MODULE-18

Ethanol & Petroleum:

Substitute and Complementary Goods

TEACHER'S GUIDE

VISUALS

Visuals for overhead projector.
Copy to transparent paper for overhead.

LESSONS

Copy and hand out to students.

DEFINED

Energy issues are constantly in the news and biofuels are frequently touted as the solution to a number of energy issues. What are the real issues and how do biofuels fit into this story? Energy uses and sources are commonly lumped together and referenced as a single market but this is incorrect. Energy is used for many different purposes. These include home heating, lighting, powering cars, trucks, operating manufacturing plants, and hundreds of other uses. Consumers use different types of energy to meet different needs. A consumer might use natural gas to heat their home while using electricity (produced from coal, natural gas, hydro or wind) to power their lights. The same consumer may use gasoline to operate their car and charcoal to barbeque their dinner. So why do consumers choose to use all of these different types of energy?

CHOOSING ENERGY

The reason a consumer buys anything is that they have a need (demand) for a particular item or for a task that they would like completed. Energy purchases are no different. A consumer interested in heating their house chooses among different energy sources to keep their home heated. A consumer may choose to use natural gas (if they have a natural gas furnace), fuel oil (if they have a fuel oil furnace), wood (if they have a fireplace) or use electric heaters. A consumer's choice is often limited to the type of fuel that their current furnace is capable of using (at least in the short term). Different or additional heating systems can be installed (over longer periods of time) which allows for the use of other energy sources. These different energy sources are all substitute products for the task of home heating.

Substitution is the ability of several different goods (energy sources in this case) to satisfy the same need of a consumer. In some cases the substitute products are very good substitutes (for example: Coke and Pepsi are very similar for quenching one's thirst) while in other cases the substitutes are not as good (for example: Riding a horse and flying on a jet are both ways of traveling but they are not very similar).

Some energy uses have a number of products that are widely available and very easily substituted for one another. Electricity can be generated from natural gas, coal, wind, nuclear, hydro, petroleum, solar, and several other sources of energy. Some other energy markets do not have a wide variety of easily substitutable products. For example, there are few alternatives to gasoline and diesel fuel for powering cars and trucks. Ethanol

and biodiesel are currently the most widely used substitutes for gasoline and diesel. A number of factors influence the ease of which products can be substituted. These factors include infrastructure, availability, price, technology, and others.

A Complement product is a product that is commonly used with another product. A hamburger bun and a hamburger is an example of two complementary products. Gasoline and ethanol are often complementary products because ethanol is blended with gasoline and sold to consumers as a single blended product. Biodiesel and diesel can also be blended together and sold to consumers. The ability of biofuels to be both a substitute for and complement to petroleum products makes biofuels very interesting products.

CONTENT STANDARDS

NATIONAL CONTENT STANDARDS IN ECONOMICS

1. (Standard-1) Productive resources are limited. Therefore, people cannot have all the goods and services they want; as a result, they must choose some things and give up others.
2. (Standard-4) People respond predictably to positive and negative incentives.
3. (Standard-7) Markets exist when buyers and sellers interact.
4. (Standard-8) Prices send signals, provide incentives to buyers and sellers.
5. (Standard-9) Competition among sellers lowers costs and prices, and encourages producers to produce more of what consumers are willing and able to buy.

MONTANA SOCIAL STUDIES CONTENT (STANDARD-5)

1. (Benchmark 1) Identify and explain basic economic concepts.
2. (Benchmark 2) Use basic economic concepts to explain current and historical events.
3. (Benchmark 5) Explain how money is used by individuals and groups.
4. (Benchmark 6) Understand the effects of new technology, global interdependence, competition on individuals, and the development of national policy.

TIME REQUIRED

1-2 class periods

MATERIALS NEEDED

Overhead projector
Transparency pen
Visuals for overhead projector: Copy to transparency.
- Visual-1: EIA Graph on Energy. Available at: www.eia.gov/totalenergy/data/annual/pdf/pecss_diagram_2009.pdf.
- Visual-2: EIA Graph on Imports. Available at: www.eia.gov/totalenergy/data/annual/pdf/sec1_3.pdf.
- Visual-3: EIA Chart. Available at: www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/company_level_imports/current/import.html.
- Lesson assessment.

PROCEDURE

1. To build a basic understanding of energy sources and uses, discuss the following questions:

   Question: How do we use energy? Students should have lots of examples.
   Answer: Home heating, cooking, powering your car, your computer, mp3 player, lights, shipping products to stores, shipping of grain to buyers, manufacturing, products, etc.

   Question: What sources of energy are there?
   Answer: Petroleum products (gas, diesel, propane, fuel oil, etc.); Coal, nuclear, hydro, wind, biomass (wood, ethanol, pellet fuel); Solar, natural gas, geothermal. Key point: Electricity is not an energy source. A battery is not an energy source. Hydrogen is not an energy source. These are methods of using or storing energy produced from energy sources.

   Question: What types of energy can be used for transportation (cars, trucks, trains, planes, boats)?
   Answer: Petroleum products (gasoline, diesel, propane) account for 94% of transportation fuels. Alternatives products (ethanol, biodiesel,

natural gas) account for 6% of transportation fuels. View 👁 Visual-1: EIA Graph on Energy, to highlight the importance of petroleum products as our main source transportation fuels.

2. To start thinking about energy choices, discuss the following questions:

   Question: What should the goal of US energy policy?
   Answer: Low cost energy, environmentally friendly energy, reduce energy imports, reliable energy supply (no shortages or blackouts), small scale energy production, energy conservation, local energy sources, other goals? Key points: Energy is a complex issue and different people have different views of what is the best policy. Policy choices inherently involve trade-offs. For example, if the cheapest energy source is least environmentally friendly then policy makers must decide choose between cheap and environmentally friendly. Every type of energy has positive and negative attributes. There is no single "perfect" energy source that satisfies all our needs.

   Question: What alternatives do individuals have to reduce their use of gasoline and diesel?
   Answer: Walk, car pool, bike, mass transit, drive a more fuel efficient car, travel less, drive a natural gas car, buy 85% ethanol and 15% gasoline *(E85), use biodiesel, drive an electric car. What trade-offs are associated with these options? Buying a different or additional car capable of using an alternative fuel like natural gas can be expensive. Will it be difficult to find a natural gas refueling station? Does your town have a bus or train system? Will it take more time to arrive at your destination if you walk? Is riding a bike a good substitute? How about in January or July?*

   Question: What alternatives do law makers have to reduce gasoline and diesel use?
   Answer: Incentives, taxes and regulatory options: Offer free bus passes; build more bike lanes; offer more passenger train destinations; mandate that all new cars be more fuel efficient that older cars; fund research into alternative fuels; pay companies to produce ethanol and biodiesel; require that all gasoline contain some ethanol; require that all cars be able to use E85 fuel; raise the current excise taxes on gasoline and diesel; increase crude oil production taxes; tax

imported gasoline, diesel and crude oil; and tax vehicle that have poor fuel efficiency. Do the students think the "carrot" approach (incentives) is better than the "stick" (taxes or regulations) approach? What would they do if they were law makers?

