



Evaluating Woody Biomass Options for North Carolina's Electricity Future

Overview

As coal-burning power plants seek ways to reduce their carbon dioxide emissions in response to the North Carolina Renewable Energy Portfolio Standard (REPS), some are evaluating the use of woody biomass for the generation of steam, heat, and/or electricity by co-firing with coal. In this activity, students will learn about and assess the potential for various types of woody biomass to replace coal with emphasis on North Carolina's biomass resources and their region specifically. **Students assume the role of various stakeholders and participate in a discussion with classmates who represent officials from a local power plant that is seeking to substitute 20% of its coal with woody biomass.** The class will evaluate each available woody biomass option and come to a group consensus about which option, if any, is best from an economic, environmental and public health perspective.

Woody Biomass options to be evaluated in this lesson include: wood waste/forest residues (chips made from bark, sawdust and other byproducts of milling timber and making paper; logging waste); torrefied wood; and pellets from higher value wood, including roundwood and short-rotation woody crops.

Courses

Biology; Earth and Environmental Science

North Carolina Essential Standards for Biology

- **Bio.2.2.1** Infer how human activities (including population growth, pollution, global warming, burning of fossil fuels, habitat destruction and introduction of nonnative species) may impact the environment.
- **Bio.2.2.2** Explain how the use, protection and conservation of natural resources by humans impact the environment from one generation to the next.

North Carolina Essential Standards for Earth and Environmental Science

- **EEn.2.2.1** Explain the consequences of human activities on the lithosphere (such as mining, deforestation, agriculture, overgrazing, urbanization, and land use) past and present.
- **EEn.2.2.2** Compare the various methods humans use to acquire traditional energy sources (such as peat, coal, oil, natural gas, nuclear fission, and wood).
- **EEn.2.5.5** Explain how human activities affect air quality.
- **EEn.2.6.3** Analyze the impacts that human activities have on global climate change (such as burning hydrocarbons, greenhouse effect, and deforestation).
- **EEn.2.8.1** Evaluate alternative energy technologies for use in North Carolina.

Essential Questions

- What are the benefits and drawbacks that arise from a power plant choosing to substitute a portion of its coal with woody biomass?
- What local sources of woody biomass (within a 50 mile radius) exist within your community?
- What are the economic, environmental and public health factors that must be taken into account when comparing woody biomass to coal?

Materials

- Internet access or other current biomass resources (books, articles, brochures- see *Resources* section)
- *Woody Biomass vs Coal Comparison Chart*, student worksheet, one per student

Teacher Preparation

Introduce students to the basics of electricity generation by conventional fossil energy: coal, natural gas, oil is used to power turbines to generate electricity. Raise awareness of how these energy sources are acquired by humans as well as the consequences of these processes on the atmosphere, lithosphere, hydrosphere and biosphere. Ask students to consider an alternative energy source for electricity generation - woody biomass – and the implications of harvesting it and using it for fuel in an effort to reduce our dependence on fossil fuels for electricity.

Duration

Part I. Time for independent research (in class or as homework) and small group discussion (60-90 minutes)
Part II: Time for in-class presentations & discussion (60-90 minutes)

Procedure

1. Ask to students to define the term “biomass” in their own words and collect their responses on the board in order to come to a consensus about what this term means. According to the US Department of Energy biomass is “organic material made from plants and animals (microorganisms).” Remind students that all biomass contains stored energy from the sun since plants, and ultimately the animals that eat those plants, rely upon photosynthesis. Tell students that this lesson is going to focus on the use of woody biomass for electricity generation, also known as **biopower**. If needed, you may want to remind students that they don’t want to confuse biopower with biofuels, which is the conversion of biomass into liquid fuels (e.g., ethanol and biodiesel) for transportation. Feel free to go ahead and introduce them to the different types of woody biomass options used to generate electricity listed in step 5.

