Evaluation of the Renewable Portfolio Standards of 39 States and D.C. in the United States of America in Terms of Effectiveness and Intention

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A Final Report to the

Senior Project Committee, Department of Physics, Case Western Reserve University, Cleveland, Ohio

July 28th , 2014

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Abstract

In the past several decades, there have been several attempts on the part of lawmakers to increase the use of renewable resources in various states via a piece of legislation known as the renewable portfolio standard (RPS), also known as a renewable energy standard, which mandates increased production or consumption of energy from renewable sources. While each state has kept track of whether or not the targets of these pieces of legislation are being reached, there is no consensus on how effective each of these programs are relative to each other, how they compare to states without similar program, or even if any new law was needed at all, in the case of states that met goals before the legislation was even written.

The purpose of this study is to determine the effectiveness of each program, in terms of how much the share of renewable energy generation and consumption changed in each state while the policy was active, as well as how this period compared to conditions prior to the implementation of the law .In addition, this study will also attempt to determine how the various traits of each RPS affect each program, in order to determine whether a certain set of traits is more favorable to achieve the goal of increased renewable energy usage and consumption within a state. In order to accomplish this, we will create a set of metrics used to evaluate each state, as well as render down each program to a set of clearly defined characteristics that be used to easily compare one program to another. Finally, we want to compare the performance of states with RPS programs to a control group of states with no such program, in order to see how they differentiate in terms of performance.

What we found in the course of the study is that the vast majority of legislation did not lead to an increase in the production or consumption of energy from renewable sources. While a few states did see a corresponding increase in either regard, there was not one particular characteristic or metric that we looked at that was common amongst the different pieces of legislation or states at hand.

Background

As shown in Fig.1, there are four primary energy sources in the United States coal, natural gas, nuclear and finally renewables. There are of course divisions within each source, most notably for the purposes of this study renewable, which can include wind energy, photovoltaic (PV) and solar energy, hydroelectric, wave and tidal sources, geothermal and biomass sources. Over the past decade the share of renewable as a source of energy in the United States has slowly increased, but not at the rate that many lawmakers believe is necessary. The basis of this necessity varies, ranging from

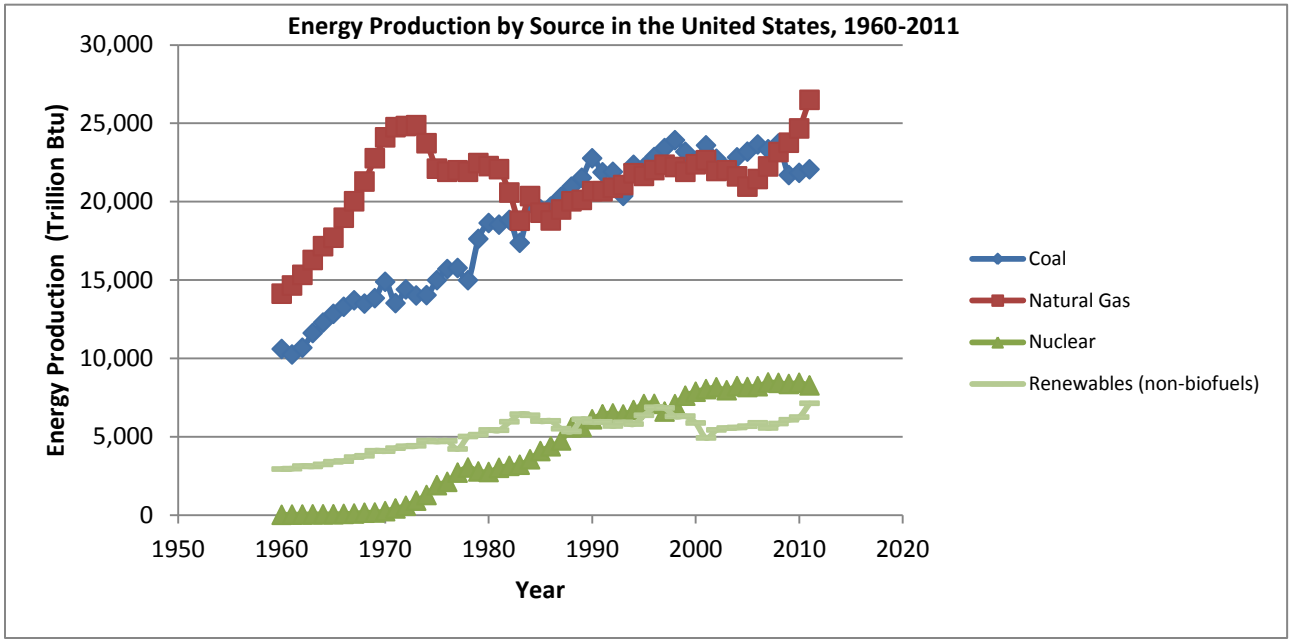
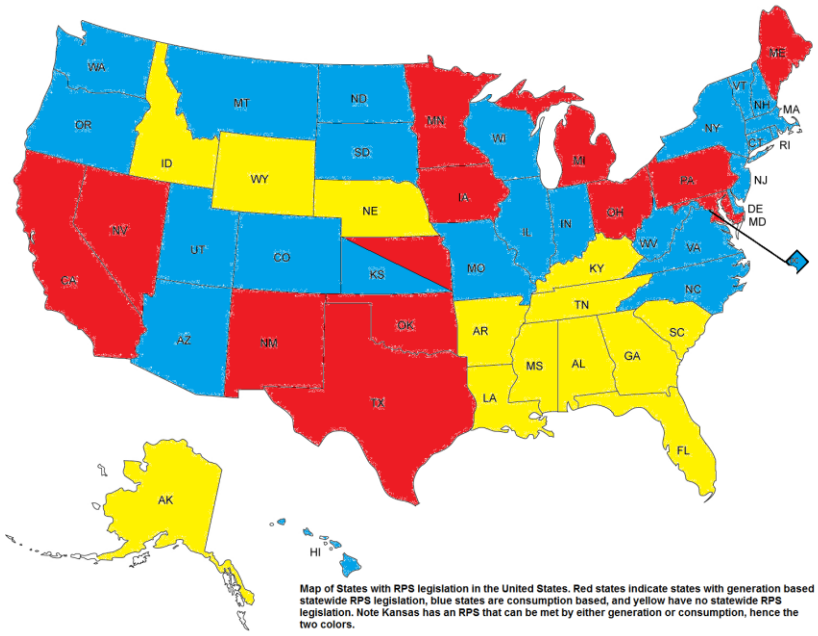


Figure 1. Energy Production by Source in the United States, 1960-2011. Source data is from the Energy Information Agency.

energy security in the U.S. to reducing carbon dioxide (CO_s) emissions, but the overall result of this perceived need was a call for increased production and consumption of energy from renewable sources. In 1983, Iowa passed the Alternative Energy Law (AEL) and became the first state to set a goal for renewable energy consumption (Iowa Code §476.41 et seq.), what we now call a RPS, though it was quickly followed by many other states. Currently, 39 states and the District of Columbia have this type of legislation in one form or another (DSIRE).



Map of States with RPS legislation in the United States. Red states indicate states with generation based statewide RPS legislation, blue states are consumption based, and yellow have no statewide RPS legislation. Note Kansas has an RPS that can be met by either generation or consumption, hence the two colors.

Each piece of legislation looks to address certain aspects within the state, primarily in terms of either increasing the total amount of renewables consumed or produced, as well as increasing the overall share of renewables as a percentage. In addition, many of the pieces of legislation apply the RPS varying levels, such as only making compliance required for investor owned utilities (IOUs), or utilities serving over 400,000 customers.

Thus, evaluating these policies once they are in place is primarily done though compliance studies done by the energy agencies within the states, in order to apply the appropriate compliance measure to responsible parties. With the rise of public accessibility to energy data, as well as the growing popularity of the RPS, studies began to be done by economists and public policy academics in order to evaluate the RPS paradigm beyond just compliance, stretching into areas such as the effect of RPSs on retail energy pricing, overall energy production, and how much the RPS really increased renewable energy production within a state. However, at the same time the rising popularity of renewable energy was met with considerable political resistance in the form of lobbying by non-renewable energy corporations, such as the American Coalition for Clean Coal Electricity, which in turn has led to a rise in the scrutiny of these programs . How these programs are scrutinized varies, though a

large portion of research currently focuses on how retail energy pricing and job creation are affected within the state.

The reasoning for studying these pieces of legislation and their effects is quite clear, as each program has the potential for enormous impacts on consumers of retail energy as well as the economy of the region where an RPS is implemented. On a global scale, as the largest consumer of energy on earth, what the United States chooses to use for energy sources can have enormous impacts on the global economy as well as the very environment itself, either through mining or climate change.

Review of Previous Work

A large body of previous work has focused on the economic impact of RPS legislation in the various states it is implemented in (Yin and Powers). Aside from these, studies that have focused on how the impact of RPSs on energy production within the state are quite few and recent, with diverse results ranging from saying the legislation is very effective to having almost no effect. This can be partially attributed to the differences in methodology, such as what metrics various researchers create to try and evaluate energy data. Another reason for why the results may be mixed stems from which states are included in each study. Since most RPSs are recent, researchers vary on which states they decide to include in evaluations as the sample of data from more recent states may be quite small.

Similar work to what is being proposed by this study has been done by the team of Haitao Yin and Thomas Lyon (Yin and Lyon), who looked at both the reasons why states adopt RPSs as well as the effects on energy generation within states that have RPSs. However, their approach, while providing in-depth focus on the market economics of renewable energy production, they focus on a relatively small sample of states relative to what actually exists in the United States, choosing the 16 states that have generation based mandatory based RPSs rather than all states with any type of RPS (Binz), (Bryce) ,(Wiser and Barbose). While their logic for choosing these states makes sense, as they in theory should

be the most ambitious programs, this still means that their programs do not constitute a representative sample of the RPS in general.

Methods and Concept

At the heart of this study is the attempt to evaluate the effectiveness of each program and the intention, or level of sincerity, behind those who wrote the program. In order to quantify and examine these attributes we must first create new metrics from the data at hand.

The first metric we developed addressed the issue of evaluating the RPSs in terms of ambition. The metric was created on the simple basis that in order for an RPS to succeed, energy production or consumption of the state in terms of renewable must also increase, though the difference between the starting conditions and final goal varies greatly state to state. Thus, we created a metric based on the annual percent change in renewable energy, as defined by Eq. 1, in order to determine which states had more progress needed in order to hit goal, i.e. which goals were more ambitious.

$$\frac{Goal\ -\ Measure_{-1}}{Years_{Allotted}}\ = Minimum\ Annual\ Percent\ Change\ Necessary$$

Equation 1.Minimum Annual Percent Change Necessary Metric. "Goal" is defined as the goal of the RPS in relative units, "$Measure_{-1}$" is defined as the measure of the relevant units one year prior to when the RPS takes effect, and "$Years_{Allotted}$" is defined as the number of year between the start of the RPS and its goal year.

As for determining effectiveness, the rate at which states progress towards hitting goal serves as a good measure to evaluate. We should also be able to track actual progress on a annual basis, defined in Eq.2,

$$\frac{Measure_{Latest}\ -\ Measure_{-1}}{Years_{Effect}} = Actual\ Annual\ Percent\ Change\ Metric$$

Equation 2. Actual Percent Change Metric. "$Measure_{Latest}$" is defined as the measure of the relevant unit as of the latest available data, hereafter defined as 2011. "$Measure_{-1}$" is defined as the measure of the relevant units one year prior to when the RPS takes effect, and "$Years_{Effect}$" is defined as the number of years the policy has been in effect, i.e. between implementation year and 2011.

and compare it to the ideal metric from Eq. 1 in order to see how progress towards RPS goals compares. If a state is seen as greatly outperform its metric from Eq.1, we can infer from this that the goal was not

particularly ambitious, and thus not very sincere, and likewise if progress is much lower than the minimum required then the program was not particularly effective.

