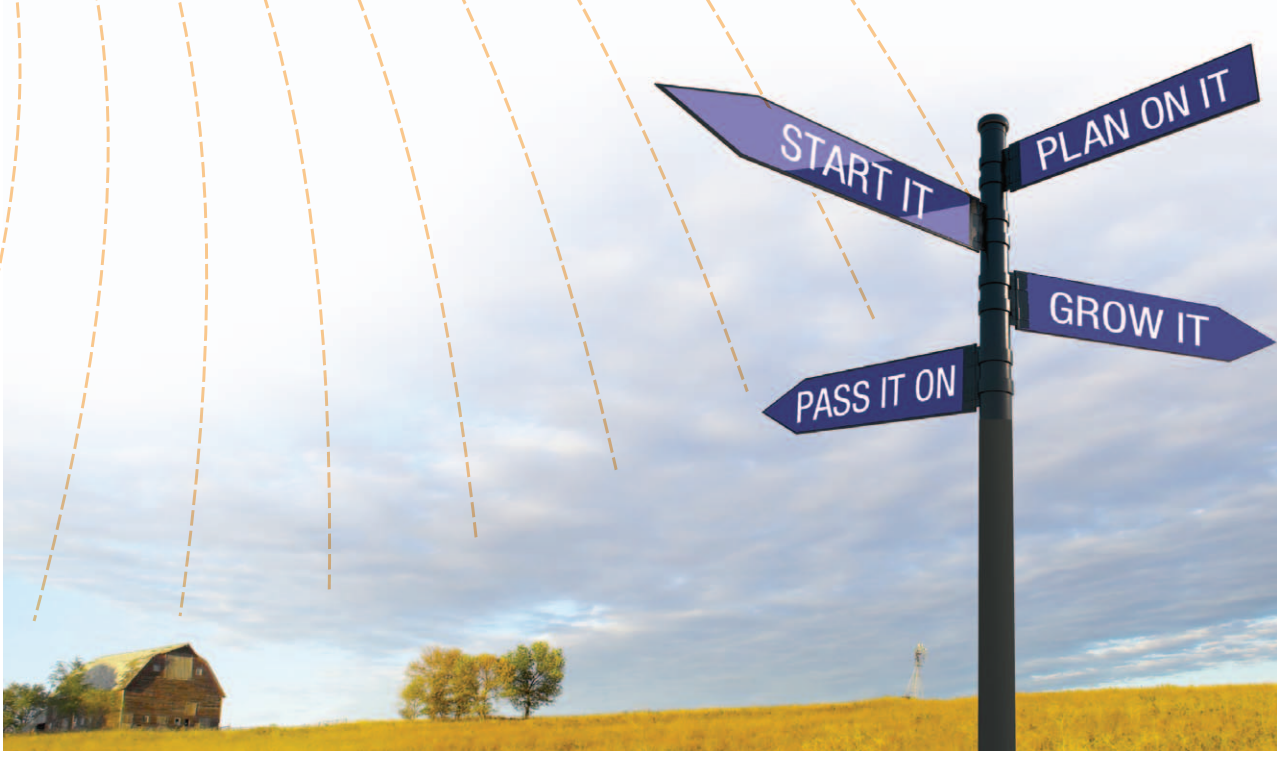
Guidelines for Estimating
Heating Fuels Cost Comparison
2012
in Manitoba



Manitoba

Guidelines for Estimating

Manitoba Heating Fuels Cost Comparison

Date: November, 2012

This guide is designed to provide planning information and a format for calculating and comparing the costs of various Manitoba heating fuels, including biomass. The costs included in this budget were not obtained from a survey of commercial energy providers or producers, nor do they necessarily represent the average heat energy cost 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 available energy types; comparing hearing 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 heat energy 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.

Manitoba Heating Fuels Cost Comparison Summary - November, 2012

Energy Cost Comparison		$ Per Million Btu	$ Per kWh	Your Cost
1.01	Electricity @ $0.0738901/kWh	$21.65	$0.0739	
1.02	Natural Gas - High Efficiency @ $0.3555/m3	$11.77	$0.0402	
1.03	Natural Gas - Low Efficiency @ $0.355/m3	$14.41	$0.0492	
1.04	Coal - lignite @ $100/ton	$12.67	$0.0432	
1.05	# 2 Diesel Fuel Oil @ $0.98/Litre	$37.85	$0.1292	
1.06	Wheat Straw cubes @ $85.33/ton	$9.56	$0.0326	
1.07	Flax Straw cubes @ $79.66/ton	$8.20	$0.0280	
1.08	Switchgrass Biomass cubes @ $120/ton	$13.38	$0.0457	
1.09	Hemp Biomass cubes @ $120/ton	$12.65	$0.0432	
1.10	Willow Biomass @ $85/ton	$10.56	$0.0360	
1.11	Sunflower Hulls @ $100/ton	$11.41	$0.0389	
1.12	Oat Hull Pellets @ $100/ton	$10.81	$0.0369	
1.13	Wood Pellets #1 @ $175/ton	$17.28	$0.0590	
1.14	Recycled Fuel Pucks @ $150/ton	$15.18	$0.0518	
1.15	Wheat HRS (60lb) @ $6.75/bushel	$23.00	$0.0785	
1.16	Oats (34 lb) @ $3.4/bushel	$21.33	$0.0728	
1.17	Barley (48 lb) @ $4.75/bushel	$21.22	$0.0724	
1.18	Corn (56lb) @ $7.25/bushel	$27.73	$0.0946	
1.19	Sunflower Seeds @ $0.2/pound	$27.87	$0.0951	
1.20	Firewood (2100lb/124cft.) @ $150/cord	$25.88	$0.0883	

