

GETTING ORIENTED

T I M E	M A T E R I A L S N E E D E D
<i>Two days</i>	Student handouts <ul style="list-style-type: none">• <i>Gasoline-Powered Engines: Time for a Change</i>• <i>The Transportation Challenge</i>• <i>In Your Community, How Important Is It?</i> Recommended for students <p><i>Project notebooks or folders for organizing handouts and other information they obtain throughout the course of this unit</i></p>
O B J E C T I V E S <ul style="list-style-type: none">• <i>To orient students to the major issues involved with transportation (specifically the shift to alternative fuels), to the six-week unit ahead, and to working in teams.</i>	

STEP 1 - Class Discussion

WHAT DO STUDENTS ALREADY KNOW?

TIME: 30 minutes

Find out what your students know about our ever-changing transportation system and the move to alternative fuels through one of the following discussion activities.

Discussion: Home for the holidays

- 1) Ask students to think about getting their family together for a holiday dinner (or traveling 50 miles or more to see a grandparent): How do they travel? How long does it take? What equipment, fuel, and resources are needed? Describe the public infrastructure that exists to support travel. What food is on the table? (turkey? burgers? pasta? rice? fruit and vegetables?) Where did the food originate? How was it delivered to their community? How did they get it from the market to their home?
- 2) If this same dinner were held in 1850, 1890, 1920, or 1950, how would the answers change? What issues were probably raised when the internal combustion engine first replaced the horse and buggy (for example, noise, smell, danger, health, refueling)? How did the community and the country change to accommodate new forms of transportation?
- 3) If this same dinner were held in 2020 or 2050, what kinds of changes would the students expect to see?

Discussion: Why use gasoline?

- 1) Ask the class to brainstorm a list of fuels and identify the ones that are or might be used in vehicles. These may include the nine fuels listed in the teacher's introduction to this unit or many more.
- 2) Ask why gasoline, rather than any of the other fuels they've identified, is the fuel primarily used in cars.
- 3) Identify issues related to each that might deter its use. The students may raise issues such as lack of knowledge or technology, safety, environmental hazards, limited supplies, lobbying by industry, and so on.

Discussion: Traveling in the future

- 1) Read the following to students to stimulate their thinking about transportation in the future.

Picture yourself in 10 years as you leave your home to do daily errands or get to your place of work.

Will you enjoy revving the internal combustion engine of your car or experience the near silence of an electric motor? Will you decide to get some exercise by riding on the new bike path that runs directly to your office, studio, or shop, or to a convenient train stop that takes you to the next town?

How often will you fuel (or charge) your car of the future? Where is the most convenient place to do it? At the service station next to the highway, while you do errands on foot after work, or at the drive-up or walk-up window as you buy your morning coffee?

As you turn on the radio or your Walkman, will you hear reports of severe weather problems due to climate change, or will the announcer have more optimistic news ('Declining automobile emissions are decreasing levels of greenhouse gases.')

2) Ask the class what kind of vehicle will move them where they want to go. How will vehicles change? Will they be running on gasoline or some other fuel? What fuel might it be? Ask what reasons exist for changing from gasoline to some other fuel.

STEP 2 - Reading and Discussion

GASOLINE-POWERED ENGINES: TIME FOR A CHANGE

TIME: 20 minutes

1) Ask students why it's important for the United States to make a change from gasoline and other fossil fuels. They may raise many issues, such as the finite supplies of oil, global warming, and other environmental issues.

2) Distribute the student handout "GASOLINE-POWERED ENGINES: TIME FOR A CHANGE," which describes in more detail the reasons for learning about alternative fuels and the issues our country faces related to transportation. Provide students time to read the handout and discuss the questions at the end. Key points to make and possible answers to the questions include the following:

#1. At first gasoline was very expensive; it was shipped long distances; it was considered unsafe; and it was dirty, leaving residue on engines and other vehicle parts. Other fuels, such as ethanol, were safer, cleaner, and available domestically.

#2. Reasons to seek alternatives to fossil fuels include depleting oil reserves; increasing amounts of harmful emissions due to a growing population's growing use of energy; conflicts between oil-producing and oil-importing countries; global warming and rising sea levels due to a buildup of carbon dioxide in the atmosphere; pollution of freshwater supplies; noise pollution.

#3. Automobile manufacturers are developing alternative-fueled vehicles. Many cars, trucks, and buses are already using alternative fuels. Governments and industry are gradually developing new fueling infrastructures.

