

Renewable Fuels



Renewable Fuels Foundation



Renewable Fuels Association



Ethanol Production and Utilization Impacts

Unit 5 Lesson 1

Precepts

- E. Awareness
 - E1. Address issues important to the community.
- F. Continuous Improvement
 - F4. Adapt to emerging technologies.

National Standards

- NL-ENG.K-12.2. Reading for Understanding.
- NSS-G.K-12.5. Environment and Society.

Student Learning Objectives

- As a result of this lesson, the student will ...
 - 1. Identify the positive impacts that ethanol has on the economy.
 - 2. Identify the negative impacts that ethanol has on the environment.

Time

Instruction time for this lesson: 50 minutes.

Resources

- www.npi.gov.au
- www.epa.gov
- www.energyportal.eu
- http://www.pbs.org/newshour/indepth_coverage/science/alt_fuels/ethanol.html

Tools, Equipment, Supplies

- Writing surface
- Projector
- Screen
- TM.A
- TM.B
- TM.C
- AS.A – one per student
- AS.B – one per student in $\frac{1}{2}$ the class
- AS.C – one per student in $\frac{1}{2}$ the class

INTEREST APPROACH

Use AS.A to determine if the statements about ethanol are true or myth. Have students fill in the correct answer using TM.A. Work through each myth, and then summarize the content from the activity sheet before moving on to objective 1.



Who has seen the show “MythBusters”? What happens on that show? Elicit responses (the cast determines whether an “urban legend” is myth or fact.)

Today, we are going to be myth busters for ethanol. Our task is to determine whether six statements are myth or fact.

Pass out copies of AS.A to each student.



In a moment, we’ll read through each statement silently. As we read through them, we will decide if we think the statement is a myth or a fact. If you think it is a myth, write an M next to the statement. If you think it is a fact, write an F next to it. Then, we’ll see how we do on our predictions! Go ahead and read through the statements and determine if they are myth or fact.

As students are reading silently, prepare TM.A to project on the screen. Once students are finished, have student volunteers read the information about each statement. Then allow time for students to write down pertinent information about each statement. Encourage students to abbreviate instead of writing the information word for word.



Let’s take a look at this first statement “Ethanol raises the cost of gasoline.” Raise your hand if you think this is a myth. Thank you. ‘Thank you’ is a key for students to put their hands down.

Raise your hand if you think this is a fact. Thank you.

Let’s find out. Who will bust this myth for us by reading information about it from the screen? Call on a student to read.

Great job! Take a moment to write down key points from this information. Allow time to write.

So, is this statement a myth or a fact? It’s a myth!

Who will bust the second myth “Ethanol contributes to global warming”? Call on a student to read.

Great job! Take a moment to write down key points from this information. Allow time to write.



So, is the statement that ethanol contributes to global warming a myth or fact? It’s a myth!

What about this third statement that says “Ethanol harms car and truck engines”? Let’s have a couple of people bust this myth, who will bust this myth? Call on two students.

Let’s have the first person read about halfway through the information to the sentence that ends with “...fuel system cleaner.” Find that spot now. Then the second person can continue with the next sentence. Okay, bust the myth!

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Great job reading, let's write down key information. *Allow time to write.*

Is this statement a fact or myth? It's a myth! Moving on to statement four, "Ethanol production wastes corn that could be used to feed a hungry world." What do we think about this myth?

Raise your hand if you initially thought it was a myth. Thank you.

Raise your hand if you initially thought it was a fact. Thank you.

Who will bust this myth? *Call on a student to read the information.*



Thanks for reading! Let's take a moment to record key information about this statement. What did we determine about this statement, is it a myth or fact? It's a myth, also!

Okay, we have two statements left. Let's try to bust one! This next one says, "Ethanol does not benefit farmers." Who will bust this myth by reading the information? *Call on a student.*

Thank you for sharing this information with us. Take a moment to write down key information. Is this statement a myth or fact? It is also a myth...ethanol can actually help farmers!

One last statement...can we bust it? Let's see what we thought initially about the statement "Ethanol adds to air pollution." Raise your hand if you initially thought this statement was a myth. Thank you.

Raise your hand if you initially thought it was a fact. Thank you.

Alright, we need one last volunteer to bust this myth. Who will read for us? *Call on a student to read.*

Hmmmm....let's take a moment to record key information on the activity sheet.

For this last statement, what do we think? This one is a myth too! All six statements are myths! Ethanol actually has many positive impacts...let's take a look at some of the positive impacts ethanol has on the economy.

