

Section 5: Energy Indicators

Introduction

Energy is a critical component of every aspect of Washington's economy and is used daily by every resident of the state. Energy lights and heats our homes, cooks our food, fuels our vehicles, and powers our industries. We have developed a series of 23 “Energy Indicators” to illustrate some of the most important long-term energy trends in Washington. For each indicator there is a chart illustrating the trend, a table with the energy data, narrative giving additional perspective or describing further aspects of the indicator, data sources for the indicator, and links to other related information.

The Energy Indicators were first published in 1999 as part of the 1999 Biennial Energy Report. They began as a successor to the Washington State Energy Use Profile, which was published last in June 1996 by the Washington State Energy Office.

In order to ensure that the Energy Indicators presented here are grounded in the best available information and can be updated on a regular basis, they are based as much as possible on regularly published data from sources in the public domain. The U.S. Energy Information Administration (EIA) has the most complete sources of annual, state-level energy data (www.eia.doe.gov). Our principal source is the EIA’s Combined State Energy Data System (SEDS). Some other sources include the US Bureau of Economic Analysis (US BEA), the US Census Bureau, the President’s Council of Economic Advisors (CEA), the Washington State Office of Financial Management (WA OFM), Federal Highway Administration (FHWA), Oak Ridge National Laboratory Center for Transportation Analysis (ORNL), and the Washington State Fuel Mix Database. The sources are listed with each indicator.

Collecting and publishing detailed statistics on energy consumption, price, and expenditures for 50 states and the District of Columbia is a large task involving analysis and compilation of fuel- and sector-specific data. Thus comprehensive state information from EIA lags the current year by two to three years. Consequently, the Energy Indicators are confined to analysis of long-term energy trends. Data for most of the Energy Indicators runs from 1970 to 2005. A few are one-year snapshots. Links to more current data are included for those Energy Indicators where this information is available.

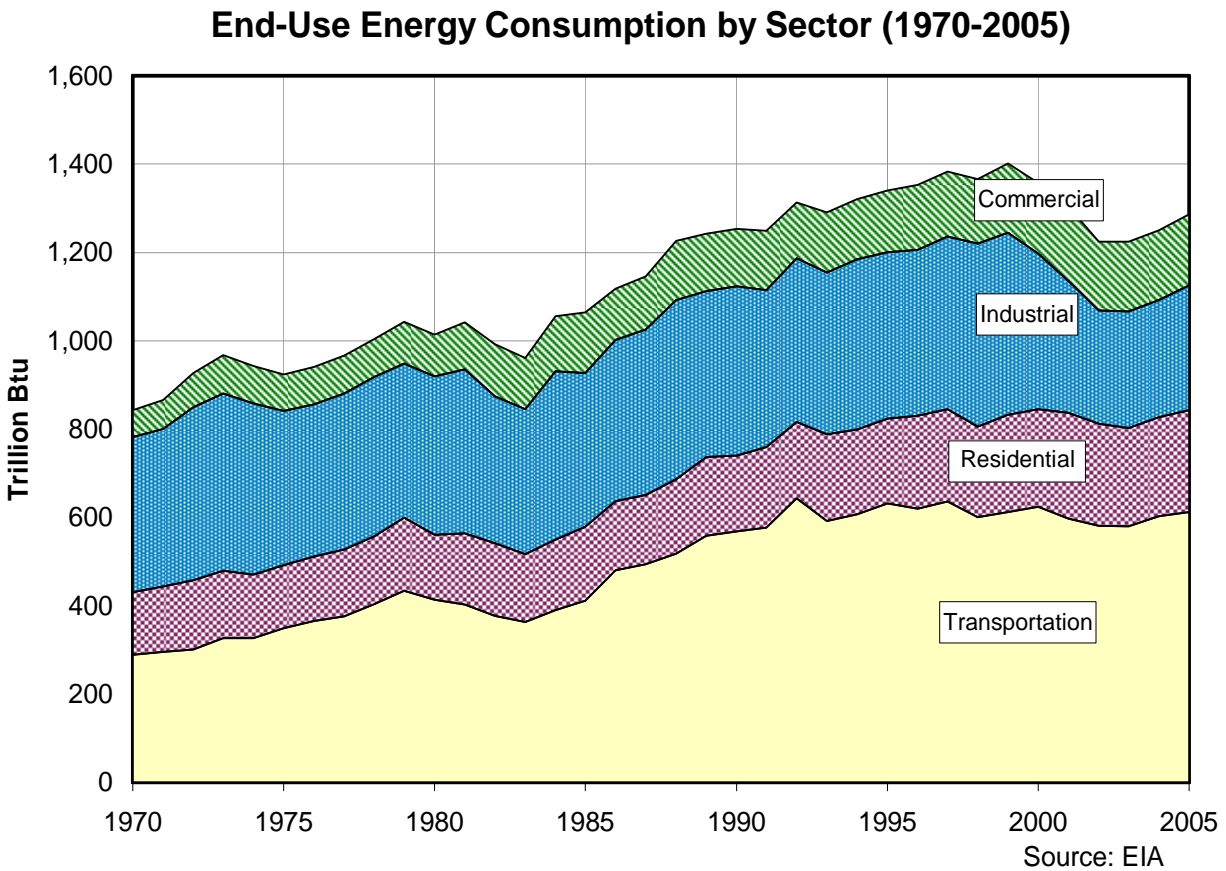
In light of the volatility of energy prices that has characterized the market over the past three years, monthly data for certain sectors and energy sources has been obtained from the EIA and is reported in this Biennial Energy Report. The data is a separate series from the annual EIA data series used for the Energy Indicators.

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Washington's End-Use Energy Consumption by Sector

End-use energy consumption in Washington was 66 percent higher in 1999, at its peak, than in 1970. Most of the increase occurred in the transportation sector, where energy use more than doubled. Since 1999, end-use energy consumption has declined due to a significant drop in industrial energy use and no growth in transportation, residential, and commercial energy use.



Washington's end-use energy consumption grew at an average rate of 1.8 percent per year between 1970 and 1999. Consumption reached an all-time high of 1.4 quadrillion British thermal unit (Btu) in 1999 before declining 13 percent by 2002 due to a drop in industrial energy consumption.

During the 1970s and early 1980s, growth in energy consumption was dampened by higher energy prices and changes in the state's economy, but grew fairly steadily between 1983 and 1999, in part due to relatively modest energy prices. The transportation sector accounted for the largest share of growth in energy consumption during this period, growing at an annual rate of 3.3 percent. Energy consumption in the commercial sector, which includes service industries such as software, finances, and insurance, has grown steadily over the years. Between 1970 and 2000 commercial sector energy use grew at a 3.3 percent rate, but total consumption is smaller than the other sectors. Residential sector energy use has also grown steadily over the years, but at a more modest 1.6 percent from 1970 to 2000. Although there was some year-to-year variation, industrial sector energy consumption showed no growth between 1970 and 2000.

In 2005 Washington's energy use was 8 percent less than the 1999 peak. Industrial sector

consumption declined 38 percent from 1999 to 2002. This reflected changes in the state's economy and in recent years the decline of the aluminum industry. While there was a slight increase in industrial energy consumption since 2002, 2005 consumption is still much lower than in 1999. Energy consumption in the residential, commercial, and transportation sectors in 2005 was similar to 1999 levels, so the decline in Washington's energy use was due to the industrial sector.

The transportation sector accounted for 48 percent of the energy use in Washington in 2005. The industrial sector accounted for 22 percent of consumption, followed by the residential sector at 18 percent and commercial at 13 percent. The industrial share has declined since 1970, when it accounted for 42 percent of Washington's energy consumption.

Source: Energy Information Administration's State Energy Data System

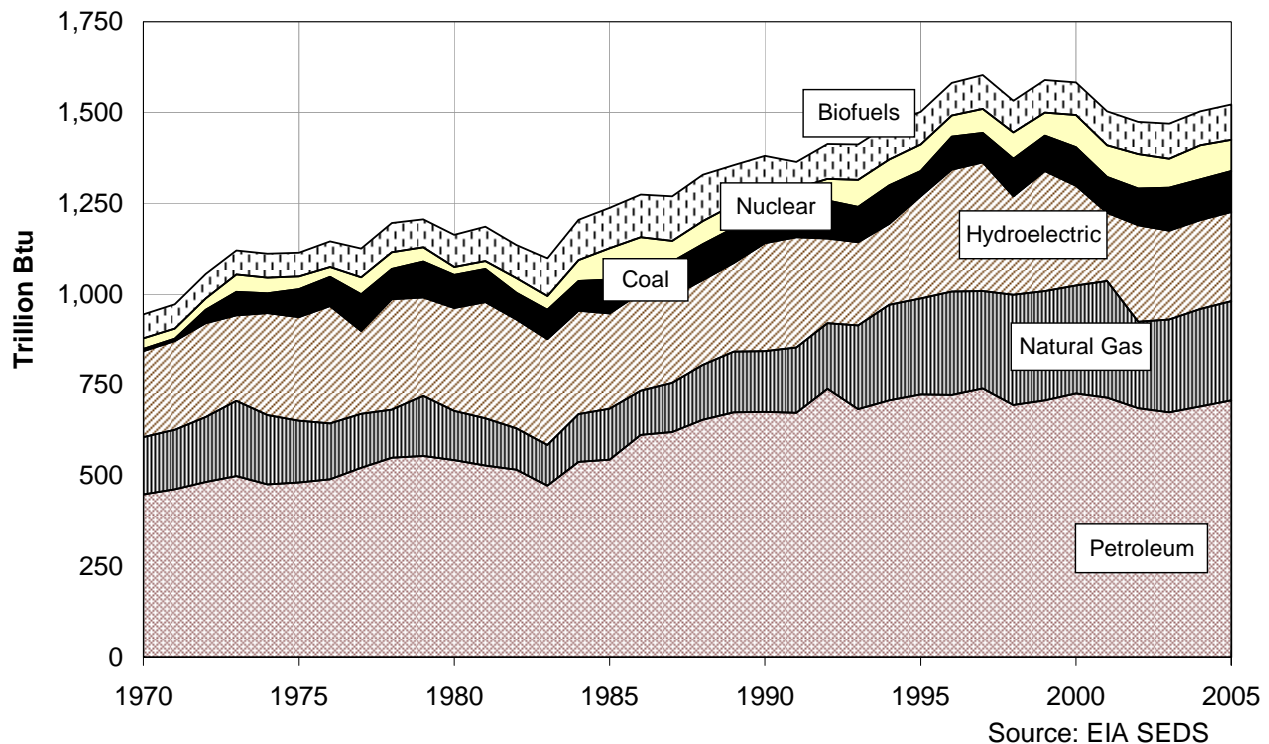
Links: EIA State Energy Data System, http://www.eia.doe.gov/emeu/states/_seds.html. In some cases, values downloaded from the SEDS system will not match the numbers in this report which are adjusted.

End-Use Energy Consumption by Sector					
Units: Billion Btu					
Year	Total	Residential	Commercial	Industrial	Transportation
1970	842,713	142,046	61,386	350,501	288,780
1971	865,967	147,652	65,580	356,911	295,824
1972	926,291	157,289	76,445	392,063	300,494
1973	967,467	152,146	86,992	401,743	326,586
1974	942,354	144,088	84,404	387,242	326,620
1975	923,420	142,347	82,660	349,088	349,325
1976	940,193	146,315	84,511	344,274	365,093
1977	966,520	151,535	86,140	353,408	375,438
1978	1,003,595	153,851	85,786	360,656	403,302
1979	1,042,258	165,308	93,967	348,969	434,013
1980	1,014,036	147,807	94,677	358,494	413,058
1981	1,041,208	160,856	105,430	372,338	402,584
1982	992,541	163,580	117,942	333,832	377,186
1983	960,639	153,198	115,993	328,033	363,415
1984	1,055,531	159,672	124,384	381,827	389,648
1985	1,064,529	167,725	138,234	347,348	411,222
1986	1,118,071	157,430	116,487	364,384	479,771
1987	1,146,080	156,794	120,730	374,414	494,142
1988	1,225,978	169,482	133,469	405,934	517,093
1989	1,242,476	178,654	130,153	375,532	558,137
1990	1,253,559	172,065	129,943	383,866	567,685
1991	1,248,553	182,160	133,499	356,166	576,728
1992	1,313,673	172,377	127,036	371,064	643,195
1993	1,290,807	196,360	135,990	366,991	591,465
1994	1,321,074	191,959	137,009	384,908	607,198
1995	1,340,665	192,192	140,065	377,362	631,046
1996	1,353,522	210,521	147,679	375,445	619,877
1997	1,382,938	208,820	147,486	390,805	635,827
1998	1,365,954	204,391	146,600	414,388	600,575
1999	1,401,138	220,721	157,106	411,285	612,026
2000	1,357,425	220,952	160,496	352,204	623,773
2001	1,303,277	239,129	168,010	299,261	596,877
2002	1,224,557	230,901	156,121	256,145	581,390
2003	1,224,678	222,698	158,512	263,799	579,669
2004	1,249,819	224,283	157,988	265,299	602,249
2005	1,285,917	230,867	160,889	282,497	611,664

Washington's Primary Energy Consumption by Source

Washington continues to rely on petroleum fuels for about half of its primary energy use. The relative contribution of hydroelectricity as an energy source has declined from about 25 percent of Washington's energy use for much of the '70s and early '80s to 16 percent the last several years.

Total Primary Energy Consumption by Source (1970-2005)



This indicator shows the extent of Washington's reliance on six major primary⁸ energy sources: petroleum, hydroelectricity, natural gas, biofuels, coal, and uranium (nuclear)⁹. Washington continues to rely on petroleum, much of which is imported by tanker from Alaska, to meet 46 percent (in 2005) of its primary energy needs. The petroleum share of primary energy use has not changed appreciably – in 1965 it was 50 percent. Fossil fuels (petroleum, coal, and natural gas) accounted for 72 percent of primary energy use in 2005.

Hydroelectricity has been a key energy source in Washington for many years. It is important to recognize that total generation from hydroelectric dams varies depending on river flows. Generation in 2001 dropped to its lowest level in 35 years, 32 percent lower than the average for the last 30 years. This compares to the peak year in 1997 when generation was 29 percent greater than the

⁶ The difference between primary and end-use energy consumption is the treatment of electricity (other fuels such as natural gas, petroleum, and coal are primary energy sources). Electricity must be generated using energy sources such as coal, natural gas, or falling water. These inputs to the power plant are counted as primary energy; the output of the power plant that is consumed by homes and businesses is end-use electricity. Since over half of the energy inputs to thermal power plants are typically lost as waste heat, primary energy consumption is larger than end-use. Note that some of the primary energy used to produce electricity in Washington may be for electricity used in other states. Washington typically generates more electricity than is consumed in the state (see Indicator #3).

⁹ Several other renewable energy sources: geothermal, wind, and solar, account for less than 1 percent of primary energy consumption.

average. By 2001 consumption of natural gas had more than doubled, regaining the market share it lost during the 1970s. Natural gas consumption has declined a little since 2001, but accounted for nearly 18 percent of Washington's primary energy consumption in 2005.

Biofuels, mainly wood and wood waste products, accounted for a little more than 6 percent of primary energy consumption in 2005. This share has declined some from the 1980s. These fuels are primarily burned for cogeneration and steam and at pulp and paper mills. Coal is consumed almost exclusively at the Centralia Steam Plant, while uranium is used at Energy Northwest's Columbia Generating Station in Richland. Together, fuel use at coal and nuclear generation plants accounted for 13 percent of Washington's primary energy consumption in 2005.

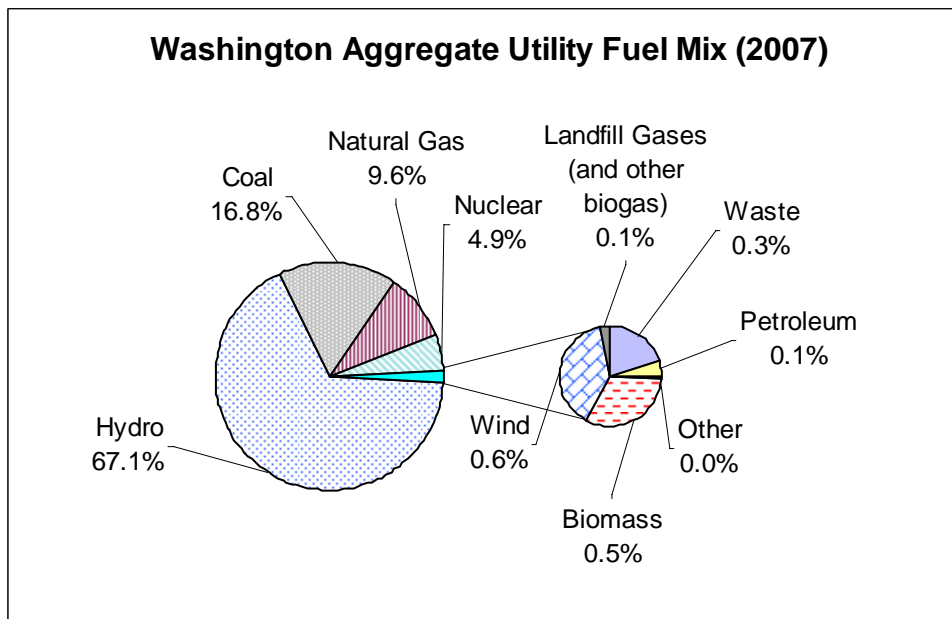
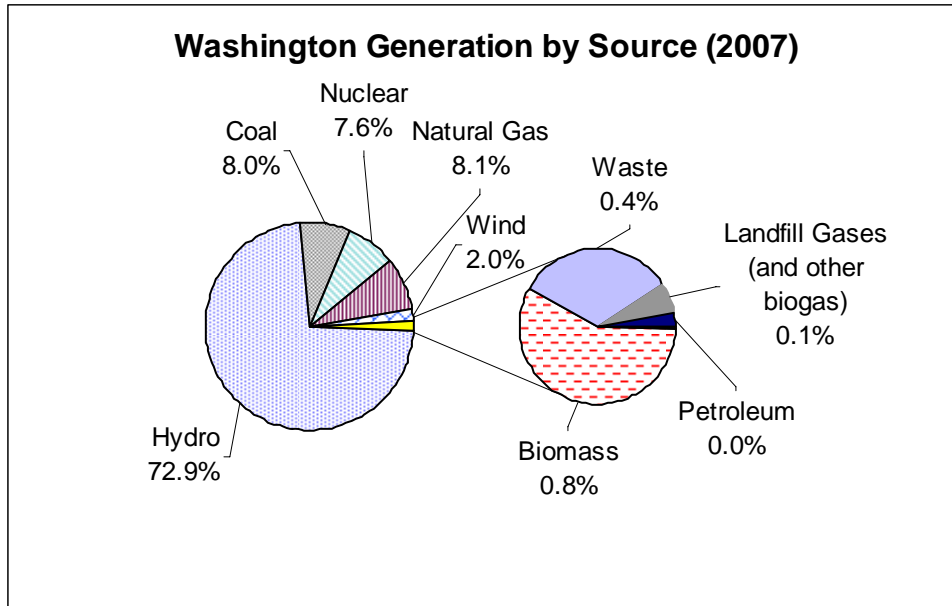
Sources: Energy Information Administration's State Energy Data System

Links: See Section 4 of the 2003 Biennial Energy Report for more information on electricity generation in Washington (particularly items 1, 2, 3, and 14). Located on the Washington Energy Policy website at: http://www.cted.wa.gov/CTED/documents/ID_1694_Publications.pdf. Also see Indicator #3. See the EIA State Energy Data System, <http://www.eia.doe.gov/emeu/states/seds.html>. In some cases, values downloaded from the SEDS system will not match the numbers in this report which are adjusted.

