

National Farmers Union

*“Renewable Energy:
Sustainable, Responsible, Affordable”*

Adult

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Lesson 2: When It Comes To Fossil Fuels, We Are Running Out Of Time

Unit Objective: Adults will consider the cost of relying on fossil fuels and what happens if we delay the adoption of renewable fuels.

Grades: Adult

Length: 2 hours.

Materials Needed: A white board, enough printed copies of **We Are Running Out Of Time, Your Assignment, We Are Still Running Out Of Time, The Q&As Of Climate Change,** and **Your Next Assignment** worksheets.

Preparation Needed: A standard classroom setting, preferably using round tables. Although this lesson can be taught with printouts, it will be more effective if you have a computer connected to the Internet and a projector.

Background: There are many good reasons to invest in developing different sources of renewable energy. The progress of civilization is founded on the cornerstones of abundant supplies of food and energy. Investments in technology and science have extended lifespans and advanced societies from merely surviving to thriving. The bottom line is fossil fuels are limited in supply and cause significant environmental damage. While fossil fuels will be a leading source of energy for the next generation, it will have to be replaced with other forms of energy. This transition could be planned and phased in with minimal disruption, or it could be abrupt and cause problems far worse than those during the energy crisis of 1973 and again in 1979. As transportation accounts for a large portion of America's consumption of energy, it makes sense to further develop biofuels for use in cars and trucks.

Teaching Strategy

1. Write the number "1940" in large letters on a white board. Beside it write the number "1970", also in large letters. And then write "400" and "Florida" and "RFS." *This may look like a puzzle that needs to be decoded. In fact, these are benchmarks of where we have been and predictions of where we are going when it comes to energy use in America.*
2. *Consider this, Niagara Falls looks fundamentally the same as it did last year. Yet it has receded seven miles in the past 12,000 years and looks much different than it did just 200 years ago. At the current rate, the U.S. side of the falls will dry up in 2,000 years and the remaining falls will run into much softer rock in 12,000 years allowing it to recede at an even greater rate. For the record, the Great Lakes are filled with fossil water left from melting glaciers. These lakes have not drained off due to the great depth of the lakes, with Superior itself having depths of more than 1,300 feet.*
3. *Of course, when Niagara Falls receded far enough to reach the end of Lake Erie, it could release a torrent of water that will radically reshape the Saint Lawrence Seaway. What does this have to do with renewable fuels? Consider this: No one questions the science behind Niagara Falls' past actions and future course of action. Geologists and hydrologists can examine the historic physical evidence and, like a crack CSI team, know what really happened, when it happened, and why. From this, they can determine what will eventually happen if nothing changes. Niagara Falls will cease to exist. Lake Erie will drain into the St. Lawrence Seaway and the immense flow of water will forever change the boundaries between Canada and the U.S., regardless of what we as humans do, and regardless of what we want to believe should happen. Of course, we can and have been able to control the flow over the falls to reduce the erosive action and thus slow down the timeline. Climate change is no different, yet many people question the scientific proof. Why do some people refute the facts and reject the obvious until it is too late?*
4. *This question brings us to 1940. Let's consider this using an example of how we have come to expect science to tell us about future. On November 11, 1940, temperatures were well above normal across the Midwest. Back then, people got their weather forecasts from newspapers, or possibly by radio, which was not yet in widespread use in rural areas. A few days earlier, a strong storm system approaching the Pacific Northwest produced winds that caused the Tacoma Narrows bridge to collapse. I am sure many of you have seen the old black and white film of this bridge wobbling in the wind*

until it broke apart. As this was the Armistice weekend, a holiday, and the weather was unseasonably warm, duck hunters were out in large numbers across the Upper Midwest. The storm that days earlier caused damage in Tacoma had swung south across Colorado and was moving up over Iowa and into Wisconsin. In just hours the warm weather turned to rain, sleet, and snow. Temperatures fell to just above zero. More than 150 people, many of them hunters not prepared for winter weather, froze to death or drowned as 80 mile an hour winds swamped their boats. In the Dakotas, snowdrifts up to 20 in depth blocked roads and buried cars. The storm hammered Minnesota and Michigan, Iowa and Illinois. Rapidly shifting winds broadsided large ships on the Great Lakes, causing some to sink, others were grounded on purpose by crews in an effort to survive. Much of the population was unaware of the danger and uninformed of the rapidly moving system.

5. *Pause. Remember, this was a holiday. Schools were closed. Many farm families took advantage of the weather and drove into their hometowns for the day. The only warning they had was when the weather quickly took a turn for the worse. Many of these families attempted to drive home in the storm. They had primitive cars, poor roads and they were not dressed for winter weather. In effect, they had no warning at all. Many became lost in the zero visibility and wound up stranded. One story is told of a family that did make it home only to have a young girl get lost in the blinding snow as she tried to find the front door. People could hear her voice calling out for help but they not see her. Today this seems impossible. We have learned a lot about weather forecasting. We have learned to trust weather watches and warnings. In 1941, no one saw the big picture; they only reacted to what was happening a few feet to a few miles in front of them.*
6. *This storm revealed the need for greatly improved national and regional weather forecasting and finding better ways to inform the public. No one person or company could handle the task, let alone collect, analyze, and distribute this information. Only the federal government has the resources to make this happen. Today, we all rely on the National Weather Service, whose investment in science has vastly increased public safety. Thanks to the National Weather Service, tornado warnings have gone from as little as five minutes to more than 30 minutes. The potential for tornado-producing storms can be estimated up to six days in advance. Similar achievements have been made in forecasting hurricanes and snowstorms. All this information benefits the general public as well as industries from airlines to tourism.*
7. *Do you think the people of the 1930s would have been willing to spend money to predict the weather? Pause to listen to their responses. Would they have any trust in such things as radar, computers, and satellites? Pause again to listen to their answers and opinions. Within one generation, these kinds of technological equipment was being put into daily use. Sometimes, it takes a full generation for the people to accept what science predicted and even proved years earlier. Had we had today's weather forecasting ability, do you think farmers would have taken their families into town on Nov. 11, 1940? Would hunters have changed their plans or at least the gear they packed? Pause again.*
8. *American history is crammed with examples of people and companies seeking short term gains that ultimately lead to long-term harm for the entire nation. Often these people ignore the science of the day. Clear cutting of timber led to unchecked avalanches that wiped out towns and caused deaths in the Pacific Northwest. Mountain-top mining in the Appalachians has choked streams and rivers. Dumping industrial waste into Lake Michigan literally killed sport fishing. Dryland plowing led to severe wind erosion that gave rise to the Depression-era Dust Bowl. The good news is, when we as a society recognized the environmental damage being done, we enacted policies that stopped the actions, incentives to change the behavior, and investment in reversing the damage and eventually restoring the environment. Well, with the exception of mountain-top mining, although new laws at least minimize the damage being done.*
9. *What about 1970? Point to the white board. In 1956 American geophysicist Dr. Hubbert presented to the American Petroleum Institute the results of his research that predicted when the U.S. peak oil production would occur. He estimated the peak would occur between 1965 and 1970. The peak occurred in 1970. Pause to let your students consider this statement. What is a peak? With any resource that has a limited supply – meaning nonrenewable, such as coal and oil – production starts at zero. Production increases until it hits a peak which cannot be exceeded. Once the peak is reached, production declines until the resource is gone. Many peaks follow a standard bell curve in which production levels do not remain flat following the peak, instead they fall sharply. U.S. production indeed has been in decline: this is one reason America had to feed its appetite for oil by importing it from the Canada, Mexico, and the Middle East: the latter being a region whose nations are politically unstable and often unfriendly toward America. The economically crippling energy crisis of 1973 and repeated in 1979 was due to the Middle East limiting the production of oil to hurt the U.S. over a disagreement about foreign policy.*

