Clean, Affordable, Reliable

Energy Efficiency and Renewable Energy in Washington

WashPIRG Foundation

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WashPIRG Foundation
February 2003

Acknowledgments

The WashPIRG Foundation gratefully acknowledges Phil Radford (Power Shift), Ron Larson (National Renewable Energy Lab, retired), Karl Gawell (Geothermal Energy Association), John Thorton (National Renewable Energy Lab), Jennifer Lane (Altair Energy, LLC), Dave Rib (KJC Operating Company), and the many other analysts who provided information for this report. Special thanks to Robert Pregulman and Rob Sargent for assistance in the development, drafting, and production of this report. Thanks to Peter West (Climate Solutions), Nancy Hirsh (Northwest Energy Coalition), Danielle Dixon (Northwest Energy Coalition), and Michael Lazarus (Tellus Institute) for peer review of sections. Thanks also to Katherine Morrison, Anna Aurilio, Rebecca Stanfield, and Susan Rakov for editorial assistance. Thanks to Chris Chatto for layout design.

Cover photographs courtesy of DOE/NREL.

This report was made possible by the generous support of the Pew Charitable Trusts and the Energy Foundation.

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Table of Contents

Executive Summary

As Washington's demand for power continues to grow and national energy markets struggle for stability, Washington state officials have the opportunity for a fundamental reassessment of long-term energy policy. We can now choose renewable resources and energy efficiency improvements to meet our power needs while reducing pollution, boosting reliability, and improving our economy.

Rapid Growth in Renewables and Conservation Is Feasible

Renewables have advanced technologically and commercially to the point where they are now ready for wide-scale development, and there are still many opportunities for efficiency improvements. Huge untapped potential exists at both the state and national levels.

- Electricity demand in Washington is growing at 1.3% per year, which would bring total demand in 2015 to 2,000 average MW (aMW) higher than it is today. Non-hydro renewable energy sources and energy conservation could meet all of this demand growth with a comfortable buffer.
  - Wind power is the renewable technology the state could develop most quickly. 625 aMW of Washington's 3,800 aMW total wind power potential could come online by 2010 and 1,260 aMW by 2015.
  - By investing in cost-effective energy efficiency measures, Washington could reduce anticipated total electricity demand by 6% by 2010 and 9% by 2015. This would save 720 aMW by 2010 and 1,160 aMW by 2015.
  - Solar power is expanding rapidly. The small current capacity will grow to significant levels over the next ten years and become a major source of electricity thereafter.
  - Widespread direct use of geothermal resources can greatly reduce electricity demand.
- Nationally, 125,000 MW of renewable energy capacity could be operational by 2010, enough to replace 80 large fossil fuel power plants.
- Policies promoting energy efficiency could cut the nation's electricity demand by 15%, saving 72,000 aMW annually.

Renewables and Conservation Reduce Pollution

If these goals are achieved in place of natural gas power plant development, Washington would reduce annual carbon dioxide (CO_2) emissions from power plants by 10 million tons per year by 2015. This would also avoid a 22% increase in health-damaging nitrogen oxide pollution.

Nationally by 2010, energy efficiency and renewable energy development at the levels described above would enable the U.S. to reduce CO_2 emissions by as much as 37% – one billion tons annually – compared to projections for the current path from the U.S. Department of Energy. Health-damaging pollution would be reduced by as much as 43%.

Renewables and Conservation Boost Reliability

Diversifying the state's energy sources would increase the overall reliability of the electricity supply.

- Over-reliance on fossil fuels and hydropower is among the biggest reasons for recent energy struggles. Ignoring renewable energy opportunities and deepening our reliance on fossil fuels would invite more price spikes and supply shortages.
- The historic average downtime for natural gas plants is higher than for wind, solar, and geothermal energy.

- Solar power is particularly valuable for its quality of reaching maximum output at times of peak demand.

Renewables and Conservation Are the Best Economic Choices

Policies encouraging renewables and energy efficiency would grow the economy more than a business-as-usual scenario.

- Four major studies in recent years each found that broad packages of policies encouraging clean energy development have greater economic returns than costs.
- Many wind and geothermal projects can produce electricity at a lower cost than fossil fuels when external life-cycle costs of electricity generation are taken into account.
- Energy efficiency programs of the past five years nationwide have avoided the need for 25,000-30,000 MW of generating capacity – the equivalent of 100 power plants – at a cost that is less than that of energy from most new power plants.

Comprehensive Energy Policies Are Needed

Specific policies that would best help Washington and the nation realize their clean energy potential include:

- An energy conservation standard requiring all retail electricity suppliers to meet a percentage of future power needs with energy conservation.
- A renewable energy standard requiring all retail electricity suppliers to obtain a set percentage of their electricity from renewable sources.
- No new permits for fossil fuel-based power plants beyond the many permits that have recently been granted.

Health and Environmental Impacts of Conventional Electricity Production

Impacts of Fossil Fuel Burning

In Washington, electricity generation is responsible for:

- 13% of the state's emissions of carbon dioxide (CO_2), a principal global warming gas.[1]
- 68% of the state's emissions of sulfur dioxide (SO_2), a precursor of fine particulate matter, acid rain, and regional haze.[2]
- 37% of the state's emissions of nitrogen oxide (NOx), a precursor of ground-level ozone (smog), particulate matter, acid rain, global warming, nitrogen overloading in waterways and forests, and regional haze.[3]
- 10% of the state's emissions of man-made mercury, a toxic metal that bioaccumulates in animals and spreads through the food chain to humans.[4]

Electricity generation in the U.S. is responsible for:

- 40% of emissions of carbon dioxide.[5]
- 67% of the nation's emissions of sulfur dioxide.[6]
- 23% of emissions of nitrogen oxide.[7]
- 33% of emissions of man-made mercury.[8]

All fossil fuel-burning power plants pollute the air to varying degrees. Coal-fired power plants are by far the dirtiest. Oil-burning power plants emit less pollution than those using coal, but more than natural gas-fired plants. Natural gas produces cleaner emissions than other fossil fuels, but U.S. power plants burn enough of it to produce hundreds of millions of tons of CO_2, the dominant greenhouse gas, each year.

Although coal is the energy source used to generate 52% of electricity in the U.S., coal-burning power plants account for 87.5% of the CO_2, 95.2% of the SO_2, and 90.9% of the NOx emitted collectively by all electric power plants.[10]

Recently, Washington has begun to allow the use of diesel generators to address immediate power needs. During the energy shortage of 2001, Tacoma Power fired up 41 tractor-trailer-sized diesel generators and Georgia Pacific used 40 diesel generators located in downtown Bellingham. Diesel generators have emission rates similar to oil and coal plants. The emissions from these generators is equivalent to 800 semi trucks running 24 hours a day. The cancer risk from exposure to the emissions of these genera-

Figure 1: CO_2 Emission Rates of Power Plants Burning Fossil Fuels[9]

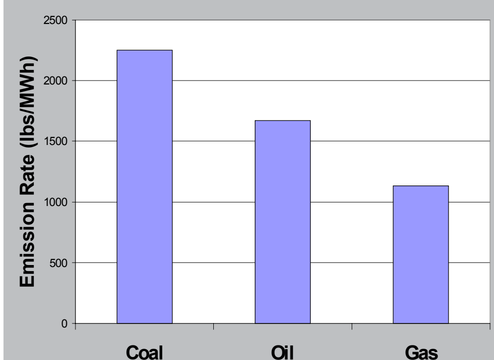
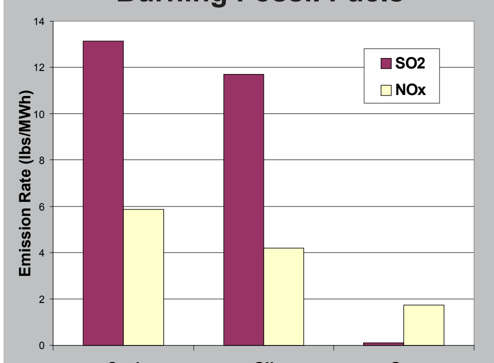


Figure 2: SO_2 and NOx Emission Rates of Power Plants Burning Fossil Fuels



tors is estimated to increase 50% for those living near a single one-megawatt diesel generator that runs as little as 250 hours annually.[11]

Had the state not been over-dependent on hydropower and fossil fuels, it would not have needed to rely so heavily on polluting diesel in 2001 when rainfall was low and the natural gas supply was disrupted. Diversifying the fuel mix with more clean, renewable energy sources would prevent this from happening again.

Global Warming and Carbon Dioxide

Global warming is perhaps the most serious environmental challenge of our time. The world's leading climate scientists, economists, and other experts formed the Intergovernmental Panel on Climate Change (IPCC) in 1988 to verify the recent dramatic increase in the earth's temperature and to identify its causes and consequences. What they have found is alarming.

- The average daytime global surface temperature rose 0.6°C (1.08°F) over the 20th century. The average nighttime minimum surface temperature over land, the more indicative measurement of global temperature change, rose an average of 0.2°C per decade since 1950.[12]
- The 1990s were warmer than the 1980s, previously the warmest decade on record. The warmest year on record was 1998, and the second warmest was 2001.[13]

The IPCC predicts that if greenhouse gas emissions are not stabilized, the average global surface temperature will increase by 1.4-5.8°C between 1990 and 2100.[14] This level of increase is put into perspective by the fact that during the last ice age (about 18,000 years ago), the earth was only 9 degrees cooler than it is now.[15]

The impacts of warmer global temperatures are predicted to include many serious and broad-ranging effects, some of which have already begun:

- Increased frequency and intensity of heat waves, fires, droughts, rainfall, and flooding.
- Rising sea levels that overtake islands and coastal areas.
- Disruption and loss of ecosystems, pushing species to extinction and rendering historically fertile farmland unproductive.
- Increased geographic range and virulence of infectious and tropical diseases.

Although natural variations in the output of the sun can contribute to climate change, the IPCC has found that natural contributions are minimal compared to the effects of human activities. By burning fossil fuels in our power plants, we are releasing pollution that is altering the atmosphere at a rapid pace. Normally the atmosphere allows excess heat to leave the earth, but air pollution referred to as greenhouse gases, such as CO_2, work like a blanket that traps heat near the earth's surface. As concentrations of greenhouse gases increase, more heat gets trapped and global temperatures rise. CO_2 is by far the most abundant greenhouse gas. The atmospheric concentration of CO_2 has increased by 31% since 1750.[16]

In its latest update on climate change, the IPCC concluded, "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities."[17] Fossil fuel burning accounts for three-quarters of the CO_2 emissions associated with human activities. The U.S. electric industry alone, which accounts for 40% of the total U.S. CO_2 emissions, emits more CO_2 than the total CO_2 emissions from any other nation.

Soot and Sulfur Dioxide

Power plants are by far the largest source of sulfur dioxide (SO_2).[18] More than 12,000 of the nearly 19,000 tons of SO_2 the nation emits annually comes from electric power plants. SO_2 makes up the largest component of fine particulate matter, or "soot".[19] Particulate matter is the type of air pollution that is visible in the air – ash, dust, and acid aerosols.

When inhaled, these tiny particles become deeply imbedded in the lungs. The particles cannot be expelled by coughing, swallowing, or sneezing. As they sit in the lungs they cause varying degrees of irritation, which can lead to loss of heart and lung function. Health consequences range from bronchitis and chronic cough to death.[20] Fine particulate matter is of most concern to vulnerable populations, including young children, the elderly, and those with asthma or other respiratory diseases. A study conducted by the Harvard School of Public Health estimates that more than 60,000 lives are cut short each year in the U.S. due to fine particulate pollution.[21]

Particulate air pollution can travel far distances from its source. The visual effect of particulate air pollution is referred to as haze. Haze has spread so far as to infiltrate some of America's most pristine national parks, blocking vistas and posing health risks for those who use the parks for recreation.

