

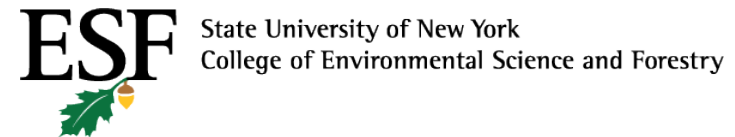
# BCAP Project Area 10: New York Willow

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ReEnergy Holdings



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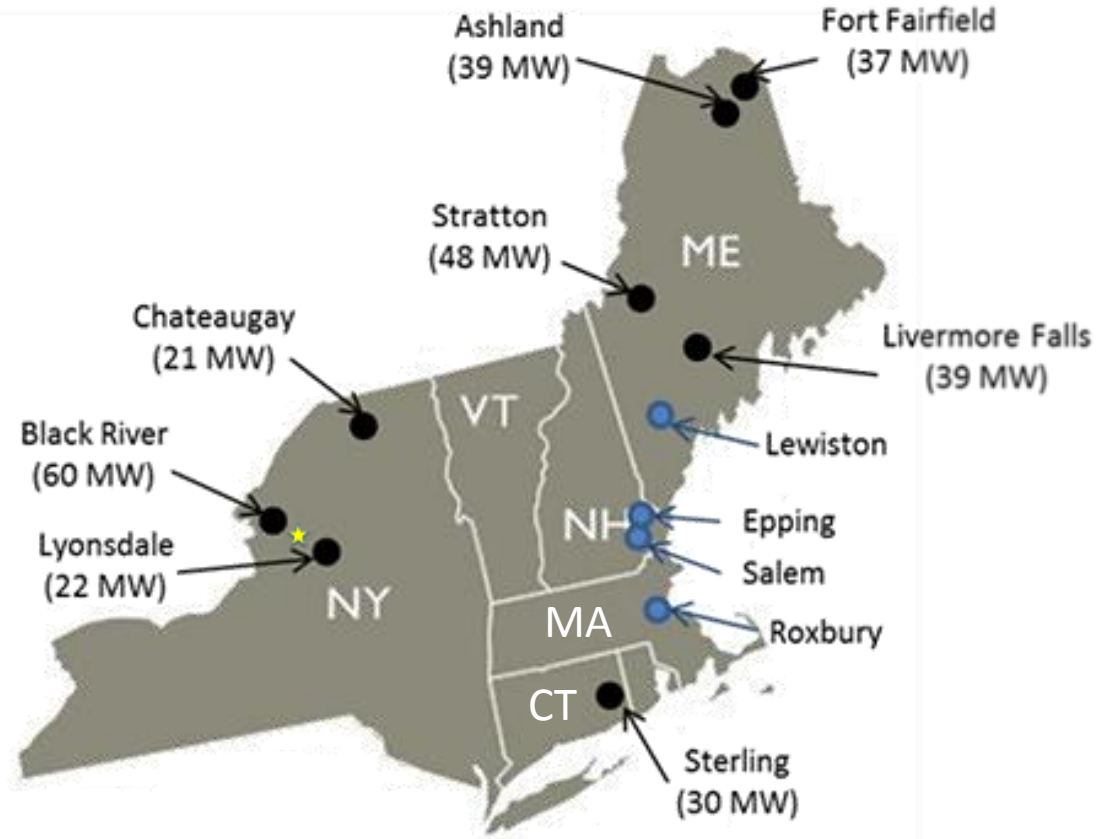
SUNY-ESF



# Fast Facts: ReEnergy Holdings



- ~300 MWs of renewable energy generation
- ~ 300 employees; 5 states



● Renewable Energy Facility  
● Recycling Facility  
★ Headquartered in Latham, NY

# ReEnergy Holdings in New York



- 80 employees
- 103 MW of installed capacity, or 738,000 MWh – enough to serve 96,000 homes
- \$24 million in annual fuel purchases
- Support more than 300 indirect jobs, most in the forest



# ReEnergy Facilities in NYS



- ReEnergy Black River: 60 MW
- ReEnergy Lyonsdale: 22 MW
- ReEnergy Chateaugay: 21 MW



- Large demand for woody feedstocks
- Primarily forest residues
- Recent contract with Fort Drum Army post; 100% renewable electricity for next 20 years



# Fuel Supply Program



- **End-market for BCAP Shrub Willow**
- **Equipment Leasing Program**
  - ReEnergy launched a program allowing loggers to gain access to state-of-the-art equipment and secure long-term agreements to provide fuel to ReEnergy
- **SFI Certification**
  - First company solely devoted to electricity production to be certified by SFI
  - Commitment to use best management practices and protect forest health