For further discussion (*optional*): Notice that the definition for biomass above would also technically include fossil fuels since they are ultimately derived from plants and animals that lived millions of years ago. Prompt your students to consider why fossil fuels are not considered to be examples of biomass; what features of fossil fuels distinguish them from biomass resources and ask why this distinction matters. *In the renewable energy world, the term biomass refers to renewable energy sources like wood, crops, manure, etc., resources that come from living, or recently living organisms. When burned, these biomass resources do contribute CO₂ to the atmosphere but, unlike the CO₂ arising from combustion of fossil fuels that are involved in the long-term cycling of carbon, the CO₂ released is part of the short-term cycling of carbon* (<http://www.koshland-science-museum.org/exhibitgcc/carbon02.jsp>).

2. Next, introduce students to some of the ways electricity is generated from woody biomass: 1) by **direct-firing** where the woody biomass is burned to produce high-pressure steam that turns a turbine connected to an electric generator; or 2) by **co-firing** where a portion of coal is replaced by woody biomass in an existing power plant. Co-firing requires some modification to the coal-burning power plant, but these modifications would generally be less expensive than building a new direct-fired power plant.

3. Draw a **T chart** on the board; draw a “+” sign in the left hand column of the chart and a “-” sign in the right hand column. Invite the students to consider how woody biomass might be touted as a solution to reducing carbon emissions from conventional power plants and brainstorm the potentially positive and negative impacts of doing so. Do not worry about right or wrong answers, just record ideas based on what students know.

4. Inform students that as coal-burning power plants seek ways to reduce their carbon dioxide emissions, some are evaluating the use of woody biomass for the generation of steam, heat, and/or electricity by co-firing with coal. Tell students they are going to assume the role of different stakeholders and take part in a “public hearing” to be facilitated by a local coal burning power plant seeking to substitute 20% of its coal with woody biomass. For woody biomass to be economically viable as a substitute for coal, sources should exist within a 50-mile radius of the power plant; prompt your students to think about *local resources* for woody biomass which could include one or more of the following:

Woody Biomass Option	Source	Examples
Forest Residue Chips	Remnants from logging operations	tree tops, branches, bark
Mill Residues	Waste products from mill operations	bark, saw dust
Urban Wood Waste Chips	Homes and Businesses; Construction sites	tree trimmings, shipping pallets and clean, untreated leftover construction wood

5. Next, divide students into the following small groups, keeping in mind the personalities and interests of the students. The success of the public hearing will, in part, hinge on the personalities of the students in Group 1; it is recommended that the teacher select students who will be comfortable asking questions, challenging other groups’ presentations, etc. If needed, the teacher can always join group 1 to ensure a productive public hearing.

Group 1: Local coal burning power plant officials	Group 5: Anything But Coal Power! Citizen Group
Group 2: Clean Air Environmental Non-profit Organization	Group 6: Local Forest Owners
Group 3: Woody Biomass Development Company	Group 7: Professional Foresters
Group 4: Torrefied Wood Manufacturer	

6. Provide each group with their group’s description and instructions for preparing for the public hearing (see pages 5-12); either in class or as a homework assignment, direct students to conduct research and prepare their presentation for the public hearing. The *Woody Biomass vs Coal Comparison Chart* will be useful for guiding their research and informing them about the kind of information they should include in their presentation; depending on the energy source they are investigating it may be difficult to find some cost information. If time will be allotted for in-class research, relevant resources such as facts sheets and news articles could be compiled in a folder that can then be given to each group to guide their research. Ask students to base their information on local data and

resources as much as possible. Students may create a short PowerPoint presentation or design a campaign poster, fact sheet or brochure that supports their argument.

7. On the day of the public hearing, ask the students in Group 1 to sit at the front of the room since they will represent the officials receiving the public comments. Ask if they have any opening remarks and at the conclusion of their opening remarks ask Groups 2-6 to take turns and briefly present their argument to the power plant officials, allowing time for questions at the end. **Direct students to complete the *Woody Biomass vs Coal Comparison Chart* as they listen to the various presentations.**

8. At the conclusion of public hearing, allow 5-7 minutes for Group 1 to meet and discuss the presentations and come to a decision about whether or not they will move forward with substituting 20% of coal with woody biomass based on the information presented by their classmates. Alternatively, Group 1 could make their deliberation public and let the class in on their discussion.