Smog and Nitrogen Oxides

Power plants are the largest industrial source of nitrogen oxide (NOx) pollution, which causes formation of ground-level ozone (also known as smog). Ozone is our nation's most prevalent and well-understood air contaminant. Despite reductions in smog levels since the passage of the Clean Air Act in 1970, today an estimated 117 million people live in areas where the air is unsafe to breathe due to ozone.[22] In 1999, the ozone health standard adopted by the EPA in 1997 was exceeded 7,200 times.[23]

Ozone is an invisible, odorless gas, which is formed when nitrogen oxides mix with volatile organic compounds (reactive man-made chemical air pollutants) in the presence of sunlight. Public health is most at risk during "ozone season," from mid-May to mid-September in most places, when there is plenty of sunlight.

When inhaled, ozone at high concentrations can oxidize or "burn through" lung tissue. Breathing ozone at high concentrations can cause airways to the lungs to become swollen and inflamed. Eventually, this causes scarring and decreases the amount of oxygen that is delivered to the body with each breath. The corrosive effect of exposure to ozone in the respiratory system increases susceptibility to infections. Outdoor exercise on days when ozone concentrations are high increases the impact on the respiratory system.

As is the case with soot, ozone poses a more serious health threat to vulnerable populations, including children, the elderly, and people with asthma or chronic pulmonary disorders (including chronic bronchitis and emphysema). A number of studies have linked ozone pollution with increased frequency of emergency room visits, including one study of 25 hospitals that found high ozone levels were associated with at least a 21% increase in emergency room visits for people aged 64 and older.[24]

Ozone has also been linked to increased frequency of asthma attacks. On high-smog days, children with asthma are 40% more likely to suffer asthma attacks compared to days with average pollution levels.[25] A 1999 Abt Associates study estimated that more than six million asthma attacks were triggered by smog during high-ozone smog season in 1997.[26] Another study found a 26% increase in the number of asthma patients admitted to emergency rooms in New Jersey on summer days when ozone concentrations were high.[27]

New research has also shown that high smog levels can not only exacerbate existing asthma, but can cause the disease as well. A five-year study conducted at the University of Southern California found that active children growing up in high smog areas are more likely to develop asthma than inactive children, while no such relation exists among children living in low smog areas.[28]

Acid Rain, Sulfur Dioxide, and Nitrogen Oxides

Sulfur dioxide and nitrogen oxides do their damage not only via airborne ozone and particulates, but also by causing acid rain, which threatens entire forest and aquatic ecosystems. Once emitted into the air, sulfur and nitrogen oxides form sulfates and nitrates respectively, which are the principal components that change the pH of rainwater from neutral to dangerously acidic.

Acid in rain, clouds, and fog damages trees in two primary ways:

1) directly damaging the needles and foliage, making them unusually vulnerable to adverse conditions including cold temperature, and,
2) depleting nutrients from the soils in which the trees grow.

Acid clouds and fog generally have even higher concentrations of damaging sulfates and nitrates than acid rain. Thus, acid deposition is linked to the decline of red spruce growing at high elevations and in coastal areas, both of which are immersed in acid clouds and fog for long time periods.[29]

Lake and stream ecosystems are also vulnerable to the effects of acid rain. As the acidity of the lakes and streams increases, the number of species that can live there declines.[30]

Nitrogen Loading and Nitrogen Oxides

Nitrogen oxide emissions from power plants are a major contributing factor to nitrogen loading in water bodies across the United States. Too much nitrogen causes algae blooms, which deplete the oxygen and kill marine life as they decay. Algae blooms also block sunlight that fish, shellfish, and aquatic vegetation need to survive. Nitrogen oxides released into the air can be carried hundreds of miles by the wind and fall into lakes and rivers.

The effects of nitrogen loading can be devastating for plant and animal life in these water bodies, as well as for people who depend on these waters for tourism, subsistence fishing, commercial fishing, and recreation.

The Toxic Food Chain and Mercury

Mercury is a toxic heavy metal that persists in the environment once it is released. When ingested in its methylated form, mercury can cause serious neurological damage, particularly to developing fetuses, infants, and children.[31] The neurotoxic effects of low-level exposure to methylmercury are similar to the effects of lead toxicity in children, and include delayed development and deficits in cognition, language, motor function, attention, and memory.[32] Other studies have linked a history of mercury exposure with neurological problems, heart disease, and Alzheimer's disease in adults.[33]

Numerous species of fish in thousands of bodies of water across 41 of the 50 states contain such high levels of toxic methylmercury that health agencies have warned against eating them. The number of consumption advisories due to mercury poisoning increased 8% from 1999 to 2000 and 149% from 1993 to 2000.[34]

People most at risk include women of child-bearing age, pregnant women and their fetuses, nursing mothers and children, and subsistence fishers. Large predator fish such as largemouth bass, walleye, shark, tuna, and swordfish have higher levels of methylmercury in them than smaller species lower in the food web.[35] People who frequently and routinely consume fish (i.e. several servings a week), those who eat fish with higher levels of methylmercury, and those who eat a large amount of fish over a short period of time (e.g., anglers on vacation) are more likely to be exposed to higher levels of mercury.[36]

Mercury's primary entrance into the human diet occurs when mercury is emitted into the air and undergoes photochemical oxidation, forming oxidized mercury. Oxidized mercury is water-soluble and is deposited to land, lakes, and streams by rain and snow, where it reacts with bacteria to form methylmercury, the form most toxic to humans.[37] Methylmercury bioaccumulates to the greatest extent in the tissue of fish and other aquatic organisms and persists forever in the environment, magnifying its public health impacts.

Based on national emission estimates for 1994-95, coal and oil-burning power plants are the largest stationary sources of mercury emissions (32.8%), followed by municipal waste incinerators (18.7%), commercial and industrial boilers powered by coal or oil (17.9%), medical waste incinerators (10.1%), and hazardous waste incinerators (4.4%).[38]

Other Impacts of Energy Production

Coal Excavation

Mining for coal is a dirty, dangerous, and destructive process. It contaminates the land, surface water, groundwater, and air. The Centralia mine, the Colstrip projects in Montana, and other mine sites that supply Washington's Centralia coal-fired power plants all suffer inevitable pollution problems.

To mine coal, enormous chunks of earth are dug up from the surface or displaced by removing mountaintops (surface mining), or are excavated from beneath the ground (underground mining) and discarded into waste piles. Wildlife habitat, agricultural crops, forests, rangeland, and deserts are destroyed and replaced by pits, quarries, and tailing piles. Reclaiming a coal mine (replacing vegetation and restoring the landscape) helps reduce permanent disruption, but in spite of restoration efforts, original ecosystems may be replaced by completely different ecosystems, and hundreds of thousands of acres of mines have been abandoned rather than restored.

Water pollution is an enormous problem of coal mining. Waste piles of excavated dirt, which are normally secured under the surface and serve as natural water filters and physical support of the land, deposit toxic heavy metals and sediment that pollute and alter the course of local waterways. More waste from the washing of mined coal is added to these piles that grow on the order of tens of millions of tons per year.[39] Underground mining can contaminate as well as physically dislocate entire underground reservoirs that serve as drinking water supplies for many Americans.

The Western Pennsylvania Coalition for Abandoned Mine Reclamation calculated the cost of cleaning up pollution from old coal mines in Pennsylvania to be $15 billion, although they believe it's likely that estimate is low.[40] The U.S. Bureau of Mines estimates that the U.S. spends over $1 million each day to treat acidic mine water.[41] The cost of cleaning up abandoned lands that had been used for mining coal is $10,000 per acre.[42]

"Clean coal" has been touted as the solution to the horrendous environmental legacy of coal, claiming energy can be harnessed from coal without causing environmental damage. Although clean coal measures involve more responsible management of coal-generated pollution, the actual pollution reduction is marginal and air pollution mitigation strategies ultimately redirect the toxins and emit them into the environment through different routes (like the land or water). "Clean coal" techniques also encourage increased coal use in the long term. The General Accounting Office has concluded that federal spending on "clean coal" technology has been a waste of money.[43] $2 billion has been spent so far, and current proposals would double that amount.[44]

Natural Gas Drilling

When natural gas is retrieved from reservoirs, the construction of roads, drilling rigs, and gas pipelines destroys huge amounts of wildlife habitat. Transporting the gas, which is explosive by nature, is increasingly dangerous as the U.S. pipeline infrastructure ages. One quarter of the nation's natural gas pipelines are more than fifty years old.[45] Over the past decade, the number of serious accidents has steadily increased.[46]

Natural gas is often found in association with oil. The damage occurring from oil drilling and transport is probably the best known of the environmental impacts of fossil fuel excavation, due to the regularity of oil spills and the duration of their scathing effects. Less known is the fact that leaks commonly go undetected, accounting for hundreds of thousands of gallons of spilled petroleum liquids each year.[47]

Coalbed Methane Excavation

The most destructive process used to access natural gas from oil-free reservoirs is coalbed methane excavation. Coalbed methane differs from natural gas only slightly in its chemical makeup. Natural gas is mostly methane with some other hydrocarbon gases in its mixture. Coalbed methane is almost always pure methane.

Coalbed methane is found trapped in subsurface coal beds. To release the gas from the porous coal, coal seams are fractured with toxic fluids. Massive volumes of water must be pumped from underground aquifers. The water, often containing high levels of sodium, arsenic, and other contaminants, is dumped on the surface and into rivers.

In the San Juan Basin of southwestern Colorado and northern New Mexico, the costly consequences of coalbed methane development are clear. The excavation process, along with the construction of roads and pipelines to transport the gas, has destroyed wildlife habitat and contaminated drinking water. Methane and hydrogen sulfide seeps have forced some families from their homes.[48] Underground coal fires have caused the ground to collapse in one area, and it is uncertain whether the gas industry can prevent the underground fires from spreading.[49]

Development in the Powder River Basin in Wyoming is more advanced than the San Juan region. If the gas industry develops the region according to current plans, the estimated cost to the state to address the water loss and contamination will be $320 million dollars, after accounting for severance tax credits the state will receive from the gas industry.[50]

Nuclear Waste

Nuclear fission, the reaction used to create energy in nuclear power plants, puts our lives at risk from potentially disastrous accidents and creates the most harmful substance known, for which there is no safe disposal process. Direct exposure to irradiated fuel from nuclear reactors delivers a lethal dose of radiation within seconds. According to the Department of Energy, 95% of the radioactive waste in this country (measured by radioactivity) is from commercial nuclear reactors. The storage of this waste poses a threat to water supplies throughout the nation.

Presently more than 42,000 metric tons of spent fuel are in temporary storage in the U.S., with that number increasing by five metric tons every day.[52] This waste material will remain hazardous for the next 250,000 years. The potential risk to human health is staggering. The total radioactivity of our spent fuel at this point is 30.6 billion curies. One single curie generates a radiation field intensity at a distance of one foot of about 11 rem per hour; the exposure limit set by federal regulation for an individual is 5 rem per year.[53] If a person were to stand within a yard from a 10-year old nuclear fuel assembly, within 30 seconds he would significantly increase his risk of genetic damage or cancer and in less than 3 minutes he would receive a lethal dose of radioactivity.[54]

The risks of both catastrophic events and leakage of radioactive material into our environment pose great threats to our public health. Even low-level radiation has been linked to cancer, genetic and chromosomal instabilities, developmental deficiencies in the fetus, hereditary disease, accelerated aging, and loss of immune response competence.

The risk of accidents at reactors is also ever-present. Because many nuclear plants in the U.S. are decaying, the risk of accidents is greater now than it ever has been.

Further risk may come from transporting high-level nuclear waste. The nuclear industry has been trying for years to establish a single national nuclear waste repository. If such a facility were to be established, the risk of accidents and leakage would be immense. The Nevada Agency for Nuclear Projects recently calculated the risks of transporting nuclear waste using analyses by the Department of Energy and independent consultants. They concluded, “Accidents are inevitable and widespread contamination possible.”[55]

Hydropower

Hydropower produces 70% of Washington’s electricity, the majority of which comes from large dams. These dams have major negative environmental impacts in spite of the fact that they produce no air pollution emissions. The negative effects of dams on fish is particularly troublesome in the Northwest, where populations of salmon and steelhead were once strong but have been greatly diminished.

