The Beacon Hill Institute

The Economic Impact of New Jersey's Renewable Portfolio Standard

How Energy Mandates Will Harm the Economy

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Executive Summary

To estimate the economic effects of the New Jersey Renewable Portfolio Standard (RPS), the Beacon Hill Institute (BHI) applied its STAMP® (State Tax Analysis Modeling Program) model. This study based our estimates on regional EIA projections and New Jersey specific data where available. The Energy Information Administration (EIA), a division of the U.S. Department of Energy, estimates renewable electricity costs and capacity factors, and is considered a comprehensive and unbiased measure of energy use in the nation.

The major findings showed:

- The current RPS law will raise the cost of electricity by an expected $1.05 billion for the state's consumers in 2021
- New Jersey's electricity prices will rise by an expected 10.92 percent by 2021.

These increased energy prices will likely hurt New Jersey's residents and businesses, and consequently, inflict harm on the state economy. In 2021, the RPS is expected to:

- Lower employment by 11,365 jobs
- Reduce real disposable income by $1.4 billion
- Decrease investment by $199 million
- Increase the average household electricity bill by $95 per year; commercial businesses by an expected $985 per year; and industrial businesses by an expected $8,745 per year.

Introduction

New Jersey was one of the first states in the country to implement a Renewable Portfolio Standard (RPS). The current policy, reviewed in this paper, grew out of two prior laws. The first was introduced in 1999, creating Class I and Class II resources which were required to produce 4 percent and 2.5 percent of electricity, respectively, by 2012. In 2004, state lawmakers moved the goal posts, pushing the deadline forward to 2008. Additionally, lawmakers added the industrial policy goal of requiring that at least 0.16 percent of electricity derive from solar power. In 2006, state leaders changed the mandate again, and expanded upon the prior industrial policy. The latest version of the law increased the requirement of renewables to a new total goal of 22.5 percent renewable energy by 2021. This included a rise in the solar power carve out to 2.12 percent.

In 2009, 2010 and 2012 the state enacted changes to the solar carve out and added another carve out, this time for offshore wind.[1] The law requires that 17.88 percent of electricity produced in New Jersey must be generated by Class I renewable sources in 2021. Class II renewables must provide 2.5 percent of all electricity generation and solar energy must generate 3.47 percent.

Class I renewable energy sources include solar, wind, wave, geothermal, landfill, fuel cells and small (less than 3 Megawatts (MW) of capacity) hydroelectricity. Class II sources include larger (between 3 MW and 30 MW of capacity) hydroelectricity and municipal solid waste located in NJ. Solar generation used to meet the solar carve out cannot be classified as Class I renewables.[2]

For each megawatt-hour (MWh) of electricity produced using an approved renewable technology, the producer receives a Renewable Energy Credit (REC), or in the case of solar energy, a Solar Renewable Energy Credit (S-REC). Once a REC or S-REC is retired to meet the RPS goal, it cannot be used again. RECs must be used in the year in which they are created, but S-RECs can be used in any of the following two compliance years after they are created.

Enacted in 2010, S.B. 2036 introduced an offshore wind carve out, to be established in the 'near future.' S.B. 2036 dictated that at least 1,100 megawatts of generation must come from

[1] U.S. Department of Energy, Database of State Incentives for Renewables and Energy Efficiency, http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=NJ05R&re=0&ee=0.

[2] New Jersey Chapter Laws, P.L.2012, c.24. http://www.njleg.state.nj.us/2012/Bills/AL12/24_.PDF

'qualified offshore wind projection.' We assume these 1,100 MWs are not mandated to come online until 2021. Offshore Renewable Energy Credits (O-REC), unlike S-RECs, can be retired for both the offshore carve out, and the Class I mandate. This means that the offshore carve out does not actually increase the RPS, just dictates how a share of the Class I mandate must be met. [3]

There is no cost cap in the New Jersey RPS, but an Alternative Compliance Payment (ACP) systems functions as a release valve for prices. ACPs can be purchased instead of supplying the renewable energy source required, and more likely to have an actual impact on the policy than typical cost caps, which generally uses abstract definitions of costs. ACPs are set at $50 per MWh, while Solar Alternative Compliance Payments (S-ACPs) were initially valued at $711 per MWh in 2009, and fall by approximately 2.5 percent per year, resulting in S-ACP of $286 per MWh in 2021. ACPs should not play a large part in the cost of the RPS, as RECs are projected to be less expensive than the ACPs.

