



Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2013 Volume III: Sustainability: Means or Ends?

The Cost of Our Futures: Oil Markets and Government Intervention

Curriculum Unit 13.03.04
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Introduction

The following unit was specifically designed to fit within the Advanced Placement (AP) Microeconomics framework. AP Microeconomics is the high school equivalent to a college Introduction to Microeconomics course (Econ 101). The course familiarizes students with key economic principles like the laws of supply and demand, market structures and market efficiency. Throughout the year, the AP content focuses primarily on market structures and market efficiency, with little discussion of how to overcome inefficiencies that arise. The culminating unit in the curriculum, however, delves into the topics of externalities and government intervention. The curriculum attempts to answer the questions:

1. What is market failure, and why does it arise?
2. How can market failure be overcome?
3. What role does the government play in overcoming market failure?

For the first time, students are encouraged to not only ask whether a market is producing at an allocatively efficient level of output, but also at a socially efficient level of output. When the private market yields an under- or overproduction of goods and services, how does the government attempt to intervene so as to shift production closer to the socially efficient level of output? In other words, how does the government regulate markets so society is better off? For once, the focus is not on profit maximization, but maximizing social utility.

To answer these questions, students will explore several markets, including the markets for fishing, energy, public education, housing, and labor. These topics have been chosen to demonstrate the breadth at which the key economic concepts affect society. Students will cycle through a set of stations to learn more about each topic. By the end of this unit, students should not only be able to explain the theory behind each of the economic concepts, but provide context to the theories. What is outlined in this specific curricular unit is merely the section on energy, with a focus on petroleum consumption. Background information includes

explanations of the overarching content (classification of goods and services, externalities, social efficiency, levels of production, and regulation) and relevant research on greenhouse gases, their externalities, and the current regulations that exist within the market.

Students will essentially take on the role of policy makers. Their job is simple in premise: to identify strategies for regulating the energy market. What regulations currently exist? How effective are these regulations? What makes these regulations either effective or ineffective? To aid in their research, students will read Chapters 10 and 11 in Bade and Parkin's *Foundations of Economics AP* Edition*.

This unit is graph intensive and requires students to interpret and analyze graphs of various markets and how government regulation impacts these graphs.

Unit Rationale

College Board, the company that runs the AP program, creates clear expectations for what constitutes a college-level class. In fact, they have minimum requirements to even allow a teacher to label his class "AP." Despite these requirements, though, College Board prefers to remain detached from the curricular side of teaching; they provide the content, but give full freedom to teachers to determine *how* to teach the material. Consequently, developing a curriculum is perhaps the most difficult aspect of teaching an AP course. Not only must the teacher teach the content, but he must also figure out strategies for helping students understand highly theoretical concepts within an engaging framework. This became my challenge in the 2012-2013 academic year.

Due to the highly theoretical framework of the content, I wanted to create a unit that would help my students develop a deeper understanding of the context surrounding the economic concepts we learned. AP Microeconomics tends to be highly conceptual and even more theoretical. The content often depicts theoretical extremities to illustrate perfect scenarios along the spectrum of market structures (i.e. perfect competition or perfect monopolies). By understanding the extremes of the spectrum, students more easily grasp the subtle transitions and differences along the market structure spectrum (i.e. monopolistic competition and oligopoly). Although market structures like monopolistic competition and oligopoly are more practical and readily seen, a much greater emphasis is placed on the extremes and much less realistic market structure of a perfectly competitive firm and the slightly more realistic structure of a monopoly.

In this unit, students will examine economic content within the context of the petroleum market. Students will learn how subsidies incentivize production and consumption of products and that while the role of government intervention in the economy is to move production toward social efficiency, that the government often overlooks marginal costs to society in order to provide increased marginal benefits. That is, tangible benefits to society, like increased production, which can partly be measured by an increase in gross domestic product (GDP), often outweigh intangible costs to society, like global warming and future negative environmental impacts. Students will debate the extent to which the government should intervene. Should the government prioritize innovation and promote alternative renewable energy sources or should it focus on growing the economy in whatever way is most efficient given the resources we have right now?

Unit Objectives

This unit proposes several large topics for students to consider. Thus far, students have studied larger topics like market structure, supply and demand, elasticity, consumer theory, and profit maximization. Students have become experts at identifying whether a market is allocatively efficient or not, but have yet to discuss how economics is used to combat inefficiency within the markets. The essential questions for the unit are thus

1. How can the government regulate the markets to increase the efficiency of the markets?
2. How do government regulations (specifically taxes and subsidies) impact the output levels of firms?

The primary objectives of the unit are for students to be able to...

1. Differentiate between and identify examples of public goods, private goods, common resources, and goods created by natural monopolies;
2. Define and differentiate between positive and negative externalities;
3. Sketch graphs of various product markets that illustrate the existence of an externality;
4. Define and identify what is socially efficient on a graph verses what is efficient within the private market;
5. Differentiate between and explain the impacts of government-imposed taxes and subsidies (per-unit and lump-sum); and
6. Identify what type of government regulation could theoretically be imposed to produce a desired economic effect.

Unlike previous units in the class where students have been instructed to not take a position, but to study the economics from a theoretical standpoint instead of a political one, students will be asked to debate the role of the government in the petroleum and energy markets. Given the many externalities that exist, students will attempt to answer the question "What is the cost of our futures?" Students will debate what role the government should play in regulating the energy market.

Overview and Background Information

Classification of Goods and Resources within the Product Market

The product market is divided into the production of four types of goods: public goods, private goods, common resources, and club goods (goods produced by natural monopolies). The classification of a good depends upon two characteristics: whether the good is rival or non-rival and whether the good is excludable or non-excludable. *Rival goods* are goods in which the consumption by one consumer decreases the total quantity available. Each unit of the good can only be used once. These goods are often known as zero-sum goods; one person cannot gain (+1) without another losing (-1). *Excludable goods* are goods that are not available to everyone, usually due to cost or regulation. Goods that aren't free are considered excludable because you can only use or have the good if you are willing to buy it.

Goods that are both rival and excludable are known as *private goods*. Because producers usually produce a limited supply (or simply because there are limited resources and unlimited wants), most goods (especially in a capitalist society like that of the US) are private goods. Examples may include the clothes you wear, the x-box you got for Christmas last year, the food you eat, the car you drive, and the house you live in. The rival nature of private goods is easily seen during the holiday season when parents wait for hours outside Toys 'R Us on Black Friday for this year's "hot toy" only to find that the person in front of them got the last one. Some stores might even mark-up the toy, reiterating the exclusive nature of the product.

Goods that are rival, but non-excludable are known as *common resources*. Common resources display the same limitations to supply that are characteristic of most goods we consume, but are available to everyone. Free samples, fish stocks in the ocean, and campsites at a free public park are all examples of common resources.