Each dam kills 5-15% of young migrating fish. The fish are killed by turbine blades and by getting lost and overheated in the slow-moving reservoirs. Salmon and steelhead in the Columbia and Snake Rivers must pass as many as eight dams on their way to the ocean. 80-95% of the fish that have to travel the full distance die on the way.[56]

Due to these effects and the already built-out state of our waterways, there are currently no plans to substantially increase the use of hydropower.

The New Energy Solution

Non-hydro renewable energy has advanced technologically and commercially to the point where it is now ready for wide-scale development, and energy efficiency advancements continue to present great opportunities. Huge untapped potential exists at both the state and national levels. Economic analysis and technological considerations suggest that Washington could meet all of its predicted growth in electricity demand through 2015 with renewables and conservation. Nationally, renewable energy resources could meet 11% of the U.S. electricity demand by 2010.

Developing the small portion of the total renewable energy and energy efficiency potential outlined below will reduce pollution dramatically. Washington would avoid a 44% increase in power plant pollution by 2015, and the nation as a whole would reduce power plant pollution by 37% compared to projections for the current path.

Renewable Energy and Efficiency Potential in Washington

Although Washington uses emission-free hydropower for the majority of its electricity generation, 23% is generated with coal, natural gas, and fuel oil, and the state is planning to substantially increase the use of fossil fuels. Nearly all power projects currently under development are fueled by natural gas.

Fossil fuel-fired power plants with a combined capacity of 958 peak MW have come online in the past two years. Fossil fuel plants totaling 2,828 MW are now under construction or have been permitted, and 4,211 MW more have been proposed. Annual electric-

Figure 3. Current Sources of Electricity Production in Washington[56]

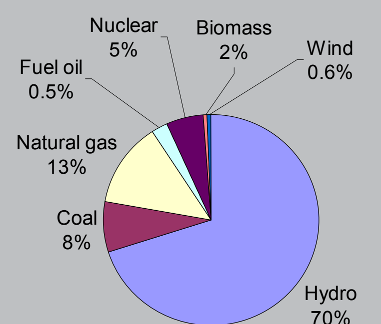


Table 1. Washington Electricity Generation Resource Mix[57]

Resource	2000		2001-2002 Additions	2001-2002 Retired	Current		Under Construction & Permitted	Total Current & Permitted	
	aMW	Pct	aMW	aMW	aMW	Pct	aMW	aMW	Pct
Hydro	10,896	72%	8	4	10,900	70%	95	10,995	60%
Coal	1,195	8%			1,195	8%		1,195	7%
Natural gas	1,568	10%	808	182	2,195	14%	2,536	4,731	26%
Fuel oil	377	2%	54	360	70	0.5%	7	77	0%
Nuclear	851	6%			851	5%		851	5%
Biomass	274	2%	9		283	2%		283	1.6%
Wind			78		78	0.5%	5	83	0.5%
Total	15,161		957	546	15,573		2,643	18,216	

Note on Units

Megawatts (MW) is a unit of measurement indicating how fast a plant can put out energy. This is the standard measure of the generating capacity of a power plant. It is also used to determine if the total generating capacity on the grid is enough to satisfy demand at any one time.

MW denotes peak megawatts, as opposed to average megawatts (aMW). aMW is used to emphasize the intermittency of electricity generation from some sources. The size of wind power projects, for instance, is often reported as aMW. One aMW is enough to power roughly 900 homes.

Megawatt-hours (MWh) is a unit measuring the total amount of energy produced over some time frame. A 50 MW power plant operating at full capacity for one hour produces 50 MWh of electricity. This is the appropriate unit for talking about how much of the state's electricity was produced by various sources in a given time frame. To measure how much such a plant could produce in one year at full capacity, simply multiply the capacity by the number of hours in a year (50 MW x 8,760 hrs/yr = 438,000 MWh/yr). 1,000 MWh equals one gigawatt-hour (GWh).

Table 2. 2015 Conservation and Renewables Potential (aMW)

Projected Demand	12,865
Energy Conservation Potential	1,158
Demand with Conservation	11,707
Wind Energy Potential	1,255
Solar Energy Potential	8
Total Renewable Energy Potential	1,263
Renewable Energy Percentage	10.8%

ity generation figures for these and other plants are listed in Table 1. If this new capacity of fossil fuel power is added, air pollution in the state will increase dramatically.

Washington has another option. The state has excellent renewable energy resources and has been very successful in the past with its conservation and energy efficiency strategies. Washington could meet all electricity demand growth through 2015 – 2,000 average MW (aMW) – with wind power and energy conservation alone. New wind farms could bring 1,260 aMW online by 2015. By investing in cost-effective energy efficiency measures, Washington could reduce anticipated total electricity demand by 9% by 2015, saving 1,160 aMW. (See Table 6.)

With this amount of wind energy and energy conservation, together with a modest amount of solar power development, non-hydro renewables would constitute 10.8 % of electricity demand in 2015. (See Table 2.)

Wind Energy Potential

Washington has enormous wind potential by all estimates.

- The Pacific Northwest Laboratory (PNL) estimated in 1994 the state could generate 3,700 aMW of electricity from wind – more than one-third the total amount of electricity the state generated in 1998.[58]
- The National Renewable Energy Laboratory (NREL) made more conservative estimates, measuring wind potential only in areas that met stricter wind classifications and that were located within ten miles of existing transmission lines. Under these criteria, NREL estimated Washington could generate 3,400 aMW of electricity from wind.[59]
- More recently, four research organizations published a survey of renewable resources in eleven Western states called the Renewable Energy Atlas of the West. This study found 7,000 aMW of wind potential in Washington. The study used higher resolution data to measure the potential for generation from taller and more advanced turbines than those used for the earlier analyses.[60]
- The Tellus Institute, in a recent report contracted by the Northwest Energy Coalition, identified 1,900 aMW of wind energy potential in Washington looking only at the windiest and most developable locations. Including medium-wind loca-

Table 3. Projected Wind Power Growth[65]

Year	Average Capacity (MW)	Peak Capacity (MW)	Generation (GWh/yr)
2002	75	228	659
2003	142	431	1,244
2004	209	633	1,830
2005	251	760	2,196
2006	301	912	2,635
2007	361	1,094	3,162
2008	433	1,313	3,794
2009	520	1,575	4,553
2010	624	1,890	5,464
2011	717	2,174	6,284
2012	825	2,500	7,226
2013	949	2,875	8,310
2014	1,091	3,306	9,557
2015	1,255	3,802	10,990

tions, many of which could be developed cost-effectively, the study found 76,000 aMW of wind potential in four northwestern states.[61]

Currently, Washington has three wind farms with a combined capacity of 228 MW, but the technology is ready and the price is competitive to build more now. Five additional wind projects with a combined capacity of 405 MW are currently in development and three others totaling 480 MW are being considered.[62] (See Table 4.) When the Bonneville Power Administration sought 1,000 MW of new wind power for the Northwest, it was "blown away with 25 proposals that could provide 4,000 MW of wind capacity."[63]

We project that Washington wind developers could complete the 405 MW of wind projects currently in development by 2004, then add wind power capacity at an annual growth rate of 20% through 2010 and 15% thereafter. In this scenario, the state would be generating more than 5,000 GWh/yr of electricity from wind by 2010 and 11,000 GWh/yr by 2015. (See Table 3.) In comparison to the U.S. wind capacity growth rates of 37% in 1999, 28% in 2000, and 60% in 2001, a projected annual growth rate in Washington of 15-20% is conservative.[64]

Table 4. Wind Projects in Washington[66]

Project	Peak Capacity (MW)	Status
Mariah	0.2	online
Nine Canyon	48	online
Stateline, phase I	180	online
Stateline, phase II	40	in construction
Klickitat Wind	15	permitted
Zintel Canyon	50	permits pending
Horse Heaven Hills	150	permits pending
Maiden Wind Project	150	permits pending
Total online	228	
Total in development	405	
Total	633	

Solar Energy Potential

Although sunlight is not as intense in Washington as it is further south, solar panels still function at sufficient voltage in a cloudy climate. Despite the state's reputation, the amount of sunlight in Washington is within 25% of the national average.[67] Solar intensity measurements throughout the state indicate that Washington has a total PV generating potential of 4,800 aMW, 45% of 1999 statewide demand.[68]

Solar PV is especially complementary to Washington's hydropower system. Solar PV output peaks during the irrigation and air conditioning season in the eastern portion of the state. Utilizing solar PV on a wide scale would assist hydropower facilities in managing river operations to satisfy the competing demands of electricity, irrigation, and salmon habitat protection. As solar PV lowers demand for hydropower in the summer, the Columbia River system acts as a "battery bank" storing power (water) for the winter.

Solar Energy

There are two different types of technology for harnessing the sun's energy to generate electricity: solar thermal electric power plants and photovoltaics.

Solar thermal power plants use reflectors to concentrate sunlight on a receiver that uses the sun's heat to drive a turbine and generate electricity. Parabolic troughs, power towers, and dish/engines are the three technologies either in use or in development for solar thermal power plants, differing mainly in the shape and configuration of the reflectors.

Photovoltaics are very different from any other method ever used to generate electricity. All other methods require at least a two-step conversion of energy from its natural state into mechanical power and then to electrical power. Photovoltaic (PV) panels convert sunlight directly into electricity without the use of a generator or any moving parts.

The basic building block of this technology is the photovoltaic cell, which is made of semiconductor materials. Cells can be connected together to form modules, and modules can be connected to form arrays. In this way, PV systems can match power output to power needs. A few PV cells will power a hand-held calculator or wristwatch, while interconnected arrays can provide electricity for a remote village.

PV systems can operate either remotely or in connection with the utility grid. Their reliability even in adverse environments has been proven over decades by their performance powering satellites, which have to operate long term with no maintenance. The Federal Emergency Management Agency now uses solar electricity systems for prevention, response, and recovery in emergency situations. FEMA learned the value of PV for this purpose after Hurricane Andrew, when some Miami suburbs were without grid power for as much as two weeks. The PV systems that had previously been installed in that region survived and were able to help in the relief efforts.[69] With PV's long life, minimal operation and maintenance requirements, versatility (remote or grid-connected operation), reliability, and sustainable nature, the U.S. Department of Energy has concluded that, "it is easy to foresee PV's 21st century preeminence."[70]

Solar thermal collectors that use the sun's heat without converting it to electricity can also have an enormous impact on efforts to reduce demand for natural gas and electricity. These collectors are increasingly popular for heating swimming pools. When heating water in a residence, usually they serve as pre-heaters used in conjunction with another heating system, most commonly fueled by natural gas.

Washington has at least 123 kW of solar PV generating electricity right now.[71] 39 kW of this is at the state's largest array next to the Columbia nuclear power plant, and the rest is dispersed throughout the state. The state is aiming to have 5,000 new solar systems in place by 2005 and 20,000 by 2010 to fulfill its part in the national Million Solar Roofs Program.[72] About half of the systems installed are expected to be PV systems. The other 10,000 systems will be solar thermal collectors for water heating. Collectively these solar thermal collectors will go a long way to conserve fossil fuels, mostly natural gas used for water heating.

At an average size of 2 kW per PV system, this program will add 20 MW of PV capacity to the state by 2010.

The state has several operations by different utilities, municipalities, and groups striving to level the playing field between fossil fuels and solar power. For example, the Western SUN (Solar Utility Network) Cooperative negotiates and resells packaged solar electric systems to its members, allowing them to acquire and implement renewable energy technologies at the lowest possible cost through market aggregation. Western SUN members are electric cooperatives, public utility districts, and municipal utilities.

