
Average Crop Residue Zone in Manitoba
This guide is designed to provide planning information and a format for calculating the costs of production in a wheat straw biomass enterprise. The production costs included in this budget were not obtained from a survey of producers, nor do they necessarily represent the average cost of production for wheat straw biomass in Manitoba.

The assumptions on which the costs were calculated are clearly defined in the supporting pages. They were developed by using a combination of recommended practices and methods.

When interpreting the costs contained in this budget for an individual situation, adjustments may be necessary. Each assumption must be examined and adjustments made where necessary.

The budget can be useful for comparative purposes. Comparison of costs can be made with other similar farms; comparing farm costs over time; or comparing actual results with projections made earlier.

**Disclaimer:** This budget is only a guide and is not intended as an in depth study of the cost of production of this industry. Interpretation and utilization of this information is the responsibility of the user. If you require assistance with developing your individual budget, please contact your local Manitoba Agriculture, Food and Rural Initiatives office.
### Wheat Straw Biomass Cost of Production Summary - November, 2012

Based on 600 Acres - 41.7 bu grain yield and 1.06 tons straw per acre
636 Total tons Straw produced

#### A. Operating Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>$/acre</th>
<th>$/ton</th>
<th>Your Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.01 Estimated Net Nutrient Value</td>
<td>$19.19</td>
<td>$18.11</td>
<td></td>
</tr>
<tr>
<td>1.02 Custom Baling</td>
<td>$18.47</td>
<td>$17.42</td>
<td></td>
</tr>
<tr>
<td>1.03 Custom Field Moving</td>
<td>$6.48</td>
<td>$6.11</td>
<td></td>
</tr>
<tr>
<td>1.04 Custom Hauling</td>
<td>$1.73</td>
<td>$1.63</td>
<td></td>
</tr>
<tr>
<td>1.05 Repairs &amp; Maintenance</td>
<td>$0.30</td>
<td>$0.28</td>
<td></td>
</tr>
<tr>
<td>1.06 Miscellaneous</td>
<td>$2.50</td>
<td>$2.36</td>
<td></td>
</tr>
<tr>
<td>Sub-total Operating Cost</td>
<td>$48.67</td>
<td>$45.91</td>
<td></td>
</tr>
<tr>
<td>1.07 Interest on Operating</td>
<td>$1.34</td>
<td>$1.26</td>
<td></td>
</tr>
<tr>
<td><strong>Total Operating Costs</strong></td>
<td><strong>$50.01</strong></td>
<td><strong>$47.17</strong></td>
<td></td>
</tr>
</tbody>
</table>

#### B. Fixed Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>$/acre</th>
<th>$/ton</th>
<th>Your Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0 Depreciation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.01 Storage</td>
<td>$5.00</td>
<td>$4.72</td>
<td></td>
</tr>
<tr>
<td>3.0 Investment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.01 Storage</td>
<td>$0.30</td>
<td>$0.28</td>
<td></td>
</tr>
<tr>
<td><strong>Total Fixed Costs</strong></td>
<td><strong>$5.30</strong></td>
<td><strong>$5.00</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Total Cost of Production**

|                      | $55.31 | $52.17 |         |

#### Energy Cost Comparison

<table>
<thead>
<tr>
<th>Item</th>
<th>Per Million Btu</th>
<th>Per kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat Straw @ $60.00/ton</td>
<td>$6.72</td>
<td>$0.0229</td>
</tr>
<tr>
<td>Wheat Straw cubes@ $100.00/ton</td>
<td>$11.21</td>
<td>$0.0382</td>
</tr>
<tr>
<td>Coal-lignite @ $100/ton</td>
<td>$12.67</td>
<td>$0.0432</td>
</tr>
<tr>
<td>Wood Pellets @ $150/ton</td>
<td>$14.81</td>
<td>$0.0506</td>
</tr>
<tr>
<td>Oats - grain @ $3.40/bu</td>
<td>$21.33</td>
<td>$0.0728</td>
</tr>
<tr>
<td>Electricity @ $0.07389/kWh</td>
<td>$21.65</td>
<td>$0.0739</td>
</tr>
<tr>
<td>Natural gas high E @ $0.3555/cu.meter</td>
<td>$11.77</td>
<td>$0.0402</td>
</tr>
<tr>
<td>Natural gas low E @ $0.3555/cu.meter</td>
<td>$14.43</td>
<td>$0.0493</td>
</tr>
</tbody>
</table>

