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Minnesota Crop Cost & Return Guide for 2011

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The report provides enterprise budgets with detailed estimates of the costs and returns expected for traditional food and feed crops (corn grain, soybeans, spring wheat, sugar beets, and alfalfa hay) as well as potential energy crops (grassland crops, hybrid poplar trees, willow trees, and corn stover) in Minnesota. Data sources for the cost and return estimates are described below.

Food and Feed Crops

Yields for the food and feed crop crops are NASS yields averaged over the most recent five years for which data was available, 2006-10 except for wheat which was 2005-09. Crop prices are based on futures prices for 2011 harvest-time futures contracts (Table 1). Government payments are based on 2010 payment rates with base yield assumed to be the same as the budget yield. The corn fertilization rates consider credits from a previous soybean crop.

Land rent, crop insurance, and miscellaneous expenses for corn, soybeans, wheat, and alfalfa are from 2009 FINBIN county crop enterprise cost and return data collected under the MnSCU Farm Business Management Program and the Southwestern Minnesota Farm Business Farm Management Association. One year's inflation was added to those 2009 averages using the Bureau of Labor Statistics producer price index and the USDA-NASS index of prices paid by farmers.

Labor hours and total labor costs are also from FINBIN county summaries. The FINBIN labor hours and cost are based on an allocation of total farm labor disappearance and usually exceed direct machinery operation labor. The difference is likely to be time spent in planning, crop marketing, and maintenance that may not be directly related to a particular crop and so this extra labor is treated as a fixed cost in the budgets.

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Seeding rates and chemical applications are based on University of Minnesota Extension recommendations and/or judgments of Extension staff about typical producer practices in Minnesota. Fertilizer rates are based on Extension recommendations, average P and K soil test levels from a commercial laboratory, and FINBIN per-acre average fertilizer expenses.

The corn and soybean seed prices are thought to be typical of a biotech hybrid, but the corn variety would not be rootworm resistant. Wheat seed prices are assumed to be $5/bushel over the market price for wheat. Seeding rates per acre are corn - 34,000 kernels, soybeans - one bushel, and wheat - 113 pounds. Fertilizer prices are based on fall 2010 industry estimates. Nitrogen prices are based on anhydrous ammonia (NH_3) for the annual crops (corn and sugar beets) where the NH_3 can be applied during a tillage operation. For the grassland, poplar, and willow crops that are not tilled at the time of fertilizer application, urea is assumed to be the nitrogen source. P_2O_5 prices are based on an 18-46-0 price with the N priced as NH_3. K_2O prices are based on 0-0-60. Chemical prices are estimated retail prices from a variety of sources.

Machinery costs reflect new equipment, and are based on the Machinery Cost Estimates extension publication dated July, 2010. The farm diesel fuel price is $2.80/gallon. Fertilizer and chemicals are assumed to be custom-applied.

One intended use for the budgets is in carbon footprint studies of renewable energy production, so energy consumption and greenhouse gas emission estimates are also provided in addition to economic cost and return calculations. The energy and greenhouse gas estimates draw on factors from the GREET model [Wang]. Energy use and emissions totals were based on the production of fertilizers and crop chemicals, production and burning of fuel in transportation and farm machine operations, and production of farm machinery. Energy consumption and greenhouse gas emissions for corn drying are not identified in GREET, so these were estimated by assuming that half of the FINBIN drying cost is for fuel and electricity and the other half is for ownership costs of the dryer and for labor. The fuel and electricity costs were converted to BTUs and CO2-equivalent emissions assuming that half of the corn is dried using propane and half with natural gas, and with fuel and electricity requirements from Wilcke [Wilcke, 2004].

Alfalfa Budgets

The alfalfa budgets are assumed to follow a four year lifecycle with an establishment year followed by three years of mature stand. Budgets were done both for alfalfa direct seeded with an establishment-year yield half as large as the mature stand, and seeded with an oats cover crop assumed to provide two tons of oatlage in the establishment year.

Energy Crops

Two grassland energy crop scenarios were developed: a higher-fertilization, higher-yield monoculture scenario with an expected ten-year stand life that might be typical of switchgrass but could be any of several other species; and a lower-fertilization, lower-yield scenario with a diverse species mix with an expected twenty-year stand life. The high-fertilization scenario is labeled as “switchgrass” and the low-

fertilization scenario as “prairie” in some of the tables to save space. Budgets were also developed for two short-rotation woody crops: hybrid poplar and willow.

The high-fertilization grassland budget is based mainly on recent data from demonstration plots in Nebraska and the Dakotas, and University of Minnesota agronomists [Sheaffer, 2008; Perrin et al., 2008a; Perrin et al., 2008b]. The report assumes a 10 year stand life, consisting of 4 budget stages: A planting year 1 with no harvest, a maintenance year 2 with a two-ton dry matter yield, and harvest years 3-10 with four ton yields. A seeding rate of seven pounds per acre is used at a cost of $3.50/lb based on a price quoted by a Minnesota native grass seed producer in October, 2008. Fertilization rates are based on University of Minnesota recommendations for pasture land.

The low-fertilization grassland budget is similar to the high-fertilization one, but seeded with a more diverse species mix of grasses, lower yield and fertilization rates, and a longer 20 year stand life. The stand life consists of a planting year 1 with no harvest, followed by three maintenance years with no yield in year 2, a one ton dry matter yield in year 3, and one and a half tons in year 4; followed by 16 years of a mature stand yielding 2 tons per year. A seeding rate of 8.5 pounds per acre at a cost of $8.24/lb is based on a 15-species mix recommended for Conservation Reserve Program land in Minnesota. Fertilization rates are based on University of Minnesota recommendations for pasture land.

Hybrid poplar is the only one of the energy crops discussed here that is already grown in significant acreages in Minnesota, with roughly 30,000 acres at present [Schmidt, 2010; Schmidt, 2006]. Most of those acres are under control by a commercial paper company, so the cultural practices such as spacing and harvest age may not necessarily be the same as would be used if the crop were to be grown for energy. The poplar budget presented here, along with the willow budget, are based mainly on a limited amount of data from the Southern Research and Outreach Center at Waseca, on soil preparation, harvest, and transportation costs from willow trials in New York State, and from information from Dr. Bill Berguson at the University of Minnesota-Duluth [Berguson, 2007; Johnson, 2010; Buchholz et al., 2010]. The Waseca plantings were harvested for the first time in the fall of 2009.