Primary Energy Consumption by Source						
Units: Billion Btu						
Year	BioMass	Coal	Hydro	Nuclear	Natural Gas	Petrol
1970	66,521	5,860	236,762	28,693	158,242	448,259
1971	67,168	6,396	243,721	27,667	165,279	461,308
1972	66,974	36,581	258,345	31,500	179,823	481,840
1973	66,238	64,974	234,938	48,321	207,952	498,035
1974	65,173	54,167	280,853	43,409	191,311	475,627
1975	64,299	76,241	284,993	36,432	171,236	480,672
1976	71,386	81,205	321,717	26,568	154,881	489,657
1977	78,315	102,385	226,797	46,468	149,077	521,924
1978	81,043	84,724	302,847	45,301	133,338	548,929
1979	77,454	99,003	270,831	39,301	165,950	553,810
1980	88,268	90,956	283,135	22,269	135,466	542,939
1981	94,936	90,872	319,268	22,523	131,189	527,374
1982	91,115	74,069	298,809	40,206	114,412	516,293
1983	104,442	80,210	291,504	38,098	111,802	472,539
1984	110,326	82,282	284,224	57,614	131,970	537,613
1985	112,047	93,669	262,462	85,377	139,983	544,184
1986	117,727	63,279	268,971	89,276	121,793	612,720
1987	122,457	95,700	237,809	57,728	136,092	619,471
1988	127,395	99,099	233,309	63,616	150,595	654,762
1989	108,226	96,650	243,288	64,745	167,988	673,834
1990	93,429	85,575	297,501	60,762	167,616	675,297
1991	73,889	89,085	303,942	44,346	179,395	673,781
1992	95,374	106,087	232,378	59,605	180,769	738,971
1993	96,463	97,804	229,001	74,946	229,616	683,828
1994	96,294	106,884	222,995	70,444	263,176	707,072
1995	90,131	69,790	280,535	72,938	264,474	723,885
1996	89,664	90,901	335,270	58,691	283,909	723,069
1997	94,158	80,465	354,420	65,526	268,141	740,804
1998	87,123	103,476	271,515	72,556	303,307	694,672
*1999	89,417	96,875	329,911	63,598	302,262	706,714
2000	89,553	106,240	273,508	89,744	297,569	726,674
2001	94,282	99,441	186,548	86,200	322,413	714,427
2002	89,129	100,832	266,098	94,457	238,157	685,789
2003	97,109	118,207	244,647	79,353	255,090	675,014
2004	94,265	112,539	243,961	93,651	268,522	690,570
2005	98,128	112,284	245,742	85,893	272,697	707,619

Washington's Electricity Generation and Consumption by Fuel

More than two-thirds of the electricity generated and consumed in Washington in 2007 was produced from hydroelectric dams. Coal, natural gas, and nuclear were the primary energy sources for the remainder. Wind accounted for 2 percent of the electricity generated in Washington and non-hydro renewable sources (including wind) accounted for a little more than 3 percent.



There are two ways to look at the energy sources for electricity in Washington. One way is to consider the sources for electricity generated in Washington. Electricity generated from hydroelectric dams accounted for 73 percent of the electricity generated in the state in 2007 while coal, natural gas, and nuclear accounted for most of the remainder. Electricity generated from non-hydro renewable sources has been growing. Winds share has grown from nothing in 2000 to 2 percent in 2007 and the

total share for biomass, wind, waste, and landfill gas was 3.3 percent of the total generation. In 2007 power plants in Washington generated 21 percent more electricity than consumed in the state.

Another approach and perhaps better estimate for "Washington's electricity sources" is the mix of generation purchased by utilities to serve customers in Washington State. Washington is part of an interconnected, regional bulk power system and utilities purchase electricity generated from a variety of sources throughout the region. The data for estimating the sources of electricity consumed in Washington is collected for the Washington State Fuel Mix Disclosure Project and includes utility spot market purchases. Hydroelectricity was still the dominant source, accounting for 67 percent of the electricity consumed in the state in 2007. Electricity generated from coal accounted for 17 percent of the electricity used by Washington consumers, which is larger than the generation share. This reflects the electricity purchased by some utilities from coal fired power plants located in other states like Wyoming. Renewable sources besides hydro accounted for one and a half percent of the electricity purchased by utilities for use by Washington consumers. This was less than the generation share, suggesting that some of the renewable energy generated in Washington was sold to customers outside the state.

Source: Washington State Fuel Mix Disclosure Database, Energy Policy Division, Washington State Department of Community Trade and Economic Development

Links: See the fuel mix disclosure link on the Washington Energy Policy website at: <http://www.cted.wa.gov/site/539/default.aspx>

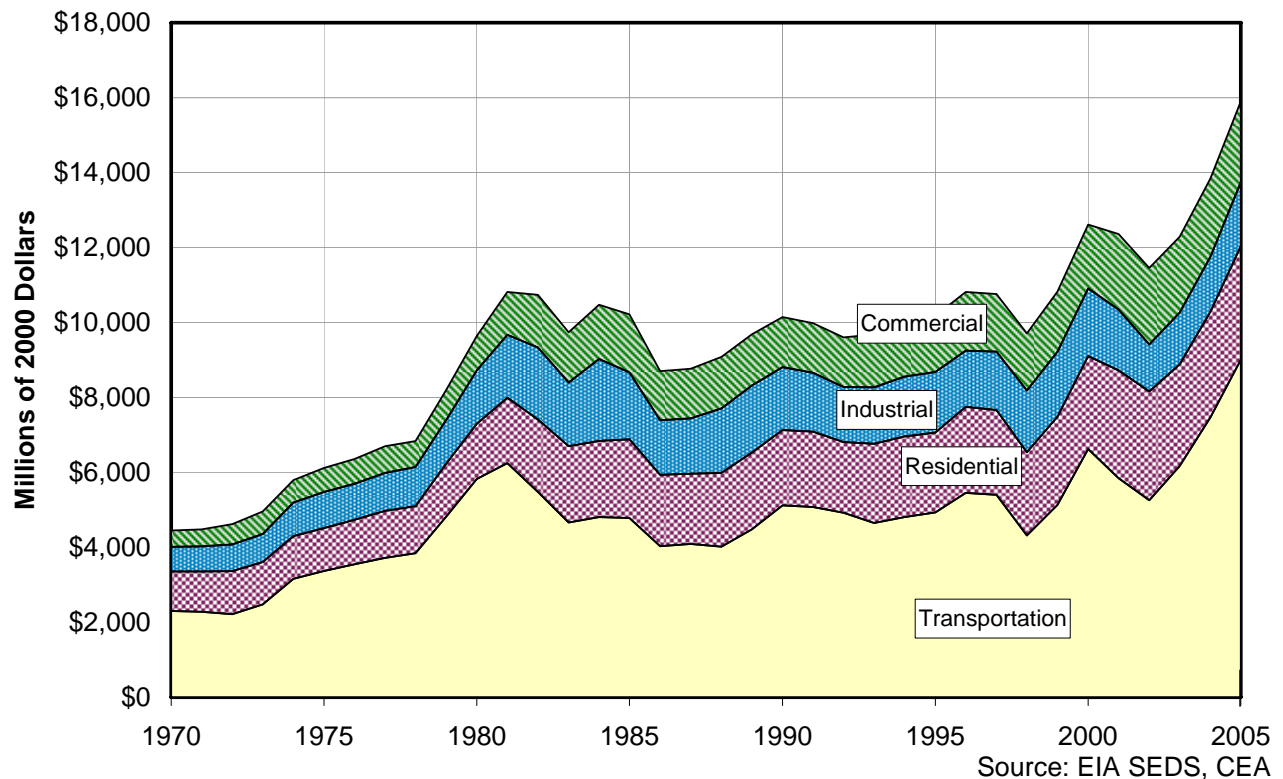
Electricity Generation by Fuel Type (2007)		
Generation by Washington Based Plants		
Fuel	MWh	Percent
Hydro	77,944,210	72.9%
Natural Gas	8,668,528	8.1%
Coal	8,576,978	8.0%
Nuclear	8,108,560	7.6%
Wind	2,170,291	2.0%
Biomass	803,221	0.8%
Waste	460,711	0.4%
Landfill Gases (and other biogas)	91,509	0.1%
Petroleum	37,684	0.0%
Other	7,107	0.0%
Total	106,868,799	100.0%

Washington Aggregate Utility Fuel Mix (2007)		
Fuel	MWh	Percent
Hydro	59,203,647	67.1%
Coal	14,866,637	16.8%
Natural Gas	8,459,744	9.6%
Nuclear	4,326,265	4.9%
Wind	545,622	0.6%
Biomass	460,983	0.5%
Waste	288,528	0.3%
Landfill Gases (and other biogas)	49,041	0.1%
Petroleum	69,267	0.1%
Other	12,923	0.0%
Geothermal	11,189	0.0%
Total	88,293,845	100%

Washington's End Use Energy Expenditures by Sector

While expenditures grew rapidly in the 1970s, during much of the 1980s and '90s inflation-adjusted¹⁰ energy expenditures in Washington declined or grew modestly despite significant growth in energy consumption. This trend changed in 1999. Energy expenditures have grown by more than 50 percent since 1998.

End-Use Energy Expenditures by Sector (1970-2005)



Washingtonians spent almost \$16 billion on energy in 2005. After peaking in the early 1980s, inflation-adjusted energy expenditures declined and then increased modestly until 1998. During this period energy prices did not keep pace with inflation. As a result expenditures remained relatively stable despite significant growth in energy consumption. This situation changed in 1999. Except for a brief respite in 2001 and 2002, energy expenditures have increased significantly, growing at an average annual rate of 7 percent from 1998 to 2005. This increase was due to higher energy prices, since energy consumption declined during this period. Most of the increase was due to growing transportation sector energy expenditures. Expenditures also increased for the commercial and residential sectors, but were more modest for the industrial sector.

The transportation sector accounts for the largest share of energy expenditures, 57 percent in 2005. This proportion has grown in recent years, reflecting the increase in the real price of petroleum fuels.

¹⁰ Energy prices are shown in real dollars. The actual (or nominal) prices in each year have been adjusted to constant dollars reflecting the value of a dollar in the year 2000. This is done by multiplying the nominal prices by a gross domestic purchases index for the U.S. for each year (where the value in 2000 equals 1). This adjusts for the effects of inflation and allows prices for different years to be compared.

The industrial share of expenditures has declined significantly in the last seven years, while the residential and commercial shares declined modestly.

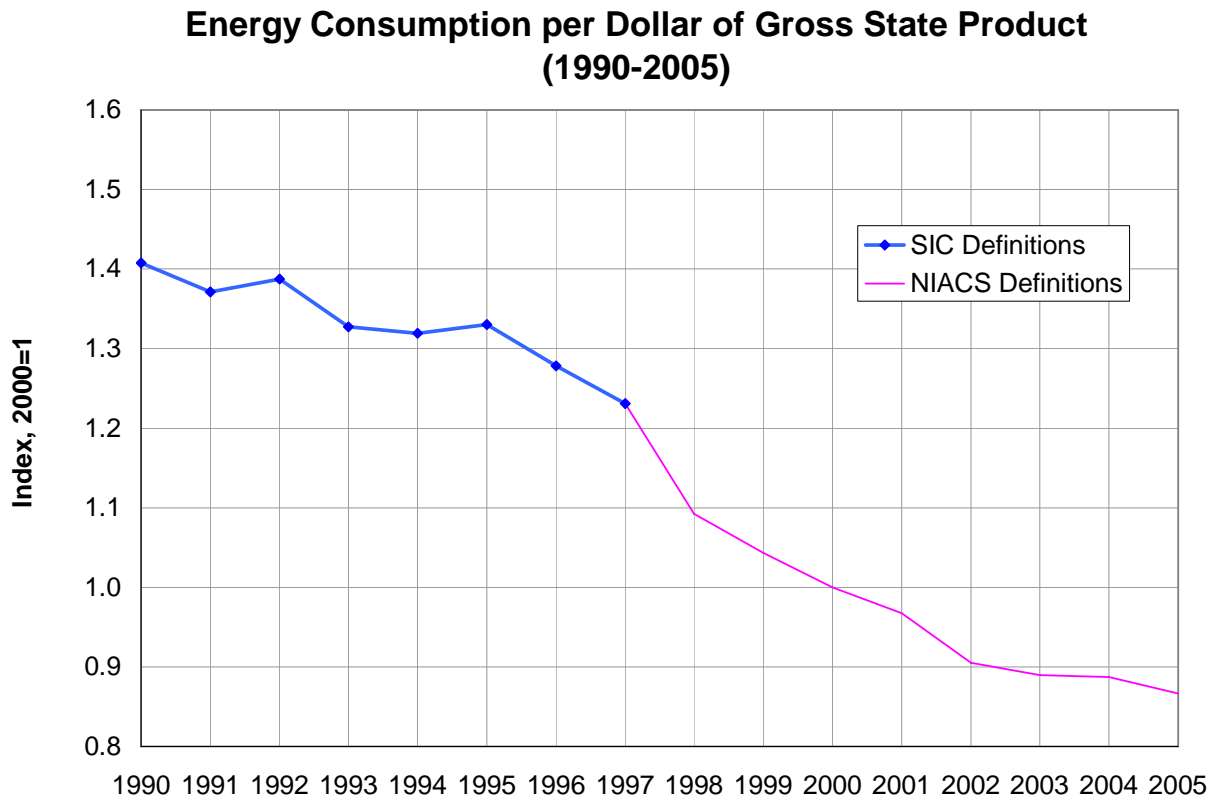
Sources: Energy Information Administration's State Energy Data System, President's Council of Economic Advisors - 2005 Annual Economic Report of the President

Links: EIA State Energy Data System, http://www.eia.doe.gov/emeu/states/_seds.html. In some cases, values downloaded from the SEDS system will not match the numbers in this report which are adjusted.

End-Use Energy Expenditures by Sector				
Units: millions of 2000 dollars				
Year	Commercial	Industrial	Residential	Transportation
1970	432.51	655.84	1,050.91	2,305.39
1971	450.82	666.85	1,075.64	2,281.12
1972	543.23	717.26	1,143.46	2,216.46
1973	595.97	747.27	1,137.33	2,472.59
1974	601.42	894.64	1,140.62	3,159.79
1975	642.08	964.87	1,145.39	3,365.59
1976	664.99	963.61	1,185.58	3,545.80
1977	715.53	1,011.89	1,255.72	3,715.99
1978	690.61	1,049.14	1,252.19	3,841.18
1979	800.45	1,163.83	1,414.91	4,820.24
1980	918.57	1,429.64	1,466.73	5,825.30
1981	1,143.01	1,678.97	1,744.50	6,248.34
1982	1,400.34	1,925.21	1,933.82	5,477.53
1983	1,342.83	1,693.30	2,043.94	4,658.12
1984	1,447.32	2,185.75	2,033.63	4,806.57
1985	1,552.42	1,777.25	2,102.95	4,783.33
1986	1,310.72	1,454.95	1,904.99	4,029.60
1987	1,319.06	1,480.07	1,870.48	4,092.22
1988	1,379.67	1,722.68	1,966.25	4,016.67
1989	1,364.01	1,784.67	2,054.47	4,476.94
1990	1,336.62	1,676.56	2,009.43	5,122.45
1991	1,324.73	1,573.38	2,007.73	5,077.82
1992	1,318.27	1,474.31	1,885.92	4,921.99
1993	1,405.09	1,510.77	2,110.50	4,648.28
1994	1,468.15	1,597.01	2,149.95	4,810.04
1995	1,498.25	1,614.60	2,134.18	4,927.27
1996	1,568.73	1,497.60	2,297.32	5,451.70
1997	1,536.99	1,559.00	2,265.06	5,398.83
1998	1,522.43	1,649.28	2,217.64	4,316.20
1999	1,606.84	1,730.73	2,353.51	5,131.19
2000	1,702.86	1,808.52	2,475.98	6,623.37
2001	2,012.35	1,624.11	2,880.53	5,840.14
2002	2,042.99	1,253.90	2,905.19	5,252.06
2003	2,017.30	1,380.98	2,719.40	6,166.24
2004	2,090.71	1,464.18	2,818.21	7,467.62
2005	2,154.79	1,708.21	3,032.30	9,003.88

Washington's Energy Consumption per Dollar of Gross State Product

Washington continues to produce more real value in goods and services per unit of energy consumed. Key reasons are a shift in the state's economy to high-value businesses that are less energy-intensive and improved energy efficiency.



Source: EIA SEDS, US BEA, CEA

This measure of the overall energy intensity of Washington's economy depicts the amount of energy we use to produce a dollar's worth of economic output¹¹. In the last 15 years energy consumption per dollar of GSP declined approximately 35 percent¹².

Washington's economy is growing faster than its energy consumption. This is due to a number of factors, chief among them is growth in the state's economic output and a shift from resource and manufacturing industries to commercial activity based on software, biotech, and other less energy intensive businesses. This trend will likely continue with the decline in production of the energy intensive aluminum industry. Gains in energy efficiency have also contributed to the reduction in Washington's energy intensity.

