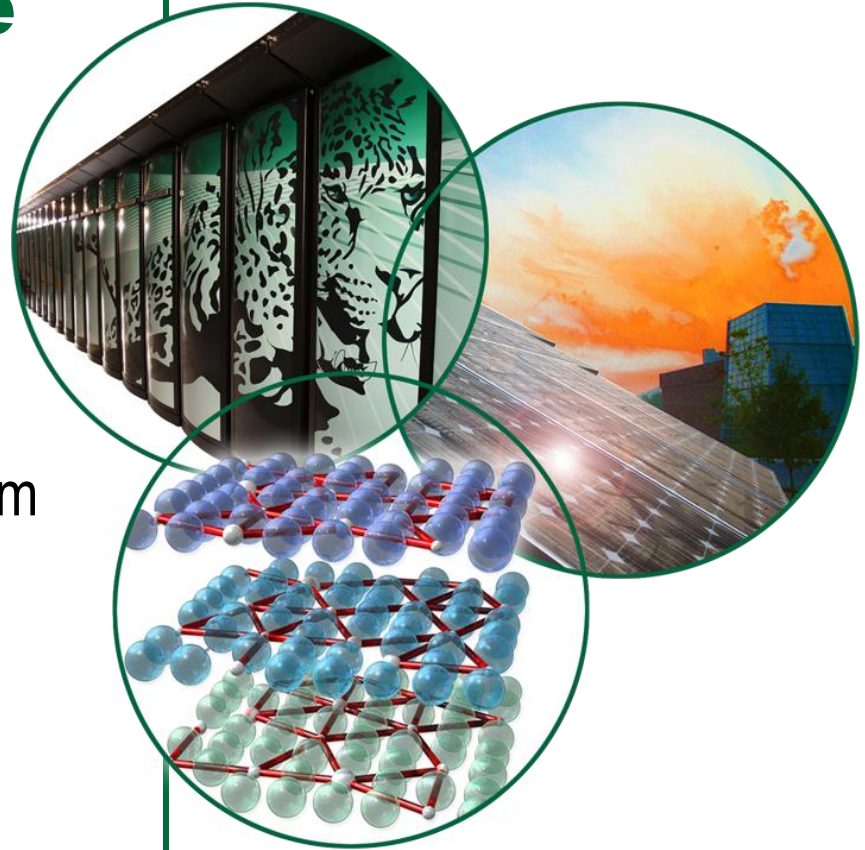


Sustainability Considerations for the ORNL Biomass Steam Plant Feedstock Supply

Center for BioEnergy Sustainability Forum
November 17, 2011



Objectives for today's discussion

- Improving sustainability of the ORNL campus is a goal of the new biomass steam plant
- Although no specific sustainability standards have been established for biomass procurement at ORNL, Forestry Best Management Practices have been included as a requirement in the current supply contract
- We believe that, as a national laboratory, it is important to make our feedstock supply a model of sustainability for biomass industries
- **Goal today:**
Discuss what sustainability means for the steam plant feedstock supply and consider ways to achieve it

Forum outline

Brief presentations followed by open discussion

History, overview, and current status of the ORNL biomass steam plant	Elliott Barnett
Recent Operational Improvement Program (OIP) project to evaluate use of Oak Ridge Reservation woody resources as feedstock for steam plant	Erin Webb
Sustainability standards development and examples from wood-fired power plants	Matt Langholtz
Review of barriers to development and implementation of sustainability standards for biomass conversion facilities	Mark Downing

