Farm Energy IQ

Farms Today Securing Our Energy Future

Modifying Energy Buying Habits

Gary Musgrave, Penn State Extension

Farm Energy IQ

Modifying Energy Buying Habits

Introductions

Learning Objectives

- Explain how energy is typically used on a farm
- Describe various fuels; liquid, solid, gas, and electric
- Identify major uses of energy on most farms
- Explain methods for keeping track of energy use to compare costs
- Explain some of the trends in energy pricing—annual cycle and longer term trending
- Identify and describe strategies to shift energy use to lower cost energy sources
- Be ready to assess the economic impact of changing fuels

Typical Large Energy Users

- Heating water
- Pumping water or milk
- Cooling (milk, etc.)
- Ventilation (fans)
- Lighting
- Feed storage and delivery

Typical Large Energy Users

- For pumping (motors), cooling (motors), ventilation (motors), feed storage and delivery (motors), and lighting, your only reasonable energy source is electricity
- But for heating water and/or space; electric resistance heating is generally very pricey. Other energy sources should at least be considered.

Fuels to Contemplate

- Liquid fuel
  - #2 fuel oil (heating oil)
- Gaseous fuels
  - Natural gas
  - Propane

Solid Fuels to Contemplate

- Coal
- Corn
- Firewood
- Wood pellets
- Wood chips
- One more fuel - Electricity

One More Thing to Contemplate

- Some fuels are renewable: Corn, firewood, wood chips, and pellets. If you have a manure digester, the gas from it is also renewable.
- Other fuels are not renewable: coal, fuel oil, natural gas, and propane
- Electricity may be renewable (or partly renewable) if it is sourced from water, solar or wind

Energy Content of Fuels

Assumptions Used in Developing This Energy Selector

Fuel	Energy Content	Efficiency
Coal	13,100 BTU/lb	75%
Corn	6,970 BTU/lb	75%
Electricity	3,412 BTU/kWh	100%
Firewood	24 x 10 ^ 6 BTU/cord	60%
#2 Fuel Oil	139,400 BTU/gal	80%
Natural Gas	100,000 BTU/therm	85%
Propane	91,600 BTU/gal	85%
Wood Pellets	8,200 BTU/lb	80%

Terminology

- Before we go further, what is a therm?
- One therm (symbol thm) is a non-SI (non-System International) unit of heat energy equal to 100,000 British thermal units (BTU). It is approximately the energy equivalent of burning 100 cu. ft (often referred to as 1 CCF) of natural gas.

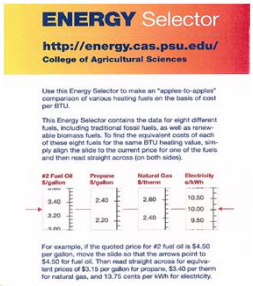
Source: Wikipedia

Fuel Cost Comparison

- So, now that we know about the energy content of various fuels, we need to compare them on a unit cost basis, $ per Btu
- That is where the Energy Selector makes life easier
- The Energy Selector helps compare your current fuel to other fuels that may be more economical

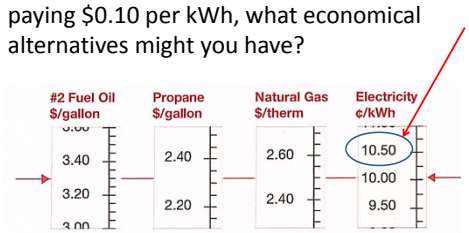
Fuel Cost Comparison

The Energy Selector compares fuel costs based on the unit sold, its price and its energy content.
An extract is shown at right.



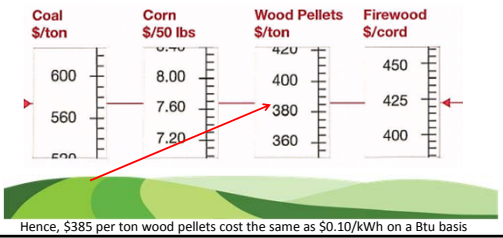
Fuel Cost Comparison

- Now, we will use the Energy Selector for a sample comparison
- If you are heating water with electricity, and paying $0.10 per kWh, what economical alternatives might you have?



