How Can We Get There?

The role of government and business in creating a sustainable world given a market economy

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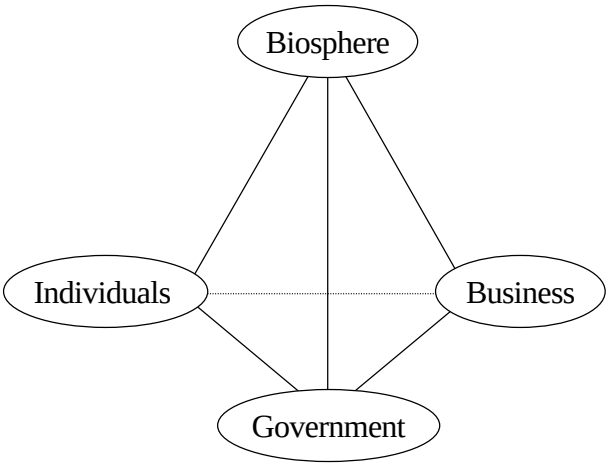
Abstract

Given the rapid worldwide population growth, increase in the resource demand per capita and the decline in availability and quality of natural resources, we need to examine how we, as a society, will satisfy these conflicting demands. This paper presumes that both governments and business will be key in making the needed changes. A survey of negative externalities as they relate to sustainable energy is presented. This is followed by a discussion of the role of markets, governments and businesses and how they relate to energy and the environment. A number of strategies for government and business are described and discussed.

Introduction

Two types of organization have a large and direct impact on our physical surroundings or biosphere – government and business. Each of them are designed for and run by individuals in environments that are dynamic.



In a capitalistic economy, businesses, governments and individuals interact with one another through markets. Goods and services are traded for money and for other goods and services. In markets, buyers and sellers, acting in their own self-interest, settle on an equitable price for the product being traded. This is a very powerful and robust arrangement – in most circumstances.

Situations exist, however, where the market fails to prices products accurately. When this occurs, it is called a market failure. One cause of market failure is known as an externality. An *externality* is an action by either a consumer or producer that affects other producers or consumers, yet is not accounted for in the market price. These affects are called externalities because they occur external to the market. An externality can be negative – when the action of one party imposes a cost on another – or positive – when the action of one party benefits another party.[1]

An example of a positive externality is a homeowner who repaints her house and plants an attractive garden. All the neighbors benefit from this activity, yet the homeowner's decision to repaint and landscape did not take these benefits in to account.[2]

[1] Robert Pindyck & Daniel Rubinfeld. *Microeconomics: 4th Edition.* (Upper Saddle River, New Jersey: Prentice-Hall, 1998), pp. 696, 648.
[2] Pindyck & Rubinfeld, p. 648.

An example of a negative externality is CO_2 emissions. Individuals driving vehicles powered by gasoline and firms producing electricity using coal and natural gas emit CO_2 to the atmosphere. There is no economic cost to doing so. CO_2 is a greenhouse gas, a gas that contributes to global warming. An increasing number of people around the world are benefiting from the inexpensive energy provided by fossil fuels. As they do so, more CO_2 is added to the atmosphere. The environmental cost was not apparent until recently. There are observable changes in the temperature of the earth. The green house gases that are causing this change have accumulated over many years and are not attributable to any single country, firm or individual.

Externalities are a common problem associated with our interaction with the biosphere. The price one pays for a product does not include the environmental costs to create the product. The incremental benefit of burning fossil fuels, for example, occurs exclusively for the individual. The environmental degradation and its costs are not felt. They are spread out among all users. The cumulative negative effect is observable only in the long term.[3]

The atmosphere would be called a *common property resource* by economists. Common property resources are those to which anyone has free access. They may be valuable but have no economic value because of free access to them. As a result, they are likely to be over utilized.[4] The total quantity demanded and supplied by individual agents in a market-based system will be more than the amount that is best for society as a whole.

We depend on the market to regulate our production and consumption – to value the goods and services at the true price to society. The market fails us when it comes to the environment and other common property resources because of the issue of externalities. What are we to do about this problem?

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[3] William D. Ruckelshaus. "Toward a Sustainable World." *Scientific American.* September 1989, pp. 166-174.
[4] Pindyck & Rubinfeld, pp. 669-670.

This paper sets out to answer several questions. Who alters the structure of markets? What options are available to governments? What keeps government from implementing the needed policy changes? What can businesses do to operate in a more sustainable manner? And, why do firms tend to resist these beneficial changes?

Discussion

Who alters the structure of markets?

The structure of markets can be influenced both from within the market (by firms and individuals) and from outside the market (by government).

Consider the government's role. Government has the ability to make laws and levy taxes on all those within the society, individuals and firms alike. This power can be used to force the market to account for costs that would otherwise not be included. The most compelling reason for government to use this power, from a market perspective, occurs when two things happen. First, there is market failure. Second, the market failure is detrimental to society at large. In the case of environmental externalities, both of these conditions are met. Government needs to intervene in the markets, changing their structure, so as to accurately represent the cost on the environment associated with the activities of individuals and firms.

