RHODE ISLAND CENTER FOR FREEDOM & PROSPERITY

THE BEACON HILL INSTITUTE AT SUFFOLK UNIVERSITY

The Economic Impact of Rhode Island's Renewable Energy Standard

How Energy Mandates Will Harm the Economy

Published in Cooperation with the Beacon Hill Institute

February 2014

Rhode Island Center for Freedom & Prosperity | **www.RIFreedom.org** | PO Box 10069 | Cranston, RI 02910

Executive Summary

In 2004, the State of Rhode Island enacted Renewable Energy Standards (RES) through legislation known as the Clean Energy Act. Many of the assumptions used to justify the Act turned out to be largely inaccurate, and implementation of its mandates will exact more costs to the Rhode Island economy, with only limited benefits, if any.

This study estimates the economic impact of maintaining RES mandates over the next six years in the Ocean State. Rhode Island's energy prices are already among the highest in the nation, and the state's poorly rated business climate hardly needs another factor to exacerbate it.[1]

The major findings of this study show:

- The current energy mandates will raise the cost of electricity by almost $150 million for the state's consumers through 2020.
- RI's electricity prices will unnecessarily rise by an additional 1.85% by 2020.

These increased energy prices will hurt Rhode Island's residents and businesses and, consequently, inflict harm on the state's economy. In 2020, the RES is expected to:

- Increase unemployment in an already-weak jobs market.
- Reduce real disposable income for families.
- Decrease private investment in the state.
- Increase the overall energy costs of households, businesses, and industries.

Rhode Island is not alone. Nationally, government mandates that require electric utilities companies to use wind and solar power instead of more-affordable hydrocarbons have left ratepayers with sticker shock in state after state, according to a recent Centennial Institute study.[2] Average electric rates are 21% higher in the 30 states with mandates than in the 20 states without them, according to expert Kelly Sloan.

Faulty Assumptions

In 2004, at the height of the manmade global warming campaign, a number of assumptions were broadly promoted as reasons for states, our nation, and other countries to enact and implement strict energy guidelines that would limit carbon dioxide emissions into the atmosphere. Nine years later, there are strong arguments to suggest that most of the assumptions that were used as a basis for the energy mandates imposed in Rhode Island were off the mark. The following are among the assumptions that are now openly in dispute:

- **Renewable energy would be more cost-efficient.** Renewable energy costs remain significantly higher than conventional sources, with few near-term expectations for change.[3]
- **Renewable energy would be abundantly plentiful.** The inconsistency of wind and solar sources creates significant periods of non-production, often requiring additional fossil-fuel plants to be built as "backup" systems.[4]
- **Fossil fuel sources would become scarce in the near future.** Technological advances, in procurement, transportation, and consumption, continue to expand available energy sources, especially for the United States, which is projected to enjoy an extended, energy-self-sufficient period as the lead producer of oil.[5]
- **Fossil fuels would become increasingly expensive.** Coal and natural gas continue to be the least expensive sources of electricity and will continue to be the most cost-efficient sources in

the coming decades. As America extracts and refines more and more of its vast reserves, oil prices could also see a significant decline.[6]

- **Renewable energy would spur a boom in green jobs.** There has been no such boom; many once-promising green companies have gone out of business because of low demand for high-priced energy sources. Some European countries that invested heavily in the "green revolution" suffered more job losses than gains.[7]
- **Renewable energy is better for the environment.** This may not be true in the near term. The need for backup power plants decreases environmental efficiency. Better air quality can be achieved via natural gas, which is significantly cleaner than coal.[8] By contrast, "energy sprawl" has become a popular term among environmentalists to describe the massive amount of land or sea area required for wind or solar farms, which many consider eye pollution.[9] Furthermore, the miles of transmission lines required for such technology often cut through pristine landscapes,[10] and windmills are a danger to birds and bats.[11]
- **Global warming is an immediate danger to our Earth.** With recent reports that global temperatures have flattened over the past 17 years, despite increasing overall carbon emissions, it is now much more of an open question as to whether or not restrictive and punitive energy mandates will actually make a decisive difference in global temperatures.[12]

Specific Findings

- Compliance costs for RI's RES requirements is already millions of dollars per year and expected to continue climbing, with much of the burden passed on to energy consumers.
- The intermittent nature of common renewable energy sources means that the standards may not even succeed in their intended purpose of reducing greenhouse gas and other emissions.
- Rhode Island's RES mandate will cost Rhode Island $21.4 million per year by 2020.
- At the end of this decade, electricity prices will be 0.24 cents per kilowatt-hour (kWh) higher because of the RES.
- These increases will cost the state 105 jobs and $4.6 million in investment dollars and lower the real disposable income by $33.0 million.