The hybrid poplar crop consists of an 18-year lifecycle including two harvests. Soil preparation takes place in year 1 with vegetation removal and a contact herbicide. That is followed by light tillage, then planting of 681 seedlings per acre on an 8’ x 8’ spacing in year 2. That is followed by maintenance in year 3 that includes an additional 136 seedlings to replace ones from the previous year that did not overwinter. Seedlings are assumed to cost $0.15 each. Maintenance continues for years 4-8, and then is followed by the first harvest in year 9. Maintenance continues in years 10-16 as the trees grow back from the stumps. The second harvest occurs in year 17. Maintenance operations by year are:

Year 3 - Spray, cultivate between the rows, and mow weeds
Year 4 - Cultivate and mow weeds
Year 5 - Fertilize and mow weeds
Year 6 - Nothing
Year 7 - Fertilize
Year 8 - Mow weeds

A yield of 32 tons per acre *per harvest* is assumed, which is equivalent to an annual yield increment of 4 tons. The harvest is assumed to be done with a timber harvesting feller-buncher and skidder. In year 18 the stumps are removed.

The willow growth pattern is a large number of small stems rather than poplar's single, larger stem. The willow is assumed to be planted in twin rows spaced 2.5 feet apart, with 5 feet between each pair of twin rows. Several other harvesting systems are available or under development for the willow and poplar in addition to the feller-buncher and skidder. Given the larger number of stems that are smaller in diameter, demonstrations in New York and Waseca show that willow can be harvested with either a modified forage harvester adapted from a unit originally designed for corn and hay crop silage, or a "biobaler" which is a beefed-up round baler with the pickup unit replaced by a rotating shaft equipped with blades. The willow budget here assumes that the harvests are done with the forage harvester travelling at 4 miles/hour.

The demonstration plot at Waseca includes hybrid poplar planted in twin rows similar to the willow arrangement. A 2009 demonstration at Waseca showed that the forage harvester would also harvest the twin-row poplar if done while the trees are small enough, but the speed would probably need to be reduced because the poplar stems are larger.

The twin-row arrangement requires more seedlings than the 8' x 8' poplar spacing mentioned above – 6,200 per acre for willow or 4,670 for poplar. An alternative poplar budget was developed for the twin row arrangement, but appeared to be less profitable than the widely-spaced arrangement so is not included in the tables.

After a soil preparation year and a planting year, the willow is harvested either six times on a four-year cycle or seven times on a three-year cycle, starting in year 4. The three-year cycle implies a stand life of 24 years including a final year for removal of the stock (roots). The four-year cycle would put the stand life at 27 years. The budget included here assumes the four-year cycle, which has a slightly lower harvest cost when averaged over the stand life because the harvester covers the field less frequently.

The willow is expected to produce a slightly higher average yield than poplar. Based on the New York data, an annual yield increment of 5 tons per acre is assumed, but 8 percent of the land is in headlands where the harvesting equipment turns, so that only the remaining 92 percent of the land is harvested. With a harvest every 3 years, the yield per acre per harvest is (5 tons * 3 years) or 15 tons x 92% harvested, or 13.8 tons per acre per harvest. No maintenance is assumed for the willow between planting and harvest.

The corn budgets with stover removal assume that the stover is shredded, raked and baled. A yield of two tons per acre of stover is assumed in the report. Additional fertilizer is required on the field when the stover is collected, with the nitrogen amounts based on Wu et al. and the phosphorus and potassium amounts based on Iowa State recommendations [Wu et al., 2006; Sawyer et al., 2002]. The budget comparison table shows the incremental costs that the stover harvest adds to the corn enterprise.

Land rents for energy crops were assumed to be less than for traditional crops as energy crops may be grown on more marginal lands that may not be suitable for traditional crops. A $40/acre land rental rate for energy crops is used, based on the FINBIN average rent for intensive pasture. Nitrogen fertilizer prices for energy crops and alfalfa are based on urea nitrogen fertilizer.

All energy crops were assumed to be sold at $70/ton dry matter. That choice of a price is necessarily arbitrary, given the lack of commercial processing facilities at present and the uncertainty about the market. That price covers costs for corn stover and willow, while the grass crops and hybrid poplar would show losses.

Crop Transportation Costs

The energy crop production costs are intended to include delivery to the final processing plant, so transportation costs and storage losses are considered. The crops are assumed to be stored temporarily at field edge, and then transported by semi to final processing. The 25-mile one-way hauling distance, 50 miles-per-hour speed, and the assumptions for transporting wood chips are from the New York Eco-willow spreadsheet [Buchholz et al., 2010].

Load size is a critical variable, but is highly speculative at this point given that large-volume biomass logistics systems are still under development. The maximum load size may be constrained by either weight or volume, depending on the density of the material. The maximum load weight will vary depending on the design and weight of the trailer, and is assumed here to be 26 tons, from Fruin and Fortowsky [Fruin and Fortowsky, 2004]. The Eco-willow willow spreadsheet assumes a maximum load volume of 3,800 cubic feet for wood chips. By comparison, an 900-bushel grain truck would be 1,125 cubic feet. Eco-willow gives the wood chip density as 17 pounds/cubic foot. Density of round bales is around 8-10 pounds/cubic foot depending on crop conditions and baler design [Woodford, 2007]. Rectangular bales are generally denser within the bale itself, plus the bale shape results in less wasted space between the bales on the truck. Research in Virginia was the basis for estimates of 12.5 tons/load of round bales, and 21 tons/load of rectangular bales [Cundiff, 2010]. If the 8 pounds/foot is accurate for round bales, the round bale load weight implies a load volume of 3,125 cubic feet, which is less than the Eco-willow estimate of 3,800 cubic feet. Cundiff's 21-ton estimate for rectangular bales implies a density of 13 pounds/cubic feet at a 3,125 cubic-foot load.

Loading and unloading time for the bale systems assumed to be 53 minutes, from Tiffany et al., with 20 minutes for wood chips from Eco-willow [Tiffany et al., 2006; Buchholz et al., 2010]. The $0.50-mile non-fuel truck cost is from the New York data. Tiffany reports a truck fuel consumption rate of 8 miles per gallon compared with 7 miles per gallon in the New York data. That difference may be due to various factors, but for the purpose of this analysis is assumed to be due to the 5-ton heavier load so 7 miles per gallon is used for the woody crops.

