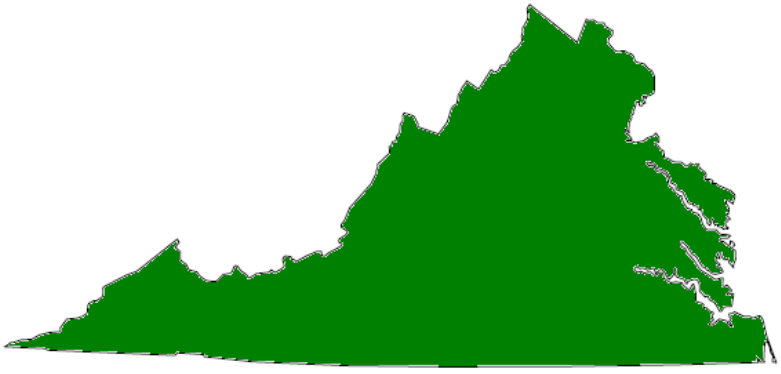


Moving to a Clean Energy Economy: Opportunities for Virginia

United States Department of Energy
September 24, 2009

OVERVIEW: VIRGINIA HAS MAJOR ECONOMIC OPPORTUNITIES IN A CLEAN ENERGY ECONOMY

The threat of climate change caused by carbon pollution poses a major challenge to the United States and the world, but it also represents an unprecedented opportunity to create new industries and build a strong, thriving clean energy economy. The clean energy sector is one of the fastest growing industries in the world -- the demand for solar panels and wind turbines, for example, has been growing exponentially over the past few years.

Among industrialized nations, the race is on for the clean energy jobs of the future. China is investing $12.6 million per hour in clean energy. Denmark has made significant investments in wind capacity and is now home to the world's leading wind turbine manufacturer. With our unrivalled natural, intellectual and scientific resources, the United States can and should emerge as the world's leader in clean energy, but success depends on making the right choices today.

President Obama has called for comprehensive legislation to create a system of clean energy incentives that will catalyze America's industrial and scientific base. It will spark public and private investments in clean energy that will create millions of new jobs.

Moving to clean energy holds major economic opportunity for Virginia today and tomorrow:

- **Virginia is a leader in science and innovation:** the Old Dominion is home to a thriving high-tech sector and its university system, including flagship institutions like the University of Virginia and Virginia Tech, hosts world leaders in science and engineering that are hard at work developing the clean energy technologies of the future. It is also home to the Department of Energy's Thomas Jefferson Lab, where staff have been awarded more than 80 patents.

- **Virginia families could reap huge benefits from energy efficiency:** The state of California has demonstrated the potential for significant consumer savings through energy efficiency. Even though California's economy has grown significantly since the 1970s, per capita energy use has remained nearly flat. If Virginia achieved the same per capita bills as California, consumers would be saving 36% on their energy bills. This highlights the tremendous opportunities for Virginians to save money through energy efficiency. (See Appendix II) To encourage expanded energy efficiency actions, Virginia has given authority for natural gas utilities to decouple its revenues from sales if they include energy efficiency as part of the programs. This year, Virginia also enacted legislation to encourage investments in efficiency by allowing electric utilities to earn a rate of return on electric efficiency programs equal to return on generation investments.

- **Businesses and industry in Virginia can also reap major energy efficiency savings:** The Department of Energy has worked with businesses in Virginia to identify steps that they can take to lower their energy bills. Assistance is provided in the form of no-cost energy assessments conducted by Industrial Assessment Centers (IACs), sponsored by DOE's Industrial Technologies Program. So far more than 1,700 ways have been identified for small- and medium-sized industrial plants in Virginia to save money and improve productivity through efficiency, with an average payback of only 1.2 years. (See: http://www.iac.rutgers.edu/database/state.php)

- **Virginia is receiving major new funding from the American Recovery and Reinvestment Act:** Virginia's families and businesses are benefitting from the investments in the Recovery Act to improve energy efficiency and support cutting-edge companies that are at the forefront of the clean energy economy. See the table below:

Recovery Act Announcements – Virginia	
Weatherization	$94, 134, 276
State Energy Program	$70,001,000
Energy Efficiency & Conservation Block Grant Program	$60,719, 900
Advanced Batteries	$720,000
Appliance Rebates	$7,454,197
State and Local	$912,836
Clean Cities Program	$8,605,100

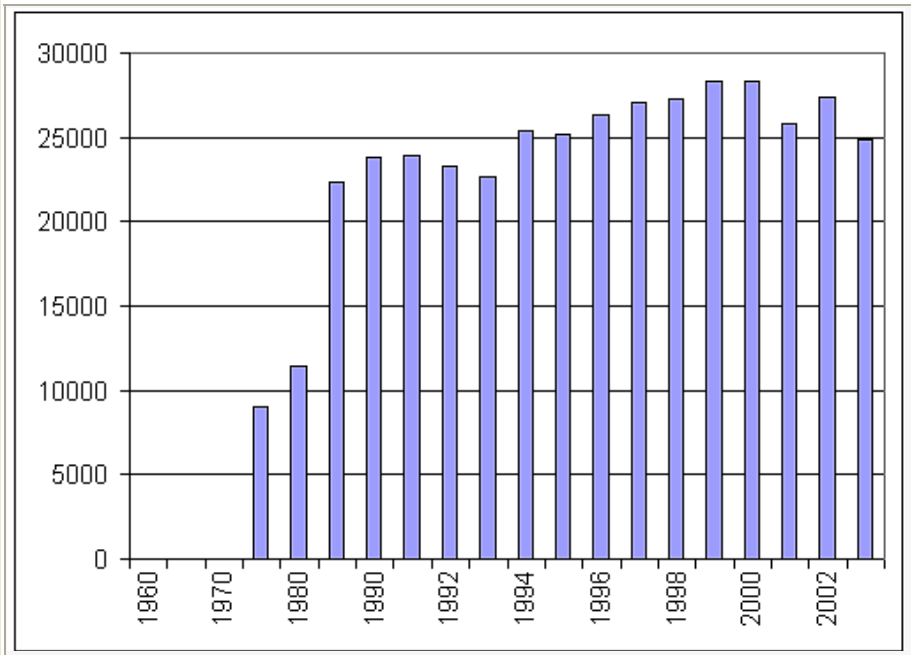
Note: *Figures above reflect funding amounts for announced award selections. Some awards are still under negotiation. Grantees are required to meet certain Recovery Act milestones in spending funds.*

