

THOMAS JEFFERSON INSTITUTE FOR PUBLIC POLICY



October 2016

**EVALUATING
THE COSTS
AND BENEFITS OF
RENEWABLE ENERGY
PORTFOLIO STANDARDS
FOR VIRGINIA**

Timothy J. Considine, Ph.D.*
Principal Investigator
Natural Resource Economics, Inc.

Dr. Timothy J. Considine is a Distinguished Professor of Energy Economics with the School of Energy Resources and the Department of Economics and Finance at the University of Wyoming. This report was prepared under a consulting agreement between Natural Resource Economics, Inc. and the Interstate Policy Alliance. The opinions, findings, and conclusions expressed in the report are those of the author and are not necessarily those of the University of Wyoming or the Interstate Policy Alliance.

Thomas Jefferson Institute for Public Policy

The Thomas Jefferson Institute for Public Policy is a non-partisan research and education organization devoted to improving the lives of the people of Virginia. The Institute was organized in Virginia in 1996 and, at that time, was the only state and local government focused public policy foundation based on a philosophy of limited government, free enterprise and individual responsibility in the state. It is a “solutions tank” seeking better ways to accomplish the policies and programs currently being undertaken by state and local government – always based on the Institute’s underlying philosophy.

The work of the Institute is geared toward educating our political, business and community leadership to the issues facing our society here in Virginia. The Institute offers suggested solutions to the problems facing our commonwealth in a non-partisan manner.

The Thomas Jefferson Institute for Public Policy is a fully approved foundation by the Internal Revenue Service. It is designated a 501 (c) 3 organization and contributions are tax-deductible under the law. Individuals, corporations, foundations and associations are invited to contribute to the Thomas Jefferson Institute and participate in our programs.

For more information on the programs and publications of the Thomas Jefferson Institute for Public Policy, please contact:

**Thomas Jefferson Institute for Public Policy
9035 Golden Sunset Lane
Springfield, Virginia 22153
703/440-9447**

This paper, “Evaluating the Costs and Benefits of Renewable Energy Portfolio Standards for Virginia” does not necessarily reflect the views of the Thomas Jefferson Institute for Public Policy nor its Board of Directors. Nothing in this study should be construed as an attempt to hinder or aid any legislation.

Foreword

The newly enacted Renewable Portfolio Standards (RPS) require Virginia's utilities to produce a specific amount of electricity from renewable energy sources such as solar and wind.

The Thomas Jefferson Institute participated in a research study that included several states to look at the costs to our consumers and to our economy as Virginia reaches to achieve these RPS goals. The full study can be found at this link for those interested in other states: https://www.researchgate.net/publication/304581173_Costs_Benefits_of_Renewable_Energy_Portfolio_Standards

The Executive Summary is for the entire study but provides important information to help the reader understand the impact of these new regulations. Following that Executive Summary is the Virginia-specific information from that study. It is this information that is most important to those of us here in the Old Dominion.

For Virginia, the federal mandate is to produce 6% of our electricity by 2025 from renewable sources of energy. The state expects to reach this goal mostly through the use of solar energy. The goal is that 83% of that six percent figure will come from solar and the rest from wind.

The cost of achieving this six percent figure is significant, as the price of producing renewable energy rises. In order to reach this goal, Virginia electric rates on consumers will increase, five percent in 2016, another 10% by 2025, and between seven percent and nine percent each year thereafter.

As this study states, "These significant rate increases reflect low capacity utilization rates for wind and solar in Virginia and RPS generation displacing low cost coal and natural gas fired electric power generation." What this means is that because Virginia has produced a vast majority of its electricity from coal, gas and nuclear generation, these projected increased costs are due from the need to build new energy plants and these costs are significant.

The ambitious Virginia RPS goal of producing 6 percent of our electricity from renewable sources by 2025 imposes significant costs on the economy of Virginia. The existing renewable energy portfolio standard raises electricity costs that on balance result in a net reduction in the state's value added and employment even after accounting for the economic stimulus from building and operating renewable energy facilities.

The costs of this mandated 6% goal will be borne by the consumers – individuals and businesses. So less money will be available to purchase items for our families and less money will be available for creating new jobs by our businesses. As Virginia struggles to create jobs and entice businesses to our state that are not tied to federal government spending, to put this additional burden on them for no appreciable impact on the environment seems counter-productive.

The end of the Virginia analysis is this concluding statement:

“From a global perspective, therefore, renewable energy portfolio standards in Virginia are an inefficient means to address global climate change. The incremental costs of environmental improvement from RPS in Virginia are significant because the state generates more than 95 percent of its power from low-cost coal, gas, and nuclear generation.”

This Renewal Portfolio Standard will cost Virginia jobs and increase our electricity bills. It will harm our ability for economic growth and have insignificant impact on the climate or our environment. This federally mandated “standard” is another federal requirement that harms our long-term ability to strengthen our economy and compete in a world that grows more competitive each and every day.

This study is presented in an effort to bring some important facts to the table in order to create better and productive public policy in this area. We hope that it does so.



