Guidelines for Estimating Wheat Straw Biomass Production Costs 2017

High Crop Residue Zone in Manitoba

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Guidelines for Estimating

Wheat Straw Biomass Production Costs

High 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.

*High Crop Residue generally refers to areas of Manitoba within the Red River Valley where farmers actively manage crop residue with various 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 - 60 bu grain yield and 1.52 tons straw per acre
912 Total tons Straw produced

A. Operating Costs	**$/acre**	**$/ton**	**Your Cost**
1.01 Estimated Net Nutrient Value [1]	-$1.82	-$1.20	
1.02 Custom Baling [2]	$38.51	$25.34	
1.03 Custom Field Moving [3]	$10.13	$6.66	
1.04 Custom Hauling [4]	$2.73	$1.80	
1.05 Repairs & Maintenance	$0.40	$0.26	
1.06 Miscellaneous	$2.50	$1.64	
Sub-total Operating Cost	$52.45	$34.50	
1.07 Interest on Operating	$1.18	$0.78	
Total Operating Costs	**$53.63**	**$35.28**	
B. Fixed Costs			
2.0 Depreciation			
2.01 Storage	$6.67	$4.39	
3.0 Investment			
3.01 Storage	$0.40	$0.26	
Total Fixed Costs	**$7.07**	**$4.65**	
Total Cost of Production	**$60.70**	**$39.93**	

Energy Cost Comparison		**Per Million Btu**	**Per kWh**
Wheat Straw @ $45.92/ton	[5]	$5.15	$0.0176
Wheat Straw cubes@ $85.92/ton	[6]	$9.63	$0.0329
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
MB Hydro @ $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

	Wheat Straw per Ton
Coal-lignite @ $120/ton	$135.66
Wood Pellets @ $250/ton	$220.30
Oats - grain @ $3.25/bu	$181.97
MB Hydro @ $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 $19.45 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, managment and profit margin).
6. Total straw COP + 15% producer markup + $40.00/ton straw cube production cost.

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)

	$/lb	Wheat Straw lbs/ton	Straw Nutrient Value
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	60.0	bu/ac
Straw to Grain Ratio	1.30	S:G
Baled/Harvested Straw	65%	

Custom Rates

Heavy harrow - custom rate ($/acre)	$4.75	$/acre
Average harrow passes per acre	2	passes
Deep tillage - custom rate ($/acre)	$9.10	$/acre
Baling - custom rate ($/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	$0.85	$/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	4.50	%
Investment interest rate	2.25	%

Energy Cost Comparisons

	Cost per unit		Btu per unit		Heat Efficien
Wheat straw - dry basis	$39.93	ton	7,713	lb.	65%
MB Hydro 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	Biomass Cost/Acre	Useful Life	Salvage Value
Storage Investment	$20	3	0%

	Market Value	% Allocated to Biomass	Allocated Biomass
Storage	$12,000	100%	$12,000
Total Capital Investment	$12,000		$12,000

Assumptions

1. Assumed a total of 600 acres of wheat straw biomass.
2. Assumed an average yield of 1.52 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 $12,000 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				**Your Cost**
1.01 Estimated Net Nutrient Value				
Nitrogen		12.5	lbs/ton straw	
		1.00	straw nutrient vaue	
	x	$0.39	cost/lb	
	=	$4.91	$/ton	
P_2O_5		4.1	lbs/ton straw	
		1.00	straw nutrient vaue	
	x	$0.44	cost/lb	
	=	$1.82	$/ton	
K_2O		28	lbs/ton straw	
		0.50	straw nutrient vaue	
	x	$0.272	cost/lb	
	=	$3.81	$/ton	
Sulfur		3	lbs/ton straw	
		1.00	straw nutrient vaue	
	x	$0.43	cost/lb	
	=	$1.06	$/ton	
subtotal	=	$11.60	$/ton estimated nutrient value	
	x	1.52	tons straw per acre	
	=	$17.63	Estimated straw nutrient value per acre	
		$4.75	heavy harrow per acre	
	x	2.0	passes per acre	
		$9.10	deep tillage per acre	
	+	$0.85	straw chopper - diesel fuel per acre	
subtotal	=	$19.45	Estimated residue management per acre	
		$17.63	Estimated straw nutrient value per acre	
	-	$19.45	Estimated residue management per acre	
Total	=	**-$1.82**	**Estimated Net Nutrient Value per Acre**	
Wheat Yield		60.0	bu/acre	
	÷	36.744	bu/tonne	
	=	1.63	tonnes per acre	
	x	1.10	tons per tonne	
	=	1.8	tons grain per acre	
Straw Yield		1.30	straw to grain ratio	

		0.65	baled/harvested straw	
	x	1.80	tons grain per acre	
	=	**1.52**	**tons straw per acre**	
	x	600	acres	
Total	=	**912**	**tons of straw produced**	

1.02 Custom Baling Costs

	1.5	tons straw per acre	
x	2000	lbs/ton	
÷	900	bale weight (lbs)	
x	$11.40	$/bale	
=	**$38.51**	**$ /acre**	

