

Transportation Fuels Debate

Students evaluate the advantages and disadvantages of conventional and alternative transportation fuels in an innovative debate format.

IT'S A FACT

DISADVANTAGE

ADVANTAGE



Grade Levels:



Intermediate



Secondary

Subject Areas:



Science



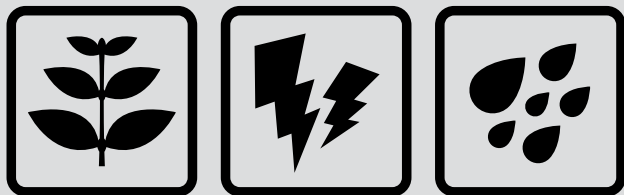
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Teacher Advisory Board

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

Energy Data Used in NEED Materials

NEED believes in providing teachers and students with the most recently reported, available, and accurate energy data. Most statistics and data contained within this guide are derived from the U.S. Energy Information Administration. Data is compiled and updated annually where available. Where annual updates are not available, the most current, complete data year available at the time of updates is accessed and printed in NEED materials. To further research energy data, visit the EIA website at www.eia.gov.



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Standards Correlation Information

www.need.org/educators/curriculum-correlations

Next Generation Science Standards

- This guide effectively supports many Next Generation Science Standards. This material can satisfy performance expectations, science and engineering practices, disciplinary core ideas, and cross cutting concepts within your required curriculum. For more details on these correlations, please visit NEED's curriculum correlations website.

Common Core State Standards

- This guide has been correlated to the Common Core State Standards in both language arts and mathematics. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED curriculum correlations website.

Individual State Science Standards

- This guide has been correlated to each state's individual science standards. These correlations are broken down by grade level and guide title, and can be downloaded as a spreadsheet from the NEED website.



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NEED Curriculum Correlations



NEED materials are correlated to the Disciplinary Core Ideas of the Next Generation Science Standards, the Common Core State Standards for English/Language Arts and Mathematics, and also correlated to each state's individual science standards.

Most files are in Excel format. NEED recommends downloading the file to your computer for use. Save resources, don't print!

- **NEED alignment to the Next Generation Science Standards**
 - Navigating the NGSS? We Have What You NEED!
 - NGSS and NEED: Fourth Grade Energy
 - NGSS and NEED Guide
- Common Core State Standards for English and Language Arts
- Common Core Standards for Mathematics



Teacher Guide

Background

In *Transportation Fuels Debate*, student teams learn about conventional and alternative transportation fuels and assess the advantages and disadvantages of each. Teams are assigned to represent one specific fuel. During the debate, students work cooperatively to develop arguments on the merits of their fuel over other fuels.

Objectives

Students will be able to list and identify the economic and environmental advantages and disadvantages of transportation fuels.

Concepts

- There are conventional and alternative transportation fuels; some are widely used, others are not.
- Some transportation fuels are more suitable for fleet vehicles, others for personal vehicles.
- Some transportation fuels are more expensive than others.
- Some transportation fuels affect the environment more than others.
- Some transportation fuels are nonrenewable while others are renewable.

Materials

- A set of *Transportation Fuels Debate Sheets* for each team
- A set of YES/NO signs for each of the judges
- *Transportation Fuels Debate Gameboard* on page 7, or download an Excel version from www.NEED.org/shop

Preparation

- Decide how many debates you will conduct. If you have limited time, have one debate. If you have more time, conduct two debates. During the first, debate the merits of the transportation fuels as used by PERSONAL vehicles. During the second, debate the merits of the transportation fuels as used by FLEET vehicles.
- Decide how many transportation fuels you will be debating, depending upon the number of students. Each team should have a minimum of three students. For smaller groups, choose fewer transportation fuels.
- Make one set of *Transportation Fuels Debate Sheets* for each team. (If you are using fewer than nine transportation fuels, you'll complete the extra sheets as a class after you introduce the activity.)
- Ask three colleagues, school administrators, community leaders, or parents to serve as judges for the debate. If volunteers are not available, you may assign three students to serve as judges.
- Make sets of YES/NO signs for the judges.