Club goods are those goods and services produced by natural monopolies and are non-rival, but excludable. Some of the best examples we have come in the form of cable television, the Internet, toll roads, and bridges. Each of these services can be offered to as many people as are willing to pay for the right to use the service.

Public goods are those goods and services that are both non-rival and non-excludable; they are available to everyone and one person's use does not prevent someone else's use. Examples of public goods might include parades, monuments, public roads, education, and national defense. Notice that most of these goods and services are offered free to the public by the government. These goods are often referred to as "social goods" because the government provides them to meet certain social needs of the public.

Some goods don't fit squarely into one of the four classifications of goods. Private goods that produce externalities are known as *mixed goods*.

Externalities and Social Efficiency

Externalities are costs or benefits of a good or service that are experienced by someone other than the person consuming that good or service. Two types of externalities exist: positive and negative.

The benefits someone receives from consuming one additional unit of a good is known as the marginal private benefit, often abbreviated MB. *Positive externalities* are the benefits others gain from someone consuming a product. For example, say that every child at your school has received a flu vaccine except you. The chances

that you will catch the flu diminish greatly because everyone else has been vaccinated; if no one else can get the flu, who can give it to you? Let's say your neighbor plants a bunch of aromatic flowers in her garden. During the spring the flowers bloom and produce a beautiful aroma enjoyed by the entire neighborhood. Since only your neighbor paid for the good, everyone else is receiving a free benefit. These benefits are known as "social benefits." People that enjoy social benefits without paying for them are known as *free riders*.

The costs someone assumes from consuming one additional unit of a good is known as the marginal private cost, often abbreviated MC. *Negative externalities* are costs to others beside those consuming the good. Examples include pollution, secondhand smoke, potholes, noise pollution, traffic, and light pollution. Negative externalities are often referred to as "social costs."

Marginal social benefits (*MSB*) and marginal social costs (*MSC*) are the marginal total benefits and costs, respectively, received by consumption of the next unit of the good. Specifically, $MSB = MB + \text{positive externalities}$; that is, the marginal social benefit is equal to the marginal benefit received by the consumer of the good plus the social benefit received by any free riders. $MSC = MC + \text{negative externalities}$; that is, the marginal social cost is equal to the marginal cost received by the consumer of the good plus the social cost received by the rest of society. Because MSB is comprised of the private and social benefits, $MSB > MB$. Similarly, $MSC > MC$. This relationship is depicted in Figure 1.

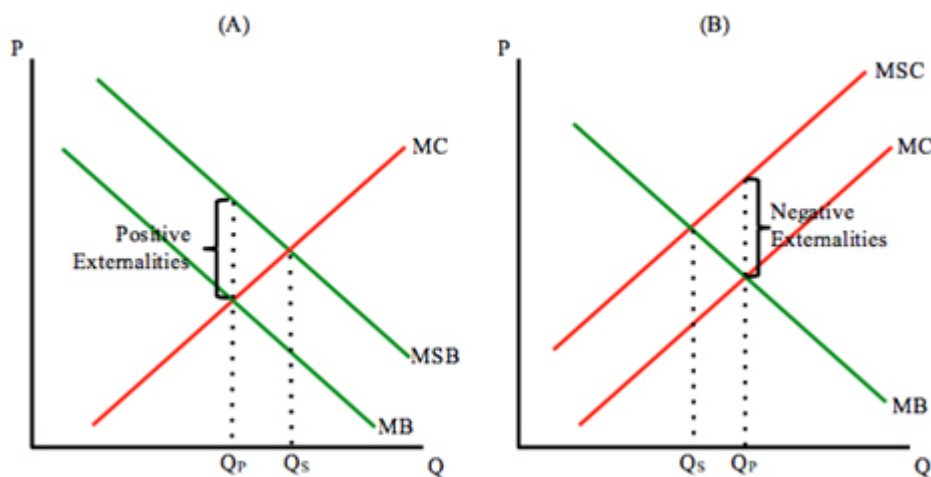


Figure 1: (A) Product market given the existence of positive externalities. (B) Product market given the existence of negative externalities.

Social efficiency is a balance between the private sector of a market and society and must be viewed from two angles. Where positive externalities exist, social efficiency occurs where the private costs balance out the additional benefits received by society; that is, where $MSB = MC$. If $MSB > MC$, as seen in Figure 1A, there exists an incentive for society to increase production until social efficiency is reached at a quantity of Q_s . Where negative externalities exist, social efficiency occurs where the private benefits balance out the social costs; that is, where $MSC = MB$. If $MSC > MB$, as seen in Figure 1B, there exists an incentive for society to decrease production until social efficiency is reached at a quantity of Q_s . Due to the nature of these relationships, we can assume that goods and services that produce positive externalities are naturally under-produced by the private sector (illustrated in Figure 1A as $Q_s > Q_p$) while those that produce negative externalities are naturally over-produced by the private sector (illustrated in Figure 1B as $Q_s < Q_p$).

Government Regulations

How is social efficiency achieved if its level of output differs from the natural level of output produced by the private market? Back in 1776, economist Adam Smith suggested that the best way to regulate a market was to leave it alone and let the market self-regulate: the invisible hand of supply and demand would govern markets. Depending upon what political side of the economic spectrum you lie, you may have varying opinions about the extent to which governments should be involved. This debate is left for discussion in AP United States Government and Politics. AP Microeconomics, given no political affiliation, studies the government's ability to regulate these markets. We will focus our attention on the two main types of government regulation: taxes and subsidies.

Taxation is a government regulation in which the government collects money for the production or consumption of a good or service. The tax is meant to serve as a disincentive to either produce or consume as it essentially increases the cost. Many types of taxes exist. We will, however, only focus on excise and sales taxes. An *excise tax* is a tax to the producer of a good or service. A *sales tax* is a tax to the consumer of said good or service. You might recall from our study of elasticity that both the consumer and producer, regardless of who is actually being taxed, share the tax burden. This is evident by changes in the consumer and producer surplus. Figures 2A-B illustrate the effects of a tax on the quantity supplied and demanded within the market.