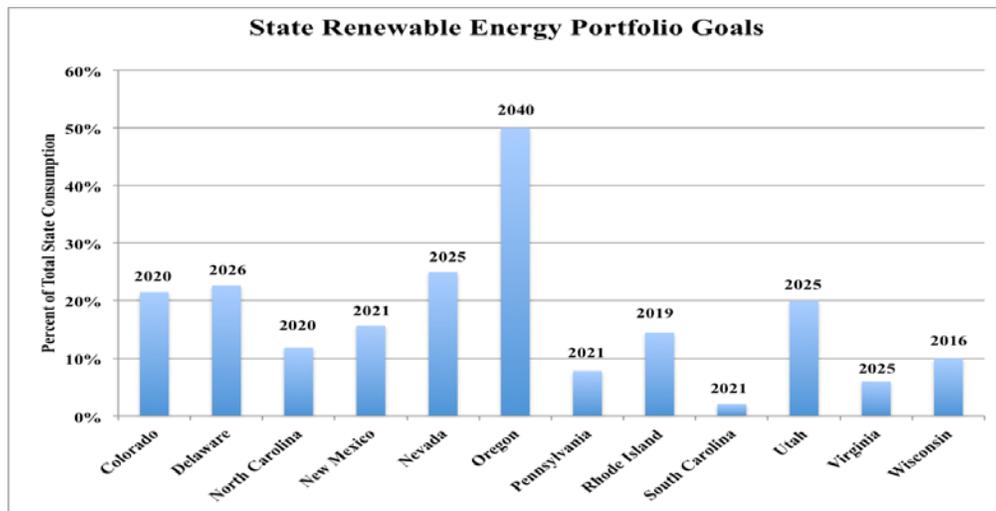
Michael W. Thompson, Chairman & President
Thomas Jefferson Institute for Public Policy
October 2016

Executive Summary

Renewable Portfolio Standards (RPS), now existing in 29 states and the District of Columbia, require utilities to provide a certain percentage of electricity consumption from wind, solar, and other forms of renewable energy. Federal policies, such as the wind production tax credit and the solar investment tax credit, also promote the production of wind and solar power. Given the widespread use of rate of return regulation based upon average cost pricing, the costs of these policies are less than transparent. Moreover, to the extent that these policies drive up electricity prices, output and employment could be adversely affected. The objective of this study is to understand and estimate these costs and economic impacts.

Central to this effort is the estimation of the opportunity costs of higher cost, intermittent renewable power in terms of the foregone electricity from lower cost, deployable fossil fuel fired electricity. These opportunity costs vary considerably by state based upon the cost of existing capacity and availability of wind and solar resources. Accordingly, this study estimates these costs for the twelve states identified in Figure ES1. The timing and stringency of the RPS goals varies considerably by state. Moreover, there is wide variation in the size and composition of electricity generation for this sample of states.¹

Figure ES1: RPS Goals by Stat



To estimate the costs and benefits of RPS, this study develops models of electricity supply and demand for each state. These models are projected using forecasts for coal and natural gas prices out to 2040 from the U.S. Energy Information Administration. The baseline forecast assumes existing electricity production capacity remains in place with new generation requirements met by natural gas integrated

¹ The selection of these states is determined by the states expressing an interest in this study to the Interstate Policy Alliance, who sponsored this study.

combined cycle (NGCC) plants. (Editor’s note: these plants use in-line generators to take “unused fuel” and produce additional power thus reducing emissions.) The RPS scenario imposes the goals identified in

Figure ES1. Average electricity generation costs, power consumption, and retail rates under the baseline and RPS scenarios are then compared.

The costs of RPS policies depend upon the opportunity costs of electricity generation from wind and solar. For states with a fleet of low cost electricity generation capacity, imposition of RPS could raise electricity costs significantly because higher cost wind and solar generation displace low cost sources of power. While this displacement reduces expenditures on fossil fuels, coal and natural gas plants are cycled (Editor’s note: this is the use of back-up generators powered by carbon fuels to produce electricity quickly when wind velocity slows or cloudy weather occur. The need is for very quick power generation thus emissions are greater.) to accommodate the intermittent generation of renewable generators, which reduces their thermal efficiency and raises generation costs. On the other hand, building more renewable energy plants to meet RPS goals reduces the need to build new NGCC plants. Finally, investments in RPS capacity earn federal tax subsidies. Wind power receives a production tax credit of \$23 per megawatt hour (Mwh) while solar plants receive a 30% investment tax credit. Hence, RPS policies contribute to lower federal tax revenues.

These costs are summarized in Figure ES1 for the entire twelve states. For example, in 2016, the RPS goals involve \$5.4 billion in additional expenditures to build and operate the required RPS facilities, \$271 million in cycling costs, and \$1.8 billion of tax subsidies. These costs are partially offset by \$1.478 billion in fossil fuel cost savings and \$261 in avoided new NGCC generation costs. Hence, the total net cost of RPS policies is \$5.762 billion in 2016. The total net costs of RPS policies reach \$8.7 billion in 2025 and increase to \$8.9 billion in 2040 after RPS goals are met and the unit costs of solar and wind decline due to technological improvements.