Deepwater Wind

The additional negative economic projections related to the implementation of the Deepwater Wind project are not included in these findings. The purpose of this report is to project the general adverse effects of continuing with existing RES mandates; the Deepwater project represents a specific choice to implement one or more of those mandates.

The RI Center for Freedom & Prosperity plans to run the estimated $350–500 million in additional costs to ratepayers through its RI-STAMP modeling tool and release those projections in the coming weeks. It is reasonable to expect the negative effect of this single, specific project to be significantly larger than the general effect of existing RES policies.

Policy Recommendations

Given the shifting landscape of the climate change debate and unchanging condition of Rhode Island's economy, the question for Rhode Islanders is whether or not the state should loosen its energy mandate policies. This study shows that, if left unchanged, current policies will indeed cause further harm to our state's already struggling economy.

Even if recent questions about the true global climate effect of carbon emissions prove unfounded, is it realistic to think that restrictive energy policies in the Ocean State will have any impact at all on the global climate, considering its small geographic and industrial footprint? Or should the state seek to roll back some of the burdens these mandates are projected to impose on families and businesses?

If the General Assembly is willing to consider reform of existing RES laws, our Center recommends:

- Enact the Electricity Freedom Act, repealing the state's renewable energy standards (see Appendix B for model legislation).
- Require that the state investigate and utilize methods of predicting and tracing the economic effects of renewable energy standards on Rhode Island, prior to renewed implementation.

Introduction

On June 29, 2004, Rhode Island enacted the state's Renewable Energy Standard (RES), known as the Clean Energy Act.[13] The act aimed to "stabilize future energy costs" and lower carbon emissions by requiring the state's electricity providers (excluding Pascoag Utility District and Block Island Power Company) to incrementally increase the amount of energy produced by renewable energy resources.[14]

The mandate began at 3% in 2007, increasing 0.5% per year through 2010, then 1% per year from 2011 until 2014, and 1.5% per year from 2014 until the mandate reaches 16% in 2019.[15] Renewable energy sources included "direct solar radiation, the wind, movement or the latent heat of the ocean, the heat of the earth, small hydro facilities, biomass facilities using eligible biomass fuels… [and] fuel cells using the renewable resources referenced above."[16]

The Act differentiated renewable energy sources into two groups: new and existing. New renewable energy sources are generating units that first went into commercial operation after December 31, 1997, or those that have "increased generation in excess of ten percent (above 1997 output levels) using eligible renewable energy resources through capital investments made after December 31, 1997."[17] Existing renewable energy sources are generation units that do not fulfill the previously stated requirements. Ultimately, only two percent of the 16% required by the RES can be produced by existing renewable energy sources.[18]

Electric utilities achieve compliance by either generating the required amount of renewable energy, purchasing New England Power Pool General Information System (NEPOOL-GIS) Certificates (a specific type of Renewable Energy Credit [REC]), or making Alternative Compliance Payments (ACPs) to the state's Renewable Energy Development Fund.[19] One GIS certificate is awarded to an electricity producer for every Megawatt hour (MWh) of renewable energy produced.[20]

ACPs' price is determined by a formula that annually adjusts the initial price ($50/MWh) with a Consumer Price Index (CPI) calculation.[21] For example, in 2012, the price of one ACP was $64.02.

The Act provides no cost cap provisions and allows firms defined as obligated entities (e.g., National Grid) to bank excess compliance generated from new renewable energy sources for up to two subsequent compliance years.[22] The maximum bankable amount of credits is set at 30% of the current year's obligation.[23] As is typical for New England states, Rhode Island relies on the ISO-New England regulatory board (NEPOOL) to track the creation, sale, and purchase of GIS certificates.

Prior to 2011, electricity firms attained compliance, for the most part, through the generation of renewable energy and the purchase of GIS Certificates. In other words, ACPs were rarely purchased. In fact, from 2009 to 2010, utilities purchased only $21,935 worth of ACPs, fulfilling a negligible portion of the new RES requirements.[24]

However, in 2011, $5.24 million worth of ACPs satisfied 30% of all new RES compliance.[25] The same year, Rhode Island's annual compliance reports found that Narragansett Electric, producer of 68% of the state's energy, incurred compliance costs of $8.43 million.[26] Narragansett Electric's 2011 compliance costs represented a "four-fold increase above the costs incurred to comply with 2010 RES targets ($2.07 million) and a 53 percent increase from 2009 costs ($5.51 million)."[27]

In the opinion of the Public Utilities Commission of Rhode Island, costs "will likely rise further, particularly in the short-term, as shortage conditions persist and the state's renewable targets increase."[28] The commission ascribed the "shortage conditions" to four developments:

- The drop in natural gas prices has displaced renewables.
- State and national economic stagnation in combination with uncertainty over federal tax incentives slowed investments in new renewable energy sources.
- Rising RES requirements across New England increased the demand and cost of GIS Certificates.
- New York ceased exporting a large sum of GIS Certificates because of their own RES requirements.[29] In other words, companies kept them for their own compliance rather than selling them to other states.