Procedure

Step One: Introduce Unit to the Class

- Introduce the *Transportation Fuels Debate* to the class, using the concepts as a guide.

Step Two: Monitor Group Work

- Once students are in their teams, explain the activity. If you are not using all nine fuels, use the extra debate sheets to explain the procedure and complete the extra sheets as a class. This will ensure students understand the concepts of advantages/disadvantages and learn about all the transportation fuels.
- Have each team complete the sheet for their assigned fuel first. This should take about five minutes.
- Have each team complete the remaining fuel sheets. This should take about twenty minutes.
- Remind the students, if necessary, that every statement is factual; some may have more "spin" than others depending on how they are read and interpreted.

Grade Levels

- Intermediate, grades 6-8
- Secondary, grades 9-12

Time

- Two or three 45-minute class periods

(It will take four to five class periods to conduct both the personal and fleet vehicle debates.)

Additional Resources

NEED has several resources on transportation fuels available to download online at www.NEED.org/shop.

- *Energy on the Move*
- *Exploring Hybrid Buses*
- *H₂ Educate*
- *Transportation Exploration*
- *Transportation Fuels Enigma*
- *Transportation Fuels Live!*

Step Three: Debate

Begin the activity by giving students the following instructions:

- The object of this game is to be the first team to reach the top of the game board. The game is played in rounds. Each team is given the opportunity to move its fuel icon up by stating an advantage of its transportation fuel. You may instead choose to move an opponent's fuel icon down by stating a disadvantage of the opponent's energy source.
 - Teams will present their advantages or opponent disadvantages to a panel of judges. An opposing team can object to the presented statement. The opposing team must convince the judges that the statement is not an advantage. The team that stated the advantage will then have the opportunity to defend its position. The judges may vote in favor of the defending team or presenting team. If they agree with the presenting team's stated advantage, that team will move up one. If they vote in favor of the defending team, the defending team moves up one position and the presenting team moves down one space. Or, the judges may decide the statement is just a fact. In this case, the defending team stays in its original position.
 - If a team states a disadvantage to try to move an opposing team down, then the opposing team can defend itself without penalty. The stating team does lose position if judges side with the opposing team.
- Ask the first team to give an advantage or disadvantage. Continue debating until each team has the opportunity to begin a round, until time is called, or until one team reaches the top line.

Step Four: Interpret the Debate Results

After the debate/s, discuss the following questions:

- Do all transportation fuels have advantages and disadvantages?
- Why isn't there an obvious winner in this debate? Even if the debate continued, would there be a winner? Why or why not?
- Why do some fuels offer more environmental benefits than others?
- Why do we use transportation fuels that have negative impacts on the environment?
- Why do some fuels cost more than others?
- What are some other factors that we need to consider in our choice of transportation fuels?
- Why are some transportation fuels more suitable for fleet vehicles and others for personal vehicles?

Extensions

- Choose one of the conventional fuels. Describe some reasons why this fuel is predominantly used by vehicles today.
- Choose one of the alternative fuels. Describe some reasons why this fuel isn't used by more vehicles today.

SAMPLE	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
 Gasoline			
1. Gasoline is a petroleum-based fossil fuel made of hydrocarbons (hydrogen and carbon molecules).	X		
2. Petroleum is a nonrenewable source of energy.			X
3. Almost all gasoline we consume is produced domestically by U.S. petroleum refineries.		X	