Question: Does the US import a large percentage of its' energy needs?
Answer: View both Visual 2: EIA Graph on Imports, and Visual-3: EIA Chart. There are two keys points in both of these graphs. First, in 2009 the US imported roughly 65% of its' petroleum consumption. Second, the US imported about 3% of all other energy consumed in the US. Many people think the US imports most of its' petroleum from the Middle East but in fact the top importers of petroleum to the US are Canada and Mexico (although in some months Mexico is the third leading importer). Many people think the US imports large quantities of all types of energy but in reality the only significant imports of energy to the US are petroleum products. Review economic learning Module-3: Exchange and Trade for more information on trade.

3. Let us now examine how biofuels are consumed in the US and how some of the rules and regulations have shaped current biofuels markets.

ETHANOL: A SUBSTITUTE AND COMPLEMENT TO GASOLINE

Most gasoline engines were designed to operate at their maximum based on a fuel that met specific technical standards. Four different octane levels (85.5, 87, 88, and 91) of gasoline are offered at most service stations. Different engine manufacturers recommend the optimal fuel for a particular engine. Pure gasoline (before any additives are added) often has an octane level that is below 87 octane. Refiners use additives to bring the fuel octane level to one of four common levels. In the 1980s (and before) lead was commonly used as an additive to increase the octane of gasoline. The use of lead was phased out due to environmental concerns. A different additive methyl tertiary-butyl ether (MTBE) was commonly used as a substitute for lead to increase the octane of gasoline. More recently another substitute (ethanol) has been used to increase the octane of gasoline. Lead, MTBE, and ethanol are all substitute products for increasing the octane of gasoline. Gasoline and one of these three products are blended together (often 90% to 95% gasoline and 5%

to 10% of an additive) and sold as a single product. Gasoline and these additive products are complement products.

Some gasoline engines were designed to operate on either gasoline or E85. The E85 fuel is a substitute for traditional gasoline (containing less than 10% ethanol). Ethanol and gasoline are complement products—for both 10% ethanol and 90% gasoline (E10) and E85 blends. However, if more consumers switch to E85 from traditional gasoline then the demand for gasoline will decline (because they are purchasing a 15% gasoline blend instead of a 90% gasoline blend). The demand for ethanol will increase if consumers increase their use of E85. In this sense, E85 and gasoline are substitute products.

EFFECTS OF RULES AND REGULATIONS:

FUEL ADDITIVE REGULATIONS

Consumers of gasoline are interested in buying fuels that meet the technical specifications of the vehicle's engine. Producers of gasoline are interested in manufacturing the fuels demanded by consumers at the lowest cost while complying with applicable rules and regulations. As mentioned previously, there have been three different additives to gasoline that have been commonly used to increase the octane of gasoline. With no rules or regulations in place, a refiner choice of additives (lead, MTBE, or ethanol) would largely be dependent on the price of the competing additives. However, rules and regulations have essentially prohibited the use of lead as an additive. This limits the choices that refiners' have to increase the octane of the fuel. Some states have also prohibited the use of MTBE as an additive. In these states, refiners primarily use ethanol as an additive to boost the octane. The restrictions on lead and MTBE have increased the demand for ethanol.

THE BLEND WALL

Engine manufactures are required to demonstrate that the emissions from their engine meet current Environmental Protection Agency (EPA) standards. The EPA tests the emissions of the engine while it is operating of the fuel it was designed for. In most cases this fuel is at least 90% gasoline. Based on the results of these tests the EPA certifies that the engine meets the emissions standards when operated on the correct fuel. Refiners are aware of these tests and generally only sell gasoline that contains 90% or more gasoline. Refiners are allowed to blend the fuel at any level between 0% and 10% ethanol. The 10%

blend level is often referred to as the "blending" wall because it is the maximum ethanol blend that meets these requirements.

In late 2010 and early 2011 the EPA completed additional emission testing for a number of newer (2001 and newer) engines that were originally tested on fuel with 10% or less ethanol. These additional tests used a 15% ethanol blend. The EPA now allows up to 15% ethanol blends for these newer vehicles. This technically increases the blend wall to 15% for newer vehicles. However to increase the blend wall, retail fuel locations need to either convert an existing fuel storage tank and pump from traditional gasoline or add another storage tank and pump to offer this new product. Many retail fuel locations may be hesitant to switch their current E10 pumps to E15 due to concerns about the loss of fuel sales to customers with vehicles older than 2001. Other retail fuel locations may be concerned about the cost of adding additional pumps and storage tanks for this new product. It is unclear how many retail stations will offer this new product.

FLEX FUEL VEHICLES

Some newer engines were tested by the EPA with both gasoline E10 and E85 fuels. These engines are referred to as flex fuel vehicles. The owners of these vehicles can choose whether to purchase traditional gasoline or E85 fuel. The consumer may consider fuel price and availability when considering which fuel to purchase. Flex fuel vehicles have been available for over a decade yet less than 1% of all ethanol produced is sold as E85 fuel. The cost of installing additional storage tanks and pumps is a significant a factor that is limiting the number of retail fuel locations that offer E85.

CURRENT SUPPLY AND DEMAND

The quantities and prices for energy products (including biofuels) are determined by the supply and demand for each energy product. (Refer to *Module-9: Market Equilibrium* for more information on market prices and quantity.)

As indicated in the Market Equilibrium Graph (page 572), producers are willing to produce different amounts of biofuels at different prices levels. Consumers are willing to purchase different amounts of biofuels at different prices. The point at which the supply curve and demand curve meet is the market clearing price (P*) and quantity (Q*). In the absence of all policies and regulations this would be the amount and quantity of biofuels produced.

IMPACT OF GOVERNMENT POLICIES

PRODUCTION SUBSIDY

Ethanol producers are currently eligible for a $0.45 per gallon production subsidy by the federal government. With a subsidy in place, the biofuel producer receives the market price plus the amount of the subsidy for each gallon of biofuel produced. This subsidy effectively shifts the supply curve to the right of the original supply curve by the amount of the subsidy.

