

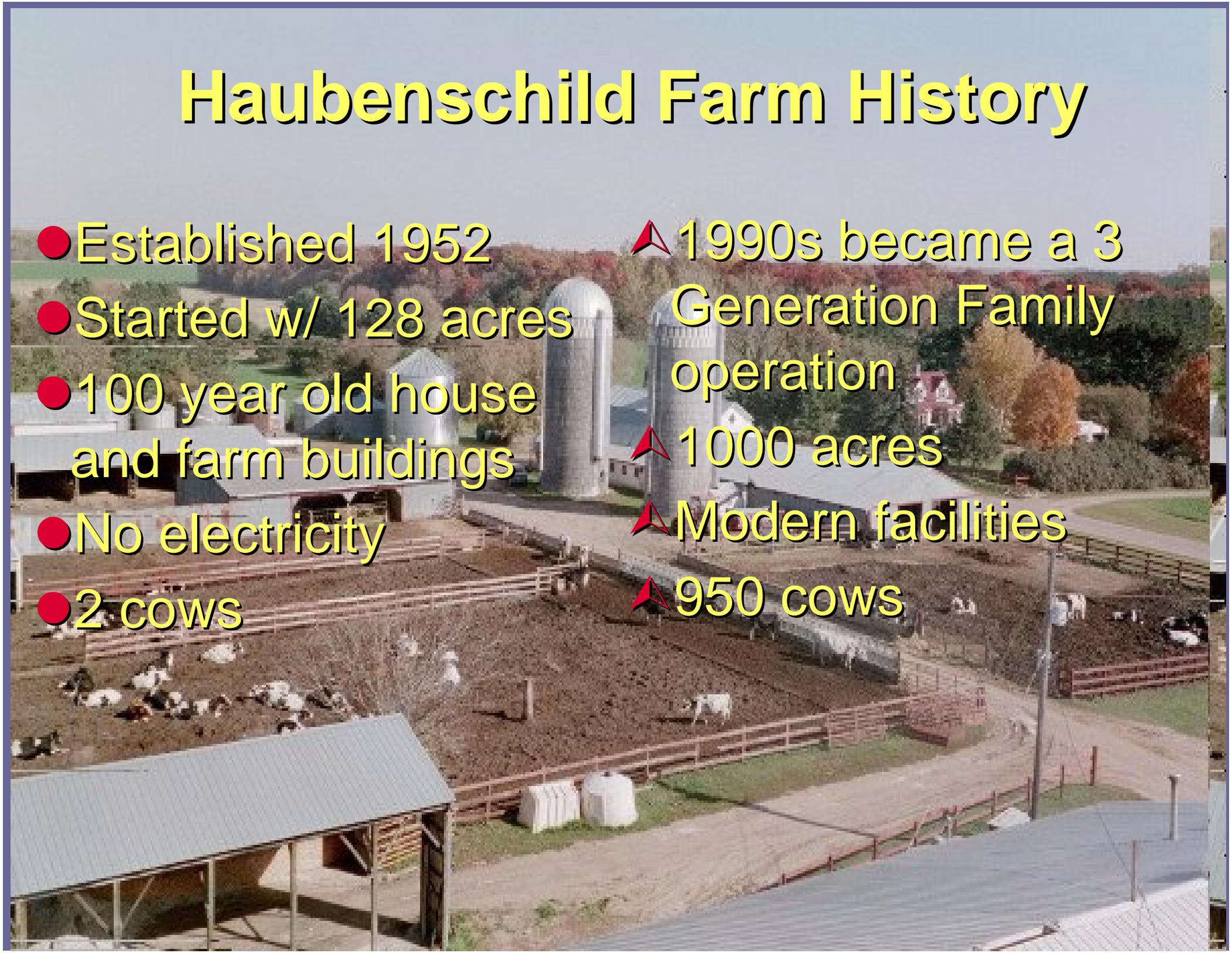
Haubenschild Farm



Producing many deliverables in an environmentally safe manner

Haubenschild Farm History

- Established 1952
- Started w/ 128 acres
- 100 year old house and farm buildings
- No electricity
- 2 cows
- ▲ 1990s became a 3 Generation Family operation
- ▲ 1000 acres
- ▲ Modern facilities
- ▲ 950 cows





Farm Objectives

Sustainable - environment-friendly farm

- ★ Milk production
- ★ Energy production
- ★ Heat recovery
- ★ Minimized odors
- ★ Soil preservation
- ★ Effective feed program
- ★ Recycled newspapers
- ★ Recycled water
- ★ Improved nutrients
- ★ Family-oriented
- ★ Fair profit
- ★ Fun



What is Sustainable Agriculture ?

Sustainable agriculture is one that produces abundant food and energy without depleting the earth's resources or polluting its environment.

I call it the carbon in – carbon out principle

U.S. Agriculture can supply all our food and 1/3 of our domestic energy needs!



Milk Production-Today

- 850 cows in production
- 100 in dry lot
- milking 3X per day
- ★ 59,500 pounds per day
or 7000 gallons





Milk Production

- no human handling
- closed sterile system
- minimal agitation



98F to 36F instantly



2 - 6,000 gallon tankers

Feed Management

- Computer generated TMR
- Minimal shrinkage

- Once a day feeding
- Recovery of unused portion
- Cost effective program





Manure Digester



Using that nondepleteable renewable resource

- 130' LX 30' WX 14' D
- 1/2 million gallons
- 20,000 gallons each day
- constant 100F degrees
- 1,800' of piping

➤ Methane production

➤ via anaerobic decay

72500 cf of biogas per day

Biogas is 60% methane

& 35% CO₂ 50 cf/min

23 cf/kWh



Methane Facts

- Naturally occurring gas
- Produced by many sources
(swamps, rice cultivation, animal husbandry, waste management)
- Captured and used as a commodity
- The conversion of wastes into value-added products represents the positive solution to pollution problems that are often caused by the accumulation of underutilized byproducts.



