Energy
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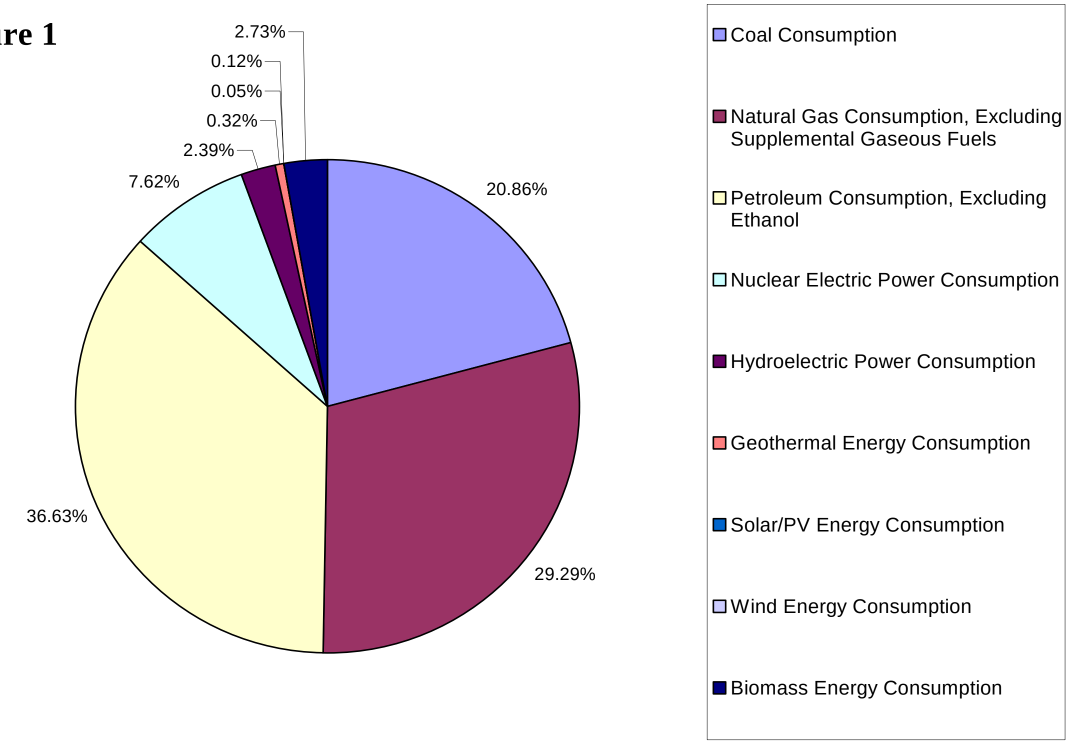
Most of the energy consumed in America today is produced from the combustion of fossil fuels, primarily oil, coal, and natural gas. Energy can be generated, however, in any number of ways. Figure 1 indicates the sources of energy employed by the American economy as of February 2004.

Figure 1



The economy has become more efficient at using energy over time. In 1949, the United States economy required 20,620 British Thermal Units (Btu, a common metric by which energy is measured) to produce an inflation-adjusted dollar of domestic goods and services. By 2002, only 10,310 Btu were required to do the same.[1]

In a free market, cost dictates energy choices. Fossil fuels, for example, are economically attractive for many applications because the energy available from fossil fuels is highly concentrated, easily transportable, and cheaply extracted. Renewable energies such as wind and solar power, on the other hand, are relatively dispersed, difficult to transport, and costly to harness given the capital costs of facility construction.

Many people recommend accelerated federal subsidies and preferences for renewable energy in order to reduce America's dependence on imported oil. But such recommendations fail to appreciate the fact that energy sources are often difficult to substitute for one another. Until we see major technological advances in electric-powered vehicles and related battery systems, for example, technological breakthroughs in solar or

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[1] Energy Information Administration, "Table 1.5: Energy Consumption, Expenditures, and Emissions Indicators, 1949-2002," http://www.eia.doe.gov/emeu/aer/txt/ptb0105.html.

wind power will have little, if any, impact on oil imports. That's because renewable energy is used primarily to generate electricity and cannot be used directly in transportation to replace oil: in 2002, only 2.5 percent of America's total electricity was generated from oil combustion.[2] The main impediment to the commercial viability of electric vehicles is the cost and operation of the vehicle's power train, not the cost of the electricity necessary as an input to that power train.