Table ES1: Costs of RPS for Entire 12 State Sample

	<i>Millions of 2013 Dollars</i>					
	2016	2020	2025	2030	2035	2040
Renewable Energy Costs	5,400.0	7,815.2	8,881.6	9,283.8	9,693.2	10,119.0
Cycling Costs	271.1	316.0	339.6	371.9	409.2	452.6
Tax Subsidies	1,830.1	2,672.2	3,098.0	3,287.2	3,485.7	3,698.8
Fossil Fuel Costs	-1,478.3	-2,319.5	-2,966.3	-3,493.3	-4,071.0	-4,687.0
New Fossil Fuel Costs	-260.7	-462.0	-597.5	-619.6	-642.1	-652.3
Total Net Costs	5,762.2	8,022.0	8,755.4	8,829.9	8,875.0	8,931.1

These higher costs are passed on to customers in the form of higher retail electricity prices, summarized in Table ES2. States with modest RPS goals, such as South Carolina, experience moderate rate increases. Similarly, states meeting their RPS goals with wind, such as Colorado, face rate increases of roughly 6%. On the other hand, states meeting rather ambitious RPS goals with relatively higher cost solar power, such as Oregon, North Carolina, Nevada, Utah, and Virginia incur much steeper electricity rate increases.

Electricity rate increases peak as RPS goals are reached in the early 2020s for most states. Thereafter, electricity rate increases begin to taper off as the costs of wind and solar decline due to

technological improvements. Despite these expected reductions in the cost of wind and solar technology, RPS policies increase prices for electricity.

Table ES2: Impact of RPS Policies on Retail Electricity Prices

	Electricity Price Changes in Percent					
	2016	2020	2025	2030	2035	2040
Colorado	6.12	8.23	7.69	7.32	6.69	5.93
Delaware	11.02	14.50	14.99	12.50	10.14	8.20
North Carolina	10.04	16.06	14.12	12.55	11.03	9.79
New Mexico	6.18	6.77	5.95	5.30	4.54	3.92
Nevada	14.77	15.60	15.14	13.28	11.21	9.12
Oregon	9.41	10.00	11.09	14.13	16.42	18.13
Pennsylvania	2.14	2.56	2.54	2.40	2.25	2.08
Rhode Island	13.61	18.16	16.62	15.55	14.46	13.17
South Carolina	0.39	1.52	2.08	1.97	1.85	1.75
Utah	5.13	9.07	12.78	11.78	10.67	9.47
Virginia	5.45	7.75	9.85	8.76	7.74	6.93
Wisconsin	4.34	4.29	4.01	3.70	3.39	3.08

Many economic studies in the peer-reviewed literature demonstrate that higher energy prices reduce economic growth and employment. Energy is an essential factor of production and consumption activities. Given limited substitution possibilities, higher electricity prices raise business costs and consumer energy bills, which reduces spending on other goods and services. Investments in renewable energy, however, constitute an economic stimulus.

A comparison of these economic impacts is summarized in Table ES3 for the entire twelve states. For example, in 2025 higher electricity prices associated with RPS policies reduce value added or net economic output by \$23.1 billion.² Investments required for new renewable energy plants increase value added by \$668 million. With a small offset from reductions in required NGCC plants to meet load growth, the net reduction in value added is nearly \$22.5 billion in 2025. Similarly, gross employment losses are over 160 thousand in 2025 but over 9 thousand jobs are created building and operating new solar and wind capacity to meet RPS goals. But again the net change involves over 150 thousand jobs lost in 2025. Overall, this study finds that the stimulus from building and operating renewable energy facilities are offset by the negative impacts that higher electricity rates have on employment and value added. The estimated losses in value added for each of the twelve states are summarized in Table ES4. The largest losses occur in North Carolina with value added reductions between \$3.9 billion in 2016 to more than \$6.6 billion in 2025. Losses in annual value added exceed \$1 billion in seven other states.

² Value added is equal to gross output less expenditures on intermediate purchases from other industries and, thereby, provides a measure of the net economic output.

Table ES3: RPS Impacts on Value Added and Employment for All States

Value Added	Millions of 2013 Dollars					
	2016	2020	2025	2030	2035	2040
Electric prices	-16,779	-22,799	-23,140	-21,555	-19,786	-18,100
RPS Invest.	2,069	1,290	668	432	439	456
NGCC Invest.	-146	-34	-22	-2	1	2
Net Change	-14,856	-21,543	-22,495	-21,124	-19,346	-17,642
Employment	Number of Jobs					
Electric prices	-118,606	-159,094	-161,595	-151,605	-140,199	-129,223
RPS Invest.	29,826	18,332	9,073	5,796	5,870	6,092
NGCC Invest.	-1,246	-305	-206	-21	10	15
Net Change	-90,026	-141,066	-152,727	-145,830	-134,318	-123,116

Table ES4: RPS Impacts on Value Added by State

	Change in Value Added in Millions of 2013 Dollars					
	2016	2020	2025	2030	2035	2040
Colorado	-1,442	-1,996	-1,992	-1,895	-1,730	-1,530
Delaware	-603	-812	-839	-715	-578	-466
North Carolina	-3,899	-7,145	-6,664	-5,918	-5,196	-4,606
New Mexico	-239	-444	-390	-348	-298	-251
Nevada	-1,711	-1,792	-1,715	-1,534	-1,287	-1,038
Oregon	-1,451	-1,571	-1,636	-2,022	-2,374	-2,636
Pennsylvania	-1,226	-1,503	-1,640	-1,545	-1,449	-1,337
Rhode Island	-629	-890	-813	-760	-707	-643
South Carolina	-63	-198	-349	-318	-298	-283
Utah	-662	-1,420	-2,025	-1,964	-1,777	-1,575
Virginia	-1,865	-2,655	-3,390	-3,149	-2,778	-2,486
Wisconsin	-1,065	-1,116	-1,041	-958	-874	-791
Total	-14,856	-21,543	-22,495	-21,124	-19,346	-17,642

The employment impacts of RPS policies are summarized in Table ES5. The jobs lost by state mirror the losses in value added. Again, the magnitudes differ by state depending upon the stringency of the RPS goals, the size of the state, and the technologies available for each state to meet the RPS goals. Solar energy is the main way to attain RPS goals for eastern states due to limited wind resources.