↑ ADVANTAGES START HERE DISADVANTAGES ↓



Biodiesel

RELEVANCE

NEUTRAL

ADVANTAGE

DISADVANTAGE

1. Biodiesel is produced by chemically reacting alcohol with vegetable oils, animal fats, or recycled restaurant grease. Most biodiesel is made from soybean oil.
2. Most biodiesel is manufactured domestically.
3. Pure biodiesel, B100, is rarely used as a transportation fuel.
4. Pure biodiesel is blended with petroleum diesel in different percentages. The most common blends are B20 and B5.
5. Only vehicles with diesel engines can use biodiesel fuel.
6. All diesel vehicles can safely use B5 and most can safely use B20 without engine modifications.
7. Biodiesel is an approved alternative fuel.
8. About 2.8 million consumer owned vehicles use B20 for fuel.
9. Government agencies, utility companies, and private businesses own fleet vehicles powered by B20, including school buses, city transit buses, snowplows, garbage trucks, U.S. Postal Service mail trucks, military vehicles, ferries, delivery trucks, and utility trucks.
10. Fleets typically have their own biodiesel fueling infrastructure on-site.
11. Some states have laws that require all petroleum diesel to contain a small percentage of biodiesel.
12. Biodiesel fuel can be used in the existing fuel infrastructure.
13. Biodiesel is sold at a little over 1,400 retail gas stations across the country.
14. Pure biodiesel is nontoxic and biodegradable. If spilled, it causes less damage to its surroundings than petroleum diesel.
15. In general, producing and using biodiesel is better for the environment than producing and using petroleum diesel.
16. Biodiesel is clean burning, which improves air quality and offers considerable greenhouse gas emissions benefits.
17. Burning higher-level biodiesel blends gives off more nitrogen oxide emissions than petroleum diesel.
18. Biodiesel is a renewable substitute for nonrenewable petroleum diesel. Using it reduces the amount of diesel fuel we use.
19. Biodiesel is a superior lubricant, which helps keep moving engine parts from wearing out, reducing maintenance costs.
20. B100 and high-level blends are sensitive to cold weather. Fuel blenders must add cold flow improver, a chemical that reduces friction and increases performance, to biodiesel sold in the winter.



Diesel

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Diesel is a petroleum-based fossil fuel made of hydrocarbons (hydrogen and carbon molecules).			
2. Petroleum is a nonrenewable source of energy.			
3. Diesel is manufactured at a petroleum refinery, where crude oil is made into different products. About 12 gallons of diesel is refined from every 42-gallon barrel of crude oil.			
4. Most of the diesel fuel we consume is produced domestically. Since we export some diesel fuel to other countries, we import a small amount from Canada to balance our supply and demand.			
5. Only vehicles with diesel compression ignition engines can use petroleum diesel fuel.			
6. Diesel engines have a lot of power and can do the most demanding work.			
7. Diesel is a conventional transportation fuel.			
8. Diesel power dominates the movement of America's freight. Over 90 percent of our goods are shipped using diesel-powered trucks, trains, boats, and barges. No other fuel can match diesel in its ability to move freight economically.			
9. Diesel powers many city transit buses and school buses.			
10. Diesel fuels more than 14.3 million medium-duty trucks, (tow trucks, box trucks, and semi-trucks/18-wheelers). Fleets own an estimated 5.4 million diesel-powered light-duty vehicles, and consumers own another 7 million diesel-powered passenger cars, pickup trucks, and SUVs.			
11. The U.S. has a vast infrastructure of refineries, pipelines, and filling stations to distribute diesel efficiently and conveniently.			
12. Diesel is available at about 71,000 fuel stations across the U.S.			
13. All diesel fuel sold in the U.S. is ultra-low sulfur diesel (ULSD), which is a cleaner-burning diesel fuel.			
14. Today, nearly 60% of commercial trucks have advanced diesel technology engines that produce near-zero-emissions.			
15. Using petroleum diesel as a transportation fuel releases harmful pollutants, including ground-level ozone, particulate matter, and smog-forming nitrogen oxides (NOx).			
16. Burning petroleum diesel releases carbon dioxide, a greenhouse gas, into the environment.			
17. About 25% of the transportation sector's carbon dioxide emissions come from burning diesel fuel.			
18. Petroleum diesel is a nonrenewable fuel.			
19. Diesel contains 10-15 percent more energy than gasoline, and diesel engines are more fuel-efficient than gasoline engines of similar size. Diesel-powered cars can go 20-35 percent farther on a gallon of fuel than their gasoline-powered equivalents.			
20. Biomass-based diesel fuels (biodiesel and renewable diesel) also contribute to the supply of diesel fuel in the U.S.			