9. Next, ask the class if they agree with the decision of Group 1. Why or why not?

10. Finally, see if the class can come to consensus about which woody biomass option(s), if any, the local utility company should pursue in order to substitute 20% of its coal. The *Woody Biomass vs Coal Comparison Chart* will be useful as the class comes to a consensus. Ask the students to explain their reasoning based on environmental, economic and social perspectives, revisiting the T-chart from the beginning of the lesson if desired. You may choose to ask students to reflect on this question individually in writing by asking them to respond to the question: *Is woody biomass a viable alternative to coal? If you think so, to what extent?*

11. Finally, you may want to ask the class, *How did public perception contribute to the decision the class made today?* According a January 2011 publication (see *Resources* section) released by the USDA Forest Service's Southern Research Station, "a number of studies cite public perception as playing an important role in the success or failure of proposed biomass energy projects."

Discussion Extensions Based on Current Events

If time permits, either of the following scenarios would make for an interesting discussion or you ask students to reflect on one or both questions in writing using the knowledge gained from this lesson.

- Throughout the Southeast, European companies are exploring or building mills to turn small diameter and other relatively low-value timber into wood pellets for export. In fact, groups 3 and 4 above are typically more interested in off-shore markets for power plants in Europe than in meeting domestic demands. Wood pellets or torrefied wood pellets allow efficient shipment on bulk ships overseas, therefore these industries are actually competing for resources as domestic coal-fired power plants comply with government policies requiring utilities to begin generating some renewable power. North Carolina is a target for these companies given its extensive forests and also paper and lumber mills; specifically, the decline in the paper and lumber industries is creating a new market for pulpwood and round wood. *What do you think about shipping wood pellets across the ocean to be burned in inefficient coal-fired power plants?*

- In October 2010, the NC Utilities Commission concluded that whole trees can count as a renewable energy resource. The argument from those who opposed such a ruling was that counting whole trees as a renewable fuel would risk the state's forests to over-harvesting. Others have expressed concern that energy policy will create unfair competition for traditional forest industry by allowing whole trees to be included in the definition. In the interest of moving forward in NC with wood energy, Senate Bill 279 of the 2011 Session of the NC General Assembly seeks to clarify the definition of "Renewable Energy Resource" as it pertains to the North Carolina Renewable Energy Portfolio Standard (REPS) to include that "wood is a renewable energy resource and that wood need not be a waste product to qualify as a renewable energy resource." This bill passed the Senate in May 2011 but must pass the House before it can become law. *What do you think about cutting down whole trees with the intent of using them to generate electricity? In the case of North Carolina, what if cutting down these trees was one step towards restoring the state's historic longleaf pine forests or other treasured ecosystems?*

Culminating Activities

Guest Speakers/Tours

- Invite someone from a local coal-fired power plant to speak about options either in place or being considered to reduce carbon dioxide emissions.
- Invite someone who works in the biopower industry to speak about the future of woody biomass for electricity generation.
- Invite a professional forester or consulting forester to visit your class and discuss trends in woody biomass in your county. A county specific list of consulting foresters can be found at:
http://ncforestservice.gov/Managing_your_forest/consulting_foresters.htm
- If possible, tour a local biopower facility:
 - Coastal Carolina Clean Power, Kenansville, NC
<http://www.reenergyholdings.com/our-facilities/>
 - Corn Products, Winston Salem, NC
 - Craven County Wood Energy Plant
http://www.biomasspowerassociation.com/profiles/membership_craven.php
 - EPCOR – Roxboro, Roxboro, NC or Southport, NC

Research Extensions

- Invite students to investigate other kinds of biomass that can be used in biopower operations; these feedstocks can include poultry litter, manure that can be converted into methane gas by anaerobic digestion, and other, non-woody agricultural waste products. Also, agricultural crops such as switchgrass or miscanthus can be grown specifically as an energy crop.
- Ask students to identify any local examples of a biopower operation and write up a description of the plant.
- Have students conduct research to see if there has been any local opposition to the use of woody biomass in a local power plant. Have them bring in news articles to discuss etc.

