The Beacon Hill Institute

The Economic Impact of the Illinois Renewable Portfolio Standard

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Executive Summary

The Beacon Hill Institute (BHI) has applied its STAMP® (State Tax Analysis Modeling Program) model to estimate the economic effects of the Illinois Renewable Portfolio Standard (RPS). The Energy Information Administration (EIA), a division of the U.S. Department of Energy, estimates renewable electricity costs and capacity factors. This study bases estimates on EIA projections and compliance reports from the Public Utilities Commission of Illinois (PUC). The major findings show:

- The current RPS law will raise the cost of electricity by $574 million for the state's consumers in 2026
- Illinois's electricity prices will rise by 4.77 percent by 2026, due to the RPS law.

These increased energy prices will likely hurt Illinois's residents and businesses, and consequently, inflict harm on the state economy. By 2026, the RPS is expected to:

- Lower employment by an expected 8,000 jobs
- Reduce real disposable income by $793 million
- Decrease investment by $134 million
- Increase the average household electricity bill by $36 per year; commercial businesses by an expected $365 per year; and industrial businesses by an expected $36,125.

However, these results are highly dependent on the projections of our underlying data through 2026. Changes to the projections of the data will produce estimates that are significantly different than those reported above, which speaks to the level of uncertainty in the future path of the data.

Introduction

The Resource Development and Energy Security Act of 2001 instituted voluntary clean energy targets for electric utilities in Illinois. The Act established a renewable energy goal of 5 percent by 2010 and 15 percent by 2020, but lacked provisions normally included in such legislation, such as compliance rules and credit-trading provisions.[1]

In 2005 the Illinois Commerce Commission adopted rules that encouraged utilities to commit to a voluntary renewable energy goal of 8 percent, and an energy efficiency goal to reduce the growth of the electricity load on the grid by 25 percent between 2015 and 2017.[2]

The Illinois Power Agency Act of 2007 established the state's Renewable Portfolio Standard (RPS) and created the Illinois Power Agency (IPA) to administer the program. The Act charges the IPA with administering renewable electricity procurement plans – contracts between the utilities and wholesale electric suppliers to obtain cost effective renewable energy resources. The Act applied to investor-owned electric utilities that supply over 100,000 customers in the state; only Commonwealth Edison (ComEd) and the Ameren Corporation qualify.

The utilities meet the RPS requirement by providing enough renewable energy to reach a percentage of actual electricity (megawatt-hours) supplied to eligible retail customers in the planning year. The mandate requires that renewable energy technologies comprise 2 percent of the utilities' electricity sales in 2009 and increases incrementally each year until it reaches 10 percent in 2016. After 2016, the mandate increases by 1.5 percentage points per year until it reaches 25 percent in 2026. Within the overall RPS mandate, the Act requires utilities to use wind to satisfy 75 percent of the mandate; solar to account for 6 percent; and distributed energy to make up 1 percent. Utilities fulfill the other 18 percent of the mandate using landfill gas, biomass, anaerobic digestion, biodiesel and hydropower that does not derive from dams and "other such alternative sources of environmentally preferable energy," which may include (among other resources) waste heat from industrial processes.

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[1] U.S. Department of Energy, Database of State Incentives for Renewables and Energy Efficiency (DSIRE) Illinois." http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=IL04R.

[2] State of Illinois, Illinois Commerce Commission, Response to Governor's Sustainable Energy Plan for the State of Illinois 05-0437, Resolution, July 19, 2005, http://www.energymarketers.com/documents/resolution_july_19.pdf

In August 2011, legislation excluded from RPS eligibility electricity generated by the incineration of tires, garbage, general household items and various types of waste. It also mandated that through 2011, eligible resources must be located in state.

Several provisions of the law caused confusion, so lawmakers subsequently replaced it with Public Act 096-0159, which required Alternative Retail Electric Suppliers (ARES) and electric utilities that sell power outside their service territories to comply with the RPS starting June 1, 2009. The ARES RPS mandate is similar to investor-owned utilities, except that the percentage of wind power required is 60 percent.