RECOVERY.GOV

A complete listing of funding announcements for Virginia is available online at: http://www.energy.gov/7953.htm

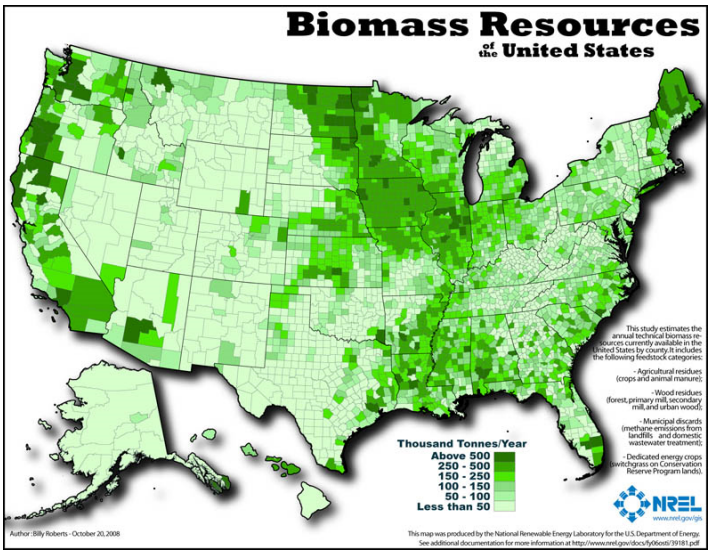
- **Virginia is a national leader in nuclear power, the largest source of carbon free baseload power.** More than a third of Virginia's electricity generation comes from nuclear power. Comprehensive energy legislation with a cap on carbon pollution would make nuclear energy even more attractive as a carbon-free source of baseload power. Virginia could continue to meet the need for clean energy through further development of nuclear power.

Nuclear Generation in Virginia, 1960 through 2003
Million Kilowatt Hours



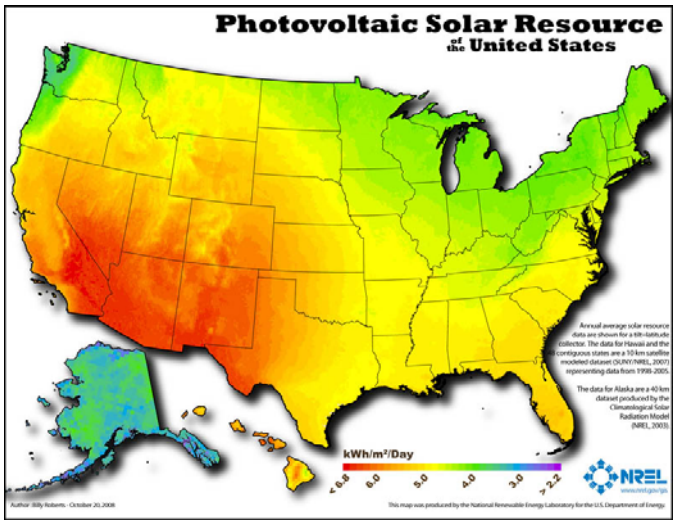
Sources: Energy Information Administration, State Energy Data Report 1999, and Electric Power Annual, Volume 1, 2001, and EIA Survey Form 906.

- **Virginia has significant biomass resources that could be converted into power:** According to the Department of Energy's National Renewable Energy Laboratory, Virginia has 6.5 million metric tonnes of biomass resources available, from agricultural wastes to wood scraps and sawdust. (See table 10, "Total Biomass Resources Available (Thousand metric tonnes/year) in the United States by State," http://www.nrel.gov/docs/fy06osti/39181.pdf) Virginia is home to both free-standing biomass generation plants and plants co-firing biomass with coal.



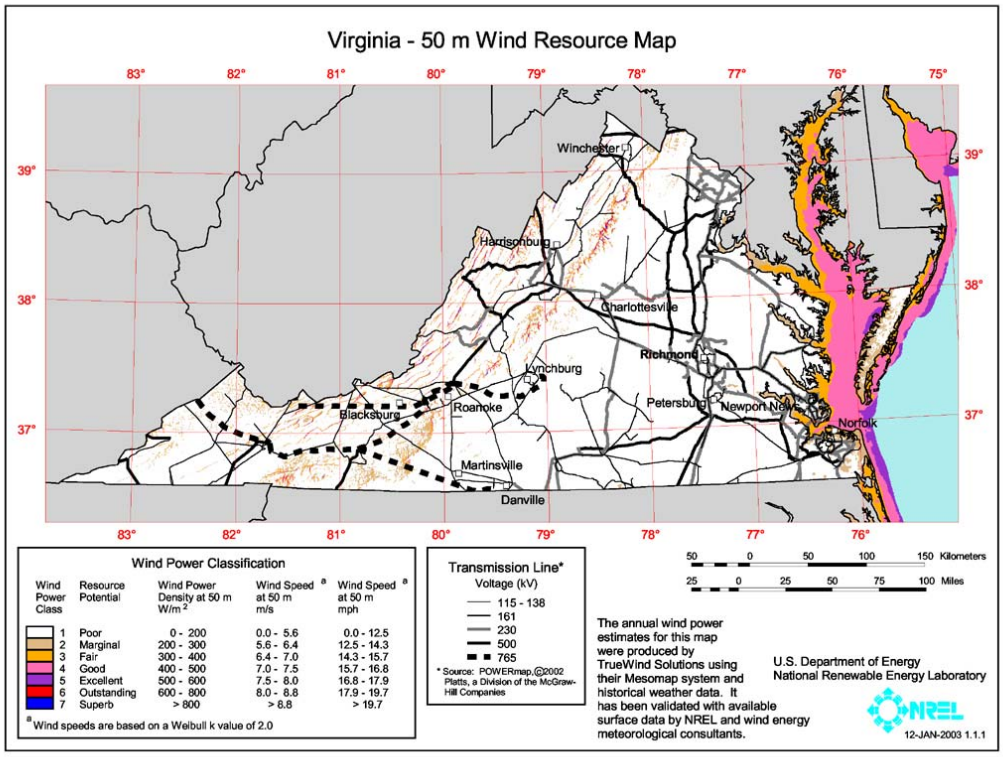
- **Virginia is creating new jobs in the clean fuel sector**: The Virginia Department of Mines, Minerals and Energy's AutoGas Corridor Program is receiving $8,605,100 in Recovery Act grant money from the Department of Energy to fund 1,064 vehicles and 17 fueling stations, creating the nation's first AutoGas Corridor through the Southeast. A network of conversion centers with trained technicians will convert more than 1,000 active fleet vehicles to propane AutoGas Hybrids. This will result in the displacement of 15,772,100 of gallons of gasoline over the four–year project period and the establishment of a solid base of alternative fuel vehicles across the Southeast. Virginia's first ethanol plant, producing fuel from winter cover crops of barley, will provide new green jobs to both Hopewell and to farmers supplying the plant. Virginia is home to five biodiesel manufacturers using input sources such as waste grease and oil from Virginia canola, and a sixth beginning production of green diesel from cellulosic fuels.

