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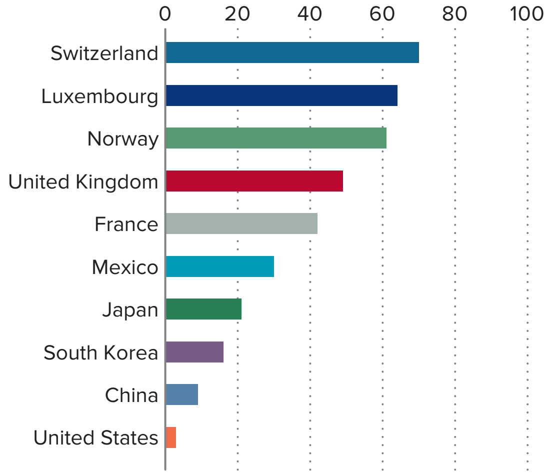
GLOBAL PERSPECTIVE 4.1

PERCENTAGE OF CO_2 EMISSIONS TAXED, SELECTED NATIONS, 2015

Countries vary widely in the percentage of their total carbon dioxide (CO_2) emissions that they tax at a price of $35 per ton or higher. The percentages vary across countries due to both differences in the tax rate per ton and differences in which industries (agricultural, industrial, transportation, etc.) are subject to CO_2 taxes in each country.

Percent of CO_2 Emissions Taxed at $35 per Ton or Higher, 2015



Source: compareyourcountry.org, Organization for Economic Co-operation and Development (OECD).

not reflect external costs, shifts leftward (upward) to the total-cost supply curve, S_t. The equilibrium price increases, equilibrium output falls from Q_e to the socially optimal amount Q_o, and the initial overallocation of resources shown in Figure 4.6a is corrected. Observe that the efficiency loss shown by triangle *abc* in Figure 4.6a disappears after the overallocation is corrected in Figure 4.6b.

Pigovian tax A tax or charge levied on the production of a product that generates negative externalities. If set correctly, the tax will precisely offset the overallocation (overproduction) generated by the negative externality.

Pigovian Taxes Another way to approach negative externalities is for government to levy taxes or charges on the related good. These targeted tax assessments are often called **Pigovian taxes** in honor of Arthur Pigou, the first economist to study externalities. Example: The U.S. government has placed a tax on CFCs, which deplete the stratospheric ozone layer protecting Earth from excessive solar ultraviolet radiation. Facing this tax, manufacturers must decide whether to pay the tax or expend additional funds to purchase or develop substitute products. In either case, the tax raises the marginal cost of producing CFCs, shifting the supply curve for this product leftward (upward).

In Figure 4.6b, a tax equal to T per unit increases the firm's marginal cost, shifting the supply curve from S to S_t. The equilibrium price rises, and the equilibrium output declines from Q_e to the economically efficient level Q_o. The tax eliminates the initial overallocation of resources and the associated efficiency loss.

Many governments have imposed Pigovian pollution taxes on carbon dioxide (CO_2) in order to raise the marginal cost of burning fossil fuels and thereby offset the negative externalities imposed by carbon dioxide emissions. Global Perspective 4.1 shows the percentage of carbon-dioxide emissions that are taxed at a rate of $35 per ton or higher in each of ten countries.

Subsidies and Government Provision Where spillover benefits (positive externalities) are large and diffuse, as in our earlier example of inoculations, government has three options for correcting the underallocation of resources:

- ***Subsidies to buyers*** Figure 4.7a replicates the supply-demand situation for positive externalities that you first encountered in Figure 4.5b. Government could correct the underallocation of resources to inoculations by subsidizing consumers of the product. It could give each new mother in the United States a discount coupon to be used for a series of inoculations for her child. The coupon would reduce the "price" to the mother by, say, 50 percent. As Figure 4.7b shows, this program would shift the demand curve for inoculations from too-low D to the appropriate D_t. The number of inoculations would rise from Q_e to the economically optimal Q_o, eliminating the underallocation of resources and the associated efficiency loss.

LAST WORD

Visible Pollution, Hidden Costs

How Can Governments Reduce Air Pollution at the Lowest Possible Cost If Only the Polluters Themselves Know the Costs of Abatement?

Governments around the world are interested in reducing air pollution, especially that which results from the carbon dioxide (CO_2) gas that is released into the atmosphere when fossil fuels like coal and gasoline are burned. But the costs of abatement vary widely depending on what policy a government chooses to pursue. An outright ban on burning fossil fuels, for instance, would be extremely costly as it would shut down tens of thousands of existing businesses, plunging their employees into unemployment.

Thus, governments have pursued less draconian methods of reducing air pollution. If implemented correctly, these alternatives, such as carbon taxes and emissions limits, can generate major reductions at a reasonable cost, thereby avoiding the severe economic dislocation what would come with a sudden outright ban on the burning of fossil fuels.

Sensible pollution-abatement polices account for marginal benefits and marginal costs. Society will want as much of an activity like burning gasoline to power ambulances as is associated with the allocatively efficient output level that takes into account all costs (including negative externalities) as well as all benefits. A draconian policy that bans gasoline would go too far; we need ambulances and are willing to tolerate some air pollution in order to transport people rapidly and affordably to hospitals.

The trick for government, then, is to figure out how to achieve the allocatively efficient output level at the lowest possible cost. As you know from this chapter, that can be accomplished by figuring out the marginal cost of pollution abatement for each source of pollution and comparing it with the marginal benefit associated with mitigating that source of pollution. The government should then take steps to shut down all the polluting activities for which the marginal benefit of abatement exceeds the marginal cost of abatement.