The legislation limits the RPS procurement of contracts to cost-effective resources. The cost to Illinois retail customers in 2008 was not to exceed 0.5 percent of the amount paid per kilowatt-hour (kWh) during the year ending May 31, 2007. The limit increases each year until it reaches 2 percent of the retail price per kWh paid in 2007, or the incremental amount paid in 2011. In the subsequent years, the limit is either 2 percent of the 2007 retail price for residential customers, or the incremental cost in 2011. Also, the renewable energy procurement costs cannot exceed benchmarks based on market prices within the region.

The Illinois Commerce Commission issued a report, as required by law, to the legislature estimating the likelihood that the cost cap "unduly constrains the procurement of cost-effective renewable energy resources."[3] The report concluded that "the IPA Act's limitation on retail price increases will ***not*** unduly constrain future purchases of renewable energy resources." The authors based their findings on four claims: (1) increased renewable energy capacity and declining prices; (2) expected increase in fossil fuel prices; (3) federal subsidies for renewable energy; and (4) federal environmental policies that favor renewables.[4]

However, the report's claims about future fossil fuel price and federal policy may not materialize. First, new technologies for oil and gas exploration, such as horizontal drilling, have driven down the price of natural gas and coal, and could do the same for oil. Congress failed to extend the federal production tax credit for wind and solar energy as part of their

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[3] DSIRE, http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=IL04R&re=0&ee=0

[4] The Illinois Commerce Commission, "Report To The Illinois General Assembly Concerning Spending Limits On Renewable Energy Resources Procurement," (June 2011: ii), https://www.icc.illinois.gov/reports/ByDate.aspx?y=2011.

fiscal year 2014 budget agreement. Any of these events would dramatically alter the report's calculus and push the RPS costs above the statutory limits.

The report also provides estimates of the cost of compliance with the RPS mandate for ComEd and Ameren customers. The IPA reports annually the cost of renewable procurement under the RPS. For the fiscal years 2009 through 2012, the companies spent over $82 million dollars for Renewable Energy Credits (REC) to comply with the RPS mandate.[5] In addition, the IPA reported that the ARES have used Alternative Compliance Payments (ACP), spent $15 million, and expect the amount to balloon to $135 million by the end of 2014.[6]

In its 2013 annual cost/benefit report, the IPA estimated the cost to purchase renewable energy, or RECs, over the period from 2009 and 2012. The costs ranged from a high of 1.927 cents per KWh in 2009 to a low of 0.088 cents per KWh in 2012, or a rate increase of 0.90 percent and 0.05 percent, respectfully, above the retail electricity price of a single family home that does not utilize electric space heaters. The report showed a consistent downward trend in costs over most of the period. However, this trend reversed in the first half of 2012, with costs of electricity increasing to 0.90 percent for ComEd and 0.61 percent for Ameren, not including transmission and other costs.

The report also claimed that wind power dramatically reduced electric energy prices in Illinois, as well as the East Interconnection. Implementing renewables into the power grid reduced Illinois electricity marginal prices by 0.13 cents per KWh for Locational Marginal Prices (LMPs), or by $176.85 million over the period, according to the report.[7]

Wind – and solar power to a lesser extent – accomplishes this due to its very low marginal cost (nearly zero). Therefore wind and solar can essentially bid a zero to the grid in a stacked bidding process in which the grid operator solicits bids lowest to highest, but for the time period all bidders receive the same price as the highest marginal provider. However wind and solar are intermittent providers of electricity, and wind mostly provides electricity at night, when demand is low. As a result, when wind power penetration rates increase in the power system, it will potentially squeeze out some of the baseload (low cost) providers like coal and nuclear power that cannot easily adjust their power output due to changes in demand. During

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[5] Ibid, 4.

[6] Illinois Power Agency, Annual Report: The Costs and Benefits of Renewable Resource Procurement in Illinois Under the Illinois Power Agency and Illinois Public Utilities Acts, March 29, 2013, http://www2.illinois.gov/ipa/Documents/201304-IPA-Renewables-Report.pdf .

