

Greening the Economy

CHAPTER 17 FOCUS QUESTIONS

- Is a “green economy” possible?
- What economic theories provide insight into the relationship between the economy and the environment?
- Is protecting the environment bad for the economy?
- What policies can promote a transition to a green economy?

17.1 THE GREEN ECONOMY: INTRODUCTION

Economic and environmental objectives are often presented as conflicting goals. A common theme in political debates in recent years is that certain environmental regulations result in unacceptable job losses. Thus the choice is presented as being between improved environmental quality on one hand, and a robust economy on the other (see Box 17.1 for a recent example of this debate).

But is the choice this simple? Can't we have *both* sufficient environmental quality and plentiful, good jobs? In this chapter we explore the relationship between protecting the environment and economic growth. We'll consider the research on the topic to determine if there is necessarily a tradeoff between the environment and the economy. While protecting the environment clearly involves some costs, including job losses in some sectors, economists focus on whether the benefits justify these costs. Environmental regulations may also create jobs in some sectors—for example, environmental restrictions on coal plants may lead to expansion of wind power production. Thus it may be possible that at least some environmental regulations actually lead to net job gains.

Some recent policy proposals suggest that a well-designed response to current environmental and energy challenges can actually be the engine for future economic growth. Companies and countries that make the investments necessary to create a low-environmental-impact society may gain a competitive advantage over those that continue to pursue business as usual. In addition, excessive rates of natural capital degradation can reduce economic productivity, measured in traditional terms as a reduction in GDP, or in broader terms using the measures we discussed in Chapter 8. Thus maintaining natural capital may be a critical factor to ensure future economic growth.

BOX 17.1 KEYSTONE XL PIPELINE PITS JOBS AGAINST THE ENVIRONMENT

Clashes over the proposed extension of the Keystone XL pipeline took place throughout the Great Plains states as public hearings allowed supporters and opponents to make their case for or against what is proposed as the longest oil pipeline in North America.

A State Department environmental impact statement released in late August said the pipeline, operated by TransCanada, would cause minimal impact on the environment. Union organizations and business interests say the pipeline will reduce the nation's dependence on overseas oil and create jobs while environmentalists, local farmers and some state government leaders question the company's safety record.

Opponents of Keystone XL also say the government has been lax in regulating oil companies. Two examples from last year that were frequently referenced at the hearings: the Gulf of Mexico oil spill and another, smaller, spill in Michigan that polluted a 35-mile stretch of the Kalamazoo River.

At particular risk, they say, is the Ogallala Aquifer, an underground water supply that is the greatest irrigation source to the nation's farmland, supplying eight states. Because 65 percent of the aquifer is in Nebraska, the national fight is focused there.

Nebraska Governor Dave Heineman (R), who is against the pipeline, is asking the State Department to require TransCanada to reroute the pipeline away from the aquifer if it eventually wins approval.

In Atkinson, Neb. Thursday, Ron Kaminski, a business manager of Laborers' Local 1140 in Omaha, told the Associated Press his organization "believes deeply in the jobs [the pipeline] will create." Union representatives and workers who traveled long distances to attend the meetings expressed the same sentiment: that the U.S. should not dismiss an opportunity to create jobs, especially in a troubled economy. TransCanada says the pipeline will create 20,000 jobs and add \$20 billion to the U.S. economy.

Detractors raised anxieties about the coarse mixture the pipelines will carry. Oil sands are more corrosive than crude oil, they say, which not only will make it more susceptible to damaging a pipeline but make it more difficult to mitigate the damage following a spill. TransCanada officials dismiss those claims, saying the Keystone XL will be thicker in construction, making it more durable, and will be monitored by sensors to ensure safety.

Source: Guarino, 2011.

green economy

an economy that improves human well-being and social equity, while reducing environmental impacts.

A more ambitious goal is to create a new "**green economy**" that embodies the concept of sustainable development. The United Nations Environment Program (UNEP) has defined a green economy as:

... one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive.

[In] a green economy, growth in income and employment is driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services. These investments need to be catalyzed and supported by targeted public expenditure, policy reforms and regulation changes. This development path should maintain, enhance and, where necessary, rebuild natural capital as a critical economic asset and source of public benefits, especially for poor people whose livelihoods and security depend strongly on nature.¹

Note that the concept of a green economy does not necessarily reject economic growth, but instead seeks to foster growth that is compatible with sustainability. It explicitly rejects the standard jobs vs. the environment choice:

Perhaps the most widespread myth is that there is an inescapable trade-off between environmental sustainability and economic progress. There is now substantial evidence that the “greening” of economies neither inhibits wealth creation nor employment opportunities, and that there are many green sectors which show significant opportunities for investment and related growth in wealth and jobs.²

In addition to environmental sustainability, the green economy should promote social equity. Thus advocates of a green economy reject the notion that sustainability must limit the economic aspirations of the world’s poorest.

Later in the chapter we’ll discuss specific policy proposals to transition to a green economy, some of which build on policies mentioned in earlier chapters, such as removing fossil fuel subsidies and internalizing externalities. We’ll also look at some empirical analysis that compares the economic and environmental performance of the green economy to a business-as-usual scenario. But first we turn to a discussion of economic theories of the relationship between the economy and the environment.

17.2 THE RELATIONSHIP BETWEEN ECONOMY AND ENVIRONMENT

We can study the relationship between the economy and the environment in both directions. We can look at how environmental protection impacts economic performance, or we can look at how economic growth impacts environmental quality. In this chapter we will consider both perspectives.

Environmental Kuznets Curves

First, let’s consider how economic growth impacts environmental quality. Specifically, as a nation gets richer over time, how will this affect its environmental quality? The answer isn’t obvious. On one hand, a richer nation is likely to use more resources, demand more energy, and produce more waste and pollution. On the other hand, a richer nation can afford to invest in renewable energy, install state-of-the-art pollution control equipment, and implement effective environmental policies.

In economic terms, it is widely accepted that environmental quality is a **normal good**—meaning that people will seek to “purchase” more of it as their income increases. What is more debatable is whether environmental quality is also a **luxury good**—meaning that spending on it increases disproportionately as income grows. It may be that environmental quality is a luxury good over some income levels, and merely a normal good at other income levels.³

An appealing hypothesis is that economic growth will eventually provide a nation with the resources to reduce its environmental impacts. As a 1992 paper argued:

... there is clear evidence that, although economic growth usually leads to environmental deterioration in the early stages of the process, in the end the best—and probably the only—way to attain a decent environment in most countries is to become rich.⁴

This notion that environmental impacts tend to increase initially as a country becomes richer, but then eventually decrease with further income gains, has

normal good

a good for which total expenditures tend to increase as income increases.

luxury good

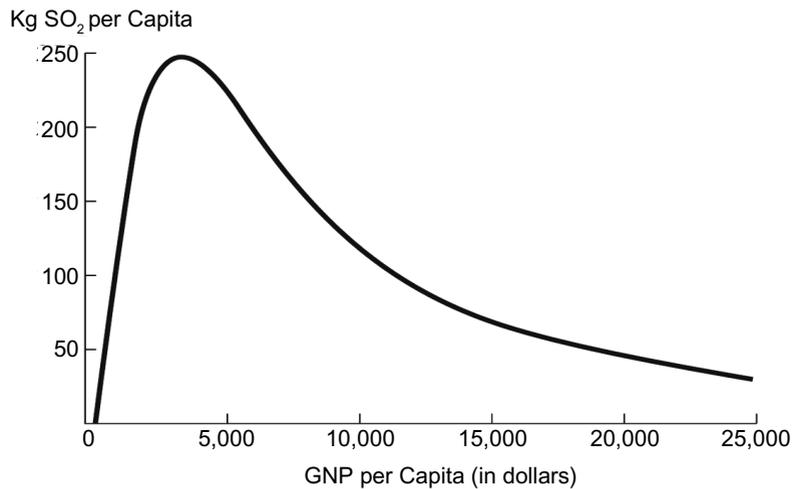
a good that people tend to spend a higher percentage of their income on as their incomes increase.