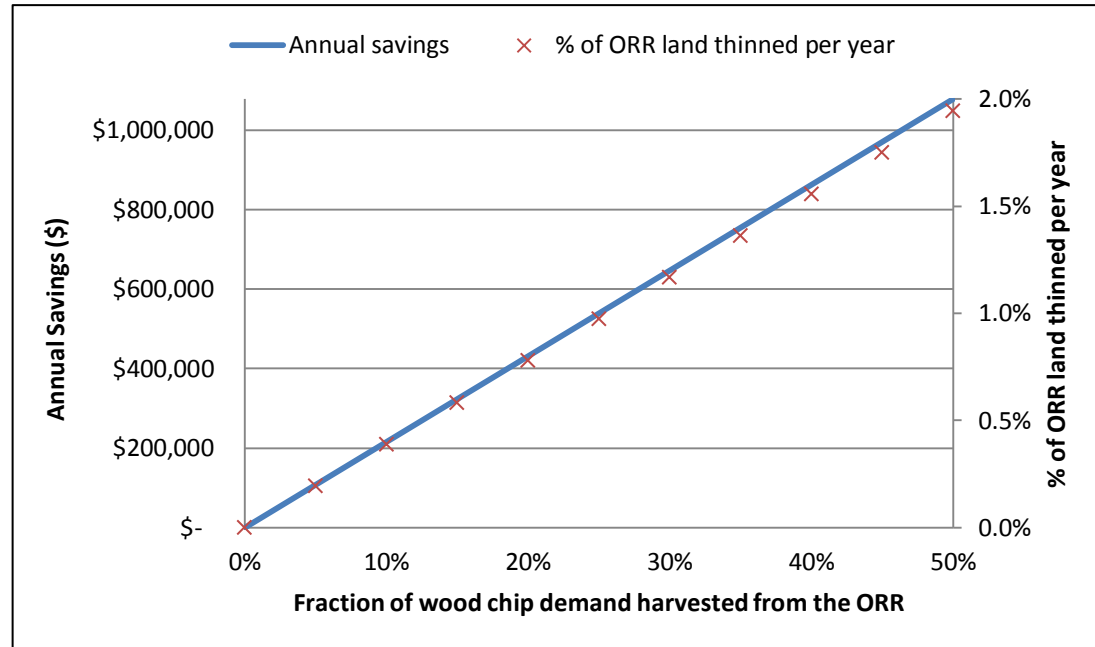
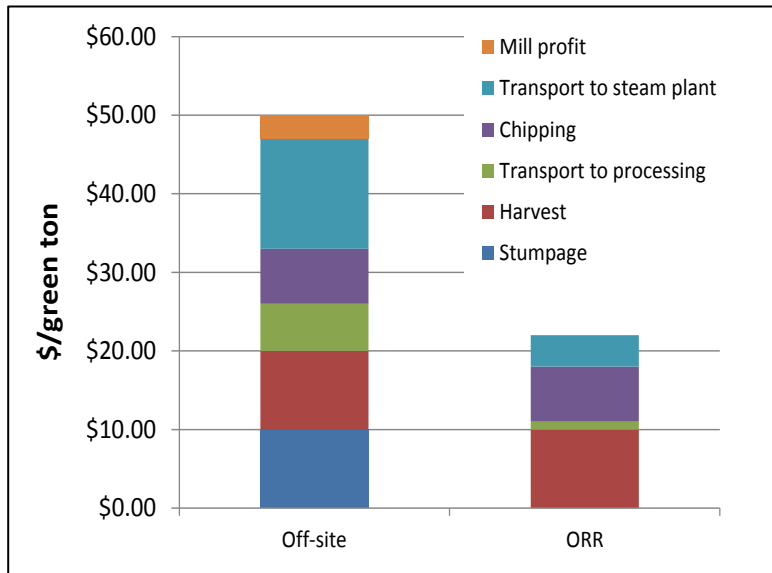
Overview of steam plant

Elliott Barnett

A 2011 OIP project evaluated use of woody resources from ORR for steam plant

- Team members
 - ESD: Matt Langholtz, Erin Webb, Mark Downing
 - Utilities: Elliott Barnett
 - Students: Kevin Caffrey, Wesley Brummette
- Objective: To investigate the potential for applying sustainable forest management practices on the Oak Ridge Reservation (ORR) for the purpose of producing wood chips for the ORNL steam plant
- Benefits
 1. Less expensive feedstock
 2. Better control of chip quality and consistency
 3. Improved supply reliability
 4. Improved forest health in areas selected for treatment
 5. Better control and implementation of sustainable forest management and harvesting practices

Potential for significant \$ savings for ORNL



An example from The Savannah River Site:

“The Savannah River Site has been producing revenue from the sale of forest products since 1955...The revenue from these sales (about \$80 million to date) has been re-invested into the infrastructure development, restoration and management of the natural resources of the SRS... Additionally, harvesting and silviculture activities are important tools for managing vegetation and habitat conditions for wildlife, restoring degraded communities such as wetlands, savannas, and hardwoods.”

