INTERNATIONAL CENTER FOR TECHNOLOGY ASSESSMENT

The Real Price of Gasoline

REPORT NO. 3
AN ANALYSIS OF THE HIDDEN EXTERNAL
COSTS CONSUMERS PAY TO FUEL THEIR AUTOMOBILES

Foreword

This report by the International Center for Technology Assessment (CTA) represents the third in a series of studies designed to assess the environmental and social impacts of transportation technology. These reports are meant to aid policy makers and the public in their ongoing deliberations concerning the future course of transportation in the United States.

This particular report contains an in-depth analysis of the many external costs associated with the consumption of gasoline. This report found that these costs fall into four broad categories and are passed on to both gasoline users and nonusers by way of higher taxes, insurances costs, and retail prices for items other than gasoline. Effectively, the cost of gasoline is substantially higher than the price consumers pay at the pump, even though the majority of this cost is hidden from the public.

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The CTA was formed in 1994 in order to assist the general public and policy makers in better understanding how technology affects society. The CTA is devoted to fully exploring the economic, ethical, social, environmental, and political impacts of technology or technological systems. Using this holistic form of analysis, the CTA provides the public with independent, timely, and comprehensive information about the potential impacts of technology. The CTA is also committed to initiating appropriate legal, grassroots, public education, and legislative responses relevant to its assessment findings.

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Executive Summary

This report by the International Center for Technology Assessment (CTA) identifies and quantifies the many external costs of using motor vehicles and the internal combustion engine that are not reflected in the retail price Americans pay for gasoline. These are costs that consumers pay indirectly by way of increased taxes, insurance costs, and retail prices in other sectors.

The report divides the external costs of gasoline usage into five primary areas: (1) Tax Subsidization of the Oil Industry; (2) Government Program Subsidies; (3) Protection Costs Involved in Oil Shipment and Motor Vehicle Services; (4) Environmental, Health, and Social Costs of Gasoline Usage; and (5) Other Important Externalities of Motor Vehicle Use. Together, these external costs total $558.7 billion to $1.69 trillion per year, which, when added to the retail price of gasoline, results in a per gallon price of $5.60 to $15.14.

Tax Subsidies

The federal government provides the oil industry with numerous tax breaks designed to ensure that domestic companies can compete with international producers and that gasoline remains cheap for American consumers. Federal tax breaks that directly benefit oil companies include: the Percentage Depletion Allowance (a subsidy of $784 million to $1 billion per year), the Nonconventional Fuel Production Credit ($769 to $900 million), immediate expensing of exploration and development costs ($200 to $255 million), the Enhanced Oil Recovery Credit ($26.3 to 100 million), foreign tax credits ($1.11 to $3.4 billion), foreign income deferrals ($183 to $318 million), and accelerated depreciation allowances ($1.0 to $4.5 billion).

Tax subsidies do not end at the federal level. The fact that most state income taxes are based on oil firms' deflated federal tax bill results in undertaxation of $125 to $323 million per year. Many states also impose fuel taxes that are lower than regular sales taxes, amounting to a subsidy of $4.8 billion per year to gasoline retailers and users. New rules under the Taxpayer Relief Act of 1997 are likely to provide the petroleum industry with additional tax subsidies of $2.07 billion per year. In total, annual tax breaks that support gasoline production and use amount to $9.1 to $17.8 billion.

Program Subsidies

Government support of US petroleum producers does not end with tax breaks. Program subsidies that support the extraction, production, and use of petroleum and petroleum fuel products total $38 to $114.6 billion each year. The largest chunk of this total is federal, state, and local governments' $36 to $112 billion worth of spending on the transportation infrastructure, such as the construction, maintenance, and repair of roads and bridges. Other program subsidies include funding of research and development ($200 to $220 million), export financing subsidies ($308.5 to $311.9 million), support from the Army Corps of Engineers ($253.2 to $270 million), the Department of Interior's Oil Resources Management Programs ($97 to $227 million), and government expenditures on regulatory oversight, pollution cleanup, and liability costs ($1.1 to $1.6 billion).

Protection Subsidies

Beyond program subsidies, governments, and thus taxpayers, subsidize a large portion of the protection services required by petroleum producers and users. Foremost among these is the cost of military protection for oil-rich regions of the world. US Defense Department spending allocated to safeguard the worlds' petroleum resources total some $55 to $96.3 billion per year. The Strategic Petroleum Reserve, a federal government entity designed to supplement regular oil supplies in the event of disruptions due to military conflict or natural disaster, costs taxpayers an additional $5.7 billion per year. The Coast Guard and the Department of Transportation's Maritime Administration provide other protection services totaling $566.3 million per year. Of course, local and state governments also provide protection services for oil industry companies and gasoline users. These externalized police, fire, and emergency response expenditures add up to $27.2 to $38.2 billion annually.

Environmental, Health and Social Costs

Environmental, health, and social costs represent the largest portion of the externalized price Americans pay for their gasoline reliance. These expenses total some $231.7 to $942.9 billion every year. Few people will dispute that internal combustion engines contribute heavily to localized air pollution. And while the amount of damage that automobile fumes cause is certainly very high, the total dollar value is rather difficult to quantify. Approximately $39 billion per year is the lowest minimum estimate reckoned by researchers in the field of transportation cost analysis, although the actual total is surely much higher and may exceed $600 billion. When you consider that researchers have conclusively linked auto pollution to increased health problems and mortality, the CTA report's estimate of $29.3 to $542.4 billion for the annual uncompensated health costs associated with auto emissions may not adequately reflect the value of lost or diminished human life. Other costs associated with localized air pollution attributable to gasoline-powered automobiles include decreased agricultural yields ($2.1 to $4.2 billion), reduced visibility ($6.1 to $44.5 billion), and damage to buildings and materials ($1.2 to $9.6 billion). Global warming ($3 to $27.5 billion), water pollution ($8.4 to $36.8 billion), noise pollution ($6 to $12 billion), and improper disposal of batteries, tires, engine fluids, and junked cars ($4.4 billion) also add to the environmental consequences wrought by automobiles.

Some of the costs associated with the real price of gasoline go beyond the effects of acquiring and burning fuel to reflect social conditions partially or wholly created by the automobile's preeminence in the culture of the United States. Chief among these conditions is the growth of urban sprawl. While monetizing the impact of sprawl may prove a challenging endeavor, several researchers have done significant work on the subject. The costs of sprawl include: additional environmental degradation (up to $58.4 billion), aesthetic degradation of cultural sites (up to $11.7 billion), social deterioration (up to $58.4 billion), additional municipal costs (up to $53.8 billion), additional transportation costs (up to $145 billion), and the barrier effect ($11.7 to $23.4 billion). Because assessment of the costs of sprawl is somewhat subjective and because study of the topic remains in a nascent stage, the CTA report follows the lead of other researchers in field of transportation cost analysis and reduces the total of the potential cost of sprawl by 25% to 50% to arrive at a total of $163.7 to $245.5 billion per year.

Other External Costs

Finally, external costs not included in the first four categories amount to $191.4 to $474.1 billion per year. These include: travel delays due to road congestion ($46.5 to $174.6 billion), uncompensated damages caused by car accidents ($18.3 to $77.2 billion), subsidized parking ($108.7 to $199.3 billion), and insurance losses due to automobile-related climate change ($12.9 billion). The additional cost of $5.0 to $10.1 billion associated with US dependence on imported oil could rise substantially, totaling $7.0 to $36.8 billion, in the event of a sudden price increase for crude oil.

Recommendations

The ultimate result of the externalization of such a large portion of the real price of gasoline is that consumers have no idea how much fueling their cars actually costs them. The majority of people paying just over $1 for a gallon of gasoline at the pump has no idea that through increased taxes, excessive insurance premiums, and inflated prices in other retail sectors that that same gallon of fuel is actually costing them between $5.60 and $15.14. When the price of gasoline is so drastically underestimated in the minds of drivers, it becomes difficult if not impossible to convince them to change their driving habits, accept alternative fuel vehicles, or consider progressive residential and urban development strategies.

The first step toward getting the public to recognize the damage caused by the United States' gasoline dependance is getting the public to recognize how much they are paying for this damage. The best way, in turn, to accomplish this goal is to eliminate government tax subsidies, program subsidies, and protection subsidies for petroleum companies and users, and to internalize the external environmental, health, and social costs associated with gasoline use. This would mean that consumers would see the entire cost of burning gasoline reflected in the price they pay at the pump. Drivers faced with the cost of their gasoline usage up front may have a more difficult time ignoring the harmful effects that their addiction to automobiles and the internal combustion engine have on national security, the environment, their health, and their quality of life.

INTRODUCTION

How much does a gallon of gasoline cost? A quick trip to a local service station in most areas of the country provides an answer of just over $1 per gallon. While we certainly recognize that there are other external costs associated with operating our automobiles, including maintenance, vehicle wear and tear, and roadway construction, most people probably feel confident that driving remains a relatively cheap endeavor. In reality, the external costs of using our cars are much higher than we may realize. The automobile and petroleum industries, with the complicity of policymakers, gladly perpetuate the myth that cheap, abundant gasoline is the best and most economically feasible fuel to power our personal transportation.

While the price at the pump seems to confirm this, how many people would hold the same opinion if the sign outside their local gas station advertized a price of $15.14 per gallon? How many people would decide that driving to work is cheaper and more convenient than taking public transportation if gasoline cost even $5.60 per gallon? How many people would question the importance of researching and developing alternative fuels if a single fillup at the gasoline pump cost between $65 and $180?

In fact, Americans currently pay at least $5.60 per gallon of gasoline. This, however, is the minimum estimate; the actual price may stand at $15.14 per gallon or higher. The many external costs of the United States' complete reliance on gasoline, not currently reflected in the price at the pump, artificially lower the immediate price consumers pay to fuel their cars. For the purpose of this report, we have conservatively assumed a retail gasoline price of $1 per gallon and have added on the numerous and often hidden externalities associated with Americans' reliance on gasoline-powered vehicles. The great disparity between our low and high estimates results from difficulties that often arise when placing dollar values on the economic, social, and cultural impacts of the United States' gasoline addiction. To ensure the accuracy and integrity of our conclusions, we took a very conservative approach when formulating our low estimate of the real price of gasoline.

It is important to emphasize that this report seeks to identify the *real cost* of gasoline. It does not propose how much we think gasoline should cost or provide estimates of what gasoline may cost at some point in the future. The *Real Price of Gasoline* is the amount that consumers are already paying in the form of hidden external costs reflected in higher taxes, insurance premiums, and consumer prices in other retail sectors.

Once we establish that consumers are paying from $4.60 to $14.14 per gallon of gasoline more than the price at the pump, it falls upon all of us to either justify this added expense or determine that it makes little economic and social sense. Should the government continue subsidizing the petroleum industry at the rate of $125.6 to $273.2 billion annually in the form of tax breaks, program subsidies, and uncompensated protection services? Given that our burning, spilling, and leaking petroleum products combined with other effects of our reliance on the internal combustion engine cost an additional $423.1 billion to $1.4 trillion each year, would it not make more sense to devote a greater share of these resources to researching, developing, and implementing transportation policies and technologies that are cleaner, safer, and less socially destructive?

Petroleum products continue to account for more than 99 percent of the fuel used to power transportation in the United States, according to the Department of Energy.[1] While the federal government has greatly increased its spending on research and development for electric vehicles, hybrid vehicles, and very low-emission fuel-cell-powered vehicles, these outlays remain dwarfed by the huge subsidies given American oil companies. A recent EPA report concluded that advanced technology vehicles, including zero-emissions vehicles fueled by energy sources other than gasoline, "could be utilized in the next generation of vehicles sold nationwide."[2] Heavy market penetration of advance-fuel vehicles would eliminate many of the externalities associated with internal combustion engines. Fantastic sums of money could be saved if the United

States were to reduce costs associated with protecting overseas oil interests, cleaning up petroleum-related pollution, ensuring the competitiveness of domestic oil producers, and covering air-pollution-related healthcare costs. What is now needed from policymakers is forward-thinking leadership and financial support to implement alternative-fuel technologies on a large-scale basis as quickly as possible, thus reducing our reliance on gasoline.

