



Willow Crop Production Scenarios Using EcoWillow 2.0

Willow Crop Production Scenarios

EcoWillow 2.0 has been comprehensively updated based on the most recent information available from research trials and commercial willow operations. Many variables influence the profitability of willow biomass crops and a wide range of possible operating conditions and management strategies exist. Some of the most critical variables influencing profitability are biomass yield, the price received for delivered biomass, the cost of planting stock, efficiency of harvesting operations, the cost of fertilizers, and transport distances.

This fact sheet presents four potential production scenarios for willow biomass crops: (1) a *base case* representing conservative estimates of profitability, (2) an *improved* scenario that modifies the base case with a number of potential system improvements and best practice targets, (3) an *incentivized* scenario that adds potential incentive payments to the base case, and (4) an *improved-incentivized* scenario that adds both potential improvements and incentives to the base case scenario.

For each scenario, the model outputs of internal rate of return (IRR), payback period and break-even price of biomass are summarized in this fact sheet. IRR is the discount rate at which the net present value (NPV) of the project is equal to zero. The payback period is the number of years until the accumulated cash flow becomes positive and stays positive for the remainder of the project lifecycle. The breakeven price is the cost of production per ton of biomass minus any incentives received. All scenarios are based on a 22 year lifecycle of the planting and project analysis period in EcoWillow 2.0. Prices are expressed in terms of wet tons for clarity from the producer's perspective. The expected moisture content of the crop is 45% for conversion into dry tons.

(1) Base Case Scenario

The assumptions of the base case scenario (Table 1) correspond to the suggested values pre-entered into EcoWillow 2.0 upon downloading the model. The inputs of this scenario represent conservative estimates of profitability that should be achievable by most producers in New York and surrounding states based on the current markets, cultural practices, and logistics for willow.

Table 1. Base case for willow biomass production*

- Minimum recommended project size of 25 acres
- Planting rate of 2.5 acres per hour
- Planting density of 5,500 stems per acre
- 10 tons_(wet)/acre/year biomass production (yield)
- Three year crop rotation (harvest cycle)
- Biomass price received at plant gate of \$27.50/ton_(wet)
- \$400/acre to remove the willow planting after 22 years

*The complete list of base case assumptions can be reviewed by downloading a copy of EcoWillow 2.0 from: www.esf.edu/willow

The expected IRR for the base case is <0%. The expected payback period is the entire lifecycle of the project, or none. The break-even price is about \$30/ton_(wet), slightly more than the assumed price received for biomass of \$27.50/ton_(wet).

(2) Improved Scenario

The improved scenario makes changes to the assumptions of the base case across numerous variables of the crop production system. All potential system improvements assumed in this scenario are listed below (Table 2). Each is considered to be a realistic system improvement or best practice target based on current data, logistics and management options of the crop.

Table 2. Improved scenario for willow biomass

- Project size increased to 100 acres, reducing the fixed costs per acre for planting and harvesting operations
- Headlands/unplanted areas reduced from 20% to 10% based on larger field size and other best practice targets
- Expected cost of planting stock reduced from \$0.12 to \$0.09 per cutting
- Planting rate increased from 2.5 to 3.0 acres/hour based on larger field, less turning-time and down-time
- 50% reduction in fertilizer inputs and costs using soil testing and more precise nutrient management
- Biomass yield increase of 0.5 ton_(wet) per acre per year assumed with the use of improved cultivars
- Harvest rate increased by 0.25 acres/hour
- Collection vehicle capacity increased from 8 to 12 tons, reducing the number of collection vehicles from 4 to 3
- Transport distance decreased by 5 miles
- Price received for biomass increased by \$0.50/ton_(wet)



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The expected IRR for the optimistic scenario is 5%, and the expected payback period is 13 years, or at the fourth harvest. The break-even price is about \$27/ton_(wet).

(3) Incentivized Scenario

The incentivized scenario adds a series of subsidy payments (Table 3) to the base case using the framework of the USDA Biomass Crop Assistance Program (BCAP). Nearly 1200 acres of commercial willow crops have been incentivized by BCAP, and more funding may become available. The expected IRR for the incentivized scenario is 10%, and the expected payback period is 13 years, or at the fourth harvest. The break-even price (production cost minus incentives) is about \$25/ton_(wet).

Table 3. Incentivized scenario for willow biomass

- All assumptions of the base case scenario (1) plus...
- One-time establishment incentive of \$500/acre
- Acreage incentive of \$40/acre in non-harvest years
- 11-year incentive program enrollment period

(4) Improved-Incentivized Scenario

The improved-incentivized scenario (Table 4) combines the previous scenarios, adding both system improvements and incentives to the base case, representing the most profitable potential outcome of the four example scenarios presented in this fact sheet. The expected IRR for the improved-incentivized scenario is 20%, and the expected payback period is 7 years, or at the second harvest. The break-even price is about \$20/ton_(wet).

Table 4. Improved-Incentivized scenario for willow

- All system improvements from improved scenario (2)
- All incentives payments from incentivized scenario (3)

Summary of Outputs

Outputs of the four example scenarios for willow biomass production presented in this fact sheet are summarized in Table 5. For the base case scenario (1), the system is not profitable at \$27.50/ton_(wet) received for biomass, with the breakeven price slightly higher at \$30/ton_(wet).

The improved scenario (2) increases profitability over the base case with expected IRR around 5%, and a payback of 13 years. The incentivized scenario (3) produces returns similar to the improved scenario, although slightly more profitable. The improved-incentivized scenario (4) offers the best potential returns of these four example scenarios, with expected IRR around 20% and payback seven years (two harvests) after planting. The project cost distribution under all these scenarios is about 15% land costs, 20% establishment, 5% fertilizers, 35% harvest, 20% transport, and 5% stock removal, with slight shifts in certain categories between the different scenarios.

Table 5. Summary of four willow production scenarios*

Scenario	IRR	Payback	Break-even Price
(1)Base Case	<0%	none	\$30/ton _(wet)
(2)Improved	5%	13 yrs	\$27/ton _(wet)
(3)Incentivized	10%	13 yrs	\$25/ton _(wet)
(4)Improved-Incentivized	20%	7 yrs	\$20/ton _(wet)

*IRR values and break-even prices are approximate (rounded)

All of these scenarios are hypothetical situations based on the best information available at this time. The projections are believed to be accurate, but results are not guaranteed. Every project will be unique and users of EcoWillow 2.0 are expected to change all individual variables within the model as appropriate to their specific operating conditions, management decisions and expected outcomes.

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