Energy Analysis on the Farm

Renewable Energy for the Farm Conference
Fairlee, Vermont

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

February 17, 2009

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carbon management • clean energy • business sustainability

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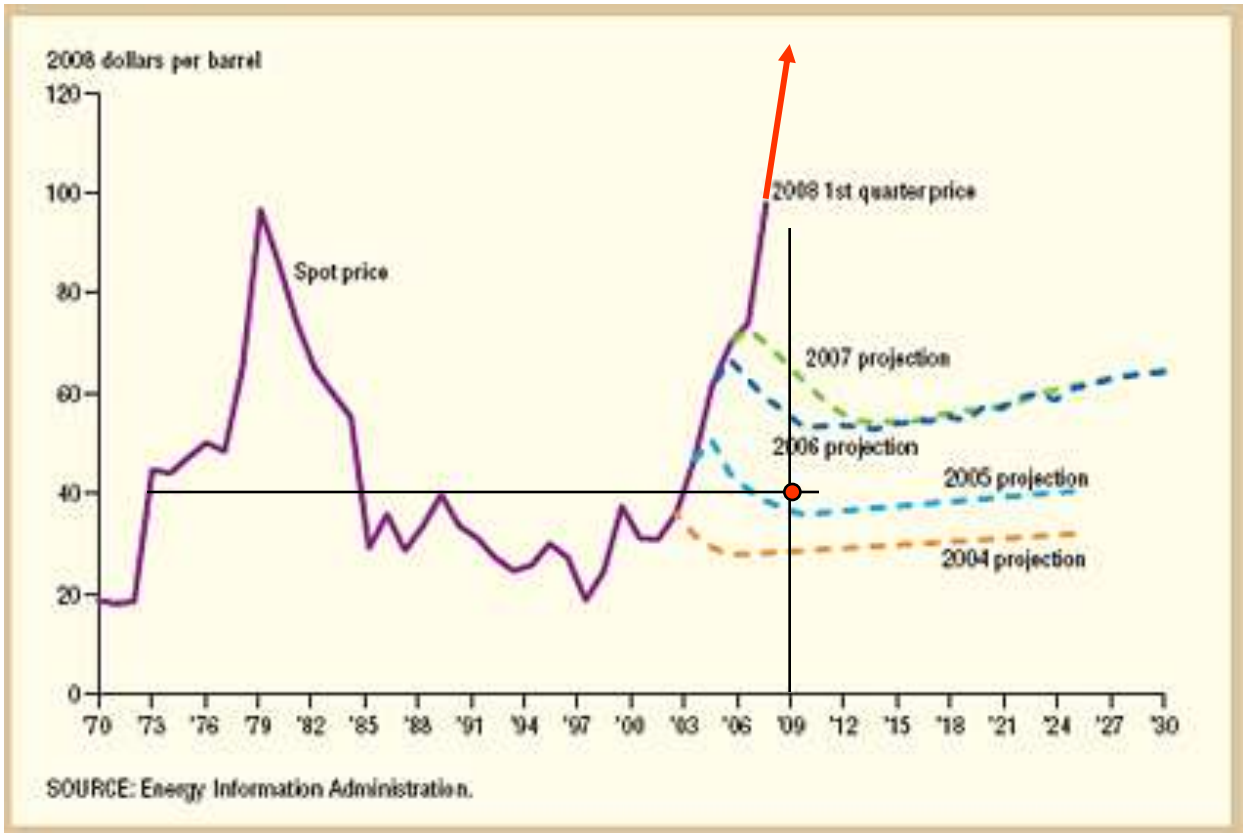
What we'll cover…