## Commercial Willow Production

- More than 3,100 tons of willow delivered to Lyonsdale and Black River facilities over first two harvest seasons, 2013 and 2014. YTD 2015: 1,200 tons.
- Willow found to be suitable fuel in terms of moisture and ash content, now incorporated directly with other feedstocks upon delivery.
- Current willow plantings are planned to be harvested about 350-400 acres per year.
- This will produce roughly 8,000-9,000 green tons of feedstock annually



# Woody Biomass in Society

## World Energy Use

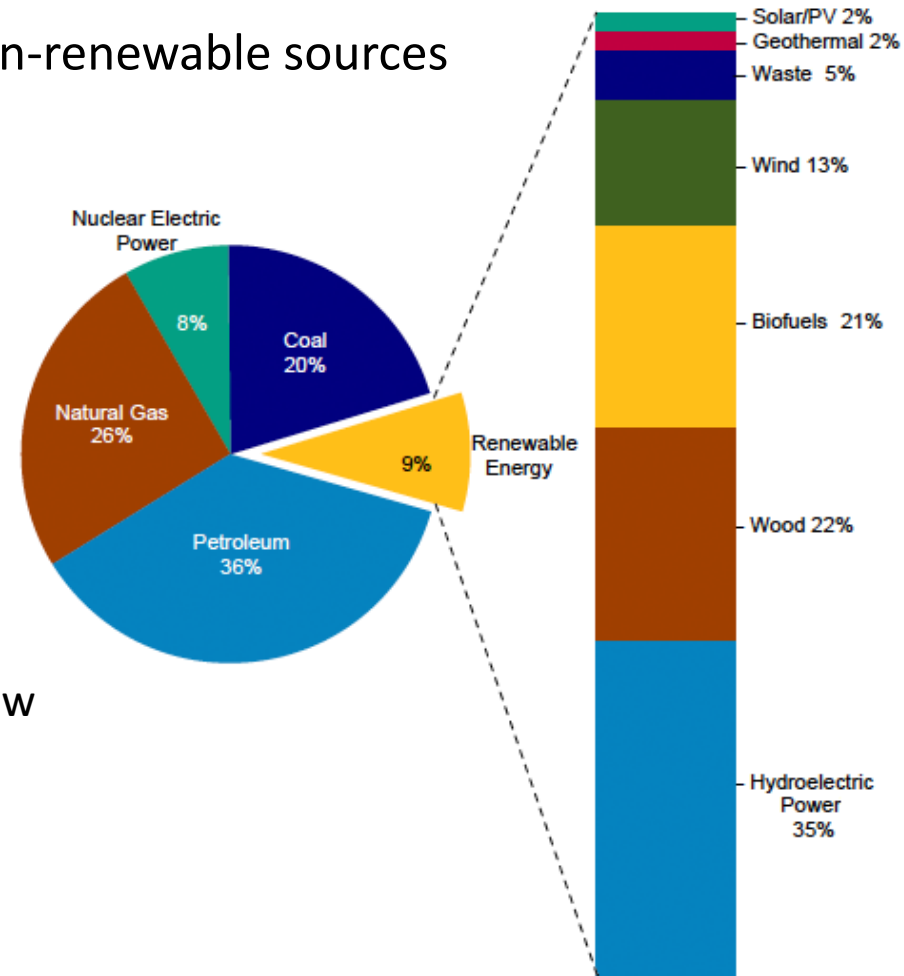
- Increasing exponentially, mostly non-renewable sources

## Biomass Energy

- 43% of all renewables world in US

## Projected Supply

- 1,500 million dry tons per year by 2030
- 600 million from energy crops like willow





# Willow Genus (*Salix* spp.)

## Shrub willow



*Salix purpurea*, *Salix miyabeana*, *Salix sachlinensis*,  
*Salix viminalis*, *Salix eriocephala*, *Salix caprea*...

...and many cultivars of these species

Not tree willows!



(*Salix babylonica*)

# SUNY-ESF Willow Project



## Research on shrub willow since 1986

- Cropping methods
- Breeding
- Yield
- Economics
- Best practices
- Environmental sustainability
- **Commercialization**



# Why Shrub Willow?

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- ✓ Unique plant characteristics
- ✓ Ease of establishment
- ✓ Regrows after each harvest
- ✓ 4-5 dry tons/acre/year
- ✓ Limited pests and diseases