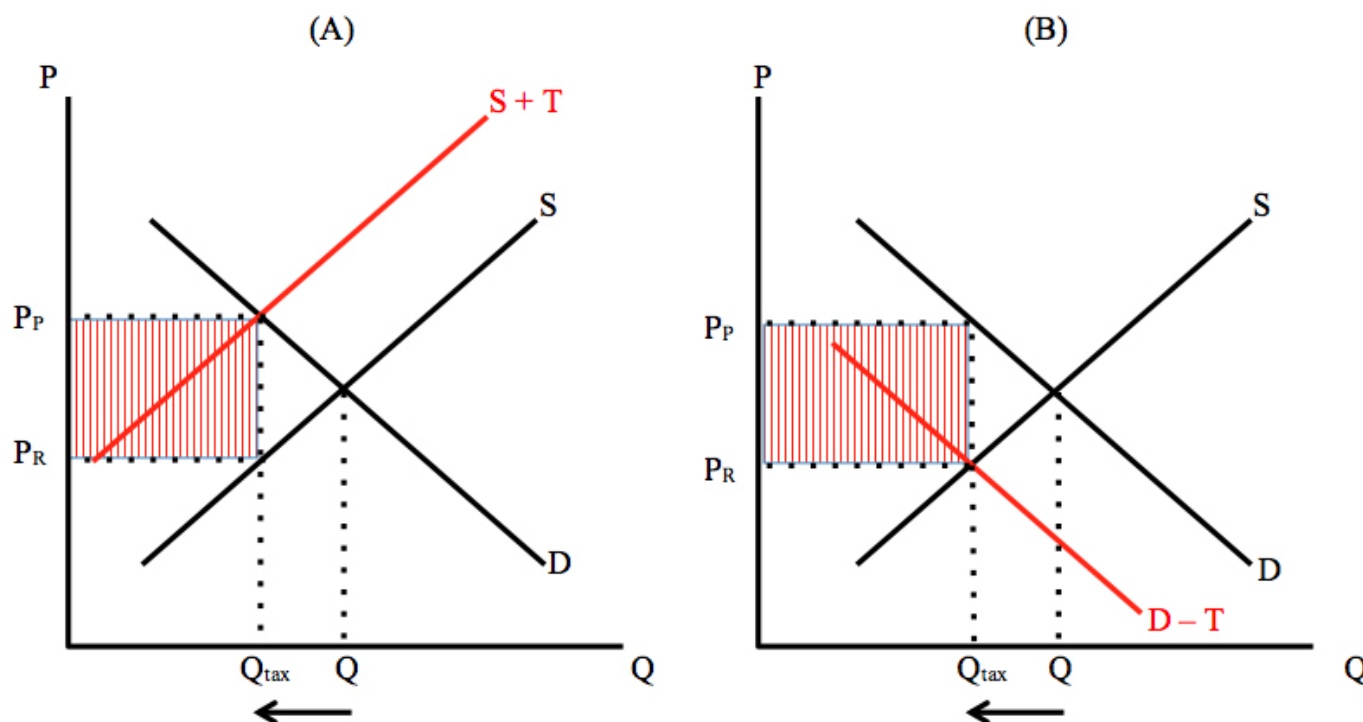


Figure 2: (A) Product market given the existence of an excise tax. (B) Product market given the existence of a sales tax. Note that regardless of the type of tax, both result in a decrease in the output level. This decrease illustrates how a tax acts as a disincentive to produce or consume.

Remember that the supply curve represents the lowest combination of prices that a producer is willing to sell its product for at a given level of output. Therefore, an excise tax is depicted at $(S + T)$. For a producer, an excise tax is similar to the price of an input increasing, which explains why the $(S + T)$ curve resembles a decrease in supply. Conversely, demand represents the highest combination of prices that consumers are willing to purchase a product for at a given level of output. A sales tax is thus depicted as $(D - T)$. For a

consumer, a sales tax is similar to a decrease in income, which explains why the $(D - T)$ curve resembles a decrease in demand.

To understand why the decrease in output in the market occurs, one must understand what happens to individual firms. When a tax is incurred, the new equilibrium price is not the price received by the firm (P_R), but rather the price paid by the consumer (P_P). The price received by the firm is actually lower at P_R , where the new equilibrium quantity hits the original supply curve. The shaded region between S and $(S + T)$ is the tax amount collected by the government. Because price falls, the marginal revenue (MR) for individual firms also falls.

Excise taxes have further sub-classifications: per-unit and lump sum. A *per-unit tax* is a tax on each unit a firm produces while a *lump sum tax* is a single tax payment whose value is not determined by the total quantity produced by the firm. The type of excise tax often depends on policy makers and which type they believe they can get passed and which type would serve as a more effective disincentive to produce. What is the economic effect on companies? Per-unit taxes primarily affect the marginal cost (MC) while lump sum taxes affect the fixed costs (FC).

Since the lump sum tax (depicted in Figure 3A) only affects a firm's profits by increasing the average total cost (ATC = AFC + AVC), no decrease in an individual firm's output is seen. The decrease in profits may serve as an incentive for some firms to leave the market, which would decrease the overall level of production in the market. If nothing else, the decrease in profits would at least serve as a deterrent for other firms to enter the market, thereby slowing the production of the good or service.

