

**A Plan
To Kick
The Saudi
Habit**

Ending the Oil Age

By Charles Komanoff

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**KOMANOFF ENERGY ASSOCIATES
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A sustainable society must depend upon renewable resources, which oil cannot be. It must recycle nonrenewable resources, and burned oil cannot be recycled. It needs to restore the base of renewable resources — our forests, soils, cities and human minds.

In this effort America needs to lead. We are in retreat.

We should be capable of doing better, and I urge that you require it. In my own fifty years' experience in the environmental movement, I have seen that most of the environmental damage, and of our stealing from children, that has turned me gray has come either from the mad dash for more energy or the thoughtless ways with which we waste what we find.

*— David R. Brower
Testimony before the U.S. Senate Committee on Energy
and Natural Resources
October 15, 1987*

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Executive Summary

The United States can cut its oil use easily by 5%, and, with greater effort, by 10%, virtually overnight, thus improving national security by reducing the importance of our network of oil-producing client states — the “assets” that put America in the line of fire on September 11 and still keep us there.

These savings, exceeding U.S. imports from Saudi Arabia, can occur immediately by tapping Americans’ desire, expressed repeatedly in recent months, to collectively change individual behavior so as to reduce our dependence on oil and the nation’s exposure to future attacks.

While the savings won’t automatically translate into barrel-for-barrel reductions in U.S. imports from Saudi Arabia, they will shrink the vast flows of oil money that financed the September attacks. Moreover, the “demonstration effect” of these initial oil savings will help turn around our collective way of thinking about energy and create momentum for larger, longer-term savings.

More than one-quarter of the world’s oil consumption takes place in the U.S., at a rate of 19.3 million barrels (over 800

5% Oil Saving Plan — Summary

Activity	% of Oil	Changes	Oil Saved, % (barrels/day)	% Oil Saved
Driving	40.7%	Eliminate 1 in 14 trips and/or miles by cars and “light trucks”	7% (550,000)	2.85%
Flying	6.7%	Frequent flyers eliminate 1 in 7 trips; higher load factors; less idling	14% (180,000)	0.93%
“Process Heat”	5.0%	Substitute natural gas made available by conserving electricity	10% (96,000)	0.50%
Heat + Hot Water	4.9%	2°F setback in ¾ of oil-heated buildings	4.5% (42,000)	0.22%
Oil refining	3.3%	“Automatic” from decline in sale of petroleum products	5% (32,000)	0.16%
Road pavement	2.8%	Decline in traffic allows deferral of some road building	5% (27,000)	0.14%
Electric generation	1.6%	5% power conservation nationwide, 20% at oil-fired power plants	20% (63,000)	0.32%
		TOTAL	989,000	5.12%

million gallons) per day. Our 5% Oil Saving Plan eliminates 989,000 barrels a day, equaling 60-65% of imports from Saudi Arabia. Three-fourths of these savings come from eliminating the least essential car and air travel. The remainder comes largely from a nationwide electricity conservation campaign modeled after incentives and public-service programs that reduced power use in California by 5% last year.

Our 10% Oil Saving Plan intensifies these conservation efforts and also taps a wider range of activities, from truck freight to plastics manufacture and motorized recreation, to save 1,941,000 barrels a day. The savings rate exceeds imports from Saudi Arabia and equals three-fourths of imports from the entire Persian Gulf.

10% Oil Saving Plan — Summary

Activity	% of Oil	Changes	Oil Saved, % (barrels/day)	% Oil Saved
Driving	40.7%	Eliminate 1 in 10 trips and/or miles by cars and "light trucks"	10% (786,000)	4.07%
Truck freight	12.7%	Eliminate 1 in 20 ton-miles through improved logistics	5% (123,000)	0.64%
Plastics manufacture	10.3%	Improved energy utilization in manufacture; increased recycling	5% (100,000)	0.52%
Flying	6.7%	Frequent flyers eliminate 30% of trips; others eliminate 5%	28% (360,000)	1.87%
"Process Heat"	5.0%	Substitute natural gas made available by conserving electricity	20% (191,000)	0.99%
Heat + Hot Water	4.9%	3°F setback in ¾ oil-heated buildings; low-flow showerheads	7.7% (72,000)	0.38%
Oil refining	3.3%	"Automatic" from decline in sale of petroleum products	9.7% (62,000)	0.32%
Road pavement	2.8%	Decline in traffic allows deferral of some road building	10% (54,000)	0.28%
Waterborne freight	2.5%	"Automatic" from decline in oil shipments (also coal)	4.5% (22,000)	0.11%
Electric generation	1.6%	5% power conservation nationwide, 25% at oil-fired power plants	25% (78,000)	0.41%
Construction machinery	1.6%	"Automatic" from reduced road building	10% (31,000)	0.16%
Air freight	1.1%	Reduced use of overnight delivery	10% (21,000)	0.11%
Recreational vehicles	1.0%	Reduced usage, particularly gas-guzzling powerboats, jet skis, etc.	20% (41,000)	0.21%
		TOTAL	1,941,000	10.05%

California illustrates the possibilities. During 2001, in response to the much-publicized power shortages of the previous year, Californians embraced energy conservation and reduced statewide power consumption by 5% — while the economy grew. More than four-fifths of Californians took some energy-saving actions. Though the power crisis has since waned, the state's citizens and businesses have nonetheless continued saving electricity.

Today, not just Californians, but all Americans are eager, as never before since World War II, to change behavior patterns that consume large amounts of petroleum. (Longer-term measures like improving gas mileage, popularizing non-gasoline-fueled vehicles, and re-developing rail and other non-car transport systems are also essential, but unlike these, the policies and programs outlined here can begin saving oil at once.)

It's time for the Bush Administration and Congress to acknowledge what much of the public already knows: that our national interest is profoundly threatened by our outsized appetite for oil; to declare that we face a choice between love of oil and love of country; to break with past policies of subsidizing oil consumption and treating every oil-consuming activity, no matter how discretionary or wasteful, as essential; and to lead Americans in taking all available steps to slash U.S. oil consumption decisively and immediately.

In this moment of crisis, environmental consciousness and patriotism speak with one voice, and the combination is uniquely powerful. The question is no longer "whether" to begin ending the Oil Age, but "when"; and our answer is, *right now*.

Introduction

On September 11, our long-simmering energy crisis finally boiled over. For decades our profligate waste of oil has dug us ever deeper into the social and political conflicts of the Middle East, and the consequences have now become plain. We face the prospect of permanent war and the loss of formerly cherished liberties; and we are asked to underwrite a grandiose and quixotic global hunt for elusive and ubiquitous enemies.

In the initial weeks after Sept. 11, it seemed that Americans were awakening at last to the true cost of their addiction to oil. There was a widely-expressed willingness to take real, significant action to break our deadly habit of profligate oil-burning — not only by employing energy-efficient technology as it became available, but by changing daily behavior to use less energy.

“I believe that most Americans are more than willing to make personal changes in their lifestyles to become independent of Middle Eastern oil,” went one letter to *The New York Times* in November. And for a while newspapers, chat rooms and daily, face-to-face conversations reverberated with similar pleas from Americans for national action to end this “deadly dependence” once and for all.

But what resonated around the country didn’t play inside the Beltway. To the oil-dominated Bush Administration, oil conservation is the stuff of nightmares; and so throughout the fall, it shrilly urged Americans to keep buying, driving and flying. The rest of official Washington — TV windbags, corporate lobbyists, elected officials — dutifully repeated the mantra that it would take a long time to make even a tiny dent in our need for Saudi oil.

Dismayingly, the prominent environmental groups also embraced this defeatist mentality. Their high-minded “energy plans,” most of them a repackaging of pre-Sept. 11 ideas, relied on making Detroit design, build and try to sell higher-mileage cars. Yet these schemes wouldn’t start saving oil

before 2009 at the earliest — a sure turnoff for a citizenry that wanted to start saving oil in seven weeks, not seven years.

The wisdom of the public has found, in short, no answering wisdom among its “leaders,” political, economic, or intellectual. The voice of the grassroots has fallen on deaf ears, and so, in more recent weeks, it has fallen silent. But the willingness, and indeed the desire, to do something real to reduce our self-imposed vulnerability has not gone away.

This report seeks to respond to that willingness and that desire. It demonstrates how our country can begin *today* to withdraw the oil needle from its arm — if we pull together for a common purpose and make some changes in how we live.

Through strategic changes in a handful of key areas, we can easily reduce our oil consumption by 5% virtually overnight, and, with more intensive effort, by twice that — almost two million barrels a day. These steps — if taken now — would turn the world’s oil equation upside down, and allow the United States to extricate itself immediately from the most dangerous of its foreign entanglements. Moreover, by finally removing us from the treadmill of ever-increasing oil usage, these oil-saving actions would lay the groundwork for a complete transition to secure and sustainable sources of energy tomorrow.

Deadly Dependence

Thirty percent of the world’s extraction of crude oil occurs in the Middle East — the countries bordering the Persian Gulf or situated on the Arabian peninsula. The region’s ten nations, including Saudi Arabia, Iraq, Iran and Kuwait, home to less than 3% of the world’s population, hold two-thirds of Earth’s known oil reserves.

In fearful symmetry, the United States consumes 25% of world oil production but has a mere 2% of reserves, even counting the hypothetical petroleum that is said to lie under the Arctic National Wildlife Refuge. With domestic oil fields largely “played out,” almost 60% of the petroleum used in the U.S. is imported.

The most prominent and important oil-producing of America's oil-producing "allies" is Saudi Arabia. This rather contrived kingdom has more than a quarter of the world's known oil reserves; indeed, there are thought to be large pools of petroleum in areas not yet fully explored, which might further increase the sheiks' share of Earth's total oil resources. Saudi Arabia supplies more than 8% of the oil used in the United States and, with its huge reserves and spare production capacity, has long functioned as the world's "swing producer" of oil, compliantly matching its output to fluctuations in world demand in order to keep product flowing and prices stable.