# Willow in Central and Northern NY

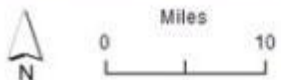
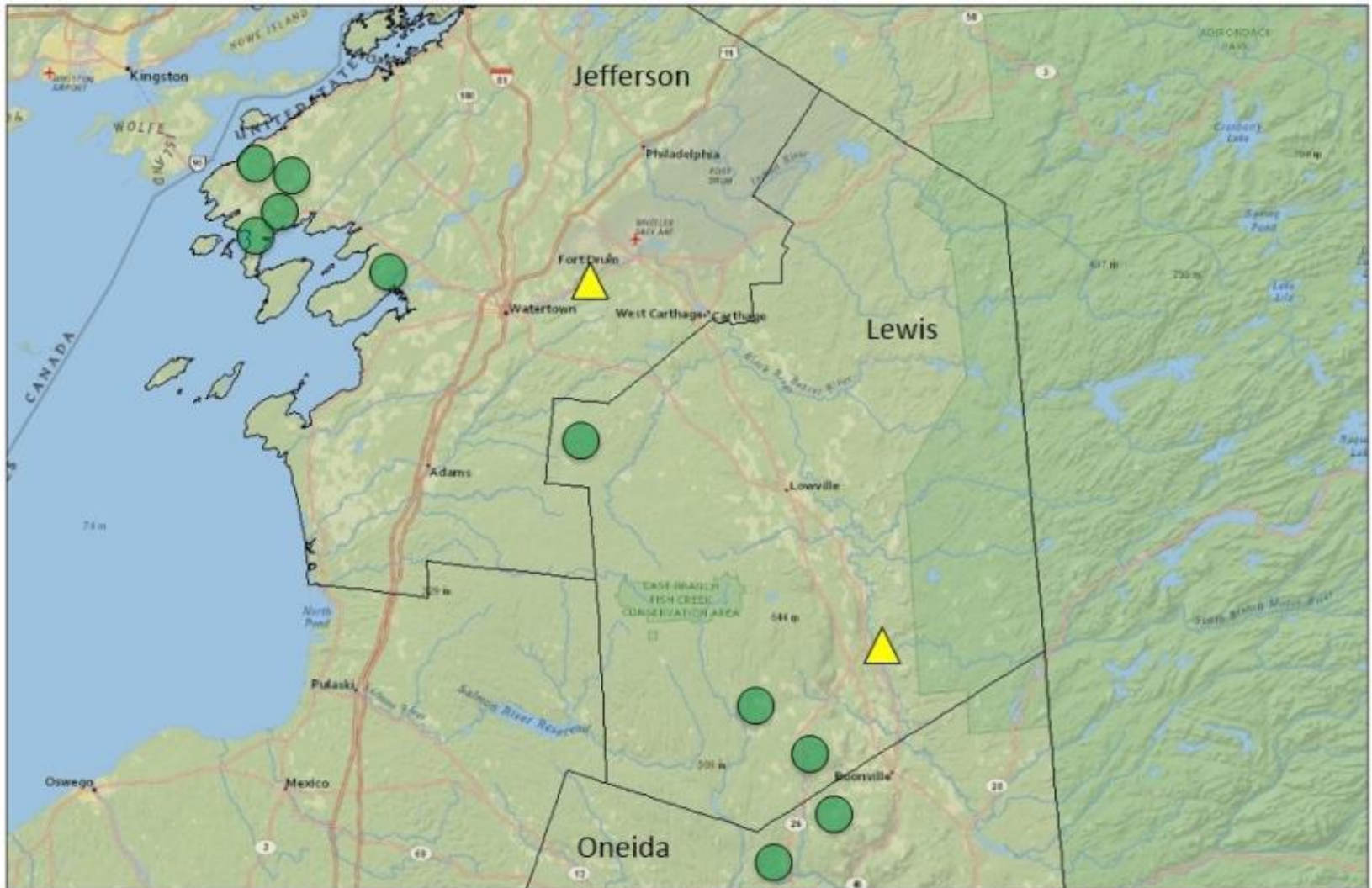
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- About 1,150 acres in the ground
- Harvesting about 350-400 acres per year
- Delivered to ReEnergy biopower facilities
- Mixed with forest residues
- Renewable electricity

