Modification of Energy Buying Habits

Introductions

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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

<table>
<thead>
<tr>
<th>Assumptions Used in Developing This Energy Selector</th>
<th>Energy Content (BTU)</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>13,100</td>
<td>75%</td>
</tr>
<tr>
<td>Corn</td>
<td>6,970</td>
<td>75%</td>
</tr>
<tr>
<td>Electricity</td>
<td>3,412</td>
<td>100%</td>
</tr>
<tr>
<td>Firewood</td>
<td>24 x 10 ^ -6</td>
<td>60%</td>
</tr>
<tr>
<td># Fuel Oil</td>
<td>139,000</td>
<td>80%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>100,000</td>
<td>85%</td>
</tr>
<tr>
<td>Propane</td>
<td>91,600</td>
<td>85%</td>
</tr>
<tr>
<td>Wood Pellets</td>
<td>8,200</td>
<td>80%</td>
</tr>
</tbody>
</table>

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.

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?

<table>
<thead>
<tr>
<th>Fuel Source</th>
<th>Price per Btu</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2 Fuel Oil</td>
<td>3.40</td>
</tr>
<tr>
<td>Propane</td>
<td>2.40</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>2.80</td>
</tr>
<tr>
<td>Electricity</td>
<td>10.60</td>
</tr>
</tbody>
</table>

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
EIA is the U.S. Energy Information Administration

**Propane Prices**

Propane Prices

- Mar 31, 2014 - U.S. Avg. Residential Propane Price, -$0.08
- Mar 24, 2014 - U.S. Avg. Residential Propane Price, -$0.08
- Mar 17, 2014 - U.S. Avg. Residential Propane Price, -$0.10
- Mar 03, 2014 - U.S. Avg. Residential Propane Price, -$0.14

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.

**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**

- 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.
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:

\[ \text{Fuel Consumption (MMBtu)} = \frac{\text{CAPY}_{\text{fuel heat}} \times \text{EFLH}_{\text{fuel furnace}}}{\text{AFUE}_{\text{fuel heat}}/1,000,000} \]

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

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

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

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Unit</th>
<th>Price per Unit ($)</th>
<th>Analysis Unit</th>
<th>Price per Analysis Unit</th>
<th>Btu per Unit</th>
<th>Price per Btu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>KWh</td>
<td>0.10</td>
<td>kWH</td>
<td>0.10</td>
<td>3,412</td>
<td>$0.000028</td>
</tr>
<tr>
<td>KF fuel oil</td>
<td>Gallon</td>
<td>3.40</td>
<td>Gallon</td>
<td>3.40</td>
<td>109,489</td>
<td>$0.000004</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>MCF</td>
<td>11.87</td>
<td>MCF</td>
<td>11.87</td>
<td>1,000,000</td>
<td>$0.000002</td>
</tr>
<tr>
<td>Propane</td>
<td>Gallon</td>
<td>3.30</td>
<td>Gallon</td>
<td>3.30</td>
<td>91,680</td>
<td>$0.000002</td>
</tr>
<tr>
<td>Wood Pellets</td>
<td>Ton</td>
<td>2.29</td>
<td>Pound</td>
<td>0.12</td>
<td>8,200</td>
<td>$0.0000015</td>
</tr>
</tbody>
</table>

Btu per (analysis) unit from the Penn State ENERGY Selector (drawing from the previous slide, various sources. 3/4/2014)
**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

**Questions?**