According to the 2010 annual report, the most recent available, there was "little or no use of ACPs;" while 72 percent of the S-RECs were met with S-ACPs. [4] This trend may not continue, due to the projected levelized energy cost falling below the S-ACP price, even before the sale of the energy is considered. The current price of S-RECs supports this theory, showing weighted average price of S-RECs to be just under $200 per MWh, although they are still substantially more than conventional energy.[5]

In the 2010 annual report, the Office of Clean Energy estimated that the cost of compliance with the RPS was $122 million, which is assumed to pass through to NJ electricity ratepayers. Additionally, "over $47 million in solar rebate payments were made on CORE and REIP commitments in 2010," referencing the Customer On-site Renewable Energy and Renewable Energy Incentive Program, although it is not clear if this cost is included in the total. In 2010, the solar carve out was only 0.221 percent, as opposed to the 3.47 percent to be seen in 2021. Additionally, the Class I requirement was only 4.685 percent, compared to the 17.88 percent to

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[3] New Jersey Chapter Laws, P.L.2010, c.27, http://www.njleg.state.nj.us/2010/Bills/S2500/2036_R2.PDF

[4] New Jersey's Board of Public Utilities, Office of Clean Energy, "New Jersey's Renewable Portfolio Standard Rules, 2010 Annual Report,"Internet, http://www.njcleanenergy.com/files/file/Final_2010_Annual_Report_for_New_Jersey_RPS.pdf.

[5]New Jersey's Board of Public Utilities, Office of Clean Energy, Renewable Energy, Project Activity Reports, SREC Pricing, Internet, http://www.njcleanenergy.com/renewable-energy/project-activity-reports/srec-pricing/srec-pricing.

be met in 2021. The Class II requirement holds steady at 2.5 percent, which cost less than $2 million of the cost reported in 2010, and the offshore wind carve out was not on the books.

The New Jersey Office of Clean Energy proclaims the New Jersey Clean Energy Program "promotes increased energy efficiency and the use of clean, renewable sources of energy including solar, wind, geothermal, and sustainable biomass. The results for New Jersey are a stronger economy, less pollution, lower costs, and reduced demand for electricity."[6] If ratepayers paid at least $122 million under a RPS mandate of less than 8 percent with no solar carve out prior to 2010, what will the true net costs be upon full implementation? Possibly even more important, how will these costs affect the state's economy?

The Beacon Hill Institute at Suffolk University (BHI) attempts to answer these questions by estimating the costs of the New Jersey RPS 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 RPS mandate.[7]

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[6] [6]New Jersey's Board of Public Utilities, Office of Clean Energy, New Jersey Clean Energy Program, http://www.njcleanenergy.com/main/about-njcep/about-njcep.

[7] Detailed information about the STAMP® model can be found at http://www.beaconhill.org/STAMP_Web_Brochure/STAMP_HowSTAMPworks.html.

Estimates and Results

In light of the wide divergence in the cost estimates available for the different electricity generation technologies, we provide a statistically expected value of New Jersey's RPS mandate that will take place for the indicated variable against the counterfactual assumption that the RPS mandate was not implemented. The Appendix explains the methodology. Table 1 displays the cost estimates and economic impact of the current RPS mandate in 2021.

Table 1: The Impact of the RPS Mandate on New Jersey (2013$)

Costs Estimates	**Expected Value**
Total Net Cost in 2021 ($ million)	1,052.6
Total Net Cost 2014-2021 ($ million)	6,692.5
Electricity Price Increase in 2021 (cents per kWh)	1.17
Percentage Increase (%)	10.92
Economic Indicators	
Total Employment (jobs)	(11,370)
Investment ($ million)	(199)
Real Disposable Income ($ million)	(1,355)

The current RPS is expected to impose costs of $1.053 billion in 2021. As a result, the RPS mandate would increase electricity prices by 1.17 cents per kilowatt-hour (kWh), or by 10.92 percent. The RPS mandate will cost New Jersey electricity customers $6.69 billion from 2014 to 2021.