Sources: Energy Information Administration's State Energy Data System; U.S. Department of Commerce, Bureau of Economic Analysis

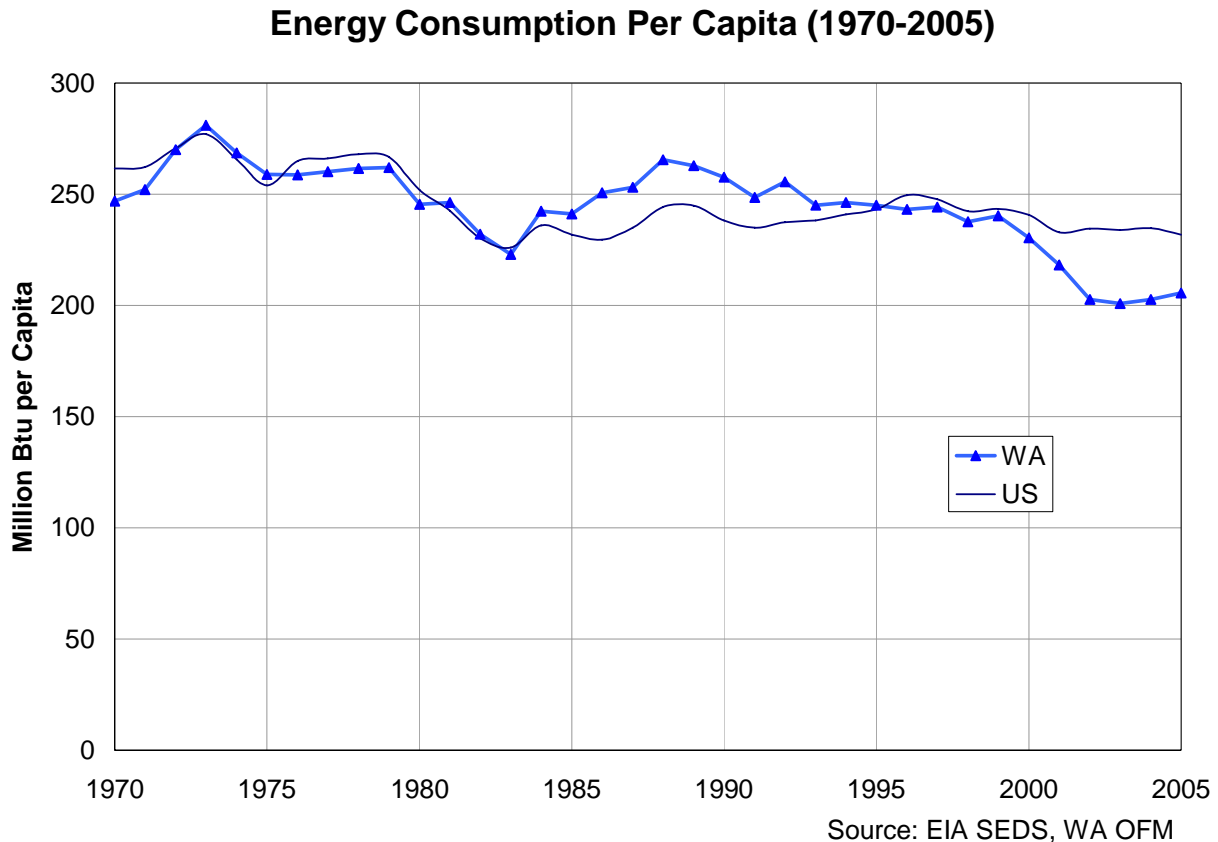
¹¹ Economic output (GSP) is in real dollars (millions of chained 2000 dollars). This adjusts for the effects of inflation and allows values for different years to be compared.

¹² Because there was a change in definitions for industry classifications used in the definition of gross state product in 1997 (from SIC to NAICS), an exact comparison of energy intensity from 1990 to 2005 is not possible. However, at a state-level the change does not appear to have a significant impact.

Energy Consumption per GSP		
Units: Index, 2000=1		
Year	Index (SIC Definitions)	Index (NAICS Definitions)
1990	1.41	-
1991	1.37	-
1992	1.39	-
1993	1.33	-
1994	1.32	-
1995	1.33	-
1996	1.28	-
1997	1.23	1.23
1998	-	1.09
1999	-	1.04
2000	-	1.00
2001	-	0.97
2002	-	0.91
2003	-	0.89
2004	-	0.89
2005	-	0.87

Washington's Energy Consumption per Capita

Energy consumption per capita in Washington was relatively constant between 1970 and 1999 with growth in energy use matching growth in population. However, since 1999 energy consumption per capita has declined 20 percent from historical levels to 200 million Btu.



Another way to look at Washington's energy intensity is energy consumption per capita. Washington's per capita energy consumption stayed fairly close to 250 million Btu from 1970 to 1999, which is the energy equivalent of about 2000 gallons of gasoline per person. This indicates growth in energy use has been similar to growth in population. Dips in per capita energy consumption during this period were generally due to drops in energy consumption during periodic economic downturns. Washington's trend was similar to the national average during the 1970-1999 periods. The growth in per capita energy use during the mid-1980s was largely due to increased transportation fuel use as Washingtonians drove more miles per year.

Washington's per capita energy consumption appears to have moved to a new level of 200 million Btu, 20 percent below the historical trend. This was likely due to the decline in energy use during 1999 to 2002, particularly in the energy-intensive aluminum industry. Higher energy prices resulted in the shutdown of some energy-intensive industrial facilities. In 2005 Washington's per capita energy consumption was less than the national average.

Sources: Energy Information Administration's State Energy Data System; Washington State Office of Financial Management

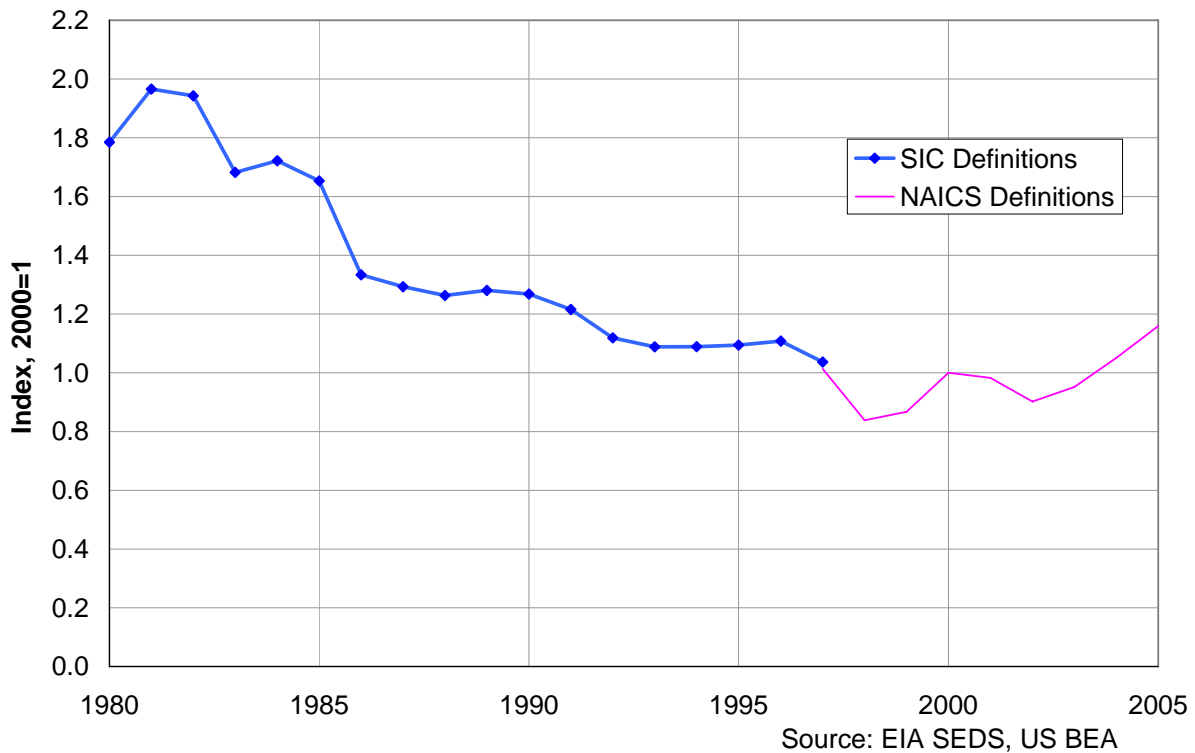
Links: EIA State Energy Data System, <http://www.eia.doe.gov/emeu/states/seds.html>. In some cases, values downloaded from the SEDS system will not match the numbers in this report which are adjusted. Washington State population data, OFM data book, <http://www.ofm.wa.gov/databook/>

Energy Consumption per Capita		
Units: Million Btu/person		
Year	WA Consumption per Capita	U.S. Consumption per Capita
1970	247	262
1971	252	262
1972	270	271
1973	281	277
1974	269	266
1975	259	254
1976	259	265
1977	260	266
1978	262	268
1979	262	267
1980	245	252
1981	246	243
1982	232	230
1983	223	226
1984	242	236
1985	241	232
1986	251	230
1987	253	235
1988	266	244
1989	263	245
1990	258	238
1991	249	235
1992	256	237
1993	245	238
1994	246	241
1995	245	243
1996	243	250
1997	244	248
1998	238	242
1999	240	243
2000	230	241
2001	218	233
2002	203	235
2003	201	234
2004	203	235
2005	206	232

Washington's Energy Expenditures and Gross State Product

Energy expenditures declined relative to economic output, despite growth in energy consumption, from 1981 through 1998. This trend reversed in 1999 due to rising energy prices.

**Energy Expenditures per Dollar of Gross State Product
(1980-2005)**



This indicator divides statewide energy expenditures by economic output, in the form of Gross State Product (GSP). The result is an estimate of the significance of energy in Washington's economy. In 2000 approximately 5.7¢ was spent on energy in Washington for every dollar of GSP. During the 1980s and '90s this value declined after peaking at more than 11¢ in 1981¹³. Two trends contributed to this decline: Washington's economy was becoming less energy-intensive and real energy prices were declining. However, energy prices began to rise in 1999, increasing Washington's energy expenditures per GSP from the low of 4.8¢ in 1998 to 6.6¢ in 2005.

Sources: Energy Information Administration's State Energy Data System; U.S. Department of Commerce, Bureau of Economic Analysis

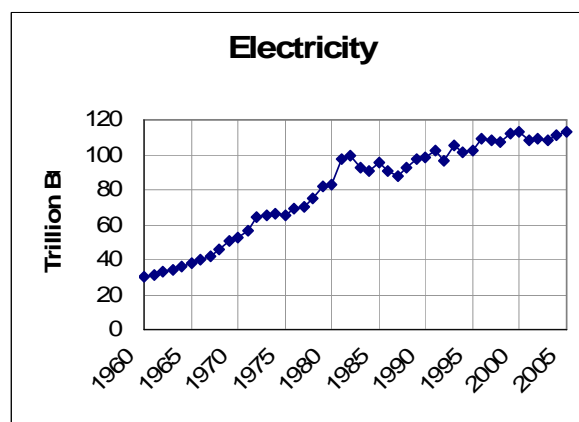
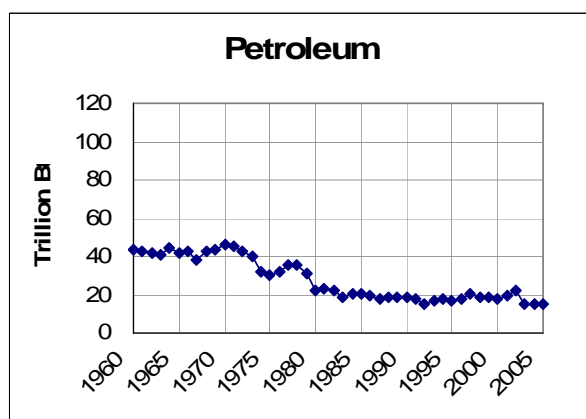
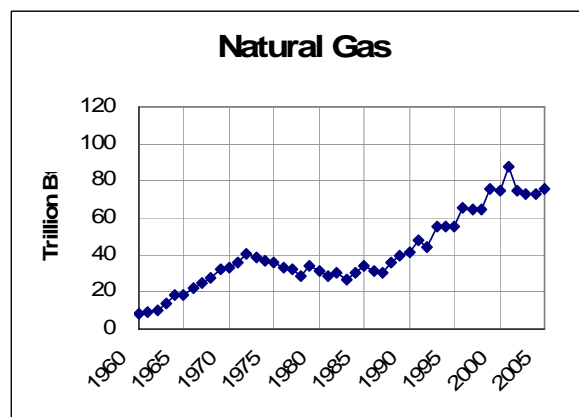
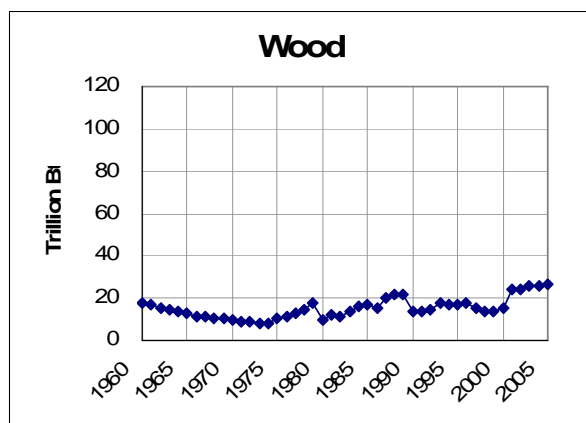
Links: EIA State Energy Data System, http://www.eia.doe.gov/emeu/states/_seds.html. In some cases, values downloaded from the SEDS system will not match the numbers in this report which are adjusted. Gross State Product; <http://www.bea.gov/regional/gsp/>

¹³ Because there was a change in definitions for industry classifications used in the definition of GSP in 1997 (from Standard Industrial Code (SIC) to North American Industrial Classification System (NAICS)), an exact comparison of expenditures/GSP from 1980 to 2005 is not possible. However, at a state-level the change does not appear to have a significant impact.

Energy Expenditures per GSP		
Units: Index, 2000=1		
Year	Index (SIC Definitions)	Index (NAICS Definitions)
1980	1.79	-
1981	1.97	-
1982	1.94	-
1983	1.68	-
1984	1.72	-
1985	1.65	-
1986	1.33	-
1987	1.29	-
1988	1.26	-
1989	1.28	-
1990	1.27	-
1991	1.22	-
1992	1.12	-
1993	1.09	-
1994	1.09	-
1995	1.09	-
1996	1.11	-
1997	1.04	1.01
1998	-	0.84
1999	-	0.87
2000	-	1.00
2001	-	0.98
2002	-	0.90
2003	-	0.95
2004	-	1.05
2005	-	1.16

Residential End-Use Energy Consumption by Fuel

Electricity and natural gas account for the majority of household energy use. Growth in household electricity consumption has slowed in the last 25 years, while growth in the use of natural gas for space and water heating accelerated through 2001. Oil consumption has declined significantly since the early 1970s, while wood use increased from 2000 to 2005 to its highest levels.



SOURCE: EIA SEDS

Electricity accounted for almost half of residential energy consumption in 2005, but average electricity use per household has declined 25 percent since 1982. Petroleum use (mostly heating oil) fell from more than 43 percent of household consumption in 1960 to 6 percent in 2005¹⁴.

Growth in natural gas consumption accelerated through 2001: residential sector gas use grew at 1.9 percent per year between 1980 and 1985, 3.9 percent per year between 1985 and 1990, 5.8 percent per year between 1990 and 1995, and 8.0 percent from 1995 to 2001. From 1980 to 2001 the natural gas share of residential energy consumption rose from 21 percent to 36 percent. This reflects increased use of natural gas for space and water heating, replacing both electricity and petroleum. However, natural gas use declined in 2002 due to high prices and has remained relatively stable since then.

¹⁴ The primary petroleum products consumed in households are heating oil (No. 2 distillate oil) and propane. Both are consumed mainly for space heating, though propane can also be used for cooking and water heating. Residential sector energy use does not include energy consumption for personal transportation.

Consumption of firewood has varied in response to higher heating fuel prices. It grew in the late 1970s due to high heating oil prices. It remained stable and declined during much of the 1990s when energy prices were relatively low. But when energy prices jumped in 2001, so did wood use as people cut back on their use of natural gas, electricity, and petroleum for heating.

Source: Energy Information Administration's State Energy Data System

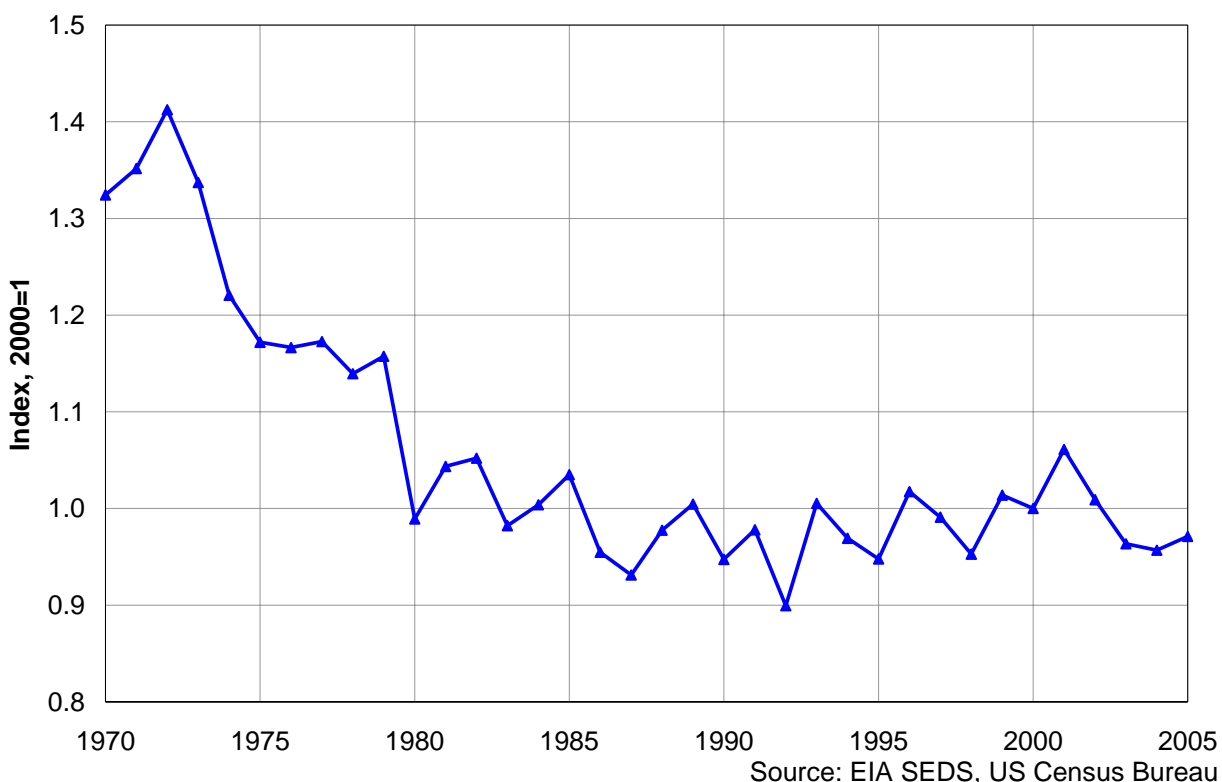
Residential End-Use Energy Consumption by Fuel				
Units: Billion Btu				
Year	Electricity	Natural Gas	Petroleum	Wood
1960	29,871	8,281	43,930	17,768
1961	31,082	8,798	43,005	16,512
1962	33,303	10,283	41,454	15,446
1963	34,479	13,529	41,309	14,448
1964	36,531	18,602	44,596	14,035
1965	37,582	18,689	41,475	12,487
1966	39,783	21,861	43,026	11,627
1967	41,750	24,619	38,661	10,888
1968	45,816	27,975	42,999	10,544
1969	50,575	32,369	43,956	10,182
1970	52,390	33,685	45,963	9,580
1971	56,371	35,800	45,743	9,219
1972	64,641	40,756	42,644	8,944
1973	65,694	38,328	39,774	8,204
1974	66,181	37,195	32,346	8,273
1975	65,541	35,792	30,646	10,251
1976	69,301	33,674	31,982	11,232
1977	70,389	31,907	35,558	12,848
1978	74,791	28,743	35,129	14,276
1979	81,908	34,398	31,063	17,372
1980	83,406	31,285	22,602	9,744
1981	97,158	28,191	22,984	12,023
1982	99,483	30,688	21,827	10,927
1983	93,030	27,116	18,899	13,351
1984	91,184	30,558	20,545	16,479
1985	95,306	34,320	20,010	16,975
1986	90,429	31,093	19,994	15,462
1987	87,938	30,782	17,618	20,187

1988	92,818	35,888	18,670	21,543
1989	97,764	39,596	18,722	21,780
1990	98,296	41,556	18,242	13,298
1991	101,982	47,656	17,872	13,941
1992	97,023	44,471	15,495	14,627
1993	105,540	55,294	16,677	17,986
1994	101,244	55,426	17,528	17,072
1995	102,862	54,988	16,640	17,072
1996	109,226	65,107	17,999	17,729
1997	108,328	64,828	20,232	14,987
1998	107,008	64,826	18,819	13,318
1999	111,972	75,553	18,757	14,019
2000	112,718	74,824	17,950	15,070
2001	107,848	87,354	19,766	23,791
2002	109,409	74,636	22,361	24,150
2003	108,747	72,705	15,494	25,421
2004	110,735	72,539	14,676	26,056
2005	113,320	75,998	14,676	26,692

Residential Household Energy Intensity

Energy consumption in Washington households declined by a third between 1972 and 1987, indicating an improvement in household energy intensity. There has been no improvement since. Consumption per household in 2005 was similar to 1986.

