

PEI created performance tasks designed to introduce middle school students to renewable and non-renewable energy resources. To date, these tasks include the following:

Renewable and Non-renewable Energy

Renewable Energy: Wind

Renewable Energy: Solar

Renewable Energy: Hydropower

Renewable Energy: Geothermal

Renewable Energy: Biomass

The tasks are designed to provide basic background knowledge about renewable energy including what it is, how it works and the advantages and disadvantages for the environment. Each task focuses on a type of renewable energy, including basic background knowledge, career information, and a variety of print and video resources. Students practice the research skills of locating information, selecting the best information, and having enough information to explain or persuade.

The first task, *Renewable and Non-renewable Energy*, culminates in a speech. Teachers are provided with the SBAC Speech rubric for scoring the student presentations. A template is provided for planning speeches. Teachers may adapt these materials as desired.

The Wind, Solar, Hydropower, Biomass, and Geothermal energy tasks are written to culminate in an argumentative essay. Students present a strong argument for the renewable energy source researched, including providing at least one counter argument with rebuttal. Each task includes an essay organizer to support students in writing an argumentative essay. The SBAC Argumentative rubric is included for scoring student work.

Teachers may want to assign additional research for the students prior to writing their essays. Otherwise, students can draw from the information provided in the performance task.

Each task includes a suggested field experience so that students may learn firsthand about the various renewable energy resources. If you are unable to conduct the field experience, you may want to create a virtual experience for the students where they investigate how the renewable energy resource is affecting their local communities.

Field Investigations are being developed for each task. These will be posted on the PEI website as they are created. The field investigations will focus on the science behind energy production and align with the NGSS standards.

Teachers should implement the performance tasks in a time frame that works best for them. The original model from SBAC has students completing Part 1 on day 1 and Part 2 on day 2. This may be inadequate for diving deeply into the research materials and ELA skills. Most likely, each performance task will fit into a three to five-day time period.

The main purpose of these tasks is to integrate ELA skills, including reading, writing, listening, and speaking, with science content. Think of the tasks as a gateway into a more in-depth study of renewable energy and an opportunity to practice and apply a wide variety of ELA skills. Make the materials work for you and for your students. And do feel free to contact PEI for additional support!



Performance Task: Renewable Energy - Biomass



PART I: Research Student Directions

Your Assignment:

Your County Council is investigating renewable energy options for the future. The council has asked middle school students to research the pros and cons for different types of renewable energy. **You will focus on biomass energy.** You will research this type of energy, determine the pros and cons, and share your findings with the county counsel in the form of an argumentative essay.

Steps you will follow:

To plan and compose your speech, you will do the following:

1. Read an article, an infographic, and a pro-con list and watch two videos.
2. Answer three questions about the sources.
3. Participate in a suggested field experience.
4. Write your essay.



Directions for beginning:

You will now watch two videos, read the article, the pro-con list, and the infographic, taking notes with the template provided. You may refer to the sources and your notes when writing your essay.

Source Information:

- Source #1: **Article:** *Biomass Explained* adapted from the US Energy Information Administration
https://www.eia.gov/energyexplained/index.cfm?page=biomass_home
- Source #2: *Biomass Energy Pros and Cons.*
Adapted from <http://energyinformative.org/biomass-energy-pros-and-cons/>
- Source #3: **Infographic:** *Environmental Benefits of Bioenergy*
<https://energy.gov/eere/bioenergy/bioenergizeme-infographic-challenge-environmental-benefits-bioenergy-corn-can-save>
- Source #4: **Video: Energy 101: How Biomass Works (3:23)**
<https://youtu.be/eYLhzadU2wE>
- Alternative Video: What is Biomass? (2:59)**
<https://youtu.be/BzxM-VG6br4>
- Source #5: **Career Video: Bioenergy: America's Energy Future (3:25)**
<https://youtu.be/OPSLWoCep8k>