10. *Hubbert also said the world supply of oil would peak due to essentially similar conditions: only so much oil can be recovered economically, and this oil which took millions of years to form was being used at an ever-increasing rate. The U.S. Department of Energy in 2005 published a report on world oil production that predicts a peak in 2015. Known as the Hirsch report for the lead author, the extensive study expanded on Hubbert's work.*
11. Hand out the **We Are Running Out of Time** and **Your Assignment** worksheets. *You will have 25 minutes to read through this information, and then discuss in your group the questions that follow.*
12. Keep track of the time. Be available should they have any questions regarding this assignment. **NOTE:** This task is designed to challenge your students to think critically and analytically about the current situation and probable future impacts if no action is taken. There will be no right or wrong answers. That said, it is important that your students understand the difference between facts and feelings in reaching a course of action.
13. After 20 minutes have passed, let your students know they have five minutes to complete this assignment.
14. *Time's up. I would like each group to tell me how they answered the questions, and whether there was overall agreement or some of you have alternative viewpoints?* By group, ask each of them to share their findings. Look for opportunities to comment on their responses. *You may not agree on when we will have used up half of all the oil that is economically and environmentally recoverable. But, all of you would have to agree that we will be burning through this oil. When it is gone, it is gone for forever.*
15. *Fossil fuels have made their mark on this world. Which brings us to 400. Actually, 400 and Florida are linked. Fossil fuels cause environmental damage both in the mining and drilling process, and in the burning of them to fuel power plant, trains, planes and automobiles. This is not to say biofuels are emissions free, but that using biofuels reduces overall emissions and especially the most damaging ones. The burning of coal and oil in vast quantities over the past 300 years has resulted in unimaginable amounts of carbon dioxide being released into Earth's atmosphere. In 2013, the carbon dioxide in the atmosphere measures at 400 parts per million. The last time it was that high was three million years ago when the Northern Hemisphere was largely ice free year round.*
16. *Earth's temperature has risen one degree during the past century. Sea levels have risen eight inches. One degree may not seem like much, but the temperature increase is accelerating as more carbon dioxide, a greenhouse gas, accumulates in the atmosphere. The National Oceanic and Atmosphere Administration is not in the business of politics, nor energy. NOAA's job is to collect and analyzes data. Nine of the ten past years have been the hottest on record, according to NOAA.*
17. *Regardless of your personal or political beliefs, carbon dioxide levels have increased alarmingly in the past 200 years. This is a fact. This increase can be linked to the burning of fossil fuels. Period. Of course, industries built around coal and oil do not like this connection. They have something to lose. Remember, people in American history have pursued short-term benefits even when they knew it would be harmful in the long run for the nation overall. Whatever individuals may choose to feel, the vast majority of Americans are not blind to the facts: melting glaciers and hotter summers cannot be hidden or ignored.*
18. *The real question is how much of the increase is due to humans burning fossil fuels, and how much may be due to naturally occurring events. Regardless of the answer, it is obvious that whatever we can do to reduce carbon dioxide emissions is certainly worth doing, providing it is reasonable, achievable and economically feasible. This is where facts and feelings unhappily get tossed aside. Some people believe anything we do to reduce carbon dioxide emissions, even if there is no net cost, is not worth doing. Others think we should shut down every coal-fired power plant and require all vehicles to get 50 miles per gallon by tomorrow. Neither point of view is reasonable, nor practical. Still, it is unrealistic and irresponsible to remain attached to the status quo.*
19. *How does Florida fit into this? National Geographic reviewed potential scenarios of how global warming will affect sea levels. A warming climate means glaciers are melting a record rates and the polar ice caps are melting as well. Plus warmer oceans expand in volume. Since 1992, Greenland and Antarctica combined have lost on average 50 cubic miles of ice each year. Put another way, that is 200 billion metric tons of ice melting each and every year just in Greenland and Antarctica. Based on huge amounts of worldwide data fed into computers that apply mathematical models, four different projections have emerged to project sea level increases due to climate change. The lowest increase by the end of this century is projected to be about two feet. The highest increase could be six feet. The U.S. Army Corps of Engineers recommends that planners prepare for a possible five foot increase.*
20. *Even a two feet increase puts thousands of miles of developed coastline and millions of people at risk of greater storm surges, meaning widespread destruction, death, and enormous costs to rebuild. Recent severe weather events from Hurricanes Sandy and Katrina to significant forest fires from Texas and Colorado to California and Washington may become more common. Should enough ice melt to raise the oceans by five feet, the state of Florida essentially disappears. Miami and New York are among the world's major cities at greatest risk. Think of the social implications to simply lose an entire state. Florida residents, and countless more along the coasts, would begin a painful exodus to higher ground.*
21. *If this seems far-fetched to you, keep in mind that in 1850 there were 150 glaciers in Glacier National Park in Montana. Now there are just 25. The park's glaciers could all be gone, melted, within 30 years. Glacier National Park could be glacier free within a generation. Even today people dispute global warming and climate change. Are they basing their beliefs on facts or feelings? While a one degree does not sound like much, consider that humans are comfortable in a relatively narrow range of ambient temperatures, say 68 to 76 degrees. Other mammals such as deer can handle much wider variations in temperature. The plants we cultivate for food are much more sensitive to temperatures and weather patterns. This is why wheat grows best in the Northern Plains, corn grows best in the heartland, and cotton does well in the southern states. Even minor changes in overall climate could radically affect our food supply.*
22. We are going to move to another discussion exercise. Hand out the **We Are Still Running Out of Time, The Q&As of Climate Change**, and **Your Next Assignment** worksheets. *You will have 25 minutes to read through this information, and then discuss in your group the questions that follow.*
23. Keep track of the time. Be available should they have any questions regarding this assignment. **NOTE:** This task is designed to challenge your students to think critically and analytically about the current situation and probable future impacts if no action is taken. There will be no right or wrong answers. What is important is that your students have an opportunity to openly voice their opinions and be respectful of different points of view.
24. *Please appreciate we are trying to find consensus on simple solutions to what are extremely complicated and interwoven problems. It may seem easier to just do nothing and hope this problem goes away or fixes itself. Americans seem to love to argue about solutions. In the end, we tend to find common ground. We have built very expensive dams to help control floods, generate electricity, provide for barge traffic and recreational activities, and to assure water supplies. When we did this there were winners and losers, yet it served the overall good. Our nation has invested in schools and universities, interstate highway systems, and military protection. Let me return to an earlier topic. Do you think the people who lived across the nation's heartland in 1940 would have preferred to do nothing, or would they have put weather forecasting at the top of the list of national priorities? Pause to listen to their answers. How would you respond to comments from people of that era who might see weather forecasting as a waste of time, unlikely to succeed, and best left to private companies?*
25. **BREAK (OPTIONAL):** Depending on your classroom, students, and your teaching style, this would be an appropriate time to break for five to ten minutes. However, if you believe this would disrupt the tempo you can continue with the next activity.
26. *One of the biggest arguments surrounding fossil fuels is climate change, or to be more accurate, global warming due to massive and unchecked accumulations of carbon dioxide in the atmosphere. This is where we separate facts and feelings. There is no question burning fossil fuels is harmful to the environment. There is no question fossil fuels will become more expensive as supplies are literally burned up. With 95 percent of scientists in agreement, there is no question fossil fuels are contributing to conditions that affect climate. There is no question if we do nothing things will get worse, and perhaps to the degree that we will no longer have the ability to slow down climate change.*
27. *Climate changes knows no borders. Its effects are felt worldwide. Is there an example we can look at that shows how humans cause climate change and how they successfully slowed down, eventually stopped, and actually reversed the damage? Yes, there is. And it is right here in America. You will have 45 minutes to work on this assignment. You should need no more than ten minutes to read the background sheet, followed by 30 minutes to discuss the questions. At the end of this time we will review your findings. Pass out the **L.A. Story: Soon Appearing Worldwide and Up For Discussion** worksheets along with highlighters for each student. First take ten minutes to read through the background information. Use your highlighter to mark specific information you find especially notable. Then begin working as a group on the questions that follow.*
28. Keep track of the time. Be available for your students should they have questions about this assignment.
29. *The behavior of some people can be confusing at best. They will have a double standard: what they expect of others may be compromised in their own lives. Most people do not want anyone farther upstream to dump motor oil into the river*

that goes behind their house, yet they themselves may do so if it is just a little and no one is looking. It is difficult to expect everyone else to do something if we are not doing it ourselves. American history is full of examples of city, state, and federal policies that were unpopular with some early on yet have stood the test of time. Other policies that did not work out as planned were in fact changed because they did not stand the test of time.

30. *How did your groups answer the questions at hand?* You may find common consensus among all the groups, or you may find different approaches, depending on the individual backgrounds and attitudes of your students. Use this time to see if there are common threads when it comes to attitudes about the need for, and value of, mandates, penalties and incentives as tools to effect real change. Ask the question
31. *How might the L.A. story apply to global climate change?* Shift to the role of facilitator and lead the entire class in discussion. Do your best to engage all your students rather than letting one or two make most of the comments.
32. *Many people will not independently educate themselves on a serious topic. Nor will they readily question any of the information they receive. Often, people base decisions on feelings rather than facts. They reject reports that counter their own views and embrace others that support their positions. Materials posted on the Internet or forwarded on Facebook often are anonymous, meaning there is no source, no fact-checking, and no consequences and no way to assure responsibility on the part of those making the posts. Some people are just disagreeable and the Internet and social media are giving them unchecked opportunities to reach large audiences.*
33. *People may support policies for the common good yet reject them if they have an individual impact. How can we build national consensus when there is a disconnect between the national policy and individual impact?* Use this question to continue the discussion on climate change.
34. *It simply is not possible to have a rational discussion with irrational individuals, or with irrational groups. This is sad to say, but consider Congress. These individuals are supposed to be among the most learned and professional people in our nation, yet recent congressional policy discussions have turned into arguments over partisan beliefs instead of building consensus for the common good. Just imagine if political and community leaders in Los Angeles in 1943 had purposely fought against any pollution measures. Would this have been the easy way out at the time? Would it have pushed even bigger problems onto future generations and cause bigger headaches for today's leaders?* Allow your students to comment on this question.
35. *Is it possible that businesses, organizations, and industries that have a financial or philosophical interest in rolling back the mandates could mount a successful campaign today?* Listen to the comments offered by your students. *What about 25 years ago?* Listen to any additional comments. *The task of convincing people of what should be obvious can be overwhelming. We know Earth is not flat, nor the center of the universe let alone of our own solar system. We are using our knowledge of nutrition and medicine to greatly increase our lifespans. For hundreds, well, for thousands of years naysayers have slowed down human endeavors to make the world a better place. If an asteroid were approaching Earth and we had decades to develop and enact a plan, I think we would act immediately and without question. Regardless of what others may say, past and current generations who are responsible for burning fossil fuels will not be around to live through the consequences. We already know the damaging that has been caused, and outcome if we do nothing to change things. The question no longer is should we do something. The real question is what can we do, how soon should we begin, and how quickly can we make a difference. You can start by being advocates for reducing the use of fossil fuels, encouraging the use of renewable fuels, and especially for standing up and speaking out when the topic comes up. You do not have to start or win an argument with someone who holds a different point of view. But by being silent when others question whether climate change is occurring and why, you are handing over your voice on the issue.*
36. Thank your students for participating in this class.

Lesson 3: How To Make The Argument For Renewable Fuel Standards

Unit Objective: Adults will consider the necessity and effectiveness of renewable fuel standards.

Grades: Adult

Length: 2 hours:

Materials Needed: Clipboards with checklists; highlighters, and discussion questions **The Time For Change Is Now, Myths Vs. Facts, Renewable Fuel Standards, and Show Up, Stand Up, Speak Out**

Preparation Needed: DSIRE map, DDGs, Food vs. fuel

Background: Renewable energy . As with all industry specific changes, there will be winners and losers, both perceived and actual as measured in real results. And, there will be arguments for and against change, often confusing facts with feelings. This lesson plan will use several discussion topics to guide the students into realizing such things as mandates, incentives, and renewable fuel standards help drive acceptance of better ways to do things.

Teaching

1. *Is wood a source of energy?* Ask them to raise their hands if they agree. *Yes? Then why do we not use it to heat our homes, our businesses, and power our cars?* Pause: listen to any answers your students offer. *True, cars such as Stanley Steamers, along with mountain cabins and small shops can still use wood as a source of energy. But for the vast majority of Americans, wood is not a good source of fuel. Why?* Encourage one or more of yours students to answer this question. Let them know this will be an interactive lesson and their participation is necessary to make the learning opportunities worthwhile.
2. Listen to their answers. Among the comments you should hear is that wood is not practical as a fuel for large scale use, it does not have a high energy value relative to the space it requires, and it is not convenient nor portable. Other logical comments might point out that wood would be in short supply quickly.
3. *It seems we choose — or sometimes have no choice but — to use fuels that are convenient to convert to energy, and that reliable and predictable in their performance, and are easily available nationwide, and are affordable compared to alternatives.*
4. *What about negative impacts? Our sources of energy are measured in bottom line performance. Yet air pollution and other environmental damage is not easily accounted for on a balance sheet. The cost of securing transportation lanes using the U.S. military are not reflected in the price paid at the pump. The environmental damage of mountaintop mining does not add a surcharge to the cost of coal and subsequently the cost of electricity. These costs are transferred to others and thus difficult to accurately measure.*
5. *Wood was a primary source of fuel for thousands of years. It was easily available, easy to use, and in good supply given the modest demands of the day. Early steam locomotives used wood to heat their boilers. What changed? Allow them to respond with their answers. Coal and oil quickly replaced wood. It was more convenient to use, packed a lot more BTUs into a smaller space, and it was available in abundant supplies and easy to transport and store.*
6. *In some ways, the conversion to oil and coal feed up supplies of wood for use in making paper, building construction, and for other durable goods. The conversion somewhat coincided with the rise of the automobile, itself suited to liquid rather than solid fuels.*
7. *From 1900 to 1950 America invested truly massive amounts of federal and private money to build its energy infrastructure, from hydroelectric dams and coal-fired power plants to oil refineries, pipelines, and gas stations. Following World War II, more attention was focused on synthetic fuels and nuclear energy. America's energy generation portfolio always has been dynamic and changing.*
8. *Since the 1960s, consumers have successfully pushed energy companies to pay attention to the environmental impacts of their operations. And since the 1970s, when the U.S. quite literally suffered through an unexpected energy crisis followed by a second one a few years later, consumers have been asking their government to consider the economic impacts*

of reliance on limited supplies of fossil fuels. The economic shock combined with personal compromises caused people and companies to demand changes. A new Department of Energy was formed to coordinate America's energy research and policies.