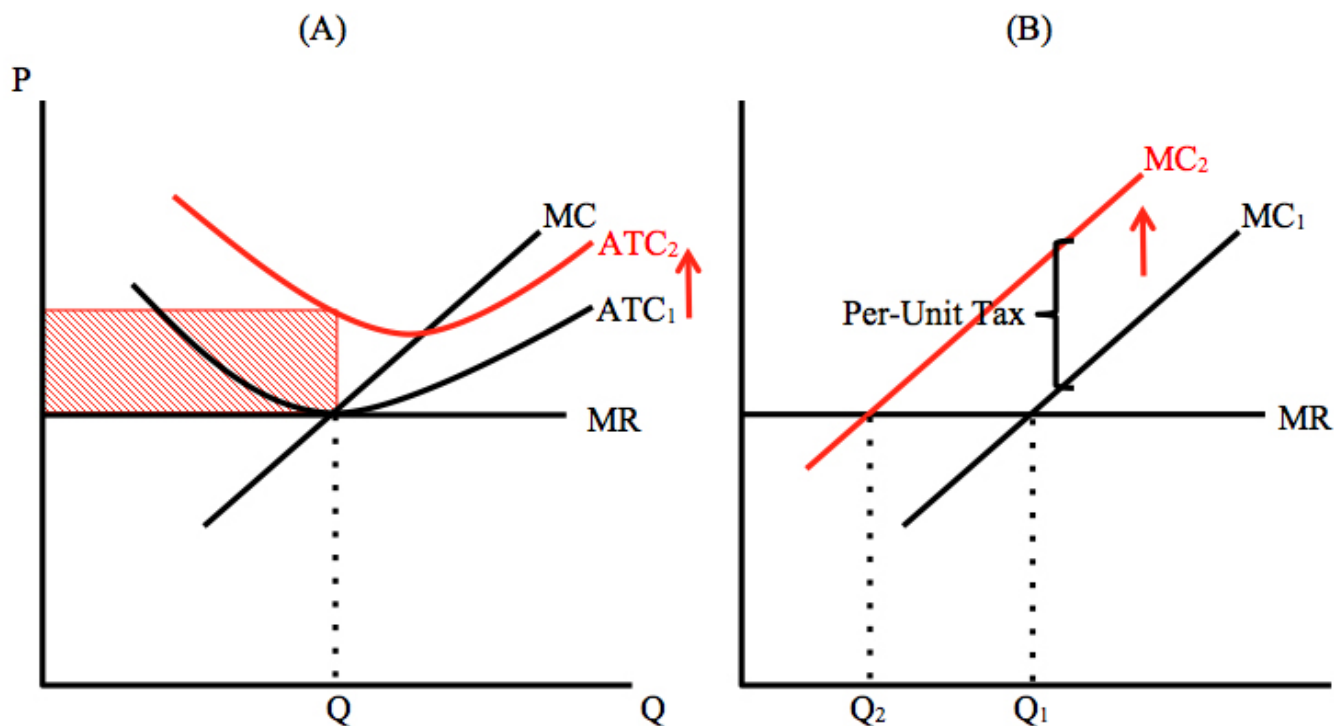


Figure 3: (A) A firm's supply and demand curves given a lump sum excise tax. The shaded region represents the area of economic loss that results from the tax. No decrease in output results from a lump sum tax. (B) A firm's supply and demand curves given a per-unit excise tax. Because the MC is affected, a decrease in the quantity produced occurs. This type of regulation results in decreased production.

Figure 3B illustrates the effects of a per-unit tax on the firm. Remember that profit maximization occurs where $MR = MC$. Because a tax increases the MC curve, the profit-maximizing level of output falls (the desired effect of the tax).

Subsidies are a government regulation in which the government pays money for the production or consumption of a good or service and have the opposite effect as a tax. The subsidy incentivizes production or consumption by decreasing the cost. Like with taxes, however, the way in which a subsidy will affect the cost depends on whether the subsidy is either a per-unit or lump sum subsidy. As with taxes, the government can choose to subsidize either the producer or the consumer. Unlike a tax, however, the per-unit subsidy decreases the MC and the lump sum decreases the FC, and in turn, the ATC. Both the per-unit and lump sum subsidy result in an increase in the level of production.

Greenhouse Gases (GHGs) and Externalities

Greenhouse gases are chemical compounds that allow sunlight to freely enter Earth's atmosphere. Carbon dioxide is the most widely thought of GHG. Carbon dioxide and the other GHGs are natural components of the atmosphere, but when their levels build up, the gases absorb more infrared radiation and trap heat in the atmosphere causing the planet's temperature to slowly rise.(1) This reaction is known as the Greenhouse Effect and has caused the earth's average temperature to rise by 1.4°F over the last century.(2) While carbon dioxide concentrations are naturally regulated by the carbon cycle, human activities that release carbon dioxide into the atmosphere disturb the cycle and are the largest contributors to the Greenhouse Effect.(3) If humans continue to pump high levels of carbon emissions into the atmosphere (through activities like driving), scientists expect Earth's temperature to rise by another $2\text{--}11.5^{\circ}\text{F}$ over the next century.(4)

The invention of the automobile has been one of the primary facilitators of economic growth and sprawl. Because of the relative cheapness and availability of cars, urban sprawl has increased dramatically. According to a report from the 2012 US census, 8.1% of Americans have commutes of 60 minutes or longer.(5) With increased sprawl comes an increased dependence on fossil fuels like petroleum, which is a well-known source of greenhouse gases. In fact, according to the Environmental Protection Agency (EPA), 28% of greenhouse gas emissions in 2011 can be attributed to automobiles.(6) Greenhouse gas emissions from transportation have increased by about 18% from 1990-2004.(7)

Gasoline consumption is a primary contributor to the increase of GHGs and consequently global climate change. Drivers are the single largest source of GHG emissions worldwide, accounting for approximately 22% of all human-generated emissions.(8) Carbon dioxide can linger in the atmosphere for around a century, so the effects of US emissions will easily be felt for generations. Clifford Cobb, author of "The Roads Aren't Free," estimates the damage caused by US emissions to be around \$66 billion each year.(9)

Temperature change greatly affects the world's climates, which can in turn have devastating effects to society. Ocean temperatures rise at a much slower rate (0.18°F over the last century) than temperatures on land, but marine ecosystems tend to be more sensitive to these changes. Coral, which provides a marine habitat for countless sea creatures, is more likely to die off as ocean temperatures rise. Krill, a major food source at the base of the food chain, reproduce at a slower rate. As food sources are affected, larger predators are affected, and human food sources become less prevalent. Invasive species and marine diseases are also more likely to spread.(10)

Apart from affecting the environment and food sources, climate change can have serious health implications

within the human population. In 2003, Europe experienced its worst heat wave in probably 500 years with nearly 22,000-45,000 heat-related deaths.(11) Heat related deaths are expected to increase in number as more cities become urban heat islands (areas with "increased heat storage and sensible heat flux caused by the lowered vegetation cover, increased impervious cover and complex surfaces of the cityscape").(12) Additionally, global warming directly impacts crops, as rising temperatures are generally associated with more frequent drought. Elevated temperatures can also change the ecology of plant pathogens. But the spread of disease is not only a concern for food crops, but for humans more directly as well. According to Jonathan Patz, author of "Impact of Regional Climate Change on Human Health," disease-spreading organisms have lifespans and reproductive functions that are affected by temperature. As temperatures increase, organisms like protozoa, bacteria, and viruses reproduce and spread more rapidly. The World Health Organization, using the Hadley Centre Global Climate Model, has estimated that the "climate-change-induced excess risk of the various health outcomes will more than double by the year 2030 (Patz, 314).

The societal and environmental impacts of global warming are vast. So what steps is the government taking to help eliminate these negative externalities? How can the government help the producer and consumer externalize intrinsic costs to society? Taxation is the obvious regulation, and yet fossil fuel subsidies abound.

Government Regulations Support Fossil Fuels?

The United States government attempts to regulate the energy market using several of the economic concepts discussed earlier. For example, consumers and producers can both receive subsidies (tax breaks) for green efforts like purchasing fuel-efficient cars. But not all government regulation is efficient. In fact, many regulations intend to provide improvements to the standard of living without regard to maximizing the allocatively efficient usage of our limited resources; that is, they don't weigh the marginal costs to society against the marginal benefits to society.

The government continues to subsidize driving, petroleum and other fossil fuels despite the negative impacts associated with increased carbon dioxide emissions. Why? Because Americans have become so dependent on automobiles, the government feels obliged to keep gas prices as low as possible. To accomplish this task, the government subsidizes the protection and reservation of foreign oil for American consumption. By protecting American rights to foreign petroleum, America is able to reduce foreign competition for resources and keep prices lower. Another way in which the government attempts to protect the American consumer is to maintain a large petroleum reserve. The US Strategic Petroleum Reserve is the world's "largest stockpile of government-owned emergency crude oil" with approximately 727 million barrels on reserve.(13) This stockpile is meant to protect the American consumer from exorbitant price hikes in the case that international supplies become unavailable for some reason. In 1999 when gas prices ranged between \$0.94 and \$1.22 with an average cost of \$1.13 in the US,(14) Cobb estimated gas prices to be subsidized by approximately \$1.60 per gallon of gasoline,(15) subsidizing gasoline by more than 50% of the cost.

