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Addressing Market Failure in Three Key Societal Issues

Much of the economic debate surrounding key issues discussed in government and politics relates to a market failure issue and the extent to which governments should intervene. In a democratic society, it's often difficult to achieve consensus on normative questions, and heated debate can arise between those with opposing viewpoints. Among the most contentious issues include climate change, health care policy, and the provision of education.

Climate Change

Every person on the planet is affected by changes in our climate, which have become more apparent in recent years. Efforts to combat climate change can be viewed as a large public good—everybody benefits without rivalry or exclusion. Therefore, climate change policy illustrates a market failure because the actions that protect against climate change are costly, but the benefits of such actions are enjoyed by all Earthlings, including those who do not pay (known as free riders). This is a common problem inherent with public goods.

Moreover, actions that affect climate change exhibit externalities. The amount of carbon emissions emitted by countries vary significantly. If one country pollutes more due to greater industrialization, an external cost is generated on the rest of the world. On the other hand, countries that promote sustainable production generate external benefits. Clearly, some countries do more to combat climate change than others, which illustrates the challenges of mitigating the issue. While nearly everyone desires a cleaner planet, not everyone wishes to pay to achieve that goal.

Governments have come together to address climate change by forming agreements to combat the problem in an equitable manner. One recent example is the Paris Agreement, which was signed by nearly every country in the world, including the United States, in 2016. But because opinions change, in 2017 the United States announced its intent to pull out of the Paris Agreement. Although official U.S. government policy may take one position, many American individuals and firms remain strong proponents of reducing climate change, with many corporations taking the lead in reducing their carbon footprint.

Another strategy used to confront climate change is to implement incentives to promote resource conservation. The Around the World feature describes a strategy implemented by some cities to reduce traffic gridlock, a major contributor to carbon emissions.

AROUND THE WORLD

Singapore: Resolving Traffic Jams and Reducing Pollution Using Price Controls

roads become more congested.

Not only do congestion charges incentivize people to drive less, they also encourage companies to change the way they operate. Companies that do not need to operate during traditional business hours might encourage their employees to arrive at work later and return home later, avoiding times when congestion charges are at their peak. By reducing traffic congestion, less time is wasted, productivity rises, and pollution is reduced. Furthermore, the fees collected are a valuable source of government revenue.

Many economists believe that market-based pricing mechanisms such as congestion charges can lead to increased efficiency and equity.

 GO ONLINE TO PRACTICE THE ECONOMIC CONCEPTS IN THIS STORY

Health Care

What is the socially desirable allocation of health care? Should everybody have health care coverage provided by the government? Or should health care be provided in a private market where consumers and providers make decisions based on their own situations? Or should it be somewhere in between? Health care is among the most expensive outlays among individuals, firms, and the government. This is especially the case in technologically-advanced countries where treatments are available for even the rarest illnesses, albeit at a very high cost.

One of the resulting normative questions is whether every person should have access to health care regardless of their ability to pay for it. In the United States, this issue is mitigated for those age 65 and over, when Medicare (a government-run health care program) becomes available. In many other countries, a similar program is provided to all citizens regardless of age. Much like climate change policy, health care policy generates many external benefits and external costs. For example, providing better health care reduces illnesses and subsequent sick days, which can boost worker productivity and overall happiness (who likes lying in bed with the flu?), a clear external benefit.

The counterargument to providing health care to everyone relates to rising costs as people live longer, experience more illnesses due to modern lifestyle factors (stress, poor nutrition, and environmental toxins), or have access to expensive treatments that can cure more diseases. These high costs can potentially impede growth as a larger portion of the budget is spent on health care. This would create an external cost. Therefore, resolving the market failure in health care is a challenge that may require other strategies, such as focusing on preventive care (to prevent major illnesses from developing) or providing incentives to individuals (such as through health savings accounts) to make more market-driven health care choices.

Education

The provision of education is another issue that generates externalities. A more educated society leads to greater productivity, which benefits all people. Because of the high cost of providing education, a market-determined equilibrium quantity of education is often viewed as too little, which means that governments must intervene to make education more affordable. Because education is not free, societies must determine how much education to provide, and how to finance it.

In the United States, public school education is funded by the government from preschool or kindergarten to the 12th grade. The price of public education is determined not in a free market but instead by individual state legislatures that determine the amount of public funds to allocate to education. Some states provide more funds for education than others. Some provide subsidized tuition to in-state residents at public colleges and universities or free tuition at community colleges. In other states, public college tuition are set at rates that exceed $16,000 per year. In many European nations, the price of attending college is negligible due to generous government subsidies. Again, the external benefits and external costs that education policy creates is one that generates significant debate among voters as each policy creates benefits and costs that vary among individuals.

In sum, the importance of markets and the efficiency they provide in the allocation of goods and services is of utmost importance in all economies. We saw how markets can generate an equilibrium price that individuals in society believe to be too high or too low or an equilibrium quantity that is too much or too little. As a result, governments intervene in certain markets in order to achieve outcomes that people believe to be more equitable. However, governments must be careful when intervening in markets to prevent the costs of such policies to exceed the potential benefits.

CHECKPOINT

MARKET FAILURE: WHEN MARKETS DO NOT DELIVER A SOCIALLY DESIRABLE OUTCOME

- Markets are typically efficient, although sometimes they fail by not providing the socially optimal amount of goods and services.
- Market failure is caused by a lack of competition, mismatch of information, existence of externalities, and existence of public goods.
- Climate change, health care, and education are important issues facing societies that involve debate of how to resolve market failures.