Differentiation

Students with Special Needs

- Place students in mixed ability groups for activity completion.

AIG

- Students can work individually on their assigned biomass source.
- Ask students to summarize their assigned woody biomass source by writing a one page report or making a brochure or fact sheet.

Resources

US Department of Energy, ABCs of Biopower

http://www1.eere.energy.gov/biomass/m/abcs_biopower.html

Southern Alliance for Clean Energy, Biopower Overview

http://www.cleanenergy.org/index.php?/Learn-About-Details.html?form_id=52&item_id=28

Union of Concerned Scientists, How Biomass Energy Works

http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html

Dictionary of Forestry

<http://www.dictionaryofforestry.org/>

Net Benefits of Biomass Power Under Scrutiny

http://www.nytimes.com/2010/06/19/science/earth/19biomass.html?_r=1

The North Carolina Renewable Energy Portfolio Standard (Senate Bill 3)

<http://www.ncuc.commerce.state.nc.us/reps/reps.htm>

NC State University Extension Forestry Service

http://www.ces.ncsu.edu/forestry/programs/woody_biomass/

The North Carolina Renewable Energy Portfolio Standard And Its Significance for NC Forest Landowners

<http://www.ces.ncsu.edu/forestry/biomass/pubs/WB003.pdf>

Understanding Forestry Terms: A Glossary for Private Landowners

<http://www.ces.ncsu.edu/forestry/pdf/WON/won26.pdf>

US Department of Energy's Biomass Program

<http://www1.eere.energy.gov/biomass/>

US Energy Information Administration, Energy for Kids, Biomass

http://www.eia.gov/kids/energy.cfm?page=biomass_home-basics

US Forest Service Woody Biomass Utilization

<http://www.fs.fed.us/woodybiomass/whatis.shtml>

Wood to Energy: Using Southern Interface Fuels for Bioenergy (USDA Forest Service January 2011 Publication)

http://www.srs.fs.fed.us/pubs/gtr/gtr_srs132.pdf

Acknowledgements

Sincere thanks to the following individuals who thoughtfully reviewed and/or piloted this lesson:

Daniel Arneman, Ph.D., Energy Services, University of North Carolina at Chapel Hill

Phil Barner, Energy Services, University of North Carolina at Chapel Hill

Paul Bonicci, North Carolina Civic Education Consortium, University of North Carolina at Chapel Hill

John Bonitz, Southern Alliance for Clean Energy

Sarah Duffer, Asheville High School

Dacia Harris, Asheville High School

Dennis Hazel, Ph.D., Department of Forestry and Environmental Resources, North Carolina State University

Mark Megalos, Ph. D., Department of Forestry and Environmental Resources, North Carolina State University

Sarah Robertson, Northwood High School

Jacqueline Quick, Williams High School

Group 1: Officials at a local coal-fired power plant

Your group represents officials from a local public utility that have been asked by company leaders to scope opportunities for biomass-based power in response to government policies that require utilities to begin generating renewable power. You have been asked to hold a public hearing in which you will defend your use of coal but also welcome feedback about woody biomass options that should be considered. Your group will provide opening remarks at the beginning of the public hearing and you will be responsible for asking questions of the various groups that participate in the hearing.

Position Statement: Coal is an affordable and reliable energy source and these features must be taken into account when evaluating woody biomass options.

