

# LARSEN ENGINEERS

Since 1955

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## Energy Independent Dairy Farms



**April 13, 2011**

# Sustainability Goal

The Federal and NYS Focus on Energy Independence  
lays the basis for Programs to Reduce Energy  
Demand and Generate Green Energy

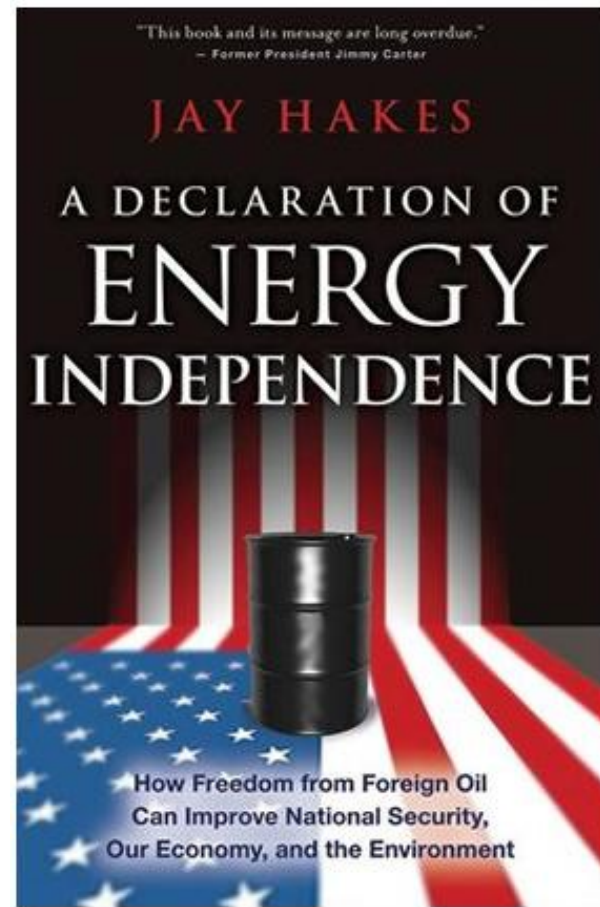
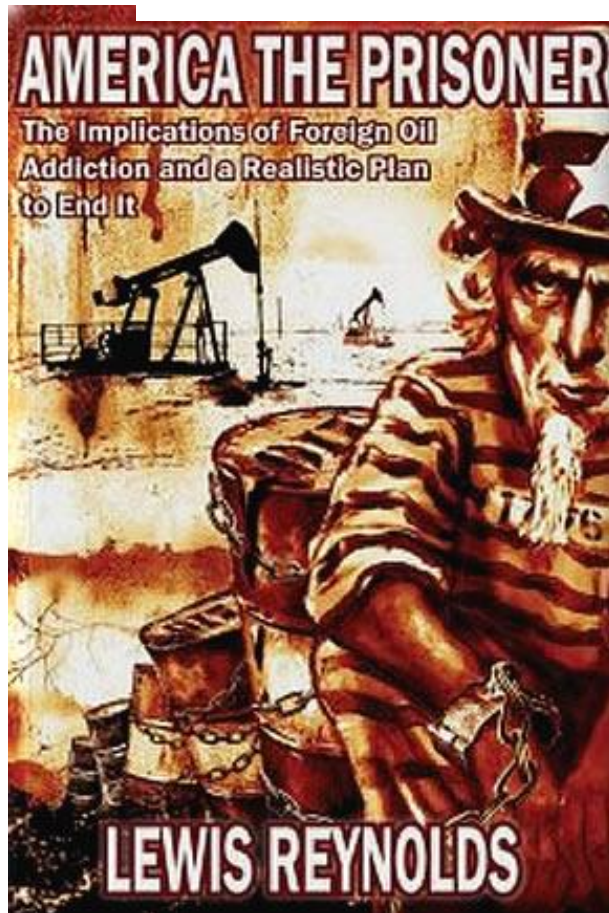


Implement  
solutions for  
dealing with  
Climate Change

# ENERGY

## INDEPENDENCE

American [EnergyIndependence.com](http://EnergyIndependence.com)



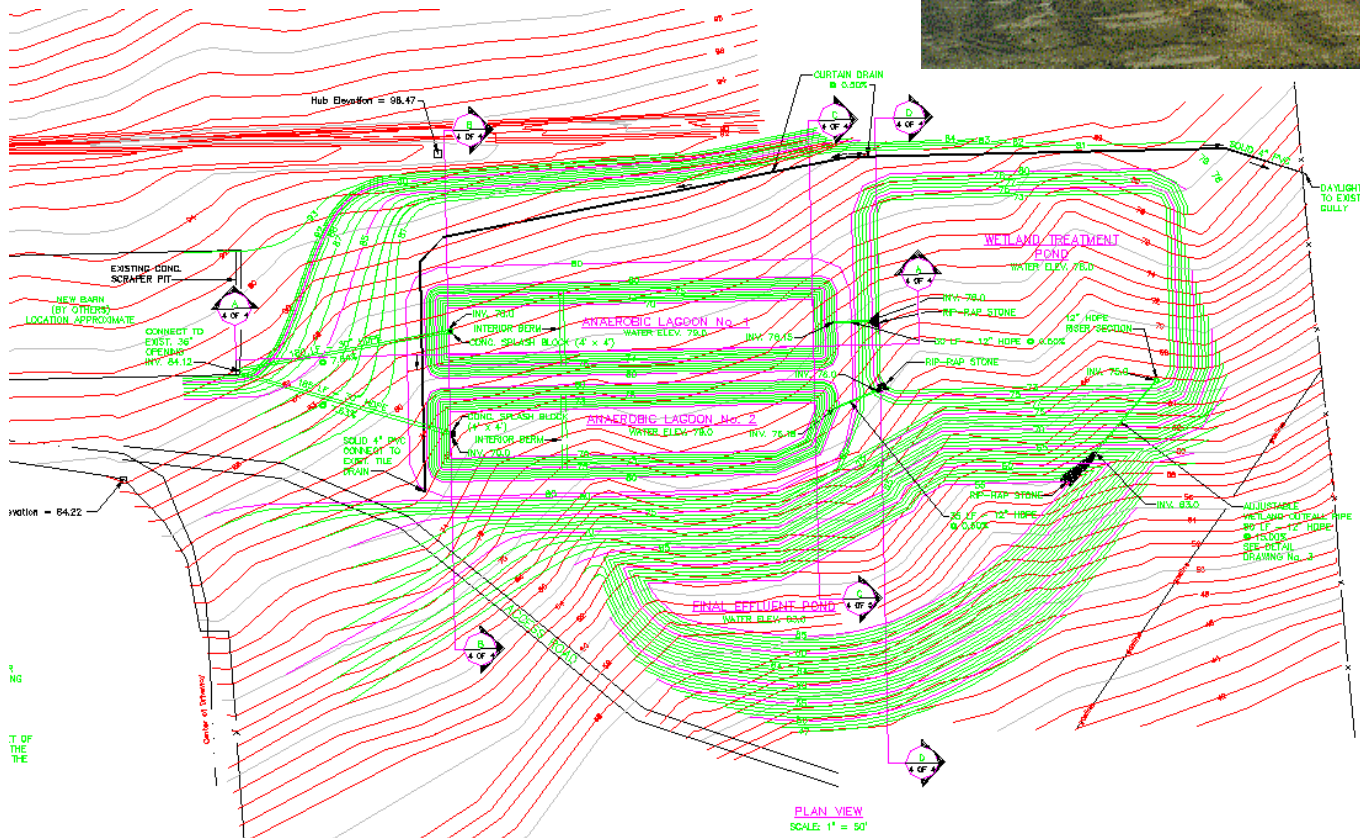
Past Project Examples  
Waste Management- Energy  
Generation