9. *The environmental focus that took root in the 1960s and the more severe supply shortages and price hikes of oil in the 1970s put America on track for getting serious about developing renewable fuels. Although many of these sources had been around for a long time, renewable energy from biofuels, wind, and solar moved from possibilities to everyday practice.*
10. *Have you ever heard of priming the pump? A pump that draws water, gas, oil, or other liquids has to be primed to run effectively. Air, rather than liquids, is found in a new or unused pump. When turned on, the pump will not work until liquid is drawn through the pump. The first few cycles of operation are not productive. Priming a pump has become a collective term for any actions required to get something started in order to make it sustainable. Renewable fuels had to go through the same step. Government and private enterprise have been funding research. As you know, development of any technology takes time and money. Think of computers. In the 1990s, personal computers were expensive and limited in processing capability and memory capacity. However, ongoing software development combined with economies of scale made computers much faster and much less expensive. Renewable energy is following a similar path. Early wind turbines were expensive and limited in output. Today, wind turbines have become an accepted and integral source of electrical power.*
11. *City, state, and federal government discusses and enacts policies for the common good. Our system of government includes opportunities for citizen participation and open elections. And, we have governors and courts to provide a system of checks and balances. Some may not like certain actions or decisions by the government, yet we all are Americans. Without our democracy we might live in anarchy, in a dictatorship, or worse.*
12. *Unfortunately, almost all policies developed by lawmakers have proponents and opponents. Not everyone gets their way. In general, this means policy development is subject to compromise to reach agreement and ultimate implementation. Without compromise, action on policy comes to a grinding halt, known as gridlock. Just like traffic in a big city, nothing happens or it happens so slowly as to be of little value.*
13. Some businesses, organizations, and individuals oppose government policies, laws, and regulations. They also object to government incentives and mandates. Yet such policies have been and continue to be beneficial to society overall. We are going to break into groups to discuss the value of policies that had strong opposition at the time but today we would object if the same policies were no longer in use.
14. Hand out the **When Policies Prevail** worksheets: each group will receive a different topic. *You will have 20 minutes to discuss this topic, after which each group will explain how and why they answered their questions. Please talk among yourselves. Please understand that all of you will have different viewpoints based on your own beliefs, experiences, and personal examples.*
15. Allow up to 20 minutes of undisturbed time for this activity. If it is apparent that they are done in 15 minutes, move on to the next step. By the end of 20 minutes, however, let them know their time is up. Choose a group and ask them to explain their topic and how and why they answered the questions on their worksheet. Look for opportunities to have them further explain their findings. And, look for opportunities to engage all the participants within each group, as in, "John, do you feel the same way?" or "Sue, do you share this point of view or see it differently?"
16. *In order to prime the pump for renewable fuels, our city, state, and federal governments have put in place both incentives and standards. This is no different than building standards that require better insulation, fuel economy and safety standards for automobiles, and drinking water and sanitation standards.*
17. *Government can and will use its resources to encourage the development new technologies for use in essential industries, including those that affect national security. These industries include food, energy, finance, education, health, and transportation. By using standards, mandates, and tax incentives, government is in a position to help some technology bridge the gap from the potential possibilities on the drawing board to practical applications in the real world. Some of this technology transfer originates in the military, or in NASA, or in public universities. Much of it comes from several different entities working together, leveraging local and state ingenuity with national resources.*
18. *Through the use of grants to universities and tax incentives for private business, government has a role to help underwrite development costs of renewable energy. One reason this is done is to keep America competitive with other nations.*

- Another is to assure long-term energy security and to protect America's environment.*
19. *It is important to recognize the difference between private enterprise and public policy. Private enterprise follows financial rules. Success or failure is measured only in money, as in profit or loss. Private businesses exist to make as much profit as possible for their owners. A proven way to do this is to dominate an industry, effectively capturing market share from other similar businesses and thus reducing competition. Businesses want to increase the value of their stock and the dividends they pay to stockholders. A business, therefore, will actively oppose public policy that could impact its operations regardless of whether the policy is good for the overall country. Businesses tend to want to concentrate on what they do best. Oil companies want to source, refine, and sell oil. The bigger the better, as reducing handling costs per barrel results in high profits. So concentration rather than diversification is the creed of many large industries.*
 20. *Public policy developed by city, state, and federal governments has to balance the overall business environment with the public good. Elected lawmakers will consider current cultural needs and future trends rather than the stock value of a singular business. A good example is our public highway department. Roads are simply too expensive to design, build, and maintain by private enterprise. In effect, they are owned by all of us. The few privately-owned roads are limited to high volume highways, not city streets or county roads. For this reason, roads have to be designed to handle private passenger cars, commercial long-haul trucks, and buses. Each user has a different need, yet the system is designed to handle the needs of the overall public.*
 21. *In the energy industry, it is important to the nation as a whole to diversify its energy portfolio for both economic and security reasons. If all our energy came from hydroelectric power, what happens during an extended drought? If all our energy comes from imported oil, what happens during an embargo? In Japan, a nuclear power plant remains off line following severe damage caused by a tsunami. All forms of energy are subject to interruptions. All forms of energy need to be variable to increase or decrease production to match changing demand.*
 22. *And government investment in energy is not singling out one source over another. In 2007, the United States provided \$724 million in subsidies for wind power, \$174 million for solar and \$14 million for geothermal. Yet, in that same year, they also provided \$854 million in subsidies to coal production and \$1.267 billion to nuclear power.*
 23. *In the past 10 years, many state legislatures and Congress have adopted policies to encourage the development of our nation's renewable energy industries, from geothermal and wind to biofuels and solar. These policies include goals or standards that set targets on future usage. Call them Renewable Fuels Standards, Renewable Portfolio Standard, Renewable Production Standards, or Renewable Energy Standards, these policies might set a goal of having renewable energy generate 25 percent of the total supply by the year 2025. Each state that has adopted such policies has its own approach, from what constitutes a renewable fuel to what percentage should be from renewable sources and by when.*
 24. *Pass out the DSIRE map. You may want to print new maps that reflect updated information. These maps may be found at www.dsireusa.org/documents/summarymaps/RPS_map.pdf. I will give you five minutes to study this map. Consider what goals or standards our state may have in place and how they compare to surrounding states.*
 25. *Let's take a closer look at Renewable Fuels Standards. Renewable fuels such as biodiesel and ethanol can be made from plants. Ethanol in particular is made by fermenting plants to make alcohol. In turn this alcohol is blended with gasoline made from crude oil. Popular blends in the U.S. are E10, E15, and E85. E10 is a blend of 10 percent alcohol and 90 percent gasoline. E85 is a blend of 85 percent alcohol and 15 percent gasoline.*
 26. *Congress in 2005 passed the first federal renewable energy policy to set a mandate requiring 7.5 billion gallons of renewable fuel to be blended into gasoline by 2012. This amount will increase to 36 billion gallons by 2022. The leading reasons for using ethanol are threefold: one, it reduces our dependence on foreign oil; two, it reduces air pollution, and especially carbon dioxide, compared to crude-oil based gasoline; three, it is generating tens of thousands of jobs and creating economic activity in America's heartland rather than sending consumer dollars overseas to buy crude oil.*
 27. *Opponents to ethanol say it raises food prices and can damage engines. There are good and bad informational campaigns at work both for and against renewable standards. Established oil companies have no financial interest in seeing renewable fuels expand, let alone stay at their current levels, regardless of what consumers want. Environmentalists believe big oil simply needs to go away, and soon. The common good can be tugged between these opposing points of view.*
 28. *Most of the points opposing the use of ethanol have been put to rest in Brazil, where straight gasoline is no longer sold. Brazil in the 1970s supported a rapid and expansive shift to ethanol blends much higher than those currently in us in America. Virtually all concerns about ethanol and its impact on cars were resolved early on, in part because the government made the shift mandatory. The point is, technological advances in biofuels make defending the status quo of relying on and burning fossil fuels much more difficult.*
 29. *Up until recently, Americans have had no choice on automotive fuel. True, a few cars were equipped with diesel engines. For everyone else, the choice was gasoline or gasoline. From one company to another, it was essentially the same, although it came in three different octane ratings with the highest octane more expensive and more suited for use in high compression engines.*
 30. *Today, car companies are making cars that can use E10, E15, and E85 ethanol blends. Car companies are making hybrids that use both gas and electric power. Car companies are making true electric cars. Diesel engines are becoming much more common. Consumers have more choices and they are welcoming those options.*
 31. *Oil companies see this as a threat. They are losing market share and profits. In a competitive culture, they are taking action to make ethanol sound bad. Of course, the ethanol industry is point out the many negative impacts of using fossil fuels.*
 32. *For our final exercise, your groups will discuss a few common myths about ethanol and how to respond to them. Hand out **The Time For Change Is Now, Myths Vs. Facts, Renewable Fuel Standards, and Show Up, Stand Up, Speak Out**. Take time on your own to read through these informational sheets. Use a highlighter to mark specific information that appeals to you. Then, as a group, develop answers to the questions on the Show Up, Stand Up, and Speak Out page. Consider both pros and cons in order to fully explore your responses.*
 33. *Keep an eye on the time during this exercise. Allow at least 10 to 15 minutes for the students to read through the worksheets. Allow another 30 minutes for discussion. This activity requires comprehension and contemplation, so rushing it will defeat the learning process. If your students appear to have completed this work in fewer than 30 minutes, proceed to the next step, but give them a five minute "warning" to allow all groups to complete their work.*
 34. *Begin with a group and ask them to report on how they answered the questions. As opportunity allows, ask these questions to further encourage discussion (NOTE: Do not ask all these questions of the first group; spread them out among the groups): Was it easy to reach consensus? How did you handle different points of view? How did you consider your different priorities? Were some of your conclusions based on your own personal beliefs and experiences? Would this task be easier or harder to conduct with people who have no working knowledge of this issue?*
 35. *Once each group has completed its report, shift the discussion to the overall group. Ask questions such as: What did you learn that surprised you? Is it easier to talk about sports than renewable energy? If so, why would that be? How would you handle someone whose information is either wrong due to a lack of knowledge, or wrong in order to support a biased point of view? Continue this discussion to allow all students to have a chance to voice their observations.*
 36. *Across America, companies are making products that are much more environmentally friendly and use less energy. These companies are revising their operations as well to use less energy and produce less pollution. Being green is good for business, both for the image it projects and for the economic advantages. In order to keep renewable and sustainable energy as essential to the American way of life, we need to become advocates. By speaking up when it counts, you can have a tremendous impact on public perceptions and on public policies. By staying silent, you let others frame the discussion and you let their comments take center stage.*
 37. **CLOSE** with what call to action next.