Residential Energy Consumption Per Household (1970-2005)



Washington households used less energy between 1972 and 1987, but energy intensity has not improved since. The 1970s were characterized by diminished oil and natural gas consumption, with natural gas use per household falling by 33 percent between 1970 and 1980. Oil consumption dropped from 300 gallons per household in 1970 to 85 in 1983, with half the decline occurring after the second oil shock in 1978. These declines in natural gas and petroleum use were likely due to improvements in efficiency (e.g. adding insulation), conservation in response to higher prices, and fuel switching. The data indicate an increased reliance on wood and electricity as space heating fuels during the late 1970s and early 1980s.

Concerted efforts to improve residential efficiency through building standards and codes began in the mid-80s. However, there is little evidence of further declines in household energy use. 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. Higher household energy use was reinforced by relatively modest energy prices during this period. 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 15 years.

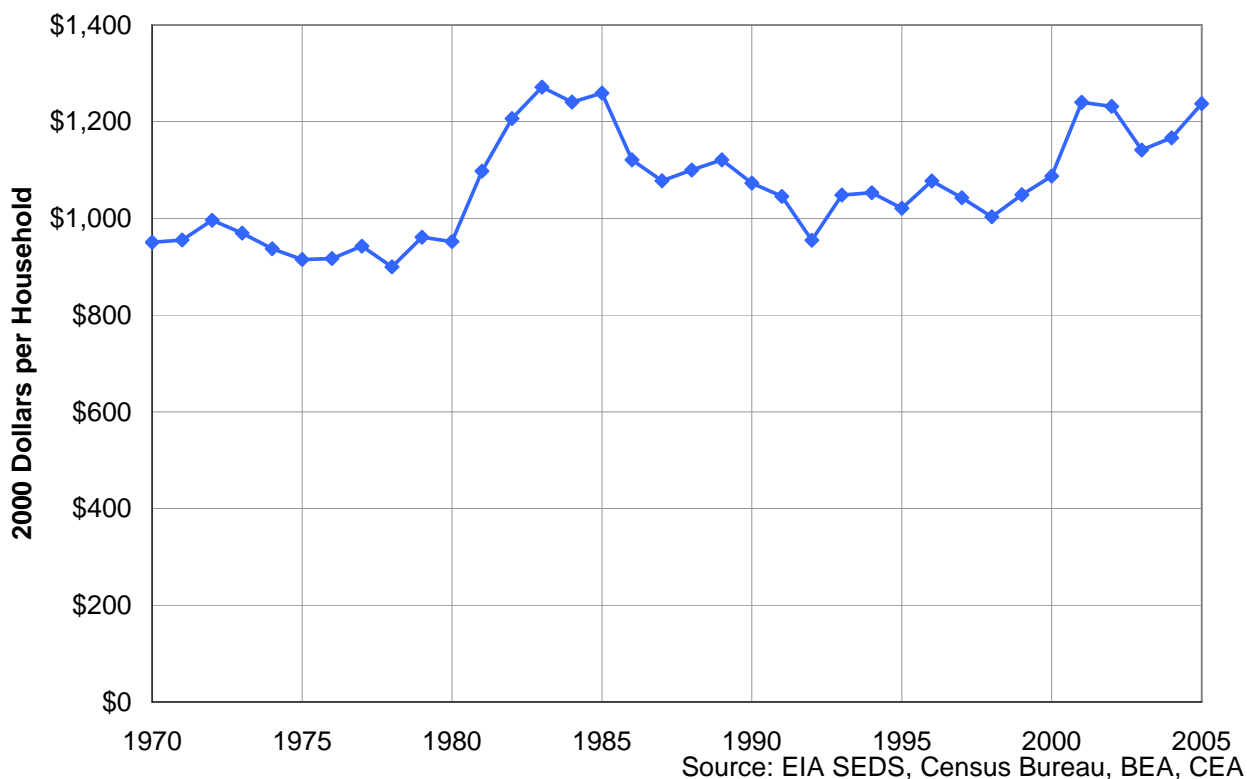
Sources: Energy Information Administration's State Energy Data System; U.S. Bureau of the Census

Residential Energy Intensity	
Units: Index, 2000=1	
Year	Index
1970	1.32
1971	1.35
1972	1.41
1973	1.34
1974	1.22
1975	1.17
1976	1.17
1977	1.17
1978	1.14
1979	1.16
1980	0.99
1981	1.04
1982	1.05
1983	0.98
1984	1.00
1985	1.04
1986	0.95
1987	0.93
1988	0.98
1989	1.00
1990	0.95
1991	0.98
1992	0.90
1993	1.01
1994	0.97
1995	0.95
1996	1.02
1997	0.99
1998	0.95
1999	1.01
2000	1.00
2001	1.06
2002	1.01
2003	0.96
2004	0.96
2005	0.97

Residential Household Energy Bill without Transportation

Adjusted for inflation, the average Washington household spent 23 percent more for home energy in 2005 than in 1998. However, household expenditures in 2005 were slightly less than their peak in 1983.

Residential Energy Expenditures per Household (1970-2005)



In 2005, the average Washington household spent the inflation-adjusted sum of \$1,237 (2000 dollars) for electricity, natural gas, and petroleum delivered to the home. This is \$234 more than they spent in 1998, but \$34 less than 1983. When household energy bills peaked in the early 1980s, increased emphasis on energy conservation and fuel switching from heating oil to wood helped to mitigate the impact of the oil shocks of the 1970s. However, there was no immediate substitute for electricity, so when electricity prices increased by 62 percent between 1980 and 1983, due largely to the inclusion in rates of the Washington Public Power Supply System (WPPSS) nuclear bonds, the average household electricity bill increased by a like amount.

During the mid-1980s and most of the '90s household energy bills declined due to lower energy prices and fuel switching from expensive electricity to natural gas for heating. Most new homes were being built with natural gas heat and water heating (78 percent in 1998) and numerous existing households switched to natural gas as well. Electricity usage per household fell 18 percent between 1985 and 2001 while natural gas usage increased 83 percent.

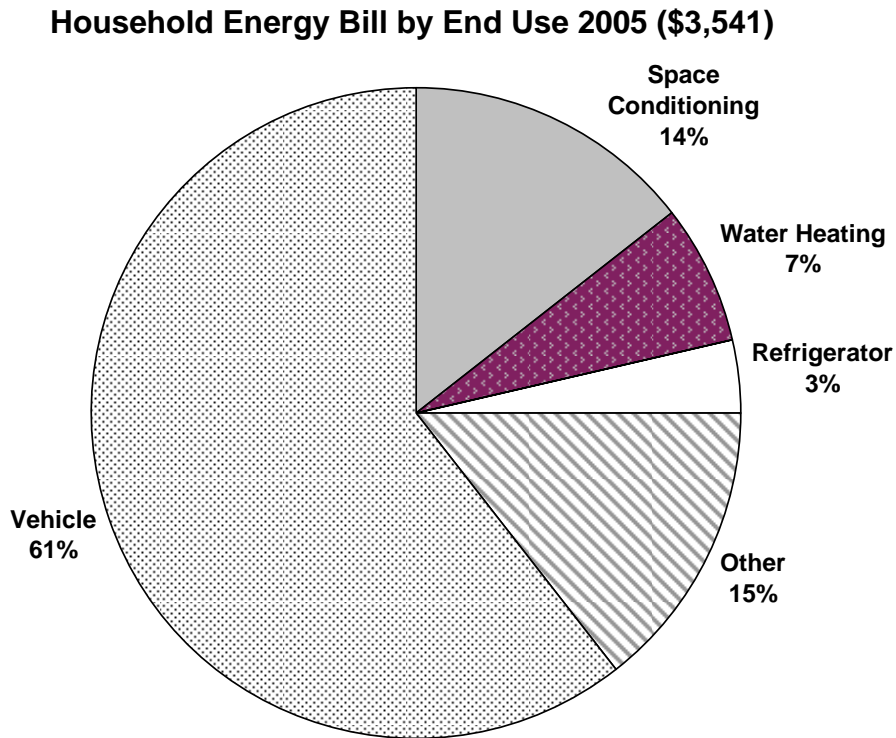
The 2001 energy crisis led to higher electricity and natural gas prices and more recently, petroleum prices have jumped as well. As a result, household energy bills are near their all-time peak.

Sources: Energy Information Administration's State Energy Data System; U.S. Bureau of the Census; and President's Council of Economic Advisors - 2005 Annual Economic Report of the President

Residential Energy Bill	
Units: Dollars per Household (2000 dollars)	
Year	Household Energy Bill
1970	\$ 951
1971	\$ 955
1972	\$ 996
1973	\$ 970
1974	\$ 937
1975	\$ 915
1976	\$ 917
1977	\$ 943
1978	\$ 900
1979	\$ 961
1980	\$ 952
1981	\$ 1,098
1982	\$ 1,207
1983	\$ 1,271
1984	\$ 1,240
1985	\$ 1,259
1986	\$ 1,121
1987	\$ 1,078
1988	\$ 1,100
1989	\$ 1,121
1990	\$ 1,073
1991	\$ 1,046
1992	\$ 955
1993	\$ 1,048
1994	\$ 1,053
1995	\$ 1,021
1996	\$ 1,077
1997	\$ 1,043
1998	\$ 1,003
1999	\$ 1,049
2000	\$ 1,087
2001	\$ 1,240
2002	\$ 1,232
2003	\$ 1,141
2004	\$ 1,166
2005	\$ 1,237

Residential Household Energy Bill with Transportation

Adding energy used for personal transportation more than doubles the annual energy bill for the average Washington household to \$3,541 (2005).



Source: EIA RECS

Most views depicting residential energy data do not include the major component of consumption and expenditure for most households – vehicles. The average household¹⁵ in Washington spent over half of its energy budget fueling vehicles for transportation in 2005. This share is growing. While homes have become more energy efficient, higher gas prices are pushing up transportation costs.

After personal transportation, major categories of household energy expenditures include other uses (lighting, household appliances, and electronic equipment), space conditioning (heating, cooling, and ventilation), water heating, and refrigerators. The ‘other uses’ category has been growing, largely due to the proliferation of computers and electronic equipment. It is now equivalent to space conditioning.

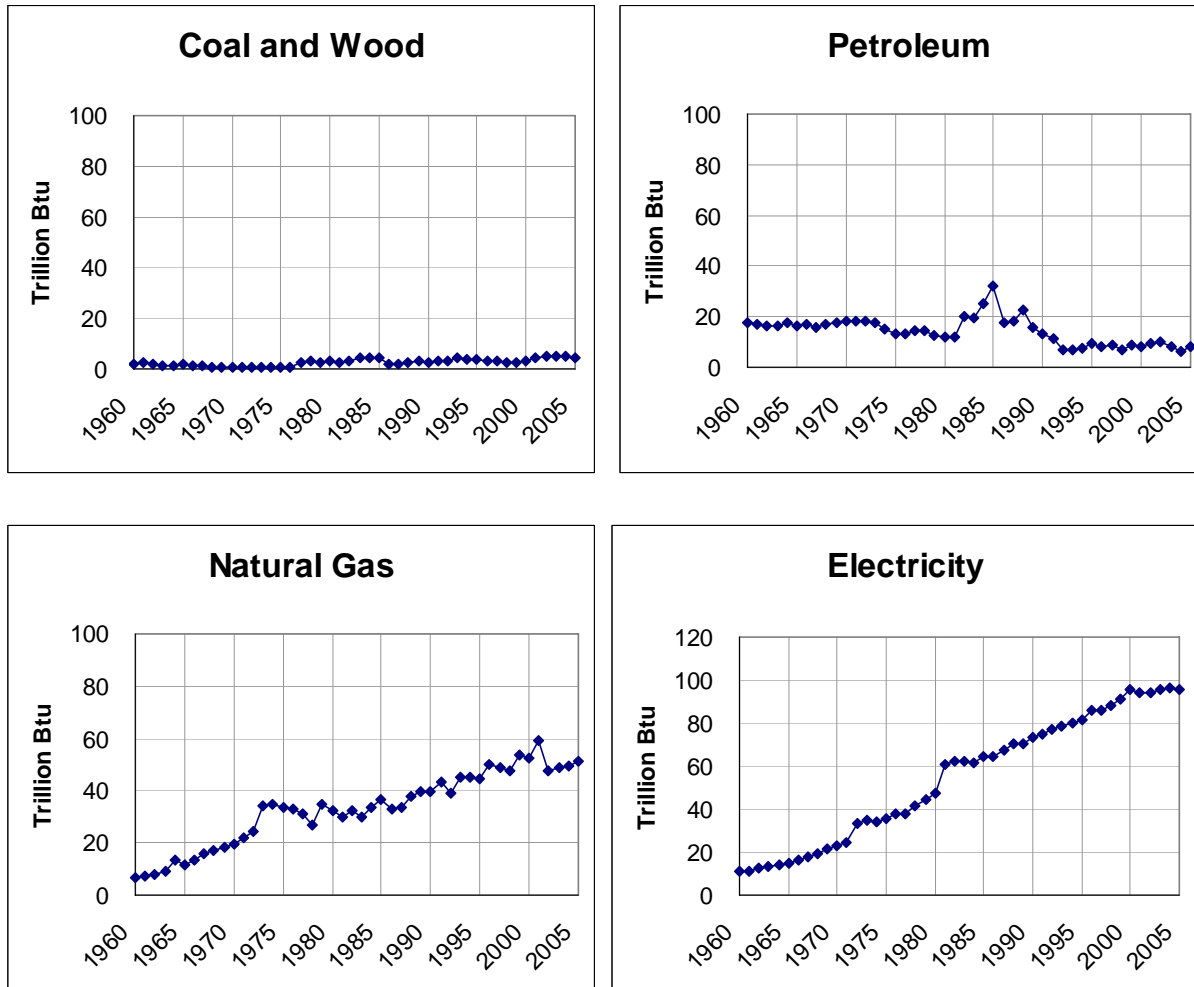
Sources: Energy Information Administration’s State Energy Data System; Residential Energy Consumption Survey; Residential Transportation Energy Consumption Survey

¹⁵ Actual household energy costs by end-use can vary significantly depending on the size and efficiency of the home, the efficiency of their vehicles and how much they drive, and their personal habits. A family living in an apartment in the city close to work and schools may have much lower expenditures than a family living in a large home in the suburbs far from work and other destinations.

Household Energy Bill with Transportation		
Units: Dollars		
End-Use	Annual Bill	Percentage
Space Conditioning	507	14%
Water Heating	254	7%
Refrigerator	122	3%
Other	518	15%
Vehicle	2140	60%
Total	3541	100%

Commercial End-Use Energy Consumption by Fuel

Electricity and natural gas use in the commercial sector grew at an average annual rate of more than 5 percent from 1960 to 2000, but have not grown since then. Electricity accounted for 60 percent of end-use energy consumption in the commercial sector in 2005 while natural gas made up the bulk of the rest.



SOURCE: EIA SEDS

Electricity and natural gas are the dominant fuels in Washington's commercial sector. With escalating use of electricity-consuming equipment such as computers, printers, and photocopiers, the commercial sector became increasingly reliant on electricity during the 1970's and 1980s. Sector electricity consumption more than quadrupled from 1970 to 2000, but consumption in 2005 was about the same as 2000.

Growth in commercial sector natural gas use stagnated in the late 1970s and early 1980s, but has grown since. Natural gas use in 2001 was three times the amount in 1970, but dropped 20 percent in 2002. Petroleum consumption in 2005 was less than half of the 1970 level, declining from 30 percent of commercial sector energy consumption in 1970 to 5 percent in 2005. Coal and wood accounted for less than 3 percent of commercial sector energy use.