Other measures in this study serve to identify external factors such as the economic climate of the state, population change, or overall change in energy production and consumption, as well as specific characteristics of the programs such as whether or not they were mandatory or if the program was specific to production or consumption. The full list of measures used for comparison are listed in the appendix, under Appendix. 1. Data for the measures comes from the United States Census Bureau, U.S. Bureau of Economic Analysis (BEA), the U.S. Internal Revenue Service (IRS) and U.S. Energy Information Agency (EIA). All economic data was adjusted for inflation into 2014 United States Dollars (USD).

With the metrics in mind, we then needed to acquire energy data for all 50 states in addition to the District of Columbia. Due to the varied nature of energy production and consumption in the United States, *vis a vis* the many different classifications of companies and municipal organizations that produce and provide energy, we opted to use publically available data from the EIA in order to keep the source data consistent. This data was originally acquired with energy broken down by source, in units of trillion BTU. In order to define the energy used for non-transportation purposes, the primary focus of this study, with first excluded all petroleum and biofuel products, as they as transportation specific and are not used in residential energy generation. This left us with coal, natural gas, nuclear energy, biomass, geothermal, hydroelectric, solar, wind and all other non-biofuel renewables. From these we grouped sources into the categories of renewables (non-biofuel renewable, wind, solar, geothermal and biomass) and non-renewables (coal, natural gas and nuclear energy), and converted the units from Btus to percentages relative to total energy minus energy used for transportation.

We then graphed each state's energy data from 1960 to 2011, the latest year of available data, and compared states based on similar placement in rankings within each of the eight metrics. We created

groupings based on whether people fell above or below the median or in the 1st or 4th quartile in a variety of metrics, listed in Appendix 1. In addition, for the RPS only states we did this using data that normalized the start year of the RPS as year 0, and looked back 10 years in addition to all data since enactment in order to see whether or not there was any evidence the RPS had an effect. In theory, enactment should lead to a increase in the relative percentage of renewable energy within a state as the state attempts to meet goal. We grouped these normalized sets based on not only their placements above the median, below the median, in the 1st percentile or 4th percentile, but also based on how long the RPS had been in effect, i.e. <5 years, 5-6 years, 7-8 years and >9 years. This was done in order to see whether or not a trend develops over time, and each grouping was built to have a consistent sample size of about 10 states or the District.

Finally, we also averaged all renewable and non-renewable values for both percentage and consumption values, as well as averaging all normalized renewable values, in order to identify overall trends in each group. We had expected to see increases in production and consumption as a percentage of overall energy for all RPS states, with lesser positive slopes for non-RPS states or even no slope or negative slopes. A period spanning from 1990 until 2011 was chosen because this covers a majority of the years of enactment for the RPS states, as well as serving as a fairly large time period for attempting to find any trends that may exist.

Results and Discussion

We found a few interesting trends that we did not expect. The first conclusion we were able to draw was that the introduction of the RPS in a state did not universally lead to an increase in either production or consumption, as expected in order to meet the goal conditions. As shown in Appendices 6 and 7, very few states saw an increase in either production or consumption following the enactment of an RPS. This can be due to a variety of reasons, but the most likely can be found by looking at the “Min.

Annual % Change Needed To Hit RPS" metric and comparing how percent change in non-biofuel renewable production compared to percent change in total energy production, as listed in Appendix 1. Any state with a negative of negligible "Min. Annual % Change Needed To Hit RPS" metric has no real incentive to develop renewable sources or increase consumption of energy from renewable sources as they have already met or surpassed their goals.

Another conclusion we found was that when we compared RPS states to non-RPS states, both sets had similar trends in increasing renewable production while oddly having inverse trends for consumption counter to what one may logically expect. We found that when we averaged the most recent ten years of available data, as shown in Appendix 8, production did increase for both groups though slightly more for RPS states, while in terms of consumption RPS states have actually seen a decline in renewable energy consumption as a relative percentage of their consumption portfolio. This is further confirmed when we look at the normalized data for RPS states as shown in Appendix 9, which shows a decline in renewable energy consumption the longer a program is left in place. The is completely counter to what might be expected, and there is no clear reason for why this might be. 12 of the 38 RPS states have negative "Min. Annual % Change Needed To Hit RPS" metrics, which could explain a part of this anomaly, along with a recent boom in the production of natural gas as shown in Fig. 1. It is also quite possible that some RPS states have opted to sell energy produced from renewable sources to non-RPS states, which may not have legislation mandating renewable energy usage but often have financial incentives in place for using renewable energy.

In regards to influence of the other measures outside of the minimum and actual annual percent change metrics, we did not find any consistent trends shared between states in the 1st and 4th quartile sets, including even type of RPS (production or consumption based) or between RPS and non-RPS states. This would seem to suggest that the decline in hydroelectric capacity has had little effect on the

renewable production or consumption, as well as changing economic conditions such as tax revenue or population.

It is important to keep in mind that we are working with small samples of data. There are only 39 statewide programs available for analysis for this investigation, and EIA data is the only database that we were able to find that has data on all the states. In future investigations, data may be compiled from multiple sources,, but the issue still remains that it does not take many states with anomalous data in order to skew each groups data. For example, Rhode Island, Delaware, and Hawaii produced almost the entirety of their energy from renewable sources, as shown in Appendix2. A way for future studies create a more representative of energy trends would be to look at gross production and consumption rather than percentages, in order to minimize the impact of smaller states whose energy portfolios may not be indicative of the majority of U.S. states or of overall energy production or consumption.

Measurement error in the data in negligible, as the uncertainty in the EIA data is in the thousands of Btus while the units we looked at were many factors larger in the trillions of Btus.

Conclusions

While the theory behind the RPS is sound, there is no clear evidence that the presence of an RPS program within a state actually promotes renewable energy consumption or production. While on the whole RPS states do produce more energy from renewable as a percentage of their portfolio than their non-RPS counterparts, the growth rates for both groups are about equal in the 20 year period we looked at.

The type of program did not seem to matter either – neither production nor consumption based RPS program was superior in increasing production or consumption rates. The same was true for whether or not the program was mandatory or voluntary, though this is a bit more tricky to generalize as

the nature of a state's RPS can change over time, as Iowas AEL did when it became mandatory in 2007 (Iowa Utilities Board).

As for the other factors that may influence energy in a state, we were not able to find any factor that appeared to encourage renewable energy production. We did find that in the 4th quartile groupings for the metrics of federal spending to revenue, average percent change in hydroelectric consumption per year and average percent change in income per year. The hydroelectric related decrease makes sense – in states that got a majority of their renewable energy from dams, the closure of these dams would lead to the decrease seen. As for the other two factors, this is more difficult to discern why the decrease would occur, especially as the state that had the lowest average percent change in state tax revenue per year actually saw renewable increase as a percent of their states energy portfolio. Future research will need to investigate why this may be, as there is no logical reason why an economic factor may be correlated while another very similar factor – i.e., federal spending to revenue ration and state tax revenue – would not be correlated also.

In conclusion, legislation to encourage development of renewable energy sources has not been universally successful in the goals set by the legislation. While some states do see an increase in the desired area, others do not, and there is no consistency in either group or the factors that may determine the legislations success. This would seem to indicate that on the whole, the RPS is not an effective legislative tool in promoting renewable energy production or consumption even while managing to hit the goals of the RPS. Even more unfortunate for the goals of these programs, renewable energy has not gained any ground when seen as a percentage of either overall production or consumption for the United States, as shown by Fig. 2 and Fig. 3.

When considering future legislation, such as more states developing their own RPS programs or even a national RPS, lawmakers may want to consider alternative forms of legislation, such as additional

federal tax credits for developing new renewable energy generation stations or even the creation of a government sponsored enterprise with the purpose of offsetting startup losses and providing construction and implementation expertise of renewable power generators such as wind turbines or solar panels, as has been done in countries like China.

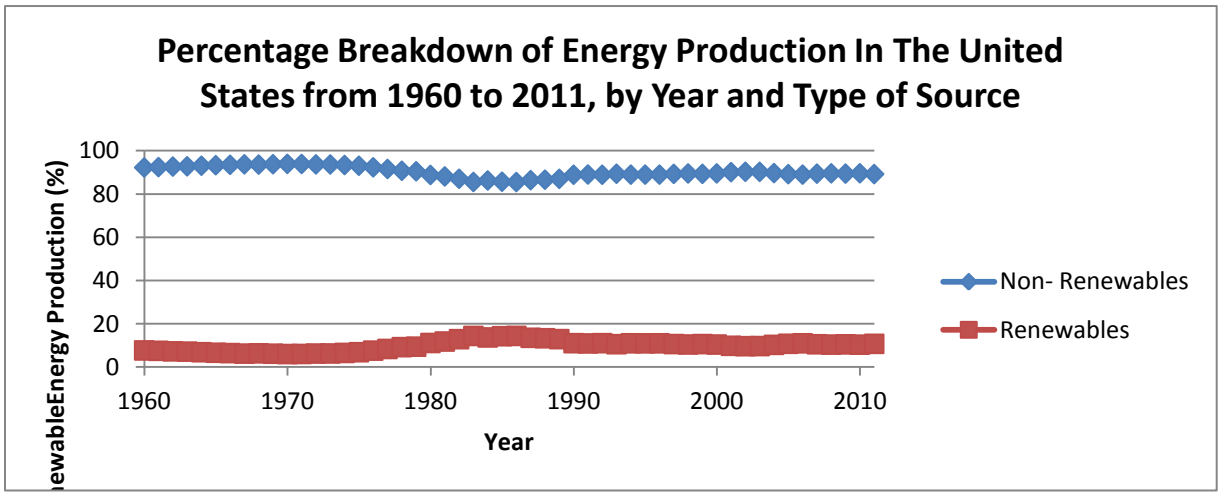


Figure 2. Percentage Breakdown of Energy Production In The United States from 1960 to 2011, by Year and Type of Source. Derived from E.I.A. data on total domestic energy production excluding biofuels and petroleum.

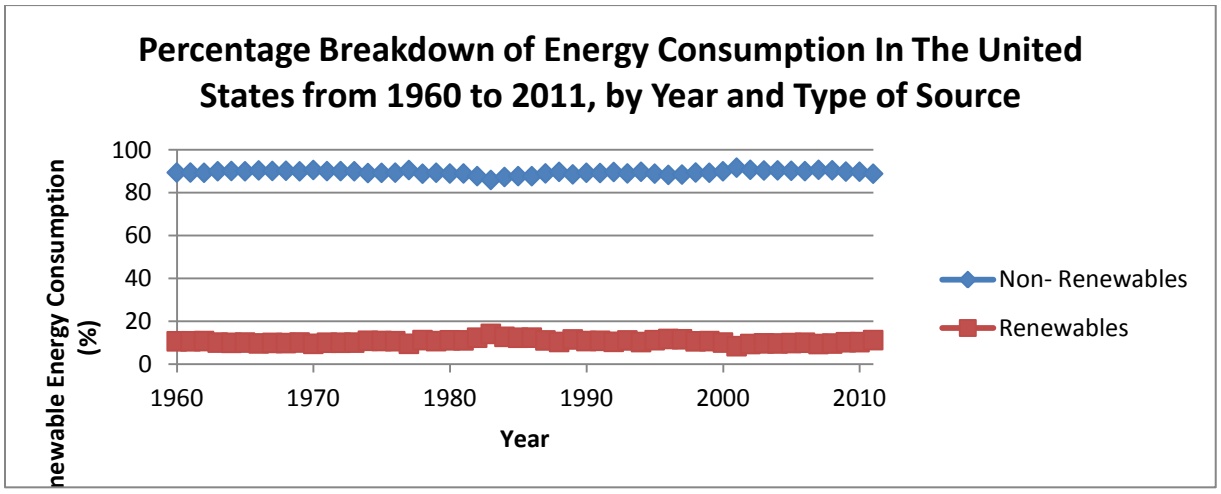


Figure 3. Percentage Breakdown of Energy Consumption In The United States from 1960 to 2011, by Year and Type of Source. Derived from E.I.A. deta on total domestic energy consumption, excluding biofuels and petroleum.