As noted on Market Equilibrium with Production Subsidy Graph (page 572), this increases the market equilibrium quantity (from Q* to Q**) and decreases the market equilibrium price (from (P* to P**). The cost to the taxpayers of this subsidy is the amount of the per gallon subsidy ($0.45) multiplied by the quantity of produced. This policy has increase the quantity of ethanol produced and decreased the price of ethanol. Ethanol production in the US was approximately 13 billion gallons in 2010. The $0.45 ethanol production subsidy cost nearly $6 billion.

Biodiesel is eligible for a $1.00 per gallon incentive by the federal government. Biodiesel production in the US was approximately 300 million gallons in 2010. The $1.00 per gallon incentive cost around $300 million dollars.

RENEWABLE FUELS MANDATE

Federal lawmakers have also mandated that minimum amounts of biofuels be consumed each year. The EPA translates the overall mandate into a percentage of total fuel sales for each individual petroleum refiners and importers. The refiners must meet the percentage set by the EPA or pay a fine for not complying with the rule.

The minimum amount required by the renewable fuels mandate has been increasing over the past few years. A few years ago the minimum quantity required by the federal mandate was less than the amount of biofuels that were being sold in the US at that time. This situation is represented by the Low Mandate Graph (page 573).

When the mandate level is below Q*, the mandate has no effect on the price or quantity of biofuels produced and sold. This was the case in 2006 and in 2007 in the US. The mandate increases each year until 2022. (Minimum Renewable Fuels Mandate Graph, page 574)

As these mandated levels increase the quantity required by this policy will likely exceed Q*. This is expected to be the situation in 2011 (High Mandate Graph, page 573).

Suppliers of biofuels are willing to produce the higher quantity of ethanol but only if the price increases from P* to P**. Consumers are also willing to consume this higher amount of ethanol but only if the price falls to P***. In this case when the quantity is not allowed to adjust to the market equilibrium quantity, then enforcement of this policy will require intervention by some regulatory agency. In this case, the producers of gasoline are required to blend a certain percentage of their gasoline production with ethanol. If they fail to meet this percentage then they are assessed a fine for each gallon they fail to purchase. The gasoline producer is the consumer of ethanol in, Ethanol as a Percent of Gasoline use Graph, (page 574). As a consumer they are willing to pay any price for the ethanol that is below their demand curve at any given quantity. In this example, this amount is not sufficient to comply with the mandate. The gasoline producer has two choices. One option is to pay the fine on the difference between the mandated quantity and the market equilibrium quantity. The fine would be based on the quantity defined by Q High less Q* in the High Mandate Graph (page 573). Another option is to pay P** for the quantity of biofuels mandated under the regulation. Gasoline producers will choose the least expensive of these options. Depending on the gasoline producer's situation they may or may not utilize a higher quantity of biofuels.

BLEND LEVEL ISSUES

The ethanol mandate increases each year until 2022. As this mandate increases the amount of ethanol then the blend level with gasoline will eventually exceed 10% level.

As indicated earlier, EPA regulations prohibit most engines from operating on ethanol blends in excess of 10% or 15%. In 2011 or 2012 the "blend wall" may pose a very significant technical hurdle for meeting the renewable fuels mandate. If most vehicles on the road are not capable of using ethanol blends higher than E10, how will the mandate be satisfied? One option is to encourage or require the owners of the approximately 7 million flex fuel capable vehicles to use more ethanol. These 7 million vehicles represent only 2.7% of the 255 million vehicles in the US . Nearly 143 million vehicles have been sold since 2001. Many of these 143 million vehicles would be eligible to use E15 based on the new EPA regulations. Even though the US may have enough E85 and E15 capable vehicles it is not clear that these owners will have access to E15 and E85 fuels. It is also not clear

if these owners will choose to purchase the higher ethanol blends. The renewable fuels mandate also provides the authority for the EPA to lower the mandate under certain circumstances.

THE FUTURE OF BIOFUELS

Significant changes for biofuel producers and consumers have taken place in the past decade and the next decade could be even more interesting. Government policy has played a very important role in biofuel markets. Government policies can change and the implications for biofuel consumers, producers and tax payers may be considerable. Understanding and critically thinking about biofuels will be a valuable skill for years to come.

DISCUSSION QUESTIONS:

Question: Would you rather that congress use a subsidy or a mandate to increase the use biofuels?

Answer: There is no simple correct answer. A subsidy has a direct cost to the government (taxpayers). A mandate effectively raises the market price which results in consumers paying for the cost of mandate.

Question: Should US taxpayers' subsidize biofuels?

Answer: The best answers will likely discuss that benefits to the US are higher than the cost of the subsidy. The benefits could come from improved air quality, reduced water quality issues from (MTBE) use, more reliable fuel supply for national security reasons, economic development in the US for biofuel production and benefits.

Question: Will consumers buy E85 or E15 if it is available?

Answer: Many flex fuel vehicles are not operated on E85 fuel. This could be due to a consumer's personal choice or due to lack of E85 refueling opportunities in their area. Currently, there are very few retail fuel stations that offer E15, so it is difficult for consumers to purchase E15 even if they want to. It also isn't clear if E15 will eventually replace E10 or if it will be sold as an additional product (much in the same way E85 is sold).

LESSON OUTLINE

LESSON-I: NOT ALL ENERGY SOURCES ARE EQUAL

1. Put students into groups of 2 to 4.
2. Assign each group make a list of the energy sources that can be used for a particular task. Group assignments: Electricity generation, transportation (cars, trucks, trains, and airplanes), building heat, lighting.
3. Question: Ask each group to list the good and bad aspect of each item on their list. Responses might include: Hydroelectric power plants are good, but you have to be near a river. A small gasoline generator is expensive to operate but can be taken to a construction site without electrical service.
4. The goal of this exercise is twofold.
   a. Encourage students to think about and understand that different energy sources have different attributes. Some energy sources are very good for home heating or lighting but are not as useful for powering a car. No single energy source is best for all of the different uses for energy.
   b. Help students recognize that some energy uses have numerous "good" substitute energy sources while others have very few "practical" substitute energy sources. For example, there are numerous options to generate electricity (coal, petroleum, natural gas, hydro power, solar, wind, nuclear and biomass) or to heat a home (electricity, natural gas, coal, wood or fuel oil). Transportation fuels have very few practical substitute products (petroleum products, natural gas and biofuels).