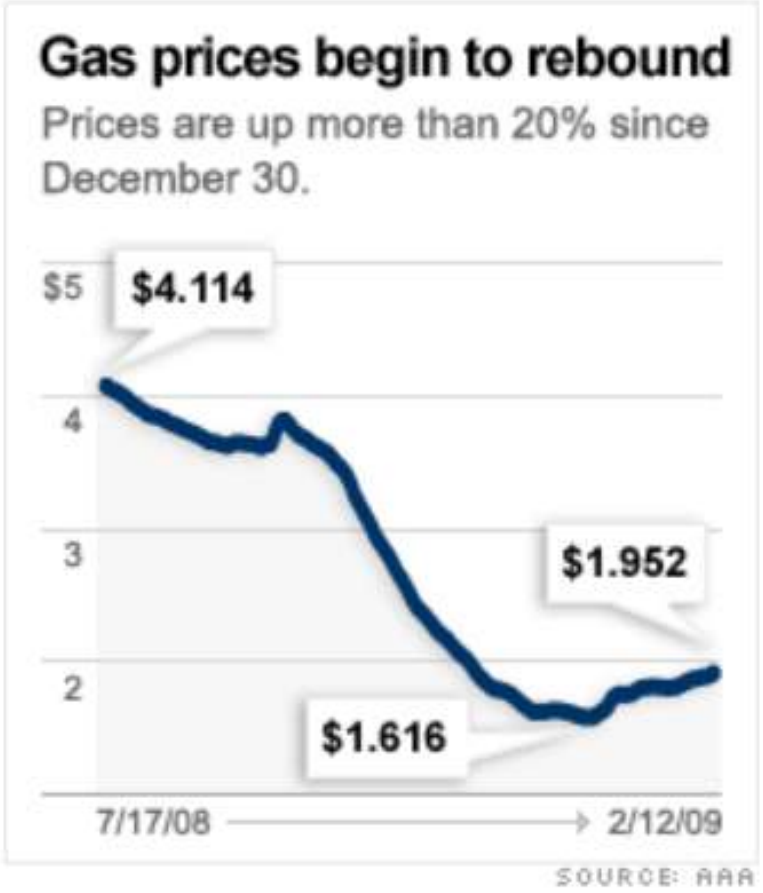
- Big picture: world energy pricing, availability / quality
- The energy-smart farm
- Paying for it
- Resources
- Energy integrated farm
- A final challenge

Scary headlines

World oil prices



Could we be here?



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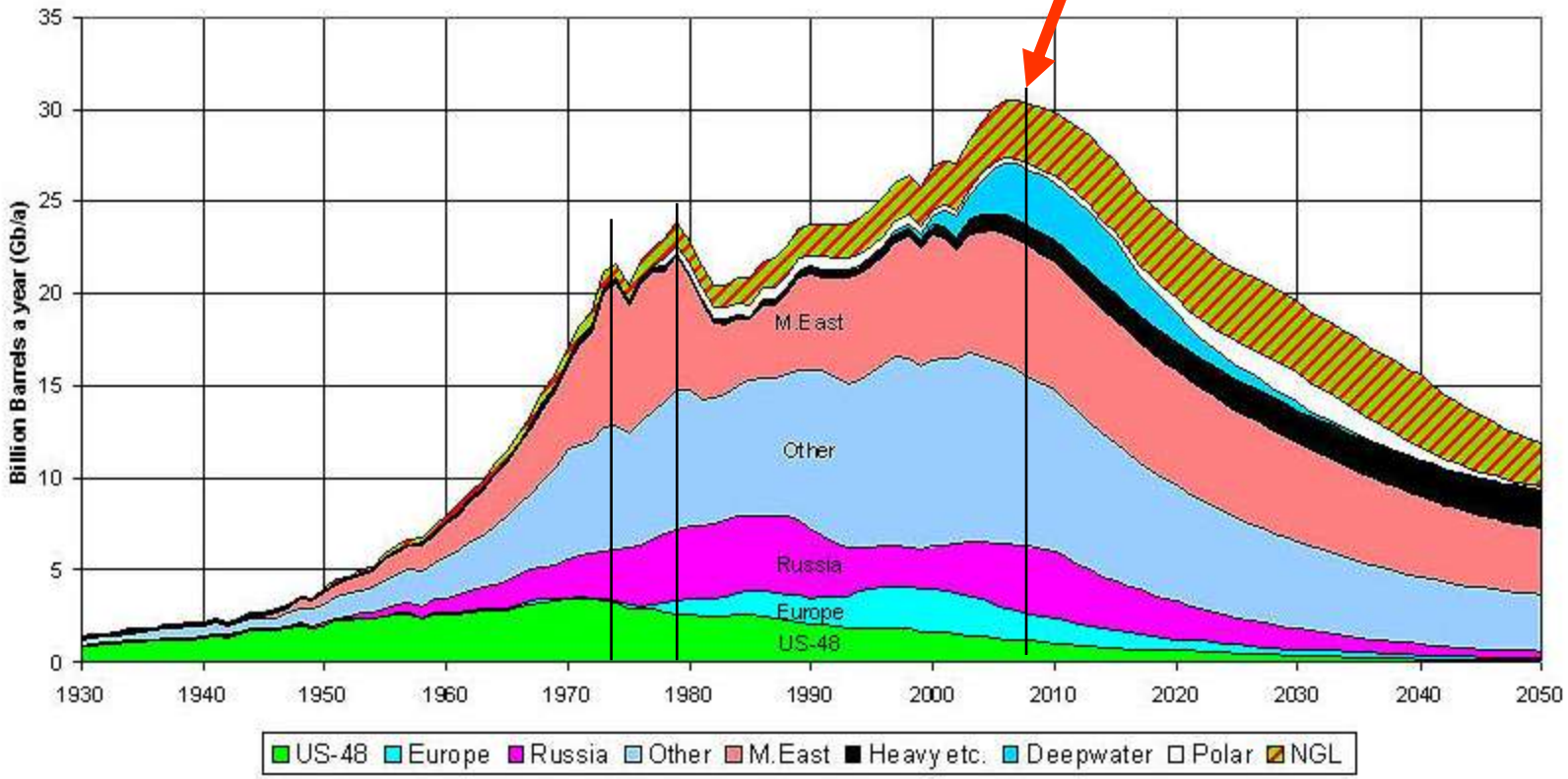

