

Commercial Production & Harvesting of Shrub Willow Crops in NY State

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Short Rotation Woody Crop Operations Working Group
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Shrub Willow

- **Research at SUNY ESF since 1986**
 - Breeding
 - Cultural Practices
 - Harvesting and Logistics
 - Economics
- **40,000 commercial acres in Europe**
- **Commercial production now accelerating in the United States**
- **Supported by USDA BCAP**



Shrub willow shortly after planting

Shrub Willow

- Can be grown on marginal land
- 1 million acres in New York State (poorly drained soils)
- Goal: target underutilized/abandoned farm land
- Not compete with food crops



Barriers to Commercial Willow

- High start up costs - \$1,000/acre
- Intermittent cash flows
- Long payback periods
- Uncertain markets
- Status quo bias
- Specialized machinery



USDA Biomass Crop Assistance Program (BCAP)

“Improve domestic energy security, reduce carbon pollution, and spur rural economic development”

“...provide assistance to land owners to establish, produce and deliver biomass feedstocks.”



Biomass Crop Assistance Program

Catalyze commercial adoption and innovation...

- **Partial establishment grants**
 - Offset high start up costs
- **Land rental payments**
 - Non harvest years
- **Purchasing contracts**
 - With biomass end user

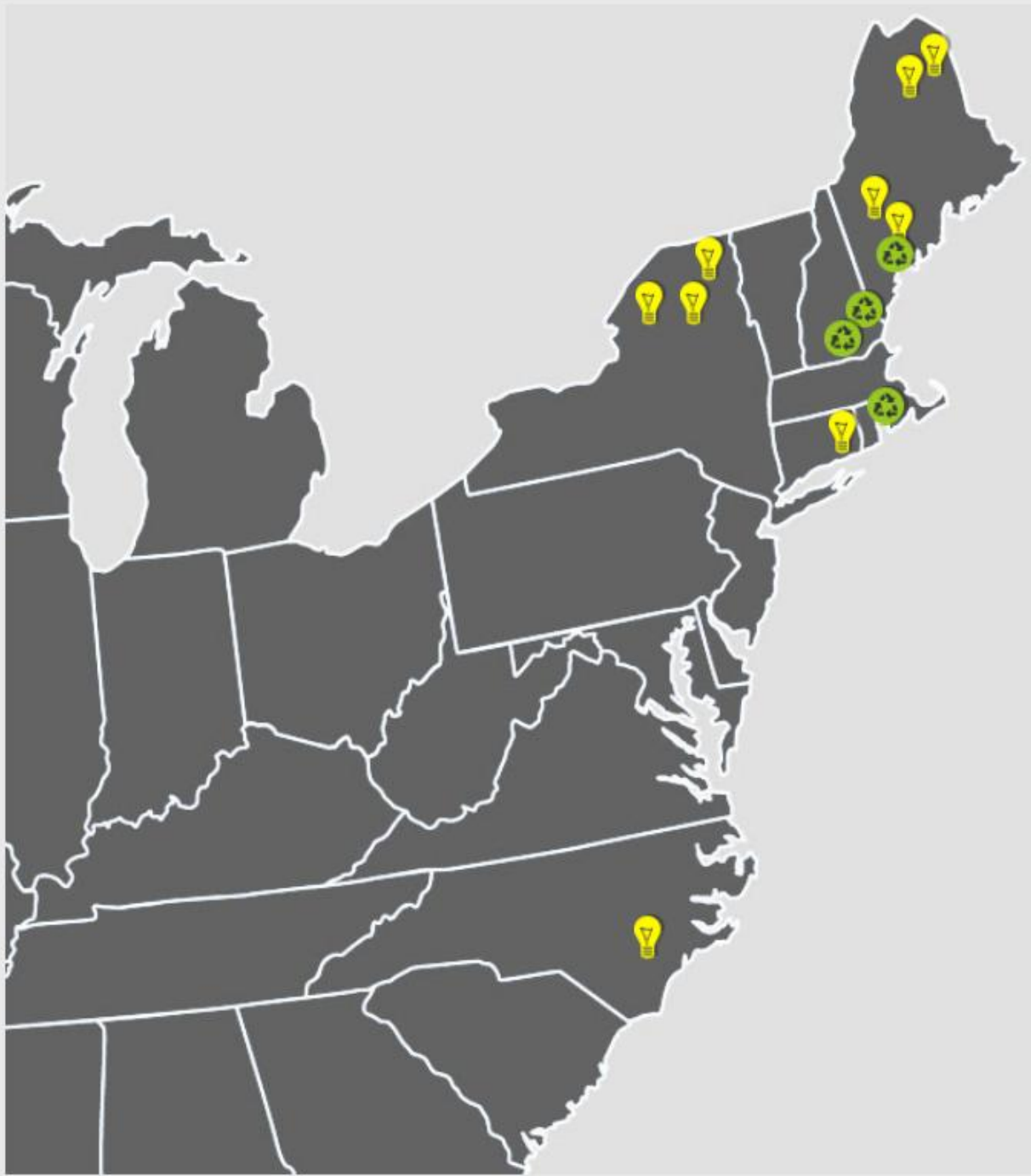


Committed to the future of rural communities.

ReEnergy LLC

- BCAP “project sponsor” for NY Willow
- Biopower company - facilities throughout the northeast
- 11 year purchasing contracts
- Mixing willow with forest residue chips
- Renewable electricity