LESSON-II: ETHANOL AS A SUBSTITUTE AND A COMPLEMENT

1. Question: Ask students to share an example of substitute products.
   a. Examples: Soda or juice, pizza or a hamburger, bike or car
2. Question: Ask students to share an example of complementary products.
   a. Examples: Hamburger and a bun, car and car tires, basketball and a basketball hoop

3. Share with students the role of octane boosting additives (lead, MTBE and ethanol) to gasoline (see procedure section for background on this issue) to show how these products are complements to gasoline. Also point out that blends of more than 10% of any of these products do not continue to improve the product.
   a. Question: Ask students if they feel these additives are substitutes or complements to gasoline? They should point out that they are complements at blend levels below 10%.
   b. Question: Ask if these additives substitutes or complements to the other additives? They should identify that the three additives are substitutes for each other.
4. Share with students the concept of E85 (see procedure section for background on this issue).
   a. Question: Ask students if ethanol is a substitute or a complement at an 85% blend level?
      i. Ethanol is both a substitute and a complement to gasoline. Blending of gasoline beyond the level needed to boost octane is "competing" with gasoline as a substitute product. Blend below 10% is clearly a complement product.
5. The goal of this exercise is help students think in more depth about the definitions of substitute and complement products.

LESSON-III: SUBSIDIES AND MANDATES

MATERIALS:
Market Equilibrium Graph (page 572)
Market Equilibrium with Production Subsidy Graph (page 572)
Low Mandate Graph (page 573)

1. Show students the basic supply and demand graph (Market Equilibrium Graph, page 572). Point out that based on supply and demand for a given product an equilibrium price and quantity are reached.
2. Policy makers at times would like to increase the equilibrium quantity of a particular product. Question: Ask students why a policy maker would want to increase the quantity of a product produced.

a. Reasons cited by policy makers often include: Environmental benefits, job growth, increase domestic production to reduce the amount imported or a variety of other reasons

3. Policy makers typically increase the equilibrium quantity through the use of a subsidy or a mandate.
   a. Explain how a subsidy works: A subsidy in a simple form is a payment to the producer of a good for each unit that they produce. For example: A car company receives a payment from the government of $500 for each car they produce. Show students the Market Equilibrium with Production Subsidy Graph (page 572). This will help them visualize the increase in the equilibrium quantity and the reduction in the equilibrium price (to consumers). Point out that this subsidy costs the government money (Q** multiplied by the amount of per unit subsidy).
      i. Question: Ask students who pays for a subsidy? The government (tax payers)
   b. Explain how a mandate works: A mandate is a requirement that producers of a product must use a minimum amount of a particular product. In most cases a fine is imposed for not complying with the mandate.
      i. Show students the Low Mandate Graph (page 573). In this case the government mandated level is below the original equilibrium quantity. Because the mandated level (Q Low) is below the market equilibrium quantity the mandate has no effect on the equilibrium quantity or price.
      ii. Show students the High Mandate Graph (page 573). In this case the government mandated level is above the original equilibrium quantity. In order to meet this mandate, suppliers will need to increase production. At this increased quantity (Q High) buyers are willing to pay P***. Suppliers are only willing produce at the new level if the market price is P**. Because the price buyers are willing to pay is less than price suppliers are willing to accept, the only way for this new quantity to be reached is force buyers to pay more or to force suppliers to accept less. In the long run, suppliers will go out of business if they are forced to accept prices below their cost of production. As a result, buyers end up paying a higher price to achieve this mandated quantity.

iii. Question: Ask student who pays for a mandate? Buyers.

c. Question: Ask students if a subsidy or a mandate is a better way to increase the equilibrium quantity?

i. Both methods have trade-offs.

4. The goal of this lesson is to help students understand that both subsidies and mandates can affect the equilibrium quantity and price but both methods have a cost.

ASSESSMENT

QUESTIONS

1. Question: True or false
   Substitute products are different products that can accomplish the same task.

2. Question: Which of the following products is not commonly used as a transportation fuel?
   a. Gasoline
   b. Ethanol
   c. Diesel
   d. Coal

3. Question: True or false
   The U.S. imports over half of all of energy used in U.S. each year.

4. Question: The effect of ethanol production subsidies will?
   a. Increase the quantity of ethanol produced.
   b. Decrease the quantity of ethanol produced.
   c. Does not change the quantity of ethanol produced.

5. Question: A flex fuel vehicle is only capable of using which fuels?
   a. E85 (85% ethanol, 15% gasoline)
   b. E10 (10% ethanol, 90% gasoline)
   c. E100 (100% ethanol)
   d. A and B
   e. A, B, and C

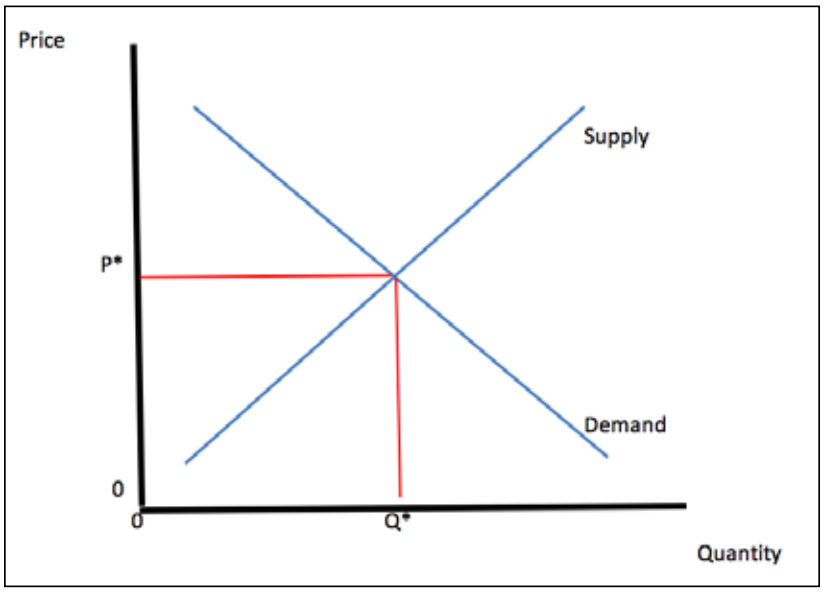
6. Question: An ethanol production subsidy of $0.50 per gallon will?
   a. Increase the price of ethanol by $0.50
   b. Increase the amount of ethanol produced
   c. Decrease the amount of ethanol produced
   d. Not affect the amount of ethanol produced

7. Question: In economic terms, ethanol and gasoline are?
   a. Complement products
   b. Related products
   c. Unrelated products