Research Focus: During the public hearing you will be receiving public comments from various stake holder groups and therefore need to be familiar with the reasons for using coal as well as the general pros and cons of making this shift to woody biomass. The *Woody Biomass vs Coal Comparison Chart* reveals the kind of information you should try to include in your presentation; complete the “Coal” column of the chart as best you can and be prepared to share this information with your classmates during your presentation.

RESOURCES

Coal

The National Academies, What you Need to Know about Energy, Coal
<http://needtoknow.nas.edu/energy/energy-sources/fossil-fuels/coal/>

The Need Project

http://www.need.org/needpdf/infobook_activities/SecInfo/CoalS.pdf

US Energy Information Administration, Energy for Kids, Coal
http://www.eia.gov/kids/energy.cfm?page=coal_home-basics

Biomass

US Department of Energy, ABCs of Biopower
http://www1.eere.energy.gov/biomass/m/abcs_biopower.html

Southern Alliance for Clean Energy, Biopower Overview

http://www.cleanenergy.org/index.php?/Learn-About-Details.html?form_id=52&item_id=28

Union of Concerned Scientists, How Biomass Energy Works

http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html

The North Carolina Renewable Energy Portfolio Standard (Senate Bill 3)

<http://www.ncuc.commerce.state.nc.us/reps/reps.htm>

NC State University Extension Forestry Service

http://www.ces.ncsu.edu/forestry/programs/woody_biomass/

The North Carolina Renewable Energy Portfolio Standard And Its Significance for NC Forest Landowners

<http://www.ces.ncsu.edu/forestry/biomass/pubs/WB003.pdf>

US Department of Energy’s Biomass Program

<http://www1.eere.energy.gov/biomass/>

US Energy Information Administration, Energy for Kids, Biomass

http://www.eia.gov/kids/energy.cfm?page=biomass_home-basics

US Forest Service Woody Biomass Utilization

<http://www.fs.fed.us/woodybiomass/whatis.shtml>

Group 2: Clean Air Environmental Non-profit Organization

You represent an environmental non-profit organization that focuses on local air quality. Your organization does not want to see woody biomass substituted for coal. Basically, you think that burning woody biomass will result in worsening air quality in your community and will not significantly reduce overall carbon dioxide emissions. You are also concerned about the impacts of biomass harvesting on NC's forests and are skeptical about the sustainability of harvesting woody biomass.

Position Statement: Burning woody biomass will result in worsening air quality in your community.

Research Focus: Conduct research on the air quality impacts of burning woody biomass compared to coal. The *Woody Biomass vs Coal Comparison Chart* reveals the kind of information you should try to include in your presentation; complete the "Air Quality Concerns" and "Human Health Concerns" columns as best you can and be prepared to share this information with your classmates during your presentation. Consider looking to news headlines to identify the concerns of citizens and non-profit organizations who have opposed either shifts to partial biopower or 100% biopower plants in their community due to air quality concerns.

RESOURCES

Coal

The National Academies, What you Need to Know about Energy, Coal
<http://needtoknow.nas.edu/energy/energy-sources/fossil-fuels/coal/>

The Need Project
http://www.need.org/needpdf/infobook_activities/SecInfo/CoalS.pdf

US Energy Information Administration, Energy for Kids, Coal
http://www.eia.gov/kids/energy.cfm?page=coal_home-basics

Biomass

Southern Alliance for Clean Energy, Biopower Overview
http://www.cleanenergy.org/index.php?/Learn-About-Details.html?form_id=52&item_id=28

Union of Concerned Scientists, How Biomass Energy Works
http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html

Net Benefits of Biomass Power Under Scrutiny
http://www.nytimes.com/2010/06/19/science/earth/19biomass.html?_r=1

NC State University Extension Forestry Service
http://www.ces.ncsu.edu/forestry/programs/woody_biomass/

US Department of Energy's Biomass Program
<http://www1.eere.energy.gov/biomass/>

US Energy Information Administration, Energy for Kids, Biomass
http://www.eia.gov/kids/energy.cfm?page=biomass_home-basics

US Forest Service Woody Biomass Utilization
<http://www.fs.fed.us/woodybiomass/whatis.shtml>

Wood to Energy: Using Southern Interface Fuels for Bioenergy (USDA Forest Service January 2011 Publication)
http://www.srs.fs.fed.us/pubs/gtr/gtr_srs132.pdf

Group 3: Biomass Energy Development Company

You represent scientists and engineers who have recently started a Biomass Energy Development Company that focuses on the identification of local wood waste and manufacturing of wood pellets for local biopower plants.

