PART I

FOUNDATIONS

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Environmental Economics

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Key Findings

Key findings of this chapter include the following:

Introduction

- No one should assume the "science is settled" regarding anthropogenic climate change or that the only role for economists is to recommend the most efficient way to reduce "carbon pollution."

History

- Economists have been addressing environmental issues since the discipline was founded in the eighteenth century.
- Economies and ecological systems have many commonalities, with the result that economics and ecology share many key concepts.
- Economists have shown markets can manage access to common-pool resources better than government agencies.

Key Concepts

- The cost of any choice is the value of forgone uses of the funds or time spent. Economists call this "opportunity cost."
- Climate change is not a conflict between people who are selfish and those who are altruistic. People who oppose immediate action to reduce greenhouse gas emissions are just as ethical or moral as those who support such action.
- Market prices capture and make public local knowledge that is complex, dispersed, and constantly changing.
- Most human action can be understood by understanding the incentives people face. "Moral hazard" occurs when people are able to escape full responsibility for their actions.
- Trade creates value by making both parties better off.
- Profits and losses direct investments to their highest and best uses.
- The art of economics consists in looking not merely at the immediate but at the longer-term effects of any act or policy.
- Discount rates, sometimes referred to as the "social rate of time preference," are used to determine the current value of future costs and benefits.
- Cost-benefit analysis, when performed correctly, can lead to better public policy decisions.

Private Environmental Protection

- Common-pool resources have been successfully protected by tort and nuisance laws and managed by nongovernmental organizations.
- Voluntary cooperation can generate efficient solutions to conflicts involving negative externalities.
- Prosperity leads to environmental protection becoming a higher social value and provides the resources needed to make it possible.
- The information needed to anticipate changes and decide how best to respond is local knowledge and the most efficient responses will be local solutions.
- "Ecological economics" is not a reliable substitute for rigorous mainstream environmental economics.

Government Environmental Protection

- Governments can protect the environment by helping to define and enforce property rights.
- Regulations often fail to achieve their objectives due to the conflicting incentives of individuals in governments and the absence of reliable and local knowledge.

- Evidence of "market failure" does not mean government intervention can improve market outcomes.

- Government bureaucracies predictably fall victim to regulatory capture, tunnel vision, moral hazard, and corruption.

- Voters have little incentive to become knowledgeable about many public policy issues. Economists call this "rational ignorance."

- Government's ability to promote the goals of some citizens at the expense of others leads to resources being diverted from production to political action. Economists call this "rent-seeking behavior."

- Government policies that erode the protection of property rights reduce the incentive and ability of owners to protect and conserve their resources. Those policies displace, rather than improve or add to, private environmental protection.

- "Leakage" occurs when the emissions reduced by a regulation are partially or entirely offset by changes in behavior.

Future Generations

- Capital markets create information, signals, and incentives to manage assets for long-term value.

- Markets reward innovations that protect the environment by using less energy and fewer raw materials per unit of output.

- Mistakes made in markets tend to be small and self-correcting. Mistakes made by governments tend to be big and are more likely to have catastrophic effects.

Conclusion

- Climate change is not a problem to be solved by markets or government intervention. It is a complex phenomenon involving choices made by millions or even billions of people producing countless externalities both positive and negative.

- The best responses to climate change are likely to arise from voluntary cooperation mediated by nongovernmental entities using knowledge of local costs and opportunities.

- Energy freedom – allowing markets rather than governments to make important choices about which fuels to use – can turn climate change from a possible *tragedy* of the commons into an *opportunity* of the commons.

Introduction

> *No one should assume the "science is settled" regarding anthropogenic climate change or that the only role for economists is to recommend the most efficient way to reduce "carbon pollution."*

Many environmentalists and climate scientists are not familiar with the latest economic research on how common-pool resources, of which the global atmosphere is one, can be managed efficiently. They therefore believe the only thing economists can contribute to the debate over climate change is expertise in finding the most efficient way to reduce "carbon pollution." Many economists allow themselves to be relegated to this role by accepting unsubstantiated claims that the "science is settled" regarding the causes and consequences of climate change. Both audiences need to be aware of basic economic concepts that apply to climate change.

The general acceptance by economists of the findings of the United Nations' Intergovernmental Panel on Climate Change (IPCC) creates the appearance that most economists endorse the theory that man-made emissions of greenhouse gases (GHGs), and carbon dioxide (CO_2) in particular, are causing harm today and possibly a catastrophe in the future. For example, 26 prominent economists signed "The Schelling consensus on climate change policy," which leads with this statement: "Global climate change is one of the greatest problems facing mankind that requires collective action in order to be solved" (Anthoff *et al.,* 2011). Why would economists, who generally do not have backgrounds in physical science and who pride themselves on not presuming to aggregate or order the preferences of others, pledge allegiance to such a dogmatic claim?

Jean Tirole, winner of the 2014 Nobel Prize in economics, wrote in 2017, "Rising sea levels

affecting islands and coastal cities, climatic disturbances, heavy rains and extreme droughts, uncertain harvests: we are all aware of the consequences of climate change. … [U]nless the international community acts vigorously, climate change may well compromise, in a dramatic and lasting way, the well-being of future generations" (Tirole, 2017, p. 195). He cites the IPCC and makes reference to the need "to contain the temperature increase to a virtuous 1.5 to 2.0 degrees Celsius" (p. 196). He attributes lack of effort to reduce GHG emissions to "*selfishness with regard to future generations and the free rider problem*" (p. 199). These statements suggest Tirole doesn't know the difference between weather and climate, or between a political organization and a scientific body, and that he thinks one hypothetical construction of global temperature is somehow more "virtuous" than another. Reading such conjecture and moralizing by a Nobel Laureate is disappointing.

Even economists who specialize in climate change fail to take the scientific debate seriously. In a recent book, William Nordhaus**,** the Sterling Professor of Economics at Yale University, cited the Summary for Policymakers (SPM) of the IPCC's Fourth Assessment Report and two National Academies reports (2001, 2011) and writes, "I could continue with further examples, but the basic findings of expert panels around the world are the same: The processes underlying projections of climate change are established science; the climate is changing unusually rapidly and the earth is warming" (Nordhaus, 2013, p. 296). But climate change in the twentieth century and so far in the twenty-first century was *not* "unusual" and at issue is not whether the planet is warming but how much of that warming is due to anthropogenic causes. His choice of panels rather than peer-reviewed literature is an appeal to authority instead of observational data or the scientific method. He also seems unaware of who writes the summaries for policymakers of the IPCC reports; most are not scientists (Goldenberg, 2014).

In the same book and as part of the same discussion of why he believes the science is settled, Nordhaus accepts the Hadley/NCDC/GISS global average surface temperature record without question or doubt, even though its accuracy has been challenged and since 1979 it has been superseded by superior satellite-based temperature data showing less warming. He cites anecdotes of "melting of glaciers and ice sheets" seemingly unaware that glaciers and ice sheets have waxed and waned for eons and in recent centuries regardless of the amount of CO_2 in the atmosphere. He repeats the IPCC's claim that its computer models cannot account for rising temperatures without a major role for CO_2, so CO_2 must account for rising temperatures … circular reasoning based on unproven presumptions. See also Heal (2017) as an example of an economist who concedes "massive uncertainty" involving climate science and economics, yet considers general circulation models to be a reliable basis for making predictions about future temperatures and climate impacts (pp. 1047, 1052).

Climate scientists have tried to school economists on the actual findings of the climate science community, instead of the distorted portrait created by the IPCC and other government panels, with only limited success. See, for example, Nordhaus (2012) and a reply by three distinguished climate scientists, Cohen, Happer, and Lindzen (2012).

It seems economists have broken what has been called Ray Hyman's Categorical Directive: "Before we try to explain something, we should be sure it actually happened" (Sheaffer, 2009, p. 84). The best available climate science shows the human effect on the global climate is likely too small to be measured against a background of natural variation (NIPCC, 2009, 2013). Most forecasts of future global warming due to human activities are implausible and violate most of the accepted principles of scientific forecasting (Green *et al.*, 2009; Green and Armstrong, 2007). The environmental benefits of a modest global warming are likely to exceed the environmental costs (NIPCC, 2014). Many scientists do not endorse the IPCC's claims of high confidence in predictions of more frequent or severe floods, droughts, hurricanes, and other calamities (Essex and McKitrick, 2007).

The failure of many economists to address the climate issue truthfully and forcefully is surprising. An extensive literature exists describing how interest groups have repeatedly exaggerated environmental threats in order to advance their financial interests or ideological agendas. Green and Armstrong (2011) studied 26 past forecasts of serious environmental harms from human activity and found none of the forecasts was the product of scientific forecasting methods and none proved to be accurate. In 20 of the situations, costly government regulations were imposed with the effect of reducing the welfare of the many while benefiting the few. See also the list of titles in Lehr (2014), the Iron Law of Regulation website, and the references in Section 1.4.5 below. Public choice theory predicts this sort of behavior and documents it across many fields. Public choice

theorists are not on the fringe of mainstream economics; at least six won Nobel Prizes for their work: Gary Becker, James M. Buchanan, Ronald Coase, Elinor Ostrom, Vernon Smith, and George Stigler.

Economists have more to offer on climate change than simply advice for designing tax and cap-and-trade schemes. By revealing the costs and benefits of various policy options and market-based alternatives to government regulation, economics can help policymakers discover cost-effective responses to a wide range of environmental problems (Block, 1990; Markandya and Richardson, 1992; Libecap and Steckel, 2011). Environmental economics has become more important as "the quick environmental fixes from command-and-control regulation mainly have been achieved and … the balance of pollution sources is shifting from large 'point sources' to more diffuse sources that are more difficult and expensive to regulate" (Dietz and Stern, 2002, p. vii). This description certainly applies to global warming, as CO_2 and other greenhouse gases are emitted from billions of sources both anthropogenic and natural.

Economists can help reconcile the real-world tradeoffs of protecting the environment while producing the goods and services needed by humanity by tapping the internal motivation of property owners, the value-creating power of trade, and local knowledge of costs and opportunities (Anderson and Leal, 2015; Morriss and Butler, 2013). They have shown how entrepreneurs can use private property, price signals, and capital markets to protect the environment without relying on government force (Anderson and Leal, 1997; Anderson and Huggins, 2008; Huggins, 2013).

Economists have pointed out the economic, political, legal, and administrative pitfalls facing renewable and carbon-neutral energies (McKitrick, 2010; Morriss *et al.*, 2011; Yonk *et al.*, 2012). Proposals to cap greenhouse gas emissions, "put a price on carbon," and other policies intended to force a transition away from fossil fuels often are advanced without an understanding of the true costs and physical limitations on the supply of alternative fuels. One consequence is their advocates support poorly designed programs that lead to unnecessary expenses, minimal or even no net reductions in emissions, and the unintentional emergence of regulatory hurdles to innovation and future discovery of alternative fuels (McKitrick, 2009; Lomborg, 2010; van Kooten, 2013; Lemoine and Rudik, 2017).

Economists also bring value to the climate change discussion thanks to their expertise in statistical analysis. Darwall (2013) remarks, "economists should be in a better position than others to make their own assessment of the science because much of it is about statistics and modeling" (p. 239). He quotes Ross McKitrick, a Canadian economist, saying, "the typical economist has way more training in data analysis than a typical climatologist," and "once they start reading climate papers they start spotting errors all over the place" (*Ibid.*).

Economists have examined the reasons why poor people and minorities often live in neighborhoods exposed to the highest levels of pollution (Banzhaf, 2012). Understanding how this situation can be the unintended consequence of policies intended to reduce emissions can lead to ideas and proposals that better protect everyone's health and rights.

Economists also can measure and help predict the distributional effects of public policies; e.g., whether the poor are hurt more than the wealthy by policies that seek to reduce greenhouse gas emissions by raising the price of energy (Büchs *et al.*, 2011; Kotkin, 2018). Similarly, economists can determine if poor countries are more vulnerable to climate change than wealthy countries (Mendelsohn *et al.*, 2006).

While some economists are occasionally guilty of the "tunnel vision" described later in this chapter, most are well-schooled in the limits of markets. Fullerton and Stavins (1998) wrote, "many economists – ourselves included – make a living out of analyzing 'market failures' such as environmental pollution. These are situations in which laissez faire policy leads not to social efficiency, but to inefficiency" (p. 5). Market-based approaches to environmental protection, they wrote, "are no panacea" and "the scope of economic analysis is much broader than financial flows" (*Ibid*., pp. 5–6). On the other hand, economists are more keenly aware than others of the failure of regulation to improve on market results even in cases of "market failure" (Winston, 1993, 2006).

Section 1.1 summarizes the history of environmental economics and introduces free-market environmentalism (FME). Sections 1.2 through 1.4 describe the basic principles and tools of environmental economics based on an earlier book by Richard L. Stroup (Stroup, 2003), one of the coauthors of the present chapter. Stroup's work appears here with the publisher's permission and has been substantially revised and updated with the author's assistance and approval. Section 1.5 describes how markets take into account the interests of future generations. Section 1.6 presents a brief summary and conclusion.

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1.1 History

Economists have been addressing environmental issues since the discipline was founded in the eighteenth century.

Economists at least since Adam Smith (1776 [1976]) and even before him (see Cantillon, 1755 and the discussion in Rothbard, 1995) have used the tools of economics to address environmental issues. Economics and scholarly interest in the relationship between humans and the natural environment emerged simultaneously due to the same historical events. Writing nearly a century ago, Thomas (1925 [1965]) observed "the first great impulse to a thorough-going development of environmental theories came as a result of the discoveries and colonizing enterprises of the sixteenth and seventeenth centuries known as the Commercial Revolution" (p. 22). Smith was fascinated by what was happening in the American colonies (see "Of Colonies," Book IV, Chapter vii, of *The Wealth of Nations*) and corresponded with Benjamin Franklin while writing his great book.

Economics and ecology emerged as disciplines with more in common than differences. Smith influenced Thomas Malthus (1766–1834), who in turn influenced Charles Darwin, born after Smith's death (Smith lived from 1723 to 1790, Darwin from 1809 to 1882). Darwin attended the University of Edinburgh, where Smith once lectured and was well known. Darwin referred to Smith and cited him in *The Descent of Man*, published in 1871 (Darwin 1871 [1981], p. 81). Smith's insight that markets lead the self-interested individual "by an invisible hand to promote an end which was no part of his intention" (Smith, 1776 [1976], Book 4, Chapter 4) is echoed in Darwin's description of evolution in *The Origin of Species*, a process in which "all organic beings are striving to seize on each place in the economy of nature" (Darwin 1859 [2003]).

Why economists would be interested in the environment was obvious to Thomas: "As economics is almost invariably considered by the economists to include a study of man's exploitation of his physical environment for his own needs, it is not necessary to dwell upon the fact that the study of the physical environment is of the utmost significance for that subject" (Thomas 1925 [1965], p. 9). Malthus, David Ricardo, and John Stuart Mill each addressed the limits on human prosperity posed by the scarcity of land suited to agriculture, coal, and other natural resources.

In 1920, A.C. Pigou recognized the special problem posed by resources owned in common rather than by individuals, observing, "No 'invisible hand' can be relied on to produce a good arrangement of the whole from a combination of separate treatments of the parts. It is therefore necessary that an authority of wider reach should intervene to tackle the collective problems of beauty, of air and light, as those other collective problems of gas and water have been tackled" (Pigou, 1920, p. 195).

By 1931, economists were laying the foundations of what would become natural resource economics (Hotelling, 1931). With some notable exceptions (Mises, [1966] 1998; Knight, 1924), a generation of economists generally accepted Pigou's argument that only governments could solve "collective problems" involving air and water. That changed in 1960 with publication of an essay titled "The Problem of Social Cost" by future Nobel Laureate Ronald Coase (Coase, 1960).

Coase observed that high transaction costs may cause markets to fail to ensure that all of the costs of a person's actions are fully borne by the actor ("internalized"), but transaction costs are ubiquitous (there is no such thing as "zero transaction costs") and positive and negative externalities are resolved everywhere, usually without government intervention. All that is necessary to achieve the most efficient outcomes is for governments to help recognize and enforce the property rights of the parties involved and allow them to negotiate toward a settlement. As Terry Anderson explains it, "Certainly, transaction costs can prevent all costs from being fully accounted for, but unaccounted for costs constitute uncaptured benefits. If water is not owned, and therefore polluted, the entrepreneur who can establish ownership captures the benefits if water quality is improved" (Anderson, 2011). Coase's contribution to the environmental debate is described in more detail in Section 1.3.2.

Environmental economics was strongly influenced by the rise of the modern environmental movement in the 1970s. Publication in 1972 of *The Limits to Growth* by the Club of Rome steered the profession in the direction of forecasting trends in population, technology, and the use of finite natural resources (Meadows *et al.*, 1972). In 1989, *Blueprint for a Green Economy* by David Pearce and coauthors spelled out the public policy implications of environmental values and concerns, calling for recognition of the economic benefits of natural resources, taxes on polluters, and measuring additions and losses to a country's stock of natural resources (Pearce *et al.*, 1989). Many modern-day economists, including Helm (2015), continue to work in this tradition. Baden and Stroup (1981) observed,

> The dawn of the environmental movement coincided with an increased skepticism of private property rights and the market. Many citizen activists blamed self-interest and the institutions that permit its expression for our environmental and natural resource crises. From there it was a short step to the conclusion that management by professional public 'servants,' or bureaucrats, would significantly ameliorate the problems identified in the celebrations accompanying Earth Day 1970 (p. x).

Also during the 1970s, an alternative school of thought called "the new resource economics," or free-market environmentalism (FME), began to emerge (Hardin and Baden, 1977; *Harvard Journal of Law & Public Policy*, 1992; Anderson and Leal, 2015). It advanced critiques of Pigou's dismissal of private solutions to the management of "collective problems" such as pollution by documenting cases where recognizing and enforcing private property rights solved environmental problems without relying on politics and governments. As Anderson commented in 2007, "Secure private property rights that hold people accountable and markets that communicate human values and opportunity costs are the core of FME, and they are as applicable to global warming as they are to land and water conservation" (Anderson, 2007).

According to FME, the market approach to protecting commonly owned resources is to find win-win solutions even when conditions might otherwise cause over-use of a resource by some agents and harm to others. People value and are willing to pay for environmental amenities, meaning there are markets for achieving environmental protection. Since the future value of assets affects their current prices, private ownership of assets creates incentives for conservation and protection that benefit future generations.

FME recognizes that markets are powerful engines of value creation thanks to the incentives created by private property rights, the knowledge generated and communicated by prices and the profit and loss system, and the value created by exchanges in which both parties benefit. Governments routinely fail to manage resources as efficiently as markets due to their isolation from these market forces resulting in

moral hazard, careerism, tunnel vision, and other maladies known to afflict government bureaucracies. The best solutions to problems involving common-pool resources, then, are often discovered and implemented by markets rather than by politics and bureaucracies.

FME scholars generally hold that human welfare is the best measure of success in managing natural resources. They stress that protecting the natural environment is a value that grows mainly or even only in the presence of the prosperity that markets make possible. Environmentalists argue to the contrary, that animals and even inanimate objects have "innate" value or make contributions to "sustainability" that should be weighed against any human benefits (Chase, 1995; Davidson, 2000). In contrast to free markets, where values emerge from voluntary transactions, it is not clear who should determine the values that environmentalists argue for or who should bear the cost of attaining them.

Some environmentalists also dispute FME's exposé of repeated government failure, instead attributing favorable trends in air and water quality, for example, entirely to government interventions and not to any market processes, even though many of those trends started before government intervention could have played a role (Simon, 1995; Goklany, 1999; Hayward, 2011, pp. 7ff). These environmentalists hold out hope that concentrating power in the hands of government officials can do more to protect the air, water, and endangered species than giving property owners and others secure property rights and incentives to do the right thing. Finally, some environmentalists blame the free enterprise system for the unequal distribution of wealth among individuals, leading them to subordinate individual liberty to their own goals (Coffman, 1994; Easterbrook, 2003; Buchanan, 2005; Klein, 2014).

Some environmentalists who reject mainstream environmental economics have attempted to create their own school called "ecological economics." The contributions and limits of that effort are described in Section 1.3.5. Not all environmentalists, however, assume a fundamental conflict between free enterprise and environmental protection. Their efforts merit some attention here.

Rothschild (1990) described "the profound similarity" of economies and ecosystems in a book titled *Bionomics: The Inevitability of Capitalism* (p. 213). The titles of sections in his book give an idea of the parallels and their application in both fields: evolution and innovation, organism and organization, energy and values, learning and progress, struggle and competition, feedback loops and free markets, parasitism and exploitation, and mutualism and cooperation. He wrote, "Bionomics is the branch of ecology that examines the economic relations between organisms and their environment. As such, bionomics provides the best starting point for a new way of thinking about the human economy. Cutting through the mind-boggling complexity of the ecosystem, the bionomic perspective illuminates the interplay of forces that maintain stability while spawning change. Problems beyond the reach of orthodox economics are readily understood from the bionomic perspective" (p. 335).

Hawken, Lovins, and Hunter Lovins (2000), in a book titled *Natural Capitalism: Creating the Next Industrial Revolution*, presented what they call "the next industrial revolution," predicting (as well as advocating) a "new type of industrialism, one that differs in its philosophy, goals, and fundamental process from the industrial system that is the standard today" (p. 2). "[N]atural capitalism does not aim to discard market economics," they wrote, "nor reject its valid and important principles or its powerful mechanisms. It does suggest that we should vigorously employ markets for their proper purpose as a tool for solving the problems we face, while better understanding markets' boundaries and limitations" (p. 260).

Hawken *et al.* (2000) were confident markets can address a wide range of environmental challenges, including climate change. They wrote, "The menu of climate-protecting opportunities is so large that over time, they can overtake and even surpass the pace of economic growth. Over the next half-century, even if the global economy expanded by 6- to 8-fold, the rate of releasing carbon by burning fossil fuel could simultaneously decrease by anywhere from one-third to nine-tenths below the current rate" (p. 244).

Nordhaus and Shellenberger (2007) are also environmentalists who endorse market-based approaches to environmental protection. Saying "the two of us had spent all of our professional careers, about thirty years between us, working for the country's largest environmental organizations and foundations, as well as many smaller grassroots ones" (p. 8), they wrote, "As Americans became increasingly wealthy, secure, and optimistic, they started to care more about problems such as air and water pollution and the protection of the wilderness and open space. This powerful correlation between increasing affluence and the emergence of quality-of-life and fulfillment values has been documented in

developed and undeveloped countries around the world" (p. 6). "Environmentalists," they observed, "have long misunderstood, downplayed, or ignored the conditions for their own existence. They have tended to view economic growth as the cause [of] but not the solution to ecological crisis" (*Ibid.*).

* * *

This brief overview of the history of environmental economics should lay to rest concerns that economists don't understand ecology or lack the tools to study the best solutions to environmental problems. The conjoined histories of economics and ecology and the extensive commonalities of the subjects mean economists can make valuable contributions to the climate change discussion by identifying market-based solutions to problems arising from pollution and by warning of the shortcomings of relying on government interventions.

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1.2 Key Concepts

This section introduces nine key economic concepts that shed light on environmental protection. Some important concepts are missing from this section, including population, technology, elasticity of demand, and probably many others. Those concepts can be found in standard textbooks and reference works (e.g., Ward, 2006; Henderson, 2008). While some examples and case studies presented in this section involve climate change, some do not.

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1.2.1 Opportunity Cost

> *The cost of any choice is the value of forgone uses of the funds or time spent. Economists call this "opportunity cost."*

Scarcity is a fundamental fact of life, not just of economics (Becker, 1976; Glaeser and Shleifer, 2014). It is always present in nature, even when human beings are not (Rothschild, 1990). Each population of a species can flourish and expand only until it reaches the limit of available habitat, sunlight, water, and nutrients. Trees grow taller as they compete for sunlight. Some plants spread their leaves horizontally, capturing sunlight while blocking access for other species that might sprout up to compete for water and nutrients. Each successful strategy captures resources, taking them from competing species or populations.

According to Sowell (2007), "the available resources are always inadequate to fulfill all the desires of all the people. Thus there are no 'solutions' … but only trade-offs that still leave many unfulfilled and much unhappiness in the world" (p. 113). Scarcity persists even when supplies increase because people's goals and wants change as they gain control over more resources, giving them the ability to climb what Abraham Maslow famously described as a "hierarchy of needs," rising from physiological needs such as food, clothing, and safety to self-actualization (Maslow, 1943). Maslow's view that basic human needs must be met before higher-level wants and desires become valued has been widely validated in psychology, history, and economics (Abulof, 2017).