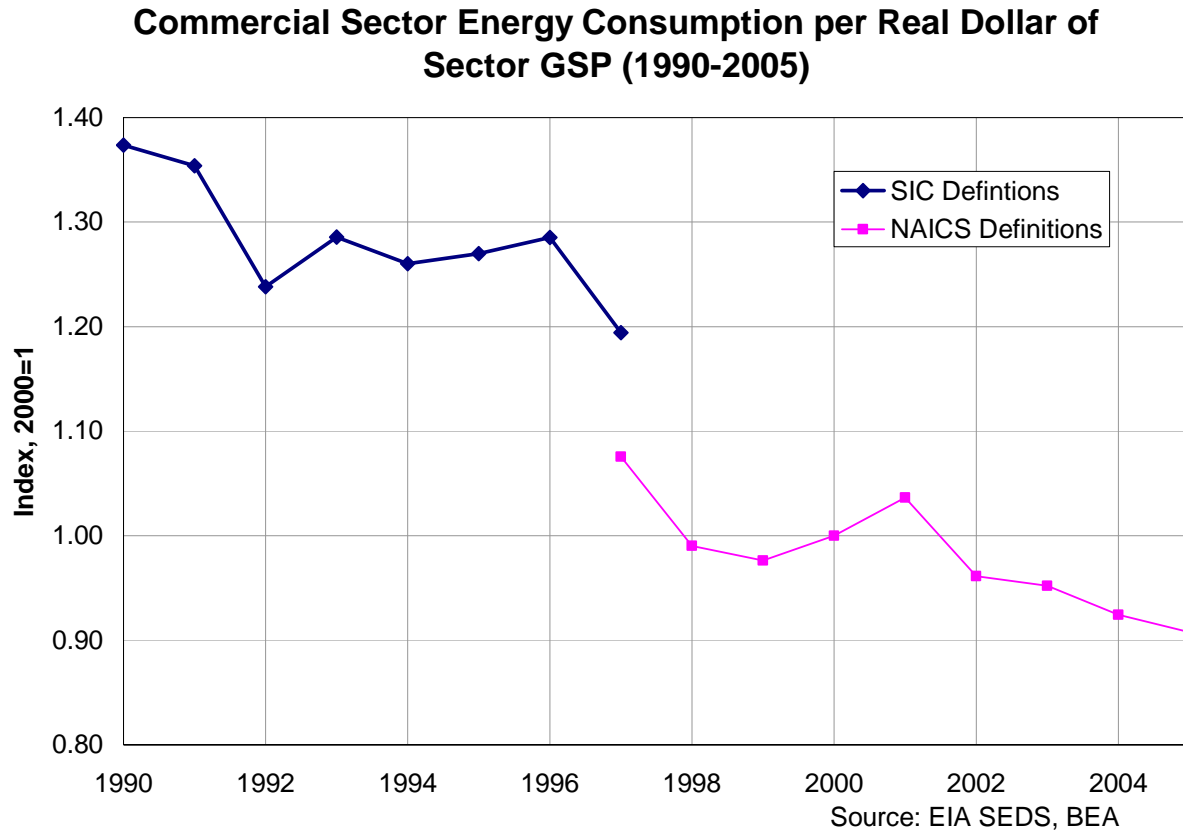
Sources: Energy Information Administration's State Energy Data System

Commercial End-Use Energy Consumption by Fuel				
Units: Billion Btu				
Year	Electricity	Natural Gas	Petroleum	Coal and Wood
1960	10,987	6,704	17,628	2,030
1961	11,417	7,218	16,866	2,225
1962	12,436	8,222	16,241	1,731
1963	13,145	8,974	16,145	1,558
1964	13,843	13,254	17,514	1,505
1965	14,943	11,457	16,531	1,669
1966	16,438	13,601	17,183	1,534
1967	17,671	16,086	15,529	1,126
1968	19,310	17,251	17,231	874
1969	21,573	18,230	17,563	855
1970	22,940	19,507	18,422	517
1971	24,714	21,746	18,408	713
1972	32,984	24,533	18,355	573
1973	35,177	33,982	17,429	404
1974	34,310	34,782	14,958	353
1975	35,405	33,331	13,456	468
1976	37,771	32,950	13,270	519
1977	37,733	31,294	14,730	2,384
1978	41,188	26,536	14,737	3,325
1979	44,139	34,942	12,291	2,596
1980	47,239	32,358	11,946	3,134
1981	60,875	30,062	11,926	2,567
1982	61,908	32,179	20,406	3,449
1983	62,255	29,963	19,264	4,512
1984	61,411	33,828	24,912	4,233
1985	64,709	36,877	32,294	4,353
1986	64,199	32,951	17,373	1,964
1987	67,209	33,434	18,497	1,590
1988	70,650	37,625	22,441	2,753
1989	70,412	39,745	15,956	3,336
1990	73,391	39,831	13,171	2,601
1991	74,951	43,033	11,625	2,988
1992	76,880	39,049	7,089	3,262

1993	78,337	45,288	7,117	4,524
1994	79,761	44,828	7,745	3,960
1995	81,586	44,364	9,229	3,875
1996	85,801	49,995	7,977	2,907
1997	86,012	48,963	8,537	2,943
1998	88,288	47,688	7,052	2,512
1999	91,082	53,458	8,734	2,680
2000	95,697	52,603	8,237	2,923
2001	93,927	59,149	9,377	4,646
2002	93,924	47,272	9,819	4,763
2003	95,670	48,918	7,954	4,996
2004	96,306	49,553	6,086	4,845
2005	95,876	51,347	8,287	4,353

Commercial Sector Energy Intensity

After declining about 30 percent during the 1990s, commercial sector energy consumption relative to economic output increased in 2000 and 2001, before returning to a downward trend.



Washington's commercial sector has become less energy intensive for most of the last 15 years¹⁶. From 1990 to 1997 commercial sector energy consumption grew only 13 percent while the value of all goods and services produced by the commercial sector grew 30 percent. 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.

However, this trend appears to have changed since 1998, with growth in energy use exceeding growth in commercial sector gross state product from 1998 to 2001. This appears to mostly be due to an economic downturn during this period. However, the downward trend returned in 2002 as the economy picked up with little or no increase in commercial sector energy use.

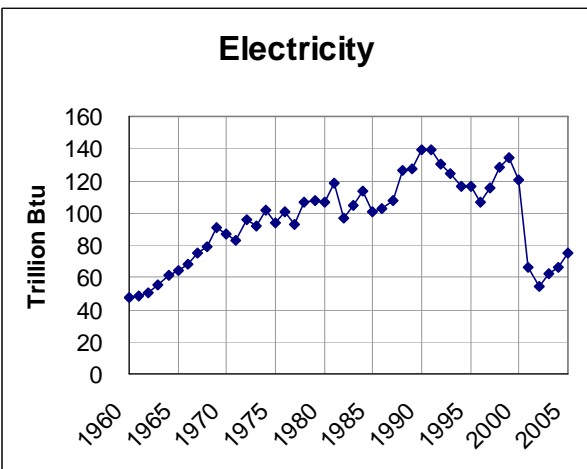
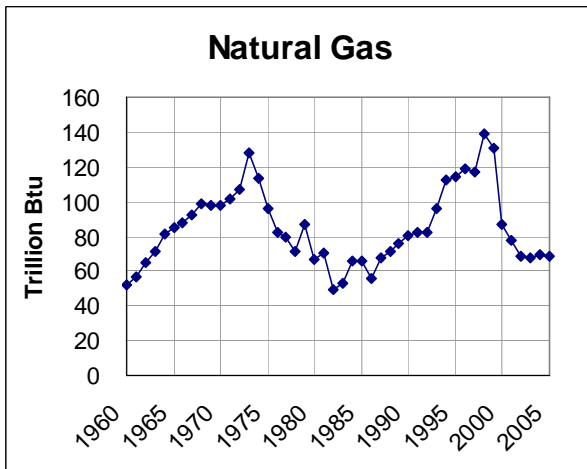
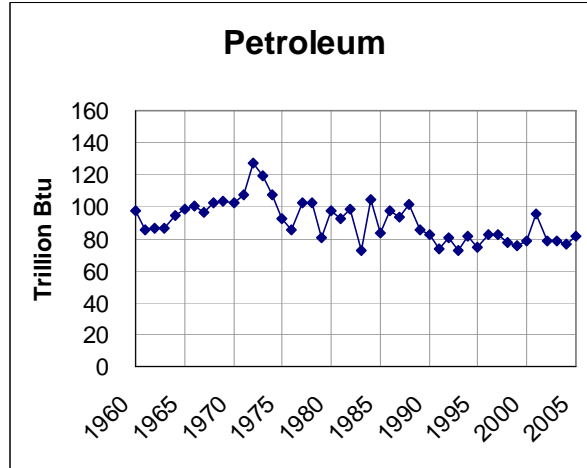
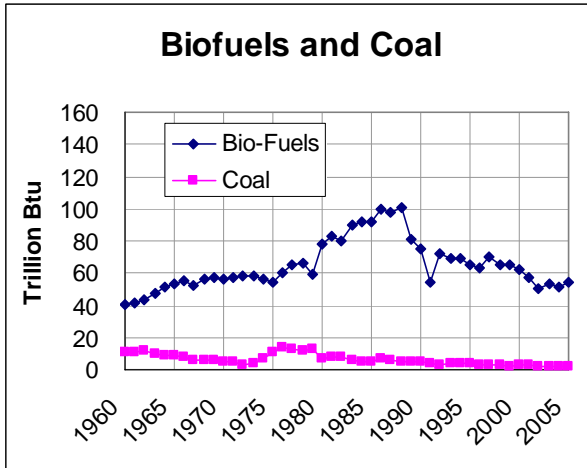
Sources: Energy Information Administration's State Energy Data System; U.S. Department of Commerce, Bureau of Economic Analysis

¹⁶ Because there was a change in definitions for industry classifications used in the definition of gross state product in 1997 (from SIC to NAICS), an exact comparison of values before and after 1997 is not possible.

Commercial Energy Consumption per Sector GSP		
Units: Index, 2000=1		
Year	Index (SIC Definitions)	Index (NAICS Definitions)
1990	1.37	-
1991	1.35	-
1992	1.24	-
1993	1.29	-
1994	1.26	-
1995	1.27	-
1996	1.29	-
1997	1.19	1.08
1998	-	0.99
1999	-	0.98
2000	-	1.00
2001	-	1.04
2002	-	0.96
2003	-	0.95
2004	-	0.92
2005	-	0.91

Industrial End-Use Energy Consumption by Fuel

Industrial energy consumption in Washington is more diversified among the different fuels than the other sectors and varies more over time. Total industrial consumption declined 38 percent between 1998 and 2002 – natural gas and electricity use declined sharply before stabilizing in the last couple years.



SOURCE: EIA SEDS

Unlike the residential and commercial sectors, which rely primarily on electricity and natural gas, or the transportation sector which consumes almost exclusively petroleum fuels, energy consumption in Washington's industrial sector is quite diversified. Petroleum accounted for 29 percent of industrial consumption in 2005, while electricity and natural gas accounted for about a quarter each and biofuels¹⁷ accounted for almost 20 percent. Coal use only accounted for half a percent of industrial consumption in 2005 declining from a high of 14 trillion BTUs in 1976 to 1.4 trillion BTUs in 2005.

Energy consumption in the industrial sector varies more than the other sectors with peaks and valleys

¹⁷ Bio-fuels consumed in the industrial sector comprise mainly wood and wood waste products such as black liquor or hog fuel. These fuels are primarily burned in industrial boilers to make steam, which can be used to fire industrial processes or to generate electricity for on-site use.

that mirror the economy. When production declines, energy use declines. High energy prices can also contribute to lower production, particularly in energy intensive industries. Peaks in industrial energy use have occurred in 1973, 1988, and 1998.

Between 1998 and 2002 industrial energy use declined 38 percent. During this period electricity use declined almost 60 percent and natural gas use declined 50 percent. This reflected the decline in aluminum production due to high electricity prices (and low aluminum prices) and cuts in production for industries relying on natural gas due to high natural gas prices. Industrial energy use has rebounded some – in 2005 it was 11 percent higher than in 2002.

Sources: Energy Information Administration's State Energy Data System

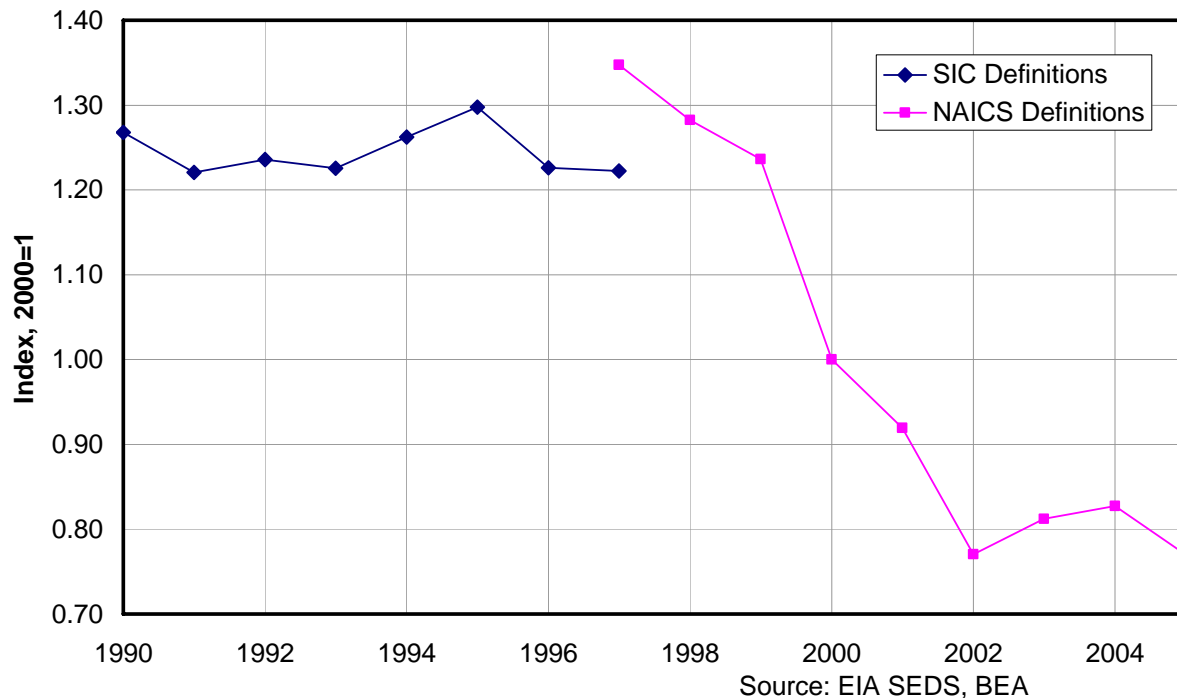
Industrial End-Use Energy Consumption by Fuel					
Units: Billion Btu					
Year	Electricity	Natural Gas	Petroleum	Biomass	Coal
1960	47,682	51,795	97,425	40,420	10,914
1961	48,469	56,353	85,731	41,039	10,997
1962	50,054	65,314	86,478	43,327	12,097
1963	55,564	70,931	86,310	47,575	10,097
1964	60,818	81,373	94,740	50,929	8,844
1965	63,816	85,330	98,507	53,526	8,774
1966	68,229	87,865	100,213	55,264	8,055
1967	75,160	91,920	96,658	52,512	6,117
1968	78,770	99,159	101,877	56,536	5,436
1969	90,416	98,060	103,112	56,846	5,551
1970	87,107	98,270	101,864	56,760	5,087
1971	83,086	101,253	107,807	57,775	5,331
1972	95,354	106,733	126,955	57,861	3,436
1973	91,404	127,904	118,978	57,878	3,922
1974	101,468	113,562	107,138	56,743	6,482
1975	93,545	96,012	92,884	53,853	10,909
1976	101,051	82,037	85,270	59,942	14,240
1977	92,460	79,413	102,368	65,222	12,412
1978	106,956	71,351	102,146	66,495	12,184
1979	107,843	86,765	80,730	59,753	12,483
1980	107,021	66,999	97,750	78,286	7,093
1981	118,487	70,030	92,173	82,627	7,669
1982	96,341	49,617	98,640	79,934	7,946
1983	105,172	53,071	72,563	90,288	5,578
1984	113,770	65,616	104,463	92,112	4,516

1985	100,419	65,703	83,659	91,723	4,492
1986	102,495	55,594	97,742	99,818	7,383
1987	107,809	67,874	93,528	97,960	5,894
1988	125,934	71,217	101,032	101,142	5,273
1989	127,504	75,602	85,040	80,755	4,949
1990	138,909	80,777	82,053	74,960	5,201
1991	139,343	82,208	73,691	54,735	4,276
1992	130,787	82,403	80,361	72,538	3,370
1993	124,752	95,802	72,711	68,803	3,509
1994	116,230	112,224	81,329	69,565	3,875
1995	116,951	114,636	74,759	64,748	4,231
1996	106,616	118,641	82,413	62,948	2,980
1997	115,858	116,581	82,830	70,100	3,223
1998	128,347	139,318	77,504	64,868	2,690
1999	134,770	131,047	75,442	65,631	2,183
2000	120,818	87,302	78,772	62,173	2,815
2001	65,984	77,628	95,113	57,619	2,891
2002	53,881	68,907	78,814	50,450	2,284
2003	62,030	67,361	78,900	53,397	2,091
2004	65,713	69,348	76,815	51,551	1,847
2005	75,445	69,028	81,857	54,660	1,482

Industrial Sector Energy Intensity

Energy intensity in Washington's industrial sector was relatively constant during the 1990s, but declined significantly from 1997 to 2002. This reflected a decline in production for energy intensive industries such as aluminum smelting that resulted from high energy prices.

