Changing Trends: A Brief History of the US Household Consumption of Energy, Water, Food, Beverages and Tobacco

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ABSTRACT

Can an historic analysis of consumption patterns of different commodities in the U.S. shed light on the consumption of energy used in homes and passenger cars? Can a review of past policies to reduce or change consumption patterns provide insight or guidance in developing new policies for reducing energy use? In order to better understand energy conservation policies, we take a brief look at the history in the US of consumption of different commodities, including residential energy, passenger car, household water, food, beverages and tobacco. While current policy makers appear reluctant to pursue strategies to reduce absolute energy consumption, there is a long history of government efforts to influence consumption of other commodities, through a variety of means, e.g., prohibition, exhortation, subsidy, regulation, and taxation. By reviewing the trends in historic consumption we see examples of where policy has led to increases and decreases in consumption, suggesting parallel strategies for promoting the long-term conservation of energy.

Introduction

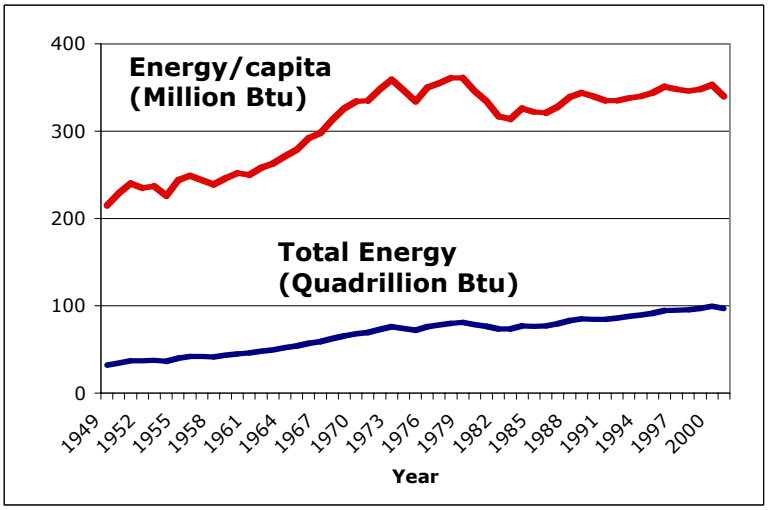
We start by looking at historical consumption data and ask questions about the social and political forces that have led to increases and decreases in consumption. In many cases the historical data have been difficult to characterize, due to changes in definition, gaps in data collection, and inherent bias in the data due to private interests providing "public" data, e.g., USDA data on food consumption is supported by several powerful food industries. We look briefly at the historic trends in household and per capita consumption of energy and water, and also at food, beverages, and tobacco, products that have been the subject of social and political experiments in promotion, curtailment and conservation. And while we raise more questions than we answer, we feel the approach of asking questions to be fruitful in giving us insights in where to focus our attention in looking at policies that can lead to reduction in energy consumption.

Patterns of Consumption—Historic Trends

Electricity & Gas

We'll start with historic US primary energy consumption from 1949 to 2001 (Figure 1). In 1949, U.S. energy use per person stood at 215 million Btu. The rate of consumption generally increased until the oil price shocks of the mid-1970s and early 1980s caused the pattern to reverse for a few years. Following a gradual increase from the mid 1980s, the rate fell 4 percent from 2000 to 2001.

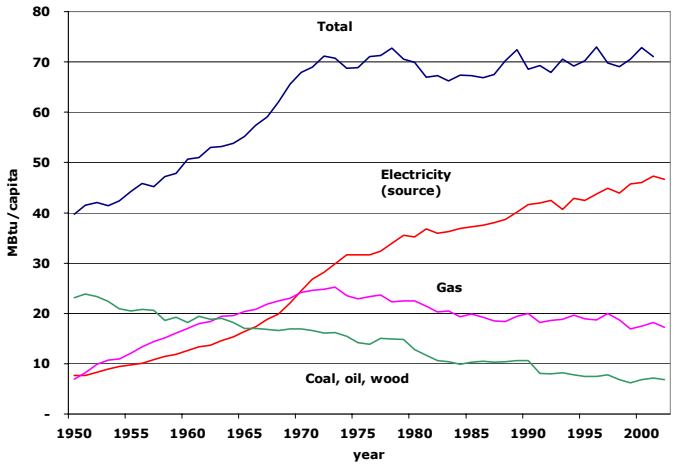
Figure 1. US Primary Energy Consumption, Total (Quads) and Per Capita Consumption (MBtu/cap) from 1949 to 2001



Source: EIA 2003

Such a figure invites several questions: Did per capita energy use increase from 1949 to 1973 due to bigger houses and cars, more appliances, more appliance usage, more energy intensive activities, air conditioning, etc.? Does this leveling off reflect a structural shift in the economy from manufacturing towards service? If we look at the historic trend in residential energy use per capita we see part of the story (Figure 2).

