Department of Commerce
Innovation is in our nature.

Energy Strategy Update and 2011 Biennial Energy Report with Indicators

Issues and Analysis for the Washington State Legislature and Governor

December 2010

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Executive Summary

Every two years Washington's *Biennial Energy Report* ("Biennial Report") describes recent trends in energy prices and expenditures, and updates various series of energy indicators dating back to 1960.[a]

Relative to the period of the 1990s through the early 2000's, the past six years have presented Washington state residents and businesses with volatile and generally increasing energy prices. After steadily increasing from 2004 through 2006, energy prices, particularly those for petroleum products and natural gas, began to rise rapidly starting in late 2007 through the first half of 2008. Prices reached a peak in mid July, and then dropped precipitously in the second half of 2008 as the global credit crisis and recession deepened. Prices continued to decline through early 2009 as the recession deepened and took its toll on the economy. By late fall of 2010 prices for petroleum products had recovered to late 2007 levels, but natural gas prices remained depressed. Since the West coast energy crisis of 2000-01 electricity prices have been less volatile, moving up at roughly the rate of inflation.

Energy expenditures, measured as a percentage of gross state product (GSP), followed the trend of prices, rising rapidly in 2007 and 2008, then declining in 2009. As of 2008, the last year for which complete data are available, gross energy consumption in the state was near record levels, though we anticipate reporting slight declines in 2009 and 2010 in the 2013 Biennial Report, when data for these years are available.

This 2011 edition of Washington's *Biennial Energy Report* features an update to the State Energy Strategy. The update is called for in legislation passed in early 2010,[b] though its importance is already underlined by the relatively high prices and consumption seen in the trends and indicators. The legislation directs the Department of Commerce, in conjunction with an Advisory Committee consisting of a broad group of energy system stakeholders, to develop a State Energy Strategy that addresses three goals:

1. **Maintain competitive energy prices that are fair and reasonable for consumers and businesses and support our state's continued economic success;**
2. **Increase competitiveness by fostering a clean energy economy and jobs through business and workforce development; and**
3. **Meet the state's obligations to reduce greenhouse gas emissions.**

With these goals in mind, the Department of Commerce has launched an 18 month long, comprehensive analytic effort to support long-term energy policy that balances energy price and

[a] RCW 43.21.F.045 (h) "No later than December 1, 1982, and by December 1st of each even-numbered year thereafter, prepare and transmit to the governor and the appropriate committees of the legislature a report on the implementation of the state energy strategy and other important energy issues, as appropriate."

[b] Engrossed Second Substitute House Bill 2658 (2010), and Directive by the Governor 10-07.

security with the increasing pressures from greenhouse gas emissions reduction obligations. The analysis is guided by a Technical Experts Panel representing several Northwest institutions with high levels of expertise in energy planning. The analysis will forecast possible energy technologies over the next 25 years, and as a consequence will also point to economic development opportunities that those new, clean energy technologies will bring to Washington.

At the time of this Biennial Report the analytic effort is less than half done. The Energy Strategy Update in this Biennial Report offers 17 short-term policy initiatives that can work together to fill gaps in existing policy, and encourage development of Washington's energy economy. The initiatives cover four main areas of action:

- Residential & Commercial Buildings Efficiency
- Industrial Energy Efficiency
- Transportation Efficiency & Technology
- Streamlined Permitting for Clean and Advanced Energy Technologies

The initiatives are necessarily cautious in scope, as the full analysis must be complete before major shifts in state energy policy can be proposed.

Chapter 1 – Energy Strategy Update

Introduction

Legislative Background

In the spring of 2010, the Washington State Legislature passed, and the Governor signed into law, Engrossed Second Substitute House Bill 2658 (E2SHB 2658), which called for the state to implement a comprehensive energy planning process and directed Commerce to lead this effort. The last state comprehensive energy strategy was adopted in 1993, and the most recent update, focusing just on electricity, was completed in 2003.

The planning process described in the legislation consists of two separate yet interrelated processes. One process being the development of the analytical tools and resources to support an ongoing planning process based on high quality, unbiased analysis and the second being the planning and development of the strategy itself. Section 404 of E2SHB 2685 established the process Commerce was to follow for the revision to the State Energy Strategy. This included producing an update by December 1, 2010 and a full revision by December 1, 2011.

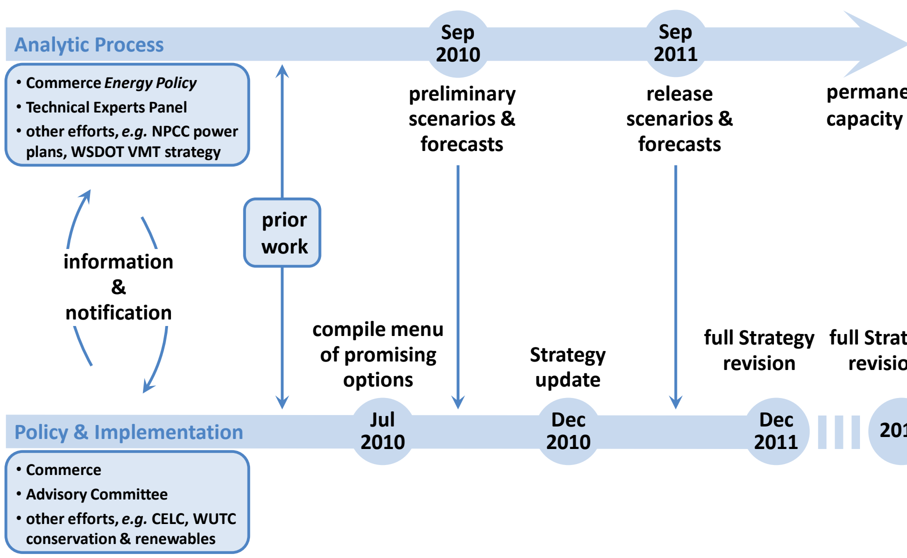

Figure 1-1: The 2010-2011 State Energy Strategy Process

The Governor vetoed Section 404 due to concerns regarding language about the separation of powers between the executive and legislative branches of government. She then issued Directive 10-07 to the Department of Commerce, instructing Commerce to honor the update process and schedule originally intended in Section 404.

E2SHB2658 declares that a successful State Energy Strategy must balance three goals to

1. Maintain **competitive energy prices** that are fair and reasonable for consumers and businesses and support our state's continued economic success;

2. Increase competitiveness by fostering a **clean energy economy and jobs** through business and workforce development

3. Meet the state's obligations to **reduce greenhouse gas emissions**.

Additionally, the legislation also specified *nine principles* that the strategy should follow:

1. Pursue all cost-effective **energy efficiency and conservation** as the state's preferred energy resource, consistent with state law;

2. Ensure that the state's energy system meets the health, welfare, and economic needs of its citizens with particular emphasis on meeting the needs of **low-income and vulnerable populations**;

3. Maintain and enhance economic competitiveness by ensuring an affordable and reliable supply of energy resources and by supporting clean energy technology innovation, access to clean energy markets worldwide, and **clean energy business and workforce development**;

4. Reduce dependence on fossil fuel energy sources through improved efficiency and development of **cleaner energy sources**, such as bioenergy, low-carbon energy sources, and natural gas, and leveraging the indigenous resources of the state for the production of clean energy;

5. Improve **efficiency of transportation** energy use through advances in vehicle technology, increased system efficiencies, development of electricity, biofuels, and other clean fuels, and regional transportation planning to improve transportation choices;

6. Meet the state's statutory **greenhouse gas limits** and environmental requirements as the state develops and uses energy resources;

7. Build on the advantage provided by the state's **clean regional electrical grid** by expanding and integrating additional carbon-free and carbon-neutral generation, and improving the transmission capacity serving the state;

8. **Make state government a model** for energy efficiency, use of clean and renewable energy, and greenhouse gas-neutral operations; and

9. Maintain and enhance our state's existing **energy infrastructure**.

Advisory Committee

In May of 2010, Commerce established an Advisory Committee of 25 members to advise Commerce on the State Energy Strategy policy and implementation recommendations. The Advisory Committee represents a broad range of energy interests, including energy generation, distribution, and consumption; economic development; and, environmental protection.

The Advisory Committee met five times during the development of the update and discussed a broad array of topics and policy options. Commerce also arranged for six webinars on a wide range of topics to inform committee members. The Advisory Committee members received briefings on topics of interest including:

Advisory Committee Meeting Discussions:

- Energy Strategy Analytic Framework
- State Energy Game Board – Physical Systems
- State Energy Game Board – Institutions and Policies
- Carbon Pricing
- Clean Energy Leadership Council recommendations
- Department of Ecology climate change update (pending)
- Department of Transportation sustainable transportation update (pending)
- Utilities and Transportation Commission update (pending)
- Technical Expert Panel updates

Webinar and workshop topics

- Evergreen Jobs Act
- Scenario Planning Overview
- Conservation Incentives and Regulation of Renewable Resources
- Transportation and Land Use
- Building Strategy
- Energy Facility Regulatory Overview
- Scenario Planning joint workshop with Technical Experts Panel

State Energy Strategy Advisory Committee

Rogers Weed, Committee Co-chair
Department of Commerce

Sharon Nelson, Committee Co-chair
National Commission on Energy Policy / Itron

David Benson, **Stoel Rives**

Terry Brewer, **Grant County PUD**

Shari Brown, **Weyerhaeuser**

Mike Davis, **Pacific Northwest National Laboratory**

Senator Jerome Delvin, **Washington State Senate**

Bob Drewel, **Puget Sound Regional Council**

Dave Finet, **Bellingham Opportunity Council**

KC Golden, **Climate Solutions**

Don Guillot, **IBEW Local 77**

Kimberly Harris, **Puget Sound Energy**

Nancy Hirsh, **NW Energy Coalition**

Tom Karier
Northwest Power & Conservation Council

William Kidd, **BP America**

Steve Klein, **Snohomish County PUD**

Bob Link, **AREVA NP Inc.**

Rick LeFaivre, **OVP Venture Partners**

Representative John McCoy
Washington State House of Representatives

Kris Mikkelsen, **Inland Power & Light Company**

Steve Rigdon, **Yakama Power**

Senator Phil Rockefeller, **Washington State Senate**

Commissioner Dave Sauter, **Klickitat County**

Representative Shelly Short
Washington State House of Representatives

Councilmember Larry Smith, **City of Vancouver**

Technical Experts Panel

Commerce also convened a Technical Experts Panel consisting of eleven members from seven different institutions including research institutions, educational institutions and economic experts. The panel is charged with providing unbiased scenarios and forecasts to inform the State Energy Strategy and to identify and help build long-term energy analytical capacity. Demand, technology and resource scenarios are being developed and evaluated in terms of price, risk and other variables.

The Technical Experts Panel met three times through the update process with their key mission to develop the detailed analytics to support the comprehensive State Energy Strategy revision due December 1, 2011.

In addition to the Technical Experts Panel and Advisory Committee processes, Commerce invited comments into the process via public input sessions at each of the Advisory Committee meetings, through the State Energy Strategy website and through public meetings. Meetings were held in diverse locations in western, central and eastern Washington. Information regarding the process is available on the project website including past energy strategies, guiding legislation, committee activities and scheduled events. Commerce solicited public input on the draft update during a public comment period. Input was requested via mail and email as well as during two public meetings. The public meetings were held on October 5, 2010 in Spokane and again on October 14, 2010 in Tacoma. The comments and our responses are posted on the State Energy Strategy website.

State Energy Strategy
Technical Experts Panel

Northwest Power and Conservation Council
Howard Schwartz

Pacific Northwest National Laboratory
Marc Cummings, Dennis Stiles

Puget Sound Regional Council
Matthew Kitchen

University of Washington
Mark Hallenbeck, Daniel Schwartz

Washington State Department of Commerce
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Washington State University
Todd Currier , Chad Kruger

Policy Initiatives Expected from Other Processes

In parallel to the State Energy Strategy Update, other state agencies and related groups are pursuing policy initiatives that affect energy demand and supply in Washington State. These efforts revolve around the three interdependent topics of energy, climate and transportation, each represented by planning processes and documents that receive input from multiple initiatives at various state agencies.

The State Energy Strategy Update is crafted as a complement to the existing initiatives, not as an alternative. The following are state policy initiatives that will produce products over the next year, and are related to one or more of the principles or goals of the State Energy Strategy:

Department of Ecology

(www.ecy.wa.gov/climatechange)

- **2010 Comprehensive Plan:** Update on projects and recommendations for meeting greenhouse gas (GHG) emission reduction targets.
- **2020 Collaboration**: Voluntary strategies to meet reduction targets for large-scale emitters.
- **GHG Benchmarking**: Voluntary emission benchmarks recommendations by industry sector for facilities that may be covered by federal, regional or state programs.
- **State Agency GHG Emissions**: Inventory of agency emission estimates and technical assistance to help agencies meet emission reduction goals.
- **Mandatory GHG Reporting**: Rules revision to synchronize agency with EPA reporting requirements.
- **Biennial GHG Emissions Inventory:** Emissions reporting by each major source sector.
- **SEPA GHG Guidance**: Guidance on evaluating proposals under the State Environmental Protection Act that may result in emissions or be vulnerable to climate change impacts.
- **Low Carbon Fuel Standard:** Recommendations on an LCFS or alternate approach to reduce transportation sector emissions.
- **Forest Carbon Workgroup:** Offset program and other incentives for forestry and forest products industry, and additional strategies for avoiding land conversion.
- **Impacts, Preparation & Adaptation:** Climate response strategy, and integration of adaptation plans into policies, programs and infrastructure projects.
- **Environmentally Preferable Purchasing:** Legislation to allow specifying of environmental criteria in agency procurement, including low-energy or low-GHG products and services.

Department of Commerce

(www.commerce.wa.gov/energy)

- **Clean Energy Leadership Council:** Clean energy industry recommendations on economic development strategies to be incorporated into the State Energy Strategy.
- **State Building Code:** Strategic plan for enhancing energy efficiency and reducing GHG emissions in homes, buildings, districts and neighborhoods.
- **Evergreen Jobs Leadership Team**: Strategies to create new green economy jobs and coordinate state efforts to secure federal training funds.

Washington Utilities & Transportation Commission

(wutc.wa.gov/rulemaking)

- **Conservation Incentives**: Review of regulatory mechanisms to ensure utilities can meet energy conservation requirements in a cost-effective manner.
- **Regulatory Treatment for Renewable Energy:** Review of regulatory policies to ensure utilities can fulfill their state Renewable Portfolio Standard (RPS) obligations.

Department of Transportation

(www.wsdot.wa.gov/sustainabletransportation)

- **Sustainable Transportation Report**: Efforts to reduce transportation sector impacts on climate change, and encourage transportation-related energy diversification and conservation.

- **Vehicle-Miles Traveled (VMT) Assessment:** Estimate current and anticipated levels, evaluate potential benchmark changes, and examine of reduction goal impacts on the economy.
- **West Coast Green Highway**: Work with other states and private interests to make alternative fuels, including electricity, available along interstate corridors and associated metropolitan centers.

Transportation Commission

(www.wstc.wa.gov/WTP)

- **Washington Transportation Plan 2030**: Sets high-level strategy for all transportation modes 2011-2030.

A diagrammatic summary of these initiatives is available in Appendix C.

New Policy Initiatives Proposed in the Update

The Department of Commerce will lead some improvements to state energy policies in response to opportunities identified during creation of the Energy Strategy Update. Commerce is pursuing specifically those policies that complement the existing work of other agencies and build on our current base of state energy policies,[c] hence requiring a minimum of long-term, inter-agency planning and allowing Commerce to act immediately in concert with the existing efforts and their proponents. The policy proposals in this section also recognize the state's current financial situation which will severely limit the ability of governor and legislature to provide any new energy incentives either via direct funding or tax taxes. The December 2011 Full Revision will feature a fully integrated strategy coordinated among all state agencies and other stakeholders to Washington State Energy Policy.

The complementary initiatives Commerce plans to pursue appear below, in four rubrics as follows:

- Residential & Commercial Buildings Efficiency
- Industrial Energy Efficiency
- Transportation Efficiency & Technology
- Streamlined Permitting for Clean and Advanced Energy Technologies

Collectively, the initiatives reduce Washington energy demand by deploying efficiency, increasing the share of renewable energy generation in Washington's supply, and supporting Washington businesses' ability to supply advanced energy technologies to the rest of the world. Energy efficiency is recognized as the most cost effective resource in Washington, and it should be the preferred resource used to meet growing energy needs.

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[c] See Washington State Energy Policies in Statute at http://www.commerce.wa.gov/site/526/default.aspx

Residential & Commercial Buildings Efficiency

Energy efficiency in buildings is often the most cost-effective method to meet growing energy needs. For example, The Northwest Power and Conservation Council's *Sixth Power Plan* indicates that the Pacific Northwest can and should meet 85% of its future electricity needs through investments in conservation and efficiency. There is a growing interest in building on over three decades of significant achievements in Northwest efficiency, by increasing both the rate and extent of residential and commercial building energy efficiency. In addition, with one-time Recovery Act funding, state and local governments are testing and deploying a wide range of new approaches to marketing, financing, and delivering efficiency programs. These include intensive neighborhood pilot projects, creative financing through mechanisms such as loan loss reserves, and improved energy marketing and information tools. We are likely to see results from many of those approaches during 2011 when we can begin to incorporate lessons into the full update of the Energy Strategy.

The items below are some possible actions that we believe could increase residential and commercial energy efficiency activity in the near term. Beyond these specific initiatives, Commerce will also be continuing to research barriers to energy efficiency retrofits in local, state and federal laws, and propose policies to overcome those barriers.

1. **Improve Consumer Confidence in Energy Efficiency Retrofits**. Significant energy savings potential is available through retrofitting existing housing and commercial buildings with energy efficiency measures. Energy efficiency retrofits offer a net monetary savings over time, as lower energy bills offset the initial cost of the retrofit. However, for consumers to invest in those retrofits they need assurance that the forecast savings will in fact appear once installation is complete. A program that offers such assurance will benefit both consumers and the energy efficiency contracting industry, as the volume of retrofit work increases in response. Statewide implementation facilitates uniform marketing and delivery of services. A large number of existing quality assurance programs could provide a basis for a Washington State approach, including the proposed federal HomeStar program, U.S. EPA Home Performance with Energy Star, Air Conditioning Contractors of America certification, and several state-level programs around the U.S..

   We propose to develop and implement a streamlined program of contractor certification and registration, training standards, periodic third party inspection of contractors' work, and a complaint resolution system. Additional standardization such as standard contractor bid forms would clarify the work for consumers. The program will be designed to be compliant with the proposed, federal HomeStar program, or whichever national standard seems most likely to prevail at the time Washington's program moves forward.

2. **Financial tools for residential and commercial energy efficiency investments.** Energy efficiency investments often pay for themselves, but over a period of several years as lowered energy bills gradually recoup the up-front investment in capital equipment or building improvements. Providing energy consumers with simple and low-cost financing

tools that neutralize the up-front investment could significantly accelerate the implementation of energy efficiency measures. Financial tools face a complex legal landscape including recent blockage of property-assessed clean energy loans by the Federal Housing Finance Agency, and a Washington State constitution prohibition against lending by the state government.

Yet, a wide variety of financial tools have already been developed and tried around the country and the world that offer Washington many options to choose from. Commerce will research these available financial tools, identifying any legal, marketing or administrative barriers others have encountered in deploying them, and identify those that show the most promise for Washington State. Just a few examples of tools that will be explored include:

- *On-bill financing*. Loans taken for energy efficiency improvements to homes, businesses or industry are repaid through the utilities energy billing system. There are many variations of on-bill financing, depending on the lessor, the lessor's relationship to the utility, the terms of the loan, and other parameters.
- *Energy efficiency tariff*. The utility may pay for a specified, allowable energy efficiency improvement, and then attach an additional tariff to the affected building's meter. The tariff is specific to the energy meter, not the building occupant, so that a change in owner or renter does affect the tariff.
- *Conservation utility*. This approach involves authorizing municipal governments to provide energy efficiency loans to their residents and businesses.
- *Electric revenue loan security*. In a few cases, electricity sales from consumer-owned renewable energy installations can offer a revenue (repayment) stream to the lender funding the installation. This tool could benefit a retrofit package that includes both generation and efficiency.
- *Energy efficiency rebate program*. Building departments would fund a revenue-neutral incentive pool with variable permit fees, such that projects designed to meet the highest levels of energy performance would receive incentive payments from the pool, rather than being assessed a fee.

3. **UTC conservation policy support**. The UTC has just completed an inquiry on conservation incentives for investor-owned utilities, described above on page 5, and has produced a policy guidance document that describes how proposals decouple of electric and gas revenues from sales volume should be structured.

   If the nature of those recommendations necessitates coordinated rulemakings or agency request legislation, the Department of Commerce will work together with the UTC to take those policy steps toward providing appropriate incentives for energy conservation.

4. **Minimum requirements for rental housing.** Though current efforts to tighten building codes will work to ensure that new housing stock is energy efficient, existing buildings are only subject to these requirements during significant remodels. Still, owners of owner-occupied housing invest in energy efficiency even when it is not a part of a major remodel, because the investment is at least partially compensated by financial savings once the

conservation measure is in place. In contrast, owners of rental housing do not benefit from the financial savings generated by efficiency investments; this lack of incentive is clearly reflected in lower efficiency housing in the rental stock than in the owner-occupied stock.

We propose to research and eventually advance policy toward increasing the energy efficiency of rental housing. Policies examined will include for example:

- *Disclosure requirements*. The building owner is required to disclose typical energy consumption data or utility costs associated with each unit prior to lease signature.
- *Minimum efficiency measures*. Rental units must include certain minimum efficiency measures, for example a certain R-value of attic insulation. The minimum efficiency measures could be required at time of sale (change of ownership) of rental housing, or mandated by a date certain.

Care will be taken to craft policy proposals in a way that do not threaten the availability or price of rental housing to low-income populations.

5. **Efficiency programs for non-electric fuels**. When homes are heated with electricity, the electric utility typically offers electric conservation programs that include retrofits of the building shell, as well as subsidies or financing for equipment. However, when homes are heated with wood, propane or oil, the consumer's access to similar programs may be limited. This same problem exists to a lesser degree for natural gas heated homes.

   Commerce proposes to research policies that provide all households with access to energy conservation programs, regardless of heating fuel. Commerce will design and implement education and access programs to the extent possible without legislation during calendar year 2011, but if necessary may propose legislation to expand these programs in the 2012 legislative session.

Industrial Energy Efficiency

6. **Federal-coupled recognition program**. Federal programs such as the U.S. DOE's Save Energy Now, and the EPA Energy Star for Industry provide resources and recognition for companies engaged in industrial energy efficiency. Meanwhile, the Washington State University Extension, Energy Program has developed a sophisticated industrial energy efficiency technical assistance program in Washington State.

   We propose to develop a partnership among the Washington State Department of Commerce and the WSU Extension Energy Program to provide additional recognition for companies engaged with federal industrial initiatives like those through DOE and/or EPA. The partnership will provide a combination of technical assistance, administrative assistance, and public recognition for successful industrial participants. A special emphasis will be given to international marketing of participating companies' products or services. Possibly, firms complying with the new ISO 50001 Energy Management Systems standard, will also be given special recognition.

7. **Streamlined permitting of combined heat & power (CHP) projects**. Various studies have indicated a large quantity of industrial waste heat available that could be used to generate electricity in combined heat & power (CHP) or "cogeneration" installations. If the industrial entity financing the CHP installation is able to sell the resulting electricity into the grid a project often appears profitable, but permitting, regulatory or economic barriers can pose an insurmountable hurdle to implementation. Meanwhile, the U.S. EPA is developing a Waste Energy Recovery Registry according to requirements of the 2007 Energy Independence and Security Act, and Washington may benefit from preparing to respond to the CHP potentials revealed by the Registry.