The economic impacts are summarized in Figure ES2 using the present discounted value of lost value added and average annual job losses from 2016 to 2040. The largest losses occur in North Carolina with a cumulative loss in value added of over \$106 billion and annual average job losses of more than 37 thousand. The next largest losses occur in Virginia with over \$50 billion in lost value added and more than 20 thousand lost jobs per year. Five other states – Colorado, Nevada, Oregon, Pennsylvania, and

Utah – incur losses exceeding \$25 billion in value added and 9 thousand jobs per year from 2016 to 2040 associated with the economic burdens associated with RPS policies.

Table ES5: Impact of RPS Policies on Employment by State

State	Change in Number of Jobs					
	2016	2020	2025	2030	2035	2040
Colorado	-8,060	-11,619	-12,445	-11,823	-10,779	-9,516
Delaware	-2,705	-3,845	-3,970	-3,536	-2,846	-2,272
North Carolina	-17,821	-43,277	-44,093	-39,107	-34,289	-30,345
New Mexico	-743	-3,483	-3,060	-2,724	-2,333	-1,921
Nevada	-11,827	-12,540	-11,868	-10,813	-9,037	-7,237
Oregon	-12,309	-13,459	-13,547	-16,428	-19,422	-21,637
Pennsylvania	-7,781	-9,712	-11,396	-10,726	-10,046	-9,255
Rhode Island	-4,003	-6,023	-5,496	-5,137	-4,771	-4,339
South Carolina	-561	-1,331	-3,084	-2,794	-2,617	-2,480
Utah	-1,912	-7,137	-10,517	-11,153	-10,077	-8,916
Virginia	-13,182	-18,779	-24,060	-23,144	-20,399	-18,241
Wisconsin	-9,121	-9,862	-9,193	-8,447	-7,701	-6,957
Total	-90,026	-141,066	-152,727	-145,830	-134,318	-123,116

RPS policies, however, generate benefits by reducing carbon dioxide emissions. These savings, however, come at a relatively high price with the avoided cost of carbon of between \$234 and \$38 per ton in 2016 and between \$136 and \$30 per ton in 2040. An emissions weighted average of CO2 abatement costs across all states is \$78 in 2016 and \$62 dollars per ton in 2040.