- **Virginia also has significant solar energy resources:** A map produced by the National Renewable Energy Laboratory shows that while the Southwestern United States has the greatest photovoltaic solar resources, Virginia also has significant potential:



- **Virginia has major wind energy potential, particularly offshore, and could see 10,000 to 20,000 new manufacturing jobs in the wind industry:** A Department of Energy validated survey of wind energy potential based on wind speeds at 50 meters in elevation shows that Virginia has major wind resources that can be tapped for renewable energy production (See the map below). In addition to benefitting from the deployment of additional wind power in the state, Virginia is poised to emerge as a major manufacturer of wind turbines and components. A 2008 report by the Department of Energy and the National Renewable Energy Laboratory found that achieving 20 percent of America's electricity from wind power would mean 10,000 to 20,000 new manufacturing jobs in Virginia. (See Appendix I). Virginia already is home to wind power manufacturing jobs such at General Electric's Salem Virginia plant.

  Construction recently started on Virginia's first on-shore wind farm. Virginia and the Minerals Management Service are forming a Federal-State-Local task force to manage the development of offshore wind resources.



NOTE: The Department of Energy's Wind Program and the National Renewable Energy Laboratory (NREL) published this new wind resource map for the state of Virginia. This resource map shows wind speed estimates at 50 meters above the ground and depicts the resource that could be used for utility-scale wind development. Future plans are to provide wind speed estimates at 30 meters, which are useful for identifying small wind turbine opportunities.

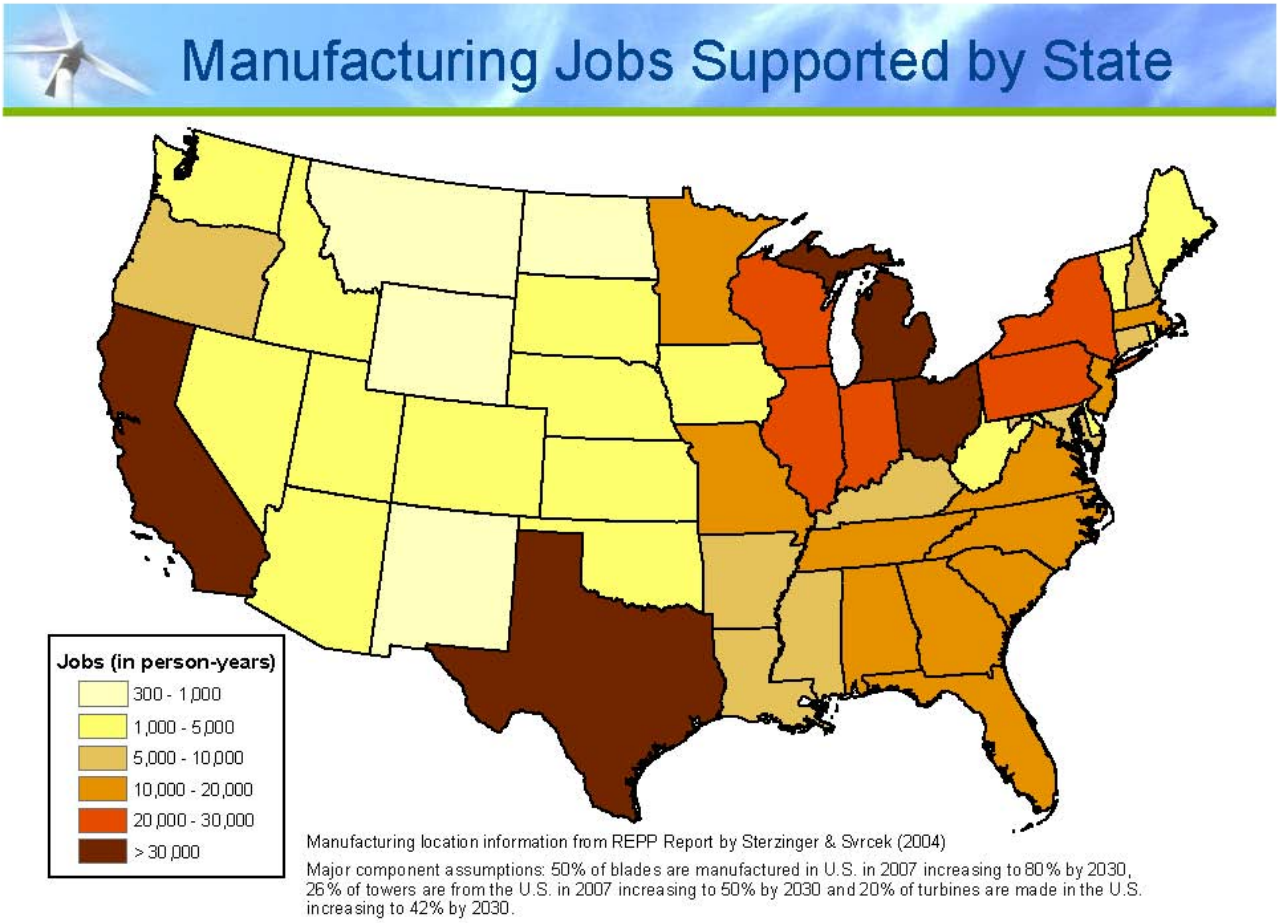
This map indicates that Virginia has wind resources consistent with utility-scale production. Several areas of the state are estimated to have good-to-excellent wind resource. These include the Atlantic coast along the Delmarva Peninsula and the Virginia Beach area, the ridge crests in the north-central part of the state, and ridge crests near the borders of West Virginia and North Carolina.

