Multiple Benefits from Shrub Willow Living Snow Fences

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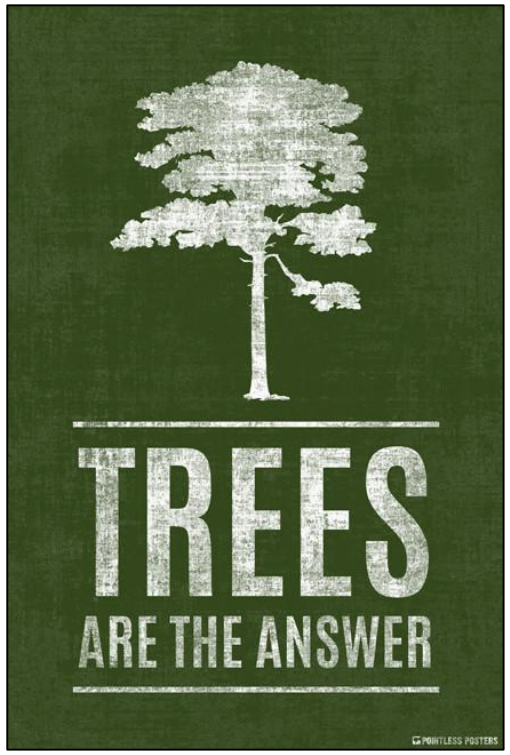
Overview

- Shrub Willow Crops
- Wind Breaks / Living Fences
- NYSDOT Project
- Landscape Integration and Biomass

About Me

- Senior Research Support Specialist
- SUNY-ESF, Syracuse NY
- B.S. Environmental Studies
- M.S. Natural Resource Management
- Sustainability and bioenergy since 2008
- Plant-based approaches to sustainability challenges



The Willow Project at SUNY ESF

All aspects of crop productions…

- Breeding
- Yield trials
- TEA/LCA
- Harvesting & Logistics
- Sustainability
- Network of partnerships
- **Commercial viability of bioenergy & alternative applications**

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USDA United States Department of Agriculture National Institute of Food and Agriculture

NEW HOLLAND AGRICULTURE

Shrub Willow (*Salix* spp.)

- Short-rotation woody crop
- Multi-stem shrub
- Yields 10-14 Mg/ha/yr (dry)
- Can grow on marginal soils
- Multiple environmental benefits
- Excellent for windbreaks and other applications

Current Willow Production

Europe

- Research and production since 1970's
- 25,000 – 30,000 ha (AEBIOM, 2011)

United States

- 500 ha in New York State
- Combined with forest residues
- Renewable electricity and heat
- USDA Biomass Crop Assistance Program
- Commitment of utility-scale end user
- Research and extension by ESF and others

Mechanized Planting

Double-Row Pattern

Unrooted Stem Cuttings

Few Weeks After Planting

2-4 Meters per Year

Multiple Stems 25-50 mm diameter

Harvest Every 3-4 Years

Seven Harvests from One Planting

Renewable Biomass Feedstock

Multiple Conversion Pathway and BioProducts

Windbreaks / Living Fences

- Single or multiple rows of vegetation (trees, shrubs, grass)
- One or more economic and environmental purposes

Purpose

- Reduce soil erosion
- Protect and enhance crops
- Shelter for livestock
- Reduce building energy use
- Noise/visual/odor screen
- Biomass potential
- Mitigate blowing and drifting snow

Blowing and Drifting Snow

Hazardous road conditions

- After the snow stops falling
- Poor visibility, drifting, icing

Financial and environmentals costs

- Plowing, salting, de-icing
- Use of heavy equipment
- Road maintenance and repair