   In this initiative, Commerce will research the barriers to CHP deployment during calendar year 2011, and recommend a set of remedies that may include programmatic, regulatory or legislative solutions to be deployed in 2012. The research will be conducted in conjunction with regulatory streamlining research described under *Streamlined Permitting for Clean and Advanced* Energy Technologies below.

Transportation Efficiency and Technology

Several efforts to directly address the energy demand and greenhouse gas emissions associated with transportation are under way at the Washington Department of Transportation, Department of Ecology, and elsewhere. However, a few aspects of enabling transitions in transportation can benefit from Commerce's unique capacities in growth management and energy policy.

8. **Energy-Aware Growth Management**.

   The Growth Management Act (GMA) requires comprehensive plans to contain a transportation element. The transportation element must be consistent with the land use element, must address all transportation modes, must include ten-year traffic forecasts and must be financially realistic. The transportation element must also be certified by the Regional Transportation Planning Organization (RTPO). Commerce provides technical assistance on GMA planning through direct assistance from staff, through its administrative rules and through its transportation planning guidebooks. Commerce recently updated its administrative rules and is in the process of updating its GMA Transportation Guidebook.

   Commerce will integrate transportation energy reduction into GMA technical assistance provided to local governments, in particular by updating the GMA Transportation Guidebook to be consistent with the goals and principles of the State Energy Strategy. Updates to the GMA Transportation Guidebook will address issues related to the integrated effects of urban planning and development on transportation energy, as well as to the required issues listed above. Commerce may also develop one or more model land use ordinances that encourage low-energy transportation choices that could be adapted and deployed by local governments that have an interest in doing so.

9. **Electric vehicle charging station siting**. The Department of Commerce and the Puget Sound Regional Council have developed model ordinances, model development regulations,

and guidance for the siting of electric vehicle charging infrastructure. These documents will assist local and regional governments with the implementation of electric vehicle infrastructure, in particular charging stations. Some of these charging stations will also play a role in the Electric Highway project being deployed along the Interstate-5 corridor by Commerce and the Washington State Department of Transportation.

Under this initiative, Commerce will provide technical assistance to local governments, when requested, on interpretation and implementation of the electric vehicle siting guidance. Though the siting guidance was developed with a primary purpose of enabling electric vehicle deployment, Commerce assistance will also help local governments coordinate charging station siting with existing laws, protecting environmental and cultural resources that may be affected.

10. **Uniform regulatory protection for charging stations**. Under current state law, operation by a private company of an electric vehicle charging station, which involves the sale or resale of electricity, may be subject to UTC regulation, including rates, terms of service, and consumer protection. The UTC is reviewing current law, rules, and tariffs to determine whether the current regulatory structure facilitates deployment of charging stations and encourages adoption of electric vehicles. If statutory changes are needed, the UTC will work with Commerce and Transportation to develop appropriate legislation.

    Following any conclusions made by the UTC, Commerce may pursue rulemaking or legislation that provides vehicle charging stations in the service territories of public utilities (which are unaffected by UTC decisions) with protections or remedies equivalent to those recommended by the UTC for charging stations potentially under its jurisdiction.

11. **Amend Renewable Fuels Standard**. In 2006 the Washington State Legislature passed a renewable fuels standard requiring gross diesel fuel sales statewide to consist of at least 2% biodiesel before December of 2008.[d] This mandate has not been achieved due in part to a lack of legislated enforcement authority, but also due to the high administrative burden associated with a volumetric requirement such as that legislated in 2006, versus the universal requirement that has been much more successfully legislated in other states.[e] Washington State is home to an innovative and motivated, nascent biodiesel industry; a more successful biodiesel standard would encourage further development of this industry in the state.

    Commerce proposes to support reasonable legislation brought to the 2011 session that converts the existing, volumetric renewable fuels standard to the universal type that has been proven by the prior work of other states.

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[d] ESSB 6508. The renewable fuels standard also sets targets for ethanol in gasoline sales, but these targets have been rendered moot by more recent, aggressive federal targets.

[e] A volumetric mandate requires that a minimum fraction of total, annual fuel sales consist of the renewable fuel. Verifying a volumetric mandate requires certification and tracking of all blendstocks entering the fuel supply throughout the year. A universal mandate requires that fuel dispensed at any pump at any time contain a minimum fraction of the renewable fuel, and can be verified by random testing.

12. **Compressed Natural Gas**. Compressed natural gas (CNG) can fuel gasoline internal combustion engines with only slight modifications, and has been deployed for that purpose for decades. CNG is currently embraced by a large number of commercial fleets to reduce greenhouse gas emissions, traditional pollutants, and costs, and to increase safety. Yet, there is comparatively little use of CNG in by Washington State fleets.

    The Department of Commerce proposes to collaborate with other agencies to identify barriers to deployment of CNG in the state's fleet, and create a program accelerating its adoption.

Streamlined Permitting for Clean and Advanced Energy Technologies

When new generation does need to be deployed in Washington State, clean energy technologies should be preferred over conventional resources. This assists with meeting greenhouse gas targets, and furthers Washington's global leadership in advancing energy technologies. Likewise, advanced energy efficiency solutions need to be preferred over low-efficiency construction or equipment. The initiatives below can encourage renewables or other clean energy technologies by streamlining the permitting process associated with their deployment. All such streamlining will be done with due respect for the practical limits dictated by the grid's ability to accept intermittent generation. Streamlining also will never be deployed in a way that circumvents protections for the environment and cultural resources, which are primary purposes of the permitting regimes to begin with, and will be developed in close collaboration with the Department of Ecology, Department of Fish & Wildlife, and other agencies responsible for protecting those resources.

Washington innovators wishing to deploy pilot projects of new, experimental technologies find their projects must meet the same permitting requirements as a full-scale, conventional generating plant, despite the much smaller size of the pilot. The last two of the initiatives below focus on Washington's role as a leader in emerging energy technologies, by launching additional streamlining efforts for advanced technology pilot projects.

In Washington State, land use decisions are primarily in the hands of local governments. None of the initiatives below are intended to change this; they merely provide tools, authority or technical assistance to local governments to apply the streamlining concepts discussed; or they streamline state-level permitting steps that are already in place.

13. **Energy Overlay Zones**. Energy Overlay Zones (EOZ) were formally acknowledged and protected by Senate Bill 5107 passed in 2009, which defines an EOZ as "a formal plan enacted by the county legislative authority that establishes suitable areas for siting renewable resource projects based on currently available resources and existing infrastructure with sensitivity to adverse environmental impact." In Klickitat County, an EOZ has been successful in promoting wind resource development in particular.

    For this initiative, Commerce will use the experience of Klickitat County and other local governments to create a guidance document to assist other counties with development of their own EOZs; and provide technical assistance when helpful.

14. **Non-Project and Planned Action SEPA reviews**. New energy projects may require State Environmental Policy Act (SEPA) review. To save time at the project permitting phase, a non-project SEPA review may be undertaken earlier by a local government. The non-project SEPA review would focus on the planning, siting, and permits needed for energy projects before a specific project is proposed. The non-project review would apply to any project of a certain class, undertaken within a certain geographic area, with the class and area both being defined within the non-project review. Once complete, any project meeting the definitions and other requirements in the non-project review may rely on the review to streamline project-level SEPA and permitting.[f]

    Planned Action SEPA reviews go a step further by proactively writing an ordinance(s) that limit the impacts and ensure project conformance with the mitigation requirements associated with a non-project Environmental Impact Statement (EIS). Streamlining associated with planned actions may go beyond ordinance writing, for example Commerce could provide information that assists in creating mitigation banks.[g]

    As with the non-project SEPA review, Commerce will be able to offer technical assistance with Planned Action SEPA review and development of implementing mitigation regulations. Commerce will partner with Ecology, Department of Fish and Wildlife, and other state agencies to create comprehensive templates for successful non-project SEPA review. Prior legislation established a Planning and Environmental Review Fund (PERF) which was designed to assist local governments with planned action reviews. This fund is currently empty. Commerce may propose legislation to re-seed the PERF, but this time as a revolving loan rather than as a grant fund. To repay the loan, a local government may assess fees to parties developing projects that fall under the non-project SEPA review.

15. **Pre-qualification of advanced technologies under I-937**. Initiative 937, voted into law in 2006, is the state's renewable portfolio standard. Power developers and utilities have raised questions about whether a particular technology is "an eligible renewable resource" under the law and how unusual cases should be treated. In the absence of a definitive method to determine eligibility, developers of innovative resources may have insufficient assurance of their project's benefits to proceed. To date, the UTC, State Auditor's Office and Department of Commerce have informally spoken to individual utilities and developers on a case by case basis.

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[f] In a 2003 study, Commerce found that every dollar invested in advance environmental analysis avoids $1.33 in project development costs. Environmental mitigation is still required, but the analysis is more efficient. A typical planned action provides streamlined permitting, ranging from five weeks for low risk projects to nine months or more for high-risk projects. (*SEPA and the Promise of GMA: Reducing the Costs of Development*, 2003. Available at: http://www.cted.wa.gov/portal/alias__CTED/lang__en/tabID__399/DesktopDefault.aspx.

[g] When renewable energy resources are deployed, areas of habitat may be lost, in which case regulations might require replacement of the lost habitat elsewhere. Mitigation banks are institutions that catalogue parties willing to preserve known, valuable habitats in return for compensation of lost development or use value. Mitigation banks can streamline mitigation of habitat loss by providing project developers with a simple financial mechanism, rather than a complex restoration and/or protection project.

We propose that the UTC, State Auditor's Office and Commerce develop a public procedure that could pre-determine whether a generating resource would likely be considered an eligible resource when submitted by a utility as part of its compliance documentation. The procedure would be set up through an MOU, an exchange of letters, or a coordinated rule-making, depending on legal advice as to how much formality is needed. Developers and utilities would be assured that if their proposed project or technology is determined to be eligible, the after-the-fact review would focus on whether the generation resource is within the parameters described in the proposal for pre-determination.

16. **Accelerated permitting for pilot projects**. Pilot energy generation or energy infrastructure projects, though smaller in scale than conventional generation or infrastructure projects, often find themselves faced by the same, substantial permitting requirements as a full-scale undertaking. By nature of their smaller size pilot projects are usually (but not always) less likely to have significant impacts; and furthermore it is in the state's interest to support our innovators by providing them the regulatory space to test new concepts.

    This initiative begins as a research project consisting of a thorough mapping of the permitting process a pilot energy project goes through at state agencies, including duration of each step. This mapping will be done in close collaboration with the Department of Ecology, the Department of Natural Resources, the Governor's Office of Regulatory Assistance, the Energy Facility Site Evaluation Council and other agencies typically participating in project review. Next, Commerce will identify those steps that can be streamlined in the case of pilot projects, once again with due respect for the special suite of possible environmental impacts associated with each class of technologies. Finally, in those cases where Commerce and the regulating agencies can come to agreement on adjustments appropriate for pilot projects, Commerce will lead administrative, regulatory or legislative steps necessary to enable an appropriate, streamlined process. Any legislation called for would be introduced in 2012 at the earliest.

17. **Energy technology test zones**. The permitting load associated with energy technology pilot projects could be vastly reduced by designating one or more energy technology test zones in which pilot projects under a maximum size and within a certain class of technologies may be deployed with limited permitting requirements that would still ensure environmental compliance. Recently, for example, the federal government opened a Solar Demonstration Zone located on Bureau of Land Management lands in Nevada. The concept is also similar to "energy parks" established at a few locations around the world that co-locate various energy research & development firms both to fertilize innovation among the inventors, as well as to allow easier deployment of test facilities.

    Given the relatively few examples in the United States, this initiative would also begin as a research project examining prior attempts to create energy test zones, the policies leading to failure or success, and the landscape of local, state and federal laws in which such a test zone would need to be deployed. Commerce will simultaneously reach out to county and municipal governments to see if there is a willing, small-government partner, and reach out to firms innovating in the energy field who would have a strong interest in utilizing such a zone. Outcomes of this research will lead to a more concrete policy recommendation in next year's Full Revision of the State Energy Strategy.

Progress Toward the Full Revision

In parallel with the development of the 17 initiatives making up this year's Energy Strategy Update, the Department of Commerce and the Technical Experts Panel have been laying the groundwork for the technical analysis that will support long-term policy initiatives in the full revision to be released in December 2011. As a first step, energy flows in Washington State have been mapped as shown in Figure 1-2.

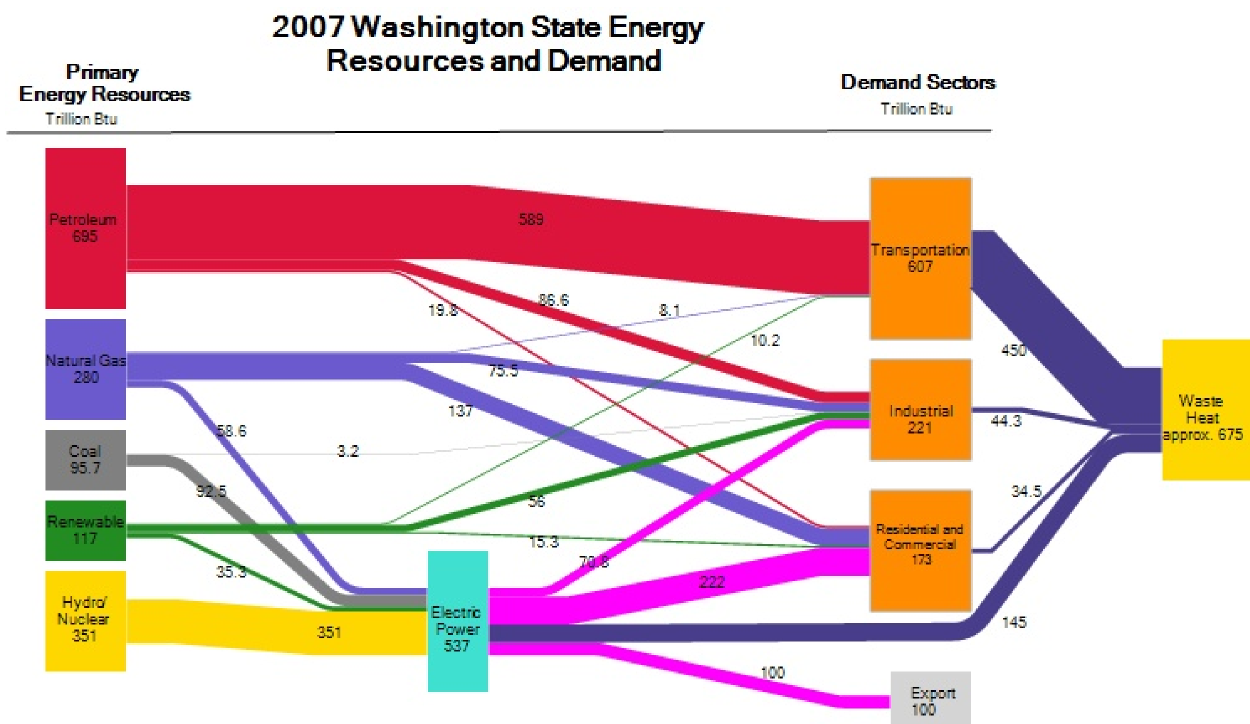

Figure 1-2: Energy flows in Washington State (2007)

Data is for calendar year 2007, the most recent year for which data are available on all sources and consumers of energy. In the figure, the thickness of each line is proportional to the quantity of energy being delivered or consumed; these quantities appear as numeric values on or adjacent to each line, in trillion British thermal units (TBtu). Of the 1,540 TBtu primary energy consumed in one year by the state, 537 TBtu was consumed by electric generators, and about 1,000 TBtu went directly to the three consuming sectors (transportation, industrial and residential/commercial). The transportation sector is the least efficient user of primary energy, delivering only 26% of the primary energy as useful work, and losing the remainder as waste heat.

When compared to other states, Washington State's energy system is characterized by relatively clean and low-cost electricity dominated by hydroelectric generators, thermal energy with a larger-than-typical contribution from biomass, and fairly typical transportation energy. The state's greenhouse gas footprint is dominated by transportation energy, thanks to the relatively low greenhouse gas emissions related to the electric grid.

In order to create the most robust possible energy strategy, during 2011 the Department of Commerce and Technical Experts Panel will be testing various policy frameworks against scenarios for demographic and technological parameters out to 2035, to determine how well the frameworks fare against the unpredictable future. In September 2010 members of the Technical Experts Panel and Advisory Committee met in a joint workshop and developed a suite of four scenarios of the 2035 world, distributed on axes of geopolitical stability and innovation & opportunity, Figure 1-3.

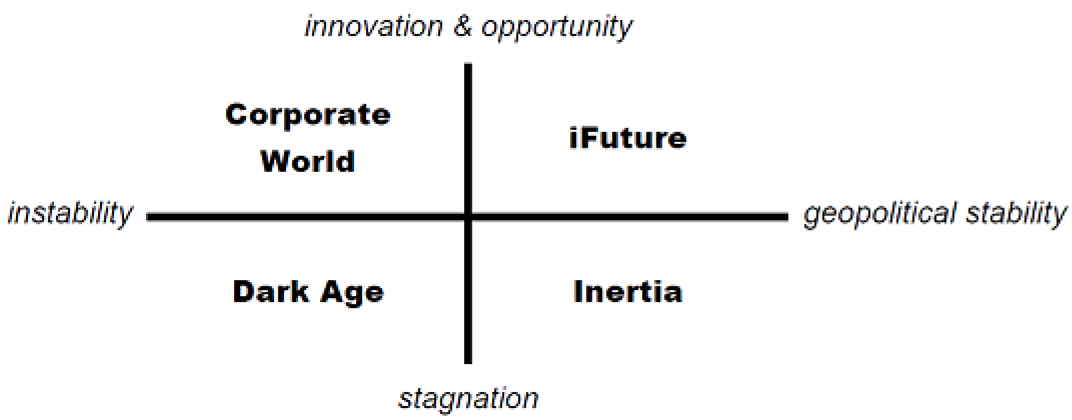

Figure 1-3: Background scenarios developed in the September 2010 scenario planning workshop, that will be used to test policy frameworks. The four scenarios *Corporate World*, *iFuture*, *Dark Age* and *Inertia* represent different outcomes for national and global parameters beyond the control of Washington policy makers; a robust energy policy framework will fare well in all of these climates.

Finally, the Technical Experts Panel has agreed on an analytic framework, available in Appendix D. Commerce and Office of Financial Management staff are drafting forecasts for Washington State energy demand out to 2035 associated with each of the four scenarios, that will be the point of departure for much of the quantitative work anticipated in 2011.

The State Energy Strategy Advisory Committee will continue to work over the coming year to provide a full revision of the State Energy Strategy that, besides being a leading-edge effort among American states, will be an enormous asset in reviving and building the state's economy by keeping energy prices low, keeping energy security high, and building a clean energy economy that fosters manufacturing, services, and high-tech job growth.

Chapter 2 – Recent Trends in Energy Prices and Energy Expenditures

Introduction

Relative to the period of the 1990s through the early 2000's, the past six years have presented Washington state residents and businesses with volatile and generally increasing energy prices. After steadily increasing from 2004 through 2006, energy prices, particularly those for petroleum products and natural gas, began to rise rapidly starting in late 2007 through the first half of 2008. Prices reached a peak in mid July, and then dropped precipitously in the second half of 2008 as the global credit crisis and recession deepened. Prices continued to decline through early 2009 as the Great Recession deepened and took its toll on the economy. In 2010 prices for petroleum products have recovered somewhat, but natural gas prices remained depressed.

The following sub-sections provide a brief overview of the price trends for petroleum products (focusing on gasoline, diesel and jet fuel), natural gas, and electricity. As a consequence of higher prices energy expenditures, as a percent of gross state product (GSP), rose rapidly in 2007 and 2008, then declined in 2009. A brief overview of energy expenditures and expenditures as a percent of GSP over the past several years is also provided.

Petroleum products

Prices for petroleum products are relatively unregulated, and are generally set by market supply and demand. These products are also unique in that they have to be refined from crude oil and transported to numerous markets, which means that in addition to the price of crude oil, constraints in refining or pipeline capacity can impact product prices. Another factor in Washington's relatively high prices for refined petroleum products is that the state has one of the highest gas taxes in the nation.

Weekly prices for gasoline and diesel in Washington State are shown in Figure 2-1. Also included are the spot prices of jet fuel in Los Angeles and West Texas Intermediate[h] crude oil. Figure 2-1 illustrates the following features:

- An increase in price volatility over recent years, and a upward trend in crude oil and product prices through 2008,
- Prices for petroleum products tend to be higher in the summer, with gasoline prices peaking during the June through August period when residents travel for summer vacation and other activities,
- Diesel fuel often exhibits a second price peak in the fall when heating oil demand is high,
- Jet fuel also peaks in the summer when demand for air travel is highest; and there is a smaller winter jump in jet fuel price when we see additional travel for the holidays.

[h] West Texas Intermediate (WTI) is a light, low sulfur crude oil that is easy to refine into gasoline, diesel and jet fuel. It is one of the primary indicators of crude oil price, and commands a higher price than lower grade heavy and high sulfur crude oils. LA spot jet fuel is the closest jet fuel market tracked by the Energy Information Administration (EIA) on a regular basis.

- Diesel prices are now consistently higher than gasoline, due to more rapidly growing national and global demand for diesel fuel,
- The collapse of crude oil and product prices in the second half of 2008 has been dramatic. The collapse was caused by a rapidly slowing global economy and subsequent bursting of the commodity price bubble,
- World oil prices recovered somewhat in late 2009 and have averaged between $70 and $80 during 2010. Forecasters see the price of oil rising steadily as the world economy recovers.

Other factors that have influenced petroleum product prices, but are less apparent in Figure 2-1 include:

- Hurricane activity had a strong impact on prices in the late summer of 2005,
- In 2006 low-sulfur diesel requirements and associated refining problems, pushed diesel prices higher,
- High fuel demand in 2006 and 2007 and refining capacity limitations caused retail prices to surge during the summer driving seasons,
- During late 2007 and 2008 most of the product price increase was due to the high cost of crude oil and not from refining capacity constraints,
- Refiner and dealer margins have remained low through 2009 and 2010 due to lower demand.

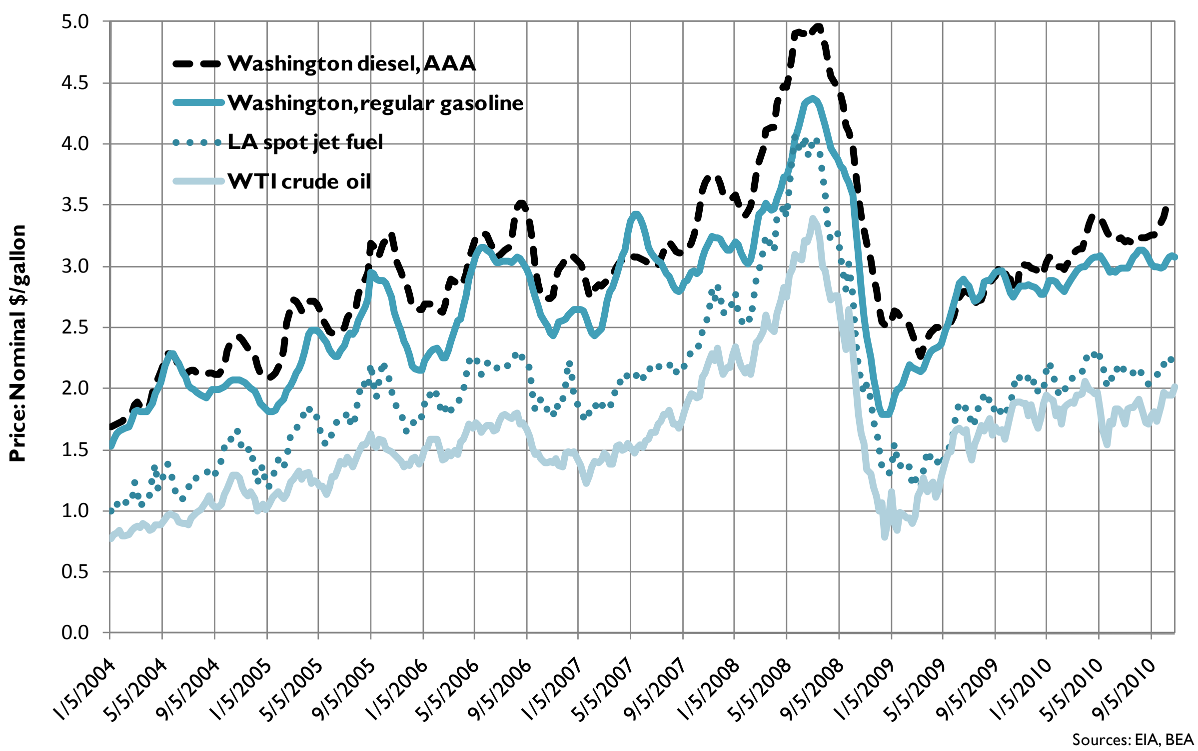

Figure 2-1: Weekly gasoline, diesel and jet prices (Jan 2004 – Nov 2010)

Natural gas

The natural gas market is more regulated than the petroleum product market. In the retail or downstream market, the majority of natural gas is sold by regulated utilities, which are overseen by state utility commissions. However, in the wholesale or upstream gas market, which covers the extraction, gathering and initial transport, for natural gas there is less price regulation. Consequently, wholesale prices of natural gas exhibit significant price variability, and since natural gas and some petroleum products (diesel and residual oil) are partial substitutes for each other in the industrial and power sectors, their prices can track to a limited degree. For the most part, utilities are generally allowed to pass increases in wholesale price along to their customers.