#4. Liquid petroleum gas (LPG, or "propane") is by far the most common alternative fuel; the numbers of other fuels are growing quickly, however, as new technologies are developed to better use them.

#5. Some students may have experience with alternative-fueled vehicles (AFVs), especially if they have been to car shows or an electric car race like the NESEA-hosted American Tour de Sol. Riding in most AFVs is similar to riding in a gasoline-powered car. Two differences may be the quiet of an electric vehicle or the french fry (or popcorn) smell associated with biodiesel.

GASOLINE-POWERED ENGINES: TIME FOR A CHANGE

Private cars have been part of the American lifestyle since they became affordable to most Americans in the 1920s and replaced horse-powered horses as a way to travel. In the 1930s, the automobile came a natural increase highway routes and increased living standards created individuals to drive away from rural areas. Road had been built for almost nothing. In the 1940s, the United States had almost no highways so people could get to the work of their lives. In the 1950s, the interstate highway system was built. In the 1960s, people in most areas of the North America were dependent on their cars. Automobiles in gas when they needed.

When cars were first invented, they were powered by what are now considered alternative fuels. However, several in fact all engines, now a popular energy source for vehicles on the 1800 until the 1920s. One of these fuels is the automobile was fueled with ethanol, an alcohol made from corn. Gasoline was introduced as a motor fuel in the late 1800s, but it was expensive. It was less costly than the coal tar products and kerosene used as a lamp oil. It was eventually replaced by petroleum. Technology improved gasoline engines, making them more powerful and more efficient.

For many reasons, gasoline was not the best fuel choice. It was more expensive than other fuels. It was flammable. It was more likely to explode and burn. It was more difficult to store. It was more difficult to transport. It was more difficult to use. It was more difficult to clean up. It was more difficult to dispose of. It was more difficult to handle. It was more difficult to store. It was more difficult to transport. It was more difficult to use. It was more difficult to clean up. It was more difficult to dispose of. It was more difficult to handle.

Nevertheless, gasoline became the major energy source for the 20th century. A growing number of these petroleum cars, trucks, and buses are already using alternative fuels. Governments and industry are gradually developing new fueling infrastructures.

SETTING ORIENTED - READER 1

GASOLINE-POWERED ENGINES: TIME FOR A CHANGE

A MAJOR CHALLENGE FOR THE COUNTRY

There are many reasons to seek alternatives to fossil fuels. The reasons are complex and generally fall into one or more of these three major categories:

- 1) Improving fuel efficiency and reducing emissions. Improving fuel efficiency means using less gasoline to travel the same distance. Reducing emissions means reducing the amount of pollutants that are released into the atmosphere. Both of these goals are important for reducing our dependence on fossil fuels and for protecting the environment.
- 2) Reducing the number of cars on the road or the number of miles that each person drives. Less cars, less driving, less pollution. Encouraging public transit, carpooling, and other ways to reduce the number of cars on the road can help reduce traffic congestion and air pollution.
- 3) Using alternative fuels. Developing new alternative fuels can help reduce our dependence on fossil fuels. Alternative fuels can be cleaner, safer, and more readily available than gasoline.

ESTIMATES OF ALTERNATIVE-FUEL VEHICLES IN USE IN THE U.S.

FUEL TYPE	1992	1993	1994	1995	1996
Gasoline-powered cars (AFVs)	22,000,000	20,000,000	17,000,000	15,000,000	13,000,000
Compressed Natural Gas (CNG)	2,000,000	2,500,000	3,000,000	3,500,000	4,000,000
Liquid Petroleum Gas (LPG)	1,000,000	1,200,000	1,400,000	1,600,000	1,800,000
Electric	1,000,000	1,200,000	1,400,000	1,600,000	1,800,000
Biodiesel	1,000,000	1,200,000	1,400,000	1,600,000	1,800,000

QUESTIONS FOR DISCUSSION

- 1) Why was gasoline not the best fuel choice for early automobiles?
- 2) Of the problems related to our current transportation system, which do you think are the most important?
- 3) In the past, how did we look for ways to improve our transportation system? What are some of the ways we are looking for now?
- 4) What has already been done to make the change to alternative fueled vehicles?
- 5) Look at the chart. Which alternative fuels are most commonly used in vehicles?
- 6) How have you seen or ridden in an alternative-fueled vehicle? If so, what were the advantages and disadvantages of that vehicle? How is it different from a gasoline-powered car? How do you experience the difference?