Figure 2. US Residential Energy Use Per Capita, Total, Electricity [Source], Gas and Other (MBtu/cap)



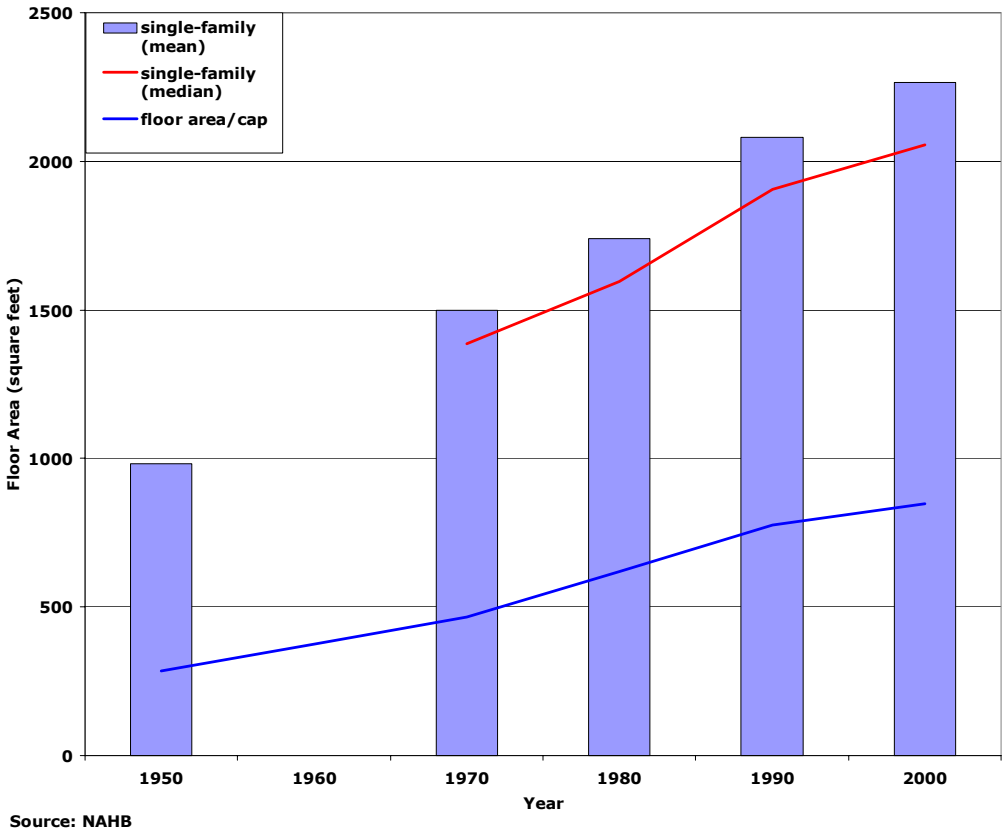
Source: EIA 2003

While the residential total per capita energy use shows the same leveling off as the US total energy use, residential gas use has declined since 1970 and electricity use has continued to increase. The decrease in gas use reflects the drop in energy for space heating and the shift to electricity (Battles 1995). The increase in electricity is due in part to greater air conditioning use (both in volume of space conditioned as well as hours of usage) as well as other appliance usage,

switching from gas to electric (heat pumps, water heaters), and other factors, such as demographic shifts to the South (Schipper 1989). Governmental policies for rural electrification, e.g., the Tennessee Valley Authority, also subsidized electricity use and growth in the Southeast, Northwest and elsewhere (Cooper 1998).