Figure 2-2 shows monthly prices for residential, commercial and industrial[i] customers. The key features revealed by Figure 2-2 are:

- Natural gas prices like petroleum products over the past several years have risen, then fallen,
- Natural gas prices exhibit less volatility than petroleum, but do tend to peak in the winter when demand is highest,
- Residential gas prices are more volatile than commercial or industrial prices, which have different contract structures and steadier demand profiles.

Less easily discerned features of Figure 2-2 are:

- Mild winters tend to depress prices, colder winters tend to inflate prices,
- Recent declines in natural gas prices can be attributed to a slowing economy and to a rapidly improving supply situation in North America due to new production coming in particular from natural gas shale resources.

[i] Larger industrial and institutional customers purchase their natural gas directly from the pipeline, thereby avoiding the transport and overhead utility fees.

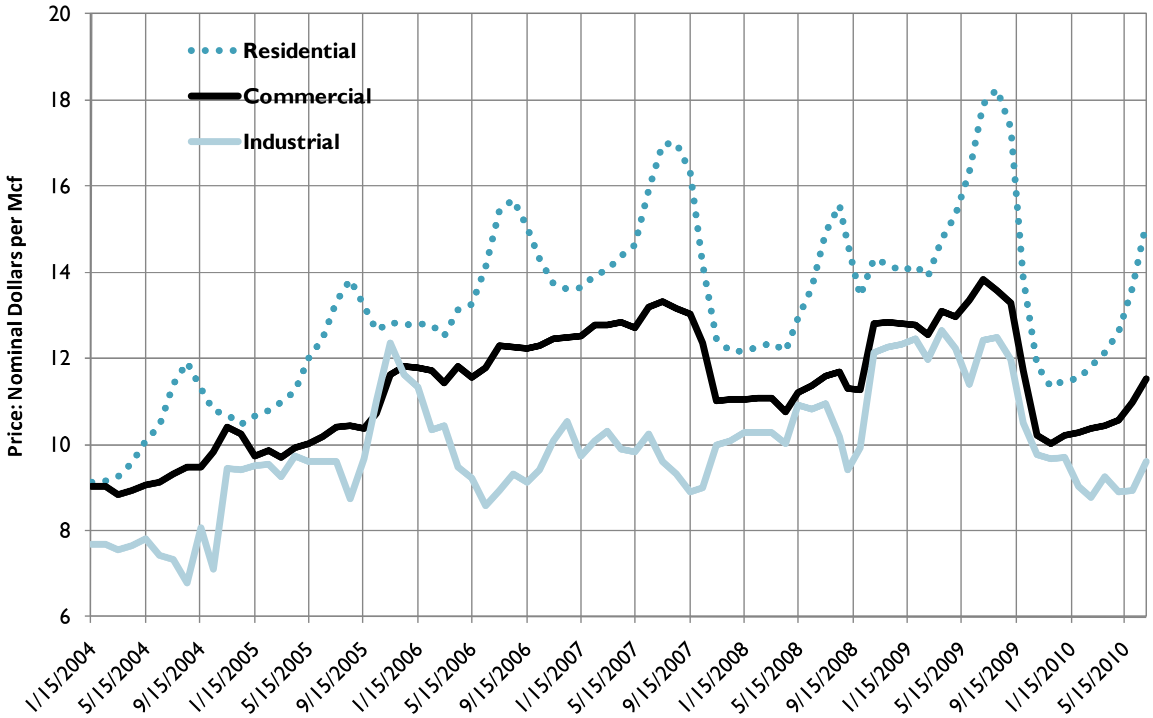

Figure 2-2: Monthly natural gas price by sector (Jan 2004 – July 2010)

Electricity

Electricity is the most regulated primary energy source for Washington state residents and businesses. It is derived from several generation technologies: hydropower, wind power, coal and natural gas fired turbines, in particular. Because of these unique factors, prices for electricity exhibit less volatility than the other main energy sources. Much of Washington's electricity is derived from the federal hydropower system on the Columbian and Snake Rivers that is administered by the Bonneville Power Administration (BPA), which markets electricity for the federal hydroelectric facilities and the Energy Northwest nuclear plant to Northwest utilities at cost. Approximately 27 percent of Washington State's electric power is derived from more expensive fossil fuel or renewable generation resources. The marginal generation resource is often natural gas combustion turbines – power from this source is more expensive and has risen with increasing natural gas price over the past several years. Recent declines in the price of natural gas have lowered the cost of electricity generated by this fuel.

Figure 2-3 illustrates several unique characteristics of average statewide electricity prices over the past several years.

- Prices have been less volatile than petroleum product or natural gas prices.
- Average statewide electricity prices have risen, increasing from approximately 5.5 cents/KWh in 2004 to slightly more than 7 cents/KWh in 2008, then declined to 6.5 cents/KWh in 2010.
- Washington's average electricity prices rank near the bottom in the U.S: fourth lowest among the 50 states.

- Commercial and industrial electricity prices are lowest during the spring and summer months when regional hydropower is abundant.
- Commercial and industrial electricity prices are highest during October through February when hydropower generation diminishes and regional demand is the highest.
- Not shown in this average price figure is the variation in electricity prices among utilities in the state which range from 2.25 cents/kWh to 8.63 cents/kWh.

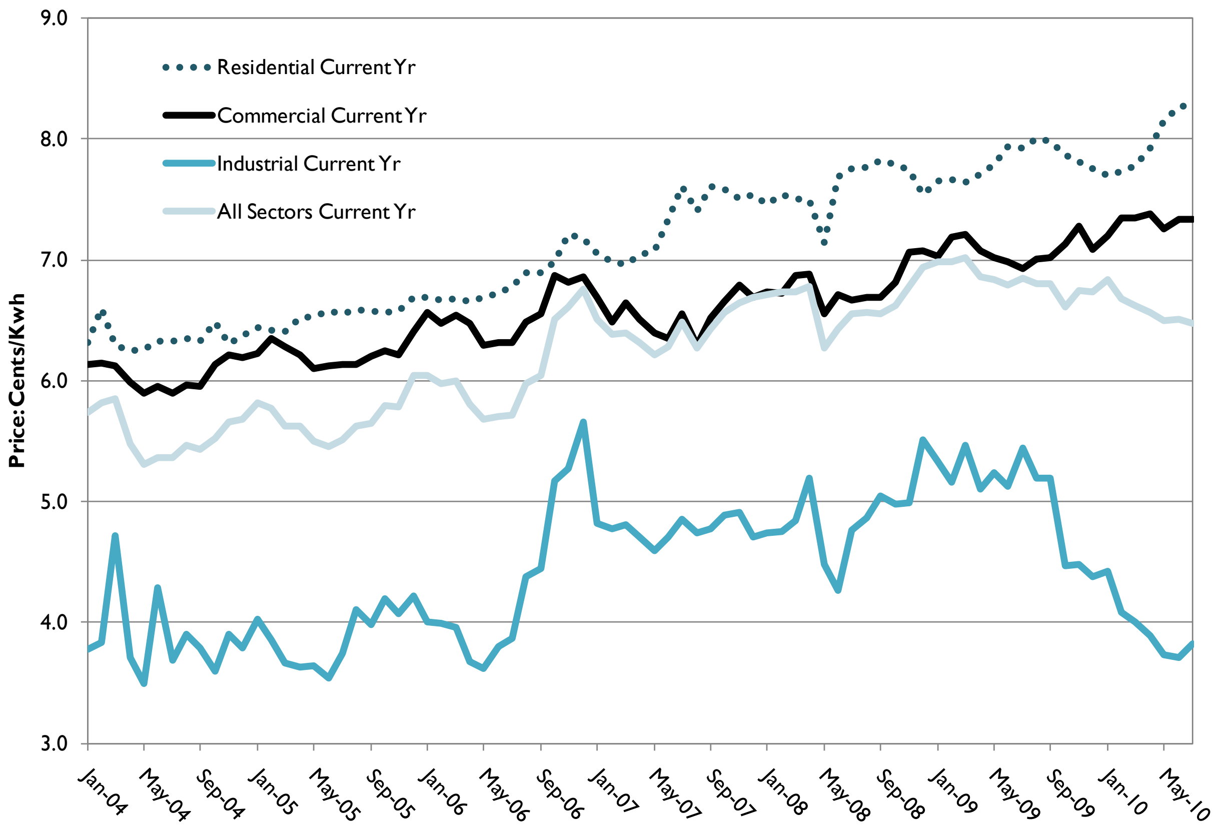

Figure 2-3: Electricity prices by sector (Jan 2004 – Aug 2010)

Energy Expenditures

Total energy expenditures are determined by the type of energy used by consumers, the quantity consumed, and the per unit price. Over the past several years there have only been small shifts in the type of energy used by consumers in Washington State. Thus the two critical factors in determining total energy expenditures for the state are quantity of energy consumed and per unit price of the various energy sources. One technique to gauge the importance of total energy expenditures is to express these expenditures as a percent of gross state product.

As the previous figures illustrate the general trend in petroleum product, natural gas, and electricity prices has been upward over the past several years. In the middle of July 2008 we saw a sharp drop in petroleum product prices; a smaller drop in natural gas prices, and a halt in the slower steady rise for electricity prices. Note that the energy prices presented in the figures below do include state and federal taxes.

Several factors contribute to the steady increase in energy consumption within Washington State. A key factor is the steady increase in the state's population – averaging slightly more than 1 percent per year. Another contributing factor over the years is the increasing wealth of state residents – as wealth increases we tend to consume more energy. The increase in imported products handled through our ports, but destined for other parts of the nation, has boosted state consumption of diesel fuel and is a factor towards increasing state energy consumption. The recent higher prices for energy have served to counter the above factors somewhat, thereby reducing overall state energy consumption, though the lag time for this effect may be several years. Structural changes in our economy, such as the decrease in energy intensive manufacturing, have decreased state energy consumption in the industrial sector.

Figure 2-4 shows energy expenditures for the United States and Washington State expressed as a percent of gross domestic and gross state products (GDP and GSP respectively) from 1990 through 2010. Note that the 2008 expenditure information is preliminary, subject to review by the Energy Information Agency (EIA), while the 2009 and 10 information is an estimate derived from the preliminary 2008 figures. The US energy expenditures as percent of GDP declined through the 1990s as energy prices expressed in constant dollars (versus nominal dollars) fell, reaching a low point of about 6 percent of GDP in 1998. The percentage began to rise in 1999-2000, but was reversed temporarily by the 2000-01 recession. Since 2002 the percentage has risen and reached 9.8 percent of GDP in 2008, a level not seen since the mid 1980s. An early estimate for 2009 puts the US expenditure figure near 7.25 percent of GDP.

Washington state energy expenditures as a percent of GSP tend to be lower than the corresponding US GDP figures, primarily because our electricity prices are significantly below the national average: for 2006 Washington average of 6.14 cents/kWh vs. US average of 8.90 cents/kWh. The Washington state energy expenditures pattern in Figure 2-4 is similar to the US pattern, reaching a low point of slightly below 5 percent of GSP in 1998, followed by a rise to 8.1 percent in 2008. With the recent drop in prices for many energy products, energy expenditures as percent of GDP or GSP have dropped markedly in 2009 and 2010. A preliminary estimate for 2009 puts the figure closer to 6 percent of GSP.

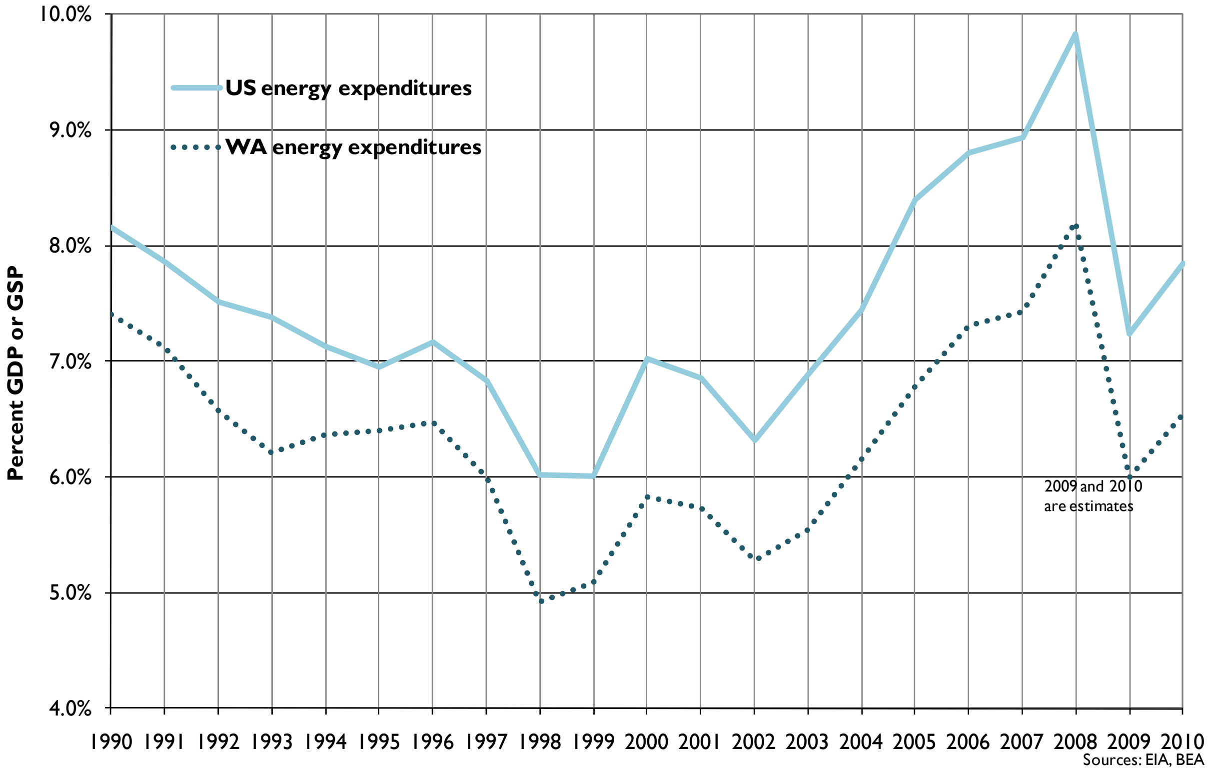

Figure 2-4: U.S. and Washington State energy expenditures (1990-2010)

Figure 2-5 below presents total energy expenditures for Washington State from 1997 through 2008 in nominal and constant dollars. From 1997 to 2002, expenditures on energy expressed in constant 2000 dollars were relatively stable at around 12 billion dollars/year. By 2008 residents and businesses of Washington were spending about 22 billion/year in constant 2000 dollars – an expenditure increase of about 10 billion/year, or just over 2.5 percent of GSP. Expenditures are estimated to be about16 billion dollars for 2009.

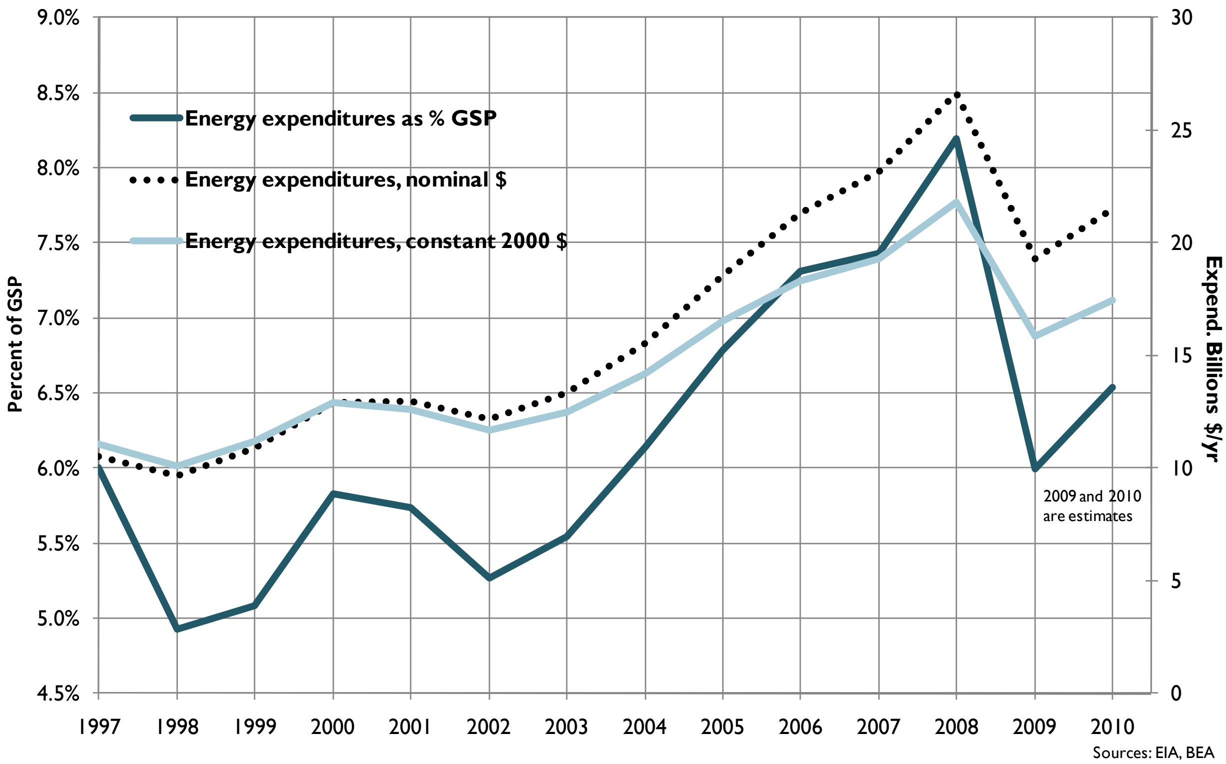

Figure 2-5: Energy expenditures in Washington State (1997-2010)

As Figure 2-5 above indicates state energy expenditures rose sharply from 2003 to 2008. Average household energy expenditures for Washington are estimated to be $4,720 in 2008[j]. Average Washington household expenditures in 2003 and 2005 were $2,837 and $3,541 respectively – all expenditures are expressed in nominal dollars, and are not adjusted for inflation. Initial estimates for 2009 expenditures appear to be lower than the estimated 2008 values shown below. As illustrated by Figure 2-6 below household expenditures are dominated by expenditures towards fuel to power vehicles. This dominance has become more pronounced over the last several years as gasoline and diesel prices have risen.

[j] This is an estimate based off of preliminary 2006 EIA household expenditure share values, adjusted for fuel price inflation.

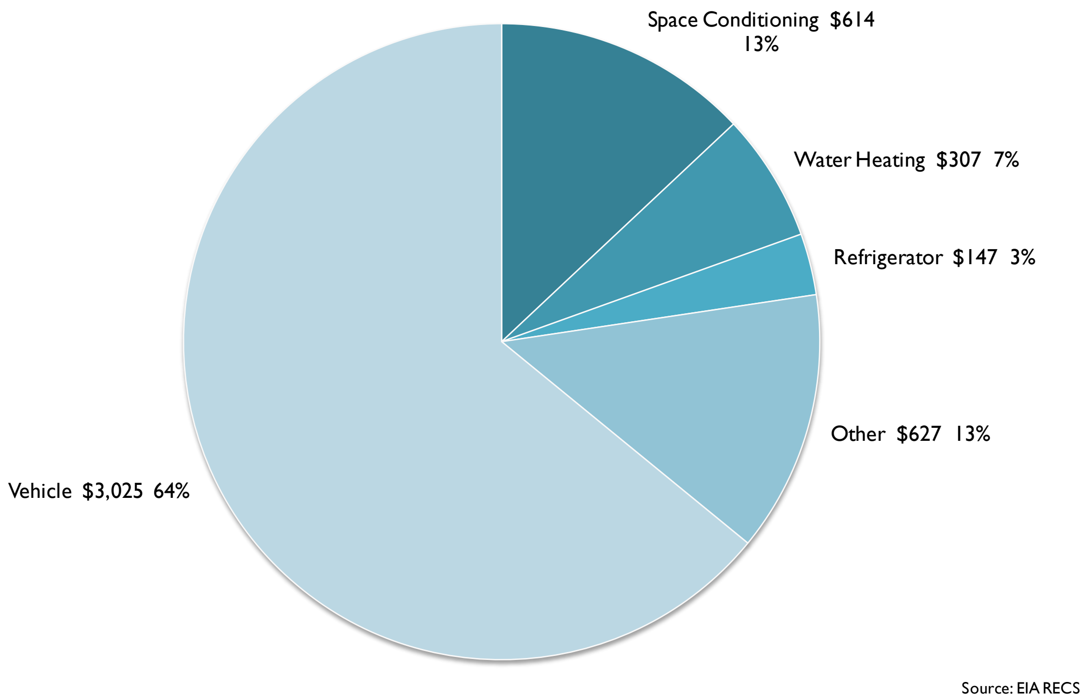

Figure 2-6: 2008 average household annual energy bill by end use (total is $4,720)

Chapter 3 – 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. Overall, the Department of Commerce does not collect a large amount of primary energy data, but rather depends on regional and national sources for most data. 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 2008. A few are one-year snapshots. Links to more current data are included for those Energy Indicators where this information is available.

Indicator 1: 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. After 1999, end-use energy consumption declined due to a significant drop in industrial energy use and little growth in transportation, residential, and commercial energy use. In 2004 energy consumption began to rise again and peaked in 2007 before high energy prices and a recession began to reduce consumption in 2008.