The co-op provides educational resources, training, and marketing to its membership and their customers. Given this activity, the goals of the Million Solar Roofs program should be reasonably attainable.

Geothermal Potential

The entire state of Washington can access resources for either direct-use of geothermal energy or geothermal heat pumps, although cost-effectiveness varies widely. Washington has been a leader in the field of geothermal heat pumps, installing the first systems in the 1950s. Case studies of installed systems revealed long-term reliability, low operation and maintenance costs, and high customer satisfaction.[73] Heat pumps provide water and building heating in the winter months and air-conditioning in the summer months, directly reducing the use of fossil fuels and electricity. According to the EPA,

Geothermal Energy

Geothermal energy is the heat that flows constantly from the center of the earth, where temperatures are believed to reach 4,000ºC. Certain regions in the subsurface contain pockets where this thermal energy is concentrated. These regions can be tapped with a well to access the steam or hot water. The heat from the steam and hot water is then used to drive turbines that generate electricity.

Although most of the high-temperature geothermal resources capable of producing electricity in the U.S. are found in the western states, mid- and low-temperature resources are more abundant and widespread. Direct use of geothermal energy and geothermal heat pumps transfer heat from the hot water accessed by a well to buildings and districts in order to heat water and air. Use of these resources can significantly reduce electricity demand.

Biomass Energy

Many types of "waste-to-energy" technologies and energy crops used to generate electricity fall under the banner of "biomass." Some are unacceptably harmful to the environment, while others provide a net benefit to the environment.

Any material that releases air pollutants or toxins into the air upon combustion at a greater rate than the fossil fuel it is replacing should not qualify as a renewable fuel. Included in this group are municipal solid waste (garbage) and construction debris, which can release dangerous toxins from the combustion of plastics and chemicals.

Burning timber wastes and agricultural wastes also have high emissions of dangerous pollutants, but can provide a net benefit over current practices. Burning organic waste in closed systems to generate electricity can result in lower emissions than disposing of it in open-air burn piles. Emissions can be further reduced with biogas digesters, although this option is not currently cost-effective.

Biogas digesters utilize bacteria to transform livestock manure and other wastes into fertilizer and biogas, which consists mainly of methane (the main component in natural gas). Some forms of digesters are currently employed for sewage treatment and fertilizer production, with biogas-generated electricity as a secondary benefit.

In most cases, landfill gas used as a renewable fuel has a net benefit for the environment. When large amounts of methane are emitted from landfills, operators are required to flare it; when emissions fall below limits requiring flaring, methane and other toxins escape into the atmosphere. Therefore, burning the methane to generate electricity is more desirable.

Various types of energy crops (i.e. willow, sweetgum, sycamore, switchgrass, woody crops) hold the potential for cleaner electricity production compared to traditional fossil fuels, especially coal, but their life-cycle impacts on the environment deserve further study.

In Washington, there will likely be opportunities for biogas and landfill gas operations, but amounts of electricity generated from these sources will be small.

geothermal heat pump systems reduce energy consumption and corresponding emissions by 70% compared to electric resistance heating with standard air-conditioning equipment.[74]

Portions of the state have high temperature geothermal resources capable of generating electricity. A rough estimate of geothermal potential in the state is 300 MW, although there is thought to be much greater potential that has not yet been tested.[75] The last nationwide geothermal resource assessment was published in 1978. Since knowledge about geothermal resources has advanced dramatically in the past 20 years, there is need for reassessment of resources in the western U.S.

Although some of Washington's geothermal electricity generation potential is developable within the next decade, geothermal is not included in this report's projections as all Washington geothermal projects are in the early planning stages.

Energy Savings Potential

Washington was extremely successful in energy efficiency efforts in the 1990s. Due to its diligent support in the preceding two decades, Washington was ranked first among all the states for its electricity savings rate in an analysis by the American Council for an Energy-Efficient Economy for both 1993 and 1998. Washington utilities' electricity savings averaged 6.8% of electricity sales in 1993 and 9.2% – 990 aMW – in 1998. However, funding for energy efficiency programs dropped considerably in the late 1990s, the effects of which have since been felt. In 1998, Washington utilities spent 1.7% of revenues, $66 million, on energy efficiency programs, down from 7.1% in 1993.[76]

In an October 2002 study commissioned by the Northwest Energy Coalition, the Tellus Institute measured potential savings from cost-effective energy efficiency improvements and fuel switching in all sectors throughout the Northwest. In the residential sector, the study found potential savings through more efficient heating, cooling, lighting, water heaters, and refrigerators. In the commercial sector, most savings were in better HVAC systems, lighting, refrigeration, and water heating. In the industrial sector, the study identified motor efficiency and improvements to the aluminum production process as the areas with highest potential energy savings. Further possible reductions were measured

Table 5. Projected Energy Conservation (aMW)

Year	Projected Demand without Conservation	Pct Conservation	Total Conservation	Projected Demand with Conservation
2002	10,855			
2003	11,018	0.8%	83	10,935
2004	11,161	1.5%	167	10,994
2005	11,306	2.3%	254	11,052
2006	11,453	3.0%	344	11,110
2007	11,602	3.8%	435	11,167
2008	11,753	4.5%	529	11,224
2009	11,906	5.3%	625	11,281
2010	12,060	6.0%	724	11,337
2011	12,217	6.6%	806	11,411
2012	12,376	7.2%	891	11,485
2013	12,537	7.8%	978	11,559
2014	12,700	8.4%	1,067	11,633
2015	12,865	9.0%	1,158	11,707
2016	13,032	9.6%	1,251	11,781
2017	13,202	10.2%	1,347	11,855
2018	13,373	10.8%	1,444	11,929
2019	13,547	11.4%	1,544	12,003
2020	13,723	12.0%	1,647	12,076

in streetlighting and irrigation. In addition, the study explored improved efficiency in electricity production through combined heat and power systems.

With all of these measures combined, the Tellus Institute determined that the Northwest could achieve a 12% overall reduction in electricity use by 2010 and 24% by 2020. The study also found that this would lead to a net economic savings of $1 million through 2010, as the cost of new equipment is offset by energy savings, and $482 million through 2020, as the previous equipment investments continue to provide energy savings.[77]

Experience shows that conservation rates much higher than this are possible. In 2001, when energy supplies were tight statewide, Seattle City Light set a goal of achieving a 10% reduction in electricity demand in a single year. Through a combination of public education, distribution of efficient light bulbs, and incentives for business customers, the utility surpassed its ambitious goal – reducing demand by 12% for the year. The utility's Energy Management Services Division acquired 11.7 aMW of programmatic energy conservation in 2001, enough energy to power 11,000 Seattle homes for a year. These savings allowed Seattle City Light to avoid the purchase of $80 million of electricity on the regional market.[78]

Similarly, in California, energy conservation was a highly visible priority throughout the energy crisis of 2001. State efforts to promote energy savings paid off, with a total annual reduction of 6.7% in statewide generation in a single year. Monthly peak load reductions from the previous year reached a high of 14% in June.[79]

Table 6. Clean Energy Development Potential (aMW)

Year	Energy Conservation	Solar Power	Wind Power	Total
2003	83	1	142	225
2004	167	1	209	378
2005	254	2	251	507
2006	344	3	301	647
2007	435	3	361	799
2008	529	4	433	966
2009	625	4	520	1,149
2010	724	5	624	1,352
2011	806	6	717	1,529
2012	891	6	825	1,722
2013	978	7	949	1,933
2014	1,067	8	1,091	2,165
2015	1,158	8	1,255	2,421

Although the energy savings outlined in the Tellus Institute study represent real, cost-effective opportunities specifically identified by their survey, to be more conservative we can set a state target of achieving half of those savings. If Washington reaches 6% cumulative savings by 2010 and 12% by 2020, the state will be reducing electricity demand by 720 aMW in 2010, 1,160 aMW in 2015, and 1,650 aMW in 2020. (See Table 5.)

National Renewable Energy and Efficiency Potential

The nation's enormous renewable energy and energy efficiency potential remains largely undeveloped today. Despite the proven effectiveness and cost savings of energy efficiency and the evolution of affordable, clean technologies to produce electricity, the electric power industry continues to use coal for more than half (52%) of its electricity-generating needs. Other major sources include nuclear power, providing 20%, and gas, providing 15% of electricity. More minor contributions come from hydropower (8%), oil (3%), and other varied sources including non-hydro renewables (2%).

Together fossil fuels make up 70% of the electricity-generating sources in the U.S.

The Energy Information Administration predicts fossil fuel contributions will increase to 75% of total sources used to generate electricity by 2010.[81]

The U.S. has another choice. Renewable projects utilizing wind, geothermal, and solar energy are already operating throughout the country, proving the technology is ready to economically harness these resources. In 2000, wind energy contributed 3,000 MW, solar energy 548 MW, and geothermal energy 2,800 MW of power to the nation's energy system.[82] Together these resources generate about 32,000 GWh/yr of electricity, enough energy for 3.2 million American homes.

This amount merely scratches the surface of remaining untapped potential. By 2010, the U.S. could be cost-effectively generating 391,000 GWh/yr of emission-free electricity – more than eleven times the current amount of electricity it generates from renewable resources. With the projected electricity demand of 4,140,000 GWh/yr reduced by 15% through energy efficiency measures, non-hydro renewable energy sources could satisfy 11% of the nation's electricity demand by 2010.

Figure 4: 1999 U.S. Electricity Sources[80]

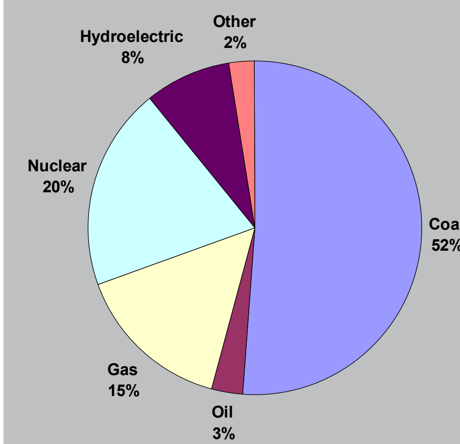


Table 7: Potential Growth of Clean Energy by 2010[83]

	Capacity (MW)			Generation (GWh/yr)	
Resource	**2000**	**New Development 2002-2010**	**2010**	**2010 Production**	**% of National Total 2010**
Wind	2,970	116,300	119,300	313,500	8.7%
Geothermal	2,800	5,600	8,400	70,000	1.9%
Solar PV	194	2,900	3,100	5,400	0.2%
Solar Thermal	354	1,000	1,300	2,400	0.1%
Total	**6,318**	**125,800**	**132,100**	**391,300**	**10.9%**
Energy Efficiency				630,000	17.5%

Given the potentially catastrophic effects of global warming, it is very much in the best interests of Washingtonians to encourage the federal government to facilitate the growth of renewable energy and energy efficiency across the country.

Wind Potential

The U.S. has enough windy spots to cost-effectively install more than a million MWa of wind power capacity, according to the Pacific Northwest Laboratory, a public/private research arm of the U.S. Department of Energy. This would generate three times the amount of electricity the country used in 2000.[84]

The National Renewable Energy Laboratory made more conservative estimates in 1994, measuring wind-generating capability only in areas that met stricter wind classifications, that avoided environmentally sensitive areas, and that were located within ten miles of existing transmission lines. They estimated that the U.S. could generate 734,000 MWa of electricity from turbines in such locations – nearly twice as much as current demand.[85]

Wind power is the fastest growing energy source worldwide. New wind power capacity grew by 24% annually throughout the 1990s, with a growth rate of 37% in 1999 and 28% in 2000.[86] In 2001, the industry installed enough turbines to generate an average of 798 MW in the U.S.[87] If new installations were to increase by 30% annually hereafter – a rapid but feasible rate – the country could generate more than 7% of its electricity from wind power by 2010, as depicted in Table 8. This modest proposal would tap only 35,000 MWa of the 734,000 MWa potential, but it would displace the need for 80 fossil fuel power plants.