Industrial Sector Energy Consumption per Real Dollar of Sector GSP (1990-2005)



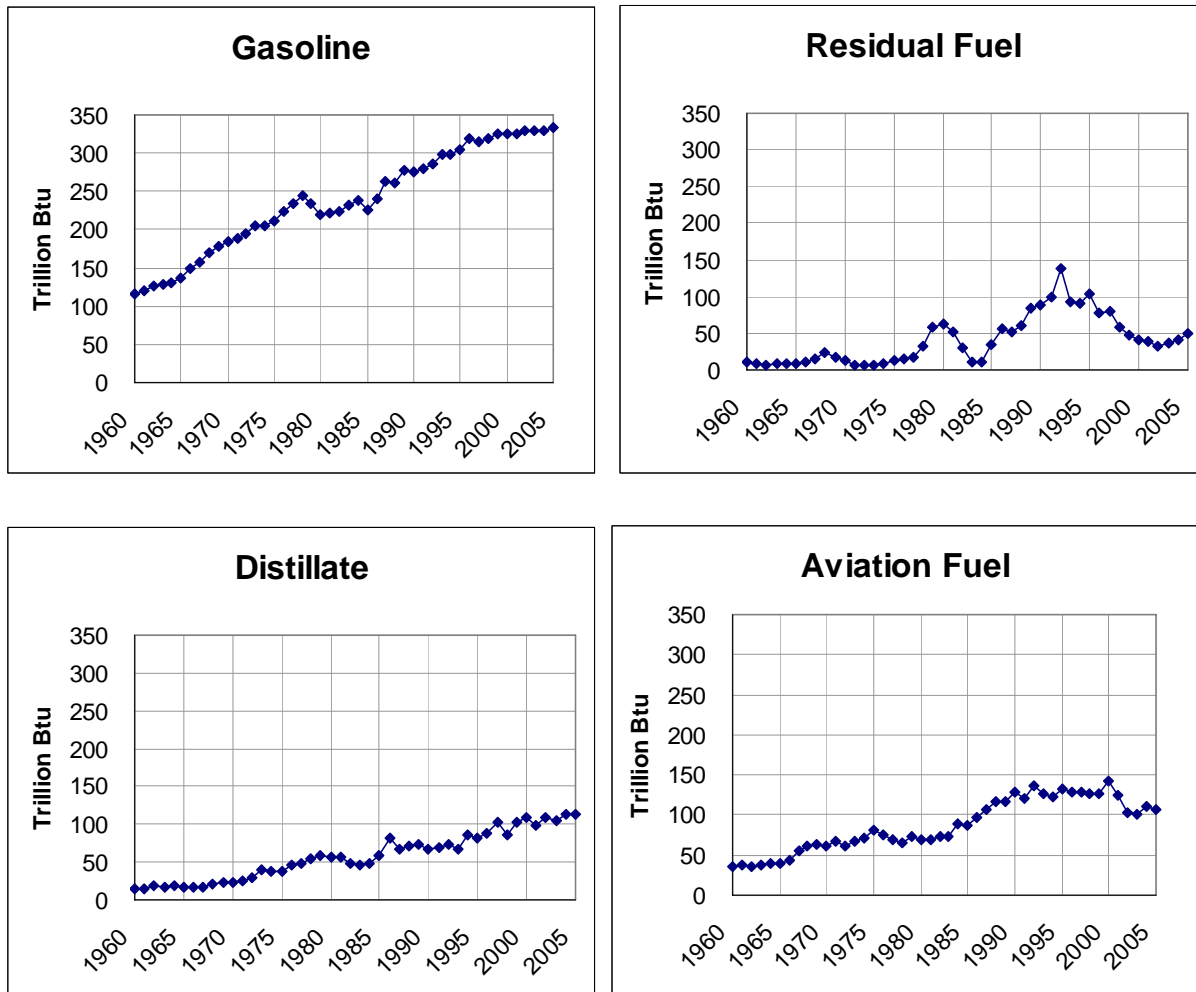
Washington's industrial sector is less energy-intensive than it was two decades ago when comparing industrial energy use to industrial gross state product¹⁸. Energy intensity did not change much during the 1990s before dropping more than 40 percent from 1997 to 2002. This reflected a decline in energy intensive industries in Washington. This was particularly true from 1998 to 2002 when industrial energy use dropped 38 percent, but industrial gross state product increased 3 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 significantly. High energy prices impact energy intensive industries the most and can contribute to cuts in production, particularly when it is not possible to switch to a less expensive fuel source.

Sources: Energy Information Administration's State Energy Data System; U.S. Department of Commerce, Bureau of Economic Analysis

¹⁸ Because there was a change in definitions for industry classifications used in the definition of gross state product in 1997 (from SIC to NAICS), an exact comparison of values before and after 1997 is not possible.

Transportation End-Use Energy Consumption by Fuel

Gasoline¹⁹ accounts for over half of transportation sector energy use in Washington. Petroleum fuels accounted for 98.5 percent of transportation energy use in 2005. Washington's status as a major seaport and aviation hub means significant consumption of aviation and marine fuels as well.



SOURCE: EIA SEDS

Except for the period between 1978 and 1985 (when prices jumped significantly), gasoline consumption has generally increased as demand for travel has outstripped any gains in vehicle fuel efficiency. Gasoline consumption in 2005 was 80 percent greater than in 1970.

Consumption of distillate fuels in trucks, ships, and railroads grew at a faster rate than other transportation fuels, reaching levels in 2005 that were almost five times greater than 1970. However, the magnitude of this consumption increase was much less than the increase for motor gasoline.

¹⁹ Motor gasoline figures include some consumption for off-road uses such as recreational vehicles and agricultural uses. No. 2 distillate, also known as diesel fuel, is used by large trucks, ships, and railroads. The only transportation use for residual fuel is by very large ships. Aviation fuel includes kerosene-based jet fuel used by major airlines, aviation gasoline consumed by smaller airplanes, and military jet fuel.

Aviation fuel consumption more than doubled between 1970 and 2000, but has dropped 25 percent since then.

Residual fuel consumption is subject to price-induced volatility because it can be stored for long periods of time without degrading. Thus purchases of this fuel dropped when prices were high, but grew when prices were relatively low. It also varies due to marine traffic at Washington ports and where ships choose to purchase their fuel.

Sources: Energy Information Administration's State Energy Data System

Links: The monthly petroleum data spreadsheet on the Energy Policy's website contains more recent monthly petroleum price and sales data by fuel type.

http://www.cted.wa.gov/CTED/documents/ID_1215_Publications.xls

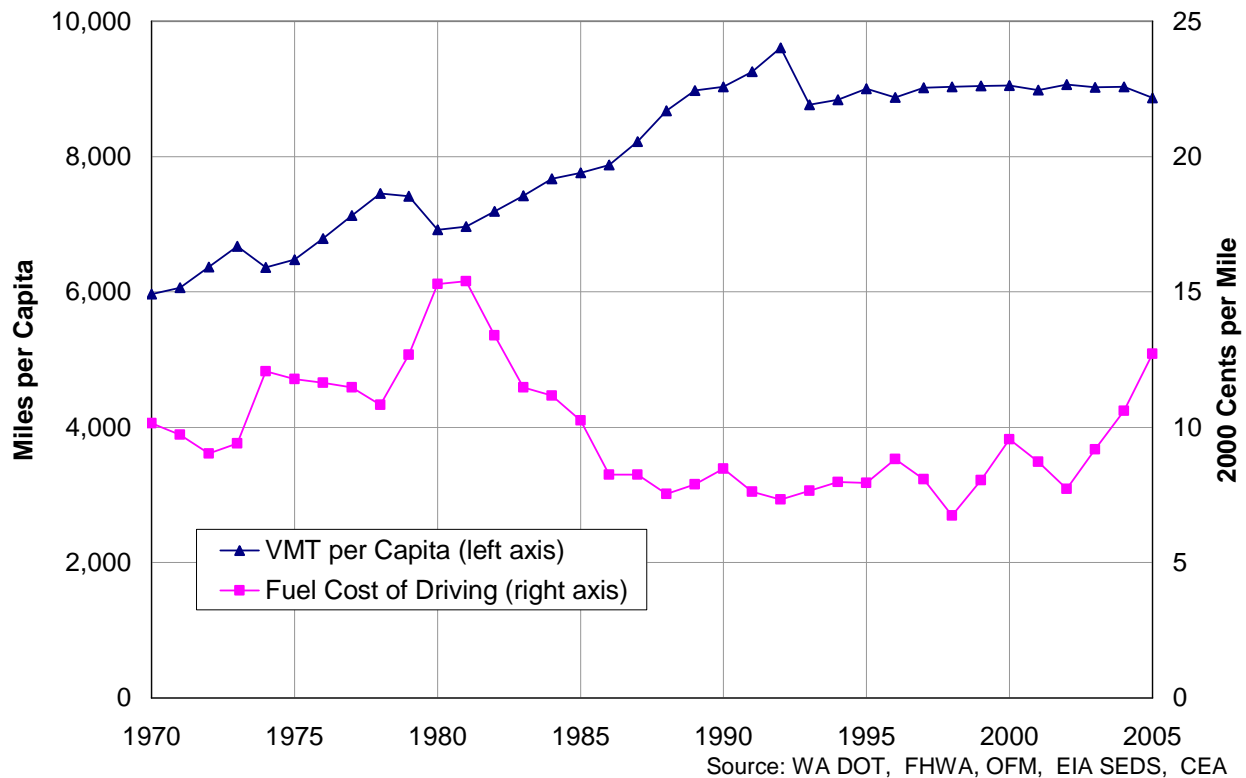
Transportation End-Use Energy Consumption by Fuel				
Units: Billion Btu				
Year	Gasoline	Distillate	Aviation Fuel	Residual Fuel
1960	115,840	14,992	35,319	10,730
1961	121,009	15,718	36,848	7,683
1962	127,336	18,186	35,978	7,184
1963	127,550	17,813	37,921	7,974
1964	130,069	19,069	39,833	7,918
1965	135,977	17,601	40,353	9,072
1966	148,438	16,332	43,946	11,732
1967	158,108	15,842	54,565	14,531
1968	169,894	21,416	61,562	23,573
1969	177,752	23,307	63,999	17,650
1970	184,973	23,042	61,096	12,733
1971	188,918	26,172	66,552	7,527
1972	195,378	29,935	61,135	6,087
1973	205,193	38,879	67,376	7,259
1974	204,647	37,630	70,503	7,923
1975	211,147	38,541	80,132	13,259
1976	223,193	46,624	74,224	14,666
1977	234,658	48,546	69,220	16,359
1978	245,037	53,587	65,830	31,848
1979	235,058	58,702	72,734	59,402
1980	220,087	55,892	69,309	63,572
1981	222,454	56,171	69,358	51,324
1982	222,991	49,100	73,008	29,630

1983	231,097	46,515	73,096	10,321
1984	237,872	48,716	88,822	10,446
1985	225,724	59,057	87,629	34,527
1986	241,114	81,959	97,236	56,150
1987	263,709	67,892	106,099	51,123
1988	261,306	71,909	117,392	60,906
1989	277,655	72,892	116,974	84,491
1990	275,912	67,623	127,600	89,459
1991	279,753	68,517	121,598	99,735
1992	285,021	73,582	137,418	139,167
1993	298,427	68,032	126,594	93,126
1994	297,409	86,803	123,292	91,719
1995	303,628	82,026	131,532	104,059
1996	318,104	88,730	128,008	77,187
1997	315,695	102,914	128,334	79,067
1998	319,387	86,576	125,736	58,750
1999	325,227	103,493	127,051	47,843
2000	324,301	109,205	141,870	41,717
2001	324,616	98,580	124,440	39,425
2002	329,428	108,003	103,791	33,246
2003	328,660	105,505	100,320	37,641
2004	328,259	113,090	109,994	40,963
2005	333,000	113,840	106,107	48,867

Transportation Fuel Cost of Driving and Miles Driven

Washingtonians drove almost 50 percent more miles per capita in 2005 than in 1970. During the same period the fuel cost of driving rose, declined and then rose again. This variation was due to changes in fuel prices and gains in vehicle fuel efficiency during the 1980s.

Fuel Cost of Driving and Miles Driven per Capita (1970-2005)



This indicator contrasts the fuel cost of driving with miles driven per capita in Washington. Not surprisingly, these series exhibit an inverse relationship. The fuel cost of driving, calculated as real dollar highway energy expenditures divided by vehicle-miles traveled (VMT), spiked upward in 1974 and 1979-1980 as a result of the oil price shocks. VMT per capita dropped slightly in response to higher prices, as unnecessary driving was temporarily curtailed. However, long-term factors such as land-use patterns, commuting habits, and the long lifetimes of vehicles mean that large swings in fuel prices lead to only small changes in miles driven.

Increasing sales of more fuel-efficient vehicles in the early 1980s combined with declines in the price of highway fuels caused a rapid drop in the fuel cost of driving, from a high of 15.4¢ per mile in 1981 to 7.5¢ in 1988 (in 2000 dollars). However, real gasoline prices changed little in the next 10 years, and new vehicle fuel efficiency declined slightly, resulting in little change in the fuel cost of driving. Low gasoline prices helped push the fuel cost of driving to an historic low in 1998, but higher fuel prices since then reversed this trend. By 2005 the fuel cost of driving had risen almost 90 percent. Meanwhile, per capita vehicle travel increased steadily during the 1980s, but has been relatively constant since 1993.

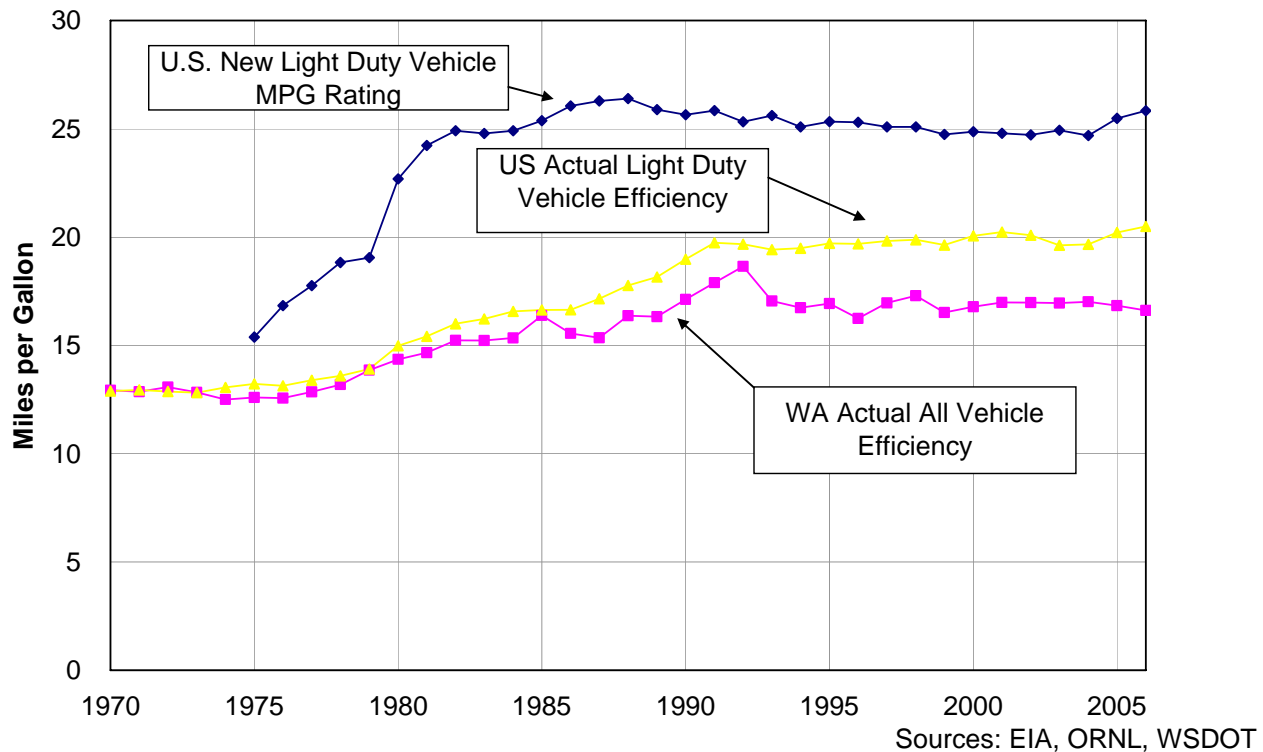
Sources: Energy Information Administration's State Energy Data System; President's Council of Economic Advisors; Federal Highway Administration, Washington State Dept. of Transportation, Washington State Office of Financial Management.

Transportation Fuel Cost of Driving and Travel		
Units: miles/person and cents/mile		
Year	Vehicle Miles per Person	Fuel Cost of Driving
1970	5,968	10.16
1971	6,066	9.73
1972	6,365	9.02
1973	6,671	9.41
1974	6,360	12.07
1975	6,476	11.78
1976	6,791	11.65
1977	7,128	11.47
1978	7,457	10.83
1979	7,416	12.68
1980	6,920	15.29
1981	6,962	15.39
1982	7,189	13.40
1983	7,421	11.47
1984	7,674	11.17
1985	7,759	10.25
1986	7,878	8.24
1987	8,219	8.25
1988	8,674	7.53
1989	8,975	7.89
1990	9,028	8.47
1991	9,250	7.62
1992	9,606	7.33
1993	8,761	7.66
1994	8,841	7.98
1995	9,003	7.94
1996	8,873	8.83
1997	9,017	8.08
1998	9,031	6.74
1999	9,041	8.05
2000	9,048	9.56
2001	8,982	8.73
2002	9,066	7.73
2003	9,021	9.19
2004	9,026	10.61
2005	8,867	12.71

Transportation Sector Energy Intensity

Spurred by high gasoline prices and new vehicle fuel efficiency, the fuel efficiency of Washington's existing vehicle fleet increased by more than 45 percent between 1975 and 1992. The increasing popularity of less fuel efficient vehicles in the 1990s such as vans, trucks, and sport utility vehicles put an end to this trend.

New Vehicle Miles per Gallon and Washington State Actual Vehicle Miles per Gallon (1970-2006)



Like other sectors, Washington's transportation sector has become more energy efficient over the years. 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, this improvement came to an end in the 1990s. Since 1992 Washington's vehicle fleet efficiency declined by 2.0 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 has not improved since the mid-1980s, when Congress last increased Corporate Average Fuel Economy (CAFE) standards. The CAFE standards required automakers to maintain the average fuel efficiency of new vehicles at 27.5 MPG for cars and 20.5 MPG for light trucks (which includes minivans, pickups, and sport-utility vehicles). CAFE had no mandates about how many vehicles may be sold in each category, and the increasing popularity of light trucks caused the fuel efficiency of the average new vehicle to drop by almost two MPG between 1988 and 1999. However, in 2005 this downward trend began to change and recent Congressional passage of higher CAFE standards should lead to higher new vehicle fuel efficiency.

It is important to note that the actual on-road fuel efficiency of new vehicles is less than the EPA-rated fuel efficiency shown by the top line in the figure²⁰. As a result, the actual on-road efficiency of new cars and trucks is not better than the existing vehicle fleet. This is reflected by the U.S. actual light duty vehicle MPG in the chart. Vehicle stock turnover has not appreciably raised the efficiency of the vehicle fleet since the early 1990s.