Position Statement: Wood pellets derived from urban wood waste can provide a promising future for electricity generation.

Research Focus: Conduct research on the benefits of woody biomass and wood pellets derived from urban wood waste in particular. The *Woody Biomass vs Coal Comparison Chart* reveals the kind of information you should try to include in your presentation; complete the “Urban Wood Waste” column of the chart as best you can and be prepared to share this information with your classmates during your presentation.

RESOURCES

Southern Alliance for Clean Energy, Biopower Overview

http://www.cleanenergy.org/index.php?/Learn-About-Details.html?form_id=52&item_id=28

Union of Concerned Scientists, How Biomass Energy Works

http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html

Dictionary of Forestry

<http://www.dictionaryofforestry.org/>

The North Carolina Renewable Energy Portfolio Standard (Senate Bill 3)

<http://www.ncuc.commerce.state.nc.us/refs/refs.htm>

NC State University Extension Forestry Service

http://www.ces.ncsu.edu/forestry/programs/woody_biomass/

The North Carolina Renewable Energy Portfolio Standard And Its Significance for NC Forest Landowners

<http://www.ces.ncsu.edu/forestry/biomass/pubs/WB003.pdf>

Understanding Forestry Terms: A Glossary for Private Landowners

<http://www.ces.ncsu.edu/forestry/pdf/WON/won26.pdf>

US Department of Energy’s Biomass Program

<http://www1.eere.energy.gov/biomass/>

US Energy Information Administration, Energy for Kids, Biomass

http://www.eia.gov/kids/energy.cfm?page=biomass_home-basics

US Forest Service Woody Biomass Utilization

<http://www.fs.fed.us/woodybiomass/whatis.shtml>

Wood to Energy: Using Southern Interface Fuels for Bioenergy (USDA Forest Service January 2011 Publication)

http://www.srs.fs.fed.us/pubs/gtr/gtr_srs132.pdf

Group 4: Torrefied Wood Manufacturer

You represent scientists and engineers who have recently started making torrefied wood pellets for biopower plants. You want to find a local market to test these pellets and would like the power plant to consider taking advantage of this woody biomass option.

Position Statement: Torrefied wood pellets are an exceptional alternative to traditional wood pellets.

Research Focus: Conduct research on the benefits of torrefied wood pellets and be able to define this term for your classmates. The *Woody Biomass vs Coal Comparison Chart* reveals the kind of information you should try to include in your presentation; complete the “Torrefied Wood” column of the chart as best you can and be prepared to share this information with your classmates during your presentation.

RESOURCES

UNC considering using torrefied pellets in place of coal

http://www.dailytarheel.com/index.php/article/2011/06/unc_considering_using_torrefied_pellets_in_place_of_coal

Roasted Wood: An Alternative To Coal Energy?

<http://www.npr.org/templates/story/story.php?storyId=112643993>

New Biomass Energy

<http://newbiomass.com/torrefied-wood/>

Making Wood A Clean, Efficient Energy Source With New Process

<http://www.sciencedaily.com/releases/2009/03/090311134802.htm>

Glorified, Torrefied & Cofired

<http://biomassmagazine.com/articles/5750/glorified-torrefied-cofired>

Group 5: Anything But Coal Power! Citizen Group

You represent members of a citizen's group that want to see your local power plant be coal free by 2020! You are excited by the potential to substitute woody biomass for coal but you are concerned about the impacts of biomass harvesting on NC's forests and do want the power plant to make it a priority to identify sources of *sustainably harvested* woody biomass so that forest habitats aren't destroyed and you want to be sure that the carbon footprint of burning woody biomass is less than that of burning coal.

