

The Global Environment and Climate Change



NEWS UPDATE

- The Russian attack on Ukraine will have dramatic effects on the price of oil (and gasoline) with the sanctions imposed by the United States on Russian oil sales, especially if other countries follow suit. Oil prices have already increased to over \$100 per barrel in anticipation of such measures (March 9, 2022).
- The Biden administration announced a moratorium on granting new oil and gas drilling rights in response to the actions of a federal judge who blocked the Biden administration from using a higher dollar amount for the cost of climate change than was used by the Trump administration in cost-benefit analysis of drilling. Whereas the Obama administration valued the cost of CO₂ emissions during the burning of fossil fuels to be \$51 per ton of fossil fuel, the Trump administration had lowered the value to \$7 or less. Biden initially raised the measure of cost back up to \$51 until the judge halted this practice. Until the matter is resolved, there will apparently be no more drilling rights granted (Lisa Friedman, *The New York Times*, February 21, 2022.)
- An intelligence report issued by the Pentagon led to an editorial, “The Rash Report: Could Climate Change Lead to War?,” in the *Minneapolis Star Tribune* (January 29, 2022). In his editorial, John Rash cites the report’s prediction of a high chance of eight risks to U.S. national security stemming from climate change by 2040. These range from the resistance of petrostates to reducing their oil production to massive climate-induced migration setting off right-wing challenges to democracies worldwide. He also cites Jessica Hellmann, director of the University of Minnesota’s Institute on the Environment, as stating, “Increasingly, we realize that climate change intersects with and is critically important to everything we care about: food security, international political stability, environment justice, public health, as well as environmental quality.”

PURPOSE

The purpose of this chapter is to introduce students to the economics of environmental protection and to make them aware that economics and the problem of pollution are indeed linked. I use a social cost-benefit analysis rather than “marginal social cost equals marginal social benefit” as the framework for evaluating environmental policy. I feel the marginal approach is too difficult to teach quickly in a text covering issues, too abstract when used to describe a “unit of pollution control,” and not necessary for teaching environmental economics at this level. I think that at an introductory level, the weighing and comparing of the monetary and non-monetary costs and benefits of pollution control is more intuitive.

WHAT'S NEW?

1. Once again, the chapter opens with contrasting quotations by former President Donald Trump and President Joe Biden — this time about global warming: conspiracy theory versus existential threat.
2. Recent policies under Trump and Biden are addressed.
3. There is new material on climate change, along with and the Paris Climate Accord and the 2021 UN Climate Change Conference (COP21) in Glasgow, Scotland.
4. There is new discussion about the role of the coronavirus pandemic and greenhouse gas emissions. For example, people drove less in 2020 amid the early phase of the outbreak.
5. Other forms of pollution in addition to greenhouse gas emissions are addressed, and there is new discussion of genetically modified organisms.
6. The populist ideology is discussed in addition to the economic left and right opinions about pollution in the *Viewpoint* section.

TEACHING SUGGESTIONS

➤ *Student Interest*

- Students often know more about specific types of pollution than we do. (They've studied it in high school and in their college biology and natural resource courses.) It may boost their self-confidence if you ask them to tell you what they know!
- I've found that students are often surprised to think of pollution and the environment as economic issues. You will want them to see that economics is involved in decisions to pollute, policies to control pollution, consumer decisions to recycle, and incentives to conserve.
- Among the issues students care about, it seems that pollution, particularly as it relates to climate change, ranks near the top. Everyone, including the Pope, is discussing the problem of climate change. Students will probably also be enthusiastic about any discussion that has to do with recycling, conservation, and incentives for these practices! They may also be interested in the ways to become "carbon neutral."

➤ *Controversy*

- I've noticed people often believe policy should be made at the local level of government because that level of government is closer to the people and their needs. They haven't given much thought to the reasons why environmental policy is usually more appropriate at the federal (or higher) levels of government. You may want to discuss this with your students, recognizing that people on the economic right are generally more supportive of policy decisions at the local level. People on the left may support a global organization charged with global rules on environmental protection.