Owned and Operated by ReEnergy

ReEnergy Ashland

39 MW facility in Ashland, ME

ReEnergy Black River

60 MW facility in Fort Drum, NY

ReEnergy Chateaugay

21 MW facility in Chateaugay, NY

ReEnergy Fort Fairfield

37 MW facility in Fort Fairfield, ME

ReEnergy Livermore Falls

39 MW facility in Livermore Falls, ME

ReEnergy Lyonsdale

22 MW facility in Lyons Falls, NY

ReEnergy Sterling

30 MW facility in Sterling, CT

ReEnergy Stratton

48 MW facility in Stratton, ME

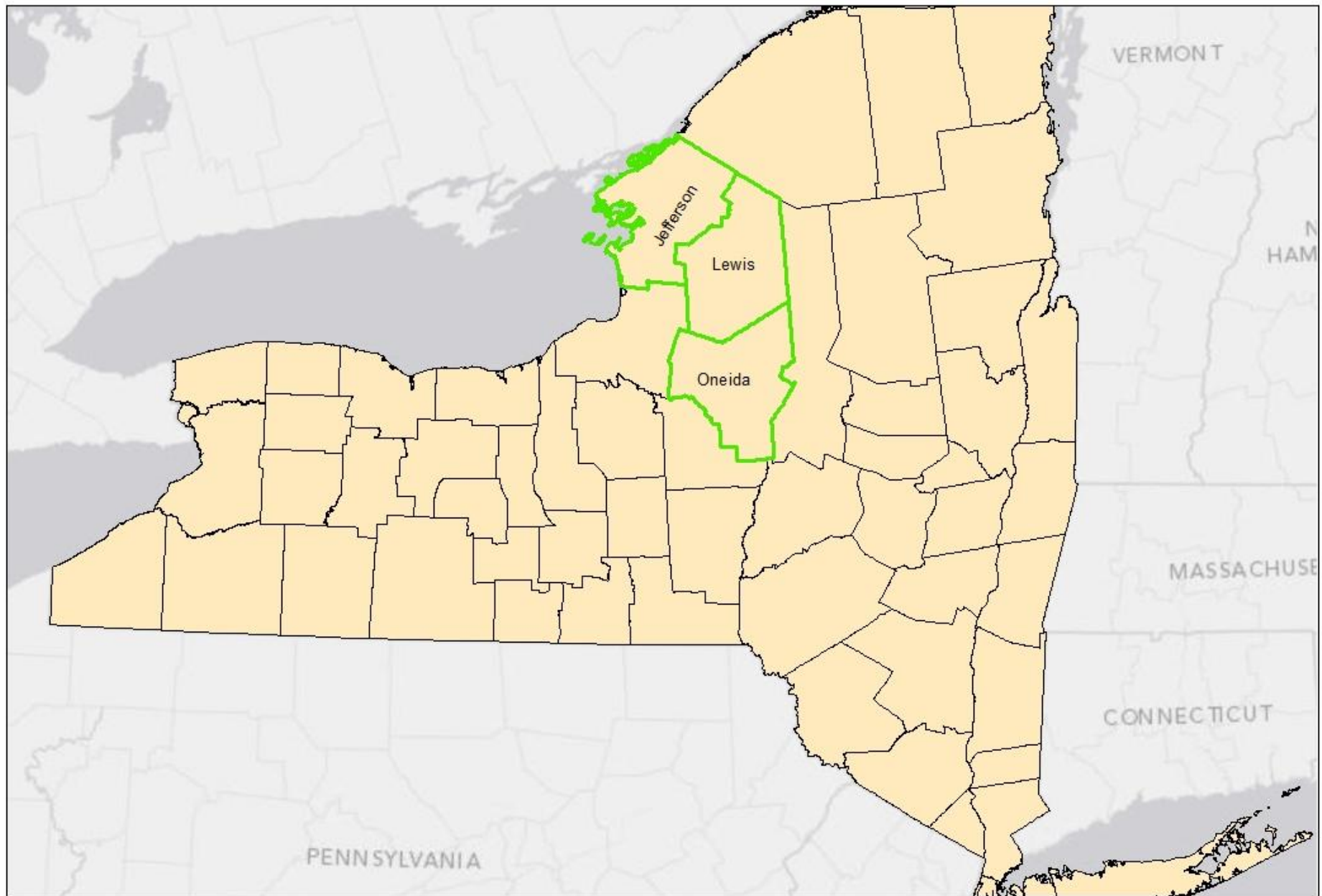
Operated by ReEnergy

Coastal Carolina Clean Power

30 MW facility in Kenansville, NC

Recycling Facilities

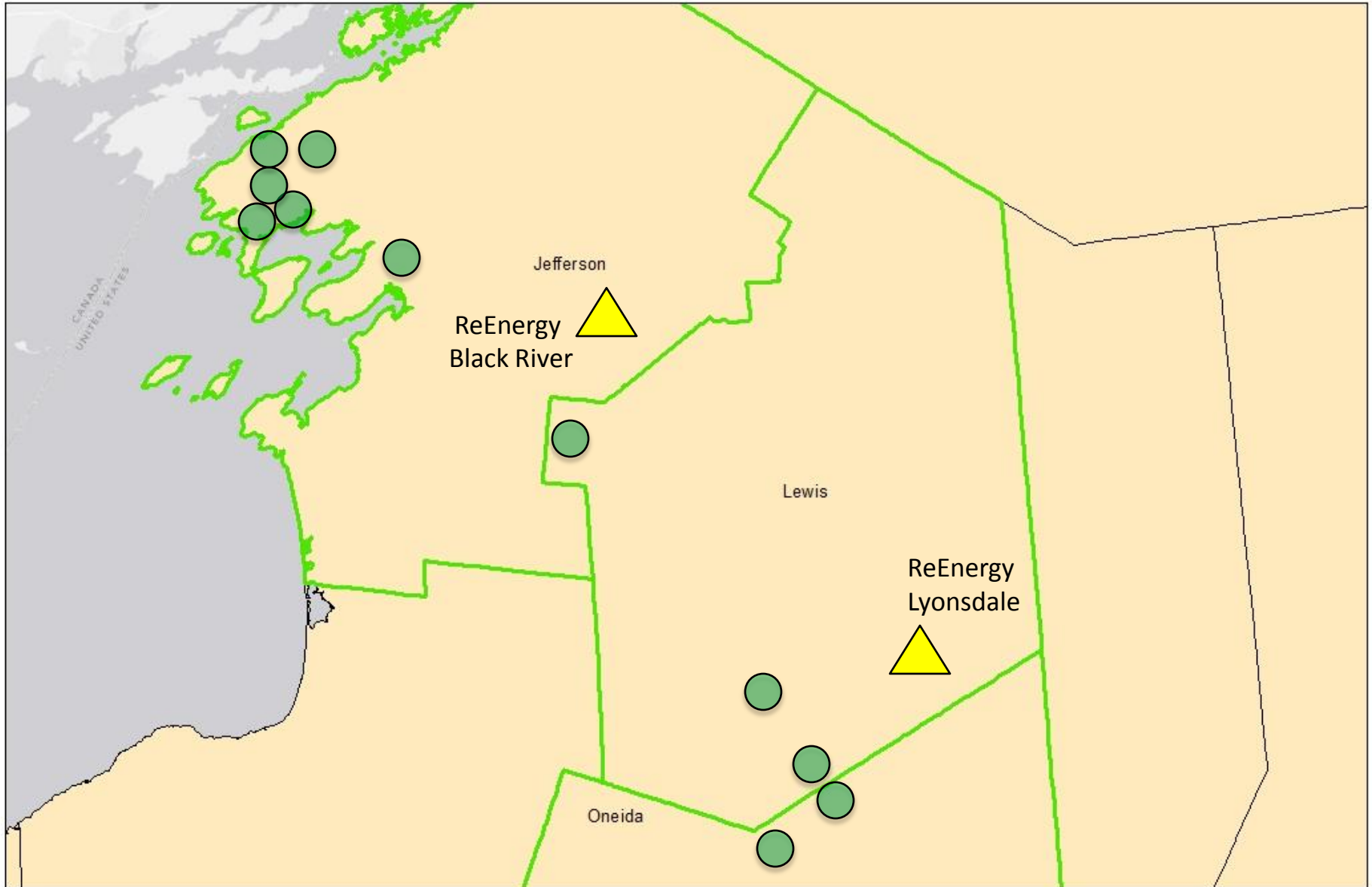
New York State Counties with Commercial Willow Production