At this point, however, even banning the internal combustion engine would not remedy many of the problems spawned by the United States' gasoline-centric transportation sector. Many Americans have come to equate cars with freedom, suburban growth with progress, and inefficient single-family housing with prosperity. This is a philosophy born of a half century's free flow of cheap, abundant gasoline, which has made possible the ability for people to live apart from where they work, shop, and socialize. At the same time, our automobile obsession has contributed to its fair share of social ills, including the loss of open spaces, growth of sprawl, and economic collapse of many urban centers. While cheap gasoline played a part in the rise of these conditions, switching to alternative fuels would not necessarily alleviate them. What quality-of-life benefits would be realized by an electric vehicle driver facing a two-hour commute or by a person stuck in a traffic jam of fuel-cell-powered cars? Perhaps these drivers would breathe easier without inhaling noxious exhaust fumes, or they would rest easier knowing that their children could run and play outdoors without being poisoned by unhealthful levels of ground-level ozone.

Still, the environmental and social legacy of the internal combustion engine will endure for decades and probably cannot be measured in dollars and cents. In this report we arrived at an estimate of $163.7 to $245.5 billion for the annual cost of the spread of urban sprawl. The negative effects of sprawl contributing to this range of totals include environmental destruction, aesthetic degradation, social decay, and inflation of expenditures on municipal services and transportation. These are not fixed costs. As sprawl continues its outward creep and conquers an ever larger portion of the nation, associated costs will grow accordingly. We continue to raze forests, fill wetlands, and pave rural areas, destroying natural assets that we cannot repurchase at any price. When we frame the issue in these terms, the $1 or so per gallon we pay the next time we gas up our cars may not merely be a gross misrepresentation of the real price of gasoline, but may be a meaningless value placed on resources that are in fact priceless.

TAX SUBSIDIZATION OF THE OIL INDUSTRY

Federal Tax Subsidies

The federal government has been extremely generous to oil producers and distributors throughout much of the industry's history. Petroleum companies are the beneficiaries of a significant set of unprecedented entitlements. Preferential tax codes directly subsidize oil consumption. According to estimates by the Union of Concerned Scientists (UCS), federal corporate income tax credits and deductions result in an effective income tax rate of 11 percent for the oil industry as compared to a non-oil industry average of 18 percent.[4] These corporate taxpayer subsidies, also known as tax expenditures, decrease tax liability through special provisions in the tax code and regulations enacted to provide economic incentives.[5] Oil companies continue to enjoy a wide variety of federal tax relief, even as parts of the federal government are charged with reducing greenhouse gas emissions in response to the Kyoto agreement. A brief description of the major federal tax breaks to the petroleum industry follows.

Percentage depletion allowance is one of the oldest and largest tax subsidies affecting the petroleum industry. This provision primarily benefits independent oil companies (enterprises not substantially involved in refining or retailing). Until 1975, it applied to major oil companies, but Congress has gradually narrowed the application and reduced the rate over time. The percentage depletion allowance enables eligible oil companies to deduct a flat 15 percent of their gross income to account for the declining value of their wells as reserves are pumped out.[6] However, this deduction overstates the actual loss in value over time. Oil companies typically end up deducting more than the value of their original investments.

Since 1990, Congress has expanded the use of the percentage depletion deduction to include transferred property.[7] Smaller "marginal production" oil companies were also given the added benefit of deducting an additional 1 percent for every dollar the price of oil drops below $20 per barrel. Since crude oil prices currently average less than $14 per barrel, these companies can deduct over 21 percent of their gross incomes.[8] The net effect of this subsidy is more than just monetary; it promotes overproduction and inefficiency rather than conservation and economic efficiency. Often, government tax subsidies account for all the profits of these small operations. Percentage depletion distorts the oil market by attracting invest-

Congressionally approved federal tax subsidies may save the oil industry up to $12.54 billion per year. State and local subsidies add to the total and also inflate the real price of gasoline.

ment to projects that are economically nonviable. This subsidy encourages the premature draining of marginally profitable domestic oil fields through the use of technology that often severely damages the surrounding ecosystems. This tax law has propped up a domestic oil industry that cannot compete with cheap foreign oil. Not only does this subsidy drain the US Treasury, but it also diverts resources and capital away from investment in renewable energy production.

Annual cost estimates of the percentage depletion allowance:

$784 million to $1.0 billion 1997 dollars[9]

The nonconventional fuel production credit provides the oil industry with another opportunity to avoid paying taxes. The federal tax code provides for a production tax credit of $5.75 per barrel of oil-equivalent for certain fuels produced from alternate energy sources. These fuels include "oil produced from shale or tar sands, synthetic fuels produced from coal, and gas produced from geopressurized brine, Devonian shale, tight formations, biomass, and methane from coal beds."[10] There are a few environmentally beneficial aspects to this credit (wells placed in abandoned coal mines trap methane, a powerful greenhouse gas, and prevent it from entering the atmosphere), but the petroleum industry captures roughly 75 percent of the total subsidy for alternative methods of oil production. The subsidy is gaining popularity among domestic producers, as they look for oil reserves in increasingly hard to reach places.

With oil prices at an all time low and the costs of nonconventional fuel production high, the credit has proven ineffective in providing a cheap substitute for imported oil. Overall production of nonconventional fuel has not increased since the credit was first enacted in 1980. The credit has succeeded only in enriching a select group of oil companies and in wasting taxpayer money.

Annual cost estimates for the nonconventional fuel production credit:

$769 to $900 million in 1997 dollars[11]

Expensing of exploration and development costs enables petroleum companies to take immediate tax deductions on many types of expenses that other industries must spread over several years. The

Various federal government subsidies and tax credits compensate petroleum companies for exploration, research, hardware, and operational costs.

ability to expense these costs immediately, regardless of the expected length of income generation from the investments, encourages increased exploration and extraction of domestic oil fields that might not otherwise be economically viable.

This subsidy primarily affects integrated oil companies (e.g. Exxon and Mobil), allowing them to immediately deduct 70 percent of intangible drilling costs (costs of wages, fuel, repairs, hauling, supplies, and site preparation). This immediate expensing also allows oil companies to write off capital depreciation (equipment and infrastructure) and costs faster than their assets actually lose value. Intangible drilling costs generally account for 75 to 90 percent of the costs associated with exploiting an oil field.[12]

Annual cost estimates for immediate expensing of E&D costs:

$200 to $255 million in 1997 dollars[13]

The enhanced oil recovery credit is another subsidy designed to prop up an increasingly noncompetitive domestic petroleum industry. It allows oil companies to take a tax credit for the costs of methods which enhance oil recovery and extend the lives of older wells with higher marginal production costs. New methods developed in the last decade, including the use of chemical injectants and horizontal drilling, have

The enhanced oil recovery credit is a tax break that allows domestic oil companies to operate older wells, even after they have outlived their ability to produce crude at competitive prices.

dramatically improved the recoverability of oil from older, heavily exploited fields. However, even with these technological advances, these wells cannot supply oil as cheaply as foreign producers. Enhanced oil recovery methods also pose a serious threat to the environment.

Annual cost estimates of the enhanced oil recovery credit:

$26.3 to $100 million in 1997 dollars[14]

Foreign tax credits (FTCs) were intended to enable multinational oil companies to avoid double taxation in the United States and in foreign countries where they are operating. In reality, FTCs enable some oil companies to avoid paying taxes in either jurisdiction. The tax dodging is blatantly obvious when petroleum companies report paying taxes in countries that have no corporate income taxes. Additionally, foreign governments lacking standard corporate income taxes or characterized by rampant corruption often help American oil firms reduce their US corporate tax liabilities. It is standard practice for companies and foreign governments to call royalty payments (which merely count as deductions) income tax and claim them as credits against US taxes owed.

It is difficult to estimate the amount lost through this substantial loophole as obtaining tax information in certain countries is practically impossible. According to calculations in a study published by the Institute for Local Self Reliance (ILSR), "if the petroleum industry could only deduct foreign taxes instead of taking a credit for them, we could [have] raise[d] an additional $3.38 billion in revenue in 1996."[15] A recent report prepared for Greenpeace takes a more conservative approach, estimating that 50 percent of all FTCs claimed by the oil industry are disguised royalties.[16]

Estimated annual cost of foreign tax credits:

$1.11 to $3.4 billion in 1997 dollars[17]

Deferral of foreign income provides further means for oil companies to avoid taxation. Income generated by foreign subsidiaries of US-owned firms is taxed only when it is repatriated as dividends or other income. The parent firm is able to time the repatriation of profits to its advantage, often deferring its tax liability for many years.

Estimated annual cost of foreign income deferral:

$183 to $318 million in 1997 dollars[18]

Accelerated depreciation allowances enable capital investments to be written off faster than their actual service lives. This subsidy applies to all industries, but the highly capital-intensive petroleum industry benefits more than most. Intended to counteract the effects of inflation, accelerated depreciation significantly overstates capital depreciation rates during times of low inflation. According to corporate tax return data, the petroleum industry accounts for approximately 4.8 percent of depreciation deductions and 12.6

percent of depreciable assets.[19] Depending on the percentage by which one assumes the accelerated depreciation to overstate inflation, cost estimates of this subsidy range from millions to billions of dollars.

Estimated annual cost of accelerated depreciation allowances:

$1 to $4.5 billion in 1997 dollars[20]

Other federal tax subsidies benefiting the oil industry include:

- Expensing of tertiary injectants—**$26.3 million in 1997 dollars[21]**
- Exclusion of interest on industrial development bonds for energy facilities—**$81 million in 1997 dollars[22]**

State and Local Tax Benefits

State and federal tax code interactions further reduce the amount of taxes paid by the petroleum industry. Most states base their income tax systems on federal tax calculations. The federal adjusted gross income value is often used as a starting point in estimating state tax liabilities. It follows that tax subsidies which reduce federal income taxes will also reduce state income taxes. Assuming an average state corporate tax rate of 5 percent, two separate studies (Koplow, Greenpeace; Wahl, ILSR) concluded that the interaction between federal and state taxes produces a 3 percent increase in tax benefits to the oil industry.[23]

Estimated annual cost of state 'piggyback' tax effect:

$125 to $323 million in 1997 dollars

State and local sales tax rates are another source of preferential treatment for the oil industry. A study published in 1994 (Loper) found that gasoline is taxed at rates significantly below average sales tax rates. For highway gasoline, the study found that 32 states do not impose a sales tax. The national average state gasoline sales tax (weighted by sales) is approximately 3 percent, less than half of the average general state sales tax.[24] Taxes for non-highway petroleum use are lower than general sales tax rates in 34 states, resulting in a rate for gasoline that is one-third lower than the average sales tax rate.[25]

Estimated annual cost of state and local sales undertaxation:

$4.8 billion in 1997 dollars[26]

New Tax Subsidies

The *Taxpayer Relief Act of 1997 (TRA)* is a recent reminder that revision (and supposed reform) of the internal revenue code often contains many new distortionary tax subsidies. Tax expenditure provisions are often passed into law with the intent of being in effect for limited periods. However, subsidies that prove beneficial to oil interests tend to receive extensions from sympathetic lawmakers. TRA contains several new provisions that will benefit the petroleum industry. The act relaxes rules on the percentage depletion allowance and the accelerated depletion provisions and will increase the annual level of subsidy by more than $70 million.[27]

A far greater subsidy effect will result from the TRA provision to eliminate the use of motor fuel tax receipts for deficit reduction. These receipts, previously allocated to reduce the national debt, are now targeted for increased road construction. What was once an offset to oil subsidies will now increase net annual subsidies by an estimated $2 billion.[28]

Estimated annual cost of the TRA:

$2.07 billion in 1997 dollars

Summary of Tax Subsidies

Provisions in the tax code reflect unparalleled government support of the oil industry and significantly distort of the real price of gasoline. Many of these subsidies are designed to promote increased exploitation of domestic oil reserves in order to reduce American dependence on foreign oil imports. However, these tax provisions are shortsighted at best. Money that could be spent on promoting energy efficiency and developing alternative fuels is instead being wasted to promote the environmentally damaging practices of a domestic oil industry that cannot compete with cheap foreign oil.

These federal, state, and local tax subsidies help obscure the true costs of oil production. Investment capital is diverted from other sectors to keep oil prices artificially low. Over the years, there have been movements to curb special tax breaks for the oil industry, culminating with the Tax Reform Act of 1986. However, since the passage of that legislation, there has been a steady increase in subsidization of the petroleum industry. The average effective tax rate on integrated oil operations has fallen from 21.5 percent in the early 1980s to only 8.7 percent in the 1990s (both figures are significantly below the statutory rate of 35 percent).[29] The effective tax rate on smaller independent oil companies (producing from domestic wells) approaches zero when all subsidies and tax breaks are included.