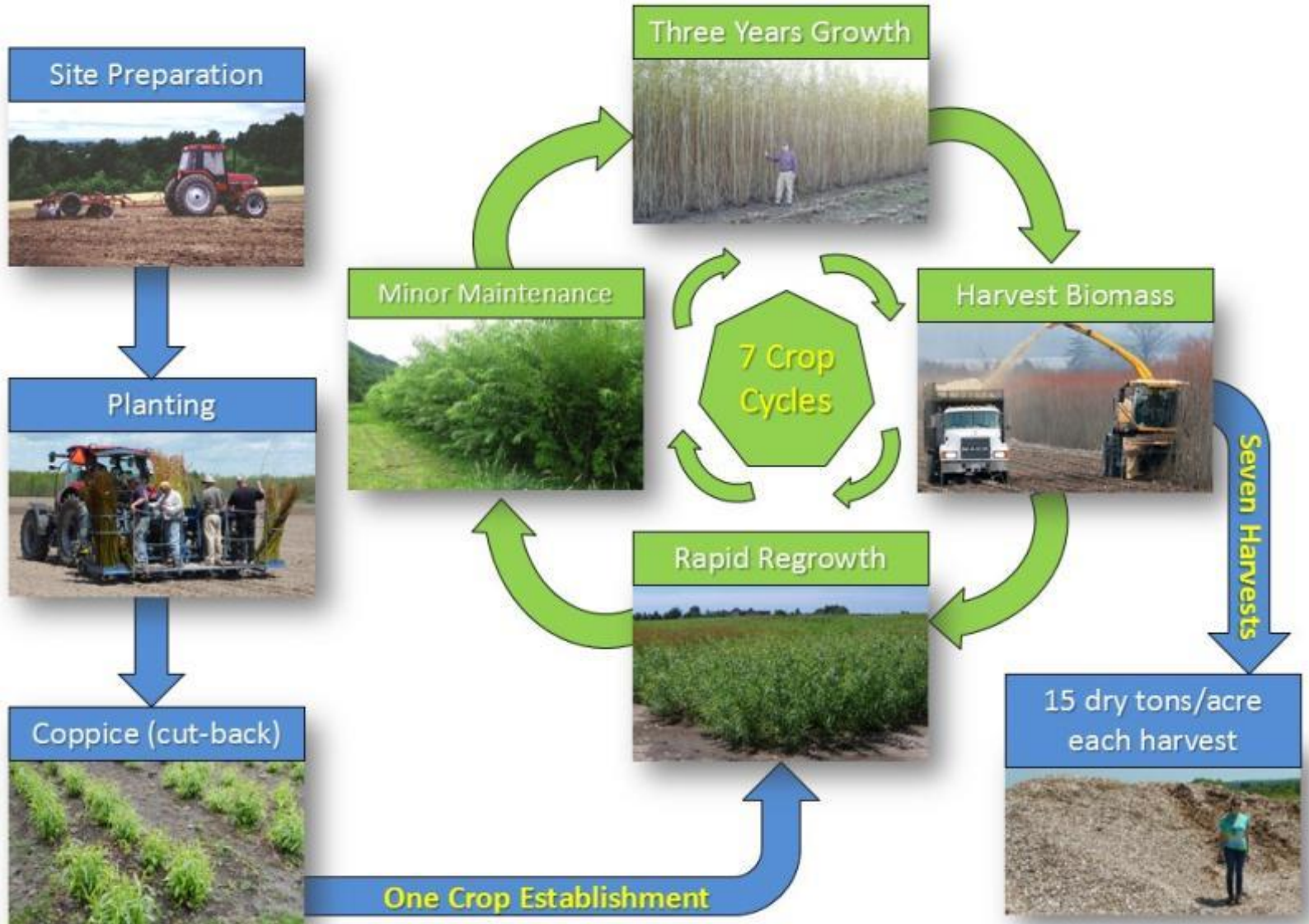


# Willow in Central and Northern NY



● Willow Production Area      ▲ ReEnergy Biopower Facility

# Willow Crop Production Cycle

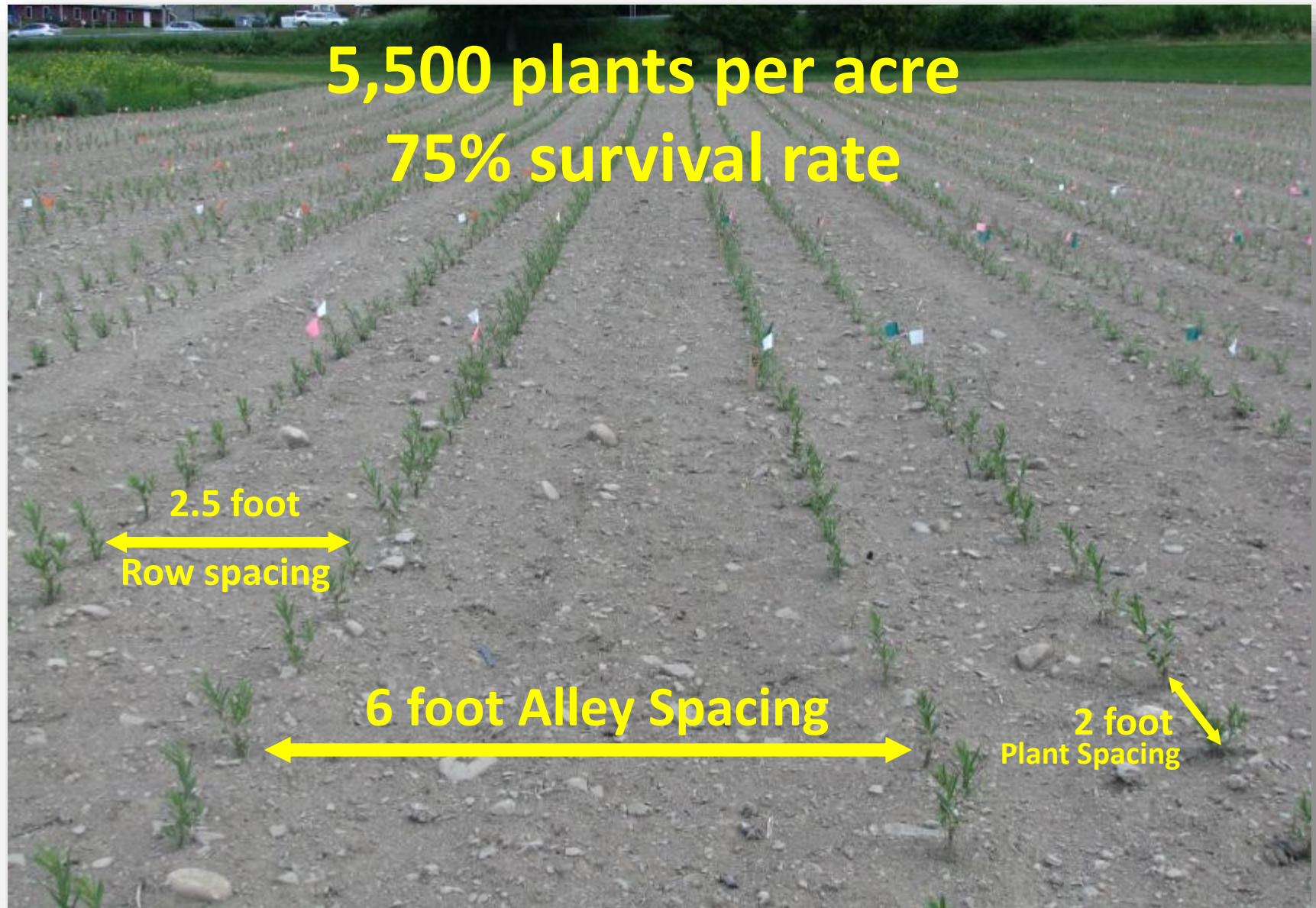


# Mechanized Planting

- Specialized planter cuts large willow stems (“whips”) to about 10 inch “cuttings” and plants in one pass
- Equipment and planting services are available from Celtic Energy and Double A Willow
- Improved willow varieties available from Double A Willow
- Orders for spring planting must be placed several months in advance