Breakeven Heating Fuel Values		Based on[1] Coal-lignite @ $100/ton	Based on[2] Electricity @ $0.07389/kWh	Your Cost
2.01	Electricity - $/kWh	$0.0432	n/a	
2.02	Natural Gas - High Efficiency - $/m3	$0.3828	$0.6542	
2.03	Natural Gas - Low Efficiency - $/m3	$0.3121	$0.5333	
2.04	Coal - lignite - $/ton	n/a	$170.89	
2.05	# 2 Diesel Fuel Oil - $/Litre	$0.33	$0.56	
2.06	Wheat Straw cubes - $/ton	$113	$193	
2.07	Flax Straw cubes - $/ton	$123	$210	
2.08	Switchgrass Biomass cubes - $/ton	$114	$194	
2.09	Hemp Biomass cubes - $/ton	$160	$205	
2.10	Willow Biomass - $/ton	$102	$174	
2.11	Sunflower Hulls - $/ton	$111	$190	
2.12	Oat Hull Pellets - $/ton	$117	$200	
2.13	Wood Pellets #1 - $/ton	$128	$219	
2.14	Recycled Fuel Pucks - $/ton	$125	$214	
2.15	Wheat HRS (60lb) - $/bushel	$3.72	$6.35	
2.16	Oats (34 lb) - $/bushel	$2.02	$3.45	
2.17	Barley (48 lb) - $/bushel	$2.84	$4.85	
2.18	Corn (56lb) - $/bushel	$3.31	$5.66	
2.19	Sunflower Seeds - $/pound	$0.091	$0.155	
2.20	Firewood (2100lb/124cft.) - $/cord	$73	$125	

[1]Breakeven heating value $/unit = $ per million Btu lignite coal x million Btu per unit

[2]Breakeven heating value $/unit = $ per kWh electricity x kWh per unit

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Manitoba Heating Fuels Cost Comparison - Equivalent Fuel Price Based on Electricity Cost per kWh

Date: November, 2012

Fuel Type	Btu's	Units	Moisture Content	Heating Efficiency	Equivalent Price of Each Fuel															
Electricity (cents/kWh)	**3,413**	**kWh**	**n/a**	**100%**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**9.5**	**10.0**
Natural Gas - High Efficiency	**32,844**	**m^3**	**n/a**	**92%**	0.18	0.22	0.27	0.31	0.35	0.40	0.44	0.49	0.53	0.58	0.62	0.66	0.71	0.75	0.80	0.84	0.89
Natural Gas - Low Efficiency	**32,844**	**m^3**	**n/a**	**75%**	0.14	0.18	0.22	0.25	0.29	0.32	0.36	0.40	0.43	0.47	0.51	0.54	0.58	0.61	0.65	0.69	0.72
Coal - lignite ($/ton)	**6,900**	**lb.**	**12%**	**65%**	46	58	69	81	93	104	116	127	139	150	162	173	185	197	208	220	231
# 2 Diesel Fuel Oil ($/Litre)	**36,984**	**Litre**	**n/a**	**70%**	0.15	0.19	0.23	0.27	0.30	0.34	0.38	0.42	0.46	0.49	0.53	0.57	0.61	0.64	0.68	0.72	0.76
Wheat Straw cubes ($/ton)	**7,713**	**lb.**	**11%**	**65%**	52	65	78	92	105	118	131	144	157	170	183	196	209	222	235	248	261
Flax Straw cubes ($/ton)	**8,587**	**lb.**	**13%**	**65%**	57	71	85	100	114	114	142	157	171	185	199	213	228	242	256	270	285
Switchgrass Biomass cubes ($/ton)	**7,929**	**lb.**	**13%**	**65%**	53	66	79	92	105	118	131	145	158	171	184	197	210	223	236	250	263
Hemp Biomass cubes ($/ton)	**8,289**	**lb.**	**12%**	**65%**	56	69	83	97	111	125	139	153	167	181	194	208	222	236	250	264	278
Willow Biomass ($/ton)	**7,739**	**lb.**	**20%**	**65%**	47	59	71	83	94	106	118	130	141	153	165	177	189	200	212	224	236
Sunflower Hulls ($/ton)	**7,491**	**lb.**	**10%**	**65%**	51	64	77	90	103	116	128	141	154	167	180	193	205	218	231	244	257
Oat Hull Pellets ($/ton)	**7,732**	**lb.**	**8%**	**65%**	54	68	81	95	108	122	135	149	163	176	190	203	217	230	244	257	271
Wood Pellets #1 ($/ton)	**8,200**	**lb.**	**5%**	**65%**	59	74	89	104	119	134	148	163	178	193	208	223	237	252	267	282	297
Recycled Fuel Pucks ($/ton)	**8,000**	**lb.**	**5%**	**65%**	58	72	87	101	116	130	145	159	174	188	203	217	232	246	261	275	289
Wheat HRS (60lb) ($/bushel)	**8,700**	**lb.**	**14%**	**65%**	1.72	2.15	2.58	3.01	3.44	3.87	4.30	4.73	5.16	5.59	6.02	6.45	6.88	7.31	7.74	8.17	8.60
Oats (34 lb) ($/bushel)	**8,242**	**lb.**	**13%**	**65%**	0.93	1.17	1.40	1.63	1.87	2.10	2.33	2.57	2.80	3.04	3.27	3.50	3.74	3.97	4.20	4.44	4.67
Barley (48 lb) ($/bushel)	**8,200**	**lb.**	**13%**	**65%**	1.31	1.64	1.97	2.30	2.62	2.95	3.28	3.61	3.94	4.26	4.59	4.92	5.25	5.58	5.90	6.23	6.56
Corn (56lb) ($/bushel)	**8,500**	**lb.**	**16%**	**65%**	1.53	1.92	2.30	2.68	3.06	3.45	3.83	4.21	4.60	4.98	5.36	5.75	6.13	6.51	6.89	7.28	7.66
Sunflower Seeds ($/pound)	**12,000**	**lb.**	**8%**	**65%**	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21
Firewood (2100lb/124cft.) ($/cord)	**6,900**	**lb.**	**20%**	**50%**	34	42	51	59	68	76	85	93	102	110	119	127	136	144	153	161	170