Firms and individuals can also change the structure of markets. Their primary intent is to gain some economic benefit or advantage. Never the less, there can be benefits to the environment that result.

As an example, consider the internet. Using the internet, new markets have been created and old ones restructured. These changes have occurred due to actions by individuals and

business intent on economic gain. New business-to-consumer markets like Priceline and Ebay and business-to-business markets like Chemdex and Metalsite have been set up. As a result of these markets, several things have happened. Buyers and sellers are brought together more easily. Secondary markets are created for items that may have been scrapped or been held as excess inventory. The ease with which information flows has become an enabling factor in reducing inventory for businesses. With increased information about other parts of the supply chain, firms can hold less physical inventory because they are better informed about the input from their suppliers and the needs of their customers. The efficiencies mentioned here have led to higher profits for some businesses. These efficiencies also lead to lower energy and material use – the environmental benefit.

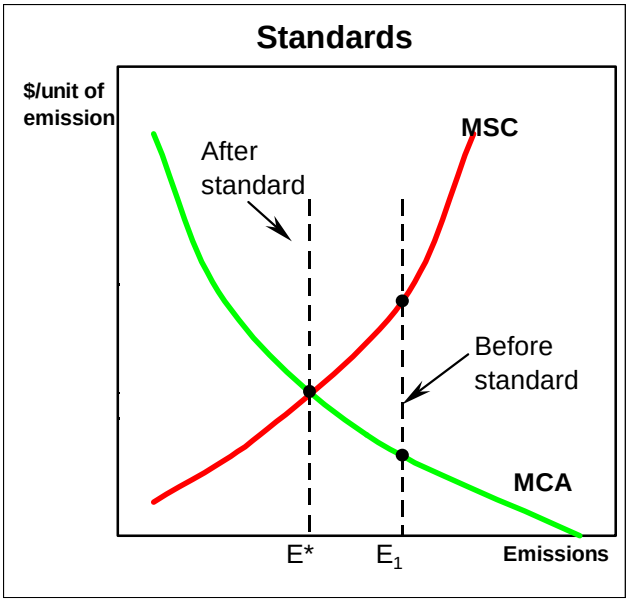
What are the options available to government?

The basic elements of environmentally sustainable energy policy are increased energy efficiency and replacing non-renewable energy sources with renewable energy sources. Governments have a variety of options available to accomplish these goals: standards, taxes, tradable permits, subsidies, trade policy and auctioning.

Standards

The most common standard related to energy policy is an emission standard. An emission standard is a legal limit on how much pollutant a firm can emit. If the firm exceeds the limit, it can face monetary and even criminal penalties. The firm meets the standard by installing pollution abatement equipment. The increased abatement expenditure will cause the firm's average costs to rise. Firms will find it profitable to enter the industry only if the price of the product in the market is greater than the average cost of production plus abatement.[5]

[5] Pindyck & Rubinfeld, p. 653.



Consider the diagram at the right. In the absence of a standard, a firm will emit at level of E_1. At this point the Marginal Cost of Abatement (MCA) is low and the Marginal Societal Cost (MSC) is high. This is an example of a negative externality. By imposing a standard government forces the firm to reduce emissions to the level E*. In doing this, the abatement costs to the firm rise and the marginal social costs fall. Ideally, the regulators choose a level of emission for each firm where the cost of abatement equals the social cost.

In practice, the enactment of an emission standard is an exercise in command and control. Rules defining the requirements are based on the level of emissions, the characteristics of the final good/service, the processes used in production or a combination of these. Ultimately, the system is completed with a monitoring component. It is likely, though, that an exclusive reliance of environmental policies on standards will result in several negative outcomes such as failure to secure cost efficient solutions or inadequate effects on technological progress. In fact, the difficulties in obtaining and processing large amounts of information induce the regulator to set uniform rules, which produce inequalities in the marginal abatement costs for different emitters (static inefficiency). On the other hand, the mere existence of a fixed limit or requirement provokes dynamic inefficiency, since polluters are not encouraged to look for a continuous reduction of emissions, thus hampering technological developments.[6]