There are other tax subsidies that have not been included in this report's cost estimates which may provide additional benefit to the petroleum industry. These include favorable tax treatment for oil concerns owned by native Americans in Alaska, as well as existing or proposed tax treaties with oil producing countries (e.g. Mexico, Russia, and Kazakhstan). These tax treaties may provide additional means for the oil industry to disguise taxable income.

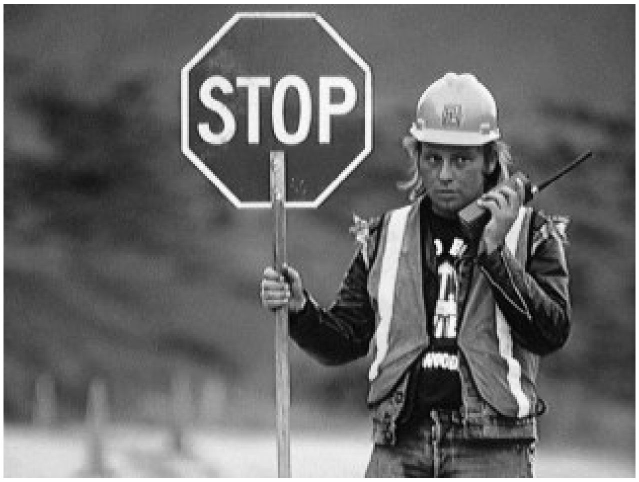
Total Annual Oil Tax Subsidies:[30]
Low estimate: $9.1 billion or $0.035/gallon
High estimate: $15.7 billion or $0.06/gallon
High (with new TRA subsidies): $17.8 billion or $0.07/gallon

Government Program Subsidies for Oil

A wide variety of government programs subsidize the oil industry at almost every stage of the production and consumption process. In a country that professes a high regard for the free market system, the US oil industry is a glaring example of the gulf that often develops between public perception and reality. Government programs provide a corporate version of "welfare" to an industry that has grown fat and complacent with entitlements. By continuing to coddle the industry, government programs discourage necessary reforms and market shifts and help to hide the true cost of this country's overwhelming reliance on gasoline.

Transportation infrastructure is almost entirely paid for by government. The annual cost of building and maintaining roads and highways is much more than the amount collected in user fees (transportation-specific taxes and tolls). About one half the bill for highway construction and maintenance is footed by non-driver sources. Fuel taxes dedicated to transportation infrastructure run about $0.32 per gallon ($0.14/gallon for the Federal Highway Trust Fund and $0.18/gallon for in-state fuel taxes).[31] However, most cost-estimate studies have shown that this tax level does not cover the total cost of roadway construction and maintenance and thus imposes external costs on non-drivers. Road user fees total approximately $75.5 billion annually.[32] That leaves tens of billions of dollars

The federal government supports the United States' addiction to the automobile with extensive spending on roadways and infrastructure.



Some $36 billion to $112 billion of government funds go towards road construction and maintenance each year.

to be funded by general tax sources. Additionally, current highway finance practices do not account for depreciation, resulting in an underestimation of capital costs. Opportunity costs also result from the large amount of investment capital tied up in highway trust fund accounts.

Estimated annual cost of roadway construction and maintenance:

$36.0 to $112 billion in 1997 dollars[33]

Research and development sponsored by government programs directly benefits oil exploration and production activities. Historically, the federal government has played a central role in funding energy research. Through the US Department of Energy (DOE), over $800 million is spent annually on fossil fuel research, of which roughly $120 million is targeted for petroleum-related R&D.[34] During the past few years, there has been a gradual, yet noticeable, shift away from fossil fuel research to renewables and fuel-efficiency research. However, petroleum retains a relatively large share of DOE's shrinking R&D budget. With one of the lowest private R&D investment rates (only about 1 percent of sales versus 3 percent for all industries), the oil industry could easily afford to do its own R&D. But, why bother when the government is willing to subsidize research costs?

DOE provides other essentially free services to the oil industry. One example is the Energy Information Agency [EIA], with an annual budget of $54 million, which provides general analysis on oil prices, production, and investment trends to benefit the industry and consumers. The Department of Interior's US Geological Survey also provides fundamental data on mineral resources (including oil field exploration and reserve estimates) with spending of $43 million.[35] The statistical data provided by EIA and USGS provides the oil industry with a basic framework from which to compile its own data, allowing firms to focus their efforts and funds elsewhere. For most other industries, basic data is compiled by the private sector and sold to interested firms rather than paid for by US taxpayers.

Estimated annual cost of government R&D programs:

$200 to $220 million in 1997 dollars[36]

OPIC, US Eximbank, and US-funded multilateral development banks all subsidize the activities of the petroleum industry. The Overseas Private Investment Corporation (OPIC) is charged with assisting American companies wishing to expand into international markets and with reducing the risks involved in overseas investment. American oil companies have reaped substantial benefits in the form of low-interest loans, loan guarantees, and political risk insurance on investments in potentially unstable countries (e.g. Nigeria, Algeria, and Russia). Between 1992 and 1996, OPIC financed over $300 million of investments and $1.8 billion of insurance for the oil industry.[37]

The Eximbank has a similar mission to that of OPIC, but has a different operational philosophy. Whereas OPIC expects to break even on its operations, the Eximbank does not and helps US exporters compete by setting extremely favorable terms on its loans and guarantees. As of 1995, Eximbank had outstanding obligations of $341 million in loans and over $4 billion in insurance and guarantees to the oil industry.[38]

The United States is a major contributor to the World Bank and the International Finance Corporation (IFC), which focus on developing industrial sectors in specific countries through project finance. Although American oil companies are not primary beneficiaries of multilateral bank lending, they are often the recipients of low-cost financing. As of 1995, the IFC had over $600 million invested in oil projects.[39]

The value of subsidies to oil in the form of international lending is calculated in a recent Greenpeace report (Koplow, 1998) at an annual rate of $31 million from OPIC and $241 million from Eximbank. A Union of Concerned Scientists report (Hwang, 1995) estimates subsidies from multilateral development banks at $15.5 to $18.9 million.

Estimated annual export financing subsidy:

$308.5 to $311.9 million in 1997 dollars[40]

The Army Corps of Engineers Civil Program subsidizes the transport of oil through coastal and inland waterways. The Army Corps of Engineers is largely responsible for building and maintaining ports, harbors, and inland water transportation routes. Its activities include the construction and operation of locks and the dredging of harbors and waterways. With an ever-increasing percentage of the oil consumed in the United States coming via tankers from overseas, the maintenance of waterways represents a substantial subsidy for the petroleum industry. Petroleum products comprise roughly 40 percent of waterborne tonnage transported annually on these waterways.[41] Water transport of oil is relatively cheap today due to massive amounts of government spending spanning several decades on port and waterway infrastructure. Although user fees cover some current expenses incurred by the Army Corps of Engineers, current and past subsidies loom large.

Estimated annual cost of Army Corps of Engineers subsidies:

$253.2 to $270 million in 1997 dollars[42]

The Department of Interior's Oil Resource Management Programs typically sell public resources to the oil industry at below fair market value. Subsidized leasing of federal lands for oil exploration and production increases the industry's profit at the taxpayers' expense and encourages otherwise uneconomical reserves to be developed. Leasing land at below fair market value can also increase the environmental impact of production, as less responsible producers enter the marketplace.

Often, the government inadvertently provides subsidies to the petroleum industry through a lack of oversight. Approximately $50 to $75 million is lost each year due to poor accounting practices in the collection of royalties on leased federal land.[43] In recent years, evidence suggests that major oil companies have systematically understated the price and real market value of oil recovered from leased federal lands. The resulting underpayment of royalties could range from hundreds of millions to billions of dollars over the last several decades.[44]

Federal leasing practices have been reformed in the past decade and are now generally competitive. However, since oil is a globally traded commodity, low cost producers in other countries (where the leasing process is often hopelessly corrupt) increase the pressure on federal and state agencies attempting to remain competitive to make concessions for oil development. A "race to the bottom" can ensue as public officials ignore environmental, safety, and health standards in favor of fleeting oil profits.

Estimated cost of subsidies for accessing oil resources:

$97 to $227 million in 1997 dollars[45]

Regulatory oversight, response to oil contamination, and environmental liability all represent economic costs that the petroleum industry has been largely successful in externalizing. The government often has the unenviable task of literally "cleaning up" after a recalcitrant industry. Many industries are guilty of shifting accident, closure, and environmental remediation costs to the state. However, the environmental liabilities created by petroleum extraction, transport, and refining occur on a scale that demands attention.

As oil is extracted from underground reserves, well pressure tends to drop over time. Operators often reinject fluids or gas (using reinjection wells) into the ground to increase the well pressure and keep the oil flowing. At the conclusion of drilling activity, all wells on the site must be plugged to prevent the remaining hydrocarbons and contaminated brines from seeping into the surrounding water table. Offshore wells also require plugging and, additionally, the dismantling of production platforms and rigs.

Federal and state agencies generally require that oil well operators purchase bonds or other forms of financial assurance to guarantee that the costs of shutting down the wells will be paid if the original well operators should become insolvent. This has helped

A major oil spill in 1989 involving the *Exxon Valdez* (above) led the government to increase petroleum companies' liability for oil spills. The cost paid by the public, however, remains high.

reduce excess liability costs that are borne by the public; however, significant subsidies to the oil industry remain. As well output declines, large oil companies often sell their leases to financially strapped independents that are unlikely to have the financial resources required to properly close their sites. The public pays an annual subsidy of $120 to $450 million in bonding premium shortfalls.[46] As the insurer of last resort, the federal government helps prevent these cleanup costs from increasing the price of gasoline. The annualized cost of remediating and plugging orphan wells (those with no current owners or bonding) is an additional $44 to $111 million per year.[47] The cost to the public of insuring offshore plugging and dismantling liabilities is $53 to $106 million.[48]

In the wake of the Exxon Valdez oil spill, the government has taken significant steps to reduce the public liability resulting from oil-related accidents and spillage. The Oil Pollution Act of 1990 set up a system of financial responsibility for oil spills which includes the Oil Spill Liability Trust Fund (OSLTF). However, the liability cap of $1 billion for any given incident may be inadequate, should another spill on the magnitude of the Exxon Valdez occur. It is likely that the public will end up paying for a large share of clean-up costs.

Leaking underground storage tanks (LUSTs) also present a serious liability problem. There are roughly 2.5 million underground storage tanks around the country and the EPA estimates that more than 25 percent may be leaking or will soon leak.[49] There are federal and state user fees and taxes in place to help defray the costs of petroleum contamination, but these are not enough to cover all of the costs generated. The EPA estimates the cost of remediation of petroleum-contaminated groundwater alone at over $800 million annually.[50] Friends of the Earth estimates the costs associated with petroleum leaks and spills at more than $4.3 billion per annum.

Estimated annual cost of regulation, cleanup, and liability coverage:

$1.1 to $1.6 billion in 1997 dollars

Total Annual Government Spending Subsidies:
Low estimate: $38.0 billion or $0.32/gallon
High estimate: $114.6 billion or $0.95/gallon

Protection Costs Involved in Oil Shipment and Motor Vehicle Services

The United States military plays a crucial role in ensuring the free flow of oil on the world market. It is important to realize that the cost of defending oil infrastructure around the world is not cheap. Although historically low gasoline prices at the pump have encouraged many US consumers to embrace trendy gas guzzling light trucks and sport utility vehicles, forsaking conservation efforts for wasteful convenience, all Americans foot the bill for increasing foreign oil dependence and the military costs (both in monetary and social terms) associated with securing a steady supply of oil. The United States economy remains heavily dependent on oil and is likely to become increasingly dependent on foreign oil as domestic production dwindles over the next decade.

In recognition of the country's overwhelming dependence on the free flow of foreign oil, the US government has enacted measures designed to insulate the country against future supply shocks. Painful lessons learned during the oil crises of the 1970s led to the creation of institutions like the Strategic Petroleum Reserve (SPR) and the International Energy Agency (IEA), which would, in theory, act to ensure the continued supply of oil. Most notably, the United States maintains a military presence in oil-sensitive areas. However, the United States has done astonishingly little in the way of demand-side management (DSM) to curb America's growing appetite for oil (which can only be satiated by an increase in imports). The vast amounts of money spent on capital, infrastructure, and security for what is in reality a "quick fix" dwarfs the meager investment being made in alternative energy resources and technologies.

