ENERGY MANAGEMENT FOR CORN DRYING

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FARM ENERGY

Wet grain

1’ to 2’ drying zone

Dry grain

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Variations

- batch or continuous flow
- cooling pressurized or suction
- cooling outside dryer, in bin
- heat re-claim
- column inverter
- differential speed across column

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100% saturated air

Air temperature, °F

lb H₂O/ lb air

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Alternate drying options:

- Natural-air drying
- Combination high-temperature & natural-air drying
- Cooling and steeping in storage bin
- Increasing drying air temperature
FARM ENERGY

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<table>
<thead>
<tr>
<th>Temperature</th>
<th>Moisture content, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>150 61 29 15 9.4 6.1</td>
</tr>
<tr>
<td>50</td>
<td>84 34 16 8.9 5.3 3.4</td>
</tr>
<tr>
<td>60</td>
<td>47 19 9.2 5.0 3.0 1.9</td>
</tr>
<tr>
<td>70</td>
<td>26 11 5.2 2.8 1.7 1.1</td>
</tr>
<tr>
<td>80</td>
<td>15 6 2.9 1.6 0.9 0.9</td>
</tr>
</tbody>
</table>

Based on 0.5% dry matter loss or single grade number loss.

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Natural-air drying

**Advantages**

- Uses drying potential of fall outdoor air
- High-quality grain
- Move only once

**Disadvantages**

- Not practical for grain > 21% m.c.
- Requires adequate fan capacity to ensure timely drying
- Grain dries slowly, bin used once each year for drying
- Check top for drying finish
- Limited use on tall, large bins

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Combination high-temperature and natural-air drying

**Advantages**

- Works well if grain too wet for natural-air drying alone
- Greatly increases capacity and efficiency

**Disadvantages**

- Must be comfortable with natural-air management
- Drying may not be completed in fall requiring spring finish

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**Dryeration:** additional 2 – 3 pts removed during steeping and cooling

**In-bin cooling:** additional 1 – 1.5 pts removed during cooling

Moisture may form on cold roof and run down walls

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http://farmenergy.exnet.iastate.edu
## FARM ENERGY

<table>
<thead>
<tr>
<th>Drying</th>
<th>Capacity, bu/time</th>
<th>LP gal/100 bu</th>
<th>kWh/100 bu</th>
<th>Cost/bu/pt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dryer cooling</td>
<td>1</td>
<td>20</td>
<td>10</td>
<td>$.0410</td>
</tr>
<tr>
<td>In-bin cooling</td>
<td>1.35</td>
<td>17.5</td>
<td>8</td>
<td>$.0358</td>
</tr>
<tr>
<td>Dryeration</td>
<td>1.6</td>
<td>14.5</td>
<td>7</td>
<td>$.0297</td>
</tr>
<tr>
<td>Combination drying</td>
<td>2.5</td>
<td>8</td>
<td>70 – 110</td>
<td>$.0250</td>
</tr>
</tbody>
</table>

25.5% to 15.5% m.c.

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Drying cost, $

- Hi-temp
- Bin cool
- Dryerate
- Combination
- Natural air

$2 LP
$.10kWh
$1.40 LP
$.08 kWh
$2 LP
$.10kWh
$1.40 LP
$.08 kWh

25% m.c.
20% m.c.

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Propane use, gal/1000 bu

Initial grain moisture content, %

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Energy use, Btu/lb water

Ames west  Ames west  Nashua east  Nashua east  Atlantic batch  Atlantic batch  Atlantic cont flow  Atlantic cont flow

Fall 2013 grain drying

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FARM ENERGY

[Bar chart showing energy use per lb of water for different locations and methods:
- Ames west
- Ames east
- Nashua east
- Nashua east
- Nashua west
- Atlantic cont flow
- Atlantic batch

Energy use is measured in Btu/lb water.

Fall 2014 grain drying

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Energy use, Btu/lb water

- Ames west
- Ames west
- Ames east
- Ames west
- Ames east

Fall 2013 & 2014 grain drying

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Gal LP/pt/bu

Ames west
Ames west
Nashua east
Nashua east
Atlantic batch
Atlantic batch
Atlantic cont flow
Atlantic cont flow

Fall 2013 grain drying
96% of total energy

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Fall 2014 grain drying
95% of total energy

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Fall 2013 grain drying
4% of total energy

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Fall 2014 grain drying
5% of total energy

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Drying corn, 175 bu/acre with 5 points removed

<table>
<thead>
<tr>
<th></th>
<th>High-temperature</th>
<th></th>
<th>Low-temperature</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LP</td>
<td>15.8 gal</td>
<td>Electricity</td>
<td>17.5 kwh</td>
</tr>
<tr>
<td>Total diesel equivalent:</td>
<td></td>
<td></td>
<td>Total diesel equivalent:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10.7 gal</td>
<td></td>
<td>6.9 gal</td>
<td></td>
</tr>
</tbody>
</table>

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Savings potential for 1000 acres

Transfer hot from dryer and cool in-bin for last 1 – 1.5 points of moisture

175 bu/acre and $2/gal LP savings = $7900

Calibrate moisture meter and grain dryer to avoid ¾ point over-drying

LP savings = $4700
Extra grain weight sold (at $4/bu) = $5300
In the introduction, click the link to download the Farm Energy log in Microsoft Excel™.
# Farm Energy Log

<table>
<thead>
<tr>
<th>Electricity kWh</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 kWh</td>
<td>4750</td>
<td>4314</td>
<td>4980</td>
<td>4780</td>
<td>4700</td>
<td>4600</td>
<td>4865</td>
<td>4900</td>
<td>5020</td>
<td>6000</td>
<td>5600</td>
<td>4900</td>
<td>$9409</td>
</tr>
<tr>
<td>Price per kWh</td>
<td>$0.1000</td>
<td>$0.0948</td>
<td>$0.0900</td>
<td>$0.1046</td>
<td>$0.1064</td>
<td>$0.1087</td>
<td>$0.1069</td>
<td>$0.1082</td>
<td>$0.1195</td>
<td>$0.1000</td>
<td>$0.1250</td>
<td>$0.1429</td>
<td></td>
</tr>
<tr>
<td>Total electric cost</td>
<td>$475</td>
<td>$409</td>
<td>$448</td>
<td>$500</td>
<td>$500</td>
<td>$500</td>
<td>$520</td>
<td>$530</td>
<td>$600</td>
<td>$600</td>
<td>$700</td>
<td>$700</td>
<td>$6,482</td>
</tr>
</tbody>
</table>

## Diesel

<table>
<thead>
<tr>
<th>Gallons</th>
<th>Price per gallon</th>
<th>Total diesel cost</th>
</tr>
</thead>
</table>

## Gasoline

<table>
<thead>
<tr>
<th>Gallons</th>
<th>Price per gallon</th>
<th>Total gasoline cost</th>
</tr>
</thead>
</table>
Farm energy savings “food for thought...”

• How many gallons of propane did you use to dry 1000 bushels?

• What percentage of a total bushel did you lose in moisture discount?
Farm energy savings “food for thought…”

- Many ag inputs are subject to variability
- Energy use can be managed and adjusted
- Energy savings improve overall profitability
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• Look for upcoming case study publications

• Join us for a spring or summer field day

• Contact: Mark Hanna,
  hmhanna@iastate.edu
  Dana Schweitzer, schweitz@iastate.edu

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