Fuel Cost Comparison

- The Energy Selector compares eight energy sources. When an energy source is set on either side, it compares all eight sources on a per Btu basis. The other side looks like this:



Hence, $385 per ton wood pellets cost the same as $0.10/kWh on a Btu basis

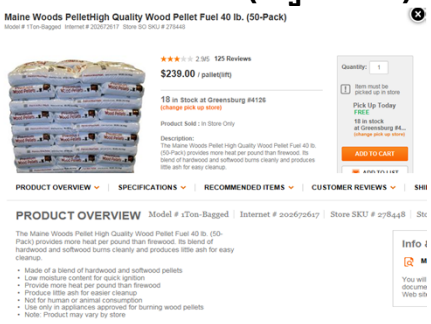
Fuel Switching

- Since you know the cost of the fuel you are using for a particular application, you can use the Energy Selector to determine if other fuels may be more economical
- Of course, you can't operate an electric water heater on wood pellets. But, if the alternate fuel saves enough money, installing a water heater that can accommodate the less expensive fuel might be a worthwhile investment.

Fuel Price Comparison

- By way of further example, suppose you are heating with oil. If you compare the price per Btu of oil with the price per Btu of wood pellets, you can calculate the breakeven point if you know how much it would cost to convert the equipment.
- Example: wood pellets advertised for $239 per pallet (1 pallet = 1 ton because a pallet contains fifty 40-lb bags)

Wood Pellet Prices (August 2014)



Source: Home Depot website

Fuel Oil Prices

July 2014 oil prices from Mid Atlantic Oil

Company Name	Town	Type	Price	Phone # / Info	Date
R & W Oil Products	McKeesport	Cash	$3.290		07/16/14
Adams Petroleum Products Inc	Pittsburgh	Cash	$3.450		07/16/14
Hartman Oil Products	Sewickley	Cash	$3.450		07/16/14
Gallatin Fuels	New Geneva	Cash	$3.219		07/16/14
Wilson Heating	Smock	Cash	$3.230		07/16/14
Smith Oil	Latrobe	Cash	$3.349		07/16/14
Joyce Oil	Mount Pleasant	Cash	$3.410		07/16/14
Top Oil CO	Norvelt	Cash	$3.280		07/16/14
Roman Oil	Vandergrift	Cash	$3.799		07/16/14
Bsf Petroleum	Vandergrift	Cash	$3.920		07/16/14

Propane Prices

Propane Prices Quick Summary (EIA Data - Price/Gallon)

- *Mar 17, 2014 - U.S. Avg. Residential Propane Price, -.09, After Change = $3.08*
- *Mar 10, 2014 - U.S. Avg. Residential Propane Price, -.13, After Change = $3.17*
- *Mar 03, 2014 - U.S. Avg. Residential Propane Price, -.18, After Change = $3.30*

Weekly propane price changes and ending propane price values are approximate. This concludes the propane price reporting for winter 2013/2014. Reporting to continue early October 2014 for winter 2014/2015 propane price data.

EIA is the U.S. Energy Information Administration

Propane Prices

- More propane prices Jan 8, 2015:

Natural Gas Prices

Natural Gas Prices
(Dollars per Thousand Cubic Feet, except where noted)

Area: Pennsylvania Period: Annual

Download Series History Definitions, Sources & Notes

Show Data By: Data Series Area Graph Clear

	2008	2009	2010	2011	2012	2013
Wellhead Price	NA	NA	NA			
Pipeline and Distribution Use Price						
Citygate Price	10.39	7.81	7.04	6.28	5.52	5.26
Residential Price	16.22	14.74	12.90	12.46	11.99	11.67
Percentage of Total Residential Deliveries included in Prices	100.0	100.0	100.0	91.2	88.6	87.2
Commercial Price	14.29	11.83	10.47	10.42	10.24	10.09
Percentage of Total Commercial Deliveries included in Prices	100.0	100.0	100.0	48.5	42.1	41.3
Industrial Price	12.09	9.19	8.23	9.86	9.58	NA
Percentage of Total Industrial Deliveries included in Prices	5.7	4.5	3.8	2.0	1.3	NA
Vehicle Fuel Price	8.30	5.15	3.76	3.40	7.96	
Electric Power Price	10.46	4.60	5.27	4.85	3.15	4.17

Oil Boiler to Wood Pellets Conversion

- My natural gas supplier tells me I use about 70 MCF per year for space heating and hot water. That is about 70,000,000 Btu/yr.
- Fuel oil contains 139,400 Btu/gal. About 500 gal/yr for 70,000,000 Btu.
- Wood pellets contain about 8,200 Btu/lb, or about 8,540 lb (4.3 tons) for 70,000,000 Btu.