Future Investigations

There is still a lot of room for improvement for future studies. This study looked at the current conditions for each RPS, though the subject to change and updates as an RPS progresses, as had happened with Iowas AEL. Furthermore, this study did not do a full economic analysis of the impact of the various economic factors, counter to what was the focus on many previous studies. An attempt to do so here may provide more clues as to how the various economic conditions affected the RPS, and provide more insight into the results we obtained. Another area for improvement is the exact groups within a state subject to the RPS. Each RPS has different levels of application to different utilities, energy cooperatives, etc. In this study the application rates were averaged, though future studies could more finally tune this so that exact application levels within each energy market can be grouped, allowing for higher accuracy for goal settings. Finally, future studies could focus on different levels of resolution beyond the statewide RPS – many municipalities and some power companies set their own RPS that goes beyond the statewide goals, though these were not considered in this study.

Acknowledgements

I would like to thank the DSIRE team for helping to make information on RPS legislation more accessible, which greatly helped in this projects' initial stages. I would also like to thank Professor Justin Gallagher, whose guidance this project was essential in determining how to characterize RPS legislation and how to evaluate their effectiveness. I would also like to thank Dr. Kenneth Singer, for his patience and instruction throughout the senior project experience.

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Appendix 1. Table of Metrics for all 50 States and the District of Columbia

States	Min. Annual % Change Needed to Hit RPS Metric	Actual Annual % Change Towards Goal Level Metric	Average % change in non-biofuel renewable production per year metric	Average % change in total energy production levels per year metric	Average % change in state tax revenue per year metric	Average % change in population per year metric	Average % change in income per capita per year	Average % change in hydroelectric consumption per year	Federal Spending to Revenue Ratio Metric
Arizona	0.253125	-0.1348	10.76498	8.202398	10.4506	11.10386	9.877652	#DIV/0!	1.392727
California	-0.92841	0.388152	12.16521	8.297885	9.384489	9.931667	9.689292	#DIV/0!	0.848182
Colorado	1.705565	0.009256	32.40364	14.38083	8.912848	10.5295	9.383319	#DIV/0!	0.696364
Connecticut	0.194805	-0.54624	9.102185	9.357195	9.746995	9.503999	9.549836	#DIV/0!	0.721818
Delaware	1.109903	0.266808	25.91803	25.91803	11.03264	10.35801	9.133587	#DIV/0!	0.447273

District of Columbia (Not a state)	0.967019	-0.43228	0.925926	0.925926	41.5819	9.82499	12.9704	#DIV/0!	1.216364
Hawaii	-0.76468	0.622542	13.95607	13.95607	9.86493	10.20769	10.57468	9.090909	1.859091
Illinois	1.21237	0.243513	21.04984	10.48236	9.502108	9.372731	9.521549	#DIV/0!	0.586364
Indiana	0.438396	#DIV/0!	16.26227	11.04041	10.6057	9.688833	9.114908	#DIV/0!	1.036364
Iowa	-2.5E+15	-1.8E+14	30.61194	43.86932	10.11537	9.523595	10.54798	#DIV/0!	1.155455
Kansas	1.42297	2.360551	43.98391	8.164934	9.709696	9.686694	10.09506	#DIV/0!	0.894545
Kansas	1.610446	0.076966	43.98391	8.164934	9.709696	9.686694	10.09506	#DIV/0!	0.894545
Maine	-3.6	0	9.596855	9.596855	9.810844	9.384253	10.12235	6.841612	1.695455
Maryland	0.175376	0.565939	15.55262	8.643892	10.62454	9.857285	10.33215	7.781142	1.18
Massachusetts	0.195158	-0.33901	9.056244	9.029237	9.14257	9.387653	9.817456	9.090909	0.782727
Michigan	-0.70757	0.994369	10.29459	8.68098	7.621956	8.986604	8.736466	9.090909	0.96
Minnesota	-0.65799	4.172927	18.00412	16.79088	9.975231	9.772078	9.613601	5.263158	0.427273
Missouri	0.466325	0.628152	17.11742	14.12325	8.153948	9.706121	9.652753	#DIV/0!	0.97
Montana	0.400727	-0.72783	15.82298	10.40597	10.97	10.0334	10.87204	#DIV/0!	1.670909
Nevada	-3.03571	0	10.76129	10.45688	11.77037	11.75527	9.095373	#DIV/0!	0.886364
New Hampshire	0.270767	2.705017	12.80551	9.772243	9.133917	9.516965	9.554235	0	0.897273
New Jersey	0.685633	0.179572	11.03279	10.12933	10.05727	9.451703	9.83753	#DIV/0!	0.658182
New Mexico	1.4533	0.163103	45.02151	7.394271	8.773145	10.34871	10.63676	#DIV/0!	2.477273
New York	2.286842	-0.01449	9.565955	9.894972	10.78965	9.307917	9.996279	10.38961	0.692727
North Carolina	-1.15719	-0.39008	10.33582	9.910197	10.22886	10.7235	9.36299	0.119617	1.012727
North Dakota	1.01733	0.032951	41.18315	20.56517	18.11065	9.799958	12.58117	#DIV/0!	2.011818
Ohio	0.366981	-0.04905	10.52412	10.19096	9.084334	9.227918	9.342143	#DIV/0!	0.662727
Oklahoma	2.287566	0.634972	17.96128	10.78286	8.734804	9.961644	10.59159	#DIV/0!	0.88
Oregon	0.224652	0.770425	13.19532	13.33461	9.691487	10.13535	9.58792	#DIV/0!	1.048182
Pennsylvania	0.814833	-0.07188	13.22963	11.91546	10.21007	9.428095	9.849964	#DIV/0!	0.916364
Rhode Island	0.65	-0.26694	7.873502	7.873502	8.603203	9.025508	10.37153	#DIV/0!	0.863636
South Dakota	0.82495	0.228829	22.64119	45.56285	10.05736	9.901737	11.11106	#DIV/0!	1.387273
Texas	7.66E+15	2.44E+16	36.49949	12.00577	10.44593	10.94518	9.868083	#DIV/0!	1.045455
Utah	1.074999	-0.18552	20.54572	9.71013	9.648795	11.28348	9.954598	#DIV/0!	0.88

Vermont	-0.67493	4.633044	15.9779	12.21496	12.33135	9.28873	10.42139	9.090909	1.250909
Virginia	-0.4727	-1.00845	10.04854	7.607397	9.481142	10.24043	10.08633	#DIV/0!	1.528182
Washington	-0.76317	0.401479	14.50974	12.255	9.781767	10.36933	9.852526	0	0.838182
West Virginia	1.018338	1.623933	27.67891	8.021281	10.84465	9.360561	10.4335	10.90909	2.35
Wisconsin	-0.49327	-0.06001	9.44762	11.94663	9.289947	9.612377	9.752612	8.522727	0.891818
Alabama	NA	NA	8.865995	8.580174	9.112682	9.779971	10.03816	#DIV/0!	1.966364
Alaska	NA	NA	8.397871	5.673833	27.61081	10.34847	10.48373	#DIV/0!	1.568182
Arkansas	NA	NA	10.9744	27.29356	11.36046	9.921251	10.5867	#DIV/0!	0.742727
Florida	NA	NA	15.15659	9.104631	9.036257	10.56629	9.735931	#DIV/0!	2.688182
Georgia	NA	NA	9.093749	9.100655	7.933931	10.6429	8.950889	6.060606	0.868182
Idaho	NA	NA	15.06152	15.6127	9.082838	10.90756	9.642049	#DIV/0!	1.283636
Kentucky	NA	NA	10.90817	7.411186	9.253819	9.77023	9.622677	#DIV/0!	1.492727
Louisiana	NA	NA	7.31715	13.0306	8.774386	9.313642	11.20071	#DIV/0!	2.678182
Mississippi	NA	NA	8.974043	9.633732	9.823637	9.474145	10.53816	#DIV/0!	2.869091
Nebraska	NA	NA	16.10715	20.09943	9.723136	9.777574	10.25488	#DIV/0!	0.662727
South Carolina	NA	NA	13.91936	10.17109	8.556692	10.46969	11.9049	#DIV/0!	2.931818
Tennessee	NA	NA	9.861636	8.691427	10.0936	10.14148	9.642873	0	0.992727
Wyoming	NA	NA	36.82732	11.34087	14.39343	10.44667	11.45456	#DIV/0!	0.857273

Note: States are color coded according to type of RPS legislation. Red indicates production based RPS, blue indicates consumption based RPS, and yellow indicates states without statewide RPS programs in place. Note how Kansas has an RPS whose goal can be met by either production and consumption, and hence both cases extremes are listed.

Appendix 2. Renewable Energy as a Percentage of Overall Energy Production, by State and by Year Between 1990 and 2011