These results are substantial, and due in large part to the offshore wind carve-out. Adding 1,100 MW of offshore wind power, as opposed to more cost efficient biomass or onshore wind, leads to two simultaneous outcomes. First, less actual energy is received from 1,100 MW of off-shore wind power then would be generated from biomass, due to the significant difference in capacity factors. Second, the Levelized Energy Cost (LEC) of wind power is much more expensive due to significant differences in capital costs and operation and maintenance costs. The overall high cost can be explained by policies that require almost 24 percent of electricity to come from renewable energy resources, making the policy one of the most burdensome in the nation. This includes specific carve outs to politically favorable industries such as solar and offshore wind, despite their relatively uncompetitive price.

The simulation indicates that, upon full implementation, the RPS law will hurt New Jersey'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 2021, the state's economy will shed a net 11,370 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 2021, real disposable income will fall by an expected $1.36 billion. Furthermore, net investment will fall by $199 million.

Table 2 below shows how the RPS mandate is expected to affect the annual electricity bills of households and businesses in New Jersey. In 2021, the RPS is expected to cost families $95 per year; commercial businesses $985 per year; and industrial businesses $8,745 per year. Over the entire period from 2014 to 2021, the RPS will cost families an expected $590; commercial businesses $5,965 per year; and industrial businesses $51,565.

Table 2: Annual Effects of RPS on Electricity Ratepayers (2013 $)

Cost in 2021	**Expected Value**
Residential Ratepayer ($)	95
Commercial Ratepayer ($)	985
Industrial Ratepayer ($)	8,745
Cost over period (2014-2021)	
Commercial Ratepayer ($)	590
Industrial Ratepayer ($)	5,965
Industrial Ratepayer ($)	51,565

Sensitivity 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). It also measures the sensitivity of our results to the assumptions about the future values of the input variables.

For instance, we used the EIA estimates of LECs for the 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 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. Thus, we calculated the 90 percent confidence interval for the cost of electricity – in other words, we are 90 percent 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 five percent chance they are lower than the lowest bound. In general, our conclusion — that the RPS mandate is economically harmful — is supported by the data and our calculations.

Table 3: Sensitivity Analysis (2013 $)

Costs Estimates	**High**	**Low**
Total Net Cost in 2021 ($ million)	1,616.4	488.7
Total Net Cost 2014-2021 ($ million)	10,379	3,005.8
Electricity Price Increase in 2021 (cents per kWh)	1.79	0.54
Percentage Increase (%)	16.76	5.08
Economic Indicators		
Total Employment (jobs)	(17,450)	(5,290)
Investment ($ million)	(306)	(93)
Real Disposable Income ($million)	(2,080)	(631)
Cost in 2021		
Residential Ratepayer ($)	150	45
Commercial Ratepayer ($)	1,515	460
Industrial Ratepayer ($)	13,420	4,070
Cost over period (2014-2021)		
Residential Ratepayer ($)	915	265
Industrial Ratepayer ($)	9,225	2,705
Industrial Ratepayer ($)	79,815	23,315

The first Column in Table 3 shows that the net costs in 2021 will fall between $488.7 million and $1.616 billion. The costs translate into average electricity price increases of 0.54 cents per kWh and 1.79 cents per kWh, or a 5.08 percent and 16.76 percent rate increase. Thus we are 90 percent confident that the RPS mandate will raise costs for electricity customers. The lower half of Table 3 shows the effect of these cost increases on electric bills. Residential, commercial and industrial ratepayers would all see their bills increase within our 90 percent confidence intervals.

The net cost translates into net employment losses of 100 jobs to 5,290 and 17,450 jobs and disposable income losses of $631 million to $2.08 billion. Investment lost will range between $93 million and $306 million.