There is a downside to this cozy arrangement: not everybody in Saudi Arabia likes it. Among these dissident elements, Osama Bin Laden is by no means unique. Wary of its militant clerics, the Saudi regime has looked the other way as religious schools trained volunteers for holy wars and oil princes funneled protection money to the Al Qaeda network. The United States, reviled by many Saudis for its "infidel" military presence, and fearful of unsettling the hand on the spigot, has tacitly seconded this strategy of accommodation.

America's patronage of authoritarian regimes throughout the Middle East had already proven very costly prior to Sept. 11. U.S. sponsorship of the Shah precipitated the 1978-79 Iranian revolution and spawned the intense hatred of our country that continues to this day. Our dangerous liaison with the Saudi regime is only the most egregious manifestation of the national-security disaster created by our programmatic commitment to the over-consumption of oil.

Of course, our oil gluttony is damaging in other respects as well: to the countries that extract the oil and send it to us, and all too often squander the wealth maintaining an idle elite in obscene luxury; to our own economy, and the world's, which is ravaged by the inequity and instability bred by the oil industry; and to the air and water and weather upon which all Earth's creatures — including us — depend.

Love of Oil vs. Love of Country

The choice is clear: love of oil or love of country. Sept. 11 should have signaled a radical break with past policies of

subsidizing oil consumption and treating every oil-consuming activity, no matter how discretionary or wasteful, as essential. We should not have to wait for technological breakthroughs or well-intentioned but Byzantine regulatory policies with long incubation periods — nor do we need to. As this report documents, America can significantly reduce consumption of gasoline and other petroleum products, starting today.

This assertion defies not one but two orthodoxies: the political establishment's view that America must forever rely on Middle Eastern oil (the title of a post-Sept. 11 article in the conservative *Weekly Standard* says it all: "Can We Do Without Saudi Oil? Alas, No."); and the environmentalist establishment's exclusive focus on long-term gains in energy efficiency, which shuts out the present crisis.

Increasing the efficiency of energy use throughout our economy is essential — indeed, over the long term that, and the transition to renewable (solar) energy, must be the bedrock on which not only energy but economic policy is based. But the trauma of Sept. 11, and the threat to our security that the attacks laid bare, should have evoked a more urgent and immediate response.

Accordingly, this report offers a blueprint for changes in our habits and daily behavior — the only sphere in which we can make a dramatic difference *here* and *now*. If our American determination and commitment are commensurate with the crisis we face, a national campaign to conserve oil could reduce usage by 5 to 10 percent immediately, with much bigger cuts to follow as the energy-efficiency and solar revolutions begin to bear fruit. This report discusses, in some detail, the means by which these initial savings can be realized quickly, and goes on to sketch a path to even greater savings over a somewhat longer term.

How We Use Oil

Prior to Sept. 11, U.S. vehicles, machines, buildings and factories consumed an average of 19.3 million barrels of gasoline, diesel fuel and other petroleum products each day. (One barrel of petroleum contains 42 gallons.) That's one-

quarter of the world's oil, and close to 3 gallons for every man, woman and child in America — twice as much as per capita use in Western Europe, and seven times the world average outside the U.S.

Table 1 shows the 16 biggest uses of petroleum — those accounting for at least 1% of U.S. oil consumption — in descending order.

Table 1: Major Uses of Petroleum Products in the United States, 2000

T = travel; F = freight; H = heat; M = misc.

Code	Where and How Used	Type of Oil	Barrels/day	Share of total, %
T	Cars (includes SUV's, minivans, pickups)	Gasoline (99%)	7,855,000	40.7%
F	Trucks (> 8500 lbs)	Diesel (80%)	2,460,000	12.7%
M	Raw material for plastics, chemicals, etc.	Feedstocks, Liquefied Petroleum Gas (LPG)	1,993,000	10.3%
T	Air travel (passenger; freight shown separately)	Jet fuel	1,287,000	6.7%
H	Process heat for factories	Various grades	956,000	5.0%
H	Heat + hot water for homes, offices, stores	Distillate, Resid (residual oil), LPG	942,000	4.9%
H	Energy to run oil refineries	Still gas	639,000	3.3%
T	Road pavement	Asphalt	537,000	2.8%
F	Waterborne freight (domestic + international)	Resid, distillate	478,000	2.5%
M	Agriculture (drying crops, farm machinery, etc.)	LPG, diesel	432,000	2.2%
H	Electricity generation	Resid (>90%)	313,000	1.6%
M	Construction machinery	Diesel	310,000	1.6%
M	Military (mostly jets)	Jet fuel, mostly	298,000	1.5%
F	Rail freight	Diesel	239,000	1.2%
F	Air freight	Jet fuel	212,000	1.1%
T	Recreational vehicles (boats, ATV's, etc.)	Gasoline	203,000	1.0%

See "Notes" following main text for source of figures and key assertions in report.

Together, these 16 "end-uses" account for 99% of U.S. oil consumption, which in turn is 39% of all energy used in the

United States (the remaining 61% being provided by a combination of coal, natural gas, nuclear power, and “renewable” sources such as hydropower, wind and wood).

All other sectors — everything from lubricants and kerosene heaters to propane grills and diesel buses — add up to only 1% of petroleum usage, and so can’t be tapped for large savings. Our 5% Saving Plan targets 7 areas of use, while the 10% Plan brings in 6 more.

The 16 end-uses fall into four groups:

Travel — Four categories of motorized travel (denoted by “T” in the table) — cars and other passenger vehicles, air travel, road pavement and recreational vehicles — account for just over half (51%) of U.S. petroleum consumption. Auto and air travel together account for more than half of the oil savings in both plans.

Freight — The four major categories of goods movement — trucks, ships, rail and air — together account for 17.5% of U.S. oil use. Most of this sector lies beyond the reach of behavior by individuals, and we target it only in the 10% Plan.

Heat — Just under 15% of the oil is burned to provide heat, either as a means (factory or refinery process heat, or electricity generation), or as an end in itself (space or hot water heating). All four categories offer opportunities for saving oil through personal conservation steps, as we discuss below.

Miscellany — The remaining four categories — chemical feedstocks, agriculture, military use and construction machinery — total almost 16% of U.S. oil usage. Only in feedstocks are there opportunities for immediate savings through changes in behavior.

The 5% Oil-Saving Plan

America could easily cut its oil consumption by 5% within six months by targeting just four activities: *driving*, *flying*, *heating* and *electricity*. Here’s one possible blueprint:

Activity #1 — Driving

● **Goal: Reduce gasoline use by 7%, saving 550,000 barrels/day.**

Before Sept. 11, U.S. passenger vehicles — cars, “sport utility vehicles,” pickups, and vans — made over a billion trips per day, consuming almost 7.9 million barrels of gasoline (almost 41% of total U.S. oil usage). Our top priority is eliminating 7% of this gasoline, or 550,000 barrels per day.

Conceptually, the simplest way to reach this target is to eliminate every fourteenth car trip, targeting long and short trips alike. Given the discretionary nature of much car travel, foregoing 1 in 14 car trips shouldn’t be difficult — provided that conserving oil is made a national priority.

How can ordinary Americans cut out 7% of their car trips? It’s easier than one might think. Some rides can be shared with friends, neighbors, or other family members. Some trips to school or soccer practice can be walked or biked (or skated or scootered) rather than taken in the minivan. Today’s drive to the grocery store might be consolidated with tomorrow’s.

The idea is not to dispense with driving altogether — 93% of each family’s trips will remain intact — but to drive more purposefully. Every car trip has some rationale, but not all have equal value to the driver. Everyone can eliminate some of their least valuable trips and consolidate others without giving up much of the overall benefit of driving.

Driving Strategically. This kind of strategic thinking about driving will become more natural if our 1-in-14 goal, or some version of it, is presented and accepted as a civic duty. Occasionally walking, cycling, taking the bus, sharing rides or just plain traveling less are all easier to imagine for oneself — and easier to explain to one’s friends and neighbors — if everyone is participating. What may be difficult to undertake individually can be eminently do-able as part of a recognized, explicit, collective effort for the common good.

Of course, the 7% gasoline-saving goal can be met without necessarily foregoing one out of every 14 trips. Gasoline can

be saved by shortening many trips for pleasure and/or shopping, or substituting closer destinations. Work trips, being more regular, are the easiest to carpool, especially if commuters are able to “cash out” the value of employer-provided free parking each time they ride-share or take transit. At workplaces in California that offer such arrangements, the same number of workers now get to work with 11% fewer cars. Since commuting trips account for 30% of U.S. car-miles driven, a universal parking cash-out policy across America could eliminate 3% of U.S. fuel consumption for personal travel — almost half of our target — right off the bat.

Moreover, since more than 60% of U.S. households own at least two cars, many people can conserve gasoline simply by re-prioritizing their daily use of vehicles. To illustrate: if half of those households switched just a tenth of their travel to their most-efficient vehicle, the nationwide savings would amount to over 1% of all gasoline consumption.

Other “behavioral” changes for saving gasoline abound; maintaining proper tire pressure and keeping highway speeds at or below 65 mph are two that come to mind. In addition, bearing in mind that reductions in highway traffic produce even larger reductions in highway gridlock, improved traffic flow from lower car volumes will itself yield further fuel savings for both drivers and truckers. (For the sake of conservatism, we have not included these and many other second- and third-order effects in our calculations, but they are quite real and will add significantly to the “bottom line.”)

Activity #2 — Flying

● **Goal: Reduce jet fuel use by 14%, saving 180,000 barrels/day.**

Prior to Sept. 11, U.S. commercial airplanes consumed just under 1.3 million barrels of jet fuel per day (almost 7% of total U.S. oil usage), conveying passengers a total of 820 billion miles annually. Our goal is to eliminate one-seventh (14%) of this fuel, or 180,000 barrels per day.