If we look at the increase in house size over this time, as well as the increase in appliance saturation and usage, we can start to see additional drivers behind the increase. Figure 3 shows that average new house floor area has increased from 983 ft^2 in 1950 to 2266 ft^2 in 2000, more than doubling. As household size has decreased, the floor area per capita has increased by more than a factor of 3, from 286 ft^2 per capita in 1950 to 847 ft^2 per capita in 2000.

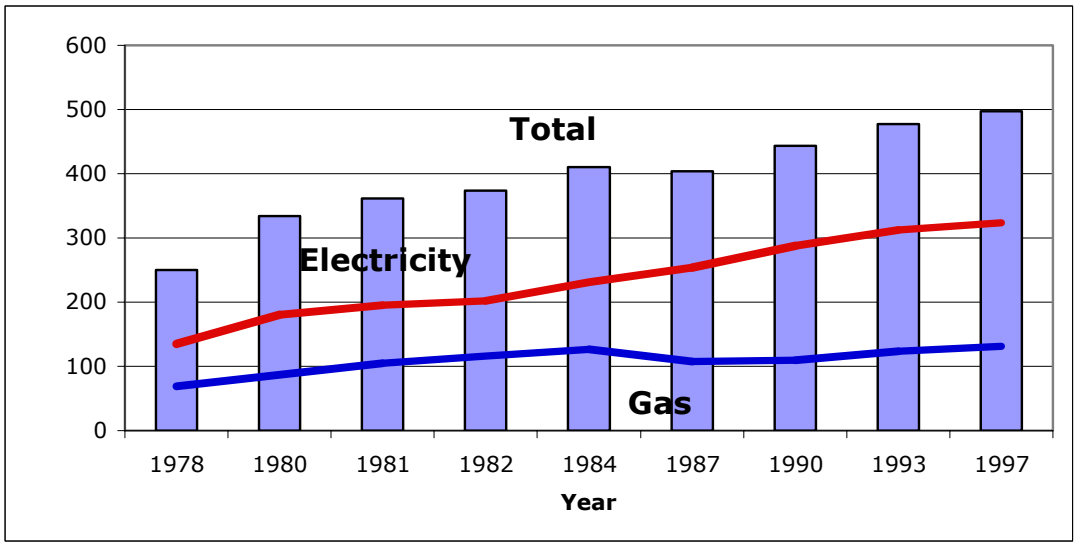
Figure 3. US New Single-Family Housing Floor Area (Square Feet) Mean, Median and Per Capita



Source: NAHB, US Census

As new houses get bigger, there is more space to condition and more space for appliances and equipment. The market share of energy-efficient appliances may be increasing, but as we have seen, so is per capita electricity consumption. A question that we raise is whether people are increasing their purchase of appliances and equipment at the same rate as improvements in energy efficiency? Figure 4 shows the annual residential energy expenditure for 1978 through 1997, with the total doubling over the time period, and with greater increases in electricity then in gas.

Figure 4. US Annual Residential Energy Expenditure 1978-1997
(Nominal dollars per capita)

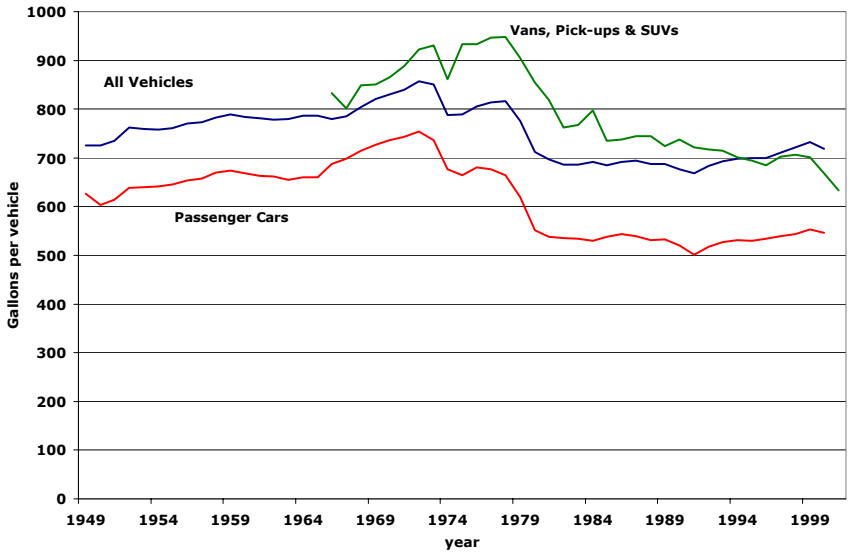


Source: EIA 2003

Gasoline for Passenger Cars

Figure 5 shows historic trend data for gasoline consumption (annual gallons per vehicle) for the fleet average for all vehicles, passenger cars, and vans, pick up trucks and SUVs. Gas consumption per vehicle rose slightly during the 50s and 60s then more sharply in the early 1970s prior to the oil shocks, dropped during the price increases of the 70s, and leveled off during the 80s and 90s, due to the increase in number of vehicles per household.