Public Costs

- Travel delays, road closures, vehicle accidents

Blowing

Drifting

Opportunity

Reduce Cost of Snow Control

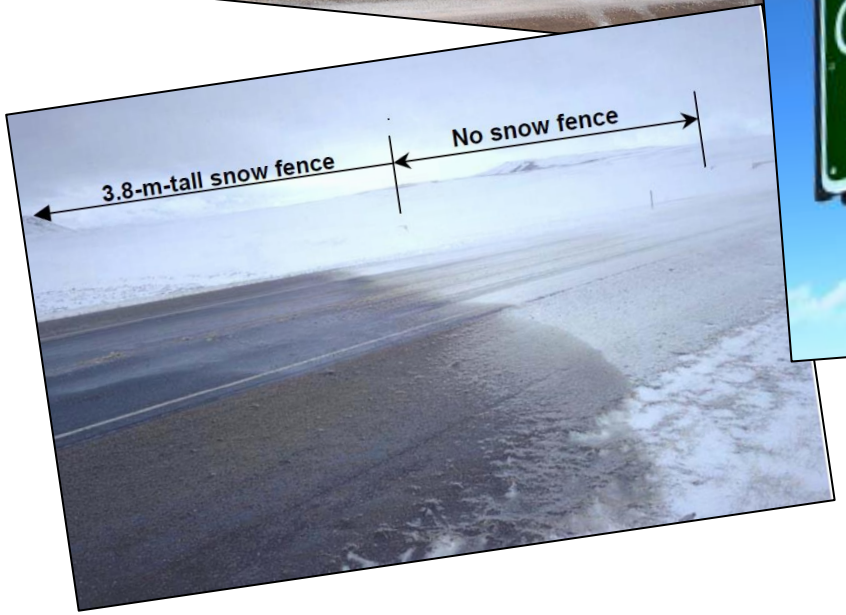
- $2.3 billion annually in the US

Improve Road Safety

- Reduce accidents rates
- Save lives

Additional Benefits

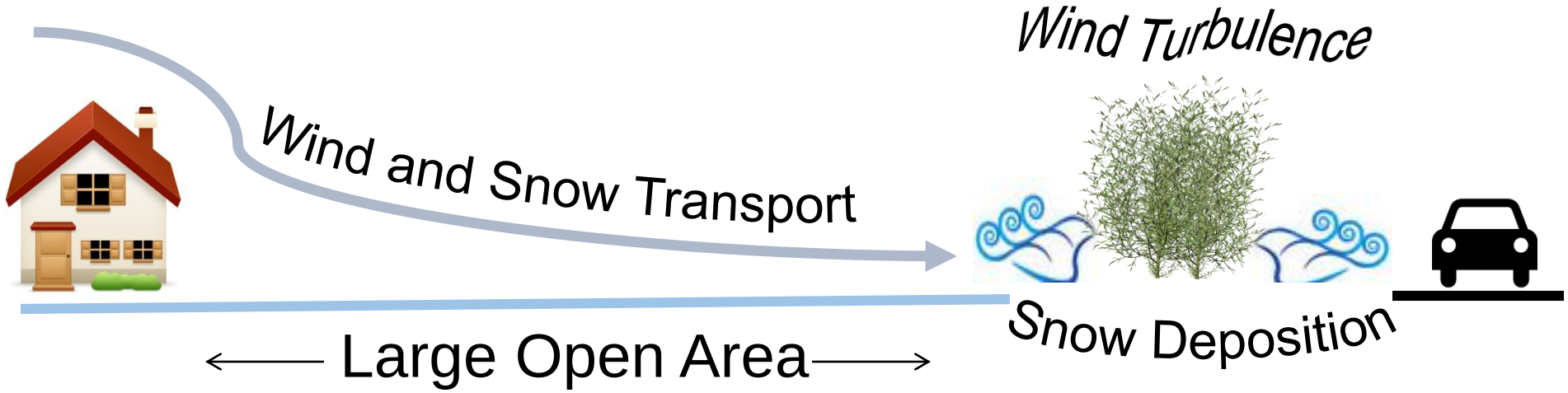
- People
- Environment
- Finances



Living Snow Fences (LSF)

- Rows of trees or shrubs
- Planted along roadways
- Same function as structural snow fences
- Trap blowing snow in drifts

How Do Snow Fences Work?



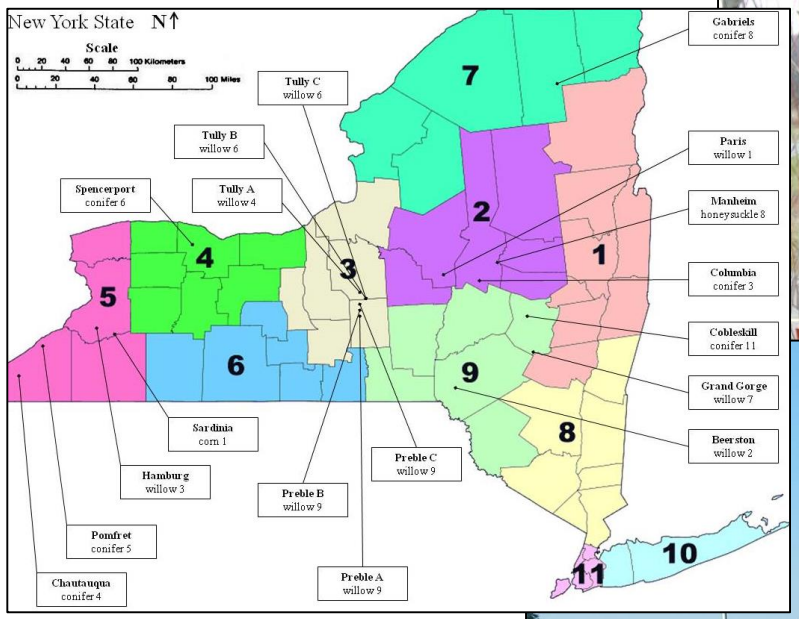
“Developing & Implementing a Living Snow Fence Program for NYS”