States	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Arizona	16.8116	13.8073	13.8646	14.7908	14.9867	15.9888	17.4271	20.0666	18.2992	16.6359	14.3212	13.2581	12.6305	12.9453	12.5041	12.8732	15.8905	14.958	15.7747	13.3703	13.7265	17.6196
Californi	47.2126	46.6953	45.3769	54.5199	47.7405	57.4588	54.6433	54.5169	53.8716	50.003	49.2697	44.5697	47.2726	49.113	50.8995	50.2648	54.3865	46.3069	46.8004	49.922	51.5682	55.0616
Colorad	3.75302	4.29257	3.4331	3.3258	2.53586	2.83806	2.5318	2.5109	1.83792	1.91134	1.82164	1.43743	1.15548	1.13762	1.07932	1.49018	1.64224	1.79953	2.75833	2.71095	2.61108	3.35902
Connect	14.2275	21.3757	18.145	14.5876	16.1035	18.9794	46.1608	100	59.116	27.1243	22.8637	15.623	15.3928	15.7261	14.9195	13.7166	12.36	12.2913	14.0959	14.5609	13.842	15.1971
Delaware	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
District c	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	0	0	0	0	0	0	100
Hawaii	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Illinois	3.27275	3.34864	3.36091	3.04236	2.63572	2.749	3.28848	3.60163	3.16608	2.81161	2.67944	2.48033	2.63979	2.6809	2.79194	2.06283	1.79186	2.11841	3.12099	3.78559	4.59226	5.1851
Indiana	6.11873	6.84399	7.29075	6.21083	5.63105	6.88605	6.27699	4.7027	4.23867	4.48733	5.33012	4.66025	4.72832	4.77169	4.92152	5.53098	4.32285	4.21247	5.10445	6.31096	7.87043	7.72742
Iowa	59.0124	53.074	57.5699	57.8198	54.2843	56.7223	58.54	52.8787	54.2545	57.215	49.8385	50.9419	51.2145	54.0763	49.8654	54.938	50.1981	56.3008	56.9839	69.1519	73.16	72.0509
Kansas	1.622	1.54805	1.48305	1.29813	1.177	1.14948	1.21109	1.02865	1.01326	1.11685	1.14506	1.34093	2.09232	2.12911	2.17763	2.30816	2.77603	3.13558	4.34733	6.50841	7.77018	9.06843
Kansas	1.622	1.54805	1.48305	1.29813	1.177	1.14948	1.21109	1.02865	1.01326	1.11685	1.14506	1.34093	2.09232	2.12911	2.17763	2.30816	2.77603	3.13558	4.34733	6.50841	7.77018	9.06843
Maine	74.6704	70.5408	73.9222	72.3997	69.3364	98.7261	75.8761	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Marylanc	33.2993	17.9767	19.2632	18.7161	20.125	18.3805	22.2822	17.9201	17.9276	17.8325	17.4574	11.5629	13.1086	16.8432	15.9691	13.4823	14.6122	16.6684	16.9461	19.0638	18.1882	20.8048
Massach	54.884	58.9813	57.9515	60.4811	64.5622	60.6172	58.3771	61.5184	52.6265	57.9847	54.715	47.1847	43.6785	49.2442	45.195	41.6495	42.8166	41.6022	41.0643	46.6254	42.9947	47.3258
Michiga	18.9079	17.4591	20.8932	16.1581	20.9479	17.1541	18.4408	17.1111	19.9782	19.5334	17.8412	14.2278	12.7465	15.2339	14.7117	15.2352	15.5798	14.9534	18.8029	20.761	18.6399	17.9361
Minnes ota	31.1999	32.4516	35.5018	33.8885	34.1034	33.0454	35.6928	37.2251	33.904	32.8559	34.7009	37.1594	31.011	30.9392	33.1881	37.7698	36.8438	41.3378	45.9993	49.6684	47.8035	53.5355
Missour	22.5619	16.6286	19.2613	32.8501	22.5042	26.7799	22.0022	23.0426	27.7049	24.8391	15.1458	23.5435	24.7426	17.5297	25.7442	28.6744	18.5629	26.9201	32.9488	33.1263	35.0661	33.8834
Montan	14.4092	16.0393	11.1707	13.3706	10.4791	14.2577	17.5894	16.1627	13.3396	16.3117	12.8831	9.22525	12.4313	11.7317	10.9927	11.9367	12.2939	11.5749	11.9043	12.3732	11.3307	14.5266
Nevada	100	99.859	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
New Hampsh ire	52.0232	36.4936	33.8761	30.8767	38.3625	30.9599	31.5388	33.5529	31.5668	30.0274	31.8561	24.9558	22.9437	23.5941	24.7623	29.5013	25.2407	23.5782	28.994	32.9889	27.289	32.7022
New Jersey	9.40432	12.1464	14.5762	12.3695	15.1867	19.6553	26.2391	21.1966	11.9924	11.6235	11.8944	8.3409	8.15128	7.92017	8.73129	5.62362	5.96922	5.66548	6.34902	8.43718	8.48916	9.08485
New Mexico	0.42377	0.45306	0.39801	0.36652	0.30713	0.32312	0.31268	0.34971	0.33004	0.35429	0.33498	0.27473	0.28875	0.31511	0.43646	0.88953	1.1071	1.30941	1.52246	1.33091	1.53524	1.75951
New York	58.6387	54.0943	58.7758	58.0664	55.6173	56.9611	53.0623	60.0383	57.031	50.9566	55.3056	43.7781	44.6403	43.6667	43.2449	42.2589	43.2069	42.0192	43.5074	42.0584	42.0878	43.536
North Carolina	38.0991	30.1672	40.1303	38.6631	35.5904	30.899	32.6109	32.6134	28.1811	26.2734	25.0307	24.405	23.2336	29.869	25.0623	25.8279	24.6807	21.1668	25.558	25.8015	26.0426	25.4532
North Dakota	4.17992	4.30003	3.94185	3.24948	4.1832	5.78615	7.17398	7.41296	5.34452	5.81532	4.90439	3.62016	3.90125	4.29469	4.41734	3.96384	4.41963	4.48281	6.48192	8.95899	11.4607	13.7507
Ohio	5.85114	6.59616	6.36341	4.7505	6.90947	6.84731	7.70937	7.09163	6.59413	8.34563	8.89143	5.57937	4.97742	6.20805	5.82197	6.01606	6.26133	6.48664	6.23793	6.00555	6.25893	6.06514
Oklaho ma	1.93545	1.67391	2.27851	2.85196	2.22088	2.52894	2.54158	2.79731	3.1252	2.95426	2.52893	2.5496	2.22866	2.32149	3.18593	3.17593	2.54209	3.54847	3.33873	3.56217	4.18276	4.19714
Oregon	87.8909	96.3838	88.0994	99.0077	99.0979	99.5737	99.7117	99.7693	99.7556	99.7346	99.7153	99.6756	99.7868	99.8079	99.8772	99.8717	99.8522	99.8933	99.8036	99.7944	99.6322	99.7307
Pennsyl vania	3.37789	3.53525	3.99277	4.33129	4.37679	4.47893	4.75067	3.96597	3.65888	3.6065	3.80523	3.26309	3.46347	4.14785	4.05278	3.88339	4.03334	3.9535	4.20781	4.75586	4.32302	3.64468
Rhode Island	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
South Dakota	97.9748	97.9284	96.4328	95.6426	97.4386	98.0638	98.4384	98.3023	97.3766	97.8103	97.33	97.1713	97.8472	97.6633	97.3429	97.2007	97.4854	97.0463	95.3842	95.9932	97.3263	98.0632
Texas	1.41133	1.48259	1.65268	1.46747	1.37883	1.4142	1.30057	1.72581	1.52532	1.35482	1.34736	1.3665	1.74439	1.65488	1.75095	1.93003	2.04453	2.38311	3.04521	3.11082	3.9492	4.10029
Utah	1.51434	1.7908	1.74345	1.85075	1.54683	1.76331	1.83276	2.18804	2.09906	2.17645	1.62373	1.11726	1.21855	1.2263	1.32493	1.53015	1.34925	1.1409	1.3405	1.60632	1.87	2.50419
Vermont	33.7368	28.6663	29.0535	33.9875	29.713	32.1001	35.4019	30.8212	36.5469	32.902	31.0792	28.4745	35.4397	34.1836	35.3964	36.4079	34.1196	27.4507	34.5812	36.0456	37.615	37.246
Virginia	6.32995	7.05591	7.12497	8.22406	8.55054	9.29908	9.62207	8.65604	8.93698	8.92078	8.41518	7.13143	6.22885	7.77496	8.44858	10.3401	9.2729	9.94822	10.0834	10.5462	9.44795	9.41883
Washingt	87.6198	88.8242	84.8944	84.0687	83.9674	86.1483	89.4508	89.4415	86.1164	89.4476	85.3256	80.6284	82.6904	82.4007	81.6605	82.722	87.089	91.2189	90.074	92.3026	89.3614	95.4356
West Virg	0.396	0.35366	0.41245	0.51259	0.42162	0.43755	0.47854	0.376	0.35004	0.34983	0.40132	0.34065	0.37483	0.52734	0.48487	0.68669	0.69037	0.62792	0.70078	1.20999	1.14018	1.1774
Wiscons	46.3352	48.4402	48.1379	46.4849	47.0039	49.0545	53.6979	74.8992	52.1826	48.6148	48.4323	50.2313	43.1266	45.0849	43.0296	53.8322	47.438	44.6215	47.4549	44.7303	46.1552	51.0287
Alabama	20.383	20.1535	17.5124	18.301	20.089	18.9551	17.9702	18.4703	19.8112	19.1661	17.8037	17.5839	17.5924	19.2128	19.3698	19.1928	19.431	16.6995	16.229	18.7922	16.7649	18.1357
Alaska	3.84577	3.21129	3.29937	3.79042	3.52394	3.77995	3.52938	2.54707	2.29233	1.77629	2.08366	2.8643	3.12256	3.24135	3.15094	2.70863	2.50179	2.68503	2.67162	3.21877	3.52694	3.45432
Arkansa:	26.9223	26.6776	25.7401	28.0437	26.0584	26.5314	24.232	25.5256	25.7477	26.3786	26.7711	22.4484	25.4325	24.7237	24.3353	25.0491	18.5819	21.6049	16.9851	12.7539	9.7683	8.37307
Florida	45.1643	48.8677	45.7568	43.4231	42.7422	41.5205	46.6104	48.1874	38.1648	37.8037	36.2423	32.1431	33.1022	36.8536	35.6332	38.1524	36.5933	39.0358	37.8763	42.7969	48.5317	52.0495
Georgia	47.2987	45.4132	44.4411	45.6223	44.3374	43.6082	44.972	45.1273	43.8006	41.2671	39.6175	35.3202	46.6229	39.0122	39.189	39.6282	38.2887	37.0195	33.8825	35.279	36.0203	36.2393
Idaho	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Kentucky	1.11016	1.34891	1.36173	1.16865	1.3349	1.26524	1.37682	1.177	1.09674	1.05417	1.06241	1.53342	1.92971	2.20924	2.17044	2.02437	1.82128	1.67351	1.71297	2.322	2.15965	2.26054
Louisian	2.09145	2.19549	2.32217	2.40185	2.48806	2.5717	2.49457	6.66099	6.56572	6.68801	6.62605	6.27905	6.93358	7.51931	9.13312	7.9782	7.62609	7.66863	5.77349	5.16829	3.76495	3.06313
Mississi	32.4029	30.1075	33.2583	35.7351	36.2617	34.0008	29.6123	27.2631	23.3872	23.5112	24.5918	18.5258	15.2903	12.7922	20.9405	22.1937	21.3026	21.6276	16.1789	14.7267	18.1326	18.9119
Nebrask	16.9701	15.5518	14.8879	16.705	20.4715	19.0951	19.538	19.3003	20.863	18.2485	18.9347	17.5489	15.679	18.668	14.7226	16.5195	16.3332	10.3478	11.8905	14.1988	17.9679	31.8477
South Ca	18.9518	19.2394	18.8351	18.513	19.7847	19.443	22.36	21.876	20.2586	15.4415	14.8375	11.9344	12.65	16.4967	15.4337	15.819	15.6845	14.5531	14.5346	15.8842	16.4005	16.3324
Tenness	34.3951	38.0713	39.3793	56.4329	47.1086	39.0907	34.3415	31.8265	29.972	26.4256	25.8727	26.1208	28.032	36.057	32.0053	29.7072	28.8435	22.1246	26.1266	31.518	28.7311	31.196
Wyoming	0.23267	0.24719	0.20646	0.23389	0.23675	0.19401	0.26154	0.2801	0.23987	0.20172	0.20782	0.18164	0.14776	0.13672	0.15801	0.20834	0.19163	0.17445	0.19696	0.32993	0.4254	0.58411

Note: States are color coded according to type of RPS legislation. Red indicates production based RPS, blue indicates consumption based RPS, and yellow indicates states without statewide RPS programs in place.