In the commission's final analysis, they recognized:

> … that the true cost of RES compliance for all electric supply customers in Rhode Island is difficult to calculate. While Narragansett Electric accounted for approximately 68 percent of total electric load in the compliance year, sixteen competitive suppliers combined to service the rest. Their costs to procure the required RECs and/or make ACPs are proprietary in nature, but are likely recovered in some fashion through the rates they charge their contracted customers throughout the Ocean State.[30]

One could justify the higher electricity costs if the environmental benefits — in terms of reduced greenhouse gases (GHGs) and other emissions — outweighed the costs. However, it is unclear that the use of renewable energy resources, especially wind and solar, significantly reduces GHG emissions. Due to their intermittency, wind and solar require significant conventional backup power sources that are cycled up and down to accommodate the variability in the production of wind and solar power. A 2010 study found that wind power actually increases pollution and greenhouse gas emissions.[31] Thus, there appear to be few benefits, if any, to RES policies based on heavy uses of wind.

If the RES compliance costs soared in 2011 when the RES mandate was only 4.5% of electricity sales, what will happen to costs when the RES mandate triples to 16% in 2019? How will these costs affect the state economy?

The Beacon Hill Institute at Suffolk University (BHI) attempts to answer these questions by estimating the costs of the Rhode Island RES law and its impact on the state's economy. To that end, BHI applied its State Tax Analysis Modeling Program (STAMP®) to estimate the economic effects of the state RES mandate.[32]

Estimates and Results

BHI has applied its Rhode Island STAMP® model to estimate the economic effects of the Rhode Island RES. The Energy Information Administration (EIA), a division of the U.S. Department of Energy, estimates renewable electricity costs and capacity factors. This study bases its estimates on EIA projections and compliance reports from Public Utilities Commission (PUC) of Rhode Island.

In light of the wide divergence in the costs estimates available for the different electricity generation technologies, we provide a statistically expected value of Rhode Island's RES mandate that will take place for the indicated variable against the counterfactual assumption that the RES mandate was not implemented. The Appendix explains the methodology. Table 1 displays the cost estimates and economic impact of the current 16% RES mandate in 2020.

Table 1
The Impact of the RES Mandate on Rhode Island (2013 Dollars)

	Expected Value
Cost Estimates	
Total net cost in 2020 ($m)	21.4
Total net cost 2014–2020 ($m)	149.1
Electricity price increase in 2020 (cents per kWh)	0.24
Percentage increase (%)	1.85
Economic Indicators (cumulative)	
Total employment (jobs)	(105)
Investment ($m)	(4.6)
Real disposable income ($m)	(33.0)

Source: Beacon Hill Institute, RI-STAMP

The current RES is expected to impose costs of $21.4 million in 2020. As a result, the RES mandate would increase electricity prices by an expected 0.24 cents per kilowatt-hour (kWh), or 1.85%. The RES mandate will cost Rhode Island electricity customers $149.1 million over the period from 2014 to 2020.

To the extent that these costs appear moderate, it is because of the dominant position of biomass and biogas technologies in meeting the RES mandate. As shown in Chart 1, in 2011, biomass comprised 27.3%, and landfill gas fulfilled 55.6% of the total compliance RECs. Biomass and landfill gas generations are more price-competitive with fossil fuels, and they do not suffer from the intermittency problems that plague wind and solar technologies. In contrast, wind power only accounted for 12.2% of compliance RECs in 2011, which greatly reduces the amount conventional electricity backup required to account for windless and/or cloudy periods. [33]

The RI-STAMP model simulation indicates that, upon full implementation, the RES law is very likely to hurt Rhode Island's economy. The state's ratepayers will face higher electricity prices that will increase their cost of living, which will in turn put downward pressure on households' disposable income. By 2020, the state's economy will shed a net 105 jobs.

