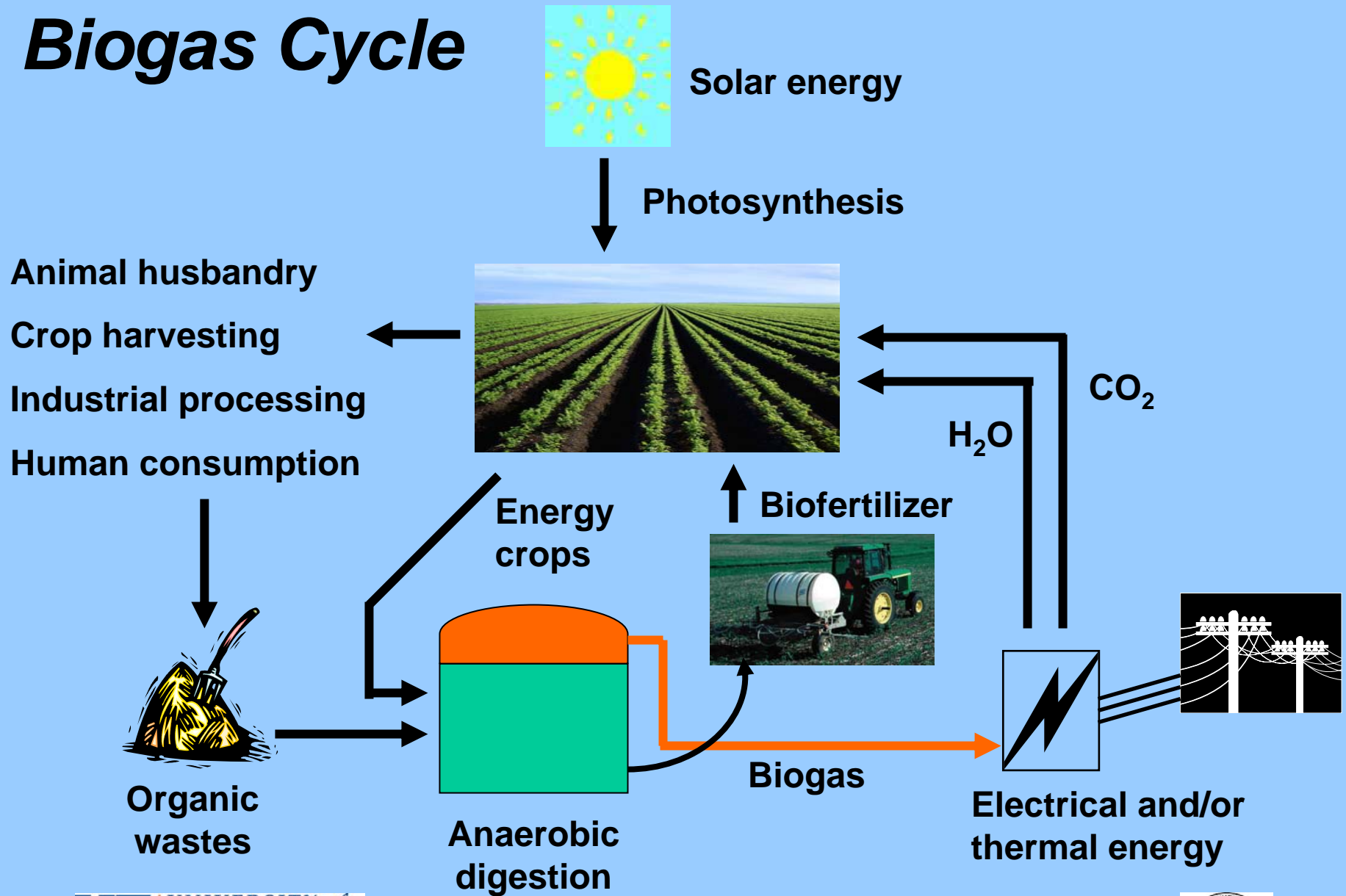
Climate Change Conference

Tampa

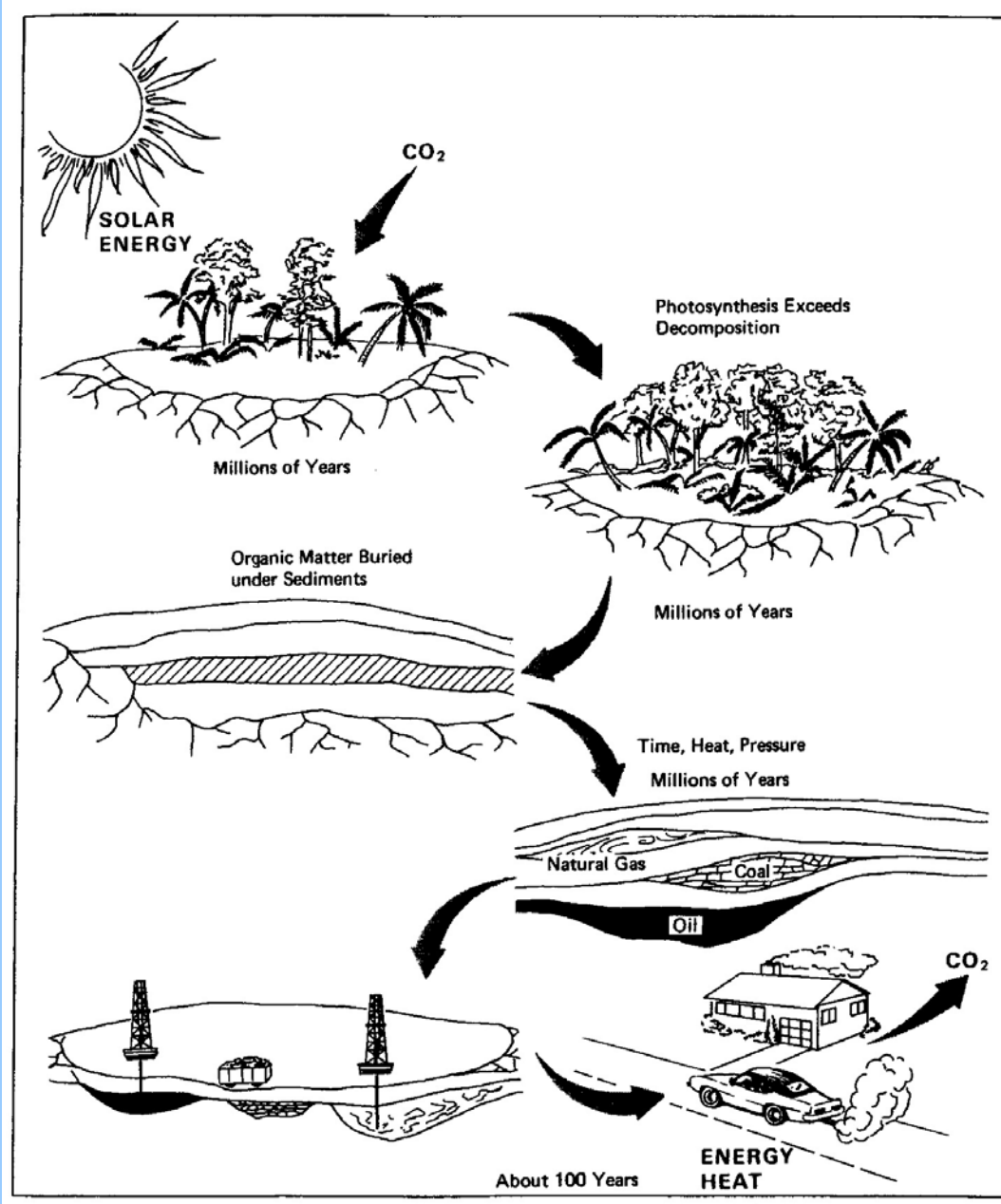
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Biogas Cycle



Fossil Fuel Cycle



Anaerobic Digestion

The microbial degradation of organic compounds, in the absence of oxygen, to biogas – a mixture of:

- Methane (50 to 70%)**
- CO₂ (30 to 50%)**
- trace amounts of H₂, NH₃, and H₂S.**