TYPES OF VEHICLES

HYBRID VEHICLE
A vehicle with two separate fuel sources, designed to run either on an alternative fuel or on gasoline or diesel, using both fuels to increase efficiency.

CONVERSION VEHICLE
A vehicle originally designed to operate on gasoline or diesel, but which has been modified or altered to run on an alternative fuel.

DEVELOPMENT VEHICLE
A vehicle that operates solely on one fuel but is being developed to operate on an alternative fuel.

HYBRID VEHICLE
A vehicle that runs on both an alternative fuel and an internal combustion engine.

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SETTING ORIENTED - READER 1

PREPARING STUDENTS TO MEET THE TRANSPORTATION CHALLENGE

TIME: 20 minutes

- 1) Distribute the student handout “THE TRANSPORTATION CHALLENGE,” which describes the six-week project ahead.

Explain to students that for the next six weeks they will work in teams to investigate alternative fuels in depth and become the class experts on at least one of them. The students will analyze the impact of widely adopting an alternative fuel in three major areas:

- its long-term availability and the ease of distribution
- its impact on emissions, human health, and the environment
- its ease of operation, maintenance, and refueling

While researching each of these three areas, the class as a whole will also analyze the needs of its own community and the impact on it of the current transportation system.

As the class experts, fuel teams present their findings to their classmates. The evaluation of the fuels can be done by the other students in one of two ways:

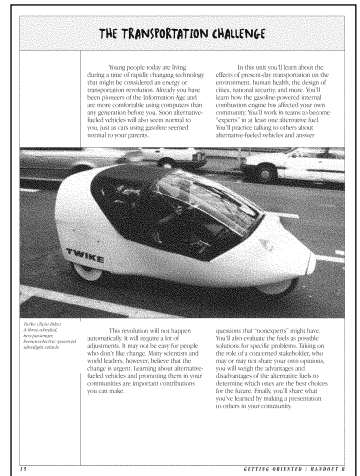
- Individual students are assigned a stakeholder or interest group to represent. They listen to the presentations and compare and evaluate the fuels from that perspective.
- Evaluation panels of students are formed and assigned a stakeholder or interest group to represent. (We suggest that each evaluation panel consist of experts on several different fuels.) As a panel, students listen to the presentations and compare and evaluate the fuels from that perspective.

The class will then decide which fuel or fuels should be adopted in their community and develop a final presentation to make to community representatives about their fuel choices.

- 2) Explain that their decision might be based on how well an alternative-fueled vehicle performs on the road, how far one can drive between fueling, or how well the car starts in cold weather. Encourage the class to also consider broader and longer term goals for the country, such as reducing environmental pollution, improving public health, slowing down global warming, and becoming more self-sufficient.

Whatever fuel the students choose, it should be appropriate for their own community. A fuel that’s most appropriate in clearing the air in southern California (where people commute long distances and smog has been a problem for 50 years) may differ from the fuel that is most readily available in the agricultural areas of the Great Plains. Those fuels may differ again from what is cleanest and most convenient for East Coast inner-city residents who use cars for a few short trips during the week. As the students make their decisions, remind them of these questions: “What are the most important transportation issues our community is facing? Which fuels best resolve those issues?”

- 3) If you have already made arrangements for a public presentation, discuss with students what form their presentation may take and who will be in their audience. If not, discuss with students the possibilities for public presentations: where and when they might take place, who the audience would be, what form the presentations would take. Presentations may take one or more forms: a poster or series of posters, a video, a PowerPoint presentation, a web site posting, or a public forum using transparencies.



Possible venues include the school or public library, other public buildings, or at a community happening such as an Earth Day event. Throughout the unit, teams will have at least three opportunities to give mini-presentations to their classmates, which should help them prepare for the community presentation.

STEP 4 - Class Discussion

IN YOUR COMMUNITY, HOW IMPORTANT IS IT?

TIME: 45 minutes

- 1) Distribute the student handout “IN YOUR COMMUNITY, HOW IMPORTANT IS IT?”
- 2) Divide the class into groups of three or four students. Have them work in teams to rate the importance (from 0 to 3) of each of the issues listed. Ask them to come to consensus as a group by giving each person an opportunity to voice his or her opinion about each issue.
- 3) When the teams are finished, have them share their answers and attempt to come to consensus as a class. Remind them to think about the importance of each issue in your unique community.