Appendix 3. Renewable Energy as a Percentage of Overall Energy Consumption, by State and by Year Between 1990 and 2011

States	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Arizona	12.8749	13.5531	14.2644	13.7958	12.1129	13.5036	12.8012	13.0252	10.1706	10.7955	11.0253	8.36337	8.45921	8.64575	8.27934	10.1906	9.39266	10.0275	11.1036	7.42188	8.10185	9.51662
Californi	9.87889	9.17318	9.64902	7.97711	7.84383	7.87598	7.68216	6.37546	5.20636	5.69896	6.40935	6.87269	5.80215	5.80209	5.64356	5.27895	4.93683	5.10093	5.29436	6.00496	6.12448	7.22187
Colorad	4.34617	4.02062	4.27198	3.7323	3.82627	3.778	3.66943	3.84856	3.50657	3.7694	3.63914	1.79865	1.67291	1.80912	1.87781	2.2113	2.13042	2.2162	2.34247	2.77332	2.49886	2.77575
Connect	11.9048	11.986	11.0149	11.3934	11.0603	11.5179	17.7551	15.7143	15.7196	14.952	9.9162	9.66744	8.85375	9.271	10.211	6.47419	6.40905	6.34648	6.56436	8.74317	8.6516	8.61314
Delaware	3.0303	3.01954	3.13043	3.97456	3.96694	4.09165	4.39189	3.86643	3.41113	3.20513	2.91262	2.13115	2.17028	2.18121	2.49169	1.69205	1.41093	1.58172	1.9573	3.36134	3.78947	3.29289
District c	4.04984	3.79009	3.89972	5.20548	5.26316	5.39773	5.17711	3.76344	3.68098	3.76812	3.88889	2.79503	2.59366	2.58621	2.59366	0	0	0	0	0	0	0.30675
Hawaii	84.188	83.5498	82.4034	79.9127	77.4038	68.4685	71.4286	68.3168	68.0412	70.8333	69.8225	58.4746	66.0377	45.5696	59.2233	58.2524	57.9439	55.9633	59.5238	63.8462	73.7179	76.0479
Illinois	5.76023	5.63357	5.70473	4.06733	3.94498	3.84768	4.09737	3.46743	3.44735	3.34537	2.92947	3.14073	3.12612	3.19415	3.39901	2.3912	1.96498	2.07533	2.051	3.0451	2.94645	2.93903
Indiana	5.54451	5.68305	5.75296	4.57123	4.69722	4.4769	4.33221	3.67774	3.59626	3.48516	2.98779	3.68285	3.77422	3.67796	3.887	4.67742	3.49393	3.31782	4.02813	4.38998	3.86245	3.84242
Iowa	14.7724	13.7529	13.835	12.7541	11.7647	11.2507	12.269	10.8927	11.0777	10.8728	9.45987	8.62179	9.49089	9.26498	9.65782	9.63476	6.6129	6.31229	5.8084	6.72783	6.66667	6.54229
Kansas	3.4594	3.42291	3.57666	2.89474	2.58	2.93206	3.01663	2.64534	2.64568	2.96243	2.70178	3.1607	2.81219	3.07747	3.37761	3.14441	2.05825	2.05702	2.28509	2.41726	2.33896	2.43902
Kansas	3.4594	3.42291	3.57666	2.89474	2.58	2.93206	3.01663	2.64534	2.64568	2.96243	2.70178	3.1607	2.81219	3.07747	3.37761	3.14441	2.05825	2.05702	2.28509	2.41726	2.33896	2.43902
Maine	90.2309	88.3607	80.3097	86.6886	86.7775	90.4328	91.0425	91.2741	91.7699	92.3012	81.25	81.7267	72.6767	85.2878	74.0561	83.0491	73.327	70.8968	74.2627	69.4539	68.1708	69.1038
Marylanc	36.0482	36.7863	40.7453	41.5495	41.2241	39.5015	41.6597	37.6775	41.7493	42.2689	41.6115	41.4013	38.6025	39.0633	39.5492	40.0587	42.5044	39.2041	37.8156	39.5227	40.1888	39.9519
Massach	11.5942	11.5156	10.109	10.2941	10.0738	10.9524	10.5114	8.64814	7.85689	8.07666	8.39304	6.85794	6.22884	7.29206	8.43916	3.85732	4.45063	4.29397	3.63432	6.15782	5.837	5.7652
Michiga	7.03429	7.71746	7.52932	6.64734	6.66079	6.51445	7.28221	6.99387	7.4443	6.99464	6.82719	5.60413	4.94711	6.02692	6.49214	7.66231	7.97661	8.5592	8.82557	8.13746	8.33867	8.19753
Minnes ota	12.1391	12.1899	12.72	11.731	12.0608	11.6925	11.1015	11.329	11.0619	10.8108	10.8847	12.5366	9.25926	8.40538	11.0874	11.7828	11.4511	11.0193	10.0987	11.2037	10.9114	10.8222
Missour	6.19015	6.29183	6.72646	5.26799	5.20194	5.17954	4.98084	4.26497	4.38687	4.40379	4.51027	6.0241	5.73379	5.98616	6.12105	9.15517	8.60331	8.93778	9.13493	11.8151	10.6948	11.2522
Montan	18.3333	23.9478	15.2961	12.8571	13.2877	18.922	19.4821	20.1235	18.8776	19.0244	17.7879	15.0246	13.5167	14.7305	15.1479	19.4833	18.1628	21.1458	19.2623	14.4284	14.5349	6.62577
Nevada	7.66129	7.33083	7.63501	7.92793	7.55712	7.30051	7.55627	8.27179	6.48855	7.11563	7.35294	6.38298	6.25	6.05327	5.837	5.30303	5.03673	5.32915	5.88843	5.70222	5.81516	6.86869
New Hampsh ire	46.9178	40.0749	44.2368	42.1212	39.6166	42.492	44.6328	39.3586	37.5405	36.9085	30.3523	23.2704	16.0535	18.6544	28.4884	29.805	19.9262	19.322	21.0345	33.1361	31.5789	30.7463
New Jersey	5.16252	5.11015	4.20459	3.71028	3.53862	3.70307	3.91776	2.80509	2.61663	2.55867	3.19889	2.93236	2.77422	2.63924	2.80319	1.21321	1.70726	1.62618	1.75176	4.4336	4.37896	4.77149
New Mexico	1.90889	2.25159	2.47168	2.31527	2.31125	2.4302	2.29268	2.27472	2.2716	2.65985	2.49886	1.79475	1.91919	1.91511	1.8664	5.92105	5.85366	6.16188	6.39269	4.87936	4.52563	4.61869
New York	8.6468	7.99714	7.46382	8.94223	8.7196	8.39552	9.23105	11.9924	11.2375	11.7823	12.107	8.70134	8.5372	8.77774	9.24311	8.70085	8.82879	8.58956	9.06903	4.84473	4.69352	4.74331
North Carolina	28.4406	22.636	26.593	27.935	32.3461	30.9247	30.2003	30.0405	29.906	29.2517	27.8804	29.0784	26.8682	30.1136	24.9927	26.7309	28.7006	24.1691	29.7619	26.5854	25.5024	27.1403
North Dakota	1.61681	1.61663	1.62482	1.37681	1.67015	1.78218	1.77596	1.66889	1.66205	1.65017	1.70132	2.34568	1.76506	1.91122	2.4026	2.1879	1.86136	1.61491	1.60692	1.79602	1.70288	1.99317
Ohio	5.69821	6.163	5.67803	3.94174	6.11466	5.64796	6.18006	5.9283	5.95533	6.49424	6.54315	4.5175	3.33092	4.1471	4.33158	4.84524	5.2284	5.30799	5.47012	5.74935	5.50281	5.39189
Oklaho ma	4.49039	4.75763	4.50307	4.75207	5.14894	5.14644	6.04689	5.29718	5.65693	5.60588	5.98714	6.63559	5.75419	5.92744	6.7827	6.75331	6.78348	6.06561	2.86674	4.38533	6.14296	6.00091
Oregon	32.696	29.6959	26.0813	23.4583	23.6515	22.6987	22.1268	21.5039	17.7925	15.8818	20.4071	23.9578	21.9525	21.0556	23.5626	21.1771	20.9563	21.8533	20.8753	24.3243	25.2661	24.038
Pennsyl vania	4.68764	5.04781	5.12864	4.81071	4.96806	5.35123	5.72374	5.24728	5.55723	5.65137	5.52523	5.42242	4.94029	4.95721	5.24128	5.66077	5.63952	5.58647	5.90603	7.32203	6.59764	6.64516
Rhode Island	9.82659	6.06586	4.49029	8.92449	5.05837	5.50071	6.20384	5.08197	3.71353	4.12371	6.66667	6.11247	6.41711	6.25	6.21891	2.07792	1.97183	1.83246	2.10526	4.25	4.06091	4.38144
South Dakota	7.61905	7.30994	7.60234	5.80808	5.54217	5.34884	5.42299	4.91071	4.96278	4.7619	4.46247	5.56901	4.61216	4.7619	5.35332	4.97835	5.18018	4.22535	4.60432	5.18207	4.62725	4.91184
Texas	3.26349	3.3325	3.68861	3.34984	3.33158	3.37427	3.09372	3.26812	3.0722	2.80414	2.6434	2.3784	2.66283	2.70308	2.6614	3.49314	3.50166	3.66776	4.20418	2.9119	3.22995	3.32279
Utah	2.05739	2.08659	2.37691	2.11886	2.21053	1.9877	2.09026	2.27376	1.90921	2.17181	2.15633	1.5976	1.79473	1.90703	1.72775	1.60455	1.65598	1.72501	1.82446	1.31234	1.11392	1.16845
Vermont	42.0561	46.5517	42.0635	43.6508	43.75	45.0382	43.5115	32.5153	37.3984	30.7692	34.9315	34.9593	26.3158	25.6637	28.0992	45.4545	45.9459	40.9396	44.1558	57.2139	55.7895	55.8974
Virginia	21.5495	21.4991	21.5836	23.3276	23.2805	23.4436	24.1233	23.1319	23.1719	23.0304	23.2291	19.6721	14.9234	18.3507	19.9555	22.818	23.5086	22.1068	22.556	22.1672	18.7115	19.4748
Washingt	34.8559	28.4827	34.4231	30.71	28.9905	27.6831	26.0883	27.2483	23.9874	23.9191	26.5052	26.7223	28.5513	29.6792	28.9391	25.6844	30.7166	23.5756	23.3574	25.4392	29.2186	27.6918
West Virg	4.20231	4.5	4.51278	4.69925	4.40967	4.76013	5.32075	4.45425	3.98315	3.94412	3.93701	3.92827	3.66361	5.34316	5.39262	8.857	8.29493	8.01956	8.70659	14.4266	11.7083	11.9545
Wiscons	18.4277	17.7395	18.1522	16.5073	16.8479	16.5294	17.341	17.7748	17.8923	18.1124	17.5583	20.1249	14.4906	16.2861	14.0458	19.5253	19.7113	18.0521	17.1769	16.1444	17.4	17.1721
Alabama	23.0754	22.5962	21.5925	25.5344	30.3198	30.121	28.1791	25.6394	30.2661	30.8636	31.1743	30.1398	30.3071	29.1125	32.6954	33.5572	36.0371	35.5801	33.752	31.3256	29.7863	31.8482
Alaska	2.69831	2.29722	2.39312	1.97802	2.74818	2.00191	1.89252	0.94153	0.48088	0.47182	0.48485	0.79324	0.82603	0.86801	0.89169	0.29681	0.35088	0.38269	0.41895	0.85281	0.81673	0.81513
Arkansa	25.7511	27.5967	27.3881	28.506	26.7112	25.4914	26.3844	26.401	25.8856	27.063	26.8339	23.9138	25.4759	26.3815	28.4126	31.1765	32.1442	33.3333	29.3706	32.7273	30.8475	31.0987
Florida	48.015	47.6258	47.0369	43.3835	39.9337	39.6657	39.6118	40.9751	38.6401	36.845	36.1204	37.1692	38.839	41.9749	41.6101	42.5761	43.0922	44.9239	46.4835	50.3358	48.6575	52.9383
Georgia	33.4578	32.2689	31.725	32.65	32.9307	32.766	32.2915	34.343	34.0251	35.8227	31.4245	30.3693	40.0939	30.8523	31.926	30.6913	32.6274	32.6923	28.4564	29.531	29.0543	31.0798
Idaho	28.6073	25.8837	28.91	25.9783	24.8087	24.6465	24.9016	26.7961	25.0712	26.3207	24.6073	25.9659	21.5116	23.5729	24.7115	30.4736	29.1209	28.9083	27.027	23.638	24.8609	24.7516
Kentucky	5.87058	6.31615	6.44835	4.75752	4.69037	4.4401	5.22677	3.95199	3.97014	3.97373	4.00913	4.54854	7.15686	8.14249	8.28935	10.2644	10.2632	10.4397	10.4596	11.3	11.1002	11.6177
Louisian	7.85709	8.26813	8.29229	8.15694	9.04319	9.08738	9.02707	8.06933	9.14305	10.1878	9.38601	10.4792	10.3047	11.1147	13.218	11.708	11.0314	10.5389	8.04115	8.02432	7.1972	7.53761
Mississi	29.6919	31.0656	31.1385	31.5484	33.5929	33.4755	30.3287	30.2367	26.4112	23.4195	26.2079	22.7126	20.6753	20.1602	25.0613	26.4805	26.4903	25.0987	19.2831	19.7948	20.6116	22.0016
Nebrask	4.00697	3.94737	4.38982	3.25019	3.13199	2.9682	5.4558	4.45993	4.30725	4.67433	4.32869	5.72879	6.39579	6.60091	6.82171	6.46921	4.69653	4.62318	4.25179	4.56338	4.39443	4.21962
South Ca	27.9377	29.046	28.0986	27.8534	28.8036	30.2824	33.026	33.0088	31.2604	27.5397	27.1091	23.4603	24.5926	25.897	27.5237	28.4696	30.3667	31.0696	31.8828	33.3333	31.7872	35.1295
Tenness	14.6746	15.5137	15.016	13.139	15.808	15.9926	14.496	12.931	12.8849	13.4091	13.6514	16.0103	16.6667	16.112	19.7159	18.7097	17.1961	15.7394	17.4188	16.0537	15.5177	15.1959
Wyoming	1.82803	1.85676	1.22494	1.28452	1.44201	1.39073	1.21406	1.29366	1.0989	1.35135	1.35777	1.15607	1.08035	1.04235	1.08696	2.09177	1.87668	1.58991	1.68113	1.11607	0.95949	0.96741