According to a study completed by the Environmental Law Institute (ELI) from 2002-2008, the federal government provided almost 2.5 times as many subsidies for fossil fuels (\$72 billion) than for renewables (\$29 billion).(16) One of the biggest distinctions the ELI draws between subsidies for the two types of energy is that those for fossil fuels were long term and written into the US Tax Code as permanent provisions while those for renewables were short term, time-limited initiatives that had to be implemented through other energy bills.

The government provides what many would consider to be contradicting policies. On one hand, the government wants to increase productivity by lowering the cost of transportation and allowing its citizens to commute to work, but on the other hand, the government is also responsible for the social welfare of its

citizens. But how do we measure the quality of life? What is the cost of our futures?

Specialists agree that simply taxing gasoline or removing the currently existing subsidies will have negligible effects on the demand for petroleum in the long run. Instead, such regulations would promote innovation of more fuel-efficient cars. Americans would still be highly dependent on fossil fuels, however.

Concept List

By the end of the unit students should be able to define and explain each of the following concepts:

1. Renewable energy
2. Nonrenewable energy
3. Public good
4. Private good
5. Club good
6. Common resource
7. Positive and negative externality
8. Free rider
9. Per-unit tax and subsidy
10. Lump sum tax and subsidy
11. Social efficiency
12. Marginal benefit (MB) and cost (MC)
13. Marginal social benefit (MSB) and cost (MSC)
14. Marginal private benefit (MPB) and cost (MPC)
15. Deadweight loss
16. Consumer surplus

Teaching Strategies

Students will move through this curricular unit by beginning with content and slowly progressing by adding context to the content. Students will watch instructional videos, listen to lectures and podcasts, complete explorations, and watch a documentary to better learn content and context for this unit. The explorations are key components to the unit in that they help students derive specific effects caused by taxes and subsidies. You may want to split your students into small groups when working on explorations so students can run ideas by one another and check each other's work. When students begin preparing for the debate that will happen at the end of the unit, students may choose to complete their research individually or in groups. I recommend that students divide their research into multiple parts, begin their research individually, and share back with their debate team. This will minimize the amount of work each individual must do.

Suggested Materials

1. Chart paper and markers
2. Computer with internet access
3. Explorations provided in lesson plans

Lesson Outline and Navigating the Class Website

Lesson 1: Marginal Social Benefit (MSB) and Marginal Social Cost (MSC)

Lesson Objectives

Students will be able to...

1. Differentiate between marginal social benefit and marginal social cost;
2. Sketch a graph of a market for a product that yields a positive or negative externality and decipher whether the product is being over or under-produced;

Posing Question and Initial Impressions

Begin the first lesson by posing a question to the students. This question is meant to present context before content in order to help students understand why they are studying this topic in the first place. This unit presents interesting contrasts between the role that the government should theoretically play and the role

that the government actually plays in promoting the general welfare of society. The posing question is...

"Should the government promote goods and services that society generally perceives as 'bad' (these products are often known as 'bads' instead of 'goods')? To what extent?"

Allow the students to discuss this question generally at first. You may want to pose some of the following questions to help students answer this question a little more deeply. What types of things might society perceive as bad? Crime? Pollution? Pornography? Drugs? Violence? Is there a market for any of these "bads"? Do society receive any benefits, however small, from any of these markets? Once students have had the chance to discuss whatever bads they thought of within the posed question, ask students to consider a good that is often perceived of as a bad: petroleum.

Petroleum Think-Pair-Share

Students will complete a quick think-pair-share and consider the question: "What are the pros and cons of petroleum consumption?" Students will be asked to create a simple graphic organizer (t-table) that lists the pros on the left and the cons on the right. An example of a student response might be

Pros	Cons
Transportation Fuel/energy source	Releases GHG Contributes to global warming

After one minute, ask students to pair up and merge their lists. Then, have them brainstorm together for another two minutes to try and come up with more answers. Finally, draw the graphic organizer on the board and ask groups to share out. Students can come to the board to list their pros and cons. During the share portion of the think-pair-share, ask students which list seems longer: the pros or the cons?

Now return to the original posed question: "Should the government promote products and services that society generally perceives as 'bad'? To what extent?" What about petroleum? Petroleum is known to be a serious contributor to the Greenhouse Effect. As stated in the background information, "Drivers are the single largest source of GHG emissions worldwide, accounting for approximately 22% of all human-generated emissions." Not only that, but America's auto industry continues to expand. According to the Bureau of Economic Analysis, auto sales have increased by 3.13 million cars (25%) just over the last two years (2011-2013).(17) Clearly Americans depend heavily on petroleum (remember that 8.1% of Americans have commutes 60 minutes or longer) even though we know it is bad for the environment and contributes to climate change. This discussion poses yet another big question. We know from earlier study that people only do things if they perceive the marginal cost to be *less than* the marginal benefit. So what value do people place on our future? To help us answer this question, we will turn to the content for this unit.

Lecture: Marginal Social Benefits and Costs

Present the information on MSB and MSC as explained in the Background Information section of this unit. When approaching students with this new content, the material should be posed in the following way: "Negative externalities involve additional social costs that are not paid for by the private consumer. Is the MSC greater than or less than the MPC? What are the implications on the graph"? Emphasize the fact that $MSB = MPB + \text{positive externalities}$ and $MSC = MPC + \text{negative externalities}$. MSC indicates what the supply curve

should be if we internalize the costs to society. Students should dialog about how to develop and analyze the graph of a product that yields a negative externality. Use the following questions to prompt their thinking.

- Which curve, supply or demand, is represented by MPC? [Student response: Supply] Therefore, MPC is upward or downward sloping? [Student response: Upward]
- Are there more costs associated with social or private costs? Explain your reasoning. What additional costs are involved with the one that aren't included in the other? [There are more costs associated with the MSC since it includes both the private costs and the negative externalities]
- If we sketch the MPC and MSC curves on the same graph as a MB curve, what do you notice about the equilibrium points? Explain the difference between where the MB curve intersects the MSC curve and where the MB curve intersects the MPC curve. [Student response: the equilibrium quantity within the private market is higher than what is socially desirable.]
- Products that yield negative externalities therefore are under or overproduced? What type of regulation could the government utilize to correct for this misallocation of resources? [Student response: Overproduced; Taxation by the difference in amount of the MSC and MPC]

Similar prompts can be used to help the students rationalize that goods that yield positive externalities are under-produced and should be subsidized by the government if the government wants to increase production to the socially efficient level.