[7] Ibid. 4.

peak demand periods in the summer when the wind is absent, the grid must depend on higher cost marginal power providers, such as diesel, to satisfy the peak demand leading to higher prices during these periods. Therefore, it is unclear if wind and solar lowers LMPs over the course of a year, before considering the cost of the RECs and ACPs.

The Illinois Power Act's intent was to provide cleaner, cost-effective energy to customers. However, in a classic case of unintended consequences, the majority of ComEd and Ameren customers moved to smaller electric companies that purchase electricity on the open market and are not affected by the RPS. Since ComEd and Ameren lost most of their customer base, they do not need to generate or buy any more renewable electricity to satisfy their current portion of the RPS mandate. The funds from the ARES and other utilities' ACPs are piling up while, at the same time, potential projects lack funding. None of the $15 million from the ACP payments have been used to fund renewable energy projects. As a result, the Environmental and Policy Center estimates that utilities were on track to generate about five percent of its electricity from renewable sources, three percent less than the RPS mandate in 2013.[8]

As the RPS mandate ratchets up over the next 13 years, its costs are likely to rise exponentially as wind power developers are forced to use sites with lower wind quality and consistency. Furthermore, most of the RPS mandates for the twenty-nine states that have them increase over the same period, causing demand to increase dramatically. The price of RECs will likely soar as utilities compete for them. How much will the RPS mandate cost Illinois households and businesses over the next decade? 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 Illinois 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.[9]

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[8] Werneau, Julie. "State's Renewable Energy Fund Lacks Power to Fulfill Purpose." *Chicago Tribune*, (May 13, 2013), August 14, 2013. http://articles.chicagotribune.com/2013-05-13/business/ct-biz-0513-renewables-fix-20130513_1_illinois-power-agency-renewable-energy-barry-matchett

[9] 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 great divergence in the cost estimates available for the different electricity generation technologies, we provide a statistically expected net cost of Illinois's RPS. Each estimate represents the change that will take place in 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 25-percent RPS mandate in 2026.

Table 1: The Cost of the 25 Percent RPS Mandate on Illinois (2013 $)

Cost Estimates	Expected Value
Total Net Cost in 2026 ($ million)	574
Total Net Cost 2014-2026 ($ million)	4,533
Electricity Price Increase in 2026 (cents per kWh)	0.398
Percentage Increase (%)	4.77
Economic Indicators	
Total Employment (jobs)	(8,000)
Investment ($ million)	(133)
Real Disposable Income ($ million)	(793)

The current RPS is expected to impose costs of $574 million in 2026. As a result, the RPS mandate would increase electricity prices by an expected 0.398 cents per kilowatt hour (kWh) or 4.77 percent. The RPS mandate will cost Illinois electricity customers $4.5 billion over the period from 2014 to 2026.

The STAMP model simulation indicates that, upon full implementation, the RPS law is very likely to hurt Illinois'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 2026, the Illinois economy will shed 8,000 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 2026, real disposable income will fall by an expected $793 million. Furthermore, net investment will fall by $133 million.

Table 2: Annual Effects of RPS on Electricity Ratepayers (2011$)

	Expected Value
Cost in 2026	
Residential Ratepayer ($)	35
Commercial Ratepayer ($)	365
Industrial Ratepayer ($)	36,125
Cost over period (2014-2026)	
Residential Ratepayer ($)	295
Commercial Ratepayer ($)	2,955
Industrial Ratepayer ($)	299,260

Table 2 shows how the RPS mandate is expected to affect the annual electricity bills of households and businesses in Illinois. In 2026, the RPS is expected to cost families $35 per year; commercial businesses $365 per year; and industrial businesses $36,125 per year. Over the entire period from 2014 to 2026, the RPS will cost families an expected $295; commercial businesses $2,955; and industrial businesses $299,260.

The industrial costs are larger than many other state-level RPS policies that we have measured. The underlying data shows there are three reasons behind the elevated costs. First, the Illinois RPS is farther reaching and more focused on industrial policy then most other state RPSs. Twenty-five percent of all electricity produced by the covered electricity supplier must come from renewable sources. Further, the Illinois RPS requires that 75 percent of that amount must come from wind power, or 60 percent for ARES, and six percent from solar power. Many other state RPSs typically allow the utilities to use the most cost-efficient forms of renewables, leading to lower expected price increases.