As it happens, the aftermath of Sept. 11 has greatly diminished commercial air travel compared to its previous levels, to the

point that our 14% savings target is already being met. Yet this downturn will be transitory without conscious changes in attitudes toward air travel, especially by those who have come to view habitual flying, whether in commercial airliners or corporate jets, as part of their way of life.

First off, we posit a rise in the airlines' average load factor to 75%, from the year-2000 level of 72.4%. This modest gain is equivalent to reducing the number of empty seats from 55 to 50 on a 200-seat flight, and so would barely be noticed by passengers. We assume further that operational modifications such as throttling down engines while waiting on runways and dispatching from the gate rather than forcing departing planes into queues will yield a 1% improvement in aircraft fuel efficiency (some of this may be occurring already as a byproduct of the contraction in air traffic). Restructuring airline pricing to base fares more heavily on distance would also lead to fuel savings as passengers chose closer destinations for some discretionary trips.

More Ground Time for “High Flyers.” Of the 820 billion “seat-miles” that Americans fly annually, roughly three-fourths are consumed by a relatively small group of people, especially corporate “road warriors” — the most active one-quarter of those who fly at all. Accordingly, our 5% Saving Plan exempts the occasional air traveler and instead targets this top tier of frequent flyers, whom we ask to forego one-seventh (14%) of their airplane trips. The combination of fewer flights and the operational changes outlined above would reduce jet fuel use by 14% from year-2000 levels.

Can the corporate frequent flyers be induced to forego 1 in 7 of their air trips? Yes, if their modest sacrifice is linked to the national interest and established as such in public discourse. While this target appears twice as ambitious as the goal of eliminating 1 in 14 car trips, the reality is that pre-September air travel patterns included a greater proportion of highly discretionary trips than the driving patterns.

Much of flying nowadays is relatively low-value trips — transcontinental journeys for a ceremonial handshake on a business deal, vacation trips obsessively programmed into

every available weekend. Under a national oil-saving ethic, such hypermobility would cease to be the norm. The benefits would go beyond oil conservation: fewer trips would mean quicker passage through airport “security” and less air traffic congestion, adding staying power to the improvement in on-time performance in the initial months following Sept. 11.

To be sure, some air travel has moved onto buses and trains since the attacks. Yet because Amtrak’s current capacity is just one percent of the airlines’, an enormous expansion of rail service will be needed before rail can assume a substantial share of the trips now made by air travel. Similarly, while buses have already substituted for some shorter plane trips, a larger shift would require that bus companies market their service, upgrade passenger comfort and improve schedules, and push for smart traffic measures like converting highway lanes to high-occupancy use. Since these rail and bus service improvements will take some time, we expect that in the short term, most of the foregone plane trips will simply not be taken, under the new ethos of conserving travel.

Activity #3 — Heat Levels in Buildings

● **Goal: Reduce fuel oil use by 4.5%, saving 42,000 barrels/day.**

Most buildings in America are heated by natural gas or electricity. But many buildings, particularly in the Northeast, are heated by petroleum. Almost a million barrels a day of distillate (light) oil, bottled gas (liquefied petroleum gas, or LPG) and residual (heavy) oil are burned to make heat and hot water for houses, apartments, stores and commercial buildings (offices, schools, hospitals, etc.). Our goal is to eliminate 4.5% of this fuel use overnight to save 42,000 barrels a day.

We aim to accomplish this saving through a 2-degree (Fahrenheit) reduction in home and office thermostats. This step can be taken without creating undue discomfort, as the drop in temperature can be offset through a number of means: turning down the heat at night (with a timer to switch it back on at dawn); turning off heat in unused rooms in winter; donning a sweater or covering bare feet with socks and slippers; and, of course, eliminating overheating, which

remains ubiquitous in America. Yet it would eliminate 8%, on average, of the fuel used for heating over the course of a year.

We apply the 8% savings rate to only 75% of buildings, on the premise that 25% of homes and offices can't or won't set back their thermostats, or have already done so; and to only 75% of annual fuel oil use in this 75% of buildings, since water heating (which we treat in our 10% Plan but ignore here) accounts for the other 25%. The result is a 4.5% reduction in the annualized average of 940,000 barrels/day of fuel oil used in buildings, for a savings of 42,000 barrels a day.

Activity #4 — Electricity

● Goal: Reduce electricity use by 5%, thereby eliminating 20% of oil-fired generation of electricity and also increasing natural gas supplies to substitute for 10% of oil used for factory process heat, saving 159,000 barrels/day.

The final element of our oil-saving quartet is an across-the-board national 5% reduction in electricity usage, yielding a 0.8% decrease in oil use. This may not seem at first sight to add up, since the manufacture of electricity consumes only 1.6% of U.S. oil use — a mere 313,000 barrels per day. But the oil savings from electricity conservation actually come in a one-two punch that creates combined savings of 159,000 barrels a day.

First, as we explain below, it should be possible to eliminate 20% of the oil used nationwide to generate electricity, saving 63,000 barrels a day directly. Second, there is a further bounty to be had from exploiting the linkages from natural gas to both electricity and oil. Natural gas is both a major fuel for making electricity and an excellent substitute for oil in many industrial applications, particularly those involving process heat. Indeed, on a total Btu basis, U.S. natural gas-burning for electricity consumes twice as much energy as oil-burning for process heat.

Accordingly, saving 5% of all natural gas burned by gas-fired utilities will free up sufficient gas to displace 10% of the 960,000 barrels a day of oil used for factory process heat; this will save 96,000 barrels a day. Adding this to the direct

savings of 63,000 barrels a day gives 159,000 barrels a day, slightly more than 0.8% of total oil demand.

California Shows the Way. California provides an illustration of the possibilities for saving electricity. Since the beginning of 2001, in response to the much-publicized power shortages of the previous year, Californians have embraced energy conservation with a passion, reducing power consumption by 5% from year-earlier levels; the city of Sacramento, whose publicly owned utility has made conservation and “green” power (solar, wind, cogeneration, etc.) its cornerstones, saved almost 15%. (What might be called the “conservation ratio” is even greater than these figures suggest, since the absolute reduction must be adjusted for increased economic activity during the same time interval.)

How did these impressive electricity savings come about? State government and the utilities rolled out all of the tools of modern marketing, from public-service ads to financial incentives (like 20% bill credits for 20% cuts in usage), to sell conservation as a civic duty — and even as a kind of contest. In surveys, 82% of customers reported taking some action to save energy, and most said they took many steps: turning off lights, reducing or switching off air conditioning, and replacing inefficient incandescent bulbs with high-tech compact fluorescent lamps that provide equivalent light output but use just one-fourth the power. Public enthusiasm shows little sign of flagging, with 73% of customers recently reaffirming their willingness to continue saving electricity.

49 To Go. The potential savings from a nationwide power-conservation campaign are even greater, since the other 49 states are less energy-efficient today (and thus have more “low-hanging fruit”) than California was when it embarked on its current conservation campaign last year. Since many oil- and gas-fired generators are dispatched primarily on a “peak” or “shoulder” basis (unlike 24-by-7 “baseload” nuclear and coal-fired plants), electricity savings during peak periods will produce even greater savings in oil and gas. Furthermore, much of the nation’s oil-fired generation is concentrated in the Northeast, where the many large office buildings are ideal candidates for quick savings via lighting makeovers.

In keeping with the broad-based spirit of our energy-saving campaign, we propose that all utilities and their customers, regardless of the local or regional fuel mix, adopt a minimum target of 5% electricity savings. Nevertheless, to obtain the greatest oil savings, it may make sense in some instances to focus initially on customers and end-uses for which the “marginal” kilowatt-hour is now generated by burning oil or gas.

If stocks of power-saving equipment are exhausted in the rush to save electricity, then compact fluorescent lamps, “peak-pricing” time-of-use meters, solar photovoltaic cells and other peak-shaving devices should be deployed first in places where their oil and gas displacement is likely to be the greatest. As electric loads decline, it should also be possible to use existing long-distance transmission networks to send more “coal-by-wire” to oil- and gas-intensive areas, reducing local and overall oil- and gas-fired generation still further.

The industrial oils for which we propose to substitute natural gas span a wide range of petroleum products, including distillate (light) oil, residual (heavy) oil, petroleum coke and other “fractions” of the oil barrel. Since most of this oil is burned for process heat, it should not be difficult to replace one-tenth of it with natural gas made available through electricity savings, provided that factory owners and managers are recruited to make the necessary adjustments. Fortunately, gas is often the industrial fuel of choice, and many factory processes already operate on a “dual-fuel” basis, switching to oil when gas is unavailable (e.g., in winter). Indeed, gas customers must demonstrate oil-burning and storage capability to qualify for such “interruptible” gas contracts.

5% Saving Plan Summary

Table 2 summarizes the assumptions and results for the oil-saving steps discussed above, but with two additional entries. Road pavement reflects the assumption that, with lesser highway traffic, much highway construction and widening can be deferred or eliminated, saving at least 5% of the asphalt ordinarily used for paving. Energy to run refineries denotes the reduction in oil refining as demand shrinks for gasoline and other petroleum products.

Table 2: 5% Oil-Saving Plan Summary

Code	Where and How Used	Type	Barrels Per day	Share of total	Sector Saving	Barrels per day	Share of total
T	Cars and light trucks	Gasoline	7,855,000	40.7%	7.0%	550,000	2.85%
T	Passenger air travel	Jet fuel	1,287,000	6.7%	14.0%	180,000	0.93%
H	Factory process heat	Various	956,000	5.0%	10.0%	96,000	0.50%
H	Heat + hot water	Distillate	942,000	4.9%	4.5%	42,000	0.22%
H	Energy to run refineries	Still gas	639,000	3.3%	5.0%	32,000	0.16%
T	Road pavement	Asphalt	537,000	2.8%	5.0%	27,000	0.14%
H	Electric generation (oil)	Residual	313,000	1.6%	20.0%	63,000	0.32%
		TOTAL	12,529,000	64.9%		989,000	5.12%

First "Share of total" denotes each sector's percent of all petroleum consumption (19,311,000 barrels per day). "Sector Saving" denotes percent projected to be saved within that sector. Second "Share of total" denotes percent of all petroleum consumption saved due to savings in that sector.

