BIOMASS POWER FOR RURAL DEVELOPMENT

TECHNICAL PROGRESS REPORT

Contractual Reporting Period
May 1 - December 31, 1996

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New York State Energy Research and Development Authority (NYSERDA)
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February 1996

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1.0 INTRODUCTION

Developing commercial energy crops for power generation by the year 2000 is the focus of the DOE/USDA sponsored Biomass Power for Rural Development project. The New York based Salix Consortium project is a multi-partner endeavor, implemented in three stages. Phase-I, Final Design and Project Development, will conclude with the preparation of construction and/or operating permits, feedstock production plans, and contracts ready for signature. Field trials of willow (*Salix*) have been initiated at several locations in New York (Tully, Lockport, King Ferry, La Facette, Massena, and Himrod) and co-firing tests are underway at Greenidge Station (NYSEG). Phase-II of the project will focus on scale-up of willow crop acreage, construction of co-firing facilities at Dunkirk Station (NMPC), and final modifications for Greenidge Station. There will be testing of the energy crop as part of the gasification trials expected to occur at BED's McNeill power station and potentially at one of GPU's facilities. Phase-III will represent full-scale commercialization of the energy crop and power generation on a sustainable basis.

Willow has been selected as the energy crop of choice for many reasons. Willow is well suited to the climate of the Northeastern United States, and initial field trials have demonstrated that the yields required for the success of the project are obtainable. Like other energy crops, willow has rural development benefits and could serve to diversify local crop production, provide new sources of income for participating growers, and create new jobs. Willow could be used to put a large base of idle acreage back into crop production. Additionally, the willow coppicing system integrates well with current farm operations and utilizes agricultural practices that are already familiar to farmers.

There are potential environmental benefits associated with willow production. Willow crops can provide soil and water resource conservation benefits and are being evaluated as riparian buffer strips to protect watersheds. Willow may also be useful for bioremediation of contaminated sites and for beneficial uses of various organic waste streams. The Consortium is investigating the possibility of demonstrating these benefits.

For this project, willow will be grown on local acreage - within a 50 mile radius of the power stations. The willow will be harvested and delivered to either the power plant or a storage site. At the power plant, the willow will be further processed ensuring proper moisture content and sizing for firing in the power plant's boilers. Years of feedstock field testing and research by SUNY ESF and more recently co-firing tests and analysis at Greenidge Station are expected to reduce the learning required to optimize these processes in scale-up efforts. In addition, it should be possible to increase the yields of U.S. clones through research and development. The investigation of these advancements are part of the goals of this project and other allied projects with SUNY ESF.

For power generation, the project will utilize commercially available equipment for co-firing dedicated feedstocks in pulverized coal boilers. An experimental project to test biomass reburn systems for NO_x control is in the planning stages. Power generated by co-firing coal and willow

offers a variety of incentives to the utilities, growers, and local economies. Co-firing biomass at existing coal-powered facilities is being considered as a technically feasible and economical strategy for SO₂ and NO_x emission reductions mandated by the Clean Air Act Amendments. Because of its low sulfur content, co-firing biomass feedstocks can improve the emission characteristics of coal-fired plants and allow generators to earn emission allowances. When used on a sustainable basis, biomass is also a near zero generator of CO₂. Therefore, substituting biomass for coal can also reduce CO₂ emissions. Although reducing greenhouse gases is being pursued by utilities on a voluntary basis, these reductions can be "banked," allowing power generators to hedge against future mandates regarding emission levels.

While co-firing is the Salix project's initial technology choice to build a biomass power infrastructure, the participation of Burlington Electric in the Consortium is providing an avenue to test the energy crop in a prototype of future high-efficiency conversion technology. Burlington's biomass gasification repowering demonstration is the first step toward an integrated gasification combined cycle power generation system. Initial plans in Burlington are to test the use of product gas in the power plant's existing boiler. Later, the product gas is expected to be used to power a combustion turbine. Ongoing work at General Public Utilities (another consortium member) in fuel cell development provides the opportunity for another match between the willow feedstock and a high-efficiency conversion device. The fuel cell option could offer additional benefits as a distributed generation source provided that fuel processing and scaling issues can be satisfactorily resolved.

1.1 Project Tasks

The specific tasks for Phase-I are as follows:

- Development of cost estimates, construction documents and site plans necessary to convert Greenidge and Dunkirk power stations to co-fire biomass fuels. Application for required environmental permits will also be completed during this phase.
- Development of detailed fuel supply plans for Greenidge and Dunkirk outlining the quantity and source of fuels to be used as feedstock. For the willow portion of the fuel supply, this would include drafting contracts, binding letters of intent, or purchase orders necessary to obtain feedstock.
- Further investigation into willow production issues such as the organization of future enterprises, cuttings sales, fuel delivery to the power plants, and ways to reduce planting, harvesting, processing, storage, and delivery costs.
- This phase will also see the expansion of willow field trials, initiation of comparative site preparation and comparative soil amendment and fertilizer studies, characterization of willow resistance to insects, and a riparian benefits analysis. The Consortium is integrating our USDA and DOE program efforts in these areas to assure the success of the

demonstration.

- The members of the development team will also be seeking product, and process guarantees from equipment manufacturers. Additional effort will be directed to evaluating possible project risk sharing strategies and their impact on the team members as willow energy crops approach commercialization. One possible opportunity to be examined is to include heavy farm equipment manufacturers (such as Case and John Deere) as Consortium partners.
- Outreach is a vital element of the program. The Consortium continues to seek new partners in both the agricultural and power sectors.

1.2 Schedule of Deliverables

Design Reports

Greenidge -	February 1997
Dunkirk -	July 1997

Fuel Supply & Site Development Plans

Greenidge -	January 1997
Dunkirk -	July 1997

<u>Risk Management Report -</u>	July 1997
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<u>System Optimization and Experimental Studies Plan -</u>	June 1997
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2.0 PROGRESS SUMMARY

A number of key milestones have been met since the start of this project. Progress has been made in areas regarding feedstock development, fuel supply planning, and power conversion. A few of the more important milestones have been outlined below.

Fuel Supply Development

- Field trials of willow are proceeding and thirty acres of willow have already been planted.
- Several studies have been initiated by the Consortium including a comparative site preparation study, a comparative soil amendment and fertilizer study, and feedstock characterization studies.
- Nursery capacity for generating cuttings at a New York nursery has been secured for Phase-II scale-up. Seven acres are planted.

- Non-binding letters of intent have been signed by a number of area farmers to commit to willow production in the Greenidge and Dunkirk areas.
- Significant progress has also been made in identifying and securing residue supplies by NYSEG for co-firing at Greenidge Station. For its part, NMPC is currently negotiating with a large producer of residues in New York in order to guarantee a supply of residue fuel.

Power Conversion Technology Development

- NYSEG completed installation of the test system for biomass fuel handling and firing. To date, nearly 300 tons of residue wood supplies have been converted to power.
- NMPC staff have identified the boiler that will be converted for co-firing and the best locations for the proposed receiving, processing, and fuel transport systems at the plant.
- SO₂ reductions have been quantified and NO_x reductions have been measured under certain feedstock and firing conditions at Greenidge.
- In December 1996, biomass was direct-fired at GPU's Seward Facility.
- Fuel delivery/processing system at Greenidge Station is operational, and options regarding biomass drying have been addressed.
- Initial combustion tests at the Federal Energy Technology Center (FETC) on waste wood have been completed. Combustion tests using willow are expected in the second quarter of 1997.
- Plans for distributing 15 tons of willow to key Consortium members (BED, NYSEG, NMPC) for Phase-I testing have been outlined.

Anticipating the Phase-II scale-up effort, Consortium members are moving forward on all of the key development efforts. Time and effort is being focused on obtaining contracts with land owners and combustion tests using willow. There may be a slight delay in the Greenidge fuel supply plan deliverable because of the complexity of negotiations.

3.0 DETAILED TASK PROGRESS REPORTS

3.1 Task 1. Design Packages

During this reporting period NYSEG has made substantial headway towards finalizing the design for the retrofit at Greenidge Station. NYSEG completed installation of the test system for biomass fuel handling and firing. This test system includes most of the basic components of the systems required for full-scale operations including:

- ✓ Receiving area for truck delivery
- ✓ Open pile storage of 3,000 tons
- ✓ Reclaim system with capacity for 40 tons per hour

The test system was completed by September 11, 1996, and test co-firing at a rate equivalent to a heat input of 10% has been underway for nearly four months. The test system has been successfully operated at 5 to 7 MWe biomass power output since early September 1996. To date, nearly 300 tons of residue wood supplies have been converted to power.

