



Guidelines for Estimating Wheat Straw Biomass Production Costs 2017

Average Crop Residue Zone in Manitoba



Guidelines for Estimating Wheat Straw Biomass Production Costs Average Crop Residue Zone

Date: January, 2017

The following budgets are estimates of the cost of producing wheat straw biomass in Manitoba. General Manitoba Agriculture recommendations are assumed in using fertilizers and chemical inputs. These figures provide an economic evaluation of wheat straw biomass and estimated prices required to cover all costs. Costs include labour, investment and depreciation, but do not include management costs, nor do they necessarily represent the average cost of production in Manitoba.

These budgets may be adjusted by putting in your own figures. As a producer you are encouraged to calculate your own costs of production for various crops. On each farm, costs and yields differ due to soil type, climate and agronomic practices.

This tool is available as an Excel worksheet at: www.manitoba.ca/agriculture or at your local [Manitoba Agriculture GO Office](#). [The Farm Machinery Custom and Rental Rate](#) is also available to help determine machinery costs.

*Average Crop Residue generally refers to areas of Manitoba outside of the Red River Valley where farmers manage crop residue with minimum tillage practices. Producers should use the publication that best corresponds to their farming practices and soil type.

Note: 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 use of this information is the responsibility of the user. If you need help with a budget, contact your local Manitoba Agriculture GO Office.

Wheat Straw Biomass Cost of Production Summary - January, 2017

*Based on 600 Acres - 45 bu grain yield and 1.13 tons straw per acre
678 Total tons Straw produced*

A. Operating Costs	<u>\$/acre</u>	<u>\$/ton</u>	<u>Your Cost</u>
1.01 Estimated Net Nutrient Value ¹	\$13.11	\$11.60	_____
1.02 Custom Baling ²	\$28.63	\$25.34	_____
1.03 Custom Field Moving ³	\$7.53	\$6.66	_____
1.04 Custom Hauling ⁴	\$2.03	\$1.80	_____
1.05 Repairs & Maintenance	\$0.30	\$0.27	_____
1.06 Miscellaneous	<u>\$2.50</u>	<u>\$2.21</u>	_____
Sub-total Operating Cost	\$54.10	\$47.88	_____
1.07 Interest on Operating	\$1.49	\$1.32	_____
Total Operating Costs	\$55.59	\$49.20	_____
B. Fixed Costs			
2.0 Depreciation			
2.01 Storage	\$5.00	\$4.42	_____
3.0 Investment			
3.01 Storage	<u>\$0.30</u>	<u>\$0.27</u>	_____
Total Fixed Costs	\$5.30	\$4.69	_____
Total Cost of Production	\$60.89	\$53.89	_____

Energy Cost Comparison	Per	
	<u>Million Btu</u>	<u>Per kWh</u>
Wheat Straw @ \$61.97/ton ⁵	\$6.94	\$0.0237
Wheat Straw cubes @ \$101.97/ton ⁶	\$11.43	\$0.0390
Coal-lignite @ \$120/ton	\$15.20	\$0.0519
Wood Pellets @ \$250/ton	\$24.69	\$0.0843
Oats - grain @ \$3.25/bu	\$20.39	\$0.0696
Electricity @ \$0.08861/kWh	\$25.96	\$0.0886
Natural gas high E @ \$0.4900/cu.meter	\$16.22	\$0.0553
Natural gas low E @ \$0.4900/cu.meter	\$19.89	\$0.0679

Breakeven Biomass Value	<u>Wheat Straw per Ton</u>
Coal-lignite @ \$120/ton	\$135.66
Wood Pellets @ \$250/ton	\$220.30
Oats - grain @ \$3.25/bu	\$181.97
Electricity @ \$0.08861/kWh	\$231.69
Natural gas high E @ \$0.4900/cu.meter	\$144.72
Natural gas low E @ \$0.4900/cu.meter	\$177.52

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

1. Est. Nutrient Value is based on 12.5lb.N@\$0.39/lb, 4.1lb.P@\$0.44/lb, 14lb.K@\$0.27/lb, 2.5lb.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 \$11.40 per bale.
3. The cost of custom field moving of bales is based on \$3.00 per bale.
4. The cost of custom hauling is based on \$5.50/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.

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.