Table 8: Future U.S. Wind Power Generation with 30% Annual Growth

Year	New Installation (MWa)	Total Capacity (MWa)	Total Generation (GWh/yr)
2000		891	7,805
2001	798	1,689	14,796
2002	1,037	2,726	23,883
2003	1,349	4,075	35,697
2004	1,753	5,828	51,055
2005	2,279	8,107	71,021
2006	2,963	11,070	96,976
2007	3,852	14,922	130,718
2008	5,007	19,929	174,582
2009	6,510	26,439	231,605
2010	8,462	34,901	305,736

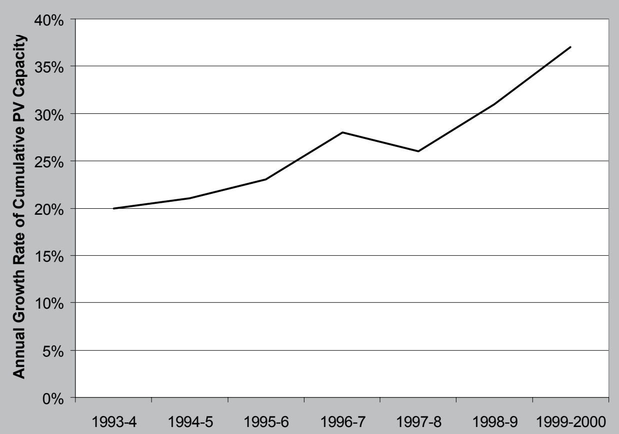
Solar Potential

There is theoretically enough sunlight in a 100-mile square patch of desert in the southwestern U.S. to generate enough electricity for the entire country.[88] Solar thermal plants could replace 100% of current fossil fuel-based electricity production using only 1% of the earth's desert area.[89]

Although transmission distances may make generating all of our electricity in the deserts unfeasible, much development can take place before this presents a barrier. As a first step, we could easily hope to encourage the construction of 1,000 MW of solar thermal capacity with just five power plants in the Mojave Desert by 2010. As fuel cell technology develops, there will likely be opportunities to process hydrogen in the deserts for shipment elsewhere.

Solar power can generate electricity directly using photovoltaics (PV) as well. PV electricity production is all around us, from satellites to road signs to watches to rooftops. Total U.S. PV capacity of 194 MW is quite small compared to other energy sources, but growth of PV use has been steady and is expected to continue at an increasing rate. Both the domestic and worldwide growth rates for cumulative installed PV capacity have been increasing. The domestic PV capacity growth rate increased to 18.3% in 1999 from an average of 15.6% through most of the 1990s. Worldwide, the

Figure 5: Increasing Growth Rate of Worldwide Cumulative PV Capacity



cumulative PV capacity growth rate increased from an average of 27% (1993-1999) to an average of 31% (1997-1999) and peaked at 37% in the last recorded year, 1999.[90]

If the cumulative U.S. PV capacity continues at the current domestic growth rate of 18%, it will increase from its current capacity of 194 MW to 1,000 MW by 2010.[91] If the U.S. strongly encourages the growth of solar energy, capacity could be added much more quickly. Growing at the 1997-99 worldwide rate of 31% annually, U.S. capacity could reach nearly 3,000 MW by 2010.

Geothermal Potential

The U.S. has tremendous geothermal resources. The DOE estimates high-temperature (electricity-generating quality) geothermal potential in the U.S. to be more than 4,000 quads (quadrillion Btus), more than forty times our current energy use.[92]

The last nationwide assessment of geothermal resources was published in 1978. It estimated a high-temperature potential of approximately 22,000 MW in nine western states from known reserves.[93] Estimates of undiscovered reserves ranged from 72,000 to 127,000 MW.[94] Since knowledge about geothermal resources has advanced dramatically since 1978, there is need for reassessment of these resources.

The DOE Office of Power Technologies project entitled "Geopowering the West" has a goal for geothermal energy to provide 10%, or 10,000 MW, of the electricity needs of the western states by 2020.

The Energy Information Administration estimates the growth rate for geothermal capacity to be 7.2% through 2010.[95] Given this growth rate, U.S. geothermal capacity would reach over 5,600 MW by 2010, as shown in Table 9.

Energy Savings Potential

The U.S. could save energy and significantly reduce pollution by implementing effective policies encouraging energy efficiency. The American Council for an Energy-Efficient Economy (ACEEE) studied the impacts of several "smart energy" policies on U.S. primary energy consumption, economics, and emissions.[96] Under the "smart energy" policy scenario, the U.S. would reduce its total primary energy consumption[97] by nearly 11% annually by 2010 compared to the business-as-usual, or base-case, scenario lacking new policies. Looking at the electricity produc-

Table 9: Future Geothermal Generation with 7.2% Annual Growth

Year	New Installation (MW)	Total Capacity (MW)	Total Generation (GWh/yr)
2000		2,800	23,302
2001	202	3,002	24,979
2002	216	3,218	26,778
2003	232	3,450	28,706
2004	248	3,698	30,773
2005	266	3,964	32,988
2006	285	4,249	35,363
2007	306	4,555	37,910
2008	328	4,883	40,639
2009	352	5,235	43,565
2010	377	5,612	46,702

tion portion of this,[98] annual energy use for electricity would be reduced by 15% in the policy case by the year 2010 as compared to business as usual. A 15% reduction in electricity use in 2010 translates to more than 630,000 GWh/yr saved – the equivalent of 140 power plants operating constantly at full capacity – and 700 million tons of carbon dioxide emissions avoided per year.

The set of policies analyzed in the study includes electricity-saving actions:

- Utility energy efficiency program to set aside funds for investment in energy efficiency.
- New and strengthened equipment efficiency standards.
- Tax incentives for energy-efficient homes, commercial buildings, and other products.
- Expanded federal energy efficiency research, development, and deployment programs.
- Promotion of clean, high-efficiency combined heat and power systems.
- Voluntary agreements and incentives to reduce industrial energy use.
- Improvements in efficiency and emissions from existing power plants.
- Greater adoption of current model building energy codes and development and implementation of more advanced codes.

Pollution Reduction

Tapping the renewable energy and energy efficiency potential ready for development now in Washington and the nation would dramatically reduce power plant air pollution at both the state and national levels. By 2010, Washington would reduce CO_2 emissions by 10 million tons per year by developing clean energy solutions in place of natural gas. The U.S. would reduce CO_2 emissions by one billion tons per year by developing clean energy solutions in place of coal.

Pollution Reduction in Washington

Washington's utilities are currently pumping an alarming 23 million tons of carbon dioxide, 63 tons of nitrous oxides, 86 thousand tons of sulfur dioxide, and 540 pounds of mercury into the air annually, along with deadly particulate pollutants and a host of other toxins.[99]

The Northwest Power Planning Council predicts that electricity demand in the Northwest will grow by at an average rate of about 1.3% annually.[100] At this rate, Washington would need 17,607 GWh/yr of additional electricity by 2015.

If Washington meets this future electricity demand using natural gas, CO_2 emissions will increase by 45% to 34 million tons/yr; NOx emissions will increase by 22% to 77,000 tons/yr; and SO_2 emissions will increase by 1,000 tons/yr.

If Washington meets its future electricity demand with renewable energy and energy conservation, it can avoid all of this increased power plant pollution. The clean energy development scenario outlined in the previous section – half of the energy conservation potential identified in the recent Tellus Institute study and 15-20% annual wind capacity growth – would more than cover projected demand growth needs.

A more ambitious scenario would involve tapping more clean energy potential in order to reduce the use of dirty power sources. New energy development could enable the state to reduce use of the 1,460 MW Centralia coal plants, built in 1972, the 165 MW of fuel oil power plants, some of which have been online since the 1930s and 1950s, the 64 MW of municipal solid waste incinerators, and the 1,216 MW Columbia nuclear reactor.

The less ambitious scenario of merely avoiding all new pollution sources is clearly achievable. The amount of clean energy development outlined in Table 6 would lead to a projected buffer of 3,600 GWh/yr. According to that scenario, Washington would be generating 10.8% of its electricity from renewable sources by 2015.

Pollution Reduction Nationwide

The U.S. potential growth of wind, geothermal, and solar power outlined above would generate 359,250 GWh/yr of electricity by 2010. This represents 8.4% of U.S. electricity demand projected by the EIA for 2010, not including current renewable energy generation and before any reductions in demand through energy efficiency measures are considered.

Table 10. Pollution Increase with Natural Gas Development in Washington

		Emissions (tons/yr)		
Electricity Demand	Generation (GWh)	CO_2	SO_2	NOx
Current Demand	95,090	23,632,000	63,000	86,000
Increase through 2015	20,307	10,547,000	14,000	1,000
Total Projected Demand in 2015	115,397	34,179,000	77,000	87,000

If these renewables were to replace coal power plants, CO_2 would be reduced by more than 400 million tons, SO_2 would be reduced by more than 2 million tons, NOx reduced by more than 1 million tons, and power plant mercury emissions would decrease by nearly 16,000 pounds in the year 2010.

Energy efficiency measures resulting in a 15% reduction in electricity demand would eliminate the pollution associated with 630,000 GWh/yr of electricity production: 710 million tons of CO_2 emissions, 4 million tons of SO_2 emissions, 1.9 million tons of NOx emissions and 28,000 pounds of mercury at the rate coal-fired plants emit pollution.

The combined impact of renewable energy and energy efficiency developed to replace coal-fired electricity generation would cut power plant CO_2 emissions by 37%, SO_2 emissions by 45%, NOx emissions by 40%, and mercury emissions by 45% by 2010 compared to projections for continuing on the current path.

The combined impact of renewable energy and energy efficiency developed to replace coal-fired electricity generation would cut power plant CO_2 emissions by 37%, SO_2 emissions by 45%, NOx emissions by 40%, and mercury emissions by 45% compared to projections for continuing on the current path.

Table 11: U.S. Power Plant Emissions Comparison[101]

Year	Scenario	Electricity Generated or *Saved* (GWh/yr)	CO2 Emissions Generated or *Avoided* (thousand tons)	SO2 Emissions Generated or *Avoided* (thousand tons)	NOx Emissions Generated or *Avoided* (thousand tons)	Mercury Emissions Generated or *Avoided* (pounds)
2000	Actual Generation	3,430,700	2,406,780	12,870	6,040	84,850
2010	Projected Generation	4,224,200	2,994,100	14,600	7,300	98,400
2010	**Projected Generation with Clean Energy Development:**	**3,590,600**	**1,880,100**	**8,000**	**4,400**	**54,300**
	Renewables	359,250	*404,000*	*2,400*	*1,000*	*16,100*
	Energy Efficiency	*630,000*	*710,000*	*4,200*	*1,900*	*28,000*
	Total Clean Energy Development		***1,114,000***	***6,600***	***2,900***	***44,100***

Figure 6: CO_2 Emissions with Renewables and Energy Efficiency Replacing Coal

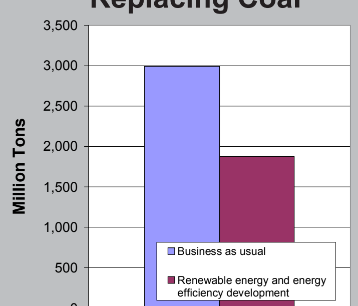


Figure 7: SO_2 Emissions with Renewables and Energy Efficiency Replacing Coal

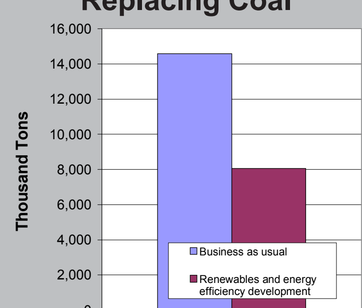
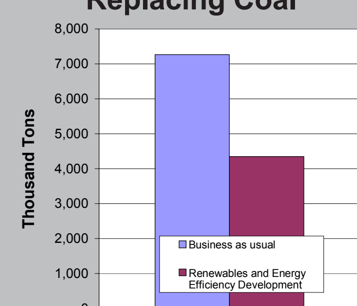


Figure 8: NOx Emissions with Renewables and Energy Efficiency Replacing Coal



Reliability

The best strategy to improve reliability is to increase the diversity of the portfolio. This remains true whether you are speaking of a stock portfolio or an energy resource portfolio. Dr. Robert Hirsch of the RAND Corporation used this analogy in his statement to the Senate Environment and Public Works Committee: "Analysts can run complex models that can demonstrate that over-dependence on a single fuel will increase national vulnerabilities. But in fact it's common sense. For instance, if all your retirement money was in the NASDAQ over the past year, you'd have problems. If all your money was in bonds in the early 1990s, you would have missed some golden opportunities."[102] Increasing the diversity of Washington's energy portfolio requires investment in renewable energy sources.