Key assumptions for the transportation from temporary storage to final processing are then:

- one-way distance 25 miles,
- speed 50 miles/hour,

- loading and unloading time 53 minutes for bales, 20 minutes/load for wood chips and grain
- fuel consumption 7 miles/gallon,
- driver labor cost $20/hour,
- diesel fuel price for on-road use $3.30/gallon
- semi costs other than fuel and labor – 50 cents/mile for the energy crops, 85 cents/mile for grain

- load sizes as follows:

Material	Form	Density	Weight/Load	Volume/Load
		lbs./ft3	tons	ft3
Corn stover and grass crops	Round bales	9	12.5	3,125
Corn stover and grass crops	Rectangular bales	13	21	3,125
Poplar and willow	Wood chips	17	32	3,800

Energy Crop Storage Losses

Storage losses in baled grasses and corn stover vary widely depending on whether the bales are round or rectangular, how the round bales are wrapped, what the bales are stored on, and whether the bales are stored outside or indoors. Bales were stored directly on the ground, on a gravel pad, and on pallets in the literature. Economic analysis is needed on the costs of gravel pads or pallets compared with the value of the reduced storage losses compared with storing directly on the ground, and on the costs of various types of storage buildings compared to storing outside, but that is beyond the scope of the present analysis. Here the round bales are assumed to be net wrapped and stored outside. Wisconsin research found a 7.5% storage loss for net-wrapped switchgrass bales stored outside on grass sod. Corn stover storage loss averaged 12.5% when stored directly on the ground and 7.5% when stored on pallets.

Tennessee researchers looked at storing round and rectangular switchgrass bales on pallets, gravel, and directly on the ground, with and without tarps, and measured losses after 200 days [Wang et al., 2009]. The lowest rates were on pallets with tarps, where the round bales lost 8% and the rectangular bales 19%. With tarps on gravel, the round bale loss was 16% and the rectangular bales 31%. Experience in Virginia has shown a lower loss of 5% for round bales, however [Cundiff, 2010].

Swedish research found that wood residue stored in bundles (similar to our widely-spaced hybrid poplar harvested with the timber harvesting equipment) experienced dry matter losses of 6% after five months and 12% after eight months. The literature suggests that the willow harvested as wood chips at around 50% moisture would be problematic to store that long unless artificially dried [Springer, undated].

Wood chip dry matter losses were 13% after 62 days of storage without ventilation or 5% with ventilation in one laboratory study [de Toro, 1994].

Switchgrass harvest season lengths of three months and nine months have been analyzed for Oklahoma [Mapemba et al., 2008]. Our analysis does not specify harvest timing but does assume that the harvest window for the corn stover, the grass crops, and the hybrid poplar are short enough that storage will be required for most of a year in order to keep the processing plant operating on a year-round basis. The willow harvest is assumed to take place on a nearly year-round basis in order to keep the storage of the wood chips to two months or less. Storage losses are assumed to be 10% for each of the energy crops except for the hybrid poplar which is assumed to lose only 5% because it is handled as pulpwood logs.

List of Tables

(See the accompanying Excel spreadsheet for detailed price and quantity information, downloadable at http://www.apec.umn.edu/faculty/wlazarus/documents/Cropbud.xls.)

Table 1. Prices Used in the Crop Enterprise Budgets

Crop Prices			
Corn	$4.50	/	bu
Soybeans	$10.50	/	bu
Wheat	$7.00	/	bu
Alfalfa	$130.00	/	ton
Poplar	$70.00	/	ton
Prairie	$70.00	/	ton
Switchgrass	$70.00	/	ton
Willow	$70.00	/	ton
Corn Stover	$70.00	/	ton
Oatlage	$70.00	/	ton
Corn silage	$37.00	/	ton

Seeds and Seedlings				
	Quantity / Acre	Price		
Corn	34	$235.00	/ 80	thousands
Alfalfa	15	$379.00	/ 100	lbs
Poplar	681	$ 0.15	/	seedling
Prairie	8.5	$ 10.00	/	lb
Soybeans	1	$ 45.00	/ 160	thousands
Wheat	1.9	$ 12.00	/	bu
Switchgrass	7	$ 11.00	/	lb
Willow	9,500	$ 0.14	/	seedling

Fertilizer and Fuel		
Nitrogen - Anhydrous Ammonia	$0.41	/ lb
Nitrogen - Urea	$0.54	/ lb
Phosphorus	$0.52	/ lb
Potash	$0.40	/ lb
Diesel Fuel (on-farm use)	$2.80	/ gal
Diesel Fuel (highway)	$3.30	/ gal

Table 2. Assumptions Made for the Energy Crop Budgets

	Grassland, high fertilization	Grassland, low fertilization	Hybrid poplar	Willow
Stand Life and Production Activities				
Establishment period (first - last year):	1 - 2	1- 4	0 - 8	1 - 5
Mature stand duration (first - last year):	3 - 10	5 - 20	9- 18	6- 27
Fertilize in year:	3-10	2-19	5,7,12,14	3, 6, 10, 14, 18, 22, 26
Spray in year:	1	1	1	2, 3
Cultivate or mow weeds in year:			1-5, 8,10-12, 15-16	1, 2
Harvest in year:	2-10	2-19	9, 17	6, 10, 14, 18, 22, 26
Stump removal in year:			18	27
Overall stand life including stump removal	10 years	20 years	18 years	27 years
Yields				
Yield/year during mature stand, tons dry matter	4.0	2.0	4.0	5.0
Yield/year average over stand life including stump removal, tons dry matter	3.4	1.7	3.8	4.5
Moisture content (%)	10%	10%	50%	50%
Yield/year during mature stand, tons as harvested	4.4	2.2	8.0	10
Yield/year average over stand life including stump removal, tons as harvested	3.7	1.9	7.6	9
Transportation of Crop to Processing				
Tons/load as harvested	19	19	26	26
Transport distance to processing plant (highway miles)	25	25	25	25
Waiting time to load & unload (minutes)	53	53	53	20
Gas mileage of trucks (miles per gallon)	7	7	7	7
Diesel fuel cost (highway use, $/gallon)	$3.30	$3.30	$3.30	$3.30
Non-fuel expenses for truck ($ per mile)	$0.50	$0.50	$ 0.50	$0.50
Driving Speed (miles per hour)	50	50	50	50
Labor cost/hour	$ 20	$20	$20	$20
Total expense/mile two-way	$1.72	$1.72	$ 1.72	$1.50
Total expense/ton dry matter	$6.17	$6.17	$6.49	$4.65

