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TRADE AND ECONOMIC DEVELOPMENT

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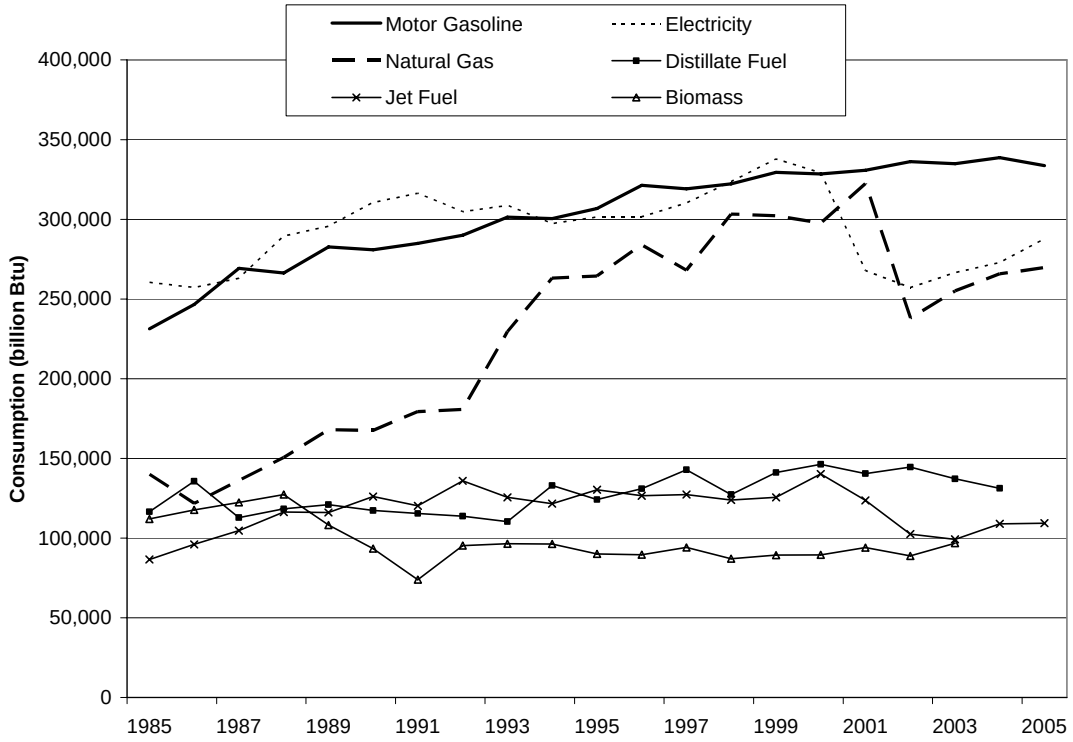
THE 2007 BIENNIAL ENERGY REPORT

Energy consumption and prices in Washington have deviated from their long-term trends in recent years. This was due to tightening energy supplies in the face of growing demand in international, national, and regional energy markets. This chapter examines energy consumption, price, electricity generation and sales, greenhouse gas emission trends in Washington, energy intensity indicators and implications for the state of Washington.

Energy Consumption Trends

Energy use in homes, businesses, industry, and transportation grew at an average rate of 1.6 percent between 1985 and 2000 in Washington, peaking in 1999 at 1.4 quadrillion Btu. Motor gasoline, electricity, and natural gas accounted for the majority of end-use energy consumption and increasing use of these fuels was the primary contributor to growth in overall energy use in Washington (Figure 1). Growth in natural gas use was most dramatic, more than doubling between 1985 and 2000.

Figure 1 End-use Energy Consumption in Washington by Major Source



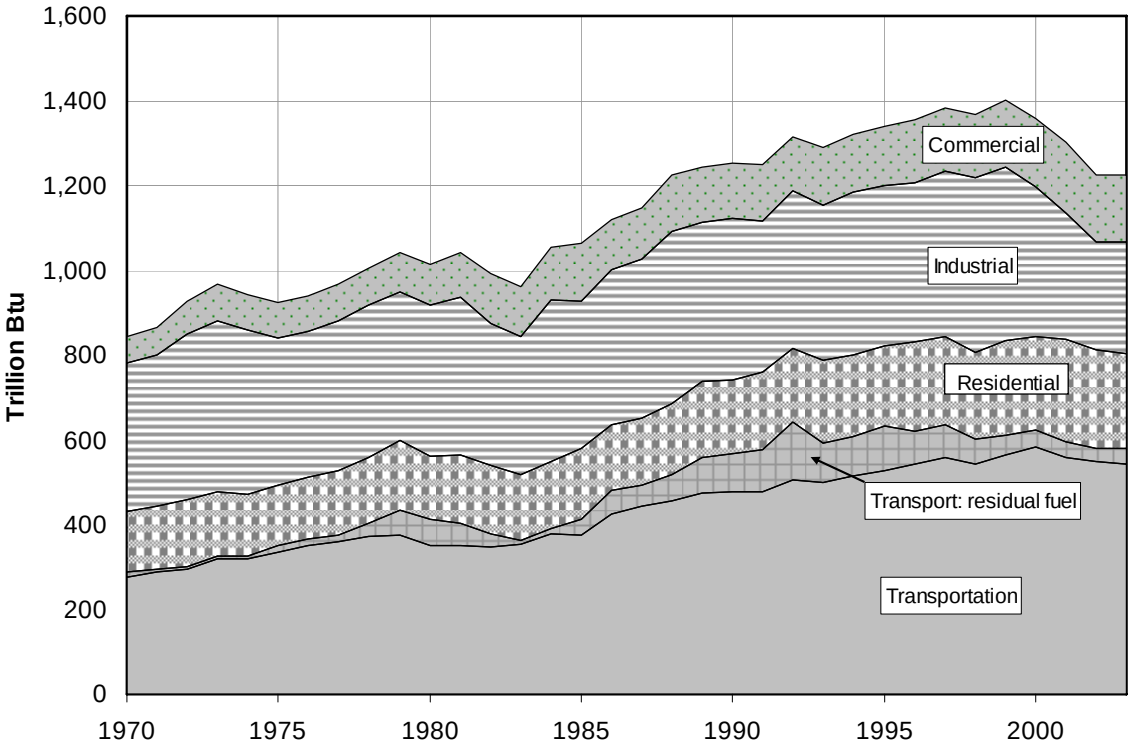
Source: U.S. Energy Information Administration

Sharp declines in electricity and natural gas consumption in 2001 and 2002 due to the West Coast Electricity Crisis briefly interrupted the growth in end-use energy consumption, although natural gas and electricity use in the last several years appears to be returning to pre-crisis growth trends. Growth in motor gasoline consumption has leveled off during the last several years.

The consumption of distillate fuel (diesel and fuel oil), jet fuel, and biomass (primarily wood and waste) account for roughly a quarter of total end-use energy consumption in Washington. The consumption of these fuels has been relatively steady over the last 20 years. Distillate fuel use grew a bit, while biomass consumption declined some, and jet fuel use rose and then fell.

Other fuels consumed in Washington include a variety of petroleum products (residual fuel oil, still gas, LPG, kerosene) that typically account for less than 10 percent of total consumption. Coal is consumed in very small amounts by end-users in Washington, although it is used in more significant quantities to generate some of the electricity produced for consumers in Washington. This is discussed in the section on electricity generation in Washington.

Figure 2 End-Use Energy Consumption in Washington by Sector (1970-2003)



Source: U.S. Energy Information Administration

The transportation sector accounted for the largest share of growth in Washington energy use, doubling since 1970 (Figure 2)[1]. Energy consumption in the commercial sector, which includes service industries such as software, finances, and insurance, grew at a higher rate than transportation during this period, but total consumption is still smaller than the other sectors. Residential sector energy use has also been growing and in recent years the rate has been higher than the other sectors. In contrast industrial energy use has declined by more than a third since 1999. This is largely due to the shutdown of aluminum smelters and a few other energy price sensitive industries in response to the West Coast Electricity Crisis.

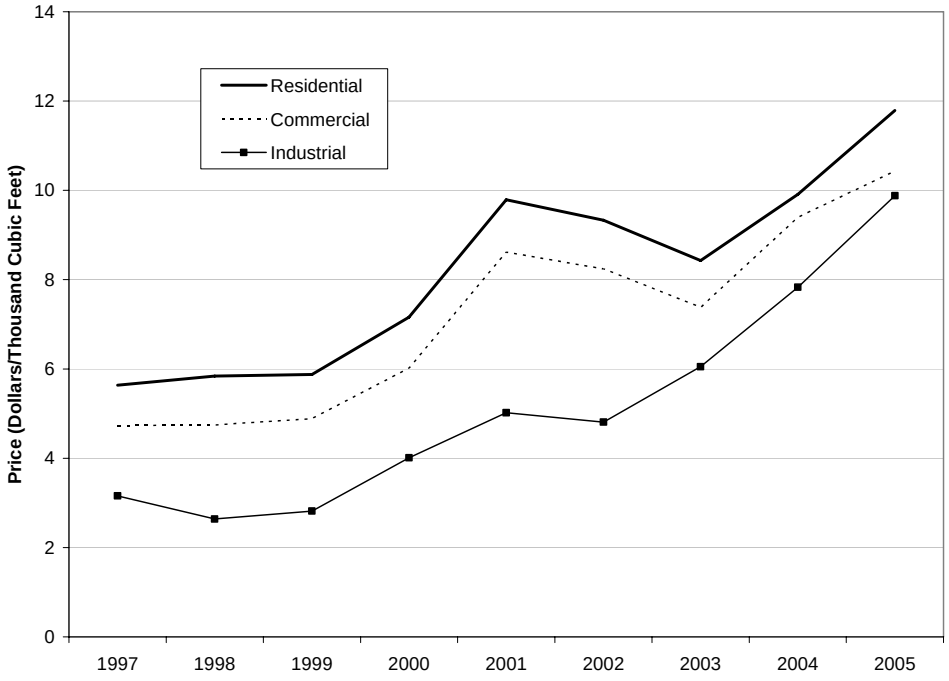
[1] Transportation residual fuel represents fuel loaded on large ships at the Port of Seattle and bound for foreign ports, and is shown as a subset of overall transportation fuel use. Tracking of transportation residual fuel is less rigorous and reliable than other transportation fuels.