QUESTION:

One proposal to reduce auto pollution would be to implement a gas tax on drivers that would subsequently make all public transportation available at little to no cost to riders. Opponents of these proposals argue that they simply provide subsidies (a form of welfare) to those without cars, without providing any benefit to those who must pay the tax. Thinking about externalities, are there any external benefits that might result to those paying the gas tax?

Answers to the Checkpoint questions can be found at the end of this chapter.

Susan E. Degginger/Alamy

Ecological conservation is a public good. Once people devote time and resources to reducing climate change, everybody benefits from it, even if one does not contribute to the costs.

Description

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Key Concepts

consumer surplus
producer surplus
total surplus
deadweight loss
laissez-faire
price ceiling
misallocation of resources
price floor
market failure
asymmetric information

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when the discounted product sells out, customers may consider buying a nondiscounted product. Therefore, the pricing strategy leads to a strategic shortage that is designed to attract customers into the store to buy goods in addition to those that are advertised.

Checkpoint: Market Failure: When Markets Do Not Deliver a Socially Desirable Outcome

If the gas tax and subsidized public transportation encourage people to drive less and use more public transportation, those who continue to drive will likely experience less traffic congestion, which saves both time and gas. Moreover, there would be fewer cars competing for limited parking spaces. And because gas-powered cars generate significant carbon emissions, reducing the number of cars on the road can improve air quality. These are all external benefits that help to offset the higher monetary cost paid by drivers.

Overconfidence

Feeling confident about one's abilities, attractiveness, or intellectual capacity is a trait often instilled from one's childhood. No doubt, self-esteem plays an important role in the success of many people. But overconfidence in one's abilities can have the opposite effect.

Watch the auditions of any reality talent show and notice the pitchy, off-key singers who belt their hearts out as if they were onstage at the Grammy Awards, only to be brought back to reality by the harsh criticism of the judges. Being overconfident can lead to decisions that have consequences, such as picking the wrong stock in which to invest, spending too much time and effort applying to only the very top graduate school or law school, or turning down potential respectable boyfriends or girlfriends in hopes of a dream mate.

Wanting to feel confident about one's abilities and choices sometimes leads to decisions that run counter to economic theory, and marketers often take advantage of this factor. One- and two-year gym memberships offered for an attractive up-front prepaid price is a great deal for someone eager to lose weight and get in shape. But often such ambitions fall short, leading many gym memberships to go unused (with the money comfortably in the gym's bank account).

Overvaluing the Present Relative to the Future

It is often difficult to plan for the future. Money saved today can earn interest, and money invested in financial instruments and assets can increase in value over time. Despite the significant growth in the amount of savings in the future, it is still money one must give up using *today*. Therefore, people sometimes are reluctant to save for the future despite lucrative incentives, such as retirement fund matching programs offered by employers.

The same is true for paying off debt. Paying the minimum payment on credit card balances seems easy, but accruing finance charges of 15% or more can put a severe crunch on finances in the future. Although differences in time preferences themselves are not irrational per se because the future often appears so distant, it can blur the reasoning behind sound economic decisions. For example, a society's unwillingness to fully tackle climate change results from overvaluing present benefits relative to future costs.

Altruism

The last factor to be discussed is **altruism**, or actions undertaken merely out of goodwill or generosity. Buying a sandwich for a homeless person you will likely not see again, donating money to a charitable organization, or helping a tourist find his or her way to a hotel all are friendly gestures that do not provide any reward except for the positive feeling one receives from helping others.

altruism
Actions undertaken merely out of goodwill or generosity.

Learning Objectives

7.1 Describe the nature of firms and markets.
7.2 Explain the difference between accounting and economic costs and how they affect the determination of profits.
7.3 Differentiate between the short run and long run.
7.4 Describe the nature of production in the short run, total product, marginal product, and average product.
7.5 Differentiate among increasing, diminishing, and negative marginal returns.
7.6 Describe and compare the differences among fixed costs, variable costs, marginal costs, and average costs.
7.7 Explain the importance of marginal costs in a firm's production decision.
7.8 Use a graph to show the relationship between the short-run average total cost and marginal cost curves.
7.9 Describe the reasons for economies and diseconomies of scale and how they affect a firm's long-run costs.

Thirty years ago, most people did not think much about what they could do to conserve fossil fuels. Energy and gas prices were low, and the problem of climate change was not very prominent in everyday discussions and news reports. This has changed, and many people today do think about the impact their consumption habits have on the environment. This has led to a rise in demand for energy-efficient products to address not only climate change issues but also spending decisions as energy costs take a larger share of a household's budget.

In the automobile industry, the use of sustainable energy resources such as ethanol remains expensive. However, in the mid-1990s, manufacturers foresaw an opportunity to satisfy consumer demand for cars that achieve much greater fuel efficiency, resulting in a similar effect as using sustainable energy. In 1997 Toyota unveiled the Prius, the first well-selling car to use hybrid electric technology. Then in 2008, Tesla unveiled its powerful electric Roadster that started a movement toward electric cars that nearly every auto manufacturer has since followed.

Creating a new type of car, especially one that runs on a new source of energy, is not like creating a new type of pizza. It costs much more to develop, design, and produce the very first car. Toyota invested over $1 billion to develop the Prius, a great deal of money for a new compact car in an untested market. Tesla also invested heavily to develop its plug-in cars, to a point that it nearly went bankrupt in its early years. What motivated Toyota and Tesla to undertake such expensive investments? The answer is profits.

Profits are one of the most important goals of firms. To determine profit, a firm must calculate its revenues from sales and subtract all of its costs. How does a firm measure these costs, and what do these costs include?