Sources: Energy Information Administration's State Energy Data System; Federal Highway Administration; Washington State Dept. of Transportation; Oak Ridge National Laboratories Center for Transportation Analysis

Transportation Sector Energy Intensity			
Units: Miles per Gallon			
Year	Washington All Vehicle Efficiency	U.S. Light Duty Vehicle Efficiency	U.S. New Light Duty Vehicle MPG Rating
1970	12.9		12.9
1971	12.9		13.0
1972	13.1		12.9
1973	12.8		12.8
1974	12.5		13.1
1975	12.6	15.4	13.2
1976	12.6	16.8	13.1
1977	12.9	17.8	13.4
1978	13.2	18.8	13.6
1979	13.9	19.1	13.9
1980	14.4	22.7	15.0
1981	14.7	24.2	15.4
1982	15.2	24.9	16.0
1983	15.2	24.8	16.2
1984	15.3	24.9	16.6
1985	16.4	25.4	16.6
1986	15.6	26.1	16.7
1987	15.4	26.3	17.2
1988	16.4	26.4	17.8
1989	16.3	25.9	18.2
1990	17.1	25.7	19.0
1991	17.9	25.8	19.7
1992	18.7	25.3	19.7

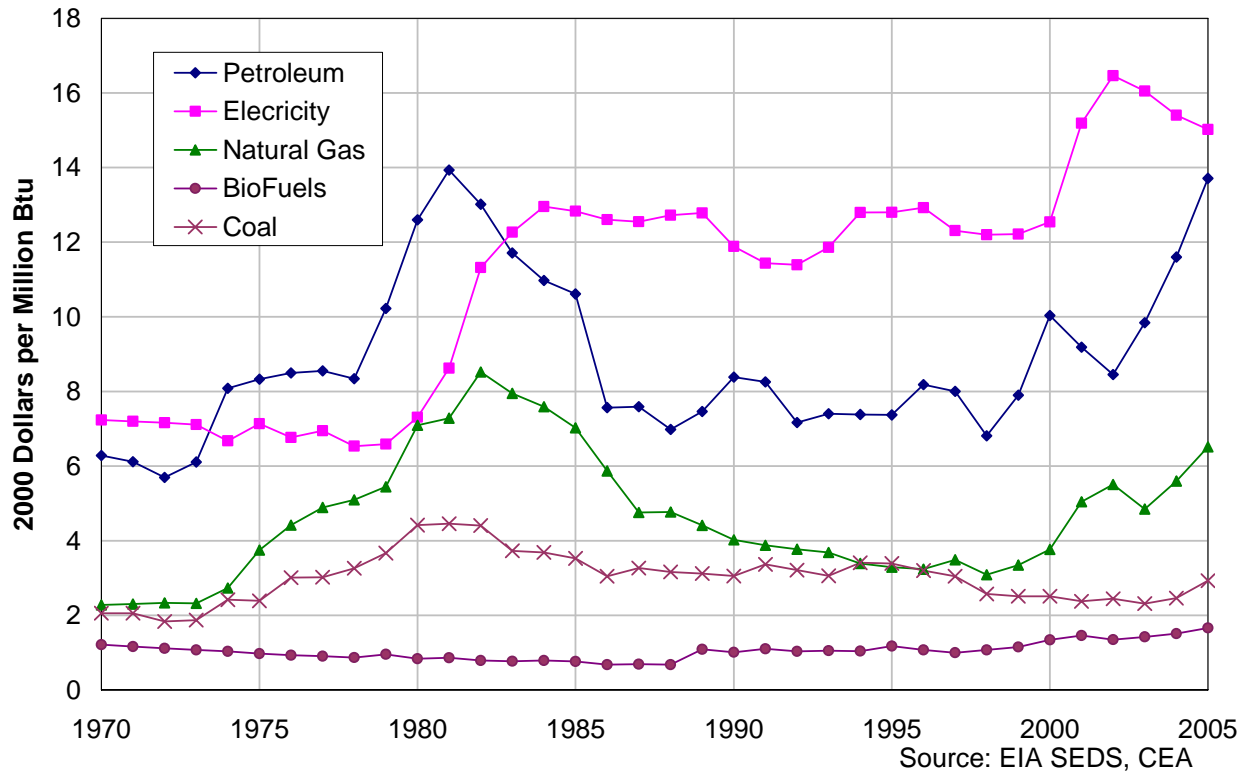
²⁰ The Energy Information Administration estimates actual, on-road performance to be 25.5 percent worse than the EPA rating for cars and 18.7 percent worse for light trucks for models in 2000. (EIA, *National Energy Modeling System*, Fuel Economy Degradation Factor).

1993	17.1	25.6	19.4
1994	16.7	25.1	19.5
1995	16.9	25.3	19.7
1996	16.2	25.3	19.7
1997	17.0	25.1	19.8
1998	17.3	25.1	19.9
1999	16.5	24.7	19.6
2000	16.8	24.9	20.1
2001	17.0	24.8	20.2
2002	17.0	24.7	20.1
2003	17.0	24.9	19.6
2004	17.0	24.7	19.7
2005	16.8	25.5	20.2
2006	16.6	25.8	20.5

Washington's Average Energy Prices by Fuel

Even though electricity prices in Washington tend to be lower than in other parts of the country, electricity is still the most expensive energy source. Real electricity prices²¹ rose in 2000 and 2001 after 15 years of relative stability. Real petroleum and natural gas prices declined significantly from highs in the early 1980s, but also began rising in the late 1990s.

Average Energy Prices by Fuel (1970-2005)



While the effect of the oil shocks of the 1970s and early '80s on Washington petroleum and natural gas prices was dramatic, it was short-lived. Real petroleum prices more than doubled from 1972 to 1981 and then returned to values close to pre-1974 levels by 1986 where they remained for almost 15 years. Real natural gas prices followed a similar trend, rising steeply during the 1970s, falling during the 1980s, and staying relatively stable in the 1990s. The average price of electricity, which had been low and stable for years, almost doubled between 1978 and 1984 as the costs of new nuclear power plants, some of which were never completed, were incorporated into electric utility rates. In contrast to oil and natural gas prices, real electricity prices did not decline from the level they reached during the early 1980s.

Prices for electricity, petroleum, and natural gas began rising in 1999 and 2000. While electricity prices have not continued to rise, natural gas and petroleum prices have increased through 2005.

²¹ Fuel prices are shown in real dollars. The actual (or nominal) prices in each year have been adjusted to constant dollars reflecting the value of a dollar in the year 2000. This is done by multiplying the nominal prices by a gross domestic purchases index for the U.S. for each year (where the value in 2000 equals 1). This adjusts for the effects of inflation and allows prices for different years to be compared.

Average price trends for coal are similar to the other fossil fuels, but the price swings have been less dramatic and the difference between coal and the more expensive energy sources has grown. Biofuel prices have been slowly rising since 1988, but this is still less expensive than the other sources.

Sources: Energy Information Administration's State Energy Data System; President's Council of Economic Advisors

Links: See the EIA State Energy Data System, <http://www.eia.doe.gov/emeu/states/seds.html>. In some cases, values downloaded from the SEDS system will not match the numbers in this report which are adjusted.

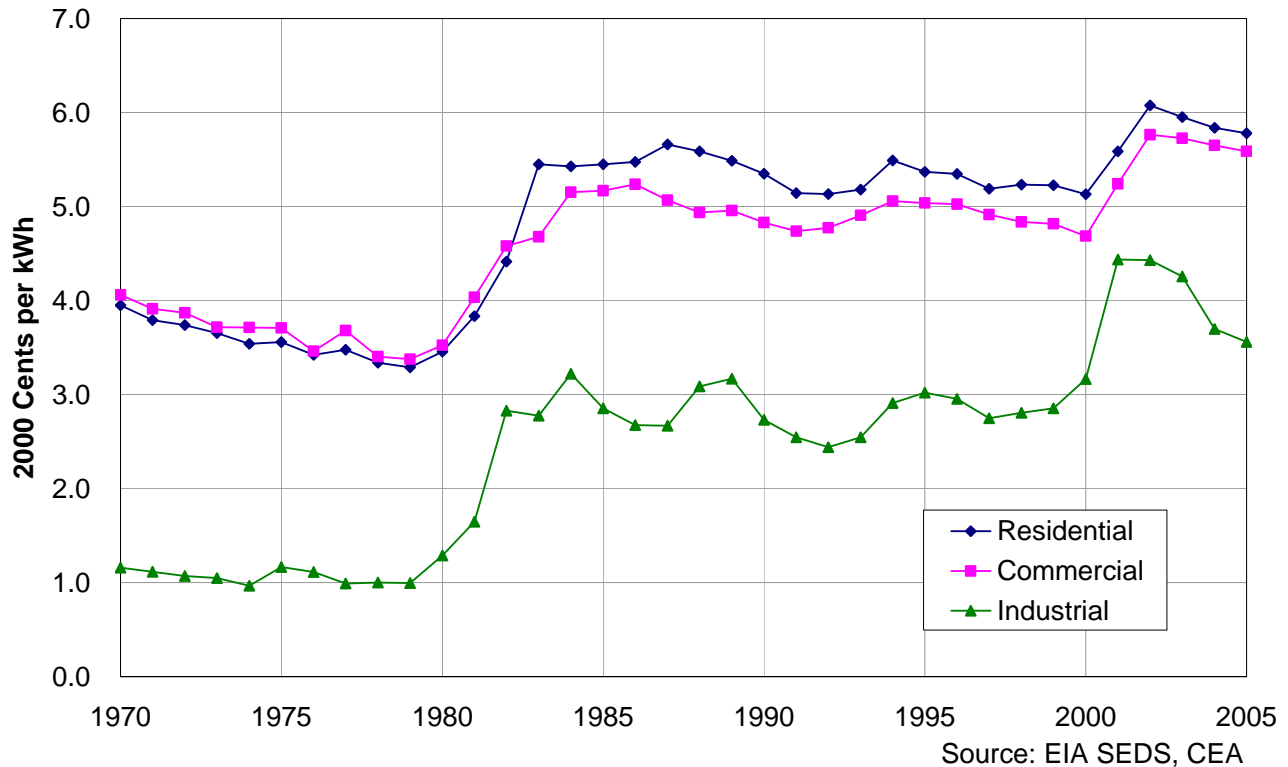
Average Energy Prices by Fuel					
Units: Dollars per million Btu					
Year	Petroleum	Electricity	Natural Gas	Bio-fuels	Coal
1970	6.28	7.23	2.28	1.21	2.05
1971	6.12	7.20	2.30	1.16	2.06
1972	5.69	7.16	2.33	1.11	1.83
1973	6.11	7.11	2.32	1.07	1.87
1974	8.08	6.67	2.73	1.04	2.42
1975	8.33	7.13	3.75	0.97	2.39
1976	8.50	6.76	4.41	0.93	3.01
1977	8.55	6.94	4.89	0.90	3.02
1978	8.34	6.53	5.09	0.86	3.26
1979	10.22	6.59	5.44	0.96	3.66
1980	12.60	7.31	7.09	0.84	4.42
1981	13.93	8.62	7.28	0.86	4.45
1982	13.02	11.32	8.52	0.79	4.40
1983	11.71	12.27	7.95	0.77	3.73
1984	10.97	12.96	7.59	0.79	3.69
1985	10.61	12.83	7.02	0.76	3.53
1986	7.57	12.60	5.87	0.68	3.04
1987	7.59	12.55	4.75	0.69	3.27
1988	6.98	12.72	4.77	0.68	3.16
1989	7.46	12.78	4.41	1.09	3.12
1990	8.38	11.89	4.02	1.01	3.05
1991	8.26	11.44	3.87	1.10	3.36
1992	7.17	11.39	3.77	1.03	3.21
1993	7.40	11.86	3.68	1.05	3.06
1994	7.38	12.79	3.39	1.04	3.41

1995	7.37	12.80	3.29	1.17	3.39
1996	8.18	12.92	3.24	1.07	3.20
1997	8.00	12.31	3.49	0.99	3.05
1998	6.81	12.20	3.09	1.07	2.57
1999	7.90	12.22	3.35	1.15	2.51
2000	10.03	12.55	3.77	1.34	2.51
2001	9.18	15.19	5.05	1.46	2.37
2002	8.45	16.46	5.51	1.34	2.44
2003	9.85	16.05	4.85	1.42	2.31
2004	11.60	15.40	5.60	1.51	2.46
2005	13.71	15.02	6.52	1.66	2.93

Washington's Average Electricity Prices by Sector

Real electricity prices²² increased dramatically between 1979 and 1984 then stayed relatively constant through 1999 before rising again in 2000 and 2001. While industrial electricity prices are lower than the residential and commercial sectors, the relative price increases around 1980 and 2000 were much higher for the industrial sector.

Electricity Prices by Sector (1970-2005)



The most notable phases in real electricity prices were the steady or declining prices in the 1970s, the rapid increase between 1979 and 1984, and the period since 1984 when prices stayed relatively constant (with some up and down variation). This period of stable prices ended in 2001 and 2002 when prices trended upward. However, electricity prices have declined some since 2002, particularly in the industrial sector. Price increases in the early 1980s were due to the costs of the WPPSS nuclear power plants, while increases in 2001 and 2002 reflect the impacts of the West Coast Electricity Crisis.

Electricity price trends for the residential and commercial sectors from 1970 to 2005 were nearly identical. Industrial sector prices have been more volatile than residential and commercial prices. Industrial electricity prices in 2005 were three times greater than 1970, versus a 40 percent increase for

²² Electricity prices are shown in real dollars. The actual (or nominal) prices in each year have been adjusted to constant dollars reflecting the value of a dollar in the year 2000. This is done by multiplying the nominal prices by a gross domestic purchases index for the U.S. for each year (where the value in 2000 equals 1). This adjusts for the effects of inflation and allows prices for different years to be compared.

the residential and commercial sectors²³. On a per unit basis, the average increase also varied: 1.8¢ per kWh for residential, 1.5¢ per kWh for commercial, and 2.4¢ per kWh for industrial.

Sources: Energy Information Administration's State Energy Data System; President's Council of Economic Advisors

Links: The Electric Sales and Revenue spreadsheet on the Washington Energy Policy website contains data on electric utilities in Washington State, including utility-level kWh sales, revenue, average prices, and number of customers from 1989 to 2002.

http://www.cted.wa.gov/CTED/documents/ID_1214_Publications.xls

EIA State Energy Data System, http://www.eia.doe.gov/emeu/states/_seds.html. In some cases, values downloaded from the SEDS system will not match the numbers in this report which are adjusted.

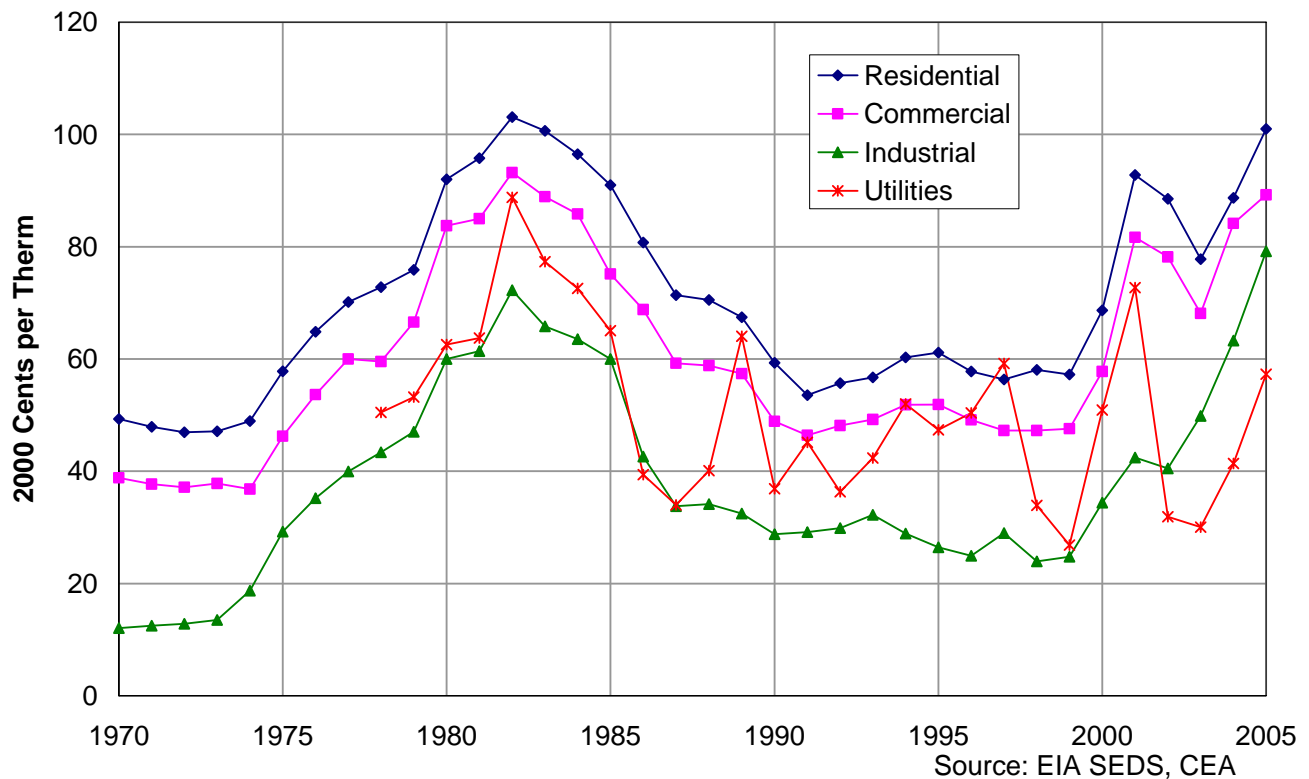
²³ Industrial electricity prices include the aluminum industry and other Direct Service Industries (DSI) that have historically had access to relatively low cost electricity from the Bonneville Power Administration. As production in these electricity price sensitive industries (such as aluminum smelters) varies, it can have an impact on average industrial electricity prices. For example, in 2001 when aluminum smelters curtailed their production, non-DSI industries paying higher electricity prices made up a larger share of industrial electricity consumption, contributing to the increase in average industrial electricity prices.

Electricity Prices by Sector			
Units: Cents per kWh			
Year	Residential	Commercial	Industrial
1970	3.95	4.06	1.16
1971	3.79	3.91	1.11
1972	3.74	3.87	1.07
1973	3.65	3.72	1.05
1974	3.54	3.71	0.97
1975	3.56	3.71	1.16
1976	3.42	3.46	1.11
1977	3.48	3.68	0.99
1978	3.34	3.41	1.00
1979	3.29	3.38	1.00
1980	3.46	3.52	1.29
1981	3.83	4.03	1.65
1982	4.41	4.58	2.83
1983	5.45	4.68	2.78
1984	5.43	5.15	3.22
1985	5.45	5.17	2.85
1986	5.48	5.24	2.68
1987	5.66	5.07	2.67
1988	5.59	4.94	3.09
1989	5.49	4.96	3.17
1990	5.35	4.83	2.73
1991	5.14	4.74	2.55
1992	5.13	4.77	2.44
1993	5.18	4.91	2.55
1994	5.49	5.06	2.91
1995	5.37	5.04	3.02
1996	5.35	5.02	2.95
1997	5.19	4.91	2.75
1998	5.23	4.84	2.81
1999	5.23	4.82	2.85
2000	5.13	4.69	3.17
2001	5.59	5.24	4.44
2002	6.08	5.77	4.43
2003	5.95	5.73	4.26
2004	5.84	5.65	3.70
2005	5.78	5.59	3.56

Washington's Average Natural Gas Prices by Sector

Real natural gas prices²⁴ increased rapidly for all sectors between 1974 and 1982 and declined just as rapidly from 1982 to 1991. After remaining relatively stable during the 1990s, natural gas prices began to rise in 2000, reflecting supply constraints and increasing demand.