Most of the savings will begin immediately upon adoption of our plan as national policy. Some savings will take time (but on the order of weeks or months, not years): e.g., replacing incandescent bulbs to save electricity, or implementing employer parking "cash out" programs to promote carpooling and save gasoline. All of the measures together should reach the 5% target level by mid- to late 2002. At that point, the oil savings, a shade less than a million barrels a day, would amount to 60-65% of U.S. imports from Saudi Arabia, which range from 1.5 to 1.7 million barrels a day.

The 10% Oil-Saving Plan

While the 5% oil-savings plan discussed above and shown in Table 2 is eminently achievable, doubling that target is a taller order. Remember, we are only counting oil-saving steps that can be taken within at most six months, which means that we necessarily concentrate on habits and behavior rather than technical fixes. (For example, in coming years people could buy hybrid cars instead of S.U.V.'s, but such long-term fuel savings haven't been included in this analysis.) Still, immediate savings of 10% of total U.S. consumption are entirely possible, provided Americans take the oil-saving imperative fully to heart.

This means participation by business and industry alongside individuals. That will be particularly important for saving oil in the two largest oil-consuming sectors, after driving: *trucking* and *plastics and chemicals manufacture*. We also ramp up the intensity of conservation actions in the activities targeted in the 5% Plan — driving, flying, heating and electricity — while adding several sectors not previously considered, such as recreational vehicles and air freight.

Table 3 and the brief discussion that follows show how the combination of these measures would allow America to reduce 10% of current oil consumption, more or less immediately.

Cars — We raise the gasoline savings rate from 7% (1 in 14 trips) to 10% (1 in 10). Obviously this requires foregoing, shortening, and “converting” (to transit, bike, walk, carpool) considerably more trips.

Trucks — Freight-hauling trucks consume almost 2½ million barrels of diesel fuel per day, or one of every eight gallons of petroleum used in the United States. We believe it should be possible to quickly save 5% of that fuel, or almost 125,000 barrels a day, through improved logistics: higher load factors and slower highway speeds, as well as restructuring of relationships with suppliers and purchasers and more distributed patterns of warehousing to reduce the distances that raw materials and finished goods are shipped. As noted in discussing the 5% Plan, improved traffic flow from lower car volumes will itself yield fuel savings for truckers as well as for ordinary drivers. In addition, charging 18-wheelers higher road fees in proportion to the wear and tear they inflict on roadways would be a further inducement to truckers and, indirectly, their customers, to conserve ton-miles shipped and, hence, fuel burned.

Plastics and chemicals — Just as we expect truckers and their customers to reduce distances for their shipments, we envision that individuals and businesses will step up recycling of plastic products, and that manufacturers will revamp operations to become more energy-efficient. We assume a 5% reduction in oil use in this sector, a saving of 100,000 barrels a day.

Table 3: 10% Oil-Saving Plan Summary

Code	Where and How Used	Type	Barrels Per day	Share of total	Sector Saving	Barrels per day	Share of total
T	Cars and light trucks	Gasoline	7,855,000	40.7%	10.0%	786,000	4.07%
F	Trucks	Diesel	2,460,000	12.7%	5.0%	123,000	0.64%
M	Plastics and chemicals	Feedstks	1,993,000	10.3%	5.0%	100,000	0.52%
T	Passenger air travel	Jet fuel	1,287,000	6.7%	28.0%	360,000	1.87%
H	Factory process heat	Various	956,000	5.0%	20.0%	191,000	0.99%
H	Heat + hot water	Distillate	942,000	4.9%	7.7%	72,000	0.38%
H	Energy to run refineries	Still gas	639,000	3.3%	9.7%	62,000	0.32%
T	Road pavement	Asphalt	537,000	2.8%	10.0%	54,000	0.28%
F	Waterborne freight	Resid+dist	478,000	2.5%	4.5%	22,000	0.11%
H	Electric generation (oil)	Resid	313,000	1.6%	25.0%	78,000	0.41%
M	Construction machinery	Diesel	310,000	1.6%	10.0%	31,000	0.16%
F	Air freight	Jet fuel	212,000	1.1%	10.0%	21,000	0.11%
T	Recreational vehicles	Gasoline	203,000	1.0%	20.0%	41,000	0.21%
		TOTAL	18,185,000	94.2%		1,941,000	10.05%

First "Share of total" denotes each sector's percent of all petroleum consumption (19,311,000 barrels per day). "Sector Saving" denotes percent projected to be saved within that sector. Second "Share of total" denotes percent of all petroleum consumption saved due to savings in that sector.

Air travel — The following four measures double the fuel savings in air travel from 14% to 28%: (i) aircraft fuel efficiency rises by 2% (vs. 1% in the 5% Plan); (ii) average load factor increases from 72.4% to 75% (same as the 5% Plan); (iii) the top one-quarter flyers eliminate 30% of their trips, vs. 14% in the 5% Plan; this very large cutback would require a major attitudinal shift regarding air travel, particularly in business; and (iv) all other flyers — the three-fourths of passengers who ordinarily account for one-fourth of air trips, and were not targeted in the 5% Plan — eliminate 5% of their trips.

Factory process heat — We raise the savings rate from 10% to 20%. This requires that electricity conservation reach 10% at natural gas utilities, rather than 5% previously, in order to make the necessary volumes of gas available to factories that

now burn oil. Saving just a fraction of the enormous amount of gas used for residential heating would make even more gas available to displace oil.

Heat and hot water — As before, we target three-fourths of oil-heated homes and other buildings. But we now lower thermostats by 3 degrees (Fahrenheit) instead of 2, raising annual heating savings to 12%, from 8%. We also assume 5% hot water savings in the same buildings from installing “low-flow” (fine spray) showerheads. The result is an overall 7.7% saving in oil used for heat and hot water, vs. 4.5% in the 5% Plan.

Energy to run refineries — The same procedure applies from the 5% Plan, except that the subtotal of oil savings from all other measures, which was 5.0%, is now 9.7%.

Road pavement — We raise the percentage of paving activities deferred or cancelled due to reduced highway travel, from 5% to 10%.

Waterborne freight — We ignored this sector in the 5% Plan. Yet crude oil and petroleum products account for 40% of shipping tonnage, and coal for 14%. We multiply these shares by, respectively, the sum of oil savings from all of the measures in the 10% Plan excepting refineries, which is 9.6%; and the drop in coal shipments due to decreased electricity generation, which is 5%. The aggregate savings is 4.5%.

Electricity generation by oil — We raise the share of oil burned for electricity that is conserved, from 20% to 25%. Lest this percentage appear overly optimistic, we note again that since most oil-fired power generation is for “peak” or “shoulder” periods, electricity-saving measures yield disproportionately large reductions in oil usage.

Construction machinery — We ignored this category in the 5% Plan. Here we assume that reduced road building leads to a 10% reduction in use of heavy construction equipment.

Air freight — We ignored this category in the 5% Plan. We posit a 10% drop in air freight, as American consumers and business managers learn of the oil-intensity of air freight and

move away from overnight delivery for routine shipments. More decentralized warehousing patterns, as discussed with reference to truck freight above, would also ease the demand for air freight.

Recreational vehicles — Tellingly, recreational vehicles — motorboats, jet skis, snowmobiles, all-terrain vehicles, etc. — consume more than twice as much petroleum fuel as all buses (transit, intercity and school buses combined) in the United States. Just as we now ask car drivers to forego one in 10 trips, we invite users of these non-essential vehicles to refrain from one in 5 trips, for a 20% reduction in their fuel use. We envision the least utilitarian and most fuel-intensive machines, such as cigarette boats, jet skis and motor yachts, taking the biggest hit, as a national fuel-saving ethic sparks a shift to natural forms of recreation.

What we omitted — Our 10% Saving Plan ignores three oil-consuming sectors: agriculture, rail freight and the military, though even in those sectors, significant savings would be possible, e.g., by expanding soil-conservation incentives that remove land from cultivation, or curbing the practice of military aircraft dumping fuel over the ocean. We should also note that in our analysis we have, for the most part, treated oil consumption in America as if each sector was separate from the others, and have counted only a few inter-relationships (less asphalt paving due to less driving, less fuel for shipping fewer barrels, and of course less oil consumed in the refining process). But in fact, oil is so central to our economy that oil consumption in one sector extensively promotes it in others.

To take one example, our 7% reduction in gasoline use (in the 5% Plan) means 7% fewer trips by gasoline tank-wagons, not to mention 7% less diesel fuel burned to power railroad tank cars. Positive feedback loops such as these almost certainly outweigh substitution effects, such as car trips replacing airplane trips, making our oil-saving figures conservative.

The total oil saving associated with the more intensive and widespread measures in the 10% Plan is 1.94 million barrels a day. That's 10% of total U.S. consumption, close to 20% of U.S. oil imports, and more than 100% of imports from Saudi Arabia. While the savings won't automatically translate into

barrel-for-barrel reductions in U.S. imports from Saudi Arabia, they will markedly reduce demand for Saudi production, the traditional “swing factor” in world oil markets, while also shrinking oil purchases from Iran, Iraq and other Middle Eastern states.

Moreover, U.S. oil savings of this magnitude will inspire similar actions in other consuming nations, particularly in Europe where some energy-saving efforts have stalled in the face of U.S. intransigence. With Saudi and other Middle Eastern oil diminished in importance, the United States will be able to reduce its profile in the Persian Gulf, eliminating much of the motivation and wherewithal for future attacks.