Oil Depletion

One of the recurring policy fights concerning energy is what the government should to do about the depletion of economically attractive crude oil reserves. Underlying this fight, however, is a dispute about whether oil is in danger of becoming scarcer in the foreseeable future.

One camp (primarily geologists) argues that few, if any, major new oil fields remain to be found and that mathematical calculation demonstrates that production will peak at some point in the not-too-distant future and then begin a slow but steady decline.[3] Another camp (primarily economists) contends that reserves are as much an economic as a geologic phenomenon. That is, reserves are discovered and counted when it makes economic sense to find them. Thus, we do not know how much economically profitable oil has yet to be "discovered." Technological advances are adding reserves at a far greater rate than they are being depleted.[4] For example, in 1970, non-OPEC countries had about 200 billion barrels in reserves. Through 2003, they had produced 460 billion barrels and still had 209 billion barrels remaining.[5] Although the debate is inconclusive, the weight of the evidence suggests that economists have the better argument.[6]

Another dispute concerns whether price signals alone are sufficient to efficiently move from one set of energy resources to another if the need arises. Some have maintained that consumers do not change their behavior much in response to price increases. The claim is true in the short run, but not true over the course of several years. Economists estimate that a ten-percent increase in oil prices reduces amount demanded in the short run by about one percent. Over the long run, however, a ten-percent increase in oil prices reduces amount demanded by about ten percent.[7]

Short- and long-term responses differ because of the costs and time associated with replacing the capital stock, switching fuel sources, and adjusting manufacturing practices. Consumers generally "wait out" a price increase until they are convinced that investments in energy efficiency or fuel switching will, at the very least, pay for themselves and, at best, yield long-term gains. Although some worry that the lag between price signals and consumer response is inefficient, given the costs involved in

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[2] 95 billion kWh were generated by oil out of a total of 3858 billion kWh in 2002. See Energy Information Administration, *Electric Power Annual 2002* pp. 1-3.

[3] Kenneth S. Deffeyes, *Hubbert's Peak: The Impending World Oil Shortage* (Princeton, NJ: Princeton University Press, 2001).

[4] M.A. Adelman, *The Genie Out of the Bottle: World Oil Since 1970* (Cambridge, MA: MIT Press, 1995), pp. 11-39, and "The World is Not Running Out of Oil," *Regulation* 27:1, Spring 2004, pp. 16-21.

[5] Adelman (2004), p. 18.

[6] Robert Arnott, "Supply Side Aspects of Depletion," *Journal of Energy Literature* 8:1, June 2002.

[7] Adelman (1995), p. 190.

changing consumption practices, consumer reluctance to react at the first sign of trouble is economically defensible.

The severe price implications of even modest supply disruptions have led some economists to support interventions to avoid the high prices that accompany oil supply shocks. To hedge against severe oil-market disruptions, the federal government maintains a Strategic Petroleum Reserve (SPR), an inventory of 660 million barrels of oil as of mid-2004. To hedge against supply shortages and high prices in electricity markets, many states require utilities to maintain reserve generation capacity. Such interventions are not necessary because private insurance against energy price volatility is readily available in the form of commodity futures on the New York Stock Exchange and various derivative financial contracts.[8] But infrequent high energy prices are more costly politically than the hidden but constant costs of rarely utilized excess electric generation capacity and oil inventory.

How important is energy to the economy as a whole? Energy expenditures were only 7.2 percent of GDP in 2000[9] and oil expenditures were only 2.1 percent of GDP.[10] Some economists claim that the effect of energy price shocks on the economy is overstated and that monetary policy—not oil price shocks—deserves most of the blame for the recessions in 1973, 1979, and 1990.[11] Other economists disagree.[12] Ideally, to disentangle the effect of monetary policy from oil price increases, one would need episodes in which interest rates were constant but oil prices increased. But this occurred only in 1990, and it is difficult to infer causality from one case. Thus, the debate is difficult to resolve at present.[13]

Subsidies

Are energy price signals so distorted by inappropriate government policies that they do not efficiently allocate resources? There are two fundamental complaints. The first is that government subsidies and preferences for various fuels and technologies reduce prices below market levels. The second complaint is that energy prices do not reflect the environmental damage inflicted on others by energy consumption.

Regarding the former complaint, the Energy Information Administration reports that federal energy subsidies as of 1999 were somewhere between $8.6 billion and $11.3 billion annually, or about one percent of total yearly energy expenditures.[14] Figure 2

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[8] Philip Verleger, Jr., *Adjusting to Volatile Energy Prices* (Washington, DC: Institute for International Economics, 1993).