Position Statement: Substituting *sustainably harvested* woody biomass for coal will significantly reduce overall carbon dioxide emissions.

Research Focus: Conduct research on the benefits of using woody biomass as a means to reduce carbon dioxide emissions from power plants. The *Woody Biomass vs Coal Comparison Chart* reveals the kind of information you should try to include in your presentation; in order to specifically evaluate the carbon footprint and environmental impacts of the various biomass options- you may choose to focus on the following: source and location of woody biomass resources, estimated transportation costs (since transportation contribute to the carbon footprint) and any environmental concerns.

RESOURCES

Southern Alliance for Clean Energy, Biopower Overview

http://www.cleanenergy.org/index.php?/Learn-About-Details.html?form_id=52&item_id=28

Union of Concerned Scientists, How Biomass Energy Works

http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html

Dictionary of Forestry

<http://www.dictionaryofforestry.org/>

The North Carolina Renewable Energy Portfolio Standard (Senate Bill 3)

<http://www.ncuc.commerce.state.nc.us/reps/reps.htm>

NC State University Extension Forestry Service

http://www.ces.ncsu.edu/forestry/programs/woody_biomass/

The North Carolina Renewable Energy Portfolio Standard And Its Significance for NC Forest Landowners

<http://www.ces.ncsu.edu/forestry/biomass/pubs/WB003.pdf>

Understanding Forestry Terms: A Glossary for Private Landowners

<http://www.ces.ncsu.edu/forestry/pdf/WON/won26.pdf>

US Department of Energy's Biomass Program

<http://www1.eere.energy.gov/biomass/>

US Energy Information Administration, Energy for Kids, Biomass

http://www.eia.gov/kids/energy.cfm?page=biomass_home-basics

US Forest Service Woody Biomass Utilization

<http://www.fs.fed.us/woodybiomass/whatis.shtml>

Wood to Energy: Using Southern Interface Fuels for Bioenergy (USDA Forest Service January 2011 Publication)

http://www.srs.fs.fed.us/pubs/gtr/gtr_srs132.pdf

Group 6: Local Forest Landowners

You represent local forest landowners who are excited about the potential for NC's forests to contribute to a growing woody biomass market. You especially like the idea of having forest residue harvested for energy so that you can more inexpensively plant trees after harvesting.

Position Statement: Moving to 20% woody biomass would be beneficial to local forest owners by creating a local market for forest residues.

Research Focus: Conduct research on the types of woody biomass products that forests can provide and define what is meant by forest residue in particular. The *Woody Biomass vs Coal Comparison Chart* reveals the kind of information you should try to include in your presentation; complete the "Forest Residue" column of the chart as best you can and be prepared to share this information with your classmates during your presentation.

RESOURCES

Southern Alliance for Clean Energy, Biopower Overview

http://www.cleanenergy.org/index.php?/Learn-About-Details.html?form_id=52&item_id=28

Union of Concerned Scientists, How Biomass Energy Works

http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html

Dictionary of Forestry

<http://www.dictionaryofforestry.org/>

The North Carolina Renewable Energy Portfolio Standard (Senate Bill 3)

<http://www.ncuc.commerce.state.nc.us/reps/reps.htm>

NC State University Extension Forestry Service

http://www.ces.ncsu.edu/forestry/programs/woody_biomass/

The North Carolina Renewable Energy Portfolio Standard And Its Significance for NC Forest Landowners