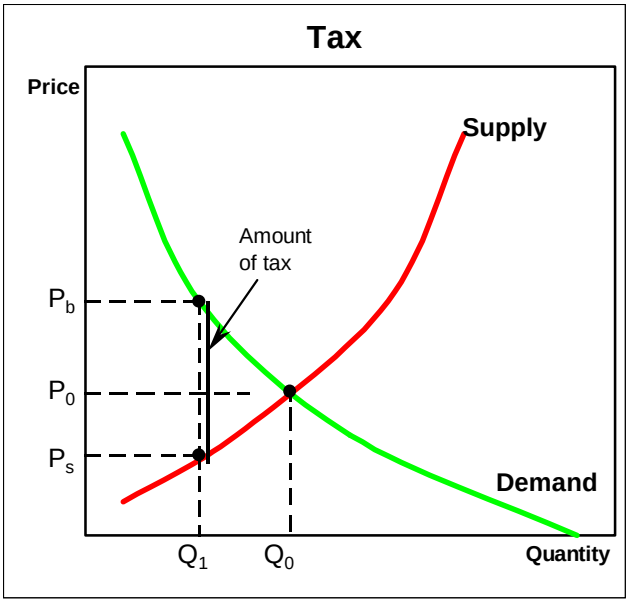
[6] Xavier Labandeira-Villot. "Market instruments and the control of acid rain damage." *Energy Policy*. Vol.24, No.9, pp. 841-854, 1996.

Market-based Regulations

In 1920, A.C. Pigou argued that negative externalities could be internalized through taxes. Using this idea, market-based mechanisms can be created that achieve similar environmental protection to standards with two important differences. Market-based regulations are more cost effective way and they encourage technological progress.[7] Two examples of these market-based approaches are taxes and tradable permits.

Taxes

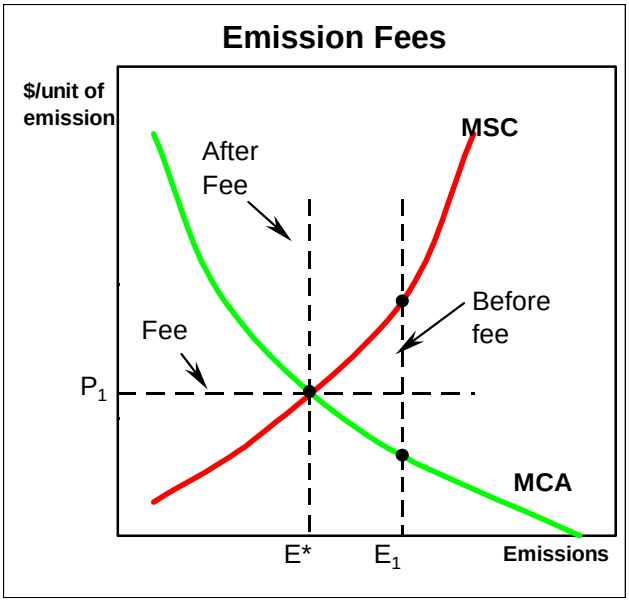
When government taxes goods and services, it has two primary effects. First, it raises revenue for the government. Second, the quantity of goods produced and consumed is decreased. When there are taxes, both the consumer and the producer of the good will pay. They will, in effect, split the cost of the tax. The relative proportions each will pay are determined by the elasticity (slope) of the demand and supply curves.[8]



Consider the figure at right. The market price for the good or service is P_0. At price P_0 a quantity Q_0 will be produced and supplied. Now, suppose the government imposes a tax equal to the amount (P_b-P_s). Doing so raises the effective price the buyer will pay from P_0 to P_b. At the same time it lowers the price the supplier will receive from P_0 to P_s. These have the effect of decreasing the total quantity produced and consumed from Q_0 to Q_1.

[7] Xavier Labandeira-Villot

An emission fee is a kind of tax. It is a charge on each unit of a firm's emissions. An emission fee will cause the firm to reduce their emissions to a level at which the marginal cost of abatement equals the imposed emission fee.[9]



Consider the diagram at the right. In the absence of a standard, a firm will emit at level of E_1. At this point the Marginal Cost of Abatement (MCA) is low and the Marginal Societal Cost (MSC) is high. This is an example of a negative externality. By imposing a per unit fee of P_1, government forces the firm to reduce emissions to the level E*. It is at this point that the MCA to the firm equals the fee imposed by government. In doing this, the abatement costs to the firm rise and the marginal social costs fall.

Fees and standards look similar in this simple explanation. In application, there are two issues with important implications. These issues arise when (i) regulators have incomplete information and (ii) when it is costly to regulate firms' emissions. A common approach is to charge all firms the same fee and to set the same standard for all firms. In this arrangement, fees are generally better for two reasons. First, they will achieve the same level of emission reduction at a lower cost. Second, firms will have an incentive to reduce their emissions beyond the levels intended by the regulators.[10]

There are instances when standards are more appropriate, however. This situation occurs when the line of marginal social cost (MSC) is much steeper than the marginal cost of abatement (MCA). In this situation, a miscalculation in the fee will result in a large excess cost to consumers. A standard will simply fix the level of emissions and the market will incorporate the associated costs.

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[8] Pindyck & Rubinfeld, pp. 318-321.
[9] Pindyck & Rubinfeld, p. 653.