How to Use This Chart:

The chart is arranged so the equivalent prices of each fuel (the cost to deliver a given amount of heat based upon a specific heating efficiency) are located in the same column. For example, if the price of # 2 diesel fuel oil is $0.53 per litre, the equivalent cost is 7.0 cents per kWh for electricity, $162 per ton for lignite coal, $183 per ton for wheat straw, or $119 per cord of firewood. A relative cost comparison chart showing heating values for various fuels and biomass types can be helpful in deciding what type of fuel to use. If the actual market value of a given fuel type is less than the equivalent comparative cost, then that fuel will offer potential saving for your heating costs.

Comparative Fuel Cost Equation:

Comparative Cost Fuel A = ((Heat Value Fuel A x (Heating Efficiency Fuel A x (1 - Moisture Content))) / (Heat Value Fuel B x (Heating Efficiency Fuel x (1 - Moisture Content)))) x Cost of Fuel B

2012 Manitoba Residential Energy Rates - electricity $0.0738901/kWh and natural gas $0.3555/m3 (approximate rates including tax)

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Manitoba Heating Fuels Cost Comparison - Equivalent Fuel Price Based on Coal Cost per Ton

Date: November, 2012

Fuel Type	Btu's	Units	Moisture Content	Heating Efficiency	Equivalent Price of Each Fuel																
Coal - lignite ($/ton)	**6,900**	**lb.**	**12%**	**65%**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	**105**	**110**	**115**	**120**	**125**	**130**	**135**	**140**
Electricity ($/kWh)	**3,413**	**kWh**	**n/a**	**100%**	0.026	0.028	0.030	0.032	0.035	0.037	0.039	0.041	0.043	0.045	0.048	0.050	0.052	0.054	0.056	0.058	0.061
Natural Gas - High Efficiency	**32,844**	**m^3**	**n/a**	**92%**	0.23	0.25	0.27	0.29	0.31	0.33	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54
Natural Gas - Low Efficiency	**32,844**	**m^3**	**n/a**	**75%**	0.19	0.20	0.22	0.23	0.25	0.27	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.39	0.41	0.42	0.44
# 2 Diesel Fuel Oil ($/Litre)	**36,984**	**Litre**	**n/a**	**70%**	0.20	0.21	0.23	0.25	0.26	0.28	0.30	0.31	0.33	0.34	0.36	0.38	0.39	0.41	0.43	0.44	0.46
Wheat Straw cubes ($/ton)	**7,713**	**lb.**	**11%**	**65%**	68	73	79	85	90	96	102	107	113	119	124	130	136	141	147	153	158
Flax Straw cubes ($/ton)	**8,587**	**lb.**	**13%**	**65%**	74	80	86	92	98	105	111	117	123	129	135	141	148	154	160	166	172
Switchgrass Biomass cubes ($/ton)	**7,929**	**lb.**	**13%**	**65%**	68	74	80	85	91	97	102	108	114	119	125	131	136	142	148	153	159
Hemp Biomass cubes ($/ton)	**8,289**	**lb.**	**12%**	**65%**	72	78	84	90	96	102	108	114	120	126	132	138	144	150	156	162	168
Willow Biomass ($/ton)	**7,739**	**lb.**	**20%**	**65%**	61	66	71	76	82	87	92	97	102	107	112	117	122	127	133	138	143
Sunflower Hulls ($/ton)	**7,491**	**lb.**	**10%**	**65%**	67	72	78	83	89	94	100	105	111	117	122	128	133	139	144	150	155
Oat Hull Pellets ($/ton)	**7,732**	**lb.**	**8%**	**65%**	70	76	82	88	94	100	105	111	117	123	129	135	141	146	152	158	164
Wood Pellets #1 ($/ton)	**8,200**	**lb.**	**5%**	**65%**	77	83	90	96	103	109	115	122	128	135	141	148	154	160	167	173	180
Recycled Fuel Pucks ($/ton)	**8,000**	**lb.**	**5%**	**65%**	75	81	88	94	100	106	113	119	125	131	138	144	150	156	163	169	175