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Note-taking Tool

Source	How Biomass Energy Works	Pros of Biomass Energy	Cons of Biomass Energy
Source #1: Article: Biomass Explained			
Source #2: Pro-Con List: Biomass Energy			
Source #3: Infographic: Biomass versus Fossil Fuels			



Performance Task: Renewable Energy - Biomass



Source	How Biomass Energy Works	Pros of Biomass Energy	Cons of Biomass Energy
Source #4: Video – How Biomass Works			

Career Video Note-taking Tool

Source	Types of Jobs	Key qualifications	Benefits of working in this industry
Source #5: Career Video - Bioenergy: America's Energy Future			



Performance Task: Renewable Energy - Biomass



Source #1: Article – Biomass Explained

Source: Excerpts from the EIA, [Your Guide to Understanding Energy](#)

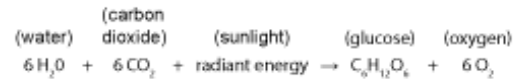
Biomass is organic material that comes from plants and animals, and it is a renewable source of energy.

Biomass contains stored energy from the sun. Plants absorb the sun's energy in a process called photosynthesis. When biomass is burned, the chemical energy in biomass is released as heat. Biomass can be burned directly or converted to liquid biofuels or biogas that can be burned as fuels.

Photosynthesis

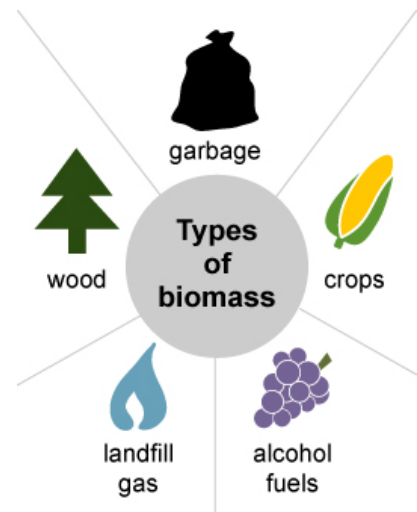


In the process of photosynthesis, plants convert radiant energy from the sun into chemical energy in the form of glucose—or sugar.



Examples of biomass and their uses for energy:

- wood and wood processing wastes—burned to heat buildings, to produce process heat in industry, and to generate electricity
- agricultural crops and waste materials—burned as a fuel or converted to liquid biofuels
- food, yard, and wood waste in garbage—burned to generate electricity in power plants or converted to biogas in landfills
- animal manure and human sewage—converted to biogas, which can be burned as a fuel



Burning wood

Using wood, wood pellets, and charcoal for heating and cooking can replace fossil fuels and may result in lower CO2 emissions overall. Wood can be harvested from forests, woodlots that must be thinned, or from urban trees that fall down or have to be cut down.



Industry, electric power producers, and commercial businesses use most of the wood and wood waste fuel consumed in the United States. The wood and paper products industry use wood waste to produce steam and electricity, which saves money because it reduces the amount of other fuels and electricity that must be purchased. Some coal-burning power plants burn wood chips to reduce sulfur dioxide emissions.



Performance Task: Renewable Energy - Biomass



Wood is used in homes throughout the United States for heating as cord wood in fireplaces and wood-burning appliances and as pellets in *pellet stoves*. In 2015, about 11.5 million U.S. households used wood as an energy source, mainly for space heating, and 2.3 million of those households used wood as the main heating fuel.

Wood smoke contains harmful pollutants like carbon monoxide and particulate matter. Modern wood-burning stoves, pellet stoves, and fireplace inserts can reduce the number of particulates from burning wood. Wood and charcoal are major cooking and heating fuels in poor countries, but if people harvest the wood faster than trees can grow, it causes deforestation. Planting fast-growing trees for fuel and using fuel-efficient cooking stoves can help slow deforestation and improve the environment.



Converting biomass to other forms of energy



Burning is only one way to release the energy in biomass. Biomass can be converted to other useable forms of energy such as methane gas or transportation fuels such as ethanol and biodiesel. Biofuels may be carbon-neutral because the plants that are used to make biofuels (such as corn and sugarcane for ethanol and soy beans and palm oil trees for biodiesel) absorb CO₂ as they grow and may offset the CO₂ emissions when biofuels are produced and burned.