Table 3. Feed and Food Crop Estimated Costs and Returns, Minnesota

Per Acre	Corn MN	Soybeans MN	Wheat MN	Corn silage MN	Alfalfa Est-Dir » MN	Alfalfa Est-CC » MN	Alfalfa Mature » MN	Perennial: Alfalfa - Dir » MN (4 yrs)	Rotation: C/S » MN (2 yrs)	Corn Stover » RndBale » MN
Product yield	164.0 0	42.0 0	51.8 0	16.1 0	2.0 0	0.0 0	4.0 0	3.5 0	103.0 0	164.0 0
Product price, present value equivalent	$ 4.50	$ 10.50	$ 7.00	$ 37.00	$ 130.00		$ 130.00	$ 130.00	$ 5.67	$ 4.50
Secondary product						Oatlage (ton)				Corn stover, every year (ton DM)
Secondary product yield	0.00	0.00	0.00	0.00	0.00	2.00 0	0.00	0.00	0.00	1.80
Secondary product price						$ 70.00				$ 70.00
REVENUE										
Product revenue	$ 738	$ 441	$ 362	$ 596	$ 260	$ -	$ 520	$ 449	$ 594	$ 738
Secondary product	$ -	$ -	$ -	$ -	$ -	$ 140	$ -	$ -	$ -	$ 126
Government payments	$ 38	$ 15	$ 22	$ 38	$ -	$ -	$ -	$ -	$ 27	$ 38
Miscellaneous income	$ 4	$ 7	$ 6	$ 6	$ 2	$ 2	$ 2	$ 2	$ 6	$ 4
Total Revenue	**$ 780**	**$ 464**	**$ 391**	**$ 640**	**$ 262**	**$ 142**	**$ 522**	**$ 451**	**$ 627**	**$ 906**
Fertilizer (lbs N-P_2O_5-K_2O)	(145-30-50)	(0-10-5)	(115-15-40)	(65-30-50)	(0-20-45)	(0-20-45)	(0-20-45)	(0-20-45)	(75-20-28)	(157-45-100)
COSTS										
Seed	$ 110	$ 55	$ 23	$ 110	$ 45	$ 65	$ -	$ 12	$ 83	$ 110
Fertilizer	$ 105	$ 7	$ 81	$ 72	$ 38	$ 38	$ 38	$ 38	$ 58	$ 138
Crop chemicals	$ 34	$ 43	$ 63	$ 34	$ 35	$ -	$ 12	$ 18	$ 38	$ 34
Crop insurance	$ 19	$ 18	$ 16	$ 14	$ 3	$ 3	$ 3	$ 3	$ 19	$ 19
Miscellaneous	$ 44	$ 36	$ 26	$ 26	$ 18	$ 19	$ 18	$ 18	$ 40	$ 43
Machinery w/labor	$ 55	$ 64	$ 52	$ 85	$ 58	$ 32	$ 74	$ 70	$ 60	$ 96
Crop drying	$ 46	$ 1	$ 2	$ -	$ -	$ -	$ -	$ -	$ 24	$ 46
Transport	$ 27	$ 7	$ 9	$ 26	$ 3	$ 3	$ 7	$ 6	$ 17	$ 42
Labor & Mgmt (non-machinery)	$ 49	$ 29	$ 24	$ 47	$ 43	$ 43	$ 43	$ 43	$ 39	$ 49
Rent	$ 147	$ 127	$ 74	$ 111	$ 110	$ 110	$ 110	$ 110	$ 137	$ 147
Interest on pre-harvest var. expenses	$ 11	$ 7	$ 8	$ 11	$ 6	$ 5	$ 4	$ 5	$ 9	$ 14
Total Listed Costs	**$ 648**	**$ 394**	**$ 377**	**$ 536**	**$ 361**	**$ 319**	**$ 309**	**$ 323**	**$ 525**	**$ 737**
NET RETURN	**$ 133**	**$ 69**	**$ 14**	**$ 104**	**$ (99)**	**$ (177)**	**$ 213**	**$ 128**	**$ 102**	**$ 169**
Labor & management hours	2.6	1.7	1.5	4.7	4.0	3.7	4.3	4.2	2.2	3.1
Total Energy (mmBTU)/A	6.39	1.16	3.54	2.85	0.89	0.63	0.88	0.88	3.77	7.29
Total Emissions (kg CO_2 eq)/A	423	100	342	225	207	53	104	130	262	503
Total Energy (mmBTU)/A main product	6.39	1.16	3.54	2.85	0.89	0.00	0.88	0.88	3.77	6.23
Total Emissions (kg CO_2 eq)/A main product	423	100	342	225	207	0	104	130	262	429
Total Energy (mmBTU)/A secondary prod	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	1.06
Total Emissions (kg CO_2 eq)/A second prod	0	0	0	0	0	53	0	0	0	73

Table 3. Feed and Food Crop Estimated Costs and Returns, Minnesota (continued)