# Becker Farm

## Waste management system

## Wyoming County N.Y.



# Leachate treatment Plant

## Anaerobic Filters

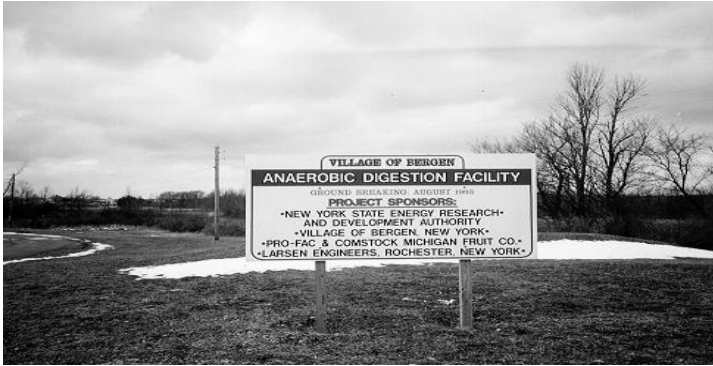


Steuben County

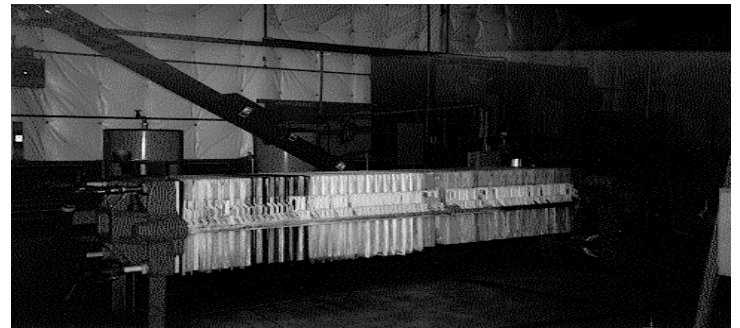
20,000 Gallons per day, from 4 Landfill sites

# ANAEROBIC DIGESTION OF MUNICIPAL AND INDUSTRIAL WASTE

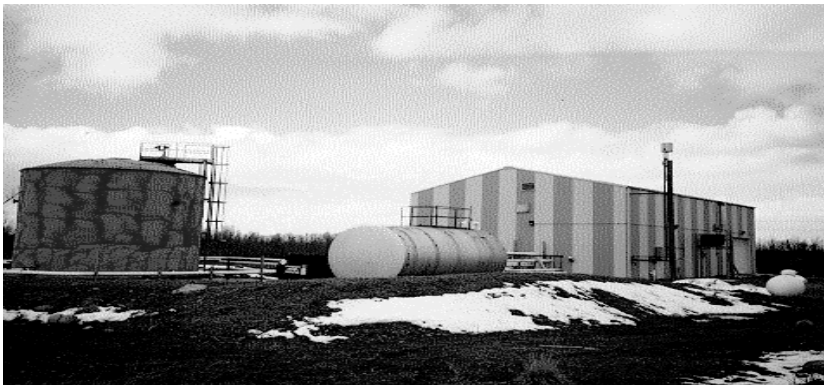
## VILLAGE OF BERGEN, NEW YORK



SIGN



FILTER



ANAEROBIC DIGESTER  
AND STORAGE TANKS

ANAEROBIC DIGESTION OF MUNICIPAL AND INDUSTRIAL WASTE  
VILLAGE OF BERGEN, NEW YORK



PROCESS BUILDING



SLURRY MIX TANK  
4,000 GALLONS



ANAEROBIC DIGESTER  
60,000 GALLONS AND  
STORAGE TANKS



# Boston Harbor STP

## 1 Billion Gallons per day



*Turnkey Digester project at Bajaj Hindusthan Ltd., India*

*Total 190+ Digesters completed for Various Industries*





# Wastewater Treatment Plant, Medina New York





# Leadership in Energy & Environmental Design

A leading-edge system for designing, constructing, operating and certifying the world's greenest buildings.





**Location: Oregon's lush Willamette Valley**

**Environmentally friendly farm and food  
processor, Sustainable agriculture**

**Philosophy : farming practices should leave the  
soil, air, water, plant life, animals and people  
healthier.**

**Sustainability is a continuing journey.**



With this facility, Stahlbush Island Farms (Oregon State) is completely energy independent!

