Farm Energy IQ

Farms Today Securing Our Energy Future

Modifying Energy Buying Habits
Gary Musgrave, Penn State Extension

Learning Objectives
• Explain how energy is typically used, especially the larger energy consuming devices
• Describe various fuels: liquid, solid, gas, and electric
• Identify major uses of energy on most farms
• Explain some of the trends in energy pricing; annual cycle and longer term trending
• Identify and describe some strategies to shift energy use to lower cost energy sources

Typical Large Energy Users
• Water heating
• 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, e.g., 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

Fuel Cost Comparison

<table>
<thead>
<tr>
<th>Assumptions Used in Developing This Energy Selector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Coal</td>
</tr>
<tr>
<td>Corn</td>
</tr>
<tr>
<td>Electricity</td>
</tr>
<tr>
<td>Firewood</td>
</tr>
<tr>
<td>42 Fuel Oil</td>
</tr>
<tr>
<td>Natural Gas</td>
</tr>
<tr>
<td>Propane</td>
</tr>
<tr>
<td>Wood Pellets</td>
</tr>
</tbody>
</table>


Terminology

- Before we go further, what is a therm?

- One therm is a non-SI unit of heat energy equal to 100,000 British thermal units (Btu). It is the energy equivalent of burning approximately 100 cubic feet (often referred to as 1 CCF) of natural gas.

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 you 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.
Now, let’s use the Energy Selector in a sample comparison.

If you are heating water with electricity, and paying $0.10/kWh, what economical alternatives might you have?

<table>
<thead>
<tr>
<th>#2 Fuel Oil/$gallon</th>
<th>Propane/$gallon</th>
<th>Natural Gas/$therm</th>
<th>Electricity/e/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.20</td>
<td>2.40</td>
<td>2.80</td>
<td>10.50</td>
</tr>
</tbody>
</table>

Hence, 5385 per ton wood pellets cost the same as 0.10/kWh electricity on a Btu basis.

When 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 equipment that can accommodate a less expensive fuel might be worth the investment.

By way of further example, suppose you are using oil for heating. 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 the equipment conversion costs.

In this example from August 2014, wood pellets are advertised for $239 per pallet (50 bags at 40 lb each; $239 per ton).

Fuel Cost Comparison

Alternate Fuel Prices

Wood Pellet Price

Oil Prices

July 2014 prices from Mid Atlantic Oil

Source: Home Depot website (August 2014)

Source: http://www.midatlanticoil.com/dealers/pennsylvania/pittsburgh/default
Propane Prices

- Propane prices per gallon:

  EIA is the U.S. Energy Information Administration

More propane prices Jan 8, 2015:

Natural Gas Prices

- My natural gas supplier tells me I use about 70 MCF per year to heat my house and hot water. That is about 70,000,000 Btu/yr
- I’d need about 500 gal/yr of fuel oil (at 139,400 Btu/gal) to supply 70,000,000 Btus
- Wood pellets contain about 8,200 Btus per lb, so I’d need about 8,540 lb (4.3 tons) for 70,000,000 Btus

Oil Boiler to Wood Pellets Conversion

- 500 gallons of fuel oil at $3.35 per gallon 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 Btus per year.
- Pellergy PB-1525 boiler conversion system is listed 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

Source: http://www.eia.gov/dnav/ng/ngpripa.cfm
JS2

Does this factor in the efficiency of heating? (80% or so?)

Jeannie Sikora, 1/18/2015
**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

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**Classroom Example**

First the formula for combustion energy requirement:

\[
\text{CAPY}_{\text{fuel heat}} = \frac{\text{Total heating capacity (Btu)}}{\text{EFLH}_{\text{fuel furnace}} 	imes \text{AFUE}_{\text{fuel heat}} 	imes 1,000,000,000} \times \text{MMBtu}
\]

- **CAPY**\(_{\text{fuel heat}}\) = Total heating capacity (Btu)
- **EFLH**\(_{\text{fuel furnace}}\) = Equivalent Full Load Heating Hours for fossil fuel furnace systems
- **AFUE**\(_{\text{fuel heat}}\) = Annual Fuel Utilization Efficiency for the furnace (%)

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

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**Classroom Example**

- We need 150 gal of hot water per day for cleanup in our dairy operation using propane. The well water temperature averages 55°F and we heat it to 130°F, giving us a 75°F temperature rise.
- One Btu is need to raise one lb of water by 1°F
- Water weighs about 8.3 lb per gal
- So, 150 gal is 1,230 lb of water

**Fuel Price Comparison per Btu**

To compare energy costs, it is useful to review price per Btu for various energy sources

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Unit</th>
<th>Price per Btu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>kW/h</td>
<td>$0.30</td>
</tr>
<tr>
<td>Diesel</td>
<td>Gal</td>
<td>$1.60</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Mcf</td>
<td>$1.07</td>
</tr>
<tr>
<td>Propane</td>
<td>Gal</td>
<td>$1.90</td>
</tr>
<tr>
<td>Wood Pellets</td>
<td>Tons</td>
<td>$299.00</td>
</tr>
</tbody>
</table>

Btu per gallon unit from the Penn State ENERGY selector Pricing from the previous slides, various sources 6/4/2014
Do you want to factor 80% for efficiency of the propane fired water heater? \( \frac{33,700,000 \text{ Btu}}{91,000 \text{ Btu/(gal propane)}} \times \frac{1}{80\% \text{ conversion eff}} = \)?
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. If it varies by season, summer is usually most expensive because the demand is highest during summer for most electric companies

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 reduce annual energy costs

Modifying Energy Buying Habits

Questions?