A partial list of 6,000 products made from petroleum

Solvents	Diesel fuel	Motor Oil	Bearing Grease	Ink	Floor Wax		
Boats	Ballpoint Pens	Football Cleats	Upholstery	Sweaters	Insecticides		
Clothes	Sports Car Bodies	Nail Polish	Fishing lures	Dresses	Tires	Golf Bags	
Perfumes	Cassettes	Dishwasher parts	Tool Boxes	Shoe Polish	Motorcycle Helmet		
Caulking	Petroleum Jelly	Transparent Tape	CD Player	Faucet Washers	Antiseptics		
Clothesline	Curtains	Food Preservatives	Basketballs	Soap	Vitamin Capsules		
Purses	Shoes	Dashboards	Cortisone	Deodorant	Footballs	Antihistamines	
Putty	Panty Hose	Refrigerant	Percolators	Life Jackets	Rubbing Alcohol	Linings	
Skis	Shag Rugs	Electrician's Tape	Tool Racks	Car Battery Cases	Epoxy	Paint	
Mops	Slacks	Insect Repellent	Oil Filters	Umbrellas	Yarn	Fertilizers	Hair Coloring
Roofing	Toilet Seats	Fishing Rods	Lipstick	Linoleum	Synthetic Rubber	Plastic Wood	
Speakers	Electric Blankets	Glycerin	Tennis Rackets	Rubber Cement	Dice	Nylon	
Candles	Trash Bags	House Paint	Water Pipes	Hand Lotion	Roller Skates	Surf Boards	
Shampoo	Wheels	Guitar Strings	Luggage	Aspirin	Safety Glasses	Dyes	
Antifreeze	Football Helmets	Awnings	Eyeglasses	Toothbrushes	Bicycle Tires		
Ice Chests	Footballs	CD's & DVD's	Paint Brushes	Detergents	Vaporizers		
Balloons	Sun Glasses	Tents	Heart Valves	Crayons	Telephones	Cameras	
Anesthetics	Artificial limbs	Bandages	Model Cars	Movie film	Soft Contact lenses		
Ammonia	Refrigerators	Golf Balls	Shaving Cream				

Americans consume petroleum products at a rate of three-and-a-half gallons of oil and more than 250 cubic feet of natural gas per day per person!

When Policies Prevail

Child Safety Seats

Synopsis: In the 1960s, American physicians first raised concerns regarding the safety of children riding in automobiles. This was at the same time that safety belts for adults were being introduced. In 1978 Tennessee becomes the first state to enact the first child passenger safety law. The use of child safety seats becomes a widespread practice in the 1980s, although studies show a lot of seats are installed and used incorrectly. Educational programs focus on the best way to use a child safety seat. Parents are learning a new way to protect their children, yet some grandparents who have never used the seats find them an inconvenience. A study shows adults are not able to restrain their children in even a low-speed crash (as in holding them in their laps or holding a hand in front of them while the children are standing on seats next to them). By the 1990s, car companies are offering built-in child safety seats. Additional research fine tunes seats to tailor protection for infants to toddlers. Research shows that when installed properly and used correctly, car seats reduce the risk of fatal injury by 71 percent for children younger than 1 and by 54 percent for children 1 to 4 years old. Motor vehicle crashes are the leading cause of death for children ages 1 to 13. It has taken 40 years for child safety seats to go from being a curiosity to a way of life. The learning curve spanned two generations and required law enforcement to fully change the culture.

Without laws, would child safety seats have been accepted as quickly by parents? By grandparents?

Do adults have an obligation to use child safety seats even if they themselves do not use seatbelts?

Would your children or grandchildren want you to wear a seatbelt if they have to be in a safety seat?

Is it possible that mandatory rules change culture more quickly than voluntary appeals?

When Policies Prevail

Get the Lead Out

Synopsis: Lead once was a common ingredient in gasoline, paint, and pipes. In gas lead was used to raise the octane level, meaning engines could run with higher compression and produce more power. Lead also served as a “lubricant” for valves in cylinder heads. Lead is a soft metal. Low levels of lead affects the human central nervous system, kidneys, and blood cells. Ongoing exposure to lead can cause delays in physical and mental development, impacts felt much more by infants and children. And, toddlers were more likely to chew on toys finished with lead paint. In 1974 the Environmental Protection Agency banned lead as a gasoline additive. Lead paint was banned for any new home. Between then and 1991, lead concentrations in the blood of Americans fell by 80 percent. Lead exposure in children resulted in a significant loss of brain volume in adult men. Also, children with higher levels of lead were much more likely to be aggressive and violent. Scientists and sociologists have suggested a strong link between the drop in lead exposure and the drop in violent crime in the United States. For the record, France and Belgium on 1909 banned lead as an ingredient in indoor paint as it had been found to be a poison causing health problems in children. The Ethyl Corporation, which made lead for gasoline, sued the EPA to block the ban. The EPA standards were upheld in court. Better metallurgy, fuel injection, and computer-controlled engine management systems made lead obsolete. Estimates put the amount of lead released into the air from gasoline alone at 7 million tons in the United States. Soil along highways still contain higher concentrations of lead.

Would you feel comfortable letting your children or grandchildren play with toys covered in lead paint?

Many adults feared removing lead would ruin their engines or result in less powerful engines. Fuel injection, turbocharging, and other technological advances have added horsepower, reliability, and fuel economy to engines that far surpass those built in the early 1970s, and all without the need for lead gasoline. Would you choose to return to engines with carburetors, and ignition systems using points and condensers as built in the 1970s, or do you prefer today’s engines which were designed by car companies to work with unleaded fuels?

Is it possible U.S. companies would have continued selling products containing lead if the government had not passed policies to “get the lead out” based on scientific reasons?

Can you think of other government policies that were controversial at the time, yet proved to be a benefit to the nation?

When Policies Prevail

The Ozone Layer

Synopsis: Banning an ingredient in hairspray may not seem like it would save the world, but it comes close. The ozone layer is at the outer edge of Earth’s atmosphere. This layer helps shield the Earth from solar radiation and ultraviolet light that causes skin cancer and is harmful to some crops and marine life. Ozone is a rare molecule containing three oxygen atoms. The ozone layer is relatively stable, neither increasing or decreasing in concentration. But humans developed chlorofluorocarbons (CFCs), which found widespread use as refrigerants in air conditioning systems, and as propellants in aerosol products such as hair spray. The CFCs were used to create the pressure that “drove” hair spray from the can. Scientists noticed the ozone layer was getting less dense. CFCs were accumulating in the upper atmosphere where they were being exposed to ultraviolet radiation which broke down the molecules releasing chlorine. One chlorine atom can destroy 100,000 ozone molecules. The first concerns surfaced in the 1970s. International cooperation to reduce CFCs became official in 1985 and by 1996 the manufacture and use of CFCs ended. Levels of chlorine in the stratosphere peaked in 1998 and have been falling since. It will take 50 years for the ozone layer to fully restore itself.

Are some policy issues so important to the world that they require international cooperation?

As the U.S. was a major emitter of CFCs, should it have stopped their use even if other countries did not?

It will take 50 years for the ozone layer to restore itself. Should some policies be put on a fast track to approval?

Is it hard to explain a policy need to someone who does not understand the science?

When Policies Prevail

Air Bags: Resistance is Futile

Synopsis: Today car companies advertise safety features of each model, including air bags that can protect the occupants. Both the driver and front passenger have air bags, and many cars include side curtain airbags and even airbags that protect knees. Some vehicles can have up to ten airbags. This is in stark contrast to the 1970s, when American car companies, especially General Motors, wanted to sell air bags but found consumers were not willing to buy them. Other car companies including Chrysler, said air bags were not practical. The truth was the concept of airbags was sound, the technology was not. It took years for computers, sensors, and switches to work in concert. Car companies also found that air bags would sell, at least they provided an advantage when included as standard equipment in upscale cars. In 1998 federal safety policies put front air bags in all passenger vehicles. It is unlikely any car company could sell a new car if it did not have an airbag regardless of the law.

Given the option, would you prefer to drive a car with or without an air bag?

What if the driver were your spouse or child?

When proposing a change to new technology, should the government help fund research?

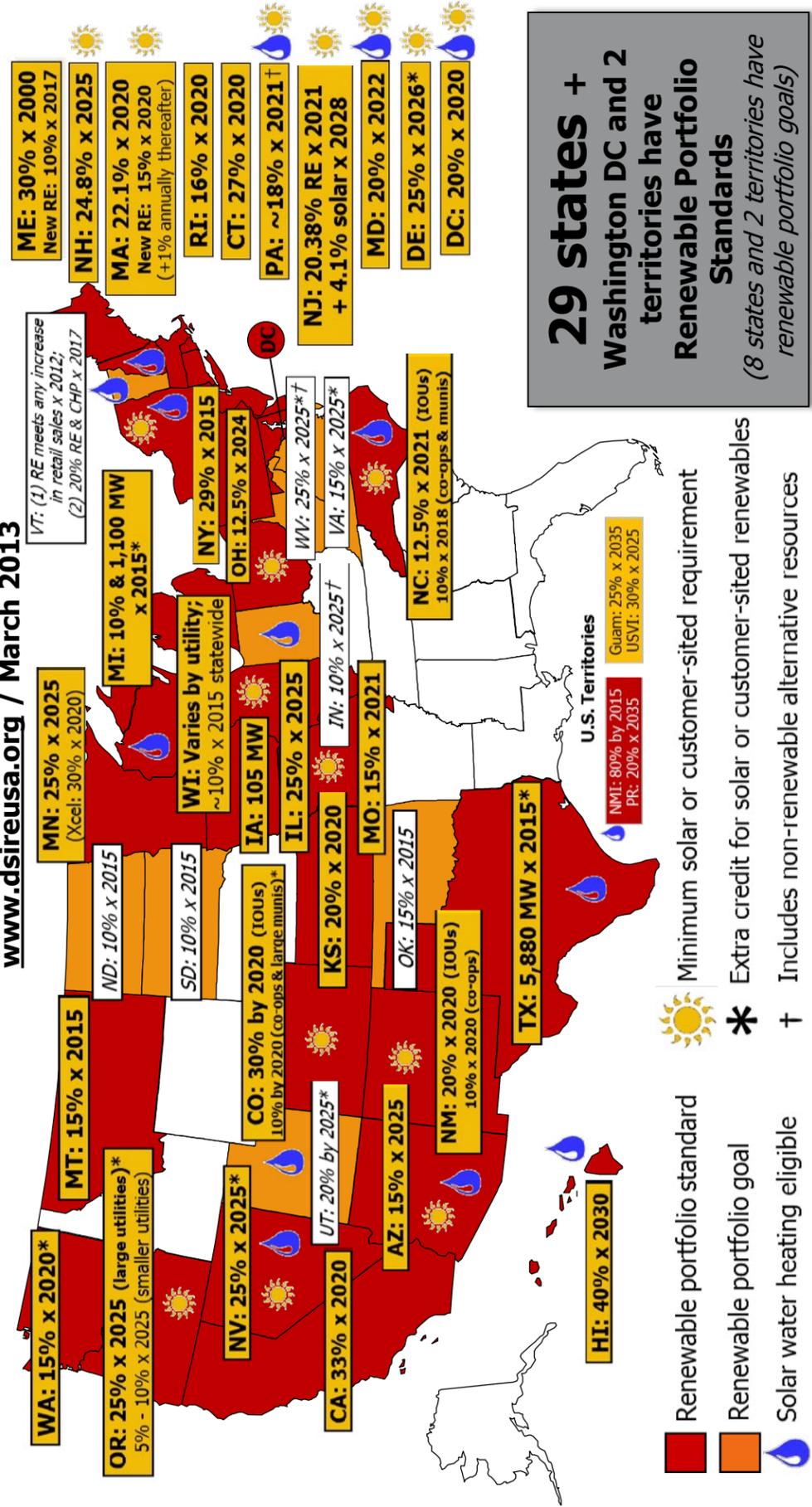
Did requiring airbags for all cars increase acceptance for this safety policy?