# Double-Row Planting Pattern





# Three Years After Coppice



# Willow Harvesting

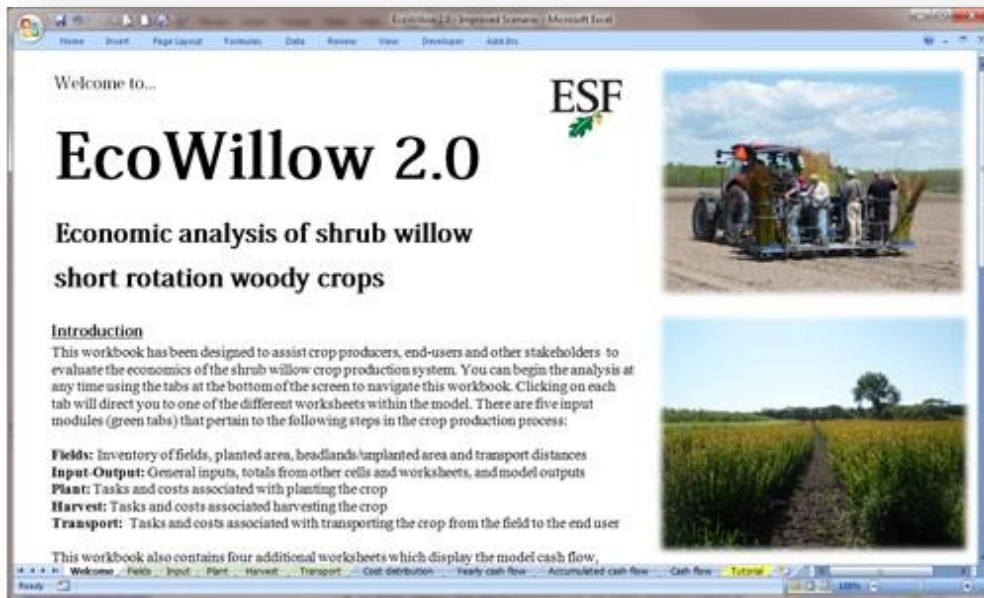
## New Holland forage harvester and 130FB header

- ✓ Developed by Case New Holland and SUNY-ESF from 2008 - 2012
- ✓ Reduced harvesting costs by 35% (Eisenbies et al. 2014)
- ✓ Now available for purchase or rental



# EcoWillow Model

- Cash flow model
- Willow biomass crops
- All phases of production
- User-friendly & customizable
- Recently updated using..
  - Commercial operations
  - Latest research studies
  - Example production scenarios