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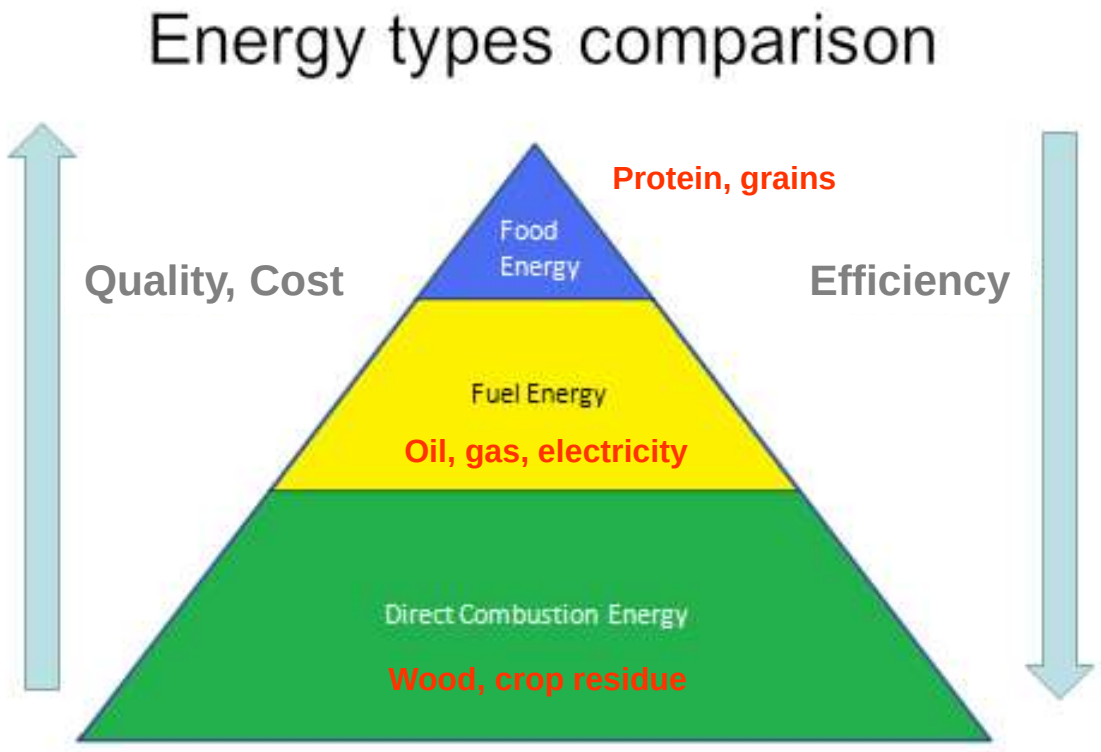
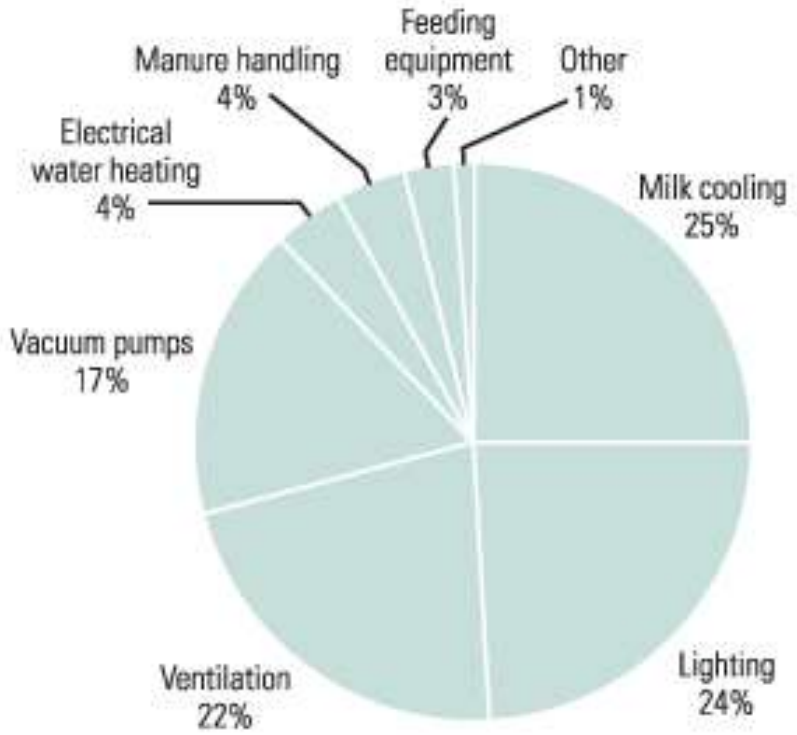
Energy quality



