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."

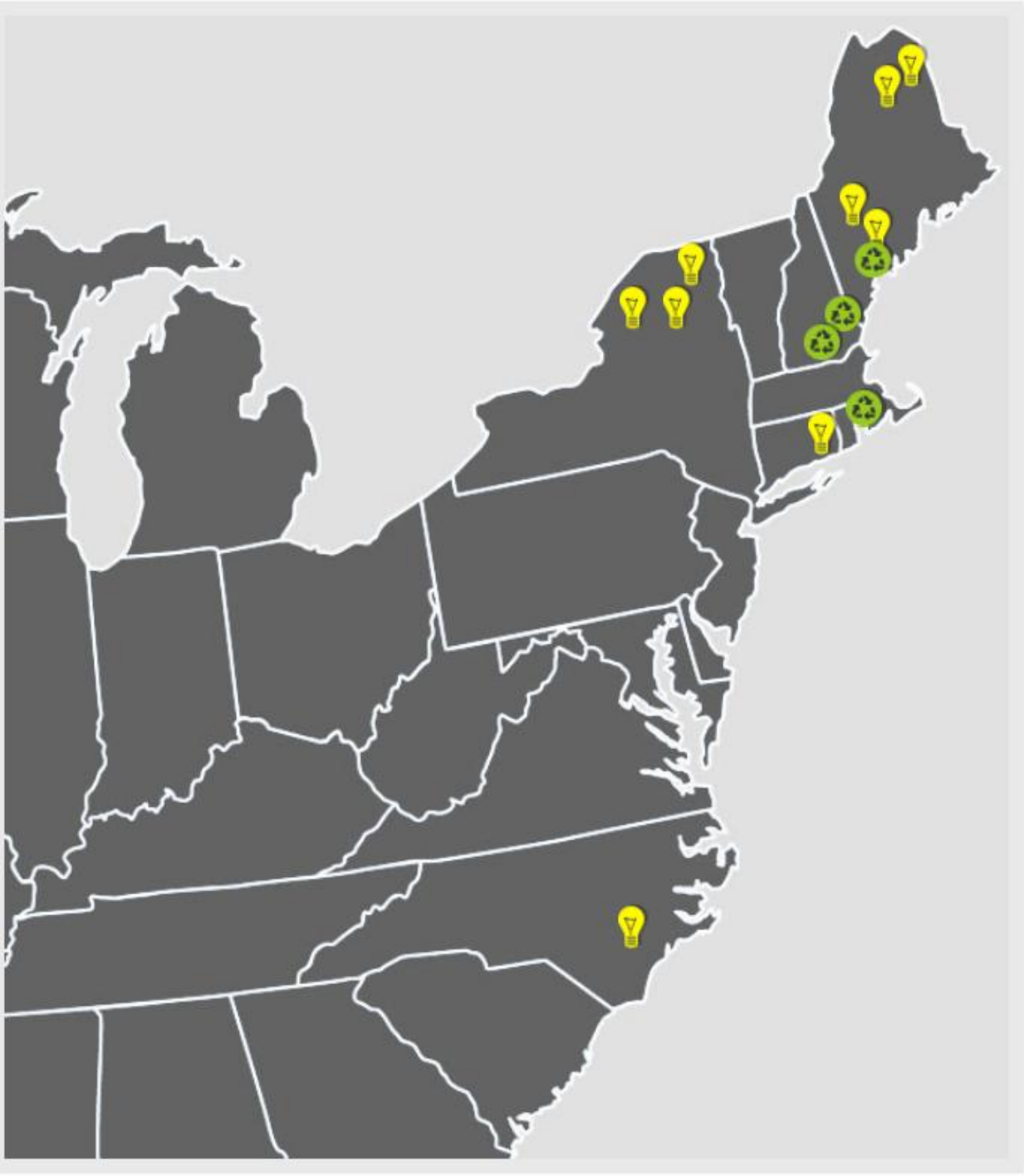
Biomass Crop Assistance Program

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