Per Unit	Corn MN	Soybeans MN	Wheat MN	Corn silage MN	Alfalfa Est-Dir » MN	Alfalfa Est-CC » MN	Alfalfa Mature » MN	Perennial: Alfalfa - Dir » MN (4 yrs)	Rotation: C/S » MN (2 yrs)	Corn Stover » RndBale » MN
Secondary product						Oatlage (ton)				Corn stover, every year (ton DM)
Secondary product yield	0.00	0.00	0.00	0.00	0.00	2.00 0	0.00	0.00	0.00	1.80
Secondary product price						$ 70.00				$ 70.00
REVENUE						/Unit of Second Prod				
Primary product	$ 4.50	$ 10.50	$ 7.00	$ 37.00	$ 130.00	$ -	$ 130.00	$ 130.00	$ 5.67	$ 4.50
Secondary product						$ 70.00				$ 70.00
Government payments	$ 0.23	$ 0.37	$ 0.43	$ 2.38	$ -	$ -	$ -	$ -	$ 0.26	$ 0.23
Miscellaneous income	$ 0.03	$ 0.17	$ 0.13	$ 0.39	$ 1.13	$ 1.13	$ 0.56	$ 0.65	$ 0.05	$ 0.03
Total Revenue	**$ 4.76**	**$ 11.04**	**$ 7.56**	**$ 39.76**	**$ 131.13**	**$ 71.13**	**$ 130.56**	**$ 130.65**	**$ 5.98**	**$ 5.53**
Fertilizer (lbs N-P_2O_5-K_2O)	(145-30-50)	(0-10-5)	(115-15-40)	(65-30-50)	(0-20-45)	(0-20-45)	(0-20-45)	(0-20-45)	(75-20-28)	(157-45-100)
COSTS										
Seed	$ 0.67	$ 1.31	$ 0.44	$ 6.82	$ 22.74	$ 32.52	$ -	$ 3.58	$ 0.79	$ 0.67
Fertilizer	$ 0.64	$ 0.17	$ 1.56	$ 4.49	$ 19.20	$ 19.20	$ 9.60	$ 11.11	$ 0.55	$ 0.84
Crop chemicals	$ 0.21	$ 1.02	$ 1.22	$ 2.11	$ 17.62	$ -	$ 2.95	$ 5.26	$ 0.37	$ 0.21
Crop insurance	$ 0.12	$ 0.44	$ 0.31	$ 0.86	$ 1.39	$ 1.39	$ 0.69	$ 0.80	$ 0.18	$ 0.12
Miscellaneous	$ 0.27	$ 0.85	$ 0.51	$ 1.59	$ 9.22	$ 9.53	$ 4.43	$ 5.19	$ 0.38	$ 0.26
Machinery w/labor	$ 0.34	$ 1.53	$ 1.01	$ 5.29	$ 29.01	$ 16.24	$ 18.50	$ 20.16	$ 0.57	$ 0.58
Crop drying	$ 0.28	$ 0.03	$ 0.03	$ -	$ -	$ -	$ -	$ -	$ 0.23	$ 0.28
Transport	$ 0.17	$ 0.17	$ 0.17	$ 1.64	$ 1.64	$ 1.64	$ 1.64	$ 1.64	$ 0.17	$ 0.25
Labor & Mgmt (non-machinery)	$ 0.30	$ 0.70	$ 0.47	$ 2.93	$ 21.42	$ 21.42	$ 10.71	$ 12.40	$ 0.37	$ 0.30
Rent	$ 0.90	$ 3.02	$ 1.42	$ 6.87	$ 55.15	$ 55.15	$ 27.58	$ 31.92	$ 1.31	$ 0.90
Interest on pre-harvest var. expenses	$ 0.07	$ 0.16	$ 0.16	$ 0.69	$ 3.16	$ 2.44	$ 1.12	$ 1.44	$ 0.09	$ 0.09
Total Listed Costs	**$ 3.95**	**$ 9.39**	**$ 7.29**	**$ 33.28**	**$ 180.55**	**$ 159.52**	**$ 77.22**	**$ 93.50**	**$ 5.01**	**$ 4.49**
NET RETURN	**$ 0.81**	**$ 1.64**	**$ 0.27**	**$ 6.48**	**$ (49.42)**	**$ (88.39)**	**$ 53.34**	**$ 37.15**	**$ 0.97**	**$ 1.03**
Total Energy (mmBTU)/unit product	0.039	0.028	0.068	0.177	0.444		0.220	0.256	0.036	0.038
Total Emissions (kg CO_2 eq)/unit main product	2.58	2.39	6.60	13.99	103.27		26.11	37.61	2.50	2.62
Total Energy (mmBTU)/unit secondary prod						0.317				0.591
Total Emissions (kg CO_2 eq)/unit second prod						26.35				40.74

Table 4. Energy Crop Estimated Costs and Returns, Minnesota

Per Acre	Perennial: Switchgrass » MN (10 yrs)	Perennial: Prairie » MN (20 yrs)	Perennial: Poplar » MN (18 yrs)	Perennial: Willow » MN (27 yrs, 4)	Corn Stover » RndBale » MN vs Corn MN
Product yield	3.1 0	1.6 0	3.4 0	4.0 0	0.0 0
Product price, present value equivalent	$ 70.00	$ 70.00	$ 70.00	$ 70.00	
Secondary product					Corn stover, every year (ton
Secondary product yield	0.00	0.00	0.00	0.00	1.80
Secondary product price					$ 70.00
REVENUE					
Product revenue	$ 204	$ 99	$ 189	$ 244	$ -
Secondary product	$ -	$ -	$ -	$ -	$ 126
Government payments	$ -	$ -	$ -	$ -	$ -
Miscellaneous income	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ 204**	**$ 99**	**$ 189**	**$ 244**	**$ 126**
Fertilizer (lbs N-P_2O_5-K_2O)	(60-20-45)	(7-0-0)	(22-0-0)	(26-0-0)	(12-15-50)
COSTS					
Seed	$ 10	$ 8	$ 10	$ 58	$ -
Fertilizer	$ 68	$ 13	$ 14	$ 16	$ 33
Crop chemicals	$ 9	$ 6	$ 6	$ 10	$ -
Crop insurance	$ -	$ -	$ -	$ -	$ -
Miscellaneous	$ -	$ -	$ -	$ 0	$ 0
Machinery w/labor	$ 45	$ 30	$ 146	$ 87	$ 41
Crop drying	$ -	$ -	$ -	$ -	$ -
Transport	$ 16	$ 8	$ 17	$ 15	$ 14
Labor & Mgmt (non-machinery)	$ 20	$ 20	$ 20	$ -	$ -
Rent	$ 40	$ 40	$ 40	$ 40	$ -
Interest on pre-harvest var. expenses	$ 5	$ 2	$ 6	$ 6	$ 3
Total Listed Costs	**$ 213**	**$ 126**	**$ 259**	**$ 233**	**$ 90**
NET RETURN	**$ (8)**	**$ (27)**	**$ (70)**	**$ 11**	**$ 36**
Labor & management hours	1.5	1.4	1.0	0.1	0.5
Total Energy (mmBTU)/A	1.88	0.38	1.36	1.27	0.90
Total Emissions (kg CO_2 eq)/A	147	28	126	106	80
Total Energy (mmBTU)/A main product	1.88	0.38	1.36	1.27	0.00
Total Emissions (kg CO_2 eq)/A main product	147	28	126	106	0
Total Energy (mmBTU)/A secondary prod	0.00	0.00	0.00	0.00	0.90
Total Emissions (kg CO_2 eq)/A second prod	0	0	0	0	80

Table 4. Energy Crop Estimated Costs and Returns, Minnesota (continued)