Biomass production can be beneficial for forest management

- “The challenge of restoring, maintaining, and enhancing the health of forestlands requires ‘the removal of large quantities of small-diameter and low-quality wood that currently has little to no commercial value’”.

Patton-Mallory, ed. 2008. *Woody Biomass Utilization Strategy*. FS-899. US Forest Service.

- To be sustainable, wood harvested from the ORR must meet site selection criteria
 - Proximal to existing roads and forest access
 - Fairly level or gentle slopes
 - Minimum setback distance of 100 ft. from streams/creeks and wetland areas
 - Not immediately adjacent to, or requiring heavy equipment transport through
 - Sensitive interior forest area, or
 - An area containing a sensitive flora or fauna species habitat, or
 - An environmentally or administratively sensitive area

Conclusions and suggested next steps

- Harvesting from the Oak Ridge Reservation can provide a less expensive feedstock AND improve forest health
- Recommendations:
 - On-site field trials are needed to validate cost estimates and test sustainability standards
 - Develop sustainability standards for steam plant feedstock supply
 - Wood procured from off-site should be held to same standard as wood harvested from Oak Ridge Reservation
 - ORNL has opportunity to be model for other bioenergy facilities

Sustainability standards

Matt Langholtz

What are the sustainability standards we want to capitalize upon?

- Sustainable compared to what?
- Measurement for quantification and monitoring
- Implementation of a plan(s)
- Technical and non-technical barriers
- Success!
 - McNeil Generating Station, Burlington, VT
 - Middlebury College Steam Plant, Middlebury, VT

Sustainable compared to what?

Do nothing business-as-usual

Sustainability standards both on- and off-site

- **Before management**



- **After management**

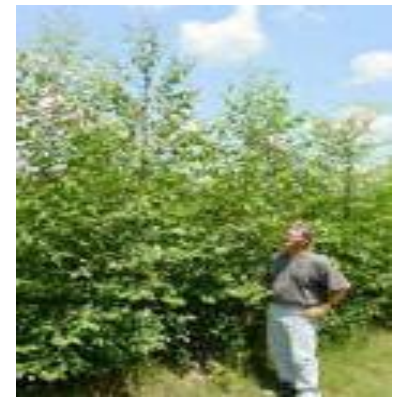


What might this all look like?