With some assistance from Antares Group Inc. and Parson Power's (under contract to the Northeast Regional Biomass Program) NYSEG's engineering division reviewed options to upgrade and automate the biomass fuel handling system for full-scale continuous operation. Key components that must be upgraded in Phase II include:

- ✓ Day bin storage for up to 18 hours capacity, or 177 tons
- ✓ Collecting conveyors with scales
- ✓ Additional/alternate biomass fuel ports at the boiler
- ✓ Dust Control

Progress realized by NMPC during this period has included the completion of a conceptual assessment for the Dunkirk Steam Station. NMPC's engineering staff, with assistance from Antares Group Inc. and Parsons Power, identified the most likely boiler for co-firing and the best locations for the proposed receiving, processing, and fuel transport systems at the plant. At a 15% co-firing level Dunkirk would require biomass fuel supplies of 55,000 tons per year to produce 13.5 MWe of power from biomass in Unit 1. Depending on the degree of automation and availability of equipment at NMPC, a retrofit budget range of \$2.7 to \$4.8 million was

Design Packages Statement of Work

An engineering design package, environmental permits, cost estimate and construction documents, sufficiently detailed to proceed in Phase 2 with construction/operation, will be prepared. The elements of the package will be used to meet the following requirements for the Greenidge and Dunkirk projects:

- ▶ utility financial approvals for investment in facilities modifications
- ▶ permits for construction/operation
- ▶ construction bid packages and internal work orders

Conceptual designs will also be prepared for 2 to 3 additional projects (U.S. Generating,* GPU, and Burlington Electric). These projects are in the wider region represented by the Consortium partners. They will be in the development evaluation phases as Greenidge and Dunkirk Stations take the lead in commercial scale-up.

*Since the preparation of the original proposal U.S. Generating has discontinued its membership in the Consortium

estimated. NMPC has also prepared a statement of work and identified the engineering firm that will assist its engineering division to prepare a complete design package and construction specifications for a co-firing retrofit at Dunkirk.

By the first quarter of 1997, NYSEG expects to complete design work for the full-scale system including preparation of the design report deliverable for the contract. NMPC expects to begin work on the retrofit design for Dunkirk in the first quarter pending resolution of fuel supply sources described below.

3.2 Task 2. Fuel Supply and Site Development Plans

The fuel requirements for the targeted biomass co-firing levels (5-15% on a heat input basis) at Greenidge and Dunkirk will require that a mixture of biomass residues and willow feedstock be obtained. To that end, non-binding letters of intent have been signed by a number of area farmers offering over 2,600 acres to willow production in the Greenidge and Dunkirk areas. Efforts underway are intended to move these agreements to more formal arrangements for willow production and purchase. NYSEG is targeting using willow for approximately 30% of the biomass co-firing requirements in the Greenidge Station boiler by the end of Phase-II.

Of particular interest has been the work of the New York State Saratoga Tree Nursery staff which is enabling the efficient scale-up of cutting (planting stock) production for commercialization. Currently, there is sufficient cutting production capacity to allow for scale-up in Phase-II to occur on schedule.

Significant progress has also been made in identifying and securing residue supplies by NYSEG for co-firing at Greenidge Station. For its part, NMPC is currently negotiating with a large producer of residues in New York in order to guarantee a base supply of fuel. NMPC is also pursuing a number of smaller sources as part of its fuel supply plan.

Contract terms and purchase agreement for the production and sale of willow are under review.

Fuel Supply and Site Development Plans Statement of Work

A fuel supply plan will be prepared, including contracts or binding letters of intent, which provide the terms and conditions for firm costs and supply quantities of fuel for the project. The plan will also detail the responsibilities and associated costs including land preparation, planting, harvesting, processing, storing and delivery to the generating station. Contingency plans will be prepared for fuel shortages and for conversion of energy crop acreage if the business fails to materialize as planned at the end of the demonstration period. As part of this planning task two acre field trials providing region specific data to select hybrids and guide plantings will be initiated. This is necessary to ensure that the information required for crop scale up scheduled for Phase 2 is available at the earliest possible date.

Activities at the field trial sites will include site selection, preparation, planting, intermediate treatments, monitoring and harvesting. Sites will be selected to include soil types representative of those available for commercial biomass crops. Tasks will include soil sampling, fall site preparation and layout, spring planting of multiple clones in randomized-block design (double-row system of 6200-7200 trees per acre), 1st-year winter cutback (to promote multiple stem coppice), 3 years of growth (monitored for productivity & pests), and winter biomass harvest (end of year 4). Planting and harvesting of measurement plots will generally be done by hand, but, mechanized operations will be used to plant and harvest border rows whenever possible. This work will be conducted by SUNY-ESF with matching support from Consortium power companies.

During the fourth quarter of 1996 several meetings between key team members have generated considerable discussion on this topic. Key Consortium members met with members of the SoCNY RC&D to discuss terms and conditions for contracting the use of private land and farm labor for the Phase-II effort. Drafts of conceptual contracts between the utilities, fuel suppliers, and growers are being circulated amongst team members and a final decision is expected in the first quarter of 1997.

Field trials of willow have also been proceeding. Thirty acres of willow have already been planted, and new sites are to be added in the second quarter of 1997 including La Fayette, Green Lakes, and Wolcott. As these field trials progress questions about potential yields and clone selection should be answered for the demonstration phase.

Another Consortium member, Ontario Hydro is conducting woody biomass crop development and forest resource studies. The main purpose of their work has been to identify suitable forest resources and residues and to develop short rotation intensive willow cultures suitable to supplement or replace wood fuel harvested from northern Ontario natural forests. The primary project application was to develop biomass for electricity production at off-grid remote northern communities. During this reporting period Ontario Hydro staff selected communities with interest in woody biomass electricity generation and identified local forest resources and woody crop sites for biomass yield and survival trials. Contracts were let to staff at the University of Toronto, Faculty Forestry Bioenergy Group to screen and develop willow clones suitable for northern Ontario sites. Further, in 1996, Silv-Econ Ltd was contracted to assist in estimating forest harvesting costs. Reports on the work have been issued. The ORNL, and previously sponsored EPRI work, will be beneficial to the staffs of SUNY ESF and UT in their teamed effort to increase yields by 15 to 20 percent.

Other progress on fuel supply issues included a visit of BED's McNeill Station by Dunkirk Station and NMPC corporate engineering staff. At the meeting tentative plans were set for the Consortium to supply willow chips for gasification trials in 1997. Discussions with staff of the Future Energy Resources Company (FERCO) have recently confirmed anticipated delivery schedules. It is also the Consortium's hope that ongoing discussions with the Wisconsin Energy Bureau and the Minnesota Valley Alfalfa Producers will also lead to the formation of a long term relationship that will allow discussion of issues related to commercial energy crop deployment.

3.3 Task 3. Major Equipment Guarantees and Project Risk Sharing

Activity under this task will gear up in the second quarter of 1997 as the partnership agreements for Phase II are developed and signed in preparation for Phase II. Preliminary discussions are being held among the partners now to establish the base line for the agreements for Phase II.

Major Equipment Guarantees and Project Risk Sharing Statement of Work

A plan and substantiating documentation should be provided which indicates process and equipment guarantees for planters, harvesters, fuel processors, and fuel preparation and feed systems. Furthermore, the plan should address how each party associated with the project will assume or share the risks of the project.

3.4 Task 4. Power Production Commitment

NYSEG has already begun producing power at the 5% to 10% cofiring level using residue supplies. In effect, its commitment to power generation from biomass has already been demonstrated. However, as part of the Phase II proposal to DOE, NYSEG will prepare a letter of commitment to continue cofiring of biomass including feedstock produced at the willow farms for the duration of the program. NMPC will not co-fire on a test basis until Phase II, but a letter of commitment similar to the letter from NYSEG will be included in the Phase II proposal.

Power Production Commitment Statement of Work

NYSEG will provide a letter stating its intention to co-fire biomass at Greenidge throughout the Phase 2 Demonstration Period. NMPC will provide a similar letter of intent for co-firing at Dunkirk.

3.5 Task 5. Power Plant Site Plan, Construction & Environmental Permits Report

During this reporting period site plans for the co-firing retrofit of Greenidge were prepared by NYSEG and will be revised pending location of the day bin and expanded yard area for receiving biomass fuel supplies. Environmental permits for co-firing biomass at Greenidge are already in place. Emissions monitoring has already begun with the test program and preliminary air emissions results are available. SO₂ reduction have been quantified and NO_x reductions have been measured under certain feedstock and firing conditions. In addition, a report is being prepared by the Electric Power Research Institute (EPRI) that will characterize the performance of the biomass fuel ramp-up tests.

Power Plant Site Plan, Construction and Environmental Permits Report Statement of Work

Site plans for the Greenidge and Dunkirk Stations showing the location of existing and proposed facilities will be provided. An area map will indicate the routes to be used for fuel supply deliveries. A general arrangement of the facility including the footprint and elevations will be provided. The plans will also include a discussion of permit modifications obtained as well as traffic impact studies performed for the increase in road use by fuel supply trucks. A plan for environmental baseline monitoring and project monitoring following construction will be provided. Copies of permit modifications obtained or correspondence from the permitting agencies indicating the likelihood of success of obtaining outstanding construction permits for the project will be included.

Other key progress made by the Consortium includes work done by GPU at the Shawville Station in Pennsylvania. Test firing of biomass went well, however limits on pulverizer capacity resulted in plant derating. In December 1996, biomass was direct-fired at GPU's Seward Facility. Using separate biomass injection ports as are used at Greenidge, pre-processed fuel was blown directly into the boiler. Preliminary results of the tests were encouraging. GPU's recent success has motivated them to move beyond combustion testing and they are now seeking sites to further test energy crop development.