Per Unit	Perennial: Switchgrass » MN (10 yrs)	Perennial: Prairie » MN (20 yrs)	Perennial: Poplar » MN (18 yrs)	Perennial: Willow » MN (27 yrs, 4)	Corn Stover » RndBale » MN vs Corn MN
					Corn stover, every year (ton DM)
Secondary product					
Secondary product yield	0.00	0.00	0.00	0.00	1.80
Secondary product price					$ 70.00
					/Unit of Second Prod
REVENUE					
Primary product	$ 70.00	$ 70.00	$ 70.00	$ 70.00	$ -
Secondary product					$ 70.00
Government payments	$ -	$ -	$ -	$ -	$ -
Miscellaneous income	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ 70.00**	**$ 70.00**	**$ 70.00**	**$ 70.00**	**$ 70.00**
Fertilizer (lbs N-P_2O_5-K_2O)	(60-20-45)	(7-0-0)	(22-0-0)	(26-0-0)	(12-15-50)
COSTS					
Seed	$ 3.38	$ 5.81	$ 3.69	$ 16.81	$ -
Fertilizer	$ 23.39	$ 8.89	$ 5.14	$ 4.72	$ 18.08
Crop chemicals	$ 3.06	$ 4.05	$ 2.26	$ 2.80	$ -
Crop insurance	$ -	$ -	$ -	$ -	$ -
Miscellaneous	$ -	$ -	$ -	$ 0.00	$ 0.12
Machinery w/labor	$ 15.44	$ 21.09	$ 54.03	$ 25.11	$ 22.53
Crop drying	$ -	$ -	$ -	$ -	$ -
Transport	$ 5.47	$ 5.47	$ 6.22	$ 4.19	$ 8.03
Labor & Mgmt (non-machinery)	$ 6.85	$ 14.13	$ 7.40	$ -	$ -
Rent	$ 13.69	$ 28.26	$ 14.79	$ 11.50	$ -
Interest on pre-harvest var. expenses	$ 1.59	$ 1.40	$ 2.29	$ 1.74	$ 1.43
Total Listed Costs	**$ 72.86**	**$ 89.11**	**$ 95.82**	**$ 66.88**	**$ 50.19**
NET RETURN	**$ (2.86)**	**$ (19.11)**	**$ (25.82)**	**$ 3.12**	**$ 19.81**
Total Energy (mmBTU)/unit product	0.644	0.271	0.502	0.364	
Total Emissions (kg CO_2 eq)/unit main product	50.33	19.72	46.57	30.57	
Total Energy (mmBTU)/unit secondary prod					0.500
Total Emissions (kg CO_2 eq)/unit second prod					44.20

Table 5. Net Returns Per Acre by Year and Net Present Value of Returns for High-Fertilization Grassland, 10-Year Stand, Minnesota

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	**Average**	**NPV**	**Annualized NPV**
CROP	Switchgrass	Switchgrass	Switchgrass	Switchgrass	Switchgrass	Switchgrass	Switchgrass	Switchgrass	Switchgrass	Switchgrass			
BUDGET	Plant » MN	Maint 1 » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN			
REVENUE													
Primary product	$ -	$ 126	$ 252	$ 252	$ 252	$ 252	$ 252	$ 252	$ 252	$ 252	$ 214	$ 1,505	$ 204
Secondary product	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Government payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ -**	**$ 126**	**$ 252**	**$ 252**	**$ 252**	**$ 252**	**$ 252**	**$ 252**	**$ 252**	**$ 252**	**$ 214**	**$ 1,505**	**$ 204**
COSTS													
Seed	$ 77	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8	$ 73	$ 10
Fertilizer & Lime	$ 61	$ 61	$ 71	$ 71	$ 71	$ 71	$ 71	$ 71	$ 71	$ 71	$ 69	$ 503	$ 68
Crop chemicals	$ 70	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7	$ 66	$ 9
Crop insurance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Machinery w/labor	$ 16	$ 42	$ 51	$ 51	$ 51	$ 51	$ 51	$ 51	$ 51	$ 51	$ 46	$ 332	$ 45
Crop drying	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Transport	$ -	$ 10	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 17	$ 118	$ 16
Labor & Mgmt (non-mach.)	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 147	$ 20
Rent	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 294	$ 40
Int on pre-harvest var exp	$ 8	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 5	$ 34	$ 5
Total Listed Costs	**$ 291**	**$ 176**	**$ 205**	**$ 205**	**$ 205**	**$ 205**	**$ 205**	**$ 205**	**$ 205**	**$ 205**	**$ 211**	**$ 1,566**	**$ 213**
NET RETURN	**$ (291)**	**$ (50)**	**$ 47**	**$ 47**	**$ 47**	**$ 47**	**$ 47**	**$ 47**	**$ 47**	**$ 47**	$ 3	$ (62)	**$ (8)**
CUMULATIVE NET RETURN	**$ (291)**	**$ (341)**	**$ (295)**	**$ (248)**	**$ (201)**	**$ (155)**	**$ (108)**	**$ (62)**	**$ (15)**	**$ 32**			

Table 6. Net Returns Per Acre by Year and Net Present Value of Returns for Low-Fertilization Grassland, 20-Year Stand, Minnesota

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16
CROP	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie	Prairie
BUDGET	Plant » MN	Maint 1 » MN	Maint 2 » MN	Maint 3 » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN
REVENUE																
Primary product	$ -	$ -	$ 63	$ 95	$ 126	$ 126	$ 126	$ 126	$ 126	$ 126	$ 126	$ 126	$ 126	$ 126	$ 126	$ 126
Secondary product	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Government payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ -**	**$ -**	**$ 63**	**$ 95**	**$ 126**	**$ 126**	**$ 126**	**$ 126**	**$ 126**	**$ 126**	**$ 126**	**$ 126**	**$ 126**	**$ 126**	**$ 126**	**$ 126**
COSTS																
Seed	$ 100	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fertilizer & Lime	$ 37	$ -	$ 15	$ 21	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10
Crop chemicals	$ 70	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Crop insurance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Machinery w/labor	$ 16	$ 5	$ 1	$ 34	$ 37	$ 37	$ 37	$ 37	$ 37	$ 37	$ 37	$ 37	$ 37	$ 37	$ 37	$ 37
Crop drying	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Transport	$ -	$ -	$ 5	$ 7	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10	$ 10
Labor & Mgmt (non-mach.)	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20
Rent	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40
Int on pre-harvest var exp	$ 8	$ 0	$ 1	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2
Total Listed Costs	**$ 291**	**$ 65**	**$ 82**	**$ 124**	**$ 118**	**$ 118**	**$ 118**	**$ 118**	**$ 118**	**$ 118**	**$ 118**	**$ 118**	**$ 118**	**$ 118**	**$ 118**	**$ 118**
NET RETURN	**$ (291)**	**$ (65)**	**$ (19)**	**$ (29)**	**$ 8**	**$ 8**	**$ 8**	**$ 8**	**$ 8**	**$ 8**	**$ 8**	**$ 8**	**$ 8**	**$ 8**	**$ 8**	**$ 8**
CUMULATIVE NET RETURN	**$ (291)**	**$ (356)**	**$ (374)**	**$ (403)**	**$ (396)**	**$ (388)**	**$ (381)**	**$ (373)**	**$ (366)**	**$ (358)**	**$ (350)**	**$ (343)**	**$ (335)**	**$ (328)**	**$ (320)**	**$ (313)**