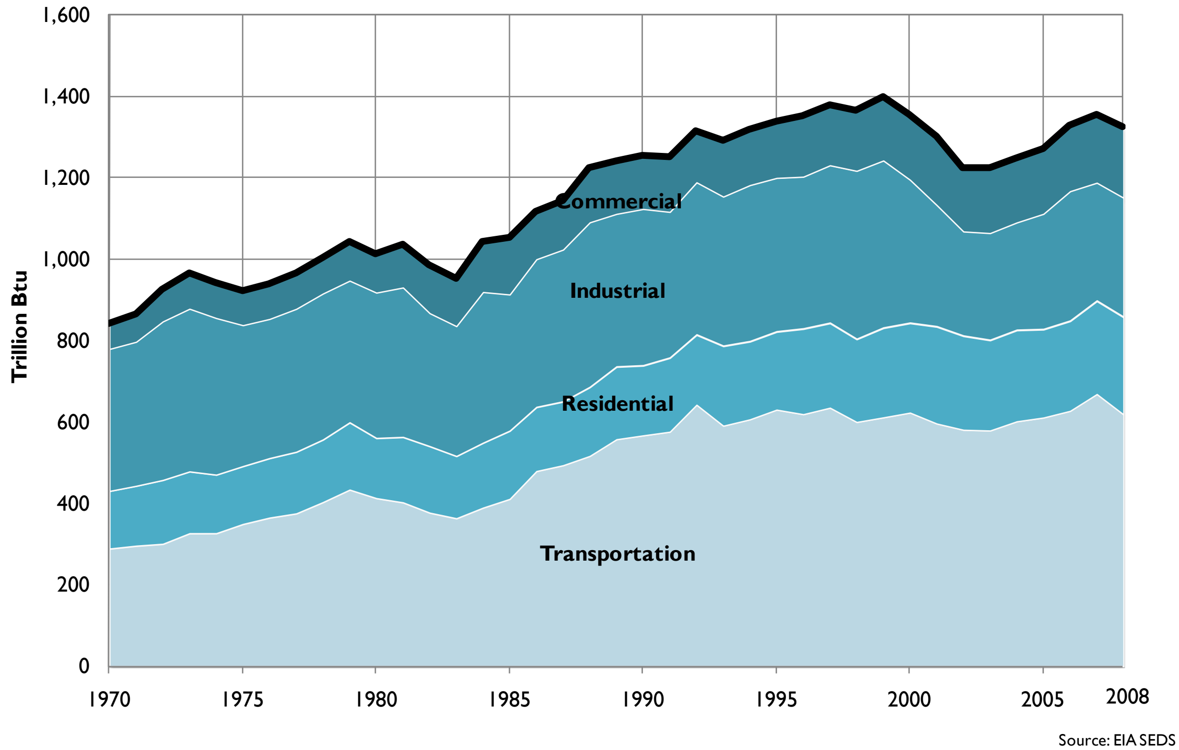

Figure 3-1: End-use energy consumption by sector (1970-2008)

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 sharp drop in industrial energy consumption. Energy use began to climb again and reached another peak in 2007. Between 2000 and 2008 energy use declined at a 0.3% annual rate.

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 1.5 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 2008 Washington's energy use was 5 percent less than the 1999 peak. Industrial sector consumption declined 38 percent from 1999 to 2002. This reflected structural 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, consumption in 2008 was still lower than in 1999. Energy consumption in the transportation sectors in 2008 was similar to 1999 levels, and residential, commercial sectors experienced modest growth so the majority of the overall decline in Washington's energy use was due to the industrial sector.

The transportation sector accounted for 47 percent of the energy use in Washington in 2008. 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 **(**see data table for **Indicator 1** in Appendix B)

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.

Indicator 2: 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 largely due to the growth in use of other fuels, particularly petroleum.

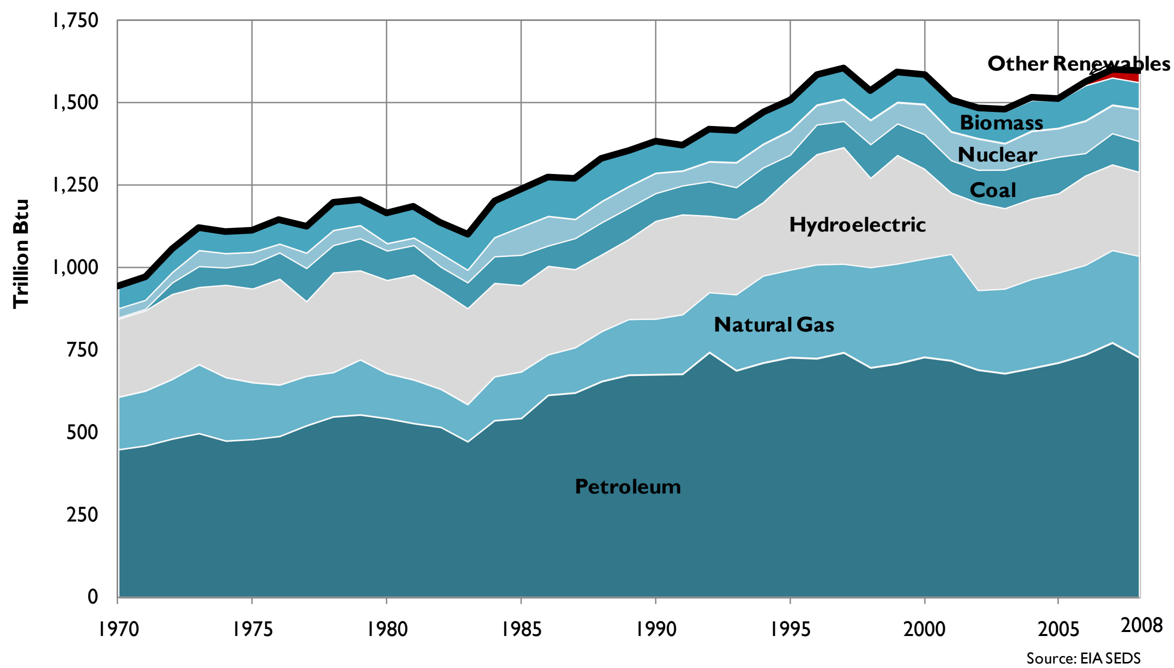

Figure 3-2: Total primary energy consumption by source (1970-2008)

Figure 3-2 shows the extent of Washington's reliance on six major primary[k] energy sources: petroleum, hydroelectricity, natural gas, biomass, coal, and uranium (nuclear).[l] Washington continues to rely on petroleum, much of which arrives by tanker from Alaska, to meet 46 percent (in 2008) 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 71 percent of primary energy use in 2008. 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 19 percent of Washington's primary energy consumption in 2008.

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 average.

Biomass, mainly wood and wood waste products, accounted for about 5 percent of primary energy consumption in 2008. This share has declined some from the 1980s. These fuels are primarily burned for electricity and process 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 used for electricity generation at coal and nuclear generation plants accounted for 12 percent of Washington's primary energy consumption in 2008.

State-level energy consumption data for 2009 is not yet available, but national energy consumption for 2009 has been released and shows a 5 percent decline from 2008 and a 7 percent decline from 2007, which also happened to be the peak year for US energy consumption (101.5 quadrillion Btu).

Sources: Energy Information Administration's State Energy Data System **(**see data table for **Indicator 2** in Appendix B)

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,

[k] 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).

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

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 to exclude non-energy petroleum products such as asphalt and road oil.

Indicator 3: 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 total non-hydro renewable sources (including wind) accounted for a little more than 3 percent.

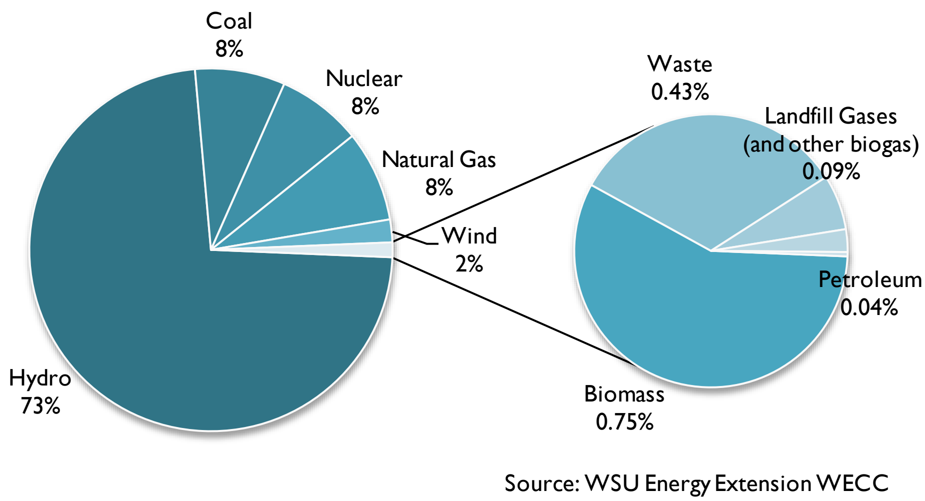

Figure 3-3: 2007 generation by source

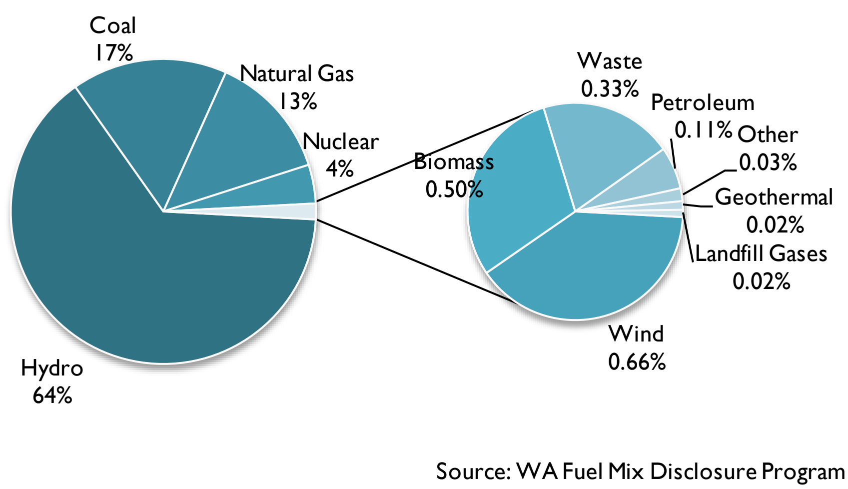

Figure 3-4: 2009 aggregate utility fuel mix

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 essentially zero in 2000 to 2 percent in 2007 (ranking fourth in the nation) 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 was 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 Montana and 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, indicating 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 (2009)		
Fuel	**MWh**	**Percent**
Hydro	57,214,771	64.4%
Coal	14,672,973	16.5%
Natural Gas	11,846,700	13.3%
Nuclear	3,653,541	4.1%
Wind	587,994	0.66%
Biomass	445,076	0.50%
Waste	296,180	0.33%
Landfill Gases (and other biogas)	16,058	0.02%
Petroleum	94,360	0.11%
Other	28,650	0.03%
Geothermal	19,237	0.02%
Total	**88,875,540**	**100%**

Indicator 4: End Use Energy Expenditures by Sector

While expenditures grew rapidly in the 1970s, during much of the 1980s and '90s inflation-adjusted[m] energy expenditures in Washington declined or grew modestly despite significant growth in energy consumption. This trend changed in 1999. By 2008 energy expenditures had grown by more than 100 percent since 1998.

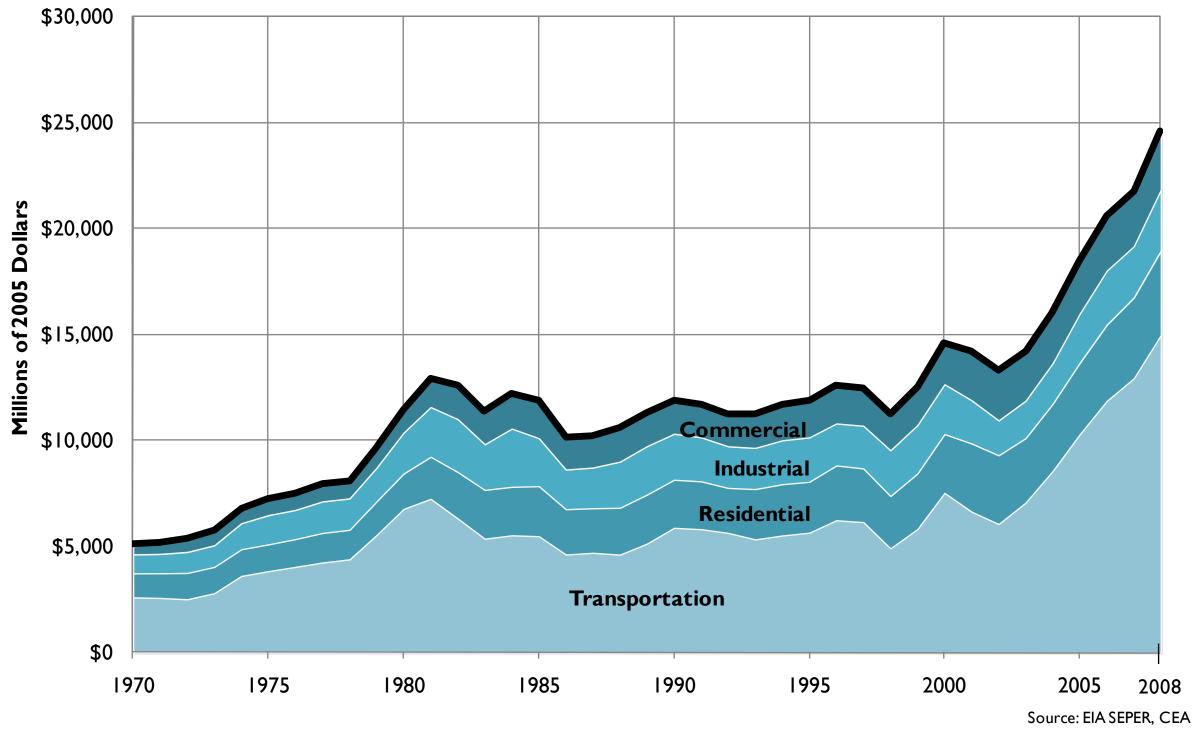

Figure 3-5: End-use energy expenditures by sector (1970-2008)

Washingtonians spent almost $25 billion on energy in 2008. 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 8 percent from 1998 to 2008. This increase was due to higher energy prices, since energy consumption was relatively flat 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.

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[m] 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 base year 2005. This is done by multiplying the nominal prices by the Bureau of Economic Analysis' gross domestic purchases index for the U.S. for each year (where the value in 2005 equals 1). This adjusts for the effects of inflation over time and allows prices for different years to be directly compared.

The transportation sector accounts for the largest share of energy expenditures, 61 percent in 2008. This proportion has grown in recent years, reflecting the increase in the real price of petroleum fuels. The industrial share of expenditures has declined significantly in the last seven years, while the residential and commercial shares declined modestly.

While energy expenditure numbers for 2009 from EIA are not yet available, they are expected to be considerably lower than 2008.

Sources: Energy Information Administration's State Energy Data System, President's Council of Economic Advisors - 2005 Annual Economic Report of the President (see data table for **Indicator 4** in Appendix B)

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.

Indicator 5: 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.

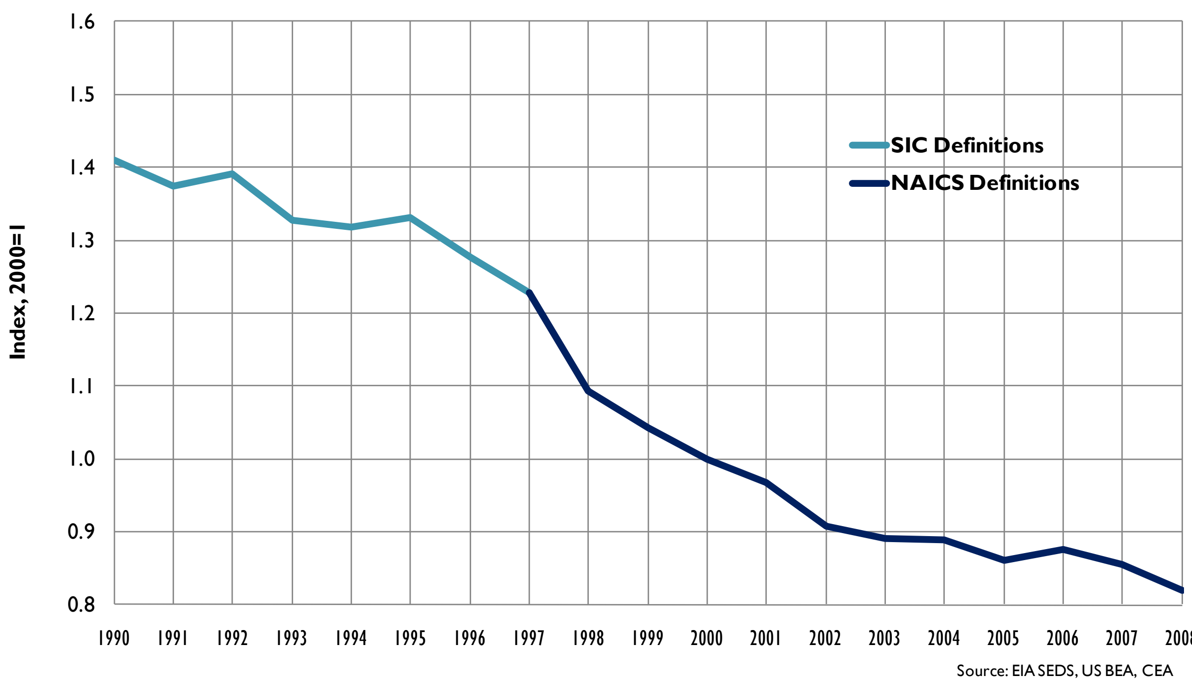

Figure 3-6: Energy consumption per dollar of gross state product (1990-2008)

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 output[n]. In the last 18 years energy consumption per dollar of GSP declined approximately 40 percent[o]. Over the same time frame the national energy consumption per dollar of GDP declined approximately 31 percent.

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. We have not tried to determine the relative contribution of these various factors to the decline in energy use per unit of GSP. (see data table for **Indicator 5** in Appendix B)

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

Indicator 6: Energy Consumption per Capita

Another way to look at Washington's energy intensity is 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 about 200 million Btu.

[n] 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.

[o] 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.

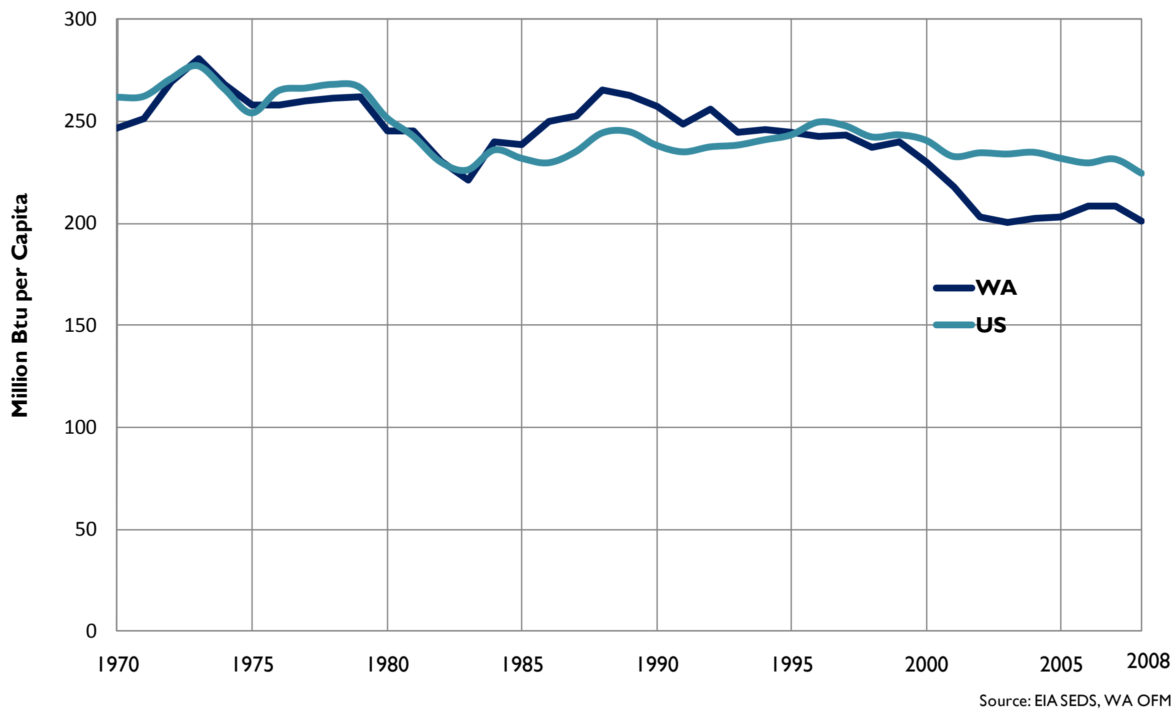

Figure 3-7: Energy consumption per capita (1970-2008)

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 implies growth in overall energy use mirrors growth in population. Dips in per capita energy consumption during this period were generally the result of high energy prices or 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 lower level of 200 million Btu, 20 percent below the historical trend. This was likely due to the decline in industrial 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 2008 Washington's per capita energy consumption was about 10 percent less than the national average.

Sources: Energy Information Administration's State Energy Data System; Washington State Office of Financial Management **(**see data table for **Indicator 6** in Appendix B)

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/

Indicator 7: 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.

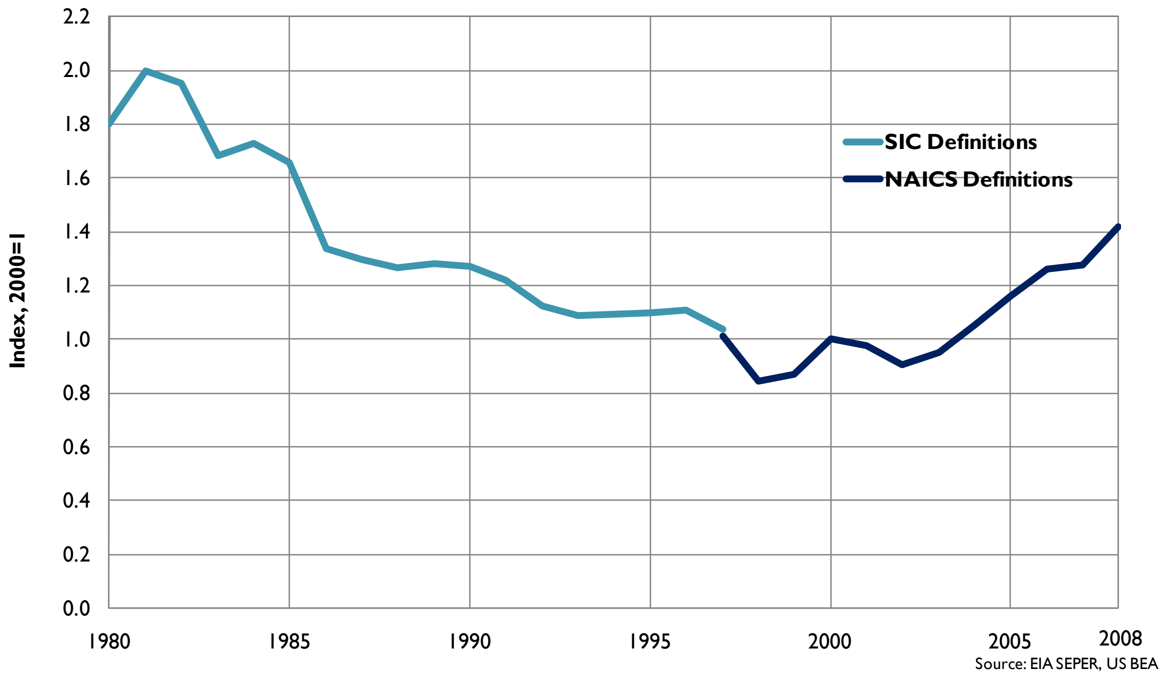

Figure 3-8: Energy expenditures per dollar of gross state product (1980-2008)

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 5.8¢ 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 1981[p]. 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 dollar of GSP from the low of 4.9¢ in 1998 to 8.1¢ in 2008.

Sources: Energy Information Administration's State Energy Data System; U.S. Department of Commerce, Bureau of Economic Analysis **(**see data table for **Indicator 7** in Appendix B)

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/

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[p] 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.

Indicator 8: 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 2004 to its highest levels, and then declined.