To date, alterations to NYSEG's Greenidge Station have not triggered the need for any new permits or permit modifications. This is because the plant modifications are not extraordinary in comparison to adjustments made for normal operation and maintenance and did not involve any

new building construction. If necessary, future permitting is expected to be limited to local permits and will be handled on an as needed basis.

NMPC has begun to evaluate potential issues for permitting a cofiring project at the Dunkirk site including potential impacts on its ash sales. NMPC's permitting process will begin in earnest as design work proceeds beginning in the first quarter of 1997.

3.6 Task 6. Experimental Strategies for System Evaluation

Several crop development studies have been initiated during this reporting period. They include: a comparative site preparation study, a comparative soil amendment and fertilizer study, a characterization of willow resistance to insects, and a riparian areas initiative.

Two key meetings were held between SUNY ESF staff, representatives from the USDA NRCS, Onondaga County Soil and Water Conservation District, and representatives of the Skaneateles Lake Watershed Agricultural Program occurred in October. Discussions centered on initiating a cooperative effort to adapt the willow production system for use in controlling non-point source pollution along riparian areas and around livestock concentrations. SUNY ESF staff also held meetings with Remediation Technologies Inc., and the Boyce Thompson Institute at the Tully Field Station and Lafayette Road Experiment Station to discuss the use of willow clones for bioremediation of contaminated sites. The Consortium believes that these efforts will lead to synergies that can be exploited to provide bankable added value to the environment and enable growers to provide a competitively price fuel.

Experimental Strategies for System Evaluation Statement of Work

A plan will be prepared for experimental strategies and designs to optimize and evaluate crop production and power production. The power production studies will be carried out at Greenidge and Dunkirk. A central site for core energy crop studies will be employed to monitor and evaluate crop nutrient cycling, crop and pest management techniques, and biodiversity impacts.

Power system optimization studies at Greenidge power station are well underway. The fuel delivery/processing system is operational, options regarding biomass drying have been addressed, the first system tests have been performed, and preliminary storage plans are being developed. In addition, combustion tests at the Pittsburgh Energy Technology Center (PETC) on waste wood are complete and combustion tests for willow are anticipated late in the next quarter.

3.7 Outreach, Extension, & Technology Transfer

Numerous outreach, extension, and technology transfer events have also occurred since the projects start. A highlight of these events has been provided below. Presentation materials, and newspaper articles have been included as part of the Appendix.

- Secretary of the Department of Energy (Hazel O'Leary) and Congressman Walsh visited Tully Station to announce the award of Phase-I funding to the Consortium.

- Consortium members and others successfully lobbied to change New York State law to include willow as an agricultural crop not a forestry crop. The change represents an improved tax treatment of income generated by the crop's production.
- At our progress review meeting in Geneva, New York, Syracuse Research Corporation presented results of a preliminary analysis of costs and benefits to the state of the new energy crop enterprise. They described several approaches to providing tax relief to encourage development of this new crop. SRC summarized their initial tax revenue analysis results that indicated that significant tax incentives could be offered to the fledgling business that would be tax revenue neutral for the state. A follow-up study by the Consortium is being discussed.
- Presentations made by the Salix Consortium include:
 - The 1996 BioEnergy Conference, Nashville, TN
 - The 1996 UBECA/NBIA Conference, Washington, D.C.
 - Fifth NREL Enterprise Growth Forum, Kansas City, MO
 - IEA/BA Task 7 Joint Conference, Vegle, Denmark
 - First Conference of SRWC Operations Working Group, Paducah, KY
 - ORNL Woody Crops Program Subcontractors Meeting, Ames, IA
- GPU Services branch, in cooperation with EPRI and the Pennsylvania Department of Conservation and Natural Resources, held a workshop on "Paths to Profitable Biomass Business", in June 1996
- In October 1996, key members of the SUNY ESF team met with a delegation from the Autonomous University of Santa Domingo (Dominican Republic) and discussed biomass-based energy ideas which might be relevant to the island nation's energy/land situation.
- Other items of note include: Field Days; Cooperative Extension; Empire Farm Days; and other meetings with landowners and agricultural/resource professionals.

4.0 PROJECT BUDGET (information to follow)

APPENDIX A

PROJECT SCHEDULE

**BIOPOWER FOR RURAL DEVELOPMENT
SALIX CONSORTIUM
SCHEDULE OF WORK & DELIVERABLES**

Project:
Date: 1/25/97

Task
Progress

Milestone
 Summary

Milestone
 Summary

Rolled Up Task
 Rolled Up Milestone

Rolled Up Progress

BIOPOWER FOR RURAL DEVELOPMENT
SALIX CONSORTIUM
SCHEDULE OF WORK & DELIVERABLES

ID	Task Name	Duration	Qtr 2, 1996		Qtr 3, 1996			Qtr 4, 1996			Qtr 1, 1997			Qtr 2, 1997			Qtr 3, 1997			Qtr 4, 1997		
			May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
41																						
42	System Optimization (Work Schedule)	303d																				
43	Task 6	303d																				
44	Feedstock	303d																				
45	Evaluate Planting, Outback, Weed Control	303d																				
46	Study Harvesting Equipment/Processes	303d																				
47	Monitor Soil Nutrient, Carbon Sequestration	303d																				
48	Study Clone-Sites for Improved Productivity	303d																				
49	Power	303d																				
50	Evaluate Ash Composition	303d																				
51	Evaluate Economics	303d																				
52	Study Fuel Preparation	303d																				
53	Conduct Combustion Tests	303d																				
54	Study Advance Conversion Technologies	303d																				
55																						
56	DELIVERABLE Schedule	131d																				
57	Task 1 & 5 (Design Reports)	106d																				
58	Greenidge	0d																				
59	Dundrik	0d																				
60	Task 2 (Fuel Supply Plan)	120d																				
61	Greenidge	0d																				
62	Dundrik	0d																				
63	Task 3 & 4 (Risk Management Report)	0d																				
64	Task 6 (System Optimization/Experimental Studies Plan)	0d																				
65	PHASE II Proposal	0d																				
							</															

APPENDIX B

PRESENTATIONS

Regional Biomass Energy Program

Stakeholder Perspectives

Edward Neuhauser
Niagara Mohawk
Power Corporation

RBEP Meeting
May 9, 1996
DOE Forrestal Bldg.

What's Happening in New York?

- First demonstration of integration of energy crops and power
 - Willow coppice crop system
 - Cofiring in modern coal boilers initial use
 - Gasification combined cycles in future
- Salix Consortium Members
 - Power Companies
 - Landowners and Farmers
 - RC&Ds / Cooperative Extension
 - R&D Institutions and Agencies

USDA & DOE Role

- Shared Risk in Demonstration Phase
 - Cost sharing in willow development
 - Technical support
 - Assistance in outreach to farmers and potential power developers

CONEG Partnership

How It Has Helped in the Past

- Philadelphia Cofiring Workshop
- Biomass Roundtable
- Northeast Cofiring Study
- PETC Fuel Tests

CONEG Partnership

How It Could Help in the Future

- Ash Issues
- Local Tax Issues for Energy Crop Development
- Resource Potential Evaluation
- Outreach and Education Programs
- Work with the Northeast State Governments to address Regional Problems
 - Emissions benefits of biomass use
 - Easing demands on landfill space

Niagara Mohawk Power Corporation
representing
The Salix Consortium
Financing The New BioEnergy Industry

Dr. Edward F. Neuhauser

Christian P. Demeter
Engineers & Economists

Kansas City, Missouri
July 1996

Our Purpose:
Communication and Feedback

NI NIAGARA
MOHAWK

Business Organization

NI NIAGARA
MOHAWK

Business Financing
and Sources

- Power Company cash flow
- Debt and Equity
- Venture Capital opportunities

NI NIAGARA
MOHAWK

Intellectual Property (IP) Issues

- Certification of clone hybrids
- Ownership of genetic material

The Salix Consortium - Organization

Government

Universities

Power Companies

Farmers

The Salix Consortium - Members

• Power Companies - NMPC - NYSEG - GPU - BED - Ontario Hydro	• Universities - SUNY ESF - Cornell Agricultural Engineering - Cornell Ornithology Lab - University of Toronto - EPRI - GRI - NYGas
• Government - DOE - USDA - NYSERDA	• Farmers - SoCNY RC&D - 26 local farmers - Vineyards

The Business Deal

High Returns
for Farmers

Low Cost
Fuel to Power
Company

Risk Management Strategies

NIAGARA
MOHAWK

Future Directions for the Consortium

NIAGARA
MOHAWK

Summary Discussion

- What can be the role of V.C. funding?
- What should the consortium evolve into?
- What resolutions are there on intellectual property issues?