The cost of any choice is the value of foregone uses of the funds or time we spend. Economists call this "opportunity cost." Some of these costs are obvious, like the price we pay for a product or service, but others are more subtle and easy to overlook, such as the time we spend learning about which product we want to buy, time spent waiting in line, and the long-term consequences of choices. When governments regulate activities, an estimate of the opportunity cost must include the consequences, many of them unintended, of the new rules.

Advocates of immediate action to reduce greenhouse gas emissions often assume the people of the world can afford to spend more on "low-carbon" fuels or that people can use less energy by being "less wasteful" or making small changes in lifestyle such as riding bicycles to work or replacing incandescent lightbulbs with LED fixtures. This is plainly not the case in developing countries, where limited access to electricity already causes hardships including disease and premature deaths.

The lifestyle change necessary to reduce greenhouse gas emissions as much as called for by the IPCC and various environmental groups would be dramatic. Calculations presented in Chapter 8 show per-capita gross domestic product (GDP) would have to fall by as much as 81% from baseline forecasts, a loss of $238 trillion. To put that figure in perspective,

U.S. GDP in 2017 was only $19.4 trillion and China's GDP was $12.2 trillion (Tverberg, 2012). Most of the economic gains of the past century would be nullified, and with them all the gains in health care, education, transportation, and practically every other part of modern civilization.

Most of the cost of a forced transition away from fossil fuels would be the opportunity cost of using less energy. Even with optimistic assumptions about the rate of innovation and investment, renewables will come up far short of producing the energy needed by a growing global population. Because access to inexpensive and reliable energy is closely correlated with economic growth and human development, a significant reduction in energy supply would cause catastrophic losses in human wellbeing. Imagine a world without cars, trucks, and airplanes, or without aluminum, fertilizer, or the Internet. These are only a few of the things that would have to be surrendered to achieve the emission reduction targets set by the IPCC and the United Nations.

No matter how wealthy the society in which we live, reducing greenhouse gas emissions or investing in adaptation strategies would mean spending less than we otherwise could on schools, public safety, or protecting the environment from threats other than climate change. Ignoring the opportunity costs of climate change actions doesn't make those costs go away. Ignoring them means we cannot prioritize our spending, which leads to wasting scarce resources on activities that produce only small or only hypothetical benefits while passing up opportunities to achieve much greater real benefits.

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1.2.2 Competing Values

> *Climate change is not a conflict between people who are selfish and those who are altruistic. People who oppose immediate action to reduce greenhouse gas emissions are just as ethical or moral as those who support such action.*

People have differing goals and disagree about which choice is best. Often this disagreement doesn't matter because decisions largely or entirely affect only the person making the choice and those who willingly cooperate with that person. But some decisions affect other people who have not agreed to be affected. In such instances, pursuit of differing goals can lead to conflict. Nowhere is this more evident than in recent environmental matters.

The United States has vast forests but not enough to provide all of the wood, all of the wilderness, and all of the accessible recreation we want. As soon as we log trees, build roads, or improve trails and campsites, we lose some wilderness. Similarly, we have large amounts of fresh water, but if we use water to grow rice in California, the water consumed cannot be used for drinking water in California cities. If we use fire to help a forest renew itself, we will have air pollution downwind while the fire burns. We must make choices about how to allocate our limited resources.

This can be seen in events surrounding the decision of California's San Bernardino County to build a new hospital facility. The county began planning the state-of-the-art complex in 1982. Eleven years later, on the day before groundbreaking in 1993, the U.S. Fish and Wildlife Service determined the Delhi Sands fly, which had been found on the site, was an endangered species. The county was required to spend $4.5 million to move the hospital 250 feet to give the flies a few acres on which to live and a corridor to the nearby sand dunes. This required diverting funds from the county's medical budget to pay for biological studies on accommodating the fly (National Association of Homebuilders *et al*., 1996; Booth, 1997; Nagle, 1998). Environmentalists who wanted biological diversity were relieved, but county officials were upset at the delay and unexpected costs that taxpayers ultimately would have to bear. To use resources one

way sacrifices the use of those resources for other things. There is no escaping this fact. San Bernardino County faced a choice between timely provision of a health care facility and protection of a unique species.

Even environmental goals often conflict. A policy of strict forest preservation (e.g., a wilderness designation) in an old-growth forest does not allow trees to be thinned, although such thinning could minimize forest dieback from insect infestations, disease, or fire. In this case, the goal of preserving the old-growth forest in the short term contradicts the goal of preserving the forest's long-term survival.

Discussions about climate change often frame it as a conflict between people who are selfish and those who care about others, including and perhaps especially future generations. This framing is incorrect. The goals of some individuals are selfish, intended to further only their own welfare, and the goals of others are altruistic, intended to help their fellow man, but in both cases, each person's concern and vision are focused mainly on a narrow set of ends (Sowell, 1980, 2011).

Even the most noble and altruistic goals are typically narrow. Consider two famous examples. The concern felt by Saint Teresa of Calcutta for the indigent and the sick was legendary. So, too, was Sierra Club founder John Muir's love of wilderness and his focus on protecting wilderness for all time. In both cases their goals were widely regarded as noble and altruistic, not narrowly selfish.

Yet one might be tempted to conclude that Saint Teresa would have been willing to sacrifice some of the remaining wilderness in India in order to provide another hospital for the people of Calcutta she cared so much about, and John Muir would have been willing to see fewer hospitals constructed if that helped preserve wilderness. Individuals with unselfish goals, like all other individuals, are narrowly focused. Each individual is willing to see sacrifices made in goals less important to him or her in order to further his or her own narrow purposes.

We know and care most about things that directly affect us, our immediate family, and others close to us. We know much less about things that mostly affect people we never see. When a person acts to achieve his or her narrow set of goals, it doesn't mean the individual cares nothing about others. It just means that for each of us, our strongest interests are narrowly focused. These narrow sets of goals, whatever the mix of selfishness and altruism, correspond to what economists call the "self-interest" of that individual.

People who oppose immediate action to reduce greenhouse gas emissions say they place a higher priority on respecting the rights of others to find their own way in the world, or providing good schools or hospitals or making sure poor people are well provided for, than delaying the uncertain arrival of a small amount of global warming a century hence (Epstein, 2014; Legates and van Kooten, 2014; Carlin, 2015; Moore and Hartnett White, 2016). This is a defendable moral choice, one that doesn't mean they are selfish. People who call themselves environmentalists may care less about the welfare of other people than they do about their own ability to enjoy wilderness or imagine playing a role in bringing about a romantic vision of unspoiled nature (Hulme, 2009). This hardly makes them altruistic.

There are thousands of environmental goals, each competing with others for limited land, water, and other resources. Even without selfishness, the narrow focus of individuals is enough to ensure there will be strong disagreements and competition for scarce natural resources. This narrowness of focus is important for understanding the economics of environmental issues. Depending on the circumstance, narrow goals can lead to tunnel vision, with destructive results, or to satisfying exchanges that make all participants better off.

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1.2.3 Prices

> *Market prices capture and make public local knowledge that is complex, dispersed, and constantly changing.*

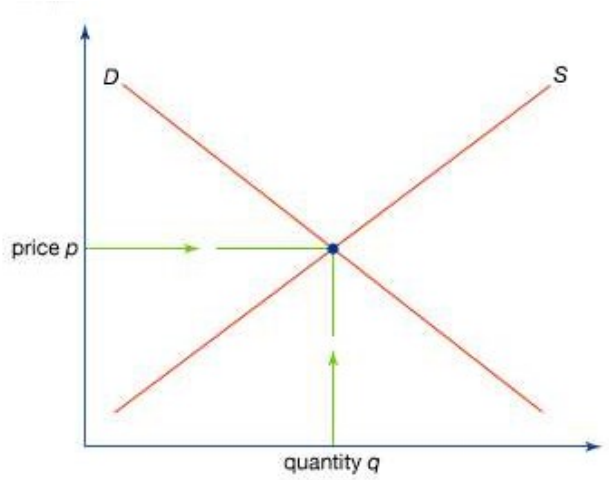
The ability of markets to harmonize personal interests and the general welfare is one of the best documented and most firmly established findings of modern economics (Watson, 1969; Becker, 1976; Eatwell *et al.*, 1989; Gwartney *et al.*, 2012). Prices make this harmony possible by capturing and making public local knowledge that is otherwise hidden, dispersed, and constantly changing.

Prices are an expression of agreement between a producer (supply) and a buyer (demand) on the value of a good or service. The price of a good or service is commonly depicted in economics as the intersection of supply and demand curves as shown in Figure 1.2.3.1.

Changes in price reflect a product's increasing or decreasing scarcity compared with other goods and services and present a powerful incentive for buyers and sellers to act on that information (Hayek, 1945; Friedman, 1976; Sowell, 1980; Steil and Hinds, 2009). Without market signals, it would be nearly impossible to evaluate the effect of (or even keep track of) all the factors influencing scarcity in many product uses and locations. Yet each one is relevant to the cost and value of what is preserved, produced, and offered in the marketplace.

Each buyer and each seller may act with little knowledge of what any other person wants or needs. But so long as people are free to choose, market prices direct each person to satisfy the needs of others. Prices encourage producers to provide what consumers want the most, relative to their cost, and to satisfy any particular want in the least costly way.

Figure 1.2.3.1
Prices are determined by supply (S) and demand (D)



Source: Encyclopedia Britannica, 2013.

Consumers, too, are strongly influenced by prices and they, too, act as if they care about their fellow consumers. When prices increase, they consume less; when prices decrease, they consume more. By economizing when goods are scarce, they allow more for other consumers. They purchase more when the goods are plentiful and there is a lot to go around. Actual and expected offers in the marketplace are guidance from the so-called invisible hand.

Consider energy markets. Each consumer of electricity chooses whether to use electric heat, and how high or low to set the thermostat. In addition to preferences about temperature, these decisions reflect the price of electricity. When prices are high, people will economize, making more electricity available for others. When prices are low, they will consume more. These decisions, in turn, influence the decisions of others, even those made by other industries. For instance, individual consumer choices about electricity consumption affect how much aluminum will be produced and which producers will supply more than others.

Primary aluminum production requires large quantities of electricity. Higher electricity prices raise the price of aluminum compared with substitute metals and especially raise costs for producers that use a lot of electricity per ton of aluminum. Producers who conserve on the use of electricity enjoy a competitive advantage and are likely to

produce a larger share of aluminum sold in the market. Thus, even with little or no knowledge of why electricity prices are rising throughout the economy, each consumer makes choices that move sales away from the expensive energy sources and toward conservation or substitute energy sources, and away from inefficient electricity producers and toward more efficient ones.

When resources are not privately owned or are not traded in open markets, the vital flow of information created by prices is missing. That is the case, for example, with national parks in the United States (Leal and Fretwell, 1997). Most of the funds for national parks come from tax dollars appropriated by Congress. Park visitors pay only a small fraction of the cost of the services they receive. Proceeds from national park recreation fees cover only about 10% of the cost of park operations (Regan, 2013). (States do somewhat better; an average of 39% of state park operating costs were recovered by user fees in 2011 (Walls, 2013, p. 5)).

With such a small portion of their budgets coming from user fees, park managers have little information about how much the various services they provide are worth to visitors. To learn what people want, they have to rely on surveys and polls, which can reach only a small number of people and can be misleading. In contrast, for owners of private campgrounds, amusement parks, museums, and other attractions that also draw visitors, information is always flowing and managers always have an incentive to respond to that information. The price they can charge for admission is determined by the value consumers place on their services. Their net profit or loss (as well as news of competitors' profits or losses) directs them to continuously change their budgets to better meet their customers' demonstrated wants.

Turning to the climate change issue, there is no marketplace in which access to the atmosphere is bought and sold; consequently, there is no price system revealing agreement on the value of competing uses. Complicating matters is the fact that human activities contribute only a tiny part to the natural exchange of carbon dioxide between the atmosphere and other reservoirs – the subject of Chapter 5, Section 5.1. Like the managers of public parks, a government agency placed in charge of managing the atmosphere would operate blindly, not knowing how much to charge for use of the atmosphere or how to invest the revenues it might raise by rationing use of the atmosphere.

Some environmentalists and economists see this as a "problem" that could be solved by "putting a price on carbon" (they mean carbon dioxide). But prices efficiently allocate resources only if they are real, that is to say, if they arise from voluntary exchanges among people with defined and enforced private property rights. Assigning a price to a ton of carbon dioxide emissions does not solve the market coordination problem, and since that arbitrary price is likely to be wrong it makes the problem worse. Advocates of a "carbon tax" also assume that an objectively correct or efficient level of taxation can be found, that political leaders would agree to it, and that such a tax could be collected and enforced without creating expenses greater than the forecast benefits of reduced climate change. In reality, there is no such thing as a government agency able to act on a calculation of the "social cost of carbon," even if such a cost were established. A carbon tax is discussed in more detail in Section 1.4.2.

Later chapters explain that the human impact on climate is likely to be too small to be seen against a background of natural variability and the "social cost of carbon" is probably near zero or even negative, if it is knowable at all. These findings suggest that the optimal "carbon tax" is likely to be zero or even negative. In short, it is fruitless to view climate change as a problem in need of a government solution. It is, instead, properly viewed as a natural process, one of many, routinely accommodated by markets without need for government intervention.

The discussion in this section suggests some preliminary implications for the climate change issue:

- Real prices allocate resources to their best and highest uses, even though that is not the intended outcome of individual buyers and sellers.
- Without prices, assets cannot be efficiently managed.
- There is currently no price system that assigns values to competing uses of the atmosphere.
- Real prices reflect agreements by buyers and sellers who are free to choose and cannot be randomly assigned to goods or services by economists or government agencies.

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1.2.4 Incentives

> *Most human action can be understood by understanding the incentives people face. "Moral hazard" occurs when people are able to escape full responsibility for their actions.*

Nearly everyone would want to save a person who is drowning. But each of us is more likely to try to rescue a person who falls into two feet of water at the edge of a small pond than to try to rescue someone who is struggling in a river near the top edge of Niagara Falls. Economists express this simple reality as a principle: People are more likely to pursue their goals (benefits) when the cost to them is minimal, and they will seek low-cost ways to attain them. These costs and benefits – or penalties and rewards – are called incentives (Becker, 1976; Lazear, 2000).

Knowing the incentives people face makes it possible to understand and sometimes even predict behavior. If a person's goal is to increase his or her income, that person has an incentive to devote long hours to a grueling job or seek to obtain a better-paying one. If the person's goal is to make friends or achieve inner peace, earning a high income is not as important and behavior will be different. The difference between these people is not that some are "greedy" and others not. Their behavior can be explained by understanding the costs and benefits they face in the pursuit of their goals.

As individuals we usually are able to recognize and evaluate the costs of our choices. We are attuned to the relative costs of alternatives available to us, but recognizing and taking into account the costs facing others is more difficult. The costs borne by others generally have less effect on our decisions than the costs we incur directly. When individuals realize they can use resources that properly belong to others for their own benefit, they are tempted to act irresponsibly. Economists call this "moral hazard" (Kotowitz, 1987).

Moral hazard exists in the private marketplace in cases where information asymmetries combine with separation of ownership and control, enabling people to escape full responsibility for their actions. Examples include excessive utilization of health services due to reliance on third-party insurers (Goodman, 2012) and reckless behavior by persons with access to trust funds (Carnegie, 1891; Feldman, 2014). However, as Hülsmann (2006) writes, "there are strong forces at work to eliminate expropriation" when it occurs in free markets. In the examples given, insurers try to limit their financial exposure by not covering treatment for preexisting conditions and by rejecting some claims, and wealthy individuals write trust fund agreements carefully to limit or end access to the funds in the event of misbehavior by the beneficiary. As a result, says Hülsmann, "moral hazard induced expropriation is therefore not only accidental, but also ephemeral in the free market."

A risk of moral hazard arises when one person can over-use a public good (or good held in common) for personal gain even though others may suffer as a result. Writers about climate change often claim manufacturers, energy companies, and people who

drive cars and trucks are "dumping carbon pollution" into the atmosphere, exploiting and degrading a common resource without paying a fair price to other stakeholders. If true, this would be an example of moral hazard. Why this is *not* the case is addressed in some detail in Section 1.3 and elsewhere in this book.

In contrast to free markets, political institutions and regulated markets are rife with moral hazard. "Strong forces to eliminate expropriation" are seldom seen. People who work in government or who qualify for government entitlement programs are usually spending someone else's money, not their own, and so have a weaker incentive to spend it wisely. The price of inefficiency, which would be borne by an individual or a business if incurred in the private market, is instead borne by taxpayers or businesses. Consequently, there is little incentive for government agencies to become more efficient. According to Baden and Stroup (1981), "Bureaucrats, like most other people, are predominantly self-interested. Given that an administrator's welfare tends to increase with increments in his budget, many of our resource administrators act as bureaucratic entrepreneurs. Unfortunately, unlike [entrepreneurs] in the private sector, these administrators are not accountable to a bottom line demarcating benefits and costs. Thus, the net 'benefits' of many of their activities are strongly negative" (p. x).

Government agencies have incentives to conceal the basis of their decisions, so they cannot be challenged by the individuals being regulated or taxed. Elected officials have incentives to make campaign promises they have no intention of keeping. Individuals have incentives to fake illnesses or hide assets to qualify for entitlement programs. All these perverse incentives compromise government's ability to deliver services efficiently.

The Endangered Species Act illustrates the harm that can occur when one party determines how another must use an asset. The law gives government officials great latitude in telling landowners what to do if they find an endangered animal such as a red-cockaded woodpecker on their properties. Government officials choose how the animal must be protected, but the landowner must pay the costs. For example, the owner may not be allowed to log land within a certain distance of the bird's colony. In some cases, government officials have prevented plowing land for farming or to create a firebreak. With such power, government officials are likely to be wasteful of some resources (such as land) while ignoring other ways of protecting the species (such as building nest boxes). To the government official, the land is almost a free good. (See Section 1.4.6 for a more detailed discussion of this example.)

A program the EPA devised for reducing nitrogen based-nutrients that build up in waters such as the Chesapeake Bay offers another example. The agency developed a list of acceptable options among which states could choose, along with an estimated cost per pound of nitrogen removed (Jones *et al*., 2010, Figure 2). States were required to submit implementation plans describing which solutions they would apply to reduce nitrogen.

One solution was to require storm water retention ponds for new land development projects, with an estimated cost of $92.40 per pound of nitrogen removed. Another option was to plant over-winter cover crops on farm fields, with an estimated cost of $4.70 per pound of nitrogen removed.

Retention ponds reduce immediate runoff but add nutrients to groundwater, the primary source of water pollution. They also impose long-term maintenance issues and attract geese, which add to the nitrogen pollution. Cover crops retain nitrogen, which is then available for the next season's crops, thus removing nitrogen from the water system and making them the superior solution.

Delaware chose to implement the far more expensive, less effective retention pond option because builders need permits and could be forced by government officials to comply, while farmers don't need permits to plant crops. The permitting agency even rejected a builders association's offer to pay into a cover crop fund instead of installing retention ponds (Jones *et al.*, 2010). It was a vivid example of moral hazard at work.

How are incentives relevant to the climate change issue? Without a marketplace in which access to the atmosphere is bought and sold, there are no prices that might make possible the efficient management of the atmosphere for the public good. Individuals have incentives to use the atmosphere to dispose of waste without regard to its possible negative effects on others, unless faced with regulations that prevent such behavior. This system might be judged wrong if actual damage to the public interest were demonstrated *and* if a superior method of rationing use of the atmosphere were available. Both assumptions are severely tested in later chapters.

Some conclusions from this section include the following:

- Human action is determined by incentives people face in the pursuit of their goals.

- In the private sector, incentives align people's actions with the public interest because people generally are held accountable for the consequences of their actions.

- In the public sector, action is often separated from accountability for results, resulting in conduct that may not advance the public interest.

- Incentives concerning the use of the atmosphere are currently distorted by the absence of a price system, but whether this causes social harms or can be corrected is unclear.

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1.2.5 Trade

Trade creates value by making both parties better off.

The First Theorem of Welfare Economics, also known as Adam Smith's Invisible Hand Theorem, reads "if everyone trades in the competitive marketplace, all mutually beneficial trades will be completed and the resulting equilibrium allocation of resources will be economically efficient." (Pindyck and Rubinfeld, 2000, p. 574). Both sides can gain when goods are exchanged; there does not need to be a winner and a loser. This means voluntary exchanges create value even though no additional goods or services are created. Trade allows people to act on the signals created by prices and the incentives created by the costs and benefits of choices freely made. Trade is the real-world manifestation of markets, the spontaneous order that is created when property rights are protected and people are free to choose how to use what belongs to them (Hayek, 1983). Trade can create value in three ways:

1. Trade channels resources, products, and services from those who value them less to those who value them more. One way to understand this principle is to think about something people really disagree about – say, music. John likes opera. Jane likes rock music. If John has a rock concert ticket and Jane an opera ticket, exchanging the tickets will make both of them better off. Without any change in production, the trade of the opera ticket for the rock concert ticket produces value.

2. Trade enables individuals to direct their resources to activities where they produce the greatest value so they can then trade the fruits of those activities for the items they want for themselves. A farmer in central Montana who grows wheat produces far more than he wants to consume. He trades the wheat for income to buy coffee from Guatemala, shoes from Thailand, and oranges from Florida. The Montana farmer might have been able to grow oranges, but given the cold Montana climate, doing so would have squandered resources. Trade enables people to obtain many things they would not have the proper talent or resources to produce efficiently themselves.

3. Trade enables everyone to gain from the division of labor and economies of scale. Only with trade can individuals specialize narrowly in computer programming, writing books, or playing professional golf, developing highly productive skills that would be impossible to obtain if each

family had to produce everything for itself. Similarly, large automobile factories lower the cost of manufacturing cars so they can be sold at prices within reach of the average worker.

Resource owners gain by trading in three ways: across *uses* (for example, trading out of low-valued crops into ones that earn more money), across *space* (marketing products across geographic distance to different states or nations), and across *time* (using resources now or gaining from conservation or speculation by saving resources until they become more valuable).

Even trade in garbage can create wealth. Consider a city that disposes of garbage in a landfill. If the city is located in an area where underground water lies near the surface, disposing of garbage is dangerous, and very costly measures would have to be taken to protect the water from landfill leakage. Such a city may gain by finding a trading partner with more suitable land where a properly constructed landfill does not threaten to pollute water. The landowner may be willing to accept garbage in return for pay. If so, both parties will be better off.

In some parts of the western United States, rights to divert and use water from rivers and groundwater are bought and sold. Anderson and Libecap (2011) documented 1,766 transactions in 11 states between 1987 and 2008. These transactions allow even water, a resource that meets the definition of a public or common-pool resource, to be traded like a private good, allowing access rights to move to those who value them most highly at a price acceptable to current holders of those rights.

In recent years, more people have been seeking high-quality streams for fly-fishing. They recognize many streams dry up in hot summer months when farmers divert large amounts of water for their fields. To keep more water in streams to keep fish thriving, some fly-fishers are willing to trade cash for the farmers' water rights. And some farmers are happy to part with a portion of the water they have been using in exchange for cash. The Oregon Water Trust (recently renamed The Freshwater Trust) works out trades between individuals committed to protecting salmon and farmers who are willing to give up some of their water. Purkey (2007) wrote,

> Consider the story of ranchers Pat and Hedy Voigt. Last year, they reached a permanent, voluntary agreement with one of the [Columbia Basin Water Transactions Program] CBWTP's partners, the Oregon Water Trust. Between July 21 and September 30, up to 6.5 million gallons of water that they would normally divert each day from the Middle Fork of the John Day River and two of its tributaries will stay in the river, enhancing flows for a distance of 70 miles. In exchange, the Voigts now have the resources to improve irrigation efficiencies on their ranch, even as they benefit one of the largest and best remaining populations of wild spring Chinook and summer steelhead in the lower 48 states.

According to Purkey, similar deals have been struck elsewhere in Oregon and in Idaho, Montana, and Washington. "Across the Columbia Basin, forward-looking landowners are creating innovative strategies that improve their bottom lines and build flexibility into ecosystems facing chronic water shortages. The results of this new model are not only benefiting communities right now but also are helping to prepare the Pacific Northwest for the future" (*Ibid.*).

Trade is important in the climate change discussion for a number of reasons. Access to the atmosphere does not need to be a zero-sum transaction whereby people who produce emissions benefit at the expense of others. Nor do the governments of the world have to agree on the terms and conditions of access for the result to be efficient. Virtually everyone benefits from the energy produced when anthropogenic greenhouse gases are produced as well as from increased agricultural production due to aerial fertilization by carbon dioxide. Positive and negative externalities are exchanged spontaneously in the absence of government policies (or taxes) or even sufficient information to place prices on either one. The result is huge net social benefits documented in Chapters 3, 4, and 5. Interfering with this trade by limiting or even banning the use of fossil fuels would jeopardize these benefits.