➤ *Economic Theory and Models*

- As in Chapter 5, the theory of externalities and resource allocation is addressed in Chapter 11, this time with respect to the negative externalities associated with pollution. (Chapter 5 addressed the positive externalities associated with education.) A two-graph demand and supply model is used to show the over-allocation of resources to a polluting industry and the under-allocation of resources to an industry harmed by this pollution. Issues of inequity and inefficiency are also discussed.
- An alternative graph is shown in Appendix 11–1, representing the market for air travel to the Bahamas over spring break. This model uses a single graph to show the impact of pollution on resource allocation.
- Students sometimes wonder why an over-allocation of resources to the production of a particular product is a problem. You will probably want to explain this in terms of scarcity and opportunity costs.
- A social cost-benefit analysis of pollution is addressed, adding that even though some costs cannot be monetized, they should nevertheless be considered.
- References to production possibilities are used to address the impact of pollution and pollution control on economic growth and economic inefficiency.
- Students may have difficulty understanding the intricacies of marketable pollution permits, but once they do understand, they are usually delighted with this approach to pollution control! It isn't a complete solution, but it is attracting growing support. I think the hypothetical but concrete example used in the text is a good one.
- A graph of demand and supply is used to demonstrate how OPEC wields its market power by restricting output to drive up prices and profits in the context of an inelastic demand curve.
- Gasoline taxes are addressed in the same way as excise taxes, resulting in less production and higher prices of gasoline. Subsidies for the production or purchase of electric vehicles are also discussed.

➤ *Data and Terminology*

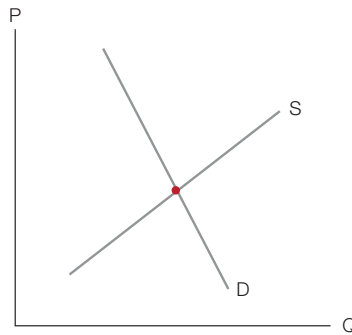
- New data reveal global and U.S. greenhouse gas emissions by type of gas.
- Updated data on emissions by individual countries reveal that China is the largest single emitter of carbon dioxide, but the United States has the highest emissions of carbon dioxide when expressed as a share of GDP.
- Updated data show recent changes in the price of gasoline (prior to the war in Ukraine).

➤ *Fundamentals*

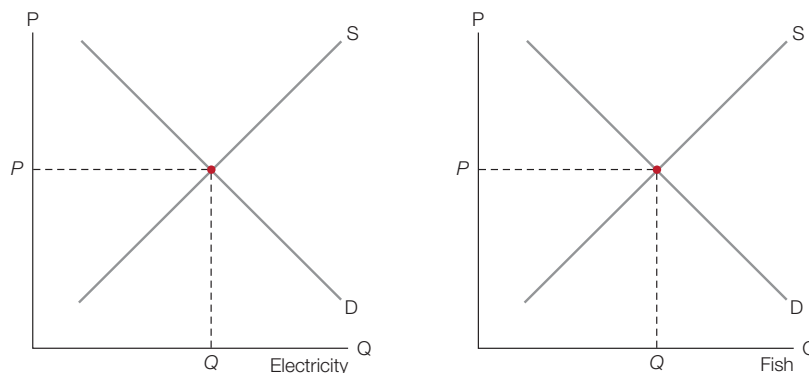
- In both the United States and globally, the poor suffer most from climate change, worsening national and global income inequality.
- Racism seems to be a factor in deciding who will get help from climate-induced damage. For example, many believe that poor Blacks suffered from government inaction amid Hurricane Katrina and Puerto Ricans suffered disproportionately from Hurricane Maria.
- Climate change and its destruction creates conditions for migration; and immigrants of color from Africa, the Northern Triangle in Central America, Haiti, and around the globe face racism in the immigration process.

CLASSROOM EXERCISES

1. The following graph depicts the global petroleum market under the assumption that the Organization of Petroleum Exporting countries (OPEC) controls the vast majority of exported oil (as it once did). Shift the appropriate curve to show what will occur if OPEC decides to act to increase the price of oil. [The supply curve will shift backward.] Does OPEC have the same extent of market power today as it once had? [No]