Sketch a MC/MB graph of the petroleum market. Based on the discussion from earlier, does petroleum yield positive or negative externalities overall? The cons list from earlier is likely to be longer, so students should indicate that petroleum yields negative externalities. Ask a student to volunteer to come to the board and draw where they think the MSC curve should be on the graph. Refer to Figure 1(a) as an example. The student should indicate that the MSC curve is above the MPC or MC curve since the MSC includes both the private costs and the externalities. What does this mean for the level of production? Does the private market produce more or less than what is deemed socially efficient? According to the graph, the private market overproduces a product when that product yields a negative externality. An easy way to remember this concept is that society always wants less of a bad thing. So if a negative externality exists, we can assume society over-produces that product. Have students walk through that same thinking for a good with a positive externality, like solar energy.

Government Regulation Exploration: Taxing the Consumer

Once students have explored the idea of MSB and MSC, have students begin to think about the role the government plays in moving production levels toward the socially efficient level of output. If left to our own devices, society will produce according to the private market, without taking into consideration the externalities others experience. What types of regulation have been discussed this year that the government could use to incentivize or disincentivize production? Taxes and subsidies are the most obvious choices. To determine why a tax disincentivizes consumption, have students complete the following exploration activity.

Assume you have \$80 and you spend all your money on just two products: movies and cigarettes. Movie

tickets cost \$8 and a pack of cigarettes costs \$10. Use marginal analysis and the table below to determine how many of each product you should purchase to maximize your utility.

	Movies	Cigarettes
Q	TU	TU
1	80	150
2	152	270
3	216	370
4	264	450
5	304	510
6	328	550
7	336	560

A new tax on cigarettes is passed. The tax raises the price of cigarettes by \$5. Use marginal analysis to determine how many of each product you will buy after the tax to maximize your utility.

Answer Key

	Movies = \$8			Cigarettes = \$10		
Q	TU	MU	$\frac{MU}{P}$	TU	MU	$\frac{MU}{P}$
1	80	80	10	150	150	15
2	152	72	9	270	120	12
3	216	64	8	370	100	10
4	264	48	6	450	80	8
5	304	40	5	510	60	6
6	328	24	3	550	40	4
7	336	8	1	560	10	1

Given a budget of \$62, the consumer would purchase 4 movie tickets and 5 packs of cigarettes.

	Movies = \$8			Cigarettes = \$10 + \$5 tax = \$15		
Q	TU	MU	$\frac{MU}{P}$	TU	MU	$\frac{MU}{P}$
1	80	80	10	150	150	10
2	152	72	9	270	120	8
3	216	64	8	370	100	6.7
4	264	48	6	450	80	5.3
5	304	40	5	510	60	4
6	328	24	3	550	40	2.7
7	336	8	1	560	10	.7

Given a budget of \$62 and a \$5 tax on cigarettes, the consumer would purchase 4 movie tickets and 2 packs of cigarettes. Marginal analysis indicates that no other combination will yield a greater utility. What was the net effect of the cigarette tax for this consumer? The consumer will choose to purchase three fewer packs of cigarettes. We can thus conclude that taxation is an effective government regulation used to disincentivize the production or consumption of a product.

What would happen if we subsidized cigarettes instead of taxing them? Open this question up for discussion among the students. Students should be able to explain that a subsidy would essentially lower the price of cigarettes and would thereby raise the marginal utility received per dollar. This change in MU/P will cause the consumer to prioritize the consumption of cigarettes over movie tickets, as cigarettes will provide a bigger bang per buck. Subsidies are thus effective government regulations used to incentivize the production or consumption of a product.

Homework Assignment

Sketch a MB/MC graph for the petroleum market. Determine whether Americans over- or under-consume petroleum based on an analysis of whether the general externalities are positive or negative. Then, indicate whether the government should utilize a tax or subsidy to shift consumption to the socially efficient level of output. Finally, indicate on the graph the amount of the tax or subsidy.

Lesson 2: Supply-Side Economics: Exploring the Effects of Taxing Production

Lesson Objectives

Students will be able to...

1. Define and differentiate between a lump sum and per-unit tax or subsidy;
2. Show how a lump sum or per-unit tax or subsidy on the producer affects the supply curve and consequently the level of output; and
3. Explain why taxing the consumer and producer has the same net effect for the government.

Posing Question – Fish Bowl

Should the government subsidize and tax production or consumption? Explain your reasoning.

The government has two options when it comes to taxes and subsidies; the government can either tax or subsidize the consumer (as we examined in lesson 1), or it can tax or subsidize the producer (as we'll examine in this lesson). Start class off by posing the question above to the students. What are the benefits and drawbacks of taxing the consumer instead of the producer? Organize this discussion as a mini fishbowl activity. To do so, have the desks organized into two circles, one smaller circle inside the larger circle. The students inside the circle will begin the discussion of the posing question. This will allow students to discuss their initial thoughts about the topic. Allow the discussion to proceed for about 10-15 minutes. Students in the outside circle are responsible for prompting the inner circle discussion in case people have trouble finding

things to say. Ask for volunteers to be in the inner circle. Provide paper for students on the outside circle to write down their thoughts. Students in the outside circle should reframe any comments they have into questions for the inner circle students to discuss (a practice in active listening). If necessary, you may also choose to rotate students from one circle to the other. Have some questions pre-made in case students struggle to develop their own. Examples might include

- What's the difference between a tax to the consumer and a tax to the producer? Is it better to have a few corporations bear the entire burden, or to have the burden spread out over a much larger quantity of consumers?
- Proportionally, who is affected more by a tax burden? Which party can handle the burden more easily?
- Do taxes and subsidies solely affect the entity receiving the burden or stimulus? Or, do both parties feel the benefits and burdens?
- What happens to the consumer and producer surplus after a tax of any kind is created?

Lecture: Supply-Side Economics – Taxes and Subsidies toward Production

Present the material as specified in the background information section earlier. Focus on the concepts that lump sum taxes and subsidies affect the average total cost (ATC), but have no effect on the marginal cost (MC). Because profit maximization occurs at the level of output at which $MC = MR$, a lump sum tax or subsidy will not change the level of output, just change the economic profit the firm will earn from production. If a tax is large enough, economic loss could occur if $ATC > P$ and a firm might choose to exit the industry, which would in turn decrease production of that product.

A per-unit tax or subsidy on the other hand will affect both the marginal cost and the average total cost. A tax will increase the cost and decrease production while a subsidy will decrease the cost and increase production. Be sure to review Figures 2 and 3 with students at this time.