#### Breakeven Biomass Value

<table>
<thead>
<tr>
<th>Item</th>
<th>Wheat Straw per Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal-lignite @ $100/ton</td>
<td>$113.05</td>
</tr>
<tr>
<td>Wood Pellets @ $150/ton</td>
<td>$132.18</td>
</tr>
<tr>
<td>Oats - grain @ $3.40/bu</td>
<td>$190.37</td>
</tr>
<tr>
<td>Electricity @ $0.07389/kWh</td>
<td>$193.20</td>
</tr>
<tr>
<td>Natural gas high E @ $0.3555/cu.meter</td>
<td>$104.99</td>
</tr>
<tr>
<td>Natural gas low E @ $0.3555/cu. meter</td>
<td>$128.79</td>
</tr>
</tbody>
</table>

Breakeven wheat straw $/ton = $ per million Btu x 8.9239 million Btu per ton wheat straw.

1. Est. Nutrient Value is based on 12.5 lb N@$0.64/lb, 4.1 lb P@$0.53/lb, 14 lb K@$0.49/lb, 2.5 lb S@$0.43/lb.
   per ton of straw minus $0.00 estimated residue management cost per acre.
2. The cost of custom baling is based on $7.84 per bale.
3. The cost of custom field moving of bales is based on $2.75 per bale.
4. The cost of custom hauling is based on $5.00/mile for 5 miles.
5. Total straw Cost of Production (COP) + 15% producer markup (risk, management and profit margin).
6. Total straw COP + 15% producer markup + $40.00/ton straw cube production cost.

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Wheat Straw Biomass Cost of Production Input Assumptions

**Land**
Total Acres 600 acres

**Producer Markup**
(Risk, management, and profit margin) 15%

**Nutrient Value (Fertilizer cost)**

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Wheat Straw Nutrient Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>0.640 12.5 100%</td>
</tr>
<tr>
<td>Phosphate</td>
<td>0.530 4.1 100%</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.490 28.0 50%</td>
</tr>
<tr>
<td>Sulfur</td>
<td>0.430 2.5 100%</td>
</tr>
</tbody>
</table>

**Grain Production**
Wheat yield 41.7 bu/ac
Straw to Grain Ratio 1.30 S:G
Baled/Harvested Straw 65%

**Custom Rates**
- Heavy harrow - custom rate ($/acre) $3.75 $/acre
- Average harrow passes per acre 0 passes
- Deep tillage - custom rate ($/acre) $0.00 $/acre
- Baling - custom rate ($/bale) $7.84 $/bale
- Pickup, load, unload and stack - ($/bale) $2.75 $/bale
- Average round bale weight (lbs) 900 lbs
- Average bale moisture content 11%
- Hauling - custom rate per loaded mile $5.00 $/mile
- Hauling - average miles per load 5 miles
- Hauling - average bales per load 34 bales

**Repairs & Maintenance**
% rate of investment 2%

**Miscellaneous**
- Miscellaneous Costs $2.50 $/acre
- Straw chopper - diesel fuel $0.00 $/acre
- Wheat straw cube production $40.00 $/ton
- Average coal moisture content 12%
- Wood pellet moisture content 5%
- Oat grain moisture content 12.5%

**Interest**
Interest on Operating 5.50%
Investment interest rate 2.50%

**Energy Cost Comparisons**

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Cost per unit</th>
<th>Btu per unit</th>
<th>Heat Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat straw - dry basis</td>
<td>$52.17</td>
<td>7,713 lb</td>
<td>65%</td>
</tr>
<tr>
<td>Electricity residential rate</td>
<td>$0.07389</td>
<td>3,413 kWh</td>
<td>100%</td>
</tr>
<tr>
<td>Coal - lignite</td>
<td>$100</td>
<td>6,900 lb</td>
<td>65%</td>
</tr>
<tr>
<td>Wood pellets</td>
<td>$150</td>
<td>8,200 lb</td>
<td>65%</td>
</tr>
<tr>
<td>Oats (grain - 34 lb. bushel)</td>
<td>$3.40</td>
<td>8,242 lb</td>
<td>65%</td>
</tr>
<tr>
<td>Natural gas - high efficiency</td>
<td>$0.356</td>
<td>32,844 m³</td>
<td>92%</td>
</tr>
<tr>
<td>Natural gas - low efficiency</td>
<td>$0.356</td>
<td>32,844 m³</td>
<td>75%</td>
</tr>
</tbody>
</table>