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Food Vs. Fuel

Misinformation and misdirection

Synopsis: One argument against ethanol is made by groups who say consumers will have to choose between food and fuel, or that ethanol production leads to higher prices for food. On the surface, this is a fair question. Ethanol is made from field corn, which is grown for industrial use and to feed cattle and other livestock. Field corn is exported to overseas markets. Field corn is different than the sweet corn sold directly to consumers. Farmers grow enough sweet corn for human consumption. About one-third of the field corn used to make ethanol is recovered for use as livestock feed known as distillers dried grain. USDA and universities have studied this topic and have concluded there is little, if any, connection between ethanol and higher food prices. Higher food prices are caused by higher crude oil costs. As the price of a barrel of oil increases, so do the costs of fertilizer, planting and harvesting, processing, packaging, and transportation to market. American farmers are so productive that their crops are exported worldwide, as we have more than enough to provide food, fuel, and fiber for Americans. Here is a final thought worth considering: The farmer's share of corn in an 18-ounce box of cereal that sells for \$4.69 amounts to about a dime. Even if cereal company doubled what it paid farmers for their corn, it would increase the price of the cereal by less than four percent.

Food costs have little to do with the actual price farmers are paid for their crops. About two-thirds of the post-2004 price increase in food is attributable to the price of crude oil. How can we explain this to consumers?

The argument that field corn diverts acres from other food crops is simplistic. Planting decisions have a lot to do with prevailing climates, soil conditions, and financial considerations. One could argue that growing cotton for clothing competes with food. The corn crop doubled in yields between 1980 and 2009, although acres planted to corn increased just three percent. Are their real world examples that might help illustrate this point?

A Merrill Lynch commodity specialist calculated that retail gasoline prices would be higher without biofuels. The annual savings for an average family amounted to \$526. Do consumers relate to these benefits or are they difficult to translate into value?

America has the most affordable (and most varied) supply of food in the world. Food costs are significantly affected by severe weather events. Increasing levels of carbon dioxide in the atmosphere could trigger more frequent severe weather events and subsequently food production. Would this cause-and-effect resonate with or confuse consumers?

Military Protection: Unseen Subsidy

The true cost of importing oil remains a shell game

Synopsis: The National Defense Council Foundation determined America spends nearly \$50 billion a year defending sea lanes used to ship Persian Gulf oil. Put another way, this amount would add a \$1 to a gallon of gasoline under a true cost allocation. Dependence on foreign oil diverts \$220 billion overseas. Somewhat ironically, the U.S. military is exploring ways to use renewable fuels for weapons systems to reduce its dependence on oil. In the event of oil supply disruptions due to terrorist attacks or wars, the U.S. military could find itself running low on fuel. During World War II, the Germans and Japanese military struggled with fuel shortages. Germany responded by introducing a crash program to develop synthetic fuels.

How does U.S. dependence on foreign oil compromise our economic status? Our foreign policy priorities?

How might Americans respond if they had to pay this cost at the pump rather than through tax dollars?

Does government investment in renewable fuels have both an economic and military benefit?

The Middle East is a leading source for crude oil. Is political unrest likely to continue in this area? Are Middle Eastern countries generally friendly to U.S. interests?

Pollution

Reducing the Nation's Carbon Footprint

Synopsis: A 10 percent blend of ethanol reduces greenhouse gases by nearly 30 percent. Transportation accounts for nearly 80 percent of the total carbon monoxide, so small changes can have a big impact. Even modest reductions of noxious exhaust will be beneficial. A study by the Yale Journal of Industrial Ecology found ethanol reduced carbon dioxide emissions by nearly 50 percent. This study looked at the engine biofuels lifecycle of emission from corn production and transportation to combustion in vehicles. While scientists quibble about inputs and conclusions, the bottom line is ethanol burns more cleanly than “pure” gasoline made from crude oil.

Are cleaner burning fuels important to you?

From the protecting the ozone layer to improving water quality in Lake Erie, government action to reduce pollution has proven to be beneficial over time.

In the event of a spill, ethanol is biodegradable. And, ethanol can be produced closer to markets with less energy required to transport it. Are these worthwhile advantages over crude oil and gasoline?

Rural Investment

Jobs Return to the Nation's Heartland

Synopsis: At least 100,000 Americans have jobs in the ethanol industry, which indirectly supports tens of thousands of additional jobs. Ethanol plants have been (and will continue to be) built in rural communities, close to the crops used to make renewable fuel. Overall, the biofuels industry supports more than 365,000 Americans. Ethanol has opened up a new market for farmers, and one that keeps the economic activity here at home.

How many jobs?

What if the drier were your spouse or child?

When proposing a change to new technology, should the government help fund research?

Did requiring airbags for all cars increase acceptance for this safety policy?

We Are Running Out of Time

Peaking oil production puts us on a slippery slope to less

The Hirsch Report accepted by the U.S. Department of Energy presents a well-researched if stark report. It employed the expertise of leaders in the oil industry, as well as economists, geologists, and others who are well versed in their respective fields. What follows is a summary of the report.

Department of Energy: *“The peaking of world oil production presents the U.S. and the world with an unprecedented risk management problem. As peaking is approached, liquid fuel prices and price volatility will increase dramatically, and, without timely mitigation, the economic, social, and political costs will be unprecedented. Viable mitigation options exist on both the supply and demand sides, but to have substantial impact, they must be initiated more than a decade in advance of peaking.”* A peak is a bell-shaped curve that drops off quickly once the peak is passed. Think of it as climbing the steps of a tall playground slide. Once you hit the top you continue forward and come back down to the ground quickly.

The report came to the following conclusions:

- World production of conventional oil will reach a maximum and decline thereafter. Some forecasters project peaking in 2015, or within one to two decades of this date.
- Oil peaking will adversely affect global economies, particularly the U.S. World demand is expected to grow 50 percent by 2025.
- Over the past century the U.S. economy has been shaped by the availability of low-cost oil. The economic loss to the United States could be measured on a trillion-dollar scale. Aggressive fuel efficiency and substitute fuel production could provide substantial mitigation.
- Oil peaking presents a unique challenge.
- Without massive mitigation, meaning lessening the impact, the problem will be pervasive and long-term.
- Previous energy transitions (wood to coal and coal to oil) were gradual and evolutionary. Oil peaking will be abrupt and revolutionary.
- The problem is liquid fuels for transportation. Motor vehicles, aircraft, trains, and ships have no real alternatives to liquid fuel. This equipment has a service life of decades, so replacement rates are low.

Mitigation efforts will require substantial time.

- Waiting until production peaks would leave the world with a liquid fuel deficit for 20 years. Initiating a crash program 10 years before peaking leaves a liquid fuels shortfall of a decade. Initiating a crash program 20 years before peaking could avoid a world liquid fuels shortfall.
- Sustained high oil prices will cause forced demand reduction (recession and unemployment). Production of large amounts of substitute liquid fuels can and must be provided.
- The production of substitute liquid fuels is technically and economically feasible.
- Government intervention will be required. The economic and social implications of oil peaking would otherwise be chaotic.
- Economic upheaval is not inevitable. Given enough lead-time, the problems are soluble with existing technologies.
- Without mitigation, the peaking of world oil production will cause major economic upheaval.

Your Assignment

Consider The Following, Find Possible Solutions

As of 2004 the U.S. share of global oil consumption was about 26 percent, while its share of world population was only 4.3 percent. Transportation accounts for two thirds of the oil consumed in the U.S. Even if drastically higher fuel economy standards for cars and trucks could be enacted today, it will take 10-15 years to replace one half of car fleet, and 9-14 years to replace half of the light truck fleet (pickups and SUVs). Just seven years ago the U.S. was home to 24 percent of total world vehicle registrations – some 200, million (250 million-plus today) – yet used 40 percent of liquid fuels worldwide. U.S. vehicle miles traveled more than doubled from 1973 to 2003. Higher fuel economy per vehicle is being offset by more miles driven per motorist and more vehicles being driven annually.

Both airlines and railroads are phasing in engines that use less fuel, use biofuels, or use alternative fuels. These companies understand a shortage of fuel or rapidly increasing prices could put them out of business. The U.S. military is taking similar steps, knowing a lack of oil would seriously jeopardize the nation's ability to defend itself. Yet in our own lives we continue to choose large vehicles such as pickups and SUVs for our primary source of transportation. Such vehicles are designed for special applications and, frankly, because they have market appeal to owners who buy into the image these vehicles project regardless of whether they every use them off road or to haul large loads. We are not accustomed to using more fuel efficient cars that better match our actual use. And, our current culture supports one person in one vehicle, which overtaxes highways designed and built for traffic volumes from 20 to 50 years ago. Americans are not quick to use public transportation which is energy efficient and reduces highway congestion.

The development of horizontal drilling is leading to an increase of U.S. oil production. However, it is critically important to understand these reserves are not new. They were first identified in the 1950s. Thus, they do not add to America's known supply of oil as determined by Dr. Hubbert, who worked for Shell Oil at that time. Hubbert's predicted curve of U.S. production has closely matched the actual production for the past 50 years. Hubbert's formulas have been applied to U.S. anthracite (hard coal) production and Norway's oil production, each of which closely matched the bell curve prediction plotted by Hubbert. For 50 years, Hubbert's "peak" has been quite accurate. Increasing U.S. production of oil using hydraulic fracture or "fracking" techniques slows down the decline of available oil supplies: it does not create a new peak. Which means the problem remains: oil is a non-renewable fuel that will run out over time and burning fossil fuels continues to put vast amounts of pollution into the air.

Discuss these questions regarding the production peak of crude oil and see if you can reach agreements on the answers.

What is likely to happen in the next 20 years in the U.S. and worldwide if we take no further action at this time?

The most promising solutions at hand are to reduce consumption, increase supply, or increase the use of renewable fuels. Which of these can be done quickly and with minimal impact to the American way of life?

If worldwide peak production happens next year and oil availability begins to fall, what are the probabilities of social upheaval, economic shock, and possibly war for the U.S.? Could the Middle East countries use this situation to undermine U.S. foreign policy? Could China take action to protect its imports of oil?

Is there a pressing need for Renewable Fuels Standards to encourage Americans to shift to renewable fuels, much as Brazil did in the 1970s following the first energy crisis?

We Are Still Running Out of Time

Greenhouse gas emissions are warming our planet

Greenhouse gases trap heat and make the planet warmer. Human activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the last 150 years. The largest source of greenhouse gas emissions from human activities in the United States is from burning fossil fuels for electricity, heat, and transportation.

EPA tracks total U.S. emissions by publishing the Inventory of U.S. Greenhouse Gases and Sinks. This annual report estimates the total national greenhouse gas emissions and removals associated with human activities across the United States.