Lump Sum v. Per-Unit Regulation Exploration

Provide students with the following information.

1. A mattress store has the following revenue schedule. It costs \$300 to manufacture each mattress. Calculate the firm's total revenues, total costs and total profits if the firm sells Q mattresses. How many mattresses should the firm produce to maximize its profits?

Quantity	Price (\$)	Total Revenue	Marginal Revenue	Total Cost	Marginal Cost	Total Profit
1	1,000					
2	900					
3	800					
4	700					
5	600					
6	500					
7	400					

2. The government decides to support mattress producers by providing a lump sum subsidy of \$500 for production. Recalculate the firm's revenues, costs, and profits. Be sure to examine the marginal revenue and marginal cost. How many mattresses should the firm produce to maximize its profits? What is the net impact of the subsidy on profit levels and output?

3. A study reveals that the technology used to make this particular type of mattress produces significant pollutants and has been contributing to the destruction of a local forest. The local government decides to dissuade mattress production by creating a per-unit tax of \$100 per mattress produced. Recalculate the firm's revenues, costs, and profits. How many mattresses should the firm produce to maximize its profits? What is the net impact of the tax on profit levels and output?

4. Compare profit levels and production levels from (2) and (3). Which type of regulation – a lump sum or a per-unit regulation – should the government utilize if it wants to more efficiently change the production level?

Answer Key

Mattress Firm Info Without Regulation

Q	P	TR	MR	TC	MC	π
1	1,000	1,000	1,000	300	300	700
2	900	1,800	800	600	300	1,200
3	800	2,400	600	900	300	1,500
4	700	2,800	400	1,200	300	1,600
5	600	3,000	200	1,500	300	1,500
6	500	3,000	0	1,800	300	1,200
7	400	2,800	-200	2,100	300	700

1. The firm should manufacture four (4) mattresses to earn a total profit of \$1,600.

Mattress Firm Info With a Lump Sum Subsidy

Q	P	TR	MR	TC	MC	π
1	1,000	1,500	1,500	300	300	1,200
2	900	2,300	800	600	300	1,700
3	800	2,900	600	900	300	2,000
4	700	3,300	400	1,200	300	2,100
5	600	3,500	200	1,500	300	2,000
6	500	3,500	0	1,800	300	1,700
7	400	3,300	-200	2,100	300	1,200

2. The lump sum subsidy affects the TR, but does not impact the MR. Since profit maximization occurs where $MR = MC$, we know the firm will maximize profits by producing between 4 and 5 mattresses. Profit analysis shows that the firm will still produce 4 mattresses to earn a profit of \$2,100. The lump sum subsidy simply added \$500 to the total profit, but does not impact the level of production.

Mattress Firm Info With a Per-Unit Tax

Q	P	TR	MR	TC	MC	π
1	1,000	1,000	1,000	400	400	600
2	900	1,800	800	800	400	1,000
3	800	2,400	600	1,200	400	1,200
4	700	2,800	400	1,600	400	1,200
5	600	3,000	200	2,000	400	1,000
6	500	3,000	0	2,400	400	600
7	400	2,800	-200	2,800	400	0

3. The per-unit tax has no impact on the MR, but it increases the MC to produce the good by \$100. Since profit maximization occurs where $MR = MC$, a change in MC means the allocatively efficient level of output will also change. This can be seen through profit analysis, which shows that the firm should produce 3-4 mattresses to earn a profit of \$1,200. Since both levels of production yield the same profit, the firm will choose to produce 3 mattresses (less work for the same amount of profit). The tax effectively decreased profit levels while also decreasing production levels.

4. A lump sum regulation only affects profit levels and was not effective in changing production levels of individual firms (though diminished profits may cause some firms to leave the market, which would have the effect of lowering the overall level of output). A per-unit regulation, however, affects both the profit levels and the levels of output. Therefore, if the government wants to create a change in the level of output, a per-unit regulation should be used.

Analyzing Types of Regulations for Efficiency – Gallery Walk

Students will analyze several graphs of economic markets. They must identify whether there exists an overproduction, an underproduction, and an externality. Then, students must identify a type of government regulation that can help shift production levels to the desired socially efficient levels. Finally, they must explain the economic models and how those regulations are meant to move production to the socially efficient level of production. Students will complete only one task for each graph before rotating to the next graph. Students will rotate however many times is necessary to complete the assignment and continue to build off

the information provided by the previous group. Some of the groups will receive prompts that say that they're being bribed by the companies to vote for government regulation that will favor the company. These prompts should help explain why inefficient regulations are purposefully being used. Students must explain what happens when inefficient regulations are implemented.

Homework – Mix and Match Activity

Students will be assigned a variety of graphs to analyze. Assign each student one category from each column. Students should receive a variety of different combinations throughout the class (e.g. Positive externality with a per-unit sales tax; negative externality with a lump sum excise tax; positive externality with a lump sum subsidy to the producer, etc.). Each student should sketch their assigned graph along with their assigned regulation. Note that some combinations might not make economic sense as the net result will be to shift the output even further from the socially optimal level, but students will complete these graphs nonetheless as this often happens. In fact, students will later see that the government subsidizes petroleum despite the many known negative externalities.

Externality	Type of Regulation
Positive	Per-Unit Sales Tax
Negative	Per-Unit Excise Tax
	Per-Unit Subsidy to the Consumer
	Per-Unit Subsidy to the Producer
	Lump Sum Excise Tax
	Lump Sum Subsidy to the Producer

Students should clearly label their graphs and answer the following questions based on their assigned graph.

1. How does your assigned regulation impact the level of production?
2. What would happen if the group being taxed/subsidized switched (i.e. sales tax became an excise tax)? What is the net effect for the government? For the consumer? For the producer? Be sure to reference the producer and consumer surplus in this response.

Lesson 3: Petroleum and Climate Change

Lesson Objectives

Students will be able to...

1. Identify the externalities associated with petroleum consumption.
2. Identify how the government regulates the petroleum industry.
3. Identify alternatives to petroleum.

Documentary: FUEL

Students will watch the documentary *FUEL* , which delves into the history of the American auto and petroleum industries. The documentary examines renewables as alternatives to standard gasoline.

The documentary can be found online at <http://topdocumentaryfilms.com/fuel/>.

Students should take notes with a focus on externalities, current government regulation, and alternatives to our current petroleum market. After the documentary is over, students will participate in a class discussion. Students should share their reactions to the film as well as responses they might have to the questions posed in their notes.

Homework

Students will read the article "The Surprising Reason that Oil Subsidies Persist: Even Liberals Love Them" published in *Forbes* magazine and written by Robert Rapier. The article can be found online at <http://www.forbes.com/sites/energysource/2012/04/25/the-surprising-reason-that-oil-subsidies-persist-even-liberals-love-them/>. Once you've read the article, answer the questions

1. Why are fossil fuels subsidized if they have so many negative impacts on society?
2. Take a position either in agreement or against the article. What points did the article make that were valid? What points weren't valid? Should the government continue to subsidize big oil?