The energy-smart farm

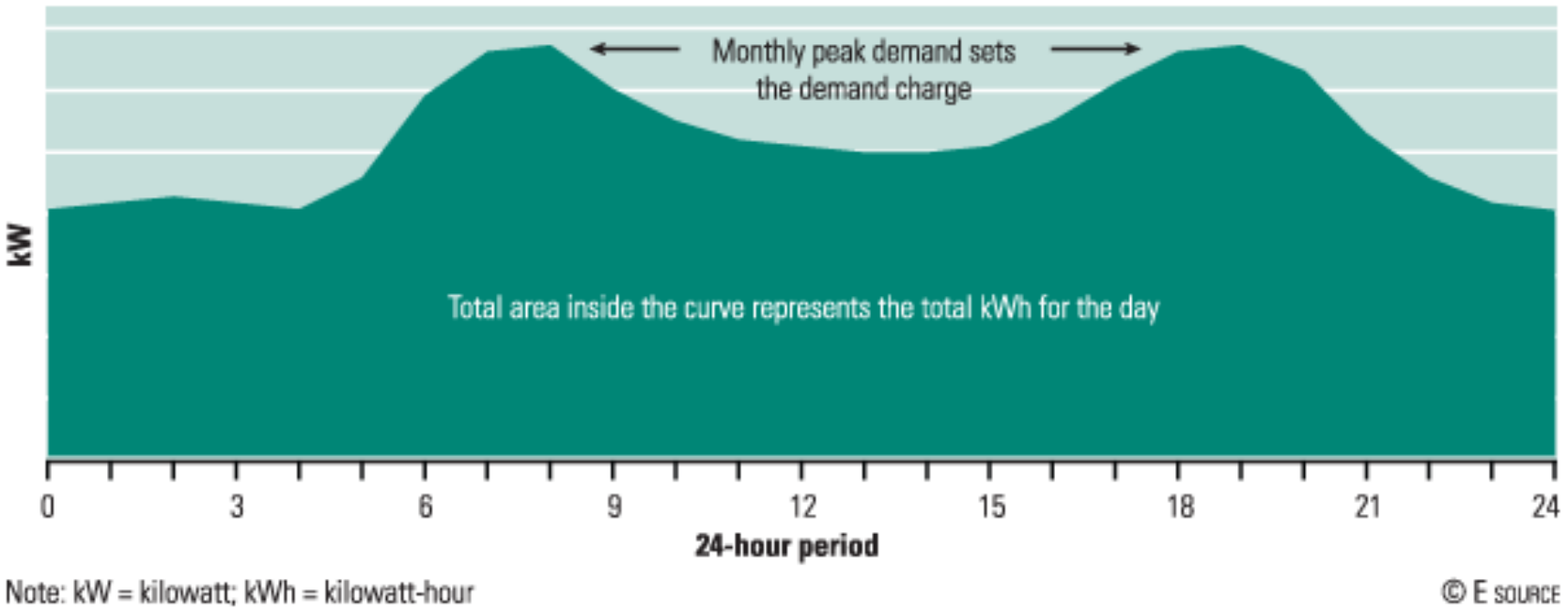
- Energy usage analysis
  - Where is your energy being used, how much, what quality level?
- Conservation
  - Where can things be turned off or tuned up?
- Energy efficiency
  - What equipment can be upgraded – and at what cost?
- Renewable energy
  - Where are the renewable energy opportunities?
- Carbon offsets
  - Are you already in the carbon market and don't even know it?