[9] Energy Information Administration, *Annual Energy Review 2002* Table 1.5 p. 13.

[10] Authors' calculations using Energy Information Administration, *Monthly Energy Review* Table 1.7 (May 2004) "Products Supplied Column" and Table 9.1 p. 123 "Composite Refinery Acquisition Price" and GDP data from the NIPA website at http://www.bea.doc.gov/bea/dn/nipaweb/SelectTable.asp?Popular=Y.

[11] The strongest argument to this effect published thus far is B.S. Bernanke, M. Gertler, and M. Watson, "Systematic Monetary Policy and the Effects of Oil Price Shocks," *Brookings Papers on Economic Activity* 1 (Washington, DC: Brookings Institution, 1997), pp. 91-157.

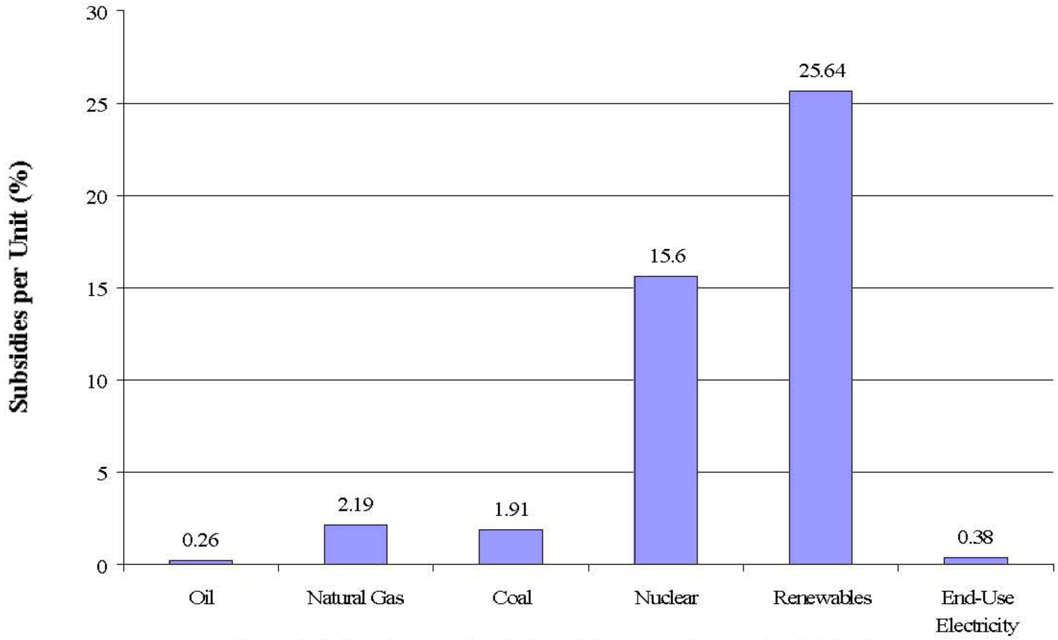
[12] James D. Hamilton and Ana Maria Herrera, "Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy," *Journal of Money, Credit, and Banking*, April 2004, vol. 36, pp. 265-286.

[13] Donald Jones, Paul Leiby, and Inja Paik, "Oil Price Shocks and the Macroeconomy: What Has Been Learned Since 1996," *Energy Journal* 25:2, 2004, pp. 1-32.

[14] U.S. Energy Information Administration, "Federal Intervention and Subsidies in Energy Markets 1999: Energy Transformation and End Use," SR/OIAF/2000-02, May 2000, p. 53.

breaks those subsidies down by fuel and considers them in relation to the size of the industry.

Figure 2
Magnitude of Energy Subsidies, 1999



Source: Energy Information Administration, "Federal Financial Interventions and Subsidies in Energy Markets 1999: Energy Transformation and End Use," SR/OIAF/2000-02, Table ES1, p. xiv.

Notice three things about the numbers reported in Figure 2. First, the fossil fuel subsidies are trivial in percentage terms. Second, they probably do not affect final prices because they do not affect marginal cost and, thus, are simple wealth transfers from taxpayers to owners of the subsidized fuels. Third, the subsidies to nuclear are even larger than those displayed in Figure 2 because of limited liability from nuclear accidents.[15]

The complaint about environmental damages is more serious. Economists believe that, in an ideal world, taxes would be imposed on users equal to the damages imposed on others. Energy consumption would then be efficient because the external costs would be internalized in its price. However, calculating environmental costs associated with fuel use is controversial. The main difficulty is knowing the effects of various concentrations of pollutants and hazardous substances on human health.

