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The Economic Impact of New Mexico's Renewable Portfolio Standard

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Executive Summary

In March 2004 Gov. Bill Richardson of New Mexico signed into law Senate Bill 43. This bill required renewable energy sources to make up 5 percent of the investor-owned electric utilities sales by 2006 and 10 percent by 2011. In 2007 Senate Bill 418 increased the mandate and extended the timeline such that by 2020, 20 percent of all retail electricity in New Mexico must be derived from renewable sources.

American Tradition Institute and the Rio Grande Foundation commissioned the Beacon Hill Institute to apply its STAMP® (State Tax Analysis Modeling Program) to estimate the economic effects of the RPS mandate. To account for the shortcomings of optimistic EIA measures of renewable electric costs and capacity factors, this study provides three estimates of the cost of New Mexico's RPS mandates — low, average and high — using different cost and capacity factors estimates for electricity-generating technologies from the academic literature. Major findings include:

- The state's electricity consumers will pay $619 million more for power in 2020, within a range of $105 million and $991 million, because of the RPS.
- Over the period of 2011 to 2020 New Mexicans will pay $2.3 billion more for electricity than they otherwise would because of the RPS, within a range of $626 million and $3.64 billion.
- In 2020 New Mexico's electricity prices will be 20 percent higher due to the RPS, within a range of 6 percent and 32 percent.

These increased energy prices will hurt New Mexico's households and businesses and, in turn, inflict significant harm on the state economy. According to the study:

- By 2020 New Mexico will lose an average of 2,859 jobs, within a range of 506 jobs under our low cost scenario and 4,573 jobs under our high cost scenario.
- In 2020 the RPS mandate will reduce annual wages by an average of $707 per worker, within a range of $139 per worker and $1,130 per worker.
- Due to higher home energy costs, in 2020 annual real disposable income will fall by $465 million, within a range of $91 million and $743 million.
- Investment will fall by $39 million, within a range of $8 million and $62 million.
- In 2020 the RPS will cost families an average of $160 per year; commercial businesses an average of $1,393 per year; and industrial businesses an average of $22,340 per year.
- Over the 10 years, the average household ratepayer will pay $628 in higher electricity costs; the average commercial ratepayer will spend an extra $5,468, and the average industrial ratepayer an extra $87,671.

Introduction

Combined with fluctuations in fossil fuel prices, the push to mitigate the adverse effects of climate change has encouraged many state governments to respond with public policy initiatives designed to promote the use of alternative energy sources.

In March 2004 Gov. Bill Richardson of New Mexico signed into law Senate Bill 43, which initiated the state's Renewable Portfolio Standard (RPS). This bill required sources of renewable energy sources to make up 5 percent of the investor-owned electric utilities sales by 2006, and 10 percent by 2011. In 2007 state lawmakers enacted SB 418, which expanded the timeline and increases the mandated percentage of retail electricity that must be derived from renewable sources, including energy from solar, wind, geothermal, biomass and small hydroelectric facilities. The bill sets lower mandates for rural utilities.[1]

Specifically, the bill requires that New Mexico's investor-owned utilities increase the percentage of electricity sold from new renewable energy sources. The RPS mandates that renewable sources account for 10 percent of all power generated by 2011; 15 percent for 2015; and 20 percent for 2020 and thereafter.[2]

The bill also contains measures to limit the impact to retail customers by implementing a "reasonable cost threshold." The threshold began at "one percent of all customers' aggregated overall annual electric charges" in 2006 and then gradually increases to reach 3 percent on January 1, 2015 and thereafter. The law allows utilities to apply for a waiver from the RPS requirement "in any given year, if the cost to procure renewable energy is greater than the reasonable cost threshold."[3]

However, the Public Regulation Commission (PRC) "may prospectively modify the reasonable cost threshold applicable to new contracts."[4] SB 418 states: "If a utility determines the costs to comply with the RPS exceed the reasonable cost threshold then they shall not be required to incur that cost, provided that the existence of this condition excusing performance in any given year *shall not operate to delay any renewable portfolio standard in subsequent years*." Also, PRC "may authorize deferred recovery of the costs of complying with the renewable portfolio standard." SB 418 gives PRC the power to "modify the reasonable cost threshold as changing circumstances warrant, after notice and hearing."[5] The law defines "reasonable cost threshold"

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[1] SB 48, "An Act Relating to Utilities: Providing for Renewable Energy Rules for Public Utilities," http://www.nmlegis.gov/Sessions/04%20Regular/final/SB0043.pdf, and SB418, "An Act Relating to Electric Utilities; Enacting Sections of the Rural Electric Cooperative Act; Amending and Enacting Sections of the Renewable Energy Act, etc.," http://www.nmlegis.gov/Sessions/07%20Regular/final/SB0418.pdf.
[2] SB 418, 13.
[3] Ibid, 15.