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)

	<u>\$/lb</u>	<u>Wheat Straw lbs/ton</u>	<u>Straw Nutrient Value</u>
Nitrogen	0.393	12.5	100%
Phosphate	0.443	4.1	100%
Potassium	0.272	28.0	50%
Sulfur	0.425	2.5	100%

Grain Production

Wheat yield 45.0 bu/ac
 Straw to Grain Ratio 1.30 S:G
 Baled/Harvested Straw 65%

Custom Rates

Heavy harrow - custom rate (\$/acre) \$4.75 \$/acre
 Average harrow passes per acre 0 passes
 Deep tillage - custom rate (\$/acre) \$0.00 \$/acre
 Baling - custom rate (\$/bale) \$11.40 \$/bale
 Pickup, load, unload and stack - (\$/bale) \$3.00 \$/bale
 Average round bale weight (lbs) 900 lbs
 Average bale moisture content 11 %
 Hauling - custom rate per loaded mile \$5.50 \$/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

	<u>Cost per unit</u>		<u>Btu per unit</u>		<u>Heat Efficiency</u>
Wheat straw - dry basis	\$53.89	ton	7,713	lb.	65%
Electricity residential rate	\$0.08861	kWhr	3,413	kWh	100%
Coal - lignite	\$120	ton	6,900	lb.	65%
Wood pellets	\$250	ton	8,200	lb.	65%
Oats (grain - 34 lb. bushel)	\$3.25	bushel	8,242	lb.	65%
Natural gas - high efficiency	\$0.490	m ³	32,844	m ³	92%
Natural gas - low efficiency	\$0.490	m ³	32,844	m ³	75%

Capital Costs

Capital Costs

	<u>Biomass Cost/Acre</u>	<u>Useful Life</u>	<u>Salvage Value</u>
Storage Investment	\$15	3	0%

	<u>Market Value</u>	<u>% Allocated to Biomass</u>	<u>Allocated Biomass</u>
Storage	\$9,000	100%	\$9,000

Total Capital Investment **\$9,000** **\$9,000**

Assumptions

1. Assumed a total of 600 acres of wheat straw biomass.
2. Assumed an average yield of 1.13 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

A. Operating Costs			<u>Your Cost</u>
1.01 Estimated Net Nutrient Value			
Nitrogen	12.5	lbs/ton straw	
	1.00	straw nutrient value	
	x <u>\$0.39</u>	cost/lb	
	= \$4.91	\$/ton	
P₂O₅	4.1	lbs/ton straw	
	1.00	straw nutrient value	
	x <u>\$0.44</u>	cost/lb	
	= \$1.82	\$/ton	
K₂O	28	lbs/ton straw	
	0.50	straw nutrient value	
	x <u>\$0.272</u>	cost/lb	
	= \$3.81	\$/ton	
Sulfur	3	lbs/ton straw	
	1.00	straw nutrient value	
	x <u>\$0.43</u>	cost/lb	
	= \$1.06	\$/ton	
subtotal	= \$11.60	\$/ton estimated nutrient value	
	x <u>1.13</u>	tons straw per acre	
	= \$13.11	Estimated straw nutrient value per acre	
	\$4.75	heavy harrow per acre	
	x 0.0	passes per acre	
	\$0.00	deep tillage per acre	
	± <u>\$0.00</u>	straw chopper - diesel fuel per acre	
subtotal	= \$0.00	Estimated residue management per acre	
	\$13.11	Estimated straw nutrient value per acre	
	± <u>\$0.00</u>	Estimated residue management per acre	
Total	= \$13.11	Estimated Net Nutrient Value per Acre	
Wheat Yield	45.0	bu/acre	
	÷ <u>36.744</u>	bu/tonne	
	= 1.22	tonnes per acre	
	x <u>1.10</u>	tons per tonne	
	= 1.34	tons grain per acre	
Straw Yield	1.30	straw to grain ratio	

		0.65	baled/harvested straw	_____
	x	<u>1.34</u>	<u>tons grain per acre</u>	_____
	=	1.13	tons straw per acre	_____
	x	<u>600</u>	<u>acres</u>	_____
Total	=	678	tons of straw produced	_____

1.02 Custom Baling Costs

		1.1	tons straw per acre	_____
	x	2000	lbs/ton	_____
	÷	900	bale weight (lbs)	_____
	x	<u>\$11.40</u>	<u>\$/bale</u>	_____
	=	\$28.63	\$/acre	_____