Energy Price Trends

Retail energy prices paid by consumers in Washington were relatively stable throughout the 1990's. This situation changed in 2000 as a result of the West Coast Electricity Crisis. Later events like Hurricane Katrina and the run up in world oil prices continued to push prices upward.

Natural gas has experienced some of the largest price increases (Figure 3). Industrial[2] natural gas prices have tripled and commercial and residential prices have doubled in the last six years.

Figure 3 Natural Gas Prices by Sector



Source: U.S. Energy Information Administration

Higher natural gas prices in Washington mirror trends in other states (Table 1). Washington natural gas prices in the last eight years have tended to be below average. While residential and commercial prices briefly exceeded the national average in 2001 and 2002, they have returned to their previous relative ranking. However, industrial natural gas prices, which were among the lowest state prices, now are close to the median price.

Table 1 Washington State Natural Gas Price Ranking

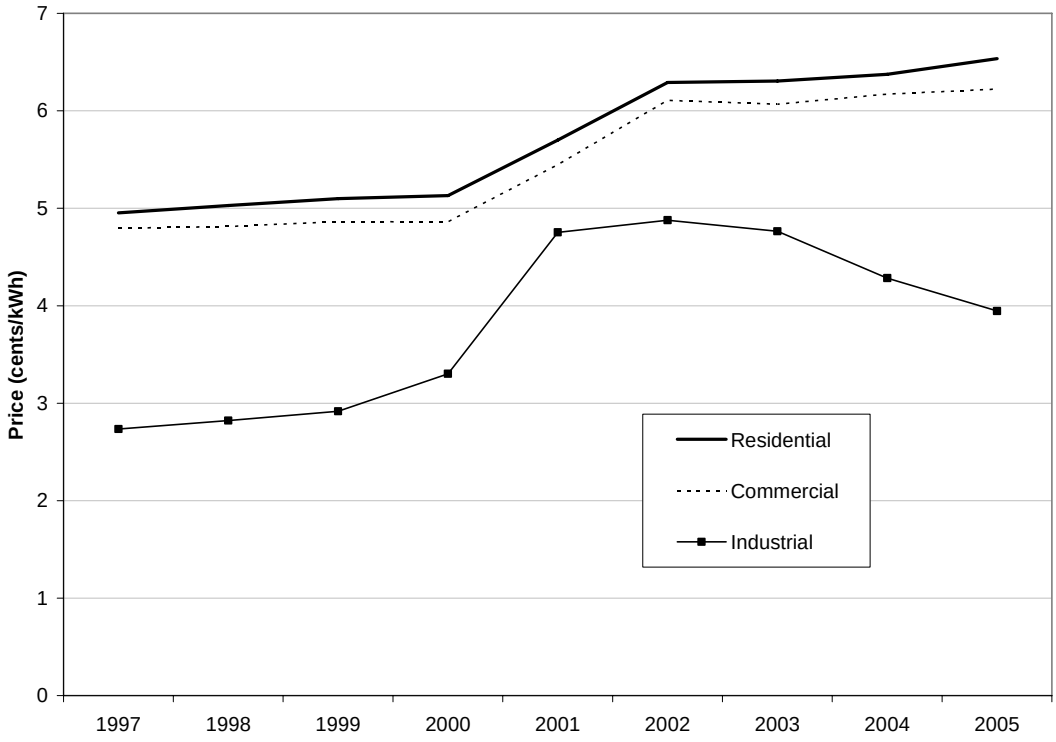
Sector	1999	2001	2003	2005
Residential	*16*	*27*	*11*	*15*
Commercial	*18*	*28*	*13*	*17*
Industrial	*6*	*8*	*19*	*25*

Rank scale: 1 = lowest, 50 = highest, Source: EIA.

[2] The industrial natural gas price data collected by the Energy Information Administration and shown in the graph represents a small portion of the industrial consumers in the state (generally less than a quarter) because many industrial customers do not buy natural gas from their local distribution company.

Electricity prices, like natural gas, also increased as a result of the West Coast Electricity Crisis. From 1999 to 2002 residential and commercial electric prices increased about 25 percent. Industrial price grew almost 70 percent before declining to 30 percent higher than pre-crisis levels by 2005. Unlike natural gas prices, electricity prices seem to have stabilized.

Figure 4 Electricity Prices by Sector



Source: U.S. Energy Information Administration

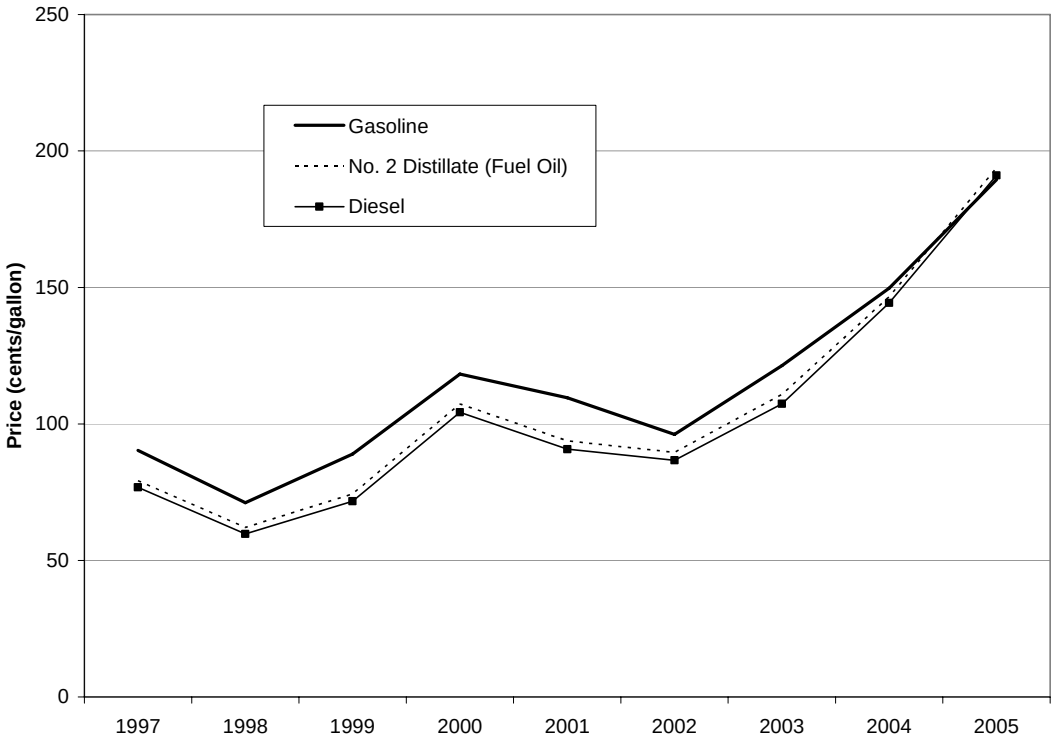
Washington historically has had some of the lowest electricity prices in the nation. This situation changed as a result of the electricity price increases from 2000 to 2002 (Table 2). After having the second lowest industrial electricity price in 1999, more than half the states had lower industrial electricity prices in 2001. However, by 2005 only five states had lower industrial prices. Washington's ranking for commercial prices moved from second to eleventh lowest, while the ranking for residential electricity prices changed from the lowest to fourth lowest. Even though electricity prices have increased significantly, Washington still enjoys some of the lowest average electricity prices in the nation.

Table 2 Washington State Ranking for Electricity

Sector	**1999**	**2001**	**2003**	**2005**
Residential	*1*	*2*	*4*	*4*
Commercial	*2*	*6*	*12*	*11*
Industrial	*2*	*29*	*25*	*6*

Rank scale: 1 = lowest, 50 = highest, Source: EIA.

Figure 5 Petroleum Prices by Fuel (excludes taxes)

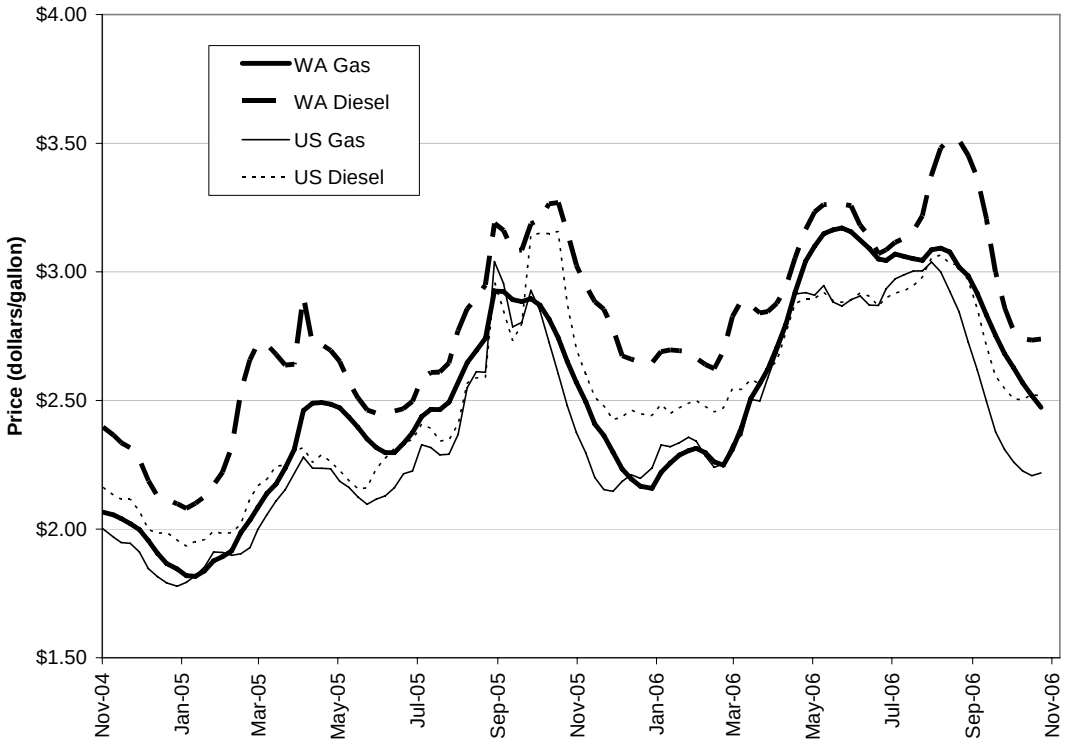


Source: U.S. Energy Information Administration

Prices for petroleum products such as gasoline, fuel oil, and diesel last peaked in the early 1980's before falling to historic lows in 1998. Prices for these fuels have risen steadily since 2002 (Figure 5) as a result of higher crude oil prices and a lack of excess refinery capacity. By 2005 prices for gasoline, fuel oil, and diesel were more than double the 1998 values. Adjusting for inflation, gasoline prices in 2005 were similar to the peak prices in 1981.