NIAGARA
MOHAWK

Biomass Power for Rural Development

Salix Consortium Biomass Power Project Progress Report

Milestones Toward Commercialization

Secretary O'Leary and Salix

Salix Consortium Goals & Objectives

- **Goal:** Commercialize willow feedstock production system for power generation w/ coproducts by 2002
- **Feedstock Objectives**
 - Obtain average yields above 7 dry tons/yr-acr
 - Demonstrate production costs under \$20/dt at farm gate
- **Power Project Objectives**
 - Demonstrate automated and reliable feed systems for cofiring and ultimately gasification
 - Determine operating conditions that offer NOx reductions
 - Demonstrate production costs under 3 c/kWh

Salix Consortium Phased Approach

- **Phase I - Final Design & Project Development at Minimum of 2 Sites by July, 1997**
- **Phase II - Power Plant Conversion and Crop Production Systems Demonstrated by 2002**
- **Phase III - Commercial Operation: Initially 25 to 50% willow in fuel mix moving toward dedicated operations by 2010**

Design Packages Contract Tasks 1 & 5

- **Task Requirement**

- Environmental permits and impact studies
- Cost estimates, construction documents, and site plans
- Internal work orders and construction bids

- **Milestones/Deliverables**

- Greenidge design optimization (2/28/97)*
- Dunkirk final design (7/2/97)

Design Packages Progress Report

- **Greenidge Design Optimization**

- Evaluated modifications to buffer storage capacities and grinder capabilities to meet 15% cofiring level
- Environmental permits in place
- Cost estimates prepared for modifications for internal budgeting
- Fuel feed systems and processing installed
- Problems in current system rectified to demonstrate efficient automated operations

- **Dunkirk Design Optimization**

- Conceptual assessment with Antares/Parsons completed
- Let contract for engineering design for cofiring retrofit with Fossil Energy Research Corp
- Design work and cost estimates to be completed on schedule

Fuel Supply Plan Contract Task 2

- Task Requirements (Greenidge/Dunkirk)
 - Identify supply and quantity of fuels
 - Establish draft contracts, binding letters of intent, or purchase orders
 - Detail costs and responsibilities for land, harvesting, crop establishment, site preparation, planting, processing, storage and delivery
 - Initiate field trials of hybrids
- Milestones/Deliverables
 - Greenidge fuel supply plan (1/31/97)*
 - Dunkirk fuel supply plan (7/15/97)
 - Site prep, planting, cutback, weed control, seed stock

Fuel Supply Plan Progress Report

- Greenidge Supply Plan
 - Letters of intent to produce willow representing 1,600 acres
 - Goal of 30% willow fuel for Commercialization Phase
 - Residue suppliers in place
 - Terms and conditions for willow purchases still in formative stage
 - 15 acres already planted, 500 acres targeted for planting in Phase II

Fuel Supply Plan Progress Report

- Dunkirk Supply Plan
 - Site for test plot has been identified
 - Currently developing residue supply structure

Risk Management Contract Tasks 3 & 4

- Task Requirements
 - Develop plan for process and equipment guarantees: planting, weed control, cutbacks, harvesting process and equipment, fuel processors, feed systems
 - Develop method for risk distribution
 - Provide letters of intent for power production from biomass at Greenidge/Dunkirk
- Milestones/Deliverables
 - Risk management plan (7/31/97)

Risk Management Progress Report

- No activity on this task

System Optimization - Feedstock Contract Task 6

- Task Requirements - Feedstock
 - Monitor nutrient balance and Carbon sequestration
 - Test and evaluate erosion and water management
 - Monitor feedstock growth, soils, and chemical run-off
 - Integrate biodiversity studies and wildlife issues
 - Evaluate fertilizers and other organic soil amendments
 - Evaluate planting, cutback, weed control techniques
 - Study harvesting equipment/processes and storage
 - Study clone-sites for improved feedstock productivity
- Milestones/Deliverables
 - System optimization report (6/27/97)

System Optimization - Feedstock Progress Report

- Commercialization Joint Ventures Proposal - Harvester Development
- Initiate Comparative Site Preparation Study
- Initiate Comparative Soil Amendment and Fertilizer Study
- Characterization of Clonal Resistance to Insects
- Expand Clonal Site Trials
- Riparian Areas Initiative
- Outreach, Extension, Technology Transfer

System Optimization - Power Contract Task 6

- Task Requirements - Power
 - Conduct combustion studies to evaluate plant performance, combustion stability, fouling and slagging rates, and emissions
 - Evaluate ash composition, quality, and marketability
 - Study fuel preparation: grinding, drying, and quality
 - Study advance conversion systems: gasification and combined cycles, and fuel cells
 - Evaluate economic impacts of transportation, processing, financing, and contracting
- Milestones/Deliverables
 - System optimization report (6/27/97)

System Optimization - Power Progress Report

- **Greenidge - Phase I**
 - Fuel delivery/processing systems operational
 - Drying option addressed
 - First run system tests performed
 - Preliminary storage plans being developed and estimated
- **Combustion Tests at PETC on Waste Wood Complete**
- **Combustion Tests for Willow Anticipated in the Spring**

Moving Toward Investments in Salix

- **The foundation is being put in place**
 - Progress toward residue biomass fuel use and supply infrastructure and crop selection for scale up
- **Gates that must be passed**
 - Sufficient confidence (all parties) and material to scale up crop production?
 - Demonstrate and provide the most efficient production and processing systems
- **Price, terms and conditions for a sale**
 - Agreement on who provides what services/materials
 - Incentives that convert environmental benefits to bottom line dollars

Biomass Power for Rural Development

Salix Consortium Biomass Power Project Management Meeting

Salix Consortium Goals & Objectives

- Goal: Commercialize willow feedstock production system for power generation w/ coproducts by 2002
- Feedstock Objectives
 - Obtain average yields above 7.5 dry tons/yr-acr (7.5-10)
 - Demonstrate production costs approaching \$22/dt delivered
- Power Project Objectives
 - Demonstrate automated and reliable feed systems for cofiring and ultimately gasification
 - Determine operating conditions that offer NOx reductions
 - Demonstrate production costs under 3 cents/kWh

Salix Consortium Phased Approach

- Phase I - Final Design & Project Development at Minimum of 2 Sites by July, 1997
- Phase II - Power Plant Conversion and Crop Production Systems Demonstrated by 2002
- Phase III - Commercial Operation: Initially 25 to 50% willow in fuel mix moving toward dedicated operations by 2010

Strategic Elements of Business Development

- Private investment in equipment for cofiring paid back via low cost fuel supplies sweetened with environmental benefits
- Financing for Salix development and scale up including crop production capital equipment is cost shared
- Develop initial acreage with select group of entrepreneurial farmers and utility/public owned acreage
- Engender needed economic stimulus for energy crops (and other biomass) via state and Federal tax benefits

Moving Toward Investments in Salix

● The Fundamentals

- Put cofiring equipment and byproduct fuel supplies in place
- Pioneer growers for 500 or more acres must be ready to sign contracts for Phase II. (~ 1/2 MWe)
- Funding agreements to support Phase II placed

● Gates that must be passed

- Agreement and funding for scale up of crop production
- Agreements with equipment manufacturers to demonstrate and provide the most efficient production and processing systems
- Price, terms and conditions for a sale - agreement on who provides what services/materials
- Incentives that convert economic & environmental benefits to bottom line dollars

Salix Enterprise Fundamentals

● Price, Terms and Conditions

- Expected feedstock price - \$1.40 to 1.80 / MMBTU [1]
- Expected coal prices - \$0.90 to \$1.45 / MMBTU
- Current value of emission reductions (SOx and CO2) valued at \$0.31 per MMBTU [2]
- Enterprise controls cuttings and sales of cuttings have large impact on enterprise income - other byproduct sales have yet to be considered [3]
- Enterprise screens for land suitability - will targeted idle lands provide the yields sought

Note 1. Enterprise ROI varied from 10% to 20%

Note 2. CO2 and SO2 valued at \$1.50 and \$100.00 per ton respectively

Note 3. Assumed that 20% of excess cuttings sold to outside markets at 10cents/1000]

Salix Enterprise Fundamentals

● Price, Terms and Conditions (continued)

- Land Rent expectations and tax treatment have a moderate effect on acceptable price [1]
- Benefits such as economic development, tax revenue generation, job creation and retention, riparian buffers, soil conservation need to be realized by partners - state tax benefit might be best option [2]
- How far can we streamline manpower requirements - should the coop be residue broker in "off season"?
- Power company ash sales must be protected

Note 1. Land rents set at low value of \$12/acre assuming use of idle land

Note 2. Cost sharing in phase II, new environmental and economic incentives in phase III]

Salix Enterprise Fundamentals

● Price, Terms and Conditions (continued)

- Incentive terms should be included - standard harvest payment augmented by high yield bonus
- Enterprise may have to provide lion's share of production costs until harvests begin.
- What services should farmers provide versus enterprise in commercial setting - what essential controls will be exercised by enterprise - how are they phased in?
- How will enterprise insure for product losses of all types - pests, disease, drought, etc?
- Bottom line - price gap of 10 to 30 cents/MMBTU [1]

Note 1. Based on coal at \$1.20 per mmbtu and willow at \$1.60 per mmbtu

with \$0.30 per mmbtu credits for emission reductions taken into account.]