Tradable Emissions Permits

Government can require each firm to have a permit to generate emissions. Each permit specifies the exact amount a firm can emit. A firm that emits more than the permit allows is subject to substantial monetary sanctions. The permits are allocated among firms to achieve the desired level of maximum emissions. In addition, the permits are marketable; they can be bought or sold.[11]

If there are enough firms and permits, a competitive market for the permits will develop. In market equilibrium, the price of a permit equals the marginal cost of abatement for all firms. The level of emissions, chosen by the government will be achieved at minimum cost. Firms with relatively low marginal abatement costs will reduce emissions the most, and those firms with relatively high marginal abatement costs will buy more permits and reduce emissions less.[12] Each firm or country will strive to balance the cost of abatement against the price of buying or selling permits.[13]

Emissions trading systems have been used most commonly in the United States. They are currently being considered as away to address the issue of global CO_2 emissions.

There are several important problems with a global emissions trading program. First, different countries have differing costs for energy. If the price of emission permits is the same for all countries, those with higher energy costs will be disadvantaged. Second, the initial allocation of permits is an important issue. If the initial distribution of permits is based on present energy consumption or income level, developing countries will be put at a disadvantage, severely restricting their economic development. A way to avoid this is to base the initial allocation on population measures. Third, abatement costs vary widely

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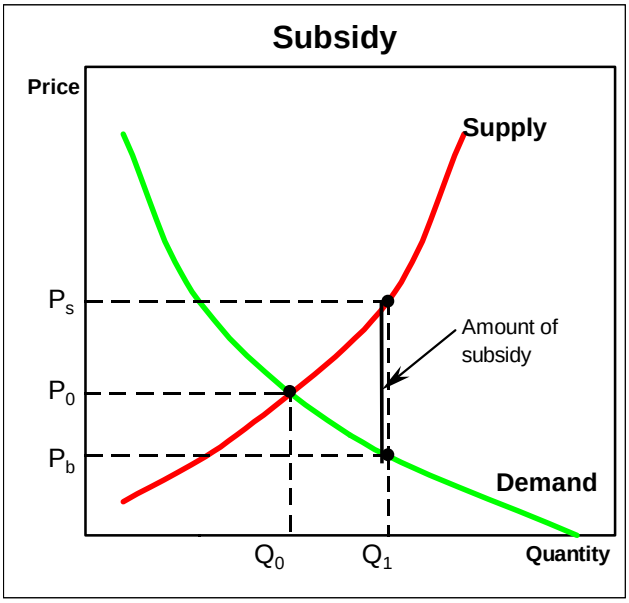
[10] Pindyck & Rubinfeld, p. 655-656.
[11] Pindyck & Rubinfeld, p. 657.
[12] Pindyck & Rubinfeld, p. 657-658.
[13] Torleif Haugland, Øystein Olsen and Kjell Roland. "Stabilizing CO2 emissions." *Energy Policy*. May 1992, pp. 405-419.

between countries. Countries with higher abatement costs, typically developing countries, will be less competitive and will use less energy limiting economic development again.[14]

Subsidies

A subsidy, in economic terms, is like a negative tax. The government pays both the seller and buyer to produce and consume more of a particular good or service. With a subsidy, the seller's price exceeds the buyer's price and the difference is the amount of the subsidy. The effect of a subsidy is the opposite of a tax; the quantity produced and consumed increases.[15]

Consider the figure at right. The market price for a good or service is P_0. At this price, quantity Q_0 will be produced and consumed. If the government offers a subsidy equal to (P_s – P_b), the price paid by the buyer will fall from P_0 to P_b. The price received by sellers will rise from P_0 to P_s. The result of these two changes is an increase in the quantity produced and consumed of the good or service.



An example of a subsidy used for societal benefit is as follows. The benefits from important scientific discoveries can take decades to materialize and may never accrue to the original researchers. As a result, many businesses, especially small ones, shy away from investment in R&D. Beneficial new technologies, like wind turbines, for example, often struggle to compete with established ones like fossil fuel power plants. It is difficult for small firms to withstand

[14] Haugland, Olsen and Roland.
[15] Pindyck & Rubinfeld, pp. 321-325.

price wars or economic downturns, to invest in large factories that capture economies of scale, and to gain the confidence of investors and consumers. Big firms, on the other hand, have large sunk costs and are often reluctant to innovate.[16] In situations like this, government subsidies are often the only way to assure that technologies beneficial to society are developed.

There are also examples of subsidies with unintended consequences. Agriculture subsidies are one of the best examples of unwittingly destructive economic policies. Virtually the entire food cycle in North America, Japan and Western Europe attracts huge direct or indirect subsidies. These subsidies encourage farmers to occupy marginal lands and to clear forests and woodlands. They induce farmers to use excessive amounts of pesticides and fertilizers and to waste underground and surface waters in irrigation. Vast crop surpluses are accumulated at great economic and ecological cost. The subsidies create political pressure for more subsidies: to increase exports, to donate food as non-emergency assistance to developing countries and to raise trade barriers against imported food. According to the Organization for Economic Cooperation and Development (OECD) and other sources, the farm subsidy structure cost Western governments in excess of *$300 billion* a year in 1989.[17]

Trade Policies

Trade policies also affect the market by changing the way firms and individuals of different countries interact with one another. Some common trade policies include quotas, tariffs, direct foreign investment, technology transfer, loans and foreign aid (both financial and food).