Environmental Kuznets Curve (EKC)

the theory that a country's environmental impacts increase in the early stages of economic development but eventually decrease above a certain level of income.

become known as the **Environmental Kuznets curve (EKC)** hypothesis.^a This hypothesis proposes that the relationship between income and environmental impacts is an inverted-U shape. The concept is illustrated in Figure 17.1, based on actual data on sulfur dioxide emissions. We see that per-capita SO₂ emissions increase with income up to a per-capita income of around \$4,000. But above that income level, SO₂ emissions per capita decline steadily. This is an encouraging result because the “turning point” occurs at a relatively modest income level. Thus a moderate amount of economic growth can lead to substantial SO₂ emission reductions.

Figure 17.1 Environmental Kuznets Curve for Sulfur Dioxide Emissions



Source: Adapted from Panayotou, 1993.

Note: GNP = gross national product; kg = kilogram; SO₂ = sulfur dioxide.

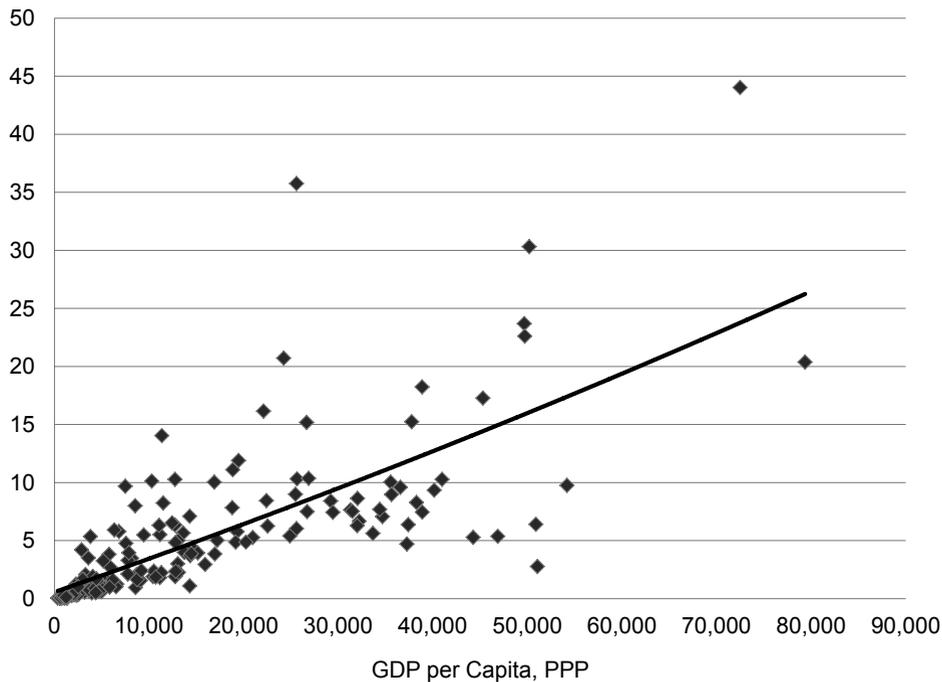
While the EKC hypothesis seems to apply to SO₂, further analysis indicates that it does not apply to all environmental impacts. Perhaps most importantly, the EKC hypothesis does not match the data on carbon dioxide emissions (the primary greenhouse gas), as shown in Figure 17.2. The figure shows an attempt to fit an inverted-U trendline through the data.^b The trendline shows that there is no turning point—per-capita CO₂ emissions continue to rise as per-capita income increases. A more sophisticated statistical analysis tested the EKC hypothesis for carbon emissions and concluded that “despite these new [statistical] approaches, there is still no clear-cut evidence supporting the existence of the EKC for carbon emissions.”⁵ Thus promoting economic growth does not appear to be a means to address the issue of global climate change.

The EKC hypothesis has been tested for numerous other environmental impacts. While it may be valid for some air pollutants such as SO₂, particulate matter, and nitrogen oxides, it does not seem to apply more broadly to other environmental impacts. A 2003 review of the evidence concluded that:

^aThe EKC hypothesis is named after Simon Kuznets, an economist who proposed a similar relationship between income inequality and economic growth in the 1950s.

^bThe trendline is a second-degree polynomial, which could show a U-shaped or inverted-U pattern.

Figure 17.2 **GDP and Carbon Dioxide Emissions** (2008 data)



Source: World Bank, World Development Indicators database, <http://data.worldbank.org/data-catalog/world-development-indicators>
Note: CO₂ = carbon dioxide; GDP = gross domestic product; PPP = purchasing power parity.

The evidence presented in this paper shows that the statistical analysis on which the environmental Kuznets curve is based is not robust. There is little evidence for a common inverted U-shaped pathway which countries follow as their income rises. There may be an inverted U-shaped relation between urban ambient concentrations of some pollutants and income though this should be tested with more rigorous time series or panel data methods. It seems unlikely that the EKC is a complete model of emissions or concentrations.⁶

Even in situations where the EKC hypothesis seems valid, we should be wary of concluding that economic growth alone will result in environmental improvements.

Improvement of the environment with income growth is not automatic but depends on policies and institutions. GDP growth creates the conditions for environmental improvement by raising the demand for improved environmental quality and makes the resources available for supplying it. Whether environmental quality improvements materialize or not, and when and how, depend critically on government policies, social institutions and the completeness and functioning of markets.⁷

The Porter Hypothesis and the Costs of Environmental Regulation

Another hypothesis looks at the interaction between the economy and environment in the opposite direction. Traditional economic theory indicates that firms minimize their costs in order to remain competitive. Thus any environmental regulation im-

poses an additional cost to firms, and thus reduces their profits. This doesn't mean that the benefits of environmental regulations can't outweigh these costs, but that firms will end up worse off as a result of environmental regulations.

This notion was challenged in a 1995 paper that suggested that the key to competitiveness, whether it be for a firm or a nation, rests in the ability to continually innovate.⁸ Well-designed environmental regulations provide an impetus for innovation, and thus can actually lower costs and provide a competitive advantage.

In short, firms can actually benefit from properly crafted environmental regulations that are more stringent (or are imposed earlier) than those faced by their competitors in other countries. By stimulating innovation, strict environmental regulations can actually enhance competitiveness.⁹

Porter hypothesis

the theory that environmental regulations motivate firms to identify cost-saving innovations that otherwise would not have been implemented.

The idea that environmental regulation can lead to lower costs for firms has become known as the **Porter hypothesis**. Like the EKC hypothesis, the Porter hypothesis is controversial. The main reason is that it contradicts the common economic assumption that firms minimize costs. If such cost-saving innovations were available, then standard economic theory would suggest that firms would pursue such options without the spur of regulation. But the Porter hypothesis notes that firms may not be focused on ways to reduce environmental impacts, thus missing potential cost-saving innovations. Regulations may make firms more aware of new technologies and direct investments into new areas of research.

The Porter hypothesis was never intended to apply to all environmental regulations. Obviously some regulations do impose net costs on firms, even after technological innovations are implemented. The Porter hypothesis has been empirically tested by comparisons of both firms and nations.¹⁰ For example, a firm-level study in India found evidence of the Porter hypothesis among water-polluting firms. Those firms with the lowest levels of water pollution also performed the best economically.