The job losses and price increases will reduce real incomes as firms, households, and governments spend more of their budgets on electricity and less on other items, such as home goods and services. In 2020, real disposable income will fall by an expected $33 million. Furthermore, net investment will fall by a cumulative $4.6 million.

Table 2 below shows how the RES mandate is expected to affect the annual electricity bills of households and businesses in Rhode Island. In 2020, the RES is expected to cost families $15 per year; commercial businesses $160 per year; and industrial businesses $1,330 per year. Over the entire period from 2014 to 2020, the RPS will cost families an expected $125; commercial businesses $1,140 per year; and industrial businesses $9,130.

Table 2
Annual Effects of RES on Electricity Ratepayers (2013 Dollars)

	Expected Value
Cost in 2020	
Residential ratepayer ($)	15
Commercial ratepayer ($)	160
Industrial ratepayer ($)	1,330
Cost Over Period (2014–2020)	
Residential ratepayer ($)	125
Commercial ratepayer ($)	1,140
Industrial ratepayer ($)	9,130

Source: Beacon Hill Institute, RI-STAMP

Monte Carlo Analysis

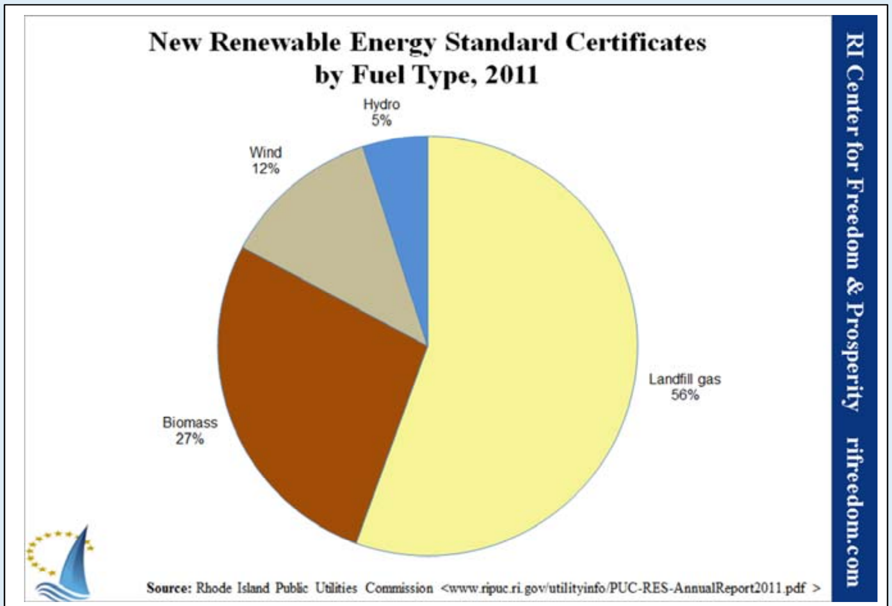
We tested our results by undertaking a “Monte Carlo analysis,” which sets a distribution of outcomes for each of the main variables and then simulates the results. This gives a better sense of what outcomes are likely (rather than merely possible).

For instance, we used the EIA estimates of levelized energy costs (LECs) of different electricity generation technologies through 2030. However, changing circumstances can cause the EIA estimates to vary over the years, such as the steep drop in natural gas prices that took place over the past few years. We then drew 10,000 random samples from the distributions and computed the variables of interest (rates of return, net present value, etc.). This allowed us to compute a distribution of outcomes, which shows the net present value of benefits minus costs, for the electricity price analysis. The full set of assumptions is shown, and the Monte Carlo analysis is further explained, in the Appendix.

The most important feature of this risk analysis is that it allows us to compute confidence intervals for our target variables. These are shown in Table 3.

Chart 1

Rhode Island renewable energy costs are kept lower by the high proportion of sources other than wind and solar.



Thus, we calculated the 90% confidence interval for the cost of electricity; in other words, we are 90% confident that the true result lies inside this band. To put it another way, there is a five percent chance that the results are higher than the upper bound and a five percent chance they are lower than the lowest bound. In general, our conclusion — that the RES mandate is economically harmful — is supported by the data and our calculations.

These cost effects over the course of seven years of the policy illustrate an important point when compared to the single year of 2020. Over time, the EIA projections show the LEC of renewable energy sources decreasing much faster than conventional energy sources, meaning the policy of requiring renewables will be more expensive to meet in year "n" versus year "n+1."

Additionally, the model's assumptions treat federal policies, such as the production tax credit and investment tax credit, as permanent. This favors renewable energy production, but becomes a less plausible assumption as time passes and federal debt and deficits force Congress to consider the elimination of targeted tax credits. For example, during the budget deal last December, the federal production tax credits for renewables were extended for only one year, and at the last minute.