OBJECTIVE 1. Identify the positive impacts that ethanol has on the economy.

The content for this objective has been chunked in two sections in AS.B and AS.C. Use the Little Professor Moment to introduce the content for this objective. Split the class into two groups. One group will be Professor and the other Expert. The instructor will teach Professor first using AS.B, while the Experts wait. Then students will switch roles, the instructor will teach the Experts the content from AS.C while the Professors wait.



Our first objective is to identify the positive impacts that ethanol has on the economy. Today, you are going to be the experts! You will be given the title of Professor or Expert for today to teach the content to your peers! We need two groups; we'll count of 1 and 2. Ones you will be Professor. twos, you will be Expert.

Pass out AS.B to the Professors and AS.C to the Experts. Pair up 1s and 2s (make appropriate adjustments with an odd number of students).

Little Professor Moment

Experts, your task is to be invisible for the next few moments while the Professors brush up on their knowledge. While you're invisible, please sit still and silent! We'll get back to you in a moment.

I. The economy benefits many ways through ethanol production and utilization.

- A. More than \$3 billion has been invested in 60 ethanol production facilities operating in 20 different states across the country.
- B. Ethanol will add \$51 billion (1996 dollars) to the U.S. economy. The goods and services purchased by ethanol producers represent increased demand for other industries. These include purchases of grain, natural gas, electricity, water, communications, accounting and legal services.
- C. Ethanol contributes more than \$2 billion annually to the U.S. trade balance. The U.S. currently imports 54 percent of its petroleum demand. Use of ethanol reduces the trade deficit by about \$1.3 billion annually by replacing imported MTBE. Another \$800 million is gained annually due to export of the byproducts of ethanol, such as corn gluten feed and gluten meal for livestock consumption.
- D. Annual farm income for crop producers will increase \$4.5 billion because of ethanol production.
- E. Increased demand for grain grown by American farmers provides market support for prices and incomes.
- F. The ethanol industry supports nearly 55,000 jobs. Ethanol production directly accounts for over 5,800 jobs in the food/fuel processing industry in 20 states. Additionally, the spending by ethanol manufacturers on goods and services indirectly supports an average of 48,900 jobs.
- G. Ethanol production will increase total household income by \$12.5 billion over the next seven years.
- H. The ethanol industry directly pays \$277 million in wages to employees. These employees and their families spend this income, thereby creating demand for other goods

and services. The indirect impact of ethanol production adds another \$1.8 billion to household income annually. •



Professors, take a look at AS.B. You will see there is information underlined. This information has been chosen as the most important information. Your task is to share this information with your partner, but you will need to give them a little more information than what is underlined. Don't let your partner just copy the information off your handout. Engage in conversation with your partner, helping them understand the information. Remember, focus on the underlined material. Your partner doesn't need to write down all the information word for word. Take a moment to look through the information.

What questions are there?

Professors, are you ready to teach?

Have the Professors teach the content to the Experts. Experts need to have paper for notes and a writing utensil. Instructor should circulate through the room while the Professors are teaching to their peers.



Okay, Experts, you will be the students. Take out paper for notes and a writing utensil. Professors, teach!

Professors teach.



Alright! Good job teaching Professors! Now, it's your turn to be invisible, silent and still. Experts, you're turn to teach. Take a look at AS.C. You will see there is information underlined. This information has been chosen as the most important information. Your task is to share this information with your partner, but you will need to give them a little more information than what is underlined. Don't let your partner just copy the information off your handout. Engage in conversation with your partner, helping them understand the information. Remember, focus on the underlined material. Your partner doesn't need to write down all the information word for word. Take a moment to look through the information.

What questions are there?

Experts, are you ready to teach?

I. The tax payer benefits through:

1. The partial excise tax exemption for ethanol blends available to gasoline marketers saves money.
2. A GAO study has shown that reduced farm program costs and increased income tax revenues offset the cost of the incentive.
3. According to the USDA, if ethanol use does not continue to grow, "deficiency payments for corn and other program crops will increase."
4. The economic activity caused by the ethanol industry will generate \$3.5 billion in additional income tax revenue over the next five years.
5. The U.S. ethanol industry will create a net gain to taxpayers of almost \$4 billion over the next five years.
6. Ethanol generates \$555 million of net tax revenue for the federal treasury annually through personal and business income tax collections. Additional revenues, provided by taxes on household and farm income that are generated and

supported by the ethanol industry, offset the cost of the partial ethanol excise tax exemption for ethanol-blended gasoline.