On-farm energy analysis



© E source; data from New York State Research and Development Authority Dairy Farm Energy Audit Summary

On-farm energy analysis



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On-farm energy analysis

- Energy usage on dairy farms has grown in the past 20 years:
  - increases in farm sizes
  - use of automated equipment
  - around-the-clock operation

- Dairy farms in the U.S. typically consume between 800 and 1,200 kilowatt-hours (kWh) per cow annually.

Conservation

Turn it off: Every 1,000 kWh you save by turning things off equals $100 off your utility bill, assuming an average electricity cost of $0.10/kWh.

Lights:

- Turn off lights during the night when they're not in use
- Install timers, photo controllers, or motion sensors on lighting systems
- Train staff to ensure that switches are off when the lights aren't needed and, especially, at the end of the day.

Fans: Cows typically begin to get heat stress at 74° with a 75% humidity level. Turn off fans when temperatures get below 70°F. Installing thermostats in the barn can help.

Conservation

Turn things down: Some equipment cannot be turned off entirely, but turning it down to minimum levels where possible can save energy.

- Reduce light levels
- Raise refrigeration temperatures
- Reduce pressure on compressors
- Reduce water heater temperatures

Clean and maintain equipment:

- Clean heat exchanger coils
- Clean fans
- Keep lights clean
- Check water heaters
- Conserve water
- Check pumps
- Replace pump and fan belts

Energy Efficiency

Vermont's electricity rates are among the highest in the country. Lighting and equipment upgrades can make a big difference in reducing monthly energy bills. Efficiency Vermont estimates:

- Reduce milk cooling costs by 50% with plate-type milk pre-cooler
- Reduce vacuum pump energy costs by up to 66% with a variable speed drive pump
- Save 65% on lighting costs by upgrading lighting.

	Annual kWh	Estimated Annual Savings	Estimated Installed Cost	Average Payback Years (range)
Install VSD on Vacuum Pump	9,988	$1,061	$3,401	4.73 years
Add Refrigeration Heat Recovery	5,781	$579	$2,861	5.00 years
Install Plate Milk Pre-cooler	9,414	$948	$2472	4.22 years
Install Energy Efficient Lighting	3,491	$344	$1,473	4.50 years
Total Savings	**28,674**	**$2,931**	**$10,207**	**4.6 years**

*These numbers are based on the average costs in the northeast region in 2002.

On-farm renewable energy

Assess on-farm opportunities for:

Solar PV and hot water: Adequate solar exposure, roof/ground availability

Wind: Approximately 12 mph average wind speed needed for small-scale wind. Three-phase power required for many larger machines.