Learning Objectives

13.1 Describe the impact of negative and positive externalities on society.
13.2 Describe the Coase theorem on social costs and the role transaction costs play in determining an optimal allocation of resources.
13.3 Explain the nature of public goods and why private markets will usually not provide them.
13.4 Explain how common resources can lead to resource degradation.
13.5 Discuss how health care exhibits characteristics of public goods and why it is prone to the free rider problem.
13.6 Recognize the importance of the discount rate in assessing the costs and benefits of environmental policies.
13.7 Use marginal analysis to determine a socially efficient level of pollution.
13.8 Describe the differences between command and control policies and market-based approaches to environmental regulation.
13.9 Understand the economic issues surrounding global climate change.
13.10 Discuss strategies that minimize greenhouse gases and promote sustainable development.

Each day, thousands of spectacular explosions occur in a process called calving, when ice breaks off from mountains of glaciers and falls into the ocean as icebergs, eventually melting away. The withering ice shelves and frozen tundra that constitute the vast wilderness of the Arctic (and the Antarctic) have affected the landscape that hundreds of wildlife species, including the polar bear, call home.

According to a recent NASA study, the volume and area of the Arctic ice caps fluctuate from year to year based on atmospheric cycles, but the overall trend has been declining as average surface temperatures rise. Estimates show that the overall area covered by the thickest ice, known as multiyear ice, has been shrinking between 12% and 17% per decade over the past 30 years. Although melting sea ice does not raise sea levels because the ice is already floating, melting land ice (such as mountain glaciers and ice sheets) do raise sea levels as the water flows into the ocean, and this carries important consequences beyond the affected wildlife. Human lives also are affected as ocean levels rise. Studies reported by the Intergovernmental Panel on Climate Change predict that global sea levels will rise between 10 and 32 inches by the end of the century, highlighting the important idea that actions taken today, both positive and negative, will affect future generations.

1988

2018

Left: NASA/Goddard Space Flight Center Scientific Visualization Studio The Blue Marble data are courtesy of Reto Stockli (NASA/GSFC); right: NASA/Goddard Space Flight Center Scientific Visualization Studio The Blue Marble data are is courtesy of Reto Stockli (NASA/GSFC)

A computerized visualization of the Arctic ice caps based on satellite observations shows the extent to which the ice has diminished from 1988 to 2018.

Description
In 1988 the glacial coverage above the western continents is expansive while 2018 shows smaller glacial coverage.

The impact of human actions that contribute to global climate change is one that economic policy tries to address, although not without significant challenges and obstacles. Environmental policies are influenced by priorities placed by individual countries. For example, during much of the 20th century, the United States was a highly industrialized country; standards of living increased dramatically, but at the cost of greater pollution. However, many Americans now place a higher priority on maintaining a cleaner environment for future generations. This transformation from a polluting industrial society to a cleaner, energy-efficient society can be seen in many developed nations, such as the United States, the countries of the European Union, Japan, and Australia.

In contrast, much of the world remains very poor. In these developing countries, efforts to improve basic living conditions often take precedence over environmental concerns. In countries that have grown significantly in recent years, such as China and India, polluting factories are churning out goods as fast as they can, and consumers are buying more cars and air travel. China is now the largest market in the world for new cars. The ability of previously impoverished nations to experience economic prosperity often comes at the expense of the environment.

Because of differing environmental priorities among nations, it is difficult to achieve a consensus. In addition, any one country's efforts to improve the environment benefit the entire world, yet that country bears the full costs of these efforts. Meanwhile, other countries may exploit the environment for their economic gain, offsetting the environmental efforts made by others.

At a microeconomic level, individuals and firms make decisions that affect the environment, such as the type of cars we buy and the production methods companies use. Each of these decisions affects not only an individual or a company but also others who share the environment that is being affected.

On a brighter note, economic growth has led to increasing efficiencies in resource use. The popularity of hybrid and plug-in electric cars has improved fuel efficiency. Even new technologies in cow feed (such as the infusion of garlic) have reduced the level of harmful methane gases emitted by cows. Yet, clearly, we still have many environmental problems that must be addressed, including global climate change, species extinction, overharvesting of fisheries, and overcrowding of highways and parks.

A challenge to mitigating global climate change is that markets do not always lead to a socially optimal allocation of resources. When competing self-interests by individuals and firms interact in a market, efforts to achieve a common goal on climate change become difficult. This chapter addresses some of these challenges including the effects of externalities and the role of public goods. The chapter then looks at ways in which environmental policy has been applied in order to achieve predetermined objectives. Finally, the chapter takes what you have learned and applies it to global climate change and sustainable development.

There are six divisions under the headline, and the contents of each are as follows:

Division 1: The text reads,

Actions taken by individuals and businesses sometimes generate benefits and costs to third parties. These effects are called externalities, specifically external benefits or external costs. Some of the most important examples of external benefits and external costs involve the environment. Some actions (such as conservation and recycling) generate external benefits, while other actions (such as using dirty production methods) create external costs. Electricity generation and usage is a major source of climate change, which is considered one of the most consequential external costs of our lifetime. This By the Numbers analyzes the trend in electricity generation over the past 10 years and how increasing the use of renewable energy can reduce the impact of climate change over time.

Division 2: Titled, Data, and includes a line graph that represents the Electricity Generation from Renewable Sources from the year 2008 to 2018.

The data for the graph is as follows:

The horizontal axis represents the years from 2008 to 2018 at intervals of one year. The vertical axis represents the Net Generation of Electricity in thousands of megawatt hours, and its values range from 0 to 700,000.