Conclusion

Lost amidst the claims of increased investment and jobs in the "green energy sector" is a discussion of the opportunity costs of RES policies. By mandating that electricity be produced from more-

Table 3
Sensitivity Analysis (2013 Dollars)

	High	Low
Cost Estimates		
Total net cost in 2020 ($m)	-19.42	61.82
Total net cost 2014–2020 ($m)	-23.75	319.00
Electricity price increase in 2020 (cents per kWh)	-0.220	0.70
Percentage increase (%)	-1.68	5.35
Economic Indicators		
Total employment (jobs)	95	(310)
Investment ($m)	4.2	(13.3)
Real disposable income ($m)	30.2	(75.7)
Cost in 2020		
Residential ratepayer ($)	(15)	50
Commercial ratepayer ($)	(150)	470
Industrial ratepayer ($)	(1,215)	3,875
Cost Over Period (2014–2020)		
Residential ratepayer ($)	(20)	265
Industrial ratepayer ($)	(180)	2,460
Industrial ratepayer ($)	(1,515)	19,775

Source: Beacon Hill Institute, RI-STAMP expensive sources, the state government forces local ratepayers to experience higher electricity prices. This means that every business and manufacturer in the state will have higher costs, leading to less investment in both capital and labor. Moreover, every household will have less money to spend on things from groceries to entertainment.

Proponents of RES laws are correct: There will be more investment and jobs in the "green energy sector," but rarely do they mention the loss of jobs and investment in every other sector. The methodology in this paper took all of the state into account, resulting in a very likely outcome of fewer jobs and lower investment for Rhode Island.

Moreover, this analysis did *not* incorporate the large amount of subsidies paid by the rest of the United States for production and investment tax credits.

The RES has and will continue to generate economic benefits for a small group of favored industries. But all of Rhode Island's electricity customers will pay higher rates, diverting resources away from spending on other sectors as well as reducing business investment. The increase in electricity prices will harm the competitiveness of the state's businesses, particularly in the energy-intensive manufacturing industries.

Firms with high electricity usage will likely move their production, and emissions, out of Rhode Island to locations with lower prices. Therefore, the RES policy will not reduce global emissions, but merely send jobs and capital investment outside the state.

As a result, Rhode Island residents will have fewer employment opportunities as they watch investment flee to other states with more-favorable business climates. With the state's unemployment rate tied for last in the nation, as of November 2013, about two percentage points higher than the national average, reducing opportunities for the unemployed is contrary to the policies that the state should be considering.[34] Policymakers should monitor the utilities' RES compliance reports for further cost increases and act to curb the mandates that benefit only a few special interests.

Appendix A

To provide a statistically significant confidence interval for net cost calculations for state-level renewable energy standards (RES), we used a Monte Carlo simulation. A Monte Carlo simulation is generated by repeated random sampling from a distribution to obtain statistically significant results. Given the uncertain future of energy policy, the supply and demand of energy production techniques, or even new entrants to the energy market, the Monte Carlo methodology allows us to be confident about our results.

With the determination of the range and probability of the cost and percentage change outcomes of a policy based on distributions on key, specific variables, we are 90% confident (a statistical standard) the future will fall within our results. Oracle's *Crystal Ball* software used an easy, established methodology for generating them.[35]

Determining the Levelized Energy Cost Distribution

Determining the mean value and standard deviation of electricity is the first step in building a Monte Carlo simulation. For this we relied upon the U.S. Energy Information Administration's (EIA's)

Annual Energy Outlook (AEO) Levelized Energy Costs (LEC). The 2013 AEO explains:

> Levelized cost is often cited as a convenient summary measure of the overall competitiveness of different generating technologies. It repre-sents the per-kilowatt-hour cost (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle. Key inputs to calculating levelized costs include overnight capital costs, fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs, and an assumed utilization rate for each plant type.[36]

Using this comprehensive and widely accepted methodology, the detailed regional data set allowed greater depth. We defined LEC for every year between 2014 and 2030, across 22 regions, for 17 types of electricity generating techniques. For example, the mean cost to produce a megawatt-hour (MWh) of power from wind power, in the Northeast Power Coordinating Council/New England, for a plant coming online in 2020 was calculated and represented as "mean" (Wind, NPCC/NE, 2020). This level of detail enabled the modeling of state-specific RPS with varying requirements year to year.