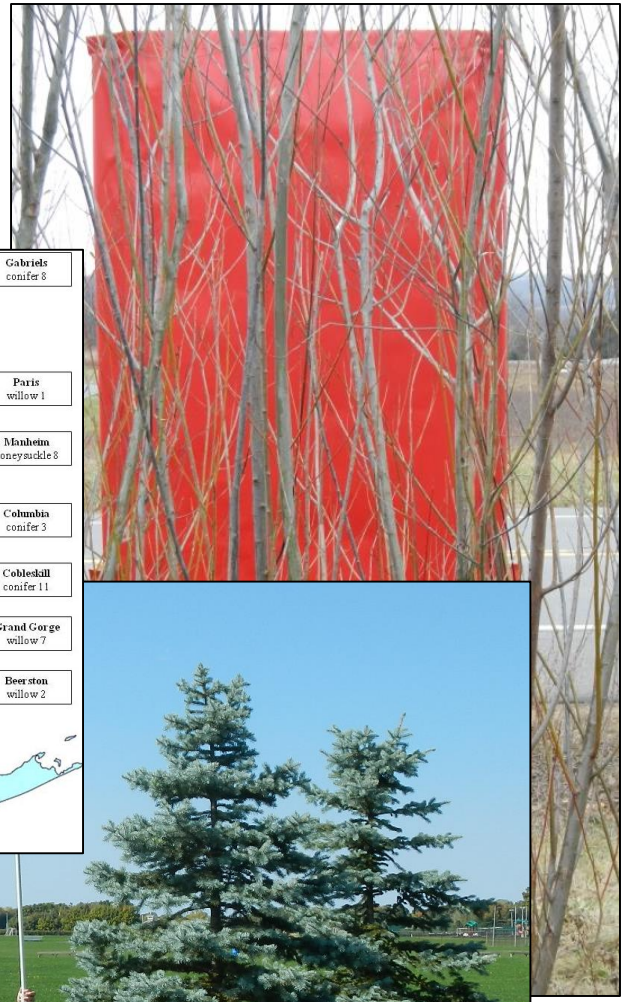
NEW YORK STATE OF OPPORTUNITY. | Department of Transportation

- Test and develop best practices
- Outreach materials
- 4 Classroom/Field Trainings
- 4 Willow LSF installation
- Study existing LSF

Research

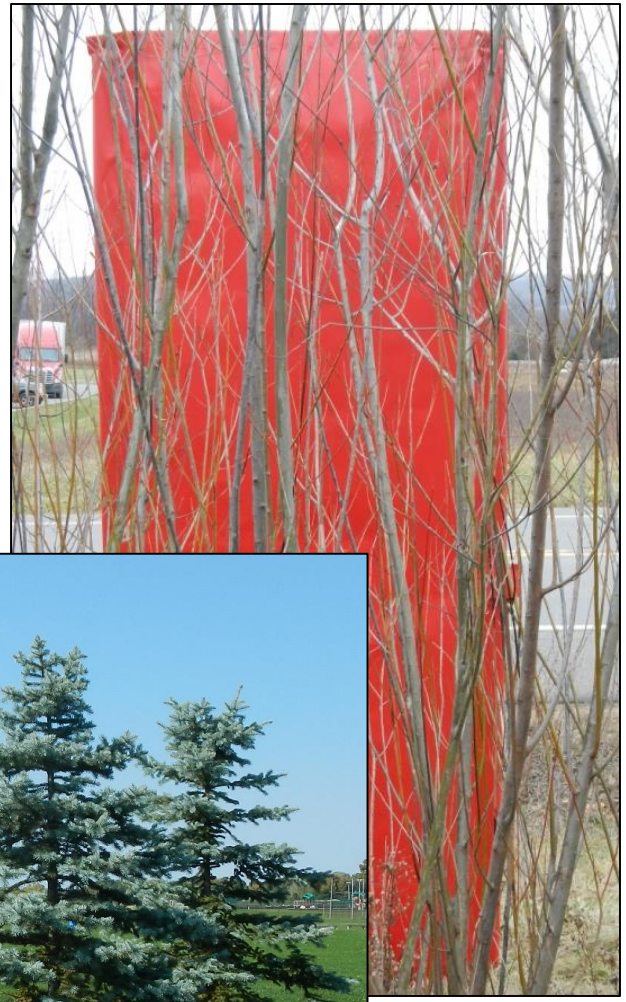
- 18 different fences
- Corn, shrub, willow, evergreen
- Ages 1-11 years after planting
- Fence Snow Capacity
  - Height
  - Optical Porosity
- Annual Quantity of Blowing Snow
  - Site and climate data
  - Percent transported by wind