Washington's gasoline and diesel prices peaked in May and August of 2006, but have declined about 70 cents/gallon since then (Figure 6). Much of this decline has occurred following the peak summer driving season and reflects the lack of any supply disruptions or shortages during the summer. Given the cyclical nature of gasoline and diesel prices and continuing constraints on supply, we can expect prices to go up when demand increases or supplies go down.

Figure 6 Recent Gasoline and Diesel Prices in Washington



Source: American Automobile Association

Washington, like other West Coast states, tends to have higher gasoline prices than most states (Figure 6 and Table 3). In recent years Washington's prices have usually been more than 10 cents/gallon higher than the national average, but at times Washington's prices have been similar to the national average. Recent data from the American Automobile Association (AAA, 11/13/06) shows Washington had the third highest regular gasoline prices. Washington's price was 27 cents/gallon higher than the national average. However, Washington gasoline prices have not always been higher than other states. From 1983 to 1991 Washington gasoline prices tended to be slightly below the national average. The change in this situation reflects the tightening supply-demand situation on the West Coast.

Table 3 Washington State Ranking for Gasoline

	1999	2001	2003	2005
Ranking	*42*	*39*	*39*	*29*
Number of States Ranked (n)	*44*	*43*	*43*	*37*
Amount Higher than U.S. Average (cents/gallon)	*16.6*	*10.4*	*11.5*	*6.2*

Rank scale: 1 = lowest, 50 = highest, Source: EIA.

Likewise, fuel oil and diesel prices tend to be higher in Washington than in other states. Washington had the second highest diesel price based on recent data from AAA[3] (25 cents/gallon above the national average). However, at times in the last two years Washington diesel prices have been as much as 50 cents/gallon higher than the national average. Historic data from the Energy Information Administration also shows Washington having higher diesel

[3] AAA Fuel Gauge Report can be found at: http://www.fuelgaugereport.com/

and fuel oil prices than the national average of the states tracked, but the differences for diesel are smaller than the data from AAA.

Electricity Trends

Washington is part of an interconnected, regional power system and utilities purchase electricity generated from a variety of sources throughout the region to serve consumers in Washington. There are two ways to look at electricity in Washington; either by electricity generated within the state or electricity sold to consumers in the state. Because of the interconnected nature of our power system, electricity generated here is not necessarily consumed here. Conversely, electricity sold to Washington consumers could be generated anywhere in the western half of the United States and Canada.

Our hydroelectric resources are highly seasonal; most of the electricity is generated in the spring and early summer when the snow melts. Our peak needs for electricity, however, are in the winter. On an annual basis Washington is typically a net exporter of electricity, yet we must import electricity to meet our winter needs. The electricity we export is primarily hydro-based while the imported electricity is primarily based on coal, nuclear and natural gas.

Figure 7 Electricity Generation by Fuel Source (1990 – 2005)

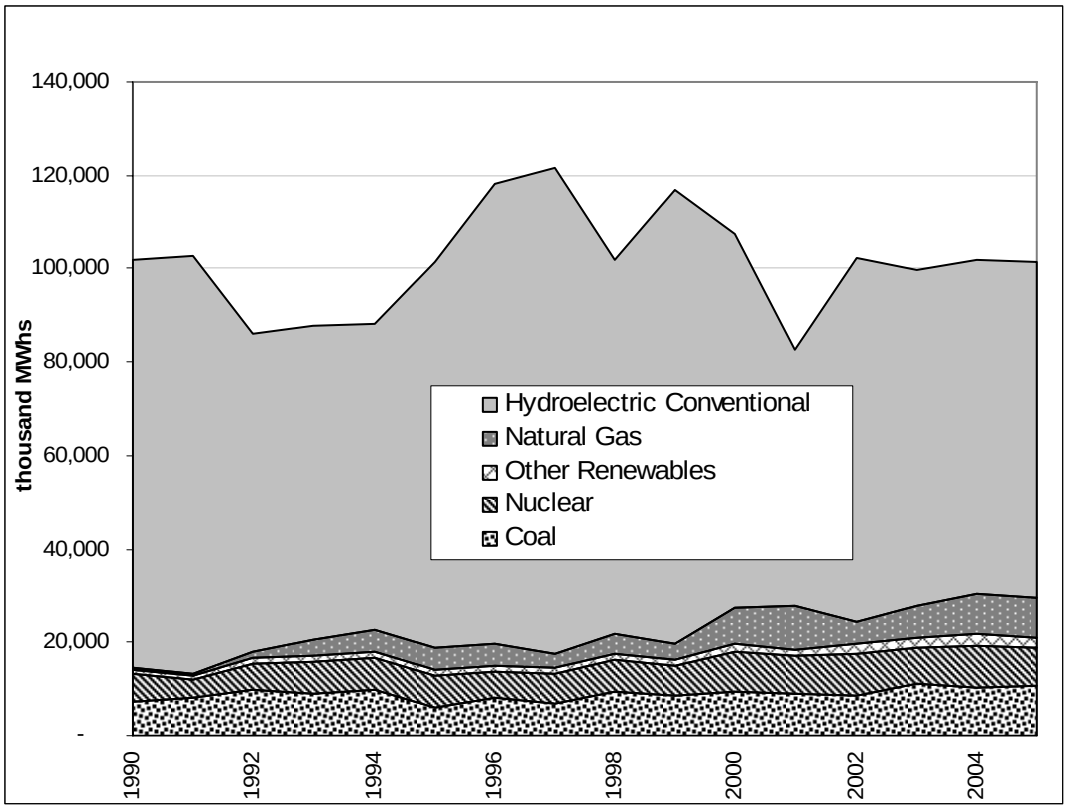
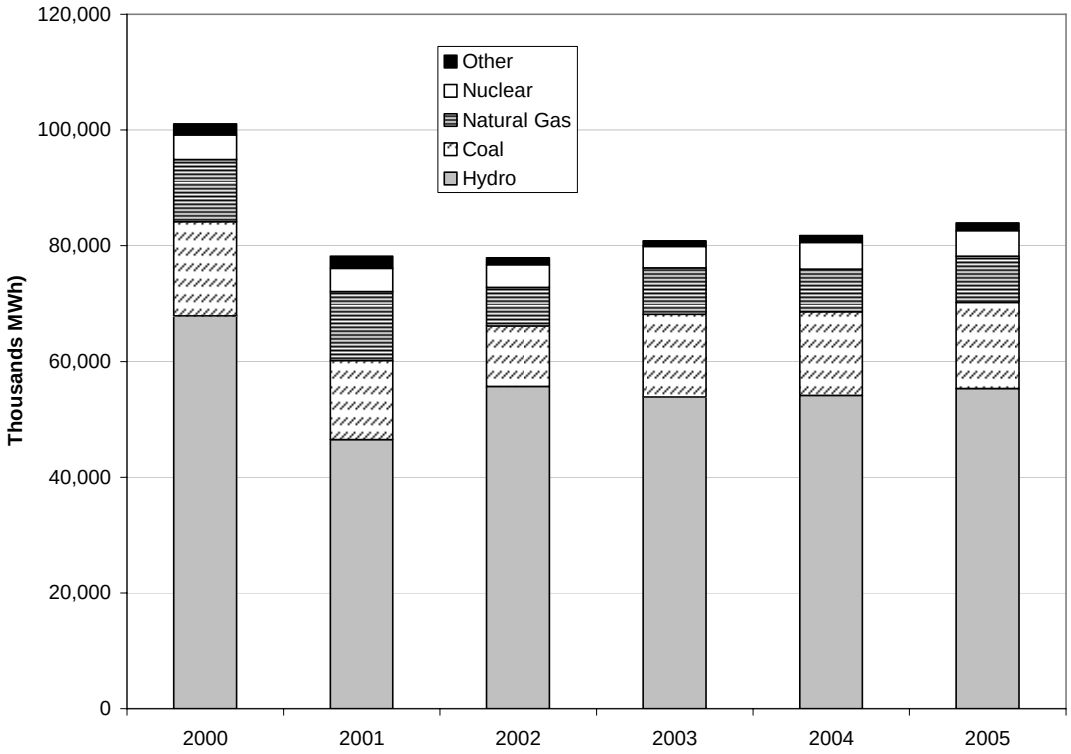


Figure 7 shows the electricity generated in Washington by fuel source. Hydroelectricity is Washington's primary resource, accounting for 71% of the generation in 2005. Electricity generated from coal accounted for 10%, nuclear and natural gas generation both represented 8% of our state's generation. Non-hydro renewables represented 2% of our state's electricity generation.

Washington's electricity generation sources have been relatively constant over the last six years with the exception of hydroelectricity. Hydroelectricity production serving Washington consumers dropped more than 30 percent from 2000 to 2001 as a result of drought conditions during this period. Drought conditions, low snow pack, or poorly timed run-off can lower hydro production. Generation capacity on the Federal hydro system was 10 to 20 percent above normal during a relatively wet period in 1996 and 1997, but dropped 30 percent below normal by late 2001. The decline in hydroelectric generation was compensated for by a drop in electricity consumption and a slight increase in fossil fuel-fired generation (particularly natural gas).