Table 6 (continued)

	Year 17	Year 18	Year 19	Year 20	Average	NPV	Annualized NPV
CROP	Prairie	Prairie	Prairie	Prairie			
BUDGET	Harvest » MN	Harvest » MN	Harvest » MN	Harvest » MN			
REVENUE							
Primary product	$ 126	$ 126	$ 126	$ 126	$ 109	$ 1,136	$ 99
Secondary product	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Government payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous income	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ 126**	**$ 126**	**$ 126**	**$ 126**	**$ 109**	**$ 1,136**	**$ 99**
COSTS							
Seed	$ -	$ -	$ -	$ -	$ 5	$ 94	$ 8
Fertilizer & Lime	$ 10	$ 10	$ 10	$ 10	$ 12	$ 144	$ 13
Crop chemicals	$ -	$ -	$ -	$ -	$ 3	$ 66	$ 6
Crop insurance	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Machinery w/labor	$ 37	$ 37	$ 37	$ 37	$ 32	$ 342	$ 30
Crop drying	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Transport	$ 10	$ 10	$ 10	$ 10	$ 8	$ 89	$ 8
Labor & Mgmt (non-mach.)	$ 20	$ 20	$ 20	$ 20	$ 20	$ 229	$ 20
Rent	$ 40	$ 40	$ 40	$ 40	$ 40	$ 459	$ 40
Int on pre-harvest var exp	$ 2	$ 2	$ 2	$ 2	$ 2	$ 23	$ 2
Total Listed Costs	**$ 118**	**$ 118**	**$ 118**	**$ 118**	**$ 123**	**$ 1,447**	**$ 126**
NET RETURN	**$ 8**	**$ 8**	**$ 8**	**$ 8**	$ (14)	$ (310)	**$ (27)**
CUMULATIVE NET RETURN	**$ (305)**	**$ (297)**	**$ (290)**	**$ (282)**			

Table 7. Net Returns Per Acre by Year and Net Present Value of Returns for Hybrid Poplar, 18-Year Stand, Minnesota

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16
CROP	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar	Poplar
BUDGET	Soil prep » MN	Plant » MN	Maint 1 » MN	Maint 2 » MN	Maint 3 » MN	Maint 4 » MN	Maint 5 » MN	Maint 6 » MN	Harvest_w » MN	Coppice 1 » MN	Maint 2 » MN	Maint 3 » MN	Maint 4 » MN	Maint 5 » MN	Maint 6 » MN	Maint 6 » MN
REVENUE																
Primary product	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,128	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Secondary product	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Government payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 2,128**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
COSTS																
Seed	$ -	$ 102	$ 20	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fertilizer & Lime	$ -	$ -	$ -	$ -	$ 64	$ -	$ 64	$ -	$ -	$ -	$ -	$ 64	$ -	$ 64	$ -	$ -
Crop chemicals	$ -	$ 75	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Crop insurance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Machinery w/labor	$ 50	$ 271	$ 49	$ 49	$ 16	$ -	$ -	$ 16	$ 997	$ 54	$ 49	$ 16	$ -	$ -	$ 16	$ 16
Crop drying	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Transport	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 189	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Labor & Mgmt (non-mach.)	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20
Rent	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40
Int on pre-harvest var exp	$ 2	$ 16	$ 2	$ 2	$ 3	$ -	$ 2	$ 1	$ 35	$ 2	$ 2	$ 3	$ -	$ 2	$ 1	$ 1
Total Listed Costs	**$ 112**	**$ 523**	**$ 132**	**$ 111**	**$ 143**	**$ 60**	**$ 126**	**$ 76**	**$ 1,281**	**$ 116**	**$ 111**	**$ 143**	**$ 60**	**$ 126**	**$ 76**	**$ 76**
NET RETURN	**$ (112)**	**$ (523)**	**$ (132)**	**$ (111)**	**$ (143)**	**$ (60)**	**$ (126)**	**$ (76)**	**$ 847**	**$ (116)**	**$ (111)**	**$ (143)**	**$ (60)**	**$ (126)**	**$ (76)**	**$ (76)**
CUMULATIVE NET RETURN	**$ (112)**	**$ (635)**	**$ (767)**	**$ (878)**	**$ (1,021)**	**$ (1,081)**	**$ (1,207)**	**$ (1,283)**	**$ (436)**	**$ (552)**	**$ (663)**	**$ (806)**	**$ (866)**	**$ (992)**	**$ (1,068)**	**$ (1,145)**

Table 7 (continued)

	Year 17	Year 18	Average	NPV	Annualized NPV
CROP	Poplar	Poplar			
BUDGET	Harvest_w » MN	Stump Rmv » MN			
REVENUE					
Primary product	$ 2,128	$ -	$ 236	$ 2,050	$ 189
Secondary product	$ -	$ -	$ -	$ -	$ -
Government payments	$ -	$ -	$ -	$ -	$ -
Miscellaneous income	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ 2,128**	**$ -**	**$ 236**	**$ 2,050**	**$ 189**
COSTS					
Seed	$ -	$ -	$ 7	$ 108	$ 10
Fertilizer & Lime	$ -	$ -	$ 14	$ 151	$ 14
Crop chemicals	$ -	$ -	$ 4	$ 66	$ 6
Crop insurance	$ -	$ -	$ -	$ -	$ -
Miscellaneous	$ -	$ -	$ -	$ -	$ -
Machinery w/labor	$ 997	$ 442	$ 169	$ 1,582	$ 146
Crop drying	$ -	$ -	$ -	$ -	$ -
Transport	$ 189	$ -	$ 21	$ 182	$ 17
Labor & Mgmt (non-mach.)	$ 20	$ 20	$ 20	$ 217	$ 20
Rent	$ 40	$ 40	$ 40	$ 433	$ 40
Int on pre-harvest var exp	$ 35	$ 16	$ 7	$ 67	$ 6
Total Listed Costs	**$ 1,281**	**$ 517**	**$ 282**	**$ 2,806**	**$ 259**
NET RETURN	**$ 847**	**$ (517)**	$ (45)	$ (756)	**$ (70)**
CUMULATIVE NET RETURN	**$ (298)**	**$ (815)**			