That's a great strategy, but can the government implement it? The answer is yes, but the government needs to overcome an important obstacle. The costs of pollution abatement are not obvious. Would it, for instance, be less costly to eliminate 1 million tons per year of CO_2 emissions by shutting down a small factory in Memphis or by paying to retire highly inefficient older vehicles in Denver? To the extent those costs are known, they are often known to the emitters themselves, but not to the government.

The government therefore encounters an asymmetric information problem. How can it reduce pollution at the lowest cost when it is the polluters themselves that are the only ones likely to know what those costs are? One way is to compel the information. Mandatory vehicle smog checks are a good example. Ninety percent of auto emissions are generated by just 25 percent of vehicles, so it is worthwhile for governments to impose the inspection costs needed to identify the high emitters.

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Tradeable emissions permits ("cap and trade") are another way to overcome the asymmetric information problem. These work by giving polluters a financial incentive to reveal their emission reduction costs and, better yet, follow through on emissions reductions. Suppose the U.S. government knows that the allocatively optimal amount of CO_2 emissions is 4 billion tons per year, but that 5 billion tons are currently being emitted. The government will cap the total amount of emissions by printing up and handing out to polluters only 4 billion tons' worth of tradable emissions permits. Each permit may be for, say, 1 ton of CO_2 emissions, and emitting that amount of CO_2 is legal only if you have a permit.

The government will have to hand out the permits without knowing whether they are going to the emitters that have the lowest costs of abatement. But then the government can let the invisible hand do its work. The permits are tradeable, meaning that they can be bought and sold freely. An emissions-trading market will pop up and what you'll find is that the firms with the highest costs of emissions reduction will purchase permits away from the firms with the lowest costs of emission reduction.

The high-cost firms benefit because it is less expensive for them to buy permits to keep on polluting than it is to reduce their own pollution. And the low-cost firms benefit because they can make more money selling their permits than it will cost them to reduce their emissions (which they must do after they sell away their permits). Both sides win, the externality is reduced at the lowest cost, and society achieves the allocatively efficient level of pollution.

Tradeable pollution permits have worked successfully in several regions for several different types of emissions. They are an economically sophisticated way of overcoming the asymmetric information problem in pollution abatement in order to reduce emissions at the lowest possible cost.

TABLE 19.1 Oil Prices at Which Alternative Energy Sources Become Economically Viable

Oil Price per Barrel at Which Alternative Fuel Becomes Economically Viable	Alternative Fuel
$110	Biodiesel
80	U.S. corn-based ethanol*
50	Shale oil
40	Tar sands; Brazilian sugar-cane-based ethanol; gas to liquids†; coal to liquids‡
20	Conventional oil

*Excludes tax credits.
†Gas to liquid is economically viable at $40 if natural gas price is $2.50 or less per million BTUs.
‡Coal to liquid is economically viable at $40 if coal price is $15 per ton or less.

Fracking and Falling Oil Extraction Costs An additional recent development also makes it unlikely that we will run out of oil any time soon. New drilling technologies like hydraulic fracturing have dramatically increased the amount of below-ground oil that can be extracted at a profit. Many older oil fields that had been abandoned because it would have been too costly with older technology to extract their oil are now profitable again with these new technologies, which involve techniques such as injecting superheated steam into oil fields to push out the remaining oil.

Hydraulic fracturing (or, informally, fracking) has vastly increased U.S. oil production, which rose from 5 million barrels per day in 2008 to nearly 11 million barrels per day in 2018, catapulting the United States into first place as the world's largest oil producer. The increase in output was so large that it more than eliminated the decades-long U.S. trade deficit in petroleum. For the first time since the first part of the twentieth century, the United States is now a net exporter of oil. One should keep these facts in mind whenever anyone claims that we will be running out of oil any time soon.

Environmental Impacts Finally, we need to acknowledge that energy sources differ not only in their prices and production costs but also in the negative externalities they may generate. Recall from Chapter 4 that negative externalities are costs—such as those associated with air pollution—that are imposed on third parties and are therefore not reflected in production costs or market prices. These negative externalities need to be accounted for if you want to eliminate the deadweight efficiency losses that they impose.

Some energy sources like solar and wind are very "green," creating almost zero pollution or other externalities. Traditional energy sources like oil and coal are more problematic. For example, burning coal generates substantial particulate and carbon dioxide emissions that may contribute to health problems as well as global warming. For this reason, many governments have instituted carbon taxes, tradable pollution credits, and tradable emissions permits. Each of them forces producers that utilize fossil fuels to pay for the costs that their activities impose on third parties. This increase in production costs eliminates the deadweight efficiency loss by reducing output levels down to the socially optimal level at which $MB = MC$.

These taxes and permit costs can have dramatic effects on the prices that consumers pay for various types of fuel and, thus, on which types of fuel they are most likely to demand. Consider biodiesel. Table 19.1 indicates that the cost of producing biodiesel is so high that it only becomes competitive with oil if the price of oil is $110 per barrel or higher. But that $110 alternative price ignores the market value of the tradable pollution credits that the U.S. Environmental Protection Agency awards to biofuel producers for reducing carbon emissions. Taking those credits into account, biofuel becomes competitive with oil at just $55 dollars per barrel. The vast majority of consumers won't know that an emissions trading permit system even exists. They will only see that the price of biodiesel looks much lower. But that lower price will provide them with a stronger incentive to switch from oil to biodiesel any time the price of oil rises above $55 per barrel.

A caveat is needed here. Cleanliness is mostly a matter of cost. Coal, for instance, can be made almost as clean as solar if one is willing to pay for smokestack scrubbers to clean soot from emissions and underground storage facilities to sequester carbon dioxide away from the atmosphere. At sufficiently high energy prices, clean methods of producing energy are not confined to wind, solar, and other "green" energy sources. Indeed, the U.S. government now mandates that all new coal-burning electricity plants invest in both scrubbers and sequestration. But as solar and wind prices