The line that represents Hydro sources begins at 270,000 in 2008, reaches 255,000 in 2009, 250,000 in 2010, 270,000 in 2011, 280,000 in 2012, 320,000 in 2013, 270,000 in 2014, 260,000 in 2015, 265,000 in 2016, 300,000 in 2017, and 299,000 in 2018.

The line that represents Wind sources begins at 10,000 in 2008, reaches 30,000 in 2009, 50,000 in 2010, 70,000 in 2011, 100,000 in 2012, 120,000 in 2013, 170,000 in 2014, 199,000 in 2015, 220,000 in 2016, 270,000 in 2017, and 295,000 in 2018.

The line that represents Solar sources begins at 0 in 2008, remains constant till 2014, and reaches 10,000 in 2015, 20,000 in 2016, 50,000 in 2017, and 70,000 in 2018.

The line that represents the Total Net Electricity generated by all three renewable sources (Wind, Hydro, and Solar) begins at 350,000 in 2008, reaches 350,000 in 2009, 370,000 in 2010, 401,000 in 2011, 420,000 in 2012, 501,000 in 2013, 510,000 in 2014, 530,000 in 2015, 570,000 in 2016, 700,000 in 2017, and 710,000 in 2018.

All values are approximate.

The text below the graph reads: 'Where Can I Find These Data? Source: U S Energy Information Administration (U S Department of Energy) Web site: h t t p s colon forward slash forward slash w w w dot e I a dot gov forward slash electricity forward slash monthly. Details: Select Table 1.1 A titled "Renewable Sources: Total—All Sectors" to view historical data by energy source.'

Division 3: Text reads, 'Assessing your Data Literacy. 1, Over the 10-year period shown in the graph, which source of renewable energy saw the greatest nominal increase in electricity generation? Which source saw the greatest relative increase in electricity generation?

2, In which year did hydroelectricity generation reach its peak?

3, What economic factors might explain why some sources of renewable energy have skyrocketed in recent years while others have declined?'

Division 4: Text reads as follows: '24,899,000 Wind power generation capacity (in megawatts) in Texas in 2018. Texas produces 26% of the total U S electricity generated from wind turbines, the most among all states.

68,050,000 Total tons of paper and paperboard solid waste generated in the United States in 2015, of which 67% is recycled. Much of the rest end up in landfills.'

Division 5: Text reads: 'Why are these Data important? According to the discussion of external costs in the text, climate change is one of the biggest problems facing the world. The data show that electricity generation from renewable sources is rising significantly as technology and innovation reduce cost. The ability to minimize climate change requires the ability to meet a greater portion of global energy needs through renewable energy sources.'

Division 6: Text reads: 'Data in the News. California Approves Goal for 100% Carbon-Free Electricity by 2045' by Alexei Koseff; Sacramento Bee, September 10, 2018

Governor Jerry Brown signed legislation that would put California on the path to eliminating fossil fuels from its energy sector. Senate Bill 100 speeds up the state's timeline for moving to renewable energy sources like solar and wind. California is the second state to adopt such a goal, after Hawaii.'

ENVIRONMENTAL POLICY

We have seen that market failure can lead to excessive amounts of products that pollute or generate other negative externalities or to overuse of commonly owned resources that result in environmental degradation. This section puts these market failures together by looking at environmental policy.

Market failure is one reason why unregulated markets may produce inequitable or inefficient results. However, government policies do not always make things better. **Government failure** occurs when (1) public policies do not bring about an optimal allocation of resources and/or (2) the incentives of politicians and government bureaucrats are not in line with the public interest.

government failure
When public policies do not bring about an optimal allocation of resources and/or the incentives of politicians and government bureaucrats are not in line with the public interest.

Government failure may result from the practical inability of policymakers to gather enough information to set good policies. Water pollution, for instance, is well understood, resulting in fairly obvious regulatory policies, but the same is not true for issues such as global climate change. Even if we all agree that the Earth is getting warmer and humans are partly to blame, controversy about the adequacy of public policy to address this problem remains.

Despite the challenges of creating and implementing environmental policy, it is still an issue that must be tackled. We now discuss various questions that arise when setting goals for environmental policy and the many choices that are available to policymakers.

Intergenerational Questions

Should politicians consider the interests of voters who haven't yet been born? Environmental issues raise complex questions involving how resources are to be allocated across generations. Some resources, such as sunlight, are continual and renewable. Others, such as forests, fisheries, and the soil, are renewable but exhaustible if overexploited. And some resources are nonrenewable, such as oil and coal. These resources are finite and cannot be renewed, but their available stock can be expanded through exploration or the use of new technologies that allow greater extraction or more efficient use.

When we develop environmental policies, we need to consider and evaluate different possible futures. Figure 5 is a reminder of the effects that discount rates have on the present value of a fixed payment that will come due at some date in the future. When evaluating environmental policies, the discount rate we choose is crucially important.

Keep in mind that regulators could have set a $300 per ton tax on effluent and achieved the same result. One advantage of permits over taxes is that no knowledge of marginal abatement costs is needed to ensure that the permit price is optimal. Once the regulator determines how much pollution to allow, the price of permits will adjust to changes in abatement technology and other market conditions.

Today, tradable permits are used in certain states to control water effluents entering rivers as well as to control sulfur dioxide (SO_2) emissions that create acid rain. As new technology leads to reduced abatement costs, demand for tradable permits falls and subsequently their price, making it easier for governments to reduce future permits to achieve greater environmental objectives.