These cost effects over the seven years of the policy illustrate an important point when compared to the single year of 2021. First, 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'. Second, the models' 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 allowed to expire. Although most analysts expect Congress to renew them this year, it is not a foregone conclusion. Moreover, the renewable energy lobby has been claiming for years that their technologies will not need the production tax credits in the future.[8] Congress may come to believe that the future is now.

Conclusion

Lost among the claims of increased investment and jobs in the "green" energy sector is a discussion of the opportunity costs of RPS polices. By mandating that electricity be produced by more expensive sources, ratepayers in the state will 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 other purchases, such as groceries and entertainment.

[8] CleanTechnica, Solar & Wind Power To Be Cost-Competitive Without Subsidies By 2025 (NREL), While Fossil Fuels Still Subsidized Through Externalities, Internet, http://cleantechnica.com/2013/08/30/solar-and-wind-power-to-be-cost-competitive-without-subsidies-by-2025-according-to-new-study-from-the-national-renewable-energy-laboratory/#ArbQzyk8M4ITSTlb.99.

Proponents of the RPS law 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 in the state. The methodology in this paper took all of the economic factors in the state into account, resulting in an outcome of less jobs and lower investment for New Jersey. This analysis did not take into account the large amount of subsidies paid by the rest of the United States for production and investment tax credits.

The RPS will continue to generate economic benefits for a small group of favored industries. But all of New Jersey'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 New Jersey to locations with lower electricity prices. As a result the RPS policy will not significantly reduce global emissions, but rather send jobs and capital investment to other states or countries.

Therefore New Jersey residents who don't specialize in green energy will have fewer employment opportunities as they watch investment flee to other states with more favorable business climates. In New Jersey policy makers have worked to turn the RPS from a clean energy policy to an industrial policy. By carving out sections of the law for solar, and future offshore wind, they are bequeathing benefits to specific industries, resulting in a more costly policy with no environmental benefits.

Appendix

To provide a statistically significant confidence interval for net cost calculations for state level Renewable Portfolio Standards (RPS), 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 percent change outcomes of a policy based on distributions placed on key, specific variables, as discussed in this appendix, we are 90 percent confident – a statistical standard – that the future will fall within our results. Oracle's Crystal Ball software provided an easy-to-use and established methodology for generating the results.[9]

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) 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 represents 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.[10]

Using this comprehensive and widely accepted methodology, we utilized the detailed regional data set, which allowed us to go into greater depth. We defined LEC for every year between 2014 and 2030, across 22 different regions, for 17 different 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.

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[9] Oracle Corporation, Crystal Ball, "Overview," http://www.oracle.com/us/products/applications/crystalball/overview/index.html.

[10] U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2013, "Levelized Cost of New Generation Resources," (January 28, 2013) http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

Two different 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. The second was the 'No Sunset' version of the same data set from the AEO2013. The 'No Sunset' version was preferable for our analysis because it assumes that expiring tax credits would be extended, which we believe is the most likely scenario.[11] Additionally, since the vast majority of expiring tax credits are for renewable generation sources – such as 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 US dollars, so that they were in 2011 US dollars like the AEO2013 data. To do this, we used the annual U.S. Consumer Price Index for Energy. The index was at 196.9 in 2006 and 243.909 in 2011 resulting in the AEO2008 prices being multiplied by approximately 1.24.[12] Additionally, the 13 regions from AEO2008 had to be matched up with the 22 regions of AEO2013. For some regions it was a simple conversion, such as the Florida Reliability Coordinating Council from AEO2008, which did not change in the AEO2013. But others were split into 2 or 3 different regions, for example region 1 in the AEO2008 was divided such that it became region 10, 11 and half of 15 (the other half of 15 came from region 9 in AOE2008). Table 4 below shows our matching.

With the data in the same year and regions, we compared the 'Total' from AEO2008 to the TOTAL from AEO2013. The AEO2013 added in 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.[13] This represents what we believe best corresponds to the expected value around which a normal distribution of possible outcomes is centered.