The primary sources of greenhouse gas emissions in the United States are:

- Electricity production (33 percent of 2011 greenhouse gas emissions) - Electricity production generates the largest share of greenhouse gas emissions. Over 70 percent of our electricity comes from burning fossil fuels, mostly coal and natural gas.
- Transportation (28 percent of 2011 greenhouse gas emissions) - Greenhouse gas emissions from transportation primarily come from burning fossil fuel for our cars, trucks, ships, trains, and planes. Over 90 percent of the fuel used for transportation is petroleum based, which includes gasoline and diesel.
- Industry (20 percent of 2011 greenhouse gas emissions) - Greenhouse gas emissions from industry primarily come from burning fossil fuels for energy as well as greenhouse gas emissions from certain chemical reactions necessary to produce goods from raw materials.
- Commercial and Residential (11 percent of 2011 greenhouse gas emissions) - Greenhouse gas emissions from businesses and homes arise primarily from fossil fuels burned for heat, the use of certain products that contain greenhouse gases, and the handling of waste.
- Agriculture (8 percent of 2011 greenhouse gas emissions) - Greenhouse gas emissions from agriculture come from livestock such as cows, agricultural soils, and rice production.
- Land Use and Forestry (offset of 14 percent of 2011 greenhouse gas emissions) - Land areas can act as a sink (absorbing CO₂ from the atmosphere) or a source of greenhouse gas emissions. In the United States, since 1990, managed forests and other lands have absorbed more CO₂ from the atmosphere than they emit.
- Certain farming practices such as minimal tillage can also act as a carbon sink, effectively locking carbon dioxide in the soil. Put another way, planting trees and cultivating crops are proven ways to literally “green” our environment.

Since 1990, U.S. greenhouse gas emissions have increased by about 8 percent. From year to year, emissions can rise and fall due to changes in the economy, the price of fuel, and other factors. In 2011, U.S. greenhouse gas emissions decreased compared to 2010 levels. This decrease was primarily due to a decrease in the carbon intensity of fuels consumed to generate electricity due to a decrease in coal consumption, with increased natural gas consumption and a significant increase in hydropower used. Additionally, relatively mild winter conditions, especially in the South Atlantic Region of the United States where electricity is an important heating fuel, resulted in an overall decrease in electricity demand in most sectors.

That said, in 2007, fossil fuels accounted for nearly 72 percent of the United States’ electric power production, while hydroelectric power supplied only 5.8 percent and other renewable fuels supplied a mere 2.5 percent, according to the Manhattan Institute. Those are daunting numbers, especially when you factor in Energy Information Administration estimations that fossil fuels and uranium will still provide 85 percent of the nation’s electricity in 2030.

The Q&As of Climate Change

We Ignore The Answers At Our Own Peril

The jury is still out on climate change, yes?

Climate change is real and it is happening now. The U.S. Global Change Research Program, the National Academy of Sciences, and the Intergovernmental Panel on Climate Change (IPCC) have each independently concluded that warming of the climate system in recent decades is “unequivocal.” This conclusion is not drawn from any one source of data but is based on multiple lines of evidence, including three worldwide temperature datasets showing nearly identical warming trends as well as numerous other independent indicators of global warming (e.g., rising sea levels, shrinking Arctic sea ice). Some people have “cherry-picked” a limited selection data to draw broad, unsubstantiated conclusions about the validity of all climate science.

What is the evidence that proves the climate is changing?

The global average temperature increased by more than 1.4°F over the last century. In fact, according to the National Oceanic and Atmospheric Administration (NOAA), the decade from 2000 to 2010 was the warmest on record, and 2010 was tied with 2005 as the warmest year on record. Rising global temperatures have also been accompanied by other changes in weather and climate. Many places have experienced changes in rainfall resulting in more intense rain, as well as more frequent and severe heat waves. The planet’s oceans and glaciers have also experienced changes: oceans are warming and becoming more acidic, ice caps are melting, and sea levels are rising.

In the past, has Earth been warmer than it is today? If so, does that mean we shouldn’t worry about global warming?

There were times in the distant past when Earth was warmer than it is now. However, human societies have developed and thrived during the relatively stable climate that has existed since the last ice age. Due to excess carbon dioxide pollution, the climate is no longer stable and is instead projected to change faster than at any other time in human history. This rapid climate change will expose people to serious risks. Sea level rise, increasing droughts and wildfires in some regions and increasing flooding in others, more heat waves, and other effects of climate change all pose risks to human health, infrastructure critical to our homes, roads, and cities, and the ecosystems that support us.

How can a change of one or two degrees in global average temperatures have an impact on our lives?

Changing the average global temperature by even a degree or two can lead to serious consequences around the globe. For about every 2°F of warming, we can expect to see

- 5-15% reductions in the yields of crops as currently grown
- 3-10% increases in the amount of rain falling during the heaviest precipitation events, which can increase flooding risks
- 5-10% decreases in stream flow in some river basins, including the Arkansas and the Rio Grande
- 200%-400% increases in the area burned by wildfire in parts of the western United States

Global average temperatures have increased more than 1.4 degrees Fahrenheit over the last 100 years. Many of the extreme precipitation and heat events that we have seen in recent years are consistent with what we would expect given this amount of warming. Scientists project that Earth’s average temperatures will rise between 2 and 12 degrees Fahrenheit by 2100.

Is it too late to do anything about climate change?

It is not too late to have a significant impact on future climate change and its effects on us. With appropriate actions by governments, communities, individuals, and businesses, we can reduce the amount of greenhouse gas pollution we release and lower the risk of much greater warming and severe consequences. Many of the actions that we can take to address climate change will have other benefits, such as cleaner, healthier air. In addition, communities can take action to prepare for the changes we know are coming.

Your Next Assignment

Consider The Following, Find Possible Solutions

Climate change, or global warming, is having a short-term impact on the world. Sea levels soon will have increased by one foot. Projections suggest additional increases of two to six feet are possible. Melting glaciers and polar ice caps are releasing water into the oceans. Higher sea levels will drown lowlands and virtually sink the state of Florida. At the same time, Greenland may become ice free. Climate change also is causing more severe weather events, from forest fires to flash floods, droughts to hurricanes. There is a strong link between climate change and the burning of fossil fuels and the subsequent build up of carbon dioxide in the atmosphere. If this is true, is it reasonable to take steps to reduce the use of fossil fuels in favor of renewable fuels?

Discuss these questions and see if you can reach agreement on the answers.

What is likely to happen if we take no action at this time?

The most promising solutions at hand are to reduce burning fossil fuels and increase the use of renewable fuels including wind, hydro, solar, and geothermal. Which of these sources can be implemented quickly and with minimal impact to the American way of life?

Some politicians and organizations say the U.S. is not obligated to take any action to reduce greenhouse gas emissions as long as China or other nations do not take similar actions accordingly. Yet the U.S. uses a disproportionately large amount of energy per person compared to the rest of the world. Is there a good argument for the U.S. going it alone in taking meaningful actions to reduce greenhouse gases?

Gas

A number of U.S. companies, industries, organizations, elected officials and individuals are actively spreading misinformation to discredit global warming. In the 1990s some Americans questioned the value of using tax dollars to look for asteroids that potentially could hit Earth and cause severe damage if not completely leaving the world uninhabitable. But in early 2013 a meteorite that blazed over Russia within hours of a 150-foot asteroid coming within 18,000 miles of Earth (inside the orbit of the moon and even within the orbit of some satellites) caused people worldwide to take renewed interest in the risks of global damage due to natural events. What might be the best way to elevate interest in truly understanding climate change and considering actions to slow down, stop, or even reduce the emissions of greenhouse gases?

Is there a pressing need for Renewable Fuels Standards to encourage Americans to shift to renewable fuels? If so, how do we convince Congress, energy companies, and consumers of why this is in their best overall interest?

The Time For Change Is Now

Points To Ponder Regarding Renewable Fuel Standards

Greenhouse gases trap heat and make the planet warmer. Human activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the last 150 years. The largest source of greenhouse gas emissions from human activities in the United States is from burning fossil fuels for electricity, heat, and transportation.

Why are biofuels so important? When it comes to carbon dioxide emissions, coal is not the worst offender. For the last 15 years, petroleum has been the leading emitter of carbon dioxide in the U.S. Not coal and not natural gas. In reality, coal is used for electricity. The share of U.S. electricity that comes from coal will soon fall below 40 percent for the year, its lowest level since World War II. Four years ago, it was 50 percent. By the end of this decade, it is likely to be near 30 percent, meaning that coal is a decreasing problem. Petroleum is not only the most total carbon-emitting fossil fuel; it is also the most costly. The U.S. spends over twenty times more on oil than on coal. Americans spent more than \$700 billion on oil 2011 alone. The cost of coal to the economy \$30 billion annually. In order to significantly reduce reliance on fossil fuels the greatest returns will come from reducing oil consumption in the transportation sectors. Airlines are testing biofuels. Railroads are testing LP gas and biofuels. The biggest results will come from reducing enormous volumes of gasoline burned in cars, pickups, and SUVs.

Food vs. Fuel

Corn is only a fraction of overall food and grain costs. For every one dollar spent in a grocery store, approximately 3 cents goes to corn-related costs at the farm-- admitted as much when General Mills CFO, Don Mulligan, was quoted in the *St. Paul Pioneer Press* saying that grain was only 5 to 10 percent of the company's total costs. USDA found that biofuels like ethanol were only responsible for .2 percent (point two percent!) of the 4.8 percent increase in grocery bills during the first four months of 2008. Food processing is energy intensive and packaging frequently uses petroleum-based raw materials. Transporting food around the world also requires large amounts of oil. The cost of oil has much more to do with the cost of food to consumers than does the increase in demand for ethanol. Carried to its extreme, one easily could argue that the U.S. should not export any of its crops. Year after year U.S. farmers produce so much wheat, corn, soybeans, and cotton that we export them by the boatload. Corn acres are not "robbing" production from wheat or soybeans. One could argue that "farms" growing grass for golf courses and football fields are causing higher food prices. One could argue that corn fed to cattle and poultry should be directly fed to humans as it is both more economical and environmentally friendly than supporting the production of protein. One could argue that all industrial uses of crops should stop: these products include soy ink and hand lotion. One could argue against growing tobacco, cotton, and Christmas trees.

Free Market vs. Subsidies

Opponents of biofuels say if they are needed the free market will deliver. Shocker: The market is not free. Overlapping monopolies prohibit competition that would reduce fuel prices. The U.S. market is inhibited by a series of interconnected monopolies: automakers that manufacture primarily for gasoline (unlike Europe or Brazil), a fuel distribution system restricted to gasoline only, and government regulations that legislate according to the status quo. Collectively, these cement oil as the fuel source of choice, preventing competition and market innovation and ensuring that consumers continue to pay the high prices of a monopoly. Gasoline has enjoyed the status quo for 100 years. When Henry Ford began producing automobiles he was certain they would be powered by biofuels and the engines were designed accordingly.

Businesses are concerned about their own profit and loss statements. City, county, state, and national government is concerned about the overall well-being of their citizens. This means some policies adopted by government will be enacted for the common good, rather than to benefit a specific industry. With every policy adopted, there will be pros and cons, advocates and opponents, and winners and losers, especially in the short term.

The oil industry itself received government incentives and subsidies in its formative years, and the industry still receives subsidies in the form of tax breaks, incentives, and research. This is not new. The large expense of establishing a new industry in unproven markets has been and continues to be possible largely because city, state, and national governments play a role in "priming the pump." A number of railroads extended lines across the western U.S. because Congress put in place land grant programs to help underwrite both the actual costs and ultimate risks. Airports are owned by their hometown communities, which in effect subsidizes the airline industry. Tax incentives are used to attract new businesses, build sports stadiums, and to enhance health care facilities.