**1.03 Custom Field Moving Costs
Pick up, load, unload & stack**

		1.1	tons straw per acre	_____
	x	2000	lbs/ton	_____
	÷	900	bale weight (lbs)	_____
	x	<u>\$3.00</u>	<u>\$/bale</u>	_____
	=	\$7.53	\$/acre	_____

1.04 Custom Hauling Costs

		5	miles per load	_____
	x	<u>\$5.50</u>	<u>\$/mile</u>	_____
	=	\$27.50	\$/load	_____
		34	bales/load	_____
	x	<u>900</u>	<u>bale weight (lbs)</u>	_____
	=	15.3	tons/load	_____
	=	\$1.80	\$/ton	_____
		1.1	tons/acre	_____
	x	<u>\$1.80</u>	<u>\$/ton</u>	_____
	=	\$2.03	\$/acre	_____

1.05 Repairs & Maintenance

		2.0%	percentage rate	_____
	x	<u>\$15</u>	<u>investment/acre</u>	_____
	=	\$0.30	\$/acre	_____

*Investment in straw biomass includes storage.

1.06 Miscellaneous

	=	\$2.50	\$/acre	_____
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1.07 Interest on operating costs

		\$54.10	subtotal operating	_____
	÷	2	average	_____
	x	<u>5.5%</u>	<u>interest rate</u>	_____
	=	\$1.49	\$/acre	_____

Capital Costs

	<u>Market Value</u>	<u>% Allocated to Biomass</u>	<u>Allocated Biomass</u>	_____
Storage	\$9,000	100%	\$9,000	_____
Total Capital Investment	\$9,000		\$9,000	_____

B. Fixed Costs

2. Depreciation

2.01 Storage

	\$9,000	storage investment	_____
-	\$0	salvage value	_____
÷	3	years useful life	_____
÷	<u>600</u>	acres	_____
=	\$5.00	\$/acre	_____

3. Investment

3.01 Storage

	\$9,000	storage investment	_____
+	\$0	salvage value	_____
÷	2	average	_____
÷	600	acres	_____
x	<u>4.0%</u>	investment rate	_____
=	\$0.30	\$/acre	_____

C. Energy Cost Comparison

4.01 Wheat Straw

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

	\$53.89	Cost of Production per ton	_____
x	<u>15%</u>	Producer Margin	_____
=	\$61.97	Cost per ton	_____
÷	<u>8.9239</u>	Million Btu per ton	_____
=	\$6.94	per Million Btu	_____

	8,923,941	Net Btu per ton	_____
÷	<u>3,413</u>	Btu per kWh	_____
=	2,614.69	kWh per ton	_____

	\$61.97	Cost per ton	_____
÷	<u>2,614.69</u>	kWh per ton	_____
=	\$0.0237	per kWh	_____

4.02 Wheat Straw Cubes

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

	\$53.89	Cost of Production per ton	_____
x	15%	Producer Margin	_____
+	<u>\$40.00</u>	Wheat Straw cube production per ton	_____
=	\$101.97	Cost per ton	_____
÷	<u>8.9239</u>	Million Btu per ton	_____
=	\$11.43	per Million Btu	_____