It may be objected that future generations do not have a place at the table in the spontaneous marketplace for access to the atmosphere, and since today's emissions may have a negative impact on them this constitutes an inefficiency or injustice. Section 1.5 of this chapter explains how capital markets create incentives for today's investors to protect the interests of future generations, so this concern can be addressed. But consider too that virtually *everything* we do today affects future generations, either for good or for ill, so this can

hardly be a justification for government intervention. The Intergovernmental Panel on Climate Change (IPCC) itself admits that the impact of climate change on future generations will be "small relative to the impacts of other drivers (*medium evidence, high agreement*). Changes in population, age, income, technology, relative prices, lifestyle, regulation, governance, and many other aspects of socioeconomic development will have an impact on the supply and demand of economic goods and services that is large relative to the impact of climate change" (IPCC, 2014, p. 662. This suggests climate change does not pose a unique danger that would justify it being treated differently than other challenges.

Common ownership of resources is not a barrier to the use of trade as a way to achieve win-win solutions to conflicts over access. Some of the biggest successes in managing other common-pool resources, such as water described in the examples given above and public lands (grazing rights) in cases described later in this chapter, rely on spontaneous or informal processes with only limited involvement by governments (Ostrom, 2005). The case against attempting to create an artificial marketplace for trading rights to the atmosphere is set forth in Section 1.3 and other parts of this book.

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1.2.6 Profits and Losses

Profits and losses direct investments to their highest and best uses.

The profit and loss system is a key element of markets. By allowing investors and producers to keep the profits they earn and suffer any losses they incur, markets ensure that resources are used as efficiently as possible to meet consumer wants and needs (Mises, 1966 [1998], pp. 241–4; Gilder, 1984; Novak, 1991, pp. 104–12).

Profit is a measure of how much value was added to a good or service relative to the cost of resources used. Profits provide a clear index of performance, with high profits indicating resources were purchased at a price much lower than the resulting product was worth to buyers. A large loss indicates the product was worth much less than the resources taken from the rest of the economy to produce it. In this way, profits and losses direct businesses toward activities that most efficiently meet consumer wants and needs

High profits act as a signal to producers to make more products and to potential producers to start making new products. Consumers benefit from the increased supply and competition among producers, which drive down prices. Awareness of profit margins leads to more careful use of natural resources as producers seek to minimize their costs. This can lead to the discovery of new ways to use resources more efficiently.

Hope for profits and fear of losses cause producers to spend untold hours figuring out how to use resources more efficiently. That is why airplanes, batteries, bicycles, bottles, cans, cars, computers and computer chips, printing devices, solar panels, telephones, televisions, and hundreds of other products we use every day are "smaller, faster, lighter, denser, and cheaper" than ever before (Bryce, 2014). The profit and loss system is driving a widespread "dematerialization" process whereby fewer resources and less energy are needed to meet human needs, a trend described and documented in detail in Chapter 5.

Profits reward those who succeed in producing goods and services people are willing to buy at a price higher than the cost of supplying them. Losses have their place, too. They penalize those who have not been able to discover how to create more value than the cost to produce. In effect, people are telling a money-losing firm they want to see that firm's resources go to other products or services more valuable to them.

Large profits are ephemeral. The competition of new entrants, drawn by profits, gradually lowers the sales of existing firms and often their prices as well, reducing profits. Entry continues until profits fall to what economists call normal rates of return. Entry then stops. The first firm to innovate successfully may make above-normal profits (an appropriate reward and critical incentive), but the profits fall as competition heats up.

An entrepreneur seeking to exploit a new profit opportunity usually must (a) discover the new opportunity and (b) find investors willing to take the risk that profits will be made. It may also be necessary to sell potential buyers on the new product or service. All of these activities are costly. But expected profit provides an incentive to persevere for entrepreneurs, investors, and those who must sell the idea to investors and the product to buyers. Expected profit rewards them for making the necessary investments of time, effort, and money to accomplish their tasks. New ideas may need years of effort before they reach fruition. Expected profit is the carrot to attract the needed efforts.

Thanks to the profit and loss system, the most efficient producers win the competition for the use of scarce resources. But this system does not exist in government agencies; unlike private entrepreneurs and investors, government officials typically cannot retain any profits their agencies might earn by being more efficient than competitors, and they do not personally suffer a loss if they are inefficient. Consequently, governments can and do systematically waste resources, taking losses over the long term because they make up the difference by taking money from taxpayers.

Government officials are typically deprived of the signals created by a profit and loss system that might direct them to the most efficient ways to produce a product or deliver a service. When they make poor decisions, they are insulated from the negative consequences because taxpayers, consumers, or regulated businesses must incur the loss. Even if regulators are smart and well-informed, they are unlikely to be smarter or better informed than private investors since they are spending other people's money and not their own.

Framing climate change as a problem requiring a government-led solution necessarily means losing the powerful efficiency-creating power of the profit and loss system. Without profits and losses directing investments in energy sources and technologies, governments must pick winners and losers based on the input of lobbyists, the judgment of bureaucrats influenced by careerism and tunnel vision, and other maladies affecting bureaucracies described in some detail in Section 1.4.3.

A key part of the climate change issue, perhaps more important than any scientific variable or theory, is who should decide what energy sources and technologies ought to be used in light of what we know about climate change. Should those choices be made by individuals and private entities that reap profits or bear losses from their choices, or by government agencies that are immune to such consequences? Vaclav Smil (2010) ended his book *Energy Myths and Realities* with this warning to those who think they can do better than markets at picking an energy source that could replace fossil fuels:

> Do not uncritically embrace unproven new energies and processes just because they fit some preconceived ideological or society-shaping models. Wind turbines or thin-film solar cells may seem to be near-miraculous forms of green salvation, ready to repower America within a decade. But ours is a civilization that was created by fossil fuels, and its social contours and technological foundations cannot be reshaped in a decade or two (p. 163).

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1.2.7 Unintended Consequences

> *The art of economics consists in looking not merely at the immediate but at the longer effects of any act or policy.*

Hazlitt (1979) wrote, "the whole of economics can be reduced to a single lesson, and that lesson can be reduced to a single sentence. The art of economics consists in looking not merely at the immediate but at the longer effects of any act or policy; it consists in tracing the consequences of that policy not merely for one group but for all groups" (p. 17). Economists are trained to ask, "and then what?"

Unintended consequences are sometimes referred to as "the seen and the unseen." Claude Frédéric Bastiat wrote in 1850, "a law gives birth not only to an effect, but to a series of effects. Of these effects, the first only is immediate; it manifests itself simultaneously with its cause – it is seen. The others unfold in succession – they are not seen: it is well for us if they are foreseen." Bastiat also observed that the difference between a bad and a good legislator is "the one takes account of the visible effect; the other takes account both of the effects which are seen and also of those which it is necessary to foresee."

Overlooking the secondary effects (side effects) of an action is easy, especially if those effects are on other people or will not be experienced soon. When those unintended consequences are negative, they can offset some or all of the benefits of an action. Advocates of a particular goal or state of affairs often are impatient with the sometimes slow pace of markets and voluntary agreements. Passing a law or funding a government program *seems* to be a faster and more direct route to their goal, and this path is often sold to activists by elected officials seeking their campaign support and lobbyists seeking clients. But most government programs fail to achieve their goals precisely because of the unintended consequences economists are trained to look for.

Turning to the issue of climate change, advocates of immediate action to reduce greenhouse gas emissions often overlook the unintended consequences of their recommendations. Reducing emissions by amounts large enough to potentially affect the planet's climate would require large reductions in energy consumption, which would reduce human well-being by diverting resources away from more urgent needs. Because wind and solar power costs two to three times as much as energy derived from the use of fossil fuels, using those alternative energy sources would reduce human well-being, especially for low-income families that cannot afford to pay more for electricity and home heating (Bezdek, 2010). "Energy poverty" is a critical issue facing developing countries today because access to electricity is crucial to the three dimensions of human development: health, knowledge, and standard of living (Kanagawa and Nakata, 2008).

The money spent today and in the near future on expensive solar and wind power would not be available for other things that contribute to human well-being, such as public health actions to protect people from malaria and other diseases, wells and dams to provide water for agriculture and use in homes, and infrastructure such as electric power plants and power lines (Yadama, 2013; Lomborg, 2006). The full consequences of those missed opportunities would only emerge over time and are largely invisible to today's environmental activists.

Another unintended consequence of reducing greenhouse gas emissions is the negative effect on food production and the natural environment. Carbon dioxide is essential to plant growth, and anthropogenic emissions are thought to be responsible for 70% of the "greening of the Earth" observed from satellites and benefiting more than 25% to 50% of the global vegetated area (Zhu, *et al.,* 2016). (Less than 4% of the globe shows browning (*Ibid.*).) Less greening also means less habitat for wildlife, so efforts to stop or slow global warming could unintentionally lead to the extinction of more species (Goklany, 2015; Hughes *et al.*, 2014). Replacing fossil fuels with wind, solar, and biofuels also would require millions of square miles of wilderness and farmland to be covered with industrial wind turbines, mirrors or photovoltaic panels, or corn planted and harvested to make ethanol. The environmental consequences would be devastating (Kiefer, 2013; Bryce, 2014, p. 212; Smil, 2015, pp. 211–2).

Over the period 2012 through 2050, the cumulative global economic benefit of aerial CO_2 fertilization will be approximately $9.8 trillion (Idso, 2013). Reducing greenhouse gas emissions would mean forfeiting some or all of this benefit. Mariani (2017), in a study described in greater detail in Chapter 5, Section 5.3.6.1, estimates a return of global temperatures and CO_2 levels to pre-industrial conditions would reduce by 18% global production of the four crops (wheat, maize, rice, and soybean) accounting for two-thirds of total global human caloric consumption. Mariani estimates that increases in atmospheric CO_2 to 560 ppm and temperature to +2°C relative to today would improve crop

production by 15% above today's values.

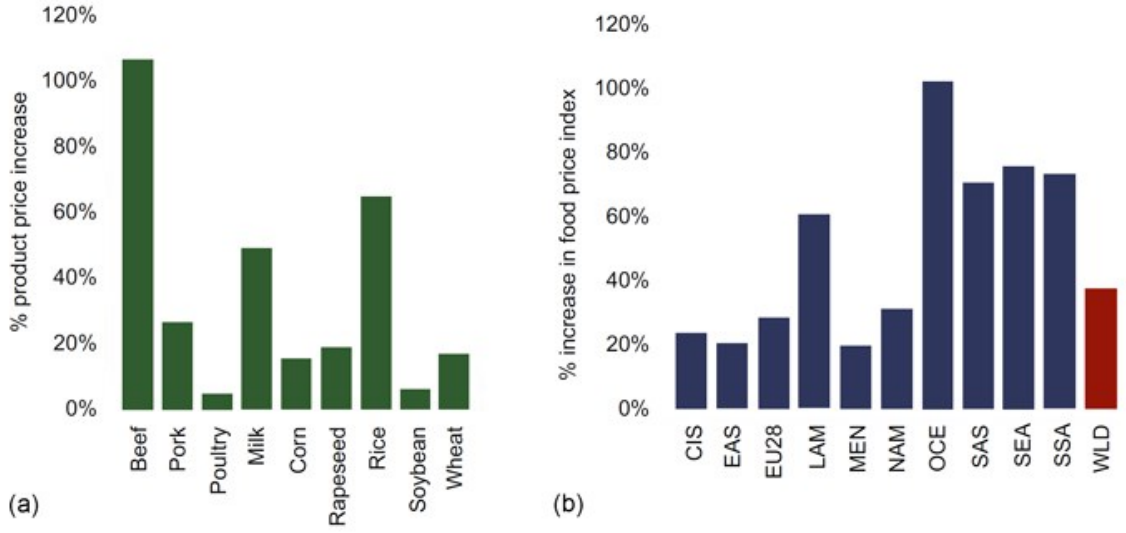
Frank *et al*. (2017) note actions to mitigate greenhouse gas emissions could negatively impact food supply in several ways: by diverting agricultural land into land used for energy (e.g. corn from feed to ethanol); by halting or slowing needed land conversion from high-carbon landscapes (forests) into agricultural production; by shifting from more to less greenhouse gas-intensive agricultural commodities (e.g., away from ruminant production); and by adopting greenhouse gas-reducing management practices (e.g., reduced fertilizer application). Figure 1.2.7.1 shows the relative product price change of nine commodities driven by a \$150 per ton of CO_2-equivalent (CO_2e) tax (left panel), as well as the overall percent increase in the food price index (right panel, relative to the base year of 2000) for the world and various regions of the world.

In all instances, the CO_2 tax raises the cost of food in all regions. The largest increases (60% to 100%) in the food price index are seen in those regions with less efficient agricultural production systems, such as Oceania, South East Asia, Sub-Saharan Africa, South Asia, and Latin America, while for the world as a whole the price increase is around 38%.

Figure 1.2.7.2 depicts the relationship between greenhouse gas mitigation targets and global average calorie consumption projected for the year 2050. As the figure shows, increasingly ambitious efforts to reduce CO_2 emissions result in greater reductions in daily dietary energy. Using the IPCC's representative concentration pathway (RCP) scenario that limits warming to 1.5°C, for example, a \$190 tCO_2e^{-1} carbon tax would reduce daily caloric intake by 285 kcal per capita per day, a 9% decrease. At first glance, such a decline may not appear significant, but as Frank *et al*. note, "this would translate into a rise of 300 million people in the global number of chronically undernourished [individuals]," a 150% increase over the current chronically undernourished population.

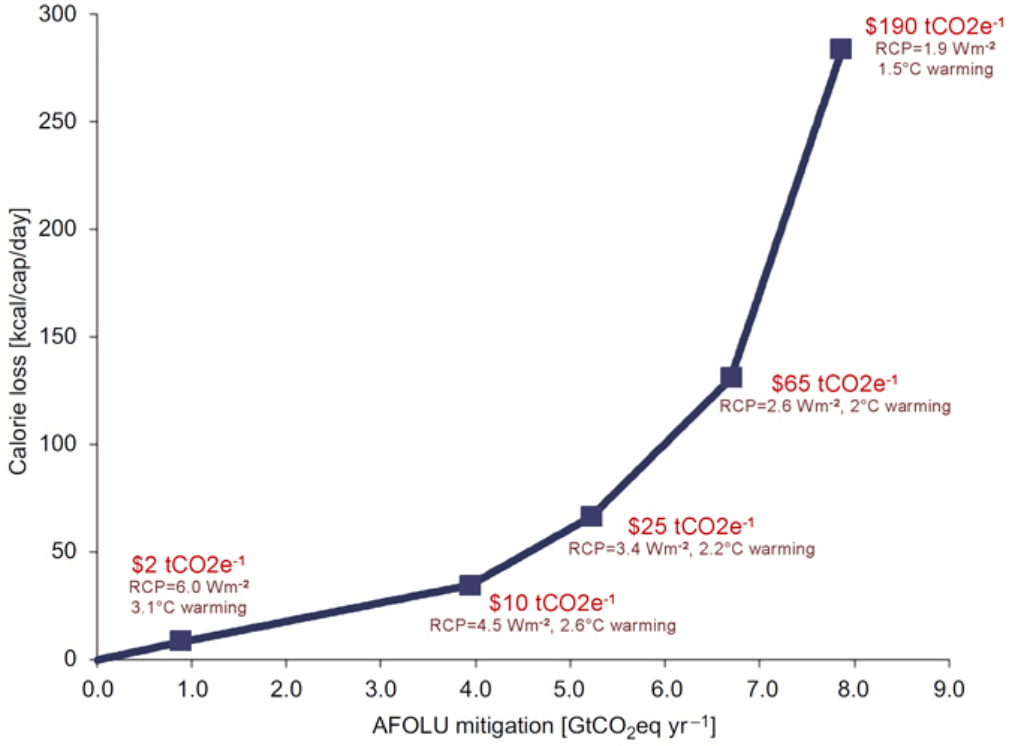
Frank *et al*. conclude "a uniform carbon price across sectors does lead to trade-offs with food security at increasingly ambitious stabilization targets. This results from rising food prices driven by the adoption of greenhouse gas abatement strategies [that] limit agricultural land expansion and increase production costs for farmers targeted by the implementation of a carbon price."

Figure 1.2.7.1
Relative price impact of a \$150 per tCO_2e carbon tax on emissions from agriculture on global commodity prices and regional food price index



CIS is Commonwealth of Independent States, EAS is East Asia, EU28 is European Union, LAM is Latin America, MEN is Middle East and North Africa, NAM is North America, OCE is Oceania, SAS is South Asia, SEA is South East Asia, SSA is Sub-Saharan Africa, and WLD is World. *Source*: Adapted from Frank *et al*., 2017.

Figure 1.2.7.2
Per-capita caloric loss caused by proposed carbon taxes



The blue line represents policies where all countries participate to achieve increasingly ambitious climate stabilization targets. Text adjacent to the blue squares indicates the carbon price (tax) associated in achieving climate stabilization for a given representative concentration pathway (RCP) and its associated global temperature reduction in 2050. *Source*: Adapted from Frank *et al*., 2017.

Advocates of immediate action to reduce the use of fossil fuels probably do not want to increase energy poverty, destroy wildlife habitat, or increase world-wide hunger. These are all unintended consequences of the IPCC's clearly stated goal of reducing and eventually banning fossil fuels (IPCC, 2014, pp. 10, 12). Economists are trained to look for such unintended consequences, to anticipate how changes in incentives lead to changes in behavior which then affect the ability to reach goals. Environmental activists ignore or downplay these consequences due to their tunnel vision. Their vision of a world where energy freedom is replaced with a government-imposed ban on fossil fuels is so compelling they simply refuse to believe it could have a dark side.

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1.2.8 Discount Rates

Discount rates, sometimes referred to as the "social rate of time preference," are used to determine the current value of future costs and benefits.

How do you place a value on a cost or benefit that occurs far in the future? How much should be spent today to avoid a possible but uncertain harm 50 years or 100 years hence?

Discount rates, sometimes referred to as the "social rate of time preference," are used to determine the current value of future benefits or harms. As Kreutzer (2016) wrote, "Discounting is an opportunity cost exercise. The rate should reflect the best alternative return that an investment of the same size could reasonably be expected to generate." Discounting has a long history of use in public policy.

Of the many controversies involved in deciding whether and how to respond to the threat of climate change, none attracts as much attention and condemnation as the choice of the discount rate used to estimate the present value of future impacts. Weitzman (2015) has described this debate over discounting damages as "vigorous," noting "the choice of a discount rate is itself one of the most significant (and controversial) uncertainties in the economics of climate change." And, as Heal and Millner (2014) conclude, there is "no convergence to a single unanimously agreed upon [discount] value in sight."

The rate at which one discounts the value of benefits expected to appear in the future is expressed annually, similar to interest paid on a savings account. "The lower the rate of discount employed, the higher the present value of the estimated future benefits of a public project. Hence, the rate of discount used in evaluating public projects has an important influence on the allocation of resources within the public sector, and may also influence the relative rates of growth of the public and private sectors" (Mikesell, 1977, p. 3).

One method of estimating the current value of future costs and benefits is exponential discounting, which is typically used in finance. It assumes preferences between consuming now or in the future do not change over time, so only the value of time needs to be taken into account. That value, in turn, can be revealed by looking at the interest paid on very safe investments, such as government bonds, for a similar period of time. This method is used by the U.S. Office of Management and Budget (OMB), which defines the "social rate of time preference" as the real rate of return on long-term government debt. It requires cost-benefit analyses be calculated using that published rate and two additional constant rates, a low rate of 3% and a high rate of 7%, to establish a band or range of outputs for decision-making (OMB, 2003). The U.K.'s Treasury uses a standard 3.5% rate (but see below for a recent modification), below the

5% rate typical in the literature (e.g., Nordhaus, 1998; Murphy, 2008; Tol, 2010).

Discount rates are important in understanding the climate change issue because the costs of reducing greenhouse gas emissions mostly occur up-front, in the form of major capital investments in new sources of energy and the infrastructure needed to support them. The benefits of reducing emissions, to the extent they exist, occur far in the future. According to Working Group I's report for the IPCC's Fifth Assessment Report, "cumulative emissions of CO_2 largely determine global mean surface warming by the late twenty-first century and beyond (see Figure SPM.10). Most aspects of climate change will persist for many centuries even if emissions of CO_2 are stopped" (IPCC, 2013, p. 27).

Money spent now to secure benefits far in the future could be used to buy other things that would produce benefits sooner. Some of those benefits, such as food to help feed the world's hungry or clean water in developing countries, are important and may be more important than battling one or two degrees of warming centuries from now (Mendelsohn, 2004; Lomborg, 2006; Lemoine and Rudik, 2017).

Consider the following example: Exponential discounting at the rate of 5% means if we choose to spend $100 today to reduce greenhouse gas emissions by one ton, we lose the opportunity to spend $1,147 50 years from now to reduce emissions then. With advancing technology, that $1,147 spent 50 years from now would likely enable us to reduce emissions by much more than we could with current technology. Since, as the IPCC says, climate is affected by cumulative emissions (ambient CO_2 concentrations) and not annual emissions, early action is difficult to justify.

This example also illustrates that avoiding $1,147 in damages 50 years from now is worth an investment today of about $100, about 9% of the future value. Expressed differently, a dollar of benefit 50 years from now is worth only about 9 cents today. Thus, benefits reaped 50 years in the future need to be worth about 11 times as much as alternative benefits that could be achieved today in order to justify their expense.

Critics of exponential discounting worry that the current generation of investors and emitters won't actually set aside the $100 needed today that would become $1,147 to be used 50 years from now to reduce emissions. What if this modest sum were spent on something else? There is also concern that discount rates of around 5% over-estimate the likely long-term rate of return on investments over so many decades. Do low-probability, high-damage events call for using a lower discount rate? (Ceronsky *et al.*, 2011; Heal, 2017).

Advocates of immediate action to reduce emissions sometimes blame the "greed" or "selfishness" of others for opposition to their plans (Bartholomew and Francis, 2017; Tirole, 2017, p. 196). This could be true, since people sacrificing today are unlikely to live long enough to be among the beneficiaries of a cooler climate 100 years from now. But more likely, people are expressing a reasonable social rate of time preference. Uncertainty grows with time over whether any sacrifice made today will actually benefit future generations. Surveys show the public in the United States cite this uncertainty as the main reason they oppose paying higher taxes on energy to help fight global warming (Ansolabehere and Konisky, 2015). This is not based on ignorance of the issue, but just the opposite. Newspapers and other popular sources of information report regularly on how China, India, and other major emitters are increasing their emissions while the United States is reducing its own, the "leakage" discussed in Section 1.2.10 below. Perhaps physical scientists are less aware of this phenomenon than the less-educated but more-attentive general public.

An alternative to exponential discounting is hyperbolic discounting. Surveys and small-scale experiments show people tend to give more weight to benefits that are very immediate or very distant in the future, and less weight to benefits that might appear at intermediate time scales. This attitude toward time is incorporated into discounting by changing the discount rate chosen for different periods of future time. Its adherents claim it leads to the choice of lower discount rates for events occurring in the far future and therefore makes a stronger case for action today to avoid far-future risks (Farmer and Geanakoplos, 2009; Arrow *et al.*, 2013; Garnaut, 2008).

The U.K.'s Treasury has moved toward hyperbolic discounting by adopting not one but 12 different discount rates taking into account the number of years over which a program operates and whether there is "risk to health and life values" (H.M. Treasury, 2018, Table 8, p. 104).

Choosing the "right" discount rate to use when addressing climate change is addressed again and in greater detail in Chapter 8.

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1.2.9 Cost-benefit Analysis

> *Cost-benefit analysis, when performed correctly, can lead to better public policy decisions.*

Because all people, including those living in wealthy countries, must cope with scarcity, they must choose how much money to spend on environmental improvements and consequently how much less to spend on other goods and services (the opportunity cost of their choices) and in which projects or programs to invest (if any). Cost-benefit analysis (CBA) can help make such choices.

Private cost-benefit analysis is used to determine if the financial benefits to an agent over the lifetime of a project exceed the agent's costs. *Social* cost-benefit analysis attempts to include environmental impacts and other costs and benefits, including unintended consequences, which are not traded in markets and so would not necessarily be taken into account by private economic agents.