J. Consumers benefit from ethanol through:

1. Consumers use more than 18 billion gallons of high performance, cleaner burning ethanol blended gasoline each year.
2. Ethanol and ethyl tertiary butyl ether increases oxygenated supplies, reducing the need for MTBE imports and helping to reduce the costs.
3. Ethanol is a high octane blending component used by many independent gasoline marketers- creating competition for the major oil companies. ETBE is a low volatility oxygenate which provides refiners a cost-effective means to meet Clean Air Amendment standards.
4. Ethanol guards against gas line freeze by absorbing moisture that may get in the tank during cold weather.

Have Experts teach the content to the Professors. Professors need to have papers for notes, and a writing utensil. Instructor should circulate through the room while the Experts are teaching to their peers.



Okay, Professors, you will be the students. Take out paper for notes and a writing utensil. Experts, teach!

Experts teach.

Congratulate students for teaching. Explain that while all the benefits that ethanol has on the economy are good, there are some serious concerns about ethanol and the environmental impacts that it may have.



Great job teaching Experts and Professors! Give your partner a high five! From each other we have learned about many positive impacts of ethanol. However, there are some serious concerns about the environmental impacts ethanol may have.

OBJECTIVE 2. Identify the negative impacts that ethanol has on the environment.

Discuss the negative impacts of ethanol, clearing up any misconceptions that students may still have. Identify with students that most of the negative impacts have not yet been proven, but are just concerns rather than fact based. For this objective, use the Hieroglyphic Moment to help students retain the information. Project the information from TM.B on the screen. Then, guide students through the Hieroglyphic Moment to create visual representations for the content.



Let's look at some of these potential negative impacts. First, we'll write down some key information. Take out paper for notes and a writing utensil. As you look at the information projected on the screen, write down the key points, feel free to abbreviate. Be sure to leave some space between each item (A, B, etc.)

Project TM. B.

II. Serious environmental and food security issues are caused by diverting land and other productive resources away from food crops and towards energy resources.

A. Concerns that the need for more corn product will become necessary, in which forest lands and grasslands will be converted to farmland to raise corn, thus allowing for less carbon cycle to occur and greater environmental impacts.

B. There has been no extensive research on the effect of ethanol emissions due to low usage levels to date, but there are serious concerns regarding what large amounts of emissions may have on the ozone.

C. Even though there is a minor impact on the industry with the use of ethanol for fuel, this issue impacts American's views on the 'food vs. fuel' debate.

D. Farmer's enjoy the price increases in local corn prices. As the price/ bushel increases so does the suppliers charge for seed and chemicals resulting in higher average costs per acre.

Hieroglyphic Moment

Students will create icons or pictures to visually represent the components of the information. Guide students through the process by using the examples on TM.C. The instructor can use the first example to prime students' creative thinking or work through all examples provided in TM.C if this is the first time students have participated in this type of activity.

Descriptions of hieroglyphics on TM.C.

- A. Bulldozer converting grassland to farmland
- B. Automobile emissions contributing to the ozone
- C. Outline of the United States with glasses (views) on food and fuel
- D. Prices are driving up seed and chemical costs



We've recorded some great information, but let's think about this information in a different way. What types of pictures or icons might help us remember this information?

Elicit student responses, record on writing surface. The instructor can use student ideas or use TM.C at this point to guide students through the process.



In the blank space we left under each item; let's create a hieroglyphic that will help us remember the information. Take a moment to do this for each item A through D.

The instructor should circulate through room to aid students. Use TM.C examples if students struggle. When students are finished, ask a few students to share for each item.



We did a great job in the creation of the hieroglyphics. Who will share with us your hieroglyphic for letter A? *Have 2-3 students share.*

Repeat for items B-D.



Awesome job! Keep these hieroglyphics in your notes to help you remember what we have learned today.

While there are a few concerns about ethanol use, it's important to remember that they are just concerns and haven't been proven. We must also remember all of the positive impacts that ethanol can have.

REVIEW/SUMMARY

Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student's responses can then be used to determine which objectives need to be reviewed and which ones are fully understood.

Let's think back to our Professor and Expert roles from earlier. Take out your handouts from objective 1. Pair up with your partners again. Determine one important point from your handout that you want to be sure your partner knows. *Allow time for students to determine important point.*

Experts, you get to go first this time. When I say "go," tell your partner that one important point you chose. Who has questions? Okay, go!