	8,923,941	Net Btu per ton	_____
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	÷	<u>3,413</u>	<u>Btu per kWh</u>	
	=	2,614.69	kWh per ton	
		\$101.97	Cost per ton	
	÷	<u>2,614.69</u>	<u>kWh per ton</u>	
	=	\$0.0390	per kWh	
4.03 Coal - Lignite		6,900	Btu per pound	
	×	<u>0.88</u>	<u>dry matter content</u>	
	=	6,072.00	Btu per pound (as received)	
	×	<u>2,000</u>	<u>Pounds per ton</u>	
	=	12,144,000	Total Btu per ton	
	×	<u>65%</u>	<u>Heat Efficiency</u>	
	=	7,893,600	Net Btu per ton	
		\$120.00	Cost per ton	
	÷	<u>7.8936</u>	<u>Million Btu per ton</u>	
	=	\$15.20	per Million Btu	
		7,893,600	Net Btu per ton	
	÷	<u>3,413</u>	<u>Btu per kWh</u>	
	=	2,312.80	kWh per ton	
		\$120.00	Cost per ton	
	÷	<u>2,312.80</u>	<u>kWh per ton</u>	
	=	\$0.0519	per kWh	
4.04 Wood Pellets		8,200	Btu per pound	
	×	<u>0.95</u>	<u>dry matter content</u>	
	=	7,790.00	Btu per pound (as received)	
	×	<u>2,000</u>	<u>Pounds per ton</u>	
	=	15,580,000	Total Btu per ton	
	×	<u>65%</u>	<u>Heat Efficiency</u>	
	=	10,127,000	Net Btu per ton	
		\$250.00	Cost per ton	
	÷	<u>10.1270</u>	<u>Million Btu per ton</u>	
	=	\$24.69	per Million Btu	
		10,127,000	Net Btu per ton	
	÷	<u>3,413</u>	<u>Btu per kWh</u>	
	=	2,967.18	kWh per ton	
		\$250.00	Cost per ton	
	÷	<u>2,967.18</u>	<u>kWh per ton</u>	
	=	\$0.0843	per kWh	
4.05 Oats - grain		8,242	Btu per pound	
	×	<u>0.88</u>	<u>dry matter content</u>	
	=	7,211.75	Btu per pound (as received)	
	×	<u>2,000</u>	<u>Pounds per ton</u>	
	=	14,423,500	Total Btu per ton	
	×	<u>65%</u>	<u>Heat Efficiency</u>	
	=	9,375,275	Net Btu per ton	
		\$191.18	Cost per ton	
	÷	<u>9.3753</u>	<u>Million Btu per ton</u>	

	=	\$20.39	per Million Btu	_____
		9,375,275	Net Btu per ton	_____
	÷	<u>3,413</u>	<u>Btu per kWh</u>	_____
	=	2,746.93	kWh per ton	_____
		\$191.18	Cost per ton	_____
	÷	<u>2,746.93</u>	<u>kWh per ton</u>	_____
	=	\$0.0696	per kWh	_____
4.06 Electricity		\$0.0886	per kWh	_____
	x	1.00	Million Btu	_____
	÷	<u>3,413</u>	<u>Btu per kWh</u>	_____
	=	\$25.96	per Million Btu	_____
4.07 Natural Gas -High Efficiency		32,844	Btu per cubic meter	_____
	x	<u>92%</u>	<u>Heat Efficiency</u>	_____
	=	30,216	Net Btu per cubic meter	_____
		\$0.490	Cost per cubic meter	_____
	x	1.00	Million Btu	_____
	÷	<u>30,216</u>	<u>Net Btu per cubic meter</u>	_____
	=	\$16.22	per Million Btu	_____
		30,216	Net Btu per cubic meter	_____
	÷	<u>3,413</u>	<u>Btu per kWh</u>	_____
	=	8.85	kWh per cubic meter	_____
		\$0.490	Cost per cubic meter	_____
	÷	<u>8.85</u>	<u>kWh per cubic meter</u>	_____
	=	\$0.0553	per kWh	_____
4.08 Natural Gas -Low Efficiency		32,844	Btu per cubic meter	_____
	x	<u>75%</u>	<u>Heat Efficiency</u>	_____
	=	24,633	Net Btu per cubic meter	_____
		\$0.490	Cost per cubic meter	_____
	x	1.00	Million Btu	_____
	÷	<u>24,633</u>	<u>Net Btu per cubic meter</u>	_____
	=	\$19.89	per Million Btu	_____
		24,633	Net Btu per cubic meter	_____
	÷	<u>3,413</u>	<u>Btu per kWh</u>	_____
	=	7.22	kWh per cubic meter	_____
		\$0.490	Cost per cubic meter	_____
	÷	<u>7.22</u>	<u>kWh per cubic meter</u>	_____
	=	\$0.0679	per kWh	_____

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For more information, contact your local [Manitoba Agriculture GO Office](#) or:

[Roy Arnott](#)

Farm Management Specialist

A decorative graphic at the top of the page consists of three solid colored bars: a green bar on the left, a dark blue bar in the middle, and an orange bar on the right. From the bottom edge of the dark blue bar, several dashed orange lines curve downwards and outwards across the page.

For more information

- Contact your local Manitoba Agriculture Growing Opportunities (GO) Office.
- Visit us at manitoba.ca/agriculture.