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

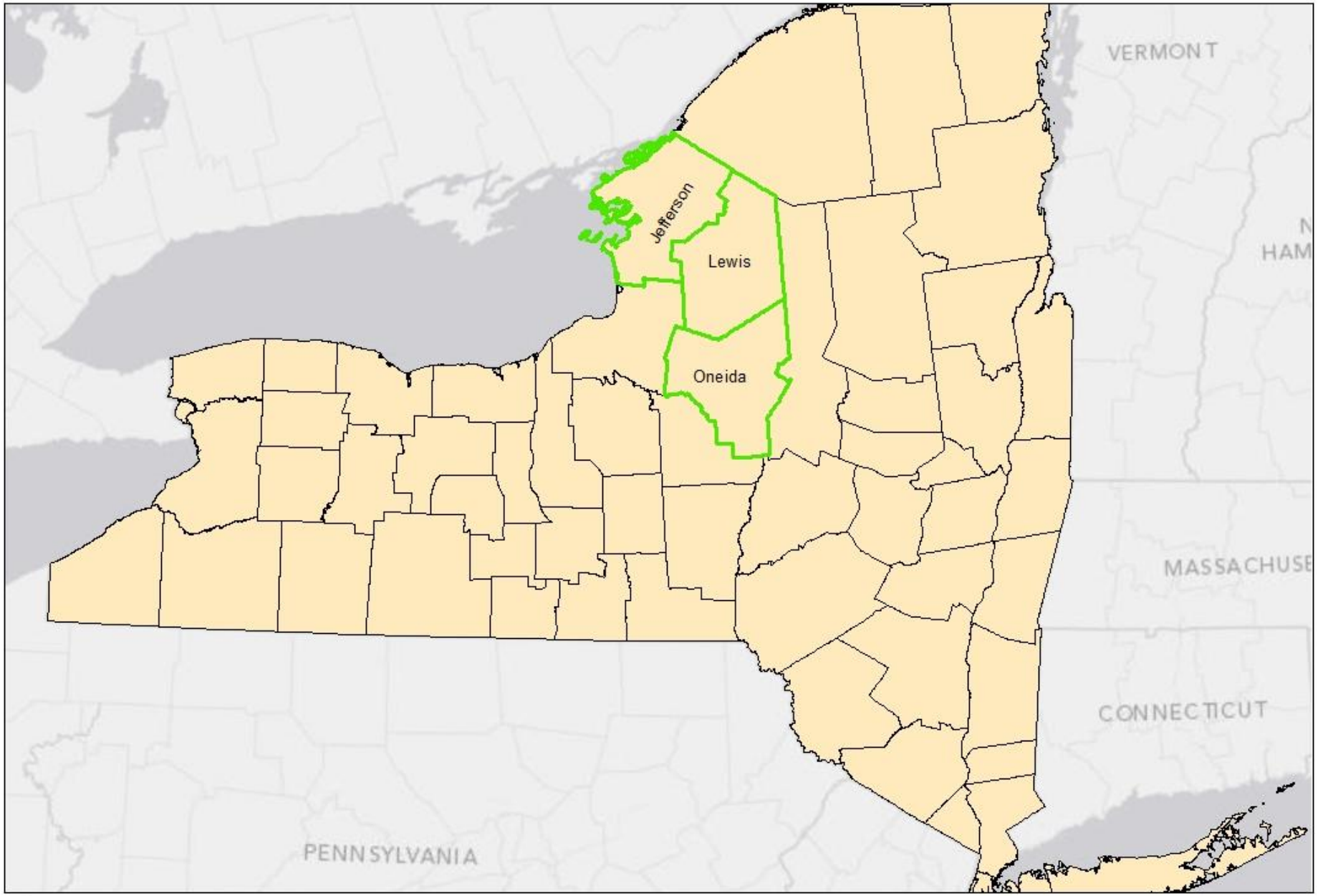
ReEnergy Stratton
48 MW facility in Stratton, ME