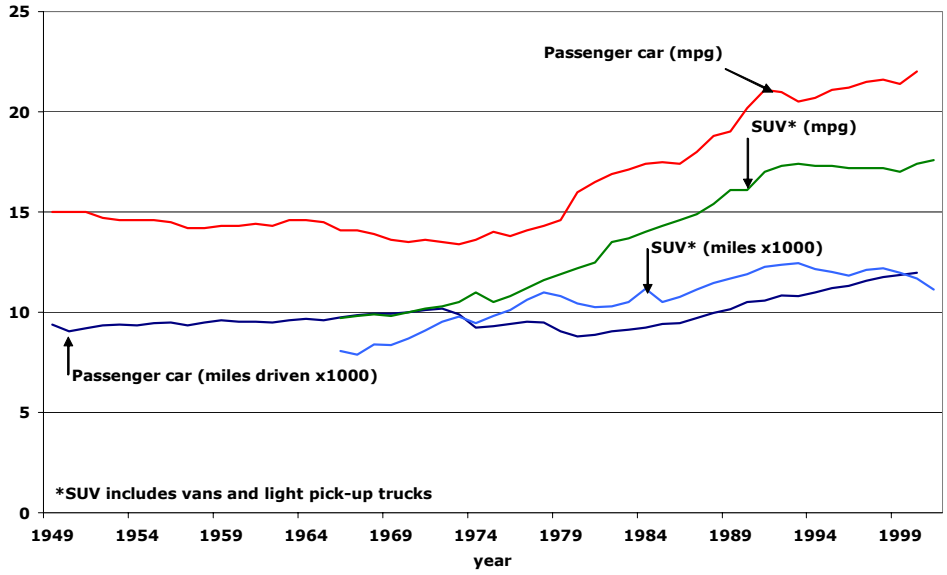
Figure 5. US Vehicle Gasoline Consumption 1949-2000
(Gallons per vehicle)



Source: EIA 2003

Figure 6 shows two of the drivers underlying gas consumption for both passenger cars and vans, pick-up trucks and SUVs: the increase in both the miles driven per passenger vehicle (mileage) and the increase in fuel efficiency (miles per gallon). What is not shown in Figure 6 is that SUVs, vans and light-pick-up trucks now account for over 50% of new vehicles.

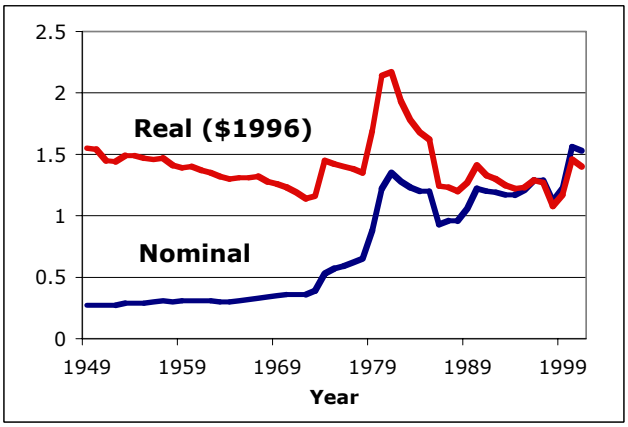
Figure 6. Passenger & SUV Fuel Efficiency and Vehicle Mileage 1949-2000



Source: EIA 2003

The findings here are that passenger car fuel efficiency was remarkably flat at 15 miles per gallon from 1950 until the mid 60s and after actually decreasing for a few years, then increased to meet the new standards. Vehicle mileage was also remarkably flat during this historic period and started increasing in the 1980s. When we look at the 50-year trend in gasoline prices (real), they have remained flat, around $1.50 per gallon, with the exception of the price spikes in the early 1980s due to the oil embargoes (Figure 7). The recent (Summer 2004) escalation in gas prices will be a significant departure from this historic trend.