Other analyses have tested whether nations with more stringent environmental regulations gain an advantage in terms of international trade. The results generally don't support the Porter hypothesis at a national level. A 2011 study based on data from over 4,000 facilities in seven developed nations found that environmental regulation does induce innovations but that the net effect of regulations is still negative (i.e., they impose net costs on firms).¹¹

Even if the Porter hypothesis is only true in a limited number of situations, the potential for innovation to at least reduce compliance costs may still be generally underestimated. Proposed environmental regulations often prompt opposition by industries on the basis of their anticipated **compliance costs** and negative impacts on the economy. A 1997 study sought instances where compliance costs estimated before an environmental regulation was enacted could be compared with actual compliance costs after the law went into effect.¹² A dozen such cases were found, including regulations on sulfur dioxide, CFCs, asbestos, and mining. In all cases the original estimates were higher than actual compliance costs, with the original estimates at least 29 percent higher. In most cases, the actual compliance costs were less than half the original estimates. The report concluded:

The case studies reviewed in this report clearly show that environmental regulations that mandate emission reduction at the source generally cost much less than expected. It is not clear to what extent businesses overstate their expected costs for strategic reasons, or to what

compliance costs

the cost to firms and industries of meeting pollution regulations.

extent they fail to anticipate process and product technology changes when making early estimates. It is clear, however, that input substitution, innovation, and the flexibility of capital have allowed actual costs to be consistently much lower than early predictions.¹³

This doesn't mean that compliance costs are insignificant. A 2012 report sponsored by an organization representing U.S. manufacturers found that the cumulative effect of federal regulations was to reduce GDP by \$240 to \$630 billion annually, and reduce labor compensation by 1.4 percent to 5.0 percent.¹⁴ The report also noted that the greatest share of the federal regulatory burden was a result of environmental regulations. However, the report mentioned that it did not consider the benefits of these regulations—an issue which we will return to later in the chapter. Also, one may question the objectivity of the analysis. For example, cost estimates for many regulations were obtained from a survey of manufacturing companies, who may have a strategic interest in over-stating costs.

Decoupling

We have emphasized the ways in which environmental protection and the economy are linked, but it is also worthwhile to think about ways the two can be separated. In many ways, economic growth has been associated with an increase in environmental impacts. Consider Figure 17.3a, which shows that between 1961 and 1978 global economic growth (measured using GDP) was associated with a similar upward trend in global carbon dioxide emissions. During this period, economic activity increased by a factor of 2.2 while CO₂ emissions increased by a factor of 2.0.

Since 1978, we see in Figure 17.3b that while global economic activity and CO₂ emissions both increased, they were not linked as closely as in Figure 17.3a. We can say that the two variables have become somewhat “decoupled” since the late 1970s. Economic activity increased by a factor of 2.3 while CO₂ emissions increased by only a factor of 1.6.

The term **decoupling** has been defined by the OECD as breaking the link between “environmental bads” and “economic goods.”¹⁵ We can differentiate between relative decoupling and absolute decoupling:

Relative decoupling: The growth rate of the environmental bad is positive but less than the economic growth rate. We would say that since the 1970s carbon emissions and economic growth have become relatively decoupled.

Absolute decoupling: The level of the environmental bad is either stable or decreasing at the same time that the economy is growing. Thus absolute decoupling breaks the linkage between economic growth and environmental degradation.

An example of absolute decoupling is shown in Figure 17.4. In the United Kingdom, real GDP increased by a factor of 2.6 between 1970 and 2008. But during this same period total CO₂ emissions in the country actually decreased by about 20 percent. Even during the period of rapid economic growth in the 1990s, CO₂ emissions stayed constant or decreased. This was in large part a result of a major shift in energy sources away from coal and towards natural gas, resulting from discoveries of large deposits of relatively inexpensive natural gas in the British North Sea. Also, CO₂ data don't account for “**exported emissions**”—emissions that are emitted in other countries to produce goods that are exported. Thus some of the decoupling efforts in developed countries have occurred merely because manufacturing has shifted to developing countries.

decoupling

breaking the correlation between increased economic activity and similar increases in environmental impacts.

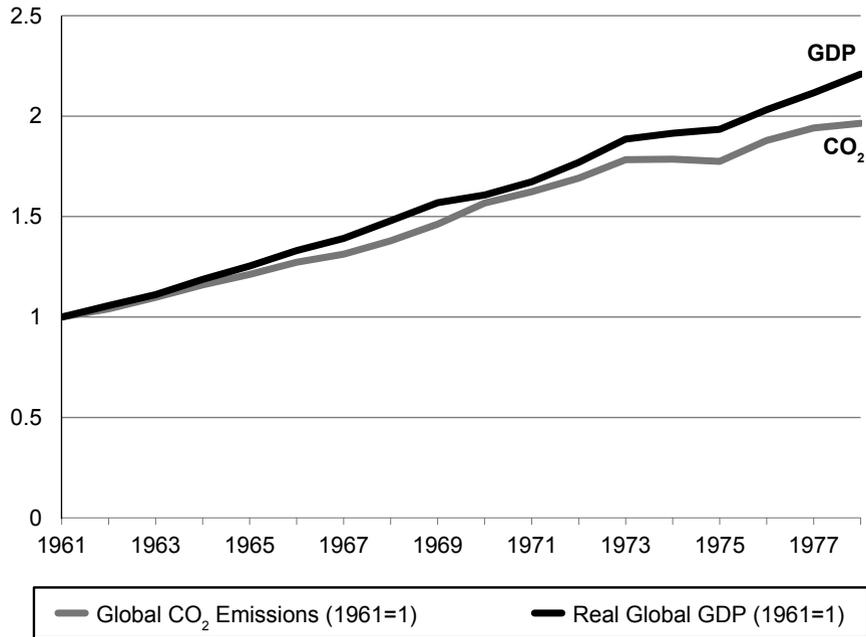
relative and absolute decoupling

breaking the correlation between increased economic activity and increases in environmental impacts; in absolute decoupling, an increase of economic activity is associated with a decrease in environmental impacts.

exported emissions/pollution

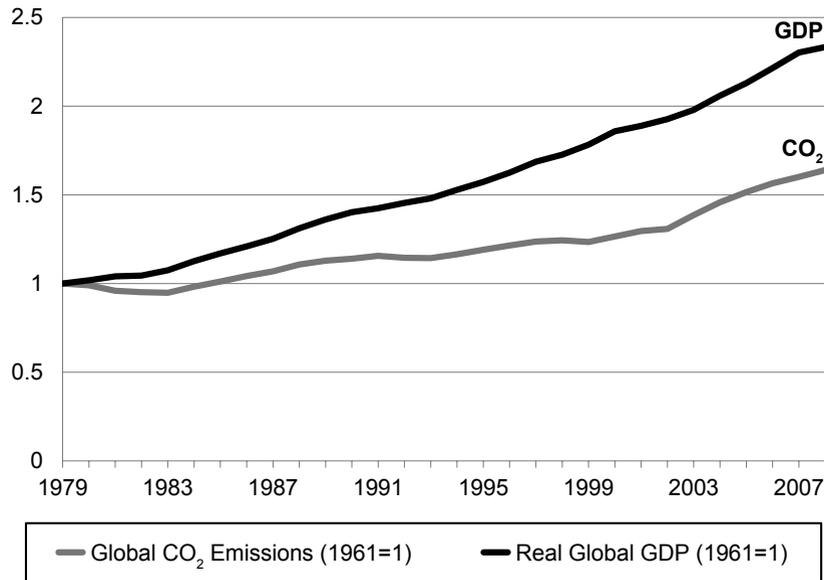
shifting the impacts of pollution to other countries by importing goods whose production involves large environmental impacts.

Figure 17.3a **Global Real GDP and Carbon Dioxide Emissions, 1961–1978**



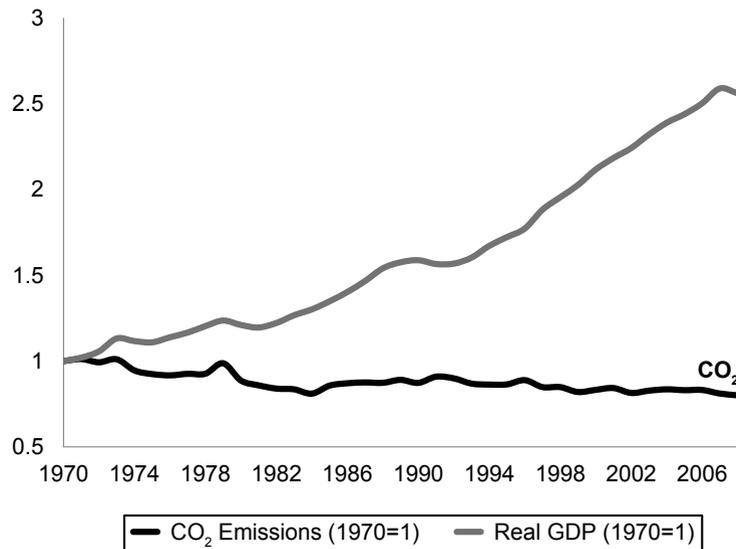
Source: World Bank, World Development Indicators database, <http://data.worldbank.org/data-catalog/world-development-indicators>.
 Note: CO₂ = carbon dioxide; GDP = gross domestic product.