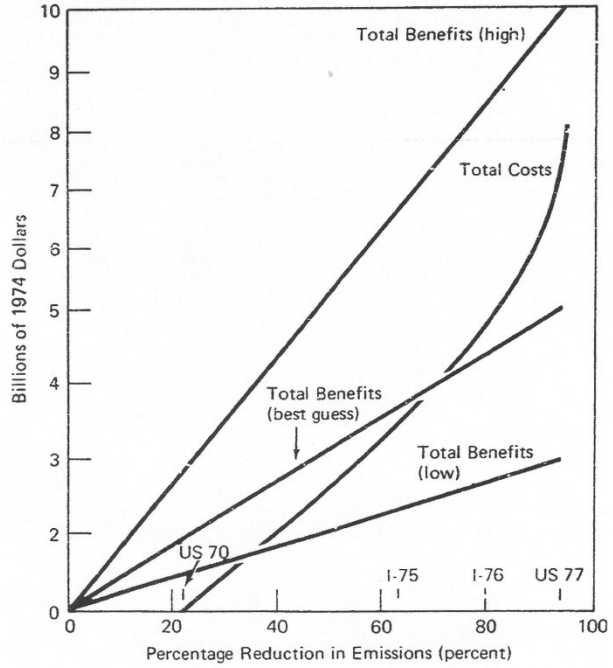
CBA is an economic tool that can help determine if the social benefits over the lifetime of a government project exceed its social costs. In the current context, CBA is used to determine in monetary terms the present worth of the social benefits and social costs of using fossil fuels, of mitigation versus unabated global warming, and of environmental regulations. A cost-benefit ratio can be obtained by dividing the projected costs by the projected benefits, or net benefits can be derived by subtracting costs from benefits. Projects earning a cost-benefit ratio less than 1 are possibly worth pursuing. Competing projects can be ranked according to their cost-benefit ratios, net benefits, or cost-effectiveness (Singer, 1979; Dorfman, 1993; Wolka, 2000, p. 8.130; Pearce *et al.,* 2006; van Kooten, 2013).

Economists and other social scientists can identify and attempt to quantify elements on both sides of the cost-benefit equation using observational data regarding supply, demand, prices, and profit generated by millions or billions of voluntary choices taking place in markets around the world and across time. Benefits can include protection of human health from hazards such as air pollution, measured in days or years of life extended, while costs can include slower economic growth (measured in per-capita income or GDP) due to higher taxes or the cost of complying with new regulations. A graph showing a hypothetical cost-benefit analysis for a proposal that would reduce emissions appears as Figure 1.2.9.1.

A variation on CBA is called benefit-cost analysis (BCA), though the two terms are sometimes used interchangeably. Zerbe (2018) writes, "CBA is the traditional approach of valuation, built on the potential compensation test ('PCT') and the avoidance of distributional and other equity considerations. CBA is limited to analyzing only the fair market value of property. BCA recognizes rights and moral sentiments as values insofar as they reflect the willingness to pay ('WTP') to obtain them or the willingness to accept ('WTA') payment for surrendering them." Chapter 8 makes a case for relying on CBA rather than BCA, so this short introduction to the topic focuses on CBA.

In Britain, the use of CBA by governments for all projects (not only environmental projects) is guided by *The Green Book: Central Government Guidance on Appraisal and Evaluation*, originally published in the 1970s by the Treasury and most recently updated in 2018, and a series of supplementary guidance documents listed on page 107 of that book (HM Treasury, 2018). The entire set of documents constitutes a very fine guide to the issue and is highly recommended, but with apologies to our British colleagues and friends around the world, the rest of this chapter focuses on the application of CBA to environmental issues only in the United States.

Figure 1.2.9.1
Cost-benefit analysis of a proposal to reduce emissions



US 70, I-75, I-76, and US 77 are emission reduction scenarios outlined in NAS, 1974. *Source:* Singer, 1979, Figure 2, p. 29.

The application of cost-benefit analysis to environmental decision-making in the United States dates back to its use by the Army Corps of Engineers in the 1950s, but was developed and applied in earnest starting in the 1970s when new federal air and water protection laws were being implemented (Mishan, 1971; NAS, 1974; Layard, 1974; Maler and Wyzga, 1976; Singer, 1979). The first systematic application of CBA to national regulations in the United States began in 1981 as a result of Executive Order 12291 by President Ronald Reagan (Reagan, 1981).

Under Reagan's executive order, cost-benefit analysis was part of a Regulatory Impact Analysis (RIA), itself part of a broader effort aimed at making regulations more cost-effective and transparent. The

effort was controversial, due partly to missteps by the Reagan administration, which "came under harsh criticism from numerous quarters for permitting the Office of Management and Budget (OMB) to delay and block new regulatory initiatives. Critics pointed out the OMB's regulatory review staff was comprised primarily of economists. There were no toxicologists, epidemiologists, or health scientists at OMB to overview EPA proposals" (Graham, 1991, p. 6).

A subsequent executive order issued by President Bill Clinton in 1993 made the Office of Information and Regulatory Affairs (OIRA) within OMB "the repository of expertise concerning regulatory issues, including methodologies and procedures that affect more than one agency, this Executive order, and the President's regulatory policies" (Clinton, 1993). President George W. Bush substantially increased OIRA's authority and staffing and appointed an activist director, the previously quoted John D. Graham.

President Barack Obama, while reaffirming the principles and review process in an executive order issued in 2011 (Obama, 2011), reduced the agency's staff, and it played a smaller role in regulatory policy. Before a congressional committee in 2013, a former deputy director of OIRA testified, "At one time, OIRA had a specific branch of a dozen or so economists who specialized in benefit-cost analysis, and OIRA hired scientific experts in risk analysis. Today it has a few experts scattered among five branches [which] are, for the most part, staffed with overworked although highly competent desk officers" (Morrall, 2013).

Beginning in 2017, it appears President Donald Trump is revitalizing OIRA. Like Bush, he appointed an activist director, Neomi Rao, and has made cutting regulations one of the major themes of his administration. According to Rao (in comments at a Brookings Institution event in early 2018), the federal government issued only three new "significant" regulations in FY 2017 and withdrew more than 15,000 planned rules, reducing regulatory costs by more than $570 million per year and $8 billion in total (Heckman, 2018). In FY 2018, OIRA expects deregulatory actions from federal agencies to outnumber new regulatory actions by a nearly four-to-one ratio, projected to save another $10 billion in compliance costs (*Ibid.*). But just how big a role OIRA plays in this regulation-cutting effort is uncertain.

OIRA has authority to review agency regulations and the analyses used to justify them, as well as to return the regulations to the agencies for reconsideration if it finds the analyses were insufficient. Since 1997, OIRA has issued annual reports to Congress on the benefits and costs of federal regulations. Its 2013 report found "the estimated annual benefits of major Federal regulations reviewed by OMB from October 1, 2002, to September 30, 2012, for which agencies estimated and monetized both benefits and costs, are in the aggregate between $193 billion and $800 billion, while the estimated annual costs are in the aggregate between $57 billion and $84 billion" (OMB, 2013, p. 3). This sounds rigorous and like evidence of a significantly positive overall benefit-cost ratio, but it is not. Williams and Broughel (2013) write,

> Of 37,786 rules finalized in FY2003–FY2012, only 115 rules had estimates of monetized benefits and costs in OIRA's draft report. This is less than one-third of 1% of all final regulations, an abysmal record. Even worse, there are no rules in the report from independent regulatory agencies that have dollar estimates for both benefits and costs.

If OIRA is getting estimates of monetized benefits and costs for less than one-third of 1% of all final regulations, then CBA clearly is not being used aggressively or successfully at the national level. Further evidence of this failure is that there appears to be no correlation between the amount of information provided in a regulatory impact analysis and the net benefits of a regulation (Shapiro and Morrall, 2012). Hahn and Tetlock (2008) also find little evidence that CBA has improved regulatory outcomes.

Requiring the use of CBA apparently doesn't prevent politics – whether ideology or pandering to special interests – from influencing regulatory choices. A study by the Mercatus Center at George Mason University found "the more liberal agencies (Labor, Health and Human Services) got through OIRA with lower-quality analyses in the Obama administration, while the more conservative agencies (Defense, Homeland Security) got through OIRA with lower-quality analyses in the Bush administration" (Morrall, 2013, p. 5, citing Ellig *et al.*, 2013).

Conducting a cost-benefit analysis of climate change is difficult and perhaps impossible due to the enormity of both costs and benefits, their wide dispersal (virtually every person on Earth benefits from the use of fossil fuels and many would benefit from a modest warming), and the long time frame

(most of the benefits and costs of climate change might emerge one or even two centuries in the future, if they emerge at all). Economists use integrated assessment models (IAMs) to attempt to monetize the net cost or benefit of climate change, called the "social cost of carbon." Such models are enormously complex and can be programmed to arrive at widely varying conclusions. They are described and critiqued in detail in Chapter 8.

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1.3 Private Environmental Protection

The belief that government action is needed to protect the global atmosphere from "carbon pollution" is based on the flawed assumption that private agents – the people and organizations that use fossil fuels to generate power – are acting without regard to the damages they create that are borne by others. According to this framing, the atmosphere is a common-pool resource in need of effective management and only a government can end this

"tragedy of the commons." But environmental economics makes clear that private environmental protection is more common, and more effective, than relying on government intervention.

Section 1.3.1 defines common-pool resources and explains how they have been successfully protected by tort and nuisance laws and managed by nongovernmental organizations that transform a "tragedy of the commons" into "an opportunity of the commons."

Section 1.3.2 explains why positive and negative externalities are ubiquitous and not justifications for government intervention. It describes Coase's theorem, which says socially efficient solutions to conflicts involving externalities can be found so long as both parties are able to negotiate, in effect trading their externalities.

Section 1.3.3 documents how prosperity makes environmental protection a higher public goal and provides the resources needed to achieve it. Economists call this the Environmental Kuznets Curve. Section 1.3.4 describes a huge advantage private environmental protection efforts have over government efforts: their ability to tap local knowledge of values and opportunities. Section 1.3.5 briefly critiques a school of economics called "ecological economics" seeking to justify government intervention rather than working with markets to protect the environment.

1.3.1 Common-pool Resources

> *Common-pool resources have been successfully protected by tort and nuisance laws and managed by nongovernmental organizations.*

Some natural resources such as air, flowing water, and wildlife are held "in common" by the people of a community, nation, or (in the case of the atmosphere) the whole world. They constitute a type of good or service called common-pool resources that is *non-excludable,* meaning non-payers cannot be readily prevented from using or consuming it, and *rivalrous,* meaning consumption or use by one person comes at the expense of others. Common-pool resources can be viewed as one of four types of goods and services that differ according to these two characteristics, as shown in Figure 1.3.1.1.

Common-pool resources are often difficult to protect because "someone has to cover the costs for everybody else. There are too many free riders. Too often, the common resource doesn't get saved" (Avery, 1995, p. 314). Free use of common resources often leads to more demand than can be met by the supply. The classic case is over-grazing on a commons, a pasture open to all herdsmen for cattle grazing (Hardin, 1968; Hardin and Baden, 1977). Each herdsman captures the immediate benefits of grazing another cow even though over-grazing may cause a reduction in next year's grass. The individual herdsman bears only a fraction of the costs – the reduced grazing available next year due to excessive grazing now – because all users share the future costs. If the herdsman removed his cow, he would bear fully the burden of reducing his use and, if someone else adds a cow, still bear some of the cost of over-grazing next year. Thus, each herdsman has an incentive to add cows, even though the pasture may be gradually deteriorating as a result. This situation is known as the "tragedy of the commons."

A similar situation can occur when a fishing territory is open to all fishermen (Anderson and Snyder, 1997; Adler and Stewart, 2013). Each fisherman captures all the benefits of harvesting more fish now, while paying only a small part of the future costs – the reduction of the fish population for future harvests. Ignoring the indirect costs that will occur in the future is easy if the fisherman will not ultimately pay the full, true cost of his or her actions.

In the United States, Canada, and other nations having legal roots in Great Britain, the courts have for centuries provided a way to stop individuals from injuring others by degrading commonly owned resources (Epstein, 1985; Abraham, 2002; Latham *et al.,* 2011; Cushing, 2017). When a victim demonstrates harm has been done or serious harm is threatened, courts can force compensation or issue an injunction to stop the harmful activity. Such harms are called torts or nuisances. Meiners and Yandle (1998) wrote:

> Legal actions can lead to recovery for damages to land as well as to recovery for damages to health or any other benefit attached to our interests in property. A public nuisance is an act that causes inconvenience or damage to public health or order or that obstructs public rights. If a business creates noxious emissions that affect many citizens a public attorney may bring an action on behalf of all affected citizens to have the activity terminated.

Figure 1.3.1.1
Types of goods and services

	Excludable	Non-excludable
Rivalry	**Pure Private** Food, clothing, furniture. Most items of private possession	**Common-pool Resources** Public domain ponds, rivers, wilderness areas, grazing areas, the atmosphere
Non-rivalry	**Club** Swimming pools, toll roads, country clubs, membership organizations, gated communities, private schools	**Pure Public** National defense, public sanitation, crime control, flood defense, contagious disease control

Source: Adapted from Hakim, 2017.

> Trespass created rights similar to those against nuisance. If a harmful substance is allowed, intentionally or carelessly, to invade the property of another, whether by land, air, or water, there may be a trespass. If so, the defendant is held responsible for damages.
>
> Since water is often not owned by property owners whose land abuts a lake or a stream, the common law extends protection to water quality through riparian rights. Riparian rights to water are user rights that allow water users to sue those who damage water quality to the point where its use and enjoyment are reduced.

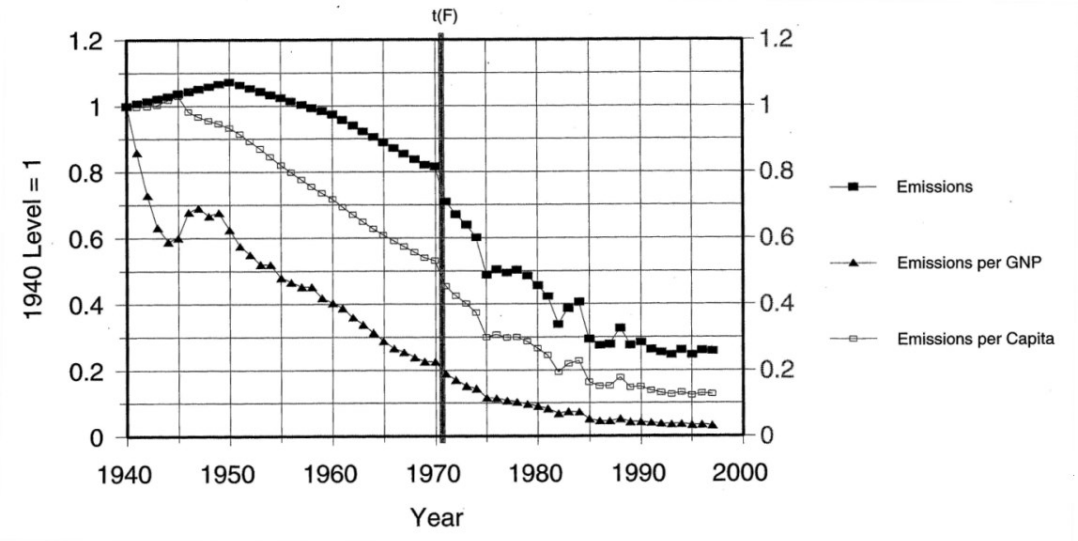
Tort law can even be used to protect the environment from government actions. In the late nineteenth century, the Carmichael family owned a 45-acre farm in Texas, with a river running through it that bordered on the state of Arkansas. The city of Texarkana, Arkansas built a sewage system that deposited sewage in the river in front of the Carmichaels' home. They sued the city in federal court on the grounds that their family and livestock no longer were able to use the river and possibly were exposed to disease.

The court awarded damages to the Carmichaels and granted an injunction against the city, forcing it to stop the sewage dumping. Even though the city of Texarkana was operating properly under state law in building a sewer system, it could not foul the water used by the Carmichaels. Indeed, the judge noted, "I have failed to find a single well-considered case where the American courts have not granted relief under circumstances such as are alleged in this bill against the city" (*Carmichael* v. *City of Texarkana*, 1899).

Reliance on tort and nuisance law to protect the environment declined in the United States beginning in the 1960s and 1970s with passage of regulations that preempted private remedies. While the purpose of these laws was to more effectively achieve the objectives of protecting public health or the natural environment than could be obtained through private legal action, whether they actually had this effect is questionable. Most trends in air and water quality in the United States showed significant improvement *before* the enactment of such laws and little or no change in trends after their adoption (Brubaker, 1995; Simon, 1995; Goklany, 1999; Hayward, 2011, pp. 7ff). For example, Figure 1.3.1.2 shows trends for particulate matter emissions in the United States from 1940 to 1997 and Goklany documents similar trends for carbon monoxide and lead emissions. McKitrick (2015) points out that federal regulations played a complicated and not always positive role in the decline of sulfur dioxide emissions associated with acid deposition. While the intentions may have been good, changes in technology played a bigger role than regulations in reducing emissions.

Climate change activists are attempting to use tort and nuisance laws to protect the atmosphere from "carbon pollution," so far without success. In a recent case where municipalities in California attempted to sue oil companies for their alleged role in causing global warming, federal district Judge William Alsup found for the defendants and dismissed the case. Relevant parts of his opinion read as follows:

Figure 1.3.1.2
U.S. particulate matter emissions, 1940–1997



U.S. particulate matter (PM_{10}) emissions relative to 1940 reported as emissions, emissions per unit of GDP, and emissions per capita. The vertical line at 1970 (tF) is time of federalization of environmental regulation. *Source:* Goklany, 1999, Figure 4-6, p. 82.

> With respect to balancing the social utility against the gravity of the anticipated harm, it is true that carbon dioxide released from fossil fuels has caused (and will continue to cause) global warming. But against that negative, we must weigh this positive: our industrial revolution and the development of our modern world has literally been fueled by oil and coal. Without those fuels, virtually all of our monumental progress would have been impossible. All of us have benefitted. Having reaped the benefit of that historic progress, would it really be fair to now ignore our own responsibility in the use of fossil fuels and place the blame for global warming on those who supplied what we demanded? Is it really fair, in light of those benefits, to say that the sale of fossil fuels was unreasonable? This order recognizes but does not resolve these questions, for there is a more direct resolution from the Supreme Court and our court of appeals, next considered. ...
>
> In our industrialized and modern society, we needed (and still need) oil and gas to fuel power plants, vehicles, planes, trains, ships, equipment, homes and factories. Our indus trial revolution and our modern nation, to repeat, have been fueled by fossil fuels.
>
> This order accordingly disagrees that it could ignore the public benefits derived from defendants' conduct in adjudicating plaintiffs' claims. In the aggregate, the adjustment of conflicting pros and cons ought to be left to Congress or diplomacy (*California* v. *BP et al.,* 2018).

Judge Alsup's opinion reveals the weaknesses in the activists' case and not a shortcoming in the tort law approach to environmental protection. If individuals cannot persuasively demonstrate to the court they are being harmed by pollution, the court will make no attempt to stop that pollution or make those causing it pay damages. Anthropogenic climate change involves billions of people burning fossil fuels and engaging in other activities that may gradually be increasing the concentration of carbon dioxide (CO_2) and other greenhouse gases in the atmosphere. The "polluters" include virtually every person in the world (a human exhales about

2.3 pounds of CO_2 every day), while bona fide "victims" probably have yet to be born. Most alleged victims benefit or will benefit from the prosperity, improved public health, and environmental benefits made possible by fossil fuels. For these reasons (and others having to do with jurisdiction), efforts to compel governments or oil companies to reduce greenhouse gas emissions have failed.

Even in cases where tort law may not prevent over-use of a common resource, solutions are possible without government intervention. Cowen (1988) presented case studies of lighthouses, bees for crop pollination, fire protection, leisure and recreational services, conservation, and public education in which common-pool resources were protected or provided through voluntary agreements and transactions. Often this involves adopting the techniques used by clubs – one of the types of goods and services shown in Figure 1.3.1.1 – to add value to a certain kind of access to a common-pool resource, giving people an incentive to pay for access.

Similarly, Ostrom (1990, 2005, 2010) and her network of researchers documented hundreds of cases where groups avoided the tragedy of the commons without resorting to top-down regulation. Decentralized ensembles of small public and private organizations work together to manage common-pool resources in ways that reflect their knowledge of local opportunities and costs, the knowledge national and international organizations typically lack. They exhibit the sort of spontaneous order that Hayek (1973, 1976, 1979) often wrote about, a coordination that is not dictated or controlled by a central planner. Ostrom identified eight design principles, summarized in Figure 1.3.1.3, shared by entities most successful at managing common-pool resources.

Ostrom's work earned her the Nobel Prize in economics in 2009. Boettke (2009) writes, "Traditional economic theory argues that public goods cannot be provided through the market. Traditional Public Choice theory argues that government often fails to provide solutions. Ostrom shows that decentralized groups can develop various rule systems that enable social cooperation to emerge through voluntary association." According to Boettke, Ostrom showed how nongovernmental organizations can transform disagreements over access to common-pool resources from a "tragedy of the commons" to "an opportunity of the commons."

In these cases and many others, the key concepts of trade, profit-and-loss, and prices allow entrepreneurs to discover what consumers value and then find ways to deliver it despite the hurdles that common ownership places in their paths. This process is described in more detail in the next section.

Figure 1.3.1.3
Ostrom's eight design principles for effective management of common-pool resources

1. Clear definition of the contents of the common pool resource and effective exclusion of external un-entitled parties;
2. Appropriation and provision of common resources that are adapted to local conditions;
3. Collective-choice arrangements that allow most resource appropriators to participate in the decision-making process;
4. Effective monitoring by monitors who are part of or accountable to the appropriators;
5. A scale of graduated sanctions for resource appropriators who violate community rules;
6. Mechanisms of conflict resolution that are cheap and of easy access;
7. Self-determination of the community recognized by higher-level authorities; and
8. In the case of larger common-pool resources, organization in the form of multiple layers of nested enterprises, with small local common-pool resources at the base level.

Source: Ostrom, 1990.

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1.3.2 Cooperation

Voluntary cooperation can generate efficient solutions to conflicts involving negative externalities.

Conflicts regarding the use of scarce resources are often rooted in opposing political viewpoints. Government decisions and regulations tend to favor the side with the most political power or the greatest ability to influence elected officials and regulators. Losers must abide by such outcomes and either pay additional taxes to fund a result they do not support or not receive a service or benefit they are willing to pay for. When politics drive decision-making the process is often a zero-sum game: What one person or interest group gains as a result of the decision, another person or interest group must give up.

Market exchanges, in contrast, produce outcomes that benefit all parties involved (Anderson and McChesney, 2002, and see Section 1.2.5). Even though there is plenty of negotiation and disagreement in the marketplace, the solutions people agree on are ones both parties want – at least compared with available alternatives. A would-be buyer whose offer is rejected does not have to pay. The parties involved are spending their own money so the risk of moral hazard is low.

Cooperation also works when conflicts arise over access to common-pool resources. In the paradigm case, one person's access to a common-pool resource imposes on others a cost, or *negative externality,* that escapes the price mechanism, so the actor is not held accountable for the entire consequences of his action. This can result in a product being overproduced and

sold at a price that is less than it should be. But externalities can be traded too, and provided transaction costs are sufficiently low, bargaining can lead to an efficient outcome without government imposing taxes or forcing a reallocation of property. This was an important lesson derived from the work of Ronald Coase, who like Elinor Ostrom mentioned in the previous section, earned a Nobel Prize for his work (Coase, 1960, 1994).

Coase's theorem, as it came to be called, was summarized in different ways by its author and by the many researchers who elaborated on it. The fundamental insight is that every externality necessarily involves two parties, the actor and the person affected by the action, and a solution necessarily involves both parties. In cases involving common-pool resources, the victim likely has several options to avoid damages, such as moving away from the nuisance, choosing to use a different product or service, interfering with the actor's enterprise, suing under tort law, or even threatening to go to elected officials and ask for legislation correcting the injustice. However, all of these options cost time or money, so the victim is probably willing to pay some amount to the actor in return for his using less of the common-pool resource or using it in such a way as to do less damage to others–to reduce the externality. The actor is probably willing to change his behavior if the cost of doing so is less than the amount offered by the victim. The resulting allocation or distribution of the good, according to Coase, will be socially efficient and in terms of resource allocation will be the same regardless of initial assignments of rights/liabilities.

Coase's writing stressed that an efficient outcome of trading in externalities is most likely to occur when "transaction costs" are low, being the costs involved in bringing the parties together and reaching an agreement. Coase knew that in reality those costs are never zero, so the success of negotiating as a solution to negative externalities depends on the design of institutions that can bring the parties together, provide them with the information they need, and make such transactions possible. In cases involving common-pool resources, these are essentially the eight design principles later discovered by Ostrom.

Coase's theorem and Ostrom's design principles tell us cooperation can lead to environmental protection without government intervention. High transaction costs may cause markets to fail to ensure that all of the costs of a person's actions are fully borne by the actor ("internalized"), but the superior solution often is to recognize the property rights of those affected by pollution or other undesirable effects and allow the two parties to negotiate toward a settlement.