The full military costs of defending petroleum resources are quite difficult to estimate due to the nature of global security and the synergy between energy supplies and economic security. While most industries operating in volatile parts of the world are responsible for arranging for private security forces to protect their investments, infrastructure, and personnel, the petroleum industry is able to externalize the costs of protection. Obviously, the entire annual budget for US military operations of approximately $260 billion cannot be attributed to the costs associated with energy security.[51] There are other strategic interests at play, even in oil rich regions like the Persian Gulf or former-Soviet Central Asia. The number of soldiers or the amount of military firepower present in a given region does not necessarily reveal the actual cost of protecting petroleum resources. However, it does not take a genius to recognize that if the main product shipped out of the Persian Gulf consisted of carbohydrates and not hydrocarbons, America's strategic interests in the region would be vastly different.

Many researchers have attempted to accurately determine the cost of America's defense of oil production and shipment throughout the world and specifically in the Persian Gulf. In the aftermath of the Gulf War, several analysts have also estimated the annualized cost of combat. In some years, the cost of

Up to $96.3 billion in US defense spending each year may go directly towards protecting overseas oil sources.

Operations Desert Shield and Desert Storm in 1990-1991, in which the United States and its allies defended oil-rich Kuwait following a hostile invasion by Iraqi military forces, cost upwards of $100 billion. US allies have pledged to pay $54 billion of the Persian Gulf War's cost, but the US has only managed to collect some $34 billion of this total to date.

defending oil interests could be quite low, while in other years, tens of billions of dollars were spent on combat. Wahl of ILSR estimates a plausible (and rather conservative) range of annual expenses devoted to routine protection of oil resources at 10 to 25 percent of the annual defense budget ($26 to $65 billion).[52] Most studies on the subject tend to estimate costs at the high end of this range. Based on a survey of literature on the subject in 1992, the Congressional Research Service found a range of estimates from $56 to $73 billion.[53]

A recent report prepared for Greenpeace by Koplow and Martin, provides a rigorous examination of oil protection costs associated with the Persian Gulf region. They estimate the cost of oil defense for the Middle East at $10.5 to $23.3 billion (1995 dollars). However, it should be noted that these figures are relatively conservative. They assume that the cost of protecting oil interests is equal in value to preserving regional stability and preventing the emergence of regional hegemonic powers. It is not unrealistic to attribute a majority of Persian Gulf defense costs to oil, which would result in an estimate closer to $70 billion (the total annual cost of defense commitments in the Middle East is approximately $80 billion).[54]

In addition to the costs of maintaining the US military presence in the Middle East, it is necessary to factor in the cost of combat. The Persian Gulf War, otherwise known as operations Desert Storm and Desert Shield, is estimated to have cost over $100 billion.[55] The United States did persuade its allies to help pay for the cost of the war. However, out of ally commitments to contribute $54 billion only about $37 billion has actually been paid.[56] If one assumes that combat on the scale of the Gulf War will keep things relatively quiet for about ten years, then the annualized cost of combat is approximately $4.6 to $6.3 billion.

Estimated annual cost of oil defense subsidies:

$55 to $96.3 billion in 1997 dollars[57]

The Strategic Petroleum Reserve (SPR) has been a flawed and little-utilized insurance policy of last resort for the oil-dependent American economy. Created in 1975 in response to the turmoil associated with the oil price shocks of 1973 and 1974, the SPR is intended to protect the United States from interruptions in the flow of oil caused by political, military, or natural causes. American taxpayers contribute an annual "premium" of up to $5.7 billion to reduce the risk of oil-shock-induced economic devastation. Given the United States' growing appetite for imported oil (as domestic reserves continue to steadily shrink), the SPR may be a wise investment for American oil consumers. The petroleum industry has little incentive to provide safeguards against price hikes and supply shocks. It is unlikely that an apparatus like the SPR would exist without government intervention.

The SPR has roughly 590 million barrels of crude oil stored in underground salt caverns along the coastline of the Gulf of Mexico. Oil from the SPR has been used for emergency purposes only once, during the Persian Gulf War in 1991 (there was some controversy at the time as to whether it was necessary to sell off some of the reserve). The Department of Energy (DOE), which administers the SPR, spends $200 million annually on management and operation costs. Taxpayers currently face the additional liability of financing over $100 million for decommissioning and moving part of the reserve because of problems with water intrusion and contamination (annualized cost of $5 to $10 million).[58]

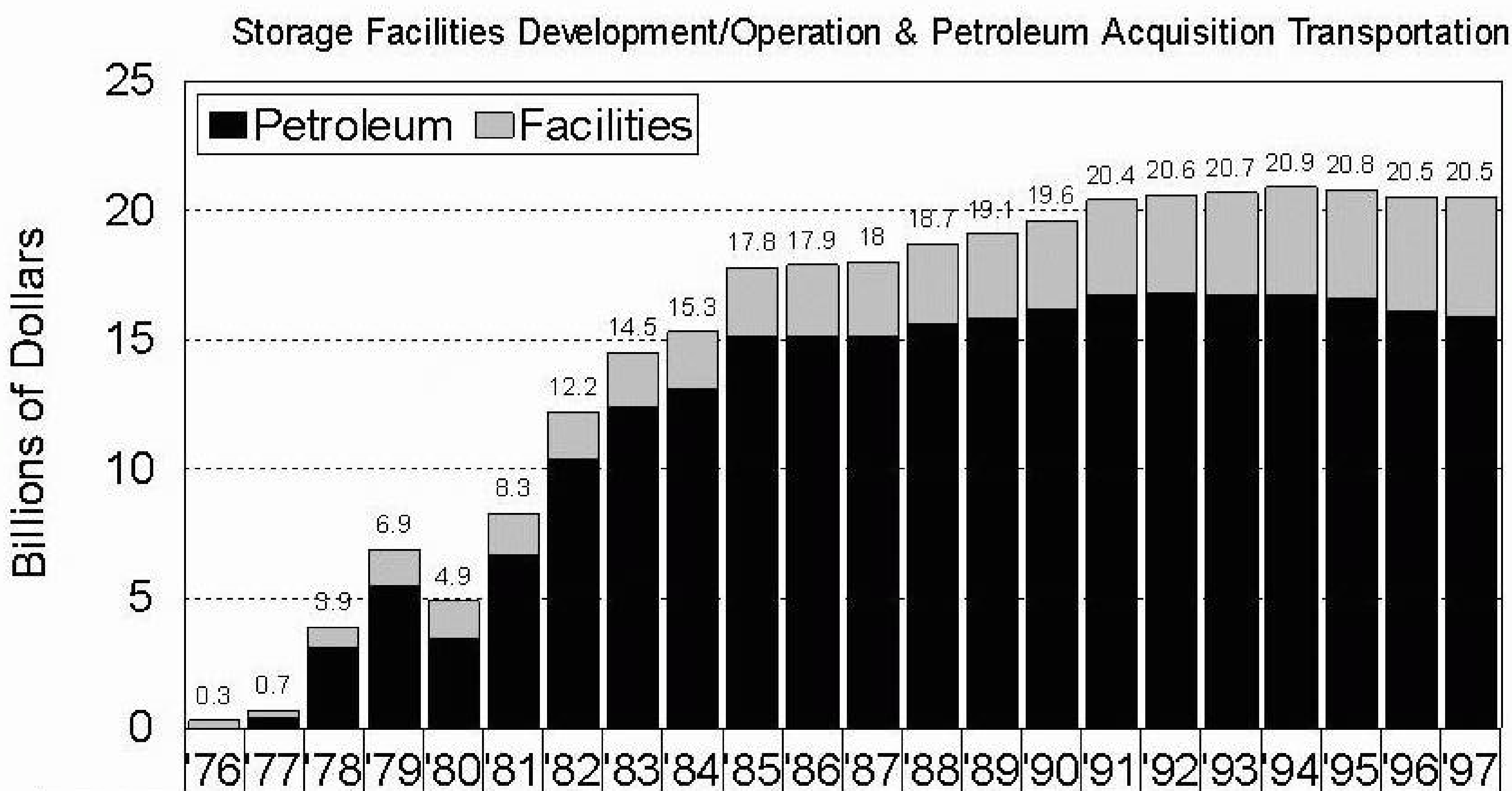
By far, the largest cost associated with the SPR results from forgone interest on the value of stockpiled oil. Billions of taxpayer dollars are invested in stores of oil, rather than ready for use in sustainable and environmentally friendly energy programs. Some of this loss could be recouped if oil were to increase dramatically in value. However, a large percentage of SPR oil was purchased at a much higher price than the oil is presently worth. The average acquisition cost per barrel of oil stored in the SPR between 1976 and 1995 was $27.30.[59] The average market price of that oil was $17.20 in 1995, representing a capital loss on acquisition of almost $6 billion.[60] With the current market price of oil below $12 per barrel, the loss increases to more than $9 billion. However, it is possible that prices will be higher at the point when oil from the reserve might be sold.

The DOE itself notes that "the United States is unique among oil stockpiling in assigning all of the cost of the reserve to the general taxpayer. Most other stockpiling countries partially shift the cost burden to the oil industry by requiring their oil companies to maintain inventories in excess of working needs."[61] The Greenpeace report estimates the total taxpayer loss of the SPR from 1976 through 1995 at $57.5 billion and estimates the total annual cost at $5.4 billion in 1995 dollars.

Estimated annual cost of the SPR:

$5.7 billion in 1997 dollars[62]

The Weeks Island Storage Site, located 95 miles southwest of New Orleans and formerly used as a salt mine by the Morton Salt Co., now serves as an integral part of the Strategic Petroleum Reserve, with the capacity to store up to 70 million barrels of oil. The graph on the following page represents SPR funding totals for 1976 through 1997.



	'76	'77	'78	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95	'96	'97
Facilities	0.3	0.3	0.8	1.4	1.4	1.6	1.8	2.1	2.2	2.7	2.8	2.9	3.1	3.3	3.4	3.7	3.8	4	4.2	4.2	4.4	4.6
Petroleum	0	0.4	3.1	5.5	3.5	6.7	10.4	12.4	13.1	15.1	15.1	15.1	15.6	15.8	16.2	16.7	16.8	16.7	16.7	16.6	16.1	15.9

Fiscal Year

Data as of December 31, 1997

SPR2362.PRS

There are other protection costs associated with gasoline usage in the United States that are picked up by general taxpayers rather than oil producers and consumers. For example the Coast Guard spends about $455 million (with offsetting collections taken into account) annually on programs that benefit oil firms, such as maintaining coastal shipping lanes, providing navigational support, clearing ice, and responding to oil spills. The Department of Transportation's Maritime Administration provides roughly $84 million a year in subsidies for US built ships, including oil tankers.[63]

Estimated annual cost of "other" protection costs:

$566.3 million in 1997 dollars[64]

Local and municipal external costs associated with gasoline-powered motor vehicles include the response of police, fire, and emergency teams to traffic accidents.

Police, fire, emergency response, and other municipal services provide various types of protection for the oil transportation industry and motor vehicle users. Often the market costs of these services are partially internalized through tolls and user fees that target drivers. However, general taxpayers shoulder the burden of the majority of these protective service costs. According to a study by a researcher in Denver, 40 percent of police activities, 15 percent of the fire department, and 16.4 percent of paramedic services should be allocated to automobile use.[65]

Using Federal Highway Administration (FHWA) statistics, Mark Delucchi of the Institute of Transportation Studies at UC-Davis estimates the external costs of highway patrol and safety in 1990 at $7.4 to $8.4 billion. Other local police protection costs related to motor vehicles not covered in FHWA statistics add $5.4 billion in externalities.[66] Fire protection costs attributable to motor vehicle use totaled between $1.4 and $3.2 billion in 1990 according to the Union of Concerned Scientists. Judicial and legal system costs imposed by motor-vehicle-related litigation adds an additional $4.8 to $6.2 billion. Jail, prison, probation, and parole costs run the taxpayer another $3.9 to $6.2 billion.

Estimated annual cost of emergency and municipal motor vehicle externalities:

$27.2 to $38.2 billion in 1997 dollars[67]

Total Annual Protection Costs:
Low estimate: $88.5 billion or $0.65/gallon
High estimate: $140.8 billion or $1.05/gallon

Environmental, Health, and Social Costs of Gasoline Usage

The production and combustion of gasoline causes a variety of environmental and health costs, most of which are not reimbursed by the petroleum industry or the operators of motor vehicles. Pollution costs are borne by society in the form of increased health care costs, loss of wages due to premature death, and reduced quality of life, among a host of other externalities. The majority of the environmental externalities created by gasoline usage are difficult to quantify in monetary terms, meaning that estimates of the size of damages can vary considerably depending on the methodologies used by analysts.