The biggest issue from an environmental perspective is the growing population in developing nations and the desire for economic growth in these nations. Combined, these

[16] David Malin Roodman. *The Natural Wealth of Nations: Harnessing the Market for the Environment*. (New York: W.W. Norton & Company, 1998), p. 134.
[17] Ruckelshaus.

two phenomenon will lead to demands on energy, food and water that will double within one lifetime. An important question arises about how these needs will be met. Given the present wealth of industrial nations and limited resources of the developing nations, trade will be an important way to meet these demands for resources. Today, however, trade between industrial and developing nations often makes this issue worse not better.

Deteriorating terms of trade and stagnating flow of aid combine to force developing countries to spend their effort and money on short-term crisis rather than on long-term development. The biggest problem is the accumulation of debt. The cumulative debt of developing nations in 1989 was $1 trillion. The interest payments alone amounted to $60 billion a year. At these levels, there is often a *net outflow* from the developing countries to the developed countries! In addition, today's trading patterns cause massive transfers of environmental costs to the poorer, resource-based economies of the developing countries, thus depleting their stock of natural resources. To make matters worse, most developing countries and many industrialized countries rely on their stocks of environmental capital in their economies. Their long-term development depends on maintaining if not increasing these resources.[18]

There are many examples, however, of these resources being depleted. In 1949 30% of Ethiopia was covered with forest. As of 1977, it was down to 4% and in 1989 it had 1% forest cover. Brazil may be losing more than 8 million hectares of forest annually. Loss of forests can lead to desertification. An area larger than the African continent and inhabited by more than 1 billion people is now at risk of desertification, and every year it grows by 6 million hectares.[19]

Auction development rights

The government controls the rights to much of the natural capital found within a country. As such, it could chose to see itself as a participant in the market for these natural

[18] Ruckelshaus.

resources and sell them to the highest bidder. More often, however, governments give away the rights of developing the natural resource to firms. In doing this, the value of the natural resource is undervalued, over-exploited and the potential government revenue is lost. This revenue could be used to projects important to strengthening the country.

The U.S. government has used giveaways and low-priced sales of government resources since the second half of the 19th century to increase development of natural resources. At that time the goal was to encourage western expansion. Today, many of these supports are still in place even though they are not needed. As an example, the U.S. government gave away 400 million hectares (about 1 billion acres) over the last century. This represents half of the continental expanse of the country! In another example, miners are free to stake claims on a large fraction of public land, and that take precedence over other land uses. In addition, governments often cover the operating expenses of companies. They often pay for clean-up, fencing and road-building for industries such as mining, ranching, and logging.[20]

As a positive example, consider several examples of governments selling the rights to use their natural resources. Countries in Africa and South America charge fishing trawlers a fee for the right to fish in their waters. Costa Rica charged $1 million to the drug company Merck for 10,000 biological samples that will be used to develop future drugs. They have also negotiated a royalty agreement with a British company developing a pesticide from a tree native to Costa Rica. In 1996 the U.S. Federal Communications Commission auctioned off the use of portions of the electromagnetic spectrum to firms who wanted to use the airwaves for wireless communications. This auction generated $10 billion in revenue for the U.S. government.[21]

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[19] Ruckelshaus.
[20] Roodman. pp. 49-50.
[21] Roodman. pp. 118-119.

Include Natural Capital in Gross Domestic Product

Capitalism, as practiced, neglects to assign any value to the largest stock of capital it employs – the natural resources and living systems that are the basis of human capital. This deficiency cannot be corrected by simply assigning a monetary value to natural capital for several reasons. First, many of the services we receive from living systems have no known substitute at any price. Second, valuing natural capital is difficult and imprecise at best. Never the less, several recent assessments estimate that biological services flowing directly into society from the stock of natural capital are worth at least $36 trillion annually. That figure is close to the annual gross world product of $39 trillion.[22]

Conventional national accounts have three drawbacks with respect to the environment. First, the value of clean air, clean water and extensive forests are not included as a part of the countries wealth. Yet people feel worse off if they live in a country that is dirty and barren. Second, man-made capital is depreciated, but not the use of natural capital. A country that exhausts its man-made capital without replacing it clearly grows poorer; one that exhausts its fish stocks of mines may appear to grow richer based on conventional measures. Finally, the cost of cleaning up environmental damage is recorded as an addition to national product. The environmental loss caused by the damage in the first place is not recorded.[23]

What keeps government from implementing environmental policy?