Coase was careful to avoid the assumption, common in welfare economics circles, that externalities could be objectively defined or measured outside the very specific circumstances in which they occurred. Since they depend on the actions and judgements of both the actor and the victim, externalities do not exist as objective value-free data. Indeed, who is the "victim" is a matter of perspective, it is not objective. Both parties are exercising rights and deserve compensation if their rights are infringed. As Medema (2011) wrote, "the point to be taken is that there is no such thing as a determinate optimal solution to social cost problems. One can only come to grips with these things on a case-by-case basis, weighing the benefits and costs associated with alternative courses of action and recognizing that both markets/exchange and government activity have associated with them certain costs – often substantial."

Not everyone will get all he or she wants in a negotiation. Those who are not willing to provide any resources will probably be forced outside of negotiations, leaving involved only those who have something to offer. Political decisions do not please everyone either, and people who do not contribute to political candidates or mobilize constituencies to vote are unlikely to have much influence in state and national capitols. The key difference is that in a private setting, those who do not engage in the negotiations or whose offers are rejected do not have to pay for the outcome. In contrast, when a decision is made by a government, taxpayers usually bear the costs, even those who had no say in the decision and who may not benefit from the decision.

Coase's theorem and more generally the success of cooperation in managing common-pool resources around the world has important implications for the climate change issue that will become more apparent in later chapters of this book. For now, consider just these implications:

- Managing Earth's atmosphere like a common-pool resource will require tradeoffs and negotiation among those who benefit from the production and use of fossil fuels (the primary source of anthropogenic greenhouse gases) and those who may suffer from the negative consequences of a warmer world.

- Distinguishing "actors" and "victims" in the climate change phenomenon is difficult or even impossible since everyone emits some greenhouse gases and everyone benefits from the prosperity and technologies made possible by the use of fossil fuels.

- "Social cost" in cases involving common-pool resources is not objectively quantifiable but involves case-specific tradeoffs of rights, costs, and benefits by both actors and victims.

- The efficient solution to climate change is likely to be decentralized, emerging from nongovernment organizations with local knowledge of opportunities and designed to effectively manage common-pool resources, rather than imposed from the top down by national or global government agencies.

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1.3.3. Prosperity

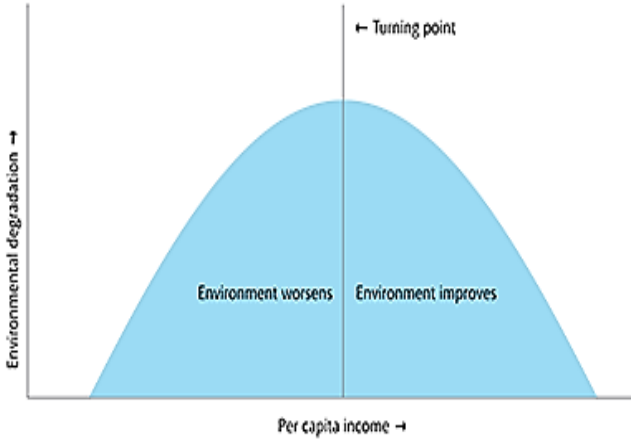
Prosperity leads to environmental protection becoming a higher social value and provides the resources needed to make it possible.

Even poor communities are willing to make sacrifices for some basic components of environmental protection, such as access to safe and clean drinking water and sanitary handling of human and animal wastes. As income rises, citizens raise their goals from mere survival to self-realization and spiritual goals (Maslow, 1943; Abulof, 2017). Once basic demands for food, clothing, and shelter are met, people demand cleaner air, cleaner streams, more outdoor recreation, and the protection of wild lands. With higher incomes, citizens place higher priorities on environmental objectives (Ausubel, 1996; Goklany, 2007).

Nordhaus and Shellenberger (2007), quoted earlier in Section 1.1, acknowledged, "As Americans became increasingly wealthy, secure, and optimistic, they started to care more about problems such as air and water pollution and the protection of the wilderness and open space. This powerful correlation between increasing affluence and the emergence of quality-of-life and fulfillment values has been documented in developed and undeveloped countries around the world" (p. 6). They continued, "Environmentalists have long misunderstood, downplayed, or ignored the conditions for their own existence. They have tended to view economic growth as the cause but not the solution to ecological crisis" (*Ibid.*).

Coursey (1992) found the willingness of citizens to spend and sacrifice for a better environment rises more than twice as fast as per-capita income. Conversely, willingness and ability to pay for a better environment falls with falling income. Economists have documented what are called Environmental Kuznets Curves (EKCs) showing how various measures of environmental degradation rise with national per-capita income until a certain tipping point and then begin to fall, often pictured as an inverted U shape (Panayotou, 1993). Figure 1.3.3.1 shows a stylized rendition of the curve.

Figure 1.3.3.1
A typical Environmental Kuznets Curve



Source: Ho and Wang, 2015, p. 42.

Grossman and Krueger (1995) conducted an extensive literature review of air quality over time and around the world and found ambient air quality tended to deteriorate until average per-capita income reached about $6,000 to $8,000 per year (in 1985 dollars) and then began to sharply improve. Later research confirmed similar relationships for a wide range of countries and air quality, water quality, and other measures of environmental protection (Goklany, 2007, 2012; Criado, *et al.,* 2011; Bertinelli *et al.,* 2012). Yandle *et al*. (2002) surveyed more recent research on EKCs and reported, "Prior to the advent of EKCs, many well-informed people believed that richer economies damaged and even destroyed their natural resource endowments at a faster pace than poorer ones. They thought that environmental quality could only be achieved by escaping the clutches of industrialization and the desire for higher incomes. The EKC's paradoxical relationship cast doubt on this assumption." They found while "there is no single EKC relationship that fits all pollutants for all places and times," the typical inverted U shape is the best way to approximate the link between income and local air pollutants such as oxides of nitrogen, sulfur dioxide, and particulate matter. "The EKC evidence for water pollution is mixed, but there may be an inverted U-shaped curve for biological oxygen demand (BOD), chemical oxygen demand (COD), nitrates, and some heavy metals (arsenic and cadmium). In most cases, the income threshold for improving water quality is much lower than the air pollution improvement threshold."

More recently, Koirala *et al*. (2011) conducted a meta-analysis of 103 empirical EKC studies published between 1992 and 2009 and found EKC-type relationships "for landscape degradation, water pollution, agricultural wastes, municipal-related wastes and several air pollution measures," though not for carbon dioxide emissions. Even sulfur emissions in fast-growing China appear to be declining as the nation prospers (Zilmont *et al.*, 2013).

The relationship between economic growth and environmental impact is more complicated than what is presented here (for more academic background see Grimaud and Rougé, 2005; Grimaud and Tournemaine, 2007; and Schou, 2000, 2002). Factors other than wealth, such as the strength of democratic institutions, levels of educational achievement, and income equality have been shown to affect the environmental impact of prosperity. But these variables are themselves affected by prosperity. Friedman (2005) documented periods of higher economic growth have led to more tolerance, optimism, and egalitarian perspectives.

The productivity and wealth of nations depend more on their institutions – the law, incentives, and rules in place – than on their natural resources. Countries where private property rights are defined, protected, and can be traded experience significantly greater per-capita wealth, economic growth rates, and rising standards of public health (Gwartney *et al.*, 2014; Miller and Kim, 2015). As might be expected, those countries also experience higher levels of environmental quality. As Hartwell and Coursey wrote, "we find that the correlation between economic freedom and better environmental and public health outcomes remains strong. We conclude that the way forward for environmental policymaking should concentrate on improving property rights and limiting the power of the state, rather than expanding it" (Hartwell and Coursey, 2015, p. 37).

The prosperity made possible by markets creates the resources and change in public values needed to protect the environment. Without markets, a poorer and hungrier world would have little regard for the environment or the interests of future generations, being too busy meeting the more immediate needs of finding food and shelter.

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1.3.4 Local Knowledge

> *The information needed to anticipate changes and decide how best to respond is local knowledge and the most efficient responses will be local solutions.*

The fact that climate change is a global phenomenon often leads to the assumptions that it is best studied by a global entity, perhaps an Intergovernmental Panel on Climate Change (IPCC), and that it requires a "solution" chosen and implemented by a global government, perhaps the United Nations. Both assumptions are wrong. Institutions may collect massive amounts of data, but this *information* must be processed, interpreted, and added to *knowledge* of local circumstances of time and place in order to lead to the discovery of efficient responses to changes in the world (Hayek, 1945; Kirzner, 1978, 2005; Sowell, 1980; Boettke, 2002; Hess and Ostrom, 2007). Actors operating in the private sector have incentives to gather just enough information – not too much and not too little – because both the costs and the benefits of seeking more information fall upon the actor. Weighing the costs and benefits of more information, the actor won't end up with perfect or complete information but will make a reasonable decision based on the costs and benefits of seeking more knowledge.

Government regulators have very different incentives regarding information and learning. They typically do not bear the cost of information collection and learning, and so will be inclined to demand or require more than is necessary before allowing regulated individuals to act. If damage occurs the regulator could be blamed, so his or her incentive will be to require as much information as possible before allowing a project to go forward. The regulator may ask for study after study to make sure the proposed plan of action will really be safe. The act of accumulating more information becomes an excuse or justification to compel others *not* to act.

Sometimes, government agencies succumb to pressure to find what they believe their superiors

want them to find. A good example is the U.S. program that measures surface ambient air temperatures – critical data for understanding climate change. Anthony Watts, a meteorologist, recruited a team of "citizen scientists" to photograph some of the climate-monitoring stations in the U.S. Historical Climatology Network (USHCN) overseen by the National Weather Service, a department of the National Oceanic and Atmospheric Administration (NOAA), to see if those stations complied with NOAA's own quality standards (Watts, 2009). The team eventually surveyed 82.5% of the stations. "We were shocked by what we found," Watts wrote, continuing:

> We found stations located next to the exhaust fans of air conditioning units, surrounded by asphalt parking lots and roads, on blistering-hot rooftops, and near sidewalks and buildings that absorb and radiate heat. We found 68 stations located at wastewater treatment plants, where the process of waste digestion causes temperatures to be higher than in surrounding areas. In fact, we found that 89 percent of the stations – nearly 9 of every 10 – fail to meet the National Weather Service's own siting requirements that stations must be 30 meters (about 100 feet) or more away from an artificial heating or radiating/reflecting heat source (p. 1).

Watts goes on, "In other words, 9 of every 10 stations are likely reporting higher or rising temperatures because they are badly sited. It gets worse. We observed that changes in the technology of temperature stations over time also has caused them to report a false warming trend. We found major gaps in the data record that were filled in with data from nearby sites, a practice that propagates and compounds errors. We found that adjustments to the data by both NOAA and another government agency, NASA, cause recent temperatures to look even higher" (*Ibid.*). The U.S. surface temperature record has long been viewed as the most accurate and complete of the national records relied on by scientists to estimate global temperature trends, so its shortcomings are likely to be shared and even greater in other countries.

A report by the U.S. Government Accountability Office (GAO, 2011) subsequently confirmed Watts' findings and urged NOAA to improve the quality of its surface station network. NOAA agreed with GAO's findings and identified a subset of the USHCN consisting only of supposedly high-quality climate-monitoring stations complying with its siting standards. In 2011, Watts and several colleagues examined "the differences between USHCN temperatures and North American Regional Reanalysis (NARR) temperatures" – that is, the temperature record produced by the subset of higher-quality stations – and found "the most poorly sited stations are warmer compared to NARR than are other stations, and a major portion of this bias is associated with the siting classification rather than the geographical distribution of stations. According to the best-sited stations, the diurnal temperature range in the lower 48 states has no century-scale trend" (Fall *et al.*, 2011).

Similarly and more recently, a doctorate degree was awarded in December 2017 by James Cook University, in Townsville, Australia, to a student whose thesis found scores of flaws in the HadCRUT4 dataset, widely used as the authoritative reconstruction of global temperatures dating back to 1850. That student, now Dr. John McLean, published an updated version of his research in 2018 in which he reported "considerable uncertainty exists about the accuracy of the HadCRUT4" (McLean, 2018, p. 2). "It seems very strange," he wrote, "that man-made warming has been a major international issue for more than 30 years and yet the fundamental data has never been closely examined" (*Ibid,* p. 1).

Whether Watts and McLean are correct or not is obviously important, but not germane to the current point. How could such important data be so unreliable? Why did it take a team of "citizen scientists" in the United States and a graduate student in Australia to expose major flaws in data collection programs created by governments in the United States and United Kingdom and relied on by researchers around the world?

Government officials who oversee government agencies have uses in mind for the data they collect, and those plans affect how data are collected and interpreted. Scott (1998) discovered this while studying failed efforts by governments around the world to force nomadic tribes to settle down, including The Great Leap Forward in China, collectivization in Russia, and compulsory villagization in Tanzania, Mozambique, and Ethiopia. "The more I examined these efforts at sedentarization, the more I came to see them as a state's attempt to make a society legible, to arrange the population in ways that simplified the classic state functions of taxation, conscription, and prevention of rebellion," Scott wrote (p. 2). "In each

case, officials took exceptionally complex, illegible, and local social practices, such as land tenure customs or naming customs, and created a standard grid whereby it could be centrally recorded and monitored" (*Ibid.*). Scott refers to this as "seeing like a state."

Climate is certainly "exceptionally complex, illegible." Early on, the IPCC admitted it is "a coupled non-linear chaotic system, and therefore … long-term prediction of future climate states is not possible" (IPCC, 2001, p. 774). The human impact on climate has been called "one of the most challenging open problems in modern science. Some knowledgeable scientists believe that the climate problem can never be solved" (Essex and McKitrick, 2007). Yet the IPCC now claims future climate conditions *centuries from now* can be predicted with sufficient certainty to make claims about how much greenhouse gases must be reduced and how soon. A mandate to "create a standard grid" out of chaotic observational data could explain the IPCC's lack of interest in natural causes of climate change and reliance on unvalidated computer models. Regarding the latter, Wernick (2014) observed,

> Climate offers a clear case of modeling exercises used to advance political agendas by choosing which data to focus on and how to tweak the (literally) hundreds of parameters in any given model. Whether by design or default, the model tends to vindicate the modeler; for instance, the modeler that selects which natural mechanisms to include and which to neglect when modeling the annual global flux of carbon. Models, and policies to be based on them, ignore the consequences of climate change mitigation strategies, such as costly regressive electricity rates that force even middle-class people to scavenge the forest for fuel, or the benefits of global carbon fertilization. What becomes obscured is the fact that a self-consistent description useful for numerical modeling may not faithfully represent reality, whether physical or social.

The world's political leaders may be motivated by a sincere belief in predictions of catastrophic climate change in centuries to come, but it could also be that collecting extensive data about global energy production and consumption makes the world's energy system "legible" and therefore easier to regulate and tax. The founder of the IPCC and leaders of the UN have not been shy about saying this is their long-term objective (Strong, 1992; UN, 2015; Figueres, 2017).

The IPCC's massive assessment reports and the seemingly endless summits of the parties to the UN's Framework Convention on Climate Change (UNFCCC) reveal the tendency of government bureaucracies to amass information without acquiring the knowledge needed to support action. Proposals from the United Nations feature transfers of billions and even trillions of dollars among international agencies and national governments with seemingly little regard to the scant benefits of such investments. They imply that the goal all along may have been redistribution of income and not preventing or slowing climate change.

The global nature of climate change and the fact that the planet's atmosphere is a global commons obscure the reality that the consequences of climate change are always experienced locally. Consequently, the information needed to anticipate changes and decide how best to respond is *local knowledge* and the most efficient responses will be *local solutions.* It often is forgotten that global estimates of temperature, sea-level rise, and other measures of consequences are model-derived abstractions largely irrelevant to what occurs at specific locations around the world (Essex *et al.,* 2007). For example, changes in sea level at any given site around the world are determined by local and regional changes in shorelines unrelated to estimates of global sea-level rise (Parker and Ollier, 2017). As de Lange and Carter (2014) observe,

> Most coastal hazard is intrinsically local in nature. Other than periodic tsunami and exceptional storms, it is the regular and repetitive local processes of wind, waves, tides and sediment supply that fashion the location and shape of the shorelines of the world. Local relative sea-level is an important determinant too, but in some localities that is rising and in others falling. Accordingly, there is no "one size fits all" sea-level curve or policy that can be applied (p. 33).

What is true of sea-level rise is true of climate impacts more generally. Climate science does not allow us to determine what the local effects of anthropogenic climate change will be. McKitrick (2001) notes,

> Anthropogenic additions to the atmosphere will (if they do anything) produce changes in the weather. But weather is a chaotic process, and we have limited expectation of being able to distinguish natural and anthropogenic changes at the local level, even *ex post*. Any damage function we define for the purposes of determining optimal mitigation policy must take for granted a future ability to accurately identify location-specific climate changes and attribute them to anthropogenic causes. If we do not have this ability, climate policy cannot be based on cost-benefit analysis (p. 1).

Since the effect of reducing greenhouse gas emissions, according to the IPCC, will be only to delay the onset of global warming by a few months or years at best, global emission reduction programs are not an effective response to the real on-the-ground consequences of climate change even if one accepts the IPCC's scientific findings. The fact that the impacts of climate change are local explains why even managing the global commons that is the planet's atmosphere is best done by individuals and organizations throughout the world who are experiencing those impacts and not by international organizations based in New York, Paris, or The Hague.

Efforts by the UN and IPCC may actually be preventing other more promising initiatives from advancing, a problem called "displacement" discussed in Section 1.4.6. The record of managing other common-pool resources compiled by Ostrom (1990, 2010) shows top-down and government-led approaches frequently fail while decentralized and often market-based approaches succeed. This insight – that a single top-down solution may be inferior to multiple bottom-up solutions discovered by people with local knowledge and incentives to find the most efficient solutions – is shared by some environmentalists. A group of mostly progressive scholars from Asia, Europe, and North America wrote in 2009:

> It is a characteristic of open systems of high complexity and with many ill-understood feed-back effects, such as the global climate classically is, that there are no self-declaring indicators which tell the policy maker when enough knowledge has been accumulated to make it sensible to move into action. Nor, it might be argued, can a policy-maker ever possess the type of knowledge – distributed, fragmented, private; and certainly not in sufficient coherence or quantity – to make accurate 'top down' directions. Hence, the frequency of failure and unintended consequences (Prins *et al.*, 2009).

The economics of information and knowledge predict neither the IPCC nor the UN will discover the truth about the causes and consequences of climate change or endorse the most efficient response to the phenomenon. Real knowledge and socially optimal responses are most likely to come from the "bottom up," from smaller units of government and private-sector initiatives modeled after those that are successfully managing other common-pool resources.

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1.3.5 Ecological Economics

> *"Ecological economics" is not a reliable substitute for rigorous mainstream environmental economics.*

Environmentalists have attempted to counter the attention given to and impact of the free-market environmentalism movement by creating their own competing school of economics, which they call "ecological economics." Notable authors contributing to this effort include Robert Costanza (1996, 1998, 2004), Herman E. Daly (2000, 2003), Juan Martinez-Alier (1994, 2002), D.J. McCauley (2006), and E.F. Schumacher (1973). This effort should not be confused with efforts by other scholars such as Rothschild (1990) and Hawken, Lovins, and Hunter Lovins (2000) who are critical of how mainstream economists treat environmental topics but not dismissive of the ability of markets and private actors to protect the environment.

While ecological economics has some merits, its origin as an attempt to defend an ideology, rather than to genuinely understand human social action, leads its practitioners to make fundamental errors. One error is to attempt to replace market prices with other means of measuring costs and benefits. The result is reliance on subjective estimates of values often based on survey results, unscientific predictions by experts, or simply popular beliefs. Prices are the essential data of economics precisely because they are an objective account of what people are willing to pay for a good or service.

A second error is uncritically accepting without question the pseudo-science of the environmental movement. For example, a textbook on ecological economics (Common and Stagl, 2005) makes some factually correct statements about climate change, starting with "as a result of the increasing use of fossil fuels in the last two hundred years, the amount of carbon dioxide in the atmosphere has increased. The expert consensus is that this has warmed the planet, and will warm it further. The amount of warming to be expected, by say 2100, is not known with any precision" (pp. 2–3). This is accurate, but the authors go on to write: "But, the expert consensus

is that it will be enough to have serious impact on human economic activity and the satisfaction of needs and desires. Beyond 2100, the impacts may be catastrophic" (p. 3). There is no such consensus among either scientists or economists on this matter, as later chapters in this volume will attest. This is simply a statement of environmentalist dogma that prejudices any effort to study the issue objectively. The textbook makes the same mistake on other issues including resource depletion, loss of species, and air and water pollution.

A third error of ecological economics is its slavish devotion to the doctrine of "sustainability." According to Common and Stagl, "The scholars who set up the International Society for Ecological Economics (ISEE) in 1989 were largely motivated by the judgement that the way the world economy was operating was unsustainable" (p. 8). "Sustainability and sustainable development are central concerns of ecological economics," they write, "which has been defined as the science of sustainability, but not of neoclassical economics" (p. 11). And indeed, ISEE's website states as its goal the facilitation of "understanding between economists and ecologists and the integration of their thinking into a trans-discipline aimed at developing a sustainable world" (ISEE, 2015).

Making "a sustainable world" the goal of something purporting to be an academic discipline is problematic at best (Goklany, 2001; Morris, 2002). First, there is no objective definition of sustainability; in particular there is no agreement on what must be sustained and what should be allowed to change and for how long. For example, a recent editorial in *Nature* opined, "'Sustainable development' is a catchphrase that neatly defines what the world must ultimately achieve, but nobody knows precisely what it looks like at full scale" (*Nature*, 2015, p. 407).

Second, sustainability is a political movement generally traced to a political document, *Our Common Future*, produced by an agency of the United Nations in 1987 and often referred to as the Brundtland Report (WCED, 1987). That document and many others in the sustainability literature simply assume that only governments are capable of protecting the environment, rather than treat that postulate as a contestable hypothesis. As the brief history of environmental economics shows, there is extensive research and commentary on how markets often do a better job than governments at protecting natural resources.

Third, sustainability literature relies heavily on forecasts of future population, consumption patterns, resource availability, emissions, the effects of those emissions, human adaptation to those effects, and more. Those forecasts are apparently made in ignorance of the scientific forecasting literature (Armstrong, 2001; Armstrong and Green, 2018) and of the evidence provided by Simon (1996) showing human ingenuity and free markets solve shortages and deliver more and cheaper resources over the long term. As Thomas Babington Macaulay wrote nearly two centuries ago upon reading similar alarmist prophesies of his day, "By what principle is it that, when we see nothing but improvement behind us, we are to expect nothing but deterioration before us?" (Macaulay, 1830).

These errors make it clear that "ecological economics" cannot be counted on to provide reliable insights into the climate change issue. Mainstream environmental economics has a longer history and superior methodology, is independent of the environmental movement's spin on matters of science and public health, and is not subordinated to a political agenda. As the rest of this chapter demonstrates, environmental economics is a very useful tool in understanding how best to address climate change.

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1.4 Government Environmental Protection

Governments may try to protect the environment by helping private parties define and enforce property rights, regulating environmental risks, and owning and managing resources. The first avenue involves the protection of rights and prevention of injury or harm by one person or group against another. In addition to police powers, governments protect rights by recording and maintaining claims, such as records of ownership and sales of land and water rights. These activities help markets function better by upholding the integrity of property rights. This is the subject of Section 1.4.1.

Government efforts to protect the environment by regulation or owning and managing resources have at best a mixed record. As reported previously in Section 1.3, voluntary cooperation, technological changes, and prosperity explain more of the improvement in air and water quality during the twentieth century than regulation. Sometimes government actions are more harmful than beneficial, as demonstrated by the environmental records of the U.S. Forest Service and the former Soviet Union. Why this is the case is the subject of Sections 1.4.2 through 1.4.7.

Understanding why government environmental protection efforts tend to fail is important because most climate change action agendas place nearly full responsibility and discretionary authority in the hands of government officials, as if implementation of mitigation strategies or adaptation programs were less important or perhaps easier than determining "equilibrium climate sensitivity" or the "residency time of carbon dioxide in the atmosphere." As incredible as it might sound, climate science may be the easy part of the climate change issue. What to do about it and how to go about doing it are the more difficult parts.

