Thank you for participating in PorkBridge 2009-10. To start the presentation, advance one slide by pressing enter or the down or right arrow key.

**What are the Issues?**

- **Propane**
  - Average price in Jan 2009 = $1.75
  - Up 136% since 2004
- **Gasoline**
  - Average price in Jan 2009 = $1.78
  - Up $0.10 from 2004
- **Electricity**
  - Price varies but many demand-side programs available

**Energy Savings: Where?**

- **Insulation?**
- **Lighting?**
- **Ventilation?**
  - New Fans?
  - New Controller?
  - System Problems?
  - Just Better Management?

**Insulation**

- **Sample**: 1000 head barn, 41 x 200
  - Assume:
    - 50 lb pigs @ 3 cfm/head
    - $2/gallon LP
    - Mason City, IA
  - Questions:
    - Does adding ceiling insulation pay?
    - Does perimeter insulation pay?

**Insulation - Attic**

<table>
<thead>
<tr>
<th>Current Insulation Depth (in)</th>
<th>Adding 6&quot; - Savings/yr</th>
<th>Adding 6&quot; - Payback (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot;</td>
<td>$4800</td>
<td>0.3</td>
</tr>
<tr>
<td>4&quot;</td>
<td>$800</td>
<td>0.9</td>
</tr>
<tr>
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<td>$1000</td>
<td>2.1</td>
</tr>
<tr>
<td>8&quot;</td>
<td>$600</td>
<td>2.6</td>
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<tr>
<td>10&quot;</td>
<td>$400</td>
<td>3.8</td>
</tr>
</tbody>
</table>

- If existing is < 6", may be justifiable.
- Building longevity important consideration.
Insulation - Perimeter

<table>
<thead>
<tr>
<th>Current Insulation Thickness (in)</th>
<th>Adding 1&quot; - Savings/yr</th>
<th>Adding 1&quot; - Payback (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0&quot;</td>
<td>$1300</td>
<td>0.7</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>$800</td>
<td>3.2</td>
</tr>
<tr>
<td>1&quot;</td>
<td>$500</td>
<td>7.0</td>
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</tbody>
</table>

- If no insulation, may be justifiable.
- Condensation & animal comfort consideration.

Uninsulated Concrete Sidewalls

- 70 F Room
- 0 F Outdoors
- 6 inch Concrete
- Condensation Occurs above 25 % RH
- R = 1.33

Effect of Cold Surfaces on Growing Pigs

<table>
<thead>
<tr>
<th>Air to Wall Gradient °F</th>
<th>Change in Effective Temperature °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>- 13</td>
</tr>
<tr>
<td>6</td>
<td>- 3</td>
</tr>
<tr>
<td>2</td>
<td>- 1</td>
</tr>
</tbody>
</table>

Mount, 1975

Lighting Example

- Incandescent
  - 75 W
  - 1065 lumens
  - 750 hr life
  - 41 cent initial cost
- Operating 8 hrs per day all year (2920 hours)
  - 219 kWh or $21.90/yr
  - Need 3.89 bulbs/yr = $1.59
  - Total cost = $23.49/yr
- $17 Saving per year or Payback less than 4 months

- Compact Fluorescent
  - 20 W
  - 1250 lumens
  - 10,000 hr life
  - $2.69 initial cost
- Operating 8 hrs per day all year (2920 hours)
  - 58 kWh or $5.80/yr
  - Need 0.29 bulbs/yr = $0.78
  - Total cost = $6.58/yr

Ventilation

- FAR and AWAY the biggest potential for wasted energy
- 80 to 90% of heating energy lost through ventilation when done properly
- A good “target” for LP usage is 2 gallons/space/yr for wean to finish
Proper Ventilation Rate?

- Sample: 1000 head barn, 41 x 200
  - Assume:
    - 50 lb pigs @ 3 cfm/head & 68 F setpoint
    - 52/ gallon LP
    - Mason City, IA
  - Questions:
    - How much does over-ventilating cost?

Ventilation

- Even slight over-ventilation
  - For given case (52 LP):
    - 10% over – $1040 LP increase (27%)
    - 20% over - $1960 LP increase (51%)
    - 30% over - $2970 LP increase (77%)
    - 40% over - $4060 LP increase (105%)
    - 50% over - $5130 LP increase (132%)
    - 59% over - $6030 LP increase (156%)
- Virtually NO investment... only management

Why is Proper Rate so Difficult?