- 4) Explain that in the coming six weeks, their opinions may change as they learn more about each fuel and issue. Some issues may not seem as important; new issues may arise. The students should analyze what they learn about the issues as a scientist analyzes data in an experiment, with an open mind willing to look at the facts objectively. Throughout their research, their conclusions and opinions may change. What’s important is that their new opinions are supported with facts.

- 5) As students work through each of the three community research activities, refer back to this discussion and ask if their opinions are changing about the importance of each issue.

IN YOUR COMMUNITY, HOW IMPORTANT IS IT?		
<p>What's the importance of each issue below? Rank in groups to discuss each one, and rate them according to this scale:</p> <p>0 - Not important 1 - Somewhat important 2 - Fairly important 3 - Very important</p>	<p>Names of group members:</p> <p>_____</p> <p>_____</p> <p>_____</p>	
TRANSPORTATION AND FUEL ISSUES	RATING	NOTES
AVAILABILITY AND DISTRIBUTION		
Regional source of fuel		
National source of fuel		
Fuel source availability		
Public fuel prices		
Fuel production, storage, and delivery		
Low cost of keeping supplies secure		
Disaster impact on people at the source		
Risk of developing a fueling infrastructure		
EMISSIONS AND HEALTH		
Toxicity in your environment		
Reduced air pollution		
Reduced water pollution		
Improved health of children and the elderly		
Ease in taking care of accidents		
Safe disposal of tanks and parts		
OPERATION, MAINTENANCE, AND REPAIRING		
Low cost of vehicle		
Easy startup		
Performance and power		
Cargo space		
Time/distance between fills or exchange		
Convenience of refueling/repairing		
Low cost of maintenance		
Easy maintenance		

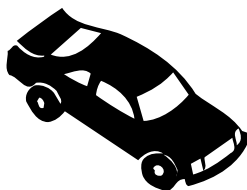
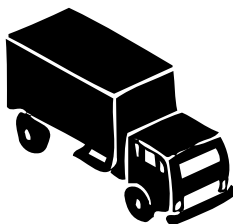
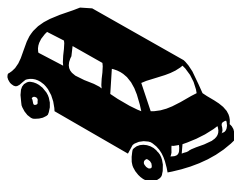
GASOLINE-POWERED ENGINES: TIME FOR A CHANGE

Private cars have been part of the American lifestyle since they became affordable for American families in the 1920s and replaced hay-powered horses as a way to travel. By the 1960s the horseless carriage, a national interstate highway system, and a national fueling infrastructure enabled individuals to drive easily from coast to coast. Motels had been built for drivers making long trips, and fast food restaurants added drive-up windows so people could eat in the comfort of their homes-on-wheels. In a few decades, people in most areas of the North America came to depend on their own automobiles to go where they wished.

When cars were first invented, they were powered by what are now considered alternative fuels. Electricity, stored in lead acid batteries, was a popular energy source for vehicles from the 1830s until the 1920s. One of Henry Ford's first automobiles was fueled with ethanol, an alcohol made from corn. Gasoline was introduced as a motor fuel in the late 1800s, but it was expensive. (It was first sold by the pint in pharmacies and sometimes used as a cleaning solvent.) Eventually, new petroleum-refining technologies produced gasoline inexpensively, and it became more widely used.

For many reasons, gasoline was not the best fuel choice. It was more toxic than ethanol, was generally more dangerous (it was more likely to explode and burn accidentally), contained threatening air pollutants, formed gum on storage surfaces, and left carbon deposits in the combustion chambers of engines. Pipelines and ships were needed to distribute petroleum from the areas where it was found to the areas where it was used. Because petroleum was physically and chemically diverse, complex refining procedures were needed to ensure that a consistent gasoline product was manufactured.

Nevertheless, gasoline became the major transportation fuel of the 20th century. A growing supply of cheap petroleum came from oil field discoveries and made the cost per mile of travel relatively inexpensive. We learned how to live with gasoline's



disadvantages and dangers. Over time, the large investments made by the oil and auto industries in a fueling infrastructure, human skills, and technology made the situation difficult to change.

With the growing number of vehicles and the increasing number of miles we drive, the gasoline-powered automobile has created a wealth of problems that weren't imagined when it first became an essential part of American life.