1.4.1 Property Rights

> *Governments can protect the environment by helping to define and enforce property rights.*

The ability to own and divest property has enormous, but often unrecognizable, effects. A recent cartoon in *The Wall Street Journal* illustrates: A husband and wife are walking out of a home. The man says to the woman, "Their house looks so nice. They must be getting ready to sell it." Pride of ownership and hope

that others will place a high value on the things we own are tremendous motivators of conduct that, by an invisible hand, turns out to benefit those around us. There are plenty of other examples: People take better care of their own cars and homes than cars and apartments they rent. People will remove litter from their front yards and carefully mow, weed, and fertilize it, yet will walk past litter and weeds in a nearby park. Property rights explain why they do that.

Property rights hold people accountable for the long-term value of assets they own. Aristotle recognized this point more than 2,000 years ago when he wrote, "What is common to many is taken least care of, for all men have greater regard for what is their own than for what they possess in common with others" (Aristotle 1939, p. 536).

Property rights are traded with mutual consent in markets. Markets are everywhere, from stock exchanges where billions of dollars' worth of ownership interest in capital is traded daily, to farmers' markets that appear along country roads and in urban plazas. Today, more than half the world's population has Internet access, allowing more than 4 billion people to buy and sell goods and services from the comfort of their home with little more than the click of a button on a keyboard (Internet World Stats, 2018). Trade has never been easier, more frequent, or more valuable than it is today.

Governments play a critical role in making these trades possible by protecting individuals' rights to hold and use their properties. A defining characteristic of government is its claim to a "monopoly of the legitimate use of physical force" (Weber, 1918). It can use force (and more often the threat of force) to protect the owners of property rights from trespass, theft, and fraud. Mises (1966 [1998]) colorfully described this realm:

> Beyond the sphere of private property and the market lies the sphere of compulsion and coercion; here are the dams which organized society has built for the protection of private property and the market against violence, malice, and fraud. This is the realm of constraint as distinguished from the realm of freedom. Here are rules discriminating between what is legal and what is illegal, what is permitted and what is prohibited. And here is a grim machine of arms, prisons, and gallows and the men operating it, ready to crush those who dare to disobey (p. 720).

When people are confident in their ownership and the protection of that ownership by their governments, they are more willing to enter a market to produce, sell, or buy goods (Blumenfeld, 1974; Baumol, 2002). But governments often are the biggest violators of enforceable property rights, since such rights restrict their sovereign authority to tax and regulate without limit (Bethell, 1998; Panné *et al.*, 1999). Historian Richard Pipes (1999) found governments rarely create property rights. Although the history of property rights varies from place to place, property rights are usually established informally when land or other natural resources become valuable enough for individuals to utilize them. Later, these informal rights are confirmed or codified as laws by a government entity.

The discovery of gold in California in 1848 illustrates this process. The sudden increase in the value of land briefly led to conflicts among California miners. But soon the miners began to make agreements about how the land and the veins of gold would be divided. Claimants worked mines together, having made contracts spelling out how finds would be allocated. They did this even though there was no effective government in those areas at the time. Later, when the national government came West, it formalized these mining rights and provided legal protection (Anderson and Hill, 2004).

Through most of the history of the United States, the role of governments with respect to land and water was primarily to recognize, record, and protect individual property rights. While the U.S. government claimed ownership to large amounts of land, most of it was gradually settled and became privately owned through various laws such as the Homestead Act of 1862. This policy of divestiture or privatization ended late in the nineteenth century, when the national government decided to keep many western lands.

Once land was privately owned, state governments provided civil courts through which disputes over ownership and incompatible land use could be resolved. As described in Section 1.3.1, among those disputes were disagreements over damage caused by pollution. By enforcing property rights, government courts protected people from excessive pollution, just as they protected individuals from theft and from personal assault (Brubaker, 1995).

Hernando de Soto (2000) discovered the critical role of protecting property rights while studying the informal economy of Peru. He found that through neglect, bureaucratic inertia, and protection of

privilege, the Peruvian government had made it impossible for many of its citizens to open businesses. Entrepreneurs had to navigate a labyrinth of onerous requirements in a costly approval process that was nearly impossible to complete. As a result, many people in the poorer sectors operated their enterprises illegally, if they had any business at all. Operating illegally, such persons did not have the basic protection of property rights that governments are generally expected to provide. De Soto concluded that if society is to be cooperative and productive, property rights must be formally recognized so people can plan for the future, knowing they can keep what they earn and any investment they make will not be taken away from them.

Understanding why private property rights are so important and the history of governments both threatening and protecting them is valuable, even critical, for those who would implement a climate change action plan. Defining, trading, and protecting property rights are activities fundamental to a free and prosperous society. While governments are relied upon to use force if necessary to protect these activities, historically governments have been unfriendly and even hostile to private property rights. That hostility has caused some of the greatest human tragedies in history. An action plan to address climate change that dismisses private property rights in favor of giving governments broad and discretionary power is unlikely to succeed.

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1.4.2 Regulation

> *Regulations often fail to achieve their objectives due to the conflicting incentives of individuals in governments and the absence of reliable and local knowledge.*

Beginning in the 1970s, several environmental laws were enacted in the United States giving federal agencies sweeping powers to directly control activities that might have negative environmental consequences. The decade saw the passage of the Clean Air Act, Clean Water Act, Endangered Species Act, National Environmental Policy Act, Resource Conservation and Recovery Act, and Toxic Substances Control Act. In 1980, the Comprehensive Environmental Response Compensation and Liability Act, known as Superfund, was enacted to clean up hazardous waste dumps (Easterbrook, 1995; Carlin, 2015).

Standards were set, but were they too tight or too lax? Would the best standards be different in different areas? Technologies are often specified in the regulations formed under such laws. Were they the right technologies? Would they continue to be the right ones? A government agency may have little interest in gathering data to objectively answer these questions because its interests may support more restrictive regulations, regardless of whether they are needed. The information it collects probably will not include valuable knowledge of local circumstances affecting costs and opportunities.

As a result of these federal laws and the mushrooming power of federal regulatory agencies, especially the Environmental Protection Agency (EPA), some potentially dangerous emissions into the air and water were reduced. Those positive outcomes led most citizens to support the environmental laws of the late twentieth century, giving power and influence to environmental activists who moved on to fight other alleged but poorly documented dangers such as acid deposition, particulate matter, and global warming. Fundraising letters produced by environmental groups were especially vivid with alarm and not always accurate regarding the science. The EPA along with state and local agencies adopted regulations that became more and more stringent. The costs imposed on those forced to comply with the new regulations, including taxpayers, grew (Djankov *et al.*, 2002; Trzupek, 2011).

EPA programs such as Superfund and the Clean Air Act allowed government officials to pursue narrow goals without taking into account competing goals or having to provide the kind of cause-and-effect information required in civil litigation. The programs were popular with the public, but when better information was produced, the realized benefits were often much smaller than initially expected because the dangers had been exaggerated and/or the intended solutions did not work in the manner expected (Gots, 1993; Tengs *et al.*, 1995; Graham, 1995; Crews, 2013). Some citizens directly affected by these environmental concerns strongly opposed specific regulations when costs were high or when the effectiveness of regulations could not be demonstrated. Public attention to the high cost of regulation led to a deregulation movement in some areas, with some success (Litan, 2014).

Dawson and Seater (2013) conducted an analysis of the effect of regulation on economic growth in the United States using the number of pages in the *Code of Federal Regulations* as a measure of regulatory burden. They found, "In 2011, nominal GDP was $15.1 trillion. Had regulation remained at its 1949 level, current GDP would have been about $53.9 trillion, an increase of $38.8 trillion. With about 140 million households and 300 million people, an annual loss of $38.8 trillion converts to about $277,100 per household and $129,300 per person. Furthermore, our estimates indicate that the opportunity cost will grow at a rate of about 2% a year (the average reduction in trend over the sample period) if regulation is merely kept at its 2005 level and not increased further" (p. 22). Per-capita GDP in 2011 was approximately $50,000, so but for the presence of federal regulations, average per-capita GDP would have been more than three times as high ($179,300 versus $50,000). The authors note, "our figures are net costs. They are based on the change in total product caused by regulation and so include positive as well as negative effects. Our results thus indicate that whatever positive effects regulation may have on measured output are outweighed by the negative effects" (*Ibid.*). In other words, the lost income is *pure waste* in the sense that it bought nothing of value.

Regulation is expensive because regulators don't have knowledge of local conditions and opportunities and cannot control all the decisions of individuals affected by the rules, leading to inefficiency, circumvention, unintended consequences, and waste (Winston, 2006; Dudley and Brito, 2012). This is particularly problematic in the case of managing greenhouse gases since "carbon emissions are a pervasive result of the use of fossil fuels, and *every decision bearing on the use of fossil fuels will affect these emissions.* Regulatory programs can only be brought to bear on a finite subset of these decisions, where specification of requirement, monitoring, and enforcement are possible" (Montgomery, 1995, p. 37, italics added).

Emission reduction programs relying on command-and-control regulations often are expensive and ineffective because they fail to allow businesses and entrepreneurs to seek out the lowest-cost opportunities to reduce emissions. Tietenberg (1985) surveyed 11 empirical studies comparing the cost of complying with command-and-control regulations to the least-costly methods of achieving the same level of pollution reduction. In all 11 cases, complying with regulations cost more than the least-cost methods, with a mean average ratio of six and a median ratio of four. In other words, command-and-control regulations typically cost between four and six times as much as the least-costly means of reducing emissions by the same amount.

More recently, Nobel Laureate economist Jean Tirole wrote, "It has been empirically verified, however, that top-down policies increase the cost of environmental policies considerably. To judge from experience with other pollutants, introducing a single carbon price might reduce the cost of cutting pollution by at least half in comparison with top-down approaches discriminating between sectors or agents" citing Ellerman *et al.*, 2003; Tietenberg, 2006; and Stavins, 2002 (Tirole, 2017, p. 215).

Taking a regulatory approach to emission reductions has a third deficiency called "new source

bias." Costly technology mandates imposed on new plants, machines, buildings, etc. raise the cost of new investments and consequently discourage replacement of existing capital. This slows down the natural turnover of capital, which is responsible for significant advances in energy efficiency. Money that would have gone to new, cleaner goods and services is diverted instead to keeping older, dirtier machines and facilities in use, offsetting some or all of the intended gains. In the case of fuel economy standards for cars and trucks, this "clunker effect" has been estimated to offset 13-16% of the expected fuel savings (Jacobsen and van Benthem, 2015).

Because of the well-known limitations of regulations, some climate change activists promote a "carbon tax" instead. Such a tax would be imposed on the greenhouse gases released during the combustion of coal, oil, and natural gas, raising their prices and giving businesses and consumers incentives to use low-carbon alternatives. A "carbon tax" would be more efficient than regulations only if it replaces existing regulations rather than being in addition to them, yet this is rarely proposed and is likely to be politically impossible. McKitrick (2016a) writes,

> [C]arbon pricing only works in the absence of any other emission regulations. If pricing is layered on top of an emission-regulating regime already in place (such as emission caps or feed-in-tariff programs), it will not only fail to produce the desired effects in terms of emission rationing, it will have distortionary effects that cause disproportionate damage in the economy. Carbon taxes are meant to replace all other climate-related regulation, while the revenue from the taxes should not be funnelled into substitute goods, like renewable power (pricing lets the market decide which of those substitutes are worth funding) but returned directly to taxpayers.

Virtually all carbon tax proposals include provisions for giving some of the revenues to the various rent-seekers who make up the global warming movement, a topic addressed in Section 1.4.5 below. Those groups have even opposed "carbon tax" initiatives that don't earmark some of the financial windfall to them (Burnett, 2016). In other words, taxpayers are rightly skeptical that all the revenues raised by a "carbon tax" would be "returned directly to taxpayers."

McKitrick (2016b) also observed, "The economic efficiency of a carbon tax comes not from setting a floor price, but a ceiling price. Policies like the federal biofuels mandate, energy conservation programs, renewables subsidies and coal phaseout rules might reduce carbon dioxide emissions, but they do so at marginal costs of hundreds of dollars per tonne. Adding a carbon tax on top of that does nothing to make the overall policy mix more efficient. But replacing those policies with a carbon tax would. In the process, *it might also lead to higher carbon dioxide emissions,* something that promoters of carbon pricing need to be upfront about" (italics added).

The incidence of a carbon tax would fall on the consumers of virtually all products (since they all require energy to be produced and transported to consumers), so it would act more as a general consumption or sales tax than an environmental tax. As Fullerton (1996) wrote, "Congress can decide who is legally liable to pay a tax, but it cannot legislate the ultimate distribution of burden. A tax on one good may reverberate through the economy in such a way that other prices are affected. An untaxed good may end up with a higher price, and anyone who buys it bears a burden." Nor are taxes free of administrative and compliance costs, or of the opportunity costs incurred when less energy is consumed.

Much of the period after 1970 has been characterized by hostile confrontations between bureaucrats and environmental activists pressing for tougher regulations, and companies and individuals who bear the largest burdens of those regulations resisting (Trzupek, 2011). The discussion of how best to address the threat of climate change takes place in this context, which explains the readiness of many economists, industry groups, and pro-consumer and pro-free enterprise groups to react quickly and negatively to plans that involve new regulations and taxes. This reaction is not knee-jerk or selfish, but based on what has been learned over the past 40 years about the costs and consequences of environmental regulations.

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1.4.3 Bureaucracy

> *Government bureaucracies predictably fall victim to regulatory capture, tunnel vision, moral hazard, and corruption.*

Government programs often are represented as solutions to social problems without any cost of implementation. But every program requires a bureaucracy to oversee the translation of legislation into regulations, public promotion of the new rules and requirements, enforcement, and regular monitoring of success or failure to achieve goals. Government bureaucracies have been closely studied by economists and found to be rarely efficient (Mises, 1944; Wilson, 1991; Breyer, 1993; Niskanen, 1996; Tullock, 2005). There are several reasons for this.

Many government agencies are given not one but three mandates: to identify, evaluate, and solve a social problem. But combining all three responsibilities in the same entity means the agency has no incentive to decide the social problem does not merit a significant investment of public monies to solve, or that the problem, should it exist, even could

be solved. The agency is also charged with measuring its own success and then reporting it to those who control its funding and future existence. The heads of such agencies, no matter how honest or well-intended, cannot objectively evaluate their own performances (Savas, 2000, 2005).

Lobbying by special interests leads to "regulatory capture," the phenomenon of government officials – bureaucrats – reflecting the interests and views of the industries they are supposed to regulate, rather than the consumers they are supposed to protect (Stigler, 1971). The bureaucrats who staff an agency often see future careers on the staffs of the corporations and trade associations that frequent their offices, and they may have been recruited from industry in the first place. Politicians are lobbied by their campaign supporters to place industry insiders on the staff of regulatory agencies, expecting them to be more sympathetic to their concerns.

Even bureaucrats who break away from this pattern are motivated by idealism or careerism to ask for larger budgets and staffs each year (Wildavsky, 1964; Blais and Dion, 1991). Bureaucrats and their staff, therefore, are usually happy to work to expand their programs to deliver benefits to special-interest groups who, in turn, work with politicians to expand their bureau budgets and programs. Hayek (1944) observed that in government "the worst get on top" since their values and skills suit them to winning internecine struggles and persuading others to follow their lead.

Another reason bureaucracies dysfunction can be summarized as tunnel vision. This is the term Supreme Court Justice Stephen Breyer applied to federal regulators, including the EPA (Breyer, 1993). For Breyer, tunnel vision is the tendency of government employees to focus exclusively on the objectives of their agencies, or even the specific programs within their agencies, at the expense of all other concerns. As noted in Section 1.2.2, all people have narrow goals. In the private sector, the rights of other people and competition from other producers bring individual goals into harmony with others. In government, no such invisible hand operates.

Tunnel vision can lead to excessive regulation causing more harm than good (Baden and Stroup, 1981; Greve and Smith, 1992; Nelson, 1995; DeLong, 2002). A notable example in the United States is the 1980 Superfund law intended to clean up abandoned waste sites. Funding came initially from a tax on chemical-producing industries, but the EPA was authorized to obtain compensation from any individual or company it could show had deposited any hazardous waste at the site, no matter how small or innocuous the contribution. Known as "joint and several liability" it enabled the EPA to target companies with the deepest pockets when assessing penalties, even if they were not significant polluters at the site. To obtain this compensation, EPA officials had no responsibility to show wrongdoing, any real damage to others, or even any real and present risk emanating from the site.

Superfund was supposed to cost at most a few billion dollars and be paid for mainly by those whose pollution had caused serious harms or risks. But that was not the result (Wildavsky, 1995, pp. 153–84). In the first 12 years after Superfund was established, the program spent $20 billion, and its costs grew along with delays in its cleanups of hazardous waste sites. Despite the expenditures, the program showed little gain in the way of human health benefits. Hamilton and Viscusi (1996) reported a number of discouraging findings. Among them:

- Most assessed Superfund risks do not pose a threat to human health now; they might do so in the future, but only if people violate common-sense precautions and actually inhabit contaminated sites while disregarding known risks there.

- Even if exposure did occur, there is less than a 1% chance that the risks are as great as the EPA estimates, because of the compounding of extreme assumptions made by the agency.

- Cancer risk is the main concern at Superfund sites, because it has a long latency period and some contaminants at the sites can cause cancer in high-dose exposures. Yet at most of the sites, each cleanup is expected to avert only one-tenth of one case of cancer. Without any cleanup, only 10 of the 150 sites studied were estimated to have one or more expected cases.

- The average cleanup cost per site in the study was $26 million (in 1993 dollars).

- Replacing extreme EPA assumptions with more reasonable ones brought the estimated median cost per cancer case averted to more than $7 billion. At 87 of the 96 sites having the necessary data available, the cost per cancer case

averted (only some of which would mean a life saved) was more than $100 million.

- Other national programs in 1996 commonly considered the value of a statistical life to be about $5 million. (Today, the EPA places that value at $7.4 million. See EPA, 2018). Diverting expenditures from most Superfund sites to other sites or other risk-reduction efforts could prolong many more lives or the same number of lives at far less cost.

Hamilton and Viscusi estimate 95% of Superfund expenditures are directed at the last 0.5% of the risk. Many people touched by the program are harmed rather than helped. A designated Superfund site causes property values to fall, residents may be forced to move away, at least temporarily, and people may be badly frightened for no good reason. Consumers and taxpayers foot the enormous bill even though they may never come near a Superfund site.

A third reason bureaucracies turn away from the public interest is moral hazard, explained in Section 1.2.4. Their administrators are tempted to use their expertise, control of information about programs, and monopoly position to push for more authority or a bigger budget. The objective may be to better achieve their agency's objectives, but just as likely it will be to advance personal career objectives or to gain popular recognition for the agency's good works, neither of which advance the public good.

For example, the National Park Service often has used what observers call the Washington Monument strategy: When told to expect budget increases smaller than it would like, the Park Service announces it may have to economize by shortening the hours it can operate the Washington Monument or other popular attractions. In essence, Park Service leaders are presenting a veiled threat, "Give us what we asked for or we will cut back on our most popular services." The tactic was seen in 2013 when the Obama administration ordered hundreds of parks to close, even those not dependent on government funding, during a budget stand-off with Congress (Preston, 2013).

The strategy tends to increase the Park Service budget. The threat of long lines of disgruntled citizens (voters) waiting to get in or expressing outrage at not being able to enter popular attractions is all that is needed to persuade political appointees or congressional committees to increase funding. Private firms rarely if ever use this or similar strategies. Can you imagine Wal-Mart threatening to not sell its most popular product lines unless more customers chose to shop at its stores?

The problem of dysfunctional bureaucracies is not a small one in the climate change discussion. For many years the head of the IPCC – the bureaucracy put in charge of finding a 'scientific consensus" on what should be done about anthropogenic climate change – also worked for the renewable energy industry, a flagrant conflict of interest (Laframboise, 2013). The IPCC's procedures were harshly criticized by an audit conducted by the InterAcademy Council, a respected organization composed of the heads of the world's leading science academies (IAC, 2010). The results of that audit are reported in detail in Chapter 2.

Worse than the IPCC is the United Nations, the IPCC's parent organization and host of the Framework Convention on Climate Change (FCCC), which is tasked with negotiating and then implementing a binding global treaty on climate change. A 2013 report by the Foundation for Defense of Democracies said "The United Nations is a hotbed for corruption and abuse. It is opaque, diplomatically immune, [and] largely unaccountable…" (Dershowitz, 2013). After recounting "the Oil-for-Food scandal, in which the U.N. profited from and covered up for billions in Baghdad kickbacks and corruption" and broken promises of "greater transparency, accountability, an end to Peacekeeper rape, the elimination of redundant mandates, and a more ethical culture," the foundation says "the U.N.'s internal audit division, the Office of Internal Oversight Services, has been roiled with scandals and frictions, including a former chief of the unit accusing the UN Secretary-General of 'deplorable' actions to impede her hiring of investigators, and charging that 'the secretariat is now in a process of decay'" (*Ibid.*).

The UN's problems appear to be structural and not the fault of whoever happens to be the Secretary-General. Allen (2013) wrote, "The United Nations [is] a famously corrupt body in which most votes are controlled by kleptocracies and outright dictatorships. Most of the member-states, as they're called, are rated as either 'not free' or 'partly free' by Freedom House, and both Communist China and Putinist Russia have veto power. And any settlement of the Global Warming issue by the UN would entail massive transfers of wealth from the citizens of wealthy countries to the politicians and bureaucrats of the poorer countries. Other than that, one supposes, the IPCC is entirely trustworthy on the

issue. (Well, aside from the fact that the IPCC's climate models predicting Global Warming have already failed.)"

Economists who look at efforts by the IPCC and the UN to address climate change immediately see regulatory capture, tunnel vision, moral hazard, and corruption, all the predictable characteristics of bureaucracies. Environmental activists and many scientists seem unaware of these flaws or willing to excuse them given the presumed gravity of the climate change issue. But the IPCC was *entrusted* to find the truth about climate change science, and the UN was *entrusted* to implement a treaty to manage the global atmosphere. Their obvious shortcomings cannot be irrelevant to the climate change discussion.

After each of its scandals, the UN promised to reform itself. After the scathing audit by the IAC, the IPCC promised to reform itself. Neither has done so because neither *can* do so. Both lack the design principles recommended by Ostrom. The IPCC was never likely to objectively study the climate change issue given its mandate to find a human impact on the global climate. The UN was never likely to negotiate and implement a global program aimed at addressing the challenge of climate change, given the equal voting rights of dictatorships and failed regimes.

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1.4.4 Rational Ignorance

> *Voters have little incentive to become knowledgeable about many public policy issues. Economists call this "rational ignorance."*

Key to the case for having governments involved in the management of a common-pool resource such as Earth's atmosphere is the belief that doing so gives the general public, or at least the voting public, a say in an important matter. But how much influence do voters have on government policies? And how valuable is their input on an issue as complex and poorly understood as climate change?

Number four of Ostrom's eight design principles for effective management of common-pool resources (listed in Figure 1.3.1.3) is effective monitoring by monitors who are accountable to the people who pay for a program. Voters, by and large, do not and cannot monitor government programs. They are "rationally ignorant" about public policy issues and their elected officials (Downs, 1957; Buchanan and Tullock, 1962; Crain *et al.*, 1988; Olson, 2000). Rational ignorance is making a reasoned choice not to study or master a complex subject because the expected benefits of doing so are not worth the cost (time and effort).

The ballot choice made by a single voter is seldom decisive. Recognizing the outcome almost never hinges on one vote, the individual voter has little incentive to spend time and effort studying issues and candidates in order to cast a more informed vote. This helps to explain why most Americans of voting age cannot name their elected congressional representatives (Haven Insights, 2017), much less identify, understand, or compare the positions of multiple candidates on multiple issues – including the environment.

The likelihood of voters punishing politicians for supporting costly special-interest legislation is low because elected officials cast many votes on many issues, some of them likely to meet with the voter's approval. Since no political candidate is likely to represent the exact interests of a voter, the voter is willing to overlook disagreements. Politicians understand that it can take many disappointments before a voter will choose to vote against an incumbent officeholder.

Those voters who do take the time to learn about issues and vote carefully may nevertheless not represent the broader public interest. A number of factors combine to make special-interest groups more powerful in a representative democracy than their numbers would otherwise suggest (Downs, 1957; Buchanan and Tullock, 1962; Mueller, 1979; Gwartney *et al.*, 2012). Members of an interest group – such as the owners of specific tracts of farmland irrigated with low-cost water – have a strong stake in the outcome of certain political decisions. Thus they have an incentive to hire lobbyists to represent them before Congress and regulatory agencies. They also have an incentive to inform themselves and their allies in local communities and to let legislators know how strongly they feel about an issue of special importance. Many of them encourage voting for political candidates strictly on the basis of whether those candidates support (or promise to support) their specific interests. Such interest groups often are also in a position to provide large financial campaign contributions to candidates who support their positions, and they are sure to remind them of those contributions when votes are on the line.