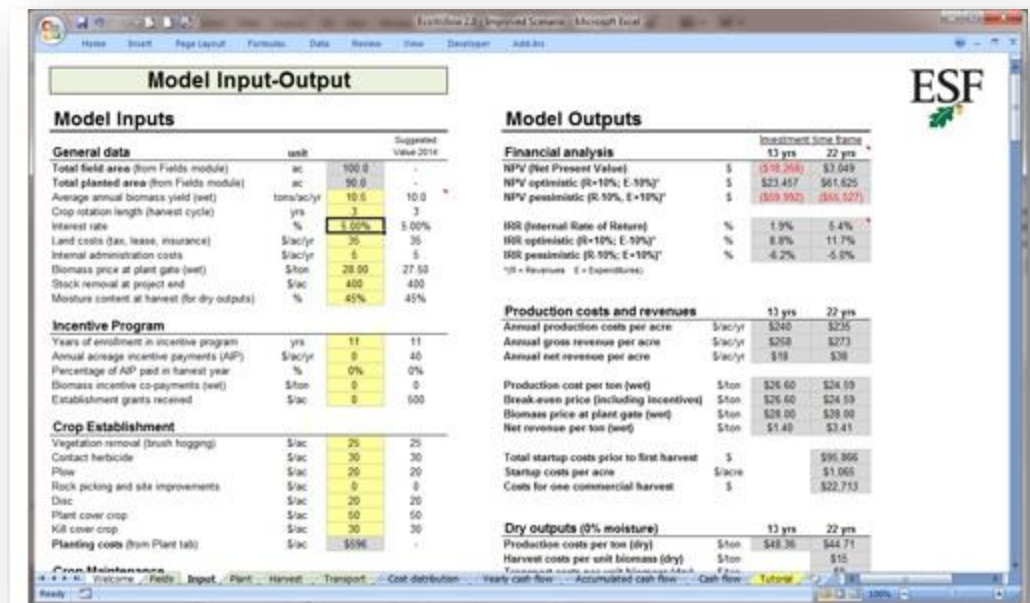
Download at:  
[www.esf.edu/willow](http://www.esf.edu/willow)

## Base Case Scenario 2014

- Conservative estimates of profitability
- 22-year life cycle of the planting including tear-out
- Does not include best BCAP incentives or best practice targets