Wheat HRS (60lb) ($/bushel)	**8,700**	**lb.**	**14%**	**65%**	2.23	2.42	2.60	2.79	2.97	3.16	3.35	3.53	3.72	3.90	4.09	4.28	4.46	4.65	4.83	5.02	5.21
Oats (34 lb) ($/bushel)	**8,242**	**lb.**	**13%**	**65%**	1.21	1.31	1.41	1.51	1.62	1.72	1.82	1.92	2.02	2.12	2.22	2.32	2.42	2.52	2.62	2.73	2.83
Barley (48 lb) ($/bushel)	**8,200**	**lb.**	**13%**	**65%**	1.70	1.84	1.99	2.13	2.27	2.41	2.55	2.69	2.84	2.98	3.12	3.26	3.40	3.54	3.69	3.83	3.97
Corn (56lb) ($/bushel)	**8,500**	**lb.**	**16%**	**65%**	1.99	2.15	2.32	2.48	2.65	2.82	2.98	3.15	3.31	3.48	3.64	3.81	3.97	4.14	4.31	4.47	4.64
Sunflower Seeds ($/pound)	**12,000**	**lb.**	**8%**	**65%**	0.05	0.06	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.10	0.10	0.10	0.11	0.11	0.12	0.12	0.13
Firewood (2100lb/124cft.) ($/cord)	**6,900**	**lb.**	**20%**	**50%**	44	48	51	55	59	62	66	70	73	77	81	84	88	92	95	99	103

How to Use This Chart:

The chart is arranged so the equivalent prices of each fuel (the cost to deliver a given amount of heat based upon a specific heating efficiency) are located in the same column. For example, if the price of # 2 diesel fuel oil is $0.33 per litre, the equivalent cost is $100 per ton for lignite coal, $0.043 per kWh for electricity, $113 per ton for wheat straw, or $73 per cord of firewood. A relative cost comparison chart showing heating values for various fuels and biomass types can be helpful in deciding what type of fuel to use. If the actual market value of a given fuel type is less than the equivalent comparative cost, then that fuel will offer potential saving for your heating costs.

Comparative Fuel Cost Equation:

Comparative Cost Fuel A = ((Heat Value Fuel A x (Heating Efficiency Fuel A x (1 - Moisture Content))) / (Heat Value Fuel B x (Heating Efficiency Fuel x (1 - Moisture Content)))) x Cost of Fuel B

2012 Manitoba Residential Energy Rates - electricity $0.0738901/kWh and natural gas $0.3555/m3 (approximate rates including tax)

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Manitoba Heating Fuels Cost Comparison Input Assumptions

Fuel Type	Cost per Unit		Btu's per Unit		Moisture Content	Heating Efficiency
Electricity	$0.07389	kWh	3,413	kWh	n/a	100%
Natural Gas - High Efficiency	$0.356	m^3	32,844	m^3	n/a	92%
Natural Gas - Low Efficiency	$0.355	m^3	32,844	m^3	n/a	75%
Coal - lignite	$100	ton	6,900	lb.	12%	65%
# 2 Diesel Fuel Oil	$0.98	Litre	36,984	Litre	n/a	70%
Wheat Straw cubes	$85.33	ton	7,713	lb.	11%	65%
Flax Straw cubes	$79.66	ton	8,587	lb.	13%	65%
Switchgrass Biomass cubes	$120.00	ton	7,929	lb.	13%	65%
Hemp Biomass cubes	$120.00	ton	8,289	lb.	12%	65%
Willow Biomass	$85	ton	7,739	lb.	20%	65%
Sunflower Hulls	$100	ton	7,491	lb.	10%	65%
Oat Hull Pellets	$100	ton	7,732	lb.	8%	65%
Wood Pellets #1	$175	ton	8,200	lb.	5%	65%
Recycled Fuel Pucks	$150	ton	8,000	lb.	5%	65%
Wheat HRS (60lb)	$6.75	bushel	8,700	lb.	13.5%	65%
Oats (34 lb)	$3.40	bushel	8,242	lb.	12.5%	65%
Barley (48 lb)	$4.75	bushel	8,200	lb.	12.5%	65%
Corn (56lb)	$7.25	bushel	8,500	lb.	15.5%	65%
Sunflower Seeds	$0.20	pound	12,000	lb.	8%	65%
Firewood (2100lb/124cft.)	$150	cord	6,900	lb.	20%	50%

Assumptions:

1. Cost per ton includes $40 per ton for biomass cube production costs for wheat straw, flax straw, switchgrass biomass,

Assumptions

1. The cost comparisons are based on the unit costs, energy contents, moisture contents and heating efficiency listed on the input page.