Figure ES2: Cumulative Economic Impacts of RPS

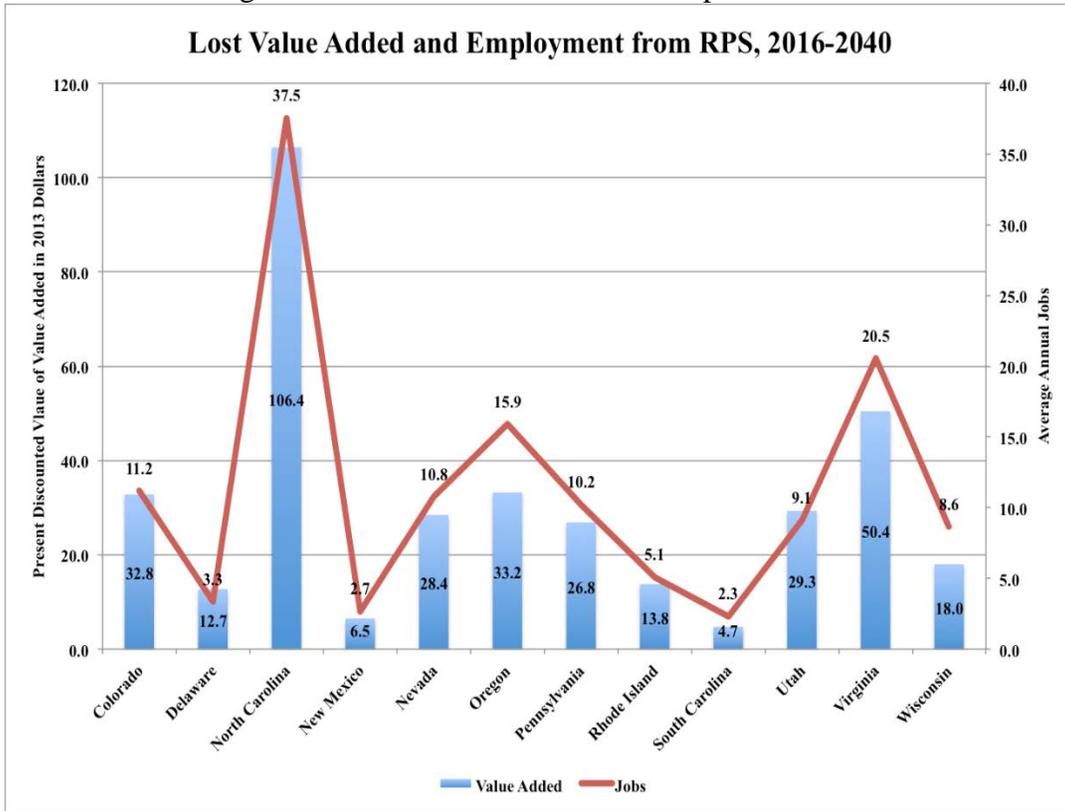


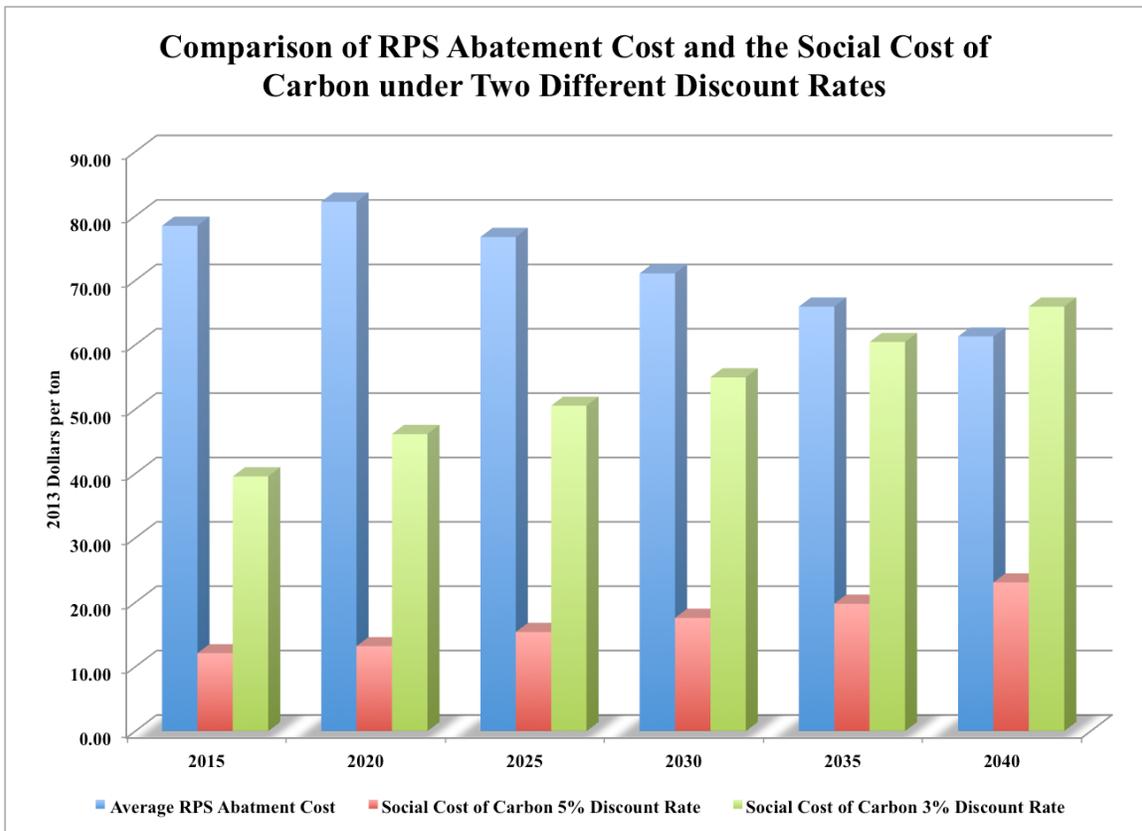
Table ES6: Costs of CO2 Reductions using RPS

State	2013 Dollars per ton					
	2016	2020	2025	2030	2035	2040
Colorado	37.92	41.89	40.22	39.79	38.56	36.78
Delaware	105.74	88.83	77.70	68.22	60.16	53.31
North Carolina	199.03	183.27	162.12	147.65	134.22	122.56
New Mexico	45.92	39.80	37.09	35.02	32.46	30.59
Nevada	76.82	56.83	51.17	46.68	42.64	38.66
Oregon	45.89	49.06	45.93	47.68	47.40	46.51
Pennsylvania	44.05	44.21	42.37	41.43	40.50	39.41
Rhode Island	205.42	172.39	156.73	148.99	141.55	133.72
South Carolina	103.38	156.21	133.88	127.07	120.60	115.27
Utah	97.22	85.42	82.54	76.74	71.33	65.94
Virginia	234.91	203.97	181.92	161.71	147.34	136.03
Wisconsin	54.22	51.15	49.46	47.67	45.88	44.06

The social cost of carbon estimated by the US Environmental Protection Agency is well below these average avoided emissions costs, suggesting that Renewable Portfolio Standards are a relatively expensive strategy to cut greenhouse gas emissions (see Figure ES3). In summary, this study finds that the economic impacts of Renewable Portfolio Standards vary significantly across states depending upon the goals and the availability of solar and wind resources. Across all states, however, RPS policies increase electricity prices.

RPS investments stimulate economic activity. The negative economic impacts associated with higher electricity prices, however, offset the economic stimulus from these RPS investments. In many cases, especially for states that must utilize solar energy technology to meet RPS goals, the costs per ton of carbon is much higher than the social cost of carbon estimated by the US federal government. Avoided carbon costs are lower for wind power but still involve net losses in value added and employment. These findings suggest that Renewable Portfolio Standards for the twelve states examined in this study are a costly and inefficient means to reduce greenhouse gas emissions and they reduce economic growth and employment.