Salix Enterprise Fundamentals

- Coop structure is a good model for enterprise
 - offers tax benefits - dividends and losses treated like S Corp
 - organizational complexity added by middleman
 - provides appropriate vehicle for investment in farm machinery
 - growers, power companies and others can all be investors but majority ownership must be farmers

Phase II Effort and Responsibilities

- Feedstock Development - SUNY, UToronto
- Production Systems Development - Cornell, SUNY, Case
- Power Production - NMPC, NYSEG (and others)
- Land for Scale Up - combination of pioneer growers, power companies and public lands
- Planting, Harvesting, Preprocessing Operations - Consortium & SUNY
- Project Management and Business Development - Consortium or Lead Utility

Phase II Funding Recipients

- SUNY, Cornell, U.Toronto, Antares, SRC
 - R&D costs
 - Technical assistance to scale-up and quality control
 - Business development support
- NMPC & NYSEG
 - Cost share for field trials
 - Incentive for Phase II feedstock purchases
 - Cost share for power generation R&D
- Pioneer Growers
 - Ground floor in new business

Phase II Funding Proposed Budget

- Phase II Budget Estimate: \$11M

Phase II Funding Proposed Budget

- Phase II Crop Development Budget:
\$8.3M - Core \$6.6M & Sites \$1.7M

Sites Shares

Note: Slice values in \$K

Phase II Funding Proposed Budget

- Phase II Power Development Budget:
\$2.6M

NMPC Dunkirk \$1,700

Note: Slice values in \$K

Phase II Funding Potential New Efforts

- SRC assessment of state incentives
 - Consortium lead
- Production equipment development and field trials with Case, Deere and others
 - Consortium lead via SUNY/Cornell
- Reburn technology tests
 - Possible NYSEG or NMPC lead
- Byproduct market tests and development
 - Possible NYSERDA lead

Biomass Power for Rural Development

Salix Consortium
Gaining Ground

Presentation Outline

- Part 1 - Overview of project objectives and progress for the RC&D representatives
- Part 2 - Scale up strategy and approach for the demonstration phase with special attention to the role for grower/landowner interface

Salix Consortium Goals & Objectives

- Goal: Commercialize willow feedstock production system for power generation w/ coproducts by 2002
- Feedstock Objectives
 - Obtain average yields above 7 dry tons/yr-acr
 - Demonstrate farm gate production costs under \$20/dt
 - **Demonstrate economic value to growers**
- Power Project Objectives
 - **Demonstrate a competitively priced fuel product**
 - Demonstrate automated and reliable feed systems
 - **Demonstrate bankable NO_x, SO_x and CO₂ benefits**
 - Demonstrate cofiring production costs under 3 c/kWh

Salix Consortium Phased Approach

- Phase I - Final Design & Project Development at Minimum of 2 Sites by July, 1997
- Phase II - Power Plant Conversion and Crop Production Systems Demonstrated by 2002
- Phase III - Commercial Operation: Initially 25 to 50% willow in fuel mix moving toward dedicated operations by 2010

Power Plant Design and Retrofit

- Developing the best power outlets for the product
 - Greenidge Power station
 - ✓ Fuel delivery/processing systems operational
 - ✓ Drying option addressed
 - ✓ First run system tests
 - ✓ Storage capacity for fully automated operation
 - Dunkirk Steam Station
 - ✓ System Design to be completed by July 1997
- Getting the most value from "green" power
 - Optimizing Conversion
 - ✓ Combustion Tests at FETC
 - ✓ Evaluating reburn options
 - Capturing external values
 - ✓ trading and banking emissions

FUEL SUPPLY DEVELOPMENT

- Establishing the best planting stock
 - Characterization of Clonal Properties
- Developing the best production methods
 - Comparative Soil Amendment and Fertilizer Study
 - Comparative Site Preparation Study
 - Partnerships with Case and Deere
- Bringing in the best growers/landowners
 - Expand Clonal Site Trials
 - Outreach to potential growers
 - Develop land lease options
- Getting the best product values
 - Developing a competitive fuel product for power
 - Riparian areas initiative

Capturing the Benefits of Green Power

- Securing Federal investment and incentives
 - DOEcost-sharing
 - USDA programs
 - Section 45 tax incentives for cofiring??
- Convert environmental benefits to incentives
 - land conservation incentives
 - watershed protection incentives
 - power plant emission incentives
- Convert state economic benefits to incentives
 - state eco-enterprise zones (tax incentives)

Moving Toward Investments in Salix

- The foundation is being put in place
 - Progress securing residue supplies as base
 - Site trials and clonal development underway
- Gates that must be passed
 - Gaining confidence in production and conversion technologies
 - Establishing nursery capacity
 - Bringing the growers/landowners on board
 - Establishing price, terms, and conditions

A New Crop Grower's Point of View

- What will growers need to know?
 - What is it?
 - Who's going to buy it, how much do they need, at what price?
 - What's in it for me?
 - Is this a secure, long term investment?
- Possible Willow Selling Points
 - Long-term contracts - cash flow stability
 - Low intensity operation
 - Demonstration phase underwritten by Salix and DOE
 - Good alternative crop for idle land
 - Environmental benefits - watershed protection, soil conservation, regulatory compliance
 - Other markets identified

Green Power Utilities' Perspectives

- Generate power at competitive prices
- Protect customer base
- Be perceived as a community partner
- Dealing with nuclear & environmental constraints
- Cooperation and creative thinking needed in today's "deregulating" energy market

Willow can be part of the solution

What are the biggest hurdles?

- Fuel price
 - competitive with coal
 - Not as cheap as residues
- Return on Investment
 - Production costs low
 - Income per acre low
- External Benefits
 - Societal benefits understood
 - Bankable value is low
- Markets
 - Biomass for power gaining attention
 - Only the Swedes have mandated use of energy crops

Greenidge Supply Shed Scale-up Goal: 500 acres

What will it take?

Tasks

- Identify and qualify growers/owners
- Site evaluation
- Supply cuttings
- Site prep
- Planting
- Crop maintenance
- Harvesting and delivery
- Crop storage
- Feedstock processing

Business Arrangements

- Land lease
- Production services contracts
- Feedstock purchase agreements
- Production QA
- Feedstock tests

Options for Phase-II Production Arrangements

Consortium Options	Farm Operator	Perceived Risk	
		Grower/ Owner	Consortium
I) Consortium Leases or Purchases all Required Land	Consortium	Low	High *
II) Consortium Leases Land, but Contracts for Production from Growers	Growers	Moderate	Moderate
III) Consortium Contracts for Production (Growers lease land and operate farms)	Growers	High	Moderate

** High risk with respect to realizing a return on investment
but lower risk with respect customer repercussions*

Grower Interface is a Key Role

- Tasks for the primary interface
 - Identify and qualify growers/owners
 - Lease land
 - Other?
- Who is the best choice for this job?
 - Knows the business
 - Knows the growers and landowners
 - Knows the community
 - Links to USDA
 - Efficient communication links to growers

Six Years into the Future Demonstration is a Success!!

- Commercialization - Phase III
 - Pioneer Growers form first U.S. Willow enterprise
 - Consortium utilities reap the benefits of SOx, NOx and CO2 offsets
 - New York economy is boosted by new jobs, improved agricultural income, reduced fuel imports

APPENDIX C

ARTICLES

Hybrid willows to be grown in WNY as fuel supplement

By BOB BUYER

News Staff Reporter

The U.S. Department of Energy selected four companies to investigate the growing of hybrid willow bushes as a fuel supplement to coal for electric power generation.

The four regional power companies are part of the Syracuse-based Salix Consortium.

"The Biomass for Rural Development" initiative is viewed as a way to reduce the reliance on coal as a power source and a long-term aid to farmers and other rural land owners.

The six-year project has been supported since 1995 by the U.S. Department of Energy, U.S. Department of Agriculture and the state Energy Research and Development Authority. Its initial phase involves five power companies — Niagara Mohawk Power Corp., New York State Electric & Gas, Penn Electric, Burlington (Vt.) Power and Ontario Hydro.

Also part of the study are 26 farmers who would grow hybrid willows, a thick-caned, fast-growing renewable energy crop.

"We are planning to plant 20 to 30 varieties of hybrid willow on a one-to two-acre site five to 10 miles inland from Niagara Mohawk's Dunkirk coal plant."

DR. EDWARD F. NEUHAUSER,
Senior researcher at Niagara Mohawk

The Department of Energy already has dispatched \$2.8 million of an anticipated \$5 million for the New York study, which will cost a total of \$13.7 million.

Dr. Edward F. Neuhauser, a biologist and senior researcher at Niagara Mohawk's Syracuse headquarters and a key industry figure, said that the first visible Western New York participation will occur either in the spring of 1997 or 1998.

"We are planning to plant 20 to 30 varieties of

hybrid willow on a one- to two-acre site five to 10 miles inland from Niagara Mohawk's Dunkirk coal plant," Neuhauser said. "We need to learn which variety grows best in Western New York. We are working closely with Dr. Robert Gamble of the University of Toronto, an expert on hybrid willow varieties."

If the development proceeds on schedule, Neuhauser sees the first power plant test-burnings of hybrid willows likely in four or five years.

The concept calls for cutting the canes after the first year of growth for planting purposes and thereafter every three years, when the bushes could reach heights of 20 feet or more. For burning, the harvested willow canes would be chopped into inches-long units.

Edward White, dean of the state College of Environmental Science and Forestry at Syracuse, has been involved in the concept for more than a decade. He said that the hybrid willow cuttings that will be planted already are in storage.

The participants call themselves the Salix Consor-

See Willows Page D8

Willows: Acre of land produces seven tons of burnable wood

Continued from Page D5

tium, after the name of the biological family that includes willows. The Salix group already has trial plantings of hybrid willows at Massena and Tully, near Syracuse.