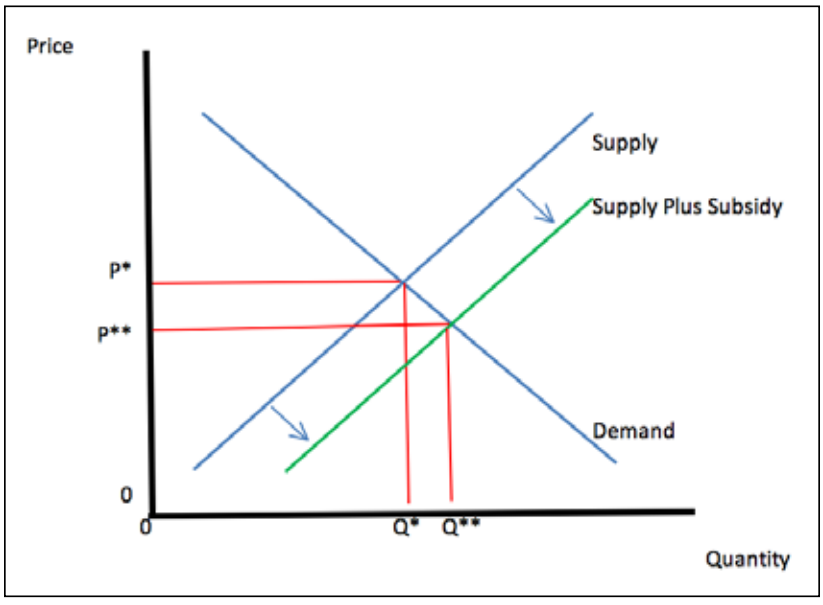
ANSWERS:

1. *True*
2. *D*
3. *False*
4. *A*
5. *D*
6. *B*
7. *A*

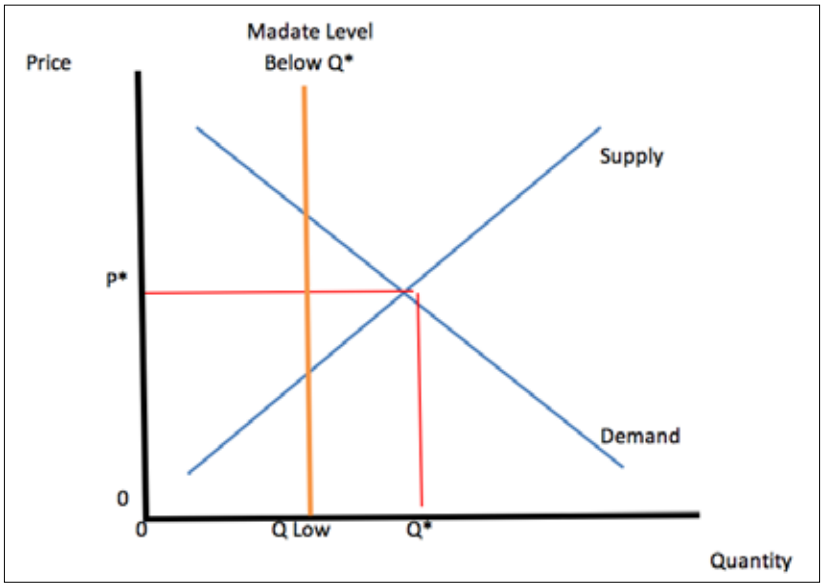
MARKET EQUILIBRIUM



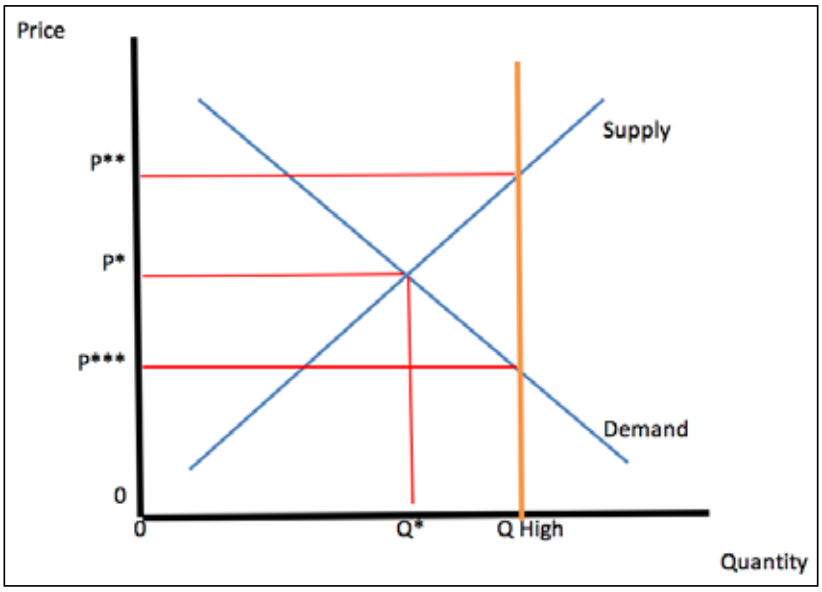
MARKET EQUILIBRIUM WITH PRODUCTION SUBSIDY