Figure 17.3b **Global Real GDP and Carbon Dioxide Emissions, 1979-2008**



Source: World Bank, World Development Indicators database, <http://data.worldbank.org/data-catalog/world-development-indicators>.

Figure 17.4 **Absolute Decoupling: Real GDP and Carbon Dioxide Emissions in the United Kingdom, 1970–2008**



Source: World Bank, World Development Indicators database, <http://data.worldbank.org/data-catalog/world-development-indicators>; example taken from Smith et al., 2010.

Note: CO₂ = carbon dioxide; GDP = gross domestic product.

A 2011 report by the United Nations looks at the extent of global decoupling across a range of resources including fossil fuels, minerals, and wood.¹⁶ The results suggest that a certain amount of relative decoupling has occurred in recent decades “spontaneously,” rather than a direct result of policy intervention. This relative decoupling reflects an increase in the efficiency of production arising from technological improvements. However, some resource extraction rates exceed recent global GDP growth rates. For example, extraction of iron ore, copper, and zinc grew faster than global GDP over the period 1990–2007.¹⁷

The UN report found that achieving absolute decoupling will require ambitious policies. According to a business-as-usual scenario, global resource use is projected to triple by 2050. Absolute decoupling would keep global resource use constant at or below current levels, which has profound implications for developed and developing countries. In developed countries, resource use would need to decline by a factor of 3 to 5 to allow enough resource availability for developing countries to improve their living standards. Even then, the more advanced developing nations would still need to reduce their resource use by 10–20 percent in order to permit the poorest countries to somewhat increase their resource use. Thus absolute decoupling at the global level:

... is only conceivable if it is accepted that sustainability-oriented innovations can result in radical technological and system change. Taken as a whole, this would be a scenario of tough restraint that would require unprecedented levels of innovation. . . . Most politicians are likely to regard this scenario as too restrictive in terms of developmental goals such as reducing poverty and providing for the material comfort of a rapidly expanding middle class.¹⁸

contraction and convergence

the concept that overall environmental impacts or economic activity should be reduced at the same time that economic inequalities are reduced.

More feasible is a scenario of moderate **contraction and convergence**, in which the resource use of developed countries declines (i.e., absolute decoupling), allowing the developing countries to increase their resource use enough to decrease

global inequality. According to the UN report, in this scenario global resource use still increases 40 percent by 2050—declining by a factor of two in developed countries but increasing by a factor of about three in developing countries. Even this scenario “would require substantial economic structural change and massive investments in innovations for resource decoupling.”¹⁹

Decoupling suggests that economic growth can be possible without an accompanying growth in physical throughput. However, current rates of decoupling need to increase in order to avoid a dramatic increase in resource use and pollution over the coming decades. Some nations are already taking the lead with innovative policies to encourage decoupling (see Box 17.2 on Japan’s decoupling effort). But major decoupling on a global scale will require a degree of international cooperation not currently evident. In particular, developed countries must be willing to lower their resource use sufficiently to meet sustainability objectives and provide enough resource availability for developing countries to eradicate poverty.

17.3 INDUSTRIAL ECOLOGY

Economic growth has tended to rely on the increased extraction of raw materials and an increase in waste generation. Manufacturing processes have typically been designed to minimize production costs, without consideration of the associated ecological costs. Transitioning to a green economy will require a reassessment of the manufacturing process so that ecological concerns are incorporated into production decisions.

Traditional manufacturing is a “straight-line” process by which raw materials are transformed into final products, generating wastes (including waste heat) that are disposed of into the air, the land, or water, as shown in Figure 17.5. These final products are eventually disposed of as they wear out, also becoming waste products.

BOX 17.2 DECOUPLING IN JAPAN

Japan’s unique culture norms and geopolitical limits have encouraged creative and effective solutions for decoupling. Japan’s high population density and reliance on imports for natural resources have pushed Japan to decouple economic growth from ecological damage. In addition, Japanese culture has a long-standing concept of *mottainai*, meaning essentially that it is a shame when a resource is not utilized to its full potential.

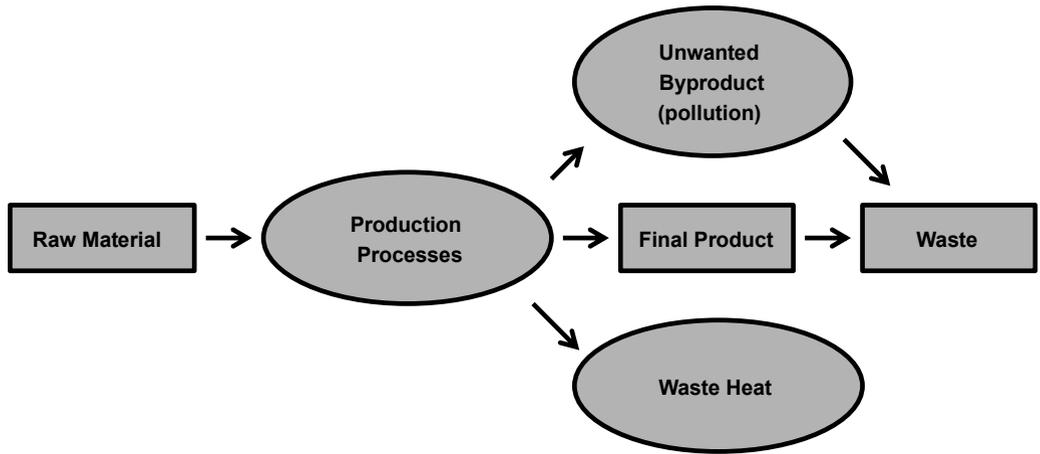
In the 1980s, public concern over pollution from incineration, landfills nearing capacity, and the *mottainai* spirit lead to numerous solid waste reforms, such as replacing old incinerators with state-of-the-art facilities that decoupled dioxin emissions from the voluminous waste incineration. Japan has continued to innovate in solid waste disposal, both on the technical and policy level and has successfully decoupled it from economic growth.

Perhaps Japan’s most successful modern decoupling initiative has been the Top Runner Programme (TRP). TRP searches the market for the most efficient product in a category, and makes that the new minimum efficiency standard, with which all companies must comply within four to eight years. As discussed in Chapter 16, standards typically create little incentive for innovation. But the TRP program motivates firms to become the industry efficiency leader, leaving other firms to catch up.

The TRP program has proven remarkably effective. In 10 out of 11 product categories, the efficiency gain was greater than initially expected. For example, diesel freight vehicles were expected to achieve a 6.5 percent efficiency improvement, but instead improved 21.7 percent. Like the Porter hypothesis, the TRP program demonstrates the significant potential for innovation when incentives are well-designed.

Source: UNEP, 2011c.