Trends in Environmental Policy

We have looked at three common policies to achieve environmental objectives in various industries: command and control, emissions taxes, and tradable permits. Additional market-based policies include user charges, subsidies, and deposit-refund systems. Furthermore, certain states and cities have created new command and control policies, such as mandatory recycling programs and bans on plastic grocery bags and straws. Moreover, increasing attention to climate change has motivated organizations to create innovative solutions, such as markets for carbon offsets. For example, an individual can purchase a carbon offset based on an activity, such as an airline flight. These funds are used to invest in projects that reduce greenhouse gases, such as restoring forests or improving energy efficiency.

In recent years, the use of tradable permits for carbon emissions has increased throughout the world, especially after the 2016 Paris Agreement, from which nearly all countries pledged to reduce their carbon footprint. The European Union implemented its tradable permit program over a decade ago, and China introduced a major tradable permit program in 2017. Although the United States does not use tradable permits at the federal level, at least eleven states use market-based policies to limit greenhouse gases. These efforts to reduce greenhouse gases are aimed at tackling the major problem of climate change, which we turn to next.

ISSUE

Cap-and-Trade: The Day Liberal Environmentalists and Free-Market Conservatives Agreed

Environmental policies in recent decades have epitomized the battle between liberal environmentalists and free-market conservatives, with the former arguing for more limits on pollution, while the latter want more market freedom. How, then, could the two sides come to an agreement that would satisfy both of their primary objectives?

In the late 1980s, the problem of acid rain reached a boiling point, with heavy pollution from

sulfur dioxide emissions causing health issues, polluted lakes and rivers, and reduced visibility. Further, it heightened tensions with Canada, which suffered negative externalities from the pollution from American power plants. With the environmental damage reaching front-page news and a fierce political battle on how to fix it, it looked like a lost cause.

Then came a very unlikely alliance between Dan Dudek of the Environmental Defense Fund and Boyden Gray, a multimillionaire conservative who was appointed President Bush's White House counsel in 1988. Gray, a strong proponent of free-market principles, had long supported a method of allowing individuals and firms to buy and sell permits to pollute. The acid rain crisis allowed Dudek and Gray to propose an emissions permit trading program that placed significant caps on sulfur dioxide (placating environmentalists) while eliminating regulations and allowing the marketplace to determine permit prices (placating free-market proponents).

The program became law with the *Clean Air Act of 1990*. When the law, which became known as "cap-and-trade," took effect in 1995, emissions fell and led to significant external cost savings. This law has been considered a success in solving a major environmental problem using a market-based approach as opposed to a command and control approach.

Today, much discussion centers on the proposed use of cap-and-trade to reduce carbon dioxide emissions. Such programs are law in the European Union and even China, but proposals to pass cap-and-trade legislation in the United States since 2008 have been held up, ironically by the same market-based proponents who created the strategy that worked in the past. Opponents of cap-and-trade today argue that cap-and-trade still imposes harsh limits on the broader market. Yet, without cap-and-trade, resolutions to reduce global warming become less likely. It may take another unlikely alliance before the problem of global warming is solved.

THE ECONOMICS OF CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

Among the most significant economic issues facing the world today is the effect of human actions on the environment. There is scientific consensus that without a significant reduction in the production of greenhouse gases, which engulf the atmosphere and lead to global warming, irreversible damage to the climate, ecosystems, and coastlines will result. However, the course of action needed to address climate change deals with equity issues that are difficult on which to achieve consensus.

Many individuals and corporations understand that natural resources are scarce, and many do their parts by conserving water and energy, and recycling. Those who are more dedicated might choose public transportation over cars, install solar panels and other energy-saving technologies in homes and businesses, and plant trees or donate to one of many organizations that will do so on one's behalf. The choice to engage in actions to minimize climate change by individuals, businesses, and governments is one that involves a **cost-benefit analysis**. A cost-benefit analysis provides a formal, rational model for policy decisions by focusing on the choices that are available, the preferences of individuals, and the present value of benefits and costs that will be incurred by today's and future generations.

cost-benefit analysis
A methodology for decision-making that looks at the present value of the costs and benefits of a given project.

The challenge with using cost-benefit analysis for environmental policies is that many of the benefits and costs are difficult to quantify. For example, what is the cost of living in a polluted city? What is the benefit of preventing a species from going extinct? The answers require a more thorough understanding of the causes and effects of climate change. Moreover, climate change has an intergenerational effect, as actions today will affect future generations. This has led many corporations and countries to adopt **sustainable development** goals, which refers to the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. Through greater knowledge of the issues at stake, individuals are more likely to make informed decisions about their impact on the environment.

sustainable development
The ability to meet the needs of the present without compromising the ability of future generations to meet their own needs.