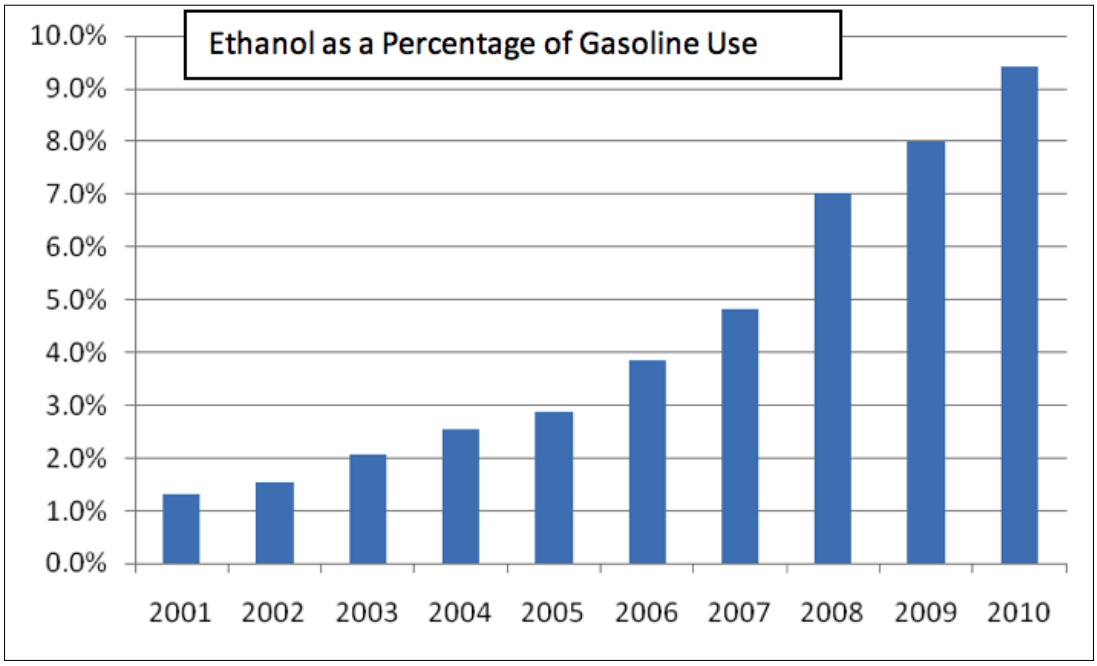
LOW MANDATE



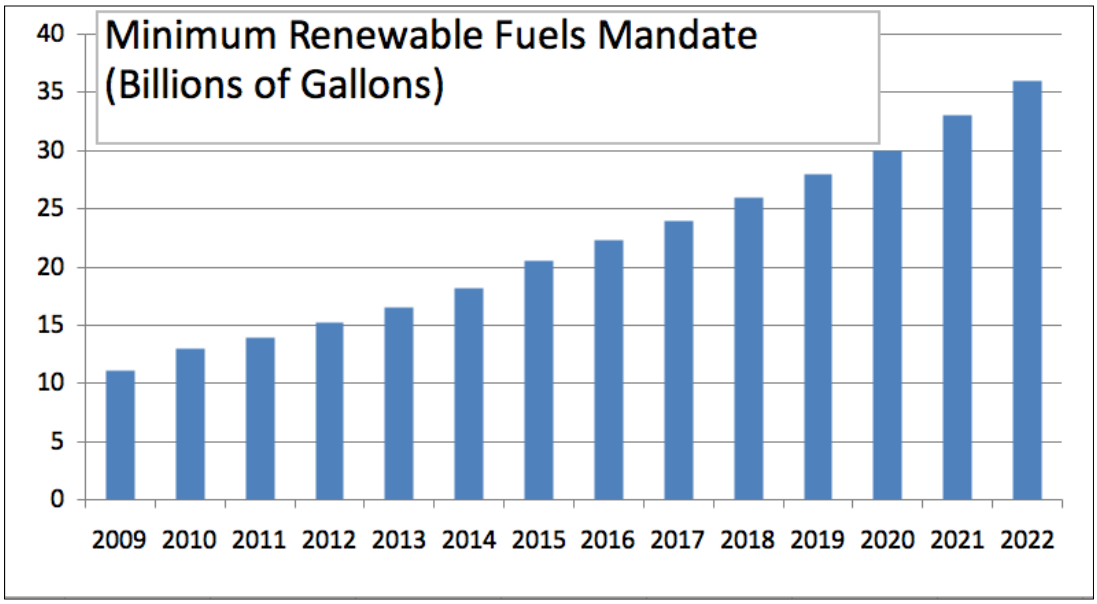
HIGH MANDATE



ETHANOL AS A PERCENTAGE OF GASOLINE USE



MINIMUM RENEWABLE FUELS MANDATE (BILLIONS OF GALLONS)