Oil Boiler to Wood Pellets Conversion

- 500 gal fuel oil at $3.35 per gal is $1,675
- 4.3 tons of wood pellets at $239 per ton is $1,028
- Savings using wood pellets is about $650 per year or 39% based on 70,000,000 Btu per year
- Pellergy PB-1525 boiler conversion system is list priced at $4,675 (plus installation)
- Simple payback (equipment only) is $4,675/$650, or about 7 years

Oil Boiler to Wood Pellets Conversion

This particular model has sufficient capacity to provide the heat equivalent to my installed equipment

Pellergy PB-1525

The PB-1525 Pellergy Wood Pellet Burner System puts out 60-120k BTU's and can be used to convert your existing boiler or be installed in a new heating system. This system includes the burner, 10ft auger with drive motor, the controller, auto combustion chamber clean-out, and a 550lb pellet storage bin. Includes warranty. May qualify for $1000 REBATE.
Made in Vermont.

$4,675.00

Oil Boiler to Wood Pellets Conversion

② Storage
③ Auger
④ Drop-tube
⑤ Burner
⑥ Boiler

Oil Boiler to Wood Pellets Conversion

- Bulk delivery may be available
- Bin storage (previous slide) may hold a one-month or more supply of wood pellets
- Or automate less, save more on installation with a smaller bin that you fill weekly from bagged pellets

Calculating Fuel Consumption

Now, some numbers; first the formula for combustion energy requirement:

$$\text{Fuel Consumption (MMBtu)} = \frac{CAPY_{fuel\ heat} \times EFLH_{fuel\ furnace}}{AFUE_{fuel\ heat} \times 1{,}000{,}000 \frac{Btu}{MMBtu}}$$

$CAPY_{fuel\ heat}$ = Total heating capacity (Btu)

$EFLH_{fuel\ furnace}$ = Equivalent Full Load Heating Hours for fossil fuel furnace systems

$AFUE_{fuel\ heat}$ = Annual Fuel Utilization Efficiency for the furnace (%)

NOTE: This calculation enables you to estimate fuel consumption but relies on some assumptions. If you know your fuel consumption, use that number instead for the fuel cost comparison. MMBtu is million Btus.

Classroom Example

- We need 150 gal of hot water per day for cleanup in our dairy operation using propane as our energy source. Well water temperature averages 55°F and outlet temperature is 130°F, so there is a 75°F temperature rise.
- One Btu raises one lb of water 1°F
- Water weighs about 8.3 lb/gal
- So, 150 gal is 1,230 lb of water

Calculating Energy Consumption

- 1°F per lb per Btu times 75°F (temperature rise) times 1,230 pounds of water per day times 365 days per year is about 33.7 million Btu/yr
- Propane contains about 91,000 Btu/gal
- 33,700,000 Btus divided by 91,000 Btu/gal of propane then requires about 370 gal of propane per year
- At about $3.15 per gallon, about $1,165 per year for propane

Energy Costs per Btu

- It is helpful to compare energy sources on a price per Btu basis

Energy Source	Unit Sold	Price per Unit Sold	Analysis Unit	Price per Analysis Unit	Btus per Unit	Price per Btu
Electricity	KWH	$ 0.10	KWH	$ 0.10	3,412	$0.000029
#2 fuel oil	Gallon	$ 3.40	Gallon	$ 3.40	139,400	$0.000024
Natural Gas	MCF	$ 11.67	MCF	$ 11.67	1,000,000	$0.000012
Propane	Gallon	$ 3.30	Gallon	$ 3.30	91,600	$0.000036
Wood Pellets	Ton	$ 239.00	Pound	$ 0.12	8,200	$0.000015

Btus per (analysis) unit from the Penn State ENERGY Selector
Pricing from the previous slides, various sources.
9/4/2014

Trends in Energy Pricing

- Energy prices generally follow the traditional supply and demand behavior—don't wait until midwinter to buy your heating oil
- Propane falls into the same category as heating oil
- Electricity varies by region and if it varies by season, summer is usually most expensive when electricity is in highest demand

Modifying Energy Buying Habits

- Firewood and wood pellets are generally less expensive in summer
- Where available, natural gas is relatively inexpensive due to the ample supply from Marcellus Shale sources

Summary

- Changing energy sources may be an economical choice if the energy cost savings pays for necessary equipment changes—work through the numbers to find out
- Buying energy (that you have room to store) when it is less expensive may help to reduce annual energy costs

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Questions?