Now, it's your turn Professors. When I say "review," tell your partner that one important point you chose. What questions are there? Okay, review!

We learned about the positive impacts ethanol has on the economy, but we also learned about some potential negative effects on the environment. Take a moment to look over the hieroglyphics you created for objective 2. Write down any questions you have about the information.

Who has questions about the information for objective 2? *Allow time to respond to and discuss student questions.*

We have done a great job of learning this information. A couple of reasons it's important for us to look at this information include the fact that ethanol use will affect our lives and our communities financially and environmentally. Additionally, we must be aware of the new technologies taking place in the world. Increased ethanol use makes a difference in the quality of our lives. Now that we have reviewed, let's take a moment to show what we know about today's lesson by taking the evaluation.

APPLICATION

Extended classroom activity: *Using the Internet as a reference tool, students can identify careers created from the demand for ethanol. Students can choose a career and create a career profile on the selected career and share it with the class.*

FFA activity: *Students can write a prepared public speech on the positive and potentially negative impacts of ethanol and deliver for the local Prepared Public Speaking Career Development Event.*

SAE activity: *Students with grain production SAE projects can research corn and other grain prices for ethanol and determine increased profits from selling grain to an ethanol production facility.*

EVALUATION

Assess. A

Answers to Assessment:

Answers will vary, please refer to content from TM.A for answers to specific questions.

TM.A**Ethanol Myth Busters:*****Ethanol raises the cost of gasoline.***

While many predicted the switch from MTBE to ethanol would increase gas prices, there has been no negative impact on gasoline supplies or the cost per gallon of gasoline. Ethanol is less expensive than other additives. In fact, ethanol is usually less expensive than ordinary gasoline. The net effect of blending ethanol with gasoline is normally a product that costs less. A May 2005 report by the Consumer Federation of America notes drivers everywhere would save as much as 8 cents per gallon if petroleum marketers would simply blend more ethanol into gasoline.

Ethanol contributes to global warming.

Because the energy balance of ethanol production is positive (1.67 to 1), greenhouse gas benefits are also positive. The Argonne National Laboratory has demonstrated that using ethanol produces 32 percent fewer emissions of greenhouse gases than gasoline for the same distance traveled. Ethanol also reduces emissions of other harmful pollutants such as carbon monoxide — and it dilutes and displaces components of gasoline that produce toxic emissions.

Ethanol harms car and truck engines.

Every major automobile manufacturer approves the use of ethanol blends up to 10 percent (E10) under warranty. In fact, many auto manufacturers go so far as to recommend the use of clean, renewable fuels such as E10. Cars built since the 1970s are fully compatible with E10. In addition, ethanol in gasoline: Adds oxygen to the fuel, raising the air/fuel ratio for more complete combustion; eliminates the need and expense of adding a gas line antifreeze, since ethanol in gasoline absorbs more water than a small bottle of isopropyl; prevents burning of engine valves because ethanol burns cooler than gasoline; prevents build-up of olefins in fuel injectors, keeping the fuel system cleaner. Ethanol takes more energy to produce than it contributes. USDA recently determined the net energy balance of ethanol production is 1.67 to 1. For every 100 BTUs of energy used to make ethanol, 167 BTUs of energy is produced. The USDA findings have been confirmed by additional studies conducted at several universities and government laboratories. These studies take into account the energy required to plant, grow and harvest the corn — as well as the energy required to manufacture and distribute the ethanol. The net energy balance of ethanol production continues to improve because ethanol and corn production are becoming more efficient. For example, one bushel of corn now yields 2.8 gallons of ethanol — up from 2.5 gallons just a few years ago.

Ethanol production wastes corn that could be used to feed a hungry world.

Corn used for ethanol reduction is field corn typically used to feed livestock. Wet mill ethanol production facilities, also known as corn refineries, also produce starch, corn sweeteners and corn oil — all products that are used as food ingredients for human consumption. Ethanol production also results in the production of distiller's grains and gluten feed — both of which are fed to livestock, helping produce high-quality meat products for distribution domestically and abroad. There is no shortage of corn. In 2004, U.S. farmers produced a record 11.8 billion bushel corn harvest — and some 1.3 billion bushels (about 11 percent) were used in ethanol

production. Additionally, the 2005 crop was among the largest on record. In other words, there is still room to significantly grow the ethanol market without limiting the availability of corn. Steadily increasing corn yields and the improved ability of other nations to grow corn also make it clear that ethanol production can continue to grow without affecting the food supply.