Students should do additional research about what subsidies currently exist for petroleum and what subsidies exist for more sustainable energy sources. This research will help the students form arguments for the debate in the next lesson.

Lesson 4: The Debate!

Students will utilize my classroom website <apmicroeconomics.weebly.com/unit-9.html> to complete their study of energy and externalities. The website reviews each of the key economic concepts, their primary learning goals and basic information regarding the costs and benefits associated with various types of energy sources. Students will explore the site in an effort to learn as much as they can.

Part 1: Economic Content

Students will follow the sequencing outlined in the class website. First, they will watch the content-specific videos *Episode 31: Market Failures* , *Episode 32: Externalities* , *Episode 33: Public Goods* , and *Episode 34: Regulation* , which were pulled from mjmfoodie's YouTube channel. The videos were originally created to help the students in her Principles of Economics classes and have since become very popular online instructional economics videos. Additionally, students will read Chapters 10 and 11 as outlined in their syllabus. The videos and reading are meant to serve as a review of everything that's been taught thus far and serve as the economic backbone of their arguments in the debate.

Part 2: Types of Energy

Students will explore the various links on the website to learn more about alternative forms of energy (solar, wind, and hydroelectric). Students should complete their own research on what types of regulations currently exist to promote innovation within these areas of sustainability.

Part 3: The Debate – What's the Cost of Our Future? Should the Government Subsidize Petroleum?

The class will divide into two groups. One group must argue in favor of subsidizing petroleum while the second must argue against subsidizing petroleum. While forming their arguments, students should take the following into consideration.

1. Identify and discuss the private and social benefits of petroleum.
2. Identify and discuss the private and social costs of petroleum.
3. How viable are alternative renewable energy sources for meeting the market's current demand for energy? To what extent are renewables substitute goods for petroleum?
4. Sketch a graph of the private markets for petroleum. Is petroleum currently being over-produced or under-produced given the socially optimal level of output?
5. Research what government regulations exist to incentivize or disincentivize the use of petroleum. How effective have these regulations been to shift the market output closer to the socially efficient level of output?
6. Illustrate the effects of each government regulation given the market sketch from earlier. How should the regulation theoretically impact the price and production level of petroleum?
7. Assuming in the future that renewable energy sources become true substitute goods, illustrate and explain the effect regulations in one market will have on the price and level of output in the petroleum market.

Suggested Student Reading and Web Resources

1. Chapters 10 and 11 in Bade and Parkin's *Foundations of Economics AP* Edition*
2. "Greenhouse Gases, Climate Change, and Energy", which can be found at <http://www.eia.gov/oiaf/1605/ggccebro/chapter1.html>
3. "Just How Much, Exactly, Are you Paying to Subsidize Fossil Fuels?" by Derek Wong. <

<http://www.desmog.ca/2013/05/10/just-how-much-exactly-are-you-paying-subsidize-fossil-fuels>>

4. "The Surprising Reasoning that Oil Subsidies Persist: Even Liberals Love Them"

<<http://www.forbes.com/sites/energysource/2012/04/25/the-surprising-reason-that-oil-subsidies-persist-even-liberals-love-them/>>

Bibliography

Bade, R., & Parkin, M. (2011). *Foundations of economics* (5th ed.). Boston: Pearson Addison-Wesley.

This is the AP edition of the Foundations of Economics textbook and discusses all the large topics covered on the AP Microeconomics exam. Relevant to this unit, Chapters 10 and 11 discuss the economics behind government regulations like taxes and subsidies while also discussing externalities and the rationale behind having government intervention in the first place.

Cobb, C. W. (1998). *The roads aren't free: estimating the full social cost of driving and the effects of accurate pricing*. San Francisco: Redefining Progress.

This book examines the full cost of driving, including the negative externalities that aren't externalized by most drivers. This book, although a bit dated, attempts to reveal that there are many aspects consumers don't take into consideration when using public goods. Specific to this unit, this book delves into the environmental costs of driving and using petroleum instead of renewables.

Estimating U.S. Government Subsidies to Energy Sources. (n.d.). *Welcome to the Environmental Law Institute*. Retrieved July 30, 2013, from http://www.eli.org/Program_Areas/innovation_governance_energy.cfm

This energy report, published by the Environmental Law Institute delves into the government subsidies for fossil fuels and renewables. This report is a great resource for learning specifics about the types of subsidies that exist for various energy resources.

Tickell, J. (Director). (2010). *Fuel* [Documentary]. USA: Blue Water Entertainment.

This documentary delves into the history of the American auto and petroleum industries. It examines renewables as alternatives to standard gasoline and discusses the role large companies play in shaping society's perception of goods and services.

Patz, J. A., Campbell-Lendrum, D., Holloway, T., & Foley, J. A. (2005). Impact Of Regional Climate Change On Human Health. *Nature*, 438 (7066), 310-317.

This report delves into the many health implications caused by climate change. The authors examine how temperature changes impact the spread and growth of human diseases. This source is particularly helpful in this unit in that it provides a lot of detail into the many negative externalities that exist and are caused by climate change.

Notes

1. <http://www.eia.gov/oiaf/1605/ggccebro/chapter1.html>
2. <http://www.epa.gov/climatechange/basics/>
3. <http://www.eia.gov/oiaf/1605/ggccebro/chapter1.html>
4. <http://www.epa.gov/climatechange/basics/>
5. http://www.census.gov/newsroom/releases/archives/american_community_survey_acs/cb13-41.html
6. <http://www.epa.gov/climatechange/ghgemissions/sources.html>
7. <http://www.epa.gov/climatechange/ghgemissions/sources/electricity.html>
8. Cobb, Clifford. "The Roads Aren't Free." 1999.
9. Cobb, Clifford. "The Roads Aren't Free." 1999.
10. <http://ocean.nationalgeographic.com/ocean/critical-issues-sea-temperature-rise/>
11. Patz, Jonathan and Diarmid Campbell-Lendrum, Tracey Holloway, and Jonathan Foley. "Impact of regional climate change on human health". Nature. Vol 438. 2005.
12. Impact of regional climate change on human health
13. energy.gov/fe/services/petroleum-reserves
14. www.eia.gov/dnav/pet/hist/LeafHandler.ashx?f=W&n=PET&s=EMM_EPMP_PTE_NUS_DPG
15. Cobb, Clifford. "The Roads Aren't Free." 1999.
16. http://www.eli.org/Program_Areas/innovation_governance_energy.cfm
17. http://ycharts.com/indicators/auto_sales

<https://teachersinstitute.yale.edu>

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