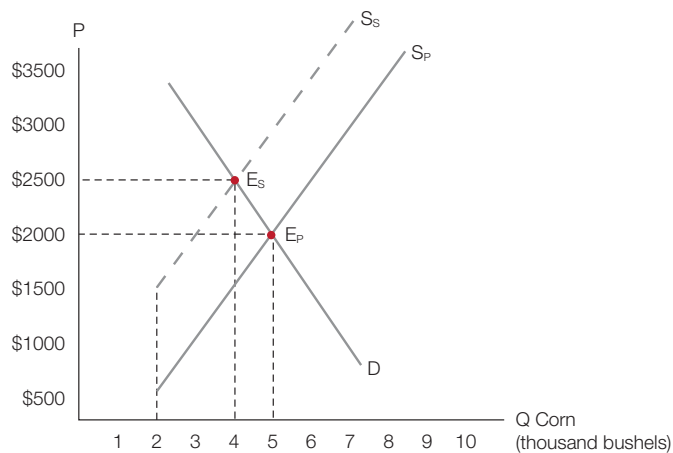


2. Consider the following demand and supply graphs for the electrical industry and the fish industry. Assume the electrical industry operates upstream of a river, while the fish industry operates downstream. Also assume that neither industry initially pollutes. Shift the curve to show what occurs in the first graph if the electrical industry decides to cut costs by dumping water into the stream without cooling it, causing thermal pollution. [Its supply curve shifts forward.] Next, shift the curve to show what happens in the fishing industry if it must undergo the expense of cooling the water before it can be used to raise fish. [Its supply curve shifts backward.]



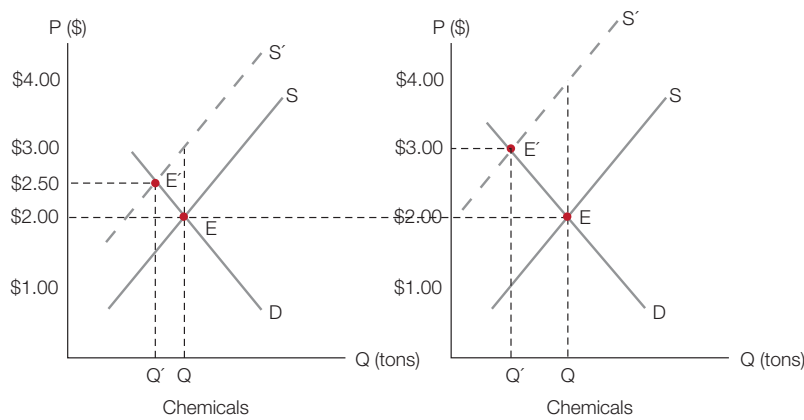
- What is the effect of the pollution by the electrical industry on the price of electricity? [Decrease]
- What is the effect on the price of fish? [Increase]
- In which industry is there now an over-allocation of resources? [Electricity]
- In which industry is there now an under-allocation of resources? [Fish]

3. Consider the graph of a market for corn in a small country, assuming that production of corn results in chemical fertilizer and pesticide runoff that pollutes nearby streams. S_p represents the private market supply curve, while S_s is the social supply curve. S_s reflects the full social costs of production.



- What costs are reflected in the social supply curve? [Private costs and spillover costs]
- What is represented by the vertical distance between the two supply curves? [The amount of pollution per unit of output] What amount is this? [\$1,000]
- Why is it possible that production of fewer than 2,000 bushels of corn results in no spillover costs? [The Earth has natural cleansing ability.]
- What is the equilibrium quantity of corn produced in the private market? [5,000 bushels]
- What is the socially optimal quantity of corn? [4,000 bushels] Why do we say that the private market results in an over-allocation of resources to corn production? [Society produces and consumes more corn than it would if the spillover costs were accounted for.] Why is this a problem? [With scarcity, if there is an over-allocation of resources to one industry, there is an under-allocation of resources to another industry.]
- Suppose an effluent fee of \$1,000 is imposed on the corn producers for every thousand bushels of corn produced. What will be the effect of the fee on the market price of corn? [Increase] Is it appropriate that consumers pay a higher price for a product whose production creates pollution? [Yes] Why? [They consume a product associated with causing pollution.]

4. Consider the following graphs of demand and supply in a polluting chemical industry under two scenarios. In the first case, an effluent fee of \$1.00 per pound of chemicals is placed on the industry, and in the second case, a larger effluent fee of \$2.00 per pound is placed on the industry.



- Why does the supply curve shift up (back) in each case with the imposition of the effluent fee? [This is considered a larger cost of production.]
 - What is the value of the vertical distance between the two supply curves in the first graph? [\$1] In the second graph? [\$2]
 - What is the effect of the fee on the equilibrium price of chemicals [Increase] On the equilibrium quantity of chemicals bought and sold? [Decrease]
 - In which graph is the quantity of chemicals (and therefore the amount of pollution) reduced the most? [In the second graph]
5. (Appendix 11-1) Draw the graph of a hypothetical market for steel, assuming that the production of steel results in air pollution. Label the private market supply curve as S_p , and label the social supply curve as S_s . S_s reflects the full social costs of production. The supply and demand schedules are as follows. Quantities are in tons.