Ethanol does not benefit farmers.

The ethanol industry opens a new market for corn growers, allowing them to enjoy greater profitability. Studies have shown that corn prices in areas near ethanol plants tend to be 5 to 10 cents per bushel higher than in other areas. This additional income helps cut the costs of farm programs and add vitality to rural economies. The additional profit potential for farmers created by ethanol production allows more farmers to stay in business — helping ensure adequate food supplies in the future. Ethanol production also creates jobs, many of which are in rural communities where good jobs are hard to come by. A 2005 study by LECG found the ethanol industry powered the U.S. economy by creating more than 147,000 jobs, boosting U.S. household income by \$4.4 billion and reducing the U.S. trade deficit by \$5.1 billion by eliminating the need to import 143.3 million barrels of oil. Those kinds of numbers help farmers and all Americans.

Ethanol adds to air pollution

Because ethanol-blended gasoline is cleaner than conventional gasoline, it emits less hydrocarbons, nitrogen oxides, carbon monoxide and hydrogen. Ethanol reduces carbon monoxide emissions by as much as 25 percent and less carbon monoxide helps reduce ozone formation and greenhouse gas levels. According to EPA, gasoline is the largest source of manmade carcinogens. Ethanol reduces overall toxic pollution by diluting harmful compounds found in gasoline such as benzene and other aromatics.

TM.B

II. Serious environmental and food security issues are caused by diverting land and other productive resources away from food crops and towards energy resources.

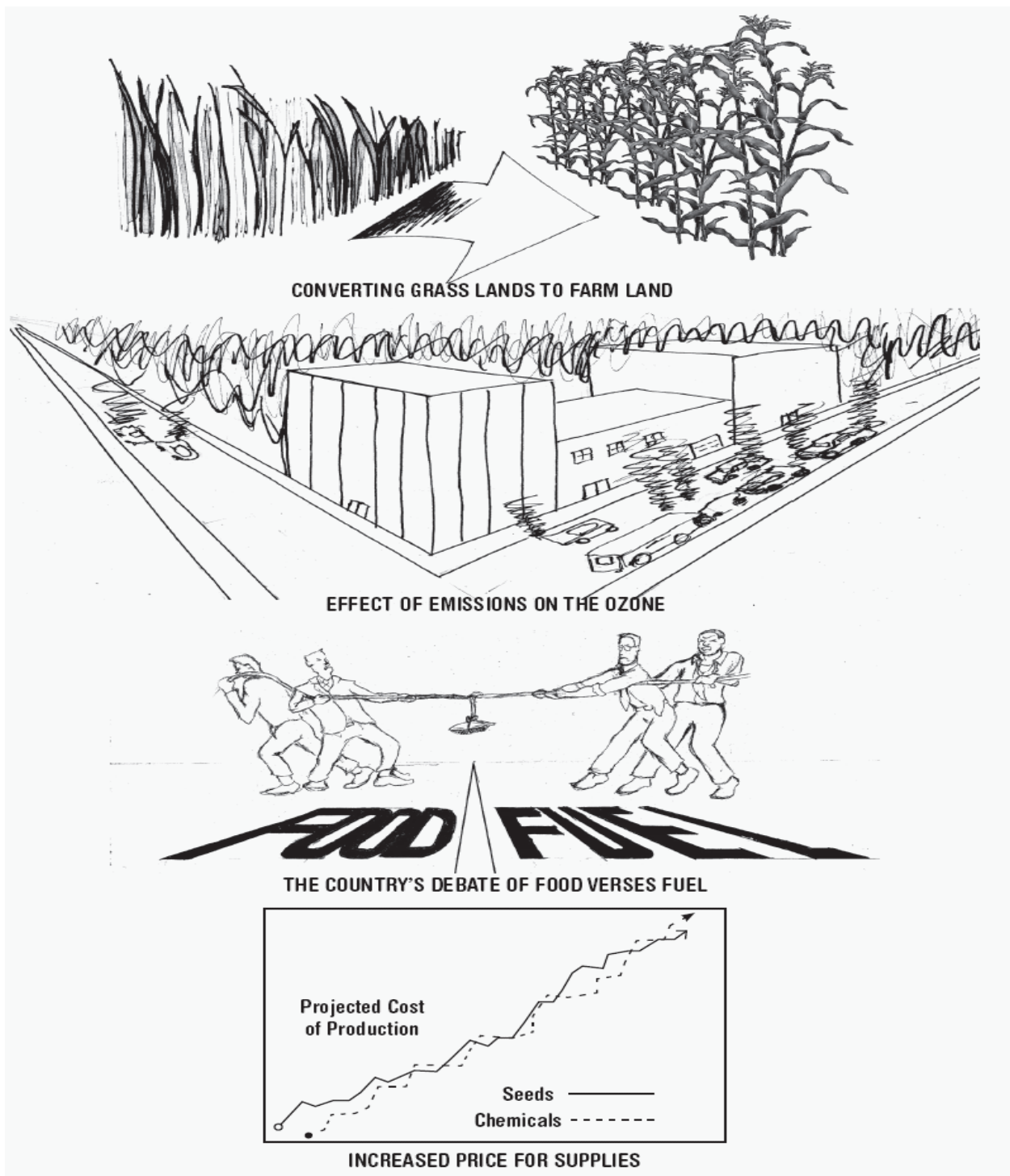
A. Concerns that the need for more corn product will become necessary, in which forest lands and grasslands will be converted to farmland to raise corn, thus allowing for less carbon cycle to occur and greater environmental impacts.

