Farm Energy IQ

Farms Today Securing Our Energy Future

Modifying Energy Buying Habits

Gary Musgrave, Penn State Extension
Modifying Energy Buying Habits

Introductions
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>Fuel</th>
<th>Energy Content</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>13,100 BTU/lb</td>
<td>75%</td>
</tr>
<tr>
<td>Corn</td>
<td>6,970 BTU/lb</td>
<td>75%</td>
</tr>
<tr>
<td>Electricity</td>
<td>3,412 BTU/kWh</td>
<td>100%</td>
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<tr>
<td>Firewood</td>
<td>$24 \times 10^6$ BTU/cord</td>
<td>60%</td>
</tr>
<tr>
<td>#2 Fuel Oil</td>
<td>139,400 BTU/gal</td>
<td>80%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>100,000 BTU/therm</td>
<td>85%</td>
</tr>
<tr>
<td>Propane</td>
<td>91,600 BTU/gal</td>
<td>85%</td>
</tr>
<tr>
<td>Wood Pellets</td>
<td>8,200 BTU/lb</td>
<td>80%</td>
</tr>
</tbody>
</table>
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.

Use this Energy Selector to make an “apples-to-apples” comparison of various heating fuels on the basis of cost per BTU.

This Energy Selector contains the data for eight different fuels, including traditional fossil fuels, as well as renewable biomass fuels. To find the equivalent costs of each of these eight fuels for the same BTU heating value, simply align the slide to the current price for one of the fuels and then read straight across (on both sides).

For example, if the quoted price for #2 fuel oil is $4.50 per gallon, move the slide so that the arrows point to $4.50 for fuel oil. Then read straight across for equivalent prices of $3.15 per gallon for propane, $3.40 per therm for natural gas, and 13.75 cents per kWh for electricity.
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?
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 electricity on a Btu basis.
Fuel Cost Comparison

- 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.
Alternate Fuel Prices

- 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).
Wood Pellet Price

Maine Woods Pellet High Quality Wood Pellet Fuel 40 lb. (50-Pack)
Model # 1Ton-Bagged  Internet # 202672617  Store SKU # 278448

⭐⭐⭐⭐⭐ 2.9/5  125 Reviews

$239.00 / pallet(lift)

18 in Stock at Greensburg #4126
(change pick up store)

Product Sold: In Store Only

Description:
The Maine Woods Pellet High Quality Wood Pellet Fuel 40 lb. (50-Pack) provides more heat per pound than firewood. Its blend of hardwood and softwood burns cleanly and produces little ash for easy cleanup.

- Made of a blend of hardwood and softwood pellets
- Low moisture content for quick ignition
- Provide more heat per pound than firewood
- Produce little ash for easier cleanup
- Not for human or animal consumption
- Use only in appliances approved for burning wood pellets
- Note: Product may vary by store

Source: Home Depot website (August 2014)
## Oil Prices

### July 2014 prices from Mid Atlantic Oil

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Town</th>
<th>Type</th>
<th>Price</th>
<th>Phone # / Info</th>
<th>Date</th>
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<tbody>
<tr>
<td>R &amp; W Oil Products</td>
<td>McKeesport</td>
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<td>Adams Petroleum Products Inc</td>
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Source: http://www.midatlanticoil.com/dealers/pennsylvania/pittsburgh/default
Propane Prices

• Propane prices per gallon:

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

(Dollars per Thousand Cubic Feet, except where noted)

Area: Pennsylvania  Period: Annual

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<thead>
<tr>
<th>Show Data By:</th>
<th>Data Series</th>
<th>Area</th>
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<td>NA</td>
<td>NA</td>
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<td>Pipeline and Distribution Use Price</td>
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<td>Citygate Price</td>
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<td>7.81</td>
<td>7.04</td>
<td>6.28</td>
<td>5.52</td>
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<td>Percentage of Total Residential Deliveries included in Prices</td>
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<td>100.0</td>
<td>100.0</td>
<td>91.2</td>
<td>88.6</td>
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<tr>
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<td>100.0</td>
<td>100.0</td>
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<td>Percentage of Total Industrial Deliveries included in Prices</td>
<td>5.7</td>
<td>4.5</td>
<td>3.8</td>
<td>2.0</td>
<td>1.3</td>
<td>NA</td>
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<tr>
<td>Vehicle Fuel Price</td>
<td>8.30</td>
<td>5.15</td>
<td>3.76</td>
<td>3.40</td>
<td>7.96</td>
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<tr>
<td>Electric Power Price</td>
<td>10.46</td>
<td>4.60</td>
<td>5.27</td>
<td>4.85</td>
<td>3.15</td>
<td>4.17</td>
</tr>
</tbody>
</table>

Source: http://www.eia.gov/dnav/ng/ng_pri_sum_dcuspa_a.htm
Oil Boiler to Wood Pellets Conversion

- 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.

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

PELLERGY
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
Classroom Example

First the formula for combustion energy requirement:

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

- \(\text{CAPY}_{\text{fuel heat}}\) = 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 fuel consumption, use that number instead for the fuel cost comparison. MMBtu is million Btus.
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
Classroom Example

• 1°F per lb per Btu times 75°F (temperature rise) times 1,230 lb of water per day times 365 days per year is about 33.7 million Btus/yr
• Propane contains about 91,000 Btu/gal and conversion efficiency is about 80% for gas-fired water heaters
• 33,700,000 Btus divided by 91,000 Btu/gal propane requires about 370 gal propane/yr
• At $3.15 per gal, that’s about $1,165/yr for propane
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 Sold</th>
<th>Price per Unit Sold</th>
<th>Analysis Unit</th>
<th>Price per Analysis Unit</th>
<th>Btus 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>$0.0000029</td>
</tr>
<tr>
<td>#2 fuel oil</td>
<td>Gallon</td>
<td>$3.40</td>
<td>Gallon</td>
<td>$3.40</td>
<td>139,400</td>
<td>$0.0000024</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>MCF</td>
<td>$11.67</td>
<td>MCF</td>
<td>$11.67</td>
<td>1,000,000</td>
<td>$0.000012</td>
</tr>
<tr>
<td>Propane</td>
<td>Gallon</td>
<td>$3.30</td>
<td>Gallon</td>
<td>$3.30</td>
<td>91,600</td>
<td>$0.000036</td>
</tr>
<tr>
<td>Wood Pellets</td>
<td>Ton</td>
<td>$239.00</td>
<td>Pound</td>
<td>$0.12</td>
<td>8,200</td>
<td>$0.000015</td>
</tr>
</tbody>
</table>

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. 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?