Second, our review of the policy takes place in 2026, a year in which the mandate is plateauing, while most other policies cap out around 2020. This leaves additional years for electricity consumption, GDP, jobs and other economic variables to grow over time, thus the percentage changes apply to a higher baseline, which boosts the results. Results such as the percent change, which are not affected by this, are comparable to other RPS policies.

Finally, Illinois has, on average, some of the largest commercial and industrial ratepayers in the nation. Average consumption for commercial ratepayers is eighth-highest, while industrial ratepayers consume on average the second-highest amount in the country.[10] These energy-hungry firms push up the average electricity consumption figures in each category, and the cost of the RPS policy on these businesses. The industrial heart of the Illinois economy will feel the burden of the electricity price increases.

Sensitivity Analysis

We expand upon our results by undertaking a "Metropolis Monte Carlo algorithm," 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 use the EIA estimates of levelized costs of different electricity generation technologies through 2030. However, changing circumstances can cause the EIA estimates to change over the years, such as the steep drop in natural gas prices that took place over the past few years.

We 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. For example the 90 percent confidence interval for the net cost of electricity means we are 90 percent confident that the true result lies inside this band. In other words, our conclusion that the RPS mandate is economically harmful is robust.

Table 3: Sensitivity Analysis

Costs Estimates (2011 $)	**Low**	**High**
Total Net Cost in 2026 ($m)	(482.26)	1,630.38
Total Net Cost 2014-2026 ($m)	(3,768.62)	12,835.43

[10] U.S. Department of Energy, Energy Information Administration (EIA). Tables 5a, 5b and 5c. http://www.eia.gov/electricity/sales_revenue_price/.

Electricity Price Increase in 2026 (cents per kWh)	(0.334)	1.130
Percentage Increase (%)	(4.01)	13.54

Economic Indicators	**Low**	**High**
Total Employment (jobs)	6,720	(22,720)
Investment ($m)	112	(379)
Real Disposable Income ($m)	666	(2,253)
Cost in 2026		
Residential Ratepayer ($)	(30)	100
Commercial Ratepayer ($)	(305)	1,035
Industrial Ratepayer ($)	(30,345)	102,595
Cost over period (2014-2026)		
Commercial Ratepayer ($)	(245)	835
Industrial Ratepayer ($)	(2,465)	8,370
Industrial Ratepayer ($)	(248,055)	846,575

The cost estimates reflect the construction of an interval that covers 90 percent of possible outcomes. That the upper bound for total net cost in 2026 is $1.63 billion comprises the possibility that the market for electricity prices is at its worst for the policy, or renewables in general. For instance, the price of natural gas or other conventional types of energy is in the lower range of what is considered possible, while the price for energy sources used to meet the RPS, such as solar or biomass, are in the upper range of possibilities. For example a new technology could make access to natural gas in the US much easier and cheaper at the same time as China shuts off access to necessary rare earth metals for solar panel production. Similar, the 'Low' outcome shows a negative cost, or net benefit, of $482 million. In this possible outcome RPS energy sources see low levelized energy costs combined with very high conventional energy prices.

A parallel story is told with the cost per ratepayer in 2026. The 'High' outcome of 100 more dollars paid in 2026 for a typical residential ratepayer bill is the upper bound of the 90 percent confidence interval, meaning that there is an estimated five-percent chance of the cost being $100 or greater. The lower bound of the 90-percent confidence interval is a reduction in annual electricity bill of $30 per residential ratepayer, with a five percent chance of the savings being that or greater.

These scenarios require extreme values for the input variables of the simulations. For example, the price of biomass power generation must fall to $74.50 per megawatt-hour from $101.42 and the price of natural gas generation must rise to $86.86 per megawatt-hour from $72.78 for the net benefit figure of $56.21 million to be realized. In other words, either of these scenarios is very unlikely to happen. The most likely outcomes are the expected values in Table 1.