# **Whatcom County slowly moving toward energy, food independence**

JARED PABEN - THE BELLINGHAM HERALD

**POSTED: Sunday, Jan. 04, 2009**

**Transform the farm at 3156 E. Badger Road.**

- Now we have a **sense of urgency**
- Now we have a county that's really **promoting green jobs and green energy**
- \* People are kind of **tired of putting money into oil company's profits.**
- it's about **benefitting future generations**



**February 2011**



Former President Bill Clinton  
Distinguished Speaker



Tom Vilsack  
Secretary of Agriculture  
Keynote Address

## Renewable Energy Opportunities Discussed at Agriculture Outlook Forum

By Wayne Maloney, USDA Office of Communications,

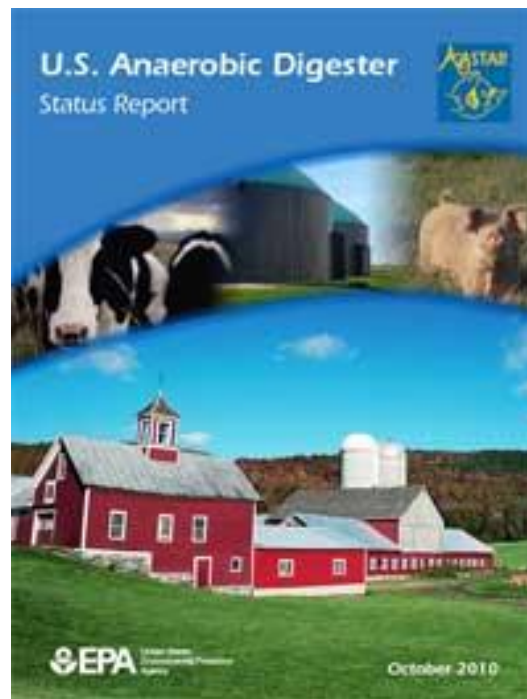


**USD Agriculture Secretary Vilsack**  
**Announces Renewable Energy Feasibility**  
**Awards**

**Monday, March 7th, 2011**

**Grants were awarded to 68 American farmers and rural small businesses to conduct ..**

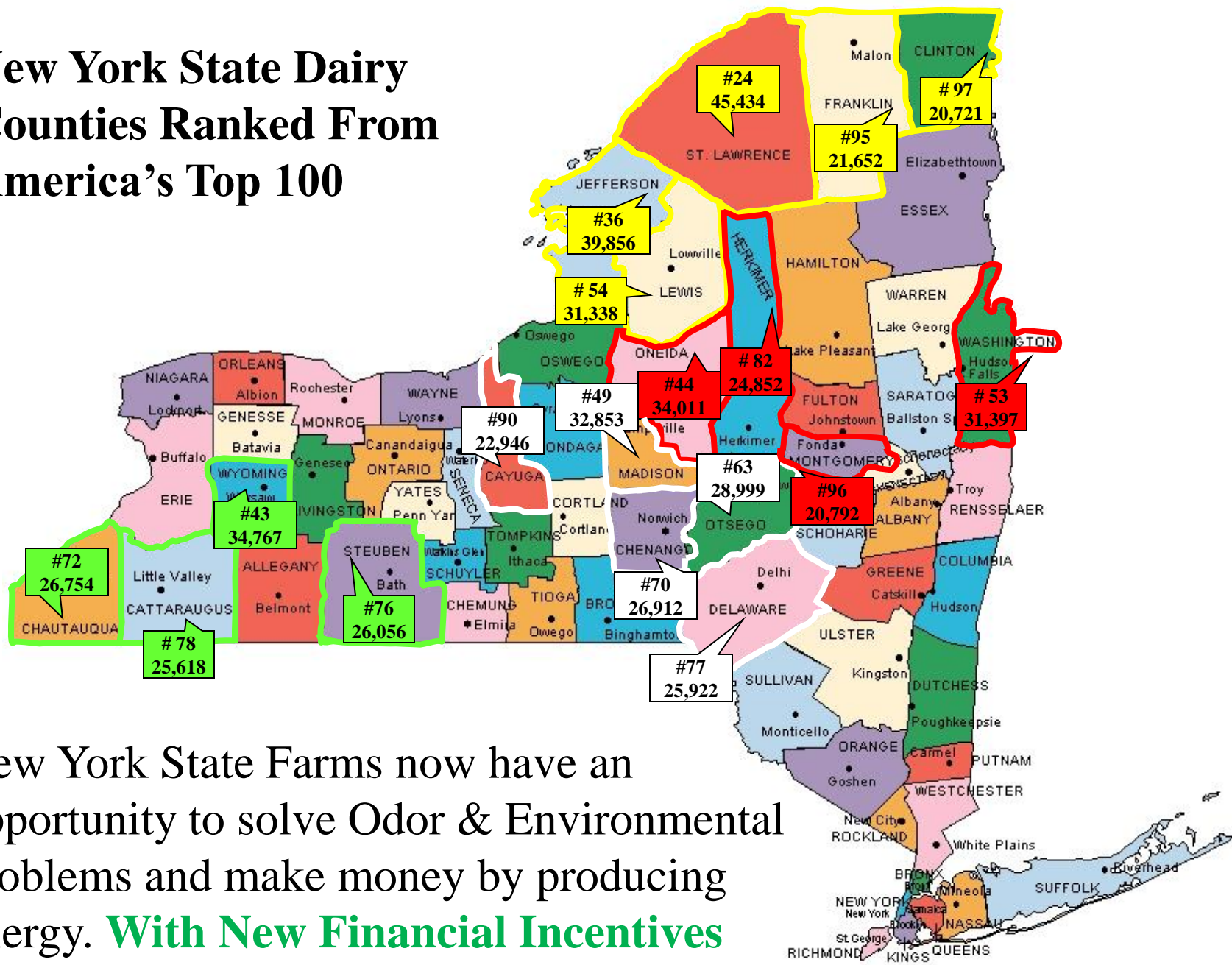
**Renewable energy feasibility studies under REAP**  
**Under the Rural Energy for America Program.**