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[11] U.S. Department of Energy, Energy Information Administration, "Issues in Focus," (April 2013) http://www.eia.gov/forecasts/aeo/IF_all.cfm

[12] U.S. Bureau of Labor, Bureau of Labor Statistics, Consumer Price Index, http://www.bls.gov/cpi/.

[13] U.S. Department of Energy, Energy Information Administration, Forecasts http://www.eia.gov/forecasts/aeo/ http://www.eia.gov/oiaf/archive/aeo08/index.html.

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

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

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 RPS 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) and electricity consumption by state and determined that there is a strong correlation between electricity consumption and SGDP.[14] To determine the strength and interaction we produced the following simple regression.

[14] See BLS and EIA: http://www.bea.gov/regional/index.htm http://www.eia.gov/electricity/data.cfm.

$$Log\ \ Electricty\ Consumption\ \ = \beta_0 + \beta_1 Log(SGDP)$$

Or

$$Log\ \ Electricty\ Consumption\ \ = 14.24013 + 0.302208Log(SGDP)$$

Table 5 below displays some of the relevant regression statistics. The simple regression fit the data quite well, with 94 percent 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 R^2	0.9062
Prob>T	0.000
Standard Error Log(SGDP)	0.0211624
Number of Observations	22

Next, we forecasted SGDP using an ARIMA (Autoregressive, Iterative, Moving Average) model which estimated a regression equation that extrapolates from historical data to estimate future data. 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 New Jersey, 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 which required estimates. The first of which was baseline sales of renewable energy – that is, the level of renewable generation that would have come online without taking into consideration 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 2005, as the RPS similar to its current form was established in New Jersey in late of 2004.[15] 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 AEO2005.[16]

The second data point calculated is the distribution of new renewable production that comes online due to the policy. The EIA's AEO was again utilized, with the current distribution of renewable net generation being the baseline, grown at the EIA projection for regional renewable growth.[17]

The results of our baseline calculations, not using Monte Carlo simulations, are presented in Table 6 on Page 15.

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[15] U.S. Department of Energy, Energy Information Administration, "Electric Power Net Generation by Primary Energy Source and Industry Sector, 1990, 1995, and 2000 through 2005 (2005) http://www.eia.gov/electricity/state/.

[16] U.S. Department of Energy, Energy Information Administration, Supplement Tables to the Annual Energy Outlook 2005, "Table 78. Renewable Energy Generation by Fuel Mid-Atlantic Area Council" (2005) http://www.eia.gov/oiaf/archive/aeo05/supplement/supref.html.

[17] For our state baseline we used U.S. Department of Energy, Energy Information Administration, State Electricity Profiles, http://www.eia.gov/electricity/state/.

For our regional growth forecast we used U.S. Department of Energy, Energy Information Administration, Electric Power Projections for EMM Region, Reliability First Corporation / East, Reference case, http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2013ER&subject=0-AEO2013ER&table=62-AEO2013ER&region=3-5&cases=early2013-d102312a.

Table 6: Projected Electricity Sales, Renewable Sales ($2013)

Year	Projected Electricity Sales	Projected Renewable	RPS Requirement	Difference
	MWhs (000s)	MWhs (000s)	MWhs (000s)	MWhs (000s)
2014	82,336.66	1,231.37	10,314.31	9,082.95
2015	83,614.97	1,231.04	11,502.91	10,271.87
2016	84,851.80	1,233.06	12,642.07	11,409.01
2017	85,970.05	1,217.05	13,742.31	12,525.26
2018	86,964.10	1,228.60	15,675.28	14,446.68
2019	87,904.42	1,229.61	17,550.12	16,320.51
2020	88,830.41	1,231.37	19,461.85	18,230.49
2021	89,778.06	1,230.33	21,412.07	20,181.73

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 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 up, or down, output at a moment's notice. The effect of this is that for every one MWh of intermittent renewable power introduced, the offset is not one MWh of conventional power, but some amount less. To account for this we used a policy 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%.[18]

We reviewed the original Gross article, which compiled numerous papers on the topic, and found the Reason Foundation calculations to be very conservative. The result was using their numbers, again to err on the conservative side, with less spinning reserves factored in, being more favorable to renewable sources.