Note: States are color coded according to type of RPS legislation. Red indicates production based RPS, blue indicates consumption based RPS, and yellow indicates states without statewide RPS programs in place.

Appendix 4. Normalized Production Data for RPS States, by State and by Year

States	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0
Arizona	17.427	20.067	18.299	16.636	14.321	13.258	12.631	12.945	12.504	12.873	15.89
Californi	45.377	54.52	47.741	57.459	54.643	54.517	53.872	50.003	49.27	44.57	47.273
Colorado	2.5359	2.8381	2.5318	2.5109	1.8379	1.9113	1.8216	1.4374	1.1555	1.1376	1.0793
Connecti	12.729	14.828	14.228	21.376	18.145	14.588	16.103	18.979	46.161	100	59.116
Delaware	100	100	100	100	100	100	100	100	100	100	100
District of	100	100	100	100	100	100	100	100	100	100	0
Hawaii	100	100	100	100	100	100	100	100	100	100	100
Illinois	3.6016	3.1661	2.8116	2.6794	2.4803	2.6398	2.6809	2.7919	2.0628	1.7919	2.1184
Indiana	4.6603	4.7283	4.7717	4.9215	5.531	4.3228	4.2125	5.1045	6.311	7.8704	7.7274
Iowa	59.636	39.36	31.483	27.648	29.408	46.659	30.511	60.495	60.541	62.016	66.069
Kansas	1.1168	1.1451	1.3409	2.0923	2.1291	2.1776	2.3082	2.776	3.1356	4.3473	6.5084
Kansas	1.1168	1.1451	1.3409	2.0923	2.1291	2.1776	2.3082	2.776	3.1356	4.3473	6.5084
Maine	98.726	75.876	100	100	100	100	100	100	100	100	100
Maryland	20.125	18.381	22.282	17.92	17.928	17.833	17.457	11.563	13.109	16.843	15.969
Massach	83.556	83.928	67.686	54.884	58.981	57.951	60.481	64.562	60.617	58.377	61.518
Michiga	19.978	19.533	17.841	14.228	12.746	15.234	14.712	15.235	15.58	14.953	18.803
Minnesota	37.225	33.904	32.856	34.701	37.159	31.011	30.939	33.188	37.77	36.844	41.338
Missouri	27.705	24.839	15.146	23.544	24.743	17.53	25.744	28.674	18.563	26.92	32.949
Montan	14.258	17.589	16.163	13.34	16.312	12.883	9.2252	12.431	11.732	10.993	11.937
Nevada	100	100	100	100	100	100	100	100	100	100	100
New Hampshire	33.553	31.567	30.027	31.856	24.956	22.944	23.594	24.762	29.501	25.241	23.578
New Jersey	12.51	9.4043	12.146	14.576	12.37	15.187	19.655	26.239	21.197	11.992	11.624
New Mexico	0.3497	0.33	0.3543	0.335	0.2747	0.2888	0.3151	0.4365	0.8895	1.1071	1.3094
New York	55.617	56.961	53.062	60.038	57.031	50.957	55.306	43.778	44.64	43.667	43.245
North Carolina	32.613	28.181	26.273	25.031	24.405	23.234	29.869	25.062	25.828	24.681	21.167
North Dakota	7.413	5.3445	5.8153	4.9044	3.6202	3.9013	4.2947	4.4173	3.9638	4.4196	4.4828
Ohio	7.0916	6.5941	8.3456	8.8914	5.5794	4.9774	6.2081	5.822	6.0161	6.2613	6.4866
Oklahoma	2.5289	2.5496	2.2287	2.3215	3.1859	3.1759	2.5421	3.5485	3.3387	3.5622	4.1828
Oregon	99.769	99.756	99.735	99.715	99.676	99.787	99.808	99.877	99.872	99.852	99.893
Pennsylvania	4.3768	4.4789	4.7507	3.966	3.6589	3.6065	3.8052	3.2631	3.4635	4.1478	4.0528
Rhode Island	100	100	100	100	100	100	100	100	100	100	100
South Dakota	97.377	97.81	97.33	97.171	97.847	97.663	97.343	97.201	97.485	97.046	95.384
Texas	1.5752	1.4113	1.4826	1.6527	1.4675	1.3788	1.4142	1.3006	1.7258	1.5253	1.3548
Utah	2.0991	2.1765	1.6237	1.1173	1.2185	1.2263	1.3249	1.5301	1.3492	1.1409	1.3405
Vermont	32.1	35.402	30.821	36.547	32.902	31.079	28.475	35.44	34.184	35.396	36.408
Virginia	8.656	8.937	8.9208	8.4152	7.1314	6.2289	7.775	8.4486	10.34	9.2729	9.9482
Washingt	89.451	89.441	86.116	89.448	85.326	80.628	82.69	82.401	81.661	82.722	87.089
West Virg	0.3498	0.4013	0.3407	0.3748	0.5273	0.4849	0.6867	0.6904	0.6279	0.7008	1.21
Wisconsi	51.857	46.335	48.44	48.138	46.485	47.004	49.055	53.698	74.899	52.183	48.615

States	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Arizona	14.958	15.775	13.37	13.726	17.62																							
Californi	49.113	50.9	50.265	54.387	46.307	46.8	49.922	51.568	55.062																			
Colorado	1.4902	1.6422	1.7995	2.7583	2.711	2.6111	3.359																					
Connecti	27.124	22.864	15.623	15.393	15.726	14.92	13.717	12.96	12.291	14.096	14.561	13.842	15.197															
Delaware	100	100	100	100	100	100																						
District of	0	0	0	0	0	100																						
Hawaii	100	100	100	100	100	100	100	100	100	100																		
Illinois	3.121	3.7856	4.5923	5.1851																								
Indiana																												
Iowa	62.969	67.955	68.197	72.171	70.381	58.696	59.012	53.074	57.57	57.82	54.284	56.722	58.54	52.879	54.255	57.215	49.839	50.942	51.215	54.076	49.865	54.938	50.198	56.301	56.984	69.152	73.16	72.051
Kansas	7.7702	9.0684																										
Kansas	7.7702	9.0684																										
Maine	100	100	100	100	100	100																						
Maryland	13.482	14.612	16.668	16.946	19.064	18.188	20.805																					
Massach	52.627	57.985	54.715	47.185	43.678	49.244	45.195	41.649	42.817	41.602	41.064	46.625	42.995	47.326														
Michiga	20.761	18.64	17.936																									
Minnesota	45.999	49.668	47.804	53.536																								
Missouri	33.126	35.066	33.883																									
Montan	12.294	11.575	11.904	12.373	11.331	14.527																						
Nevada	100	100	100	100	100	100	100	100	100	100	100	100	100	100														
New Hampshire	28.994	32.989	27.289	32.702																								
New Jersey	11.894	8.3409	8.1513	7.9202	8.7313	5.6236	5.9692	5.6655	6.349	8.4372	8.4892	9.0848																
New Mexico	1.5225	1.3309	1.5352	1.7595																								
New York	42.259	43.207	42.019	43.507	42.058	42.088	43.536																					
North Carolina	25.558	25.801	26.043	25.453																								
North Dakota	6.4819	8.959	11.461	13.751																								
Ohio	6.2379	6.0055	6.2589	6.0651																								
Oklahoma	4.1971																											
Oregon	99.804	99.794	99.632	99.731																								
Pennsylvania	3.8834	4.0333	3.9535	4.2078	4.7559	4.323	3.6447																					
Rhode Island	100	100	100	100	100	100	100																					
South Dakota	95.993	97.326	98.063																									
Texas	1.3474	1.3665	1.7444	1.6549	1.751	1.93	2.0445	2.3831	3.0452	3.1108	3.9492	4.1003																
Utah	1.6063	1.87	2.5042																									
Vermont	34.12	27.451	34.581	36.046	37.615	37.246																						
Virginia	10.083	10.546	9.4479	9.4188																								
Washingt	91.219	90.074	92.303	89.361	95.436																							
West Virg	1.1402	1.1774																										
Wisconsi	48.432	50.231	43.127	45.085	43.03	53.832	47.438	44.621	47.455	44.73	46.155	51.029																

Note: States are color coded according to type of RPS legislation. Red indicates production based RPS, blue indicates consumption based RPS, and yellow indica states without statewide RPS programs in place.