APPENDIX I: VIRGINIA AND THE 20 PERCENT WIND SCENARIO

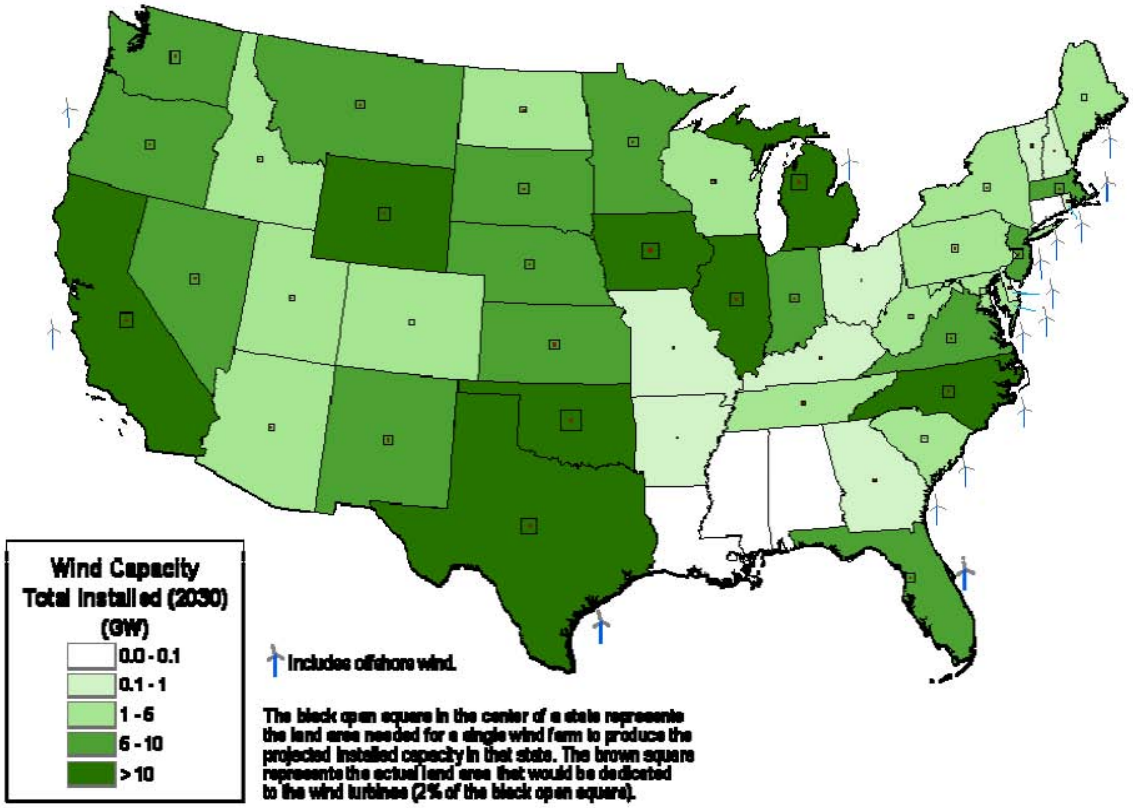
The Department of Energy and the National Renewable Energy Laboratory issued a report in 2008 outlining a scenario where the United States could conceivably generate 20 percent of our electricity from wind power by 2030. (Read the full report at http://www.20percentwind.org/)

Comprehensive energy legislation under consideration in Congress would help to encourage the further development and deployment of wind power in the United States and achieve President Obama's goal of doubling renewable energy capacity in three years.

Under the 20 percent wind scenario, Virginia would see a substantial expansion of wind power and an additional 10,000 to 20,000 manufacturing jobs in the industry.



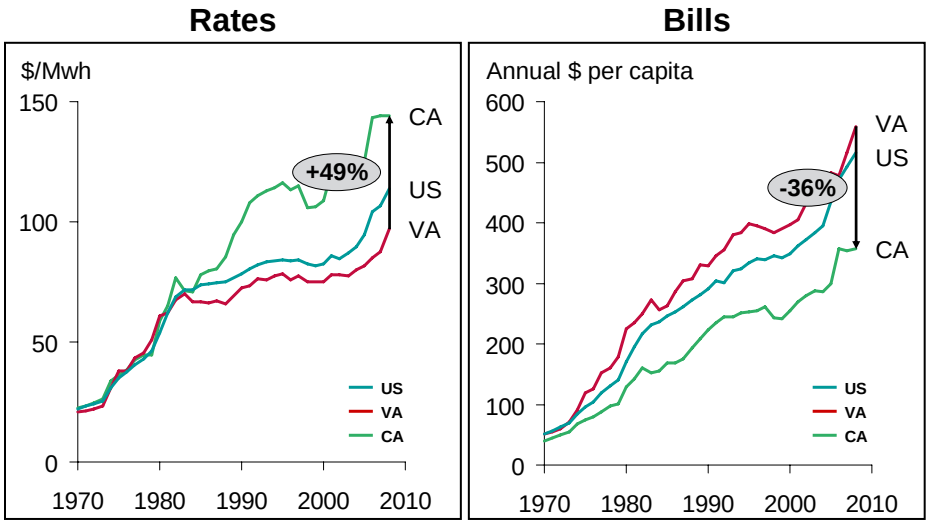
46 States Would Have Substantial Wind Development by 2030



APPENDIX II:
ENERGY EFFICIENCY CAN SAVE VIRGINIA FAMILIES MONEY

Energy efficiency saves money

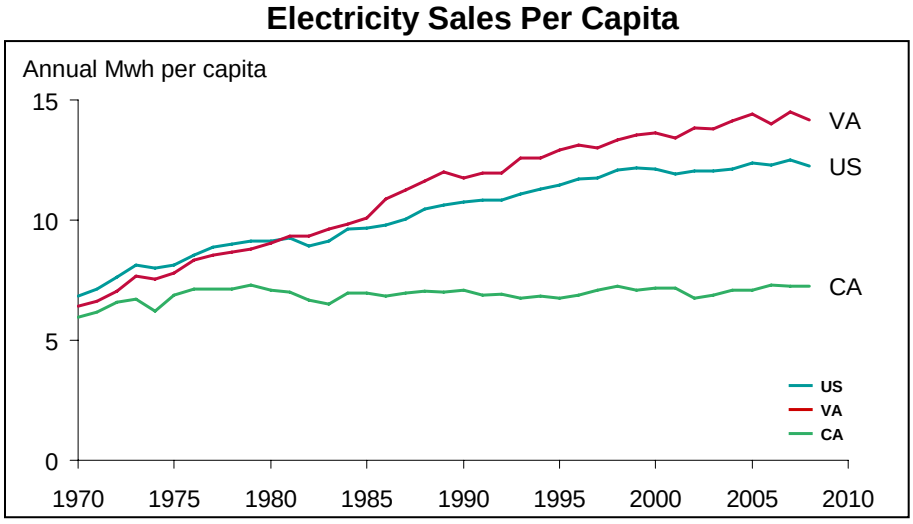
Despite its high electricity rates, California has maintained **lower than average electric bills** by implementing strong energy efficiency measures.