Figure ES3: RPS Abatement Costs and the Social Cost of Carbon



The Virginia Analysis of EPA’s Renewable Portfolio Standards

(Editor’s Note: this discussion on Virginia is pulled from a larger study that analyses several states and the impact of the Renewal Portfolio Standards now required by the EPA. Thus the numbers on the Tables are from 75 to 80 because that is how they are numbered in the larger study. This Virginia report was “extracted” and reprinted here by the Thomas Jefferson Institute for Public Policy since this Virginia analysis is what concerns us here in the Old Dominion. The full study can be found at this link: [file:///C:/Users/Mike/Desktop/RPS%20--%20CostsBenefitsRenewableEnergyPortfolio_Study%20\(6\).pdf](file:///C:/Users/Mike/Desktop/RPS%20--%20CostsBenefitsRenewableEnergyPortfolio_Study%20(6).pdf)

Virginia generated 76.9 million MWh of electric power in 2013 from a diverse portfolio of generation assets (see Table 75). Nuclear power plants provided 38 percent of the total generation. Natural gas plants provided 29.5 percent while coal supplied 27.5 percent of total generation in 2013. Hydroelectric facilities provided 1.6 percent of total generation. There was no wind or solar energy generation capacity in Virginia. The following two sub-sections summarize the impacts of existing and future RPS goals on the electricity market and state value added and employment in Virginia.

Table 75: Capacity, Generation, and Utilization Rates for Virginia 2013

Energy Source	Capacity MW	Generation Mhr	Capacity Utilization %
Coal	6,292	21,160,501	0.3839
Geothermal	0	0	0.0000
Hydroelectric	822	1,253,670	0.1740
Natural gas	9,219	22,651,167	0.2805
Nuclear	3,654	29,326,231	0.9161
Other	96	474,767	0.5646
Other biomass	346	959,725	0.3168
Other gas	0	0	0.0000
Petroleum	2,745	313,288	0.0130
Pumped storage	3,109	-1,189,000	-0.0437
Solar	0	0	0.0000
Wind	0	0	0.0000
Wood	662	1,946,217	0.3357
Total	26,945	76,896,565	0.3258

Source: US Energy Information Administration

Impacts on Electricity Sector

The RPS goal for Virginia is 6 percent of total consumption by 2025. The impacts on electricity markets from the enactment of these goals are presented in Table 76. The RPS goals reduce the need for additional new NGCC (Editor’s note: NGCC is “natural gas integrated combined cycle” and refers to the in-line energy generators in these facilities that take unused fuel and produce additional power thus reducing emissions.) as these goals are met. For instance, in the base case without additional RPS

capacity, new NGCC capacity required to balance the market is 214 MW in the base case and under the RPS incremental NGCC capacity required is 200.3 MW in 2025 (see Table 76).

Solar power provides more than 83 percent of new capacity to meet RPS in Virginia with the remainder met by new wind generating plants. RPS wind and solar capacity to meet the RPS goals are 83.2 and 227.8 MW respectively in 2016 and 153 and 419 MW respectively in 2025. The electricity generation from these new facilities rises from 3.5 million MWh in 2016 to 9.8 million MWh in 2040 (see Table 76). As expected, new NGCC generation is lower in the RPS scenario than the base case.

The increases in average electricity costs from new RPS capacity additions are 15.6 percent in 2016, 23 percent in 2020, and over 20 percent after 2025 (see Table 76). With legacy costs average electricity rates in Virginia increase over 5 percent in 2016 due to renewable energy portfolio standards. After 2016, rates increase almost 10 percent in 2025 and increase between 7 to 9 percent thereafter compared to the base case without RPS standards. These significant rate increases reflect low capacity utilization rates for wind and solar in Virginia and RPS generation displacing low cost coal and natural gas fired electric power generation.

Table 76: Impacts of RPS on Virginia Electricity Market

	<i>Megawatts</i>					
	2016	2020	2025	2030	2035	2040
New NGCC Capacity						
Without RPS	0.0	0.0	214.0	221.7	230.6	249.4
With RPS	0.0	0.0	200.3	220.9	232.9	251.3
New RPS Capacity						
Wind	83.2	121.5	153.0	24.1	25.4	27.4
Solar	227.8	332.7	419.2	66.0	69.6	75.1
	<i>Million Megawatt hours</i>					
New NGCC Generation						
Without RPS	3.7	3.5	11.6	19.6	28.1	37.1
With RPS	3.3	2.4	10.0	17.9	26.4	35.5
Legacy RPS Generation	0.0	0.0	0.0	0.0	0.0	0.0
New RPS Generation	3.5	5.4	8.3	8.8	9.3	9.8
	<i>Percentage Changes from Base Case</i>					
Average Costs	15.59	23.15	28.60	25.01	21.69	19.32
Electricity Consumption	-0.33	-0.78	-1.13	-1.18	-1.08	-0.97
Average Rates	5.45	7.75	9.85	8.76	7.74	6.93
Average Rates + Legacy Costs	5.45	7.75	9.85	8.76	7.74	6.93

The decomposition of RPS costs for the Virginia electricity sector appears in Table 77. Net RPS legacy costs are zero because there was no existing wind and solar capacity in Virginia in 2013. The costs associated with adding new RPS capacity to reach the RPS goals also appear in Table 77. The direct costs to achieve 6 percent of electricity consumption supplied by renewable energy are \$510.7 million in 2016 and rise to over \$1.1 billion in 2020 and subsequent years (see Table 77). After adding cycling costs (Editor’s note: these are the costs for back-up power generators using carbon fuel to produce electricity

quickly when the wind slows down or heavy cloud cover blocks the sun. Because of the need for quick ‘speed up’ of these plants the emissions generated are greater.) and deducting for fossil fuel and NGCC capacity costs, the net costs to meet the RPS goal are \$534 million in 2016, \$748 million in 2020, \$1 billion in 2025, and over \$833 million per year thereafter. With subsidies, the total costs of Virginia’s renewable energy portfolio standards are \$712 million in 2016, \$1 billion in 2020, \$1.4 billion in 2025 and more than \$1.2 billion per year from 2030 to 2040 (see Table 77).