Electricity

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Electricity is a secondary energy source since it must be generated by other sources.			
2. Most utility-scale electricity is generated domestically at electric power plants using a turbine to drive an electric generator.			
3. We use both renewable and nonrenewable resources to make electricity, including natural gas, coal, uranium, wind, hydropower, solar energy, biomass, and geothermal energy.			
4. Using electricity as a transportation fuel requires a specially manufactured electric vehicle (EV).			
5. The batteries on board an EV are charged with electricity from the grid and through regenerative braking while the car is in motion. Energy stored in batteries powers electric motors that drive the car.			
6. Electricity is an alternative transportation fuel.			
7. Consumers own about 3.6 million all-electric passenger cars, trucks, and SUVs, while fleets own roughly 137,000.			
8. Fleet vehicles include all-electric school buses, city transit buses, motor coaches, trolleys, box trucks, cargo vans, truck cabs, and motorcycles.			
9. Consumers can install a small unit in their home's garage to conveniently charge EVs and plug-in hybrids using AC power.			
10. Most fleets and businesses will charge their vehicles on-site using AC power.			
11. Charging batteries with electricity from the grid takes significantly longer than refueling with conventional fuels.			
12. To refuel quickly, an EV can connect directly to DC power at a rapid charging station to fast charge its batteries. Over 66,000 public EV charging stations are located along heavy-traffic corridors. Most locations have several charging ports, allowing multiple cars to charge at the same time.			
13. An EV produces zero tailpipe emissions.			
14. Air pollutants and greenhouse gases may be produced when an EV is manufactured and during electricity generation at a power plant.			
15. In some areas, consumers can purchase electricity generated by renewable resources which will decrease their vehicle's impact on the environment.			
16. EVs generally cost more to purchase and have less range than similar conventional vehicles.			
17. EVs have lower maintenance costs than similar conventional vehicles.			
18. Consumers purchasing EVs may qualify for federal tax credits and utility company incentives.			
19. Widespread use of EVs could dramatically reduce petroleum consumption, increasing the nation's energy security and lessening our dependence on foreign oil supplies.			
20. Electricity is typically more cost-efficient than gasoline, so EVs have lower fueling costs than similar conventional vehicles.			



Ethanol

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Ethanol is a type of alcohol produced by fermenting the sugar in corn kernel starch.			
2. Ethanol is made from biomass, a renewable source of energy.			
3. Most of the ethanol used in the U.S. is produced domestically at ethanol production facilities in the Midwest.			
4. We export millions of barrels of ethanol to other countries.			
5. We import a small amount of ethanol from Brazil. Brazilian ethanol is produced by fermenting the sugar in sugar cane.			
6. Brazilian imports are mostly consumed in California to help meet state standards requiring the use of low-carbon fuels.			
7. After it is made, fuel ethanol goes to a fuel terminal where it's blended with gasoline for use as a transportation fuel.			
8. Conventional vehicles can use gasoline containing ten percent ethanol, (E10), without harming their engines.			
9. Higher ethanol blends, such as E85, can only be used in specially manufactured flexible fuel vehicles (FFVs).			
10. There are only a few new FFV models available for sale in the U.S., but these and used FFV models are very popular models.			
11. E85 is an approved alternative fuel.			
12. Historically, FFVs have been the most widely available alternative fueled vehicles. It's estimated about 2.9 million fleet vehicles run on E85.			
13. Consumers own more than 20 million FFVs, but many owners don't realize they have a choice of fuel, or, they might not have access to E85.			
14. More than 4,400 public fueling stations offer E85, mostly in the Midwest.			
15. The Federal Renewable Fuel Standard requires all transportation fuel sold in the U.S. to contain a minimum volume of renewable fuels. This program has led to an increased use of fuel ethanol, with E10 widely used across the U.S. as a replacement fuel.			
16. Replacing even a small volume of gasoline with fuel ethanol reduces tailpipe emissions and offers environmental benefits.			
17. Producing and using fuel ethanol reduces lifecycle greenhouse gas emissions, since plants absorb carbon dioxide as they grow, offsetting the carbon dioxide released as ethanol burns.			
18. A gallon of fuel ethanol contains less energy than a gallon of gasoline, lowering fuel economy.			
19. Ethanol is a high-octane fuel, so it offers increased power and performance.			
20. Since U.S. ethanol is made from crops grown in the U.S., using it may help reduce the amount of petroleum we import from other countries.			