0 50 Miles



New York State Counties with Commercial Willow Production



0 16 Miles

● Willow Production Area

▲ Biopower Facility

Commercial Plantings - 2013

- 850 acres in northern New York State
- Mostly marginal soils or fallow
- Willow step planter



Commercial Plantings - 2013

- Planting speed = 1.5 acres per hour
- Planting stock quality (sorting)
- Wet spring delayed planting
- Fall site prep for large acreage
- Weed pressure and controls vary field to field



Commercial Plantings - 2013

- Coppiced over winter 2013/2014
- Majority well established
- 50 of 850 acres to be replanted
 - Late establishment
 - Hot & Dry
 - 2014 Site Prep
 - 2015 replant
- Weed control ongoing some areas



May 2014



May 2014



June 2014



06.23.2014

June 2014



06.23.2014

Commercial Harvesting

- 300 acres previously established crops in USDA BCAP
- No establishment grants
- Land payment & contracts
- 100 acres harvested 2013
- 200 acres next 1-2 years
- **1200 commercial acres - harvest every year**



Harvesting Platform

- New Holland self propelled forage harvester - 130FB header
- Developed by New Holland Agriculture from 2008 - 2012
- Tested in commercial-scale trials by SUNY ESF 2012
- Efficient harvesting platform – now commercially available



Chip Collection System

- Matching harvester throughput
- Up to 70 -100 tons/hour (wet)
- Keeping harvester moving
- Limit collection vehicles
- Maintain efficiencies
- High-dump sugar cane wagons
 - Dump directly into transport vehicles
 - Large 12 ton capacity
 - Narrow wheel base



Biopower 2013

- 2,500 tons of chips harvested from BCAP fields
- ReEnergy Lyonsdale - mixed with forest residue chips
- 1400 Mwh of renewable electricity from willow (5% gen)



Second Rotation Coppice Regrowth



Second Rotation Coppice Regrowth



06 19 2014

Commercial Willow Chip Quality

- Low variability feedstock that meets end user specs
- Mixing with forest residue chip for biopower
- 2013 harvest samples taken at plant gate



Moisture Content

	<u>2013</u> Commercial Harvest	<u>2012</u> Commercial Trials	Previous Research Trials
Average	43%	45%	44%
Stan Dev	± 2%	± 2%	-
Range	35% – 55%	37% - 52%	-

Ash Content

	<u>2013</u> Commercial Harvest	<u>2012</u> Commercial Trials	Forest Residue Chips
Average	3.0%	2.6%	~2%
Stan Dev	± 0.7%	± 0.6%	-
Range	2% - 4%	1% - 3%	-

Energy Density

	2013 Commercial Harvest	2012 Commercial Trials	Forest Residue Chips
btu/lb (dry)	8,240	8,200	8,200 - 8,600

- Overall chip quality similar to forest residues chips
- Meets end user specs
- Suitable for mixing feedstocks



Willow Extension Services

Training and education for BCAP willow...

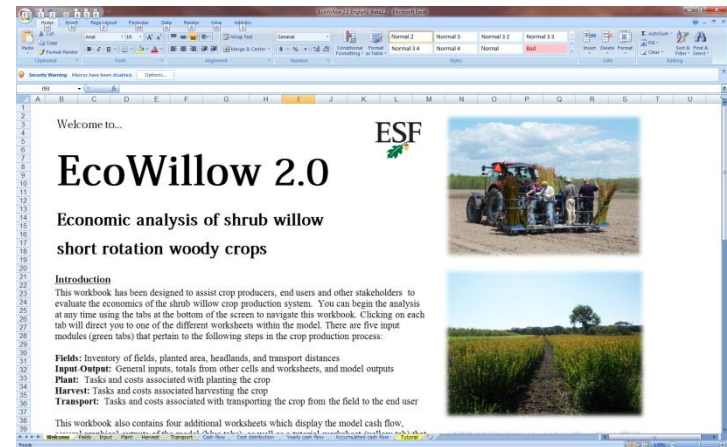
- Technical assistance
- Outreach programs
- Crop monitoring
- Equipment access
- Analytical tools and research summaries