The federal government promotes ethanol use as a transportation fuel to help reduce oil imports and CO₂ emissions. In 2007, the government set a target to use 36 billion gallons of biofuels by 2022. As a result, nearly all gasoline now sold in the United States contains some ethanol.

Ethanol and gasoline-ethanol blends burn cleaner and have a higher-octane rating than pure gasoline, but they also have higher evaporative emissions from fuel tanks and dispensing equipment. These emissions add to harmful ozone and smog. Gasoline must be processed more to reduce these emissions.

Collecting and using biogas from landfills

Landfills for municipal solid waste can be a source of energy. Methane gas is a component of *landfill gas* or *biogas* that forms when garbage, agricultural waste, and human waste decompose in landfills or in special containers called digesters. Methane is the same energy-rich gas found in natural gas, which is used for heating, cooking, and electricity.



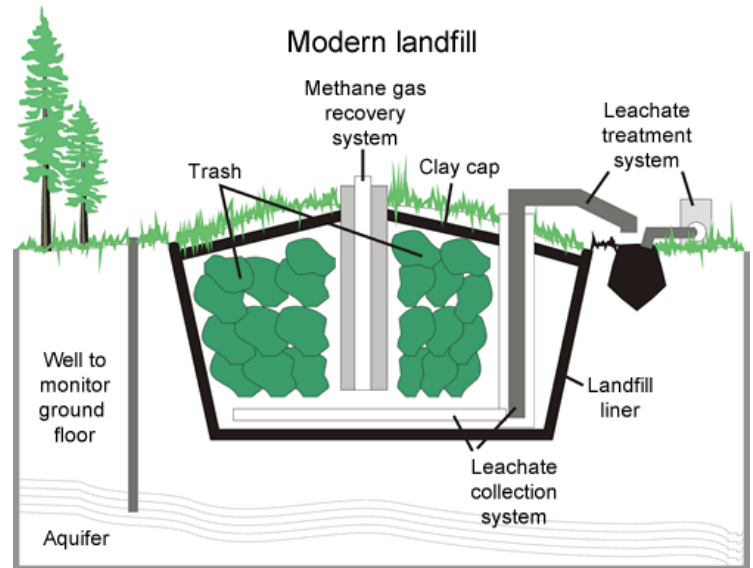


Performance Task: Renewable Energy - Biomass



Farmers use digesters for manure and used bedding material from their barns. Some farmers cover their manure ponds (also called lagoons) to capture biogas. Biogas digesters and manure ponds contain the same anaerobic bacteria found in landfills. The methane in the biogas can be used for heating and for generating electricity on the farm.

Landfill biogas can be dangerous to people and the environment because methane is flammable, and it is a strong greenhouse gas. In the United States, regulations under the Clean Air Act require landfills of a certain size to install and operate a landfill gas collection and control system. Some landfills control the methane gas emissions simply by burning or flaring methane gas. Methane gas can also be used as an energy source. Many landfills collect biogas, treat it, and then sell the methane. Some landfills use the methane gas to generate electricity.



Biofuels may be carbon-neutral because the plants that are used to make biofuels (such as corn and sugarcane for ethanol and soy beans and palm oil trees for biodiesel) absorb CO₂ as they grow and may offset the CO₂ emissions when biofuels are produced and burned.

Cool Facts

Energy from trees: People can get energy by burning the scrap wood that's left over after trees have been trimmed. It's an efficient way to use a resource that might otherwise get thrown away.

Turning trash into electricity: Waste-to-energy power plants burn trash to produce electricity. They generate enough electricity to supply 1.3 million U.S. homes. In 2016, about 2% of total U.S. annual energy consumption was from wood and wood waste (bark, sawdust, wood chips, wood scrap, and paper mill residues).