Figure 7. US Retail Motor Gasoline Price 1949-2001



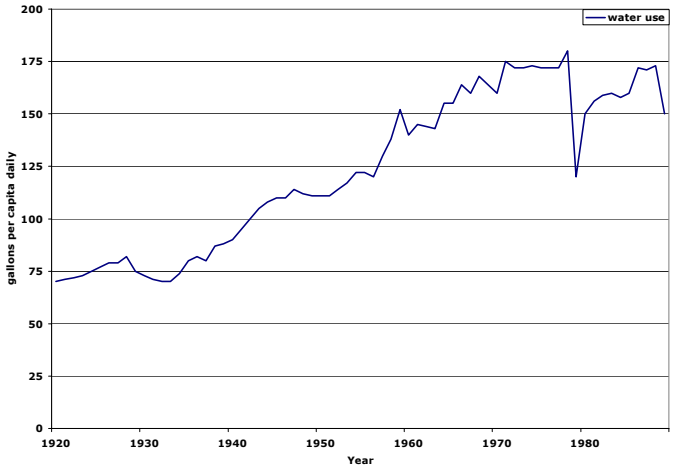
Source: EIA 2003

Household Water

Household water consumption is an interesting parallel to household energy consumption in that the monthly expenditures are similar in much of the US. Like energy, water is metered (generally) and households pay a monthly or bi-monthly bill. And similar to energy, most households have no idea of how much water they use and how they use it.

From the beginning of this century until 1970, urban per capita water use increased steadily, as illustrated by Figure 8, which charts increases in per capita water use in the San Francisco Bay Area (California 1993). Because most residential urban water use is for landscape watering, weather variations affect water use significantly from one year to the next. The trend towards fewer people per household, increases in household income, and population growth in warmer inland areas have tended to counteract the effects of multifamily housing and conservation, which drive per capita water use downward. Large reductions in per-capita water use are pronounced during drought years when aggressive short-term conservation and rationing programs are in effect. In the long term, permanent water conservation programs and other factors have begun to reduce overall per capita water use in some areas (California 1993).

Figure 8. Urban Per Capita Water Use, San Francisco Bay Area, 1920-1990



Source: California 1993

The effort to conserve urban water has paralleled the energy conservation/efficiency activities of the past 20 years, with demand-side management programs, education, rebates, incentives, etc., following much the same pattern as the energy utilities and municipalities. One significant difference is the lack of overall data on water use and end use. Another difference is the lower expectations for conservation. The 1990 projection for the San Francisco Hydrologic Region urban residential water use was a 7% reduction by 2020, from 106 gallons per day per capita (gpcd) to 98 gpcd, due to best management practices. A 7% reduction over 30 years is a pretty modest goal—much less stringent then federal energy standards, e.g., 30% reduction in 25 years. But water in much of the US is relatively cheap—households in California pay an average of $1.80 for a thousand gallons of tap water, nearly the same price as for *one* gallon of bottled water. Government subsidies of water play out not only on the household level, but across all sectors of the economy, with large subsidies for agribusiness and industry.

Food Consumption

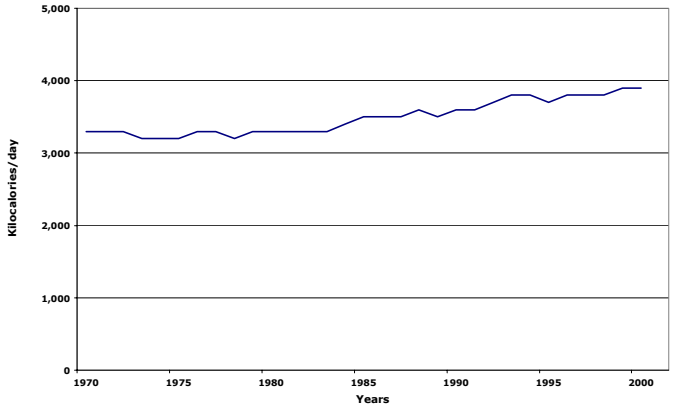
Evidence from various sources suggests that Americans now consume, on average, more total food, more snacks, bigger portions of food, and more calories than they did 30 years ago (Putnam 1999). A variety of factors are responsible for the changes in US food consumption patterns in the last 30 years, including changes in relative food process, increases in real disposable income, and more food assistance for the poor. New products, particularly more convenient ones, along with more imports, growth in the away-from-home food sector, expanded advertising programs and changes in food enrichment standards and fortification policy. Socio-demographic trends also driving food choices include smaller households, more two-earner households, more single-parent households, an aging population and increased ethnic diversity. New dietary guidelines designed to help people make food choices to promote health and prevent disease, improved nutrition labeling and increased awareness of nutrition also influence marketing and consumption trends (Putnam 1999).