Methane Powered Co-gen Electricity Production

- Started project June 1999
- Fully operational Oct 1999
- 150Kw generator
- Waste heat recovery for digester operation and building heat



As of 12/06/05

Total kWh made 5,800,000

Sept. 99 – Sept 05 had a net metering contract
with local co-op (win-win)

As of Sept.05 have a below break even contract

Burned 145,189,500 Cubic feet of Bio-gas

The system has been running for over 53,000
hours. 24 - 7

Been running 96.8% of the time since 9/20/99

Have been supplying electricity for the dairy plus
70 house holds

What is it going to take ?

Renewable Portfolio Standards

- RPS creates a minimum commitment to a sustainable energy future!
- RPS will ensure development of renewable energy technologies!
- Haubenschild's Cows:
 - Produce 90-100 tons of Carbon Credits per week !
Haubenschild Farm as sold its Carbon Credits through Environmental Credit Corp.!
 - We use energy that took 21 days to produce not 21 million years
 - ✓ Avoids Burning 50 tons of Coal per Month (1/2 railroad hopper car)

Electrical Transfer



connection to power company

Heat Recovery



heat exhaust recovery



hot water storage - 180F



heat exchanger



boiler & pump

Layout



digester



Free stalls



Co-generator



tanker bay



dairy



Free stalls





Soil Preservation

Nutrient Management

- Increased nutrient value of the processed manure
- More readily available to crops



- Estimated \$40,000 savings in fertilizer
- Manure is a commodity
- Digestate is a soil amendment
- 90+ % odor reduction
- One cow supplies the nutrients for one acre of land – One acre supplies the forage for one cow

Recycled Water



- Reused many ways
- Milk cooling water goes to cow drinking water
- Milk equipment wash water goes for floor washing
- Floor wash water goes to digester/lagoon

Water could be the next commodity we will be fighting over

Recycled Newspaper for Cow Bedding



- 4 tons per week
- minimal costs



- Optimal bedding
- Excellent anaerobic breakdown

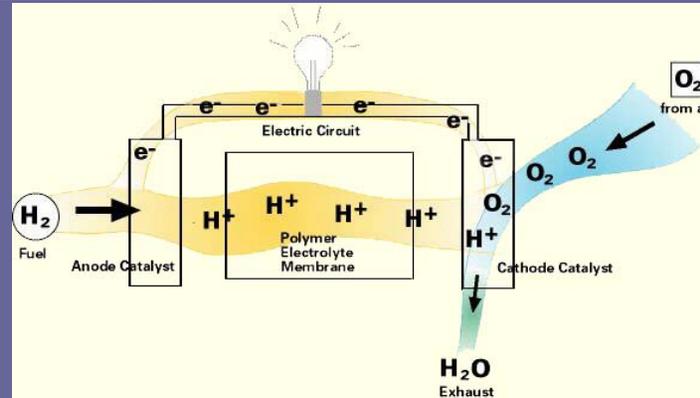
Biogas produced from one day's manure from 100 cows has about the same energy content as 1 barrel of oil



Is this the next step - Hydrogen?



Research Lab



- University of Minnesota, Biosystems and Agriculture Engineering
- Legislative Commission on Minnesota Resources
- John Deere
- Electric Power Research Institute



Plug Power's PEM

Fuel Cell:

Uses hydrogen to
generate electricity
without
combustion. Output is
5 kW at
120 VAC

IT WORKS !!!!!

Jan.27,2005

We did it! Now what do we do with it ?

Hydrogen production in rural area for use in rural transport. (tractors, trucks, cars) ??



Hydrogen production and supplying the Hydrogen Highway fuelling stations on the interstates??

Challenges to using biogas in a PEM fuel cell

- Hydrogen sulfide removal
 - Initial concentration 3000-5000 ppm
 - Need concentration < 25 ppb
- Moisture removal
 - Need dry gas
 - Dewpoint < -30 degrees Celsius
- Carbon dioxide removal
 - Need concentration < 5 ppm

Renewable Sources:



Conversion Processes:

Thermal

Chemical

Biological

Electrolysis

Biofuels

- Syngas
- Methane
- Biocrude

Reformer



Hydrogen Storage

+ N



Anhydrous Ammonia (NH3)



Sustainability in agriculture is achieved by using all of mother natures tools.

I believe Agriculture can play a big part in the Bush Administration's goals to accelerate our transition to a hydrogen economy .

We have shown that we can produce hydrogen from bio-gas. Now we need to do it in a sustainable way. That is by using a high temperature fuel cell like a molten carbonate or solid oxide. This would allow heat as a byproduct to be used to run a Stirling engine that is designed for waste heat to generate electricity or we could use the heat to convert excess hydrogen into ammonia for farm use or hydrogen storage with hot water left over to heat the digester.

When the heat byproduct is used for cogeneration applications, overall energy efficiencies of 70+ % are possible. Agriculture can be a part of the hydrogen production and delivery infrastructure.

Thank You, Dennis Haubenschild

SUMMARY

"Even if you are on the right track,
you will get run over
if you just sit there..."

Will Rogers