**Capital Costs**

<table>
<thead>
<tr>
<th>Capital Costs</th>
<th>Biomass Cost/Acre</th>
<th>Useful Life</th>
<th>Salvage Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>$15</td>
<td>3</td>
<td>0%</td>
</tr>
<tr>
<td>Market Value</td>
<td>$9,000</td>
<td>100%</td>
<td>$9,000</td>
</tr>
<tr>
<td>Total Capital Investment</td>
<td>$9,000</td>
<td></td>
<td>$9,000</td>
</tr>
</tbody>
</table>
Assumptions

1. Assumed a total of 600 acres of wheat straw biomass.
2. Assumed an average yield of 1.06 tons per acre.
3. Assumed a 15% producer markup per ton of straw.
4. Straw value is based on net nutrient value per acre.
5. Machinery and equipment costs for the wheat straw biomass enterprise are based on custom rates. Storage facilities were valued at $9,000 in total.
6. The budget is based on a round bale production system with outside storage.

Wheat Straw Biomass Cost of Production Worksheet

<table>
<thead>
<tr>
<th>A. Operating Costs</th>
<th>Your Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.01 Estimated Net Nutrient Value</td>
<td></td>
</tr>
<tr>
<td>Nitrogen</td>
<td>12.5 lbs/ton straw</td>
</tr>
<tr>
<td>1.00 straw nutrient value</td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>$0.64 cost/lb</td>
</tr>
<tr>
<td>=</td>
<td>$8.00 $/ton</td>
</tr>
<tr>
<td>P2O5</td>
<td>4.1 lbs/ton straw</td>
</tr>
<tr>
<td>1.00 straw nutrient value</td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>$0.53 cost/lb</td>
</tr>
<tr>
<td>=</td>
<td>$2.17 $/ton</td>
</tr>
<tr>
<td>K2O</td>
<td>28 lbs/ton straw</td>
</tr>
<tr>
<td>0.50 straw nutrient value</td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>$0.49 cost/lb</td>
</tr>
<tr>
<td>=</td>
<td>$6.86 $/ton</td>
</tr>
<tr>
<td>Sulfur</td>
<td>3 lbs/ton straw</td>
</tr>
<tr>
<td>1.00 straw nutrient value</td>
<td></td>
</tr>
<tr>
<td>x</td>
<td>$0.43 cost/lb</td>
</tr>
<tr>
<td>=</td>
<td>$1.08 $/ton</td>
</tr>
<tr>
<td>subtotal =</td>
<td>$18.11 $/ton estimated nutrient value</td>
</tr>
<tr>
<td>x</td>
<td>1.06 tons straw per acre</td>
</tr>
<tr>
<td>=</td>
<td>$19.19 Estimated straw nutrient value per acre</td>
</tr>
<tr>
<td>+</td>
<td>$3.75 heavy harrow per acre</td>
</tr>
<tr>
<td>x</td>
<td>0.0 passes per acre</td>
</tr>
<tr>
<td>=</td>
<td>$0.00 deep tillage per acre</td>
</tr>
<tr>
<td>+</td>
<td>$0.00 straw chopper - diesel fuel per acre</td>
</tr>
<tr>
<td>subtotal =</td>
<td>$0.00 Estimated residue management per acre</td>
</tr>
<tr>
<td>-</td>
<td>$19.19 Estimated straw nutrient value per acre</td>
</tr>
<tr>
<td>-</td>
<td>$0.00 Estimated residue management per acre</td>
</tr>
<tr>
<td>Total =</td>
<td>$19.19 Estimated Net Nutrient Value per Acre</td>
</tr>
</tbody>
</table>