Demand for food in the aggregate is not very responsive to price changes, because there is little room for substitution between food and non-food items. However, demand for individual foods is more responsive to prices as consumers substitute among alternative food commodities.

Internationally, Americans spend the least on food in relation to per capita consumption, 7% of personal consumption expenditure for food eaten at home. This figure compares with 10% in Canada and 11% in the UK and over 50% for India or Philippines (Putnam 1999.)

The level of food energy in the US food supply increased from 3300 calories per capita per day in 1970 to 3900 calories in 2000 (Figure 9). This 15% increase reflects higher levels of all three food groups, carbohydrates (grains & sweeteners), fats and proteins (grains, poultry & cheese). Total calories in 1909 is estimated at 3400 kilocalories/day, so the level was flat for several decades before the recent increase.

Figure 9. US Per Capita Food Consumption (Supply)



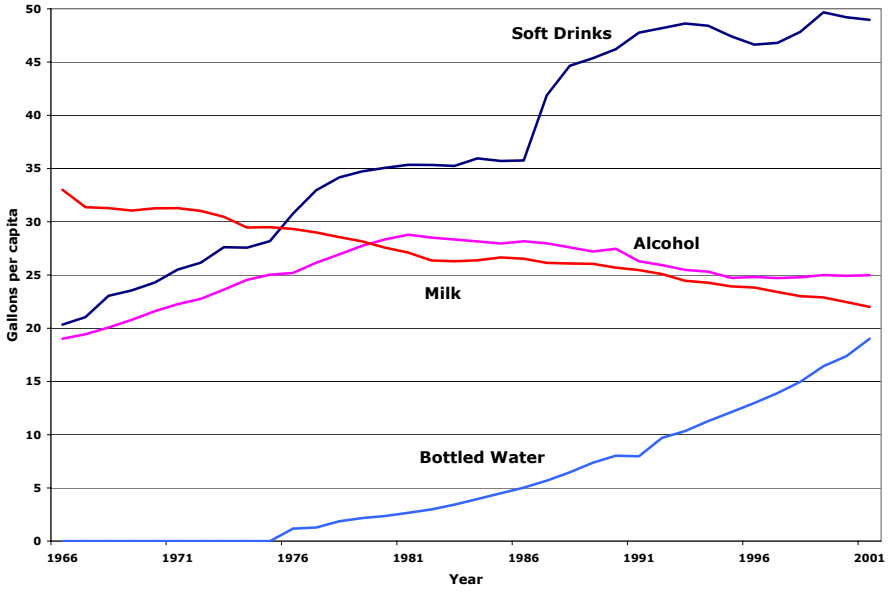
Source: USDA 2002

Policies such as the USDA food pyramid that are subject to extensive lobbying from the meat. cereal, dairy and sugar industry, and cutbacks in school lunch programs and physical fitness programs are also factors in the growing rate of obesity in children, with exposure to TV advertising being perhaps the single largest factor (Willett 2002).

Beverage Consumption

Beverages provide an example of how government subsidies, marketing and other forces change patterns and trend of consumption. Consumption of beverages has changed dramatically in the US over the past 40 years (Figure 10). In 1945, Americans drank more than four times as much milk as carbonated soft drinks; in 1997, they downed nearly two and a half times more soda than milk. Milk consumption has decreased, alcohol consumption has leveled off and decreased slightly and soft drinks and bottled water have increased dramatically. The reasons for the increase in soft drink consumption have been advertising and heavy subsidies to the producers of corn syrup, which surpassed cane and beet sugar for the first time in 1985 (Putnam 1999). Apparently the "Got Milk" advertising, despite their clever sales pitches, has not been able to reverse the decline in whole milk sales, although other milk products have increased.