Making changes to government policy will be required in order to address the many issues of sustainability. Instituting new public policy is notoriously difficult in democratic systems because of the detail and dynamic complexity of writing good legislation and getting it ratified by the appropriate legislative bodies. With that in mind, the best strategy for sustainable development is that the environmental and economic concerns be merged

[22] Paul Hawken, Amory Lovins and L. Hunter Lovins. *Natural Capitalism: Creating the Next Industrial Revolution*. (Boston, New York, London: Little, Brown & Company, 1999), p. 6.

in the decision-making. Although they are tightly coupled, they are currently treated as two separate questions.[24] Approaching them separately will inevitably lead to polarization of the parties with interests in the outcome of the negotiations.

Some of the most important environmental issues of today affect people around the globe and are caused by individual actions taken far from the site where the damage finally occurs. As a result, the leaders of many countries consider coordinated, international implementation as a prerequisite for environmental taxation. Several international agreements on different environmental issues have been negotiated. So far, none of them includes binding commitments concerning the use of policies and measures, such as environmental taxes, to reach the agreed environmental target.[25]

Explanations for why environmental taxes are not used include: (i) economic actors' resistance to new taxes, (ii) lack of knowledge of the damage done in monetary terms, (iii) the need to preserve the status quo in society, (iv) a "regulatory gap" between the theoretical virtues of a tax and the practical difficulties in legislation and implementation and (v) fear of possible loss of efficiency or competitiveness.[26]

The lack of knowledge of the environmental damage done in monetary terms is being addressed through numerous studies being conducted throughout the industrialized world. The most comprehensive of these studies is the ExternE: Externalities of Energy project. This effort is being conducted in fifteen European countries in which the local, regional and global impacts of nuclear, coal, lignite, oil, gas, biomass incineration and wind are assessed.

The "regulatory gap" between the theoretical virtues of a tax and the practical difficulties in legislation and implementation is an important issue. Implementation of a global market-based emissions policy will need to address the following issues that exist between

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[23] "The price of everything, the value of nothing." *The Economist*. July 31st 1993, p. 63.
[24] Ruckelshaus
[25] Jarmo Vehmas, Jari Kaivo-oja, Jyrki Luukanen and Penitti Malaska. "Environmental taxes on fuels and electricity – some experiences from the Nordic countries." *Energy Policy*. Vol.27, pp. 343-355.

countries. First, differences in flexibility, the economies ability to substitute one energy carrier for another. As a general rule, energy demand in developing countries is less flexible than industrialized countries. Second, differences in energy structure, the composition of energy demand varies significantly between countries. Third, differences in economic growth as they relate to fossil fuels are important. Some countries are more reliant on fossil fuels for their growth. Fourth, differences in relative price levels are important. A country with low fossil fuel costs will suffer a larger relative change than a country with higher costs for a given energy tax. This leads to the final issue, the overall effect on GDP growth. One needs to consider the feedback from the energy sector to GDP.[27]

The desire to preserve the status quo and a resistance to new taxes are universal problems of policy implementation, whatever the issue. These issues are highlighted in the debates over environmental taxes for two reasons. First, the cost of environmental taxes often affect a select group of individuals or firms but the benefits of decreased environmental damage are distributed to a wide group of people. This is a classic example of negative externalities again. Second, in a democracy, the small group of firms that face the increased cost of taxation are often able to defeat legislation through targeted lobbying efforts. Because the benefits of the tax are diffuse, no such political counterweight develops in support of the environmental legislation.

Finally, there is resistance to accepting environmental taxes for fear of loss of efficiency or competitiveness. One can argue against this as an impediment to environmental taxation in several ways. First, in the era of knowledge economies, comparative advantage based on production factors is an incomplete explanation for international trade. Second, Nordic countries have been among the most competitive in Europe in recent years. At the same time, these countries have lead the way in implementing environmental taxes on energy use. Third, high energy prices are no obstacle to industrialization or rapid economic growth (witness the success of Singapore, Hong Kong and Japan). Conversely, the

[26] Vehmas, Kaivo-oja, Luukanen and Malaska.
[27] Haugland, Olsen and Roland.

availability of ample, low-cost energy reserves is not sufficient to provide a high degree of success in international trade (consider Nigeria, Iran and the UK).[28]

These are difficult issues. Some generalizations can be made about potential solutions. First, a uniform tax rate is not equitable. Countries likely to suffer the most under these regimes will not participate, thus defeating the goal of global emissions controls. Second, because abatement costs vary widely between countries it may be appropriate for groups of countries to coordinate their emission control efforts. [29]

What can firms do to operate in a more sustainable manner?

One of the basic elements of environmental sustainability is increased efficiency, both energy and material use. These match well with business desire to cut costs. Often costs savings are a result of increased efficiency in business. It seems that these two, environmental sustainability and business, should go together. Often they do not, but that is not to say that they cannot.