Gasoline

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Gasoline is a petroleum-based fossil fuel made of hydrocarbons (hydrogen and carbon molecules).			
2. Petroleum is a nonrenewable source of energy.			
3. Almost all gasoline we consume is produced domestically by U.S. petroleum refineries.			
4. Each 42-gallon barrel of crude oil is refined into about 20 gallons of unfinished gasoline blendstock. At a blending terminal, fuel ethanol and other chemicals are added to create finished motor gasoline.			
5. A very small amount of gasoline is imported to cities on the east and west coasts when it's cheaper than shipping across the U.S.			
6. Vehicles built with an internal combustion engine can use gasoline for fuel.			
7. Gasoline powers about 243 million consumer owned passenger vehicles in the U.S.			
8. Gasoline powers nearly 20 million fleet vehicles owned by commercial businesses, government agencies, utilities, and taxi and rental car companies.			
9. There are about 142,000 retail gasoline fueling stations in the U.S.			
10. The U.S. has a vast infrastructure of refineries, pipelines, and fueling stations to distribute gasoline efficiently and conveniently.			
11. Gasoline is a highly flammable fuel.			
12. Gasoline is toxic and can make you very sick if you breathe in the vapors or get it on your skin.			
13. Gasoline is not biodegradable.			
14. Burning gasoline produces carbon dioxide, a greenhouse gas, and contributes to air pollution.			
15. Ethanol, a renewable fuel, is added to gasoline to reduce greenhouse gas emissions.			
16. Some areas of the country are required by law to use specially formulated gasoline to reduce tailpipe emissions of carbon monoxide, smog, and other air toxins.			
17. Every day, gasoline leaks happen at gas stations. As people fill up their gas tanks, gasoline drips from the nozzle onto the ground and vapors leak from open gas tanks into the air.			
18. Gasoline has a high energy content of 116,000 (Btu)/gallon, which helps light-duty cars and trucks drive a long way on a few gallons of gas.			
19. Since petroleum is nonrenewable, our oil supply might run out someday, and therefore we would run out of gasoline.			
20. Consuming less gasoline in our cars could mean depending less on other countries for our oil supply.			