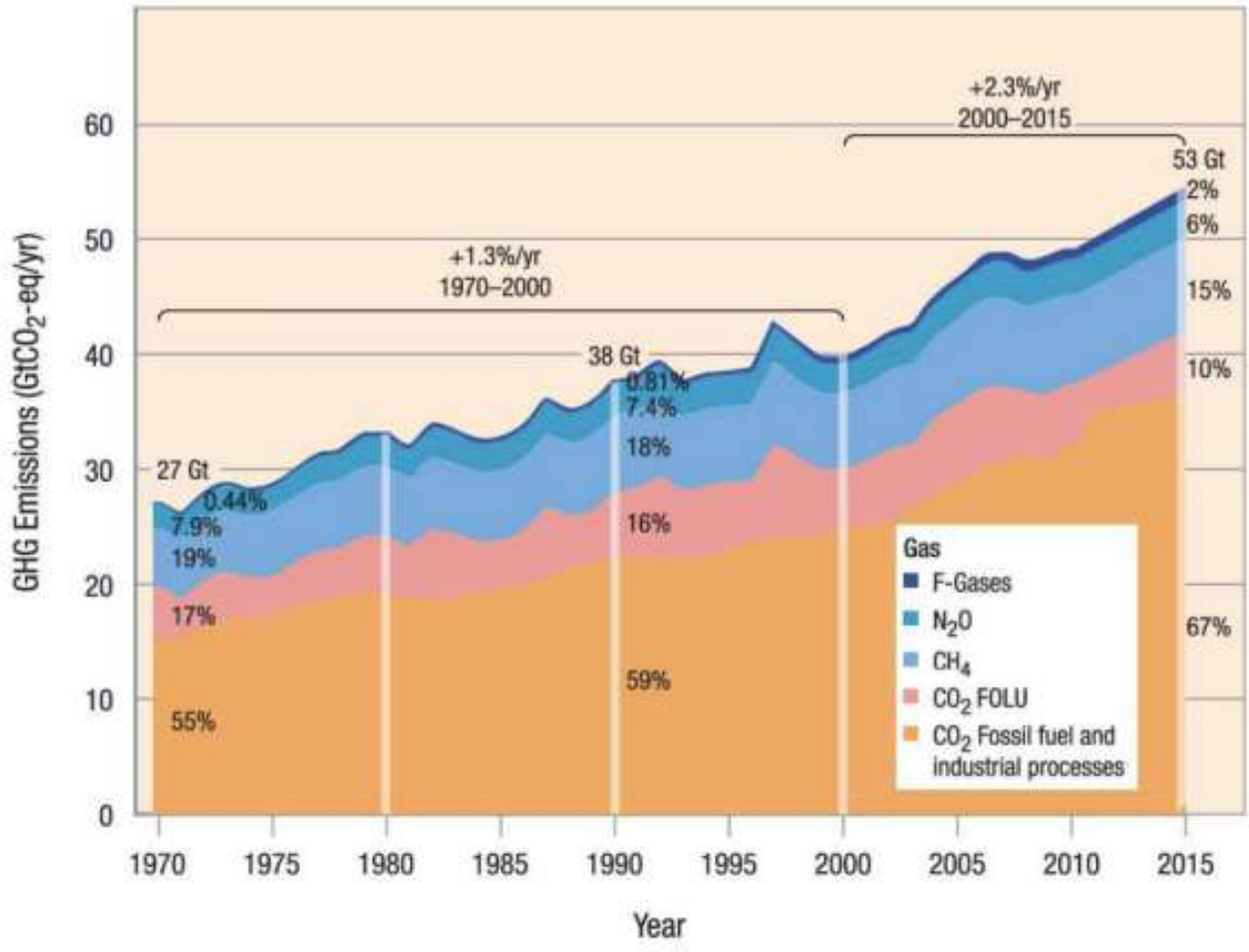
Understanding Climate Change

Climate change refers to the gradual change in the Earth's climate due to an increase in average temperatures resulting from both natural and human actions. It is largely irreversible, particularly in its effect on rising sea levels and on ecosystems. According to the Intergovernmental Panel on Climate

Change (IPCC), the average temperature "from 1983 to 2012 was *likely* the warmest 30-year period of the last 1400 years in the Northern Hemisphere."[3] And the trend has not ebbed, as average temperatures in 2018 reached the highest ever recorded in modern times. Understanding the causes and effects of climate change is necessary to adopt appropriate actions to address the problem.

The Causes of Climate Change

The primary causes of climate change are related to actions that emit greenhouse gases. Greenhouse gases created largely by human activities include carbon dioxide (CO_2) from fossil fuel and industrial processes, carbon dioxide (CO_2) from forestry and other land use (FOLU), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (F). Figure 9 shows both the global nominal rise in each of these greenhouse gases from 1970 to 2015 and the percentage of overall greenhouse gases that each source represents.



Chiang, *Microeconomics: Principles for a Changing World*, 5e © 2020 Worth Publishers

Figure 9 · Annual Greenhouse Gas Emissions, 1970–2015

Greenhouse gases from human activities include carbon dioxide from fossil fuel and industrial processes, carbon dioxide from forestry and other land use (FOLU), methane, nitrous oxide, and fluorinated gases. From 1970 to 2015, the nominal amount of all greenhouse gases increased. As a percentage of all greenhouse gases, carbon dioxide from fossil fuel and industrial processes increased from 55% to 67%, while fluorinated gases increased from 0.44% to 2%.

Data from 1970 to 2010 obtained from IPCC. Data from 2011 to 2015 obtained from the Global Carbon Project and the World Bank.

Description
Years are plotted along the horizontal axis, and the values corresponding to G H G emission (tonnes of C O 2 equivalent) are plotted along the vertical axis. The graph shows a trend for each of the following gases: carbon dioxide from fossil fuel and industrial processes, carbon dioxide from forestry and other land use (F O L U), methane, nitrous oxide, and fluorinated gases.

The data presented in the graph are as follows:

The trend representing Carbon dioxide from fossil fuel rises from 15 percent in 19 70 to 35 percent in 20 15. It contributes an overall amount of 55 percent between 19 70 and 19 80; 59 percent between 19 90 and 2000; and 67 percent between 2000 and 20 15.

The trend representing carbon dioxide from forestry and other land use (F O L U), rises from 5 percent in 19 70 to 6 percent in 20 15. It contributes an overall amount of 17 percent between 19 70 and 19 80; 16 percent between 19 90 and 2000; and 10 percent between 2000 and 20 15.