And That’s Not All . . .

A 10% immediate saving in oil use, while quite significant, would still be just the first (but essential) in a series of steps to reduce oil use. As environmental organizations and others have documented over the years, there are many feasible, cost-effective oil-saving measures with longer implementation times that can enable the United States to slash oil imports beyond our short-term 10% target, while also offsetting continuing declines in domestic oil production. Among these measures are:

- Raising market shares for high-mpg automobiles and efficient appliances via stronger performance standards, consumer rebates and manufacturer incentives;
- Retrofitting oil-heated homes and commercial buildings (by using instrumented air- and duct-sealing to find and fix energy leaks, for example), which would save anywhere from 20% to 70% of the energy used for heat and hot water, depending on the initial condition;
- Making communities less car-dependent and thus reducing vehicle-miles driven through reforms in policy, pricing, land use and traffic engineering.
- Extensive deployment of solar-based technologies such as wind turbines and photovoltaic cells for electricity, and hydrogen-fueled automobiles and transit vehicles.

Brief summaries of these measures, with “links” to more detailed treatments, are provided in the section, Seven Steps to Save More Oil.

Making It Permanent

Patriotism and a sense of social responsibility can give a tremendous initial impetus to the behavioral changes outlined in this report. But human nature being what it is, backsliding is inevitable. Daily petroleum use is the product of literally hundreds of millions of short- and long-term decisions by individuals and institutions, almost all of which are sensitive to price. Cheap fuel and subsidized mobility in America are standing temptations to treat energy casually and wastefully. Over the long term, then, the only effective way to continue saving petroleum fuels at a high rate is to raise their price by taxing them more heavily.

Ideally, the U.S. would have begun phasing in higher taxes on gasoline and other fossil fuels years ago. That would have forestalled much of the “big box” development of the past two decades — the big vehicles, big stores and big houses strewn around the outer metropolitan fringe, at the end of big commutes — that has driven up oil use by 25% since the early 1980s. Even a belated increase in taxes on fuels and/or driving would have given families and businesses some time to purchase fuel-efficient vehicles or relocate to places where trips don’t cover so many miles and don’t always require cars.

But Congress hasn’t raised energy taxes to keep up with inflation, let alone offset much of the social cost of using oil and other fuels. Now the bill has come due. We estimate that if it were necessary to rely entirely on higher prices to induce conservation, a tax increase of around 50 cents a gallon would be needed to bring about the 7% reduction in gasoline consumption envisioned in the 5% Saving Plan. No doubt the patriotic impulse could motivate an immediate decline of this magnitude without the need for such heavy taxation; but that impulse could not sustain the saving indefinitely, and we conclude that a tax increase at this level will be necessary.

Surviving Higher Gas Taxes

It has been for years a truism that seeking even a nickel rise in the gas tax is tantamount to committing political suicide. And it is a precept of economics that the more rapidly relative prices change, the greater the dislocation to businesses and workers. But these are not normal times, and the usual rules may not apply. In fact, since Sept. 11, a surprising number of Americans have expressed a willingness to accept higher gasoline taxes. Moreover, thanks to the recent plunge in gasoline prices, higher gas taxes can be introduced with less than usual economic shock. Finally, we propose that the proceeds of this new tax be rebated to individuals on a “flat,” per-capita basis, a step which will greatly sweeten the pill.

We estimate that the revenue from a 50 cent a gallon gasoline tax increase would yield close to \$200 for each of America’s 285 million inhabitants, or \$800 for a family of four. Since the rich drive much more on average than the poor, this “tax shift” would be progressive. Indeed, a family of four that used fewer than 30 gallons a week would come out ahead. Similarly, the 80 cent a gallon increase required to maintain a 10% drop in gasoline consumption (for our 10% Saving Plan) has the same 30 gallon a week “breakeven” point for a family of four, provided the entire proceeds are returned to individuals via annual rebates (\$300 per capita in this case).

To further cushion the shock and broaden support, the tax increase could be phased in over several years, as needed to offset the probable backsliding in the behavioral changes discussed here. Indeed, the reduced demand for oil consequent on our plan will make it imperative to continue raising gasoline taxes in progressively smaller increments for some period of time, until usage and price levels stabilize, lest falling oil prices stimulate a rebound in consumption.

Petroleum Taxes Must Rise Across the Board

To ensure that oil savings reach into every nook and cranny of the U.S. economy, taxes should be increased comparably on other petroleum products such as diesel and jet fuel. All proceeds should be added to the proposed taxpayer rebates to make the tax increases revenue-neutral.

We estimate that the 5% drop in truck fuel use targeted under the 10% Saving Plan could be made permanent through an 80 cent a gallon rise in taxes on diesel fuel. The same increase in gasoline taxes would yield at least a 10% decline in use of recreational vehicles such as powerboats. Similar tax increases on other “fractions” of the oil barrel would ensure that savings were retained in other sectors, e.g., the 5% reduction we anticipate in consumption of petroleum feedstocks for making chemicals and plastics.

Finally, insofar as flying is more of a luxury activity than driving, airline fuel taxes should be raised at least as sharply as taxes on gasoline. With higher taxes on jet fuel, carriers would raise load factors and rationalize fare structures to boost fuel efficiency per passenger mile. But the primary effect would be higher fares that would dampen demand and make the current downturn in air travel permanent. After a period of adjustment — which is already under way — the airlines would restructure at a lower volume, and the nation would enjoy a respite from relentless airport expansion while pocketing major, enduring fuel savings. Moreover, with air travel (and highway travel as well) priced closer to its true social cost, the market pull would be magnified to create a national first-class high-speed passenger and freight rail network, like those serving Europe and Japan.

The People Are Waiting

None of the measures in our Oil Saving Plans received much consideration prior to Sept. 11. But America is a different country now. Last fall, Americans witnessed mass murder in New York and Washington and experienced mass anxiety over biological-warfare attacks. We also learned, to our astonishment and dismay, of the major role played by some of our Saudi Arabian “allies” in enabling the September attacks.

A quick scan of the Op-Ed pages and the letters-to-the-editor columns in October and November, or a few conversations with “just folks” at that time, made it clear that Americans were ready, indeed eager, to participate in a broad-based national movement to end our dependence on oil. Our fellow-

citizens were open, as never before, to bold and decisive initiatives for this purpose, and were quite prepared both to undergo some personal inconvenience for their country's sake, and to embrace, over the longer term, a real transition to sustainable lifestyles built on thrifty rather than profligate use of the Earth's resources.

Unfortunately, the moment was not seized, and public attention has turned elsewhere. Yet the logic is as compelling now as it was in the fall — if not more so, with America facing the prospect of perpetual war against a poorly-defined and elusive set of enemies — enemies who, as we now know, possess in abundance the capacity to strike back. With U.S. oil use reduced by an amount approaching our imports from the Persian Gulf — and with even greater reductions “in the pipeline” from longer-term initiatives — the United States would no longer feel compelled to prop up and defend the repressive and corrupt Saudi regime and others like it. We will be able to remove our troops whenever we choose from Saudi territory, without fearing that our economic well-being will be endangered. An arm's-length relationship with the widely-despised Saudi rulers will certainly improve America's standing among the world's billion or more Muslims.

The intent is not to embargo imports of Saudi oil, but to loosen the stranglehold that the supposed “need” for Saudi and other Middle Eastern oil has had on American strategic thinking and foreign policy. Our plan will also shrink the vast quantities of oil money that sustain the social and political milieu from which the September attacks originated.

The Bigger Picture

The insecurity arising from America's oil addiction is not solely a consequence of our entanglements in the Middle East; rather, it is an inevitable concomitant of the vast scale of present-day oil consumption and production. Oil confers extraordinary wealth on the tiny elites that own or control it; this wealth is inherently corrupting, not to mention dangerous when it fuels religious or political fanaticism, either directly or in the form of protection money. Moreover, as *New Yorker* economics commentator James Surowiecki pointed out last year, great wealth derived from the extraction of natural

resources, like oil, invariably depresses the entrepreneurial spirit, hindering orderly economic growth and the development of open and democratic political institutions.

Look around the world. Not just Saudi Arabia, Iraq, Iran and Kuwait in the Middle East, but also Russia, Libya, Algeria, Nigeria, Indonesia, Azerbaijan and even Ecuador and Colombia — virtually all of the major oil-exporting nations — are racked by huge disparities between rich and poor, political authoritarianism, ecological devastation, human rights abuses and intercommunal violence. The consequences to the citizens and environments of those countries are grave enough; but now the United States, as both the chief sponsor of distorted development based on oil, and the world's sole superpower, has become the target of the grievances that inevitably result. At the current scale of use, oil sows anger and instability, which in turn feed chronic conflict and violence.

The Oil Tithe

For these reasons, everyone should applaud and support efforts by individuals to move off of oil and toward sustainability. But we also believe that Americans need to be asked to conserve. Whenever change is required of people, the sense of working toward a common goal is all-important. Everyone who has ever raised money for a charity knows this. The idea of pulling together in service to our country is a very powerful one. The actions proposed here — carpooling and biking, driving and flying less, turning off lights, swapping incandescent for compact fluorescent lamps — can and will occur on a mass scale if — but only if — they are made part of the national purpose.

What we are calling for is really *tithing oil* — making oil conservation a form of charitable giving, by which individuals set aside a small but crucial piece of consumption for a higher ideal. While it may seem novel to apply this time-honored religious practice to energy use, America has, really, no alternative. Our country will remain exposed to attack, no matter how heavily policed we become, until we end our dependence on oil. Happily, Americans appear ready to practice a modest degree of self-restraint in order to do so. Moreover, the benefits will extend beyond regaining our

security, to enhancing equity, creating a more peaceful world and helping sustain life on Earth.