Heating Fuel Cost Comparison Worksheet

A. Energy Cost Comparison				Your Cost
1.01 Electricity		$0.0739	per kWh	
	x	1.00	Million Btu	
	÷	3,413	Btu per kWh	
	=	**$21.65**	**per Million Btu**	
1.02 Natural Gas - High Efficiency		32,844	Btu per cubic meter	
	x	92%	Heat Efficiency	
	=	**30,216**	**Net Btu per cubic meter**	
		$0.356	Cost per cubic meter	
	x	1.00	Million Btu	
	÷	30,216	Net Btu per cubic meter	
	=	**$11.77**	**per Million Btu**	
		30,216	Net Btu per cubic meter	
	÷	3,413	Btu per kWh	
	=	8.85	kWh per cubic meter	
		$0.356	Cost per cubic meter	
	÷	8.85	kWh per cubic meter	
	=	**$0.0402**	**per kWh**	
1.03 Natural Gas - Low Efficiency		32,844	Btu per cubic meter	
	x	75%	Heat Efficiency	
	=	**24,633**	**Net Btu per cubic meter**	
		$0.355	Cost per cubic meter	
	x	1.00	Million Btu	
	÷	24,633	Net Btu per cubic meter	
	=	**$14.41**	**per Million Btu**	
		24,633	Net Btu per cubic meter	
	÷	3,413	Btu per kWh	
	=	7.22	kWh per cubic meter	
		$0.355	Cost per cubic meter	
	÷	7.22	kWh per cubic meter	
	=	**$0.0492**	**per kWh**	
1.04 Coal - lignite		6,900	Btu per kWh	
	x	0.8800	dry matter content	
	=	6,072.00	Btu per pound (dry matter)	
	x	2,000	Pounds per ton	
	=	12,144,000	Total Btu per ton	
	x	65%	Heat Efficiency	
	=	**7,893,600**	**Net Btu per ton**	
		$100.00	Cost per ton	
	÷	7.8936	Million Btu per ton	
	=	**$12.67**	**per Million Btu**	
		7,893,600	Net Btu per ton	
	÷	3,413	Btu per kWh	
	=	2,312.80	kWh per ton	
		$100.00	Cost per ton	
	÷	2,312.80	kWh per ton	
	=	**$0.0432**	**per kWh**	
1.05 # 2 Diesel Fuel Oil		36,984	Btu per litre	
	x	70%	Heat Efficiency	
	=	**25,889**	**Net Btu per litre**	
		$0.980	Cost per litre	
	x	1.00	Million Btu	
	÷	25,889	Net Btu per litre	
	=	**$37.85**	**per Million Btu**	
		25,889	Net Btu per litre	
	÷	3,413	Btu per kWh	
	=	7.59	kWh per litre	
		$0.980	Cost per litre	
	÷	7.59	kWh per litre	
	=	**$0.1292**	**per kWh**	
1.06 Wheat Straw cubes		7,713	Btu per pound	
	x	0.8900	dry matter content	
	=	6,864.57	Btu per pound (dry matter basis)	
	x	2,000	Pounds per ton	
	=	13,729,140	Total Btu per ton	
	x	65%	Heat Efficiency	

=	**8,923,941**	**Net Btu per ton**	
	$85.33	Cost per ton	
÷	8.9239	Million Btu per ton	
=	**$9.56**	**per Million Btu**	
	8,923,941	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,614.69	kWh per ton	
	$85.33	Cost per ton	
÷	2,614.69	kWh per ton	
=	**$0.0326**	**per kWh**	
1.07 Flax Straw cubes	8,587	Btu per pound	
x	0.8700	dry matter content	
=	7,470.69	Btu per pound (dry matter basis)	
x	2,000	Pounds per ton	
=	14,941,380	Total Btu per ton	
x	65%	Heat Efficiency	
=	**9,711,897**	**Net Btu per ton**	
	$79.66	Cost per ton	
÷	9.7119	Million Btu per ton	
=	**$8.20**	**per Million Btu**	
	9,711,897	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,845.56	kWh per ton	
	$79.66	Cost per ton	
÷	2,845.56	kWh per ton	
=	**$0.0280**	**per kWh**	
1.08 Switchgrass Biomass cubes	7,929	Btu per pound	
x	0.8700	dry matter content	
=	6,898.23	Btu per pound (dry matter basis)	
x	2,000	Pounds per ton	
=	13,796,460	Total Btu per ton	
x	65%	Heat Efficiency	
=	**8,967,699**	**Net Btu per ton**	
	$120.00	Cost per ton	
÷	8.9677	Million Btu per ton	
=	**$13.38**	**per Million Btu**	
	8,967,699	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,627.51	kWh per ton	
	$120.00	Cost per ton	
÷	2,627.51	kWh per ton	
=	**$0.0457**	**per kWh**	
1.09 Hemp Biomass cubes	8,289	Btu per pound	
x	0.8800	dry matter content	
=	7,294.32	Btu per pound (dry matter basis)	
x	2,000	Pounds per ton	
=	14,588,640	Total Btu per ton	
x	65%	Heat Efficiency	
=	**9,482,616**	**Net Btu per ton**	
	$120.00	Cost per ton	
÷	9.4826	Million Btu per ton	
=	**$12.65**	**per Million Btu**	
	9,482,616	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,778.38	kWh per ton	
	$120.00	Cost per ton	
÷	2,778.38	kWh per ton	
=	**$0.0432**	**per kWh**	
1.10 Willow Biomass	7,739	Btu per pound	
x	0.8000	dry matter content	
=	6,191.20	Btu per pound (dry matter basis)	
x	2,000	Pounds per ton	
=	12,382,400	Total Btu per ton	
x	65%	Heat Efficiency	
=	**8,048,560**	**Net Btu per ton**	
	$85.00	Cost per ton	
÷	8.0486	Million Btu per ton	
=	**$10.56**	**per Million Btu**	
	8,048,560	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,358.21	kWh per ton	
	$85.00	Cost per ton	
÷	2,358.21	kWh per ton	
=	**$0.0360**	**per kWh**	