LIQUEFACTION
PHASE

GASIFICATION
PHASE

COMPLEX
ORGANIC
MATTER

SIMPLE
ORGANICS

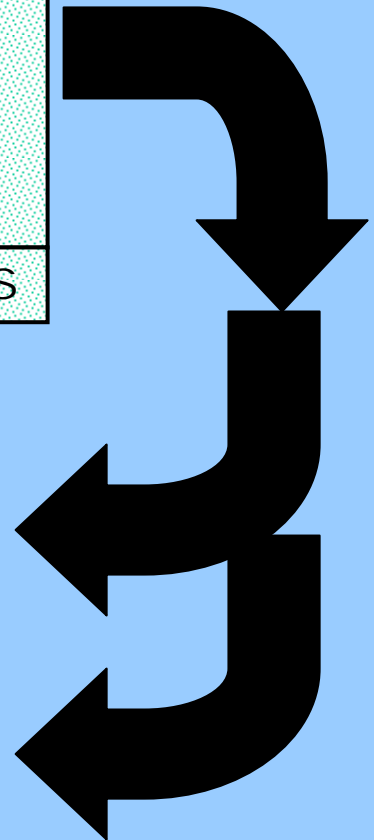
ACIDOGENS

ACETATE
 H_2 / CO_2

METHANOGENS

METHANE and CARBON DIOXIDE

LOW ODOR EFFLUENT



Feedstocks

- **Animal manures**
- **Agro-Industrial wastewaters**
- **Municipal wastewaters**
- **Municipal solid wastes**
- **Biofuels by-products**
- **Energy crops / crop residues**