Source: Energy Information Administration, US Department of Energy

Energy efficiency saves money

Since 1975 California's per-capita electricity consumption has remained flat, while Virginia's has grown even faster than the US average.



Source: Energy Information Administration, US Department of Energy

APPENDIX III:
COSTS OF INACTION

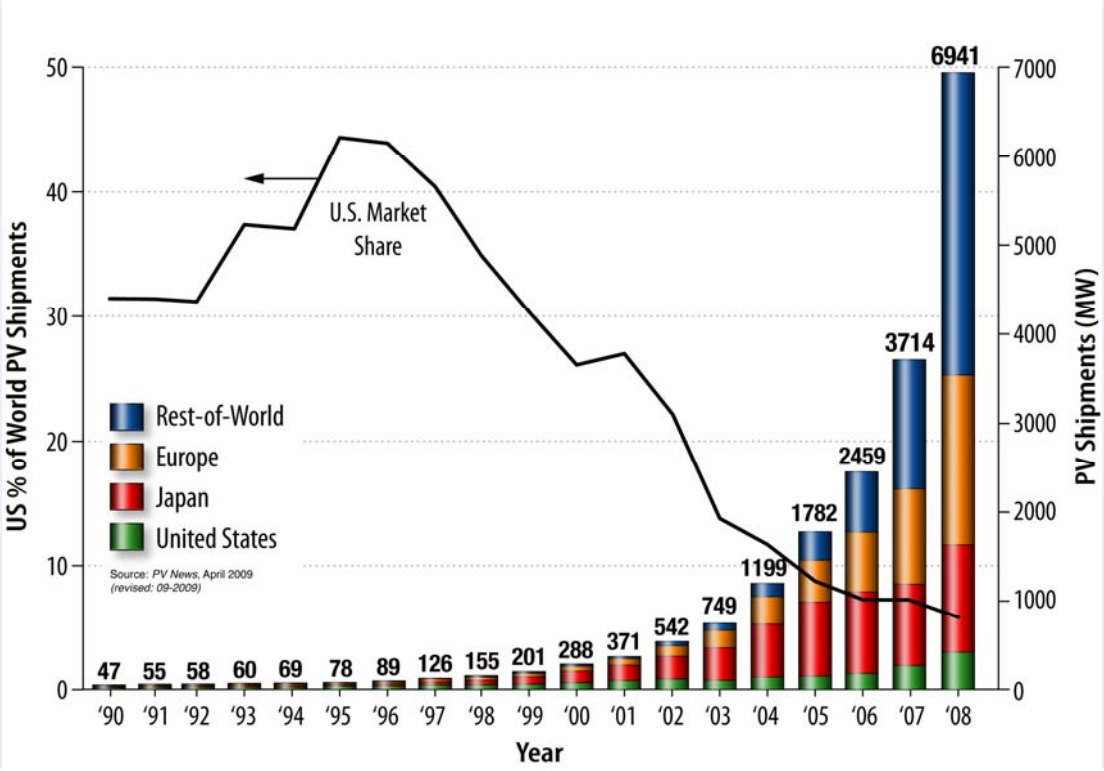
This is a crucial moment for our economy. From China to Germany to Australia to Denmark, countries around the world are making major investments in clean energy industries and adopting policies that create powerful incentives for clean energy industries to take hold.

In the international race for clean energy industries, the countries that take bold action to cut carbon emissions will have the advantage. The countries that don't take action will be at a disadvantage.

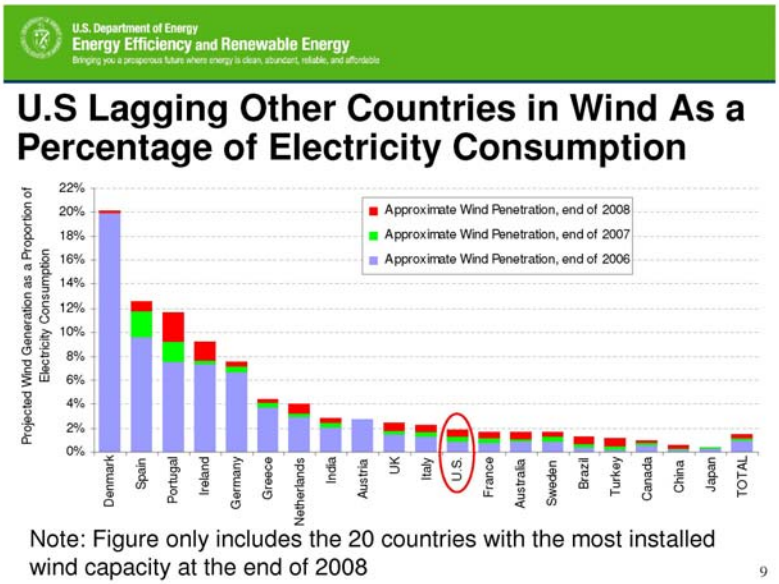
For example:

1) **If the U.S. does not act, we will forfeit the opportunity to lead the new industrial revolution:** In fact, 99 percent of the batteries that power America's hybrid cars are made in Japan. China is investing $12.6 million per hour in clean energy.