EcoWillow 2.0

Lifecycle Economic Model

- Establishment, harvest, transport
- SUNY ESF (2007) - Updated 2014
- Current data, logistics and best practices from commercial willow
- More user friendly design based on grower feedback
- Currently beta testing



Model Input-Output			Investment time frame	
Model Inputs			13 yrs	22 yrs
General data				
Total Field Area (from Fields module)	ac	25.0		
Planted Area (from Fields module)	ac	23.5		
Average biomass yield delivered (wet)	tons/ac/yr	10.5		
Crop rotation length	yr	3		
Interest rate	%	5.00%		
Land costs (tax, taxes) and insurance	\$/ac/yr	35		
Internal administration costs	\$/ac/yr	5		
Biomass price at plant gate (wet)	\$/ton	27.50		
Stock removed at project end	\$/ac	415		
Moisture content at harvest (for dry outputs)	%	40%		
Incentive Program				
Years of enrollment in incentive program	yr	0	11	
Annual average incentive payments (APY)	\$/ac/yr	0	30	
Percentage of APY paid in harvest year	%	0%	0%	
Biomass incentive (on payments (wet))	\$/ac	0	20	
Establishment grants received	\$/ac	0	741	
Crop Establishment				
Vegetation removal (brush hogging)	\$/ac	25	25	
Contact herbicide	\$/ac	30	30	
Flux	\$/ac	20	20	
Rock picking and site improvements	\$/ac	0	0	
Disc	\$/ac	20	20	
Plant cover crop	\$/ac	0	0	
Kill cover crop	\$/ac	0	0	
Model Outputs				
Financial analysis tools				
Total Present Value (NPV)	\$/ac	\$20,525	\$19,368	
NPV optimistic (R=10%, E=10%)	\$/ac	\$8,072	\$2,430	
NPV pessimistic (R=10%, E=10%)	\$/ac	\$12,379	\$16,302	
Internal Rate of Return (IRR)	%	-0.4%	49.6%	
IRR optimistic (R=10%, E=10%)	%	-0.1%	3.0%	
IRR pessimistic (R=10%, E=10%)	%	45.0%	45.0%	
Production costs and earnings				
Average costs per acre	\$/ac/yr	\$305	\$294	
Average (gross) revenue per acre	\$/ac/yr	\$251	\$207	
Average (net) earning per acre	\$/ac/yr	\$54	\$28	
Average costs per ton (wet)	\$/ton	\$53	\$30	
Average (net) earning per ton (wet)	\$/ton	\$5	\$2	
Biomass price at farm gate (wet)	\$/ton	\$22	\$22	
Startup costs for first harvest	\$/ac	\$18,170		
Startup costs per acre field area	\$/ac	\$1,284		
Costs for one commercial harvest	\$/ac	\$8,331		
Dry weight outputs (0% moisture)				
Average costs per ton (dry)	\$/ton	\$61	\$55	
Average (net) earning per ton (dry)	\$/ton	\$10.67	\$5.22	
Biomass price at farm gate (dry)	\$/ton	\$40	\$40	
Harvest costs per unit biomass	\$/ton	\$20	\$20	
Transport costs per unit biomass	\$/ton	\$10	\$10	

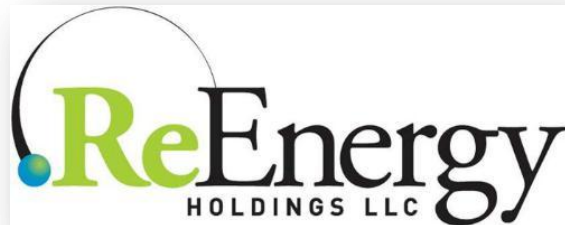
National BioEnergy 2013



10.17.2013

Future Crop Outlook

- Commercial production just beginning in NYS
- Seeing innovation and system improvements by growers
- Ongoing breeding programs and experimental trials...
 - SUNY ESF, Cornell University and others
- Numerous commercial and collaborative partnerships...



Future BCAP Incentives

Included in approved 2014 Farm Bill

-pending allocation of funds...

- Establishment grants
- Land rental payments
- Purchasing contracts
- Possible biomass co-payments



Summary

- Commercial willow production happening in the US
- Starting with 1200 acres in New York State
- BCAP incentives, contracts, and extensions services
- Catalyzing adoption and innovation
- Chip quality meets end user specs for mixing
- Continued opportunities & improvements expected!

Thank You For Your Time!

More Info...

www.esf.edu/willow/

Contact...

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