In contrast, most persons eligible to vote are not attached to any particular special-interest group. For them, examining the issues takes more time and energy than it is worth because they have only a relatively small amount to gain personally from the elimination of special-interest programs or subsidies. For a political candidate, supporting the position of a well-organized, narrowly specialized interest group can generate vocal supporters, campaign workers, and campaign contributions. Supporting the opposition, which is often uninformed, unorganized, and unmotivated, offers politicians little benefit or reward.

Voters who try to become informed and take the time to vote even though their vote won't matter may nevertheless be misinformed. The legacy media (newspapers and broadcast television stations) devote little time and space to the detailed and complicated information necessary for making informed decisions. What sells today are the soft human-interest stories about villains and heroes and dramatic images of shocking, high-risk situations (Sandman *et al.,* 1987; Cohen, 2000; Milloy, 2001). Hard news has largely been reduced to headlines or brief sound-bite-length articles often reporting on the opinions of celebrities, not experts (Ciandella, 2015). The public's loss of respect for legacy media outlets has increased its reliance on new media sources such as cable news (e.g., CNN, Fox, MSNBC), websites (e.g., Drudge Report, Huffington Post), and social media platforms (e.g., Twitter, Facebook), all of which have credibility and bias problems of their own and most of which devote even less space and

time to issue analysis.

The media, whether legacy or new, mostly cover the climate change issue by reporting as news the latest claims made by environmental groups, and no wonder: Environmental groups spend billions of dollars a year hyping the possibility of catastrophic climate change. In the United States alone, some 13,716 environmental groups reported combined revenue of $7.4 billion and total assets of $20.6 billion in 2012 (Nichols, 2013). Some of the larger groups include the Environmental Defense Fund (EDF), with $112 million in revenues and $173 million in assets; Natural Resources Defense Council (NRDC), with $97 million in revenue and $248.9 million in assets; and three tax-exempt Greenpeace organizations in the United States with $39.2 million in revenue and $20.6 million in assets.

Voter apathy and rational ignorance, along with the failure of media to report the truth about climate change and many other issues, allow for the creation and maintenance of laws and regulations that do not advance the public interest. Once a law is implemented, a voter will often turn to other matters, especially since the details are complex and unrelated to the voter's everyday activities. Voter apathy and ignorance explain why Superfund was popular when it was passed, why most voters know little or care little about the program's problems, and why voters have not demanded their elected politicians fix the program's flaws or repeal the law. Most voters are likewise ignorant of many other environmental issues.

The same people who fail to act as informed voters often are highly motivated *shoppers* for goods and services. They spend considerable amounts of time and effort evaluating the pros and cons of the choices they make. Imagine you are planning to buy a car next week and also to vote for one of two candidates for the U.S. Senate. In purchasing a car, you have a nearly unlimited number of choices. Do you buy new or used? Sedan or minivan? Honda or Ford? Your options are many and varied. In the voting booth, however, your choice is probably limited to just two candidates. The winning Senate candidate will represent you on hundreds of issues, and it is inconceivable that he or she will agree with you on all of them. Both the car purchase and the Senate vote involve complex tradeoffs. Which of these decisions will command more of your scarce time and energy to research and ultimately choose?

If you spend more time choosing a car than the next Senator, you are not acting irrationally. When it comes to the car, your choice is entirely up to you (or your spouse), and only you are responsible for the costs and reap the full benefits. An uninformed car purchase could be very costly. With respect to the election, if by chance you mistakenly vote for the wrong candidate out of ignorance, the probability is nearly zero that your vote will decide the election. Cumulatively, your vote and those of all others in your state will decide who wins, but your individual choice will not. Thus, a mistake or a poorly informed selection at the ballot box will have little consequence on the actual outcome of an election or on your life.

In light of all this, what is the best way to involve the public in deciding the best ways to respond to climate change? Asking the public to vote on candidates who promise to take one position or another on the issue is unlikely to work for the reasons explained above. Even asking the public to vote on a referendum, say for a "carbon tax" or some emission mitigation plan, won't work because most people won't vote and those who do vote will likely be ill-informed or misinformed.

The more promising route, as our example of the car purchase illustrates, is to engage the public as *shoppers,* individuals seeking to achieve their own goals as efficiently as possible. Respect the value of their time by not insisting they become experts on climate science or vote for candidates who may or may not win and if they do, may or may not deliver on their promises. Instead, give the public opportunities to buy products that are "low-carbon" or otherwise promise to reduce greenhouse gas emissions. Offer investment opportunities in promising new technologies or projects that help people in developing countries adapt to climate change, whether due to natural or anthropogenic causes. Stop subsidizing behavior such as building in floodplains that might lead to higher social costs if sea levels rise or if severe weather events become more frequent.

Treating the public as shoppers rather than voters avoids the problem of rational ignorance, making it the only real market-based response to climate change. Of course it is not without its own difficulties: The global atmosphere remains a common-pool resource, so every individual's private cost-benefit analysis will not include the possible effects of his or her actions on other people. But the "social cost of carbon," if it can be calculated at all, is likely to be zero or even negative (in other words, climate change produces net benefits rather than costs), so its absence from cost-benefit analyses won't be missed. (This is the subject of Chapter 8.)

The tremendous prosperity created by the use of fossil fuels has elevated the value people place on environmental protection as well as their willingness and ability to pay for it. Media exaggeration of the "threat" of climate change probably increases this willingness to pay, helping to transform, as Boettke wrote in 2009 of disagreements over access to common-pool resources generally, from a "tragedy of the commons" to "an opportunity of the commons" (Boettke, 2009).

This option, of treating the public as shoppers rather than voters in the climate change discussion, seldom appears in the academic literature, since writers there simply assume a "social cost of carbon" can be accurately set, is positive, and can be efficiently implemented as a public policy. It seldom appears in the fundraising letters or advocacy reports of environmental groups or in speeches delivered by politicians, either, because it a solution that requires little or no action by governments.

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1.4.5 Rent-seeking Behavior

> *Government's ability to promote the goals of some citizens at the expense of others leads to resources being diverted from production into political action. Economists call this "rent-seeking behavior."*

Government's monopoly on the legitimate use of force gives it the ability to take resources from some people and give them to others. That ability can be used promote transfers that are widely supported and beneficial to most people – what is referred to in the U.S. Constitution as the "general welfare" – but also to advance the specific welfare of a small number of constituents. The beneficiaries of the second type of activity, who economists call rent-seekers, invest resources to convince government officials to take actions that benefit them at the expense of the general public (Olson, 1965, 1984; Rowley *et al.*, 1988; Laband and Sophocleus, 2018). Politicians in turn extract rent from individuals and businesses by threatening to withhold privileges or bestow them on competitors (McChesney, 1987).

The U.S. federal government's program to supply below-cost water to farmers in the arid West illustrates rent-seeking behavior. Using the Central Utah Project's dams and canals, the U.S. Bureau of Reclamation delivered irrigation water from a tributary of the Colorado River to Utah farmers. This transfer of water was highly subsidized by the national treasury. The price to the farmers was only $8 per acre-foot (enough water to cover an acre 1-foot deep) even though the cost of the delivered water was about $400 per acre-foot. Estimates put the value of the water to farmers at about $30 per acre-foot (Anderson and Snyder, 1997). The below-cost water delivery served the landowners and farmers and the small communities where they lived. The high costs

(above the amount the farmers paid) were passed on to taxpayers across the nation. Because each individual taxpayer paid only a fraction of the total cost, most taxpayers have never heard of the project and have no idea of the costs they paid.

A more recent example of rent-seeking was documented in a 2017 lawsuit heard by the U.S. Court of Appeals for the District of Columbia Circuit (U.S. Court of Appeals, 2017). The EPA had used an ozone depletion provision of the Clean Air Act to regulate refrigerants for their global warming potential. Use of a $4/pound refrigerant produced by Mexichem Fluor and other manufacturers was banned in favor of a $65/pound option produced by only two companies under patent protection, Honeywell and Chemours. Mexichem Fluor sued the EPA, and the court overturned the regulation. Honeywell and Chemours asked the court to reconsider, which it refused to do. In petitioning the court to reject the request for review, attorneys for Mexichem Fluor noted, "Industry intervenors are rent-seekers trying to use the government to foreclose their competitor's products, not to foster development of new ones" (*Ibid*., p. 2).

The output-expanding, positive-sum activities of market discovery, innovation, and production are increasingly being replaced by rent-seeking behavior (Tullock, 1987, 2005; Del Rosal, 2011). As transfers dependent on political clout increase, people increasingly redirect their energies to gaining political influence, taking more time, energy, and other resources away from productive activities. Many businesses invest in lobbying because they view it as a cost-effective way to protect their rights and slow the rising costs of complying with environmental regulations. Federal regulation in the United States cost $1.9 trillion in 2017 (Crews, 2018).

Examples of rent-seeking in the heavily subsidized wind and solar power industry are easy to find. NextEra Energy, Inc. is a Florida-based utility that "has grown into a green Goliath, almost entirely under the radar, not through taking on heavy debt to expand or by touting its greenness, but by relentlessly capitalizing on government support for renewable energy, in particular the tax subsidies that help finance wind and solar projects around the country. It then sells the output to utilities, many of which must procure power from green sources to meet state mandates" (Gold, 2018).

Industries producing alternative energies – wind, solar, biofuels, and even nuclear and hydropower – invest hundreds of millions of dollars a year in campaigns to require utilities to purchase their products and taxpayers to pay for their subsidies and tax breaks. Utilities themselves lobby for such policies since rate-of-return regulation gives them a strong incentive to overinvest in capital (Averch and Johnson, 1962). Exelon Nuclear, a division of Exelon Generation that operates the largest fleet of nuclear power plants in the United States, has been vocal in its support of the man-made global warming hypothesis, running full-page ads hyping its "emission free" energy and lobbying for a carbon tax that its fossil-fuel-reliant competitors would have to pay (Snyder and Johnsson, 2013).

Insurance and reinsurance businesses seek to profit from higher insurance rates justified by fears of floods and severe weather (Lloyd's, 2009), even though historically climate extremes are associated with increased profitability for insurance firms as more severe weather creates more interest in their products (Hu and McKitrick, 2015). Banks expect to make billions and even trillions of dollars financing the premature destruction and rebuilding of the world's fossil-fuel-dependent energy system (HSBC, 2016).

Environmental advocacy groups invest in lobbying to advance their own narrow agendas, and their resources rival or exceed those of the business community (Arnold and Gottlieb, 1993; Arnold, 2007; Isaac, 2012). Organizations such as the Environmental Defense Fund (EDF) use fear of catastrophic climate change to raise money using slick direct mail campaigns (Taylor, 2015).

Rent-seeking sometimes makes odd bedfellows, a phenomenon Yandle (1983) labeled "bootleggers and Baptists," a reference to how the two interest groups worked together in the United States to outlaw alcohol sales in some counties or on Sundays. Chesapeake Energy, a company that mostly sells natural gas, gave $26 million to the Sierra Club to attack its rivals in the coal industry (Barringer, 2012). In 2018, ExxonMobil pledged to donate $1 million to a group called Americans for Carbon Dividends which advocates for a "carbon tax" (Pearce, 2018).

Rent-seeking behavior negatively affects more than just the efficient use of resources. The legitimacy of government suffers when the public realizes interest groups and elites use it to their benefit (Codevilla, 2010). Those who lose income without compensation are often upset. For them and for others who do not benefit from "crony capitalism," the public-interest rhetoric of even sincere environmentalists seems hollow (Gilder, 2009, pp. 10–1).

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1.4.6 Displacement

Government policies that erode the protection of property rights reduce the incentive and ability of owners to protect and conserve their resources. Those policies displace, rather than improve or add to, private environmental protection.

One of the events that launched the modern environmental movement was a 1969 report that the Cuyahoga River, which flows through the city of Cleveland and empties into Lake Erie, was so polluted that it burned. Of course, the water didn't literally burn, but there was oil and debris on the water; a spark, probably from a train, ignited it. Public outrage that a river could go up in flames galvanized action and helped bring about tougher laws (Meiners *et al.*, 2000).

It turns out the Cuyahoga River fire occurred because efforts to obtain relief from river pollution through the courts had been replaced by command-and-control regulation. A state pollution control board was responsible for issuing permits allowing pollutants to be emitted into the water. According to Meiners *et al.,* the board classified a key stretch of the Cuyahoga as an industrial river, so the companies along its banks did not have to clean up their effluent to any significant degree. In 1965, Bar Realty Corporation, a real estate company, had tried to clean up a Cuyahoga tributary, but the Ohio Supreme Court concluded the state pollution control board, not the courts deciding common-law claims, had the authority – and that board did not require cleanup.

The use of property rights, common law, and market relationships has real advantages. Judges and juries listen to experts on both sides, each bound by rules of evidence and cross-examined by the other, before rendering a decision. Yes, the decisions may not be perfect and the judges and juries may not be experts, but they will likely be much better informed than when they enter an election booth to vote, or when politicians vote as elected representatives.

Evidence from Canada – where, as in the United States, statutory law and government control have been replacing decisions by private owners – suggests common-law protections are stronger than regulatory efforts. Brubaker (1995) reviewed dozens of legal decisions and statutes and found as political control supplanted common law as the favored approach to avoiding pollution, the protection of pollution victims weakened. She wrote:

> Governments have shown that they are not up to the task of preventing resource degradation or pollution; indeed they have often actively encouraged it. … It is long past time for resources to be shifted away from governments and back to the individuals and communities that have strong interests in their preservation. Such a shift can best be accomplished by strengthening property rights and by assigning property rights to resources now being squandered by governments (p. 161).

Brubaker's book offers a compelling case that defending property rights historically has been the best way to protect environmental values, more so than relying on governments to do the same thing. Individuals with strong property rights to protect them against those who might cause them harm – governments included – will benefit by finding ways to use those rights effectively to protect themselves and their resources.

Many environmental policies erode property rights. When they do, they often work against the very environmental protection they are intended to provide. The unintended consequences can be dramatic, as illustrated in the case of the Endangered Species Act (Stroup, 1995; Chase, 1995). The intent of this law is to save species presumed to be in danger of extinction, yet only 31 of the approximately 1,800 species it monitors have recovered since the act was passed in 1973 (U.S. FWS, 2014). The law gives federal agents far-reaching powers to control landowners' use of their properties. Those powers have sometimes worked to protect endangered species, but often they have had the opposite effect.

A landowner who provides good habitat for an endangered species, even if by accident, is likely to face restrictions on his or her property rights. Michael Bean, an environmental defense attorney who is sometimes informally credited with authorship of the Endangered Species Act, explained this to a group that included Fish and Wildlife Service (FWS) officials. He said there is "increasing evidence that at least some private landowners are actively managing their lands so as to avoid potential endangered species problems." He emphasized these actions are "not the result of malice toward the environment" but "fairly rational decisions, motivated by a desire to avoid potentially significant economic restraints." He called them a "predictable response to the familiar perverse incentives that sometimes accompany regulatory programs, not just the endangered species program but others" (Bean, 1994).

The case of Benjamin Cone Jr. is a cautionary tale (Welch, 1994). Cone inherited 7,200 acres of land in Pender County, North Carolina. He managed the land primarily for wildlife. He planted chuffa and rye for wild turkey, for example, and the wild turkey made a comeback in Pender County partly due to his

efforts. He frequently conducted controlled burns of the property to improve the habitat for quail and deer.

Red-cockaded woodpeckers are listed as an endangered species. They nest in the cavities of old trees and are attracted to places that have both old trees and a clear understory. By clearing the understory to protect quail and deer and by selectively cutting small amounts of timber, Cone may have helped attract the woodpecker to his property.

When Cone intended to sell some timber from his land, the presence of the birds was formally recorded by the U.S. Fish and Wildlife Service. The agency warned Cone not to cut trees or take any other actions that might disturb the birds. FWS did not, however, tell Cone where the nests were. Cone hired a wildlife biologist, who estimated there were 29 birds in 12 colonies. According to the FWS guidelines then in effect for the red-cockaded woodpecker, a circle with a half-mile radius had to be drawn around each colony, within which no timber could be harvested. If Cone harvested the timber, he would be subject to a severe fine, possible imprisonment, or both under ESA. Biologists estimated the presence of the birds put 1,560 acres of Cone's land under the restrictions of the Fish and Wildlife Service.

In response, Cone changed his management techniques. He began to clear-cut 300 to 500 acres every year on the rest of his land. He told an investigator, "I cannot afford to let those woodpeckers take over the rest of the property. I'm going to start massive clear-cutting. I'm going to a 40-year rotation instead of a 75- to 80-year rotation" (Sugg, 1993). By harvesting younger trees, Cone could keep the woodpecker from making new nests in old tree cavities. He also took steps to challenge FWS in court, asking to be compensated for his losses. The agency ultimately avoided that court challenge by negotiating a settlement giving Cone more freedom to use his land.

Cone's experience provides a warning to all landowners under similar circumstances. After Cone informed the owner of neighboring land about possible liabilities in connection with the red-cockaded woodpecker, he noticed the owner clear-cut the property (Welch, 1994). Overall, what has been the result of ESA for the red-cockaded woodpecker? As Bean (1994) has said, "The red-cockaded woodpecker is closer to extinction today than it was a quarter century ago when protection began." Bean recommends the rules be changed to help landowners avoid large reductions in the value of their land from application of ESA, but no change in the law is currently in sight.

More recently Brian Seasholes, director of Reason Foundation's endangered species project, described how plans by the U.S. Department of the Interior (DOI) to use ESA to protect the greater sage grouse would have had just the opposite effect (Seasholes, 2015a). Although DOI eventually decided against designating the bird as an endangered species, it pursued instead a plan critics (including Seasholes) say would have essentially the same negative effects (Seasholes, 2015b). By using ESA to justify land-use controls that seriously erode the property rights of land owners, the Fish and Wildlife Service has ignored the important positive role that private landowners and institutions historically have played in protecting rare plants and animals.

Displacement is an issue in the climate change discussion for multiple reasons. First, investing in greenhouse gas mitigation efforts displaces investments in other efforts to meet better documented and more urgent needs. Much of the international aid being directed to climate change projects is simply aid that otherwise would have gone to other, presumably valuable, projects (Levi, 2015). Lomborg (2007) wrote of this problem, "This is the real moral problem of the global-warming argument – it means well, but by almost expropriating the public agenda, trying to address the hardest problem, with the highest price tag and the least chance of success, it leaves little space, attention, and money for smarter and more realistic solutions" (p. 123).

Second, seeking a top-down global response displaces more promising national, state, and local responses. Writing about air and water pollution controls before passage of national legislation in the United States, Yandle (1989) observed, "the absence of federal jurisdiction and federal money forced people in states and cities to deal directly with the problem of environmental scarcity. They had no other choice. *As a result, those closest to the problem and most sensitive to the costs resulting from their actions found innovative ways to deal with the problem.* Instead of uniform rules, which are clearly simpler to enforce, local bodies could tailor controls to meet local conditions" (p. 57, italics added). See also Anderson and Hill (1997) and Higgs and Close (2005) for the value of having multiple decentralized solutions to environmental problems.

Third, efforts already underway to mitigate emissions or encourage adaptation are displaced by more expensive and less effective national or international programs. A study of the Joint

Implementation (JI) program, part of the United Nations' Kyoto Protocol, by the Stockholm Environment Institute found "the use of JI offsets may have enabled global GHG emissions to be about 600 million tonnes of carbon dioxide equivalent higher than they would have been if countries had met their emissions domestically" (Kollmuss *et al.,* 2015). The authors analyzed 60 projects and found 73% of the carbon credits did not meet the requirement of "additionality," meaning the projects would have occurred without the added incentive of carbon credits.

More generally, paying to build higher dikes or "harden" infrastructure, or promising to compensate people for flooding or storm damage, discourages potential victims of climate change from taking actions on their own to avoid damages by voluntarily relocating, not investing in improvements in homes or businesses in vulnerable locations, or making their own plans to minimize damages. Because climate change is a slow-moving phenomenon, occurring over decades and centuries, gradual adaptation could be virtually costless as lifestyles and investment patterns change gradually.

Displacement is due to several economic phenomena described earlier in this chapter: moral hazard, unintended consequences, bureaucracy, and rent-seeking. *It is unavoidable* given the incentives faced by and information available to the entities involved. Yet calls for immediate action in response to climate change rarely if ever acknowledge the existence of this problem.

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1.4.7 Leakage

> *"Leakage" occurs when the emissions reduced by a regulation are partially or entirely offset by changes in behavior.*

In the academic literature on climate change, leakage refers to increases in carbon dioxide or other greenhouse gas emissions occurring outside a state or nation in response to that state or nation's adoption of emission caps or carbon taxes. Leakage can offset

much or even all of a state or nation's emission reductions. Leakage can occur for at least four reasons (Niles, 2002):

- Programs that reduce emissions in some countries or industries reduce demand for fossil fuels, allowing businesses in other countries or industries to purchase those fuels at lower prices. This is called the "rebound effect."

- Businesses located in countries or states with lower energy prices and fewer regulations have cost advantages over those in countries and states with high energy prices and burdensome regulations. Consequently, capital migrates from countries and states that impose emission controls to those that do not (Becker and Henderson, 2000; Brunnermeier and Levinson, 2004; Levinson and Taylor, 2008; Hanna, 2010; Stevenson, 2018).

- Changes to behavior occur in response to changes in prices, offsetting some or all of the anticipated emission reduction. For example, higher Corporate Average Fuel Economy (CAFE) standards for new cars and trucks sold in the United States result in people driving more miles and holding onto their older cars longer.

- "Ecological leakage" occurs when secondary and tertiary effects of an effort to reduce emissions produce new emissions that reduce or even entirely cancel out the first round of reductions. For example, production of ethanol from corn resulted in a net *increase* in greenhouse gas emissions due to the energy used to grow the corn and changes in land use prompted by subsidies to producers (Searchinger *et al.,* 2008).

Every study of the Kyoto Protocol, which exempted developing countries from obligations to reduce greenhouse gas emissions, forecast significant leakage. "The imposition of increased energy costs will devastate the U.S. steel industry without a significant decrease in worldwide energy-related emissions from steel making," concluded a study by the Argonne National Laboratory (U.S. Department of Energy, 1997). "Production will simply be shifted to developing countries and may lead to higher levels of overall pollution due to lower standards in those countries" (*Ibid*.). According to a study by WEFA, a consulting firm, 41% of the loss in U.S. GDP due to the Kyoto Protocol would have come from lost exports and increased imports from developing countries (Novak *et al.,* 1998, p. 30). IPCC (2007) estimated "carbon leakage rates for action under Kyoto range from 5 to 20% as a result of a loss of price competitiveness, but they remain very uncertain." The shift of manufacturing from developed countries such as the United States to developing countries such as China is increasing leakage.

Driven by this global economic transformation, developing countries are dramatically increasing their use of fossil fuels and consequently their share of global greenhouse gas emissions. According to the Netherlands Environmental Assessment Agency, "since 1990, in the EU27, CO_2 emissions decreased from 9.1 to 7.4 tonnes per capita, and in the United States from 19.6 to 16.4 tonnes per capita, they increased in China from 2.1 to 7.1. As such, Chinese citizens, together representing 20% of the world population, on average emitted about the same amount of CO_2 per capita in 2012 as the average European citizen" (Oliver *et al.,* 2013, p. 15).

Not all of the growth in greenhouse gas emissions in developing countries is due to leakage from developed countries. Energy consumption is closely linked to economic growth in both developed and developing countries, and fossil fuels are the least expensive and most reliable source of power for home and commercial applications (Bradley and Fulmer, 2004; BP, 2014; EIA, 2014; Bezdek, 2015). Greenhouse gas emissions therefore will rise if developing countries are successful in raising their populations out of poverty. Global warming policies are among many tax and regulatory policies encouraging investment and manufacturing in developing countries.

Different types of climate programs experience different amounts of leakage. Policies raising costs for energy-intensive industries are likely to have high levels of leakage by driving customers and investors to other countries or industries with lower energy costs. Policies focusing on utilities and with long time frames – giving utilities time to replace older generating capacity with newer, lower-emitting capacity – would have less leakage, since utility customers are relatively immobile.

Imposing higher fuel economy standards on cars and trucks is a good example of leakage (National Research Council, 2001; Lutter and Kravitz, 2003). Mandating higher fuel economy for cars may not reduce the total amount of carbon dioxide emitted if consumers use the fuel savings to drive more miles or

drive alone more often. Both changes in behavior occur and historically have cancelled out 20% or more of the fuel savings that might have arisen from U.S. CAFE standards. Summarizing their empirical analysis of gasoline prices and vehicle miles traveled, economists John W. Mayo and John E. Mathis (1988) wrote, "CAFE standards had no independent, statistically significant impact on ... the demand for gasoline."