Figure 3 demonstrates the problem. It is a survey of the published range of external cost estimates associated with the consumption of various fuels for electricity generation. The wide disparity in published estimates in peer-reviewed journals suggests that, whatever the merits of this exercise, it is impossible at the moment to conclude scientifically what the correct tax should be.

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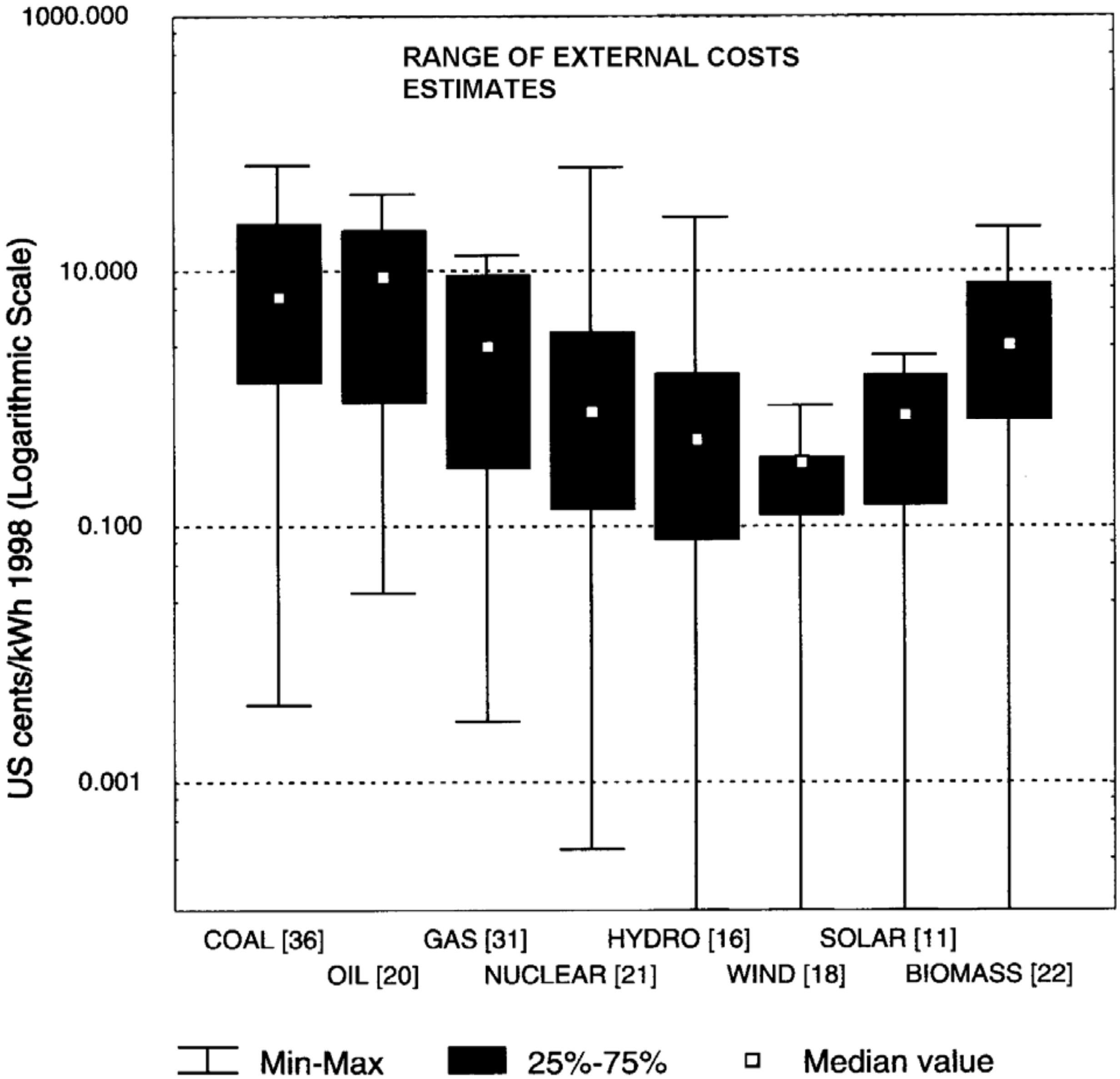
[15] Anthony Heyes, "Determining the Price of Price-Anderson," *Regulation* 25:4, Winter 2002-2003, pp. 26-30.