1.11 Sunflower Hulls		7,491	Btu per pound	
	x	0.9000	dry matter content	
	=	6,741.90	Btu per pound (dry matter basis)	
	x	2,000	Pounds per ton	
	=	13,483,800	Total Btu per ton	
	x	65%	Heat Efficiency	
	=	**8,764,470**	**Net Btu per ton**	
		$100.00	Cost per ton	
	÷	8.7645	Million Btu per ton	
	=	**$11.41**	**per Million Btu**	
		8,764,470	Net Btu per ton	
	÷	3,413	Btu per kWh	
	=	2,567.97	kWh per ton	
		$100.00	Cost per ton	
	÷	2,567.97	kWh per ton	
	=	**$0.0389**	**per kWh**	
1.12 Oat Hull Pellets		7,732	Btu per pound	
	x	0.9200	dry matter content	
	=	7,113.44	Btu per pound (dry matter basis)	
	x	2,000	Pounds per ton	
	=	14,226,880	Total Btu per ton	
	x	65%	Heat Efficiency	
	=	**9,247,472**	**Net Btu per ton**	
		$100.00	Cost per ton	
	÷	9.2475	Million Btu per ton	
	=	**$10.81**	**per Million Btu**	
		9,247,472	Net Btu per ton	
	÷	3,413	Btu per kWh	
	=	2,709.48	kWh per ton	
		$100.00	Cost per ton	
	÷	2,709.48	kWh per ton	
	=	**$0.0369**	**per kWh**	
1.13 Wood Pellets #1		8,200	Btu per pound	
	x	0.9500	dry matter content	
	=	7,790.00	Btu per pound (dry matter basis)	
	x	2,000	Pounds per ton	
	=	15,580,000	Total Btu per ton	
	x	65%	Heat Efficiency	
	=	**10,127,000**	**Net Btu per ton**	
		$175.00	Cost per ton	
	÷	10.1270	Million Btu per ton	
	=	**$17.28**	**per Million Btu**	
		10,127,000	Net Btu per ton	
	÷	3,413	Btu per kWh	
	=	2,967.18	kWh per ton	
		$175.00	Cost per ton	
	÷	2,967.18	kWh per ton	
	=	**$0.0590**	**per kWh**	
1.14 Recycled Fuel Pucks		8,000	Btu per pound	
	x	0.9500	dry matter content	
	=	7,600.00	Btu per pound (dry matter basis)	
	x	2,000	Pounds per ton	
	=	15,200,000	Total Btu per ton	
	x	65%	Heat Efficiency	
	=	**9,880,000**	**Net Btu per ton**	
		$150.00	Cost per ton	
	÷	9.8800	Million Btu per ton	
	=	**$15.18**	**per Million Btu**	
		9,880,000	Net Btu per ton	
	÷	3,413	Btu per kWh	
	=	2,894.81	kWh per ton	
		$150.00	Cost per ton	
	÷	2,894.81	kWh per ton	
	=	**$0.0518**	**per kWh**	
1.15 Wheat HRS (60lb)		8,700	Btu per pound	
	x	0.8650	dry matter content	
	=	7,525.50	Btu per pound (dry matter basis)	
	x	2,000	Pounds per ton	
	=	15,051,000	Total Btu per ton	
	x	65%	Heat Efficiency	
	=	**9,783,150**	**Net Btu per ton**	
		$225.00	Cost per ton	
	÷	9.7832	Million Btu per ton	
	=	**$23.00**	**per Million Btu**	

	9,783,150	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,866.44	kWh per ton	
	$225.00	Cost per ton	
÷	2,866.44	kWh per ton	
=	**$0.0785**	**per kWh**	