Using Biomass for fuel: Biomass fuels provided about 5% of the primary energy used in the United States in 2016. Of that 5%, about 48% was from biofuels (mainly ethanol), 41% was from wood and wood-derived biomass, and about 11% was from the biomass in municipal waste. Researchers are working to find ways to make more biomass fuels available.





Source #2: Biomass Energy Pros and Cons List

Advantages of Biomass Energy:

1. Renewable

We will always have the sources of biomass such as crops, manure, and garbage. As you make this year's crop into fuel, you are growing another one for next year's fuel. Renewing takes just as long a time as it takes to grow or gather, and that can be as little as months in some cases.

2. Carbon Neutral

This is maybe the most important of the advantages of biomass energy. Biomass is a part of the carbon cycle. Carbon from the atmosphere is absorbed into plants during photosynthesis and when the plant decays or is burnt, that carbon goes back into the atmosphere. Because it is a cycle, the next crop of plants absorbs that carbon over again, so there is a balance between the amount of carbon that the biomass fuel release into the atmosphere and the amount that they take out from it. This is why biomass fuels do not contribute to global warming. Biomass fuels are clean.

3. Cost Effective

Energy harnessed from biomass is inexpensive compared to coal and oil. Typically, they cost about 1/3 less than fossil fuels doing the same job. This means you can spend 1/3 less every year on heating your home and after 10 to 15 years that adds up to a considerable saving.

4. Abundant

Biomass is available in large quantities all over the world. Large pipelines across country borders and oceans are therefore most likely not necessary.

Disadvantages of Biomass Energy

1. Expensive

Extraction of biomasses can be expensive. In some areas we find that biomass projects may not be worth the price and the project is therefore never finished. This is also true for the harvesting and storing of the different types of biomass

2. Requires Space

We need big areas for all the different processes that are required in harnessing energy from biomass. The areas that are needed for storing can be particularly large.

3. Environmental Concerns

Burning wood to create heat and energy can put pollutants into the atmosphere. These include carbon monoxide and particulate matter which can cause respiratory problems for people and animals.

4. Land Use Issues

Growing crops for biofuels takes away land for food crops. In some parts of the world, large areas of natural vegetation have been harvested to create biofuels including sugar cane for ethanol and palm trees for biodiesel.

In Summary:

There is no doubt that biomass energy is one of the few potential replacements for fossil fuels. The benefits of both a renewable and clean energy source cannot be overlooked. It will be interesting to see how big a part biomass energy will play in the future.



Source #3: Infographic: Biomass Energy

WHAT IS BIOMASS?

BIOMASS is any renewable organic material that has stored sunlight in the form of chemical energy.¹
BIOENERGY can be in the form of electricity, transportation fuels, and bioproducts.²

BIOMASS vs. FOSSIL FUELS

Biodiesel produces **FEWER** carbon dioxide emissions than petroleum diesel because biofuels also **ABSORB CARBON** during photosynthesis, thereby reducing greenhouse gas emissions that cause climate change.⁷

BIOMASS BURN CLEANER than fossil fuels: they preserve air quality, **PROTECT** water quality, **CREATE HABITATS** for animals, and **REVEGETATE** barren land⁸

Scientists estimate the world will run out of fossil fuels within the next **50 to 120** years.³

The United States is currently importing **58%** of its oil from other countries.⁴

Corn and other energy crops can be grown **LOCALLY** so energy is not used to foreignly transport oil.⁵

For many energy crops, energy ratios (the quantity of useful bioenergy crop produced per unit of fossil fuel consumed) for feedstock production are high enough to make them attractive energy resources.⁶

Remember the environmental disaster, the 2010 oil spill in the Gulf of Mexico, which released millions of gallons of oil and caused extensive damage in the process?⁹

DOMESTIC BIOFUELS ARE SAFER than transporting imported petroleum fuels.¹⁰

Sources: ¹ Biomass Basics: The Facts about Bioenergy (U.S. Department of Energy).
² Biomass Basics: The Facts about Bioenergy.
³ Biomass Basics: The Facts about Bioenergy.
⁴ Biomass Basics: The Facts about Bioenergy.
⁵ Biodiesel Benefits and Concerns (EPA).
⁶ Strickland, What are the Environmental Benefits of Biofuels.
⁷ Jonathan Strickland, What are the Environmental Benefits of Biofuels (HowStuffWorks).
⁸ Biodiesel Benefits and Concerns.
⁹ Strickland, What are the Environmental Benefits of Biofuels.
¹⁰ Strickland, What are the Environmental Benefits of Biofuels.