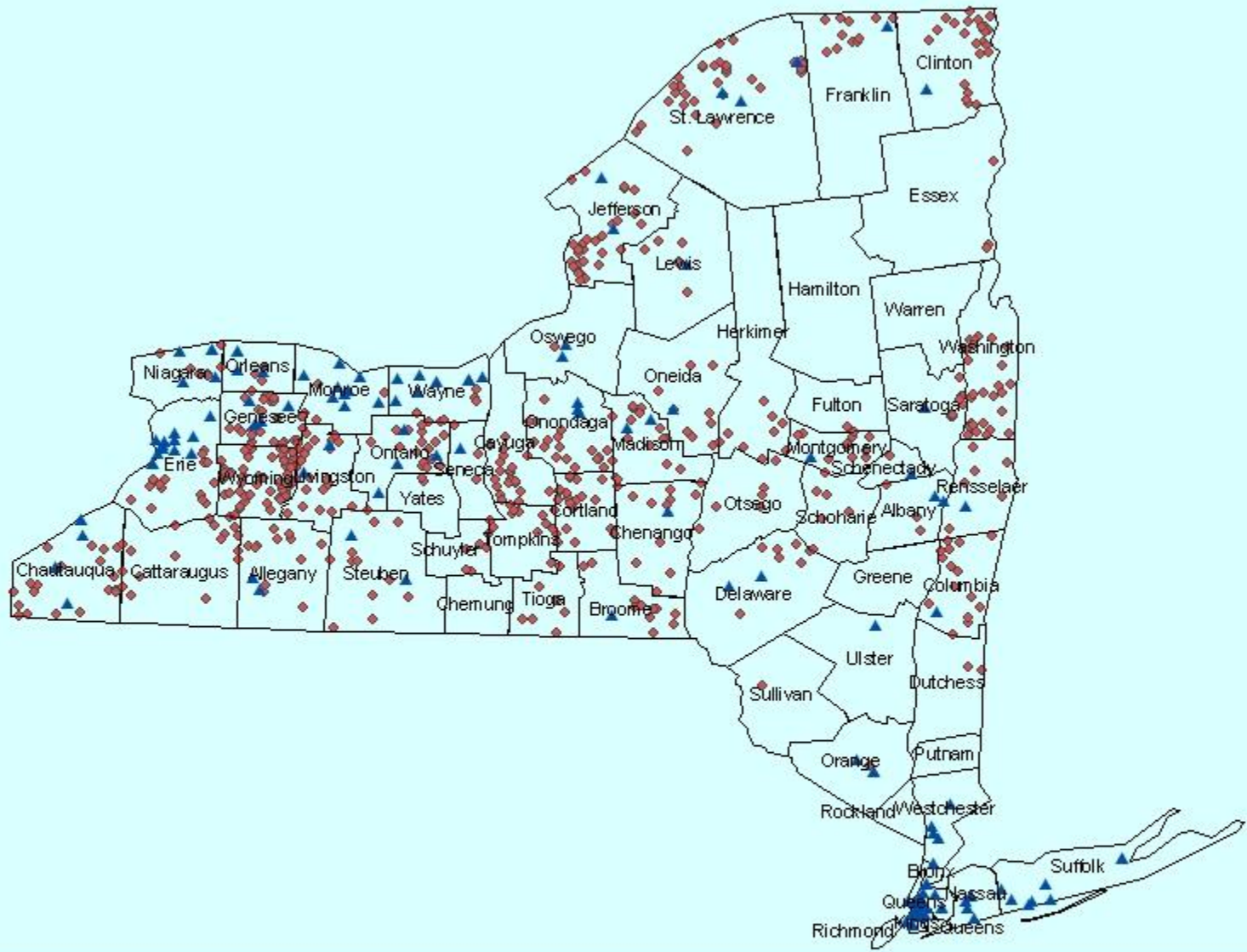
## Biogas Use Technologies for Livestock Manure Anaerobic Digestion Projects

| Use                 | Number of Digester Projects* | Percent of Digester Projects (%) |
|---------------------|------------------------------|----------------------------------|
| Cogeneration        | 78                           | 49.7                             |
| Electricity         | 48                           | 30.6                             |
| Boiler/furnace Fuel | 20                           | 12.7                             |
| Flared full time    | 15                           | 9.6                              |
| Unknown use         | 7                            | 4.5                              |
| Pipeline gas        | 4                            | 2.5                              |
| Vehicle fuel        | 1                            | 0.6                              |
| Not disclosed       | 1                            | 0.6                              |

# New York State Dairy Counties Ranked From America's Top 100



New York State Farms now have an opportunity to solve Odor & Environmental problems and make money by producing energy. **With New Financial Incentives**



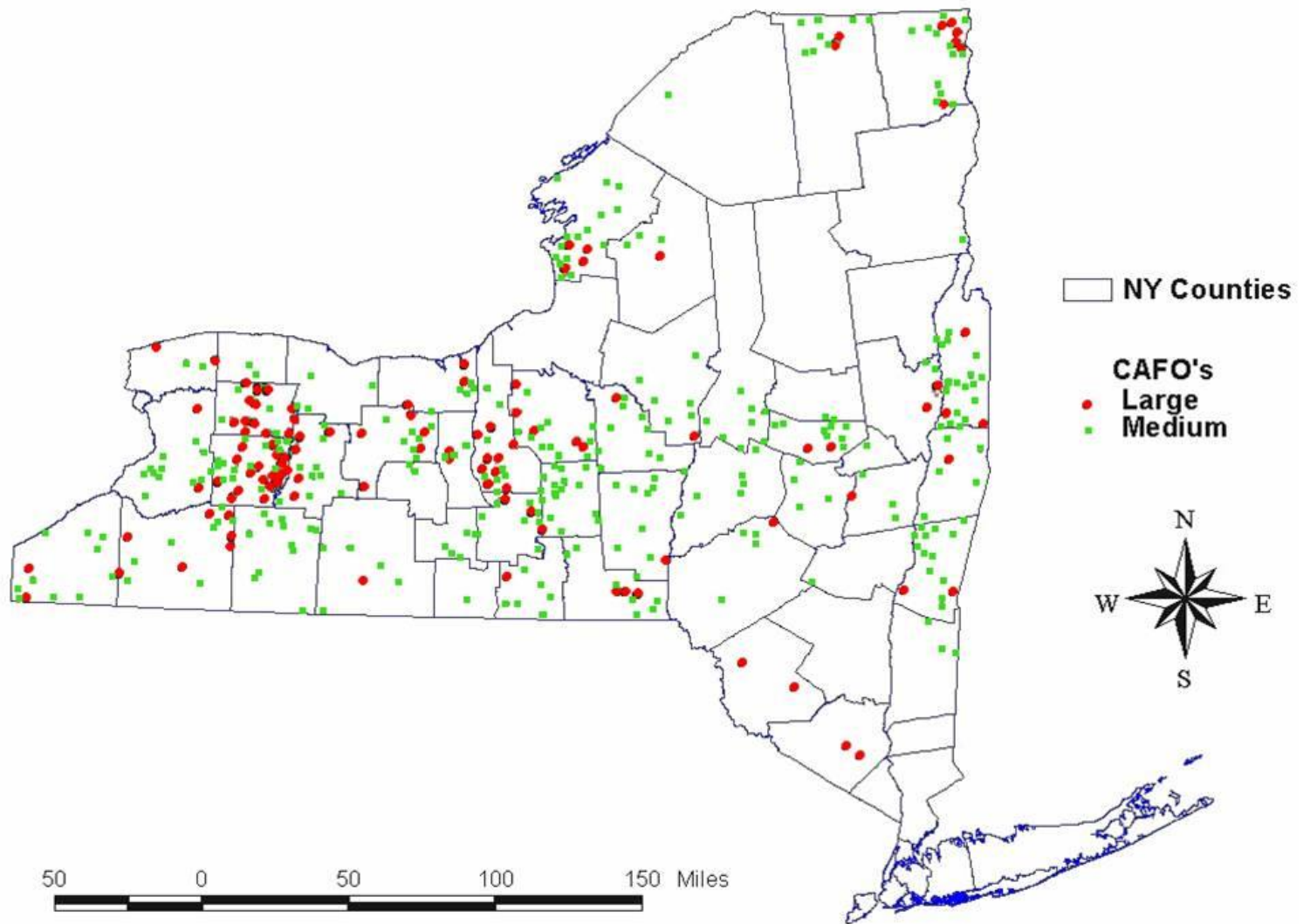
## Distribution of CAFOs & Major Food Processors in New York State

Mark Scoll, Janguo Ma  
05/17/2003

Source: Dept. of Environmental Conservation, NYS Office of Real Property Services.  
Created in ArcGIS 8 using ArcMap.