Act Now

It's long past time for the Bush Administration and Congress to acknowledge what much of the public grasped immediately after the attacks on New York and Washington: our national interest is profoundly threatened by our outsized appetite for oil. If our leaders are really interested in "national security," they must mobilize the public now to slash U.S. oil consumption decisively and immediately.

The decades-long debate over *whether* the United States will curb its use of oil should have ended on Sept. 11; we clearly must display a little self-discipline if we intend to survive as a free, open, unfearful society. In this moment of crisis, environmental consciousness and patriotism can speak with one voice, and the combination is uniquely powerful. The question is no longer "whether," but "when"; and our answer is, *right now*.

Seven Steps to Save More Oil

Our 5% and 10% Oil Saving Plans rely on tens of millions of Americans changing their behavior purposefully and in concert. Policy measures are needed, though, to institutionalize the effect of these actions and multiply the oil savings over the long haul. These seven initiatives are particularly important:

1. Price petroleum correctly

Charging consumers the true “social price” for petroleum products will create powerful incentives to curb usage. The two key steps are to cut off federal subsidies and to raise petroleum taxes (while rebating the revenues to individuals as described in the main text of this report). The amounts involved are substantial: current oil industry subsidies are estimated at \$23 billion over the next ten years, and even so the Administration is seeking an additional \$21 billion. (Friends of the Earth) Above and beyond these direct subsidies, the huge social costs of oil extraction and usage — geopolitical instability, U.S. military expenditures, global environmental pollution — should be internalized via higher fuel taxes. These levies should be raised on all petroleum products — diesel, jet fuel, and chemical feedstocks in addition to gasoline — for the greatest possible oil savings.

2. Reduce driving via per-mile incentives

Shifting some of the fixed costs of driving to per-mile payments would further induce drivers to drive less and thus save gasoline. In particular, if the fiscal base for local (municipal and county) road maintenance, policing and administration were mileage-based user fees rather than property and sales taxes, the incremental cost of each mile driven would rise by as much as a nickel, with sales and property taxes reduced correspondingly. A similar benefit would accrue if drivers could purchase car insurance *by the mile*, paying premiums not in up-front lump sums but as the product of their individual, actuarially-based insurance rate times their miles driven. By letting car owners pocket big savings for each mile they *didn't* drive, these policies would

make it profitable to economize on driving. (Litman) It should also be noted that both of these measures — revenue shifting and per-mile insurance — promote equity in addition to oil conservation.

3. End the CAFE loophole for “light trucks”

SUV’s, minivans and pickup trucks are partially exempt from the so-called CAFE (Corporate Average Fuel Economy) mileage standards. This loophole, originally crafted to aid a few million farmers and small contractors, has encouraged tens of millions of absurdly oversized gas guzzlers to invade our roads, and now accounts for around a million barrels a day of utterly unnecessary excess gasoline consumption. Although steps 1 and 2 above would eliminate most of that demand, the CAFE loophole remains a glaringly irrational incentive to overconsume, and ought to be shut immediately, if only to put the auto industry on notice that fuel efficiency must be a fundamental criterion in design and marketing.

4. Remake public transportation

Successful transit (buses, light rail and trains) creates oil savings many times over: through directly displacing car and air travel; by substituting electric propulsion for oil in many cases; by fostering higher-density development in which proximity renders long-distance driving unnecessary; and generally by breaking the car’s exclusive grip on transportation’s “mindshare.” Federal support of urban and metropolitan transit should be multiplied in order to upgrade current service (new rolling stock, modern maintenance facilities, conversion to non-oil propulsion) and to finance new routes. A national high-speed rail network along the lines of the French high-speed TGV (“*train à grande vitesse*”) could command much of the intercity travel market now monopolized by automobiles and airplanes, while an even more ambitious system of maglev (magnetic levitation) trains traveling at three hundred plus miles per hour could shift development back to energy-efficient central cities from sprawl-based freeways and airports. (Lazare, pp. 293-296)

5. Stop subsidizing sprawl

The measures described above can greatly deflate the “big box” development balloon that has jacked up U.S. oil use over the past 20 years. Land-use reforms can attack sprawl head-on as well. Zoning and other impediments to infill, brownfield and rehab development should be identified and eliminated. Programs that reward people for living close to their workplace, such as Fannie Mae’s Location-Efficient Mortgages and Maryland’s Live Near Your Work program, should be implemented broadly. Likewise for measures that support locally based agriculture, such as Suffolk County (NY)’s Farmland Preservation Program, which pays farmers for their “development rights,” and the Community Preservation Fund through which Suffolk townships buy former farmland outright through a 2% tax on real estate sales. Finally, all federal tax subsidies for mortgage payments and local property taxes, through which middle and working class families subsidize gargantuan sprawl homes for the wealthy, should end. (Lazare, pp. 273-276) Here again, as with petroleum taxes and local revenue-shifting, the proceeds should be rebated to individuals on a per-capita basis.

6. Make all homes energy-efficient

One of the few energy-efficiency success stories of recent decades was the immense reduction — amounting to half or more — of power consumed by new air conditioners, refrigerators and other appliances. The federal efficiency standards that catalyzed this progress should be updated to keep pace with advancing technology, not watered down as proposed by the Bush Administration. (ACEEE) Similarly, as many as possible of the nation’s incandescent lights — “heaters that also throw off light” — should be replaced through a federal program to install, at little or no charge, new “compact fluorescent” lamps that provide equivalent light output but use just one-fourth the power. And all U.S. homes should be heat-retrofitted: state-of-the-art ultra-efficient furnaces, high-performance windows, programmable thermostats and instrumented air- and duct-sealing together can slash household use of natural gas or heating oil by up to two-thirds.

7. Remove the threat to bicyclists

Half of all U.S. car trips are 3 miles or shorter, and millions of Americans long for (and need) affordable, time-saving regular exercise. The bicycle is the obvious, oil-saving solution, as well as the travel mode that best harmonizes mobility and community. The greatest single deterrent to cycling on a mass scale is the quite correct belief that in practice, cyclists have no rights on the road. Far more essential than bike lanes and paths — and able to be provided at once rather than years hence — would be to amend state motor vehicle codes (and police practice) to unequivocally grant bicycles right of way over motor vehicles wherever there is no explicit traffic indicator such as a signal. (U.S. NHTSA-CDC, p. 7.) This road-equivalent of the time-honored nautical rule granting sailboats precedence over powerboats would send to drivers the essential message that cyclists are fully entitled to be on the road, and could trigger a boom in U.S. bicycle use.

Slippery Barrels

Since Sept. 11, a number of well-intentioned commentators have revealed some confusion about the basic arithmetic of petroleum consumption, and inadvertently made oil conservation look easier than it really is.

Getting agreement on programs that actually reduce oil usage is hard enough without having to work through competing sets of numbers, some of them faulty. The following three examples illustrate the problem:

Oil consultant Philip Verleger, quoted by *New York Times* columnist Thomas L. Friedman (“Let’s Roll,” Jan. 2, 2002), said, “One out of every seven barrels of oil produced in the world is consumed on American highways. We could cut that by a third in five years [with] tax incentives for manufacturers to produce more efficient vehicles and for consumers to buy them.”

But almost one-quarter of the highway oil targeted by Mr. Verleger is used in trucking (see Table 1), a sector which vehicle-based tax incentives won’t affect more than minimally. His goal of a one-third reduction in “highway oil” is thus tantamount to reducing fuel consumption by passenger vehicles by 44%. Attaining that improvement solely through greater efficiency would require raising the average gas mileage of cars and light trucks to at least 35 from the current 20 — an obvious impossibility in just five years by any means, and *a fortiori* impossible through vehicle incentives alone.

Martin Feldstein, professor of economics at Harvard, president of the National Bureau of Economic Research, and chief economic advisor to President Reagan, wrote in the *Wall Street Journal* (“Vouchers Can Free Us From Foreign Oil,” Dec. 27, 2001), “One-third of our oil consumption is used to heat our homes. With the right incentives, home heating could be converted over time to domestically produced natural gas and to electricity produced by a combination of nuclear power, coal, natural gas and renewable sources.”

But most buildings are already heated by natural gas or electricity, limiting the scope of oil savings in this sector. As Table 1 shows, heating accounts for just 4.9% of oil use. Even if we take Prof. Feldstein's "homes" to mean "all buildings," his estimate of oil used for heating is still too high by a factor of seven.

Robert F. Kennedy Jr., an attorney with the Natural Resources Defense Council, wrote in the *New York Times* (op-ed, "Better Gas Mileage, Greater Security," Nov. 24, 2001), that "An improvement [in passenger vehicles' fuel efficiency] right now of 2.7 miles per gallon would eliminate our need for all Persian Gulf oil." Famed energy policy analyst Amory Lovins subsequently made the same claim in *The American Prospect* ("Energy Forever," Feb. 11, 2002). This seems curious, insofar as the resulting 12% reduction in fuel per mile, applied to the 7.9 million barrels a day burned by cars and light trucks (Table 1), doesn't even yield a million barrels a day, whereas U.S. imports of Persian Gulf oil exceed 2.5 million barrels a day.

On further inspection, the claim of Messrs. Kennedy and Lovins is seen to rest on the unsupported assumption that each gallon of gasoline saved will "leverage" savings of at least two gallons of crude oil. But this assumption is far more optimistic than the available evidence supports. There is no real basis for believing that conservation of gasoline saves crude oil at much more than a 1-to-1 rate. At this rate, average car and light truck mileage would need to rise 8-9 mpg, or triple the increment that Messrs. Kennedy and Lovins say would suffice to eliminate Gulf imports through improved mileage alone.