Localized Pollution

Air pollution is perhaps the most noticeable and damaging external effect of gasoline-based motor vehicle use. Motor vehicles emit various air pollutants, including carbon monoxide (CO), carbon dioxide (CO2), nitrogen oxides (NOx), sulfur oxides (SOx), volatile organic compounds (VOCs), particulate matter (PM), and other toxic gases.[68] These emissions may cause a host of negative effects, including human illness and mortality, global warming, ozone depletion, crop damage, reduced visibility, deterioration of buildings, and acid rain. Transportation is the largest single

Gasoline combustion produces a variety of noxious air pollutants, including carbon monoxide, nitrogen oxides, sulfur oxides, particulate matter, and volatile organic compounds. These, in turn, contribute to serious health problems, acid rain, and global warming, source of pollution in the United States.

Human mortality and morbidity resulting from air pollution emitted by motor vehicles has been documented in numerous scientific studies. Benzene, a major component of gasoline, is just one of the human carcinogens found in petroleum products. Cancer, cardiopulmonary problems, and respiratory diseases, including asthma and emphysema, are commonly linked to auto pollution. Eye irritation, poisoning from gasoline ingestion, and injuries caused by explosions, gas spillage, and fires also impose significant health costs.[69]

Ground level ozone is a primary ingredient of the smog that envelops many major American cities, particularly during the summer months. Urban ozone pollution has been linked to increases of over 25 percent in hospital admissions for asthma. Recent scientific evidence reveals that repeated exposure to low levels of ozone may cause more damage than isolated exposures to high levels.[70]

Particulate matter includes particles of soot, metals, and road dust. Fine particles are the most serious health threat, as they can penetrate deep into the lungs and aggravate respiratory problems. A recent study determined that the risk of early death increased among residents in areas with high PM levels by 26 percent over those in less polluted areas.[71]

ENVIRONMENTAL EFFECTS OF AUTOMOBILE EMISSIONS

Causes	Transportation Share of Total Emissions	Effects
Carbon Monoxide	70%	Health Effects Global Warming
Hydrocarbons/Volatile Organic Compounds, except Methane	38%	Health Effects Acid Rain
Sulfur Dioxide	5%	Health Effects Acid Rain
Nitrogen Oxides	41%	Smog Component Acid Rain Global Warming Algal Blooms
Carbon Dioxide	30%	Global Warming Cancer
Air Toxins (Including Benzene) Particulates	23%	Cancer Health Effects
CFCs		Health Effects via stratospheric ozone depletion Damage to vegetation Global Warming
Odor from Automobiles and Diesel Exhaust		Discomfort

Source: TransAct—www.transact.org/er/aa.htm.

Carbon monoxide is a colorless, odorless gas, which when inhaled blocks the transport of oxygen to the brain, heart, and other vital organs of the body. CO is particularly harmful to fetuses, newborn children, and the chronically ill.

Nitrogen Oxides play a major role in the formation of ground level ozone and account for a third of PM pollution. NOx exposure can cause lung irritation and weaken the body's immune system, increasing the occurrence of respiratory infections like pneumonia and influenza. Sulfur dioxide, like NOx, poses health risks to children and asthmatics because it constricts airways and can trigger asthma attacks.

Science is only just beginning to unravel the relationship between toxic exposure levels and increased human morbidity and mortality. Due to data variations in clinical and epidemiological studies on the health effects of the various pollutants, health cost estimates of the effects of exposure can differ by hundreds of billions of dollars. Increasingly, smaller PM is linked in credible research to lung disease. Earlier attempts to put a monetary figure on the health costs of motor vehicle pollution seriously underestimated the link between PM and mortality and morbidity. The dollar value of health effects is the sum of the costs of lost work days, restricted activity, health care treatment, and a reduced value of life.

This report relies on the estimates of environmental and social costs derived for the 1990-91 period by Mark Delucchi of ITS-UCDavis. Delucchi estimates the range of the external cost of air pollution related to human morbidity and mortality at $24.3 to $450 billion in 1990 dollars.[72] The spectacular range in this estimate is largely reflected in the uncertainty surrounding the health effects of PM and specifically road dust (particles from tires appear to be highly allergenic, also particles from brake lining wear are possibly carcinogenic). As the scientific evidence of the PM hazard mounts, so will the cost estimates. More conservative estimates of human morbidity and mortality costs include the following studies: $10 billion (MacKenzie), $42.1 to $181 billion (Union of Concerned Scientists), and $4 to $93 billion (Gordon).[73] However, it is important to recognize that even though Delucchi's high estimate is almost twice the size of the United States' annual defense budget, this figure does not include calculations of health costs indirectly caused by motor vehicle activity. For example, CFCs used in automobile air conditioners have contributed to the depletion of the ozone layer that filters harmful UV light. Skin cancer incidence has increased exponentially in the last decades as a result of CFC production and use. The real health costs of motor vehicle pollution may perhaps be measured in trillions not billions of dollars.

Auto pollution causes $2 billion to $4 billion worth of damage to agricultural crops each year in the United States.

Estimated annual health costs attributable to motor vehicles:

$29.3 to $542.4 billion in 1997 dollars

Agricultural crop losses occur as a result of damage inflicted by pollutants attributable to motor vehicles. Ozone and NOx are the primary culprits in lowered crop yields. Acid rain can also damage crops and stunt agricultural productivity. According to a report released in 1996 by the EPA's Office for Research and Development, air pollution from motor vehicles causes between $2 and $4 billion in crop damage annually.[74] Delucchi's estimate is very close at $2.1 to $3.9 billion per year.

Estimated annual cost of crop damage due to auto pollution:

$2.1 to $4.2 billion in 1997 dollars

Loss of visibility results from motor vehicle air pollution and imposes significant external costs. "Visibility impairment occurs as a result of the scattering and absorption of light by particles and gases in the atmosphere.... The same particles which are linked to serious health effects [sulfates, nitrates, organic carbon, and soot] can significantly affect our ability to see."[75] Poor summer visibility in the eastern United States is caused by the interaction of high humidity with high sulfate concentrations, producing more haziness than in the dryer climates of the western states. Motor-vehicle-induced loss of visibility imposes a variety of costs ranging from decreased tourist spending to travel delays (particularly in aviation).

Estimated annual cost of decreased visibility:

$6.1 to $44.5 billion in 1997 dollars[76]

Pollution damage to buildings and materials can be linked to the chemical compounds released in the exhaust of motor vehicles. Acid rain, which forms when water interacts with NOx and SOx in the atmosphere, contains acidic compounds that speed the decay of buildings and materials. The ravages of air pollution and acid rain particularly imperil historic buildings and statues. The costs of repairing the decay can be extensive and in some cases the damage cannot be undone, representing a loss to our cultural heritage.

Estimated annual cost of pollution damage to buildings and materials:

$1.2 to $9.6 billion in 1997 dollars

Planet-Wide Effects

Global warming is an inevitible result of the concentration of "greenhouse gases"—particularly carbon dioxide, methane, and nitrous oxide—in the earth's atmostphere, leading atmospheric scientists agree. The Intergovernmental Panel on Global Climate Change (IPCC) in a comprehensive 1995 report concluded that "the balance of evidence suggests that there is a discernible human influence on global climate."[77]

The American transportation sector is a driving force behind global climate change. After a trend during which cars' average mileage per gallon increased from the 1970s until the late 1980s, the nation's fleet of vehicles is getting less efficient in the 1990s. More and more Americans are driving oversized gas guzzling trucks, vans, and sport utility vehicles, many of which get barely half the mileage of the average sedan. Because of this, the transportation sector is overtaking utilities and manufacturing industries as the primary consumer of energy and emitter of greenhouse gases.

Urban haze obscures visibility in many large US cities. Other ramifications of auto pollution include human health problems and damage to buildings and other urban structures.

Estimates of the cost of global warming cited in this report are based only on US emissions and the resulting domestic externalities. Obviously this narrow estimate of the costs of climate change ignores the significant impact of US emissions on the rest of the world. The United States accounts for approximately 26 percent of global oil consumption and 22 percent of gross world product, but only 4 percent of the world's population.[78] If China, for example, with almost one quarter of the world's population and already in the grip of a severe environmental pollution crisis, were to match the per capita oil usage of the United States, the implications for global warming would be catastrophic. Americans continue to waste energy and emit greenhouse gases as if there were no climatic or environmental costs. There has been a failure by US leadership to recognize the long-term implications and communicate with industry and the public in order to formulate responsible energy and transportation policies.

The IPCC's data indicate that "global mean temperature has increased between 0.3° and 0.6° C (up to 1° F) since the late 19th century." Given current emissions trends, global temperatures are expected to increase another 1.0° to 3.5° C by 2100. "In all cases the average rate of warming would probably be greater than any seen in the last 10,000 years.... Warmer temperatures will lead to a more vigorous hydrological cycle; this translates into prospects for more severe droughts and/or floods in some places and less severe droughts and/or floods in other places."[78] Before the industrial revolution, the earth's atmosphere contained 280 ppm of CO2, by 1997 the average level of CO2 had increased to 360 ppm. Various estimates by IPCC scientists put the CO2 levels at the end of the next century at somewhere between 500 and 800 ppm.[80]

The potential environmental and health costs of global warming could be astronomical. To keep our gas-guzzling cars running today, we risk an inter-temporal disaster: cheap gasoline today in return for a hotter, poorer, deadlier planet tomorrow. As many Americans have witnessed firsthand over the last decade, global warming means more powerful and extreme weather, thus increasing agricultural losses and property damage (see insurance costs in next section). As the average surface temperature of the earth continues to rise, existing ecosystems will be under increased stress. Forests weakened by drought and disease may burn more easily and frequently. Certain animal and plant species may be unable to survive in a changed climate. The geographic range of diseases such as malaria, hantavirus, dengue, and cholera has been steadily spreading northward from tropical climes up into the heart of the United States. According to a study published in the *Journal of the American Medical Association*, malaria, which currently kills about 2 million people annually, could cause an additional million deaths each year as a result of global warming.[81]

In the United States alone, according to a study by the Institute for International Economics, a 2.5° C mean temperature increase by the year 2025 would "translate into overall damages of $60 billion annually from agricultural losses, a rise in sea level, increased mortality, losses to the ski industry, increased electrical use from air conditioners, and lost water supply."[82] If, as the IPCC predicts, the sea level rises by up to 3 feet over the next century, huge dikes would have to be constructed to protect coastal metropolitan areas at a cost of $1 billion per mile based on construction experience in the Netherlands.[83] Using a greenhouse-gas emissions model which excludes many potential climate change externalities, Delucchi estimates the annual global warming "damage" cost of US fuel cycle emissions from $500 million to $9.2 billion in 1990 dollars. Union of Concerned Scientists estimates of the current US cost of global warming due to US fuel cycle emissions of greenhouse gases range from $3.0 to $27 billion (1996 dollars). Of course, some of golbal warming's consequences, including the loss of human life and biological species, cannot truly be quantified monetarily.

Estimated annual cost of climate change:

$3.0 to $27.5 billion in 1997 dollars[84]

Water Pollution Costs

Water pollution can be linked to several aspects of the oil industry and the transport sector. As mentioned in the section on government program subsidies to the oil industry, leaking underground storage tanks (LUSTs) contaminate underground aquifers. Oil

Cleanup in the aftermath of the *Exxon Valdez* disaster. The total cost of the spill probably exceeded $7 billion.