Figure 17.5 Straight-Line Process of Traditional Manufacturing

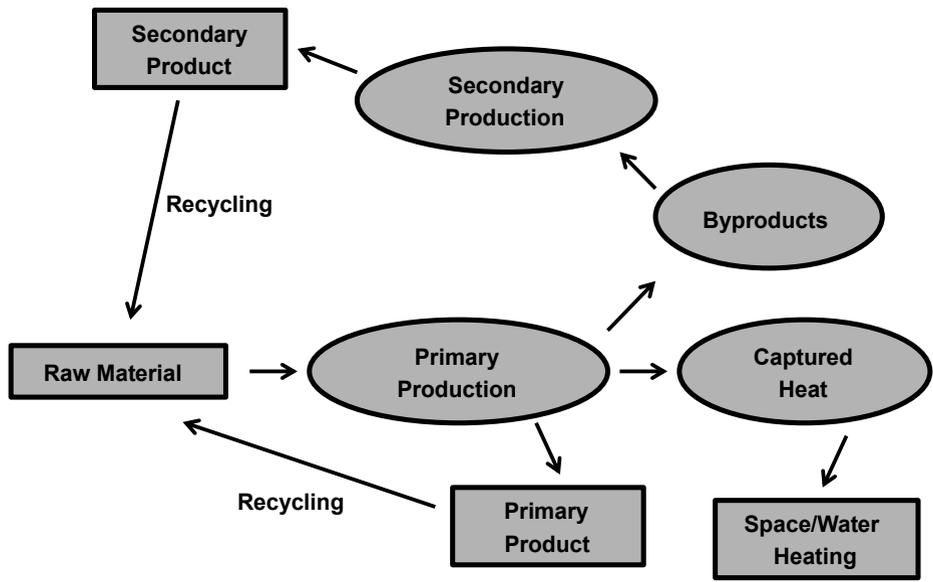


Natural systems, in contrast to economic systems, typically follow a cyclical pattern, with wastes being recycled and reused. Healthy natural systems show no buildup of pollution and wastes. Inorganic elements such as water and nitrogen cycle through the environment. Dead and decayed organic materials form the basis of fertile soils from which new plant life can grow, in turn supporting new animal life. Rather than creating a problem requiring a solution or disposal, wastes become inputs at a new stage in the cycle.

industrial ecology
the application of ecological principles to the management of industrial activity.

The emerging field of **industrial ecology** seeks to model human manufacturing systems on the closed-loop cycles found in nature. The concept of industrial ecology is illustrated in Figure 17.6. Taking this perspective, wastes can potentially become inputs into secondary production. Recycling rates are maximized to reduce the extraction of raw materials. Even waste heat that is typically unused can be directed toward productive uses such as heating water or living/working spaces.²⁰

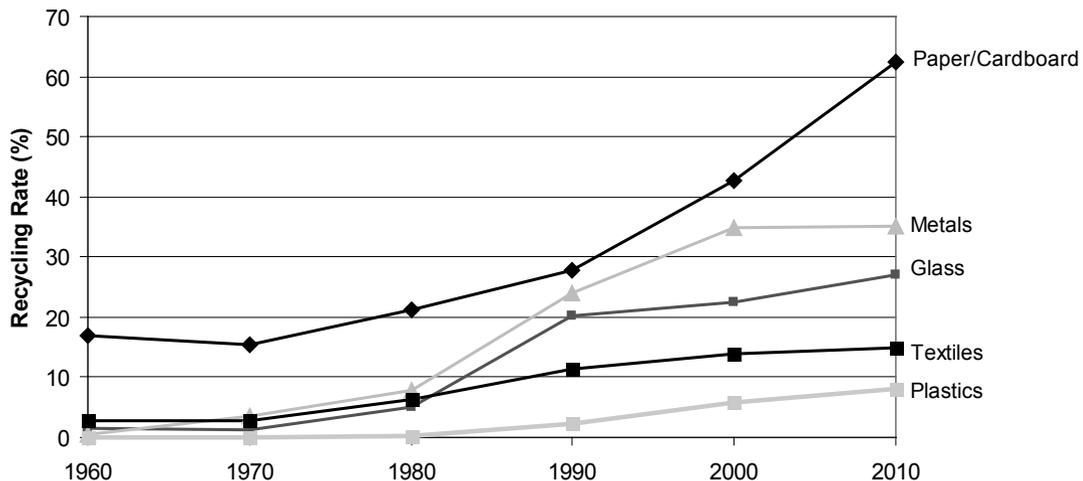
Figure 17.6 Cyclical Production Processes of Industrial Ecology



Recycling rates in the United States and elsewhere have been steadily increasing in recent years, as shown in Figure 17.7. Across the entire U.S. municipal waste spectrum, about one-third of total wastes by weight are recycled. Another 13 percent is incinerated to generate heat or electricity. The total amount of waste sent to municipal landfills has actually declined in recent years, from about 145 million tons in 1990 down to 135 million tons in 2010.²¹

The profitability of recycling depends on the demand for recycled products and the relative costs of recycled and virgin materials. One of the reasons that paper recycling rates have increased significantly over the last few decades is that it is generally cheaper to produce many paper products using recycled materials rather than virgin inputs. A 2007 study of recycling in New Zealand found that the overall recycling rate could be increased from 38 percent to 80 percent while providing society with net economic benefits.²² The study found that recycling is particularly profitable for paper, used oil, metals, glass, and concrete. The economics of plastic recycling is mixed—while it generally makes economic sense to recycle PET (polyethylene terephthalate; recycling code #1) and HDPE (high density polyethylene; recycling code #2), it is generally not profitable to recycle PVC (polyvinyl chloride; recycling code #3) or LDPE (low density polyethylene; recycling code #4).

Figure 17.7 Recycling Rates in the United States, 1960–2010



Source: U.S. EPA, 2011.

dematerialization
the process of achieving an economic goal through a decrease in the use of physical materials, such as making aluminum cans with less metal.

In addition to increasing recycling rates, industrial ecology also promotes **dematerialization**—achieving the same economic goal with less materials use. Aluminum beverage cans, for example, contain about 30 percent less metal than they did in the 1970s, and aluminum cans themselves replaced cans made of much heavier metal used in previous decades. Achieving the same function (delivering a beverage to consumers) using less material benefits the supplier, as well as the environment, cutting resource use and transportation costs, and reducing wastes even if the cans aren’t recycled.

materials substitution
changing the materials used to produce a product, such as using plastic pipe instead of copper in plumbing systems.

Another principle of industrial ecology is **materials substitution**—replacing a scarce, hazardous, or highly polluting material with a more environmentally benign substitute. Many uses for copper, for example, have been replaced by plastics, optical fibers, and lighter metals such as aluminum. Government regulation has contributed to the partial replacement of metal-based pigments in paints with organic pigments, reducing the dangers of lead poisoning and the amount of lead and other heavy metals in the waste stream.

17.4 DOES PROTECTING THE ENVIRONMENT HARM THE ECONOMY?

What is the evidence regarding efforts to “green” the economy? Specifically, is there a tradeoff between protecting the environment and the economy and job creation? The conventional wisdom, particularly in the United States, seems to be that such a tradeoff exists:

Environmental regulation in the United States stands accused of causing a broad array of undesirable economic consequences. The view that environmental regulation seriously harms the U.S. economy is so firmly established that it has become the centerpiece in the series of attempts over the last few years to roll back the very rules that have produced such dramatic improvements in environmental quality.²³

A 1999 report to the U.S. EPA considered four approaches to assess the impact of environmental protection on the economy:²⁴

1. Is environmental protection too expensive?
2. Does protecting the environment result in job losses?
3. Does environmental protection reduce economic growth?
4. Does environmental protection harm international competitiveness?

Let’s now consider the empirical evidence to answer each of these questions.

Is Environmental Protection Too Expensive?

The first step to answering this question is to estimate how much is spent on environmental protection. One of the most comprehensive estimates of total environmental spending in the United States was produced in a 1990 EPA report which calculated total pollution control expenditures as 2.1 percent of GDP in 1990 (about \$100 billion), rising to 2.6–2.8 percent of GDP in 2000.²⁵ These costs include the cost of complying with environmental regulations, as well as costs that would be incurred in the absence of such regulations, including basic water treatment and trash collection and disposal.

Using a slightly different methodology, the OECD estimated that pollution control expenditures in the U.S. in the mid-1990s were 1.6 percent of GDP.²⁶ More recent estimates are less comprehensive, and not comparable to these numbers. For example, 2005 data estimate U.S. pollution abatement capital and operating costs of only about \$27 billion, or about 0.2 percent of GDP.²⁷

Thus overall it seems the U.S. is spending 2–3 percent of its GDP protecting the environment. Is this too much? One answer would consider how environmental

protection spending compares with other categories of spending. The 1990 EPA report mentioned above noted that “national environmental pollution control expenditures [are] less than half those for clothing and shoes, one-third those for national defense, one-third those for medical care, one-fifth those for housing, and one-sixth those for food.”²⁸ Thus environmental spending is well within the range of what we spend on other essentials.