- In the United States, two-and-a-half million people are added to the population every year, each needing to travel to work, to home, to school. While the United States owns only 2 to 3 percent of the world's proven oil resources, the country already consumes 25 percent of the world's annual oil production.

- With world population growing at the fastest rate in human history and standards of living rising throughout the world, the demand for oil for transportation and other uses is also sharply increasing.

- Demands for oil have created international conflicts and war between oil-exporting and oil-importing countries.

- Excessive amounts of carbon dioxide, produced when gasoline burns, are building up in the atmosphere and contributing to global warming and climate change.

- In some regions, rates of lung problems, especially among young children and the elderly, are high because of air pollution caused by tailpipe emissions.

- Oil spills, leaking underground storage tanks, and road runoff are polluting freshwater supplies and oceans and endangering natural areas.

- Noise pollution from traffic is spreading.

These problems are severe enough to cause many people to look for alternatives. What alternatives do we have?

A MAJOR CHALLENGE FOR THE COUNTRY

There are many responses to the challenges we face. The various approaches generally fall into one or more of these three major categories:

1) Improving fuel efficiency and emissions controls. Designing more fuel-efficient and less polluting gasoline-powered vehicles; choosing to buy and use smaller and/or more fuel-efficient cars; making good use of efficient technologies by keeping cars well maintained and driving them conscientiously.

2) Reducing the number of cars on the road or the number of miles that each person drives. Using mass transit; bicycling; walking; carpooling; combining multiple errands into single trips; telecommuting.

3) Using alternative fuels. Developing and using alternative-fueled vehicles.

There is no one right or best solution; in fact, we need to look at them all. For this project, however, we're going to look most closely at alternative fuels.

Adopting different transportation fuels is a major challenge for the country. We need to find and develop new sources of power, design and test new vehicles, and develop a fueling infrastructure to make traveling in the future as convenient as it is today. This work is very costly, takes decades, and requires the involvement of governments, industry, and inventive individuals and the support of consumers. The good news is that it is already under way.

As the chart shows, the number of alternative-fueled vehicles (AFVs) in the United States is growing. These cars, trucks, and buses are owned by individuals, businesses, and governments. For many

years conversion kits have been available to assist people wishing to convert gasoline-powered cars to AFVs. Alternative fuels have been used in dual-fuel, flexible-fuel, or hybrid vehicles, which run on either gasoline or an alternative fuel, or both. Recently, in response to public demand, auto manufacturers have been producing small numbers of vehicles dedicated to alternative fuels. AFVs are being driven throughout the United States and especially in metropolitan areas involved with the federally sponsored Clean Cities Program, where industry and governments have joined forces to clean up the air. In the next 10 years, we can expect to see automobile manufacturers marketing new models of AFVs powered by a variety of engines, motors, and fuels.

The rising number of AFVs goes hand in hand with the development of fueling infrastructures for alternative fuels. Governments and businesses are gradually

ESTIMATES OF ALTERNATIVE-FUEL VEHICLES IN USE IN THE U.S.

FUEL TYPE	1992	1995	1999	Annual change 1992-99
Liquid Petroleum Gas (LPG)	221,000	259,000	274,000	3.1%
Compressed Natural Gas (CNG)	23,191	50,218	96,017	22.5%
Liquefied Natural Gas (LNG)	90	603	1,517	49.7%
Methanol (M85)	4,850	18,319	21,829	24.0%
Ethanol (E85)	172	1,527	17,892	94.2%
Electricity	1,607	2,860	6,481	22.0%
Total Vehicles on the Road	181,519,150	193,440,393	209,509,161	1.8%

developing new fueling infrastructures that make alternative fuels more widely available. Eventually two or three fuels will probably become most popular nationwide, and national fueling infrastructures will be developed for them. Other fuels may be widely used only in certain regions of the country.

What will those fuels be? The answer is partly up to you — the people who will be driving the next generation of cars. The decisions you make can greatly resolve the security, health, and environmental problems we are facing today.

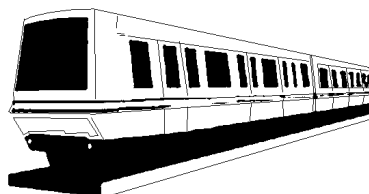
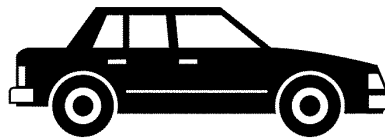
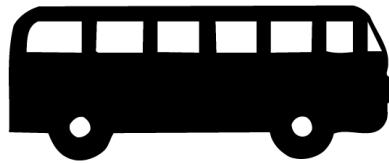
Source of AFV data: U.S. Energy Information Administration, URL: <http://www.eia.doe.gov>.