Hydrogen

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Hydrogen is the most abundant element in the universe.			
2. Pure hydrogen does not exist on Earth as a gas; it is only found in molecules with other elements.			
3. We can extract hydrogen from fossil fuels, biomass, and water, which makes hydrogen a secondary source of energy.			
4. Hydrogen is produced domestically, mostly at large industrial facilities that make and use it on-site for industrial purposes.			
5. Very little hydrogen is currently used as a transportation fuel.			
6. Producing hydrogen is very expensive.			
7. Most hydrogen is produced using a process called steam reforming, combining high-temperature steam with nonrenewable natural gas to extract hydrogen.			
8. Hydrogen can be produced by electrolysis, where an electric current splits water molecules into hydrogen and oxygen.			
9. "Green" hydrogen projects use excess renewable electricity, when available, to make hydrogen through electrolysis. When the electricity is produced by renewable sources, such as solar or wind, the hydrogen produced is renewable, too.			
10. Using hydrogen as a transportation fuel requires a specially manufactured Fuel Cell Electric Vehicle (FCEV).			
11. A fuel cell electric vehicle uses pure hydrogen gas stored in a tank on board for fuel. A fuel cell stack inside the car turns hydrogen from the tank and oxygen from the air into electricity. The electricity powers an electric motor that drives the wheels.			
12. Hydrogen is an alternative transportation fuel.			
13. Auto manufacturers offer very few FCEV models, and those are only for sale or lease in specific areas of California or Hawaii that have an adequate number of hydrogen fueling stations. There are only about 17,000 consumer owned and 700 fleet owned FCEVs in the U.S. today.			
14. There are 55 public retail hydrogen fueling stations, mostly in California.			
15. Fuel cell technology uses hydrogen to produce electrical power without emitting air pollutants or carbon dioxide, a greenhouse gas. The only tailpipe emissions are water and warm air.			
16. Producing hydrogen by steam reforming releases carbon dioxide emissions into the environment.			
17. Hydrogen is a gas at normal temperature and pressure. It takes up six times as much space as gasoline per energy equivalent, so hydrogen is stored as a compressed gas in a large high pressure fuel tank on board a FCEV.			
18. A hydrogen fuel tank fills in a few minutes, giving FCEVs 300 to 400 miles of range.			
19. There is very limited infrastructure to produce, deliver, and dispense hydrogen in the U.S.			
20. Ongoing government and industry research and development projects aim to reduce the cost of producing and distributing hydrogen, as well as reduce the size and cost of fuel cell electric systems.			



Natural Gas

RELEVANCE

NEUTRAL

ADVANTAGE

DISADVANTAGE

1. Natural gas is an energy-rich fossil fuel. It's a gaseous mixture of hydrocarbons, mostly methane, CH₄. Straight from the ground, it is wet gas, which is cleaned and separated into different products at a natural gas processing plant.
2. Natural gas operates compressors that move products through pipelines.
3. A small amount of natural gas is compressed or liquefied to fuel vehicles.
4. Almost all the natural gas we use is produced domestically. A small amount is imported from Canada during the winter to help meet seasonal demand.
5. Natural gas can power heavy vehicles like street sweepers, cargo trucks, shuttle buses, school buses, and waste collection vehicles.
6. Auto manufacturers do not build any natural gas-powered light-duty cars or trucks.
7. Most cars and trucks can be retrofitted to run on natural gas with an after-market engine conversion, as long as it's done by a qualified vehicle modifier.
8. Worldwide, about 23 million vehicles run on natural gas.
9. In the U.S., less than 25,000 consumer owned and an about 26,000 fleet owned vehicles use natural gas as a transportation fuel.
10. Compressed natural gas (CNG) is a good choice for fleets that drive a lot of miles but stay close to their fueling station. Most stations compress their natural gas on-site.
11. You can fuel a CNG vehicle at home using a small fueling appliance that attaches to your home's natural gas line.
12. To change natural gas into its liquid state, it is cooled to -260°F at a liquefaction facility.
13. Ships and trucks that travel long distances have better range using liquefied natural gas (LNG), since it's more energy dense.
14. There are 738 CNG and 41 LNG retail stations in the U.S.
15. Natural gas is an alternative fuel.
16. Natural gas is not toxic and does not catch on fire easily. If there is a leak, methane rises and dissipates quickly. Surrounding ecosystems and ground water won't be contaminated.
17. Natural gas is a cleaner-burning vehicle fuel. CNG and LNG vehicles slightly reduce life-cycle greenhouse gas emissions compared to gasoline and diesel-powered vehicles.
18. Most natural gas is nonrenewable, produced from fossil organisms hundreds of millions of years ago. However, some natural gas is produced from renewable biomass resources that decay to produce methane.
19. The U.S. has a large supply of natural gas.
20. Using CNG and LNG as transportation fuels may help reduce the amount of petroleum we need to import from other countries, increasing our energy security.