Another way to assess U.S. environmental spending is to compare it to spending in other countries. Table 17.1 shows that environmental spending in the U.S. is comparable to spending in other industrialized countries. U.S. pollution control spending is higher, as a share of GDP, than in Canada and the UK, but lower than in Austria and the Netherlands.

Table 17.1

Pollution Control and Abatement Expenditures, Select Countries (data from mid-1990s)

Country	Pollution abatement and control expenditures (as a percent of gross domestic product)
Austria	2.4
Netherlands	2.0
France	1.6
Germany	1.6
United States	1.6
Canada	1.1
United Kingdom	0.7

Source: OECD, 2003.

From the point of view of economic analysis, the most appropriate way to determine whether environmental expenditures are justified is to compare these costs to the benefits society receives. Using the techniques discussed in Chapter 6, one could theoretically estimate the market and non-market benefits of environmental expenditures. However, no comprehensive estimate has been made of the benefits of all environmental regulations in the United States or any other country. Instead, cost-benefit analyses have been conducted for many individual federal regulations. Under various executive orders in the United States, starting with Ronald Reagan and reaffirmed by Barack Obama, federal agencies proposing major regulations must quantify the costs and benefits of the proposal to the extent possible.^c This requirement applies for nonenvironmental regulations as well as those related to the environment.

Each year the U.S. Office of Management and Budget publishes a report summarizing the results of cost-benefit analyses for all major regulations enacted that year, and also the aggregate impact of all regulations over the previous 10 years. Table 17.2 presents the cost-benefit results for various major federal agencies covering the period 2000–2010.²⁹

During these 10 years, the U.S. EPA enacted more regulations (33) than any other federal agency, or about 31 percent of all major federal regulations. The annual costs of these 33 regulations are estimated to be \$24–\$29 billion. However, the annual benefits are estimated to be \$82–\$550 billion, implying a benefit-cost ratio of at least 2.8:1 and as high as 23:1.

^cA major regulation is generally defined as one that has an impact on the economy of at least \$100 million annually.

Table 17.2

Costs and Benefits of Major Federal Regulations, 2000–2010

Agency	Number of rules	Annual benefits (billions)	Annual costs (billions)
Department of Agriculture	6	0.9–1.3	1.0–1.34
Department of Energy	10	8.0–10.9	4.5–5.1
Department of Health and Human Services	18	18.0–40.5	3.7–5.2
Department of Homeland Security	1	< 0.1	< 0.1
Department of Housing and Urban Development	1	2.3	0.9
Department of Justice	4	1.8–4.0	0.8–1.0
Department of Labor	6	0.4–1.5	0.4–0.5
Department of Transportation	26	14.6–25.5	7.5–14.3
Environmental Protection Agency	33	81.7–550.4	23.8–29.0
Joint DOT and EPA	1	9.5–14.7	1.7–4.7
Total	106	136.2–651.2	44.2–62.2

Source: U.S. OMB, 2011.

While the EPA regulations impose about half of all federal regulatory costs, these regulations generate 60–85 percent of the benefits of all regulations. Thus EPA regulations result in higher benefit-cost ratios, on average, than other federal regulations. These results suggest that while environmental expenditures are large, and the EPA does enact more regulations than any other federal agency, environmental regulations provide significant net benefits to society.

Does Environmental Protection Result in Job Losses?

As mentioned earlier, the purported tradeoff between jobs and the environment is a common critique of environmental regulation. Several research studies have explored the relationship between employment and environmental regulation. While increased environmental spending leads to the loss of certain jobs, it creates other jobs. These effects may cancel out or actually result in a net gain of jobs. For example, a 2002 paper analyzed U.S. data in four industries: pulp and paper mills, plastic manufacturers, petroleum refiners, and iron and steel mills. The results found that:

... increased environmental spending generally does *not* cause a significant change in employment. Our average across all four industries is a net gain of 1.5 jobs per \$1 million in additional environmental spending.³⁰

A broader 2008 national analysis also dispelled the notion that environmental protection results in job losses.³¹ Using a model of the United States economy, the study was able to estimate how environmental spending and regulation affects employment in various industries. Their major finding was that:

... contrary to conventional wisdom, [environmental protection (EP)], economic growth, and jobs creation are complementary and compatible: Investments in EP create jobs and displace jobs, but the net effect on employment is positive.³²

Further, the study found that states that have the strongest environmental regulations also have the best job opportunities. The authors suggested that state-level policies integrate environmental protection as a key component of job creation proposals.

A 2007 study in the United Kingdom also studied the effect of environmental regulation on employment. The results found that regulations had a slightly negative impact on employment, although the results were not statistically significant. They concluded that their analysis found “no evidence of a trade-off between jobs and the environment.”³³

While environmental regulations clearly lead to job losses in specific industries, such as coal mining and oil refining, they also create many jobs. According to one estimate, environmental protection is responsible for about 5 million jobs in the United States.³⁴ This study found that just like spending in any other sector, environmental spending creates a broad range of jobs:

[W]e found that classic environmental jobs constitute only a small portion of the jobs created by EP [environmental protection]. The vast majority of the jobs created by EP are standard jobs for accountants, engineers, computer analysts, clerks, factory workers, truck drivers, mechanics, etc. In fact, most of the persons employed in these jobs may not even realize that they owe their livelihood to protecting the environment.³⁵

A 2009 study found that the “clean energy economy” has grown considerably, creating jobs at a higher rate than the economy as a whole.³⁶ While overall national job growth during 1997–2008 was 3.7 percent, clean energy jobs increased by 9.1 percent during the same period. The report also noted that an increasing share of venture capital is flowing into the clean energy sector.

Does Environmental Protection Reduce Economic Growth?

Another criticism of environmental protection is that it reduces economic growth, based on the results of studies showing that environmental regulations reduce GDP growth rates. For example, a comprehensive analysis of the Clean Air Act in the United States estimated that GNP in 1990 was about 1 percent lower than it would have been without the policy. The aggregate macroeconomic loss from the Act over the period 1973–1990 was estimated to be about \$1 trillion. Analysis of the economic impact of major environmental regulations in Europe suggests an aggregate economic loss of about 0.2 percent of GDP.³⁷

The aggregate macroeconomic impacts of environmental regulations are estimated using **computable general equilibrium** (CGE) models. These models allow economists to determine how impacts in one sector of the economy carry through to employment and income changes in other sectors. The models include feedback loops to model longer-term impacts, particularly how capital investments respond to supply and demand changes in different sectors. However, the results of CGE models must be interpreted with caution.

CGE models *have to* predict reduced economic growth because of environmental compliance. After all, pollution control costs in these models are treated as extra expenditures necessary to produce the same level of valued output. . . . The outcome is implicit in how the model is constructed. So this finding isn’t necessarily a complete picture for what people and policymakers want to know about real world regulation, where a pollution control sector emerges as part of the economy, and helps to produce environmental protection, which is also an “output” with value.³⁸

CGE models do not estimate the benefits of regulation, particularly those that don’t appear in markets. For example, the CGE costs mentioned above regarding

computable general equilibrium

economic models that aim to estimate the effect of policy changes throughout an entire economy.

the Clean Air Act provide no insight into the benefits of the Act, which can only be obtained with additional economic analysis. When an estimate of the Clean Air Act benefits was made, it was found that the central estimate of the 1973–1990 benefits was \$22 trillion, or a benefit cost ratio of 22:1.³⁹ CGE models also fail to account for positive feedback loops such as the increase in productivity as negative health impacts decline with better air quality.