1.16 Oats (34 lb)

	8,242	Btu per pound	
x	0.8750	dry matter content	
=	7,211.75	Btu per pound (dry matter basis)	
x	2,000	Pounds per ton	
=	14,423,500	Total Btu per ton	
x	65%	Heat Efficiency	
=	**9,375,275**	**Net Btu per ton**	
	$200.00	Cost per ton	
÷	9.3753	Million Btu per ton	
=	**$21.33**	**per Million Btu**	
	9,375,275	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,746.93	kWh per ton	
	$200.00	Cost per ton	
÷	2,746.93	kWh per ton	
=	**$0.0728**	**per kWh**	

1.17 Barley (48 lb)

	8,200	Btu per pound	
x	0.8750	dry matter content	
=	7,175.00	Btu per pound (dry matter basis)	
x	2,000	Pounds per ton	
=	14,350,000	Total Btu per ton	
x	65%	Heat Efficiency	
=	**9,327,500**	**Net Btu per ton**	
	$197.92	Cost per ton	
÷	9.3275	Million Btu per ton	
=	**$21.22**	**per Million Btu**	
	9,327,500	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,732.93	kWh per ton	
	$197.92	Cost per ton	
÷	2,732.93	kWh per ton	
=	**$0.0724**	**per kWh**	

1.18 Corn (56lb)

	8,500	Btu per pound	
x	0.8450	dry matter content	
=	7,182.50	Btu per pound (dry matter basis)	
x	2,000	Pounds per ton	
=	14,365,000	Total Btu per ton	
x	65%	Heat Efficiency	
=	**9,337,250**	**Net Btu per ton**	
	$258.93	Cost per ton	
÷	9.3373	Million Btu per ton	
=	**$27.73**	**per Million Btu**	
	9,337,250	Net Btu per ton	
÷	3,413	Btu per kWh	
=	2,735.79	kWh per ton	
	$258.93	Cost per ton	
÷	2,735.79	kWh per ton	
=	**$0.0946**	**per kWh**	

1.19 Sunflower Seeds

	12,000	Btu per pound	
x	0.9200	dry matter content	
=	11,040.00	Btu per pound (dry matter basis)	
x	2,000	Pounds per ton	
=	22,080,000	Total Btu per ton	
x	65%	Heat Efficiency	
=	**14,352,000**	**Net Btu per ton**	
	$400.00	Cost per ton	
÷	14.3520	Million Btu per ton	
=	**$27.87**	**per Million Btu**	
	14,352,000	Net Btu per ton	
÷	3,413	Btu per kWh	
=	4,205.10	kWh per ton	
	$400.00	Cost per ton	
÷	4,205.10	kWh per ton	
=	**$0.0951**	**per kWh**	

1.20 Firewood (2100lb/124cft.)

	6,900	Btu per pound	
x	0.8000	dry matter content	
=	5,520.00	Btu per pound (dry matter basis)	
x	2,000	Pounds per ton	
=	11,040,000	Total Btu per ton	

	x	50%	Heat Efficiency	
	=	**5,520,000**	**Net Btu per ton**	
		$142.86	Cost per ton	
	÷	5.5200	Million Btu per ton	
	=	**$25.88**	**per Million Btu**	
		5,520,000	Net Btu per ton	
	÷	3,413	Btu per kWh	
	=	1,617.35	kWh per ton	
		$142.86	Cost per ton	
	÷	1,617.35	kWh per ton	
	=	**$0.0883**	**per kWh**	
2.01 Electricity		$12.6685	per Million Btu (coal lignite)	
	x	3,413	Btu per kWh	
	÷	1.00	Million Btu	
	=	**$0.0432**	**Breakeven cost per kWh**	
2.02 Natural Gas - High Efficiency		$12.6685	per Million Btu (coal lignite)	
	x	30,216	Net Btu per cubic meter	
	÷	1.00	Million Btu	
	=	**$0.3828**	**Breakeven cost per cubic meter**	
		$0.0739	per kWh (electricty)	
	x	8.85	kWh per cubic meter	
	=	**$0.6542**	**Breakeven cost per cubic meter**	
2.03 Natural Gas - Low Efficiency		$12.6685	per Million Btu (coal lignite)	
	x	24,633	Net Btu per cubic meter	
	÷	1.00	Million Btu	
	=	**$0.3121**	**Breakeven cost per cubic meter**	
		$0.0739	per kWh (electricty)	
	x	7.22	kWh per cubic meter	
	=	**$0.5333**	**Breakeven cost per cubic meter**	
2.04 Coal - lignite		$0.0739	per kWh (electricty)	
	x	2,312.80	kWh per ton	
	=	**$170.89**	**Breakeven cost per ton**	
2.05 # 2 Diesel Fuel Oil		$12.6685	per Million Btu (coal lignite)	
	x	25,889	Net Btu per litre	
	÷	1.00	Million Btu	
	=	**$0.3280**	**Breakeven cost per litre**	
		$0.0739	per kWh (electricty)	
	x	7.59	kWh per litre	
	=	**$0.5605**	**Breakeven cost per litre**	
2.06 Wheat Straw cubes		$12.6685	per Million Btu (coal lignite)	
	x	8.9239	Million Btu per ton	
	=	**$113.05**	**Breakeven cost per ton**	
		$0.0739	per kWh (electricty)	
	x	2,614.69	kWh per ton	
	=	**$193.20**	**Breakeven cost per ton**	
2.07 Flax Straw cubes		$12.6685	per Million Btu (coal lignite)	
	x	9.7119	Million Btu per ton	
	=	**$123.04**	**Breakeven cost per ton**	
		$0.0739	per kWh (electricty)	
	x	2,845.56	kWh per ton	
	=	**$210.26**	**Breakeven cost per ton**	
2.08 Switchgrass Biomass cubes		$12.6685	per Million Btu (coal lignite)	
	x	8.9677	Million Btu per ton	
	=	**$113.61**	**Breakeven cost per ton**	
		$0.0739	per kWh (electricty)	
	x	2,627.51	kWh per ton	
	=	**$194.15**	**Breakeven cost per ton**	
2.09 Hemp Biomass cubes		$12.6685	per Million Btu (coal lignite)	
	x	12.6547	Million Btu per ton	
	=	**$160.32**	**Breakeven cost per ton**	
		$0.0739	per kWh (electricty)	
	x	2,778.38	kWh per ton	
	=	**$205.29**	**Breakeven cost per ton**	
2.10 Willow Biomass		$12.6685	per Million Btu (coal lignite)	
	x	8.0486	Million Btu per ton	
	=	**$101.96**	**Breakeven cost per ton**	
		$0.0739	per kWh (electricty)	
	x	2,358.21	kWh per ton	
	=	**$174.25**	**Breakeven cost per ton**	
2.11 Sunflower Hulls		$12.6685	per Million Btu (coal lignite)	
	x	8.7645	Million Btu per ton	