Figure 3



Source: Thomas Sundqvist & Patrik Soderholm, "Valuing the Environmental Impacts of Electricity Generation: A Critical Survey," The Journal of Energy Literature 8:2, December 2002, p. 19.

A further implication of Figure 3 is worth considering. Although consumers are not explicitly taxed to reflect the "environmental externalities" associated with their energy use, the environmental costs of their energy choices are, to some degree, reflected in energy prices via the compliance costs associated with existing environmental regulations. Whether those regulatory costs are greater than, equal to, or less than the environmental externalities imposed by energy consumption is unclear for the same reasons that the findings reported in Figure 3 are unclear. If we accept estimates from the U.S. Environmental Protection Agency concerning the effect various energy-related pollutants have on human health, it would appear that energy prices today generally do a reasonable job of reflecting environmental costs. Economist W. Kip Viscusi et al find that, if EPA's analysis of the impact of various pollutants on human health is accurate, then coal prices are somewhat less than optimal, natural gas prices are too high, and gasoline prices are about right.[16]

Does Conservation Require Subsidies?

Some energy analysts argue that consumers invest too little in energy conservation measures such as insulation, fluorescent lights, or hybrid cars.[17] Even if true, can government collect and assimilate information better than people left to their own devices and then, through regulation based on that information, provide net benefits? Empirical analysis suggests that the record of government-directed conservation is rather poor.[18]

Between 1989 and 1999, for example, electric utility companies—primarily at the behest of state public utility commissions—spent $23.1 billion in the United States to subsidize ratepayer energy conservation investments. Yet a recent study found that those expenditures reduced electricity sales by only between 0.3 and 0.4 percent within their service territories and did so at an average cost of 14-22 cents per kilowatt hour—roughly two to three times as expensive, on average, than the energy it was attempting to conserve.[19]

Similarly, a recent study found that federal energy efficiency standards for appliances will provide net negative benefits of between $46.4 and $56.2 billion through 2050 and that those costs will be borne disproportionately by low- and middle-income households.[20]

Energy Research and Development (R & D)

Because investors cannot easily capture all the economic benefits associated with a particular technological advance, most economists agree that no government involvement leads to a less-than-efficient level of investment in energy R&D.

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[16] W. Kip Viscusi et al., "Environmentally Responsible Energy Pricing," *Energy Journal* 15:2, 1994, pp. 23-42. The authors did not consider greenhouse gas emissions in their calculations given the uncertainty surrounding the environmental and economic ramifications of global warming.

[17] Interlaboratory Working Group, *Scenarios for a Clean Energy Future* (Oak Ridge, TN; Oak Ridge National Laboratory and Berkeley, CA; Lawrence Berkeley National Laboratory), ORNL/CON-476 and LBNL-44029, November 2000. lFor an alternative view, see Mikael Togeby and Anders Larsen, "The Potential for Electricity Conservation in Industry: From Theory to Practice," Proceedings from the 18th International Association for Energy Economics International Conference, *Into the 21st Century: Harmonizing Energy Policy, Environment, and Sustainable Economic Growth* (Cleveland: International Association for Energy Economics, 1995), pp. 48-55.

[18] Franz Wirl, *The Economics of Conservation Programs* (Boston: Kluwer Academic Publishers, 1997).

[19] David Loughran and Jonathan Kulick, "Demand Side Management and Energy Efficiency in the United States," *Energy Journal* 25:1, 2004, pp. 19-43.

[20] Ronald Sutherland, "The High Costs of Federal Energy Efficiency Standards for Residential Appliances," Policy Analysis 504, Cato Institute, December 23, 2003.

The standard economic remedy is federal support of energy R&D projects. Although economists do not object to such policies on principle, they do find that government's record of support for various energy investments is dismal.[21] This has led most economists to conclude that, while there may be a "market failure" in the R&D sector, there is at least an equally serious problem of "government failure" in the "solution."[22]

Economist William Niskanen reminds us that "[t]he case for government support of civilian R&D is that the return to the economy is greater than the return to the firm, not that government has better information on what R&D has the highest return."[23] Niskanen accordingly suggests that targeted federal R&D efforts be eliminated and replaced with a robust R&D tax credit and matching grants to universities to supplement funds raised from private sources.[24] While the idea appears meritorious, it has not attracted much political support.