Appendix 5. Normalized Consumption Data for RPS States, by State and by Year

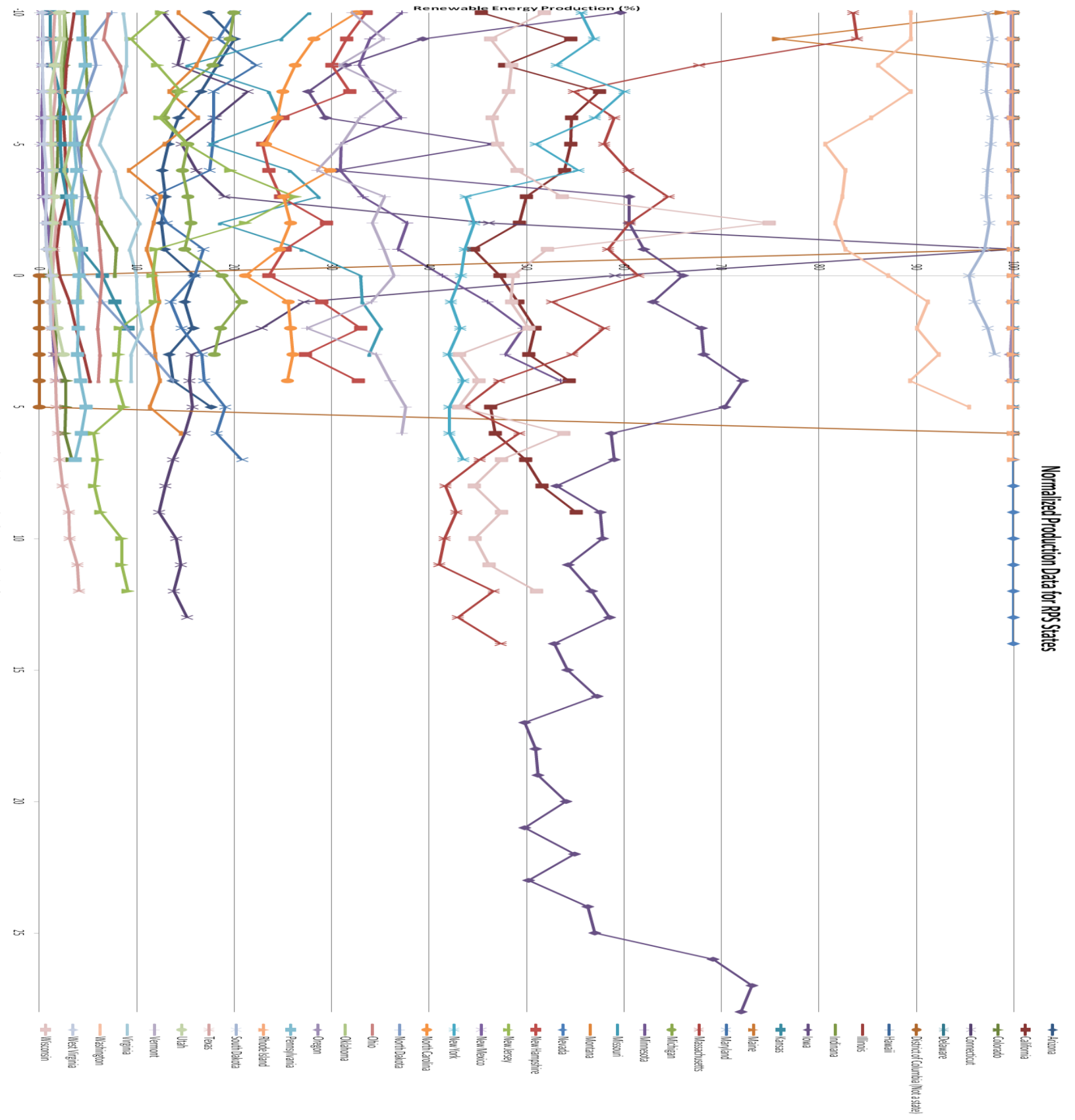
States	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0
Arizona	12.801	13.025	10.171	10.795	11.025	8.3634	8.4592	8.6458	8.2793	10.191	9.3927
California	9.649	7.9771	7.8438	7.876	7.6822	6.3755	5.2064	5.699	6.4094	6.8727	5.8021
Colorado	3.8263	3.778	3.6694	3.8486	3.5066	3.7694	3.6391	1.7987	1.6729	1.8091	1.8778
Connecti	24.034	16.637	11.905	11.986	11.015	11.393	11.06	11.518	17.755	15.714	15.72
Delaware	4.0917	4.3919	3.8664	3.4111	3.2051	2.9126	2.1311	2.1703	2.1812	2.4917	1.692
District of	5.3977	5.1771	3.7634	3.681	3.7681	3.8889	2.795	2.5937	2.5862	2.5937	0
Hawaii	83.55	82.403	79.913	77.404	68.468	71.429	68.317	68.041	70.833	69.822	58.475
Illinois	3.4674	3.4473	3.3454	2.9295	3.1407	3.1261	3.1941	3.399	2.3912	1.965	2.0753
Indinana	3.6828	3.7742	3.678	3.887	4.6774	3.4939	3.3178	4.0281	4.39	3.8625	3.8424
Iowa	1.9445	2.0965	2.2072	2.4568	2.8101	3.496	2.8843	13.984	14.694	15.562	17.478
Kansas	2.9624	2.7018	3.1607	2.8122	3.0775	3.3776	3.1444	2.0583	2.057	2.2851	2.4173
Kansas	2.9624	2.7018	3.1607	2.8122	3.0775	3.3776	3.1444	2.0583	2.057	2.2851	2.4173
Maine	90.433	91.042	91.274	91.77	92.301	81.25	81.727	72.677	85.288	74.056	83.049
Maryland	41.224	39.501	41.66	37.678	41.749	42.269	41.611	41.401	38.603	39.063	39.549
Massach	22.583	22.951	15.962	11.594	11.516	10.109	10.294	10.074	10.952	10.511	8.6481
Michiga	7.4443	6.9946	6.8272	5.6041	4.9471	6.0269	6.4921	7.6623	7.9766	8.5592	8.8256
Minneso ta	11.329	11.062	10.811	10.885	12.537	9.2593	8.4054	11.087	11.783	11.451	11.019
Missouri	4.3869	4.4038	4.5103	6.0241	5.7338	5.9862	6.121	9.1552	8.6033	8.9378	9.1349
Montan	18.922	19.482	20.123	18.878	19.024	17.788	15.025	13.517	14.731	15.148	19.483
Nevada	5.6122	5.4118	6.7762	7.6613	7.3308	7.635	7.9279	7.5571	7.3005	7.5563	8.2718
New Hampshi re	39.359	37.54	36.909	30.352	23.27	16.054	18.654	28.488	29.805	19.926	19.322
New Jersey	7.986	5.1625	5.1102	4.2046	3.7103	3.5386	3.7031	3.9178	2.8051	2.6166	2.5587
New Mexico	2.2747	2.2716	2.6598	2.4989	1.7948	1.9192	1.9151	1.8664	5.9211	5.8537	6.1619
New York	8.7196	8.3955	9.2311	11.992	11.238	11.782	12.107	8.7013	8.5372	8.7777	9.2431
North Carolina	30.041	29.906	29.252	27.88	29.078	26.868	30.114	24.993	26.731	28.701	24.169
North Dakota	1.6689	1.662	1.6502	1.7013	2.3457	1.7651	1.9112	2.4026	2.1879	1.8614	1.6149
Ohio	5.9283	5.9553	6.4942	6.5432	4.5175	3.3309	4.1471	4.3316	4.8452	5.2284	5.308
Oklaho ma	5.9871	6.6356	5.7542	5.9274	6.7827	6.7533	6.7835	6.0656	2.8667	4.3853	6.143
Oregon	21.504	17.792	15.882	20.407	23.958	21.952	21.056	23.563	21.177	20.956	21.853
Pennsyl vania	4.9681	5.3512	5.7237	5.2473	5.5572	5.6514	5.5252	5.4224	4.9403	4.9572	5.2413
Rhode Island	5.0584	5.5007	6.2038	5.082	3.7135	4.1237	6.6667	6.1125	6.4171	6.25	6.2189
South Dakota	4.9628	4.7619	4.4625	5.569	4.6122	4.7619	5.3533	4.9784	5.1802	4.2254	4.6043
Texas	3.7723	3.2635	3.3325	3.6886	3.3498	3.3316	3.3743	3.0937	3.2681	3.0722	2.8041
Utah	1.9092	2.1718	2.1563	1.5976	1.7947	1.907	1.7277	1.6046	1.656	1.725	1.8245
Vermont	45.038	43.511	32.515	37.398	30.769	34.932	34.959	26.316	25.664	28.099	45.455
Virginia	23.132	23.172	23.03	23.229	19.672	14.923	18.351	19.956	22.818	23.509	22.107
Washingt	26.088	27.248	23.987	23.919	26.505	26.722	28.551	29.679	28.939	25.684	30.717
West Virg	3.9441	3.937	3.9283	3.6636	5.3432	5.3926	8.857	8.2949	8.0196	8.7066	14.427
Wisconsi	22.022	18.428	17.739	18.152	16.507	16.848	16.529	17.341	17.775	17.892	18.112

States	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Arizona	10.027	11.104	7.4219	8.1019	9.5166									
California	5.8021	5.6436	5.2789	4.9368	5.1009	5.2944	6.005	6.1245	7.2219					
Colorado	2.2113	2.1304	2.2162	2.3425	2.7733	2.4989	2.7757							
Connecti	14.952	9.9162	9.6674	8.8538	9.271	10.211	6.4742	6.409	6.3465	6.5644	8.7432	8.6516	8.6131	
Delaware	1.4109	1.5817	1.9573	3.3613	3.7895	3.2929								
District of	0	0	0	0	0	0.3067								
Hawaii	66.038	45.57	59.223	58.252	57.944	55.963	59.524	63.846	73.718	76.048				
Illinois	2.051	3.0451	2.9465	2.939										
Indinana														
Iowa	17.401	17.681	23.866	24.571	23.715	15.611	14.772	13.753	13.835	12.754	11.765	11.251	12.269	10.893
Kansas	2.339	2.439												
Kansas	2.339	2.439												
Maine	73.327	70.897	74.263	69.454	68.171	69.104								
Maryland	40.059	42.504	39.204	37.816	39.523	40.189	39.952							
Massach	7.8569	8.0767	8.393	6.8579	6.2288	7.2921	8.4392	3.8573	4.4506	4.294	3.6343	6.1578	5.837	5.7652
Michiga	8.1375	8.3387	8.1975											
Minneso ta	10.099	11.204	10.911	10.822										
Missouri	11.815	10.695	11.252											
Montan	18.163	21.146	19.262	14.428	14.535	6.6258								
Nevada	6.4885	7.1156	7.3529	6.383	6.25	6.0533	5.837	5.303	5.0367	5.3292	5.8884	5.7022	5.8152	6.8687
New Hampshi re	21.034	33.136	31.579	30.746										
New Jersey	3.1989	2.9324	2.7742	2.6392	2.8032	1.2132	1.7073	1.6262	1.7518	4.4336	4.379	4.7715		
New Mexico	6.3927	4.8794	4.5256	4.6187										
New York	8.7008	8.8288	8.5896	9.069	4.8447	4.6935	4.7433							
North Carolina	29.762	26.585	25.502	27.14										
North Dakota	1.6069	1.796	1.7029	1.9932										
Ohio	5.4701	5.7493	5.5028	5.3919										
Oklaho ma	6.0009													
Oregon	20.875	24.324	25.266	24.038										
Pennsyl vania	5.6608	5.6395	5.5865	5.906	7.322	6.5976	6.6452							
Rhode Island	2.0779	1.9718	1.8325	2.1053	4.25	4.0609	4.3814							
South Dakota	5.1821	4.6272	4.9118											
Texas	2.6434	2.3784	2.6628	2.7031	2.6614	3.4931	3.5017	3.6678	4.2042	2.9119	3.23	3.3228		
Utah	1.3123	1.1139	1.1685											
Vermont	45.946	40.94	44.156	57.214	55.789	55.897								
Virginia	22.556	22.167	18.711	19.475										
Washingt	23.576	23.357	25.439	29.219	27.692									
West Virg	11.708	11.954												
Wisconsi	17.558	20.125	14.491	16.286	14.046	19.525	19.711	18.052	17.177	16.144	17.4	17.172		