Findings

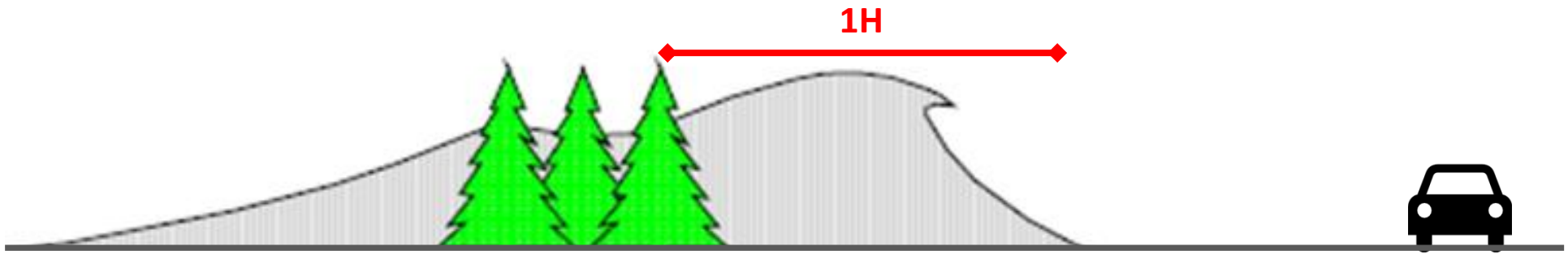
- Height 1.3-7.0 m (average 3.6, +/- 1.7)
- Porosity (average 50%, +/- 20%)
- LSF Capacity up to 411 t/m
- Capacity far exceeded annual snow load
- Willow LSF functional 3 years after planting
- Previously reported 5-10 years after planting



Plant Growth & Drift Length

- Small plants = small snow storage capacity = long drift length

- Larger plants = more snow storage capacity = shorter drift length
- More potential sites
- More effective snow control
- More accurate design standards based on research results



Setback Distance

- Distance between fence and road
- Chosen based on maximum drift length

- **Observed drift length:** <10 m
- **Observed Setback Distances:** 10 - 100 m
- **Published Recommendations:** 30 - 180 m
- **Need for improved design standards**

Economics

Cost of Single-row Willow LSF

- $10,000-$12,000 USD/km
- Cheaper and more effective than other vegetation types

Snow and Ice Control Savings

- $5,000 annually
- $70,000 NPV over 20-year lifecycle

Public Benefits - DOT Metrics

- Accident reduction factor
- Value Travel Time Savings
- Avoided Road Closures
- Additional $10,000 annually or more

DOT Environmental Metrics

Improving Sustainability of Transportation Projects…

- ✓ Use of trees, shrubs, vegetation
- ✓ Enhancement to wildlife habitat
- ✓ Use of native species
- ✓ Reduce DOT carbon footprint
- ✓ Visual enhancement
- ✓ Noise screen

GreenLITES Certified

GreenLITES Silver

GreenLITES Gold

GreenLITES Evergreen

GreenLITES Recognizing Leadership in Transportation Environmental Sustainability

Biological system in nature

Positive interactions with environment

- Erosion control
- Bees and pollinators
- Wildlife habitat and diversity
- High nutrient cycling
- Low fertilizer/herbicide/pesticide
- Carbon sequestration
- Education, research recreation, aesthetics