One other thing to keep in mind: Government investment in energy is not singling out one source over another. In 2007, the United States provided \$724 million in subsidies for wind power, \$174 million for solar and \$14 million for geothermal. Yet, in that same year, they also provided \$854 million in subsidies to coal production and nearly \$1.3 billion to nuclear power. Until 2008, most government subsidies went to the fossil fuel industries, according to the Congressional Budget Office.

Is ethanol bad for cars?

In a word, no. After exhaustive studies, the EPA determined E15 is fine for all Flexible-fuel vehicles, all 2001 and newer cars, light-duty trucks, and SUVs.

E15 should not be used in any motorcycles; vehicles with heavy-duty engines such as school buses, transit buses, and delivery trucks; all off-road vehicles, such as boats and snowmobiles; all engines in off-road equipment, such as lawnmowers and chain saws; and all cars, light-duty trucks, and SUVs built prior to 2001.

Is this a problem? No. E15 pumps are clearly identified at gas stations. Gas stations offer several blends of fuels, so the standard fuel will continue to work well in motorcycles as well as in off-road applications such as lawnmowers. Anyone who has a concern about E15 can simply use E10 or regular unleaded gasoline.

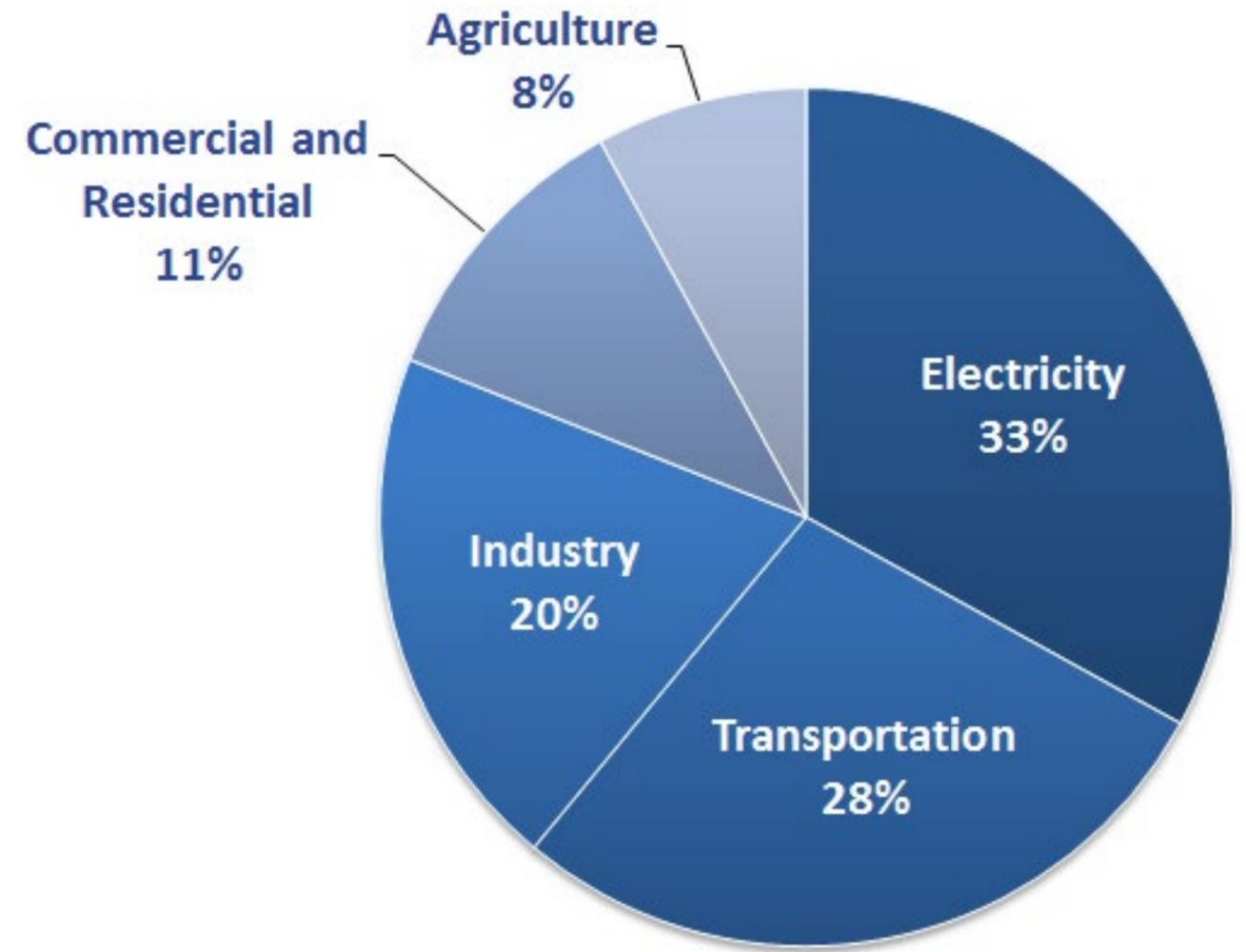
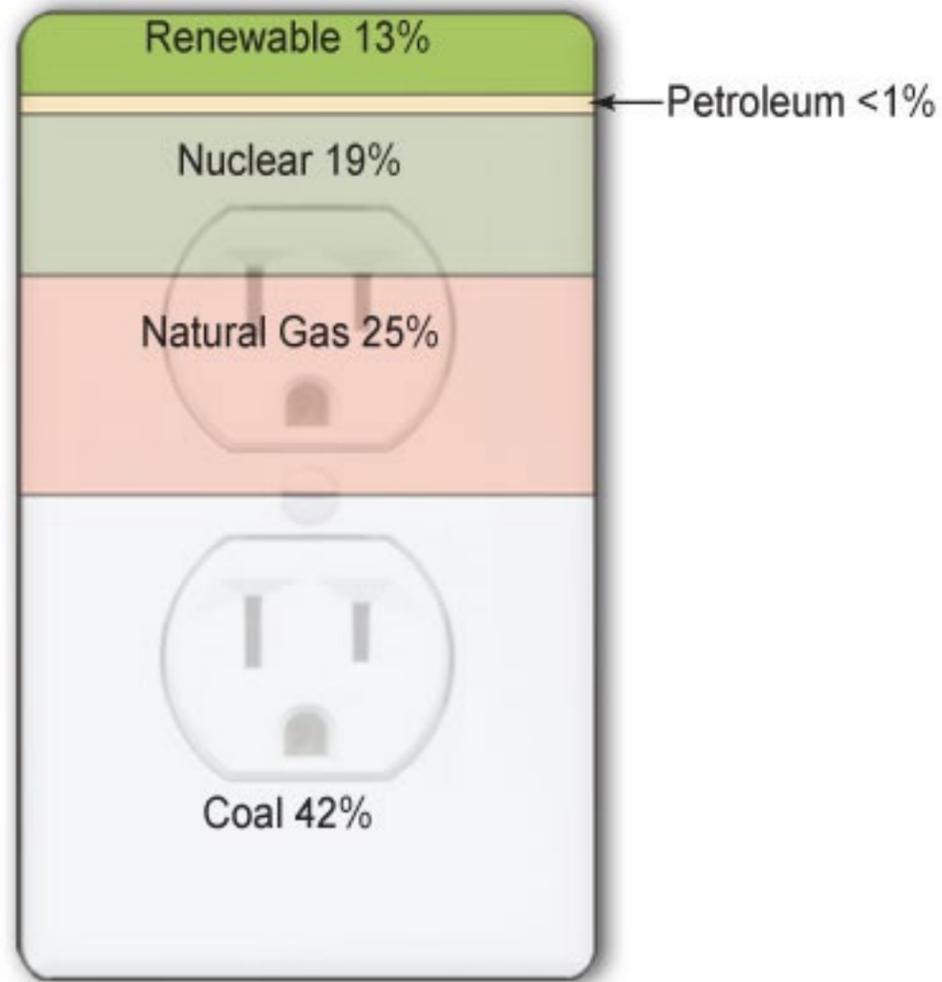
A question remains on how E15 use may affect car warranties, especially for cars built between 2001-07. A test widely referred to by car companies suggested concerns that E15 could cause corrosion in some of the fuel line components. However, that test actually used E20 and thus the results have been called into question. Others have pointed out that most cars built in 2007 and earlier already have exceeded their warranty coverage. The simple solution is not to use the well-labeled E15 fuel in cars not specifically built to E15 standards. Of course, the percentage of cars built to E15 standards will increase as they replace older cars being retired from use. For the record, most gas sold in the U.S. contains 10 percent ethanol. As with any transition, there will be overlaps, just as there have been in so many markets and industries. Both digital and film cameras were in use at the same time. So too were cassette tapes and CDs, radial and bias ply tires, free and cable television. People were able to adapt without any serious issues.

How does ethanol compare to fossil fuels?

A common argument by opponents of ethanol is that it takes 3 gallons of water to make a gallon of ethanol. The suggestion is ethanol uses a lot of water. As compared to what? Gasoline? It takes 13 gallons of water to produce a gallon of gasoline. And, it is common for individuals, industries, and organizations to compare apples to oranges in trying to make their case. This has to do with which inputs are included in the comparison. Does the actual energy cost of making one gallon of gasoline include the cost of drilling, storing, shipping, unloading, refining, transporting, and marketing? Or are advocates only using the refining costs alone?

It is true ethanol has fewer BTUs per gallon than gasoline. It also has a higher octane rating. Vehicles designed to use up to E85 will take advantage of the higher octane rating. The cost of E85 is less than a gallon of gas: the bottom line is E85 can be cheaper per mile in terms of cost. In terms of emissions, E85 emissions of carbon dioxide are 20 percent less than gasoline and have the potential to reach 50 percent less than gasoline.

Sources of U.S. Electricity Generation, 2011



<http://www.epa.gov/climatechange/images/ghgemissions/sources-overview.png>

Renewable Fuel Standards

Growing Our Economy Here At Home

The Renewable Fuel Standard (RFS) program regulations were developed in collaboration with refiners, renewable fuel producers, and many other stakeholders. The RFS program was created under the Energy Policy Act (EPAct) of 2005, and established the first renewable fuel volume mandate in the United States. As required under EPAct, the original RFS program required 7.5 billion gallons of renewable- fuel to be blended into gasoline by 2012.

Under the Energy Independence and Security Act (EISA) of 2007, the RFS program was expanded in several key ways:

- EISA expanded the RFS program to include diesel, in addition to gasoline.
- EISA increased the volume of renewable fuel required to be blended into transportation fuel from 9 billion gallons in 2008 to 36 billion gallons by 2022.
- EISA established new categories of renewable fuel, and set separate volume requirements for each one.
- EISA required the Environmental Protection Agency to apply lifecycle greenhouse gas performance threshold standards to ensure that each category of renewable fuel emits fewer greenhouse gases than the petroleum fuel it replaces.

The latest law lays the foundation for achieving significant reductions of greenhouse gas emissions from the use of renewable fuels, for reducing imported petroleum, and encouraging the development and expansion of our nation's renewable fuels sector.