Price	Quantity Demanded	Private Quantity	Public Quantity
		Supplied	Supplied
\$1,000	5	1	—
\$2,000	4	2	0
\$3,000	3	3	1
\$4,000	2	4	2
\$5,000	1	5	3

- What is represented by the vertical distance between the two supply curves? [The spillover cost]
- Specifically, what costs are reflected in the social supply curve? [Private costs and spillover costs]
- Why is it possible that production of less than 1 ton of steel results in no spillover costs? [Earth's natural cleansing]
- What is the equilibrium quantity of steel produced in the private market? [3,000 tons] What is the socially optimal quantity of steel? [2,000 tons] Why do we say that the private market results in an over-allocation of resources to steel production? [We produce more steel than is socially optimal.] Why is this a problem? [It means we must give up something society values more.]
- Suppose an emissions fee of \$2,000 is imposed on the steel producers for every 1 ton of steel produced. What will be the effect of the fee on the market supply? [It will shift backward.] The market price of steel? [Increase] Is it appropriate that consumers pay a higher price for a product whose production creates pollution? [Yes]

SAMPLE TEST QUESTIONS

Multiple Choice Questions

1. Pollution causes:
 - a. spillover costs.
 - b. inefficient resource allocation.
 - c. an inequitable burden of costs.
 - d. all of the above**

2. Spillover benefits derive from:
 - a. childhood vaccinations.
 - b. education tuition provided by employers.
 - c. your education.
 - d. all of the above**

3. The earliest efforts to control pollution in the United States through legislation came from:
 - a. city governments.**
 - b. state governments.
 - c. the federal government.
 - d. none of the above

4. According to the textbook, the decisions about pollution control in the case of pollution that extends beyond state boundaries should be made by:
 - a. city governments.
 - b. county governments.
 - c. state governments.
 - d. the federal (and possibly international) governments.**

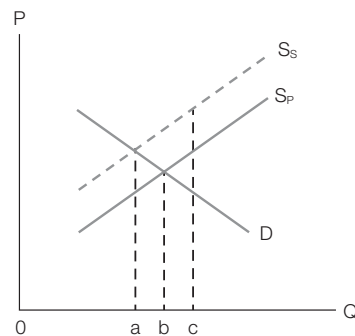
5. Which of the following economic terms represents a regulation that is more likely to encourage research into new technologies and lower cost methods of meeting environmental quality?
 - a. Performance standard**
 - b. Design standard
 - c. Technology standard
 - d. Business standard

6. A tax on production that causes air pollution is called:
 - a. a pollution permit.
 - b. a specific standard.
 - c. an effluent fee.
 - d. an emissions fee.**

7. Why is the overallocation of resources to a particular market a problem?
 - a. We give up something society values more.**
 - b. We must give up something society values less.
 - c. Society should always seek a greater allocation of resources to any good it desires.
 - d. It is not really a problem.

8. *Technology forcing* is defined as:
- allowing firms to choose the type of technology used in pollution control.
 - requiring firms to use specific types of technology used in pollution control.**
 - forcing firms to purchase the technology used in pollution control.
 - forcing firms to produce the technology used in pollution control.
9. Marketable pollution permits:
- allow producers to buy and sell permits.
 - minimize the costs of pollution control.
 - utilize the marketplace.
 - all of the above**
10. The creation of a market for pollution permits:
- completely eliminates air and water pollution.
 - causes firms to seek out low-cost pollution-reducing technologies.**
 - is only supported by economic liberals.
 - all of the above
11. Economists and environmentalists may differ in that:
- environmentalists often want to eliminate all pollution, but economists may approve some level of pollution if society values the product associated with it.**
 - environmentalists care about the environment, but economists do not.
 - economists rarely support a cost-benefit approach.
 - all of the above
12. If an emissions fee equal to the spillover cost of pollution is levied on the polluting firm:
- it will eliminate the over-allocation of resources to the product produced by the firm.
 - it will increase the price of the firm's product.
 - it will decrease the firm's output.
 - all of the above.**
13. Based on data in the text, which country causes the largest total amount of carbon dioxide emissions?
- China**
 - the United States
 - Russia
 - India
14. Based on data in the text, which country causes the largest carbon dioxide emissions per capita (per person)?
- China
 - the United States**
 - Russia
 - India