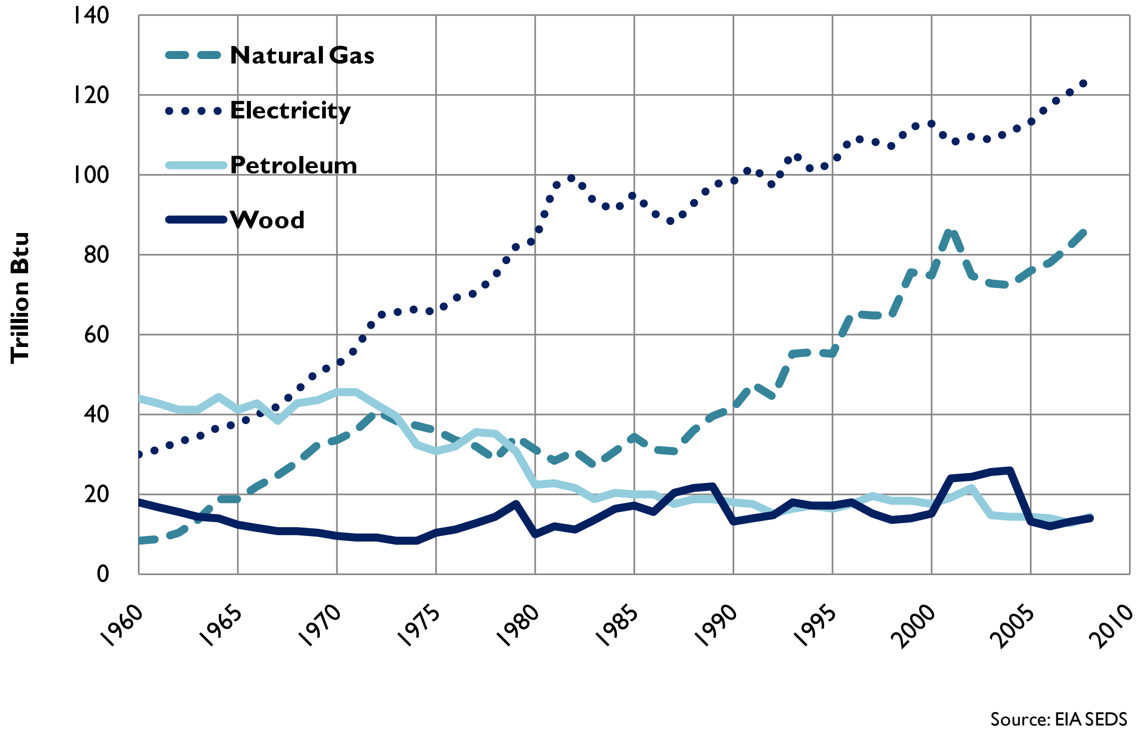

Figure 3-9: Residential end-use energy consumption by fuel (1980-2008)

Electricity accounted for half of residential energy consumption in 2008, 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 2008[q].

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 slowly risen since then.

[q] 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 **(**see data table for **Indicator 8** in Appendix B)

Indicator 9: Residential Household Energy Intensity

Energy intensity[r] in Washington households declined by a third between 1972 and 1987indicating an improvement in household energy intensity. There has been no improvement since. Consumption per household in 2008 was similar to 1987.

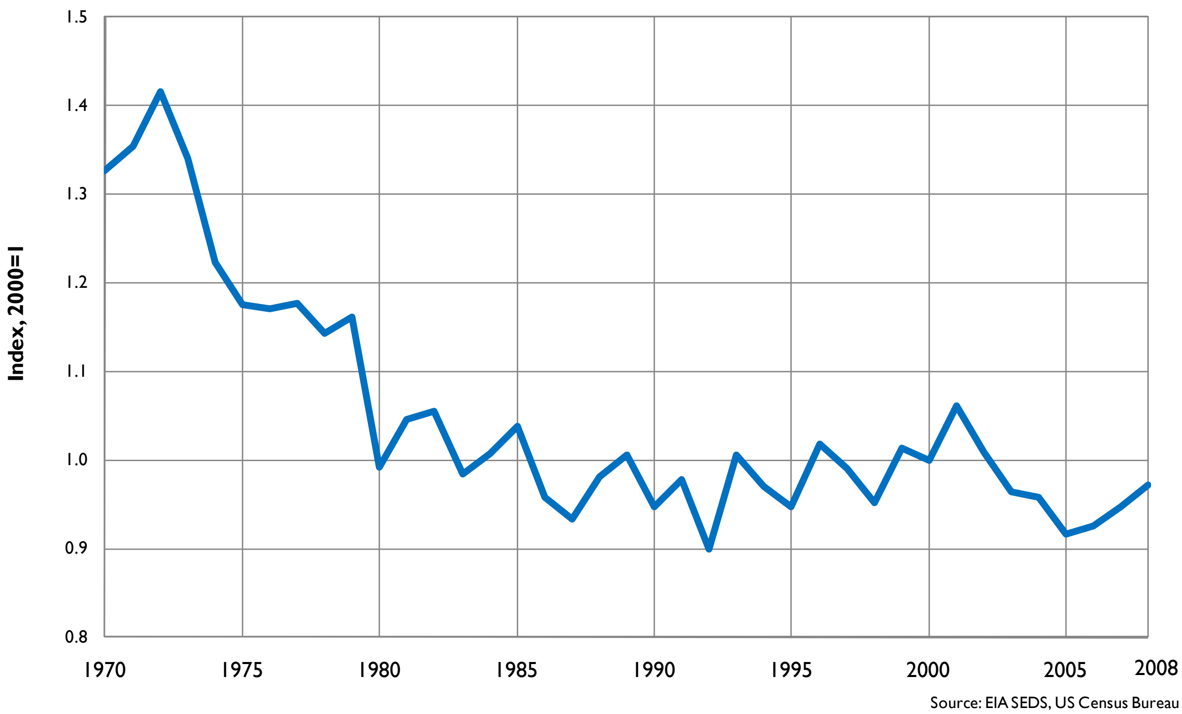

Figure 3-10: Residential energy consumption per household (1970-2008)

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 1978/79. These declines in natural gas and petroleum use were likely due to improvements in efficiency (e.g. adding insulation),

[r] Energy intensity is calculated by dividing total residential sector energy consumption by number of households. Excludes transportation fuel unless otherwise noted.

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 building code and standard updates, household energy use would be much higher. Note that these data do not include energy used for personal transportation, which has increased markedly during the last 25 years.

Sources: Energy Information Administration's State Energy Data System; U.S. Bureau of the Census **(**see data table for **Indicator 9** in Appendix B)

Indicator 10: Residential Household Energy Bill without Transportation

Adjusted for inflation, the average Washington household spent 39 percent more for home energy in 2008 than in 1998. Household expenditures in 2008 were noticeably more than the previous peak in 1983.

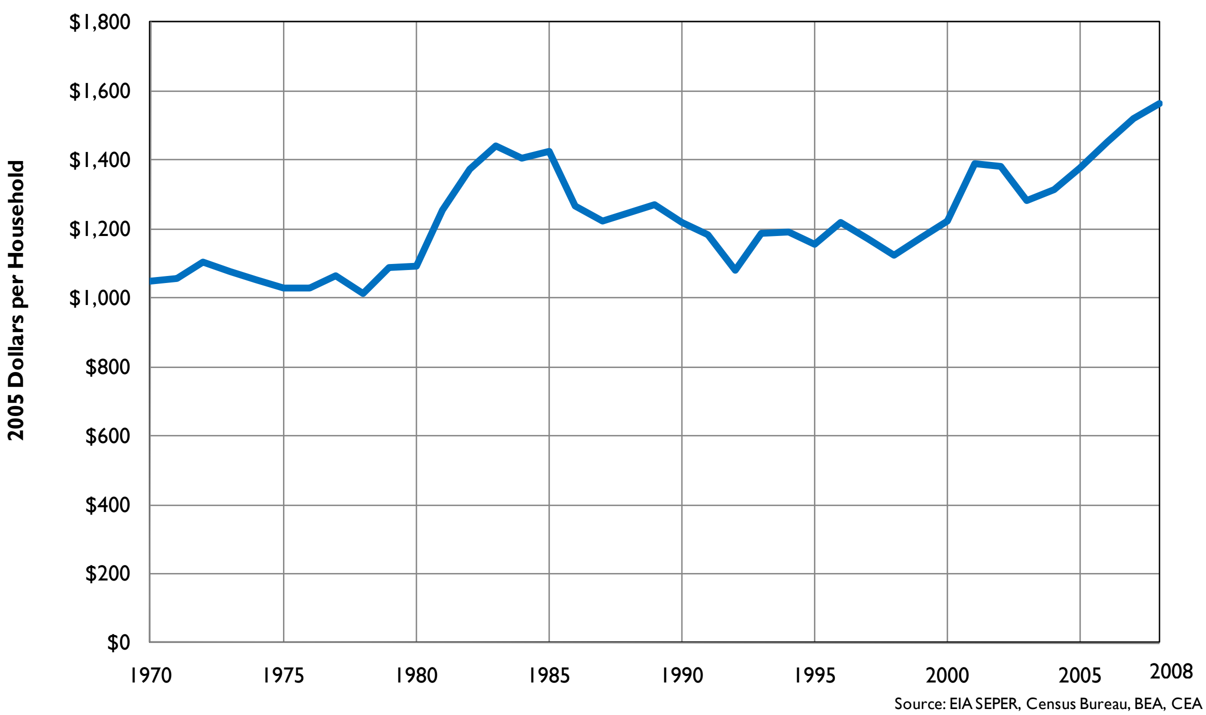

Figure 3-11: Residential energy expenditures per household (1970-2008)

In 2008, the average Washington household spent the inflation-adjusted sum of $1,563 (using constant 2005 dollars) for electricity, natural gas, and petroleum delivered to the home. This is $397 more than they spent in 1998, and $111 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 2000-2001 energy crisis led to higher residential electricity prices and eventually natural gas prices and petroleum prices have increased resulting in higher overall residential energy expenditures.

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 **(**see data table for **Indicator 10** in Appendix B)

Indicator 11: 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 $4,720 (2008).

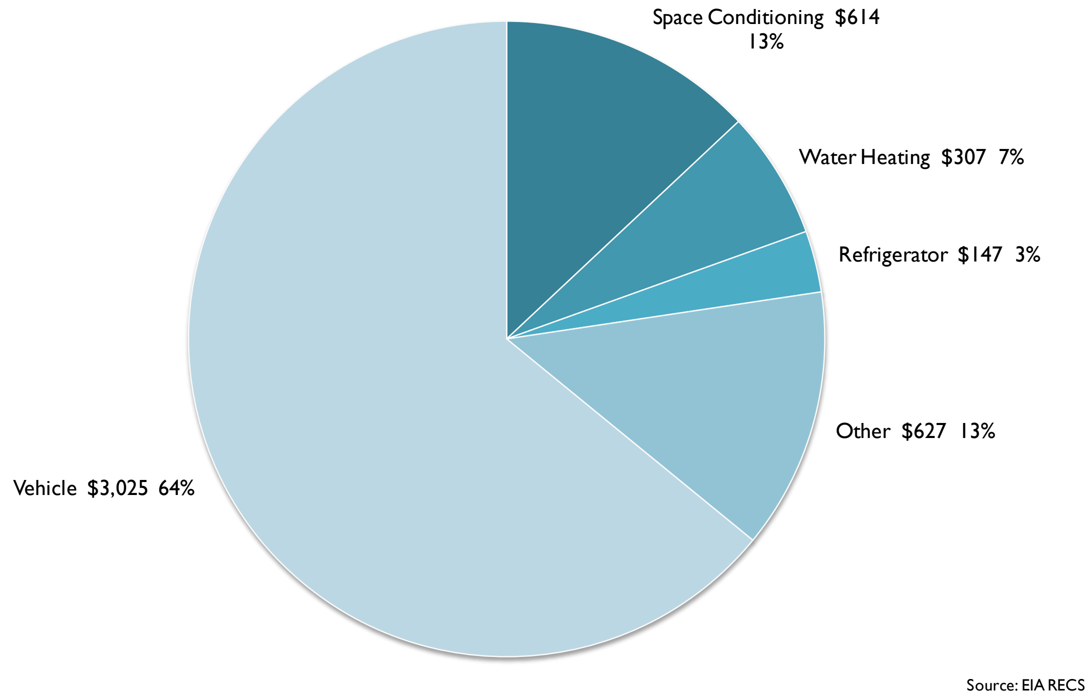

Figure 3-12: Household energy bill by end use

Most views depicting residential energy data do not include the major component of consumption and expenditure for most households – vehicles. The average household[s] in Washington spent well over half of its energy budget fueling vehicles for transportation in 2008. This share has grown over the last several years, but will likely decline for 2009. Recent higher gas prices have pushed up transportation costs, but increasing vehicle efficiency is forecast to slowly drive transportation costs down.

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

[s] 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	614	13%
Water Heating	307	7%
Refrigerator	147	3%
Other	627	13%
Vehicle	3,025	64%
Total	4,720	100%

Indicator 12: 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, and at a slower annual rate of about 1 percent since then. Electricity accounted for 58 percent of end-use energy consumption in the commercial sector in 2008 while natural gas made up 33 percent.

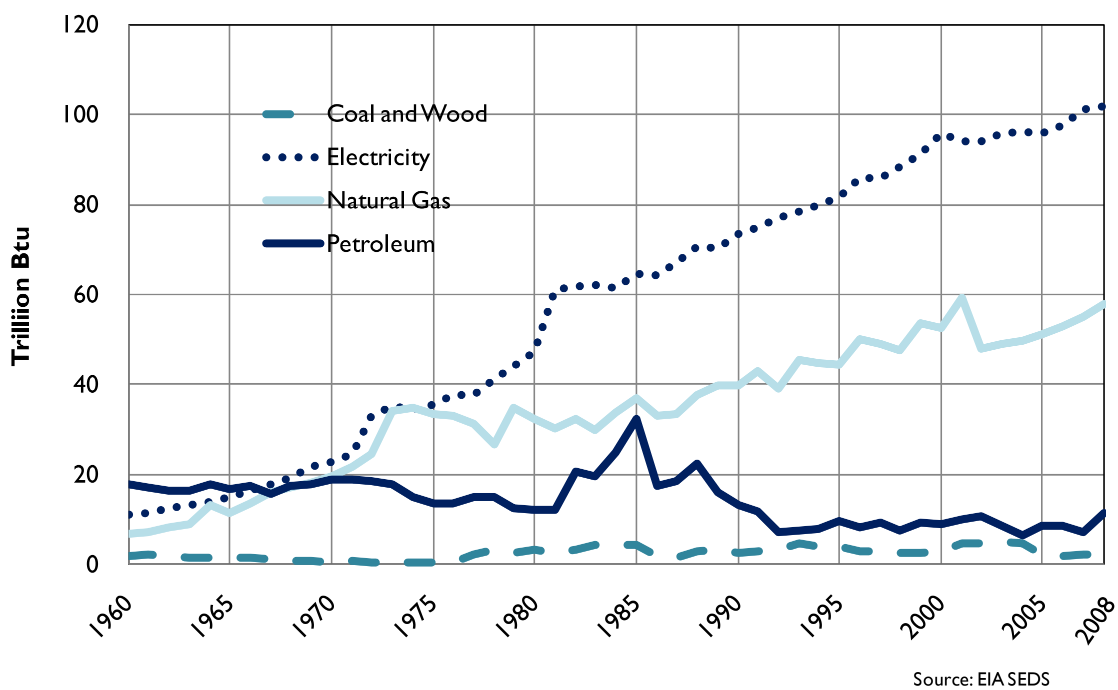

Figure 3-13: Commercial energy consumption by fuel 1960-2008

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 increased more than fivefold from 1970 to 2008.

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 6.5 percent in 2008. Coal and wood accounted for less than 3 percent of commercial sector energy use.

Sources: Energy Information Administration's State Energy Data System **(**see data table for **Indicator 12** in Appendix B)

Indicator 13: 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 resuming a downward trend.

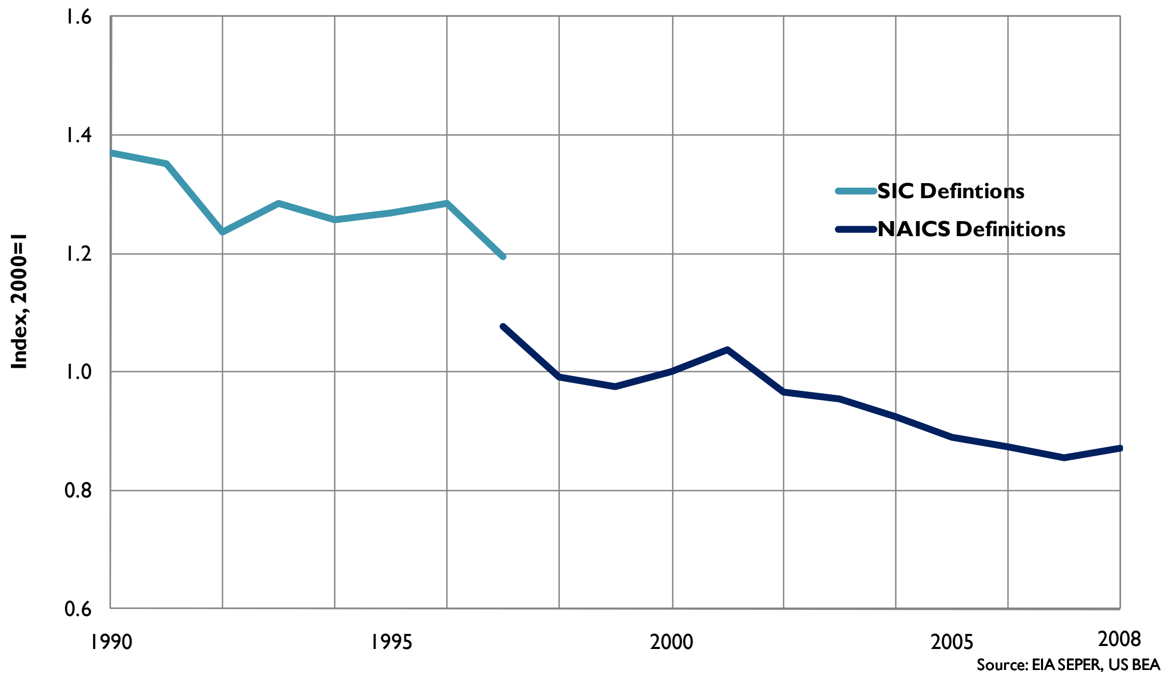

Figure 3-14: Commercial sector energy consumption per real dollar of sector GSP (1990-2008)

Washington's commercial sector has become less energy intensive for most of the last 15 years[t]. 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.

[t] 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.

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 (see data table for **Indicator 13** in Appendix B)

Indicator 14: Industrial End-Use Energy Consumption by Fuel

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

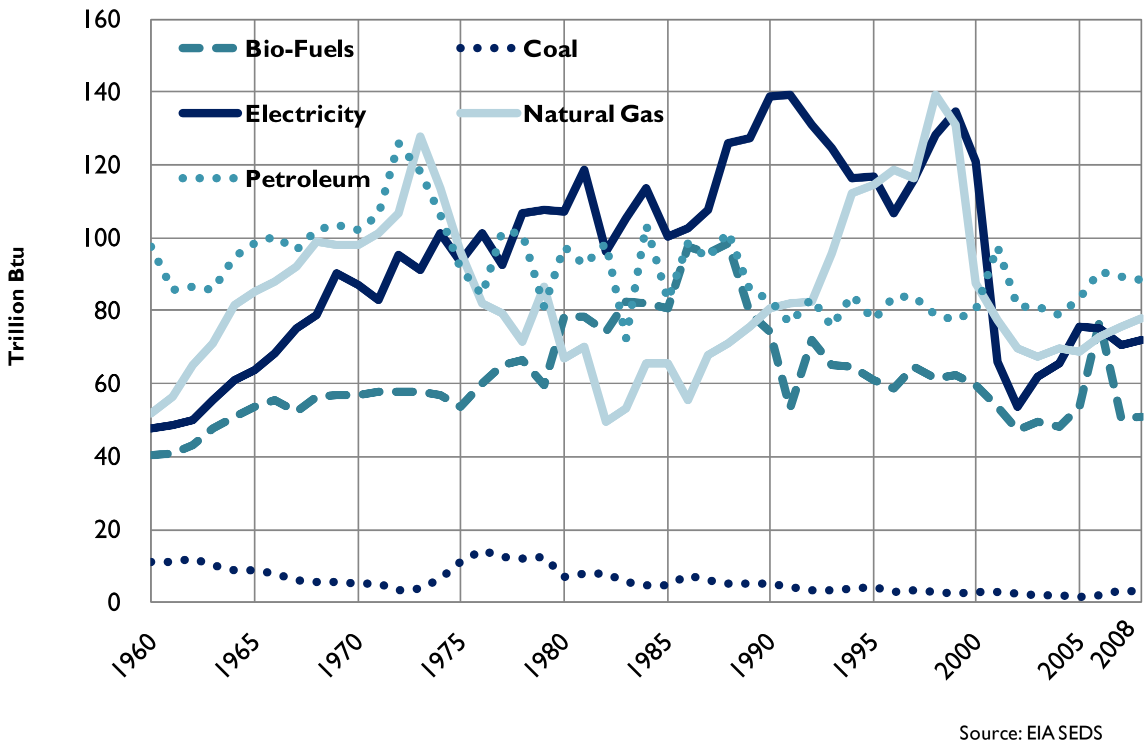

Figure 3-15: Industrial energy consumption by fuel (1960-2008)

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 30 percent of industrial consumption in 2008, much of which occurs at refineries, while electricity and natural gas accounted for about a quarter each and biofuels[u] accounted for 18 percent. Coal

[u] Biofuels 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.

use accounted for only one percent of industrial consumption in 2008 declining from a high of 14 trillion BTUs in 1976 to 3 trillion BTUs in 2008.

Energy consumption in the industrial sector varies more than the other sectors with peaks and valleys that mirror economic activity. When industrial 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 2008 it was 15 percent higher than in 2002.

Sources: Energy Information Administration's State Energy Data System (see data table for **Indicator 14** in Appendix B)

Indicator 15: 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.

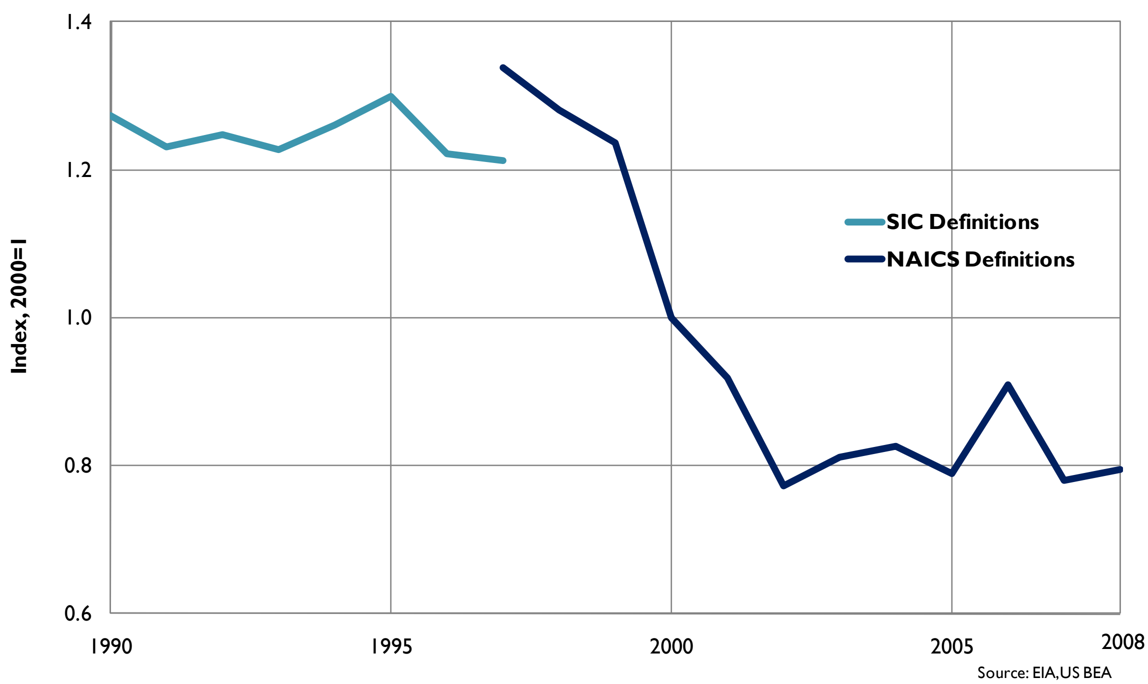

Figure 3-16: Industrial sector energy consumption per real dollar of sector gross state product (1990-2008)

Washington's industrial sector is less energy-intensive than it was two decades ago when comparing industrial energy use to industrial gross state product[v]. 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 (see data table for **Indicator 15** in Appendix B)

Indicator 16: Transportation End-Use Energy Consumption by Fuel

Gasoline[w] accounts for just over half of transportation sector energy use in Washington. Petroleum fuels accounted for 98.5 percent of transportation energy use in 2008. Washington's status as a major seaport and aviation hub means significant consumption of aviation and marine fuels as well.