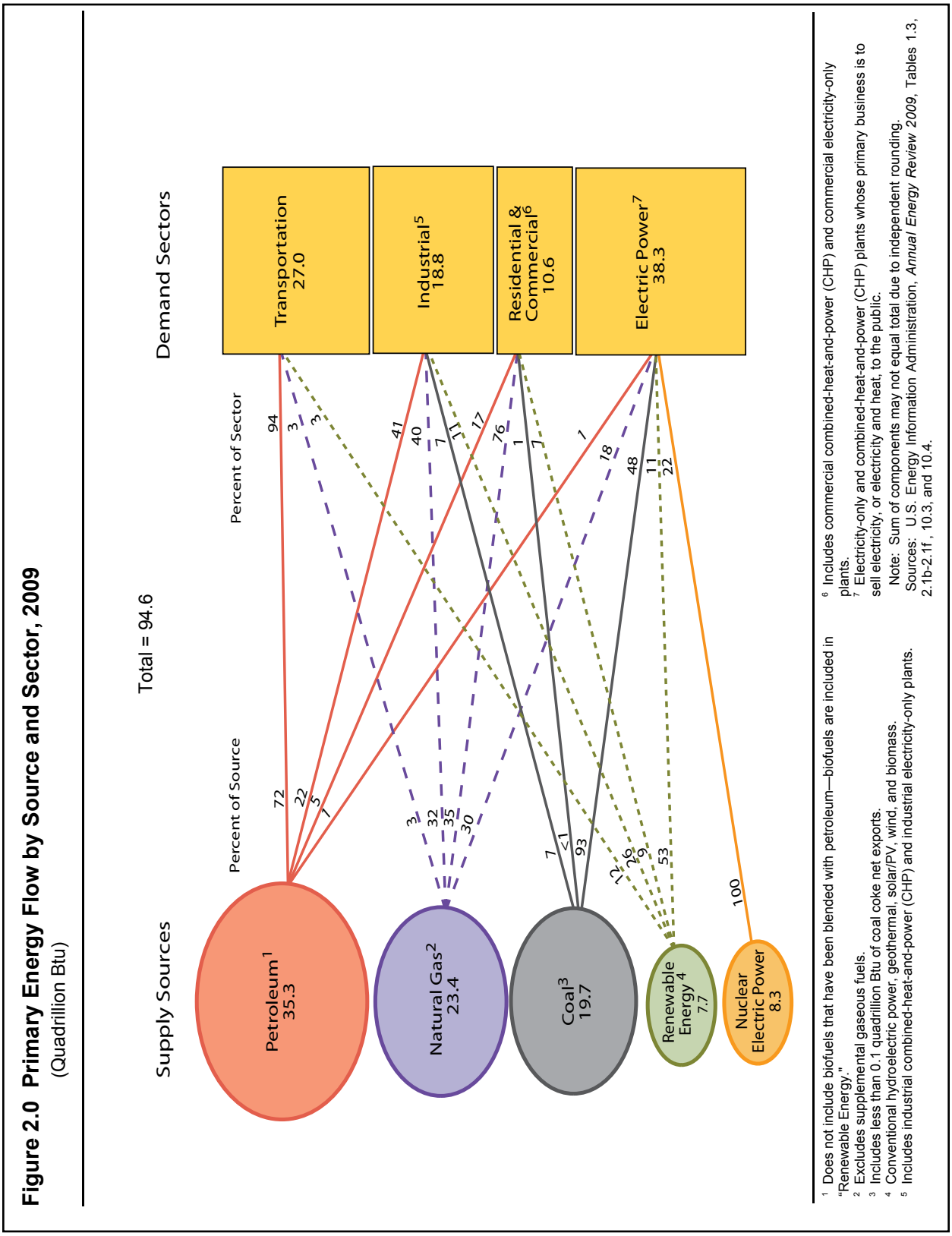


MODULE-18

Overhead Visuals

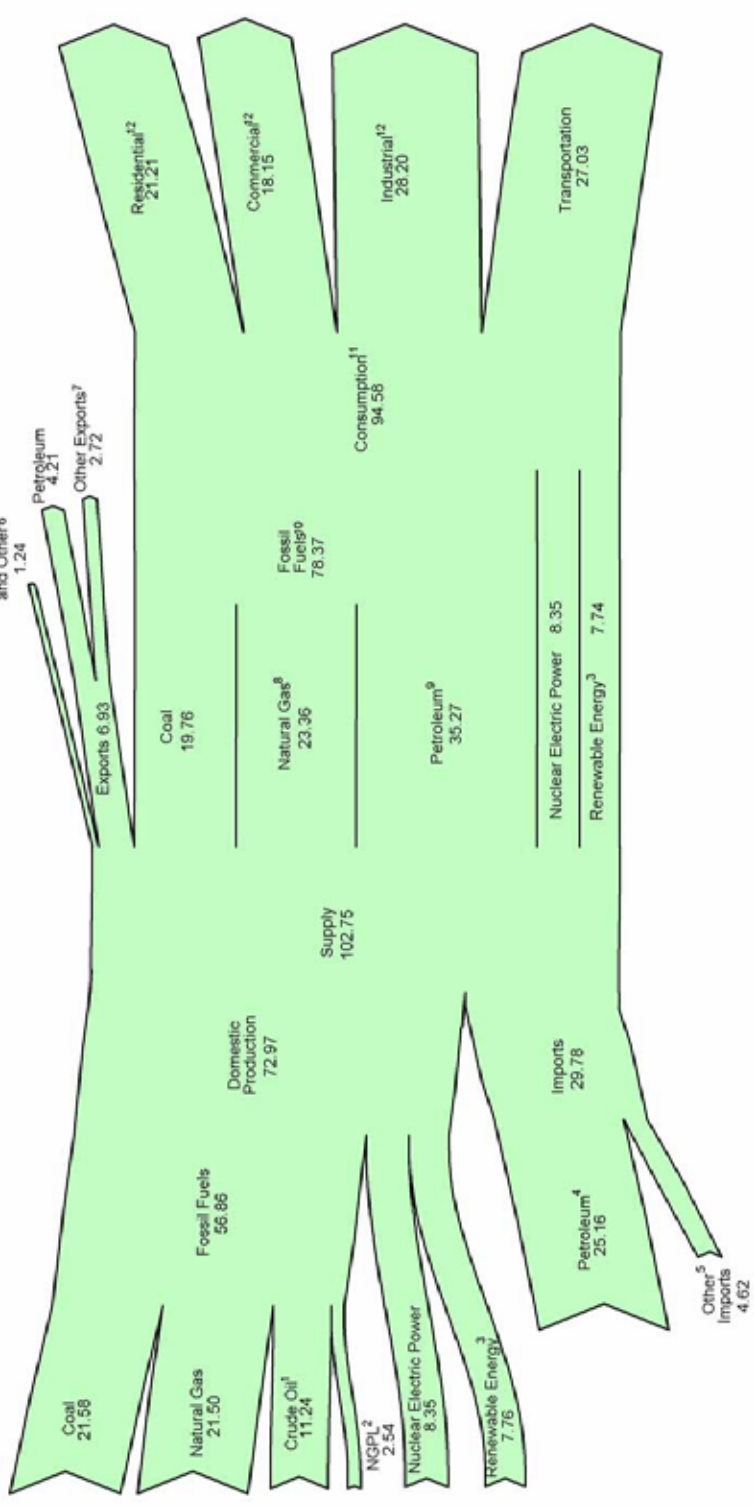
ETHANOL & PETROLEUM

VISUAL-1: EIA GRAPH ON ENERGY



VISUAL-2: EIA GRAPH ON IMPORTS

Figure 1.0 Energy Flow, 2009
(Quadrillion Btu)



[1] Includes lease condensate.
[2] Natural gas plant liquids.
[3] Conventional hydroelectric power, biomass, geothermal, solar/photovoltaic, and wind.
[4] Crude oil and petroleum products. Includes imports into the Strategic Petroleum Reserve.
[5] Natural gas, coal, coal coke, biofuels, and electricity.
[6] Adjustments, losses, and unaccounted for.
[7] Coal, natural gas, coal coke, electricity, and biofuels.
[8] Natural gas only; excludes supplemental gaseous fuels.
[9] Petroleum products, including natural gas plant liquids, and crude oil burned as fuel.
[10] Includes 0.02 quadrillion Btu of coal coke net exports.
[11] Includes 0.12 quadrillion Btu of electricity net imports.
[12] Total energy consumption, which is the sum of primary energy consumption, electricity retail sales, and electrical system energy losses. Losses are allocated to the end-use sectors in proportion to each sector's share of total electricity retail sales. See Note, "Electrical System Energy Losses," at end of Section 2.

Notes: • Data are preliminary. • Values are derived from source data prior to rounding for publication. • Totals may not equal sum of components due to independent rounding.

Sources: Tables 1.1, 1.2, 1.3, 1.4, and 2.1a.

VISUAL-3: EIA CHARTS

Crude Oil Imports (Top 15 Countries)
(Thousand Barrels per Day)

Country	Mar-11	Feb-11	YTD 2011	Mar-10	YTD 2010
CANADA	2,151	2,193	2,163	2,020	1,934
MEXICO	1,186	998	1,138	1,086	1,040
SAUDI ARABIA	1,107	1,114	1,107	1,149	1,000
VENEZUELA	957	878	930	984	908
NIGERIA	840	948	918	939	945
IRAQ	382	263	375	475	506
COLOMBIA	363	175	284	216	291
RUSSIA	314	97	174	248	199
ALGERIA	268	138	265	276	296
ANGOLA	261	357	302	490	358
KUWAIT	161	118	143	218	169
BRAZIL	158	175	198	299	256
ECUADOR	142	242	186	183	182
NORWAY	100	21	41	5	9
UNITED KINGDOM	88	0	42	142	177

Total Imports of Petroleum (Top 15 Countries)
(Thousand Barrels per Day)