There are many things that business *could* do to operate in a more sustainable manner. A more realistic question is, "what *will* they do?" The fact is, most firms are for-profit institutions. As such, the primary interest of business is to make a profit. Change originates within a firm for several reasons. The first is external requirements, e.g. government regulation. This was covered in our discussion of government's role in the market. The second reason for change is one based on opportunity. The form of the opportunity can vary. For example, the opportunity may be a new cost-saving technology or business practice. Another opportunity is a new source of revenue, either from a new product or a new market for an existing product. The following ideas highlight the opportunities available to business that create either cost savings or new sources of revenue *and* provide an environmental benefit as well.

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[28] Vehmas, Kaivo-oja, Luukanen and Malaska.

A service business as a biological analog

Biomimicry is a term that indicates redesigning industrial systems with biological systems as a model. In biological systems, there is no "waste." Systems operate in closed, continuous cycles. Today, businesses are not operating this way. In the U.S. it is estimated that 6% of the material flows actually end up as products. Durable goods are even worse, close to 1% of the material flows end up as products. With respect to energy use, the U.S. economy is less than 10% efficient as the laws of physics permit.[30] There are opportunities to be found here.

One example is the idea of a "zero-emissions" industrial park. The tenants of this park would constitute an industrial ecosystem in which one company feeds on the waste output of others in close proximity. Operating costs decline because of decreases in the cost of disposing of "waste" output and transporting inputs.[31]

Having businesses own the products they produce from cradle to grave and beyond is one way to specify product rights very precisely. Through well-specified property rights, it is clear who is responsible. Property rights are the legal rules that describe what people and firms can do with their property. Under this idea, results that were once externalities are now internal to the firm. In this way, economic efficiency can be achieved without government intervention.[32]

In the mid 1980's, Swiss industry analyst Walter Stahel and German chemist Michael Braungart independently proposed a new industrial model. Instead of an economy in which goods are made and sold, they proposed a service economy wherein customers obtained services by leasing or renting goods rather than buying them outright. Manufacturers stop seeing themselves as sellers of products and become, instead, deliverers of service, provided by long-lasting, upgradeable durables. Their goal is to sell

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[29] Haugland, Olsen and Roland.
[30] Hawkins, Lovins & Lovins, pp. 10, 14-15.
[31] Hawkins, Lovins & Lovins, p. 16.

results rather than equipment, performance and satisfaction rather than motors, fans, plastic, or condensers.[33]

Stahel coined the term "extended product responsibility" (EPR) to describe the cradle-to-cradle responsibility of a manufacturer for its products. EPR is actually becoming a standard in some European industries. As an example, Agfa Gaevert pioneered the leasing of copier services, which has spread to the entire industry. Also, Carrier Corporation, a division of United Technologies, is creating a program to sell cooling services to companies while they retain ownership of the air conditioning equipment.[34]

Braungart's model of a service economy focuses on material cycles. Products that do not degrade back into natural nutrient cycles are designed to be re-incorporated into the technical nutrient stream of industry. Consider an industrial system where there are no landfills, or smokestacks. How would a company design it product and processes if none of the input could be discarded and everything that was produced eventually returned? This is more than a theoretical question. The earth works in exactly this way and has for billions of years.[35]

There are a number of benefits that result from a service economy. First, the minimization of material use, the maximization of product durability, and enhanced ease of maintenance improve the customer experience of the product and protects the manufacturer's investment. Second, both the customer and manufacturer have an incentive to continuously improve the productivity of the resource. The result of these is that there is less demand on the planet's resources. Importantly, this decrease in demand is achieved while both the customer and manufacturer pursue their respective self-interests.[36]

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[32] Pindyck & Rubinfeld, p. 666.
[33] Hawkins, Lovins & Lovins, p. 16.
[34] Hawkins, Lovins & Lovins, p. 17.
[35] Hawkins, Lovins & Lovins, p. 18.
[36] Hawkins, Lovins & Lovins, p. 18.

Do more with less

The world's population cannot attain a Western standard of living by following traditional industrial paths to development. The resources required are too vast, too expensive and too damaging to local and global systems. In the U.S. today individuals waste or cause to be wasted *1 million* pounds of material per person per year. The total annual flow of waste in the U.S. industrial system is *250 trillion* pounds. Less than 2% of this is recycled. Developing nations generally aspire to an economy like that in the United States. A revolutionary leap in resource productivity is needed and there is *a lot* of room for improvement.[37]

Increasing resource productivity means obtaining the same amount of utility or work from a product or process while using less energy and material. When an industry reduces the energy and material content of its product, it saves on overall costs per unit of production and reduces environmental emissions and waste as well. In fact, this is often a more effective way of reducing emissions than expensive "end of pipe" technologies that serve no other purpose.[38]

In addition, the environmental benefits of resource reduction and recycling extend back to the beginning of the production cycle. They manifest themselves in decreased mining and mining waste, decreased consumption and pollution of water, decreased air pollution, decreased deforestation and decreased erosion.[39]

Furthermore, increasing the energy and resource efficiency of industrial plants or communities adds up to increasing the efficiency and competitiveness of the national economy.[40]

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[37] Hawkins, Lovins & Lovins, pp. 14, 52-53.
[38] Jim MacNeill. "Strategies for Sustainable Economic Development." Scientific American. September 1989, pp. 155-165.
[39] McNeill.
[40] McNeill.