Figure 8 Fuel Mix for Electricity Sold to Consumers in Washington State

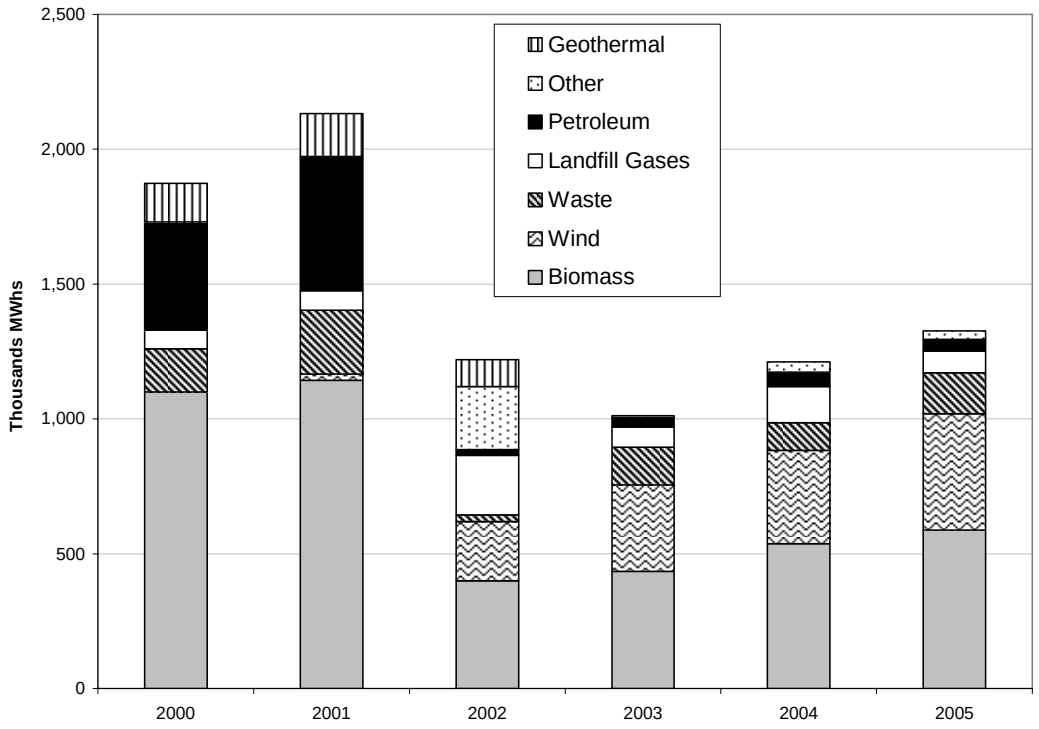


Source: Washington Fuel Mix Disclosure Data

Figure 8 shows the mix of fuels used to generate electricity which is sold to consumers in Washington State. In 2005, 66% of electricity consumed in Washington was generated by hydro, coal represented 18%, natural gas 10%, nuclear 5%, other sources contributed 2%.

The majority of 'other' sources from Figure 8 were renewable, accounting for about one and a half percent of the electricity consumed in 2005. Figure 9 below shows the "other" category in more detail. Biomass (0.7%) was the largest renewable generation source followed by wind generation (0.5%). Wind was the only one of these sources that was growing. Prior to 2001 no electricity from wind generation was consumed in Washington. In 2000 and 2001 petroleum generation was used to help address electricity supply shortages from the West Coast Electricity Crisis, but by 2002 this generation had largely disappeared.

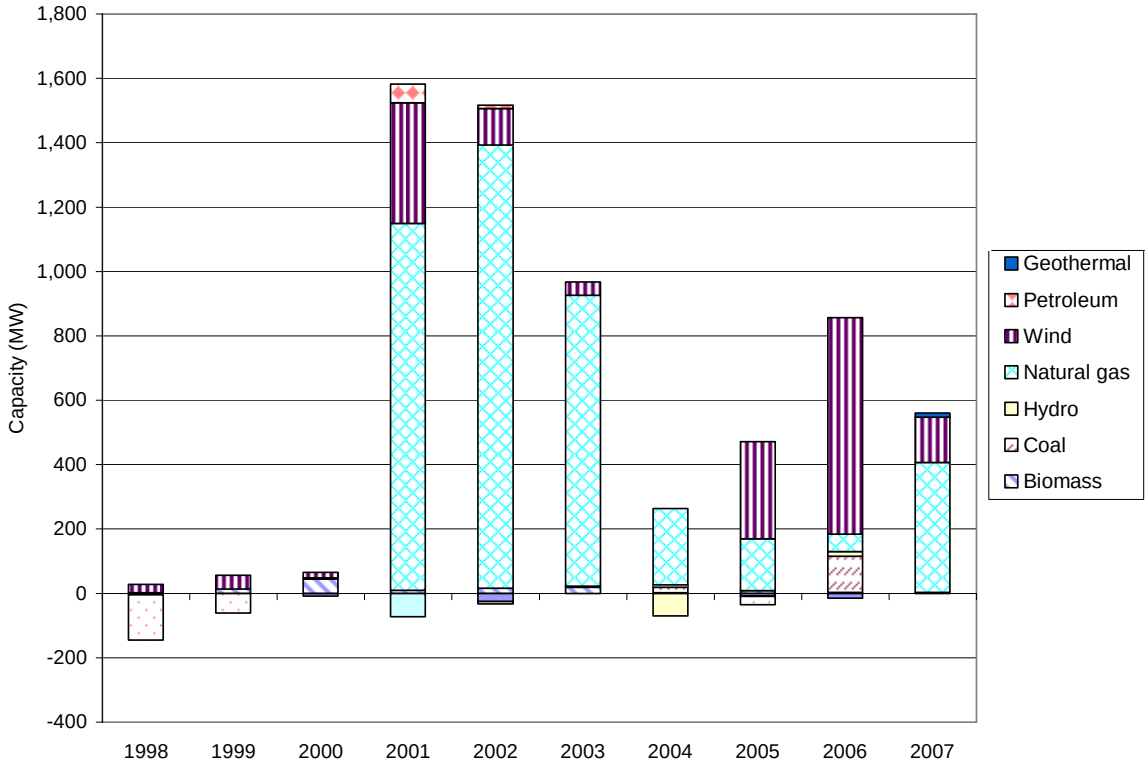
Figure 9 Fuel Mix for Electricity Sold to Consumers in Washington by 'Other' Fuel Sources



Source: Washington Fuel Mix Disclosure Data

The "other" category shown in Figure 9 includes sludge waste, tires, and agriculture byproducts.

Figure 10 Additions of New Electricity Generation Capacity in the Northwest

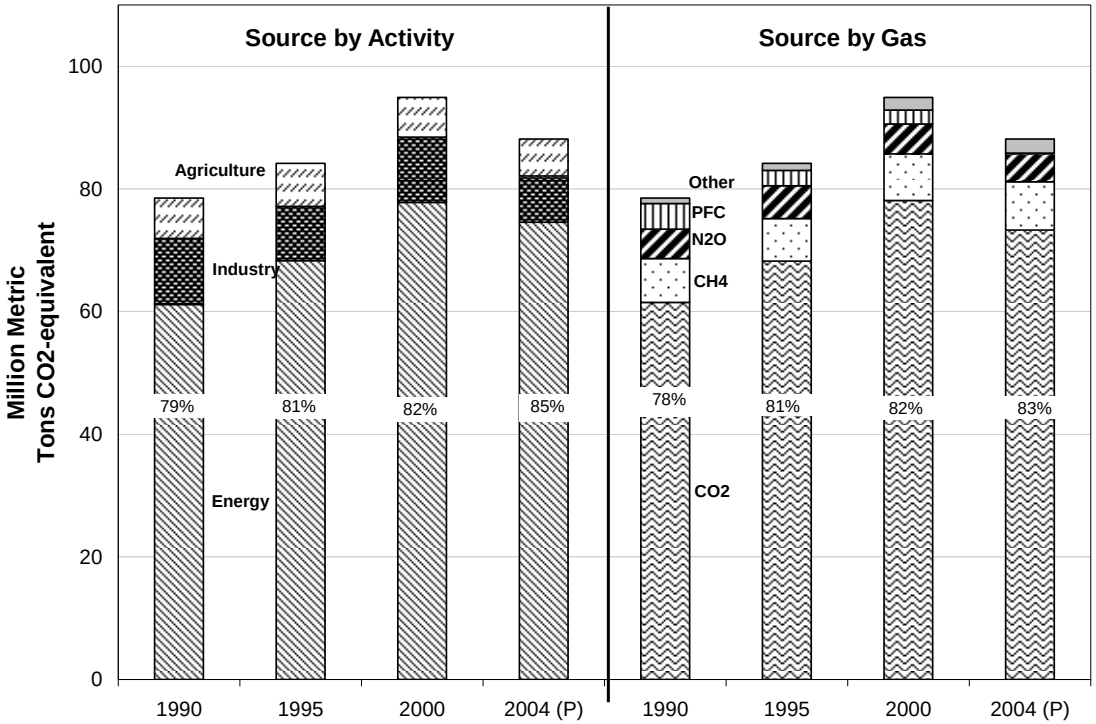


Source: Northwest Power and Conservation Council

New power plant additions in recent years show how the electricity generation mix is changing. Data collected by the Northwest Power and Conservation Council (NPCC) show that between 1998 and 2006 two-thirds of the generation capacity added in the Northwest was natural gas-fired followed by wind at 27 percent (Figure 10). However, in the last two years almost three-quarters of the new capacity was wind generation. Since wind-powered generation on average operates at 30 to 40% of its nameplate capacity, the relative share of wind-generation was less than nameplate capacity may suggest. NPCC estimates for 2007 suggest that natural gas-fired generation will account for the majority of new capacity.

Greenhouse Gas Emissions

Figure 11 Greenhouse Gas Emissions by Sector and Gas Type



Notes: PFC includes CF4 and C2F6. "Other" includes SF6 and HFCs. Residual Fuel used in transportation sector is not included.

Energy related emissions are the dominant source of greenhouse gas (GHG) emissions, carbon dioxide (CO_2) is the dominant GHG followed by methane, nitrous oxide, perfluorocarbons and sulfur hexafluoride. Figure 11 shows the contributions from the various sectors and gases for the years 1990, 1995, 2000 and 2004.