Operated by ReEnergy

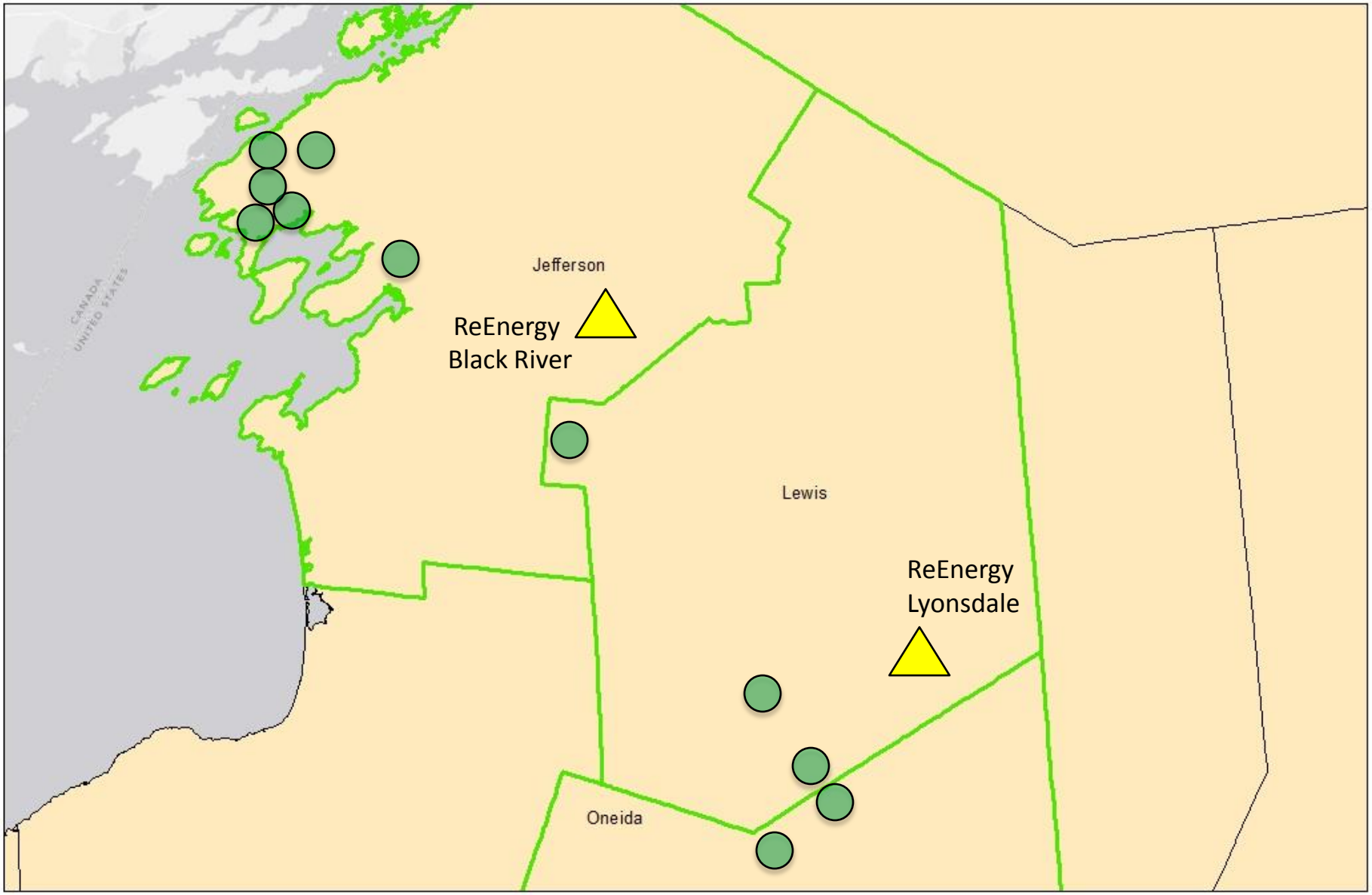
Coastal Carolina Clean Power
30 MW facility in Kenansville, NC