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

	1.5	tons straw per acre	
x	2000	lbs/ton	
÷	900	bale weight (lbs)	
x	$3.00	$/bale	
=	**$10.13**	**$ /acre**	

1.04 Custom Hauling Costs

	5	miles per load	
x	$5.50	$/mile	
=	**$27.50**	**$/load**	
	34	bales/load	
x	900	bale weight (lbs)	
=	**15.3**	**tons/load**	
=	**$1.80**	**$/ton**	
	1.5	tons/acre	
x	$1.80	$/ton	
=	**$2.73**	**$ /acre**	

1.05 Repairs & Maintenance

	2.0%	percentage rate	
x	$20	investment/acre	
=	**$0.40**	**$ /acre**	

***Investment in straw biomass includes storage.**

1.06 Miscellaneous

=	**$2.50**	**$/acre**	

1.07 Interest on operating costs

	$52.45	subtotal operating	
÷	2	average	
x	4.5%	interest rate	
=	**$1.18**	**$/acre**	

Capital Costs

	Market Value	% Allocated to Biomass	Allocated Biomass	
Storage	$12,000	100%	$12,000	
Total Capital Investment	$12,000		$12,000	

B. Fixed Costs

2. Depreciation

2.01 Storage	$12,000	storage investment	
-	$0	salvage value	
÷	3	years useful life	
÷	600	acres	
=	**$6.67**	**$/acre**	

3. Investment

3.01 Storage

	$12,000	storage investment	
+	$0	salvage value	
÷	2	average	
÷	600	acres	
x	4.0%	investment rate	
=	**$0.40**	**$/acre**	

C. Energy Cost Comparison

4.01 Wheat Straw

	7,713	Btu per pound	
x	0.89	dry matter content	
=	6,864.57	Btu per pound (as received)	
x	2,000	Pounds per ton	
=	13,729,140	Total Btu per ton	
x	65%	Heat Efficiency	
=	**8,923,941**	**Net Btu per ton**	
	$39.93	Cost of Production per ton	
x	15%	Producer Margin	
=	$45.92	Cost per ton	
÷	8.9239	Million Btu per ton	
=	**$5.15**	**per Million Btu**	
	8,923,941	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,614.69	kWh per ton	
	$45.92	Cost per ton	
÷	2,614.69	kWh per ton	
=	**$0.0176**	**per kWh**	

4.02 Wheat Straw Cubes

	7,713	Btu per pound	
x	0.89	dry matter content	
=	6,864.57	Btu per pound (as received)	
x	2,000	Pounds per ton	
=	13,729,140	Total Btu per ton	
x	65%	Heat Efficiency	
=	**8,923,941**	**Net Btu per ton**	
	$39.93	Cost of Production per ton	
x	15%	Producer Margin	
+	$40.00	Wheat Straw cube production per ton	
=	$85.92	Cost per ton	
÷	8.9239	Million Btu per ton	
=	**$9.63**	**per Million Btu**	
	8,923,941	Net Btu per ton	

÷	3,413	Btu per kWh	
=	2,614.69	kWh per ton	
	$85.92	Cost per ton	
÷	2,614.69	kWh per ton	
=	**$0.0329**	**per kWh**	

4.03 Coal - Lignite	6,900	Btu per pound	
x	0.88	dry matter content	
=	6,072.00	Btu per pound (as received)	
x	2,000	Pounds per ton	
=	12,144,000	Total Btu per ton	
x	65%	Heat Efficiency	
=	**7,893,600**	**Net Btu per ton**	
	$120.00	Cost per ton	
÷	7.8936	Million Btu per ton	
=	**$15.20**	**per Million Btu**	
	7,893,600	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,312.80	kWh per ton	
	$120.00	Cost per ton	
÷	2,312.80	kWh per ton	
=	**$0.0519**	**per kWh**	

4.04 Wood Pellets	8,200	Btu per pound	
x	0.95	dry matter content	
=	7,790.00	Btu per pound (as received)	
x	2,000	Pounds per ton	
=	15,580,000	Total Btu per ton	
x	65%	Heat Efficiency	
=	**10,127,000**	**Net Btu per ton**	
	$250.00	Cost per ton	
÷	10.1270	Million Btu per ton	
=	**$24.69**	**per Million Btu**	
	10,127,000	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,967.18	kWh per ton	
	$250.00	Cost per ton	
÷	2,967.18	kWh per ton	
=	**$0.0843**	**per kWh**	

4.05 Oats - grain	8,242	Btu per pound	
x	0.88	dry matter content	
=	7,211.75	Btu per pound (as received)	
x	2,000	Pounds per ton	
=	14,423,500	Total Btu per ton	
x	65%	Heat Efficiency	
=	**9,375,275**	**Net Btu per ton**	
	$191.18	Cost per ton	
÷	9.3753	Million Btu per ton	

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

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For more information, contact your local **Manitoba Agriculture GO Office or:**

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For more information

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

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