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[v] 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.

[w] 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.

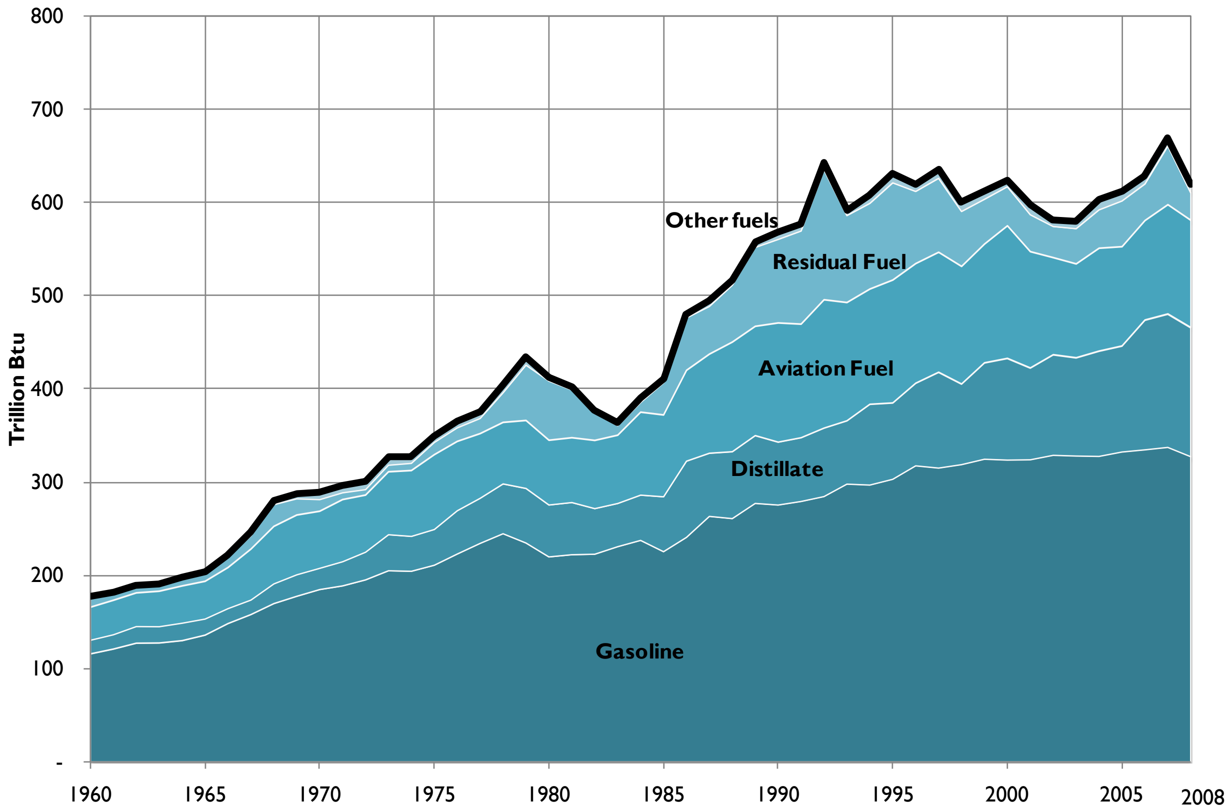

Figure 3-17: Transportation sector consumption by fuel (1960-2008)

Except for the period between 1978 and 1981 and in 2008 (when prices jumped significantly), gasoline consumption has generally increased as population growth and demand for travel has largely outstripped gains in vehicle fuel efficiency. Overall, gasoline consumption has roughly tracked population growth and in 2008 was 77 percent greater than in 1970.

Consumption of distillate fuels in trucks, ships, and railroads grew at a much faster rate than other transportation fuels, reaching levels in 2008 that were six times greater than 1970. However, due to a low base level of diesel use in 1970 the magnitude of this consumption increase (in Btu's) was only half the increase for motor gasoline. Aviation fuel consumption more than doubled between 1970 and 2000, but has dropped 20 percent since then due to fuller flights and more efficient aircraft.

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 large ocean going ships choose to purchase their fuel. The volatility of residual fuel use in Washington may indicate tracking and accounting problems with this fuel.

Sources: Energy Information Administration's State Energy Data System **(**see data table for **Indicator 16** in Appendix B)

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

Indicator 17: Miles Driven and Transportation Fuel Cost of Driving

Washingtonians drove about 40 percent more miles per capita in 2008 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.

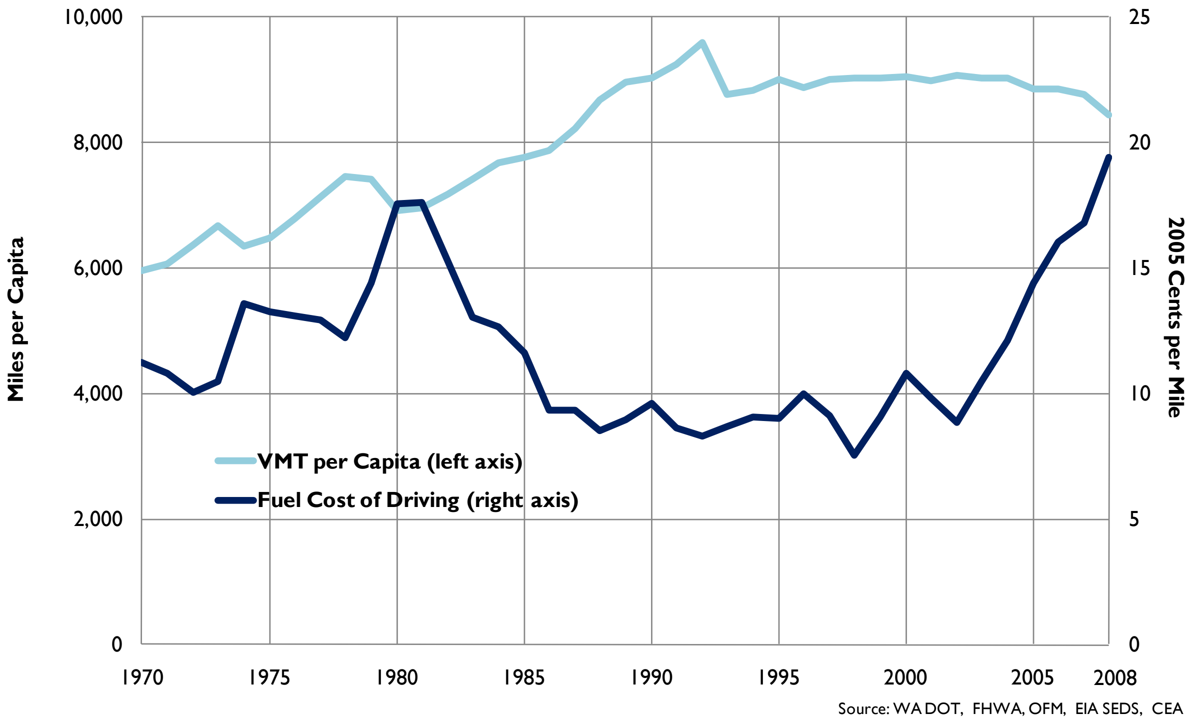

Figure 3-18: Fuel cost of driving and miles driven per capita (1970-2008)

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, 1979-1980 and 2007-2008 as a result of the oil price shocks. VMT per capita dropped slightly in response to higher prices, as discretionary driving was temporarily curtailed. However, long-term factors such as land-use patterns, commuting habits, and the long lifetimes of vehicles (limiting the ability to switch to fuel efficient vehicles) mean that large swings in fuel prices lead to only small changes in miles driven and fuel consumed.

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 17.6¢ per mile in 1981 to 8.5¢ in 1988 (in 2005 dollars). However, real gasoline prices changed little over 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 2008 the fuel cost of driving had risen almost 150 percent. Meanwhile, per capita vehicle travel increased steadily during the 1980s, then remained relatively stable from 1993 through 2006, declining noticeably in 2008 with higher fuel prices and the onset of a recession. The fuel cost of driving reached a new peak high of 19.4 cents per mile in 2008.

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. **(**see data table for **Indicators 17a** and **17b** in Appendix B)

Indicator 18: Transportation Sector Energy Intensity

Spurred by high gasoline prices and new vehicle efficiency standards, 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 temporarily put an end to this upward trend.

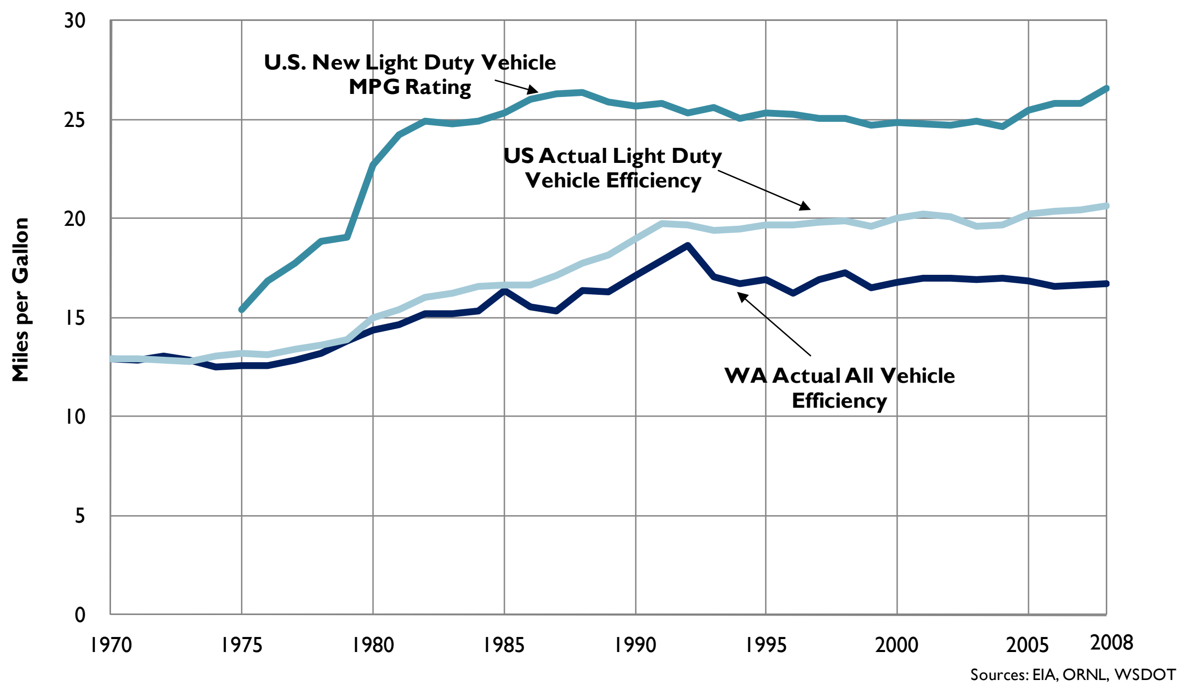

Figure 3-19: New vehicle miles per gallon and Washington State actual vehicle miles per gallon (1970-2008)

Like other sectors, Washington's transportation sector has become more energy efficient over the years. The average efficiency of Washington's total vehicle fleet (light and heavy duty vehicles), based on estimated total miles driven divided by fuel use, increased from 12.6 miles per gallon (MPG) in 1975 to 18.7 MPG in 1992. However, this improvement came to an end in the early 1990s. Since 1992 Washington's vehicle fleet efficiency declined by 2.0 miles per gallon. Several factors have likely contributed to this decline including: a shift to heavier and performance vehicles in the light duty fleet, a rapid increase in freight being moved through the state by heavy duty trucks, and increasing congestion on our roadways.

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 did not change after the mid-1980s. The Corporate Average Fuel Economy (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 did not apply to the largest pickup trucks, and as a result the increasing popularity of trucks and SUVs 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 adoption of higher CAFE standards (2007 and 2010) should lead to higher new vehicle fuel efficiency through the next decade. An executive order prompting EPA and NHTSA to improve the fuel economy of medium and heavy duty trucks should also contribute to high vehicle 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 figure[x]. As a result, the actual on-road efficiency of new cars and trucks since about 1990 has not better than the existing vehicle fleet. This is reflected by the U.S. actual light duty vehicle MPG in Figure 3-19. Vehicle stock turnover has not appreciably raised the efficiency of the vehicle fleet since the early 1990s, though recent high fuel prices have been driving a slow improvement over the past four years.

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 **(**see data table for **Indicator 18** in Appendix B)

Indicator 20: Average Energy Prices by Fuel

Even though electricity prices in Washington tend to be lower than in other parts of the country, electricity, until recently, was the most expensive primary energy source (Btu basis). Real electricity prices[y] 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 began rising in the late 1990s and reached record levels by 2007-2008.

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[x] 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).

[y] 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 2005. 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 2005 equals 1). This adjusts for the effects of inflation and allows prices for different years to be directly compared.

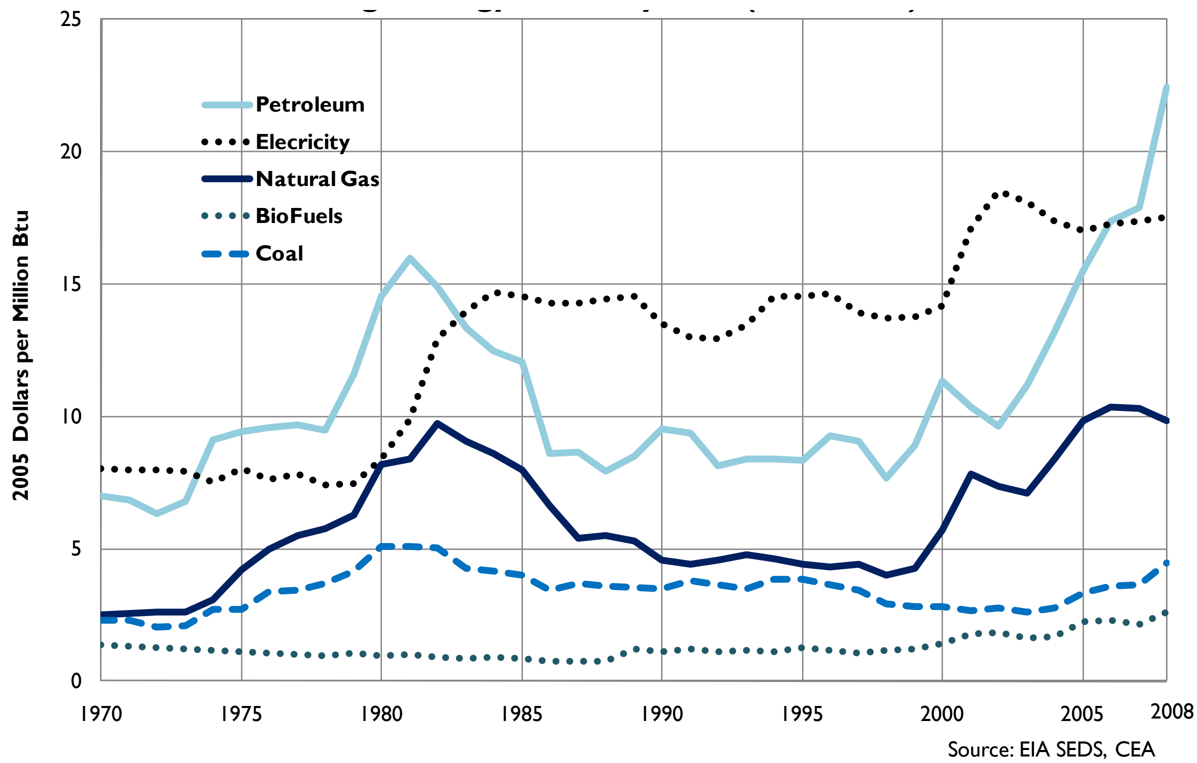

Figure 3-20: Average energy prices by fuel (1970-2008)

While the effect of the first 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 increased significantly through 2008.

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 **(**see data table for **Indicator 20** in Appendix B)

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.

Indicator 21: Electricity Prices by Sector

Real electricity prices[z] 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.

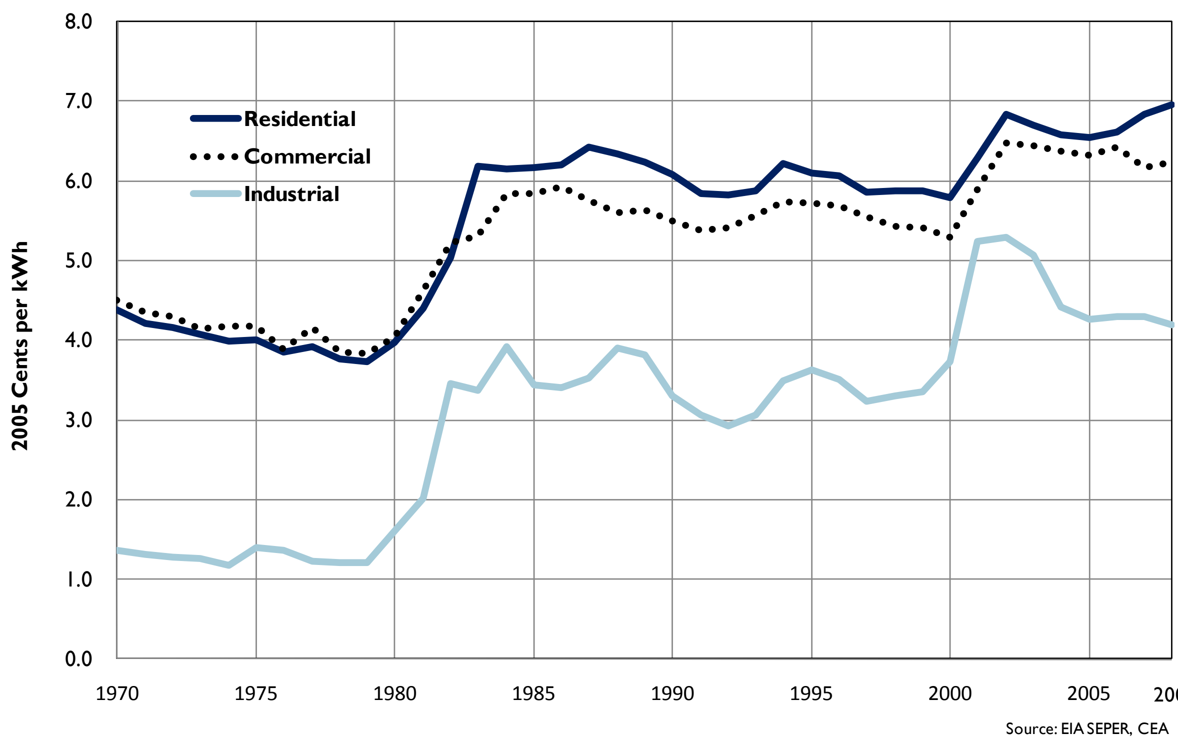

Figure 3-21: Electricity prices by sector (1970-2008)

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.

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z 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 2005. 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 2005 equals 1). This adjusts for the effects of inflation and allows prices for different years to be compared.

Electricity price trends for the residential and commercial sectors from 1970 to 2008 were nearly identical. Industrial sector prices have been more volatile than residential and commercial prices. Industrial electricity prices in 2008 were three times greater than 1970, versus a 50 percent increase for the residential and commercial sectors[aa]. On a per unit basis, the average increase also varied: 2.5¢ per kWh for residential, 1.7¢ per kWh for commercial, and 2.8¢ per kWh for industrial. Washington exhibits significant variation in price from utility to utility.

Sources: Energy Information Administration's State Energy Data System; President's Council of Economic Advisors **(**see data table for **Indicator 21** in Appendix B)

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.

Indicator 22: Natural Gas Prices by Sector

Real natural gas prices[bb] 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.

[aa] 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.

[bb] 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 2005. 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 2005 equals 1). This adjusts for the effects of inflation and allows prices for different years to be compared.

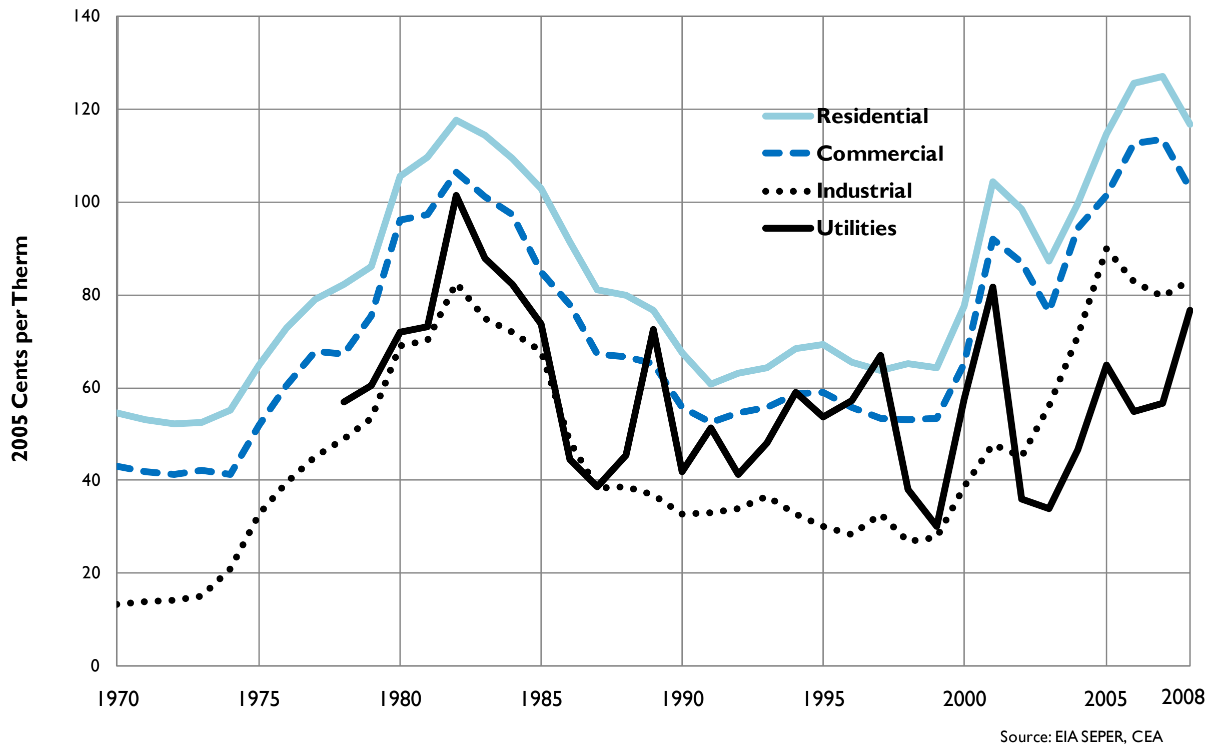

Figure 3-22: Natural gas prices by sector (1970-2008)

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 2006 and 2007, prices had exceeded the historic highs of 1982 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. Figure 3-22 also shows a decline for 2008 which reflects the first year that natural gas from shale resources began to enter the market in large quantities. This new natural gas resource is expected to keep natural gas price lower for at least a decade.