It is difficult to put a price tag on many environmental consequences of an oil spill. Some damage cannot be undone.

spills in inland waterways, harbors, and oceans represent another significant environmental externality of gasoline usage. Other major sources of water pollution associated with motor vehicles are roadway de-icing, urban runoff of engine fluids (i.e. motor oil), and roadside herbicides. In addition to direct water contamination, motor vehicles and roadway infrastructure have a major impact on wetlands, streams, rivers, and shorelines. Concentrated runoff from roadway drainage systems leads to increased flooding of waterways as well as streambed erosion. Roads can create barriers that starve wetlands of their water sources. The externalities imposed by motor vehicles include "polluted surface and ground water, contaminated drinking water, increased flooding and flood control costs, wildlife habitat damage, reduced fish stocks, and loss of unique natural features."[85]

LUSTs and Oil Spills impose significant environmental and health costs. As noted earlier, EPA spends about $800 million annually on LUST clean-up and has subsidized billions in oil spill clean-up costs. "Large quantities of petroleum are released from leaks and spills during extraction, processing, and distribution."[86] Recent government policies and initiatives have been successful in internalizing cleanup expenses associated with spills and leaking tanks (via the Oil Spill Liability Trust Fund and other financial requirements and taxes established by the Oil Pollution Act of 1990).[87] Set aside funds often pay only for superficial clean-up and do not remedy damage done to the water supply and manifested in higher medical bills and lower crop yields. The infamous Exxon Valdez spill is a prime example of the magnitude of externalities produced by oil spills. Exxon spent $1.28 billion on a cleanup effort that collected only 20 percent of the crude released from the tanker. The difference between very polluted water and slightly less polluted water is certainly of less value than the difference between slightly polluted water and pristine water. In other words, the $1.28 billion did not effectively repair the environmental damage inflicted by the oil spill, because it left 80 percent of the crude in the water (each fish, bird, and sea mammal can only be killed once). The actual cost of the Exxon Valdez spill was probably well in excess of $7 billion. One study estimates that oil tankers spill 0.02 to 0.11 percent of their contents, imposing an external cost of $0.10 to $0.47 per gallon of gasoline produced from imported crude oil.[88]

Estimated annual environmental cost of oil spills:

$2.2 billion in 1997 dollars[89]

Roadway de-icing and run-off materials have a profound impact on water quality and plant and wildlife. Road de-icing salts pollute groundwater, streams, and rivers, adversely affecting fish and the growth of plants and trees. The salt also damages materials, speeding up the corrosion of metals in bridges, infrastructure, and automobiles.

In addition to salt pollution, water contamination and environmental degradation result from herbicides applied to roadsides as part of vegetation control programs. Other toxins, contained in crankcase oil, antifreeze, and transmission, hydraulic, and brake fluids, also contaminate water. Approximately half of all vehicles in use on US roads are leaking fluids, and an estimated 500 million gallons of engine lubricating fluids are either burned or lost to leaking, with another 180 million gallons disposed of improperly into the ground or roadway drainage systems.[90] This roadway runoff is toxic to a variety of aquatic organisms and has serious environmental implications.

Estimated annual cost of roadway de-icing and runoff:

$2.0 to $5.2 billion in 1997 dollars[91]

The hydrologic impact of roadways and parking lots creates significant externalities. By increasing the impervious surface in a given area, they concentrate storm water runoff, thus intensifying flooding, siltation, and erosion in waterways. Roadway culverts interfere with fish mobility. Reduced flow and vegetation cover near roadways can increase water temperatures, which affects the aquatic equilibrium. Many streams and wetlands have been severely degraded by the construction of roadway beds and drainage systems. The disruption of waterways and the damage inflicted on their ecosystems by roads and parking lots has a profound effect not only on water quality but also on the environment as a whole. Todd Litman of the Victoria Transport Policy Institute estimates a total annual national runoff cost of $22 billion in hydrologic impact.

Total annual cost of water pollution and hydrologic impact:

$4.2 to $29.4 billion in 1997 dollars[92]

Other Pollution Costs

Noise pollution and vibrations created by motor vehicles impact the lives of millions of Americans daily. Noise is often overlooked as having an environmental or health impact, even though the external costs of motor vehicle noise are real (although difficult to quantify). Obviously, if noise were not considered a problem, there would be no need to build costly and unsightly barriers to protect homes and businesses from the sounds of highway traffic. Roadway noise causes stress and fatigue in many people and may reduce worker productivity in those exposed to high levels. Lower property values near heavily traveled roads provide an indication of the external cost of noise pollution. Various studies have shown a direct correlation between declining property values and increasing traffic volume.

Annual road de-icing and runoff costs may reach $5.2 billion.

Annual cost of noise pollution:

$6.0 to $12.0 billion in 1997 dollars[93]

Waste disposal related to motor vehicle use imposes a variety of environmental, health, aesthetic, and economic externalities. Used tires, batteries, scrapped cars, fluids (see water pollution section), and certain semi-hazardous materials are, more often than not, disposed of improperly. Waste tires are particularly difficult to deal with and often end up in huge piles at landfills, as they can not be safely incinerated or efficiently recycled. Tire piles often become breeding grounds for various pests like mosquitoes, which thrive on the standing water that collects inside the tires. Americans dispose of some 250 million waste tires each year, and approximately 3 billion waste tires sit in American landfills at any given time, according to Doug Howell of the Environmental and Energy Study Institute. The cost municipalities pay to process these automotive waste products is about $1.50 per tire.[94] Used batteries often end up in landfills, leaching lead and contaminating soil and groundwater. Waste oil and antifreeze, containing heavy metals and other toxins, often end up in dumps instead of being properly processed and recycled.

Annual cost of external motor vehicle wastes:

$4.4 billion in 1997 dollars[95]

Costs of Sprawl

The land-use impact of motor vehicles and related transportation infrastructure is readily apparent in metropolitan areas across the country. The sprawling low-density land use patterns that have characterized development in the second half of the 20th century has been largely facilitated by American subsidization of motor vehicles to the detriment of other modes of transport. The external costs of sprawl run the gamut from ecological damage to the breakdown of community cohesion and quality of life. Transportation and land use are highly interactive, making it very difficult to measure all of the direct and indirect environmental, economic, and social costs imposed by motor vehicles and roadways. The following breakdown and cost analysis of the impact of sprawl is largely based on Todd Litman's research. He is one the few transportation analysts to have attempted to quantify and monetize the externalities of sprawl.

Those who criticize the characterization of urban sprawl as an external transportation cost, argue that sprawl is a land-use management issue, not a motor vehicle issue. Certainly, there are other factors at play in the *suburbanization* of America (low mortgage rates, tax codes that encourage home ownership, socioeconomic problems in the urban core, etc.). However, it is hard to deny the negative land-use effects caused by the country's highway-oriented development. Automobile use creates sprawl by first degrading the urban environment as a high percentage of land is paved for roadways and parking, encouraging many to leave the cities in search of greener surroundings. Those fleeing the concrete jungle of the inner core often end up living in low-density developments which cannot economically sustain mass transit systems. As development in these areas matures, there is an almost total reliance on automobiles, as residents must drive farther distances than city dwellers to get to commercial centers. The increased travel time adds to vehicle costs, pollution, and congestion. As conditions become increasingly intolerable, there is pressure on residents to move even further out to escape the prison of inefficient land use. Unfortunately, more often than not, this perpetuates the destructive scourge of sprawl. One need look no further than the Northeast transportation corridor to see what poorly planned low-density development looks like; where one generic town infested with strip malls bleeds into the next faceless suburb, and open spaces are few and far between.

The environmental impact of sprawl begins with the clearing and paving of land for roadways as the relentless march of development is set in motion. It is estimated that over 1 percent of the total surface area of the United States is paved roadways, parking areas, and driveways.[96] Automobile-dependent sprawl has serious consequences for wildlife habitats. Roads create barriers and fragment wildlife populations, re-

Suburban homogeny is a result of an automobile-reliant culture and the associated development of sprawl.

AVERAGE TRAVEL TIME TO WORK IN THE UNITED STATES

	1980		1990	
Travel Time to Work	Number	Percent	Number	Percent
Total	94,487,095	100.0	111,664,249	100.0
Less than 10 minutes	16,871,572	17.9	18,257,921	16.4
10 to 19 minutes	31,846,602	33.7	36,980,181	33.1
20 to 29 minutes	18,849,260	19.9	22,436,930	20.1
30 to 44 minutes	15,996,009	16.9	20,053,109	18.0
45 minutes or more	10,923,652	11.6	13,936,108	12.5
Mean travel time (minutes)	21.7		22.4	

Source: U.S. Bureau of Census—www.census.gov/population/socdemo.journey/ustime.txt.

ducing both the habitat size and mobility of animals. Motor vehicles are often the greatest predator of wildlife. According to the Humane Society and the Urban Wildlife Research Center, more than one million large animals are killed each year on American highways.

The most obvious effect of sprawl is the destruction of natural environments. More than 1 percent of the United States' 3.5 million square miles of land area is covered by pavement.

Species averse to crossing roads often suffer as a result of isolation in dwindling pockets of habitat. Roads also increase the access of hunters, poachers, and environmentally irresponsible hikers to fragile and exotic habitats. Land development often brings with it new species of flora and fauna which can destroy native species.

Much of the United States' most productive farmland is located within a two-hour drive of a major city. Every minute in this country several acres of high quality farmland are lost to sprawl.[97] In addition to pristine wilderness and farmland, other environmentally important greenspace is gobbled up by sprawl. As these lands are paved over, important biological processes are interrupted. Impervious surfaces, such as roads and parking lots, seriously degrade watersheds and increase flooding. Paved surfaces also have a heat island effect, often raising local temperatures by 2° to 8° F in the summertime.[98] Although the more densely developed city areas have more impervious surface overall, the per capita land coverage is much greater in low-density suburban conditions.

Estimated annual environmental impact of sprawl development:

$58.4 billion in 1997 dollars[99]

Aesthetic degradation is another symptom of sprawl. Cultural sites (which often generate tourist dollars) can be destroyed aesthetically by traffic and the ugly roadside development that is epidemic across the land. Strip malls with large parking lots and visually jarring signs typically spoil beautiful landscapes. Property adjacent to heavily traveled commercial strips reflects the external cost of aesthetic degradation in the form of lost real estate value. Calculating the costs of visually anarchic, architecturally bankrupt strip malls along roads may seem to some a frivolous endeavor, but shouldn't we strive to build visually pleasing communities that are more than just dysfunctionally utilitarian? A particularly ugly commercial strip in Boston, which sullied waterfront views, is estimated to have lowered downtown property values by as much as $600 million.[100]

Estimated annual cost of sprawl in terms of aesthetic degradation/loss of cultural sites:

$11.7 billion in 1997 dollars[101]

The social impacts of sprawl are perhaps somewhat subjective, but the evidence is visible in everyday life. Litman arrives at an annual cost of about $58 billion. Several researchers have argued that roads and traffic tend to degrade public spaces and reduce community interaction and cohesion. People living on heavily traveled roads are less likely to visit neighbors, and it is doubtful that anyone enjoys sitting on the front porch inhaling car fumes. Widening roads to optimize them for vehicle traffic tends to foster feelings of social alienation, *placelessness*, and isolation. Daniel Carlson, author of a book on land use, transportation, and communities argues that "automobile-based development has reduced opportunities for public life and magnified the polarization of our society by aggravating the geographical and time barriers between people with different incomes, and by making it more difficult for those who don't own cars to participate in life outside their communities."[102] Non-drivers suffer when corner stores close under competitive pressure from mega-stores that are only accessible by car. Long commutes put additional strain on the social fabric as drivers return home stressed and frustrated from battling traffic and "road rage." When people do not live and work in the same community, as is the case for many in our sprawl culture, there is less incentive to care about local environmental and social issues.

The growth of low-density suburbs has increased the amount of time commuters spend traveling to and from work (see chart, page 24) and sitting in traffic.

Estimated annual social costs of sprawl:

$58.4 billion in 1997 dollars[103]

Increased municipal costs result from the economic inefficiencies of low-density development. Low-density land use translates into higher per capita public expenditures for roadway infrastructure, utilities, emergency services, government services, and schools. Traditionally, rural residents accepted lower levels of basic services (roads, sewers, etc.), but new *sprawl* residents often expect a higher level of services and demand urban-style amenities in the *exurbs*. Zoning also plays a significant role in the inefficiencies of low-density development by creating two distinct infrastructures in place of the traditional multipurpose town or city. With the home and the workplace separated, often by long auto commutes, two well-serviced developments are created with duplicate retail, service, and parking institutions: the bedroom community and the office park.

Estimated annual increase in municipal costs:

$53.8 billion in 1997 dollars[104]

Increased transportation costs result from low density, automobile-oriented land-use patterns. Access to destinations such as employment, commercial and retail establishments, and social activities, is largely dependent upon the automobile. Travel costs tend to increase with larger distances between destinations. According to a recent study, households in low-density suburbs generate 66 percent more vehicle-use hours per person than similar households in traditional cities. Low-density dwellers end up spending greater amounts of time in their cars; they often find themselves stuck in highly congested traffic that generates air pollution, lowers the overall efficiency of the automobile, and degrades low-density dwellers' quality of life in relation to those living in centralized locations where motor vehicle travel is not a necessity. Cars travelling more miles each year also cost their operators more in maintenance costs. If gasoline prices were to rise abruptly, those living in auto-dependent developments would face significant economic costs, as almost all aspects of commerce become more expensive.