Image Credit: US Department of Energy <http://bit.ly/2ruPFAJ>



PART 2: Renewable Field Experience

Arrange to take your students a site where biomass energy can be observed such as a farmland or landfill. Plan the field experience prior to the students writing their essays. Encourage the students to use information they learn about the benefits of biomass energy, including employment opportunities, in their essays.

Field Experience Note Taking Template

Site Visited:

Date and Time:

Benefits of biomass energy:

Challenges we face using biomass energy:

How these challenges are being addressed:

Career Opportunities in the biomass energy field:



PART 3: Essay

Student Directions:

You will review your notes and plan your argumentative essay. You may use notes from the resources and from the field investigation to write your essay. You may also refer to the sources. Read your assignment and the information about how your essay will be scored. Then begin your work.



Your Assignment:

You have been asked by the County Council to research the pros and cons of biomass energy and to make a case for continuing to use and expand this type of renewable energy. Your essay should persuade your reader to support biomass energy production and include the following

- Explain what biomass energy is and why it is considered renewable.
- Identify a few important pros and one significant con, providing a counter argument to the con.
- Convince the reader why it is important to use biomass energy as a valuable renewable resource. Consider location, impact on the environment, and potential employment opportunities.

Use the planning template to help you to compose your essay.

How your essay will be scored:

1. **Statement of Purpose/Focus**– how well you clearly state and maintain your claim including addressing counter arguments,
2. **Organization**– how well the ideas progress from the introduction to the conclusion using effective transitions and how well you stay on topic throughout the essay.
3. **Elaboration of Evidence**– how well you provide evidence from source about your claim and elaborate with specific information.
4. **Language and Vocabulary**– how well you effectively express ideas using precise language that is appropriate for your audience and purpose.
5. **Conventions**– how well you follow the rules of usage, punctuation, capitalization, and spelling.

Now begin work on your essay.

- Review your notes
- Plan your essay using the template provided
- Write your essay
- Revise and edit for a final draft





Planning My Essay

Essay Components:
Introduction: Capture the reader's interest!
Explain what biomass energy is and how it is a renewable resource.
State the argument for biomass energy, including at least three strong pros. Consider access, impact on the environment, and employment opportunities. 1. 2. 3.
Identify an important con of biomass energy and provide a counter argument to this con:
Provide a persuasive conclusion:



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Argumentative Writing Rubric (Grades 6–11) Scoring Version