On a percentage basis average industrial natural gas prices have been significantly lower than the other sectors, but by 2008 that difference had declined. 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 late 1999, the increase was more dramatic for the industrial sector than the other sectors.

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 and seasonal, with gas often being purchased on the spot market when needed. But the use of natural gas for electricity generation has been growing over the past decade. 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 **(**see data table for **Indicator 22** in Appendix B)

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.

Indicator 23: Gasoline Prices

Adjusted for inflation[cc], gasoline prices[dd] in Washington first peaked in 1981, and then declined to an historic low in 1998, before exceeding the 1981 peak in 2006 and reaching an all time high in 2008.

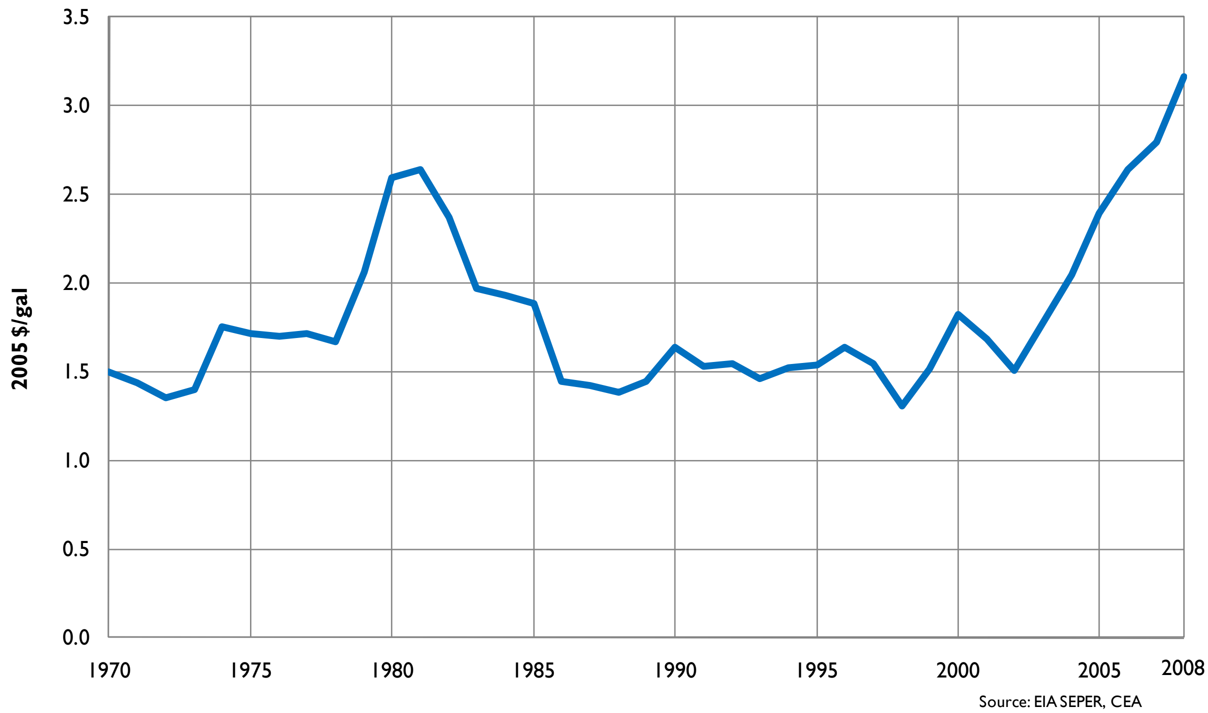

Figure 3-23: Washington State gasoline prices (1970-2008)

For nearly 40 years inflation-adjusted gasoline prices in Washington have been relatively stable except for two periods: from 1979-1982 when prices spiked due to the conflict in the Middle East and since 2004 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, following the Asian financial crisis, gasoline prices fell to their lowest level in nearly 30-years, 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

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[cc] 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 2005. 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 2005 equals 1). This adjusts for the effects of inflation and allows prices for different years to be compared.

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

gasoline in Washington exceeded the peak price in 1981. Crude oil and gasoline prices have fallen dramatically since 2008 and will be reflected in future reports.

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, even excluding taxes, tend to be a little bit higher than the national average. See discussion of more recent gasoline prices in chapter 1.

Sources: Energy Information Administration's State Energy Data System; President's Council of Economic Advisors **(**see data table for **Indicator 23** in Appendix B)

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/

Indicator 25: Energy-Related Carbon Dioxide Emissions

State level energy related carbon dioxide emissions from 1980 through 2007 are determined and posted by the EIA, and are shown below for Washington State[ee]. Washington's reliance on fossil fuels has led to steady growth in emissions of carbon dioxide, the principal anthropogenic greenhouse gas. Petroleum use, primarily for transportation, accounted for 71 percent of CO_2 emissions from energy use in Washington in 2007. Preliminary national CO_2 data for 2008 and 2009 suggest that carbon dioxide emissions have fallen noticeably from 2007.

[ee] Independently the state also produces a GHG emission inventory which differs from the EIA estimates shown below in the following ways: the state inventory includes gases other than carbon dioxide, the state inventory goes beyond energy related carbon dioxide emissions and includes process emissions, and the state inventory includes other sectors of the economy such as agriculture and forestry.

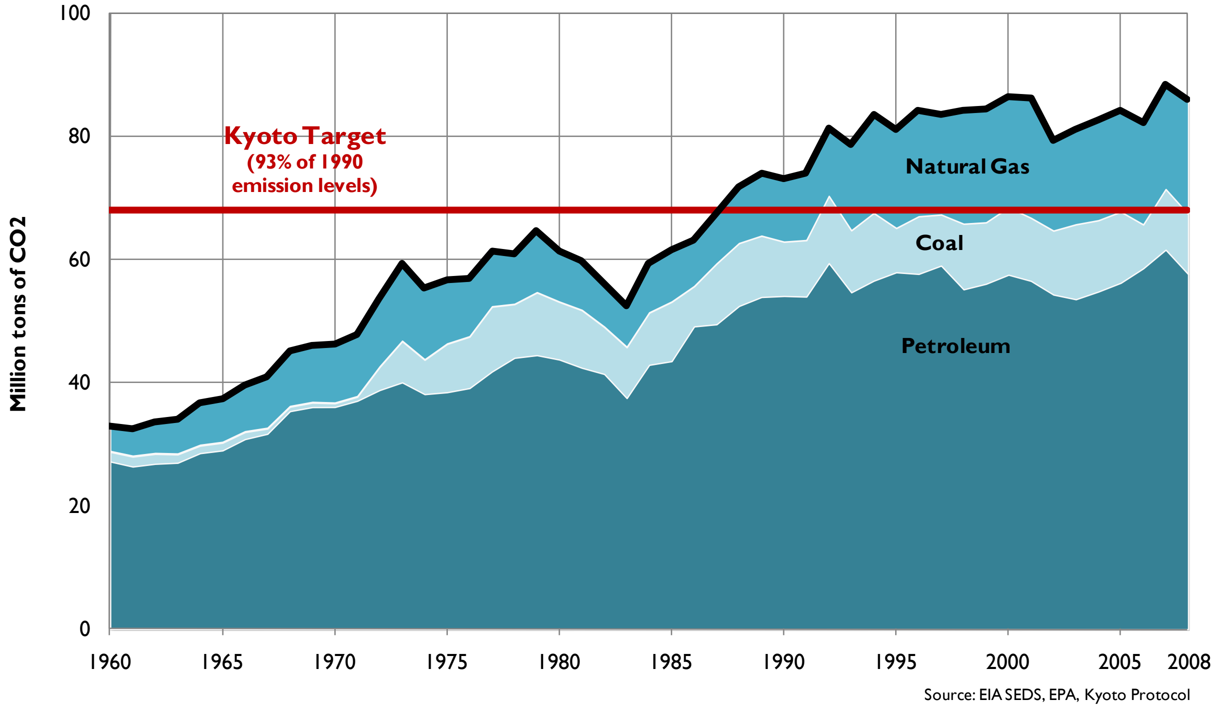


Figure 3-24: Carbon dioxide emissions from energy use by fuel source (1960-2008)

Washington's continued dependence on fossil fuels for energy, particularly petroleum, has led to growth in emissions of carbon dioxide (CO_2), 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 CO_2 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, the partial shutdown of the Northwest aluminum industry, and higher energy prices; emissions appear to have returned to a slow growth pattern since then. The 911 terrorist attacks sharply curtailed emissions from airlines.

Consumption of petroleum products, the vast majority for transportation, accounted for most of the growth in Washington's energy-related CO_2 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 CO_2 emissions than coal.

Sources: Energy Information Administration, CO2 Energy Emissions by State **(**see data table for **Indicator 25** in Appendix B)

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

Appendix A: 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. Since 2001 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.

Sector Definitions

Residential sector: An energy-consuming sector that consists of living quarters for private households. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a variety of other appliances. The residential sector excludes institutional living quarters. Note: Various EIA programs differ insectoral coverage.

Commercial sector: An energy-consuming sector that consists of service-providing facilities and equipment of businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups. The commercial sector includes institutional living quarters. It also includes sewage treatment facilities. Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a wide variety of other equipment. Note: This sector includes generators that produce electricity and/or useful thermal output primarily to support the activities of the above-mentioned commercial establishments.

Industrial sector: An energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods. The industrial sector encompasses the following types of activity manufacturing (NAICS codes 31-33); agriculture, forestry, fishing and hunting

(NAICS code 11); mining, including oil and gas extraction (NAICS code 21); and construction (NAICS code 23). Overall energy use in this sector is largely for process heat and cooling and powering machinery, with lesser amounts used for facility heating, air conditioning, and lighting. Fossil fuels are also used as raw material inputs to manufactured products. Note: This sector includes generators that produce electricity and/or useful thermal output primarily to support the above-mentioned industrial activities. Various EIA programs differ in sectoral coverage-for more information

Transportation sector: An energy-consuming sector that consists of all vehicles whose primary purpose is transporting people and/or goods from one physical location to another. Included are automobiles; trucks; buses; motorcycles; trains, subways, and other rail vehicles; aircraft; and ships, barges, and other waterborne vehicles. Vehicles whose primary purpose is not transportation (e.g., construction cranes and bulldozers, farming vehicles, and warehouse tractors and forklifts) are classified in the sector of their primary use.

Electric power sector: An energy-consuming sector that consists of electricity only and combined heat and power(CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public--i.e., North American Industry Classification System 22 plants. See also Combined heat and power (CHP) plant and Electricity only plant.

Appendix B: Data Tables

- Data tables for indicators 3 and 11 appear in the body of the document, not in this appendix.
- Indicator numbers 19 and 24 do not exist.
- See discussion in body of document for explanations of indicators.
- Data prior to 1970 available by request; contact Angela Burrell, Department of Commerce at angela.burrell@commerce.wa.gov or tel. 360-725-3120.
- Data displayed to approximately 3 significant digits.
- abbreviations used in table headings:

av. fuel	aviation fuel
Btu	British thermal unit
comm.	commercial
elec.	electricity
gal	gallon
GSP	gross state product
ind.	indicator
ind'l	industrial
mi	mile
mmBtu	million Btu
NAICS	North American Industry Classification System
NG	natural gas
pers	person
petrol.	petroleum products
res.	residential
resid.	residual fuel
SIC	Standard Industrial Classifications
trans.	transportation
wd	wood

Indicators **1** end use energy consumption by sector, **2** primary energy consumption by source.

year	indicator 1, trillion Btu res.	comm.	ind.	trans.	total	indicator 2, trillion Btu biomass	coal	hydro	nuclear	NG	petrol.	year
1970	142	61.7	351	289	843	66.5	5.9	237	28.7	158	448	1970
1971	147	65.9	356	296	865	67.2	6.4	244	27.7	165	460	1971
1972	157	76.7	391	300	925	67.0	36.6	258	31.5	180	481	1972
1973	152	87.2	401	327	967	66.2	65.0	235	48.3	208	497	1973
1974	144	84.6	386	327	941	65.2	54.2	281	43.4	191	475	1974
1975	142	82.8	348	349	922	64.3	76.2	285	36.4	171	479	1975
1976	146	84.6	343	365	939	71.4	81.2	322	26.6	155	489	1976
1977	151	86.3	353	375	966	78.3	102.4	227	46.5	149	521	1977
1978	154	85.9	360	403	1,003	81.0	84.7	303	45.3	133	548	1978
1979	165	94.1	349	434	1,042	77.5	99.0	271	39.3	166	554	1979
1980	148	94.8	358	413	1,014	88.3	91.0	283	22.3	135	543	1980
1981	161	105.6	368	403	1,037	94.9	90.9	319	22.5	131	528	1981
1982	163	118.1	328	377	987	91.1	74.1	299	40.2	114	516	1982
1983	153	116.2	321	363	953	104.4	80.2	292	38.1	112	472	1983
1984	159	124.3	371	390	1,045	110.3	82.3	284	57.6	132	537	1984
1985	168	138.4	336	411	1,053	112.0	93.7	262	85.4	140	543	1985
1986	157	116.6	364	480	1,117	117.7	63.3	269	89.3	122	614	1986
1987	157	120.9	374	494	1,145	122.5	95.7	238	57.7	136	621	1987
1988	169	133.6	405	517	1,225	127.4	99.1	233	63.6	151	656	1988
1989	178	130.3	375	558	1,242	108.2	96.7	243	64.7	168	675	1989
1990	172	130.1	384	568	1,254	93.4	85.6	298	60.8	168	676	1990
1991	182	133.7	358	577	1,250	73.9	89.1	304	44.3	179	678	1991
1992	172	127.2	374	643	1,316	95.4	106.1	232	59.6	181	743	1992
1993	196	136.2	366	591	1,290	96.5	97.8	229	74.9	230	688	1993
1994	192	137.3	383	607	1,319	96.3	106.9	223	70.4	263	712	1994
1995	192	140.4	377	631	1,340	90.1	69.8	281	72.9	264	728	1995
1996	210	148.0	373	620	1,351	89.7	90.9	335	58.7	284	725	1996
1997	208	148.1	387	636	1,379	94.2	80.5	354	65.5	268	743	1997
1998	204	147.2	413	601	1,364	87.1	103.5	272	72.6	303	697	1998
1999	220	157.6	410	612	1,400	89.4	96.9	330	63.6	302	709	1999
2000	220	161.0	351	624	1,356	89.6	106.2	274	89.7	298	729	2000
2001	239	168.6	298	597	1,302	92.7	99.4	187	86.2	322	718	2001
2002	231	157.5	256	581	1,226	87.6	100.8	266	94.5	240	690	2002
2003	222	159.3	263	580	1,224	95.7	118.2	245	79.4	256	679	2003
2004	224	158.5	264	602	1,249	92.6	112.5	244	93.7	270	695	2004
2005	217	158.8	283	612	1,271	83.4	112.3	241	86.0	272	712	2005
2006	221	162.0	318	628	1,329	106.2	69.2	272	97.3	271	736	2006
2007	229	166.5	289	669	1,355	81.9	95.7	260	85.0	280	773	2007
2008	239	174.5	293	619	1,326	79.6	94.6	255	96.9	307	728	2008

Indicators **4** end use energy expenditures by sector, **5** energy consumption per GSP (index)
6 energy consumption per capita, **7** energy expenditures per GSP (index)

	indicator 4, billion 2005$				**ind. 5** 2000=1	**indicator 6** mmBtu/person		**ind. 7** 2000=1	
year	**res.**	**comm.**	**ind.**	**trans.**		**WA**	**US**		**year**
1970	1,161	481	888	2,606		247	262		**1970**
1971	1,190	502	908	2,579		252	262		**1971**
1972	1,268	605	988	2,515		270	271		**1972**
1973	1,264	665	1,015	2,805		281	277		**1973**
1974	1,282	679	1,223	3,617		268	266		**1974**
1975	1,286	723	1,376	3,843		258	254		**1975**
1976	1,332	749	1,374	4,046		258	265		**1976**
1977	1,416	809	1,484	4,251		260	266		**1977**
1978	1,413	781	1,480	4,402		261	268		**1978**
1979	1,603	910	1,591	5,549		262	267		**1979**
1980	1,682	1,057	1,934	6,782		245	252	1.80	**1980**
1981	1,995	1,312	2,349	7,259		245	243	2.00	**1981**
1982	2,204	1,600	2,497	6,333		231	230	1.95	**1982**
1983	2,319	1,529	2,155	5,375		221	226	1.68	**1983**
1984	2,302	1,639	2,747	5,537		240	236	1.73	**1984**
1985	2,378	1,759	2,263	5,493		238	232	1.66	**1985**
1986	2,155	1,486	1,870	4,630		250	230	1.34	**1986**
1987	2,121	1,500	1,919	4,710		253	235	1.30	**1987**
1988	2,230	1,568	2,175	4,624		265	244	1.26	**1988**
1989	2,329	1,551	2,284	5,146		263	245	1.28	**1989**
1990	2,283	1,523	2,170	5,890	1.41	258	238	1.27	**1990**
1991	2,274	1,506	2,076	5,824	1.37	249	235	1.22	**1991**
1992	2,136	1,499	1,963	5,651	1.39	256	237	1.13	**1992**
1993	2,391	1,597	1,942	5,343	1.33	245	238	1.09	**1993**
1994	2,435	1,668	2,071	5,528	1.32	246	241	1.09	**1994**
1995	2,417	1,704	2,095	5,660	1.33	245	243	1.10	**1995**
1996	2,599	1,782	1,983	6,247	1.28	243	250	1.11	**1996**
1997	2,547	1,744	2,014	6,159	1.23 [a]	243	248	1.01 [b]	**1997**
1998	2,484	1,718	2,159	4,920	1.09	237	242	0.84	**1998**
1999	2,639	1,813	2,286	5,831	1.04	240	243	0.87	**1999**
2000	2,784	1,929	2,353	7,542	1.00	230	241	1.00	**2000**
2001	3,230	2,274	2,041	6,652	0.97	218	233	0.98	**2001**
2002	3,255	2,309	1,649	6,069	0.91	203	235	0.91	**2002**
2003	3,052	2,281	1,769	7,083	0.89	201	234	0.95	**2003**
2004	3,177	2,363	1,922	8,574	0.89	203	235	1.05	**2004**
2005	3,377	2,435	2,323	10,305	0.86	203	232	1.16	**2005**
2006	3,593	2,588	2,560	11,884	0.88	209	230	1.26	**2006**
2007	3,808	2,597	2,425	12,952	0.85	209	231	1.28	**2007**
2008	3,982	2,730	2,878	14,994	0.82	201	225	1.42	**2008**

[a] Based on NAICS 1997 & after, SIC 1996 & before; SIC-based index in 1997 (the transition year) is 1.23

[b] Based on NAICS 1997 & after, SIC 1996 & before; SIC-based index in 1997 (the transition year) is 1.04

Indicators **8** residential end use by fuel, **9** residential energy intensity (index), **10** residential energy bill excl. transportation

	indicator 8, trillion Btu				**ind. 9** 2000=1	**ind. 10** $/hhld	
year	**elec.**	**NG**	**petrol.**	**wood**		(2005 $)	**year**
1970	52.4	33.7	45.7	9.58	1.33	1,050	**1970**
1971	56.4	35.8	45.4	9.22	1.35	1,057	**1971**
1972	64.6	40.8	42.4	8.94	1.42	1,105	**1972**
1973	65.7	38.3	39.6	8.20	1.34	1,078	**1973**
1974	66.2	37.2	32.2	8.27	1.22	1,054	**1974**
1975	65.5	35.8	30.5	10.25	1.18	1,027	**1975**
1976	69.3	33.7	31.9	11.23	1.17	1,030	**1976**
1977	70.4	31.9	35.4	12.85	1.18	1,063	**1977**
1978	74.8	28.7	35.0	14.28	1.14	1,015	**1978**
1979	81.9	34.4	30.9	17.37	1.16	1,089	**1979**
1980	83.4	31.3	22.4	9.74	0.99	1,092	**1980**
1981	97.2	28.2	22.8	12.02	1.05	1,256	**1981**
1982	99.5	30.7	21.6	10.93	1.06	1,375	**1982**
1983	93.0	27.1	18.7	13.35	0.98	1,442	**1983**
1984	91.2	30.6	20.4	16.48	1.01	1,404	**1984**
1985	95.3	34.3	19.9	16.97	1.04	1,424	**1985**
1986	90.4	31.1	19.9	15.46	0.96	1,268	**1986**
1987	87.9	30.8	17.4	20.19	0.93	1,222	**1987**
1988	92.8	35.9	18.5	21.54	0.98	1,248	**1988**
1989	97.8	39.6	18.6	21.78	1.01	1,271	**1989**
1990	98.3	41.6	18.1	13.30	0.95	1,219	**1990**
1991	102.0	47.7	17.6	13.94	0.98	1,185	**1991**
1992	97.0	44.5	15.3	14.63	0.90	1,081	**1992**
1993	105.5	55.3	16.4	17.99	1.01	1,187	**1993**
1994	101.2	55.4	17.3	17.07	0.97	1,193	**1994**
1995	102.9	55.0	16.3	17.07	0.95	1,156	**1995**
1996	109.2	65.1	17.7	17.73	1.02	1,218	**1996**
1997	108.3	64.8	19.6	14.99	0.99	1,173	**1997**
1998	107.0	64.8	18.3	13.32	0.95	1,123	**1998**
1999	112.0	75.6	18.2	14.02	1.01	1,176	**1999**
2000	112.7	74.8	17.4	15.07	1.00	1,222	**2000**
2001	107.8	87.4	19.2	23.79	1.06	1,390	**2001**
2002	109.4	74.6	21.6	24.15	1.01	1,380	**2002**
2003	108.7	72.7	14.9	25.42	0.96	1,281	**2003**
2004	110.7	72.5	14.5	26.05	0.96	1,315	**2004**
2005	113.3	76.0	14.5	13.21	0.92	1,378	**2005**
2006	117.5	77.9	13.7	12.03	0.93	1,453	**2006**
2007	120.7	82.3	12.6	13.26	0.95	1,522	**2007**
2008	124.0	87.1	14.2	13.88	0.97	1,563	**2008**