Estimated annual *sprawl*-related transportation costs:

$145 billion in 1997 dollars[105]

Litman takes the total of these cost estimates for sprawl and reduces it by 50 percent to avoid double-counting such factors as air pollution, environmental degradation, and the influence of other sprawl 'inducements' such as mortgages, free parking, federal housing programs which favor low-density developments, and social phenomena like 'white flight.' With the serious study of the costs of sprawl still in its infancy, there is simply not yet enough data for a highly accurate estimation of costs. However, the presumption that the combination of roads and the 'driving culture' are the greatest catalyst for sprawl, imposing enormous environmental, social, aesthetic, public, and economic costs, is backed up by a growing body of transportation research. It may well be the case that sprawl costs are equal to Litman's full estimate of $327.4 billion; however, the estimate below takes the more conservative range of 50 to 75 percent of his total.

Total cost of sprawl attributable to motor vehicle use:

$163.7 to $245.5 billion in 1997[106]

The *barrier effect* of roads represents the costs imposed by motor vehicle users on non-motorized travel. Traffic has a profound impact on the mobility, safety, and well being of pedestrians and cyclists. Roadways heavily traveled by cars and trucks degrade the experience of walking or riding and force many individuals to drive short distances due to safety concerns. Traffic speed and volume are the major determinants of the *barrier effect.* School systems across the country spend an increasing percentage of their operating budgets on busing children who live within walking distance of schools, because traffic patterns makes walking too dangerous. Unfortunately, most roads built during the last several decades were designed primarily with motor vehicles in mind, considering cyclists and pedestrians only as an afterthought or ignoring them entirely.

Estimated annual cost of the *barrier effect*:

$11.7 to $23.4 billion in 1997 dollars[107]

Summary of Total Environmental, Health, and Social Costs

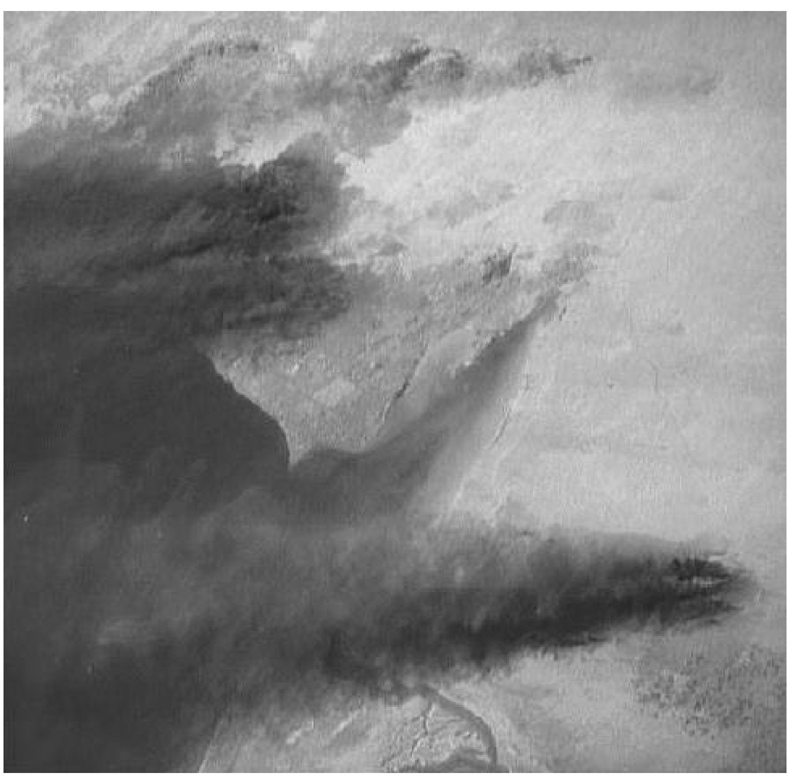
This estimate represents an attempt to include as many major well-researched and quantifiable cost factors as possible. Many health and environmental effects of petroleum exploitation are still being discovered. Similarly, analyzing the ecological impact of motor vehicle use is a truly gargantuan and daunting task. Air, water, and soil pollution, as well as habitat destruction, are all interrelated problems. It is very difficult to assign dollar values to costs that are at once intangible in the current economic system (in part because they have been externalized from gasoline prices) and yet quantifiably huge in terms of the social and environmental health of the planet.

Total Annual Environmental, Health, and Social Costs
Low estimate: $231.7 billion or $2.00/gallon
High estimate: $942.9 billion or $8.13/gallon[108]

Other Important Externalities of Motor Vehicle Use

US dependence on imported oil has a signifi cant effect on the American economy. In addition to the opportunity costs created by the country's need to import vast quantities of crude oil, there are other important economic factors to consider. Obviously, the costs of energy security are driven up substantially by the American transportation sector's overwhelming dependence on petroleum (97 percent).[109] Section III of this report covered the high cost of protecting oil, including military expenditures in the Persian Gulf and in maintaining the Strategic Petroleum Reserve. There are other externalities relating to America's increasing appetite for imported oil that ought to be included in our estimates on the real price of gasoline.

Economic vulnerability results from reliance on the price and availability of a single commodity. Certainly, the United States has made a serious though untested effort to reduce the risk from price spikes in the oil market by encouraging production in non-OPEC countries and through the creation of the institutions of the IEA and SPR (the IEA would operate an oil rationing system among member states, allowing them to conserve and pool petroleum resources). With the current supply glut on the world oil market anyone suggesting the possibility of a price hike anytime soon is quickly greeted with ridicule. But then, who among the worshippers of the 1990s-style "utopian free trade" expected the Asian financial crisis or the recent slump of world financial markets? The fact remains that despite the numerous proclamations of a fundamentally "new economy" with permanent prosperity, supposedly created by a combination of deregulation, globalization, low inflation, and the high-tech information revolution, economic disruptions and distortions will continue to occur. The sputtering global economy has dampened demand for oil in the near term. However, it is not hard to imagine a scenario in the not-so-distant future when demand for oil in East Asia combined with instability in the Persian Gulf (where approximately 70 percent of the world's proven oil reserves are located) sends the price of crude on an upward trajec-



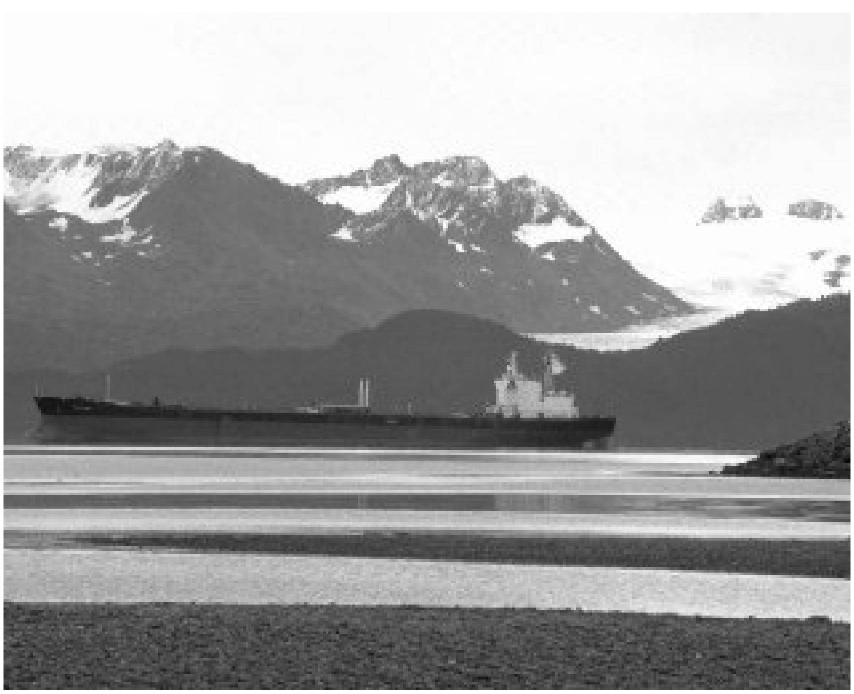
American dependence on imported oil has tied the fortunes of the United States to those of such volatile regions as the Middle East. In this photograph taken from the Space Shuttle Discovery on Sept. 18, 1991, smoke pours from Kuwaiti oil fields, which Iraqi forces had set ablaze in the waning days of the Persian Gulf War.

tory.

In recent years, US net oil imports have accounted for almost half of the country's merchandise trade deficit. As the single largest component of the trade deficit, oil import purchases represent a huge outflow of American capital. Additionally, the United States' terms of trade are diminished by the growing need to purchase imported crude. Domestic oil production is expected to fall dramatically over the next decade as existing fields are exhausted and relatively few new reserves are discovered, meaning America will be even more desperate to buy foreign oil. The United States consumes roughly 25 percent of the world's oil production, creating a monopsonistic effect.[110] In other words, high US demand increases international oil prices, imposing a cost on all oil consumers. The American level of demand also raises the economic rent paid for oil, transferring wealth to oil producers. This in turn, reduces demand for US goods and services and lowers overall economic growth. Several studies in recent years have concluded that money spent on imported oil is largely lost to the American economy, with gasoline purchases providing relatively few jobs per dollar spent (most are also not high wage jobs).[111]

The price effect (a pecuniary externality or wealth transfer between consumers and producers) of using petroleum fuels for motor vehicles causes non-transportation petroleum product users to pay more to foreign oil producers due to the effect on oil prices of demand for motor fuels. The almost total dependence of the US transportation sector on petroleum fuels has created an externality in the form of higher prices for consumers and producers using oil for non-motor vehicle purposes. Delucchi estimates the cost of this price effect for the 1990-91 period at $4 to $8.4 billion.[112]

A sudden change in the price of oil has the potential to seriously damage the US economy. The potential loss in GNP due to petroleum use arises from the "inability of the economy to adjust instantly to rapid changes in the price of oil."[113] The SPR offers protection against price and supply shocks for slightly over one month. While this provides some room to maneuver during short periods of market or security volatility, it cannot stop the economic consequences of longer-term price hikes. Rising petroleum prices result in rising transportation costs, which consumers end up paying for in the form of higher retail prices. Companies whose profit margins are sensitive to transportation costs are forced to pursue cost-cutting measures that may result in layoffs. Oil price hikes can trigger inflationary pressures as occurred during the 1970s. The higher cost of transport also has the potential to negate gains in productivity. The American economy is much more dependent on oil than those of comparably developed countries in Europe, which



A massive tanker moves crude oil to a refinery on the way to gasoline pumps in the United States. A disruption in the flow of oil could have devastating financial repercussions.

could react with more flexibility to rising petroleum prices; thus the United States' potential for GNP loss is much greater. Delucchi estimates the expected loss due to a sudden change in oil prices at $1.6 to $30.5 billion in 1991 dollars.[114]

Estimated annual cost of US oil import dependence (not including protection costs):

$5.0 to $10.1 billion in 1997 dollars

In case of a sudden price rise:

$7.0 to $36.8 billion in 1997 dollars[115]

Travel delays caused by congestion and overreliance on automobiles impose serious social and economic costs. Individuals dependent upon automobiles must deal with other drivers as they attempt to travel to and from work. Often, accidents or traffic backups occur on heavily traveled roads. The economic costs of congestion are wide-ranging and difficult to estimate, but there is little doubt that they are quite large. Lost time, wasted fuel, and increased insurance premiums due to accidents are easily quantified. However, perhaps just as significant are the effects on the health and mental well being of drivers, such as increased blood pressure, frustration, aggressive driving habits, and *road rage.* Weary drivers show up at work late or in a less than ideal state-of-mind, thus lowering workplace productivity. Travel delays not only sap productivity and cause workers to forgo paid time, they also displace unpaid activities, such as leisure time, civic activities, and time spent with family and friends. Delucchi estimates foregone paid work costs at $9.1 to $30.5 billion, lost unpaid activity time at $22.5 to $99.3 billion, and extra fuel consumption costs at $2.3 to $5.7 billion.[116] MacKenzie estimates a cost of $8.1 billion in increased vehicle insurance premiums relating to congestion and travel delays.[117] A GAO report from 1989 figures the loss of national productivity due to travel delays at $100 billion per annum and estimates the cost of truck delays at $24 to $40 billion each year.[118]

Estimated annual cost of travel delays:

$46.5 to $174.6 billion in 1997 dollars[119]

Uncompensated damages from accidents, or the portion of accident costs not borne directly by drivers, represent a major external cost of motor vehicle

Travel delays may cost Americans up to $174.6 billion a year.

use. Productivity losses result from motor vehicle accidents in the form of lost earnings due to injuries or deaths and lower productivity in the workplace and at home. The majority of these costs are recovered through insurance policies, although federal and state governments and non-motorists pick up about 23 percent of productivity loss, or approximately $18.3 billion. Medical expenses not covered by insurance or the drivers involved in accidents adds another $3.8 billion in uncompensated damages. Workplace costs not borne by drivers include expenses associated with recruiting and training replacements for injured or killed employees; employers also must make up for lost worker productivity that results when employees engage in workplace conversations about accidents or miss work to care for accident victims. These costs total about $600 million. The pain, suffering and reduced quality of life resulting from traffic accidents fall squarely on accident victims and their families. While drivers bear the majority of these costs through insurance, it is pedestrian and cyclist victims of car accidents who bear the external cost of roughly $54.4 billion annually.