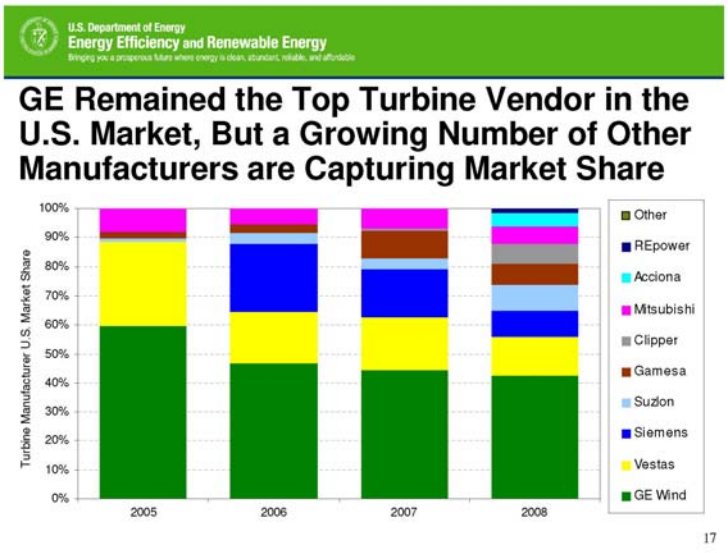
2) **The United States pioneered solar cell technology. In recent years, the global market for photovoltaics has been growing by 40 percent a year -- but we have now fallen behind, with about 7 percent market share:**

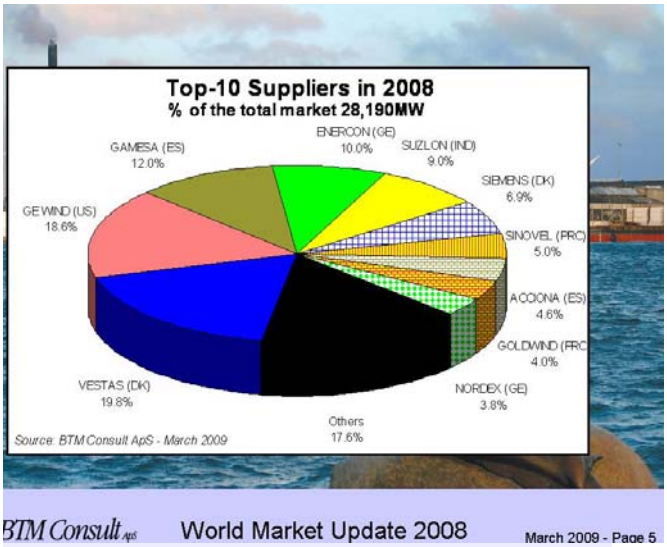


3) **As the market for wind power facilities expands dramatically, the U.S. is at risk of losing our competitive position and watching as those jobs increasingly are created overseas.** The U.S. ranks 12th in the world in wind power (as a percentage of total electricity). The world's largest turbine manufacturing company is headquartered in Denmark:



U.S. Market **Global Market**





4) **The stakes are huge:** As the world moves to limit carbon pollution, more than 500,000 wind turbines will be needed. At roughly $4 million each, this represents a market of more than $2 trillion (2007 dollars). Similarly, the global market for solar PV panels amounts to nearly 3 million panels worth $1.5 trillion. (Source: IEA's 2008 World Energy Outlook 440 PPM Case, using typical facility sizes and costs from EIA.)

   Again, this is just for solar and wind power. Many more jobs are at stake in energy efficiency, advanced batteries, nuclear power, carbon capture and sequestration, and a wide range of other clean energy technologies.

5) **Unless we act to mitigate climate change, Virginia will face serious economic consequences:** The U.S. Global Change Research Program issued a June 2009 report outlining the projected consequences of climate change, including major negative impacts on the Southeast.

   According to the report – which drew extensively from a number of rigorously reviewed studies including the International Panel on Climate Change – key issues facing the Southeastern United States as a result of climate change include the following:

   - **Projected increases in air and water temperatures will cause heat-related stresses for people, plants, and animals.**
     Effects of increased heat include more heat-related illness; declines in forest growth and agricultural crop production due to the combined effects of heat stress and declining soil moisture; declines in cattle production; increased buckling of pavement and railways; and reduced oxygen levels in streams and lakes, leading to fish kills and declines in aquatic species diversity.

   - **Decreased water availability is very likely to affect the region's economy as well as its natural systems.**
     Increasing temperatures and longer periods between rainfall events coupled with increased demand for water will result in decreased water availability. The 2007 water shortage in the Atlanta area created serious conflicts between three states, the U.S. Army Corps of Engineers (which operates the dam at Lake Lanier), and the U.S. Fish and Wildlife Service, which is charged with protecting endangered species. Such competition for limited water supplies is expected to continue.

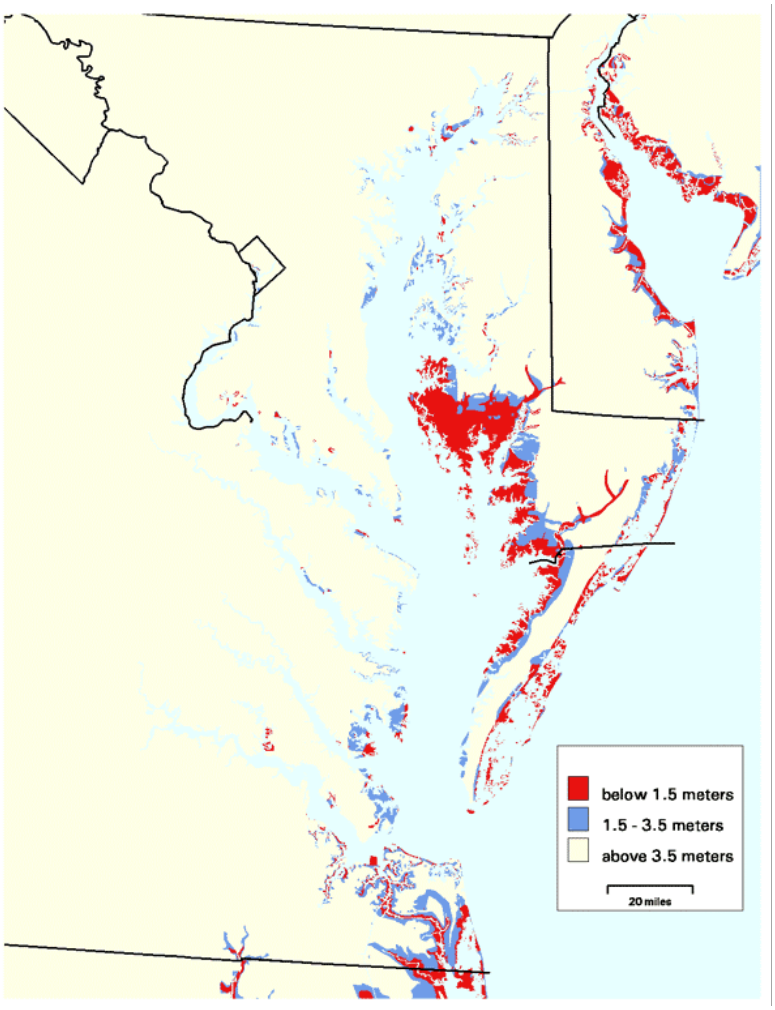
   - **Sea-level rise and the likely increase in hurricane intensity and associated storm surge will be among the most serious consequences of climate change.**
     Low-lying areas, including some communities, will be inundated more frequently – some permanently – by the advancing sea. Current buildings and infrastructure were not designed to withstand the intensity of the projected storm surge, which would cause catastrophic damage. If sea-level rise increases at an accelerated rate (dependent upon ice sheet response to warming) a large portion of the Southeast coastal zone could be threatened.