These writers, and many others, appear to be clinging to the hope of a painless way to save oil: something that can be done without requiring Americans to change their behavior in any way, and ideally without their even noticing that anything has happened. But wishful thinking won't save oil. Changing what we demand from oil, particularly how and where we travel, will be required as well as improving efficiency — especially since we need to start saving in large quantities *now*.

Notes

Data in this report are for the United States, for 2000 to make a pre-Sept. 11 baseline. Other data are most recent available. *M.E.R.* = *Monthly Energy Review*. Spreadsheet = our master spreadsheet discussed after these notes. “mbd” = million barrels per day.

A sustainable society (opening quote) — Brower, pp. 489-490.

“I believe that most Americans are more than willing ...” — *New York Times*, letter, published Nov. 7, 2001.

These schemes wouldn't start saving oil before 2009 — For example, even ramping up the theoretical (as opposed to actual “on-road”) average mpg of new cars and light trucks to 40 in 2012 in equal increments starting in 2004, an ambitious two-thirds increase from the current 23.9, won't shrink gasoline consumption (and then only modestly) until 2009. That is because (i) the stock of vehicles turns over only gradually, and (ii) total vehicle miles traveled continue to rise so long as gasoline is priced far below its social cost.

Thirty percent of the world's crude oil extraction occurs in the Middle East — 1999 production of crude oil, natural gas plant liquids and other liquids totaled 72,663,000 barrels per day for the world, and 21,667,000 from Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates and Yemen, or 30%. Excluding Syria (546,000), the other nine countries accounted for 29%. U.S. DOE, *International Energy Annual*.

The region's ten nations ...hold two-thirds of Earth's known oil reserves. By the two sources in *International Energy Annual*, the ten countries' reserves account for 64% or 66% of the world's, with Saudi Arabia alone accounting for 27% or 26%; the U.S. share is 2%.

With domestic oil fields largely “played out,” almost 60% of the petroleum used in the U.S. is imported. — Domestic oil production (including natural gas plant liquids) in 2000, 8.08 mbd, is only 41% of petroleum consumption of 19.7 mbd (*M.E.R.*); imports made up the difference. The mean estimate of 3.2 billion barrels of recoverable ANWR oil (U.S. Geological Survey) equates to a 30-year supply of just 0.29 mbd, only 1.5% of current consumption.

Saudi Arabia supplies 8% of the oil used in the United States — Total imports from Saudi Arabia are 1.572 mbd for 2000 and 1.758 for 2001 eight months (*M.E.R.*), or roughly 1.6-1.7 mbd, which is 8-9% of total consumption of 19.3 mbd.

The Saudi regime has looked the other way — See, for example, Douglas Jehl, “Holy War Lured Saudis As Rulers Looked Away,” *New York Times*, Dec. 27, 2001, p. A1.

“Can We Do Without Saudi Oil? Alas, No.” — by Irwin M. Stelzer, *The Weekly Standard*, Nov. 19, 2001.

U.S. vehicles etc. consumed an average of 19.3 million barrels of petroleum products each day — *M.E.R.* has 19.7 mbd for both 2000 and 2001. Our 19.3 mbd is from [spreadsheet](#).

One-quarter of the world’s oil, twice as much as per capita use in Western Europe, seven times the world average — 1998 petroleum consumption was 18.9 mbd for U.S., 54.7 mbd for non-U.S. (*International Energy Annual*, 1999, Table 3.1) Applied to populations of 280 million U.S. and 6 billion non-U.S., ratio of per capita U.S. to non-U.S. was 7.4. 1998 ratio of U.S. per capita use to Western European countries is: France, 2.01; Germany, 1.97; Italy, 1.93; U.K., 2.35. Source: oil consumption from U.S. DOE/EIA, *International Energy Annual*, Table 3.1 (“apparent consumption, including bunkers”); population from *World Population Prospects, the 1998 Revision*, UN Population Division, on OECD website.

The 16 biggest uses of petroleum — Figures in table are derived from [spreadsheet](#) and are discussed more or less [seriatim](#) here. Btu-to-barrel conversion factors are in table further below.

U.S. oil consumption accounts for 39% of all energy used in the United States — Of 98.8 “Quads” (quadrillion Btu) of energy consumption in 2000, petroleum accounted for 38.4 (*M.E.R.*).

U.S. passenger vehicles consume 7.9 million barrels of gasoline daily — Light-duty vehicle motor gasoline (7.627 mbd) + light-duty vehicle diesel fuel (0.102 mbd) + commercial and industrial motor gasoline (0.126 mbd), all from [spreadsheet](#), sum to 7.855 mbd.

At workplaces in California, the same number of workers now get to work with 11% fewer cars — Shoup (1997) studied eight such workplaces with 1,700 total employees, and found that parking cash-outs reduced vehicle commute trips per 100 employees from 82 to 73.

Commuting trips account for 30% of car-miles — a well-known finding from U.S. DOT 1995 *Nationwide Personal Transportation Survey (NPTS)*.

More than 60% of U.S. households own at least two cars — 1995 *NPTS* (summarized in *Statistical Abstract 2000*, Table 1033) reports

59.5% of households had two or more cars, vs. 58.0% in 1990, indicating that year-2000 share reached at least 60%.

If half of those households switched just a tenth of their travel — Light-duty vehicle miles traveled of 2.412 trillion (from spreadsheet), averaged over estimated 190 million vehicles, yields 35 miles per vehicle per day. We assume 30 miles per vehicle for households with two cars, split evenly between vehicles with mpg of 16 and 24, yielding 3.125 gallons of gasoline per day. Switching 6 of these 60 household miles from low- to high-mpg vehicle reduces gallons needed to 3.0, a 4% savings. Applying this savings rate to half of the 60% of households yields a 1.2% reduction in gasoline.

Commercial airplanes consume just under 1.3 million barrels of jet fuel per day — Domestic air carriers (0.873 mbd) + international air carriers (0.323 mbd) + general aviation (0.091 mbd), all from spreadsheet, sum to 1.287 mbd.

Airline load factor of 72.4% — from Air Transport Association.

Three-fourths of air passenger seat-miles are consumed by the most active one-quarter of those who fly — Author's estimate, based on conversations with air travel experts; unfortunately, no definitive data were available.

Jet fuel use would be 14% less than year-2000 levels — a 10.5% reduction in flights (as passengers responsible for three-fourths of trips eliminate an average of 14%) + 1% efficiency gain + load factor gain yields 15% savings (via $0.895 \times 0.99 \times 72.4/75.0$), adjusted to 14% for conservatism.

The improvement in on-time performance following Sept. 11 — *New York Times* "Practical Traveler" column, Sunday, Feb. 10, 2002, attributed a U.S. DOT finding of an 84.7% on-time arrival rate for the 11 largest U.S. air carriers in Nov. 2001, vs. 72.8% in Nov. 2000, to the decline in air travel since Sept. 11.

Almost a million barrels a day are burned to make heat and hot water — Residential distillate (0.413 mbd) + residential LPG (0.321 mbd, calculated as 90% of LPG of 0.356 mbd for buildings) + commercial distillate (0.166 mbd) + commercial resid (0.042 mbd), all from spreadsheet, sum to 0.942 mbd.

A 2°F reduction in thermostats would eliminate 8% of the fuel used for heating — assuming 5,000 degree days in a 200-day heating season; a 2°F setback eliminates 400 (200 x 2) degree days, or 8%.

The manufacture of electricity consumes a mere 313,000 barrels of oil per day — the sum of 0.287 mbd of resid burned in steam turbines and 0.026 mbd of distillate in combustion turbines, from [spreadsheet](#).

U.S. natural gas-burning for electricity consumes twice as much energy as oil-burning for process heat — From [spreadsheet](#), 3.977 Quads of natural gas are burned annually to make electricity; that's the energy equivalent of 1.870 mbd (converted with the heat content of distillate oil), or 1.96 times the 0.956 mbd of oil used for process heat (see next entry).

960,000 barrels/day [rounded from 956,000] of oil are used for factory process heat — This is the sum of four categories, all from [spreadsheet](#): (i) one-third of industrial distillate of 0.466 mbd, or 0.155 mbd (we allocate the remaining two-thirds to construction machinery); (ii) industrial resid of 0.072 mbd; (iii) petroleum coke of 0.273 mbd, calculated from EIA approximation (in private communication) that 0.6 Quads of "Other Petroleum" is petroleum coke; and (iv) miscellaneous petroleum of 0.456 mbd, calculated as remainder of 0.965 Quads from Other Petroleum of 4.265 Quads, less still gas (see below), asphalts (ditto) and petroleum coke.

California Shows the Way — Many figures and text here are from *Sacramento Bee* (see References).

Californians have reduced power consumption by 5% — California Energy Commission web site shows following declines in kWh purchased statewide for first 11 months of 2001 vs. same period in 2000: 4.6% unadjusted, 5.2% weather-adjusted, 7.0% adjusted for weather and economic activity.

Road pavement — From [spreadsheet](#), calculated from EIA approximation (in private communication) that 1.3 Quads (or 0.537 mbd) of "Other Petroleum" of 4.265 Quads is for asphalt, essentially all of which is for roads.

Energy to run refineries — From [spreadsheet](#), calculated from EIA approximation (in private communication) that 1.4 Quads (or 0.639 mbd) of "Other Petroleum" of 4.265 Quads is "still gas" burned in refineries.

Trucks — Total usage of 2.460 mbd is sum of commercial light trucks gasoline (0.323 mbd), freight trucks motor gasoline (0.159 mbd), freight trucks distillate, i.e., diesel (1.966 mbd), and freight trucks LPG (0.012 mbd), all from [spreadsheet](#).

Plastics and chemicals — From [spreadsheet](#), this entry, 1.993 mbd, is the sum of 0.628 mbd of petrochemical feedstocks and 1.365 mbd of

LPG (the latter is based on personal communication from DOE that 1.8 of the 2.370 Quads of industrial LPG are feedstock to chemical industry; note that this is converted to barrels @ 3.613 MMBtu/bbl).