	=	**$111.03**	**Breakeven cost per ton**	
		$0.0739	per kWh (electricty)	
	x	2,567.97	kWh per ton	
	=	**$189.75**	**Breakeven cost per ton**	
2.12 Oat Hull Pellets		$12.6685	per Million Btu (coal lignite)	
	x	9.2475	Million Btu per ton	
	=	**$117.15**	**Breakeven cost per ton**	
		$0.0739	per kWh (electricty)	
	x	2,709.48	kWh per ton	
	=	**$200.20**	**Breakeven cost per ton**	
2.13 Wood Pellets #1		$12.6685	per Million Btu (coal lignite)	
	x	10.1270	Million Btu per ton	
	=	**$128.29**	**Breakeven cost per ton**	
		$0.0739	per kWh (electricty)	
	x	2,967.18	kWh per ton	
	=	**$219.25**	**Breakeven cost per ton**	
2.14 Recycled Fuel Pucks		$12.6685	per Million Btu (coal lignite)	
	x	9.8800	Million Btu per ton	
	=	**$125.16**	**Breakeven cost per ton**	
		$0.0739	per kWh (electricty)	
	x	2,894.81	kWh per ton	
	=	**$213.90**	**Breakeven cost per ton**	
2.15 Wheat HRS (60lb)		$12.6685	per Million Btu (coal lignite)	
	x	9.7832	Million Btu per ton	
	=	**$3.72**	**Breakeven cost per bushel**	
		$0.0739	per kWh (electricty)	
	x	2,866.44	kWh per ton	
	=	**$6.35**	**Breakeven cost per bushel**	
2.16 Oats (34 lb)		$12.6685	per Million Btu (coal lignite)	
	x	9.3753	Million Btu per ton	
	=	**$2.02**	**Breakeven cost per bushel**	
		$0.0739	per kWh (electricty)	
	x	2,746.93	kWh per ton	
	=	**$3.45**	**Breakeven cost per bushel**	
2.17 Barley (48 lb)		$12.6685	per Million Btu (coal lignite)	
	x	9.3275	Million Btu per ton	
	=	**$2.84**	**Breakeven cost per bushel**	
		$0.0739	per kWh (electricty)	
	x	2,732.93	kWh per ton	
	=	**$4.85**	**Breakeven cost per bushel**	
2.18 Corn (56lb)		$12.6685	per Million Btu (coal lignite)	
	x	9.3373	Million Btu per ton	
	=	**$3.31**	**Breakeven cost per bushel**	
		$0.0739	per kWh (electricty)	
	x	2,735.79	kWh per ton	
	=	**$5.66**	**Breakeven cost per bushel**	
2.19 Sunflower Seeds		$12.6685	per Million Btu (coal lignite)	
	x	14.3520	Million Btu per ton	
	=	**$0.0909**	**Breakeven cost per pound**	
		$0.0739	per kWh (electricty)	
	x	4,205.10	kWh per ton	
	=	**$0.1554**	**Breakeven cost per pound**	
2.20 Firewood (2100lb/124cft.)		$12.6685	per Million Btu (coal lignite)	
	x	5.5200	Million Btu per ton	
	=	**$73.4266**	**Breakeven cost per cord**	
		$0.0739	per kWh (electricty)	
	x	1,617.35	kWh per ton	
	=	**$125.4811**	**Breakeven cost per cord**	

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**.

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