Table 77: Costs of Virginia RPS

	<i>Millions of 2013 Dollars</i>					
	2016	2020	2025	2030	2035	2040
RPS Legacy Costs						
Direct	0.0	0.0	0.0	0.0	0.0	0.0
Cycling Costs	0.0	0.0	0.0	0.0	0.0	0.0
less Fuel Costs	0.0	0.0	0.0	0.0	0.0	0.0
Net RPS Legacy Costs	0.0	0.0	0.0	0.0	0.0	0.0
New RPS Costs						
Direct	510.7	760.5	1,101.9	1,100.7	1,101.4	1,102.8
Cycling Costs	4.7	5.6	8.1	8.3	8.6	9.5
less Fuel Costs	-33.1	-14.7	53.6	120.1	178.1	225.1
less NGCC Costs	14.7	31.9	50.4	56.6	56.5	53.4
Net New RPS Costs	533.8	748.9	1,006.0	932.4	875.4	833.8
RPS Tax Subsidies	179.0	265.3	383.2	380.7	378.9	377.4
Total RPS Cost	712.8	1,014.2	1,389.2	1,313.1	1,254.2	1,211.2
	<i>Million Tons</i>					
CO2 Reductions	3.03	4.97	7.64	8.12	8.51	8.90
	<i>2013 Dollars per ton of CO2 Reduced</i>					
Direct RPS Costs	175.92	150.61	131.73	114.83	102.83	93.65
Subsidy Costs	58.99	53.36	50.18	46.88	44.51	42.38
Total Costs	234.91	203.97	181.92	161.71	147.34	136.03

The RPS policies in Virginia reduce carbon dioxide (CO₂) emissions by 3 million tons in 2016 to over 8.9 million tons per year by 2040 (see Table 77). The direct costs per ton of avoided emissions (Direct RPS Costs) are \$175.92 per ton in 2016, \$150.61 per ton in 2020, \$131.73 per ton in 2025 and \$93.65 per ton in 2040. Tax subsidies (Subsidy Costs) are nearly \$60 per ton in 2020 and remain over \$42 per ton in 2040. The total costs of avoided carbon emissions, therefore, are \$234.91 per ton in 2016, \$203.97 per ton in 2020 and gradually decline to \$136.03 per ton in 2040 (see Table 77). These large unit costs of carbon emission reductions reflect the low capacity utilization rates for wind and solar in Virginia. Another factor is the predominance of low cost coal and natural gas capacity in total generation.

These RPS carbon abatement costs are far above the EPA social cost of carbon of \$12 to \$24 per ton, assuming a 5 percent discount rate (Editor’s note: discount rate reflects that a dollar today is worth more than a dollar in the future due to inflation or due to individual time rate of preference – what good is \$1.00 to me in ten years if I am dead!), suggesting that RPS policies in Virginia are an inefficient greenhouse gas emission strategy. Under a 3 percent discount rate, EPA’s social cost of carbon is around

\$40 per ton in 2016 and gradually increases to \$60 per ton in 2040. So from a global cost-benefit perspective, adopting RPS policies in Virginia is not cost effective. There are also economic impacts resulting from higher electricity rates that lead to losses in economic output and employment. These impacts are now presented and discussed.

Economic Impacts

By raising retail prices for electricity, RPS goals increase consumer electricity bills and the costs of providing goods and services in the Virginia economy. These impacts of higher electricity prices are summarized by sector from 2016 to 2040 in Table 78. Annual losses in Virginia value added range from \$1.9 billion in 2016 to \$3.5 billion in 2025, and remain over \$2.5 billion per year out to 2040. Employment levels are 14-26 thousand below employment in the base case without renewable energy portfolio standards after 2020 (see Table 79).

Table 78: Impacts of RPS on Virginia Value Added by Sector

	Millions of 2013 Dollars					
	2016	2020	2025	2030	2035	2040
Metals	-21.27	-30.24	-38.42	-34.15	-30.17	-27.04
Paper	-41.46	-58.93	-74.88	-66.54	-58.79	-52.70
Wood	-31.09	-44.20	-56.16	-49.91	-44.09	-39.52
Other Man	-106.37	-151.20	-192.12	-170.73	-150.83	-135.20
Textiles	-19.64	-27.91	-35.47	-31.52	-27.85	-24.96
Minerals	-14.18	-20.16	-25.62	-22.76	-20.11	-18.03
Const.	-291.29	-414.06	-526.13	-467.54	-413.05	-370.25
Trans.	-119.46	-169.81	-215.77	-191.74	-169.40	-151.85
Services	-1,545.88	-2,197.47	-2,792.21	-2,481.27	-2,192.13	-1,964.98
Utilities	210.55	299.30	380.31	337.96	298.57	267.64
Total	-1,978.99	-2,813.13	-3,574.50	-3,176.44	-2,806.29	-2,515.50