Conclusion

Lost among the claims of increased investment and jobs in the 'green energy sector' is a discussion of the opportunity costs of RPS policies. By mandating that electricity be produced by more expensive sources, ratepayers in Illinois 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 necessities.

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 takes all of the state into account, resulting in a very likely outcome of fewer jobs and lower investment for Illinois. This analysis does 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 has and will continue to generate economic benefits for a small group of favored industries. In Illinois this will be the owners of various wind or solar power plants, who aim to guarantee a market for their product via government fiat. But all of Illinois's electricity customers will pay higher rates, diverting resources away from spending on other sectors, as well as reducing business investment. The expected outcome for a typical residential ratepayer is an increase in annual electricity bills of $295 over the time period studied, with 90 percent of outcomes falling between paying $835 more and paying $245 less, dependent on the often fickle price of oil, gas and renewable energy.

The increase in electricity prices is likely to 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 Illinois to locations with lower electricity prices. Therefore, the RPS policy will not reduce global emissions, but rather send jobs and capital investment outside the state.

As a result, Illinois residents will have fewer employment opportunities as they watch investment flee to other states with more favorable business climates. Policymakers should monitor the utilities' RPS compliance reports for further cost increases and act, if necessary, to curb the mandates that benefit only a few special interests.

Appendix

To provide a statistically significant confidence interval for net cost calculations for state level Renewable Energy Standards (RES), we used a Metropolis Monte Carlo algorithm simulation. A Metropolis Monte Carlo algorithm 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 Metropolis 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.[11]

Determining the Levelized Energy Cost Distribution:

Determining the mean value and standard deviation of electricity is the first step in building a Metropolis Monte Carlo algorithm 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.[12]

Using this comprehensive and widely accepted methodology, we utilized the detailed regional data set, allowing us to go into extensive depth. We defined LEC for every year between 2014 and 2030, across 22 different regions for 17 different types of electricity generating technologies. 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

[11] Oracle Crystal Ball, Overview, http://www.oracle.com/us/products/applications/crystalball/overview/index.html.
[12] U.S. Department of Energy, EIA, Annual Energy Outlook 2013, "Levelized Cost of New Generation Resources," (January 28, 2013) http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.

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 different data sets were examined to calculate the variables required for the Metropolis Monte Carlo algorithm 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.[13] Additionally, since the vast majority of expiring tax credits are for renewable generation sources, such as wind, solar and biomass, it makes 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, 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.[14] Additionally, the 13 regions from AEO2008 had to be matched up with the 22 regions of AEO2013. For some this was a simple conversion, such as the Florida Reliability Coordinating Council from AEO2008, which did not change in the AEO2013. But others were split up into 2 or 3 different regions, for example region 1 in the AEO2008 was split up such that it became region 10, 11 and half of 15 (the other half of 15 came from region 9 in AOE2008). Table 3 below shows our matching.

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

[13] U.S. Department of Energy, EIA, "Issues in Focus," (April 2013) http://www.eia.gov/forecasts/aeo/IF_all.cfm
[14] U.S. Department of Labor, Bureau of Labor Statistics, Consumer Price Index, http://www.bls.gov/cpi/.

Table 4 Continued

AEO 2008 Region*	AEO 2013 Region*
10	17, 18
11	21
12	19, 22
13	20

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

With the data in the same year and regions, we compared the TOTAL variable from AEO2008 to the TOTAL variable 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.[15] 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. 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:

The Illinois law has two different mandates that apply to specific areas of state utilities, with different mandates depending on if you are classified as an Electric Utility or Alternative Retail Electric Supplier. Within these two groups, along with other producers not subject to the RPS law, there have been large shifts in demographics since the RPS was passed. For this reason projections of what amounts of electricity consumption would be subject to the state RPS law could not be based on historical trends. For this reason, we contacted the Illinois Commerce Commission, which was able to supply us with five-year projections of energy consumption from both the EUs and the ARES. For consumption projections from 2019 onwards, we used the average annual growth seen in the five year projections supplied to us.