Benefits of Anaerobic Digestion

- **Renewable energy**
- **BOD/COD reduction**
- **Odor reduction**
- **Pathogen reduction**
- **Nutrient conservation**
- **Greenhouse gas reduction**

Biogas – A Bioenergy Vector

- **Direct Utilization (Heat / Steam)**
- **Conversion to Bioelectricity (CHP)**
- **Natural Gas Pipeline**
- **Vehicular fuel**
- **Fuel Cells**
- **Methanol**
- **Biodiesel**





GatorGas

UF-IFAS

**Anaerobic
Digester**

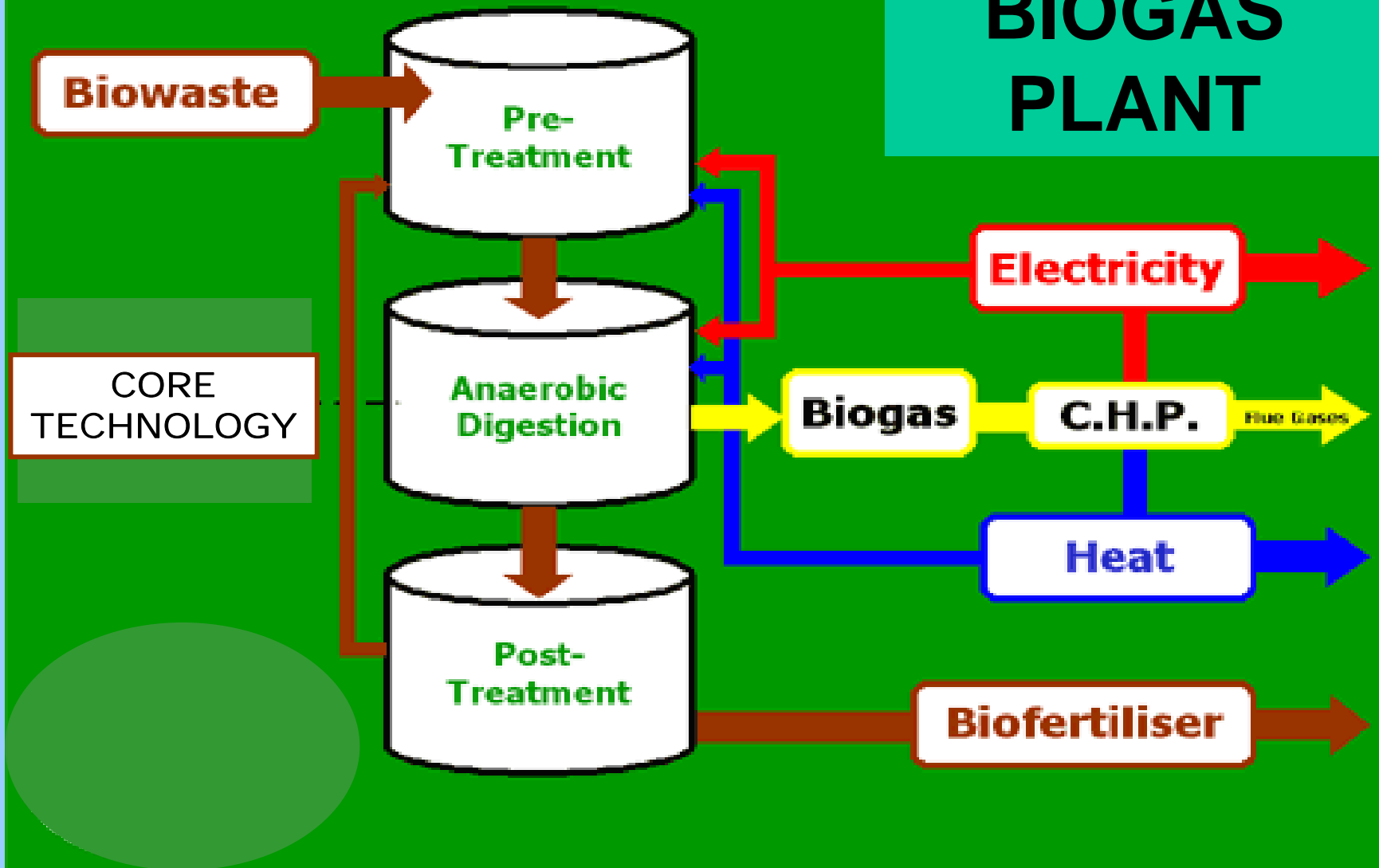
(80-90% CH₄)