The practical inspiration for the Biomass for Rural Development project is Sweden, a nation without oil or coal reserves of its own and no desire to use nuclear power. Sweden has been relying on hybrid willows to fuel rural heating plants.

"The Swedes are far ahead of us in hybrid willow use," Neuhauser said. "The English also are investigating the idea."

White said, "Hybrid willow varieties are said to grow their canes densely at the rate of five feet a year and can be harvested for burning every three years. They offer farmers an opportunity to get return from idle land."

A State University of New

York estimate envisions hybrid willow plantations in Central and Western New York that could reach 40,000 to 60,000 acres by 2010 and create 300 jobs. Nationally, a 200,000-acre hybrid willow energy crop is foreseen in five years.

Energy produced from hybrid willow burning is nearly 50 percent more expensive than power from coal, White said.

"But biomass energy has other environmental benefits and offers fresh opportunities to use idle land," White said.

An acre of land might produce seven tons of burnable wood that might sell for \$20 to \$25 a ton, he added.

Generating electric power from wood currently occurs in Burlington, Vt., where a 50-megawatt power plant burns 75 tons an hour of waste wood that has no other commercial use, Neuhauser said.

Associated Press/MICHAEL OKONIEWSKI

U.S. SECRETARY OF ENERGY Hazel O'Leary tours a year-old willow stand with Edwin White, dean of research at the New York State College of Environmental Science and Forestry, Friday morning. The willow shrubs are being grown as part of an experiment in bio-mass fuel.

Willow farm renews interest in old fuel

■ **The scientists running the demonstration are exploring the economic viability of bio-mass energy**

BY WILLIAM KATES
Associated Press

TULLY — An idea with ancient roots holds future promise for farmers and electricity consumers. U.S. Energy Secretary Hazel O'Leary was told Friday during a tour of a willow forest.

That idea — burning wood.

Scientists believe the fast-growing shrubs can be raised as a cash crop and burned as a cleaner, renewable fuel alternative.

"We are growing a renewable fuel — trees — on idle farm land that is not producing cash crops for farmers right now," explained Edwin White, dean of research at the State University of New York College of Environmental Science and Forestry and the biomass project's originator.

"It seems a simple, almost prehistoric idea. But this is a good way to deal with the

environment, the economy and our energy needs," he said after leading O'Leary on an inspection of the 15-acre demonstration farm, located 10 miles south of Syracuse.

While the payoffs to consumers may be more long-range, O'Leary said the project could sooner "mean the difference between economic famine and economic feast" for struggling farmers.

"It will help keep farm families on the farm and keep them viable and growing," said O'Leary, who was in the Syracuse area for a daylong series of stops that also included a breakfast meeting with business leaders and a roundtable meeting with employees at Carrier Corp.

The nine-year-old SUNY project is the first to be awarded federal funding under a cost-shared research and development program to grow energy feedstocks, O'Leary said. The federal government will pay 45 percent of the project's \$14 million estimated cost over the next six years.

A consortium of utilities, corporations, associations, universities and local government agencies, including Niagara Mohawk Power Corporation and New York State Electric and

Gas Corp., are sponsoring the project.

NYSEG plans to produce up to 15 megawatts of electricity at its Greenidge Station in four years by burning a biomass-coal mixture using willows grown in Tully, said Jeffrey K. Smith, the Binghamton-based utility's vice president of generation.

New equipment has already been installed at Greenidge and tests will begin during the next year, he said.

Willow shrubs are carbon dioxide-neutral and would not add any emissions to the atmosphere when burned.

Nationwide, power companies have already spent more than \$10 billion on wood-burning plants in the United States since 1980. Biomass fuels have the potential to capture as much as 15 percent of the nation's \$60 billion electric power fuel market within 20 years, according to industry analysts.

Willow shrubs, which are not to be confused with willow trees, grow as much as 12 feet a year and can be harvested every three years.

Already, 26 central New York farmers have agreed to grow willow shrubs for the project, which ultimately will cover 2,600 acres in New York.

AL CAMPANIE/The Post-Standard

ENERGY IN THE MAKING

U.S. Energy Secretary Hazel O'Leary inspects willow trees in Tully on Friday during a tour of the region's energy research projects. Looking on is Edwin White, dean of research at SUNY College of Environmental Science and Forestry. O'Leary announced a \$13.5 million grant to help the college and a research group try to commercialize willows as an alternative to fossil fuels such as coal. She visited the college's Tully Genetics Field Station off Route 281 in Tully. She also met with Carrier Corp. employees in DeWitt and toured the company's manufacturing plant.

SYRACUSE, NY 22 AUGUST 1996

Energy Boss To Check Out Local Projects

■ Among the sites that Hazel O'Leary will visit is a farm of willow trees that could be used to fuel power plants.

By MARK WEINER
The Post-Standard

U.S. Energy Secretary Hazel O'Leary will visit Syracuse Friday to tour the region's energy research and development projects, and promote their ties to economic development.

O'Leary will meet with Central New York business leaders to talk about energy-related development opportunities at a morning roundtable at the Milton J. Rubenstein Museum of Science & Technology.

After the breakfast meeting, she will inspect a forest in Tully where researchers are growing willow trees as an alternative to fossil fuels such as coal.

The willows are grown in the Tully Genetics Field Station operated by the SUNY College of Environmental Science and Forestry in Syracuse. College researchers are working with utilities such as Niagara Mohawk Power Corp. and New York State Electric and Gas to see if the fast-growing trees could be used in power plants.

STEPHEN D. CANNERELLI/The Post-Standard

Edwin White, dean of research at SUNY College of Environmental Science and Forestry in Syracuse, looks at the school-operated willow forest in Tully. The trees are being grown as possible alternatives to fossil fuels.

The trees are a renewable energy source that burns cleaner than other fossil fuels, according to college officials.

Later in the morning, O'Leary will visit an energy-saving weatherization project at a low-income housing complex in LaFayette.

The energy secretary will attend a roundtable lunch with Carrier Corp. employees in

DeWitt, and then tour the company's manufacturing plant. An aide said she is interested in Carrier's new energy-efficient products.

Carrier officials said they will show off their Evergreen centrifugal chiller production line. The chillers, used in large buildings, use a chlorine-free refrigerant that does not deplete the ozone layer.

\$13.5 million grant to energize ESF's willow tree power project

U.S. energy chief to
inspect project that
could replace coal.

by Mark Weiner
Staff Writer

A 16-year experiment growing
willow trees as an energy crop is
about to reap big dividends for the
State College of Environmental
Science and Forestry.

U.S. Energy Secretary Hazel
O'Leary plans to visit the college's
Tully Genetics Field Station off
route 281 on Friday to view the
crop, touted as a renewable alter-
native to fossil fuels such as coal.

O'Leary, recognizing commer-
cial potential of the fast-growing
trees, will announce a \$13.5 million

grant to the Syracuse college and a
research consortium working on
the project, officials say.

The award is the first in the na-
tion under a federal program that
aims to develop environmentally
friendly power sources from agri-
culture and provide an economic
stimulus to rural America.

The research grant also is the
largest in the history of the State
University of New York's College
of Environmental Science and For-
estry, said Edwin White, the col-
lege's dean of research.

The college will receive about \$8
million from the grant to help turn
its willow plantations into a viable
commercial energy source, White
said.

"This is kind of a kick in the
pants to jump start this project,"
White said.

The first commercial use of the
willows will be at a coal-fired New
York State Electric and Gas Corp.
power plant in President White
said. The 100-megawatt plant will
use about 10 percent wood in place
of coal.

NYSEG is among more than 25
government and private industry
partners in the project. The part-
ners work together as the Salix
Consortium.

Syracuse-based Niagara Mo-
hawk Power Corp. is the lead part-
ner in the consortium, which is
headquartered at the college. The
consortium also includes 26 local
farmers.

During the last 16 years SUNY-
ESF researchers have shown that
willows are a plentiful and rela-
tively clean-burning energy
source, said Daniel Robison, the

STEPHEN D. CLAWSON/ILLUSTRATION PHOTOGRAPHY
EDWIN WHITE, dean of research at the College of Environmental Sci-
ence and Forestry, looks at the college's willow trees in Tully.

college's biomass program direc-
tor. Shrub willows used for the proj-
ect commonly grow on the banks
of streams in New York and Penn-
sylvania. As a crop they grow in

■ WILLOW CROP, Page A7

Willow crop at ESF might replace coal as fossil fuel

■ WILLOW CROP
Continued from Page A1

THE CROP IS ready to harvest in three-year cycles, and then grows back in a hurry, Robison said. Each plant produces as many as seven harvests over its lifetime.

"We tell people these are the redwoods of New York," Robison said. "They have the highest rate of growth of anything around here."

The willows are especially attractive as an energy source because of the fast growth, the high yield of wood and its relatively clean burn compared to coal or oil, Robison said.

When the willow wood is burned, it emits less sulfur and nitrogen — the elements that contribute to acid rain — than other fossil fuels.

Also, researchers say the willow plantations could help restore up to 50,000 acres of idle farmland in Western and Central New York.

Robison said the federal Department of Energy grant will help start new willow crops on 500 to 2,000 acres across the state.