15. The Organization of Petroleum Exporting countries (OPEC) in the past has been able to keep petroleum prices high by:
- increasing demand.
 - increasing supply.
 - decreasing demand.
 - decreasing supply.**
16. When performing cost-benefit analysis of environmental protection, we should include:
- monetary costs such as business firms using less polluting but more expensive inputs.
 - monetary costs such as consumers buying high-efficiency but more expensive appliances.
 - non-monetary costs such as consumers' inconvenience associated with recycling.
 - all of the above**
17. A major problem with recycling is:
- that people absolutely refuse to recycle.
 - finding a market for recyclable materials.**
 - incentives simply do not work.
 - most such programs make recycling very convenient.
18. Which of the following environmental problems have not been successfully overcome in developing countries?
- Loss of biodiversity
 - Deforestation
 - Desertification
 - All of the above**
19. Which of the following should be considered when comparing costs and benefits of pollution control?
- Spillovers of production activity
 - Spillovers of consumption activity
 - Spillovers that occur over time
 - All of the above**
20. (Appendix 11-1) Assuming the production of paint results in chemical pollution of the land and water and that S_p represents the private supply curve for paint and S_s represents the social supply curve for paint, which is the socially optimal output of paint in the following graph?



- Amount a**
- Amount b
- Amount c
- We don't know because we've ignored social costs of production.

True / False Questions

1. Generally speaking, the economist's view is that all pollution should be eliminated. (F)
2. Environmental quality is a luxury good. (T)
3. Externalities can be positive or negative. (T)
4. Over-allocation of resources occurs in markets harmed by pollution caused in another market. (F)
5. Both positive and negative externalities cause inequity and inefficiency if government doesn't intervene. (T)
6. Economists believe the proper level of government to enact pollution control policies is almost always the local government, since the local government knows most clearly the needs of the local community. (F)
7. The performance standard approach to regulation specifies the maximum level of pollution as well as the specific means of compliance. (F)
8. The term *pollution fees* can include both effluent fees and emissions fees. (T)
9. A design standard specifies not only the required level of performance (in controlling pollution), but also the means to reach that performance. (T)
10. Marketable pollution permits are considered efficient but have never actually been used. (F)
11. Effluent and emissions fees are more likely to result in least-cost pollution control than the use of standards. (T)
12. People are more likely to recycle and purchase recyclable products if they are charged per bag of garbage rather than a fixed fee for garbage pickup. (T)
13. If the supply of recyclable materials increases, the price of these materials will increase. (F)
14. A higher gasoline tax is more likely to encourage conservation than a lower one. (T)
15. Pollution permits usually result in firms that are initially not heavy polluters doing all the cleanup. (F)
16. Cost-benefit analysis is useless in evaluating environmental policy. (F)
17. Present U.S. laws do not allow trade in pollution permits. (F)
18. Ten-cent deposits on aluminum soda cans would be an example of an incentive to recycle. (T)
19. Critics of environmental regulation argue that higher production costs will make products less competitive in the international market. (T)
20. Economists on the economic left are more likely than those on the right to support government regulation, including standards, as well as policies drafted at the national and international levels. (T)
21. Economists on the economic right like pollution controls that work via the marketplace, such as pollution fees and marketable pollution permits. (T)
22. Greta Thunberg is a young woman who says blah blah blah. (T)
23. Former President Trump vastly increases financing of pollution control. (F)
24. Under President Trump, the number of environmental regulations increased dramatically and even surpassed those of President Obama. (F)
25. (*Appendix 11-1*) The social costs of production that cause pollution include the private costs of production and the spillover costs of pollution. (T)

Critical Thinking Questions

1. Your author developed a three-pronged approach to externalities. Explain these three forms of spillovers.
2. What are the viewpoints on the economic left and economic right regarding pollution control? What has been the role of populism on the issue?
3. What are some negative externalities not mentioned in the textbook? What are some positive externalities?
4. Incentive-based pollution control (taxes, subsidies, improved convenience of recycling, pollution permits, etc.) allows research and development of least-cost technology and production processes to control pollution, allows the costs as well as the benefits of pollution control to be considered, and often results in the largest polluters having more incentive to reduce pollution than small polluters. Economists often favor these incentive-based pollution controls. On the other hand, standards may assure greater compliance and pollution control. Which do you prefer?
5. Is it appropriate that consumers pay a higher price for a product whose production causes pollution? Is there anything the government can do for poor consumers if they suffer severely from higher prices caused by pollution control for necessary products such as gasoline.
6. Additional roads and parking structures enable more people to drive in cities, thereby causing more pollution and congestion. What would be the impact of policies such as higher gasoline taxes, road tolls, automobile fees, expensive parking, high-price auto insurance, and inexpensive and convenient mass transit?