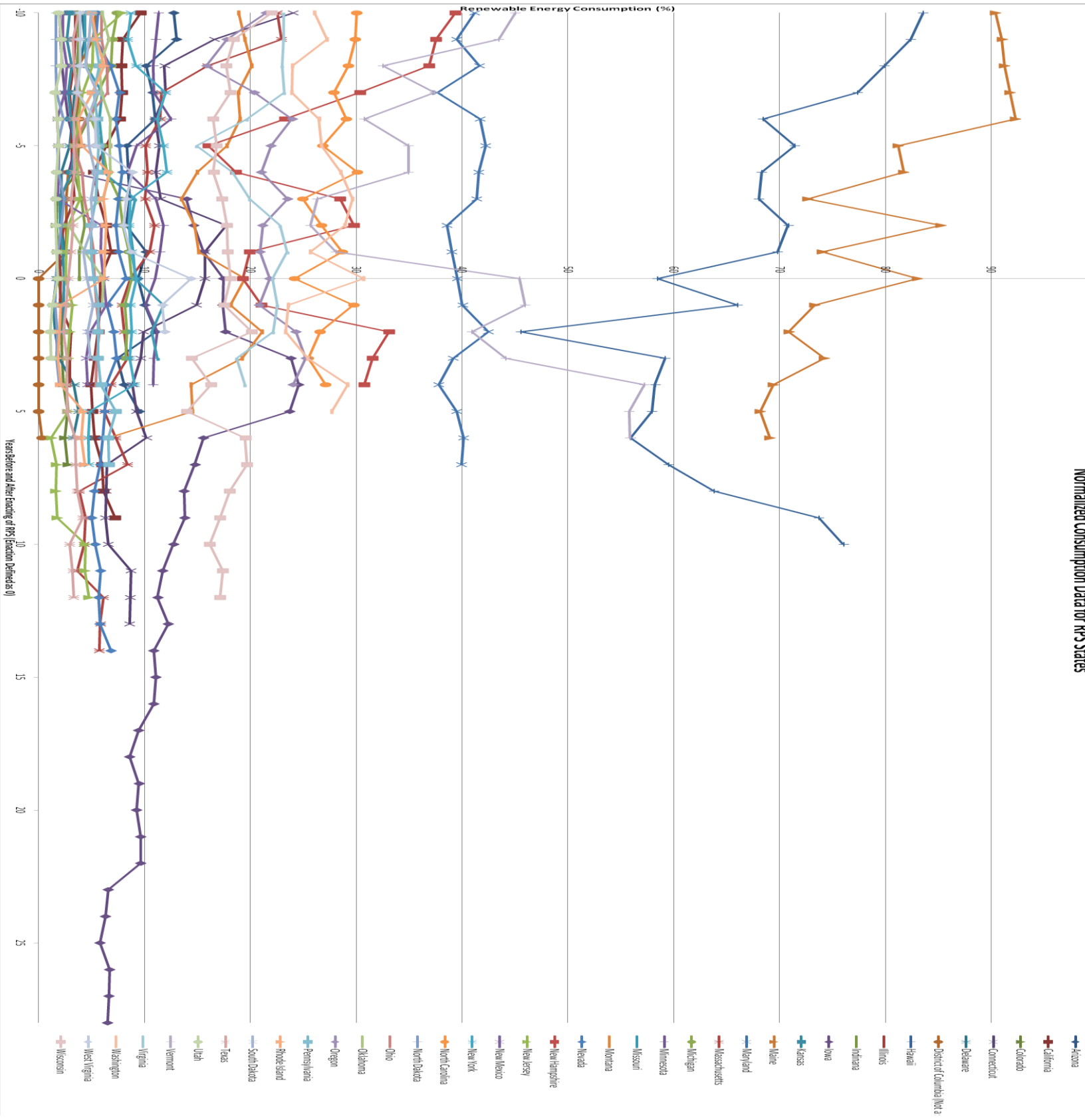
States	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Iowa	11.078	10.873	9.4599	8.6218	9.4909	9.265	9.6578	9.6348	6.6129	6.3123	5.8084	6.7278	6.6667	6.5423

Note: States are color coded according to type of RPS legislation. Red indicates production based RPS, blue indicates consumption based RPS, and yellow indicates states without statewide RPS programs in place.

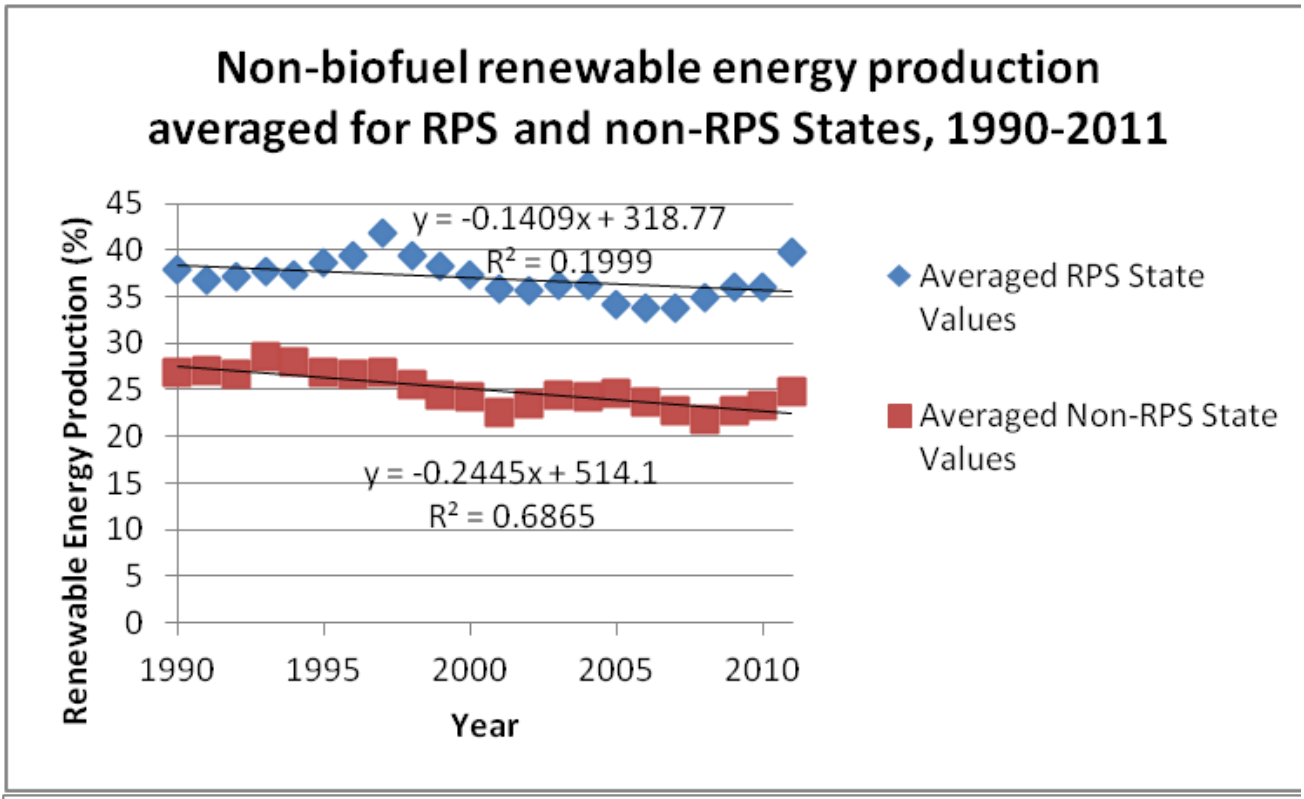
Appendix 6. Normalized Production Data for RPS States, Graphed

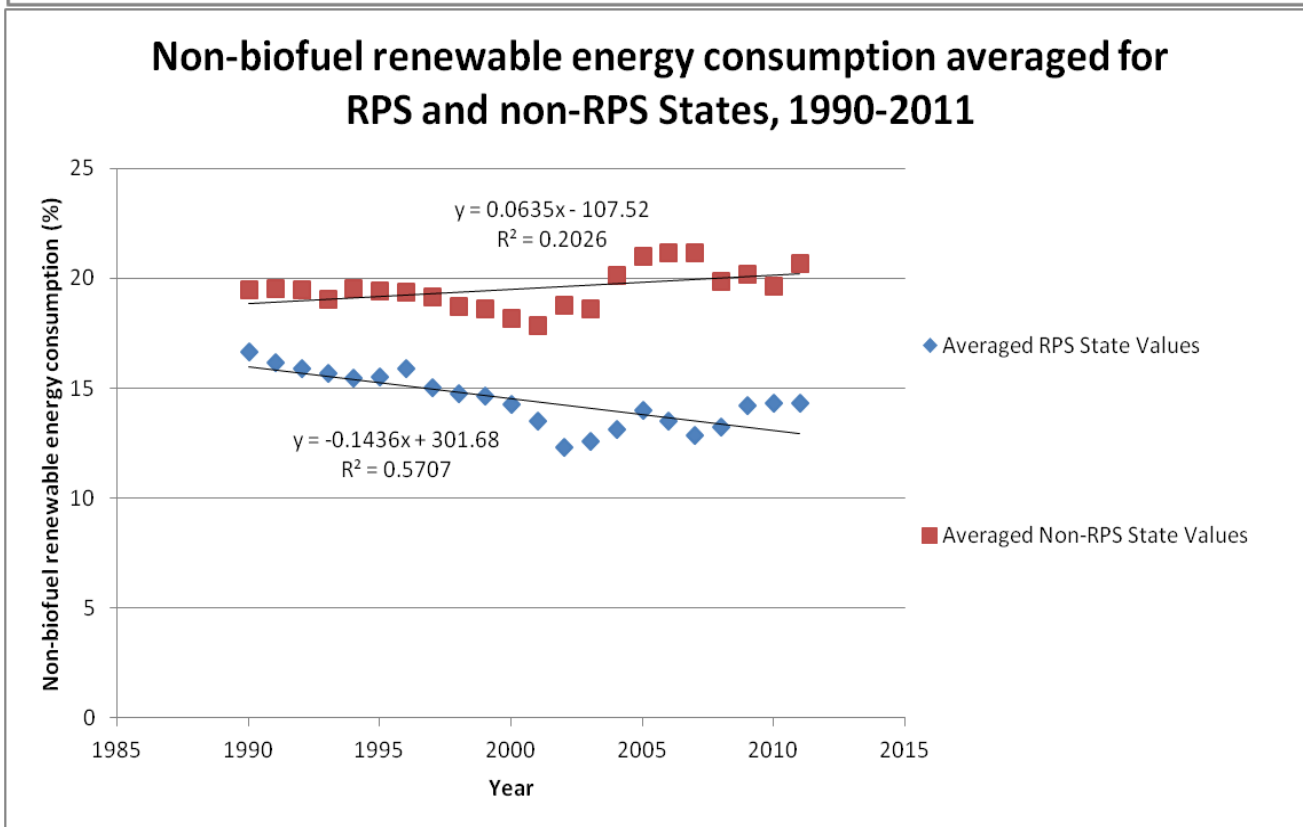


Appendix 7. Normalized Consumption Data for RPS States, Graphed



Appendix 8. Averaged Renewable Energy Production and Consumption Values as a Percentage by Year for RPS States vs. Non-RPS States





Appendix 9. Normalized and Averaged Values for Production and Consumption in RPS States.