<http://www.ces.ncsu.edu/forestry/biomass/pubs/WB003.pdf>

Understanding Forestry Terms: A Glossary for Private Landowners

<http://www.ces.ncsu.edu/forestry/pdf/WON/won26.pdf>

US Department of Energy's Biomass Program

<http://www1.eere.energy.gov/biomass/>

US Energy Information Administration, Energy for Kids, Biomass

http://www.eia.gov/kids/energy.cfm?page=biomass_home-basics

US Forest Service Woody Biomass Utilization

<http://www.fs.fed.us/woodybiomass/whatis.shtml>

Wood to Energy: Using Southern Interface Fuels for Bioenergy (USDA Forest Service January 2011 Publication)

http://www.srs.fs.fed.us/pubs/gtr/gtr_srs132.pdf

Group 7: Professional Foresters

You typically find that forest landowners under-manage their forest land at least in part to a lack of markets. You are seeing the paper industry being reduced in size year after year in the U.S. The paper industry has traditionally been the market for pine plantation thinnings (necessary to maintain stand vigor to produce the final high-value sawtimber crop) and low-value standing timber from final harvests in both plantations and natural forests. Removal of these whole trees (roundwood) is seen by professional foresters as being essential for forest health and productivity. Furthermore, the forest industry is also seeing an increasing demand for these whole trees for wood pellet production since whole trees produce cleaner pellets.

Position Statement: Moving to 20% woody biomass would be beneficial to local forests by creating a local market for roundwood in light of the decline of the paper industry.

Research Focus: Conduct research on the types of woody biomass products that forests can provide. The *Woody Biomass vs Coal Comparison Chart* reveals the kind of information you should try to include in your presentation; complete the “Roundwood” column of the chart as best you can and be prepared to share this information with your classmates during your presentation.

RESOURCES

Southern Alliance for Clean Energy, Biopower Overview

http://www.cleanenergy.org/index.php?/Learn-About-Details.html?form_id=52&item_id=28

Union of Concerned Scientists, How Biomass Energy Works

http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html

Dictionary of Forestry

<http://www.dictionaryofforestry.org/>

The North Carolina Renewable Energy Portfolio Standard (Senate Bill 3)

<http://www.ncuc.commerce.state.nc.us/rep/rep.htm>

NC State University Extension Forestry Service

http://www.ces.ncsu.edu/forestry/programs/woody_biomass/

The North Carolina Renewable Energy Portfolio Standard And Its Significance for NC Forest Landowners

<http://www.ces.ncsu.edu/forestry/biomass/pubs/WB003.pdf>

Understanding Forestry Terms: A Glossary for Private Landowners

<http://www.ces.ncsu.edu/forestry/pdf/WON/won26.pdf>

US Department of Energy’s Biomass Program

<http://www1.eere.energy.gov/biomass/>

US Energy Information Administration

http://www.eia.gov/kids/energy.cfm?page=biomass_home-basics

US Forest Service Woody Biomass Utilization

<http://www.fs.fed.us/woodybiomass/whatis.shtml>

Wood to Energy: Using Southern Interface Fuels for Bioenergy (USDA Forest Service January 2011 Publication)

http://www.srs.fs.fed.us/pubs/gtr/gtr_srs132.pdf

A Primer on Woody Biomass Energy for Forest Landowners

<http://pubs.cas.psu.edu/freepubs/pdfs/ee0027.pdf>

Woody Biomass versus Coal: Comparison Chart

NAME: _____

Complete the chart below as you hear about each biomass option from your classmates.

Conclude by circling the column of the woody biomass option that you think should be pursued by the power plant as a substitute for coal.

	<i>Coal</i>	<i>Urban Wood Waste</i>	<i>Forest Residue</i>	<i>Torrefied Wood</i>	<i>Logging Residue & Roundwood (whole trees)</i>
<i>Source/Raw Materials</i>					
<i>Is there a source within a 50 mile radius?</i>					
<i>Estimated Transportation Costs</i>					
<i>BTU Content per pound</i>					
<i>Current Cost per ton</i>					
<i>Air Quality Concerns</i>					
<i>Human Health Concerns</i>					
<i>Environmental Concerns</i>					
<i>Economic Concerns</i>					