Natural Gas Prices by Sector (1970-2005)



Real natural gas prices have followed a cyclical pattern over the last 35 years. Prices rose from 1974 and 1982, then declined between 1982 and 1991, stayed relatively stable during the 1990s and then started rising again in 2000. By 2005, prices were approaching or had exceeded the historic highs of 1992 for the residential, commercial and industrial sectors. This reflects supply constraints and growing demand, in part due to the increasing use of natural gas by the utility sector for electricity generation.

Average industrial natural gas prices have been significantly lower than the other sectors, but by 2005 that difference had declined significantly. Many large industrial customers began to make bulk purchases of commodity gas from suppliers other than their local utilities during the 1990s, helping to keep industrial prices down. But when prices began to climb in 1999, the increase was more dramatic for the industrial sector than the other sectors.

²⁴ Natural gas prices are shown in real dollars. The actual (or nominal) prices in each year have been adjusted to constant dollars reflecting the value of a dollar in the year 2000. This is done by multiplying the nominal prices by a gross domestic purchases index for the U.S. for each year (where the value in 2000 equals 1). This adjusts for the effects of inflation and allows prices for different years to be compared.

The utility sector has historically used natural gas to fire relatively small power plants used for “peaking,” which at least partially explains the price volatility experienced in that sector. Consumption was historically low, with gas often being purchased on the spot market when needed. But the use of natural gas for electricity generation has been growing. Utility natural gas prices spiked in 2001 due to shortages in hydroelectricity, creating a need to operate natural gas power plants, resulting in high demand for natural gas.

Sources: Energy Information Administration's State Energy Data System; President’s Council of Economic Advisors

Links: EIA State Energy Data System, http://www.eia.doe.gov/emeu/states/_seds.html. In some cases, values downloaded from the SEDS system will not match the numbers in this report which are adjusted.

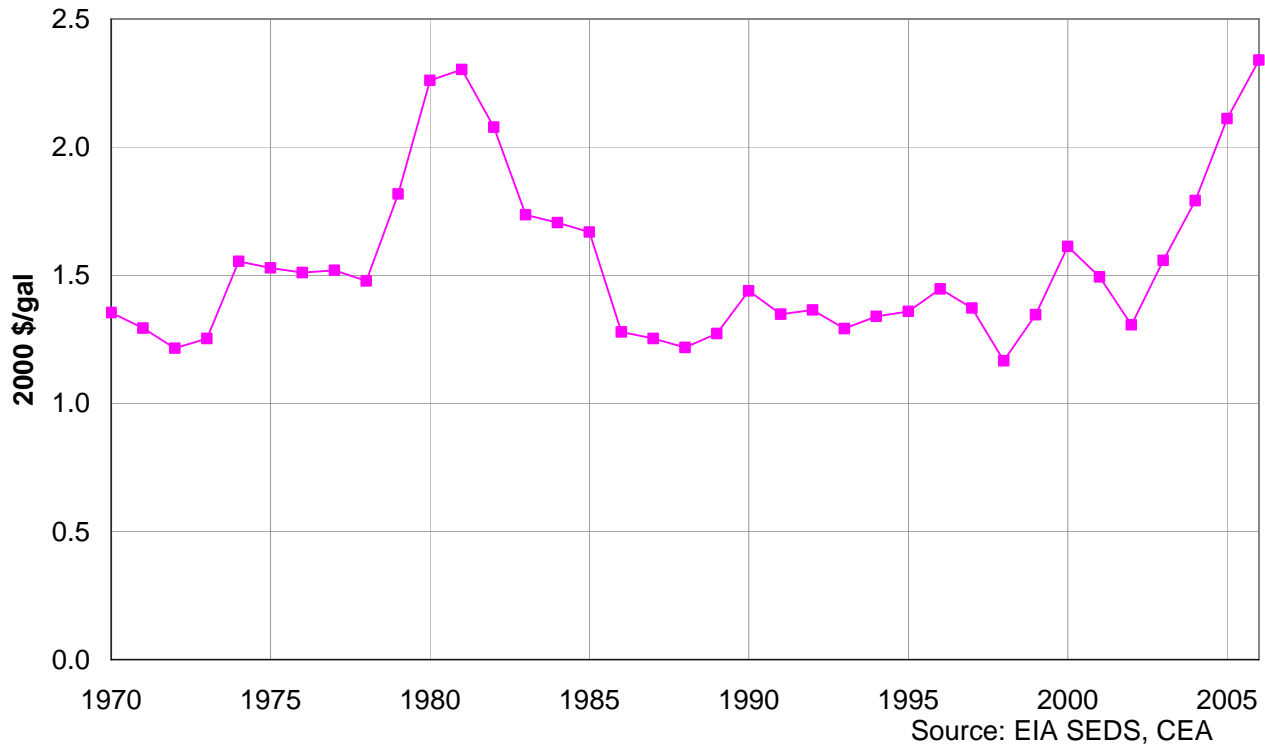
Natural Gas Prices by Sector				
Units: Billion Btu				
Year	Residential	Commercial	Industrial	Electric Utility
1970	49.3	38.8	12.1	-
1971	47.9	37.7	12.5	-
1972	46.9	37.2	12.8	-
1973	47.1	37.8	13.5	-
1974	48.9	36.8	18.7	-
1975	57.8	46.2	29.2	-
1976	64.8	53.6	35.2	-
1977	70.1	60.0	40.0	-
1978	72.8	59.5	43.4	50.5
1979	75.9	66.6	47.0	53.2
1980	92.0	83.7	60.0	62.6
1981	95.7	85.0	61.4	63.8
1982	103.1	93.2	72.2	88.8
1983	100.6	88.9	65.8	77.3
1984	96.5	85.8	63.5	72.6
1985	91.0	75.1	60.0	65.1
1986	80.8	68.8	42.6	39.4
1987	71.4	59.2	33.8	34.0
1988	70.5	58.8	34.2	40.1
1989	67.4	57.4	32.5	64.0
1990	59.3	48.9	28.8	36.9
1991	53.6	46.4	29.2	45.1
1992	55.7	48.1	29.9	36.3
1993	56.7	49.2	32.2	42.4
1994	60.3	51.8	28.9	52.0

1995	61.1	51.9	26.5	47.4
1996	57.8	49.1	24.9	50.4
1997	56.3	47.3	29.0	59.2
1998	58.1	47.2	23.9	33.9
1999	57.2	47.6	24.8	26.8
2000	68.7	57.7	34.4	50.9
2001	92.8	81.7	42.4	72.7
2002	88.5	78.2	40.5	31.9
2003	77.8	68.1	49.9	30.1
2004	88.7	84.1	63.3	41.4
2005	101.0	89.2	79.2	57.3

Washington Gasoline Prices Since 1970

Adjusted for inflation²⁵, gasoline prices²⁶ in Washington peaked in 1981, and then declined to an historic low in 1998, before exceeding the 1981 peak in 2006.

Washington State Gasoline Prices (1970-2006)



For 30 years inflation-adjusted gasoline prices in Washington have been relatively stable except for two periods: from 1979-1983 when prices spiked due to the world oil crisis and since 2002 when growing world petroleum demand approached supply. After peaking in 1981 at \$2.30 per gallon (2000 dollars), prices dropped to pre-oil crisis levels by 1986. In 1998, gasoline prices fell to their lowest level in this 30-year period, but rose again beginning in 1999, reflecting increasing world oil prices. A downturn in the world economy briefly interrupted this climb in prices, but by 2006 the price of a gallon of gasoline in Washington exceeded the peak price in 1981.

The majority of petroleum for Washington comes from Alaska and most of this is refined into gasoline in Washington, but the price we pay for gasoline is influenced by world oil prices. Gasoline prices in Washington tend to be a little bit higher than the national average.

²⁵ Fuel prices are shown in real dollars. The actual (or nominal) prices in each year have been adjusted to constant dollars reflecting the value of a dollar in the year 2000. This is done by multiplying the nominal prices by a gross domestic purchases index for the U.S. for each year (where the value in 2000 equals 1). This adjusts for the effects of inflation and allows prices for different years to be compared.

²⁶ Gasoline prices from EIA include state and federal gasoline taxes but they do not include local sales tax.

Sources: Energy Information Administration's State Energy Data System; President's Council of Economic Advisors

Links: For more information on gasoline prices, see the "Primer on Gasoline Prices in Washington State" on the Energy Policy website:

http://www.cted.wa.gov/CTED/documents/ID_1923_Publications.pdf.

For current gasoline price information see AAA's Fuel gauge report: <http://www.fuelgaugereport.com/>

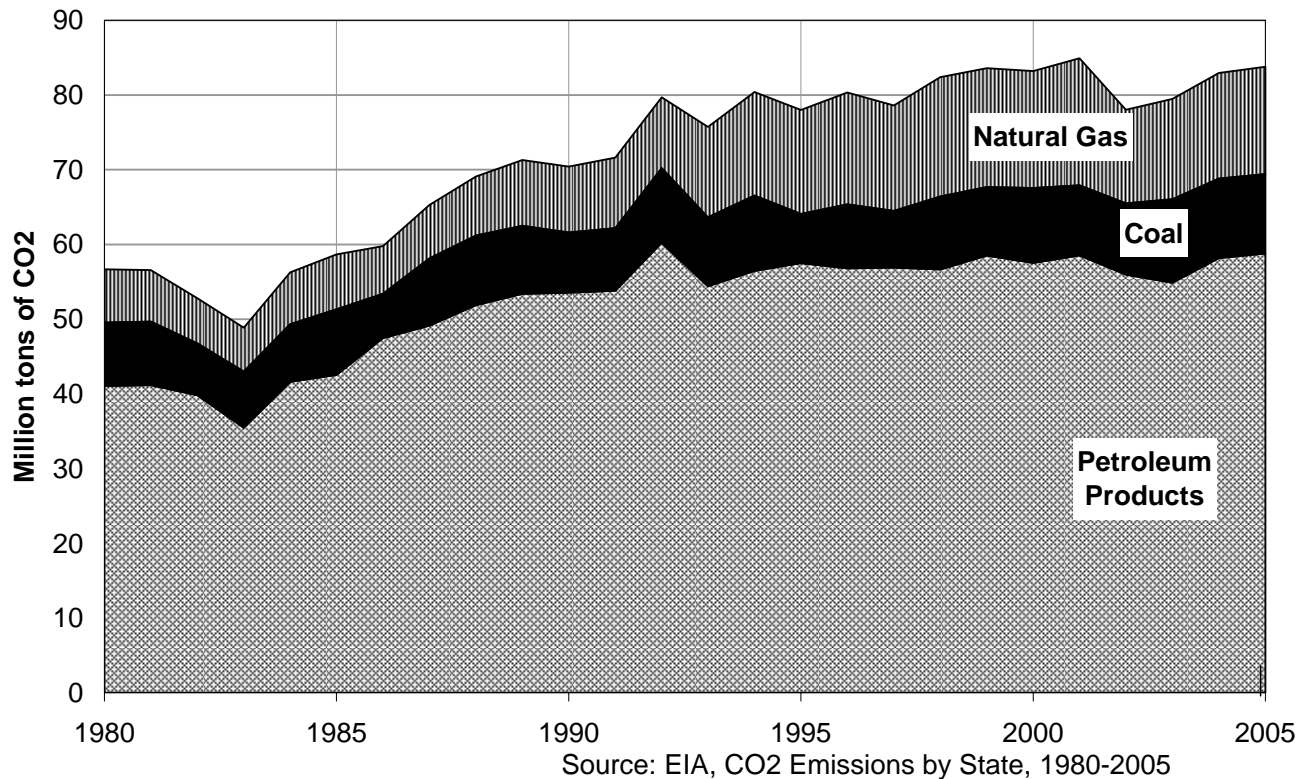
Washington State Gasoline Prices	
Units: \$/gallon (2000 \$)	
Year	Motor Gasoline Price
1970	1.35
1971	1.29
1972	1.21
1973	1.25
1974	1.55
1975	1.53
1976	1.51
1977	1.52
1978	1.48
1979	1.82
1980	2.26
1981	2.30
1982	2.08
1983	1.74
1984	1.71
1985	1.67
1986	1.28
1987	1.25
1988	1.22

Washington State Gasoline Prices	
Units: \$/gallon (2000 \$)	
Year	Motor Gasoline Price
1989	1.27
1990	1.44
1991	1.35
1992	1.36
1993	1.29
1994	1.34
1995	1.36
1996	1.45
1997	1.37
1998	1.17
1999	1.35
2000	1.61
2001	1.49
2002	1.31
2003	1.56
2004	1.79
2005	2.11
2006	2.34

Energy-Related Carbon Dioxide Emissions

Washington's reliance on fossil fuels has led to steady growth in emissions of carbon dioxide, the principal anthropogenic greenhouse gas, through 2001. Petroleum use, primarily for transportation, accounted for 70 percent of CO₂ emissions from energy use in Washington in 2005.

**Carbon Dioxide Emissions from Energy Use by Source
(1980-2005)**



Washington's continued dependence on fossil fuels for energy, particularly petroleum, has led to growth in emissions of carbon dioxide (CO₂), the principal "greenhouse gas" contributing to global climate change, for much of the last 25 years. After dipping in the early 1980s, growth in carbon dioxide emissions accelerated after 1983 as the economy recovered from a protracted recession and oil prices plummeted. Washington's CO₂ emissions from energy use grew more than 70 percent between 1983 and 2001. Emissions dropped in 2002 as a result of lower energy use due to a recession, shut down of the Northwest aluminum industry, and higher energy prices; emissions appear to have returned to a growth pattern since then.

Consumption of petroleum products, the vast majority for transportation, accounted for most of the growth in Washington's energy-related CO₂ emissions. Emissions from coal are almost entirely from one source, the Centralia Steam Plant which burns coal to produce electricity. Natural gas contains less carbon per unit of energy than other fossil fuels, but because of higher levels of consumption accounts for a larger share of Washington's CO₂ emissions than coal.

Sources: Energy Information Administration, CO₂ Energy Emissions by State

Links: http://www.eia.doe.gov/oiaf/1605/state/state_emissions.html

Carbon Dioxide Emissions from Energy Use by Source				
Units: Million Tons of CO ₂				
Year	Coal	Petroleum Products ²⁷	Natural Gas	Total
1980	8.5	41.1	7.1	56.7
1981	8.5	41.2	6.9	56.6
1982	6.9	39.8	6.0	52.8
1983	7.5	35.5	5.9	48.9
1984	7.7	41.6	6.9	56.3
1985	8.8	42.5	7.4	58.7
1986	5.9	47.5	6.4	59.8
1987	9.0	49.1	7.1	65.3
1988	9.3	51.9	7.9	69.1
1989	9.1	53.4	8.8	71.3
1990	8.0	53.6	8.8	70.4
1991	8.4	53.8	9.4	71.6
1992	10.0	60.2	9.5	79.7
1993	9.2	54.4	12.1	75.7
1994	10.1	56.5	13.9	80.4
1995	6.6	57.5	13.9	78.0
1996	8.6	56.8	15.0	80.3
1997	7.6	56.9	14.1	78.6
1998	9.8	56.6	16.0	82.4
1999	9.1	58.5	15.9	83.6
2000	10.0	57.5	15.7	83.2
2001	9.4	58.5	17.0	84.9
2002	9.5	56.0	12.5	78.0
2003	11.2	54.9	13.4	79.5
2004	10.6	58.2	14.1	82.9
2005	10.6	58.8	14.4	83.8

²⁷ The petroleum products category includes residual fuel, which is not as accurately tracked by the EIA, and leads to considerable category variance. Some fuel and emission inventories exclude residual or bunker fuel as much of it ends up powering foreign flagged ships.

Methodology

Introduction

Most publicly available comprehensive energy data at the state level originate with surveys and estimates developed by the Energy Information Administration (EIA), an independent branch of the federal Department of Energy. We rely heavily on the EIA's State Energy Data System (SEDS) to produce Energy Indicators and other products. However we modify data from the EIA, based on years of experience with their components to more accurately portray energy use in Washington. This includes the exclusion of non-energy uses of petroleum and the calculation of primary energy use for hydroelectricity generation.

Excluded Petroleum Products

We exclude the consumption of petroleum products for non-energy purposes. This includes asphalt, road oil, and lubricants from the transportation and industrial sectors. These are easily removed series that are clearly not used as energy sources.

We also exclude industrial petroleum coke, used in various forms as a source of pure carbon. The EIA series for industrial coke comprises coke used in oil refining and primary aluminum smelting. Neither of these processes uses coke for its energy content, but rather for its catalytic and conductive properties. These two types of coke are allocated to states, not according to measured use at the state level, but instead based on their share of the United States' annual capacity in the respective industries multiplied against US industrial coke use. The capacity of both industries has grown considerably in Washington, and their share of the US total has also grown.

Indexed against 1970, the first year in which data pairs showing consumption and expenditure are available in SEDS, the Washington aluminum industry expanded by almost a third by 1997, and represented the largest primary smelting share of any state, at 29 percent of the nation's total. Recently this share has declined.

While representing a much smaller share of the nation's petroleum refining industry, Washington's oil refineries have seen continued growth, while US capacity has changed little since the mid-80s.

The effect of these growing industries combined with the EIA inclusion of the (non-energy) petroleum coke they use as industrial energy consumption has resulted in distortion of the true patterns of industrial energy consumption, and thus an inflated view of energy use overall in Washington. That effect was magnified in the 1980s and 90's, when at their peak, these non-fuel petroleum products accounted for more than a fourth of the total Washington industrial energy use claimed by the EIA.

We have also excluded other non-energy consumption such as petroleum used as feedstock for paints and solvents, or to make waxes to coat packaging. The focus of this analysis is energy consumption in Washington, rather than the supply of and demand for petroleum products or other fossil fuels. Excluding these non-energy uses provides the most accurate picture of the consumption of energy in the state.

Hydroelectric Conversion

One last methodological note must be made to explain the differences one may notice here compared to other tallies of state primary energy use. In a steam powered generator, as much as two-thirds of the energy in the fuel that is consumed is not converted to electricity, but is lost as waste heat due to thermal inefficiencies. Hydroelectric power generation does not experience thermal losses, but the EIA assigns losses to it equivalent to an average loss rate for fossil fuel powered generation, in an effort to enable comparison of primary energy consumption between individual states. We remove those imputed losses from our primary totals. This difference does not affect depictions of sector end-use consumption of energy, as these do not show primary consumption.

Methodology Summary

In summary, non-energy petroleum products used in aluminum smelting, oil refining, and other applications and the calculation of primary energy use for hydroelectricity generation require modifications to standard views of energy consumption to accurately portray the trends depicted in these Indicators.