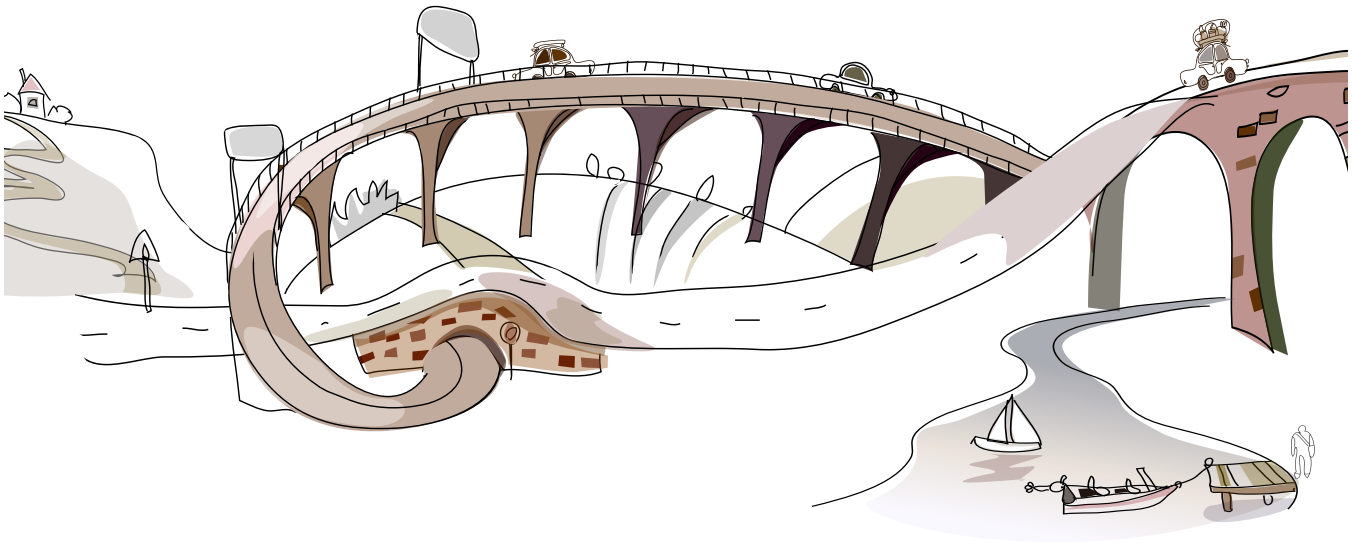
Country	Mar-11	Feb-11	YTD 2011	Mar-10	YTD 2010
CANADA	2,666	2,831	2,773	2,517	2,535
MEXICO	1,319	1,104	1,269	1,265	1,178
SAUDI ARABIA	1,108	1,114	1,108	1,149	1,007
VENEZUELA	1,067	989	1,030	1,061	993
NIGERIA	913	978	966	962	970
RUSSIA	690	437	556	488	459
ALGERIA	500	394	489	455	472
COLOMBIA	399	211	318	251	318
IRAQ	382	263	375	475	506
ANGOLA	280	370	320	502	371
UNITED KINGDOM	197	110	155	267	318
BRAZIL	161	177	205	302	296
KUWAIT	161	118	143	218	173
NORWAY	156	69	104	59	94
VIRGIN ISLANDS	149	182	203	228	243

MODULE-18

LESSON WORKSHEETS

ETHANOL & PETROLEUM

LESSON: ASSESSMENT



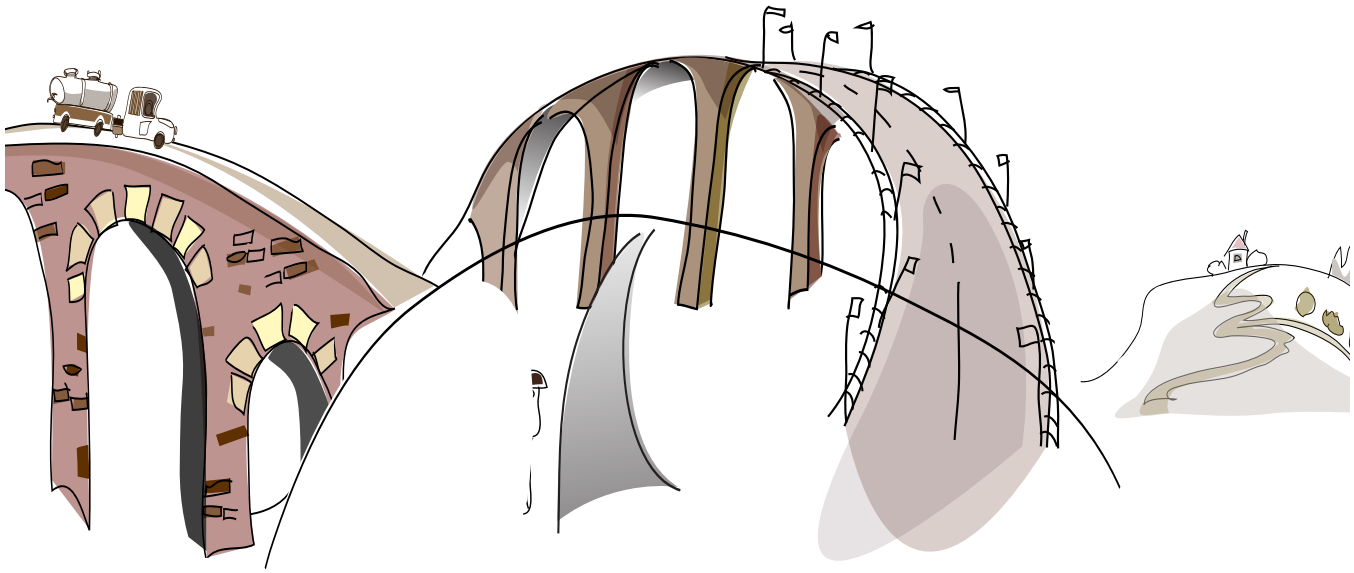
1. Question: True or false
   Substitute products are different products that can accomplish the same task.

2. Question: Which of the following products is not commonly used as a transportation fuel?
   a. Gasoline
   b. Ethanol
   c. Diesel
   d. Coal

3. Question: True or false
   The U.S. imports over half of all of energy used in U.S. each year.

4. Question: The effect of ethanol production subsidies will?
   a. Increase the quantity of ethanol produced.
   b. Decrease the quantity of ethanol produced.
   c. Does not change the quantity of ethanol produced.

LESSON: ASSESSMENT



5. Question: A flex fuel vehicle is only capable of using which fuels?
   a. E85 (85% ethanol, 15% gasoline)
   b. E10 (10% ethanol, 90% gasoline)
   c. E100 (100% ethanol)
   d. A and B
   e. A, B, and C

6. Question: An ethanol production subsidy of $0.50 per gallon will?
   a. Increase the price of ethanol by $0.50
   b. Increase the amount of ethanol produced
   c. Decrease the amount of ethanol produced
   d. Not affect the amount of ethanol produced

7. Question: In economic terms, ethanol, and gasoline are?
   a. Complement products
   b. Related products
   c. Unrelated products

NOTES