"We don't think of this as a get-rich crop," Robison said. "This is really a blue-chip crop. A retired farmer could plant this to keep their property, rather than having to sell it off."

So far, 26 local farmers have committed about 2,600 acres to the program.

Willow plantations could become even more attractive now that the state Department of Agriculture and Markets has ruled that farmers who grow wood biomass crops for energy are eligible for lower agricultural tax assessments.

THE IDEA BEHIND the federal grant money is to use the crops as a catalyst to help rural economies thrive.

The Department of Energy's Biomass for Rural Development initiative is looking at other promising energy crops across the nation. But the willow project is on the top of the list.

The project began in 1980 under the direction of White and ESF professor Lawrence Abrahamson. They focused on poplars and then willows, a tree that grows worldwide with more than 500 species.

Research and development concentrated on finding the fastest-growing and most productive willows for Central and Western New York's climate, Robison said.

"We were looking for the best of the best," Robison said.

More than 300 willow clones were tested. The clones occur naturally and are not genetically engineered.

Researchers have picked the 19 best varieties, which are growing this summer on 30 acres at the college's Tully field station. Another 50 acres of experimental willow plantations have been started across the state.

Robison said the results have been impressive. The 6,200 willow trees planted per acre have yielded up to 8 dry tons of wood per acre each year. A typical hardwood forest in New York might produce 1 dry ton per acre each year.

A dry ton is roughly equal to a full cord of wood.

THE WILLOWS grow 4 to 6 feet in their first year after planting, but are cut down in the winter, Robison said. The cutting produces a growth spurt the next year.

"It might grow 10 to 12 feet after we cut it the first year," he said. By the third year, the willow bushes are up to 30 feet tall and ready for harvest in the winter.

White, the college's research dean, said the \$13.5-million grant will give the project six years to prepare to commercialize the willow plantations and compete with other fuels in the open market.

The agricultural crop is especially important for New Yorkers, who spend \$1,000 per capita each year to bring in energy from out of state, White said.

The home-grown wood energy source also could help lower New York's dependence on foreign oil, which accounted for 79 percent of the state's total petroleum consumption in 1994.

"The goal of this project is to produce a fuel at, or less than, the prices of other fossil fuels," Robison said. But at the moment, the wood is a little more expensive.

Willow wood, which is chipped into sawdust before burning in power plants, costs about \$2 to produce 1 million BTUs, a measure of energy. Coal costs about \$1.25 per million BTUs, Robison said.

NEW YORK STATE FAIR

File photo

LET THE FUN BEGIN

■ **Schedule:** Page D6-D8 ■ **Opening day:** Story below ■ **Music previews:** Page D5 ■ **Fairgrounds map:** Page D6-D7

Mother
Teresa ill

Page A12

MOTHER TERESA

\$13.5 million grant fuels local
willow tree project

Story Below

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neateles, who was working in the horse barn with friend Janet Troup of Camillus. "We have all our stuff between the tack stalls."

On this, the first day of the 12-day State Fair, hardly anyone sleeps. No one has the time. Not with so much to do, not with this much excitement.

Even the vendors are hustling at 5:58 a.m. "We're always busy. You know we've got all the Fair people: the state police, security, Fair workers," said a man who'd only give the name Tom, working at Speeches Family A'fair restaurant. The enterprise is open 24 hours a day.

"Egg sandwiches, that's the big thing," Tom said as a Freihofer truck made a delivery.

At the cow barn, 17-year-old Amanda Wadsworth, of Middlesex, was up at 5:30 a.m., charged with

■ DIRECTOR, Page A6

ANDREW GILMAN, 19, of Delaware waits Wednesday for the setup crew to build the German Funhouse on the Fair's midway.

ESF's willow crop brings Energy chief here

► \$13.5 million grant could be a catalyst to boost rural economies.

By Mark Weiner
Staff Writer

A 16-year experiment growing willow trees as an energy crop is about to reap big dividends for the state College of Environmental Science and Forestry.

U.S. Energy Secretary Hazel O'Leary plans to visit the college's Tully Genetics Field Station off Route 281 on Friday to view the crop, touted as a renewable alternative to fossil fuels such as coal.

O'Leary, recognizing commercial potential of the fast-growing trees, will announce a \$13.5 million grant to the Syracuse college and a research consortium

working on the project, officials say.

The award is the first in the nation under a federal program that aims to develop environmentally friendly power sources from agriculture and provide an economic stimulus to rural America.

The research grant also is the largest in the history of the State University of New York's College of Environmental Science and Forestry, said Edwin White, the college's dean of research.

The college will receive about \$6 million from the grant to help turn its willow plantations into a viable commercial energy source, White said.

"This is kind of a kick in the pants to jump start this project," White said.

The first commercial use of the willows will be at a

■ WILLOW CROP, Page A8

istration to take curb smoking a including possibly vending machine some forms of t such as ads at sp

Clinton signing w President's book

The proposed declare that cig less tobacco are for nicotine, w terminated to be last year. While theory use such the sale and av rettes for smok agency and t have backed aw reaching step.

The presiden sion would stre of the FDA to bacco firms at into enforcer smoking curbs t every state. It tobacco compa million a year agers on the dal

Clinton fir steps in August — just a few d ocratic Nation the rules being

The presiden will enable his trast a strong tive with Re Dole's rece statements q nicotine is ind

Lawmakers bacco-growing may over the strictions on tr

Willow crop at ESF might replace coal as fossil fuel

■ WILLOW CROP

Continued from Page A1

coal-fired New York State Electric and Gas Corp. power plant in Dresden, White said. The 100-megawatt plant will use about 10 percent wood in place of coal.

NYSEG is among more than 25 government and private industry partners in the project. The partners work together as the Salix Consortium.

Syracuse-based Niagara Mohawk Power Corp. is the lead partner in the consortium, which is headquartered at the college. The consortium also includes 26 local farmers.

During the last 15 years, SUNY-ESF researchers have shown that willows are a plentiful and relatively clean-burning energy source, said Daniel Robison, the college's biomass program director.

Shrub willows used for the project commonly grow on the banks of streams in New York and Pennsylvania. As a crop they grow in dense thickets, reaching heights of 25 to 30 feet after only three years at the Tully field station.

THE CROP IS ready to harvest in three-year cycles, and then grows back in a hurry, Robison said. Each plant produces as many as seven harvests over its lifetime.

"We tell people these are the redwoods of New York," Robison said. "They have the highest rate of growth of anything around here."

The willows are especially attractive as an energy source be-

cause of the fast growth, the high yield of wood and its relatively clean burn compared to coal or oil, Robison said.

When the willow wood is burned, it emits less sulfur and nitrogen — the elements that contribute to acid rain — than other fossil fuels.

Also, researchers say the willow plantations could help restore up to 50,000 acres of idle farmland in Western and Central New York.

Robison said the federal Department of Energy grant will help start new willow crops on 500 to 2,000 acres across the state.

"We don't think of this as a high-rich crop," Robison said. "This is really a blue-chip crop. A farmer could plant this to keep their property, rather than having to sell it off."

"So far, 26 local farmers have committed about 2,600 acres to the program."

Willow plantations could become even more attractive now that the state Department of Agriculture and Markets has ruled that farmers who grow wood biomass crops for energy are eligible for lower agricultural tax assessments.

THE IDEA BEHIND the federal grant money is to use the crops as a catalyst to help rural economies thrive.

The Department of Energy's Biomass for Rural Development initiative is looking at other promising energy crops across the nation. But the willow project is on the top of the list.

The project began in 1980 under

the direction of White and ESF professor Lawrence Abrahamson. They focused on poplars and then willows, a tree that grows worldwide with more than 500 species.

Research and development concentrated on finding the fastest-growing and most productive willows for Central and Western New York's climate, Robison said.

"We were looking for the best of the best," Robison said.

More than 300 willow clones were tested. The clones occur naturally and are not genetically engineered.

Research has narrowed to the 19 best varieties, which are growing this summer on 30 acres at the college's Tully field station. Another 10 acres of experimental willow plantations have been established across the state.

Robison said the results have been impressive. The 6,000 willow trees planted per acre have yielded up to 8 dry tons of wood per acre each year. A typical hardwood forest in New York might produce 1 dry ton per acre each year.

A dry ton is roughly equal to a full cord of wood.

THE WILLOWS grow 4 to 6 feet in their first year after planting, but are cut down in the winter, Robison said. The cutting produces a growth spurt the next year.

"It might grow 10 to 12 feet after we cut it the first year," he said. By the third year, the willow bushes are up to 30 feet tall and ready for harvest in the winter.

White, the college's research dean, said the \$13.5 million grant will give the project six years to

New York energy facts

prepare to commercialize the willow plantations and compete with other fuels in the open market.

The agricultural crop is especially important for New Yorkers, who spend \$1,000 per capita each year to bring in energy from out of state, White said.

The home-grown wood energy source also could help lower New York's dependence on foreign oil, which accounted for 79 percent of the state's total petroleum consumption in 1994.

"The goal of this project is to produce a fuel at, or less than, the prices of other fossil fuels," Robison said. But at the moment, the wood is a little more expensive.