# New York State Permitted CAFOs





## **Concentrated Animal Feeding Operations (CAFOs).**

Large CAFO Dairy farm has 700 or more cows

Medium CAFO Dairy farm has 200 to 699 cows.

In New York:

Large CAFO Dairy farms > 145 Farms

Medium CAFO Dairy farms = 475

# Phased Strategy for Energy Independence

1. Base line Green Assessment. Energy Use Profile, Waste Generation and Water Consumption
  2. Define the Electric loads and frequency of usage ( hrs/day)
  3. Identify all operating cost factors and conservation measures
  4. Evaluate Capacities of existing Treatment Facilities
  5. Identify potential external sources of Organic wastes
  6. Evaluate appropriate digester technology for biogas production with hauled in industrial strength waste
  7. Study co-gen opportunity for power production and waste heat for digester heating.
  8. Evaluate concepts for waste heat reuse, composting, and Green house etc.
  9. Evaluate site for wind power, geothermal and solar power
- First conserve energy** and then **produce green power**

# Small Farms Needs and Opportunities

- Modular low cost digester design
- Process operations assistance
- Maximize biogas generation- Trucked in food waste- revenue \$\$\$\$
- Install Energy Conservation Measures at Farm to reduce power cost
- Green Power generation to be energy independent
- Use Wind and Solar to make power



# Basic Overview of Anaerobic Process

# Historical Background


Biogas from waste and waste water treatment - Copyright LIOR 1999 - V2.1

Areas of interest Examples Directory Data bank Info Language

- Biogas and landfill gas  
- History

## - Periods

The history of biogas can be divided into four periods

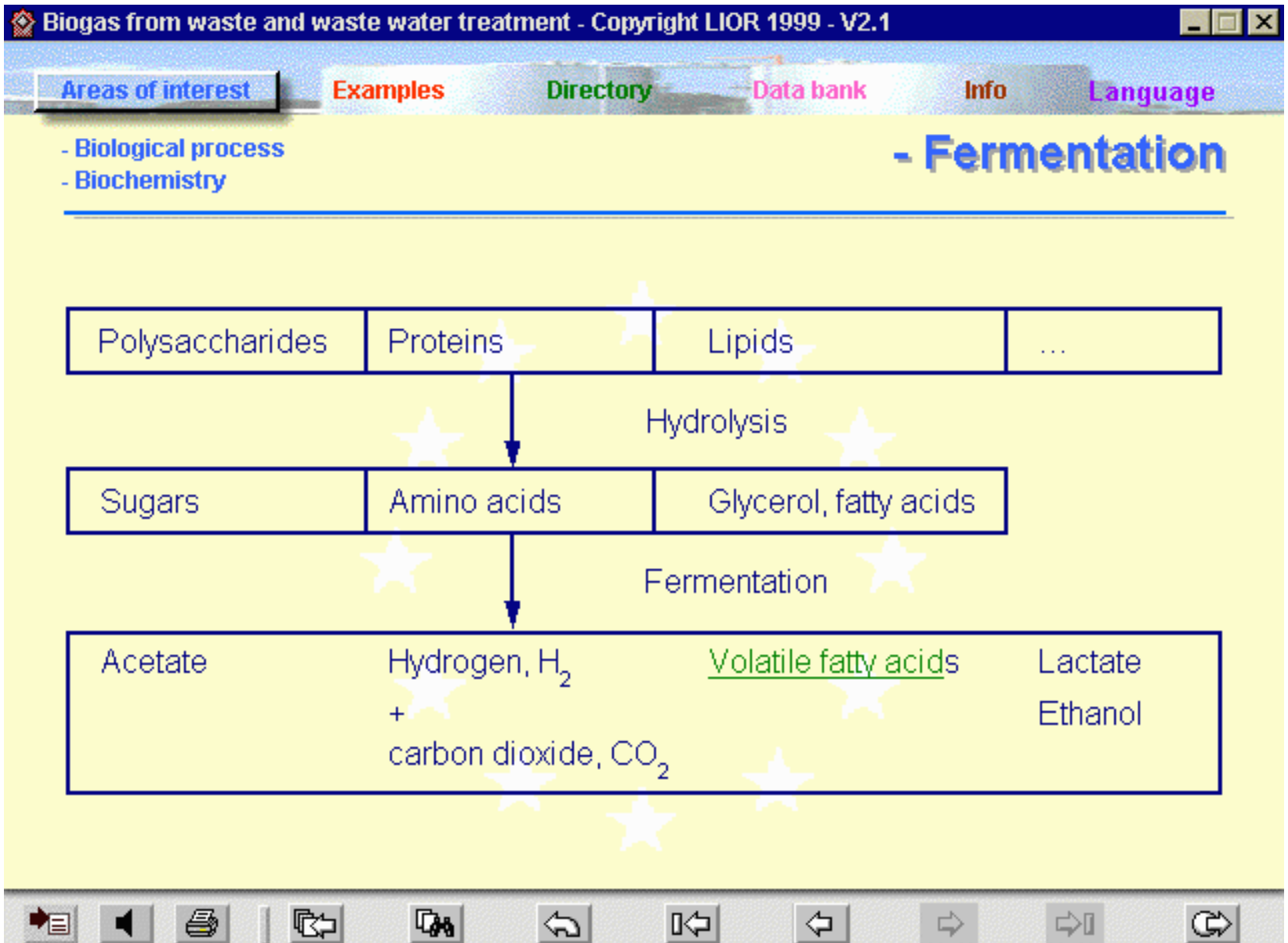


A horizontal timeline arrow pointing to the right, with major ticks at 1900, 1950, 1970, and 1995. Below the timeline, four vertical yellow boxes represent different periods of biogas history. The first box (1900-1950) is labeled 'Earlier work' and describes 'First progress in research and technology' and 'Pioneer work in microbiology' for 'Anaerobic digestion of Sewage sludge'. The second box (1950-1970) is labeled 'Increasing interest in Anaerobic Digestion (all fields)' and 'Maturity', noting 'Mainly agricultural waste'. The third box (1970-1995) is labeled 'Research and development full-scale' and 'Also industrial Waste'. The fourth box (1995 onwards) is labeled 'Mature implementation in research, development, demonstration and dissemination (RDDD)'. White stars are placed above the 1950 and 1970 markers on the timeline.