Biomass: Organic matter such as wood chips, manure, pellets, crops and crop residues

Biofuels: Liquid fuels derived from organic matter such as oilseeds, algae, crops

Geothermal: Supplemental heating/cooling

Methane generation: Many great working examples of this in Vermont and elsewhere. Technology is scaling down in size.

Hybrid: Solar and wind makes a good seasonal combination; combined heat and power.

Carbon offsets & RECs

Monetize the carbon benefits of:

- Agricultural land conservation/restoration
- Renewable energy production
- Alternative crop practices
- Carbon sequestration
- Methane capture
- Soil rebuilding
- Composting

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Anerobic digestion in Newport

Maxwells' Neighborhood Farm:

- 850 milking cows in Newport
- 2003 Dairy of the Year
- Digester online in late 2008
- CVPS Cow Power™ program
- Expected to produce 1,750 MWh/year
- Effluent used as fertilizer and bedding
- Vermont Electric Co-op buys the power and CVPS buys the renewable energy credits (RECs)

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Growing biodiesel in Shaftsbury

State Line Farm:

- Pilot scale, farm-based biodiesel and ethanol production system
- Oilseed crop (sunflower, canola, soybean) trials with UVM Extension
- 2,450 gallons made to date; 1,000 from virgin oil grown on the farm
- Using fuel in tractors and heavy equipment
- Plans to produce 300,000 gallons of biodiesel per year

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Wind in Westfield

Butterworks Farm:

- 35 kW refurbished Vestas turbine installed in 2003
- Jack Lazor: “The wind is wicked up here!”
- Several problems with the used wind turbine
- Turbine could have been 65kW on the same tower if the farm had 3-phase power
- Farm now produces 60% of its electricity from the wind turbine

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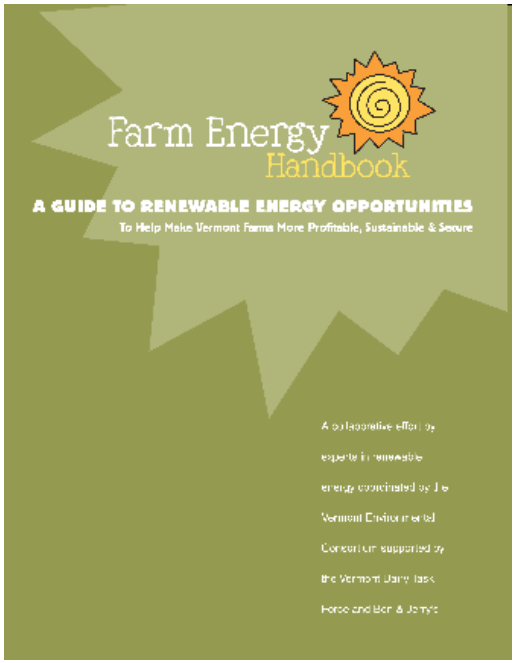
Paying for it

- Energy usage analysis
  - Your time/experts gathering data, compiling, and writing it down
- Conservation
  - Your time deciding what can be reduced and teaching others
  - Costs associated with conservation equipment (timers, etc.)
- Energy efficiency
  - Your time/experts, cash, and Efficiency Vermont
- Renewable energy
  - Your time/experts for research, grant-writing, loans, subsidies
- Carbon offsets
  - Your time/experts for research and implementation

Research resources

- Northeast Organic Farming Association of Vermont
- UVM Center for Sustainable Agriculture
- Vermont Department of Public Service
- Renewable Energy Resource Center
- Vermont Farm Energy Handbook
- Vermont Sustainable Jobs Fund
- Vermont Agency of Agriculture
- Renewable Energy Vermont
- Efficiency Vermont
- EnSave
- SARE
- USDA



Financial resources

- Vermont Small Scale Renewable Energy Incentive Program
- Vermont Agency of Agriculture – REAP grants
- Clean Energy Development Fund
- AgRefresh, Native Energy, CVPS
- Vermont Sustainable Jobs Fund
- State & Federal tax incentives
- USDA Rural Development
- CVPS biomass grants
- Efficiency Vermont
- Low-interest loans

Energy integrated farm

A whole-farm system designed to integrate energy conservation, efficiency, and on-site renewable energy sources to provide all of the energy needed for farm operations.