Propane Autogas

	RELEVANCE		
	NEUTRAL	ADVANTAGE	DISADVANTAGE
1. Propane is an energy-rich fossil fuel product often called liquefied petroleum gas, or LPG.			
2. Propane is a by-product of petroleum refining and natural gas processing.			
3. Most of the propane we use is produced domestically.			
4. Propane is a nonrenewable source of energy.			
5. The chemical formula for propane is C_3H_8 .			
6. Under normal pressure and temperature, propane is a gas. Under moderate pressure and/or lower temperature, propane can easily be changed into a liquid and stored in pressurized tanks, making propane a portable fuel.			
7. Auto manufacturers build propane-powered trucks and buses.			
8. Auto manufacturers do not build any propane-powered cars, vans, or pickup trucks.			
9. After purchasing a conventional vehicle, the engine can be converted to run on propane autogas.			
10. Converting a conventional engine to run on propane is an added expense.			
11. Propane autogas is an approved alternative fuel.			
12. After gasoline and diesel, propane is the most widely used and accessible transportation fuel. Worldwide, about 28 million vehicles run on propane.			
13. In the U.S., autogas only powers about 6,000 consumer owned vehicles and roughly 14,500 fleet owned cars, pickup trucks, and SUVs.			
14. Fleets can build their own refueling stations on-site for their propane-powered police cars, taxis, school buses, and delivery trucks.			
15. There are about 2,400 public LPG vehicle fueling stations in the U.S.			
16. Autogas costs significantly less per gallon than both gasoline and diesel fuel.			
17. Vehicles burning propane autogas may produce less air pollution and less greenhouse gas emissions than vehicles burning other petroleum fuels.			
18. Since propane is portable and cleaner burning than other petroleum fuels, it is often used to power vehicles and equipment indoors, such as forklifts in a warehouse.			
19. Propane autogas contains less energy per gallon than gasoline. This means LPG vehicles have less fuel economy.			
20. Our supply of propane depends on our supply of petroleum and natural gas. Since they are nonrenewable, we might run out someday.			



Renewable Diesel

RELEVANCE

NEUTRAL

ADVANTAGE

DISADVANTAGE

1. Renewable diesel is a biomass-based diesel fuel. It is a hydrocarbon, processed to be chemically the same as petroleum diesel fuel for use in diesel engines.
2. Renewable diesel can be made from nearly any biomass feedstock, using several different technologies.
3. Most commercial production facilities use a traditional hydrotreating process to make renewable diesel from animal fats, soybean oil, or canola oil. Hydrotreating reacts oil with hydrogen under high temperature and pressure in the presence of a catalyst.
4. Renewable diesel fuel is manufactured domestically.
5. To meet demand, renewable diesel fuel is imported from Singapore, the Netherlands, and Finland.
6. Renewable diesel is a direct replacement for petroleum diesel fuel.
7. Renewable diesel fuel can be used in its pure form, R100, or mixed and blended with petroleum diesel in any amount. The most common blends are R20 and R5.
8. Since renewable diesel is chemically the same as petroleum diesel, it can be used in existing petroleum pipelines and storage tanks without harming them.
9. Renewable diesel works in newer and older diesel vehicles without any engine modifications.
10. Renewable diesel is an approved alternative transportation fuel.
11. Renewable diesel is an important fuel for fleets trying to lower their carbon emissions. It can be used in any diesel vehicle, including school buses, trucks, and garbage haulers.
12. Nearly all renewable diesel fuel is consumed in California to help meet state standards requiring the use of low-carbon fuels.
13. There are 647 retail gas stations selling renewable diesel.
14. Renewable diesel is nontoxic and biodegradable. It releases lower levels of soot and particulate matter when burned, producing less air pollution than petroleum diesel.
15. Vehicles using renewable diesel produce less carbon dioxide and less nitrogen oxide emissions than vehicles using petroleum diesel.
16. Manufacturing renewable diesel requires significantly more hydrogen than manufacturing petroleum diesel. Hydrogen is typically made using natural gas, a fossil fuel.
17. Renewable diesel costs more to make than petroleum diesel, which means it costs more to buy.
18. The supply of renewable diesel is slowly growing, and new production facilities are being built.
19. Existing petroleum refineries can convert to produce renewable diesel with minor retrofits.
20. Using renewable diesel made from waste cooking oil diverts waste from landfills and sewer pipes by converting it to an energy source.