Recycling Facilities

New York State Counties with Commercial Willow Production



New York State Counties with Commercial Willow Production



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

June 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

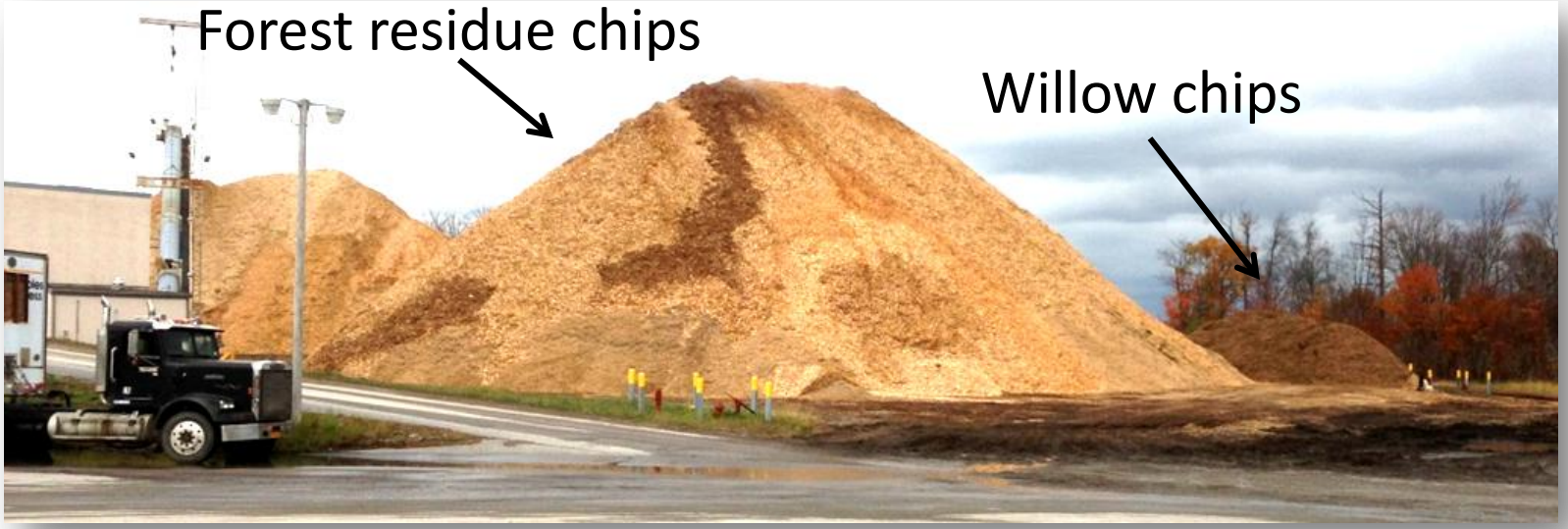
- New Holland self propelled forage harvester - 130FB header
- Developed by New Holland Agriculture from 2008 - 2012
- Tested in commercial-scale trials by SUNY ESF 2012
- Efficient harvesting platform – now commercially available

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

Commercial Willow Chip Quality

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

Moisture Content

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

Ash Content

	2013 Commercial Harvest	2012 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

ESF

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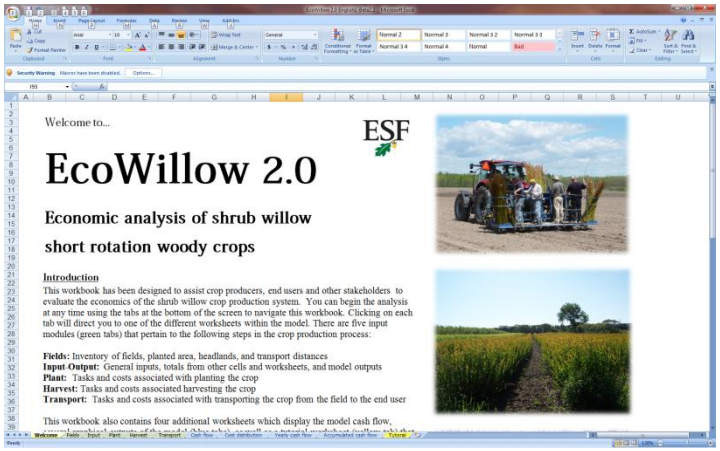
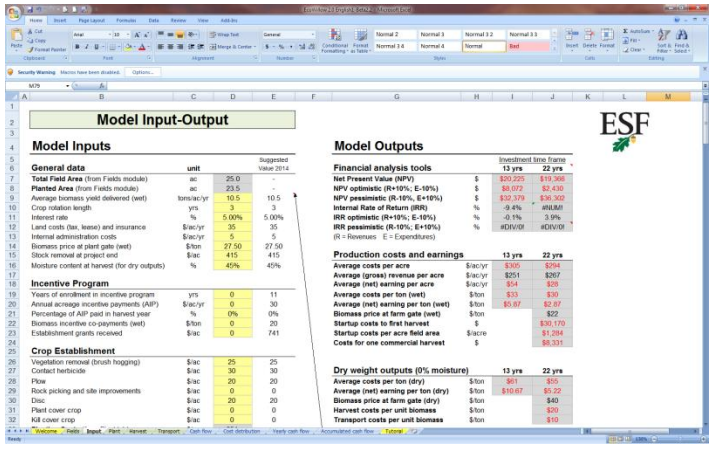
Energy. Innovation. Solutions.

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





National BioEnergy 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…

ReEnergy HOLDINGS LLC

NEWBio

NEW HOLLAND AGRICULTURE

Double A Willow

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!

More Info…

www.esf.edu/willow/

Contact…

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