The trend representing carbon dioxide from methane, rises from 7 percent in 19 70 to 8 percent in 20 15. It contributes an overall amount of 19 percent between 19 70 and 19 80; 18 percent between 19 90 and 2000; and 15 percent between 2000 and 20 15.

The trend representing carbon dioxide from nitrous oxide, rises from 2 percent in 19 70 to 4 percent in 20 15. It contributes an overall amount of 7.9 percent between 19 70 and 19 80; 7.4 percent between 19 90 and 2000; and 6 percent between 2000 and 20 15.

The trend representing carbon dioxide from F gases, rises from 21 percent in 19 70 to 2 percent in 20 15. It contributes an overall amount of 0.44 percent between 19 70 and 19 80; 0.81 percent between 19 90 and 2000; and 2 percent between 2000 and 20 15.

The largest portion of greenhouse gases is carbon dioxide, which is created by fossil fuel usage, industrial production, and deforestation. Fossil fuel usage includes the use of automobiles and airplanes, electricity and home heating fuels, and the production of products such as plastics and tires and even everyday items such as ink pens, cosmetics, and toothpaste. Deforestation contributes to greenhouse gases because trees absorb carbon dioxide, and when they are cut down or burned, the stored carbon dioxide is released into the atmosphere.

Other forms of greenhouse gases include methane, nitrous oxide, and fluorinated gases. Methane is generated largely from livestock farming, landfills, and the production and use of fossil fuels. Nitrous oxide is produced on farms from the use of synthetic fertilizers along with fossil fuel usage. Finally,

fluorinated gases are created in products such as modern refrigerators, air conditioners, and aerosol cans. Because fluorinated gases do not harm the ozone layer and are energy efficient, products that emit these gases have grown in popularity over the past decade, though they still contribute significantly to global warming.

The Consequences of Climate Change Today and in the Future

A sense of urgency surrounds climate change because the state of climate change science has advanced to the point where scientists are able to put probability estimates on certain impacts of warming, some of which are catastrophic. The major impacts of climate change are in the areas of food security, water resources, ecosystems, extreme weather events, and rising sea levels. The IPCC summarizes the consequences of climate change by listing five key "reasons for concern" as follows:

1. **Unique and threatened systems:** Many ecosystems are at risk, such as the diminishing Arctic sea ice and coral reefs, which leads to the extinction of species.
2. **Extreme weather events:** An increase in heat waves, heavy precipitation, and coastal flooding leads to major economic costs due to natural disasters and reductions in agricultural yields.
3. **Distribution of impacts:** The risks of climate change on disadvantaged people and communities are greater, especially those that depend on agricultural production.
4. **Global aggregate impacts:** Extensive biodiversity loss affects the global economy.
5. **Large-scale singular events:** Melting ice sheets will lead to rising sea levels, causing significant loss of coastal lands.

The difficulty with addressing these effects is that unlike air or water pollution that can be seen today, climate change has a cumulative effect. In other words, this year's CO_2 adds to that from the past to raise concentrations in the future. Once CO_2 levels reach a certain level, it may lead to extreme consequences that cannot be reversed. The global environment is essentially a common resource with many public goods aspects, and climate change is a huge global negative externality that extends long into the future.

The Challenges of Addressing Climate Change

Cleaning up pollution problems typically involves finding a level of abatement at which the marginal costs of abatement equal the marginal benefits. This can be achieved by taxing, assigning marketable permits, or using command and control policies to limit emissions. However, reducing global warming is not a short-term objective but rather a cumulative process across many years. Yet, our short-run decisions will have immense impacts in the long run. Small changes in emissions today may have little effect on the current generation but will have sizable effects many decades out. This aspect of the problem seriously complicates policymaking and economic analysis.

To further compound the problem, global climate change is a public good. Nobody can have less of it

when someone has more (nonrivalry), and nobody can be excluded from its negative effects (nonexcludability). Technical innovations that help reduce CO_2 emissions are costly to develop and are difficult to profit from due to the free rider problem, which means that efforts to combat climate change need to involve governments or organizations wishing to fix the problem for the greater good.

NOBEL PRIZE

ELINOR OSTROM (1933–2012)

cooperate to solve a resource issue, can be effective.

Born in 1933 during the depths of the Great Depression and completing her doctorate in political science in 1965, her dissertation looked at a case in which salt water was seeping into western Los Angeles's water basin. A group of individuals formed a water association to solve the problem by creating rules and injected water along the coast. Their efforts saved the basin. This experience led her to look at other common resource problems from a new perspective.

She used field studies and thousands of case studies by other social scientists along with game theory to determine how these informal organizations evolved and what conditions make them successful.

Her work has determined the requirements for sustainable user-managed common resources, including (a) rules must clearly define entitlement to the resource, (b) adequate conflict resolution measures must exist, (c) an individual's duty to maintain the resource must be in proportion to his or her benefits, (d) monitoring and sanctioning must be by users or accountable to users, (e) sanctions should be graduated—mild for a first violation and stricter as violations are repeated, (f) governance and decision processes must be democratic, and (g) self-organization is recognized by outside authorities. When these institutional conditions are met, user management of common resources typically is successful.

Ostrom's insights and research have opened up an alternative to prevent the "tragedy of the commons." Her work will be particularly important as nations work together to reduce the potential harm from global climate change, maybe our biggest common resource problem to date.

Globally, there has been increased effort in recent years to combat climate change, especially in the United States and China, the two biggest emitters of greenhouse gases. In 2016, nearly every country in the world signed the Paris Agreement to reduce greenhouse emissions by setting targets (a *nationally determined contribution*) that would lead to a collective worldwide effort to keep the global average temperature to well below 2°C above preindustrial levels. The agreement requires signing nations to reconvene every five years to report their progress, essentially creating global peer pressure to achieve its goals.