## Model Outputs

- Break-even scenario
- Payback is entire life cycle of project



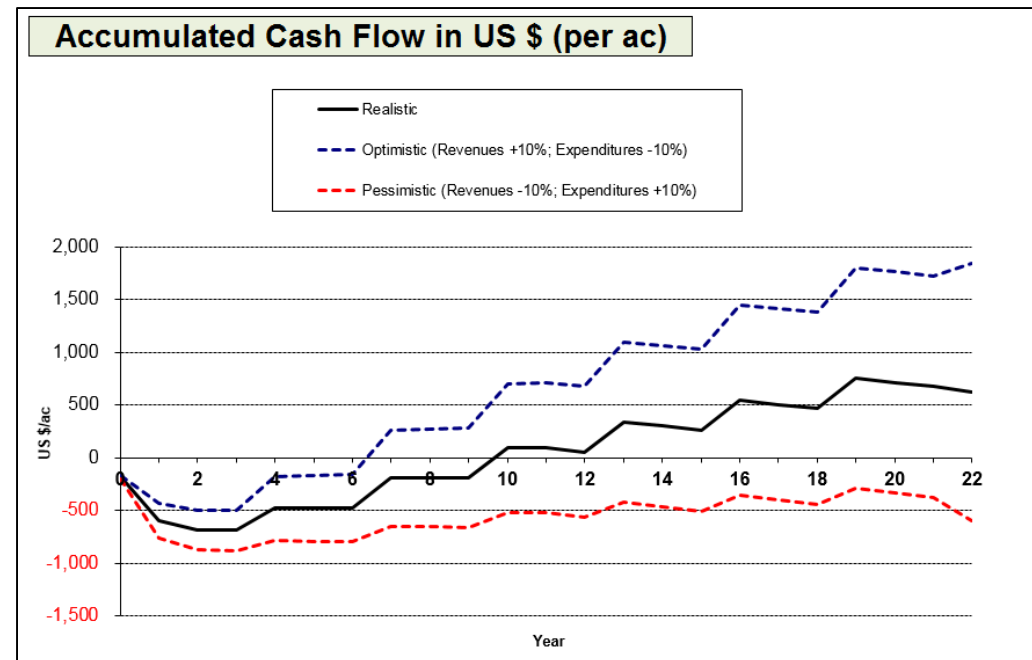
Model Input-Output		
<b>Model Inputs</b>		
<b>General data</b>		
Total field area (from Fields module)	ac	100.0
Total planted area (from Fields module)	ac	90.0
Average annual biomass yield (wet)	ton/ac/yr	10.5
Crop rotation length (harvest cycle)	yr	3
Interest rate	%	5.00%
Land costs (tax, lease, insurance)	\$/ac/yr	35
Internal administration costs	\$/ac/yr	5
Biomass price at plant gate (wet)	\$/ton	20.00
Stack removal at project end	\$/ac	400
Moisture content at harvest (for dry outputs)	%	45%
<b>Incentive Program</b>		
Years of enrollment in incentive program	yr	11
Annual average incentive payments (AP)	\$/ac/yr	0
Percentage of AP paid in harvest year	%	0%
Biomass incentive co-payments (wet)	\$/ton	0
Establishment grants received	\$/ac	0
<b>Crop Establishment</b>		
Vegetation removal (brush hogging)	\$/ac	25
Contact herbicide	\$/ac	30
Plow	\$/ac	20
Rock picking and site improvements	\$/ac	0
Disc	\$/ac	20
Plant cover crop	\$/ac	50
Kill cover crop	\$/ac	30
Planting costs (from Plant tab)	\$/ac	5596
<b>Model Outputs</b>		
<b>Financial analysis</b>		
NPV (Net Present Value)	\$	(\$23,368)
NPV optimistic (R=10%, E=10%) <sup>†</sup>	\$	\$23,457
NPV pessimistic (R=10%, E=10%) <sup>†</sup>	\$	(\$63,992)
IRR (Internal Rate of Return)	%	1.9%
IRR optimistic (R=10%, E=10%) <sup>†</sup>	%	8.8%
IRR pessimistic (R=10%, E=10%) <sup>†</sup>	%	-6.2%
<b>Production costs and revenues</b>		
Annual production costs per acre	\$/ac/yr	\$340
Annual gross revenue per acre	\$/ac/yr	\$268
Annual net revenue per acre	\$/ac/yr	-\$78
Production cost per ton (wet)	\$/ton	\$26.60
Break-even price (including incentives)	\$/ton	\$26.60
Biomass price at plant gate (wet)	\$/ton	\$20.00
Net revenue per ton (wet)	\$/ton	\$1.40
Total startup costs prior to first harvest	\$	\$91,956
Startup costs per acre	\$/acre	\$1,065
Costs for one commercial harvest	\$	\$22,713
<b>Dry outputs (0% moisture)</b>		
Production costs per ton (dry)	\$/ton	\$48.36
Harvest costs per unit biomass (dry)	\$/ton	\$15

## Base Case Scenario + BCAP Incentives

- 2014 base case assumptions and 2015 BCAP funding

## Model Outputs

- Positive NPV
- IRR 10%
- Payback...
  - 10 years after planting
  - Third Harvest
- All-in costs about \$25/ton

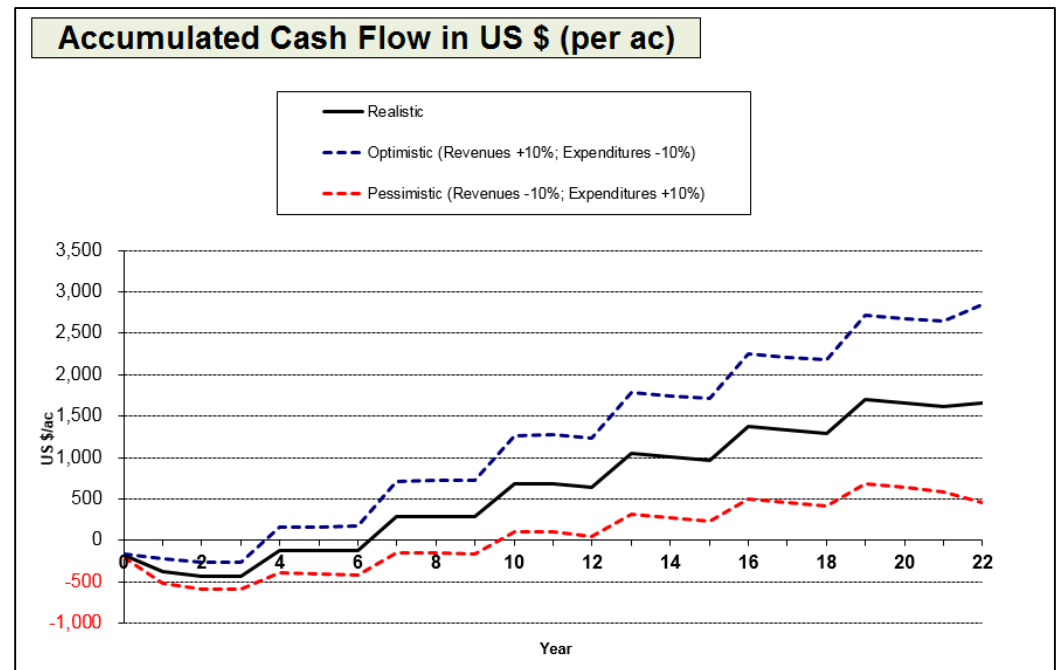


## Improved Base Case + BCAP Incentives

- Adds current BCAP incentives and best practice targets to base case

## Model Outputs

- Positive NPV
- IRR 20%
- Payback
  - 7 years after planting
  - Second harvest
- All-in costs about \$20/ton