Willow wood, which is chipped into sawdust before burning in power plants, costs about \$2 to produce 1 million BTUs, a measure of energy. Coal costs about \$1.25 per million BTUs, Robison said.

NEW YORK STATE

Willows May Be An Alternative Energy Source

Associated Press

TULLY — An idea with ancient roots holds future promise for farmers and electricity consumers, U.S. Energy Secretary Hazel O'Leary was told Friday during a tour of a willow forest.

That idea — burning wood.

Scientists believe the fast-growing shrubs can be raised as a cash crop and burned as a cleaner, renewable fuel alternative.

"We are growing a renewable fuel — trees — on idle farm land that is not producing cash crops for farmers right now," explained Edwin White, dean of research at the State University of New York College of Environmental Science and Forestry, Syracuse, and the biomass project's originator.

"It seems a simple, almost prehistoric idea. But this is a good way to deal with the environment, the economy and our energy needs," he said after leading O'Leary on an inspection of the 15-acre demonstration farm, located 10 miles south of Syracuse.

While the payoff to consumers may be more long-range, O'Leary said the project could sooner "mean the difference between economic famine and economic feast" for struggling farmers.

"It will help keep farm families on the farm and keep them viable and growing," said O'Leary, who was in the Syracuse area for a daylong series of stops that also included a breakfast meeting with business leaders and a roundtable meeting with employees at Carrier Corp.

The nine-year-old SUNY project is the first to be awarded federal funding under a cost-shared research and development program to grow energy feedstocks, O'Leary said. The federal government will pay 45 percent of the project's \$14 million estimated cost over the next six years.

A consortium of utilities, corporations, associations, universities and local government agencies, including Niagara Mohawk Power Corp. and New York State Electric and Gas Corp., are sponsoring the project.

NYS&G plans to produce up to 15 megawatts of electricity at its Greenidge Station

ASSOCIATED PRESS

U.S. Energy Secretary Hazel O'Leary and Edwin White, research director at SUNY College of Environmental Science and Forestry, Syracuse, tour a field of year-old willows in Tully on Friday. Willows are being grown as a renewable alternative to fossil fuels.

in four years by burning a biomass-coal mixture using willows grown in Tully, said Jeffrey K. Smith, the Binghamton-based utility's vice president of generation.

New equipment has already been installed at Greenidge and tests will begin during the next year, he said. Willow shrubs are carbon dioxide-neutral and would not add any emissions to the atmosphere when burned.

Nationwide, power companies have already spent over \$10 billion on wood-burning plants in the United States since 1980. Biomass fuels have the potential to capture as much as 15 percent of the nation's \$60 billion electric power fuel market within 20 years, according to industry analysts.

The SUNY scientists presently grow 19 species of willow shrubs on 15 acres, cloning

off more than 400 different varieties as they search for the best strain to use for fuel, said Richard Kopp, a senior research specialist.

Willow shrubs, which are not to be confused with willow trees, grow as much as 12 feet a year and can be harvested every three years. The stumps reproduce for about a 21-year period before new shrubs must be planted, said White.

"We plant it like corn. We manage it like hay. We cut it every three years and it sprouts back just like a hay crop," White said.

There are no special growing practices, fertilizers or pesticides needed to grow a willow crop, White said. Existing farm machinery can be modified to handle the jobs of planting and harvesting, he said.

Already, 26 central New York farmers

have agreed to grow willow shrubs for the project, which will ultimately cover 2,600 acres in New York.

Willow crops also will be tested at sites in Wisconsin, Minnesota, Pennsylvania and Vermont, O'Leary said.

White projected that 40,000 to 60,000 acres of willows planted in New York by 2010 would produce energy crop fuel sales of almost \$20 million annually, with electricity sales approaching \$135 million a year.

There were other benefits from the project too, O'Leary said. The shrub crop would help control farmland erosion and the quick-growing plant would serve as a ground-water purifying system.

She also envisioned support businesses blossoming up to service the new willow crop industry.

New Renewables To Lift N.Z. (Cont.)

"Other examples of innovative energy sources already adopted by enterprising New Zealanders include landfill gas at commercial and industrial sites in Dunedin, and more than half the process residues from New Zealand's 1.3 million hectares of forest estate being used by the forest-processing industry for heat and/or power generation." Use of biomass fuels (wood-processing scraps and forest prunings) is expected to double by 2005.

Furthermore, EECA envisions that photovoltaic cells in 2005 will be less than half of what it is today, falling from 30-60¢ per kilowatt-hour to 15-20¢/kWh. Also, EECA predicted that within 10 years New Zealanders can buy new, price-competitive homes that are almost self-sufficient in energy.

For information on obtaining the report, contact Energy Efficiency and Conservation Authority, Level 10, 33 Bowen Street, P.O. Box 388, Wellington, New Zealand; (04) 470 2200, fax (04) 499-5330.

DOE Formally Names Salix Winner Under Rural Biomass Program

Department of Energy has formally announced its award to Salix Consortium under the federal Biomass Power for Rural Development program for a project (TSL, April 12, 1996, p. 140) in which fast-growing willow trees are being developed in central New York as an agri-forest energy crop. With the project, DOE predicted potential benefits for the environment and the economy of rural America.

Salix is led by Niagara Mohawk Power Corp., Syracuse, N.Y., and consists of State University of New York College of Environmental Science and Forestry (SUNY ESF), Syracuse; New York State Electric and Gas Corp. (NYSE&G), Albany; U.S. Generating Co., Bethesda, Md.; General Public Utilities, Parsippany, N.J.; Burlington Electric Department, Burlington, Vt.; New York State Energy Research and Development Agency, Albany; Ontario-Hydro, Ottawa, Ont., Canada; and other organizations. Antares Group, Landover, Md., has been contracted by Salix to provide management assistance.

The award will provide federal funding to cover about 45% of the willow biomass projects' anticipated cost of \$14 million over six years. The project will test, develop and establish operational and planning techniques for the mass production of willow shrubs to be used for electricity generation. A 50-acre demonstration farm at SUNY ESF's Genetics Field Station in Tully, about 15 miles south of the college's campus, will serve as the base of the research.

"This initiative is a perfect complement to Niagara Mohawk's overall commitment to sustainable development and global climate control."

As part of the project, NYSE&G expects eventually to produce up to 15 megawatts of electricity at its Greenidge Station by burning biomass, including willows produced on about 500 acres.

Localities Win Urban Consortium Energy Funds for Next Year from DOE

Several cities have won funding for 1997 renewable-energy projects under a Department of Energy program administered by Urban Consortium Energy Task Force of Wash-

ington, D.C.-based Public Technology Inc. The following individual awards range from \$25,000-70,000:

- **Cabo Rojo/Mayaguez, P.R.**, will enter the demonstration phase of its program to use solar-assisted air-conditioning and dehumidification systems to offset demand for electricity in subtropical climates. The project will design a pilot system for an existing facility, determine the technology's economic and technical feasibility, and outline a technology-transfer plan. Call Nohemi Zerbi at (787) 721-4370.

- **Chittenden County, Vt.**, will try expanding the opportunity for biomass district-energy systems, decentralized generating systems that can supply electricity to a group of buildings. The project will address institutional capacity and the support needed for implementing a biomass district-energy system, among other topics. Call Arthur Hogan at (802) 658-3004.

- **Honolulu, Hawaii**, will introduce electric vehicles into municipal duty cycles and determine where EV use makes the most sense and what its benefits are. The project will generate data for 12 months of actual vehicle operation in municipal duty cycles. Call Ross Sasamura at (808) 523-4171.

- **Portland, Ore.**, will develop a GreenPower Partnership to offer Portland businesses the opportunity to buy electricity generated by non-hydro renewable resources such as wind, geothermal or solar. The project is designed to flow with the trend toward increased customer choice accompanying electric-utility-industry restructuring. Call Susan Anderson at (503) 823-7222.

- **Yolo County, Calif.**, has partnered with other local governments statewide to accelerate the rate of methane generation in landfills and maximize capture of the resulting gas. The county will monitor an already-constructed project to evaluate methane-capture technologies and develop guidelines for their application. Call Ramin Yazdani at (916) 757-5567.

- In addition to Portland's focus on restructuring with its GreenPower program, Barnstable County, Mass. (Margaret Downey, [508] 362-2511); Chicago, Ill. (Dwight Bailey, [312] 744-3634); Columbus, Ohio (Jim Joyce, [614] 645-6141); and San Jose, Calif. (Rita Norton, [408] 277-5533), will address the local impacts of restructuring.

Overall, 19 cities received rewards. "A quick review of these projects highlights how important this program is to our nation as a whole and to local governments especially," said PTI research executive Arthur Morris. "It brings new technology and environmental benefits to all, and economic good to local residents—attracting \$3 for every \$1 of federal funds. Clearly, this time-tested program is promoting fresh innovations in communities around the country, and those communities are reaping rich rewards."

Eight Industry Partners Join NREL In Signing Renewables CRADAs

National Renewable Energy Laboratory has signed cooperative research and development agreements (CRADAs) with eight industry partners to bridge the gap toward making certain biomass, photovoltaic, hydrogen and sludge technologies marketable in the energy sector.

Under one CRADA, NREL, Argonne National Laboratory, Pacific Northwest Laboratory and Oak Ridge National

(Continued on following page)