B. There has been no extensive research on the effect of ethanol emissions due to low usage levels to date, but there are serious concerns regarding what large amounts of emissions may have on the ozone.

C. Even though there is a minor impact on the industry with the use of ethanol for fuel, this issue impacts American's views on the 'food vs. fuel' debate.

D. Farmer's enjoy the price increases in local corn prices. As the price/bushel increases so does the supplier's charge for seed and chemicals resulting in higher average costs per acre.

TM.C



AS.A

Ethanol Myth Busters:

Ethanol raises the cost of gasoline.

Ethanol contributes to global warming.

Ethanol harms car and truck engines.

Ethanol production wastes corn that could be used to feed a hungry world.

Ethanol does not benefit farmers.

Ethanol adds to air pollution

AS.B

A. More than \$3 billion has been invested in 60 ethanol production facilities operating in 20 different states across the country.

B. Ethanol will add \$51 billion (1996 dollars) to the U.S. economy. The goods and services purchased by ethanol producers represent increased demand for other industries. These include purchases of grain, natural gas, electricity, water, communications, accounting and legal services.

C. Ethanol contributes more than \$2 billion annually to the U.S. trade balance. The U.S. currently imports 54 percent of its petroleum demand. Use of ethanol reduces the trade deficit by about \$1.3 billion annually by replacing imported MTBE. Another \$800 million is gained annually due to export of the byproducts of ethanol, such as corn gluten feed and gluten meal for livestock consumption.

D. Annual farm income for crop producers will increase \$4.5 billion because of ethanol production.

E. Increased demand for grain grown by American farmers provides market support for prices and incomes.

F. The ethanol industry supports nearly 55,000 jobs. Ethanol production directly accounts for over 5,800 jobs in the food/fuel processing industry in 20 states. Additionally, the spending by ethanol manufacturers on goods and services indirectly supports an average of 48,900 jobs.

G. Ethanol production will increase total household income by \$12.5 billion over the next seven years.

H. The ethanol industry directly pays \$277 million in wages to employees. These employees and their families spend this income, thereby creating demand for other goods and services. The indirect impact of ethanol production adds another \$1.8 billion to household income annually.

AS.C

I. The tax payer benefits through:

1. The partial excise tax exemption for ethanol blends available to gasoline marketers saves money.
2. A GAO study has shown that reduced farm program costs and increased income tax revenues offset the cost of the incentive.
3. According to the USDA, if ethanol use does not continue to grow, “deficiency payments for corn and other program crops will increase.”
4. The economic activity caused by the ethanol industry will generate \$3.5 billion in additional income tax revenue over the next five years.
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3. Ethanol is a high octane blending component used by many independent gasoline marketers- creating competition for the major oil companies.
ETBE is a low volatility oxygenate which provides refiners a cost-effective means to meet Clean Air Amendment standards.
4. Ethanol guards against gas line freeze by absorbing moisture that may get in the tank during cold weather.

Assess.A

Short Answer:

For each of the following myths write two facts that support otherwise.

1. **Ethanol** contributes to global warming.

2. **Ethanol** harms car and truck engines.

3. **Ethanol** production wastes corn that could be used to feed a hungry world.

4. **Ethanol** does not benefit farmers.

5. **Ethanol** adds to air pollution.