Score	4	3	2	1
Statement of Purpose/Focus	<p>The response is fully sustained and consistently and purposefully focused:</p> <ul style="list-style-type: none"> claim is introduced clearly communicated, and the focus is strongly maintained for the purpose, audience, and task alternate or opposing argument(s) are clearly acknowledged or addressed* 	<p>The response is adequately sustained and generally focused:</p> <ul style="list-style-type: none"> claim is clear and the focus is mostly maintained for the purpose, audience, and task alternate and opposing argument(s) are adequately acknowledged or addressed* 	<p>The response is somewhat sustained and may have a minor drift in focus:</p> <ul style="list-style-type: none"> claim may be somewhat unclear, or the focus may be insufficiently sustained for the purpose, audience, and task alternate and opposing argument(s) may be confusing or not acknowledged* 	<p>The response may be related to the purpose but may provide little or no focus:</p> <ul style="list-style-type: none"> claim may be confusing or ambiguous; may be too brief or the focus may drift from the purpose, audience, or task alternate and opposing argument(s) may not be acknowledged*
Organization	<p>The response has a clear and effective organizational structure, creating a sense of unity and completeness:</p> <ul style="list-style-type: none"> consistent use of a variety of transitional strategies to clarify the relationships between and among ideas effective introduction and conclusion logical progression of ideas from beginning to end; strong connections between and among ideas with some syntactic variety 	<p>The response has an evident organizational structure and a sense of completeness, though there may be minor flaws and some ideas may be loosely connected:</p> <ul style="list-style-type: none"> adequate use of transitional strategies with some variety to clarify relationships between and among ideas adequate introduction and conclusion adequate progression of ideas from beginning to end; adequate connections between ideas 	<p>The response has an inconsistent organizational structure, and flaws are evident:</p> <ul style="list-style-type: none"> inconsistent use of transitional strategies and/or little variety introduction and conclusion, if present, may be weak uneven progression of ideas from beginning to end; and/or formulaic; inconsistent or unclear connections among ideas 	<p>The response has little or no discernible organizational structure:</p> <ul style="list-style-type: none"> few or no transitional strategies are evident introduction and conclusion, if present, may be missing frequent extraneous ideas may be evident; ideas may be randomly ordered or have unclear progression
Elaboration of Evidence	<p>The response provides thorough and convincing support/evidence for the argument(s) and claim that includes the effective use of sources (facts and details).</p> <ul style="list-style-type: none"> comprehensive evidence from sources is integrated; references are relevant, and specific effective use of a variety of elaborative techniques** 	<p>The response provides adequate support/evidence for the argument(s) and claim that includes partial or uneven use of sources (facts and details).</p> <ul style="list-style-type: none"> adequate evidence from sources is integrated; some references may be general adequate use of some elaborative techniques** 	<p>The response provides uneven, cursory support/evidence for the argument(s) and claim that includes partial or uneven use of sources (facts and details).</p> <ul style="list-style-type: none"> some evidence from sources may be weakly integrated, imprecise, or repetitive; references may be vague weak or uneven use of elaborative techniques**; development may consist primarily of source summary or may rely on emotional appeal 	<p>The response provides minimal support/evidence for the argument(s) claim that includes little or no use of sources (facts and details).</p> <ul style="list-style-type: none"> evidence from source material is minimal or irrelevant; references may be absent or incorrectly used minimal, if any, use of elaborative techniques**; emotional appeal may dominate
Language	<p>The response clearly and effectively expresses ideas, using precise language:</p> <ul style="list-style-type: none"> vocabulary is clearly appropriate for the audience and purpose effective, appropriate style enhances content 	<p>The response adequately expresses ideas, employing a mix of precise with more general language:</p> <ul style="list-style-type: none"> vocabulary is generally appropriate for the audience and purpose generally appropriate style is evident 	<p>The response expresses ideas unevenly, using simplistic language:</p> <ul style="list-style-type: none"> vocabulary use is uneven or somewhat ineffective for the audience and purpose inconsistent or weak attempt to create appropriate style 	<p>The response's expression of ideas is vague, lacks clarity, or is confusing:</p> <ul style="list-style-type: none"> vocabulary is limited or ineffective for the audience and purpose little or no evidence of appropriate style
Score	2	1	0	
Conventions	<p>The response demonstrates a command of conventions:</p> <ul style="list-style-type: none"> adequate use of correct sentence formation, punctuation, capitalization, grammar usage, and spelling 	<p>The response demonstrates partial command of conventions:</p> <ul style="list-style-type: none"> limited use of correct sentence formation, punctuation, capitalization, grammar usage, and spelling 	<p>The response demonstrates little or no command of conventions:</p> <ul style="list-style-type: none"> infrequent use of correct sentence formation, punctuation, capitalization, grammar usage, and spelling 	
NS	<p>Unintelligible, in a language other than English, off-topic, insufficient evidence (incomplete) or copied text. (Off-purpose writing will still receive a score in Conventions).</p>			

* Acknowledging and/or addressing the opposing point of view begins at grade 7

** Elaborative techniques may include the use of personal experiences that support the controlling idea