Table 8. Net Returns Per Acre by Year and Net Present Value of Returns for Willow, 27-Year Stand, Minnesota

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16
CROP	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow
BUDGET	Soil prep » MN	Plant » MN	Maint 1 » MN	Maint 2 » MN	Maint 2 » MN	Harvest4 » WoodForHarv » MN	Maint 2 » MN	Maint 2 » MN	Maint 2 » MN	Harvest4 » WoodForHarv » MN	Maint 2 » MN	Maint 2 » MN	Maint 2 » MN	Harvest4 » WoodForHarv » MN	Maint 2 » MN	Maint 2 » MN
REVENUE																
Primary product	$ -	$ -	$ -	$ -	$ -	$ 1,260	$ -	$ -	$ -	$ 1,260	$ -	$ -	$ -	$ 1,260	$ -	$ -
Secondary product	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Government payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,260**	**$ -**	**$ -**	**$ -**	**$ 1,260**	**$ -**	**$ -**	**$ -**	**$ 1,260**	**$ -**	**$ -**
COSTS																
Seed	$ -	$ 868	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fertilizer & Lime	$ -	$ -	$ 64	$ -	$ -	$ 64	$ -	$ -	$ -	$ 64	$ -	$ -	$ -	$ 64	$ -	$ -
Crop chemicals	$ -	$ 75	$ 75	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Crop insurance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous	$ -	$ -	$ -	$ -	$ -	$ 0	$ -	$ -	$ -	$ 0	$ -	$ -	$ -	$ 0	$ -	$ -
Machinery w/labor	$ 145	$ 278	$ -	$ -	$ -	$ 277	$ -	$ -	$ -	$ 277	$ -	$ -	$ -	$ 277	$ -	$ -
Crop drying	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Transport	$ -	$ -	$ -	$ -	$ -	$ 75	$ -	$ -	$ -	$ 75	$ -	$ -	$ -	$ 75	$ -	$ -
Labor & Mgmt (non-mach.)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rent	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40
Int on pre-harvest var exp	$ 5	$ 43	$ 5	$ -	$ -	$ 12	$ -	$ -	$ -	$ 12	$ -	$ -	$ -	$ 12	$ -	$ -
Total Listed Costs	**$ 190**	**$ 1,303**	**$ 183**	**$ 40**	**$ 40**	**$ 469**	**$ 40**	**$ 40**	**$ 40**	**$ 469**	**$ 40**	**$ 40**	**$ 40**	**$ 469**	**$ 40**	**$ 40**
NET RETURN	**$ (190)**	**$ (1,303)**	**$ (183)**	**$ (40)**	**$ (40)**	**$ 791**	**$ (40)**	**$ (40)**	**$ (40)**	**$ 791**	**$ (40)**	**$ (40)**	**$ (40)**	**$ 791**	**$ (40)**	**$ (40)**
CUMULATIVE NET RETURN	**$ (190)**	**$ (1,494)**	**$ (1,677)**	**$ (1,717)**	**$ (1,757)**	**$ (965)**	**$ (1,005)**	**$ (1,045)**	**$ (1,085)**	**$ (294)**	**$ (334)**	**$ (374)**	**$ (414)**	**$ 377**	**$ 337**	**$ 297**

Table 8 (continued)

	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Average	NPV	Annualized NPV
CROP	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow	Willow			
BUDGET	Maint 2 » MN	Harvest4 » WoodForHarv » MN	Maint 2 » MN	Maint 2 » MN	Maint 2 » MN	Harvest4 » WoodForHarv » MN	Maint 2 » MN	Maint 2 » MN	Maint 2 » MN	Harvest4 » WoodForHarv » MN	Stock Rmv » MN			
REVENUE														
Primary product	$ -	$ 1,260	$ -	$ -	$ -	$ 1,260	$ -	$ -	$ -	$ 1,260	$ -	$ 280	$ 3,217	$ 244
Secondary product	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Government payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenue	**$ -**	**$ 1,260**	**$ -**	**$ -**	**$ -**	**$ 1,260**	**$ -**	**$ -**	**$ -**	**$ 1,260**	**$ -**	**$ 280**	**$ 3,217**	**$ 244**
COSTS														
Seed	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 32	$ 773	$ 58
Fertilizer & Lime	$ -	$ 64	$ -	$ -	$ -	$ 64	$ -	$ -	$ -	$ 64	$ -	$ 17	$ 217	$ 16
Crop chemicals	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6	$ 129	$ 10
Crop insurance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Miscellaneous	$ -	$ 0	$ -	$ -	$ -	$ 0	$ -	$ -	$ -	$ 0	$ -	$ 0	$ 0	$ 0
Machinery w/labor	$ -	$ 277	$ -	$ -	$ -	$ 277	$ -	$ -	$ -	$ 277	$ 300	$ 88	$ 1,154	$ 87
Crop drying	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Transport	$ -	$ 75	$ -	$ -	$ -	$ 75	$ -	$ -	$ -	$ 75	$ -	$ 17	$ 193	$ 15
Labor & Mgmt (non-mach.)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rent	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 40	$ 528	$ 40
Int on pre-harvest var exp	$ -	$ 12	$ -	$ -	$ -	$ 12	$ -	$ -	$ -	$ 12	$ 11	$ 5	$ 80	$ 6
Total Listed Costs	**$ 40**	**$ 469**	**$ 40**	**$ 40**	**$ 40**	**$ 469**	**$ 40**	**$ 40**	**$ 40**	**$ 469**	**$ 351**	**$ 204**	**$ 3,074**	**$ 233**
NET RETURN	**$ (40)**	**$ 791**	**$ (40)**	**$ (40)**	**$ (40)**	**$ 791**	**$ (40)**	**$ (40)**	**$ (40)**	**$ 791**	**$ (351)**	$ 76	$ 144	**$ 11**
CUMULATIVE NET RETURN	**$ 257**	**$ 1,049**	**$ 1,009**	**$ 969**	**$ 929**	**$ 1,720**	**$ 1,680**	**$ 1,640**	**$ 1,600**	**$ 2,392**	**$ 2,041**			

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