So while there appears to be a slight negative impact of environmental regulation on economic growth as traditionally measured, we need a more complete analysis to determine its effect on social welfare. As we saw in Chapter 8, GDP was never intended to measure social welfare, and economists have developed alternative national accounting approaches to supplement or replace GDP. These alternatives may present a better framework for fully assessing the impacts of environmental regulations on social welfare. We need to analyze environmental regulations in light of both their benefits and their costs. The studies reviewed above indicate that environmental regulations provide society with significant net benefits.

Does Environmental Protection Harm International Competitiveness?

Finally, we consider whether environmental regulation makes a nation less competitive than nations with less stringent regulations. Assuming environmental regulations lead to higher production costs, firms having to meet stricter regulations would seem to be at a competitive disadvantage.

Various studies have addressed this issue, commonly looking at how regulations affect the quantity of exports in various sectors of the economy. A 1995 study collected the results of the available research at the time and concluded that “there is relatively little evidence to support the hypothesis that environmental regulations have had a large adverse effect on competitiveness.”⁴⁰ Some recent analysis finds that regulations can have negative impacts on certain sectors, particularly those reliant upon fossil fuels, but positive impacts on other sectors. For example, a 2010 paper found that environmental regulations have a positive effect on exports of wood, paper, and textile products, but negative impacts on most other sectors.⁴¹

A 2011 study of U.S. manufacturing found that highly polluting manufacturing plants tend to be associated with lower overall productivity. The study estimated that inefficiencies associated with the failure to meet Clean Air Act standards lowers productivity by about 5 percent.⁴² Finally, a 2012 study of European regulations also found evidence that certain regulations can have a positive impact on competitiveness:

... the overall effect of environmental policies does not seem to be harmful for export competitiveness of the manufacturing sector, whereas specific energy tax policies and innovation efforts positively influence export flows dynamics, revealing a Porter-like mechanism. These results show that public policies and private innovation patterns both trigger higher efficiency in the production process through various complementarity mechanisms, thus turning the perception of environmental protection actions as a production cost into a net benefit.⁴³

What Conclusions Can We Draw?

The evidence suggests that the common notion that environmental regulation harms the economy is a myth. While regulations may harm particular industries and re-

duce international competitiveness in some instances, the benefits of environmental regulations consistently outweigh the costs. Further, well-designed regulations can actually have a net positive impact on economic growth and competitiveness, and foster job creation.

17.5 CREATING A GREEN ECONOMY

The transition to a greener economy is occurring slowly, driven by economics and government policies. However, rates of decoupling, recycling, and dematerialization are generally not occurring fast enough to achieve sustainability targets such as reducing CO₂ emissions or protecting biodiversity. The United Nations concludes that “we are very far from being a green economy.”⁴⁴

Creating a green economy will require a significant shift in investments in infrastructure, research, and development. UNEP has developed a complex model to analyze the economic and environmental impacts of directing investments to promote a transition to a green economy.⁴⁵ They consider a green scenario where 2 percent of global GDP is invested in various ways to promote sustainability, including energy efficiency, renewable energy, waste management, infrastructure improvements, agricultural production methods, and water management. They compare the results of this green economy scenario to a business-as-usual scenario where investment rates follow existing trends.

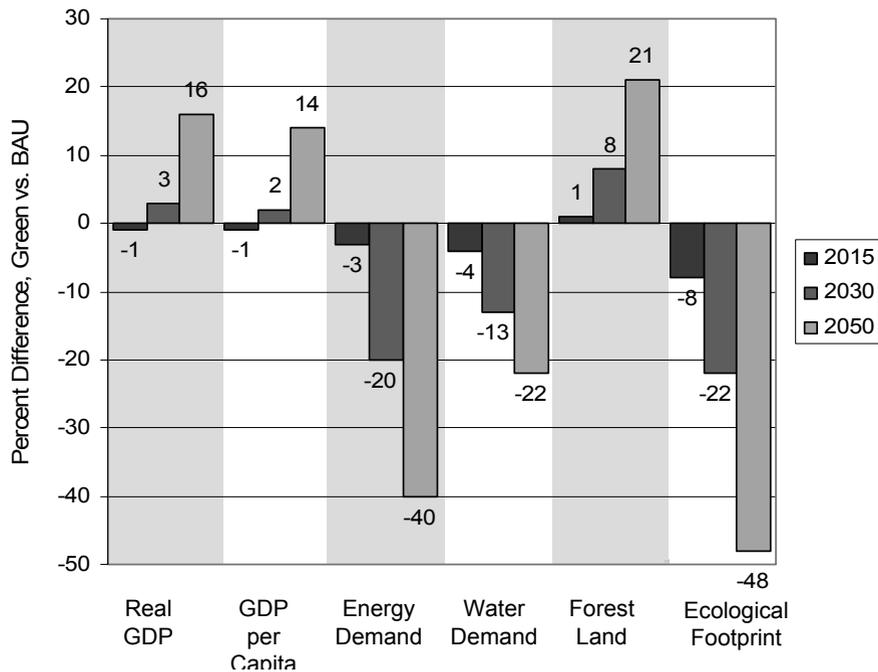
The results are shown in Figure 17.8, indicating the percentage difference in various variables for the green economy scenario relative to the BAU scenario. In the short-term (2015), the green economy scenario results in about 1 percent lower real GDP and lower GDP per capita. But in the longer term the green economy shows substantially better economic performance than the BAU scenario. By 2050 real GDP in the green economy scenario is 16 percent higher than in the BAU scenario. The environmental differences between the two scenarios are initially small, but become dramatic over the following decades. By 2050 global energy demand is 40 percent lower in green economy scenario, and the ecological footprint is 48 percent lower.

Green investments are also relatively job-intensive, particularly in the agricultural, forestry, and transport sectors. In the energy sector, employment would initially decline as jobs related to fossil fuel use decline, but in the long run (after about 2030) net employment rises, primarily as a result of the creation of millions of jobs related to energy efficiency.

The UNEP model finds that investments for the green economy particularly benefit the world’s poorest. The poor disproportionately depend upon natural resources for their livelihood. So investments in natural capital, including water resources, sustainable agriculture, and forests increase incomes while also improving the environment. Investments in natural capital also foster ecotourism, which offers another way to increase incomes in developing countries. In the energy sector, investment in renewable energy can also benefit the world’s poor. There are about 1.6 billion people in the world who lack access to electricity. Given the lack of an existing distribution grid in many poor regions, small-scale off-grid solar energy is currently more cost-effective than electricity generated using traditional fossil fuels.

The transition to a green economy will require more than investment, it will require major policy shifts at the national and international levels. The policy recommendations from the UNEP report include:

Figure 17.8 Environmental and Economic Projections, Green Economy Scenario versus Business as Usual



Source: UNEP, 2011a.

Note: BAU = business as usual; GDP = gross domestic product.

- *Use taxes and other market-based instruments to internalize negative externalities.* As we've seen in other instances in the book, pricing pollution promotes more efficient resource use and encourages innovation. Well-designed taxes or permit systems can also be net job creators. For example, a German tax on fossil fuels and electricity, introduced in 1999 and slowly phased in over several years, used the revenues to reduce the costs of hiring employees by lowering firms' required social security contributions. The tax was estimated to have created 250,000 full-time equivalent jobs while also reducing carbon emissions.
- *Decrease government spending that depletes natural capital.* We discussed the distortionary impact of fossil fuel subsidies in Chapter 12. And as noted in Chapter 13, at least 60 percent of global fishery subsidies have been identified as harmful, leading to over-exploitation of fisheries. Subsidy reforms should be phased in slowly to reduce negative economic impacts, and be supplemented with policies to protect the poor. In Indonesia, for example, reductions in energy subsidies in 2005 and 2008 were implemented along with cash transfers to low-income households.
- *Efficiency and technology standards can sometimes be more cost-effective and easier to administer than market-based instruments.* Developing countries often lack the institutions for complex tax and tradable permits systems. Technology standards are easier to enforce, and can ensure a rapid transition to the best available technologies. The challenge is to set appropriate standards, and adjust them as new technologies become available. Standards for government procurement have been demonstrated to be an effective way to jump-start the demand for environmentally friendly goods and services.