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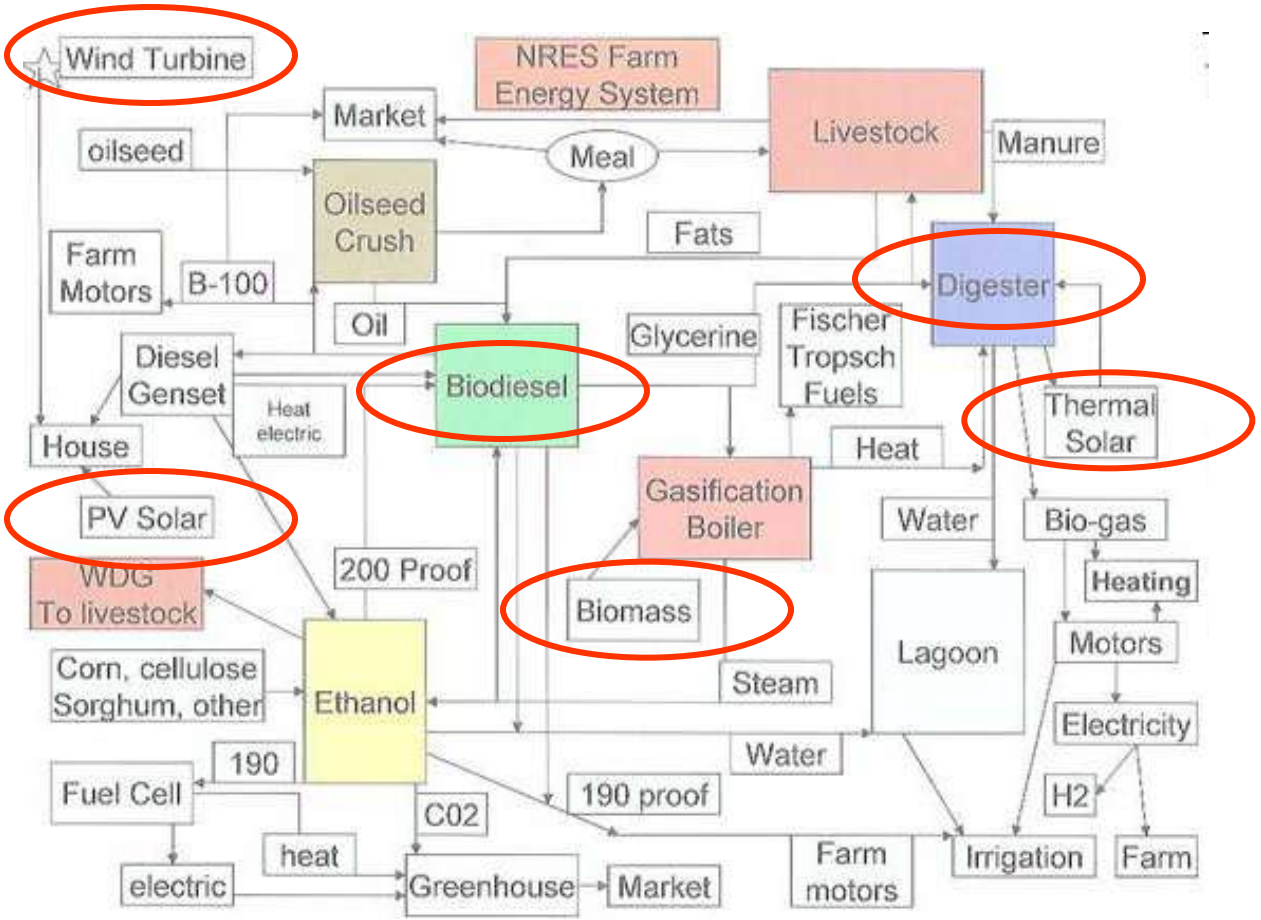
Energy integrated farm



A challenge

Farming is the most influential and essential industry on the planet – through its values and practices it has the power to change the world…

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