These four measures double the fuel savings in air travel from 14% to 28% — A 30% cutback in 75% of travel and a 5% cutback in the remaining 25% yield a 23.7% overall cutback. With a 2% efficiency gain and a load factor improvement to 75% from 72.4%, the combined effect is $(1 - 23.7\%) \times 98\% \times 72.4\% / 75\%$, or 0.72, i.e., a 28% savings.

Heat and hot water savings — A 3°F setback eliminates 600 degree days, or 12% of the 5,000 degree day base. Applied to 75% of oil use in 75% of buildings, the savings are $12\% \times 75\% \times 75\%$, or 6.75%. The 5% hot water savings, applied to the remaining 25% of oil use in same 75% of buildings, provides an additional 0.94% ($5\% \times 25\% \times 75\%$), for a combined 7.69%.

Waterborne freight — Total of 0.478 mbd is sum of 0.346 mbd international shipping (assumed to be resid), and 0.132 mbd domestic (assumed to be split evenly between resid and distillate), from spreadsheet.

Crude oil and petroleum products account for 40% of shipping tonnage, and coal for 14% — Statistical Abstract 2000, Table 1088.

Construction machinery — we allocate two-thirds of industrial distillate total of 0.466 mbd to this sector, yielding 0.310 mbd.

Air freight — Fuel consumption of 0.212 mbd is from spreadsheet.

Recreational vehicles consume more than twice as much petroleum fuel as buses — From spreadsheet, recreational boats use 0.162 mbd; we increase this by 25%, to 0.203 mbd, to include so-called “personal” off-road vehicles. Buses consume only 0.087 mbd (0.042 transit, 0.011 intercity, 0.034 school, all from spreadsheet).

Usage categories not targeted for savings (all data from spreadsheet) — Agriculture (0.432 mbd) is LPG for agricultural machinery and drying crops, calculated as the remainder of 2.370 Quads of industrial LPG after 1.8 Quads are allocated to chemical industry, and converted to barrels @ 3.613 MMBtu/bbl). Military (0.298 mbd) is sum of 0.246 mbd military aviation, 0.045 mbd military distillate and 0.008 mbd military resid. Rail freight (0.239 mbd) is all distillate (diesel).

Oil use up by 25% since the early 1980s — Compare “petroleum products supplied” in M.E.R. of 19.693 mbd in 2000 with 1981-85 average of 15.607 mbd, a 26% increase.

A tax increase of around 50 cents a gallon would be needed to bring about an immediate 7% reduction in gasoline consumption — We assume a short-run price-elasticity of gasoline of negative 0.2, such that each 10% increase in the price of gasoline induces a 2% drop in usage, and a base price (including taxes) of \$1.20 a gallon. Since $1.70/1.20$ raised to the -0.2 power is 0.93, an increase to \$1.70 (via a 50 cent/gallon tax hike) would cut usage 7% overnight.

The revenue from a 50 cent a gallon gasoline tax increase would yield a \$200 annual rebate check for each of America's 285 million inhabitants — We multiply 7.855 mbd x 42 gallons per barrel x 365 days/yr x 50¢/gallon x 93% (to account for the 7% decline in consumption), and divide by 285 million (the U.S. was home to 284,796,887 residents on July 1, 2001, per U.S. Census Bureau web site, press release of Dec. 28, 2001) to yield \$196.

The rich drive much more on average than the poor — Cameron's classic study of Southern California (Los Angeles, Orange, Riverside and San Bernardino Counties) found 1991 household VMT distributed among income quintiles (in ascending order, from Fig. I-2): 6,000 / 13,000 / 17,000 / 23,000 / 32,000. Similar figures obtain elsewhere.

A family of four that used fewer than 30 gallons a week would come out ahead. — The estimated \$196 annual per-capita rebate, times four, offsets 1,568 gallons a year (30 a week) taxed @ 50¢.

The 80 cent a gallon increase required to induce an immediate 10% drop in gasoline consumption — Again assuming a negative 0.2 short-run price elasticity, since $2.00/1.20$ raised to the -0.2 power is 0.90, an 80 cent a gallon tax hike would cut usage 10% overnight. The revenue calculation yielding \$300/year is as above, except that 80¢ replaces 50¢ and 90% replaces 93% (reflecting the 10% decrease in usage), yielding \$303.

The 5% drop in truck fuel use could be made permanent through an 80¢/gallon rise in taxes on diesel fuel — Same as above, except elasticity is assumed to be half that for passenger travel, i.e., -0.1 .

The same (80¢/gallon) increase in gasoline taxes would yield at least a 10% decline in use of recreational vehicles — The author has estimated (*Drowning In Noise*) that fuel, at \$1.35/gallon, accounts for roughly 11% of the total owning and operating costs of jet skis, and that this discretionary, largely luxury activity has a price elasticity of negative 2. An 80¢/gallon surcharge adds 6.5% to annualized costs, and, with the assumed elasticity, results in a 12% decline in usage

(since 1.065 raised to the -2 power is 0.88). Similar results apply for similar machines, e.g., snowmobiles, cigarette boats, etc.

A quick scan of the Op-Ed pages and the letters-to-the-editor columns — see, for example, *New York Times* columnist Thomas L. Friedman (“Drilling for Tolerance,” Oct. 30, 2001), letters in the *Times* (under the heading, “Gas-Guzzling in a Patriotic Age,” Nov. 27, 2001), Keith Schneider in *Grist* (“Land of the Oil-Free?,” Nov. 20, 2001), Arlie Hochschild and David Hochschild in the *Los Angeles Times*, (“Hooray For The Red, White, Blue And Green,” Nov. 11, 2001), Arianna Huffington in *Salon* (“Why I gave up my Lincoln Navigator,” Nov. 13, 2001), *Seattle Post-Intelligencer* Editorial Board (“Recognize the link between oil, war,” Nov. 18, 2001), Ann Patchett in the *New York Times Magazine* (“The Long Drive Home”), Nov. 25, 2001, and *Chicago Tribune* Editorial Board (“How to Reduce Oil Imports,” Jan. 8, 2002).

The resulting 12% reduction in fuel per mile doesn't even yield savings of a million barrels a day, whereas U.S. imports of Persian Gulf oil exceed 2.5 million barrels a day. — U.S. cars and light trucks currently average approximately 20 mpg. At 22.7 mpg (after the hypothesized gain of 2.7 mpg), the same miles require 88% (that's 20 divided by 22.7) as much fuel, a 12% savings. Applied to current usage of 7,855,000 barrels a day (Table 1), this yields a savings of 940,000 barrels a day. *M.E.R.* shows imports from Persian Gulf nations (largely Saudi Arabia, Iraq and Kuwait) of 2.5 million barrels a day in 2000 (2.7 million for the first eight months of 2001).

Master Spreadsheet

The spreadsheet from which we calculated Table 1 (Major Uses of Petroleum Products in the United States, 2000) and otherwise estimated the amounts and types of petroleum used in the U.S. prior to last Sept. 11 is an extensive (15 columns by 2679 rows) compilation of both oil usage and transportation energy developed by the U.S. Dept. of Energy's Energy Information Administration for forecasting purposes.

We obtained the spreadsheet from a U.S. Environmental Protection Agency staff member in December, 2001 and performed the calculations for this report during that month. While the spreadsheet itself is not available from DOE, the data in it are contained in the downloadable files listed below. Our 2000 figures are normalized (e.g., for weather) and may differ slightly from actual data. We will do our best to provide copies of the spreadsheet itself upon request.

The following table displays the values we used to convert Btu/year data in the spreadsheet to the barrels/day format in this report.

Heat Content of Petroleum Products

Petroleum Product	Btu/barrel	Primary Uses
Distillate (Diesel) Fuel Oil	5,825,000	Trucks, machinery, buses, rail, home heat, industry
Kerosene / Jet Fuel	5,670,000	Commercial aircraft
Jet Fuel (Naphtha Type)	5,355,000	Military aircraft
LPG	3,613,000	Home heat, industrial heat, petrochem. feedstock
Motor Gasoline	5,253,000	Cars and light trucks; recreational vehicles
Petrochem. feedstocks	5,691,000	Petrochemical feedstock
Residual Fuel	6,287,000	Electricity, industry, shipping, heat big buildings
Still Gas	6,000,000	Refinery fuel
Asphalt	6,636,000	Pavement
Petroleum Coke	6,024,000	Industrial heat, smelting, steel-making
Miscellaneous	5,796,000	Misc.

Source: M.E.R., Appendix A. LPG value is 1996-98 average (Table A3). Petrochemical feedstocks is average of 3 values shown there.

Downloadable Files

(Note: AEO stands for EIA's *Annual Energy Outlook* publication.)

http://www.eia.doe.gov/oiaf/archive/aeo01/pdf/aeo_base.pdf for AEO2001 appendix A tables in pdf format

http://www.eia.doe.gov/oiaf/archive/aeo01/pdf/aeo_base.exe for AEO2001 appendix A tables in wk1 format (must download and unzip)

http://www.eia.doe.gov/oiaf/aeo/supplement/sup_rci.pdf for supplemental details for residential, commercial, and industrial sectors in pdf format

http://www.eia.doe.gov/oiaf/aeo/supplement/sup_rci.exe for supplemental details for residential, commercial, and industrial sectors in wk1 format (must download and unzip)

http://www.eia.doe.gov/oiaf/aeo/supplement/sup_tran.pdf for supplemental details for transportation sector in pdf format

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U.S. Dept. of Energy, Energy Information Administration, *Monthly Energy Review*, available at <http://www.eia.doe.gov/mer/>

U.S. National Highway Traffic Safety Administration and U.S. Centers for Disease Control and Prevention, *National Strategies for Advancing Bicycle Safety*, 2001.

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