Two data sets were examined to calculate the variables required for the simulation. The first was the LEC as modeled by the National Energy Modeling System from the AEO2008.[37] The second was the "No Sunset" version of the same data set from the AEO2013, which was preferable because it assumes the most likely scenario: that expiring tax credits would be extended.[38] Also, since the vast majority of expiring tax credits are for renewable generation sources (e.g., wind, solar, and biomass) it made the projections much more conservative.

Before calculating the mean and standard deviation for each data point, some minor adjustments to the AEO2008 data were required to match with the AEO2013 data. The first step was to grow the AEO2008 numbers, originally in 2006 U.S. dollars, so that they were in 2011 U.S. dollars like the AEO2013 data. To do this, the annual U.S. Consumer Price Index for Energy was employed. The index was at 196.9 in 2006 and 243.909 in 2011, resulting in the AEO2008 prices being multiplied by approximately 1.24.[39]

Additionally, the 13 regions from AEO2008 had to be matched up with the 22 regions of AEO2013 (see Table 4). Some regions were a simple conversion, such as the NPCC/Northeast (NEWE), which was region 5 in AEO2013 and region 7 in AEO2008. But others were split into two or three different regions. For example, region 1 in the AEO2008 was divided to become region 10, 11, and half of 15 (the other half of 15 came from region 9 in AOE2008).

Table 4
AEO2008 to AEP2013 Region Matching

AEO 2008 Region	AEO 2013 Region
1	10, 11, (½) 15
2	1
3	6, 7, 9
4	3, (⅓) 4, 13
5	(⅔) 4
6	8
7	5
8	2
9	12, 14, (½) 15, 16
10	17, 18
11	21
12	19, 22
13	20

Note: Numbers based on Electricity Market Module Regions from the respective AEOs.

Source: U.S. Energy Information Administration

With the data in the same year and regions, we compared the total from AEO2008 to the total from AEO2013. The AEO2013 included additional information in the form of ITC/PTC, which stands for Investment Tax Credit/Production Tax Credit, a negative cost to the producer of the energy. This was added back into the calculations after, as it did not exist in the AEO2008, allowing an apples-to-apples comparison.

We calculated the mean for each of these data points. This was accomplished by comparing the projections of LEC from the AEO2008 to those made in the most recent AEO2013. This represents what we believe best corresponds to the expected value around which a normal distribution of possible outcomes is centered.

The standard deviation is likely the most widely used measurement of dispersion of data. To calculate each individual standard deviation — for example, Standard Deviation (Wind, 5, 2020) — we calculated the sample standard deviation between the AEO2008 and AEO2013 points. Additionally, the lower bound was set equal to the amount of the ITC/PTC, the effect of which was that the LEC of any electricity production technique could not be less than zero minus ITC/PTC. With these two calculations completed, the result allowed us to create projections of normal distributions for the LEC of various energy production techniques.

Determining Future Electricity Consumption

As with predicting the LEC of electricity production techniques, predicting future electricity consumption is difficult, yet essential to determining the effects of RES policies. For this reason, we again calculated a normal distribution for electricity consumption for the state, by year.

We reviewed the last 22 years of state gross domestic product (SGDP)[40] and electricity consumption[41] by state and determined that there is a strong correlation between electricity consumption and SGDP. To determine the strength and interaction we produced the following simple regression.

$$\text{Log(Electricity Consumption)} = \beta_0 + \beta_1\text{Log(SGDP)}$$

or

$$\text{Log(Electricity Consumption)} = 12{,}95989 + .0271405\text{Log(SGDP)}$$

Table 5 displays some of the relevant regression statistics. The simple regression fit the data quite well, with 94% of the variance Log(Electricity Consumption) explained by changes in the independent variable. The test statistic associated with Log(SGDP) is individually significant.

Table 5
Relevant Regression Statistics

Adjusted R2	0.9415
Prob>T	0.000
Standard Error Log(SGDP)	0.0147355
Number of Observations	22

Source: Beacon Hill Institute

Next, we forecast SGDP using an autoregressive, iterative, moving average (ARIMA) model, which estimated a regression equation that extrapolates from historical data to predict the future. We used the Log(SGDP) to transform the growing series into a stable series and included Log(US GDP) as an independent variable.

In estimating the regressions, we paid particular attention to the structure of the errors, in order to pick up the effects of seasonal, quarterly, and monthly variations in tax collections. This was done by estimating the equations with autoregressive (AR) and moving average (MA) components. The number and nature of the AR and MA lags were determined initially by examining the autocorrelation and partial correlation coefficients in the error term, and then fine-tuning after examining the structure of the equation residuals. For Rhode Island, the SGDP series conformed to an AR(1) and MA(1) in addition to a constant term.