Water heater at UF-IFAS Dairy powered by manure biogas



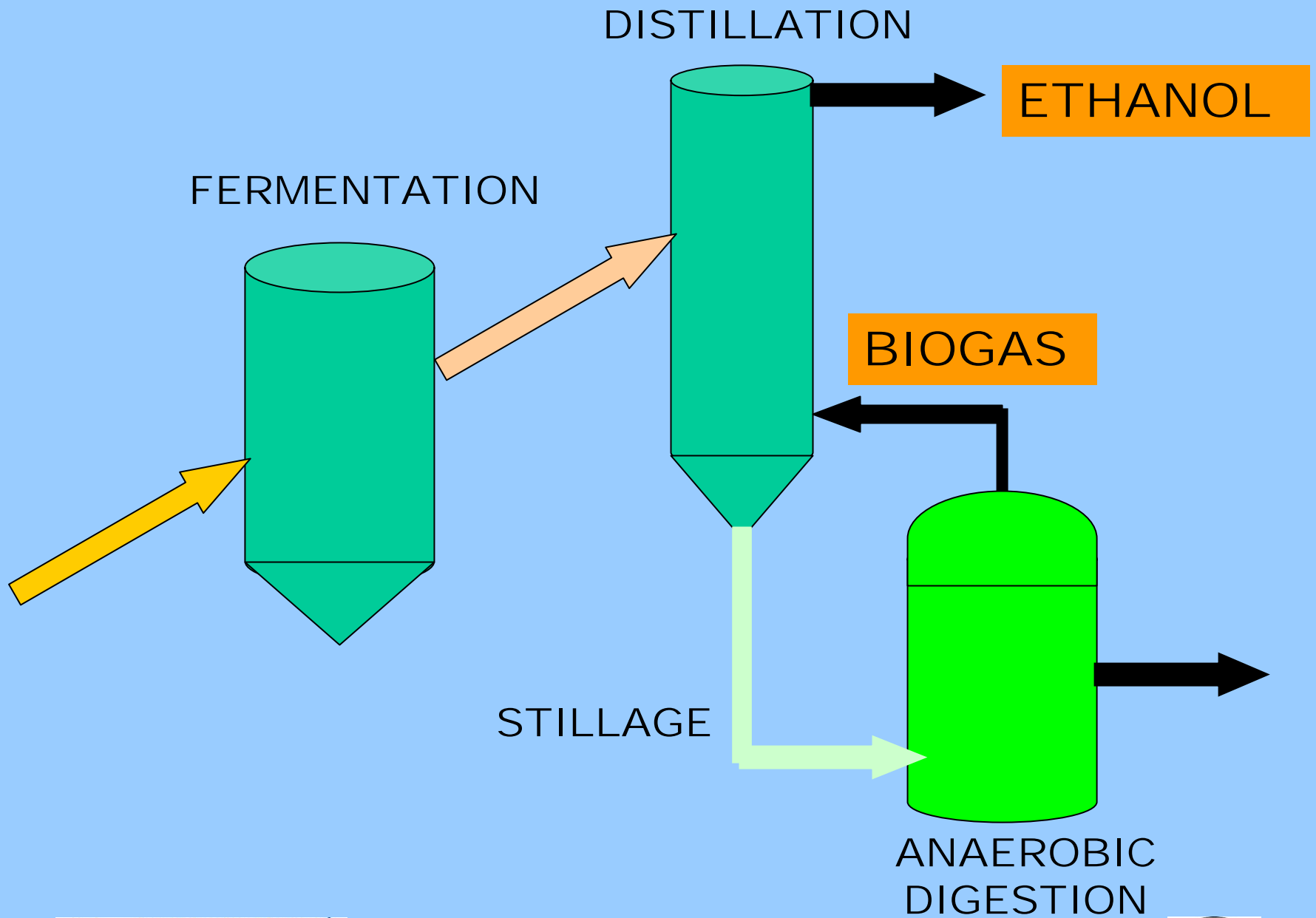


BIOGAS PLANT



Bioethanol Production

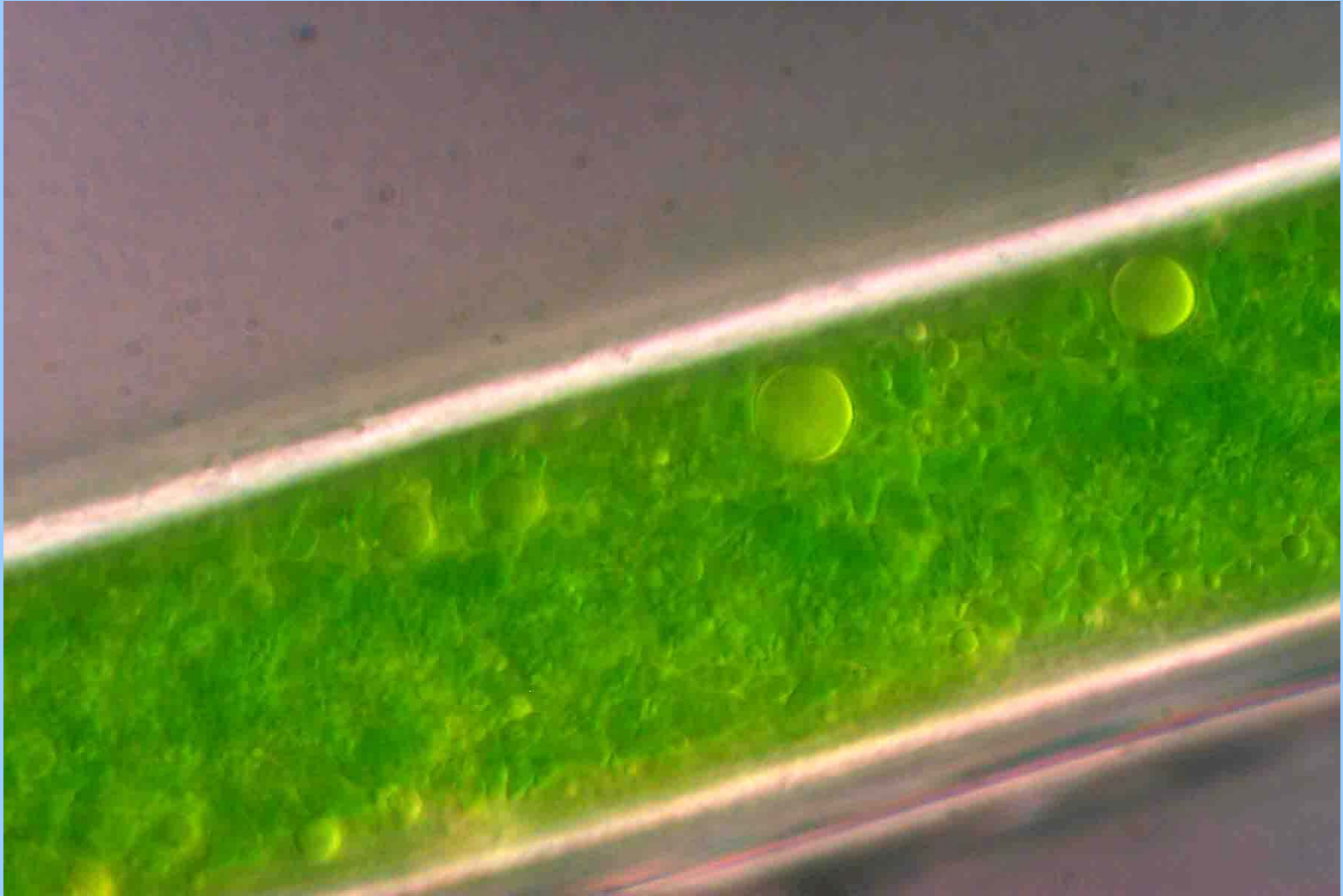
- **Up to 20 liters stillage per liter ethanol**
- **Increased ethanol production requires effective stillage treatment**
- **Anaerobic digestion provides a sustainable solution, reducing pollution potential and producing biogas for use as an in-plant fuel**