Fossil Fuels

The historic average levels of down time for traditional power plants are higher than for renewable energy. The average availability factor – a measure of the percentage of time a generating unit is available to produce power – is higher for each renewable energy technology than it is for fossil fuels and nuclear plants.

These availability factors do not take into account down time from interruptions in fuel supply. As we have seen in recent years, natural gas price spikes can limit the ability of power plants to operate. And we can expect such supply difficulties to return in coming years as fossil fuel supplies are reduced. As current reserves are depleted, new deposits which are located deeper into wild places will be increasingly hard to develop and may offer diminishing returns.

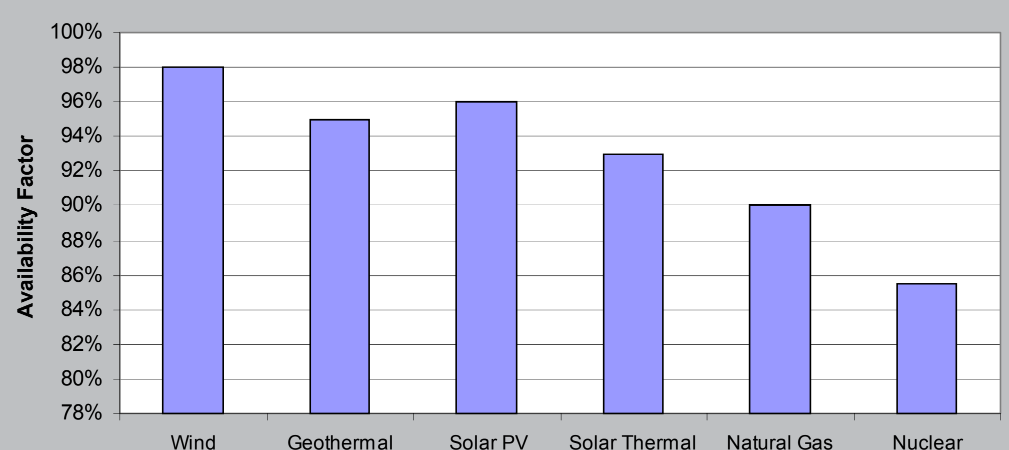
Because their fuel is free, renewable energy plants do not have this limitation.

Wind

High-quality modern wind turbines have an availability factor above 98%. This availability factor is beyond any other electricity generating technology. In addition, maintenance requirements are minimal. Modern wind turbines require maintenance checks only once every six months.[103]

The reliability of wind power, therefore, is not determined by its technology, but rather by the intermittency of wind. A single site, or wind farm, will have an intermittent power output that corresponds to when the wind blows. Different sites will each have differ-

Figure 9: Average Historic Reliability of Energy Technologies[104]



ent wind characteristics that will directly affect what percentage of the time they actually operate and generate power. Site development in differing geographic locations is the key to addressing the issue of intermittency and optimizing electricity generation from wind power. The average amount of high wind hours per day at good wind power sites is predictable, with most wind turbines operating at 25-35% of peak capacity on average. Spreading this over geographically diverse regions raises the overall steadiness of wind power.

Geothermal

Geothermal power has been proven reliable for nearly a century. The oldest geothermal plant is in the Larderello field in Italy, which has been generating electricity since 1904. Plants in Wairakei, New Zealand and at The Geysers in California have been operating for nearly 40 years. The Geysers has a reputation of safety, cost-effective operation, and low impact on the environment.[105]

The heat from geothermal reservoirs is constant. Since no combustion is needed to generate the heat, maintenance demands are lower than for fossil fuel plants. Geothermal electric power plants are available for generation 95% of the time or more.[106]

Solar PV

Photovoltaics were first developed to power satellites in the late 1950s. It was absolutely crucial that they perform reliably with minimal maintenance. Because of the lack of moving parts and its unique ability to operate remotely, PV was then and continues to be far superior to conventional energy sources for many uses.

The Federal Emergency Management Agency now uses solar electricity systems for prevention, response, and recovery in emergency situations. After Hurricane Andrew, some Miami suburbs were without grid power for as much as two weeks. The PV systems that had previously been installed in that region survived and were able to help in the relief efforts.[107] Remote navy installations are also increasingly relying on PV for their operations.

In addition, the electrical power output from PV can be engineered for virtually any application, regardless of size. The Department of Energy describes the future of PV in its Overview of Photovoltaic Technologies: "PV enjoys so many advantages that, as its comparatively high initial cost is brought down another order of magnitude, it is very easy to imagine its becoming nearly ubiquitous."[108]

Generating Costs

Clean energy resources are economically viable today. Both energy efficiency measures and renewable energy technologies are more cost-effective in the long term than the current fossil fuel-dominated energy system. This was not the case a few decades ago when renewable energy resources were first presented as alternatives to oil and coal. But today any truly sound financial investment in the nation's energy future must involve aggressive and timely development of these resources.

- Energy efficiency measures have been proven on both the local and national levels to be the best response to immediate power needs. They reduce pollution and energy demand at a cost that is less than most new power plants.
- Renewable energy technologies provide stable and declining electricity costs because their "fuel" is free, in contrast to ongoing purchases of fossil fuel at volatile prices. Renewable energy projects have the added economic benefit of creating more jobs than traditional fossil fuel electricity generation since renewable energy costs are more tied to skilled labor than to fuel.
- Clean energy solutions are even more attractive compared to fossil fuels when externalized environmental costs are accounted for.

Clean energy policies resulting in the increased use of both renewable energy and energy efficiency provide the best overall strategy for America's energy future. Several recent studies examining the economic impact of efficiency and renewables stimulus programs found that the nation's economy would experience greater growth with policies encouraging renewables and energy efficiency than under a business-as-usual scenario.

Fossil fuel-generated electricity, on the other hand, is not a good long-term financial investment. Much of its costs are tied to limited fuel resources. Although the up-front capital costs of constructing a new fossil fuel power plant are less than the up-front costs of a renewable energy power plant, the price of fossil fuel-generated electricity will forever carry a fuel cost. As changes occur in the supply and demand of the limited fuel, the cost will oscillate in response and eventually increase as the resource heads toward depletion.

Fossil fuel-generated electricity also has significant externalized costs. Expenses related to the environmental and public health damages associated with fossil fuel extraction and power plant emissions do not appear on electricity bills, yet they are very real costs to society.

Even though hydropower does not emit air pollutants, dams have major negative environmental impacts. Hydropower is not being considered as a significant source to meet future electricity needs.

Nuclear power, the only other option for electricity generation, is expensive, highly polluting, and unacceptably dangerous.

Energy-Efficient Technologies and their Costs

History has proven that adopting energy efficiency measures is the cheapest, as well as the easiest, quickest, and cleanest way to address urgent power needs. Nationally, utilities have saved 25,000 to 30,000 MW annually, the equivalent of 100 large power plants, over the past five years through energy efficiency programs. These programs averaged 2.8 ¢/kWh, a cost that is less than that of most new power plants.[110] In addition to cost savings, energy efficiency measures have avoided the logistics and time involved with the siting of 100 large power plants, the acquisition of the rights of way for power lines and gas pipelines, and the emission of 190 million tons of CO_2.[111]

Several recent studies have shown that the U.S. would continue to save energy and money in the future by implementing more energy efficiency programs and setting stricter efficiency standards.[112] The ACEEE study referred to on page 22 that determined the U.S. could reduce its electricity demand by 15% by 2010, for example, also revealed that a net savings of $152 billion dollars would accompany the energy savings by 2010 under their smart energy policy scenario.[113]

A variety of measures fall under the energy efficiency umbrella. Examples of utility energy efficiency measures include replacing older, less-efficient equipment with newer equipment. This equipment can include:

- High-efficiency pumps and motor retrofits for large oil and gas producers and pipelines.
- Redesigned electricity generators with combined heat and power systems that recycle and reuse waste heat, which significantly increases their efficiency.
- Smaller onsite efficient electricity generators (rather than large central power plants) that match the power needs of the district or building and bypass the need for long-distance transmission of electricity where significant losses of energy occur.
- More efficient motors and use of steam for all industrial operations.
- Better lighting and refrigeration equipment for commercial uses.
- Advanced heating and air conditioning systems.

Examples of consumer energy efficiency measures include:

- Weatherizing homes.
- Replacing old appliances with newer, more efficient ones.
- Installing electricity, heat, and air-conditioning systems that are responsive to real-time energy demand.

Individual households can always see significant savings in their electricity bills by implementing simple energy efficiency measures. Replacing a single incandescent light bulb with a compact fluorescent bulb saves its owner $40 in electricity costs over the lifetime of the bulb. Weatherizing a home reduces the average household's energy expenditures by $200-$400 annually.[114] There are energy savings opportunities in every home or business.

Renewable Energy Technologies and their Costs

Because renewable energy has no fuel costs, its total costs are predictable and stable. Once the plants are built, producers only have to pay the regular operating and maintenance costs to keep the power flowing. The fluctuating fuel costs of fossil fuel-based power plants are not a factor for renewable energy producers.

The fact that more of the costs are up-front rather than spread out in the form of ongoing fuel costs constitutes a challenge in the development of renewable energy projects, since investors need to undertake more financing at the start of the project. However, since this also results in greater certainty of the total costs over the full lifetime of the plants, hesitation over high initial investments can be eased through market certainty. When a market is guaranteed

through procurement policies or long-term contracts, the initial investment hurdle is greatly reduced.

The combination of advanced technology fuel-generated electricity right now for some situations, such as remote applications in the U.S. and vast areas of the developing world that have no grid/power plant infrastructure in place. However, without subsidies, it is not competitive with the lowest rates from gas and coal-fired power plants today in the grid-connected developed world.

An important consideration in cost comparisons of traditional power plants and PV is that when a PV system is installed in a home or business, there are no mark-up costs to middlemen and no distribution costs. Therefore, the comparisons must take place at the retail cost of electricity rather than the wholesale cost of the fuel or the power plant generating cost. The average U.S. residential retail cost of electricity is 8.5 ¢/kWh, though it can cost over 14 ¢/kWh in some states.[117] In 1996, the cost of installing a PV system represented either no net cost or profit over remaining completely dependent on grid-connected power in only five states. Just three years later, this was true in fifteen states.[118] Residential rates, along with tax credits and/or capital cost reduction policies, were the most influential factors rendering PV cost-effective in these states.

Economies of Scale

Although technological breakthroughs may lower PV prices significantly, the biggest price reductions are expected from economies of scale due to increased PV panel manufacturing volume.

The current cost of PV modules is quoted at about $3.50-$3.75 per watt wholesale and $6-$7 per watt for an installed system.[119] This is a dramatic reduction in cost from $20 per watt ten years ago and a hundred-fold drop in cost since 1972.[120] The cost will continue to decline as PV manufacturers reach economies of scale. Since nearly all of the costs for PV-generated electricity lie in the equipment, the more equipment manufactured on a mass scale, the cheaper the electricity becomes.