Biomass Potential - DOT

- Interest from NY and MN DOT
- Right of way land for LSF
- Heat garages and other facilities
- Multiple rows of willow on rotation
- Maintain snow trapping in harvest years
- Regular harvests rejuvenate willow LSF
- Extending their lifecycle indeffinintely

Biomass Potential – On the Farm

- On-farm heating/digester applications
- Need long rows and/or multiple rows
- For substantial biomass
- Subdivision of fields
- Multipurpose windbreaks
- Conservation reserve programs

Biomass Challenges

- Outreach and education
- Understanding of LSF and Biomass
- Landowner consent/incentives
- Taking crop land out of production
- Harvesting machinery and logistics

Willow Harvesting Equipment

- Commercial-scale acreage
- High fixed cost to transport
- Stand-alone unit

- Smaller-scale plantings
- Lower fixed cost to transport
- Integration with DOT equipment

Remediation of Former Industrial Sites

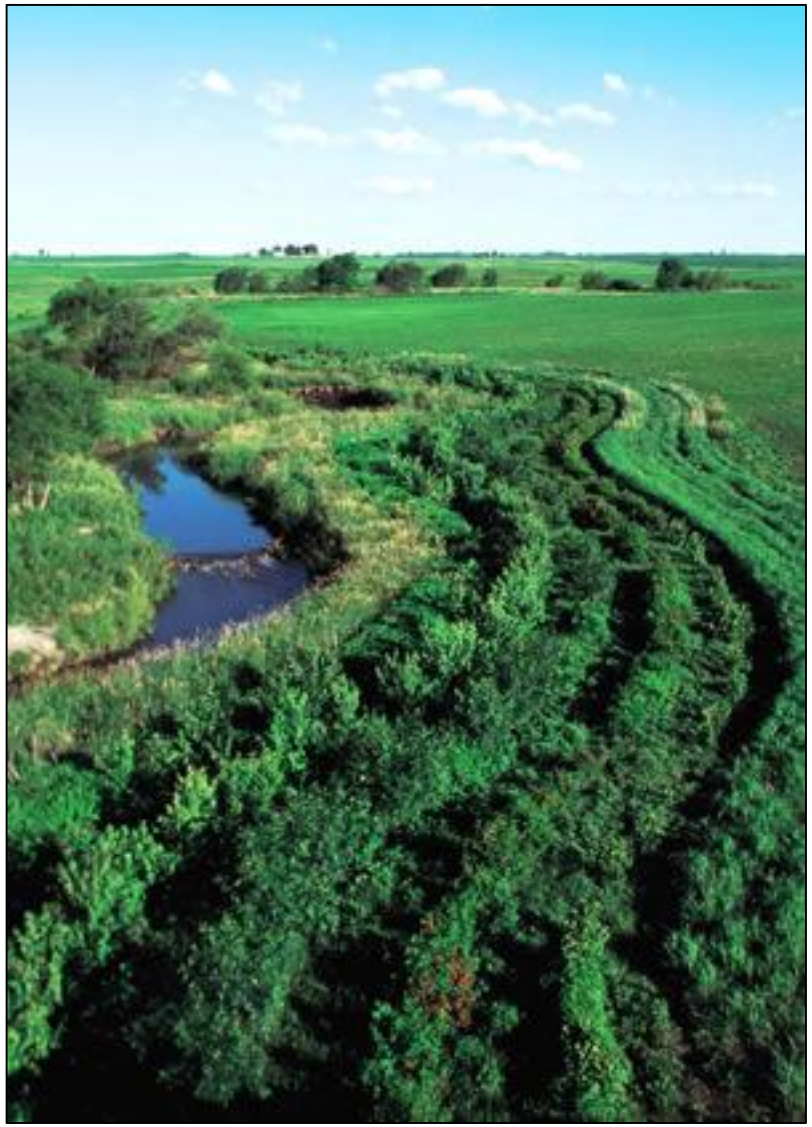
Former Industrial Sites

Ecological Engineering

Precision Ag and Intercropping

Stream Bank Stabilization

Vegetated Buffers



Landscaping and Aesthetics

Social and Cultural

Summary

- Shrub willow ideal plant choice for biomass and LSF
- Willow LSF effective just three years after planting
- Very large snow holding capacity
- Shorter drifts, more potential sites, improved design standards
- Willow LSF Economically favorable for snow and ice control
- Numerous additional benefits add value
- Multiple options for landscape integration for willow and other species

Thank You!

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www.esf.edu/willow