Table 79: Impacts of RPS on Virginia Employment by Sector

	Number of Jobs					
	2016	2020	2025	2030	2035	2040
Metals	-80	-114	-145	-129	-114	-102
Paper	-229	-325	-413	-367	-324	-291
Wood	-393	-559	-710	-631	-558	-500
Other Man	-1,206	-1,714	-2,177	-1,935	-1,709	-1,532
Textiles	-284	-403	-512	-455	-402	-361
Minerals	-47	-67	-85	-75	-67	-60
Const.	-2,297	-3,265	-4,149	-3,687	-3,257	-2,920
Trans.	-1,578	-2,242	-2,849	-2,532	-2,237	-2,005

Services	-8,892	-12,640	-16,062	-14,273	-12,610	-11,303
Utilities	363	516	656	583	515	462
Total	-14,642	-20,814	-26,447	-23,502	-20,763	-18,612

These losses from higher electricity prices are partially offset by output and employment gains from building and operating electricity capacity needed to meet RPS goals. These different impacts of RPS on Virginia value added and employment are summarized in Table 80. For example, in 2025 RPS investments contributed \$188 million in value added and 2,420 jobs in 2020.

Like the other states, the stimulus from RPS investment, however, is not large enough to offset the negative impacts of higher electricity prices. On balance, therefore, net annual losses in value added from Virginia's RPS goals are \$1.8 billion in 2016, \$2.6 billion in 2020, \$3.4 billion in 2025, and remain over \$2.4 billion through the end of the forecast horizon. Employment levels are more than 24 thousand lower in 2025 compared to the base case after 2020 (see Table 80).

Table 80: Net Impacts of RPS on Virginia Value Added and Employment

	Millions of 2013 Dollars					
	2016	2020	2025	2030	2035	2040
RPS Invest.	560.20	782.21	932.61	139.13	139.05	142.29
Value Added						
Electric prices	-1,978.99	-2,813.13	-3,574.50	-3,176.44	-2,806.29	-2,515.50
RPS Invest.	113.62	158.52	188.80	28.13	28.09	28.71
NGCC Invest.	0.00	0.00	-3.86	-0.23	0.66	0.54
Net Change	-1,865.37	-2,654.61	-3,389.56	-3,148.54	-2,777.55	-2,486.26
Employment						
Electric prices	-14,642	-20,814	-26,447	-23,502	-20,763	-18,612
RPS Invest.	1,460	2,035	2,420	360	359	366
NGCC Invest.	0	0	-32	-2	5	4
Net Change	-13,182	-18,779	-24,060	-23,144	-20,399	-18,241

In summary, the costs of avoiding carbon dioxide emissions using renewable portfolio standards in Virginia are much higher than EPA estimates of the social cost of carbon assuming a 5 percent discount rate and even assuming a 3 percent discount rate. From a global perspective, therefore, renewable energy portfolio standards in Virginia are an inefficient means to address global climate change. The incremental costs of environmental improvement from RPS in Virginia are significant because the state generates more than 95 percent of its power from low-cost coal, gas, and nuclear generation.

The ambitious RPS goal of 6 percent imposes significant costs on the economy of Virginia. The existing renewable energy portfolio standard raises electricity costs that on balance result in a net reduction in the state's value added and employment even after accounting for the economic stimulus from building and operating renewable energy facilities.

Thomas Jefferson Institute for Public Policy

Board of Directors

Michael Thompson: Chairman and President: For 25 years Mr. Thompson owned his own marketing company. He has been very active in national, state and local politics as well as a number of state and community organizations, commissions, and committees.

Randal C. Teague: Secretary/Treasurer/Counsel: Chairman of the Fund for American Studies and retired Partner in the law firm of Vorys, Sater Seymour and Pease, Mr. Teague is a noted international attorney.

John Alderson: President of the John Alderson Insurance Agency

William W. Beach: Vice President of Policy Research, Mercatus Center at George Mason Univ

James W. Beamer: Managing Dir. for Legislative Outreach at Dominion Resources Services

Stephen Cannon: Partner, Constantine Cannon, PC, former Sr. VP of Circuit City Stores

Stephan Cassaday: President, Cassaday and Company

Rebecca Donatelli: President, Campaign Solutions/Connell Donatelli

James W. Dyke Jr: Partner, McGuireWoods and former VA Secretary of Education

John Hager: Former Lt. Governor of Virginia

Robert L. Hartwell: President, Hartwell Capitol Consulting

Alan I. Kirshner: Chairman and CEO of Markel Corporation

Joseph Ragan: Retired as Founder and President of Joe Ragan's Coffee

John Rust: Former State Delegate and Partner, Rust and Rust law firm

John Ryan: Former Senior Counsel and Director of Gov't Affairs for Bristol Myers Squibb

Robert W. Shinn: President of Public Affairs, Capitol Results

Dr. Robert F. Turner: Law professor at the University of Virginia at Charlottesville



“... a wise and frugal government, which shall restrain men from injuring one another, shall leave them otherwise free to regulate their own pursuits of industry and improvement, and shall not take from the mouth of labor the bread it has earned. This is the sum of good government, and this is necessary to close the circle of our felicities.”

Thomas Jefferson, 1801

*Thomas Jefferson Institute for Public Policy
9035 Golden Sunset Lane • Springfield, VA 22153
703-440-9447 • info@thomasjeffersoninst.org
www.thomasjeffersoninst.org*