Using the combination of the regression equation and the calculated standard error, we constructed a normal distribution of electricity sales for each year in our prediction range.

Additional Data

With the distributions of LEC and electricity consumption defined, we turned our attention to the other data points that required estimates. The first was baseline sales of renewable energy — that is, the level of renewable generation that would have come online without the policy under review. The difference between this baseline and the policy requirement is the amount of renewable energy that has to come online due to the policy itself.

The baseline level of renewables was set equal to the total amount of renewable generation in 2003, as the policy was established in Rhode Island in June 2004.[42] To err on the conservative side, we included all renewable energy, even though hydroelectric facilities larger then 30MW are excluded. This amount was then grown annually according to the projected growth of renewables in the region per the AEO2003.[43]

The second data point calculated is the distribution of new renewable production that comes online due to the policy. The share of new renewable generation was set equal to the "Distribution of Settled New RES Certificates" per the 2011 Annual Report (the most recent year available).[44] The results of our baseline calculations, not using Monte Carlo simulations, are presented below in Table 6.

Some types of renewable generation, such as wind and solar power, are intermittent power sources. That is, output varies greatly over time, depending on numerous, difficult-to-predict factors. If the wind blows too slowly, too fast, or if a cloud passes over a

Table 6
Projected Electricity Sales and Renewable Sales (2013 Dollars; MWhs [000s])

Year	Projected Electricity Sales	Projected Renewable	RES Requirement	Difference
2014	8,205.11	147.56	697.43	549.87
2015	8,331.41	153.01	833.14	680.13
2016	8,452.41	158.61	972.03	813.42
2017	8,560.07	166.84	1,112.81	945.97
2018	8,654.13	171.03	1,254.85	1,083.81
2019	8,742.25	176.21	1,398.76	1,222.55
2020	8,828.63	182.22	1,412.58	1,230.36

Source: Beacon Hill Institute, RI-STAMP solar array, the output supplied changes minute to minute while demand does not mirror these changes.

For this reason, conventional types of energy need to be kept as "spinning reserves." That is, they need to be able to ramp output up, or down, at a moment's notice. The effect is that, for every MWh of intermittent renewable power introduced, the offset is not one MWh of conventional power, but some amount less. To account for this factor, we used a study from the Reason Foundation, which noted:

> Gross et al. show that the approximate range of additional reserve requirements is 0.1% of total grid capacity for each percent of wind penetration for wind penetrations below 20%, raising to 0.3% of total grid capacity for each percent of wind penetration above 20%.[45]

We reviewed the original Gross article, which compiled numerous papers on the topic and found the Reason Foundation calculations to be very conservative. We attempted to contact the authors to determine their methodology but were unable to reach them. Ultimately, we determined to use their numbers, again to err on the conservative side, with less spinning reserves factored in, being more favorable to renewable sources.

Finally, a calculation of the distribution of conventional energy resources that would be crowded out due to a higher share of renewables was needed. In Rhode Island, 99.8% of nonrenewable energy comes from natural gas, with the remainder from petroleum.[46] For this reason, we assumed that all spinning reserves, and crowded out electricity, comes from natural gas.

Using the data compiled as described above, we were able to calculate the amount of new renewables that would likely come online due to the policy, as well as the likely conventional energy displaced. At this point, we combined this information with the estimated distributions of the LEC of electricity to produce our Monte Carlo simulation.

Ratepayer Effects

To calculate the effect of the policy on electricity ratepayers, we used EIA data on the average monthly electricity consumption by type of customer: residential, commercial and industrial.[47] The monthly figures were multiplied by 12 to compute an annual figure. We inflated the 2011 figures for each year using the regional EIA projections of electricity sales.[48]

We calculated an annual per-kWh increase in electricity cost by dividing the total cost increase (calculated in the section above) by the total electricity sales for each year. We multiplied the per-kWh increase in electricity costs by the annual kWh consumption for each type of ratepayer for each year. For example, we expect the average residential ratepayer to consume 7,059 kWh of electricity in 2020 and the expected percentage rise in electricity to be 0.24 cents per kWh in the same year. Therefore, we expect residential ratepayers to pay an additional $17 in 2020.

Modeling the Policy Using STAMP

We simulated these changes in the Rhode Island State Tax Analysis Modeling Program® (RI-STAMP) model as a percentage price increase on electricity to measure the dynamic effects on the state economy. The model provided estimates of the proposal's impact on employment, wages, and income. Each estimate represents the change that would take place in the indicated variable against a "baseline" assumption of the value of that variable for a specified year in the absence of the RES policy.