   - **Ecological thresholds are likely to be crossed throughout the region, causing major disruptions to ecosystems and to the benefits they provide to people.**
     Ecosystems provide numerous important services that have high economic and cultural value in the Southeast. Climate change may result in abrupt changes to these ecosystems, such as hurricane-induced sudden loss of landforms that serve as storm surge barriers and homes for coastal communities.

- **Quality of life will be affected by increasing heat stress, water scarcity, severe weather events, and reduced availability of insurance for at-risk properties.**
  The Southeast "sunbelt" has attracted people, industry, and investment. The population of Florida has increased by 100 percent during the past three decades and growth rates in most other southeastern states were between 45 and 75 percent. The challenges associated with climate change will affect the quality of life for these residents and affect future population growth.

Source: http://www.globalchange.gov/images/cir/pdf/southeast.pdf

Land Vulnerable to Sea Level Rise – Chesapeake and Delaware Bays



Source: U.S. EPA. Clarification of the map and the methodology are available online at: http://www.epa.gov/climatechange/effects/downloads/maps.pdf

APPENDIX IV:
VIRGINIA STATE ENERGY PROFILE
U.S. ENERGY INFORMATION ADMINISTRATION

Virginia Quick Facts

- Virginia accounts for more than 5 percent of U.S. coal production east of the Mississippi river.
- Virginia's only petroleum refinery, in Yorktown, processes foreign crude oil delivered by barge via Chesapeake Bay.
- Virginia has two nuclear power plants, which typically provide about one-third of the electricity generated within the state.
- Two of Virginia's coalbed methane fields are among the top 100 natural gas fields in the United States.

Overview

Resources and Consumption

Virginia has minor natural gas and coal reserves, nearly all of which are found in the Central Appalachian Basin in the southwestern part of the State. In addition, resource assessments show that substantial oil and gas reserves could underlie the land beneath Virginia's offshore waters, which are part of the federally administered Mid-Atlantic Outer Continental Shelf (OCS). However, congressional and Presidential moratoria have prohibited energy development in that offshore area since 1990. Virginia's offshore Atlantic waters also have high wind power potential, as do the waters of the Chesapeake Bay. Virginia's energy demand is distributed among the sectors of the economy, with transportation leading the others by a small margin.

Petroleum

Virginia's only petroleum refinery, in Yorktown, processes foreign crude oil delivered by barge via the Chesapeake Bay. The Yorktown refinery primarily supplies regional markets. Petroleum products are also delivered to Virginia at the Port of Norfolk and via the Colonial and Plantation pipelines from the Gulf Coast. Virginia's total petroleum

consumption is high. Reformulated motor gasoline blended with ethanol is required in the northern Virginia suburbs of Washington, D.C., and in the metropolitan areas of Richmond and Norfolk-Hampton Roads.

Natural Gas

Virginia's natural gas production is minor but enough to supply a substantial share of State demand. Virginia produces both conventional natural gas and coalbed methane in the Central Appalachian Basin, which covers the State's western panhandle. Most of Virginia's natural gas production comes from coalbed methane fields, two of which are among the 100 largest natural gas fields in the United States. As with most States on the East Coast, most of Virginia's natural gas supply is delivered from the Gulf Coast region via several major interstate natural gas pipelines. Virginia's natural gas consumption is distributed relatively evenly among the residential, commercial, industrial, and electricity generation sectors. About one-third of households in Virginia use natural gas as their primary energy source for home heating.

Coal, Electricity, and Renewables

Virginia accounts for more than 5 percent of U.S. coal production east of the Mississippi River. Production takes place at surface and underground mines in the Central Appalachian Basin. Large volumes of coal move through Virginia by rail. Virginia coal is shipped to about one-half of the continental United States. The primary recipients are Georgia and Tennessee. Virginia receives large coal shipments from Kentucky and West Virginia. Most coal consumed in Virginia is used for electricity generation.

Coal-fired power plants typically account for about one-half of the State's electricity generation. Two nuclear power plants account for about one-third of the State's electricity generation, and natural gas- and petroleum-fired power plants account for much of the rest. Over two-fifths of households in Virginia use electricity as their primary energy source for home heating.

Data

Economy

Population and Employment	Virginia	U.S. Rank	Period
Population	7.8 million	12	2008
Civilian Labor Force	4.1 million	12	Jul-09
Per Capita Personal Income	$41,347	10	2007
Industry	**Virginia**	**U.S. Rank**	**Period**
Gross Domestic Product by State	$397.0 billion	11	2008
Land in Farms	8.1 million acres	34	2007
Market Value of Agricultural Products Sold	$2.9 billion	30	2007

Prices

Petroleum	Virginia	U.S. Avg.	Period
Domestic Crude Oil First Purchase	—	$63.08/barrel	Jun-09

No. 2 Heating Oil, Residential	$2.04/gal	$2.29/gal	Jun-09
Regular Motor Gasoline Sold Through Retail Outlets (Excluding Taxes)	$2.10/gal	$2.15/gal	Jun-09
State Tax Rate on Motor Gasoline (other taxes may apply)	$0.18/gal	$0.22/gal	Aug-08
No. 2 Diesel Fuel Sold Through Retail Outlets (Excluding Taxes)	$2.03/gal	$2.04/gal	Jun-09
State Tax Rate on On-Highway Diesel (other taxes may apply)	$0.16/gal	$0.22/gal	Aug-08

Natural Gas	**Virginia**	**U.S. Avg.**	**Period**
Wellhead	—	$6.37/thousand cu ft	2007
City Gate	NA	$5.63/thousand cu ft	Jun-09
Residential	$18.39/thousand cu ft	$13.81/thousand cu ft	Jun-09

Coal	**Virginia**	**U.S. Avg.**	**Period**
Average Open Market Sales Price	$52.89/short ton	$26.20/short ton	2007
Delivered to Electric Power Sector	$ 2.92/million Btu	$ 2.22 /million Btu	Jun-09