The majority of energy-related GHG emissions and almost half of total emissions are from the transportation sector. Emissions from the direct use of fossil fuels (excluding electricity-related emissions) in the residential, commercial and industrial sectors have been relatively constant over the past 40 years, even though the use of energy in these sectors has increased. There has been fuel switching from coal and petroleum fuels to natural gas, which emits fewer pounds of carbon dioxide per million Btu of heat content. Also, there has been an increase in efficiency with which fossil fuel energy is utilized in these sectors. However, if CO_2 from electric power generation is

apportioned to the commercial and residential sectors according to their consumption of electricity, emissions for these sectors more than doubles.

Figure 12 All Greenhouse Gas Emissions in Washington for 2004 (preliminary estimate)

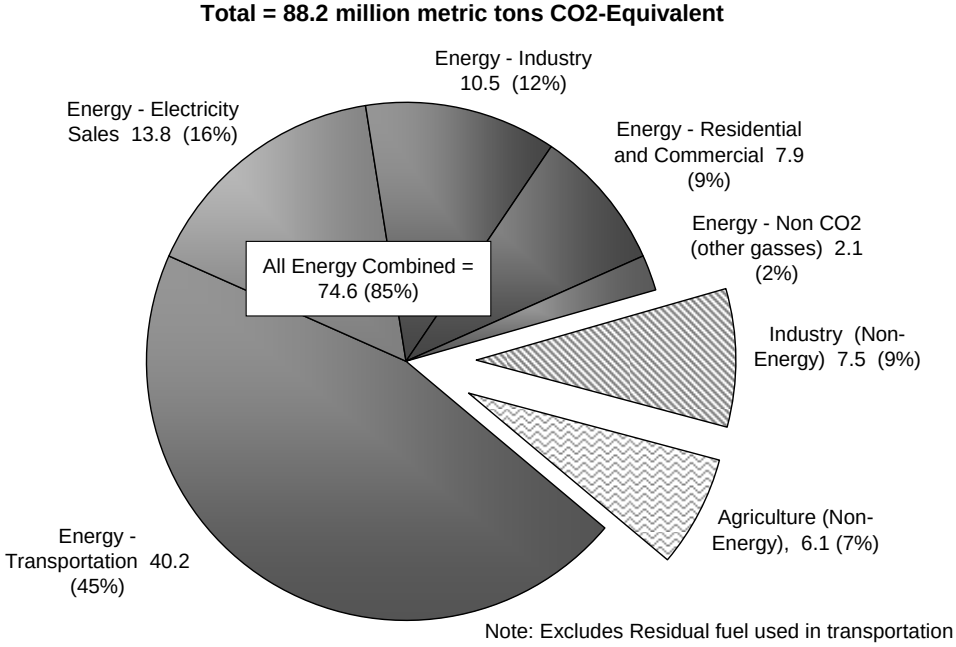


Figure 13 shows that most of the growth in overall CO_2 emissions in Washington State is from the transportation or electricity generation sectors. The total transportation[4] CO_2 emissions are more than three times higher today than in 1960.

Figure 13 Cumulative Energy-related CO_2 Emissions by Sector

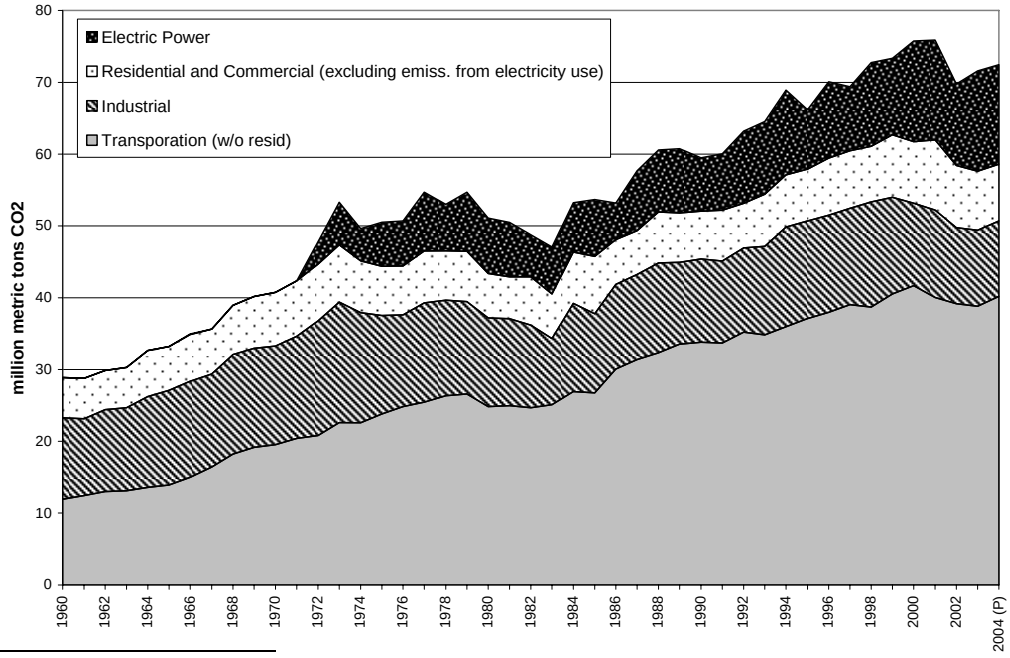
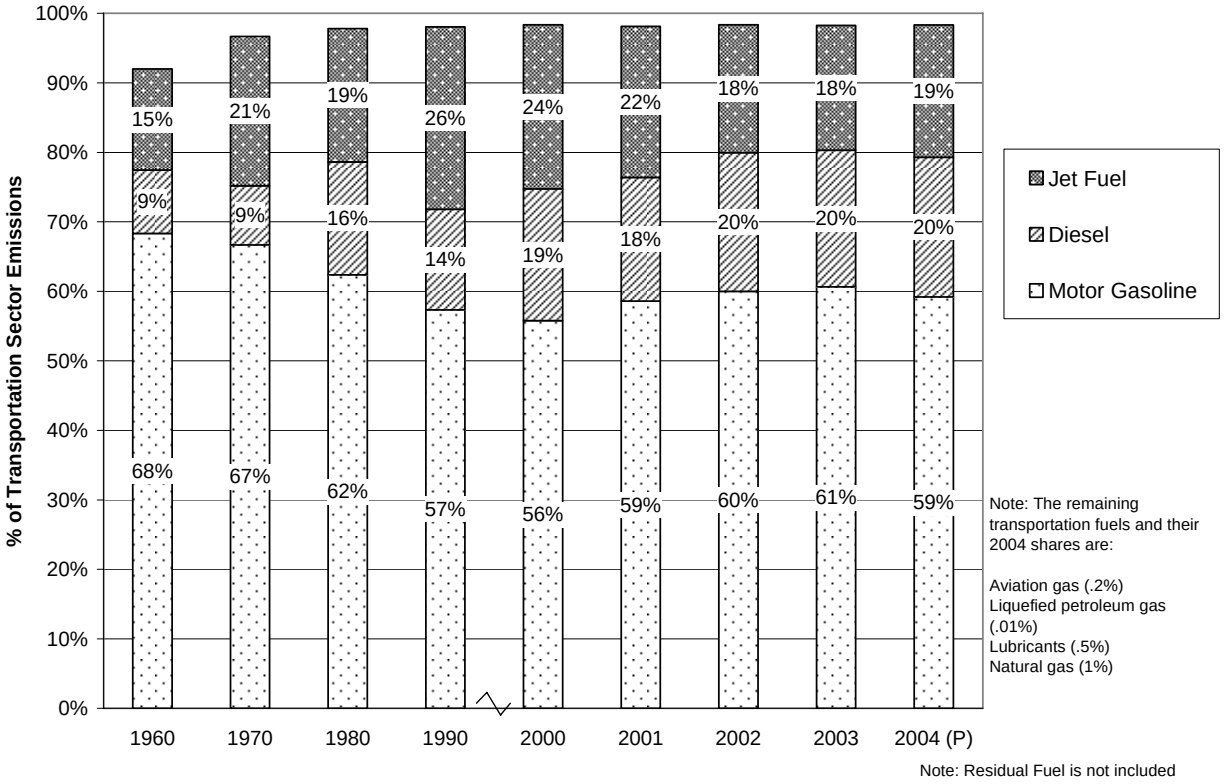


Figure 14 looks closer look into the transportation sector. Motor gasoline, diesel and jet fuel CO_2 emissions are responsible for nearly all the transportation sector, accounting for 98 percent of this sector's emission in the year 2004. While absolute CO_2 emissions have increased for the transportation sector, the share of CO_2 emissions within this sector corresponding to motor gasoline use declined through 2000.

From the late 1970's through 1985 automotive fuel economy standards (CAFE standards) and high fuel prices resulted in a rapid increase in vehicle fuel economy and slowed the increase in per capita vehicle-miles traveled (VMT). In more recent years, the waning effects of vehicle fuel efficiency standards, increasing population and per capita VMT resulted in growth in transportation CO_2 emissions. Washington ranks 26th in per capita petroleum-related emissions (8.4 tons per capita) and is equal to the national average.

Figure 14 Transportation CO_2Emissions



Carbon dioxide emissions from electric power generation are quite different from the other sectors (See Figure 15). Up until 1972, there were virtually no carbon dioxide emissions, as electric power in Washington was generated almost entirely by hydropower. When the coal fired Centralia power plant came on line there was an obvious significant increase in emissions from the electric power sector. Emissions stayed relatively constant until the early 90's when natural gas began to be used for electrical generation and the emissions increased, although emissions from Centralia are still the majority. Over the last 40 years, about a third of the increase in Washington's CO_2 emissions has been from the electric power sector.

Another method of accounting for electricity emissions is to look at the electricity *purchased or generated* for use by electric utility customers in Washington (often referred to as load based CO_2 emissions) rather than the electricity that is generated in Washington but not necessarily for

consumers here. Figure 16 compares these two methods. It is apparent that some utilities in our state rely heavily on out-of-state fossil-based electricity generation to serve their customers and to balance seasonal electricity needs. Figure 16 reveals that CO_2 emissions associated with electric consumption are actually 30 percent higher than estimated using generation based data.