Annual cost of uncompensated damages from accidents:

$18.3 to $77.2 billion in 1997 dollars[120]

Subsidized parking imposes considerable external and social costs on society and specifically on those who do not own or operate motor vehicles. Some costs related to parking facilities have been covered in other sections, but here we consider the perk of free or reduced-rate parking provided by retailers, employers, and the government. Many mass transit systems are rendered ineffective by the one-two punch of low-density land use and free parking. Most motorists receive some form of parking subsidy; only 5 percent of driving commuters pay full parking costs, while 9 percent pay subsidized rates and the remainder park for free.[121] Government helps subsidize parking through local zoning laws that require developers to build more parking spaces than the market demands; the resulting oversupply pushes the market price of parking down toward zero. Most employee parking is exempt from federal income tax, and can be a means of avoiding taxes for both employers and employees. It is much cheaper for employers to pay for employees' parking spaces than to increase employees' salaries and pay additional social security and other benefit costs. Free parking also increases the incentive for workers to drive, making more fuel efficient transportation options less attractive.

Estimated annual cost of subsidized parking:

$108.7 to $199.3 billion in 1997 dollars[122]

Weather-related financial loss seriously affects the insurance industry. With approximately one-third of annual greenhouse gas emissions coming from motor vehicle exhaust, it is statistically reasonable to attribute 33 percent of the increase in storm related insurance losses (due to climate change) as an external cost of gasoline usage. According to Christopher Flavin of the Worldwatch Institute, insurance losses caused by climate change-related weather damage totaled more than $36 billion in 1995.[123] As the average global temperature rises and the destructive power of storms increases, insurance losses can be expected to grow exponentially. This represents a formidable financial challenge to the $1.5 trillion-a-year insurance industry. The economic drain of insurance losses caused by the occurrence of numerous "hundred-year" weather disasters each year could shatter the industry and ultimately cripple the US economy, unless steps are taken soon to alleviate the problem.

Estimated annual cost of weather-related insurance loss:

$12.9 billion in 1997 dollars[124]

Total Annual Cost of "Other" Economic Costs:
Low estimate: $191.4 billion or $1.59/gallon
High estimate: $474.1 billion or $3.95/gallon
Estimate w/petroleum price spike:
$500.8 billion or $4.17/gallon

The Real Price of Gasoline

The External and Social Cost of Gasoline

Low estimate: $4.60/gallon or $558.7 billion/year
High estimate: $14.14/gallon or $1,690.1 billion/year

Estimate assuming oil price spike and new tax subsidies:
$14.37/gallon or $1,718.9 billion/year

The Real Price of Gasoline[125]

Low estimate: $5.60/gallon
High estimate: $15.14/gallon
W/price spike: $15.37/gallon

As these figures show, the *real price of gasoline* is significantly higher than the price paid by the average consumer at the local filling station. So who pays for the difference between the price at the pump and the total cost of a gallon of gasoline? The answer is not simply *all of us*, but is rather more complex. The externalities and social costs created by motor vehicle usage in the United States have inter-temporal consequences. The full effects of the destruction wrought by the age of the gasoline-powered vehicle have yet to be realized. Future generations will no doubt pay for today's mistakes in consequences ranging from environmental degradation to decreased quality of life.

Even if it were possible to wave a wand and magically convert every vehicle on the nation's roads into a low- or no-emission vehicle (EV or fuel cell), we would continue to bear the costs and consequences of the past. Unfortunately, current trends in transportation sector growth and efficiency point to considerable increase in the external and social costs of petroleum consumption. The rapid growth in motor vehicle usage throughout the developing world could make the estimated current annual external cost of gasoline ($1.7 trillion) in the United States seem trivial, as carbon emissions skyrocket globally and farmland is gobbled up for roads and sprawl in places like China and India where the environment is already overstressed. According to DOE's Energy Information Agency (EIA), the world's demand for oil has risen by almost 7 million barrels per day (107 billion gallons annually) since 1993.[126] That means that each year global petroleum consumption grows by a quantity almost equivalent to the amount of gasoline used annually by the US transportation sector. This may add over half a trillion dollars in externalities worldwide.

Somewhat ironically, with the price of oil on the world market fluctuating around $10 to $12 per barrel, the external and social cost of gasoline usage appears to be increasing in the United States as the energy efficiency gains of the last two decades have been squandered on recent shortsighted trends in the American automotive market. The growing preference among American drivers for light-duty trucks and sport utility vehicles, which are less fuel efficient than normal passenger cars, is eroding the overall average gas mileage for all the vehicles on American roads. Growth in the demand for transportation energy has generally kept pace with population growth. While the number of drivers has remained fairly constant in recent years, the amount of miles they drive each year has grown substantially. Low motor fuel costs, coupled with low-density *sprawl* growth in most major cities around the country has increased driving distances and, consequently, increased energy consumption, pollution, and inefficiency.

The low price of oil on the world market reflects an overcapacity of production that is unlikely to disappear in the near-term. Several countries with huge oil production capacities are currently not active in the world oil market (Iraq and several countries of the former Soviet Union). When these countries obtain or regain effective access to the market, there will be significant downward pressure on petroleum prices that could have significant implications on oil externalities in the United States. The major oil-producing countries in the Persian Gulf have incredibly low production costs due to the high grade of their petroleum and the geological structures of their oil fields, which makes it extremely difficult for American oil producers, with smaller and costlier operations, to compete. This price pressure inevitably leads to intense lobbying by US producers for federal subsidies and tax breaks. Once federal giveaways are established they have a tendency to outlive their usefulness.

In the long-term, there is a very real potential for escalating protection costs as US production begins to decline after the turn of the century and it becomes necessary to import ever-increasing amounts of crude. It is important to realize that 70 percent of the world's proven petroleum reserves are located in the Persian Gulf, and as reserves in other regions are depleted the US will need to import more crude from the Middle East. With an active arms race, an exploding population, and social and political unrest all on the upswing in the region, it is not unrealistic to expect pervasive instability there. This means the United States may have to spend considerably more on strategic interests in the region. Specifically, the costs of protecting the free flow of oil from the Middle East could rise rapidly, especially if a full-blown conflict erupts.

Obviously, the real price of gasoline bears little resemblance to the number posted at the local service station. It seems that the lower the price at the pump, the higher the price in terms of environmental, health, and economic costs. Certainly, these costs cannot be eliminated overnight, but it is time to start searching for long-term solutions and implementing methods for internalizing these costs. If the American driver had to pay $15 for a gallon of gasoline, we would soon see a shift in driving and development patterns. It is probable that some economic pain will accompany a shift toward the accurate pricing of petroleum products. However, it is better to bear the pain gradually than to face an abrupt crisis due to a price shock or supply disruption. If we do not start paying the real costs created by our reliance on cheap gasoline, future generations will surely suffer as a result of our selfish and shortsighted policies. Instead of wasting billions of dollars annually, preserving and subsidizing an unsustainable transportation status quo, we should begin making the transition to efficient alternatives.

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42. Estimates taken from Greenpeace.
43. "Onshore Benefits: Oil and Gas, obtained from *www.house.gov/resources/105cong/democrat/subsidy.htm.*
44. Greenpeace, p.6-10.
45. Estimates taken from Exhibit A-1, Greenpeace, subsidy includes royalty undercollection, management of leases (including outer continental shelf leases and subsidies).
46. Greenpeace, p.5-6.
47. Greenpeace, p.5-6.
48. Greenpeace, p.5-9.
49. Office of Underground Storage Tanks, EPA.
50. ILSR, p.12.
51. OMB.
52. ILSR, p.9.
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54. Greenpeace, p.4-12; Ravenal, *www.cato.org.*
55. Office of Management and Budget (cited in ILSR).
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57. Using data from ILSR, Greenpeace, Ravenal, and *www.dtic.mil/execsec/adr98/chap21.html#top.*
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59. Greenpeace, p.4-21.
60. Greenpeace, p.4-21.
61. US Department of Energy, Office of Strategic Petroleum Reserve at *www.fe.doe.gov/spr/sprfedrg.html.*
62. Estimates taken from Greenpeace.
63. Greenpeace, Exhibit a-3a.
64. Estimates from Greenpeace.
65. Litman, p.3.8-3.
66. Delucchi, p.43.
67. Estimates taken from Delucchi.
68. Litman, p.3-10.
69. ILSR, p.12.
70. Union of Concerned Scientists, "Cars and Trucks and Air Pollution," 1998.
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76. Estimates taken from Delucchi (converted from 1990 dollars to 1997 dollars).
77. IPCC, 1995a, p.5.
78. EESI, *Oil and Transportation Fact Sheet* (1993).
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80. Paul Rauber, "Heat Wave" *Sierra Magazine* Sep/Oct 1997.
81. Paul Rauber, "Heat Wave" *Sierra Magazine* Sep/Oct 1997.
82. ILSR, p. 13.
83. Paul Rauber, "Heat Wave" *Sierra Magazine* Sep/Oct 1997.
84. Estimates taken from Delucchi and UCS.
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87. Greenpeace, p. 5-10.
88. Paul Chernick and Emily Caverhill, *Valuation of Externalities from Energy Production, Delivery and Use*, Boston Gas Company, Dec 1989, p.85.
89. Douglas Lee, *Full Cost of Pricing of Highways* National Transportation Systems Center, Jan 1995, p.21.
90. Litman, p.3.15-1.
91. Low estimate from Delucchi (includes his high estimate of runoff and salt pollution), high estimate covers only

salt pollution costs from study by Murray and Ulrich of US EPA.
92. Low estimate does not include national hydrologic impact.
93. Low estimate from UCS, High estimate from Delucchi (variation depends on uncertainty regarding cost of noise per decibel above a threshold).
94. Doug Howell, telephone interview, Nov. 6, 1998.
95. Estimate from Lee (figure converted from 1995 dollars).
96. Committee for a Study on Transportation and a Sustainable Environment, 1997, p.4.
97. American Farmland Trust.
98. US EPA "Cooling Our Communities", Jan 1992.
99. Litman, p.3.14-13 (this is the annualized environmental cost of road building).
100. Segal, *The Economic Benefits of Depressing an Urban Expressway*, 1981.
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103. Litman, p.3.14-13.
104. Litman, p.3.14-14.
105. Litman, p.3.14-15.
106. Litman, p.3.14-16.
107. Litman, p.3.13-3 (estimate based on limited amount of research, therefore low number is estimated rather conservatively at 50 percent).
108. Based on estimated 116 billion gallons of annual gasoline consumption in the US.
109. Oak Ridge National Laboratory, *Transportation Energy Data Book: Edition 17.*
110. Litman, p.3.12-2.
111. DeCicco and Ross, "Improving Automotive Efficiency," *Scientific American*, Dec 1994, p.56.
112. Delucchi, p.74.
113. Delucchi, p.74.
114. Delucchi, p.44.
115. Note this estimate includes only Delucchi figures updated to 1997 dollars, no estimate of other trade and macroeconomic effects of oil import dependence.
116. Delucchi, p.44, 46.
117. MacKenzie, p.18.
118. GAO, " Traffic Congestion: Trends, Measures, and Effects," GAO/PEMD-90-1, 1989, p.63-64.
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121. USDOT, *NPTS Summary of Travel Trends*, 1992 as cited in Litman, p.3.4-2.
122. Low estimate is from MacKenzie, p.10; High estimate from Office of Technology Assessment as cited in Litman, p. 3.4-7.
123. Christopher Flavin, "Storm Warning: Climate Change Hits the Insurance Industry" taken from *www.worldwatch.org.*
124. Estimate represents one third of Flavin's 1995 figure adjusted for inflation.
125. The final estimates are based on a retail gasoline price of $1 per gallon.
126. DOE/EIA *International Energy Outlook 1998*, (DOE/EIA: Washington: 1998), p.25.