Wheat Yield

41.7 bu/acre

= 36.744 bu/tonne

= 1.13 tonnes per acre

= 1.10 tons per tonne

= 1.25 tons grain per acre

Straw Yield

1.30 straw to grain ratio

= 0.65 baled/harvested straw

= 1.25 tons grain per acre

= 1.06 tons straw per acre

= 600 acres

Total = 636 tons of straw produced

1.02 Custom Baling Costs

1.1 tons straw per acre

= 2000 lbs/ton

= 900 bale weight (lbs)

x | $7.84 $/bale |

= $18.47 $/acre

1.03 Custom Field Moving Costs

Pick up, load, unload & stack

1.1 tons straw per acre
Guidelines: Wheat Straw Biomass Production Costs

1.04 Custom Hauling Costs

- 2000 lbs/ton
- 900 bale weight (lbs)
- $2.75 $/bale

\[ \times = \frac{2000}{900} \times 2.75 = 6.48 \text{ $/acre} \]

1.05 Repairs & Maintenance

- 2.0% percentage rate
- $15 investment/acre

\[ \times = \frac{0.02 \times 15}{1.0} = 0.30 \text{ $/acre} \]

*Investment in straw biomass includes storage.

1.06 Miscellaneous

\[ = \frac{2.50}{1.0} = \frac{2.50}{1.0} \text{ $/acre} \]

1.07 Interest on operating costs

- $48.67 subtotal operating
- 2 average
- 5.5% interest rate

\[ \times = \frac{48.67}{2} \times 0.055 = 1.34 \text{ $/acre} \]

Capital Costs

<table>
<thead>
<tr>
<th>Market Value</th>
<th>% Allocated</th>
<th>Allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>$9,000</td>
<td>100%</td>
</tr>
</tbody>
</table>

Total Capital Investment

\[ = \frac{9,000}{8.9239} = 6.72 \text{ per Million Btu} \]

B. Fixed Costs

2. Depreciation

2.01 Storage

- $9,000 storage investment
- $0 salvage value
- 3 years useful life
- 600 acres

\[ = \frac{9,000}{3} \times \frac{600}{1} = 5.00 \text{ $/acre} \]

3. Investment

3.01 Storage

- $9,000 storage investment
- $0 salvage value
- 2 average
- 600 acres
- 4.0% investment rate

\[ = \frac{9,000}{2} \times \frac{600}{1} \times 0.04 = 0.30 \text{ $/acre} \]

C. Energy Cost Comparison

4.01 Wheat Straw

- 7,713 Btu per pound
- 0.89 dry matter content
- 6,864.57 Btu per pound (as received)
- 2,000 Pounds per ton
- 13,729,140 Total Btu per ton
- 65% Heat Efficiency
- 8,923,941 Net Btu per ton

\[ \times = 7,713 \times 0.89 \times 6,864.57 \times 2,000 \times 0.65 \times 8,923,941 = 52.17 \text{ Cost of Production per ton} \]

\[ \times = 15\% \text{ Producer Margin} \]

\[ = \frac{52.17}{1} \times \frac{15}{1} = 60.25 \text{ Cost per ton} \]

\[ = \frac{8,923,941}{2,000} \times \frac{15}{1} = 6.72 \text{ per Million Btu} \]

MAFRI, GO Team Branch
8,923,941  Net Btu per ton  
+ 3,413  Btu per kWh  
= 2,614.69  kWh per ton  

$60.00  Cost per ton  
÷ 2,614.69  kWh per ton  
= $0.0229  per kWh  

| 4.02 Wheat Straw Cubes | 7,713  Btu per pound  
× 0.89  dry matter content  
= 6,864.57  Btu per pound (as received)  
× 2,000  Pounds per ton  
= 13,729.140  Total Btu per ton  
× 65%  Heat Efficiency  
= 8,923,941  Net Btu per ton  

$52.17  Cost of Production per ton  
× 15%  Producer Margin  
+ $40.00  Wheat Straw cube production per ton  
= $92.17  Million Btu per ton  
÷ 100,000  per Million Btu  
= $0.0092  per Million Btu  