# Willow Environmental Benefits

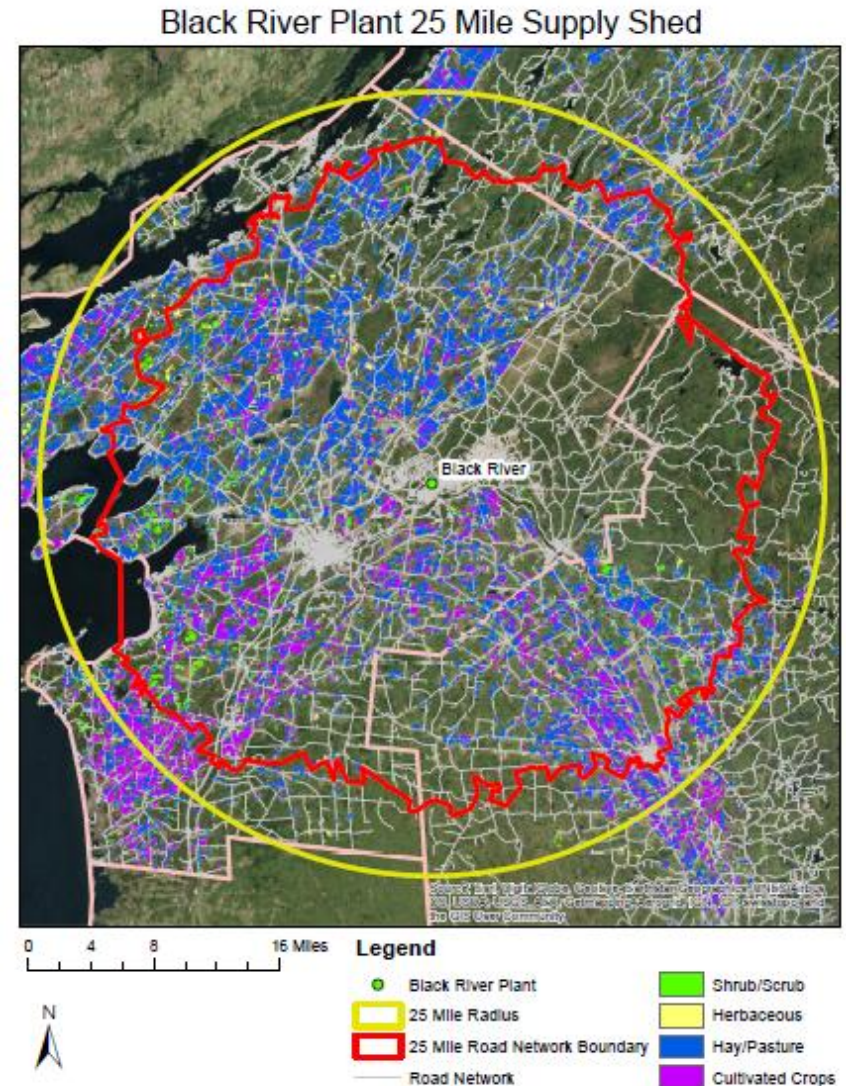
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- Carbon neutral lifecycle does not contribute to climate change
- Low lifecycle herbicide/pesticide/fertilizer requirements
- Perennial crop limits soil erosion and nutrient runoff
- Revitalize idle or marginal lands
- Wildlife habitat for birds and mammals
- Creates jobs and rural development



# Potentially Available Land

- Recent GIS analysis
- 25-mile road network
- ReEnergy Black River
- 170,000 suitable acres
  - Hay/Pasture: 110,000 acres
  - Row Crops: 40,000 acres
  - Herbaceous/Scrub: 20,000 acres
- Can be grown on marginal lands
- Revitalize underutilized land base





# Willow Extension Services

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## Training and education for BCAP willow...

- Technical assistance
- Outreach programs
- Crop monitoring
- Equipment access
- Analytical tools & research summaries
- Land assessments & consulting services



# Willow Summary

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- ✓ Promising source woody of biomass
- ✓ Years of research at SUNY-ESF
- ✓ Positive economic returns with BCAP
- ✓ 1,150 acres already established
- ✓ Secure market in ReEnergy
- ✓ Environmental benefits
- ✓ Extension services available
- ✓ **BCAP incentives for a limited time**



# Thank You!



## Please contact us at...

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