Economists agree that prices allocate all resources (including energy) better than government edicts do. If politicians intervene in the energy market, manipulating price signals through tax credits is preferable to direct regulation.

CAFE Standards

An example of the economic case against direct regulation is the fuel economy standards for cars and trucks. The Congressional Budget Office estimates that increasing the Corporate Average Fuel Efficiency (CAFE) standards to achieve a ten-percent reduction in gasoline consumption would cost producers and consumers about $3.6 billion a year *more* than the value of fuel savings, or about a net cost? of $228 per new vehicle sold. Achieving the same reduction through a gasoline tax increase of 46 cents per gallon would cost producers and consumers about $2.9 billion a year, or $184 per new vehicle sold.[25] While few dispute such observations, CAFE standards are more politically palatable than gasoline taxes because the costs of the former are hidden from consumers, while the costs of the latter are not.

CAFE standards not only cost more than gasoline taxes to achieve a specific consumption reduction, but also reduce the marginal cost of driving a mile and, thus, ironically, increase vehicle miles traveled. The economics literature suggests that for every ten-percent increase in fuel efficiency through standards, people increase their miles driven by two percent.[26] In fact, any efficiency standard that reduces the marginal cost of consuming energy will have an analogous effect, known to economists as the "rebound effect."

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[21] Linda Cohen and Roger Noll, *The Technology Pork Barrel* (Washington, DC: Brookings Institution, 1991); U.S. General Accounting Office, "DOE's 'Success Stories' Report," GAO/RCED-96-120R, April 15, 1996; William Niskanen, "R&D and Economic Growth – Cautionary Thoughts," in *Science for the 21st Century: The Bush Report Revisited*, Claude Barfield, ed. (Washington, DC: American Enterprise Institute, 1997), pp. 84-86.

[22] Ronald Sutherland, "Time to Overhaul Federal Energy R&D," Policy Analysis 424, Cato Institute, February 7, 2002.

[23] Niskanen, p. 90.

[24] Niskanen.

[25] Congressional Budget Office, "The Economic Costs of Fuel Economy Versus a Gasoline Tax," December 2003.

[26] David Greene, James Kahn, and Robert Gibson, "Fuel Economy Rebound Effect for U.S. Household Vehicles," *Energy Journal* 20:3, 1999, pp. 6-10.

One of the consequences of the rebound effect in relation to CAFE standards is a net increase in air pollution. According to one recent study, a 50-percent increase in fuel efficiency standards would reduce gasoline consumption by about 21 percent, but would increase net emissions of volatile organic compounds by 1.9 percent, nitrogen oxides by 3.4 percent, and carbon monoxide by 4.6 percent.[27]

Compensating Losers

Much of the debate about energy policy, however, is not about economic efficiency (the subject of this essay so far), but about compensating losers. That's because energy prices tend to be volatile, and even minor changes in supply and demand have unusually large effects on prices in the short run. This encourages consumers to campaign for government protection from market forces when prices go up and producers to campaign for government protection from market forces when prices fall.

Past interventions driven by the desire to protect people from losses have included consumer price controls, gasoline rationing, government-managed and protected producer cartels, strict public utility regulation, fuel use mandates and prohibitions, and windfall profit taxes—all of which have been harshly criticized by economists in retrospect.[28] Interventions today are far milder, including subsidized energy services, preferences and subsidies to select energy producers, largely symbolic periodic investigations of alleged industry misbehavior, and somewhat lighter public-utility regulation. Economists disagree among themselves about whether government should be shielding people from losses in the first place. However, they agree, for the most part, that in addressing such concerns regarding energy prices, general income transfers are far more efficient and less costly than are direct regulatory interventions in particular markets.

[27] Andrew Kleit, "CAFE Changes, By the Numbers," *Regulation* 25:3, Fall 2002, p. 35.

[28] For a summary of criticisms, see Robert L. Bradley, *Oil Gas, and Government: The U.S. Experience*, Vols I & II (Lanham, MD: Rowman & Littlefield, 1996); Richard Posner, *Natural Monopoly and Its Regulation* (Washington, DC: Cato Institute, 1999); and Peter Van Doren, *Politics, Markets, and Congressional Policy Choices* (Ann Arbor: University of Michigan Press, 1991).