- *Temporary support measures are needed to ensure an employment transition for affected workers.* As shown in Figure 17.8, in the short term the transition to a green economy will cause a slight decline in GDP. Training will be needed to provide displaced workers with the skills to gain new jobs in the green economy. In many cases workers will remain employed in their current jobs, but through skill enhancement they can learn to do their jobs in new ways. Construction workers will still build houses, but construction techniques can incorporate better insulation, solar photovoltaic systems, and more efficient lighting.
- *International environmental governance needs to be strengthened.* Even with the potential economic benefits of green economy policies, individual nations remain hesitant to act alone. Strong international agreements create a level playing field and are the only effective way to deal with global environmental issues such as climate change and ozone depletion. An important step toward a green economy would be reform international trade laws, as we'll discuss further in Chapter 20. For example, international trade agreements can be set to reduce harmful subsidies while lowering certain tariffs to foster trade in environmental goods and services. Current trade laws on intellectual property rights have been criticized for failing to meet the needs of developing countries, and actually inhibiting the development of green markets. In some cases developing countries will need greater flexibility in protecting infant industries. Finally, developing countries often have an advantage in markets for ecosystem services such as carbon sequestration and watershed protection. International agreements that create markets for these services can reduce poverty while enhancing natural capital.

While some of these recommended policies will require major changes in current political institutions, others, such as reducing harmful subsidies or increasing efficiency standards, can be relatively easily and quickly implemented. The transition to a green economy will be a major issue confronting all economic policy makers in the coming decades. Significant steps are already being taken, as a greater share of public investment is directed toward greening the economy. According to the World Bank, about 16 percent of the global stimulus spending enacted as a response to the 2007 financial crisis was classified as “green” stimulus—spending on renewable energy, energy efficiency, waste management, and water sustainability.⁴⁶ The leader was China, spending \$221 billion on green stimulus, about half of it directed toward rail transport. The United States allocated \$112 billion as green stimulus, with about \$30 billion each invested in renewable energy and energy efficient buildings. The European Union allocated about 60 percent of its stimulus spending toward green measures, including carbon capture and storage and electricity grid efficiency.

But the transition to a green, sustainable economy will require a sustained commitment. Countries that are proceeding as “first movers” are already starting to realize the benefits. South Korea has pledged 2 percent of its GDP toward investment in green sectors. Recent efforts there to increase recycling rates have saved billions of dollars and created thousands of jobs.⁴⁷ The UK is another country investing heavily in the green economy. Over a third of the UK’s economic growth in 2011 and 2012 is estimated to be a result of green businesses.⁴⁸ The challenge is to maintain and extend these efforts through bold initiatives, long-term thinking, and international cooperation.

SUMMARY

The concept of a “green economy” is that improved human well-being and reduced inequality can be driven by investments to reduce environmental impacts. It is based on the finding that economic growth is compatible with protecting the environment.

We explored the relationship between the economy and the environment based on several theories. The Environmental Kuznets curve (EKC) hypothesis is that economic growth eventually leads to a reduction in environmental impacts. The empirical evidence supports the EKC hypothesis for some pollutants, but it does not apply to other environmental impacts, most importantly to carbon emissions. The Porter hypothesis states that well-designed environmental regulations can actually result in lower costs for firms. Again, the theory is valid in some cases but the evidence finds it does not apply to all regulations. Decoupling suggests that economic growth can be “delinked” from negative environmental impacts. Absolute decoupling has occurred in some instances, but much greater decoupling progress is needed to achieve sustainability targets.

The field of industrial ecology seeks to maximize resource efficiency and recycling. It promotes using the wastes from one industry as the inputs into additional production. Through dematerialization products can be constructed using a smaller volume of materials. Another focus of industrial ecology is to use materials that are nontoxic, recyclable, and low-polluting.

We explored the common perception that protecting the environment harms the economy. The evidence indicates that the benefits of environmental regulations far exceed their costs. Rather than leading to job losses, protecting the environment can actually be a source of net job creation. Environmental protection does not harm international competitiveness and has little effect on GDP growth rates.

While creating a green economy will entail short-term costs, the long-term benefits are projected to be significant. Rates of GDP growth are expected to be higher under a green economy scenario than a business as usual scenario, while environmental impacts are significantly reduced. The transition to a green economy will require strong policy action, including eliminating harmful subsidies, training workers, using economic policy instruments such as taxes and tradable permits, and meaningful international agreements.

KEY TERMS AND CONCEPTS

compliance costs
computable general equilibrium
contraction and convergence
decoupling
dematerialization
exported emissions
Environmental Kuznets Curve (EKC)

green economy
industrial ecology
luxury good
materials substitution
normal good
Porter hypothesis
relative and absolute decoupling

DISCUSSION QUESTIONS

1. What news stories have you heard recently that refer to the interaction between the environment and the economy? Was environmental protection presented as compatible with

- economic growth? What were the various points of view presented in the story? What is your opinion of the story?
2. What steps, if any, do you think should be taken to promote a green economy in your country or region? What steps do you think would be most effective? Can you propose policies that businesses may support?
 3. What groups would be hurt most by the transition to a green economy? What groups would most benefit from the transition? Can you think of scenarios in which those who gain could compensate those who would be hurt?

NOTES

1. UNEP, 2011a, p. 16.
2. UNEP, 2011b, pp. 1–2.
3. Yandle, et al., 2004.
4. Beckerman, 1992, p. 482.
5. Aslanidis, 2009.
6. Stern, 2003, p. 11.
7. Yandle, et al., 2004, p. 29.
8. Porter and van der Linde, 1995.
9. Ibid., p. 98.
10. Wagner, 2003.
11. Lanoie, et al., 2011.
12. Hodges, 1997.
13. Ibid, p. 12.
14. NERA Economic Consulting, 2012.
15. OECD, 2002.
16. UNEP, 2011c.
17. Jackson, 2009.
18. Ibid., pp. 30, 32.
19. Ibid., p. 31.
20. See Ayres and Ayres, 1996 and Socolow ed., 1994, for an overview of industrial ecology, and Cleveland and Ruth, 1999, on materials flows in the industrial process.
21. U.S. EPA, 2011.
22. Denne, et al., 2007.
23. Arnold, 1999, Summary.
24. Arnold, 1999.
25. Carlin, 1990.
26. OECD, 2003.
27. United States Census Bureau, 2008.
28. Carlin, 1990, pp. 4–9.
29. U.S. Office of Management and Budget, 2011.
30. Morganstern, et al., 2002, p. 412.
31. Bezdek, et al., 2008.
32. Ibid., p. 63.
33. Cole and Elliott, 2007, p. 1.
34. Bezdek, et al., 2008.
35. Ibid., p. 69.
36. The Pew Charitable Trusts, 2009.
37. Commission of the European Communities, 2004.

38. Arnold, 1999, p. 10.
39. Commission of the European Communities, 2004.
40. Jaffe, et al., 1995, p. 157.
41. Babool and Reed, 2010.
42. Greenstone, et al., 2011.
43. Constantini and Mazzanti, 2012, p. 132.
44. UNEP, 2011b, p. 3.
45. UNEP, 2011a.
46. Strand and Toman, 2010.
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WEB SITES

1. <http://www.unep.org/greeneconomy/>. The United Nations’ page on the Green Economy, including their Green Economy report, national case studies, and several videos.
2. <http://is4ie.org/>. Homepage for the International Society for Industrial Ecology, with links to their journal, job postings, and events.

3. <http://www.epa.gov/gateway/learn/greenliving.html>. The U.S. EPA's site on green living, including numerous tips on how to reduce your environmental impacts.
4. <http://www.thegreeneconomy.com/>. Homepage for "The Green Economy" magazine, with articles and news stories targeted toward businesses leaders seeking to take advantage of green opportunities.
5. <http://www.guardian.co.uk/environment/green-economy>. Web page assembled by The Guardian, a UK newspaper, which collects stories related to the green economy.