Biodiesel Production

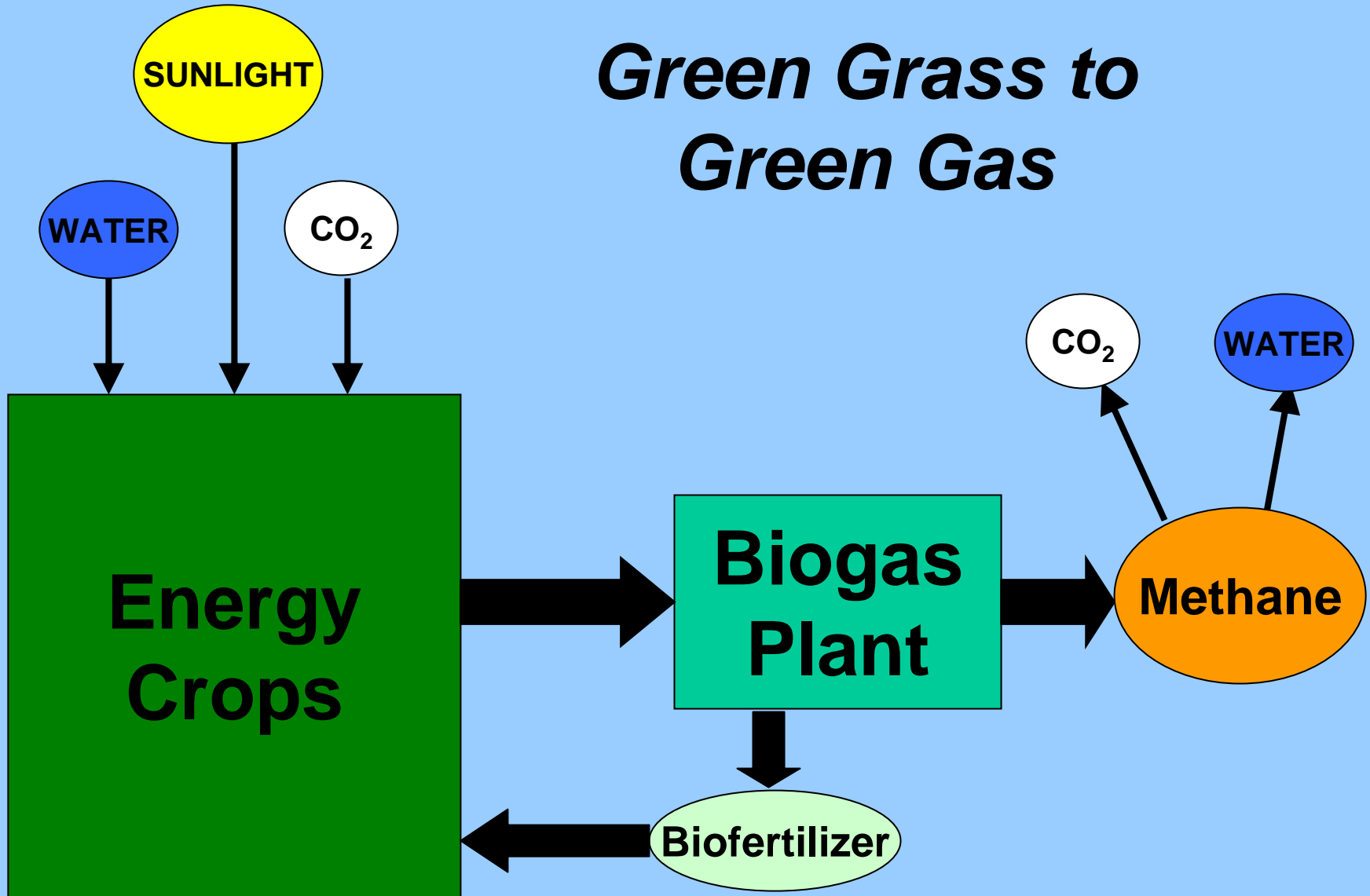
- **Crude bottoms**
 - Crude glycerol
- **Anaerobic digestion offers a sustainable solution**
 - In-house energy / export
 - Reduced process complexity
 - Capital cost savings
 - Avoid non-energy markets