- Variable speed fans make delivering a prescribed minimum rate difficult.
  - So WHY use them???

Why do we use variable-speed fans?

- Example: 24-crate farrowing room
  - Needs 480 cfm for minimum
  - Smallest fan available is about 1,000 cfm

- Example: 1200-head, wean-to-finish barn
  - Needs ~ 1,800 cfm for minimum
  - 24" fan = 6,000 cfm

Why are Variable Speed Fans Complicated?
How Does Your Controller Work with Your Variable-Speed Fans?

Controller → Volts → Motor → RPM → Fan → CFM

Fan Delivery vs. Motor Speed
Example at 0.05 inches static pressure

\[ \text{CFM} = 50\% \text{ cfm} = 1.43 \times \%\text{rpm} + 43 \]

AP Motor Curves

<table>
<thead>
<tr>
<th>%</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<tr>
<td>95</td>
<td>199</td>
<td>162</td>
<td>140</td>
<td>113</td>
<td>113</td>
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<td>113</td>
<td>113</td>
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<td>220</td>
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<td>128</td>
<td>112</td>
<td>86</td>
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<tr>
<td>80</td>
<td>128</td>
<td>145</td>
<td>147</td>
<td>173</td>
<td>205</td>
<td>166</td>
<td>132</td>
<td>118</td>
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<td>70</td>
<td>113</td>
<td>130</td>
<td>136</td>
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<td>50</td>
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<td>130</td>
<td>130</td>
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<td>130</td>
</tr>
</tbody>
</table>

Motor curve recommendations for various fan sizes using Aerotech controller.

Motor curve recommendations for various fans using Airstream controller.
Generally, minimum speed is ~50% of voltage.

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### Proport Temperature?

- Are you using the proper temperature?
- How can you tell?
- How much does using an improper temperature cost?

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### Energy-efficient 175W lamp vs. conventional 250W lamp - Xin Study

- Annual energy saving of $36 per unit or $5,500 per 1,000 sows
- Improved livability, 284 extra pigs per 1,000 sows per year
- Reduced lamp failure rate, 50%
- Slightly higher ADG of piglets
- More uniform resting pattern of piglets under the lamp

---

### Minimum Speed Setting and Motor Curve Selection

<table>
<thead>
<tr>
<th>Phase</th>
<th>Model Revision</th>
<th>Control Setting</th>
<th>Minimum Speed</th>
<th>Maximum Voltage</th>
<th>Output</th>
<th>CPM</th>
<th>RPM</th>
<th>HP</th>
<th>S.P.</th>
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</thead>
<tbody>
<tr>
<td>6&quot;</td>
<td>J7010, J7101P, J7106P</td>
<td>1</td>
<td>45</td>
<td>81</td>
<td>50</td>
<td>Aerotech</td>
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<tr>
<td>14&quot;</td>
<td>J7114, J7116P, J7118P</td>
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<td>45</td>
<td>42</td>
<td>90</td>
<td>Aerotech</td>
<td></td>
<td></td>
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<tr>
<td>15&quot;</td>
<td>J7115, J7116P</td>
<td>1</td>
<td>95</td>
<td>101</td>
<td>120</td>
<td>Aerotech</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18&quot;</td>
<td>J7118, J7119</td>
<td>3</td>
<td>20</td>
<td>101</td>
<td>140</td>
<td>Aerotech</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24&quot;</td>
<td>J7124, J7126J, 7134P</td>
<td>3</td>
<td>40</td>
<td>107</td>
<td>160</td>
<td>Aerotech</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>36&quot;</td>
<td>J7136, J7138J, 7152P</td>
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<td>40</td>
<td>117</td>
<td>1250</td>
<td>Aerotech</td>
<td></td>
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</tr>
</tbody>
</table>

This is an example table taken from a single source and does not apply universally. You must use the specific data provided by the manufacturer of YOUR motor/DC when programming your controller.

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### Postural Behaviors of Pigs at Different Thermal Comfort Levels

- Cold
- Comfortable
- Warm

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### Appendix C: Supra motor curves

The table below lists typical available speed range. The mean information about some features or testing prior to purchase or installation. 