Figure 15 Carbon Dioxide Emissions from In-State Electric Power Generation by Fuel Type

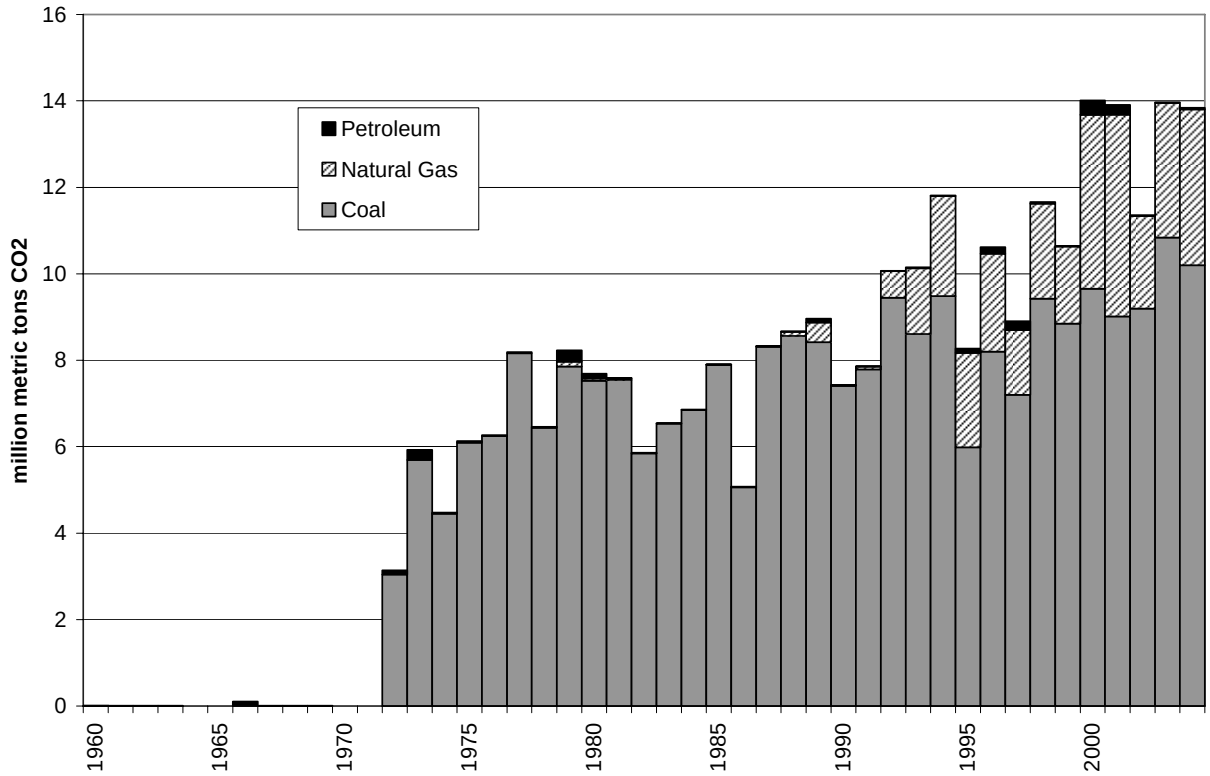


Figure 16 Washington State Electricity Sector CO_2 Emissions: Generation vs. Sales

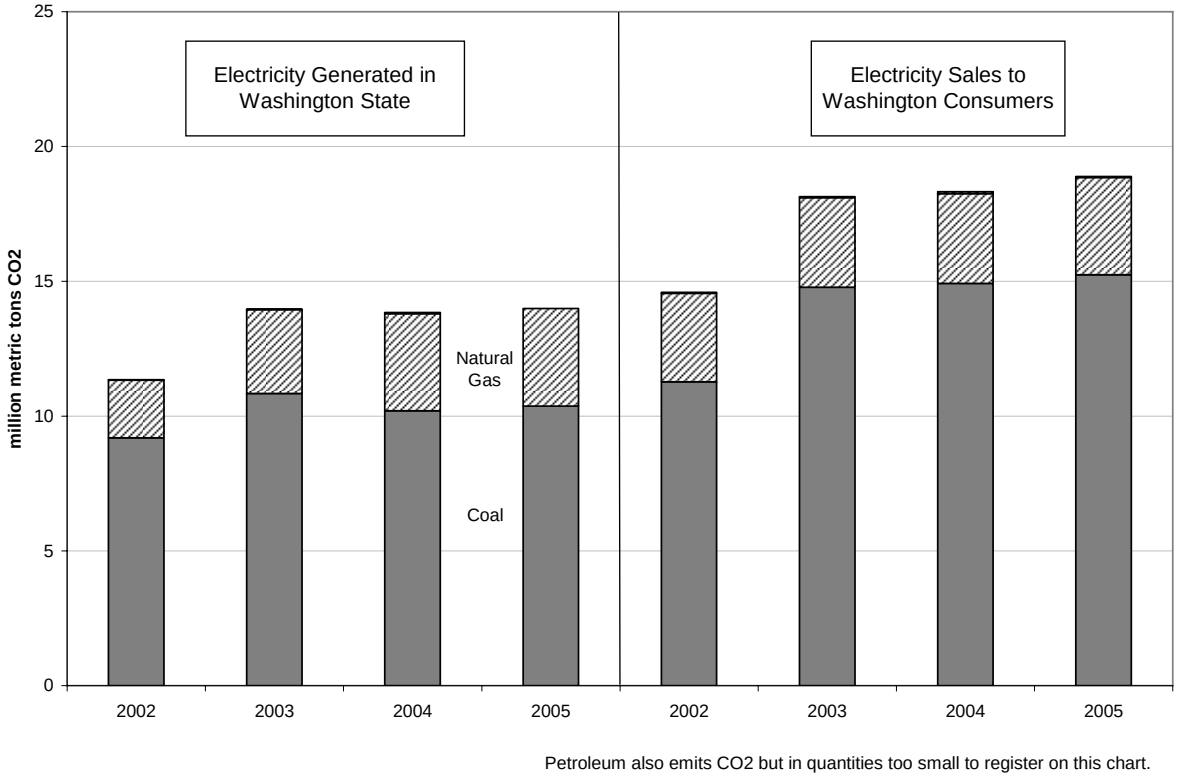
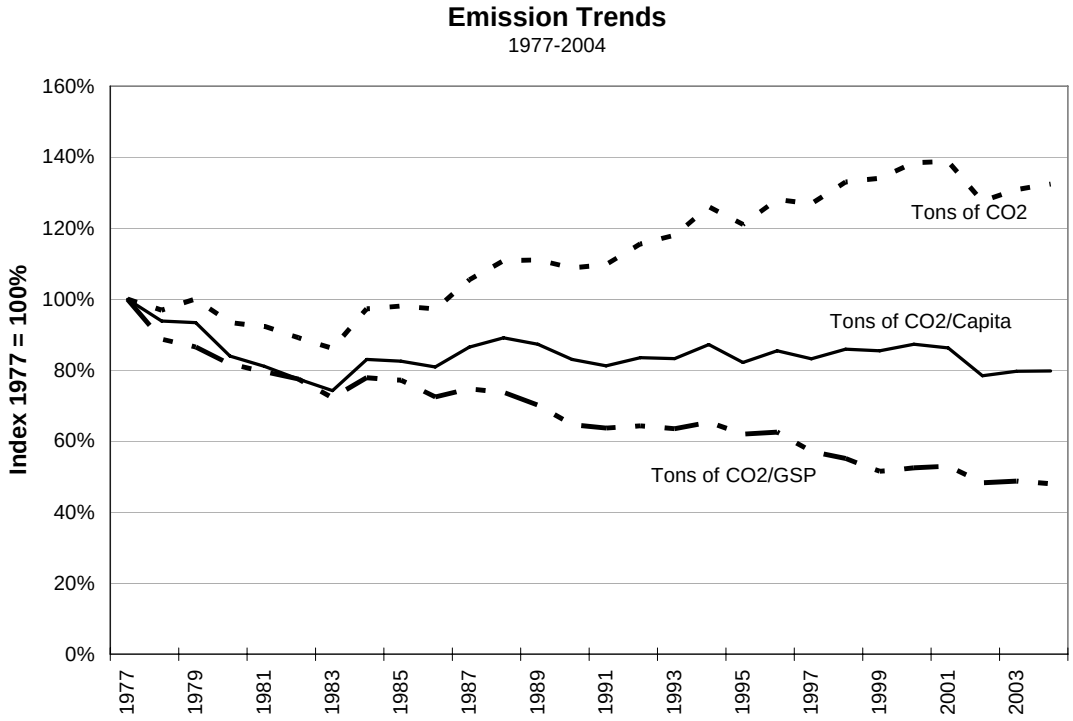


Figure 17 shows that between 1977 and 2004, total emissions increased about 32 percent (average annual increase of 1.2 percent), the emissions per capita have dropped 20 percent (average annual decrease of 0.75 percent), and the emissions per constant dollar of gross state product have decreased by 52 percent (average annual decrease of 1.9 percent).