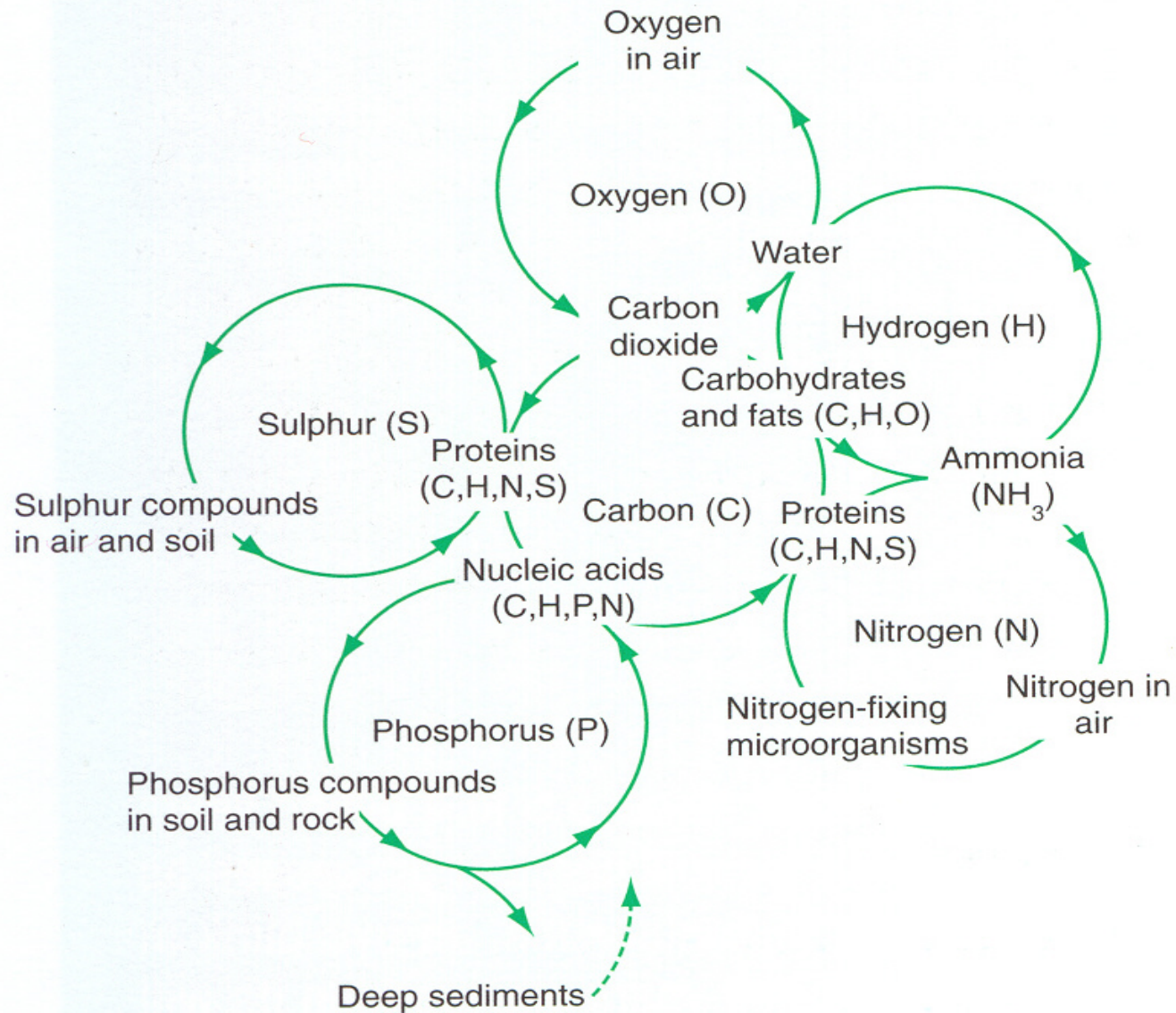
Biodiesel from Algae





Green Grass to Green Gas





Biogas is a sustainable energy solution that is:

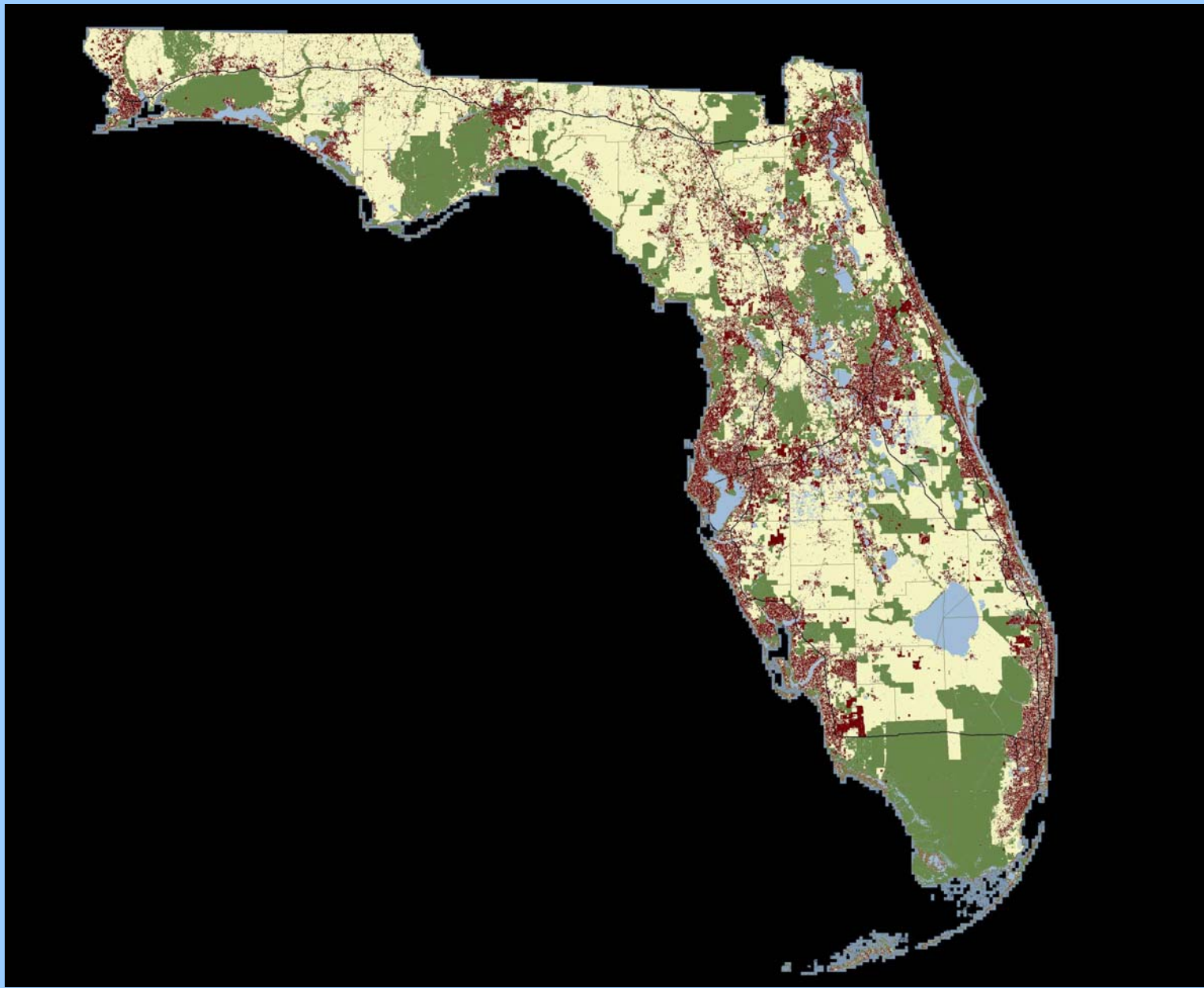
- **Renewable**
- **Carbon dioxide neutral**
- **Locally based**