Indicators **12** commercial end use by fuel, **13** commercial energy intensity (index), **14** industrial end use by fuel, **15** industrial energy intensity (index)

	indicator 12, trillion Btu				**ind. 13** 2000=1	**indicator 14**, trillion Btu					**ind. 15** 2000=1	
year	**elec.**	**NG**	**petrol.**	**coal,wd**		**elec.**	**NG**	**petrol.**	**biomass**	**coal**	(2005 $)	**year**
1970	22.9	19.5	18.73	0.52		87.1	98.3	102.0	56.8	5.09		**1970**
1971	24.7	21.7	18.72	0.71		83.1	101.3	106.5	57.8	5.33		**1971**
1972	33.0	24.5	18.59	0.57		95.4	106.7	125.9	57.9	3.44		**1972**
1973	35.2	34.0	17.64	0.40		91.4	127.9	118.3	57.9	3.92		**1973**
1974	34.3	34.8	15.14	0.35		101.5	113.6	106.2	56.7	6.48		**1974**
1975	35.4	33.3	13.56	0.47		93.5	96.0	91.5	53.9	10.91		**1975**
1976	37.8	32.9	13.38	0.52		101.1	82.0	84.3	59.9	14.24		**1976**
1977	37.7	31.3	14.86	2.38		92.5	79.4	101.5	65.2	12.41		**1977**
1978	41.2	26.5	14.88	3.32		107.0	71.4	101.3	66.5	12.18		**1978**
1979	44.1	34.9	12.44	2.60		107.8	86.8	80.9	59.8	12.48		**1979**
1980	47.2	32.4	12.11	3.13		107.0	67.0	97.6	78.3	7.09		**1980**
1981	60.9	30.1	12.10	2.57		118.5	70.0	92.4	78.4	7.67		**1981**
1982	61.9	32.2	20.59	3.45		96.3	49.6	98.6	74.2	7.95		**1982**
1983	62.3	30.0	19.48	4.51		105.2	53.1	72.4	82.7	5.58		**1983**
1984	61.4	33.8	24.83	4.23		113.8	65.6	103.6	82.2	4.52		**1984**
1985	64.7	36.9	32.44	4.35		100.4	65.7	82.9	80.5	4.49		**1985**
1986	64.2	33.0	17.48	1.96		102.5	55.6	98.7	97.8	7.38		**1986**
1987	67.2	33.4	18.67	1.59		107.8	67.9	94.6	95.7	5.89		**1987**
1988	70.7	37.6	22.58	2.75		125.9	71.2	101.9	98.7	5.27		**1988**
1989	70.4	39.7	16.12	3.34		127.5	75.6	85.8	79.3	4.95		**1989**
1990	73.4	39.8	13.34	2.60	1.37	138.9	80.8	82.8	74.4	5.20	1.27	**1990**
1991	75.0	43.0	11.86	2.99	1.35	139.3	82.2	76.7	53.2	4.28	1.23	**1991**
1992	76.9	39.0	7.32	3.26	1.24	130.8	82.4	83.3	72.0	3.37	1.25	**1992**
1993	78.3	45.3	7.36	4.52	1.28	124.8	95.8	75.7	64.9	3.51	1.23	**1993**
1994	79.8	44.8	7.99	3.96	1.26	116.2	112.2	84.2	64.7	3.88	1.26	**1994**
1995	81.6	44.4	9.55	3.88	1.27	117.0	114.6	77.6	61.2	4.23	1.30	**1995**
1996	85.8	50.0	8.30	2.91	1.28	106.6	118.6	83.6	58.9	2.98	1.22	**1996**
1997	86.0	49.0	9.16	2.94	1.08 [a]	115.9	116.6	84.0	64.6	3.22	1.34 [b]	**1997**
1998	88.3	47.7	7.62	2.51	0.99	128.3	139.3	78.9	61.4	2.69	1.28	**1998**
1999	91.1	53.5	9.25	2.68	0.98	134.8	131.0	77.3	62.6	2.18	1.24	**1999**
2000	95.7	52.6	8.77	2.92	1.00	120.8	87.3	80.2	59.5	2.81	1.00	**2000**
2001	93.9	59.1	9.96	4.65	1.04	66.0	77.6	97.5	53.9	2.89	0.92	**2001**
2002	93.9	47.8	10.62	4.76	0.97	53.9	69.7	81.2	47.2	2.28	0.77	**2002**
2003	95.7	49.1	8.58	5.00	0.95	62.0	67.6	81.0	49.7	2.09	0.81	**2003**
2004	96.3	49.8	6.30	4.85	0.92	65.7	69.7	78.7	48.0	1.85	0.83	**2004**
2005	95.9	51.2	8.49	2.11	0.89	75.4	68.9	83.6	53.7	1.48	0.79	**2005**
2006	97.5	52.8	8.47	1.96	0.87	75.1	72.9	90.8	77.0	2.01	0.91	**2006**
2007	101.0	55.1	7.20	2.08	0.85	70.8	75.5	89.4	50.4	3.19	0.78	**2007**
2008	101.9	57.9	11.26	2.21	0.87	72.1	78.0	88.2	51.0	2.95	0.79	**2008**

[a] Based on NAICS definitions from 1997 forward; SIC definitions 1996 and earlier. SIC-based index in 1997 is 1.19.

[b] Based on NAICS definitions from 1997 forward; SIC definitions 1996 and earlier. SIC-based index in 1997 is 1.21.

Indicators **16** transportation end use by fuel, **17a** travel per capita, **17b** fuel cost of driving, **18** transportation energy intensity

	indicator 16, trillion Btu				**ind.17a** mi/pers	**ind.17b** ¢/mi	**indicator 18**, mi/gal			
year	**gasoline**	**distillate**	**av. fuel**	**resid.**		(2005 $)	**WA**[a]	**US**[b]	**US**[c]	**year**
1970	185	23.0	61.1	12.7	5,968	11.26	12.9		12.9	**1970**
1971	189	26.2	66.6	7.5	6,066	10.80	12.9		13.0	**1971**
1972	195	29.9	61.1	6.1	6,365	10.03	13.1		12.9	**1972**
1973	205	38.9	67.4	7.3	6,671	10.49	12.8		12.8	**1973**
1974	205	37.6	70.5	7.9	6,360	13.60	12.5		13.1	**1974**
1975	211	38.5	80.1	13.3	6,476	13.25	12.6	15.4	13.2	**1975**
1976	223	46.6	74.2	14.7	6,791	13.10	12.6	16.8	13.1	**1976**
1977	235	48.5	69.2	16.4	7,128	12.95	12.9	17.8	13.4	**1977**
1978	245	53.6	65.8	31.8	7,457	12.23	13.2	18.8	13.6	**1978**
1979	235	58.7	72.7	59.4	7,416	14.39	13.9	19.1	13.9	**1979**
1980	220	55.9	69.3	63.6	6,920	17.56	14.4	22.7	15.0	**1980**
1981	222	56.2	69.4	51.3	6,962	17.63	14.7	24.2	15.4	**1981**
1982	223	49.1	73.0	29.6	7,189	15.29	15.2	24.9	16.0	**1982**
1983	231	46.5	73.1	10.3	7,421	13.03	15.2	24.8	16.2	**1983**
1984	238	48.7	88.8	10.4	7,674	12.66	15.3	24.9	16.6	**1984**
1985	226	59.1	87.6	34.5	7,759	11.60	16.4	25.4	16.6	**1985**
1986	241	82.0	97.2	56.2	7,878	9.33	15.6	26.1	16.7	**1986**
1987	264	67.9	106.1	51.1	8,219	9.37	15.4	26.3	17.2	**1987**
1988	261	71.9	117.4	60.9	8,674	8.55	16.4	26.4	17.8	**1988**
1989	278	72.9	117.0	84.5	8,975	8.96	16.3	25.9	18.2	**1989**
1990	276	67.6	127.6	89.5	9,028	9.64	17.1	25.7	19.0	**1990**
1991	280	68.5	121.6	99.7	9,250	8.64	17.9	25.8	19.7	**1991**
1992	285	73.6	137.4	139.2	9,606	8.32	18.7	25.3	19.7	**1992**
1993	298	68.0	126.6	93.1	8,761	8.69	17.1	25.6	19.4	**1993**
1994	297	86.8	123.3	91.7	8,841	9.05	16.7	25.1	19.5	**1994**
1995	304	82.0	131.5	104.1	9,003	9.00	16.9	25.3	19.7	**1995**
1996	318	88.7	128.0	77.2	8,873	10.01	16.2	25.3	19.7	**1996**
1997	316	102.9	128.4	79.1	9,017	9.12	17.0	25.1	19.8	**1997**
1998	319	86.6	125.8	58.8	9,031	7.57	17.3	25.1	19.9	**1998**
1999	325	103.5	127.1	47.8	9,041	9.05	16.5	24.7	19.6	**1999**
2000	324	109.2	141.9	41.7	9,048	10.80	16.8	24.9	20.1	**2000**
2001	325	98.6	124.4	39.4	8,982	9.86	17.0	24.8	20.2	**2001**
2002	329	108.0	103.8	33.2	9,066	8.87	17.0	24.7	20.1	**2002**
2003	329	105.5	100.3	37.6	9,021	10.47	17.0	24.9	19.6	**2003**
2004	328	113.1	110.0	41.0	9,026	12.09	17.0	24.7	19.7	**2004**
2005	333	113.8	106.1	48.9	8,867	14.41	16.8	25.5	20.2	**2005**
2006	335	139.4	106.3	39.0	8,865	16.04	16.6	25.8	20.4	**2006**
2007	338	143.2	116.8	62.7	8,776	16.82	16.7	25.8	20.5	**2007**
2008	328	138.6	114.7	29.2	8,434	19.44	16.7	26.6	20.7	**2008**

a All Washington on-road vehicles, regardless of class

b (for reference) Registered U.S. light duty vehicles

c (for reference) U.S. new light duty vehicle fuel efficiency rating

Indicators **20** energy prices by fuel, **21** electricity prices by sector, **22** natural gas prices by sector

	indicator 20, 2005$/mmBtu					**indicator 21**, ¢/kWh			**indicator 22**, ¢/therm[a]				
year	**petrol.**	**elec.**	**NG**	**biomass**	**coal**	**res.**	**comm.**	**ind'l.**	**res.**	**comm.**	**ind'l**	**utility**	**year**
1970	6.98	8.02	2.53	1.34	2.28	4.38	4.50	1.37	54.7	43.1	13.4	0.0	**1970**
1971	6.82	7.99	2.55	1.29	2.28	4.21	4.34	1.32	53.2	41.9	13.9	0.0	**1971**
1972	6.35	7.96	2.59	1.24	2.04	4.16	4.30	1.27	52.2	41.3	14.3	0.0	**1972**
1973	6.81	7.93	2.58	1.19	2.09	4.07	4.14	1.26	52.5	42.2	15.0	0.0	**1973**
1974	9.13	7.52	3.08	1.17	2.72	3.99	4.18	1.18	55.1	41.5	21.1	0.0	**1974**
1975	9.39	8.02	4.21	1.09	2.68	4.00	4.17	1.39	65.0	52.0	32.9	0.0	**1975**
1976	9.59	7.61	4.97	1.05	3.38	3.85	3.89	1.36	72.9	60.3	39.6	0.0	**1976**
1977	9.68	7.84	5.52	1.02	3.41	3.93	4.16	1.22	79.2	67.7	45.1	0.0	**1977**
1978	9.46	7.38	5.74	0.98	3.68	3.77	3.85	1.21	82.2	67.3	49.0	57.1	**1978**
1979	11.59	7.48	6.25	1.08	4.16	3.73	3.83	1.22	86.1	75.5	53.4	60.4	**1979**
1980	14.50	8.40	8.21	0.96	5.07	3.97	4.05	1.61	105.7	96.2	68.9	71.9	**1980**
1981	15.99	9.88	8.38	0.98	5.10	4.39	4.62	2.02	109.7	97.4	70.3	73.0	**1981**
1982	14.89	12.92	9.73	0.90	5.03	5.04	5.23	3.46	117.6	106.4	82.4	101.3	**1982**
1983	13.35	13.94	9.03	0.87	4.24	6.19	5.32	3.38	114.3	101.0	74.8	87.9	**1983**
1984	12.49	14.69	8.61	0.88	4.18	6.15	5.84	3.93	109.4	97.3	72.0	82.3	**1984**
1985	12.05	14.52	7.96	0.84	3.99	6.17	5.85	3.45	103.0	85.0	67.9	73.6	**1985**
1986	8.59	14.27	6.65	0.75	3.45	6.20	5.93	3.41	91.4	77.9	48.3	44.6	**1986**
1987	8.64	14.25	5.40	0.76	3.71	6.43	5.75	3.53	81.0	67.3	38.4	38.6	**1987**
1988	7.94	14.44	5.48	0.75	3.59	6.34	5.61	3.91	80.0	66.8	38.8	45.5	**1988**
1989	8.47	14.51	5.28	1.19	3.54	6.23	5.63	3.81	76.6	65.1	36.9	72.7	**1989**
1990	9.54	13.52	4.58	1.10	3.47	6.08	5.49	3.31	67.5	55.6	32.7	42.0	**1990**
1991	9.36	12.98	4.43	1.20	3.82	5.84	5.38	3.07	60.8	52.7	33.1	51.2	**1991**
1992	8.13	12.92	4.58	1.12	3.64	5.82	5.42	2.93	63.2	54.6	33.9	41.2	**1992**
1993	8.39	13.45	4.78	1.14	3.47	5.88	5.57	3.06	64.3	55.8	36.5	48.1	**1993**
1994	8.37	14.51	4.61	1.13	3.87	6.23	5.74	3.50	68.4	58.8	32.8	59.0	**1994**
1995	8.36	14.52	4.42	1.29	3.85	6.09	5.71	3.63	69.3	58.9	30.0	53.7	**1995**
1996	9.28	14.64	4.32	1.16	3.62	6.06	5.69	3.50	65.4	55.7	28.3	57.1	**1996**
1997	9.04	13.90	4.40	1.08	3.44	5.86	5.55	3.24	63.6	53.3	32.7	66.8	**1997**
1998	7.66	13.71	4.02	1.15	2.89	5.88	5.43	3.30	65.3	53.1	26.9	38.1	**1998**
1999	8.89	13.74	4.24	1.23	2.82	5.88	5.41	3.36	64.3	53.5	27.9	30.2	**1999**
2000	11.32	14.15	5.70	1.42	2.83	5.79	5.29	3.73	77.5	65.1	38.8	57.4	**2000**
2001	10.34	17.09	7.82	1.76	2.67	6.29	5.90	5.24	104.4	91.9	47.8	81.8	**2001**
2002	9.64	18.51	7.37	1.82	2.74	6.83	6.48	5.30	98.4	86.9	45.0	35.9	**2002**
2003	11.17	18.07	7.07	1.64	2.61	6.70	6.45	5.06	87.3	76.4	56.0	33.8	**2003**
2004	13.17	17.39	8.39	1.69	2.78	6.59	6.38	4.43	99.6	94.5	71.1	46.7	**2004**
2005	15.52	17.01	9.81	2.23	3.31	6.54	6.33	4.27	114.6	101.3	89.9	64.9	**2005**
2006	17.37	17.25	10.33	2.31	3.59	6.61	6.42	4.30	125.6	112.5	82.8	54.9	**2006**
2007	17.90	17.39	10.29	2.15	3.63	6.84	6.17	4.30	127.1	113.5	79.5	56.6	**2007**
2008	22.45	17.53	9.85	2.63	4.48	6.95	6.23	4.19	116.9	102.8	83.2	76.6	**2008**

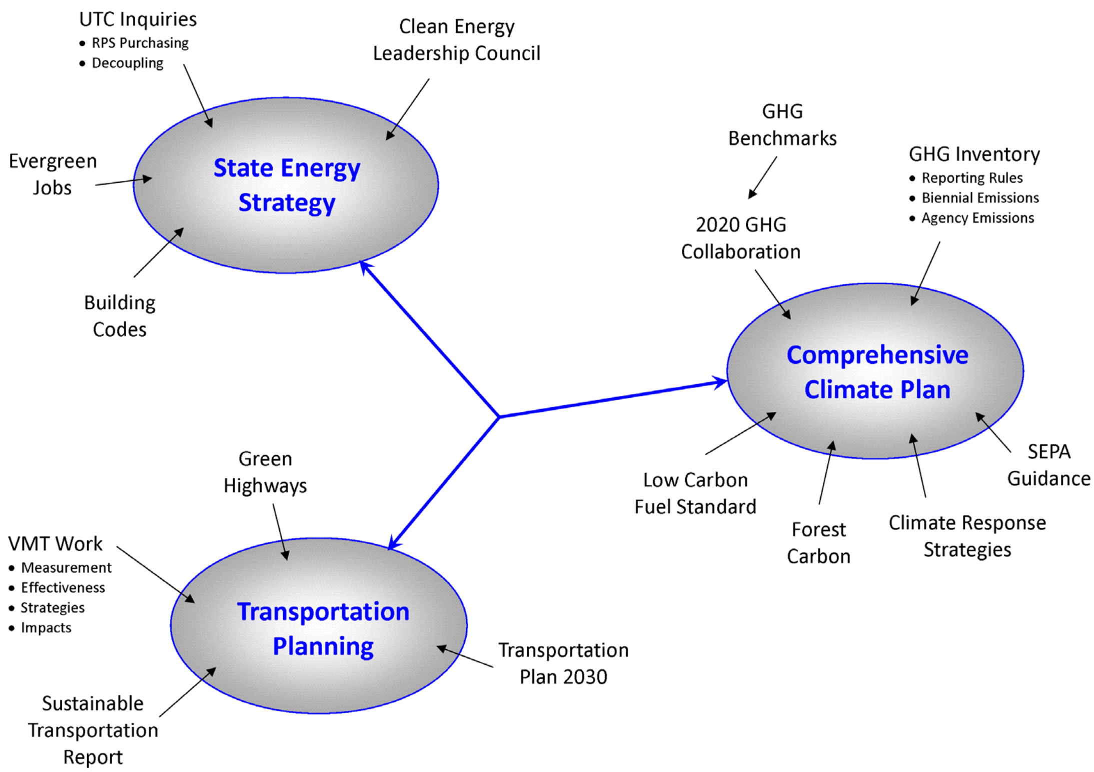
a 1 therm = 100,000 Btu

Indicators **23** gasoline prices, **25** carbon dioxide emissions by source

	ind. 23 $/gal	indicator 25, million ton CO_2				
year	(2005 $)	**petrol.**	**coal**	**NG**	**total**	**year**
1970	1.50					**1970**
1971	1.44					**1971**
1972	1.35					**1972**
1973	1.40					**1973**
1974	1.75					**1974**
1975	1.72					**1975**
1976	1.70					**1976**
1977	1.71					**1977**
1978	1.67					**1978**
1979	2.06					**1979**
1980	2.60	41.1	8.50	7.13	56.7	**1980**
1981	2.64	41.2	8.50	6.90	56.6	**1981**
1982	2.37	39.8	6.94	6.02	52.8	**1982**
1983	1.97	35.5	7.52	5.87	48.9	**1983**
1984	1.93	41.6	7.71	6.93	56.3	**1984**
1985	1.89	42.5	8.79	7.36	58.7	**1985**
1986	1.45	47.5	5.93	6.39	59.8	**1986**
1987	1.42	49.1	8.99	7.14	65.3	**1987**
1988	1.38	51.9	9.31	7.90	69.1	**1988**
1989	1.44	53.4	9.09	8.82	71.3	**1989**
1990	1.64	53.5	8.05	8.79	70.4	**1990**
1991	1.53	53.7	8.38	9.42	71.5	**1991**
1992	1.55	59.9	9.98	9.49	79.4	**1992**
1993	1.46	53.9	9.20	12.09	75.2	**1993**
1994	1.52	55.9	10.07	13.86	79.8	**1994**
1995	1.54	57.3	6.57	13.93	77.8	**1995**
1996	1.64	56.9	8.57	14.96	80.5	**1996**
1997	1.55	56.9	7.59	14.11	78.6	**1997**
1998	1.31	56.7	9.76	15.97	82.4	**1998**
1999	1.51	58.6	9.14	15.91	83.6	**1999**
2000	1.82	57.2	10.03	15.66	82.9	**2000**
2001	1.69	53.5	9.40	16.98	79.8	**2001**
2002	1.51	50.7	9.53	12.52	72.8	**2002**
2003	1.78	50.5	11.18	13.42	75.1	**2003**
2004	2.05	51.9	10.65	14.13	76.6	**2004**
2005	2.39	53.3	10.62	14.35	78.3	**2005**
2006	2.64	55.2	6.54	14.28	76.0	**2006**
2007	2.80	58.2	9.06	14.72	82.0	**2007**
2008	3.16					**2008**

Appendix C:

Energy, Transportation and Climate Initiatives in Washington State

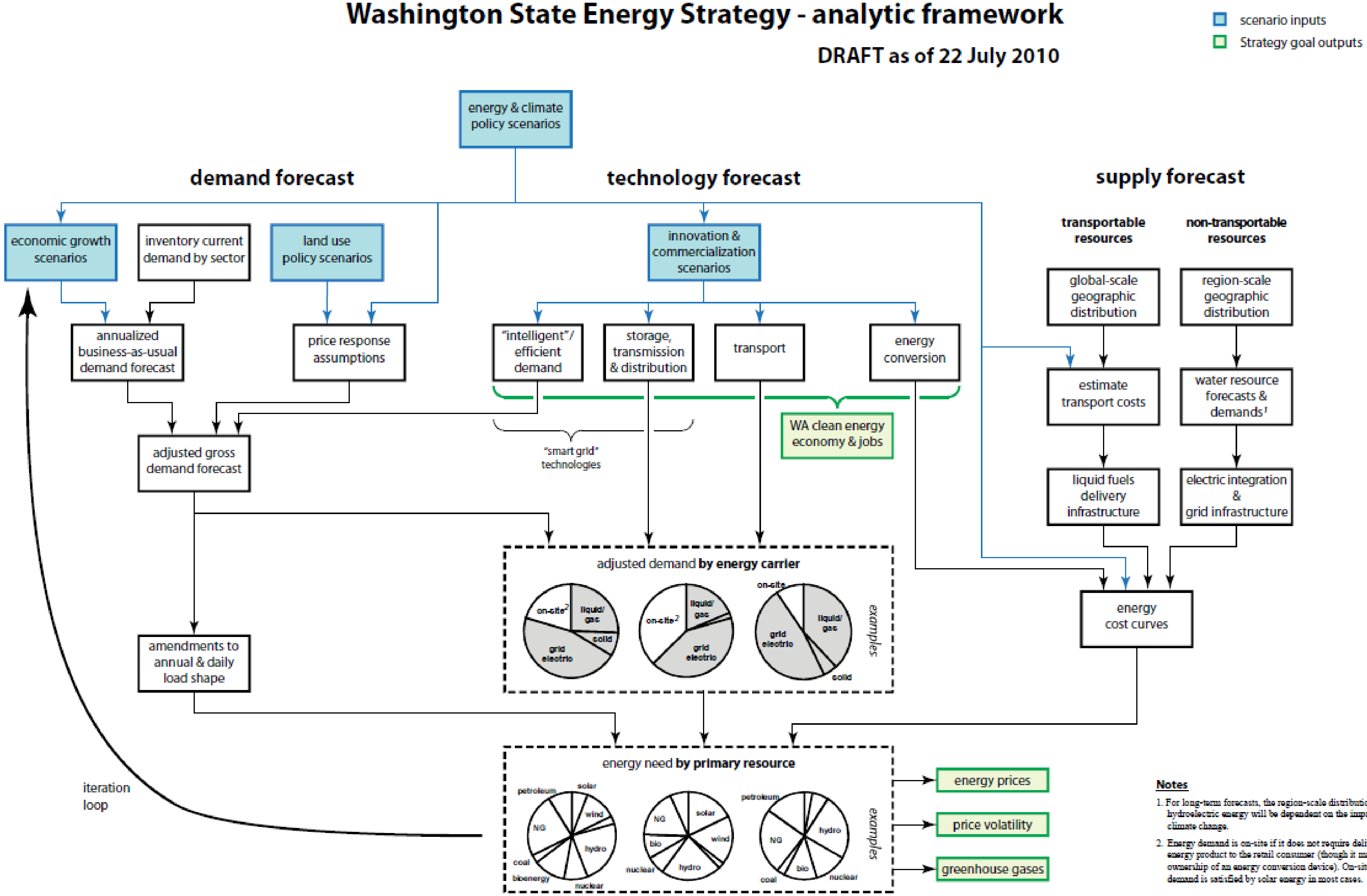


Appendix D:

State Energy Strategy Analytic Framework

Washington State Energy Strategy - analytic framework

DRAFT as of 22 July 2010



Notes

1. For long-term forecasts, the region-scale distribution of hydroelectric energy will be dependent on the impacts of climate change.
2. Energy demand is on-site if it does not require delivery of an energy product to the retail consumer (though it may require ownership of an energy conversion device). On-site energy demand is satisfied by solar energy in most cases.