Figure 10: Annual PV Manufacturing Volume[124]

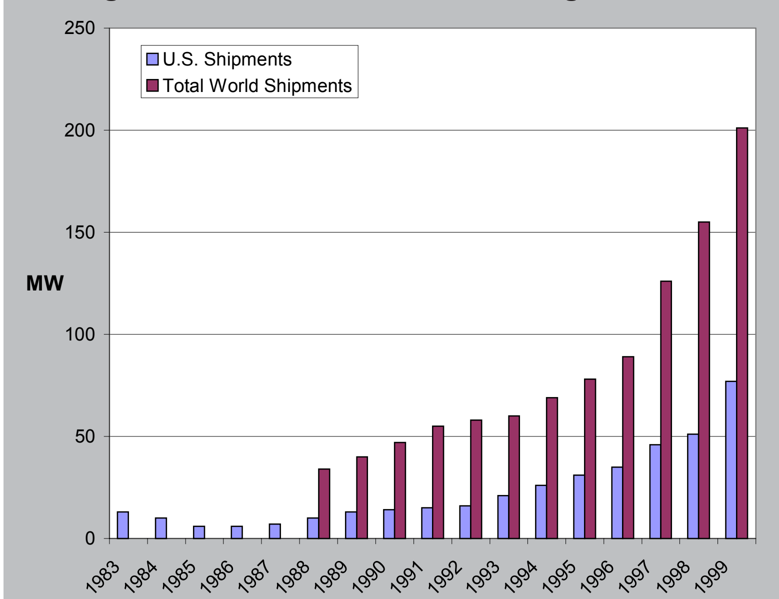


Table 13. Experience Curve for PV Module Price

Doubling	Installed Capacity (MW)	Wholesale Price per Watt	Installed System Price per Watt
0	1,034	$3.50	$6.50
1	2,068	$2.87	$5.33
2	4,136	$2.35	$4.37
3	8,272	$1.93	$3.58
4	16,544	$1.58	$2.93
5	33,088	$1.30	$2.40
6	66,176	$1.06	$1.97
7	132,352	$0.87	$1.62
8	264,704	$0.72	$1.32
9	529,408	$0.59	$1.08
10	1,058,816	$0.48	$0.89

The relationship between increased volume and decreased price is called the experience curve. For PV, it is estimated to be 82%. That is, for every doubling of cumulative production volume, the price of PV is expected to decline by 18%.[121]

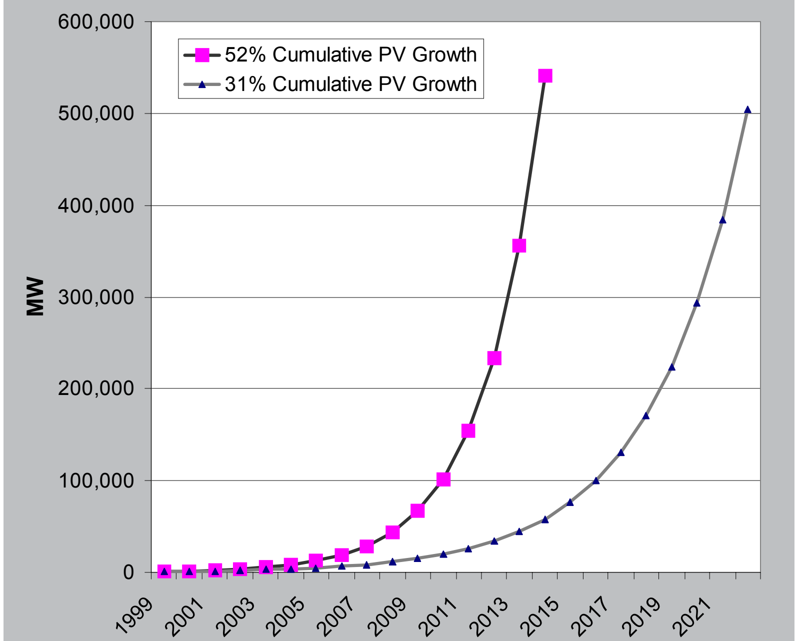
In 1999, total worldwide installed PV capacity was 1,034.[122] The next four doublings of this amount will each reduce the price of installed systems by about one dollar per watt.

To compete on equal footing with traditional power sources in a short-term economic view, PV prices will need to be near $1/watt for an installed system.[123] According to this experience curve, that price will be reached once total PV installations surpass 500,000 MW.

The PV industry clearly has a fair distance to go, but it is steadily progressing toward its goal. Every step taken to install solar panels will boost the industry. PV module shipments in the U.S. and worldwide have steadily increased over the past twenty years. Furthermore, the rate by which shipments have increased has risen.

From 1989-99, the growth rate of worldwide PV module shipments averaged 18%. For the same time period, the U.S. growth rate was 21%. Recently the growth rate has been much higher. The average growth rate in 1997-99 in the U.S. and worldwide was 31%. In 1999, the U.S. growth rate of PV module shipments was 52%, the highest ever, while the worldwide growth rate of shipments remained at a healthy 30%.[126]

Figure 11: PV Market Growth Rate Projections[125]



If the growth rate in PV manufacturing activity continues at the 52% level it reached in the U.S. in the past year, cumulative worldwide PV capacity will have reached 500,000 MW by 2013. If growth in manufacturing only grows at the 1997-99 average rate of 31%, the industry will have reached this milestone in 2022.

Geothermal

Geothermal energy provides the U.S. with 2,700 MW of generating capacity. Currently geothermal fields are generating electricity for 1.5-8 ¢/kWh.[127]

The Geysers in California are a good example of how renewable energy, with the bulk of its costs up-front, can provide electricity at stable and declining costs. The plants were built in the 1960s and are still operating today with much of the original infrastructure, including the wells. Since the capital costs of the original construction have been paid off and the resource continues to fuel the plant at no cost, the only expenses are ongoing operation and maintenance costs. They are now producing electricity for 3 ¢/kWh.[128]

Economic Development Benefits of Clean Energy

The 1997 Kyoto protocol, an international treaty to reduce global-warming greenhouse gases, prompted analyses of the feasibility and impacts of carbon reduction strategies in the U.S. Given that power plants account for 40% of U.S. carbon dioxide emissions, power plants were featured prominently in these strategies. Each of these reports produced concurring results:

- A 1997 study by five national laboratories concluded that a vigorous national commitment to developing and deploying energy-efficient, low-carbon, and renewable technologies can reduce pollution, reduce energy consumption, and produce energy savings that equal or exceed the costs of the endeavor.[129]
- Another 1997 study by five environmental and public policy organizations found that policies encouraging energy efficiency, renewable energy, and other advanced clean technologies would result in lower energy consumption, lower CO_2 emissions, billions of dollars in consumer energy bill savings, and a net employment boost of nearly 800,000 jobs in the U.S. by 2010.[130]
- In 1998, the U.S. Environmental Protection Agency analyzed policy and program scenarios with help from the Lawrence Berkeley National Laboratory. The analysis identified a relationship between carbon emissions mitigation (through development of energy-efficient, low-carbon, and renewable technologies) and economic activity. In this model, carbon mitigation resulted in increased gross domestic product and economic savings by 2010 larger than the business-as-usual projections.[131]
- In 2000, the Interlaboratory Working Group on Energy-Efficient and Clean Energy Technologies examined the potential for public policies and programs to address current energy-related challenges. Their study concluded that public policies promoting energy efficiency and clean energy production can significantly reduce power plant air pollution with economic benefits that are comparable to overall program implementation costs.[132]

All of these studies address the problem of pollution with a comprehensive and long-term approach, and all of these studies disprove the long-held misconception that we must choose between cleaner energy production and economic growth. Their solutions are similar in that each multifaceted scenario involves using energy more efficiently and diversifying our energy mix by adding renewable technologies to our portfolio.

Comparison with Natural Gas

Since natural gas power plants are dependent on unstable supplies of natural gas and fluctuating prices for the gas, electricity generating costs from gas plants can rise dramatically during gas price spikes. The strongest example of this was seen in California in 2001. The Federal Energy Regulatory Commission (FERC) has determined that generating costs in California went as high as 27 ¢/kWh in January of that year and 43 ¢/kWh in February.[133] One of the biggest reasons for this price spike was natural market fluctuation. Fifteen years of low gas prices and the resulting disincentive for resource development followed by an exceptionally cold winter led to depleted stocks and unprecedented wholesale prices. With limited domestic reserves of natural gas and uncertain foreign supplies, we can expect such price spikes to be a regular occurrence in the future.

Even the optimistic forecasts of the U.S. Department of Energy are predicting natural gas prices to rise steadily.[134] Since higher prices are predicted and we are trying to reduce dependence on foreign energy sources, we should be moving away from natural gas rather than deepening our reliance on it.

Taking into account some externalized costs shows an even greater number of renewable energy projects that are cost competitive with natural gas plants. Seven major studies on the environmental costs of electricity production have been done in the past twenty years. The studies mostly measure the costs of compliance with air quality regulations, transportation costs associated with energy production, land use impacts, and some public health costs. None of the studies take into account all categories of costs – human death and illness from disease and accidents, reduced production of crops and fisheries, degraded structures, lost recreational opportunities, degraded visibility, loss of habitat and biodiversity, and use of land, water, and minerals. Rather, each study contains some subset of these impacts.

In these studies, the average externalized cost for combined cycle natural gas plants was 2.1 ¢/kWh, compared with almost negligible externality costs for renewable energy technologies. This adds up to a drain on the state economy of $430 million per year from the state's natural gas plants alone.[137]

Using these conservative numbers, the costs of nearly all proposed wind plants are as low as the best natural gas plants, and even the most expensive proposals for geothermal plants are only 35% more than gas plants.

Of the studies on the environmental costs of electricity production, only the Pace University study attempted to capture some of the costs of climate change. Even that study, however, measured the climate change costs in terms of mitigating for carbon emissions through forest sequestration, rather than measuring the actual expected costs which climate change will cause. As our understanding of the issue has evolved considerably since then, even the forest sequestration measurement is vastly undervalued. The Pace

Table 14: Generating Costs without Externalized Costs (¢/kWh)[135]

	2002	2010
Wind	4 - 8	2.11 - 8
Geothermal	1.5 - 8	3 - 7
Solar PV	12 - 25	10 - 23
Natural Gas	4.16 - 43	4.16 - 43

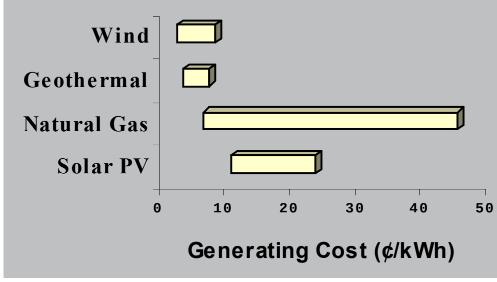
Table 15: Studies of External Costs of Electricity Generation (¢/kWh)[136]

Study	Coal	Combined Cycle Natural Gas	Solar PV	Wind	Geothermal	Biomass
2001 U.S. DOE/European Union	5.8	1.8	0.6	0.15		1.1
1999 Fraunhofer Institute			0.4	0.009		
1991 Tellus Institute	6.03-13.45	2.27				
1990 Pace University	3.91-9.58	1.5	0.0-0.5	0.0-0.1		0.0-0.9
1989 PLC Consulting	4.7-8.4	2.8				
1986 Bonneville Power					0.0-0.029	
1982 NRDC	4.05-6.75			0.0-0.27		
Average	**6.6**	**2.1**	**0.4**	**0.09**	**0.01**	**0.8**

Table 16: Electricity Generating Costs with Some Externalized Costs (¢/kWh)[135]

Resource	Externalized Costs	2002	2010
Wind	0.09	4.1 - 8.1	2.2 - 8.1
Geothermal	0.01	1.5 - 8.0	3.0 - 7.0
Solar PV	0.4	12.4 - 25.4	10.4 - 23.4
Natural Gas	2.1	6.3 - 45.1	6.3 - 45.1

Figure 12. Range of Generating Costs in 2010 with Some Externalized Costs



study also looks only at carbon emissions, excluding other greenhouse gases.