Despite the promising progress, issues of equity arise when combating global warming. Why should one country invest in expensive clean energy processes when its neighbor countries choose a less expensive approach? Such issues can become very political quickly. In 2017, the Trump administration announced that the United States would withdraw from the Paris Agreement. Yet, the United States continues to meet its targets from the Paris Agreement due to market forces demanding cleaner energy and an increased urgency by local and state governments, corporations, and individuals to take action. In fact, efforts to promote sustainable development have increasingly become part of political platforms, corporate sustainability missions, and individual environmental awareness.

Governmental Social Responsibility

As the world's population continues to grow and countries become wealthier, there is an enhanced effort to improve sustainable development to prevent future generations from suffering the consequences of actions taken today. Sustainable development involves a concerted effort by individuals, businesses, and governments to recognize the causes and impacts of climate change and to take appropriate actions. Much of the technology needed to reduce greenhouse gas emissions is already available today, yet many governments fail to enact policies at the federal level. This has led many state and local governments to pass their own legislation in order to do their part in keeping global warming from worsening.

Examples of governmental social responsibility include supporting bicycle-sharing programs, investing in emissions-free public transportation and light-rail systems, and committing to sustainable procurement practices, such as minimizing unnecessary consumption by reducing, reusing, and recycling products.

Corporate Social Responsibility

Nearly every company's primary responsibility to shareholders is to maximize profits. However, promoting the image of the company as socially responsible has also become common. Take a glance at most major corporations' Web sites, and one will see a link to the company's page on corporate social responsibility, highlighting its efforts to improve sustainable development and to provide educational opportunities and other economic programs for local communities.

But much like equity issues faced by countries, corporations face equity issues, too. Those in competitive industries must balance what they spend on their social responsibilities with their ability to generate sufficient monetary returns. Some companies have used social responsibility as a marketing strategy to promote market share. For example, both PepsiCo and Coca-Cola have extensive corporate social responsibility teams that spend tens of millions of dollars each year to improve the efficiency of their operations and to operate programs helping the environment and local communities. Today, it has become a necessity for corporations to promote sustainability, though large differences in commitment still exist.

Individual Social Responsibility

One of the most common methods of reducing greenhouse gases by individuals is through recycling, with some communities even requiring households and businesses to recycle or face fines. Yet, the process of recycling itself uses energy, in addition to labor and other resources. A more effective means of promoting sustainability is to conserve resources. Examples of ways to improve conservation include the following actions:

- Forgo paper financial statements and printed newspapers, magazines, and books—for example, the use of online homework systems and digital textbooks has significantly reduced the use of paper.
- Use LED or compact fluorescent bulbs that use up to 90% less energy than incandescent bulbs

(many countries including the United States have phased out incandescent bulbs).
- Install smart temperature controls in homes that automatically reduce air conditioning and heating when the home is empty.
- Plant trees or purchase carbon offsets to fund efforts to plant trees.
- Drive less or drive fuel-efficient or alternative fuel cars (or self-driving cars that reduce traffic congestion).
- Insulate walls and modernize windows.
- Install solar panels.

Clearly, undertaking efforts to reduce our carbon footprint as a nation represents an insurance policy on the future. As new climate change information and technology becomes available, policies can be adjusted to reduce the potential costs in the future. Although climate change is frequently placed on political agendas, environmental policies such as cap-and-trade remain largely unfamiliar to everyday citizens, allowing politicians to portray policies in a manner that helps to promote their own goals rather than the goals of society. Political issues combined with economic issues will continue to make climate change a thorny problem for the future.

CHECKPOINT

THE ECONOMICS OF CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

- Global climate change is a huge negative externality with an extremely long time horizon.
- The public goods aspects of climate change make it a truly global problem.
- Balancing the current generation's costs and benefits against the potential harm to future generations raises difficult economic issues.
- Actions taken today to reduce a potential future calamity are a form of insurance.

QUESTION:

One of the most difficult aspects of climate change policy is determining how much individuals are willing to sacrifice today for a better environment in the future. What are some factors that may influence whether a person holds a high or low discount rate on the future with regard to environmental policy?

Answers to the Checkpoint questions can be found at the end of this chapter.

Chiang, *Microeconomics: Principles for a Changing World*, 5e
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A surprising source of pollution is the methane and ammonia gases produced by cows through belching and flatulence. These account for approximately 14% of the world's greenhouse gases.

Description
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13.8 Environmental policy aimed at addressing market failure takes on several forms:

- **Command and control:** Fixed standards for polluters that are enforced through inspections and legal action (does not always lead to optimal pollution levels).
- **Emissions taxes:** A fee that is paid to the government per unit of pollution emitted (can lead to optimal pollution levels if the fee is set appropriately).
- **Pollution permits:** Also known as cap-and-trade, allows firms to buy, sell, and trade permits to pollute (can lead to optimal pollution levels).

SECTION 4 THE ECONOMICS OF CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

13.9 Global climate change is a huge global negative externality accompanied by public goods aspects and extremely long time horizons, making the inherent market failure difficult to address.

Equity issues arise when some countries pay significantly more to reduce global climate change than other countries.

13.10 Solutions to global climate change require countries and corporations to engage in **sustainable development**. Individuals can do their part by taking actions to reduce fossil fuel usage through conservation efforts in everyday life.

National Geographic Image Collection/Alamy

Crowded streets filled with polluting vehicles are a common scene in India, contributing to global pollution as the nation develops.

Description

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Key Concepts

externalities
market failure
shadow price
Coase theorem