Before



After

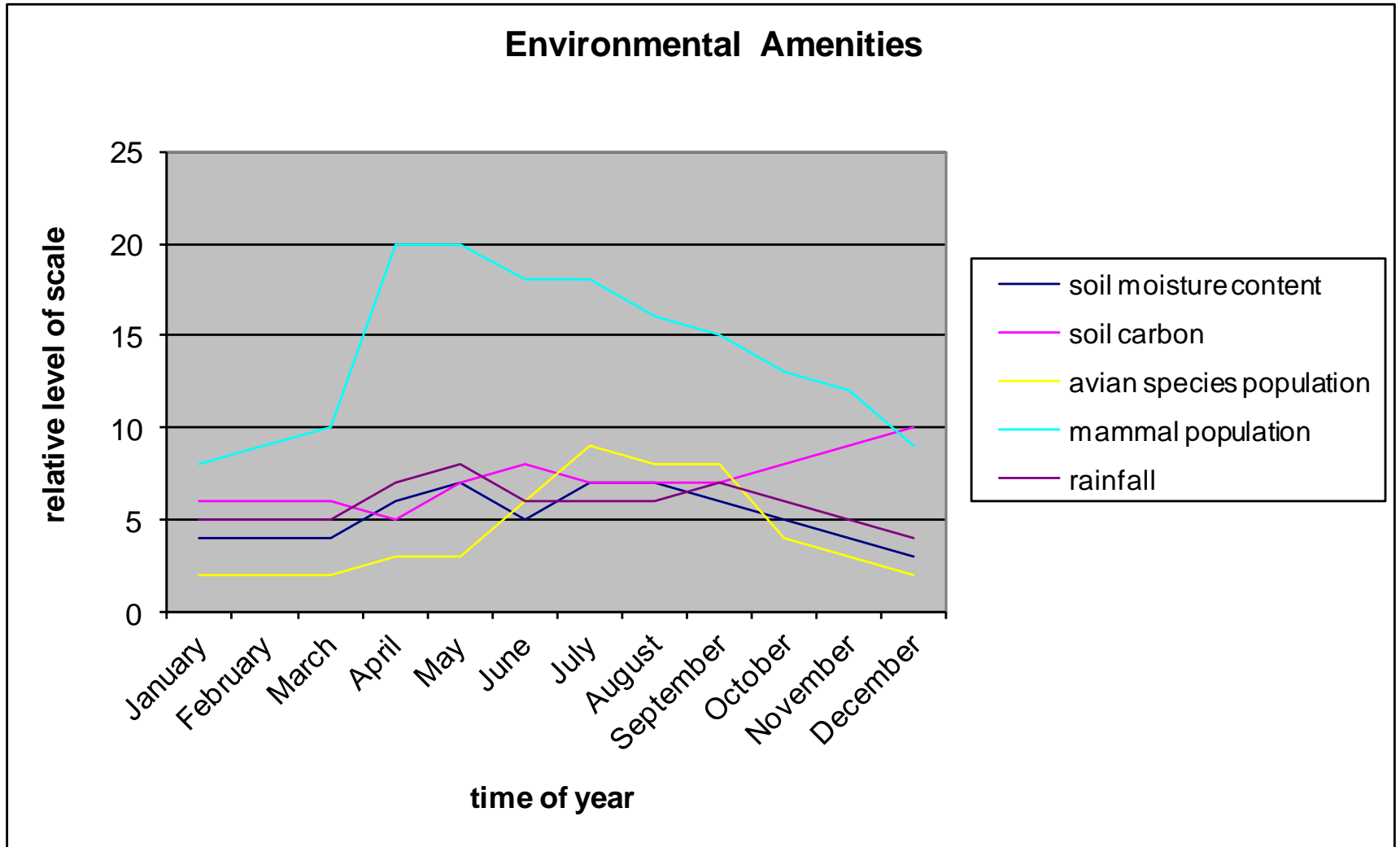


Measurement for quantification and monitoring (general examples)

- Increase or decrease in certain avian species at different times (sample population)
- Change in water quality in streams, groundwater, run-off (N, P)
- Soil change in carbon levels, structure, measured by organic matter, and tilth
- Air quality?
- Decrease in existence of invasives, increase in plant materials we want
- Current state-of-the-world, and monitoring

Relative changes over time

(dynamic modeling of environmental amenities inter-temporally, and inter- and intra-regionally)



Implementation of a plan

Proposed Guidelines for Designing, Planning, and Executing Short Rotation Woody Crops Installation on the Oak Ridge Reservation

Mark Downing, Elliott Barnett, Matt Langholtz, Erin Webb (white paper in progress) - November 8, 2011

- Procedure for Planting and Establishment
- Site Selection
- Site Preparation
- Planting
- Planting Stock
- Care of Cuttings
- Planting
- Weed Control
- Maintenance
- Cultivation and 1st Year Operations
- Plantation Monitoring
- 2nd Year Monitoring and Maintenance
- 3rd Year Tending and Monitoring
- Insects, Disease, and other Plant Health Considerations
- Herbicide Research, Labeling, and Use
- Pre-emergent herbicides applied directly after planting
- Post emergent herbicides applied during the growing season
- Herbicides applied in plantations 1-year and older
- Sustainability
- 6 Measurements for Yield, and other junk

Implementation of a plan

Establishing measurable standards for both off-site and on-site supply chain operations

- Sets an example of ORNL leadership in operations on the reservation transferred to off-site operations for procurement
- Provides tailored implementation of sustainability standards for particular operations that meet the needs for each site (site-specific management)
- Suggests that business-as-usual is not acceptable
- Helps us understand the cost structure and how to incorporate risk management in the operations