[18] William J. Korchinski and Julian Morris, "The Limits of Wind Power," Reason Foundation (October 4, 2012). http://reason.org/studies/show/the-limits-of-wind-power.

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 New Jersey, the second-most prevalent form of conventional energy production is natural gas; nuclear is number one.[19] Additionally, natural gas electricity production techniques lend themselves to being the most likely source of spinning reserves. For this reason we assumed that all spinning reserves come from natural gas.

Using the above compiled data, 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 the above information with the estimated distributions of the LEC of electricity to produce a Monte Carlo simulation. The total cost of the policy divided by the amount of electricity consumed yielded a percent cost of the policy.

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.[20] 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.[21]

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 8,280 kWh of electricity in 2021 and the expected percent rise in electricity to be by 1.167 cents per kWh in the same year. Therefore, we expect residential ratepayers to pay an additional $97 in 2021.

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[19] U.S. Department of Energy, Energy Information Administration, New Jersey Electricity Profile "Table 5. Electric Power Industry Generation by Primary Energy Source, 1990 through 2010," http://www.eia.gov/electricity/state.

[20] U.S. Department of Energy, Energy Information Administration, "Electric Sales, Revenue, and Average Price" http://www.eia.gov/electricity/sales_revenue_price/.

[21] U.S. Department of Energy, Energy Information Administration, "Electric Power Projections for EMM Regions," http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2013ER&subject=0-AEO2013ER&table=62-AEO2013ER&region=3-5&cases=early2013-d102312a.

Modeling the Policy using STAMP

We simulated these changes in the State Tax Analysis Modeling Program (STAMP®) model as a percentage price increase on electricity to measure the dynamic effects on the state economy. The model provides 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 that variable for a specified year in the absence of the RPS 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 also utilized its STAMP® model to identify the economic effects and understand how they operate through a state's economy. STAMP is a five-year dynamic CGE (computable general equilibrium) 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.[22]

In order to estimate the economic effects of the policy we used a compilation of six STAMP models to garner the average effects across various state economies: New York, North

[22] For a clear introduction to CGE tax models, see John B. Shoven and John Whalley, "Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey," *Journal of Economic Literature* 22 (September, 1984): 1008. Shoven and Whalley have also written a useful book on the practice of CGE modeling entitled *Applying General Equilibrium* (Cambridge: Cambridge University Press, 1992).

Carolina, Washington, Kansas, Indiana and Pennsylvania. These models represent a wide variety in terms of geographic dispersion (northeast, southeast, midwest, the plains and west), economic structure (industrial, high-tech, service and agricultural), and electricity sector makeup.

Using three different utility price increases – 1 percent, 4.5 percent and 5.25 percent – we simulated each of the six STAMP models to determine what outcome these utility price increases would have on each of the six states' economy. We then averaged the percent changes together to determine the average effect of the three utility increases. Table 7 displays these elasticities, which were then applied to the calculated percent change in electricity costs for the state as discussed above.

Table 7: Elasticities for the Economic Variables

Economic Variable	Elasticity
Employment	-0.022
Investment	-0.018
Disposable Income	-0.022

We applied the elasticities to percentage increase in electricity price and then applied the result to state level 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.[23]

[23] For employment, see the following: U.S. Bureau of Labor Statistics, "State and Metro Area Employment, Hours, & Earnings," http://bls.gov/sae/. Private, government and total payroll employment figures for New Jersey were used. For investment, see "National Income and Product Account Tables," U.S. Bureau of Economic Analysis, http://www.bea.gov/itable/; , "Gross Domestic Product by State," http://www.bea.gov/regional/. We took the state's share of national GDP as a proxy to estimate investment at the state level. For state disposable personal income, see "State Disposable Personal Income Summary," BEA, http://www.bea.gov/regional/.

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The Beacon Hill Institute at Suffolk University in Boston focuses on federal, state and local economic policies as they affect citizens and businesses. The institute conducts research and educational programs to provide timely, concise and readable analyses that help voters, policymakers and opinion leaders understand today's leading public policy issues.

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