Figure 10. US Beverage Consumption (gallons per capita) 1967-2001



Source: USDA

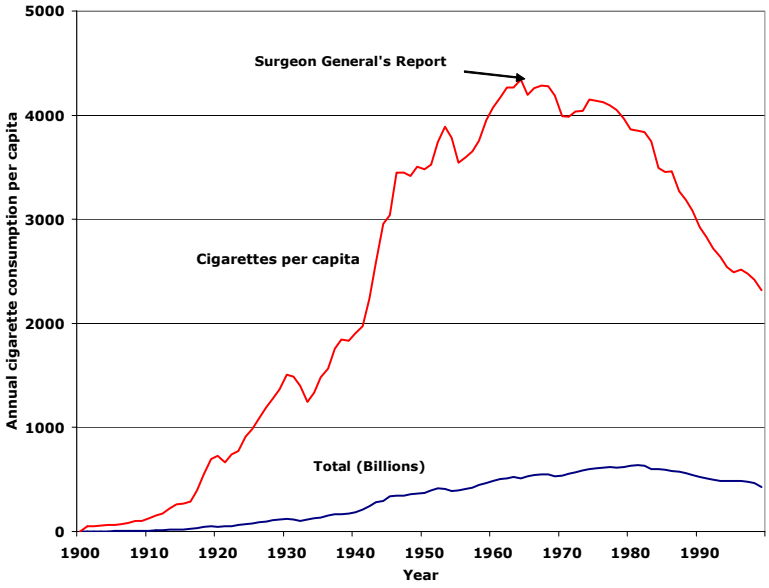
Tobacco

One wouldn't generally compare the consumption of a commodity like tobacco with a commodity like energy, but if we are looking for examples of where government intervention seems to have led to a reduction in use, there are few cases as dramatic as cigarettes. Cigarette consumption increased dramatically in the first half of the 20th century, particularly during the two world wars. The turning point came in 1964 following the US Surgeon general's report on smoking (Figure 11).

Since 1990, though, the decline in the percent of adults who smoke has slowed. In 2000, 25 percent of men and 21 percent of women were smokers. If we are interested in how to break people of their "energy habit," it is worth noting that changing behavior is far more difficult than establishing "good" behavior initially. This is a special challenge for energy consumption, both because it is a continuous process, linked to myriad other choices but almost always indirect, and

because energy (unlike water) is not consumed for itself, but as an integral part of several activities, many of which do not change quickly.

Figure 11. Total and Per Capita (Adults) Cigarette Consumption 1900-2000



Why Does Consumption Go Up?

If we want to be able to formulate policies that focus on reducing consumption of energy—or any good—it may help to understand the basis for why people consume in the first place. Basic consumption is needed for survival—shelter, fuel, food and clothing. But the levels of consumption seen by contemporary US culture vastly exceed any level for assuring that basic needs are met. Social scientists have written on the multiple reasons for why people consume beyond what they need for survival—e.g., for status, for pleasure, for display, convenience, marketing, etc. (Wilk 2002). A recurring phenomenon noted by several observes of the contemporary scene is that wants and desires become necessities.

Juliet Schor in her work, "The Overspent American" (Schor 1998), has made several observations on the motivations for contemporary American consumer culture:

"In the old days, our neighbors set the standard for what we had to have. Today a person is more likely to be making comparisons with .. people whose incomes are significantly higher."

"We are more likely to identify with the characters on "Friends" than with our real friends."

"Consumer satisfaction depends less on what a person has in an absolute sense than on socially formed aspirations and expectations"

Schor also traces the changes from a set of early American values that held, thrift, sufficiency and modest consumption with changes in the wave of mass prosperity. "Spending, even spending to excess, was extolled as good for the ego, if not for the soul. Consumerism

became the new, therapeutic belief system. Religious, legal, and folk impediments to consumption declined markedly. Most insidious of all, aggressive spending was made patriotic. It spread the wealth, we were told, creating jobs for the unemployed as well as profits for American industry" (Schor 1998). Anthropologist Willett Kempton notes that from an environmental perspective, a problem with consumption to display social status is that status is always relative, generating an unending spiral of increasing consumption, display and recomparison (Kempton 2001).

When Does Consumption Go Down?