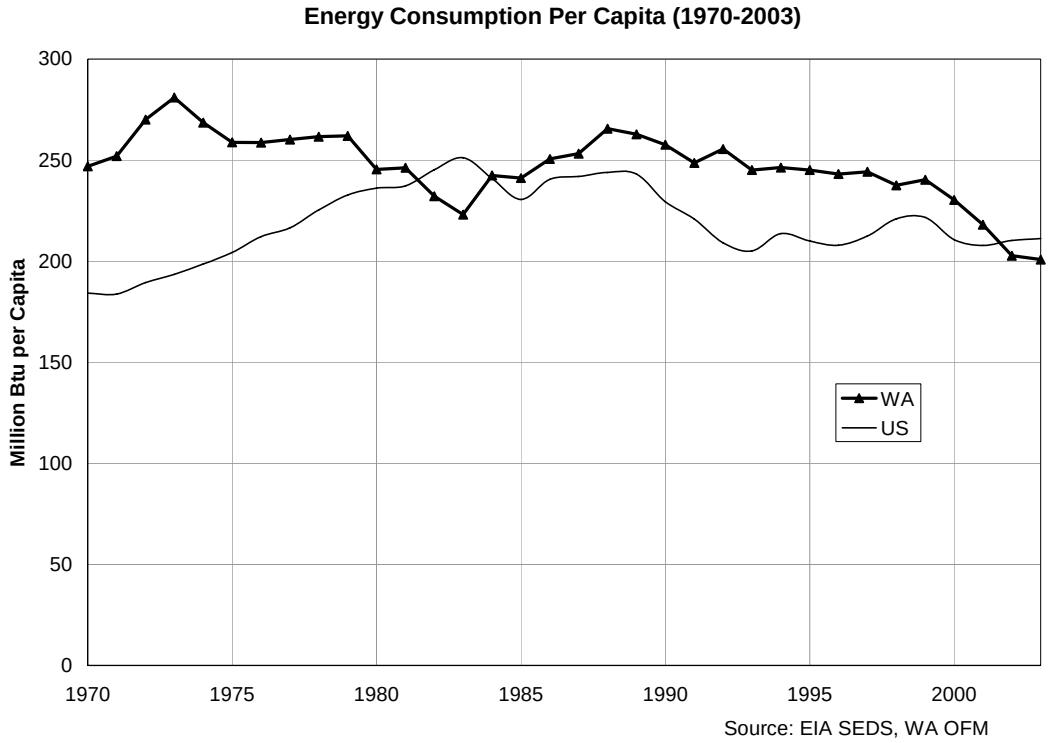
Figure 17 Greenhouse Gas Emission Indicators and Trends (1977-2004)



Energy Intensity Indicators

Washington's per capita energy consumption has stayed fairly close to 250 million Btu during the last 20 years, which is the energy equivalent of about 2000 gallons of gasoline per person per year (Figure 18). This indicates growth in energy use has been similar to growth in population. However, there have been a few notable relative drops in per capita energy consumption from 1973 to 1975, 1979 to 1983, and 1999 to 2002 largely due to economic downturns during these periods. Per capita energy consumption dropped to 200 million Btu in 2002, about 20% lower than the average during the last 20 years. This decline mostly reflects the reduction in industrial energy use from the shut down of aluminum smelters in Washington. Until this decline, Washington's per capita energy consumption has usually been greater than the national average.

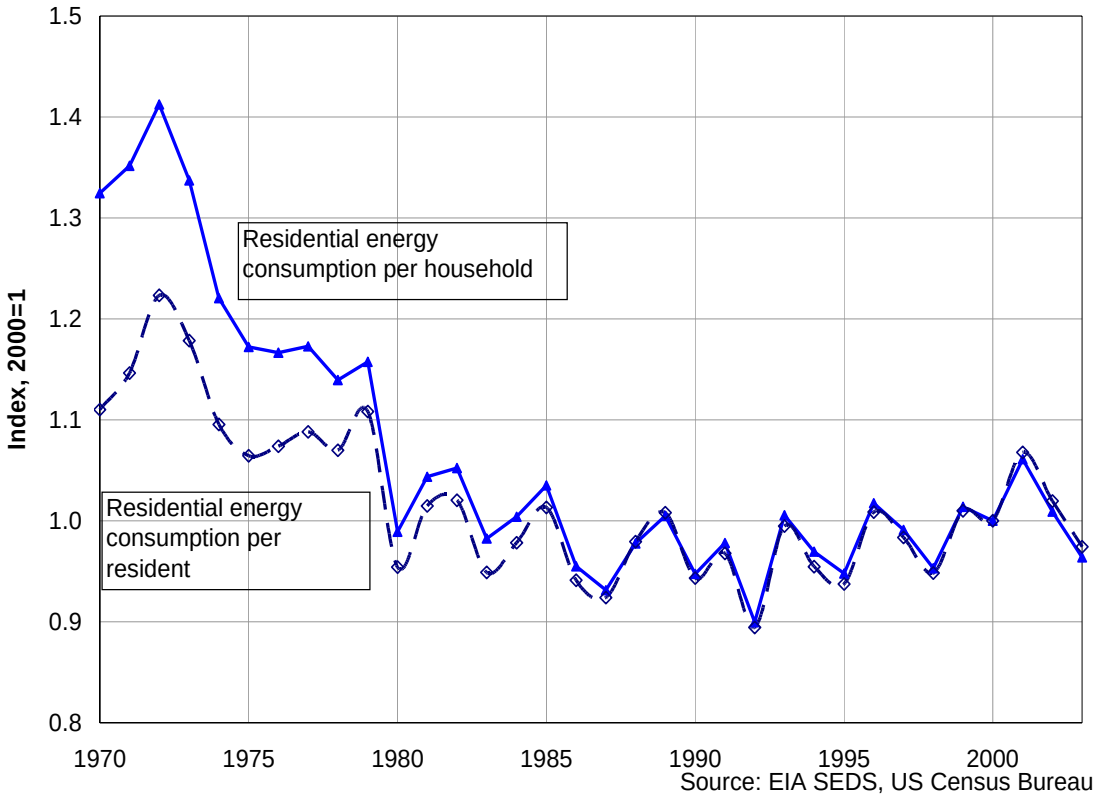
Figure 18 Washington and U.S. End-Use Energy Consumption per Capita (1970-2003)



Washington households became less energy intensive during the 1970s and 1980s as shown in Figure 19. On a per household basis the decline in energy intensity since the early 1970's is striking, but when factoring in the decrease in the number of residents in the average household the energy intensity decline is less pronounced. The long-term decline in household energy intensity was likely due to gains in efficiency (e.g. adding insulation), conservation in response to higher prices, and fuel switching. Concerted efforts to improve residential efficiency in Washington through building standards and codes began in earnest in the mid-80s. However, there is little evidence of further declines in household energy use in the last 15 years. Presumably gains in efficiency due to building standards and codes are being offset by larger homes, more widespread use of air conditioning, and the proliferation of electricity-using appliances, computers, and entertainment systems. Without the codes and standards, household energy use would

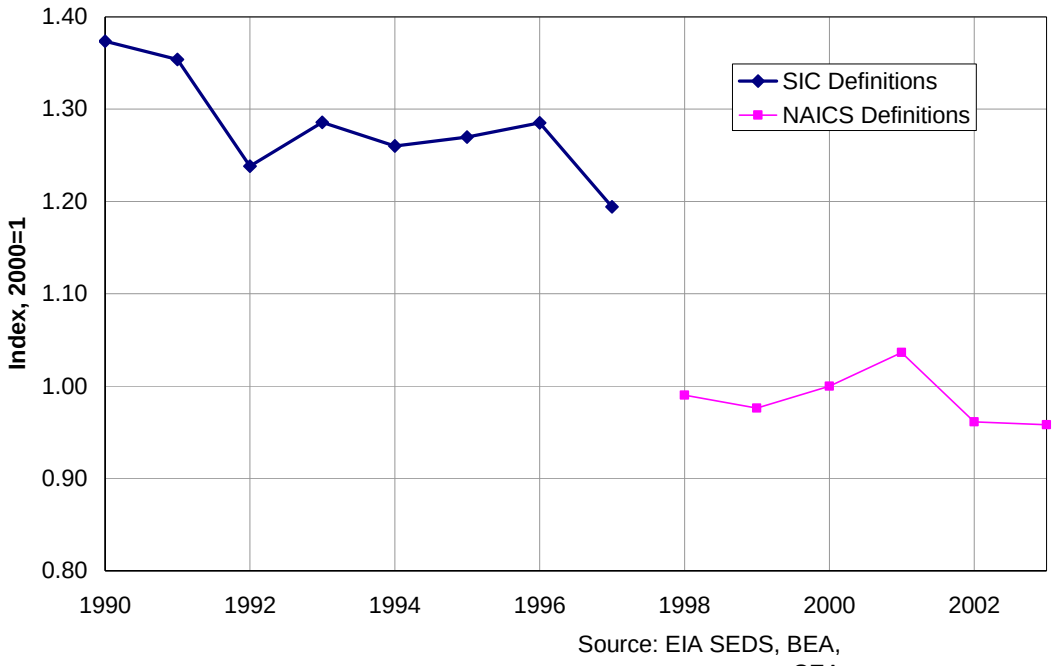
be higher. Note that these data do not include energy used for personal transportation, which has increased markedly during the last fifteen years.

Figure 19 Washington Residential Energy Use per Household and per Resident (excluding transportation energy use) (1970-2003)



Washington's commercial sector became less energy intensive from 1990 to 1997 when commercial sector energy consumption grew only 13% while the value of all goods and services produced by the commercial sector grew 30% (Figure 20). This decline in commercial sector energy intensity can be attributed to growth in the economy, shifts to less energy intensive businesses, increased productivity, and improvements in the efficiency of buildings, lighting, and equipment. Since 1998 commercial sector energy intensity has changed very little.

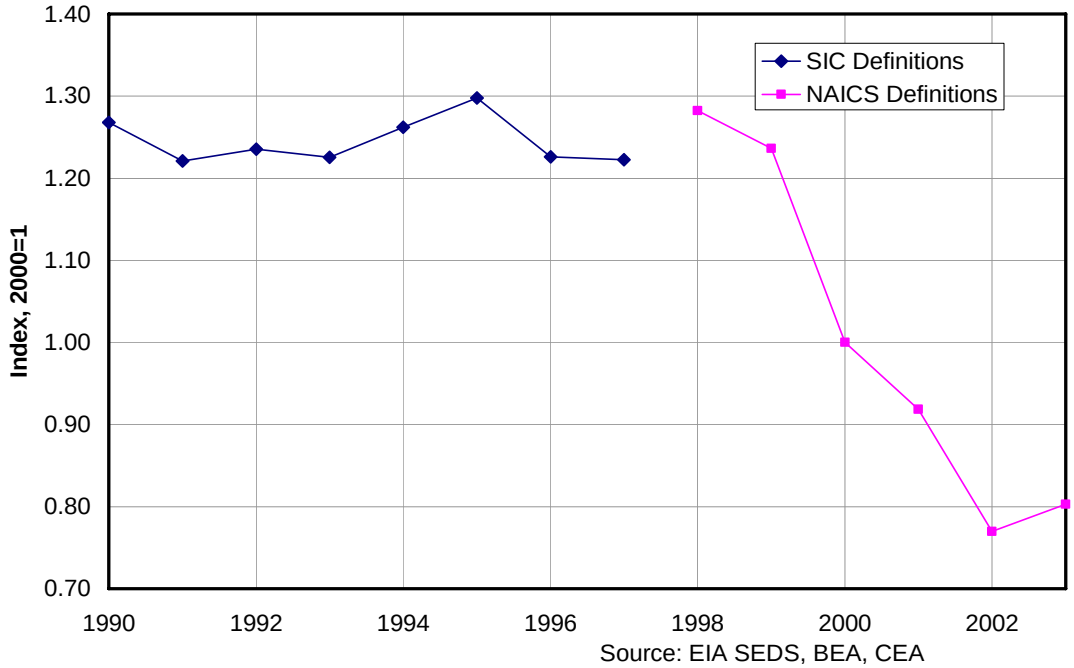
Figure 20 Washington Commercial Sector Energy Use per Commercial Sector Gross State Product (excluding transportation energy use) (1990-2003)



Note: Beginning in 1998 the U.S. Department of Commerce, Bureau of Economic Analysis changed the industrial classification system they use for calculating gross state product, which creates the discontinuity in the chart.