Source of data about total vehicles: Ward's Motor Vehicle Fact and Figure Book, 2000 Edition. Ward's Communications, Southfield, Mich.

1999 figures reported as of July 1.

QUESTIONS FOR DISCUSSION

- 1) Why was gasoline not the best fuel choice for early automobiles?
- 2) Of the problems related to our current transportation system, which do you think are the most important?
- 3) In this unit you will look most closely at changing to alternative-fueled vehicles. What are some other ways of resolving our nation's fuel and transportation problems? Do you know people who are already doing any of these things?
- 4) What has already been done to make the change to alternative-fueled vehicles?
- 5) Look at the chart. Which alternative fuels are most commonly used in vehicles?
- 6) Have you ever seen or ridden in an alternative-fueled vehicle? If so, what was the vehicle like? Was it very different from a vehicle running on gasoline or diesel? Was your experience different?



TYPES OF VEHICLES

BI-FUEL VEHICLE -

A vehicle with two separate fuel systems, designed to run either on an alternative fuel or on gasoline or diesel, using only one fuel at a time.

CONVERTED VEHICLE -

A vehicle originally designed to operate on gasoline or diesel that has been modified or altered to run on an alternative fuel.

DEDICATED VEHICLE -

A vehicle that operates solely on one fuel. In general, dedicated vehicles provide superior emissions and performance results because their design has been optimized for operation on only one fuel.

DUAL FUEL VEHICLE -

See bi-fuel vehicle.

HYBRID ELECTRIC VEHICLE -

A vehicle that relies on both internal combustion engines and electric motors.

THE TRANSPORTATION CHALLENGE

Young people today are living during a time of rapidly changing technology that might be considered an energy or transportation revolution. Already you have been pioneers of the Information Age and are more comfortable using computers than any generation before you. Soon alternative-fueled vehicles will also seem normal to you, just as cars using gasoline seemed normal to your parents.

In this unit you'll learn about the effects of present-day transportation on the environment, human health, the design of cities, national security, and more. You'll learn how the gasoline-powered internal combustion engine has affected your own community. You'll work in teams to become "experts" in at least one alternative fuel. You'll practice talking to others about alternative-fueled vehicles and answer



*Twike (Twin Bike)
A three-wheeled,
two-passenger,
human/electric-powered
ultralight vehicle*

This revolution will not happen automatically. It will require a lot of adjustments. It may not be easy for people who don't like change. Many scientists and world leaders, however, believe that the change is urgent. Learning about alternative-fueled vehicles and promoting them in your communities are important contributions you can make.

questions that "nonexperts" might have. You'll also evaluate the fuels as possible solutions for specific problems. Taking on the role of a concerned stakeholder, who may or may not share your own opinions, you will weigh the advantages and disadvantages of the alternative fuels to determine which ones are the best choices for the future. Finally, you'll share what you've learned by making a presentation to others in your community.

IN YOUR COMMUNITY, HOW IMPORTANT IS IT?

*What's the importance of each issue below?
Work in groups to discuss each one, and rate them according to this scale:*

- 0 - Not important
- 1 - Somewhat important
- 2 - Fairly important
- 3 - Very important

Names of group members:

TRANSPORTATION AND FUEL ISSUES	RATING	NOTES
<i>AVAILABILITY AND DISTRIBUTION</i>		
Regional source of fuel		
National source of fuel		
Long-term availability		
Stable fuel prices		
Safe production, storage, and delivery		
Low cost of keeping supplies secure		
Positive impact on people at the source		
Ease of developing a fueling infrastructure		
<i>EMISSIONS AND HEALTH</i>		
Decrease in greenhouse-gas emissions		
Reduced air pollution		
Reduced water pollution		
Improved health of children and the elderly		
Ease in taking care of accidents		
Safe disposal of fluids and parts		
<i>OPERATION, MAINTENANCE, AND REFUELING</i>		
Low cost of vehicle		
Easy start-up		
Performance and power		
Cargo space		
Long distance between fill-ups or recharge		
Convenient recharging/refueling		
Low cost of maintenance		
Easy maintenance		