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

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 2003, as the policy was established in Illinois in June of 2004.[16] To err on the conservative side, we include 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.[17]

Table 5: Projected Electricity Sales, Renewable Sales

Year	Projected Electricity Sales	Projected Renewable	RPS Requirement	Difference
	MWhs (000s)	MWhs (000s)	MWhs (000s)	MWhs (000s)
2014	123,322.57	2,248.19	9,865.81	(7,617.61)
2015	126,400.62	2,581.83	11,376.06	(8,794.22)
2016	127,508.24	3,000.88	12,750.82	(9,749.94)
2017	128,239.28	3,197.33	14,747.52	(11,550.19)
2018	129,263.46	3,062.40	16,804.25	(13,741.85)
2019	131,118.72	3,286.94	19,012.21	(15,725.27)
2020	133,013.76	3,210.55	21,282.20	(18,071.65)
2021	134,772.90	3,146.80	23,585.26	(20,438.45)
2022	136,575.09	3,207.19	25,949.27	(22,742.08)
2023	138,420.79	3,165.89	28,376.26	(25,210.37)
2024	140,310.50	3,226.50	30,868.31	(27,641.81)
2025	142,244.70	3,239.72	33,427.51	(30,187.79)
2026	144,223.92	3,283.19	36,055.98	(32,772.79)

[16] U.S. Department of Energy, EIA, "Electric Power Industry Generation by Primary Energy Source, 1994, 1998, and 2003 (2003) http://www.eia.gov/electricity/state/.

[17] U.S. Department of Energy, EIA, Supplement Tables to the Annual Energy Outlook 2003, "Table 82. Renewable Energy Generation by Fuel Northeast Power Coordinating Council / New England" (July 21, 2003) http://www.eia.gov/oiaf/archive/aeo03/supplement/suptab_82.htm.

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.[18]

The results of our baseline calculations, not using Metropolis Monte Carlo algorithm simulations, are presented above in Table 5.

Some types of renewable generation, such as wind and solar power, are considered 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 a cloud passes over a solar array, the output supplied changes minute to minute while demand will 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 citation from 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%.[19]

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.

Finally, a calculation of the distribution of conventional energy resources that would be crowded out due to a higher share of renewables is needed. In Illinois, we referenced the EIA

[18] 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.

[19] 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.

to determine the current and future mix of conventional energy in the state.[20] Using these projections we assumed that coal and natural gas, with the vast majority being coal, would be the offset generation techniques, according to their relative usage in projections.

Using the above compiled data, we were able to calculate the amount of new renewables that will likely come online due to the policy, as well as the likely conventional energy displaced. Combining this information with the estimated LEC of electricity in each of the studied years yields the total cost of the policy. The total cost of the policy divided by the amount of electricity consumed yields 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.[21] 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.[22]

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 1,011 kWh of electricity in 2020 and the expected percent rise in electricity to be by 0.22 cents per kWh in the same year. Therefore, we expect residential ratepayers to pay an additional $233.91 in 2015.

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.

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[20] U.S. Department of Energy, EIA Table 5. Electric Power Industry Generation by Primary Energy Source, 1990 through 2010. http://www.eia.gov/electricity/state/illinois/. Electric Power Projections, Reference Case. http://www.eia.gov/oiaf/aeo/tablebrowser.

[21] U.S. Department of Energy, EIA, “Electric Sales, Revenue, and Average Price” http://www.eia.gov/electricity/sales_revenue_price/.

[22]U.S. Department of Energy, EIA, “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.

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.[23]

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 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

[23] 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).

simulated each of the six STAMP models to determine what outcome these utility price increases would have on each of the six states' economies. We then averaged the percent changes together to determine the average effect of the three utility increases. Table 6 displays these elasticities, which were then applied to the calculated percent change in electricity costs for the state as discussed above.

Table 6: 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.[24]

[24] For employment, see the following: U.S. Department of Labor, Bureau of Labor Statistics, "State and Metro Area Employment, Hours, & Earnings," http://bls.gov/sae/. Private, government and total payroll employment figures for Illinois. For investment, see "National Income and Product Account Tables," U.S. Bureau of Economic Analysis (BEA), 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 BEA "State Disposable Personal Income Summary,", http://www.bea.gov/regional/.

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