Washington's industrial sector energy intensity was relatively constant during much of the 1990's (Figure 21). However, since 1998 the industrial sector has become significantly less energy intensive. During this period, industrial sector energy use dropped by almost a third while industrial gross state product grew 2 percent. High electricity prices along with low aluminum prices contributed to a significant decline in Washington's aluminum production. Aluminum production is energy intensive (high energy use relative to product value) and relies on low-cost electricity in the production process. At the same time, natural gas prices rose. High energy prices impact energy intensive industries the most and can contribute to declines in production, particularly when it is not possible to switch to a less expensive fuel source. The slight increase in energy intensity in 2003 suggests that some of these industries may be recovering.

Figure 21 Washington Industrial Sector Energy Use per Industrial Sector Gross State Product (excluding transportation energy use) (1990-2003)



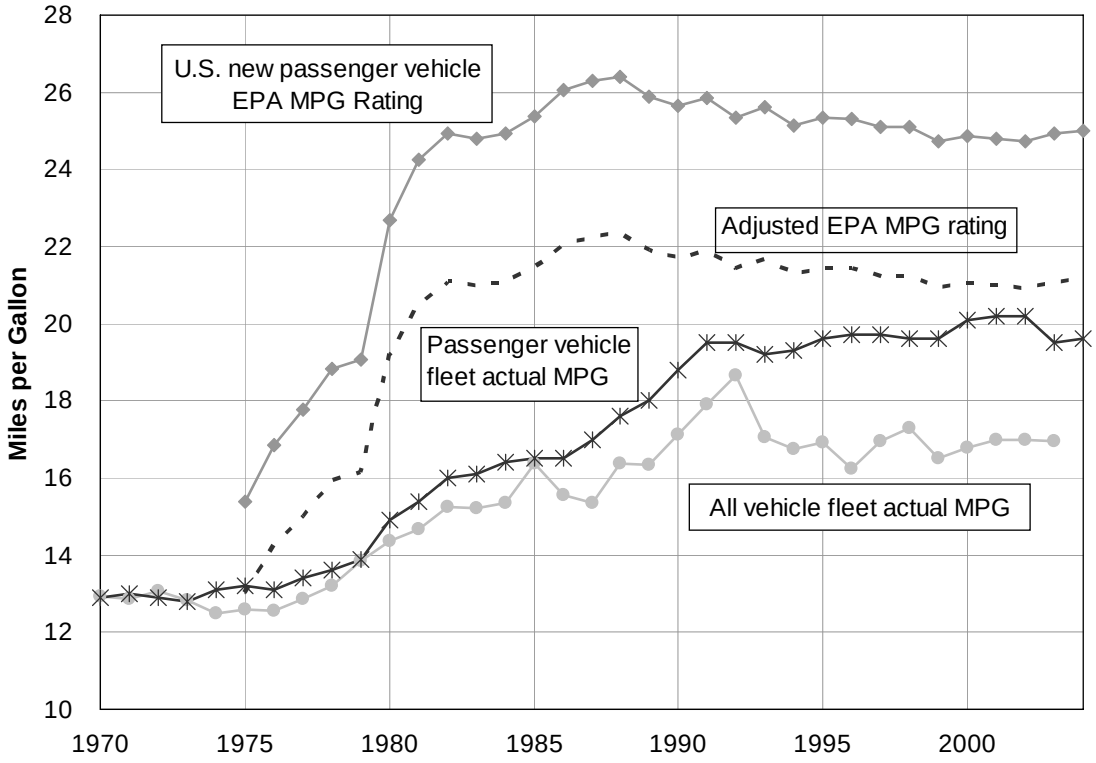
Note: Beginning in 1998 the U.S. Department of Commerce, Bureau of Economic Analysis changed the industrial classification system they use for calculating gross state product, which creates the discontinuity in the chart.

The average efficiency of Washington's vehicle fleet, based on total miles driven divided by fuel use, grew from 12.6 miles per gallon (MPG) in 1975 to 18.7 MPG in 1992. However, since 1992 Washington's vehicle fleet efficiency declined by 1.7 miles per gallon.

Gains in the efficiency of Washington's vehicle fleet through the 1980s were due to the replacement of old vehicles with more efficient models. However, new vehicle fuel efficiency standards have changed little from the mid 1980's, when Congress last increased Corporate Average Fuel Economy (CAFE) standards[5]. It is important to note that the actual on-road fuel efficiency of new vehicles is less than the EPA-rated fuel efficiency value shown in the figure: compare adjusted EPA MPG with on-road passenger vehicle fuel efficiency. The all vehicle fuel efficiency line includes heavy trucks, which dramatically lowers the fuel efficiency of the entire vehicle fleet. Figure 22 suggests that the actual on-road efficiency of new cars and trucks purchased in Washington for the last ten years was not better than the existing vehicle fleet.

[5] CAFE standards require automakers to maintain the average fuel efficiency of new vehicles at 27.5 MPG for cars and at a new increased level for 2007 of 22.2 MPG for light trucks (which includes minivans, pickups, and sport-utility vehicles). Light trucks with gross vehicle weights greater than 8,500 lb are not required to meet CAFE requirements. CAFE has no mandates about how many vehicles may be sold in each category, and the increasing popularity of light trucks has caused the fuel efficiency of the average new vehicle to drop by almost two miles per gallon since 1988.

Figure 22 Average Efficiency of Highway Travel in Washington



Implications of Washington's Energy Trends

There are several key conclusions that follow from the preceding data.

- Energy demand in Washington declined from 1999 to 2002, mostly as a result of the closure of electric intensive industrial plants (primarily aluminum smelters). However, recent data suggest this was a short-term decline and that electricity and other energy consumption may be growing again. Although it is too early to determine for certain, long-term high petroleum prices may moderate some this growth trend through increase purchases of more fuel efficient vehicles and changes in travel patterns. Nonetheless, the overall renewed growth in energy demand will have implications for energy supply, price, environmental impacts, and infrastructure needs.

- Energy prices in Washington, like other parts of the U.S., have gone up significantly in the last several years. Natural gas prices have increased the most and recent data suggest prices will stay high. While electricity prices seem to have stabilized and gasoline and diesel prices have recently declined, our experience in the last five years has shown that any interruption in supply or increase in demand can cause prices to increase in tight energy markets. The State should continue to develop policies that address the risk of exposure to higher, more volatile energy prices need to be considered. In particular, these should include efforts to capture all cost effective energy conservation opportunities for all fuels, to defend the state's recently adopted California vehicle emissions standards, and to expand support for and development of in-state energy resources.

- While energy use per capita in Washington has declined in the last several years, this is largely due to the closure of electric intensive aluminum smelters. The energy intensity of the industrial sector (dollars of industrial state product per energy consumption) has improved significantly. However there has been no reduction in the energy use of Washington households or improvement in the efficiency of Washington's vehicle fleet in the last ten to fifteen years. While energy policies to improve energy efficiency in homes and buildings have helped reduce growth in energy demand, it is clear that more aggressive action is needed to overcome other societal trends that push energy use higher (for example larger homes, demand for trucks and SUVs, increases in the type and number of new energy using products). This is particularly true for the transportation sector, which accounts for the largest share of energy use in Washington.

- The mix of sources used to generate the electricity consumed in Washington has changed very little in the last six years. Hydroelectricity accounts for two-thirds, followed by coal and natural gas-fired generation, and nuclear power. Washington's dependence on hydroelectricity was clear during 2001 when drought conditions limited production and wholesale electricity prices increased dramatically. Other renewable electricity sources account for less than 2 percent of production. While wind generation increased from zero to over 400 MWh in 2005, this is still only one half of a percent of total electricity use in Washington. The recent passage Initiative 937 energy portfolio standard requirements will encourage more electricity generation from renewable sources as well as ensure that the state's major utilities maintain a long term commitment to cost-effective electricity efficiency. CTED and other state agencies need to ensure that the provisions of I-937 are effectively implemented.

- Energy consumption accounts for 85 percent of the greenhouse gas emissions in Washington. Except for several brief declines greenhouse gas emissions have grown steadily over the last 25 years and in 2004 were 14 percent greater than in 1990. The majority of greenhouse gas emissions occur in the transportation sector followed by the electric power sector. Over the last two year, the state has adopted a number of major climate friendly policies – California vehicle emissions standards, "green" public buildings requirements, appliance efficiency standards, biofuels content standards, etc. The state should continue to look toward additional policies that reduce greenhouse gas emissions, offer economic development opportunities, and, in particular, address transportation emissions.

Regional, national, and international growth in energy consumption has eliminated much of the surplus energy supply in markets and this has led to higher, more volatile energy prices. While higher prices will encourage development of new sources and make energy efficiency improvements more cost-cost effective, energy markets are likely to remain volatile. There is growing awareness of the implications of greenhouse gas emissions on our climate and our quality of life. Energy consumption accounts for most of the greenhouse gas emissions in Washington. While the closure of aluminum smelters and other energy intensive industries led to a reduction in energy consumption in Washington from 1999 to 2002 and a significant decline in the energy intensity of the industrial sector, the energy intensity of the other sectors (residential, commercial, transportation) has not declined. These trends suggest that continued attention must be given to energy policies that reduce the risk to Washington consumers of higher energy prices, supply disruptions, and the environmental consequences of energy consumption.