Implementation of a plan

Contracting and written standards that go beyond simple compliance

- Two DOE Orders, DOE O 430.1B Life Cycle Asset Management, and DOE Order 450.1 Environmental Protection, govern the management of forest resources at ORR.
- [Requirements of DOE Order 450.1 applicable to forest management include:
- 4b(1)(b) implementation of a watershed approach for surface water protection;
- 4b(1)(c) implementation of a site-wide approach for groundwater protection;
- 4b(1)(d) protection of other natural resources including biota;
- 4b(1)(e) protection of site resources from wildland and operational fires;
- 4b(1)(f) protection of cultural resources
- 4b(2) Promote the long-term stewardship of a site's natural and cultural resources throughout its operational, closure, and post-closure life cycle.
- 4b(4) Ensure the early identification of, and appropriate response to, potential adverse environmental impacts associated with DOE operations, including, as appropriate, preoperational characterization and assessment, and effluent and surveillance monitoring.]
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- Laws, Regulations, Guidance, and Rules Governing Forest Management at ORR
- Major governing documents influencing ORR forest management include the following:
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- National Environmental Policy Act of 1969 (42 USC 4321)
- Endangered Species Act of 1973 (16 USC 1531)
- National Historic Preservation Act of 1966 (16 USC 470)
- Clean Water Act of 1977 (33 USC 1251)
- Rivers and Harbors Act of 1899 (33 USC 401)
- Clean Air Act of 1970 (42 USC 7401)
- Federal Insecticide, Fungicide, and Rodenticide Act of 1972 (7 USC 136)
- Sikes Act of 1960 (16 USC 670)
- Executive Order 11988 – Floodplain Management
- Executive Order 11989 – Off-Road Vehicles on Public Lands
- Executive Order 11990 – Protection of Wetlands
- Executive Order 13112 – Invasive Species
- Executive Order 13148 – Greening the Government Through Leadership in Environmental Management
- Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds
- DOE Policy 450.4 Safety Management System Policy
- DOE Order 450.1 Environmental Protection Program
- DOE Order 430.1B Real Property Asset Management
- DOE Guidance 4300.1C Real Property Management
- Rules of Tennessee Department of Agriculture Division of Forestry Chapter 0080-7-3 Forestry Best Management Practices
- Tennessee Water Quality Control Act of 1977

Technical and non-technical challenges

- Enforceability of our proposed environmental standards
- Non-competition with private industry
- Chips at a competitive price, or a lower price given other benefits derived
- Local buy-in to a renewable energy system using locally procured and sourced wood
- Possible transition to something other than “wood”
- Being “successful” in power plant operations
- Tying sourced fuel quality to power plant performance
- Research vs. demonstration vs. successful demonstration

JOSEPH C. MCNEIL GENERATING STATION



- 55 mW gross power production
- 1275 psi 950F steam at 500,000 tph
- 76 tons wood/hour
- 550,000 cubic feet of gas/hour
- 80 foot boiler box
- 39,300 gallons water boiler capacity
- The McNeil Station is jointly owned by BED (50 percent), Central Vermont Public Service (20 percent), Vermont Public Power Supply Authority (19 percent) and Green Mountain Power (11 percent).

JOSEPH C. MCNEIL GENERATING STATION

- Wood procurement does not allow clearcutting unless a new stand of trees is installed – limited to 25 acres
- Wood procurers and suppliers must adhere to strict set of standards established by VT and BED
- Range of prices is \$18 - \$30 per delivered ton
- Truck less expensive than rail
- private contractor who transports the ash and markets it as a soil conditioner for pH control and a source of potash and potassium. McNeil ash is approved as a soil conditioner for organic crops. The heavier portion of the ash (bottom ash) is used as a base for building roads or an additive for manufactured topsoil.

MIDDLEBURY COLLEGE GASIFIER



- The biomass plant uses the excess pressure from the steam to co-generate approximately 3-5 million kilowatt-hours of electricity per year. Also, the heat from the exhaust is used to preheat water going into the boiler.
- 20,000 tons wood use per year
 - 2-3 truckloads per day
- 1,000,000 No. 6 fuel oil displaced
- \$840,000 into the local economy through wood chip purchase
- broker to source wood chips within a 75-mile radius
- in collaboration with the SUNY School of Forestry, is 2-1/2 years into a promising 4-year research project on College lands to test fast-growing willow shrubs as a locally produced fuel source

MIDDLEBURY COLLEGE GASIFIER