Federal CAFE standards require car and truck manufacturers to meet national fleet-wide standards for cars and light trucks or pay fines. If one state insists on better fuel economy for the fleet of cars and trucks sold within its borders, manufacturers will oblige by selling only smaller, lighter, and less powerful vehicles in that state, and then sell larger, heavier, and more powerful vehicles in other states, bringing their national corporate average fuel economy back to where it was before the state adopted its standards. Consequently, leakage will simply cancel out whatever emission reductions the stricter state is seeking to make.

Estimates of leakage for national greenhouse gas reduction programs range from 12% (Brown, 1999) to 130% (Babiker, 2005). In other words, reducing carbon emissions by 10 metric tonnes would cause emissions by other countries or states to *increase* between 1.2 and 13 tons. *A net* reduction of 10 tons assuming the lower of the two estimates would require a reduction by the first country or state of 11.4 tons. The second estimate means no reductions by the first country, no matter how high, will lead to a *net reduction* in global emissions since emissions in other countries rise faster than reductions in the first country. In the decades since greenhouse gas reduction programs have been implemented, a large body of research has been created estimating leakage rates by industry, by type of program, and by country (Fischer *et al.,* 2010). While many efforts have been made to discourage leakage, some of them partially successful, it appears to remain an unavoidable part of emission control programs.

Leakage is a classic example of an unintended consequence of government actions, something economists know to look for. Estimates of the effectiveness of greenhouse gas reduction initiatives that don't take leakage into account will over-estimate the benefits of the programs, leading to inaccurate cost-benefit analysis results.

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1.5 Future Generations

Previous sections of this chapter showed how markets turn self-interested behavior into behavior that benefits others. In this section, we show how markets create incentives to conserve and protect natural resources for future generations and help ensure the best solutions are the ones adopted.

1.5.1 Conservation and Protection

> *Capital markets create information, signals, and incentives to manage assets for long-term value.*

People sometimes assume private owners have little incentive to protect resources for the future, that they are quite willing to destroy long-term value to realize short-term gain. This line of reasoning suggests only governments can truly preserve a natural resource because the government, unlike the private sector, plans for the long run. This common assumption, however, is largely false (Goklany and Sprague, 1992; Meiners, 1995; Rosegrant *et al.*, 1995; Taylor, 1997; Norton, 1998; Smith, 1999, 2000; Anderson and Leal, 2001; Logomasini and Smith, 2011).

The prices of land and other assets today reflect the future benefits owners expect to receive. In economists' language, today's price is the capitalized value of the future stream of benefits, net of the costs required to protect or produce those benefits.

Just as prices convey information about changing demand and supply all over the globe, a capital market – the buying and selling of capital assets such as land, buildings, bonds, or corporate stock certificates – conveys information about the expected demands, desires, and preferences of people in the future. People who believe a resource will increase in value – that people in the future will value it more highly than people today – can hope to profit by buying it, preserving it, and selling it at a higher price later. Even a shortsighted owner who is personally concerned only with the present will respond to these signals because they change the current value of his or her assets. Of course, the owner can ignore the price signals, but then he or she must deal with the resulting reduction in wealth.

The future value of a resource influences the behavior of its owner. A land owner, for example, will do what the market demands in order to maintain the land's productivity and, where possible, to make investments that improve it. If the land is damaged, its value declines whether the damage occurs through misuse, negligence, trespass, or pollution. If necessary, an owner will go to court against trespassers or polluters to protect the value of property.

Millions of private investors are highly motivated to monitor the performance of private asset managers. When investors in a company's stock view a management decision as a good one, they keep their stock or buy more anticipating the value of the firm will rise. If many investors begin to think this way, their decisions lead the stock's price to rise, increasing shareholder wealth. Similarly, poor decisions lead shareholders to sell the stock and the price tends to fall. Management responds to these capital market signals since they are typically compensated partly with stock options. Managers who fail to keep stock prices stable or rising are likely to be replaced by disappointed stockholders.

The incentive to look to the future is clear for conventional sources of income such as agricultural

crops or housing developments, but it also holds true for assets of an environmental nature. Wilderness areas, open spaces, scenic locations, shorelines, and other areas are economic assets that can be and are managed for profit and higher future resale value. In Section 1.2.5 we described a case where rights to water are treated as assets and bought and sold. That market system rewards good stewardship and efficiency.

Consider another example. After a successful and innovative career, television magnate Ted Turner began buying ranches in the West and Southwest (Anderson and Leal, 1997, pp. 4–8; Gunther, 2006). On the Flying D Ranch, south of Bozeman, Montana, he decided not to raise traditional livestock but instead to manage the ranch largely for bison and elk. He decided to increase the number of trophy animals over time. In 2006 he was charging a small number of elk hunters an annual fee of about $12,000 each to spend a week on the ranch trying to shoot a trophy elk. At that time, the ranch was earning roughly $300,000 in additional revenue per year. This added revenue stream raised the resale value of the ranch. It also drove Turner to manage the ranch in a way that is desirable for hunters and encourages the proliferation of diverse wildlife, not just elk, deer, and bison. Admittedly, Turner's motivation was not financial profit; he could afford to lose money and probably could earn more by subdividing and selling the ranch. But the Flying D Ranch and other examples of environmental assets privately managed and earning revenue show how markets allow individuals to achieve their own goals – to "maximize their utility," as economists say – in ways that benefit future generations.

In contrast to private landowners and asset managers, government asset managers receive few if any signals from capital markets. Their property is not for sale and they will not reap the benefits of investments that might improve its long-term value. Government managers are motivated to produce glossy brochures and annual reports highlighting the natural beauty of their latest acquisitions but not to report shortcomings in services and maintenance of parks, wildlands, and other assets already in their possession. Environmental groups realize lack of maintenance of existing parks is a strong argument against acquiring more parkland, so they too are silent on the issue.

The elected officials who oversee the bureaucracies created to manage public assets have strong incentives to promise short-term benefits, such as more recreational opportunities, fewer forest fires, or more logging on public lands to satisfy well-organized interest groups that make campaign contributions and turn out the vote. But future generations don't vote in the next election, so politicians are free to disregard their interests.

Elected officials often say they care deeply about future generations, since this presumably is what voters want to hear. Perhaps some do. But no one is able to hold them accountable for actually fulfilling their promises. Unlike investors in the private sector, few voters have a financial incentive to monitor the performance of government agencies. Because the assets can't be sold, no one benefits directly from knowing about management changes, so voters choose to remain rationally ignorant. If they vote, they may vote for a candidate on the basis of positions he or she takes on many other issues, or on the basis of misinformation circulated by interest groups.

When an owner or manager in the private sector improves or damages the future value of a natural resource, capital markets change the resource's current price and communicate that change to investors and entrepreneurs in the form of profits and losses, which then motivates decision-makers to take actions that encourage good long-term asset management. A rancher in Montana, for example, can recognize the higher value people are placing on hunting and recreation and profit from it by dedicating some or all of his land to wildlife. Government agencies operate without such information and without the system of rewards and penalties, and so are unlikely to make wise or efficient decisions about managing assets for future generations.

The preceding analysis is relevant to the climate change issue because political entities such as the United Nations or U.S. government should not be assumed to be better stewards of the environment than private parties motivated by profit or by charitable goals. The concerns of future generations are no better protected by politicians and voters today than they are by private asset managers and investors, and probably less so. The best responses to climate change are probably found in the private sector and not in the public sector.

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1.5.2 Innovation

Markets reward innovations that protect the environment by using less energy and fewer raw materials per unit of output.

Markets reward innovation, and innovation in turn benefits the environment. The best protection of the atmosphere rests in ensuring that technological innovations continue to increase humanity's ability to meet its material needs without further reducing the land available to wildlife or contaminating the planet's air and water. This is the message of Chapters 3, 4, and 5, but it is introduced briefly here to help explain why economic growth today helps future generations.

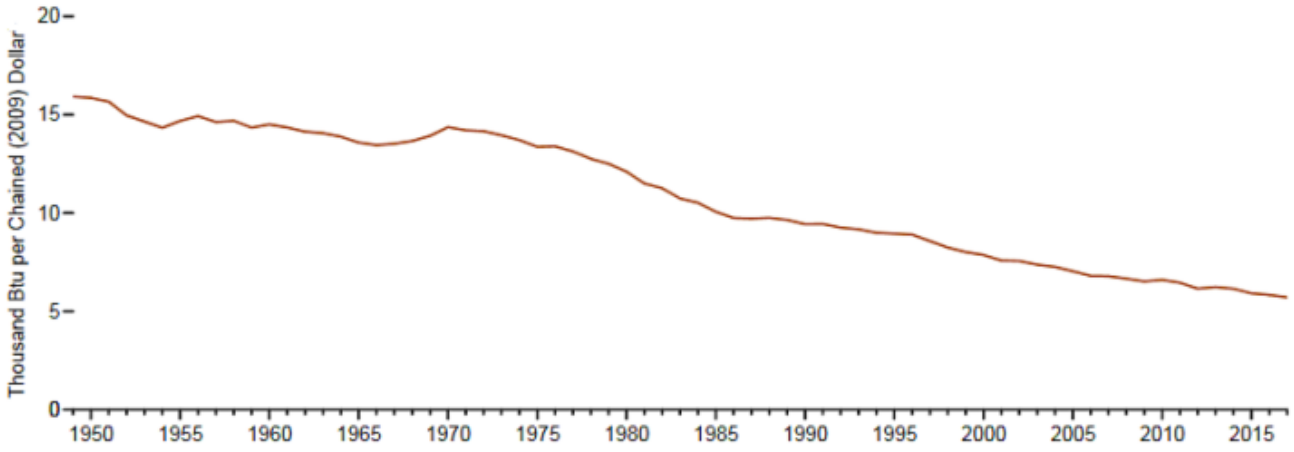
Over the past century, new technologies have led to less pollution and to the use of fewer raw materials per unit of output (Simon, 1995; Huber, 1999; Goklany, 2007, 2009; Bryce, 2014; Smil, 2016). This has been true for everything from steel mills (once fiery behemoths belching smoke but now relatively clean, with many using scrap steel as their raw materials) to aluminum cans (which over time have been engineered to become ever thinner and lighter). New technologies have reduced the amount of energy required to produce a dollar of real gross domestic product (GDP) in the United States by two-thirds since 1949. (See Figure 1.5.2.1.)

Innovation is essential to progress, but it means change, and change is always difficult. Choosing to continue doing something the way it has always been done is usually easier than change. Markets reward with profits the creators of innovations that help people meet their goals at lower costs, and penalizes with losses innovations that people don't want or that waste resources (Baumol, 2002).

To have an incentive to innovate, an inventor or entrepreneur must be able to benefit personally from his or her achievement. This incentive comes through private ownership. The owner of a new product or the investors who help him bring it to market can earn large returns in a short period of time by licensing others to use the new product. License-holders in turn can earn larger-than-before returns by using the new product to lower their cost of production or better meet their customers' needs.

The pace of innovation in countries without private property rights is slow, as could be seen by the socialist economies of Eastern Europe before the fall of communism in 1989. The Trabant automobile, produced in East Germany between 1959 and 1989, is a good example. An American auto magazine, *Car and Driver*, brought the Trabant over for a look in 1990 (Ceppos, 1990). On the positive side, the editors reported the car provided basic transportation and was easy to fix (similar things were said about the Model T Fords in the early twentieth century). But the Trabant's top speed was 66 miles per hour, it was noisy, and, the editors said, it had "no discernible handling." It spewed "a plume of oil and gray exhaust smoke" and didn't have a gas gauge. In fact, the Trabant's exhaust was so noxious the Environmental Protection Agency refused to let *Car and Driver* staff drive it on public streets.

Figure 1.5.2.1
U.S. primary energy consumption per real dollar of gross domestic product, 1949–2017



Source: EIA, 2018, Figure 1.7, p. 16.

The Trabant was backward, dirty, and inefficient because its design was the same as when it was first manufactured in 1959. The last model had been introduced in 1964 and since market pressures were absent, the automobile experienced no technological change since then. Cars are much cleaner and still improving today because of market innovation. Today's cars emit a tiny fraction of the pollution emitted by the cars of the early 1970s (Schwartz, 2006; O'Toole, 2012). And while even electric cars require energy from burning fuel in power plants, the emissions from such plants have fallen dramatically, too, as owners have searched out low-sulfur coal and technical devices to reduce pollution. Advances in technology continue to make cars cleaner and safer, just as diesel train engines replaced dirty steam locomotives, and gas and electricity replaced coal for home heating. This story is told in greater detail in Chapters 3, 5, and 6.

Technological change is expected to continue to reduce the energy intensity of the global economy in coming decades, partially offsetting the dramatic rise in demand for energy due to global population growth and rising prosperity (BP, 2014; EIA, 2014; Bezdek, 2015). The environmental consequences of a growing global population would be far worse without innovation, as forests would need to be converted to cropland and emissions of all kinds, not just greenhouse gases, would grow in pace.

The institutions that encourage innovation – property rights and markets – and the freedom and prosperity they make possible must remain in place for future generations to enjoy the safe and clean environment we enjoy today. This is not always made clear in the plans put forward by environmental activists who seem to believe capitalism and protecting the planet's atmosphere are incompatible (Gore, 2006; Klein, 2014).

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1.5.3 Small versus Big Mistakes

> *Mistakes made in markets tend to be small and self-correcting. Mistakes made by governments tend to be big and more likely to have catastrophic effects.*

Free markets are spontaneous orders, self-correcting systems in which many small mistakes are made and quickly corrected. Governments are deliberately created planned institutions whose monopoly on the legitimate use of force allows them to impose the costs and consequences of mistakes on others, sometimes with catastrophic effects (Hayek, 1973, 1976, 1979; Butos and McQuaid, 2001; Hasnas, 2005).

In a market system, inventors and entrepreneurs continuously come up with new products and introduce them to customers, who reject many of them. Most of the businesses launched to sell new goods and services quickly go out of business. In the United States, only about half of newly incorporated businesses survive for five years and only a third survive 10 years or longer (Shane, 2012). But the inventions that do work, the products that do sell, and the businesses that do survive provide the change that transforms the economy and increases wealth over time. Schumpeter (1942) called this the "gale of creative destruction," which he described as the "process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (pp. 82–3).

Change occurs rapidly in a market system because individuals don't need consensus or majority approval to pursue their ideas as they would if operating under a democratic political process. They are free to invest their own money in new ideas and test them in the marketplace. Successful innovators earn temporary profits, while others must adopt the innovations that work in order to survive in business. The system tolerates many small mistakes in exchange for tapping the wisdom, energy, and aspirations of anyone with an original idea and willingness to work hard.

History is replete with examples of people who have challenged conventional wisdom and produced enormous social benefits. In the 1970s, it looked as though computers would be ever increasing in size and complexity, but a few hobbyists had a different idea. Some innovators put together a crude computer and began selling it as an assemble-it-yourself kit through *Popular Science* magazine. They created the first personal computer, revolutionizing the future of computers and to a large extent changing the way people conduct business and leisure activities.

Such innovations occur in the environmental realm as well, often long before politicians embrace the need for change. The Hawk Mountain Sanctuary in eastern Pennsylvania is a good example of such an innovation (Smith, 1984, 1990, 1999; Anderson and Leal, 1997, pp. 44–6; Furmansky, 2009). Hawk Mountain is a mountain ridge in Pennsylvania that lies along a natural migration route for hawks. In the early 1930s, hunters came to Hawk Mountain from miles around to shoot hawks. At the time, not only was hunting hawks popular, but the biological

experts thought hawks and other predatory birds were undesirable and not worth preserving. In fact, the state paid a bounty to those who killed a certain kind of hawk.

Rosalie Edge, a conservationist and activist, opposed the wholesale slaughter of hawks. She tried to convince biologists, state officials, and leaders of the National Audubon Society that hawks have a rightful place in nature and should not be eradicated. Her efforts at persuasion failed, so she took another tack. In 1934, she and some friends came up with enough money to buy an option on Hawk Mountain, and later they bought the mountain. She created a sanctuary for the hawks, forbidding hunts there. Today the 2,000-acre reserve is a prime bird-watching location.

Edge's view that hawks have an important place in nature is now conventional wisdom, but it was radical 84 years ago. Actions taken by far-sighted individuals like Edge can be crucial for environmental protection, since by the time a political majority might be ready to act to save a species, it may be too late. Only because Hawk Mountain was privately owned could Edge exercise her vision of wildlife protection.

The private nonprofit sector historically has been a key component of conservation efforts. Starting late in the nineteenth century, for example, the National Audubon Society was formed to save birds like the snowy egret, which was endangered because women's hats were decorated with egret plumes. In addition to campaigning against wearing such feathers and trying to change some laws, the Audubon Society began to purchase or accept by donation natural areas that would become wildlife preserves. In 2013, Audubon had 44 nature centers, 23 sanctuaries, and 118 million acres of land under conservation (Audubon, 2013).

Mistakes made by private investors and philanthropists mainly affect the actors themselves and only a few others. The mistakes are self-correcting as failed innovations end when their private funding runs out and customers fail to appear, and their failures generate the information needed for later successes. Mistakes made by governments are different in each of these ways. The people affected are often orders of magnitude more than the investors and consumers affected by even a big business's failure. Governments can hide mistakes from public view for many years, and the regulations and subsidies keeping them afloat can send distorted signals to investors and consumers preventing better products or services from being discovered and commercialized. Contemporary examples in the United States of big mistakes by governments include the U.S. Forest Service's policy for many years of suppressing all forest fires (leading to increasingly dangerous wildfires (DeVore, 2018)), fuel economy standards for cars and trucks that result in thousands of highway fatalities every year, and subsidies for ethanol that cost drivers and taxpayers billions of dollars each year but do nothing to benefit the environment.

An infamous example of a government mistake is Lysenkoism, a theory of genetics named after Trofim Lysenko, director of the Soviet Union's Lenin All-Union Academy of Agricultural Sciences (Zubrin, 2013; Ferrara, 2013). Lysenko's theory that plants and animals can pass on to offspring characteristics acquired during their lifetimes was prominent in the Soviet Union of the 1930s. Lysenko rose to power by creating the appearance of being a problem solver, not because he was a highly regarded scientist. Joseph Stalin hailed his pseudoscientific theory because it seemed consistent with the Communist dogma that human nature could be changed by experience.

Once in power, Lysenko used his position to systematically remove from government anyone who challenged his preferred theory, even to the point of ordering the exile and execution of scientists who disagreed with him. Lysenko didn't tolerate disagreement because he didn't need to. He was narrowly focused on what he thought was right, and often that was consistent with advancing his own career. He was given power to suppress dissent and forbid experiments that would have revealed the flaws in his theory.

Lysenko's flawed beliefs contributed to crop failures in the Soviet Union and may have caused millions of deaths. But because it was endorsed by the Communist Party and backed by government force, Lysenkoism remained the official theory of crop genetics in the Soviet Union until the 1960s.

While Lysenkoism may be an extreme example, the growing influence of governments over science is a widely recognized danger (Lindzen, 2012; Curry, 2017). U.S. President Dwight Eisenhower in his Farewell Address of January 17, 1961, warned "against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist." Importantly, Eisenhower went on to say:

> The free university, historically the fountainhead of free ideas and scientific discovery, has experienced a revolution in the conduct of research. Partly because of the huge costs involved, a government contract becomes virtually a substitute for intellectual curiosity …
>
> Yet, in holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite. The prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever present – and is gravely to be regarded.

Eisenhower's warning seems especially germane to climate science today. The scientific debate about climate change is dominated by government institutions, most notably the Intergovernmental Panel on Climate Change (IPCC), and in the United States by government agencies such as the Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), and National Aeronautics and Space Administration (NASA). During the Obama administration, all three U.S. agencies took positions on the climate change issue that supported the president's calls for immediate action. Scott Pruitt, the first EPA administrator following the Obama administration, said publicly that Obama had "weaponized" the agency to advance his climate change agenda (Bluey, 2018).

Nearly all of the scientists calling for immediate action to slow or prevent catastrophic climate change debate are government employees or depend on government grants to support their academic careers (Nova, 2009). Many of the "skeptics" are in the private sector, emeritus professors no longer needing grant dollars, or independent scientists with no financial motive to take one side or the other. The possibility that public financing influences the views and public statements of climate change advocates is readily apparent to economists and others who have studied the close-knit climate science community (e.g., Wegman *et al.,* 2006). But efforts to discuss this possible conflict of interest are called "assaults on climate science" by spokespersons for the government science establishment (Gleick *et al.,* 2010, pp. 689–90).

Is concern over anthropogenic climate change the latest Big Mistake by governments around the world? The rest of this book presents extensive evidence that it is. One scientist or a small group of scientists speaking their mind on a controversial issue is unlikely to cause much harm and is to be welcomed. But when the rules of political competition spill over into a scientific controversy and science becomes politicized, the damage to both science and public policy can be huge. Policymakers are well advised to look outside government agencies and beyond government-funded academics to get an accurate presentation of the state of climate science.

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1.6 Conclusion

The best responses to climate change are likely to arise from voluntary cooperation mediated by nongovernmental entities using knowledge of local costs and opportunities.

Economics explains how property rights, prices, profits and losses, and exchange lead to the efficient allocation of scarce resources. It reveals how access to common-pool resources – such as wilderness areas, grazing areas, and the atmosphere – can be efficiently managed so long as private property rights are defined and enforced and people are free to negotiate terms. Many institutions have evolved to facilitate such negotiation. Markets produce the prosperity needed to make voluntary environmental protection a social value today, ensuring the necessary resources will be made available to preserve and protect Earth's atmosphere now and for future generations.

Climate change is not a problem to be solved by markets or by government intervention. It is a complex phenomenon involving choices made by millions or even billions of people producing countless externalities both positive and negative. The benefits created by the use of fossil fuels, alleged to be the cause of climate change, have been huge and are well documented; the costs attributed to climate change are less certain but, as will be documented in Chapter 8, are known to be orders of magnitude smaller than the benefits from using fossil fuels.

Climate change presents an opportunity to use the wealth created by fossil fuels today to support an environmental movement based on sound science to study the causes and consequences of climate change and find the responses (plural, because there are likely to be more than one) that maximize private as well as social benefits. The best responses cannot be found in a laboratory by physicists, biologists, or geologists, no matter how brilliant they might be. They must be found in the real world of human action: either in the private sector where decisions are made based on prices and incentives and value is created by trading goods and services; or in the public sector where governments may force compliance with laws shaped by politics and implemented by bureaucracies.

The market approach to climate change involves treating people as shoppers rather than voters. This means allowing them to conduct their own private cost-benefit analyses and then use their local knowledge to discover and craft the best local responses to a global phenomenon. This approach can be called simply "energy freedom."

The freedom-based approach to protecting commonly owned resources is to find win-win solutions even when conditions might otherwise allow some people to over-use the resource and harm

others. People value and are willing to pay for environmental amenities, meaning there are markets for finding such solutions. Institutions already exist that can lower the transaction costs that might otherwise stand in the way of such solutions. Since the future value of assets impacts their current prices, private ownership of assets creates incentives for conservation and protection that benefit future generations.

Economics suggests that governments have an important but very limited role to play in environmental protection. They help mainly by recognizing, defining, and enforcing property rights and prosecuting fraud and other criminal acts. Governments historically have done a poor job regulating environmental risks and owning and managing resources such as wilderness areas. Government regulation and ownership often fail to achieve their objectives due to conflicting incentives of individuals in governments (moral hazard), capture of regulatory agencies by special interests, and their inability to collect reliable information or achieve local knowledge.

Efforts to protect Earth's atmosphere by limiting energy freedom and instead empowering governments to restrict the use of fossil fuels or ban them outright fail to work in practice. They erode the protection of private property rights, reducing the incentive and ability of owners to protect and conserve their resources. Taxes, subsidies, and regulations distort the signals sent by prices and profits and losses, resulting in inefficient use of resources. Even when government programs seem to succeed, they often displace rather than improve or add to private environmental protection. Government's ability to promote the goals of some citizens at the expense of others also leads to resources being diverted from production of valuable goods and services into political action (rent seeking) and often outright corruption.

Asking the general public to vote on what to do about climate change is not likely to lead to the most efficient responses. Even voters who are intelligent and well-intentioned often choose to remain ignorant about the issues being voted on by their elected representatives. They realize their individual votes for a candidate are unlikely to affect policies and they often are misinformed by interest groups.

The prosperity made possible by the use of fossil fuels has made environmental protection a social value in countries around the world. The value-creating power of private property rights, prices, profits and losses, and voluntary trade can turn climate change from a possible *tragedy* of the commons into an *opportunity* of the commons. Energy freedom, not government intervention, can balance the interests and needs of today with those of tomorrow. It alone can access the local knowledge needed to find efficient win-win responses to climate change.