Is the general pattern that we always consume more and more of everything, or are their cases when consumption drops? And in those cases, is it the direct result of policies, or shifts in societal and economic forces? One of the goals of American energy policy is to increase efficiency, not to decrease energy consumption, although decreased consumption is implied in carbon-emissions reductions objectives. Efficiency achievements are typically stated in terms of avoided energy consumption, calculated as energy savings relative to a (necessarily) abstract baseline. But energy efficiency policy generally addresses efficiency on an end use by end use, technology by technology, rather than on a more aggregate (for example, societal) basis. In this sense, achieving absolute reductions in overall or per capita energy consumption *is not* the goal of energy policy. There is also the moral argument for reducing consumption, which we do not review here (Rudin 2002).

While policy makers and politicians may not care to admit it, there have always been numerous ways in which government influences the consumption of products and materials, favoring increases in some commodities while instituting practices that lead to decreases in others. As a quick—but not exhaustive—review, here are several policies for reducing consumption, both mandatory measure and voluntary measures, using water conservation as a model (Renwick 1998).

Mandatory Policy Measures

- **Rationing** programs generally allocate a fixed quantity of water to households, based on some allocation criteria, and impose penalties for exceeding the allotment, such as severe marginal price penalties.
- **Restrictions** on water use constitute a more precise form of rationing. Use restrictions place constraints on when certain types of water use practices can occur, such as no washing down sidewalks or driveways, or bans on landscape irrigation during peak evapo-transpiration hours. During the 1990-1991 drought, Santa Barbara banned nearly all forms of irrigation and hired "water police" to enforce the policy.
- **Compliance measures**. The SF Water Department adopted a compliance affidavit program. Households were required to file an affidavit attesting that specific water-efficient devices were employed. Those that did not faced higher marginal prices.

Voluntary Measures

- **Information**. Public information campaigns to alert households to shortages, to motivate more efficient water behavior, and to provide information on means to reduce usage.
- **Rebates**. Subsidies to encourage adoption of water-efficient technologies, such as ultra low-flow toilets, horizontal-axis washing machines.
- **Retrofits**. Distribution of free retrofit kits, including low-flow showerheads, tank displacement devices and dye tablets for leak detection.

Some economists would argue that these policies are unnecessary; if people paid the true cost of water [or energy], then these actions would not be needed. Economic theory also suggests that residential water demand should be price inelastic for three reasons: 1) there exists no close substitutes for water in most of its uses, 2) the amount of money spent on water is a relatively small share of the typical household budget, and 3) water is frequently demanded jointly with some other complementary good, e.g., clothes or dish washing.

An interesting parallel with energy use is the observation that the use of price as an allocation mechanism is constrained by the fact that water is generally regarded as a basic necessity, even as a right, not an economic good (Renwick, 1988). But, in contrast to energy, policy makers are willing to talk about conservation of water, not just efficiency.

Conclusions: What Is in the Policy Toolbox?

Our initial question was whether historical trend data would show the impact of policies to change consumption—and whether these policies would provide insight in shaping the current debate to reduce energy consumption. Based on the cursory review of the trend data included here, we have seen examples of where policies have led to both increases and decreases in consumption. These policies have had direct and indirect impacts on consumption. The types of policies we have seen include: **1) Standards & Regulation**, such as water and energy standards for new appliances and fuel ratings for new vehicles that lead to decreases in per unit consumption, vs. unregulation, as in the case of SUVs being exempt from stricter mileage standards and water consumption not metered in certain communities. **2) Taxes & Rebates**, which through tax breaks can lead to increases in consumption of some commodities or services, such as advertising, home mortgages, photovoltaic panels, etc., or to decreases, e.g., taxes on alcohol and tobacco, etc. **3) Subsidies**, as in the case of cheap corn syrup leading to increases in beverage consumption, or subsidized water used to grow rice in arid regions, or the subsidies for a variety of energy sources, e.g., oil, gas, wind, ethanol, nuclear, etc. **4) Procurement**, by which government leads by example and influences product design and durability, and **5) Education**, as in the example of the food industries' interests in promoting certain food groups, e.g., meat and dairy, vs. improved food labeling, and in the issuance of health advisories leading to the reduction of tobacco use.

What this review of the historical consumption data suggests is that government policies have often played a role in shaping consumption, and if policy makers are serious about reducing energy consumption, there is historic precedent and a range of strategies to pursue.

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