Suing for Damages

As an example of the way externalities are often handled today (poorly), consider litigation. A party that is harmed (the victim) by another has the legal right to sue. If successful, the victim can recover monetary damages equal to the harm it has been caused. A suit for damages is different from emission fees because the victim, not the government, is paid.[41]

What motivates some businesses today is not the desire to "do good," nor to recognize new revenue opportunities described above. Instead, companies change their practices because of the fear of litigation. Newspapers regularly contain stories of individuals and firms who are suing for damages resulting from the action of a firm. As a way to force a firm to internalize the cost of a negative externality, it is arguably effective. As a way to improve the overall efficiency of industry, it fails. It becomes, in effect, a simple transfer of cash from one party to another. No additional goods or services are created.

Why do they tend to resist these changes?

One explanation for businesses' reluctance to implement these beneficial changes is that the instruments they use to set targets, evaluate performance and hand out rewards are faulty. Below a number of common responses to the question "why doesn't business implement these changes?" are given along with a brief analysis of why it is faulty and what could be done differently.

Don't use life cycle costs

Decisions to buy small items are based upon the initial cost rather than their full life cycle cost. For example, distribution transformers that supply electricity to buildings are a minor item at just $320 a piece. Most companies try to save a few bucks by buying the

[41] Pindyck & Rubinfeld, p. 668.

lowest priced model. A great deal of the nation's electricity must flow through the devices. Using less efficient models wastes about $1 billion per year. As another example, consider the wiring of new homes and offices. The electrician who quotes using a larger gage wire will have a higher bid than those who quote the standard wire gage, which is specified as a minimum to prevent electrical fires. The first electrician will not win the bid if only initial costs are considered. On the other hand, if life cycle costs are used, the savings due to lower electrical resistance would tip the decision toward the first bidder and result in a reduction in energy demanded.[42]

Energy costs are small relative to total costs

Energy costs represent about 2% of the total costs of a business. This may be true, but any savings that result go straight to the bottom line. In addition, today's technologies can lead to dramatic savings. For example, Malden Mills, a maker of products like Polartec, recently retrofitted a warehouse with the latest lighting technology, replacing metal-halide lights that were state of the art in the mid-1990's. They realized a reduction in energy use of 93%, improved visibility and the investment paid for itself in 18 months.[43] In another example, a manager in the plant of a Fortune 100 company was identified as saving $3.50 per square foot per year in a million square-foot facility. The CEO remarked, "That is pretty good. He is adding $3.5 million a year to our bottom line." In the next breath, he added, "I can't get really excited about energy though – its only a few percent of my cost of doing business." When he was shown that similar savings in the 90-million square-feet of facilities worldwide would result in an increase in the net earning by 56%, he promoted the manager and made him responsible for energy saving practices throughout the company.[44]

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[42] Lovins, Amory B., L. Hunter Lovins and Paul Hawken. "A Road Map for Natural Capitalism." Harvard Business Review, May-June 1999, pp. 145-158.
[43] Lovins, Lovins & Hawkens
[44] Hawkins, Lovins & Lovins, p. 266.

Use simple payback analysis

Often, companies use a method called simple payback to analyze their investments. A sampling of companies showed that the median simple payback required for an energy investment was 1.9 years – equivalent to an after tax rate of around 71% per year. What is more, companies readily invest in production-increasing projects that do not return 71%. In fact, the savings generated by the energy saving investment is a lower-risk investment that will probably have a higher rate of expected return over the investment in additional production[45]

Furthermore, analyzing a project using simple payback is not the most accurate. The more accurate analysis is using discounted cash flows. Even if a discounted cash flow is used, firms sometimes omit savings that result from energy-saving investment. Not performing a good life cycle analysis leads to a firm choosing to not invest in material and energy saving projects.

Conclusion

Government and business will have to work together to if we hope to sustain the world in which we live. Economic and environmental decisions will need to be viewed together instead of in isolation, as they are today. Government needs to combine appropriate standards with market-based regulation in order to give the market the structure it needs to price goods and services accurately, taking into account negative externalities. Business needs to review its current practices and look for ways to increase the efficiency with which it uses energy and material. Running a business as if it were a part of a continuous closed cycle creates new opportunities. Looking for projects that reduce energy and material consumption represent significant savings for the firm, that are often less risky than investments in additional production and good for the environment.

[45] Hawkins, Lovins & Lovins, p. 267.

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