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### Rebates Available:

Example: Alliant Energy offers $5 per lamp for 175 W or smaller lamps.
Lamp or Mat Control

Variable output allows the creep temperature to be managed while saving energy.

Rheostats do not do the same thing. They “chop” voltage… only reducing output, not input.

Zone Heating

- Transfer of heat to a surface without direct contact
- 30-50% of total heat loss
- Main component:
  - Pig’s surface area exposed to other surfaces
  - Difference in temperature between pig & surface (ΔT)
- Less expensive to zone heat than heat the entire building

Zone Heating

- The benefit comes in being able to lower the room temperature.
- Zone heating without lowering the room temperature is pointless.

Proper Temperature

Example: 1000 head curtain sided barn in Iowa. 50 lb pigs – ANNUALIZED results

<table>
<thead>
<tr>
<th>Setpoint</th>
<th>Annualized LP</th>
<th>Cost</th>
<th>Different from Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>69 F</td>
<td>2100 gallons</td>
<td>$4200</td>
<td>-34.4%</td>
</tr>
<tr>
<td>71 F</td>
<td>2600 gallons</td>
<td>$5200</td>
<td>-18.8%</td>
</tr>
<tr>
<td>73 F</td>
<td>3200 gallons</td>
<td>$6400</td>
<td>Base</td>
</tr>
<tr>
<td>75 F</td>
<td>3900 gallons</td>
<td>$7800</td>
<td>+21.9%</td>
</tr>
<tr>
<td>77 F</td>
<td>4700 gallons</td>
<td>$9400</td>
<td>+46.9%</td>
</tr>
</tbody>
</table>

Other Ventilation Management

- Curtains
- Heater setup
- Efficient fan operation
- Emergency thermostat setup
- Do new fans pay?

Curtain Management

- Maladjustments can cause drafts
Curtain Leakage

<table>
<thead>
<tr>
<th>Curtain overlap, inches</th>
<th>7 cfm/pig</th>
<th>10 cfm/pig</th>
<th>20 cfm/pig</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

2 foot wide opening

Results of Testing

- Overlaps absolutely necessary... **minimum of 3 inch.**
- Slightest crack can serve to over-ventilate barn.
- Small differences between 2-layer and 7-layer curtain leakage.

Heater Management

**Quiz:**
A properly sized heater will run what percent of the time on the coldest day of the year?

100%

Heater offset [1.5 °F] Helps to Prevent Temperature Run-by

Impact of Furnace Offset on Furnace Run Time

<table>
<thead>
<tr>
<th>Offset Changed</th>
<th>Temperature Run Time (Hour)</th>
<th>Propane Cost (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2.0</td>
<td>2.0</td>
<td>$4.50</td>
</tr>
<tr>
<td>-1.5</td>
<td>2.5</td>
<td>$0.00</td>
</tr>
</tbody>
</table>
| Room temperature dropped 0.5 °F with lower offset. No ramping of variable speed pit fans.
Fan Transition from Pit

Is it a Restriction?

Cross-Sectional Area of Transition
sq. ft. = fan capacity (cfm) / 800 fpm

NEEDS at least 7.5 Square Feet

Very High Static Pressure Loss

Fan running 100%

Pit Fans Need Inlets

Fan Selection Matters

• 24” fans @ 0.05” H2O (4200 hrs per year)
• Most efficient
  – 19.4 cfm/W, 7610 cfm
  – $115 per year
• Least efficient
  – 8.7 cfm/W, 6070 cfm
  – $205 per year

Rebates available:
Example: Alliant Energy offers $75 if over 13.0 cfm/W for 24 inch fans

Summary

• Ventilation Management is critical to energy management
• Can amount to several $1000
• Controller Settings are an important part of efficient operation.
• No investment in many cases .. Only management

Summary

• Insulation may be helpful if there is little currently, may have animal comfort and building longevity issues.
  – Attic ~$1000 if less than 6” exists
  – Perimeter ~$1300 if no perimeter insulation
• Lighting
  – Lighting is an easy savings, but small impact
  – <$1000, quick payback
Thank you for your time!

What questions do you have?