| Period         | Key Events / Research   |
|----------------|---|
| 1900 - 1950    | <u>Earlier work</u><br>First progress in research and technology<br>Pioneer work in microbiology<br>Anaerobic digestion of <u>Sewage sludge</u> |
| 1950 - 1970    | <u>Increasing interest in Anaerobic Digestion (all fields)</u><br><u>Maturity</u><br>Mainly agricultural waste                                  |
| 1970 - 1995    | Research and development full-scale<br>Also industrial <u>Waste</u>   |
| 1995 - Present | Mature implementation in research, development, demonstration and dissemination (RDDD)  |

Navigation icons: Home, Back, Forward, Search, Print, etc.

# Fermentation



# Biogas Characteristics

Biogas from waste and waste water treatment - Copyright LIOR 1999 - V2.1

Areas of interest Examples Directory Data bank Info Language

- Biogas and landfill gas  
- What is it ?

## - Characteristics

→ Biogas = Methane,  $\text{CH}_4$  + Carbon dioxide,  $\text{CO}_2$   
60-80% 40-20%

→ Quantity of produced biogas depends not only on quantity but also on quality of initial Organic matter:

Organic matter  $\left\{ \begin{array}{l} \text{Difficult to break down} \rightarrow \text{Less biogas produced} \\ \text{Easy to break down} \rightarrow \text{More biogas produced} \end{array} \right.$

→ Methane,  $\text{CH}_4$  = < energy vector >



# Biogas Treatment

Biogas from waste and waste water treatment - Copyright LIOR 1999 - V2.1

Areas of interest

Examples

Directory

Data bank

Info

Language

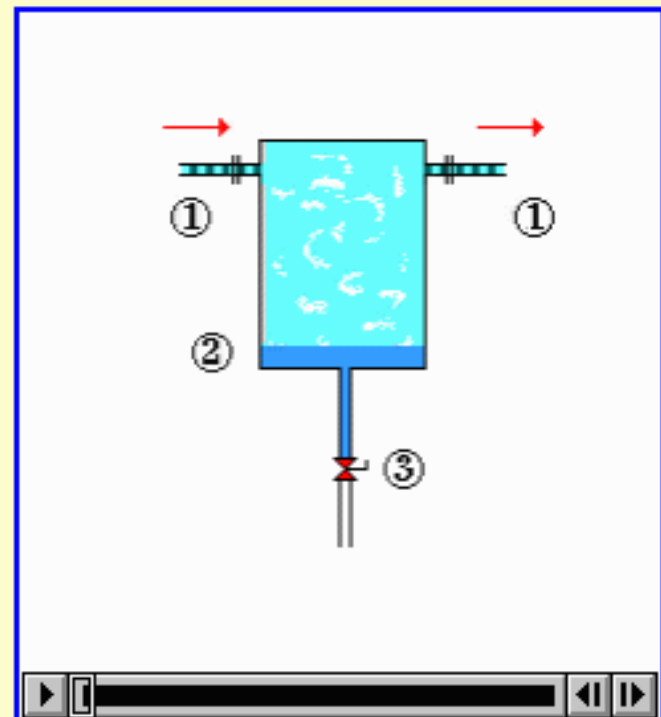
- Downstream of the digester
- Biogas treatment

## - Dewatering

### < Dewatering processes >>

- 1 - Condensation processes
- 2 - Physical Adsorption onto a solid:
  - Alumina
  - Silica gel
- 3 - Physical Absorption into a liquid:
  - Chlorides
  - Ethylene glycols

- 1 - Biogas circulation
- 2 - Condensed water
- 3 - Valve-Condensed water outlet



# Energy Values

Biogas from waste and waste water treatment - Copyright LIOR 1999 - V2.1

Areas of interest

Examples

Directory

Data bank

Info

Language

- Biogas and landfill gas
- What is it ?

## - Energy content

1 m<sup>3</sup> of Biogas (70% Methane, CH<sub>4</sub> + 30% carbon dioxide, CO<sub>2</sub>)

= 0.66 l diesel fuel

= 0.75 l petrol (or gas)

= 0.25 m<sup>3</sup> propane

= 0.2 m<sup>3</sup> butane

= 0.85 kg coal

Heat and electricity production from biogas

Plant output: 8 MW

Sanitary landfill, Rautenweg, Vienna, Austria

Developed by Jenbacher Energiesysteme AG, Austria



# Power Generation

Biogas from waste and waste water treatment - Copyright LIOR 1999 - V2.1



[Areas of interest](#)

[Examples](#)

[Directory](#)

[Data bank](#)

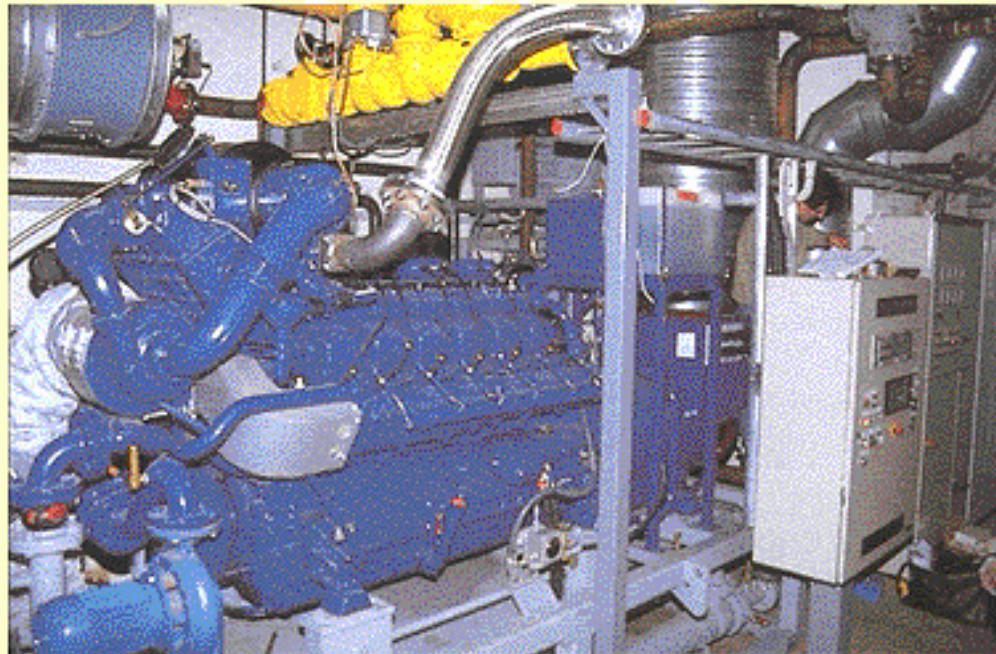
[Info](#)