YOUTH AWARDS PROGRAM FOR ENERGY ACHIEVEMENT

NEED's annual Youth Awards Program for Energy Achievement rewards students for their efforts in energy outreach and student leadership.

The Youth Awards Program is great for all schools—new to energy education, or veteran. Projects and outreach completed for the program provide opportunity for enrichment and engagement, as well as an opportunity for your students, classroom, and school to shine. Youth Awards projects can be completed by afterschool/out-of-school time programs, community groups, and even families!

What's involved?

Students and teachers set goals and objectives and keep a record of their activities. Students create a digital project to submit for judging. In April, digital projects are uploaded to the online submission site.

Check out:

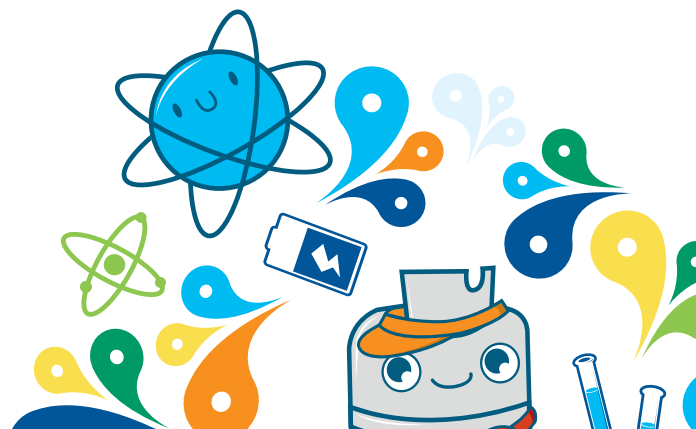
For more information and project submission details, we invite you to visit <https://youthawards.need.org>. Be sure to explore the site to view past winning projects and garner inspiration!

YOUTH ENERGY CONFERENCE & AWARDS

The NEED Youth Energy Conference and Awards gives students more opportunities to learn about energy and to explore energy in STEM (science, technology, engineering, and math).

The annual June conference has students from across the country working in groups on an Energy Challenge designed to stretch their minds and energy knowledge. The conference culminates with the Youth Awards Ceremony recognizing student work throughout the year and during the conference.

For More Info:
www.need.org/youthenergyconference



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Transportation Fuels Debate Evaluation Form

State: _____ Grade Level: _____ Number of Students: _____

- | | | |
|--|------------------------------|-----------------------------|
| 1. Did you conduct the entire activity? | ☐ Yes | ☐ No |
| 2. Were the instructions clear and easy to follow? | ☐ Yes | ☐ No |
| 3. Did the activity meet your academic objectives? | ☐ Yes | ☐ No |
| 4. Was the activity age appropriate? | ☐ Yes | ☐ No |
| 5. Were the allotted times sufficient to conduct the activity? | ☐ Yes | ☐ No |
| 6. Was the activity easy to use? | ☐ Yes | ☐ No |
| 7. Was the preparation required acceptable for the activity? | ☐ Yes | ☐ No |
| 8. Were the students interested and motivated? | ☐ Yes | ☐ No |
| 9. Was the energy knowledge content age appropriate? | ☐ Yes | ☐ No |
| 10. Would you teach this unit again? | ☐ Yes | ☐ No |

Please explain any 'no' statement below.

How would you rate the activity? ☐ excellent ☐ good ☐ fair ☐ poor

How would your students rate the activity overall? ☐ excellent ☐ good ☐ fair ☐ poor

Did you use any of NEED's other transportation materials? If yes, which ones?

What would make the unit more useful to you?

Other Comments:

Please fax or mail to: **The NEED Project**

8408 Kao Circle
Manassas, VA 20110

FAX: 1-800-847-1820
Email: info@need.org



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