Electricity	**Virginia**	**U.S. Avg.**	**Period**
Residential	11.19 cents/kWh	11.86 cents/kWh	May-09
Commercial	8.37 cents/kWh	10.12 cents/kWh	May-09
Industrial	7.00 cents/kWh	6.89 cents/kWh	May-09

Reserves & Supply

Reserves	**Virginia**	**Share of U.S.**	**Period**
Crude Oil	—	—	2007
Dry Natural Gas	2,529 billion cu ft	1.1%	2007
Natural Gas Liquids	—	—	2007
Recoverable Coal at Producing Mines	256 million short tons	1.4 %	2007

Rotary Rigs & Wells	**Virginia**	**Share of U.S.**	**Period**
Rotary Rigs in Operation	5	0.3%	2008
Crude Oil Producing Wells	3	0.0%	2008

Natural Gas Producing Wells	5,735	1.3%	2007
Production	**Virginia**	**Share of U.S.**	**Period**
Total Energy	1,297 trillion Btu	1.8%	2006
Crude Oil	0 thousand barrels	0.0%	Apr-09
Natural Gas - Marketed	112,057 million cu ft	0.6%	2007
Coal	24,582 thousand short tons	NA	2008
Capacity	**Virginia**	**Share of U.S.**	**Period**
Crude Oil Refinery Capacity (as of Jan. 1)	64,500 barrels/calendar day	0.4%	2009
Electric Power Industry Net Summer Capability	22,992 MW	2.3%	2007
Net Electricity Generation	**Virginia**	**Share of U.S.**	**Period**
Total Net Electricity Generation	6,067 thousand MWh	1.7%	Jun-09
Petroleum-Fired	30 thousand MWh	1.4%	Jun-09
Natural Gas-Fired	999 thousand MWh	1.2%	Jun-09
Coal-Fired	2,273 thousand MWh	1.5%	Jun-09
Nuclear	2,469 thousand MWh	3.6%	Jun-09
Hydroelectric	163 thousand MWh	0.6%	Jun-09
Other Renewables	205 thousand MWh	1.9%	Jun-09
Stocks	**Virginia**	**Share of U.S.**	**Period**
Motor Gasoline (Excludes Pipelines)	843 thousand barrels	1.5%	Jun-09
Distillate Fuel Oil (Excludes Pipelines)	3,340 thousand barrels	2.7%	Jun-09
Natural Gas in Underground Storage	7,759 million cu ft	0.1%	Jun-09
Petroleum Stocks at Electric Power Producers	2,618 thousand barrels	6.0 %	Jun-09
Coal Stocks at Electric Power Producers	2,592 thousand tons	1.3 %	Jun-09

Production Facilities	Virginia
Major Coal Mines	None
Petroleum Refineries	Western Refining Yorktown Inc (Yorktown)
Major Non-Nuclear Electricity Generating Plants	Bath County (Virginia Electric & Power Co) • Possum Point (Virginia Electric & Power Co) • Chesterfield (Virginia Electric & Power Co) • Yorktown (Virginia Electric & Power Co) • Tenaska Virginia Generating Station (Tenaska Virginia Partners LP)
Nuclear Power Plants	North Anna (Virginia Electric & Power Co) • Surry (Virginia Electric & Power Co)

Distribution & Marketing

Distribution Centers	Virginia
Oil Seaports/Oil Import Sites	Newport News • Norfolk
Natural Gas Market Centers	None

Major Pipelines	Virginia
Crude Oil	None
Petroleum Product	Colonial • Plantation.
Liquefied Petroleum Gases	None
Interstate Natural Gas Pipelines	Columbia Gas Transmission Corp. • Dominion Transmission Co. • East Tennessee Natural Gas Co. • Transcontinental Gas Pipeline Co.

Fueling Stations	Virginia	Share of U.S.	Period
Motor Gasoline	4,140	2.6%	2008
Liquefied Petroleum Gases	38	1.5%	2009
Compressed Natural Gas	11	1.4%	2009
Ethanol	8	0.4%	2009
Other Alternative Fuels	26	2.1%	2009

Consumption

per Capita	Virginia	U.S. Rank	Period
Total Energy	339 million Btu	26	2007

by Source	Virginia	Share of U.S.	Period

Total Energy	2,611 trillion Btu	2.6%	2007
Total Petroleum	186.8 million barrels	2.5%	2007
Motor Gasoline	99.0 million barrels	2.9%	2007
Distillate Fuel	44.6 million barrels	2.9%	2007
Liquefied Petroleum Gases	5.2 million barrels	0.7%	2007
Jet Fuel	19.0 million barrels	3.2%	2007
Natural Gas	319,935 million cu ft	1.4%	2008
Coal	W	W	2007

by End-Use Sector	Virginia	Share of U.S.	Period
Residential	628,417 billion Btu	2.9%	2007
Commercial	600,540 billion Btu	3.3%	2007
Industrial	567,402 billion Btu	1.7%	2007
Transportation	814,549 billion Btu	2.8%	2007

for Electricity Generation	Virginia	Share of U.S.	Period
Petroleum	51 thousand barrels	1.5%	Jun-09
Natural Gas	8,004 million cu ft	1.2%	Jun-09
Coal	936 thousand short tons	1.2%	Jun-09

for Home Heating (share of households)	Virginia	U.S. Avg.	Period
Natural Gas	34%	51.2%	2000
Fuel Oil	13%	9.0%	2000
Electricity	44%	30.3%	2000
Liquefied Petroleum Gases	5%	6.5%	2000
Other/None	4%	1.8%	2000

Environment

Special Programs	Virginia
Clean Cities Coalitions	Virginia Clean Cities

Alternative Fuels	Virginia	Share of U.S.	Period
Alternative-Fueled Vehicles in Use	18,308	2.6%	2007
Ethanol Plants	0	0.0%	2008
Ethanol Plant Capacity	0 million gal/year	0.0%	2008

Ethanol Consumption	5,415 thousand barrels	3.3%	2007
Electric Power Industry Emissions	**Virginia**	**Share of U.S.**	**Period**
Carbon Dioxide	46,721,552 metric tons	1.9%	2007
Sulfur Dioxide	197,290 metric tons	2.2%	2007
Nitrogen Oxide	63,854 metric tons	1.7%	2007

— = No data reported. * = Number less than 0.5 rounded to zero. NA = Not available. NM = Not meaningful due to large relative standard error or excessive percentage change. W = Withheld to avoid disclosure of individual company data.