[Language](#)

- Characteristics of biogas

## - Biogas energy

[Net production of energy from engineered digester](#)  
[Energy recovery from waste anaerobic treatment](#)



Engine running on biogas, Denmark





**focus on energy™**

*The power is within you.*

## **Suring Community Dairy in Suring, Wis.**



This anaerobic digester at Suring Community Dairy is producing heat and electricity from the manure of the farm's 800 milking cows.



# Alternative Uses

Biogas from waste and waste water treatment - Copyright LIOR 1999 - V2.1

Areas of interest

Examples

Directory

Data bank

Info

Language

- Biogas and landfill gas
- What is it ?

## - End-uses

< Biogas end-uses >

- Power (mechanical and/or electrical)
- Heat
- Combined heat and power
- Upgraded to city gas
- Used in vehicles

Old diesel vehicle

Biogas vehicle



Courtesy of Solagro, France



# Vision for Energy Independence

## Whatcom County, Northwest ,Washington State

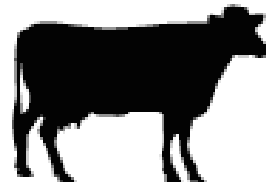


- 50,000 cows
- 133 million gallons of milk every year.
- Produce over 1 million tons of manure -waste
- Digesters planned for biogas production
- Dramatically reduce greenhouse gas
- Make the Whatcom County and City of Bellingham vehicle fleets energy independent.

Source- by NW farms and food - February 18, 2010

# Methane Available for Fuel

Whatcom County, Washington



1 cow

=  
produces

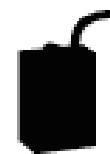


1/2 gallon  
gas equivalent  
per day



50,000 cows

=  
produce



25,000 gallons  
gas equivalent  
per day



Whatcom Transit  
Authority Fleet  
(135 vehicles)

=  
uses on  
average



1,700 gallons  
fuel per day

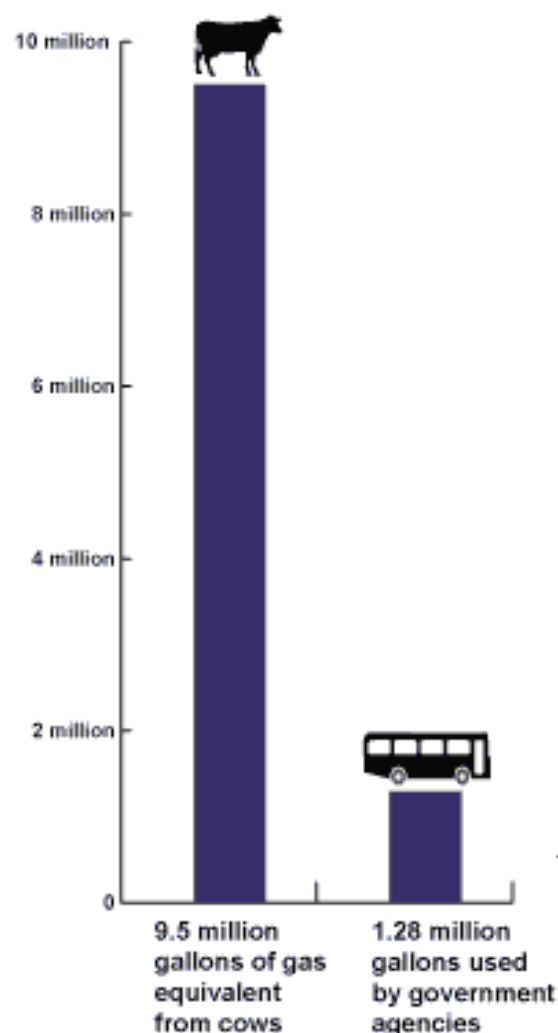
Whatcom County's cows produce enough methane (natural gas) every 3.5 weeks to power the entire WTA bus fleet for one year.

Sources: WWU Vehicle Research Institute, Whatcom Transit Authority (WTA)

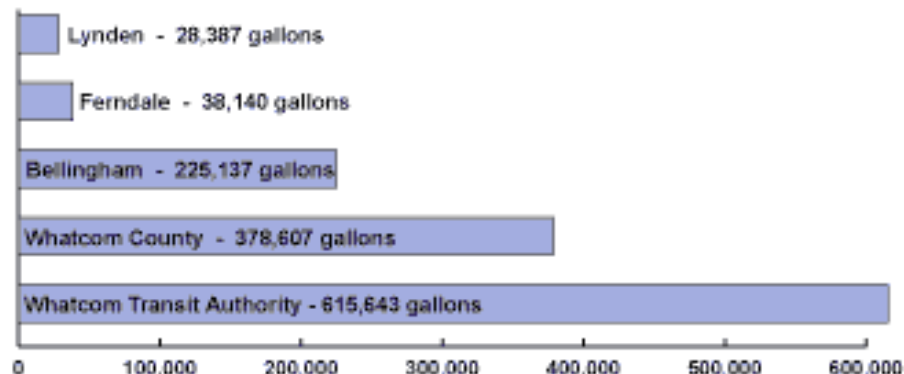
NWFarmsandFood.com

# Methane Available for Government Fuel Use in 2008

## Whatcom County, Washington



### Major Government Fuel Use in 2008



Sources: WWU Vehicle Research Institute, City of Lynden, City of Ferndale, City of Bellingham, Whatcom County, Whatcom Transit Authority (WTA)

NWFarmsandFood.com



# **Methane Energy in Whatcom County, Washington USA**

Digesters— Whatcom County and nearby Skagit County

Features and Benefits:

- Pollution Prevention-dramatically reduce the watershed contamination from dairy farming.
- Reduction in greenhouse gas heating potential.
- Power existing public vehicle fleets with Clean renewable energy
- Put an additional \$20 million into the local agricultural economy.
- Provide the fuel for thousands of additional cars , to be converted to CNG
- Supply the region with an emergency fuel supply that is not dependent on imports or subject to disruption.
- Position the county as an agro-tourism destination.