Including climate change and the full range of public health and other environmental costs would greatly increase the acknowledged cost of electricity generation from natural gas power plants. Although quantifying all future costs of climate change is difficult, it is easy to justify large subsidies and marginally increased rates for energy sources that do not lead to climate change.

Also not included in these calculations are government subsidies, which historically have been much higher for fossil fuels than renewable energy. Federal subsidies from 1948-1998 were more than seven times as high for fossil fuels and nuclear power than for renewable energy – $66 billion for nuclear, $26 billion for fossil fuels, and $12 billion for renewables.[138]

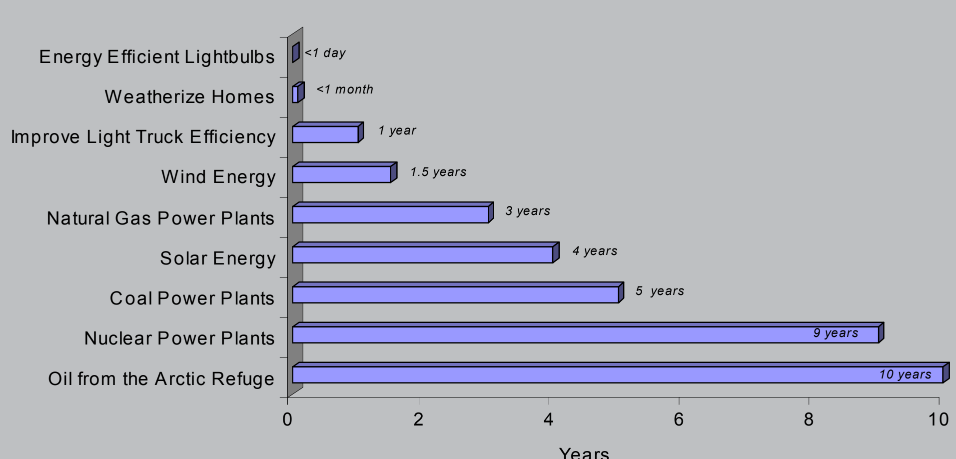
Clearly the renewable energy projects with the most favorable conditions should be developed immediately, as they are cheaper in the short term in addition to their other benefits. Since they do not harm the environment and lead us more quickly to a sustainable energy future, some renewable energy projects which are marginally more expensive in the narrow view of short-term accounting should also be developed. Because the costs of generating electricity make up less than 30% of the average customer's electricity bill, small increases in generating costs are not felt strongly by consumers.[139] A 20% increase in generation costs, for example, only results in a 6% increase in a customer's bill.

Construction Time

The ability to respond quickly to market changes and immediate needs is an important consideration in evaluating energy technologies. By encouraging the development and readiness of renewable energy, Washington would also be ensuring that resources are readily available when needed.

- ***Energy Efficient Light Bulbs:*** Compact fluorescent bulbs use one-fourth the energy of incandescent bulbs, last ten times as long, and are more cost-efficient. These bulbs would save the average household $35-$60 and avert 1.5 tons of global warming pollution annually.[140]
- ***Weatherize Homes:*** This would drastically reduce energy demand. A homeowner can weatherize in less than a month, saving $200-$400 and averting ten tons of global warming pollution annually.[141]
- ***Wind Energy:*** According to the American Wind Energy Association, a typical 300 MW wind farm would take a year and a half to build. A farmer would receive $20,000 in annual lease payments for ten turbines and 95% of the land would still be used for farming.[142]
- ***Geothermal Energy:*** According to the Center for Renewable Energy and Sustainable Technology, a 10 MW geothermal plant can be built in six months while larger plants can be built in two years. This short timeline is possible due to the modular design of today's modern geothermal plants.[143]
- ***Natural Gas Power Plants:*** The Energy Information Administration (EIA) of the U.S. Department of Energy estimates that it normally takes three years for a utility to build a 300 MW natural gas power plant.[144]
- ***Solar Energy***: According to the Sacramento Municipal Utility District, it would take four years to build a 300 MW photovoltaic power plant.[145] Also, contractors can convert a home to solar power in one week.[146]
- ***Coal Power Plants:*** According to the EIA, utilities could build a new coal-fired power plant in five years.[147]
- ***Nuclear Power Plants:*** According to an EIA study, it takes an average of nine years to build a nuclear power plant.[148]

Figure 13. Construction Time to Put 300 MW Online



Policy Recommendations

A comprehensive energy policy on a local, state, or national level must address four major priorities:

1) Energy conservation and efficiency.

2) Promotion of clean, renewable energy sources.

3) Ending wasteful subsidies for fuels and technologies that are neither clean nor sustainable.

4) Promotion of more local control and democratic governance over energy.

State Policy Recommendations

With energy policies that address these four areas, Washington can more than meet its projected electricity demand growth by developing clean, renewable resources and reducing overall demand through energy efficiency strategies. The benefits of such a transition include a dramatic reduction in pollution, a more reliable energy system, and a stronger, more stable economy for the state. Several policy options would lead the state toward that goal.

1) Policies Promoting Energy Conservation and Efficiency

Energy Conservation Standard

Washington should require all utilities doing business in the state to meet a percentage of future power needs with energy conservation. Opportunities for energy savings are abundant, and the utilities are well positioned to administer the development of many of those opportunities. As part of their public interest responsibilities, utilities should be required to include energy conservation as part of their energy development plans.

State Tax Incentives

Taxation has long been a proven method for encouraging or discouraging targeted business practices. Yet compared to neighboring states, Washington currently offers very few tax incentives for energy efficiency improvements. Tax incentives should be set for energy efficiency measures to encourage individuals and businesses to incorporate energy efficiency improvements and technologies.

2) Policies Promoting Clean, Renewable Energy

Washington has some renewable energy-promoting programs, such as generation disclosure, mandatory utility green power option, rebate program for solar PV systems, tax incentives for renewables, net metering, and low interest rate loans for renewables. These policies are a good start, but Washington is lacking some effective renewable energy-promoting policies that have been proven effective elsewhere:

Renewable Energy Standard

A renewable energy standard would require all retail electricity suppliers to include a percentage of renewable resources in their generation mix. Washington should enact a standard calling for all retail electricity suppliers to gradually increase the amount of electricity they obtain from renewable sources by set percentages. This could work in conjunction with an energy conservation standard.

Deny Permits to Pending Fossil Fuel Power Plant Proposals

Energy companies have built 958 MW in fossil fuel-based power plants in Washington in the past two years. In addition, the state has granted approval to fossil fuel power plants with a combined capacity of 2,828

Table 17. Proposed New Generating Projects (MW)

Resource	Permits Pending	Planned	In Study	Total	Pct
Hydro	21	36	31	87	2%
Coal			349	349	7%
Natural gas	2,597	11	1,254	3,862	73%
Nuclear			150	150	3%
Biomass		6	24	30	0.6%
Wind	300	50	480	830	16%
Total	2,918	102	2,288	5,308	

MW that are now being developed. Nearly all of this capacity is fueled by natural gas.

This amount of natural gas power plant development has more than achieved its purpose of boosting energy reliability in Washington. At this point, the state risks decreased reliability due to over-dependence on volatile fossil fuels.

Most power projects currently proposed also are fueled by natural gas. The state should reverse this trend and not grant approval to any more natural gas power plants. The wind projects currently being studied are enough for the next stage of energy capacity development in Washington.

3) Policies Ending Wasteful Subsidies for Fuels and Technologies that Are Neither Clean Nor Sustainable

Washington should not subsidize coal and gas production, both of which cost us dearly in environmental and public health consequences and which, in the case of gas, may soon be too expensive for widespread use even with subsidies.

4) Policies Promoting More Local Control and Democratic Governance Over Energy

In a democratic society, public preferences must be represented during the process of energy policy development. To ensure the voices of Washingtonians are heard, the state should:

- Include public participation in energy policy decisions.
- Guarantee that communities are notified about policy decisions that could affect their future.
- Support efforts for the public to buy electricity through their local governments.
- Support Citizen Utility Boards to give the public greater representation in the regulatory process.

Federal Policy Recommendations

Just as on the state level, a clean energy policy on the national level must include policies that address the same major areas. The two most important policies needed on a federal level to achieve the goal of a clean and sustainable energy future for America are a renewable energy standard and a utility energy efficiency and renewable energy development program (Public Benefits Fund).

Renewable Energy Standard

A renewable energy standard, as described above in the state policy recommendation section, should also be implemented on the federal level. The potential power output of wind, solar, and geothermal resources in the U.S. is many times greater than our total electricity consumption. A national renewable energy standard requiring all retail electricity suppliers to include 20% of renewable resources in their generation mix by 2020 would benefit the country's economy and environment.

Utility Energy Efficiency and Renewable Energy Development Program

As described under the state policy recommendation section, the revenues received from the uniform utility charge are set aside for a wide range of energy efficiency and renewable energy programs. On the federal level, however, revenues collected would be distributed by matching funds collected by individual state utility energy efficiency and renewable energy development programs.

In addition to these priorities, other federal measures should be continued or created to ensure a viable national energy policy.

Incentives for Energy-Efficient Products, Buildings, and Power Systems

Efficient use of energy is critical to a sustainable energy system. Multiple incentives targeted at different consumers and uses should:

- Provide consumers with energy efficiency incentives such as rebates for energy-efficient home appliances and construction.
- Provide incentives to industrial users of power to become more energy-efficient.
- Require real-time pricing structures for large industrial power users.
- Provide incentives to power plants that adopt combined heat and power systems to use waste heat and increase efficiency.

Efficiency Standards and Building Codes

Efficiency standards and building construction codes need to be updated in order to take advantage of technology advancements. Aggressive but achievable standards should be established for the construction industry and for appliances, transformers, industrial motors, air conditioners, lighting, and other products that consume significant amounts of electricity.

Interconnection Standards and Net Metering Regulations

Renewable energy sources have a new capability that no traditional energy source to date ever had. Not only can they operate like traditional power plants, dispatching their power through the infrastructure of power lines, but they can also generate electricity onsite.

Onsite electricity generation saves energy and money in several ways: 1) it can match the power needs of the onsite home, building, or district accurately, 2) it eliminates the losses of energy that occur in long-distance transmission, and 3) excess power generated at onsite locations can be sent to the power grid for distribution elsewhere, reducing the number of new central power plants needed. However, current interconnection penalties and barriers limit our ability to effectively harness electricity generated from these sources. Setting uniform and consumer-friendly interconnection standards would address the inconsistencies that now exist. Net metering standards, as described in the state policy section above, should be set without caps to encourage onsite clean electricity generation.

Expansion of Federal Energy Efficiency and Renewable Energy Research and Development Funding

Energy efficiency offers the fastest, cleanest, and cheapest solution to the nation's power needs and renewable energy technologies are essential for the U.S. to develop and maintain a sustainable energy system. Congress should increase funding for research and development of these technologies.

Carbon Tax

Currently, the costs of environmental and public health damage caused by power plant emissions from fossil fuel combustion are not accounted for in the electricity generation industry. A carbon tax would assign responsibility for these costs to the appropriate sources, instead of passing them on to other sectors of society. A carbon tax should be adopted for the electricity industry.

Retirement Plan for Grandfathered Coal Plants

The Clean Air Act of 1970, as amended in 1977 and 1990, exempts coal-burning power plants from new source standards, allowing them to emit four to ten times the amount of pollution that new plants may emit under the Clean Air Act. These grandfathered coal power plants should be required to meet the same air pollution standards as new power plants. Otherwise these plants should be retired and replaced by renewable energy technologies, low-carbon technologies, or energy efficiency.

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