**thereby protecting the environment,
creating jobs and strengthening
local economies.**

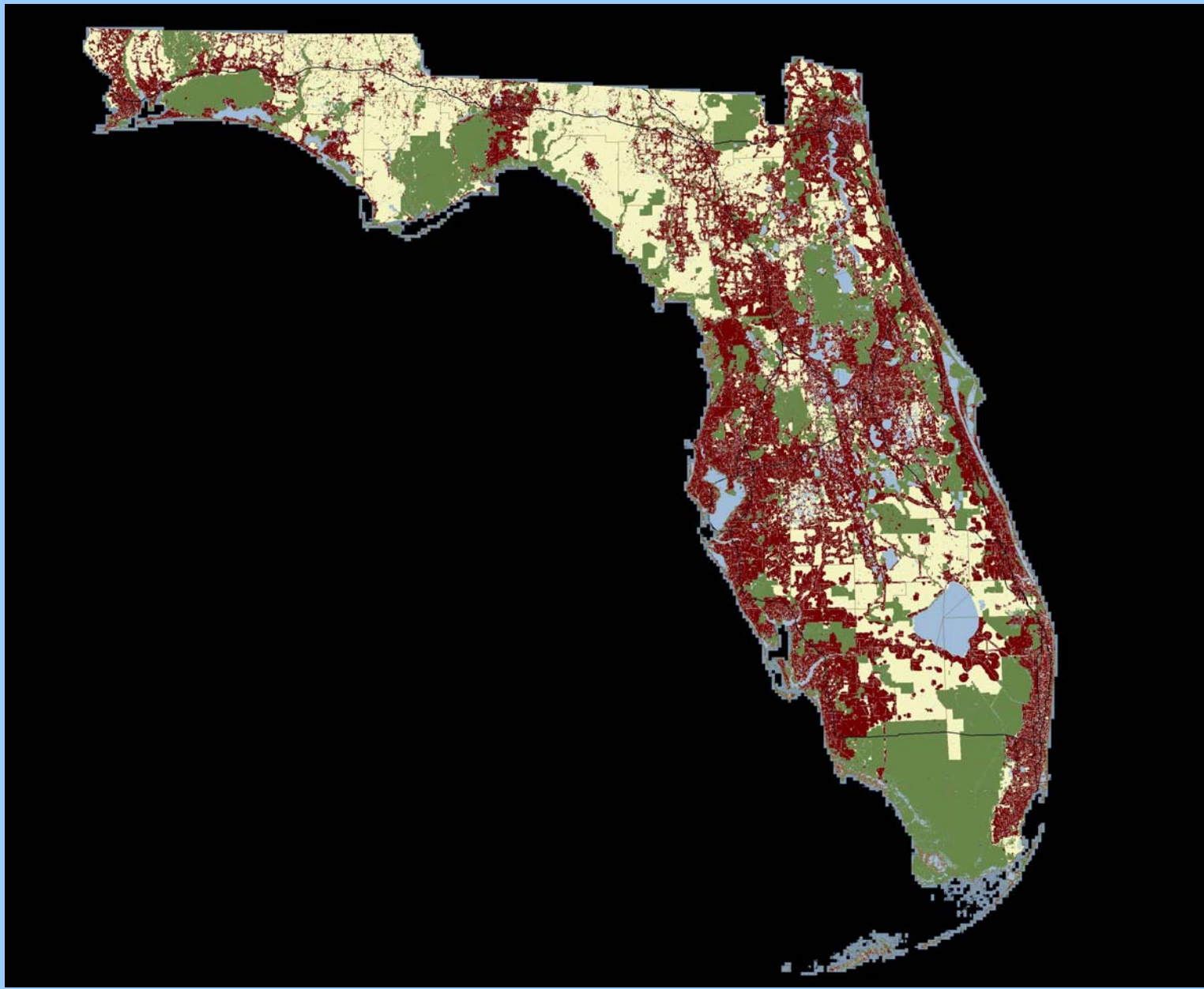
Biogas power provides ...

- **Energy independence**
 - Renewable natural gas
- **Energy reliability**
 - Based on locally based feedstocks

2005
18 million



2060
36 million



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