Since 2002, during the greatest period of ethanol growth, U.S. corn exports increased by 60 percent. Over the past 20 years, the average corn yield has increased by 36 percent, from 109 bushels per acre in 1991 to an estimated 147 bushels per acre in 2011. Results from a study conducted by Informa Economics, Inc. projects the average corn yield to increase another 29% by 2020, to 189 bushels per acre.

Thanks to ethanol, gas prices have been lower, on average, by \$1.09 per gallon which translates into savings of \$1,200 for the average American household. Other benefits include:

- Reducing our reliance on foreign oil to the tune of \$44 billion dollars saved in 2012.
- Supports hundreds of thousands of jobs, including more than 300,000 jobs in 2012 alone.
- Drives innovation in new and advanced fuel from feedstocks like algae or switchgrass.
- Reduces harmful greenhouse gas emissions compared with oil; in the case of "cellulosic" biomass, that difference can range from over 50 percent to 100 percent as compared to oil.

Myths vs. Facts: Let's Get It Right

Big Oil Has Big Profits, Big Market Share At Risk

U.S. energy consumption is expected to grow 50 percent by 2030 and biofuels must continue to play a significant role to diversify our nation's energy sources. As biofuel critics look to derail the efforts for developing renewable fuels, the US Department of Energy has prepared a new fact sheet that dispels a number of myths that keep being repeated.

MYTH: In terms of emissions, biofuels emit the same amount as gasoline or more.

FACT: Biofuels burn cleaner than gasoline, resulting in fewer greenhouse gas emissions, and are fully biodegradable, unlike some fuel additives.

MYTH: Ethanol cannot be produced from corn in large enough quantities to make a real difference without disrupting food and feed supplies.

FACT: Corn-based ethanol is only one source of biofuel. As we address the technical hurdles associated with the efficient and cost-effective production of biofuels, ethanol will increasingly play a more significant role.

MYTH: Ethanol gasoline blends can lower fuel economy and may harm your engine.

FACT: Ethanol blends in use today have little impact on fuel economy or vehicle performance.

MYTH: More energy goes into producing ethanol than it delivers as a fuel.

FACT: Each gallon of corn ethanol today delivers as much as 67% more energy than is used to produce it.

MYTH: 40 percent of corn goes toward ethanol production

FACT: 18 percent of corn goes toward ethanol production. While 40 percent of the corn crop goes into ethanol plants, only the starch is used for ethanol. The rest, which consists of protein, oils and fiber, is used to make distillers' grain, used as animal feed. Thus, the net corn acreage in reality that goes to ethanol is 18 percent.

MYTH: Waiving the RFS would have an immediate impact on corn prices.

FACT: Waiving the RFS would have a minimal effect on corn and feed prices next year. According to a recent study by the Food and Agriculture Policy Research Institute, waiving the RFS would lower corn prices by \$.04 per bushel or .05%, and beef prices would be lowered by .04% or \$.01 per pound. Put another way, that is four cents per bushel and one penny per pound of beef. This study comes on the heels of two other reports this summer from Purdue University and Iowa State University that have concluded that the waiving the RFS would have little to no impact on corn prices. The former Chief Economist for USDA said livestock and poultry producers, along with food processors and retailers, have enjoyed cheap corn at the expense of farmers, adding corn prices were returning the levels more in keeping with the cost of production.

MYTH: World food prices are at record highs because of ethanol.

FACT: According to the Food and Agriculture Organization of the United Nations, the Food Price Index for September 2012 is 216, down from September of 2011, when it was 225. In other words, food prices have decreased by 4 percent at a time when U.S. ethanol production was meeting its production capacity.

Show Up, Stand Up, Speak Out

Your Voice Counts, But Only If You Use It

People live in the moment. Many people have a hard time reflecting on historical lessons and considering the likely impact of predictions for the future. On-line responses to news stories routinely show how ill-informed or unrealistic some people can be when it comes to major issues. Other on-line comments reveal that some Americans hold deeply rooted partisan positions on political issues. These people are more likely to want to argue to prove a point than to consider alternative points of view, or put aside their feelings to focus on facts. In the 1950s, some people were opposed to the Interstate Highway system. Today, few if any Americans would want to return to the two-lane highways designed and built before the 1950s. Changing the culture requires committed and well-informed people who are willing to show up, stand up, and speak out.

When making the case for weaning the U.S. from fossil fuels for environmental and economic reasons, it is important to recognize there will be opposing points of view. Individuals, organizations, elected officials, industries and will take issue with any policies that will negatively impact them. It takes time to change the culture of Americans. In the 1970s motorists complained that using child safety seats was an inconvenience and the seats were ineffective. By the 1990s, one generation later, motorists would cringe at the thought of driving with unsecured children. What caused this change? Safety seats became more effective due to ongoing research and redesign. Hospitals gave away free safety seats to build acceptance. States passed laws mandating the use of safety seats. Incentives, mandates, and product improvements all contributed to changing things for the better.

Unfortunately, we live in a time when America is more polarized than ever. The concept of compromise and cooperation have been trampled by a strong “I am right, you are wrong” attitude. It is far easier for some people and organizations to do nothing or to disagree than to craft real solutions by working within the time-tested public policy development embraced by the United States.

Discuss these questions and see if you can reach agreement on the answers.

The renewable energy industry is making significant advances thanks to ongoing research and improving technology. How might we explain to people that Renewable Fuels Standards will help us better develop viable, affordable, and essential biofuels?

When we obtain ethanol from the Midwest that offsets oil from the Middle East, what are the benefits to America?

How might we explain that ethanol does not create a food vs fuel conflict?

Some of us may remember waiting in line on odd numbered days just to buy 10 gallons of fuel in 1974. How might today's Americans respond to this type of situation? Is it better for our economy to make a gradual or abrupt transition when the next fuel crisis hits?

In future years Congress will revise the current Renewable Fuel Standards. As these standards become more successful, there will be efforts by some to reduce or eliminate them. What can we do to make sure Renewable Fuel Standards are not watered down or outright eliminated?

The Hidden Cost Of Fuel

It's Hard To Defend Importing Oil From The Mideast

Fossil fuels—coal, oil, and natural gas—are America's primary source of energy, accounting for 85 percent of current U.S. fuel use. Some of the costs of using these fuels are obvious, such as the cost of labor to mine for coal or drill for oil, of labor and materials to build energy-generating plants, and of transportation of coal and oil to the plants. These costs are included in our electricity bills or in the purchase price of gasoline for cars.

But some energy costs are not included in consumer utility or gas bills, nor are they paid for by the companies that produce or sell the energy. These include human health problems caused by air pollution from the burning of coal and oil; damage to land from coal mining and to miners from black lung disease; environmental degradation caused by global warming, acid rain, and water pollution; and national security costs, such as protecting foreign sources of oil.

Since such costs are indirect and difficult to determine, and since the producers and the users of energy do not pay for these costs, society as a whole must pay for them. In brief, here are the key “hidden” costs of using fossil fuels.

Global Warming

Among the gases emitted when fossil fuels are burned, one of the most significant is carbon dioxide, a gas that traps heat in the earth's atmosphere. Over the last 150 years, burning fossil fuels has resulted in more than a 25 percent increase in the amount of carbon dioxide in our atmosphere. Since reliable records began in the late 1800s, the global average surface temperature has risen 0.5-1.1 degrees Fahrenheit. Scientists with the Intergovernmental Panel on Climate Change concluded in a 1995 report that the observed increase in global average temperature over the last century “is unlikely to be entirely natural in origin” and that “the balance of evidence suggests that there is a discernible human influence on global climate.”

Climate scientists predict that if carbon dioxide levels continue to increase, the planet will become warmer in the next century. Projected temperature increases will most likely result in a variety of impacts. In coastal areas, sea-level rise due to the warming of the oceans and the melting of glaciers may lead to the inundation of wetlands, river deltas, and even populated areas. Altered weather patterns may result in more extreme weather events. And inland agricultural zones could suffer an increase in the frequency of droughts.

Air Pollution

Clean air is essential to life and good health. Several important pollutants are produced by fossil fuel combustion: carbon monoxide, nitrogen oxides, sulfur oxides, and hydrocarbons. In addition, total suspended particulates contribute to air pollution, and nitrogen oxides and hydrocarbons can combine in the atmosphere to form tropospheric ozone, the major constituent of smog.

Carbon monoxide is a gas formed as a by-product during the incomplete combustion of all fossil fuels. Exposure to carbon monoxide can cause headaches and place additional stress on people with heart disease. Cars and trucks are the primary source of carbon monoxide emissions.

Two oxides of nitrogen—nitrogen dioxide and nitric oxide—are formed in combustion. Nitrogen oxides appear as yellowish-brown clouds over many city skylines. They can irritate the lungs, cause bronchitis and pneumonia, and decrease resistance to respiratory infections. They also lead to the formation of smog. The transportation sector is responsible for close to half of the U.S. emissions of nitrogen oxides; power plants produce most of the rest.

Sulfur oxides are produced by the oxidization of the available sulfur in a fuel. Utilities that use coal to generate elec-

tricity produce two-thirds of the nation's sulfur dioxide emissions. Nitrogen oxides and sulfur oxides are important constituents of acid rain. These gases combine with water vapor in clouds to form sulfuric and nitric acids, which become part of rain and snow. As the acids accumulate, lakes and rivers become too acidic for plant and animal life. Acid rain also affects crops and buildings.

Finally, fossil fuel use also produces particulates, including dust, soot, smoke, and other suspended matter, which are respiratory irritants. In addition, particulates may contribute to acid rain formation.

Water and Land Pollution

Production, transportation, and use of oil can cause water pollution. Oil spills, for example, leave waterways and their surrounding shores uninhabitable for some time. Such spills often result in the loss of plant and animal life. Coal mining also contributes to water pollution. Coal contains pyrite, a sulfur compound; as water washes through mines, this compound forms a dilute acid, which is then washed into nearby rivers and streams.

Coal mining, especially strip mining, affects the area that is being mined. Characteristically, the material closest to the coal is acidic. After the mining is completed, the land will remain barren unless special precautions are taken to ensure that proper topsoil is used when the area is replanted. Materials other than coal are also brought to the surface in the coal mining process, and these are left as solid wastes. As the coal itself is washed, more waste material is left. Finally, as the coal is burned, the remaining ash is left as a waste product.

National Security Impacts of Fossil Fuel Use

Our nation's fossil fuel dependence means that, to ensure our supply, we may be forced to protect foreign sources of oil. The Persian Gulf War is a perfect example: U.S. troops were sent to the Gulf in part to guard against a possible cutoff of our oil supply. Not only were billions of dollars spent in protecting the oil, but lives were lost as well. Although the war is over, through taxes we are continuing to pay for protecting oil supplies with our armed forces. Estimates for what the U.S. spends to provide military protection of shipments of oil from the Mideast range from \$50 billion annually. This cost is not reflected in the price we pay for fuel. Nor is the cost of the economic shocks of fuel supply disruptions. Reliance on Middle East oil also creates a danger of fuel price shocks or shortages if supply is disrupted. Today, about one-third of our oil comes from the Middle East. By 2030, if we do not change our energy policy, we may be relying on Middle East oil for two-thirds of our supply. (Fracturing techniques being used in the U.S. and Canada to obtain oil from horizontal drilling may reduce the nation's dependence on foreign oil, yet it means Americans will continue to burn fossil fuels with all the attendant problems.)