4.03 Coal - Lignite  

6,900  Btu per pound  
× 0.88  dry matter content  
= 6,072.00  Btu per pound (as received)  
× 2,000  Pounds per ton  
= 12,144,000  Total Btu per ton  
× 65%  Heat Efficiency  
= 7,893,600  Net Btu per ton  

$100.00  Cost per ton  
÷ 7,893,600  Net Btu per ton  
= $0.01267  per Million Btu  

4.04 Wood Pellets  

8,200  Btu per pound  
× 0.95  dry matter content  
= 7,790.00  Btu per pound (as received)  
× 2,000  Pounds per ton  
= 15,580,000  Total Btu per ton  
× 65%  Heat Efficiency  
= 10,127,000  Net Btu per ton  

$150.00  Cost per ton  
÷ 10,127,000  Net Btu per ton  
= $0.01481  per Million Btu  

4.05 Oats - grain

\[
\begin{align*}
\text{8.242 Btu per pound} \times 0.88 \text{ dry matter content} &= 7.211.75 \text{ Btu per pound (as received)} \\
\times 2,000 \text{ Pounds per ton} &= 14,423.500 \text{ Total Btu per ton} \\
\times 65\% \text{ Heat Efficiency} &= 9,375.275 \text{ Net Btu per ton} \\
\div 2,000 \text{ Pounds per ton} &= 9.375275 \text{ Million Btu per ton} \\
\div 7,211.75 \text{ Btu per pound} &= \$213.33 \text{ per Million Btu} \\
\times 2,000 \text{ Pounds per ton} &= 4,050.00 \text{ Cost per ton} \\
\div 14,423.500 \text{ Total Btu per ton} &= \$0.283 \text{ per kWh} \\
\times 65\% \text{ Heat Efficiency} &= 9.375275 \text{ Net Btu per ton} \\
\div 3,413 \text{ Btu per kWh} &= 2,746.93 \text{ kWh per ton} \\
\div 2,000 \text{ Pounds per ton} &= 0.8836 \text{ Cost per kWh} \\
\div 14,423.500 \text{ Total Btu per ton} &= \$0.0728 \text{ per kWh} \\
\end{align*}
\]

4.06 Electricity

\[
\begin{align*}
\$0.0739 \text{ per kWh} \times 1.00 \text{ Million Btu} &= 0.0739 \text{ million kWh} \\
\div 3,413 \text{ Btu per kWh} &= 21.65 \text{ per Million Btu} \\
\end{align*}
\]

4.07 Natural Gas

- High Efficiency

\[
\begin{align*}
\text{32,844 Btu per cubic meter} \times 92\% \text{ Heat Efficiency} &= 30,216 \text{ Net Btu per cubic meter} \\
\div 1.00 \text{ Million Btu} &= 30,216 \text{ Net Btu per cubic meter} \\
\div 32,844 \text{ Btu per cubic meter} &= \$0.356 \text{ Cost per cubic meter} \\
\times 1.00 \text{ Million Btu} &= 30,216 \text{ Net Btu per cubic meter} \\
\div 3,413 \text{ Btu per kWh} &= 8.85 \text{ kWh per cubic meter} \\
\div 1.00 \text{ Million Btu} &= 0.0402 \text{ per kWh} \\
\end{align*}
\]

- Low Efficiency

\[
\begin{align*}
\text{32,844 Btu per cubic meter} \times 75\% \text{ Heat Efficiency} &= 24,633 \text{ Net Btu per cubic meter} \\
\div 1.00 \text{ Million Btu} &= 24,633 \text{ Net Btu per cubic meter} \\
\div 32,844 \text{ Btu per cubic meter} &= \$0.356 \text{ Cost per cubic meter} \\
\times 1.00 \text{ Million Btu} &= 24,633 \text{ Net Btu per cubic meter} \\
\div 3,413 \text{ Btu per kWh} &= 7.22 \text{ kWh per cubic meter} \\
\div 1.00 \text{ Million Btu} &= 0.0493 \text{ per kWh} \\
\end{align*}
\]

For more information contact your local MAFRI office.

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For more information

• Contact your local Manitoba Agriculture, Food and Rural Initiatives (MAFRI) Growing Opportunities (GO) Office.

• Visit us at manitoba.ca/agriculture.