Because the policy requires households and firms to use more-expensive renewable power than they otherwise would have under a baseline scenario, the cost of goods and services will increase under the policy. These costs would typically manifest through higher utility bills for all sectors of the economy.

For this reason, we selected the sales tax as the most fitting way to assess the impact of the policy. Standard economic theory shows that a price increase of a good or service leads to a decrease in overall consumption, and consequently a decrease in the production of that good or service. As producer output falls, the decrease in production results in a lower demand for capital and labor.

BHI utilized its RI-STAMP model to identify the economic effects and understand how they operate through a state's economy. RI-STAMP is a five-year dynamic computable general equilibrium (CGE) model that has been programmed to simulate changes in taxes, costs (general and sector-specific), and other economic inputs. As such, it provides a mathematical description of the economic relationships among producers, households, governments, and the rest of the world.

It is general in the sense that it takes all the important markets (such as the capital and labor markets) and flows into account. It is an equilibrium model because it assumes that demand equals supply in every market (goods and services, labor and capital). This equilibrium is achieved by allowing prices to adjust within the model. It is computable because it can be used to generate numeric solutions to concrete policy and tax changes.[49]

In order to estimate the economic effects of the policy, we increased the sales tax paid by the utility sector by the calculated net cost of the policy. The output was the percentage change in the key economic variables to determine the effect of the policy. These variables were gathered from the Bureau of Economic Analysis Regional and National Economic Accounts as well as the Bureau of Labor Statistics Current Employment Statistics.[50]

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The authors would like to thank Frank Conte, BHI Director of Communications, for his editorial assistance.

Appendix B: Electricity Freedom Act

Summary: The Electricity Freedom Act repeals the State of Rhode Island's requirement that electric distribution utilities and electric services companies provide 16 percent of their electricity supplies from renewable energy sources by 2019.

WHEREAS, forcing business, industry, and ratepayers to use renewable energy through a government mandate will increase the cost of doing business and push companies to do business with other states or nations, thereby decreasing American competitiveness;

WHEREAS, many renewable sources of power currently cost more than traditional electricity generation technologies and are projected to do so for the foreseeable future;

WHEREAS, the costs of renewable energy will be borne by consumers regardless of income or circumstances;

WHEREAS, the costs of renewable energy that are not directly internalized are financed by taxpayers through numerous state and federal financial incentives;

WHEREAS, forcing renewable sources of power will impose the additional burden of integrating intermittent energy onto the electricity grid and threatening electricity reliability;

WHEREAS, the costs of such expensive transmission projects are also financed by ratepayers;

WHEREAS, no state or nation has enhanced economic opportunities for its citizens or increased Gross Domestic Product through renewable energy mandates;

WHEREAS, due to the renewable energy mandate a tremendous amount of economic growth is sacrificed for a reduction in greenhouse gas emissions that would have no appreciable impact on global concentrations of greenhouse gases;

WHEREAS, government mandates to produce renewable energy necessarily involve increasing costs for ratepayers while benefiting politically favored industries;

WHEREAS, primary emissions standards that leave to the marketplace the choice of compliance technologies can address air quality standards more efficiently than "technology forcing" mandates;

WHEREAS, technological advances continue to reduce the rate of air emissions from all fossil fuel sources where vibrant market economies are allowed to exist; and

WHEREAS, electric utilities may have invested in long-term renewable energy assets and/or purchase power agreements, as well as other infrastructure necessary to comply with current and future levels of renewable energy mandates;

THEREFORE LET IT BE RESOLVED, that the legislature of the State of Rhode Island understands that a renewable energy mandate is essentially a tax on consumers of electricity that forces the use of renewable energy sources beyond what would be called for by real market forces and under conditions of real competition in generation resources; and

BE IT FURTHER RESOLVED, that the State of Rhode Island does not wish to discourage the marketing of “green” power and “green” pricing such that willing buyers and sellers of renewable energy sources are free to negotiate the terms and conditions of such sales, and no technology or class of technologies is given an unfair competitive advantage; and

BE IT FURTHER RESOLVED, that this Act also recognizes the prudency and reasonableness of many of the renewable contracts and investments and allows for recovery of costs where appropriate; and

BE IT THEREFORE ENACTED, that the State of Rhode Island repeals the renewable energy mandate and as such, no electric distribution utilities and electric services companies will be forced to procure renewable energy resources as defined by the State of Rhode Island’s renewable energy mandate.

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