# Bio-methane fueled vehicle at Vehicle Research Inst., Western Washington University







**EPA People Prosperity  
Planet  
Award Winner  
April 2007**

Green Power Options for Farms to supplement the biogas power generation..

Each site offers different potential based on building orientation ground elevations etc.



# Medina Compost Facility

## Net Positive



With solar panel installed on south facing side of building,  
Net energy production makes it the Greenest compost plant.  
EV Charging Station in Planning Phase for Municipal Vehicles

# Solar PV Technologies

- Funded with GIGP  
Typically provides 10 to 20% of the facility's electric needs



# WIND POWER GENERATION OPPORTUNITY



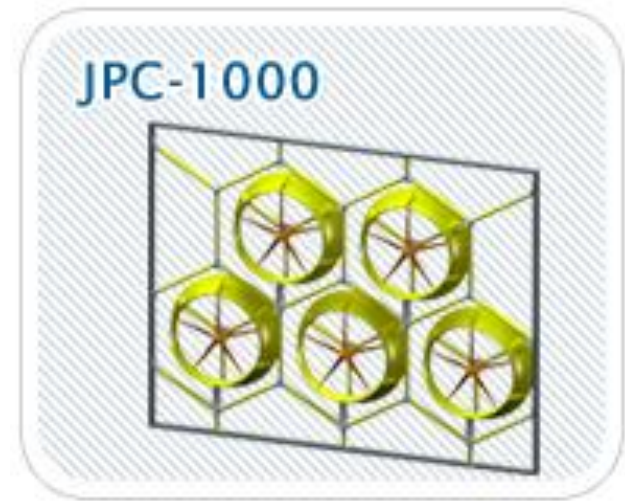
Cost = 4-6 Cents/KWH

Freedom from dependence on imported Oil !!

Secure stability in future energy costs



# Wind turbines for Urban sites- 200w-5kw



A Global Leader in  
Sustainable Planning ?  
( Tax deductible Trip?



# Sweden

- Total population of about 9.4 million
- \* 450,295 square km 173,860 sq mi
- The third largest country in the European Union by area
- **In 2005 announced plan to phase out oil, decrease of nuclear power,** and multi-billion dollar investments in renewable and energy efficiency.



# **Linköping , Southern Sweden's Renewable Energy Plan**

Source- by NW farms and food - February 18, 2010

A city of 98,000 inhabitants, in southern Sweden.

\* Swedish Parliament's mandates to create a sustainable environment, in the late 1990s.

\*City and County authorities began to use the region's dairy manure and meat processing wastes to generate biogas.

\* Expanded production and distribution of the processed biogas. Today, methane powers the city's buses and taxis.

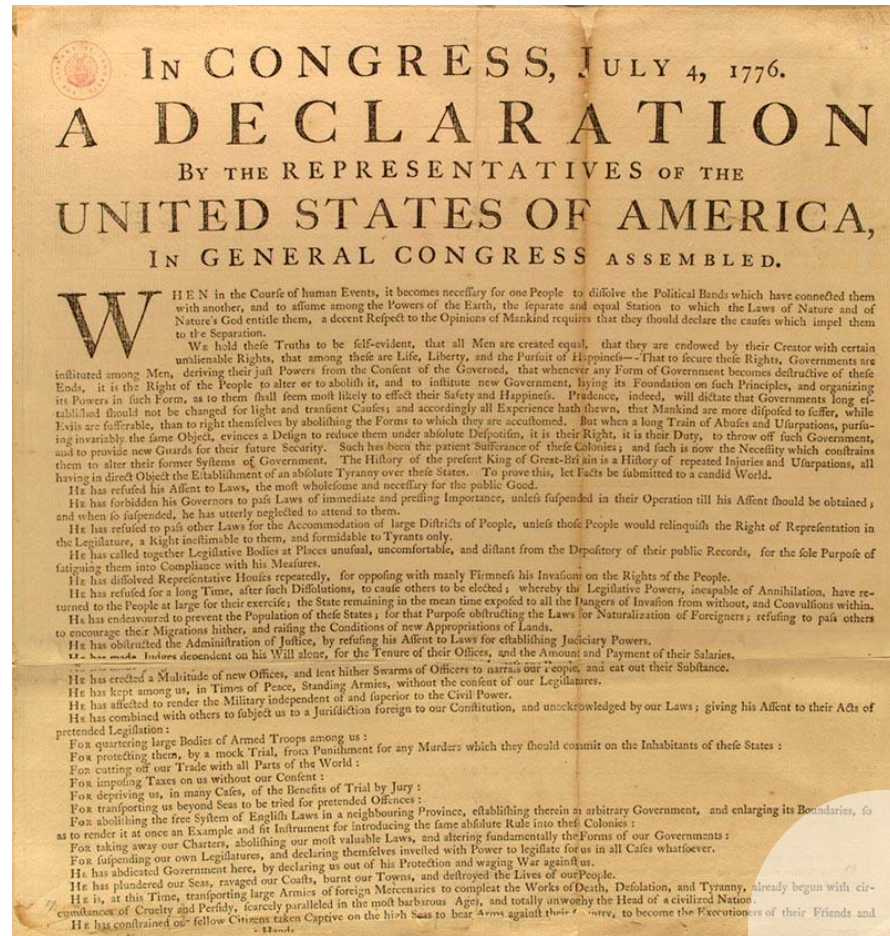
Most recently, converted a former diesel commuter train methane power for its 50 mile (80 km) run to the coastal city of Västervik.

**The Energy Independent Farm** is a new approach, where **farmers** will be able to generate their own **energy** to run their **farm** and agricultural equipment.

[\*www.youtube.com/watch?v=jnhaUzpVnmg\*](http://www.youtube.com/watch?v=jnhaUzpVnmg)



# July 4<sup>th</sup> 2020 – Community Achieves Energy Independence Goal







# LARSEN ENGINEERS

Contact - 585-272-7310, [ram@larsen-engineers.com](mailto:ram@larsen-engineers.com)

**“Environmental Solutions for a Better Tomorrow”**

**Serve the Client**

**Benefit the Community**

**Protect the Environment**