[5] In modifying the reasonable cost threshold, the PRC will take into account (1) the price of renewable energy at the point of sale to the public utility; (2) transmission and interconnection costs required for the delivery of

as "the cost *established by the commission* above which a public utility shall not be required to add renewable energy to its electric energy supply portfolio pursuant to the renewable portfolio standard." So by the language of the law, the PRC is required to assure that utilities attain the RPS, and has the sole authority to determine what "reasonable costs" are to comply with the RPS. Therefore the cost cap is meaningless, as PRC is required by law to assure that utilities attain the RPS and costs are not to stop that effort.

Public Service Company of New Mexico, the state's largest electric utility, is seeking a waiver from the RPS regulation, saying it won't be able to comply next year without exceeding cost thresholds designed to protect customers. It filed a revised version of its proposed renewable energy procurement plan in December, and the PRC has scheduled a hearing in April on its waiver request. It is unclear if the PRC will keep the current "reasonable cost threshold" and grant waivers or modify the threshold upward to reflect the actual cost of renewable electricity generating technologies.

The law also contains measures to contain the cost impacts to large consumers of electricity (10 million kWh per year). Specifically it limits the cost to 1 percent of that customer's annual electric charges or $49,000 whichever is lower. This procurement limit increases by 0.2 percent or $10,000 per year until January 1, 2012, when it remains fixed at the lower of 2 percent of the customer's annual electric charges or $99,000. In subsequent years the limit is adjusted for inflation as measured by the Consumer Price Index.[6] This requirement is in effect a renewable energy tax that businesses and industries will pass along to their customers.

Another component of the bill – the banking of unused renewable energy credits (RECs) – helps defray costs initially. By producing more renewable energy than required by law in the first few years of the 5 percent RPS requirement, producers can 'bank' these extra units for up to four years, and use them to meet the RPS obligations in the future. However, since the utilities can trade these banked credits, and other states with RPS mandates will have a need for credits, it is likely that these will be sold. The Public Service Company waiver filing provides strong evidence that there is already a lack of RECs to fulfill the mandate.

Since renewable energy generally costs more than conventional energy, many have voiced concerns about higher electric rates. There exist a wide variety of cost estimates for renewable electricity sources. The U.S. Energy Information Administration (EIA), a division of the Department of Energy, provides estimates for the cost of conventional and renewable electricity generating technologies. However, the EIA's assumptions are optimistic regarding the cost and capacity of renewable electricity generating sources to produce reliable energy.

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renewable energy to retail customers; (3) the impact of the cost for renewable energy on retail customer rates; (4) overall diversity, reliability, availability, dispatch flexibility, cost per kilowatt-hour and life cycle cost on a net present value basis of renewable energy resources available from suppliers; and (5) other factors, including public benefits, the commission deems relevant.

[6] Ibid,14.

A review of the literature shows that in most cases the EIA's projected costs can be found at the low end of the range of estimates while the EIA's capacity factor for wind to be at the high end of the range. The EIA does not take into account the actual experience of existing renewable electricity power plants. Therefore we provide three estimates of the cost of New Mexico's RPS mandate: low, average and high, using different cost and capacity factors estimates for electricity-generating technologies from the academic literature.

One could justify the higher electricity costs if the environmental benefits – in terms of reduced GHG 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 backup power sources that are cycled up and down to accommodate the variability in the production of wind and solar power. A recent study found that wind power actually increases pollution and greenhouse gas emissions.[7] Thus, there appear to be few, if any, benefits to implementing RPS policies based on heavy uses of wind.

Governments enact RPS policies because most sources of renewable electricity generation are less efficient and thus more costly than conventional sources of generation. The RPS policy forces utilities to buy electricity from renewable sources and thus guarantees a market for the renewable source. These higher costs get passed on to electricity consumers including residential, commercial and industrial customers.

Increases in electricity costs are known to have a profound negative effect on the economy not unlike taxes, as prosperity and economic growth are dependent upon access to reliable and affordable energy. Since electricity is an essential commodity, consumers will have limited opportunity to avoid these costs. For the poorest members of society, these energy taxes will compete directly with essential purchases in the household budget, such as food, transportation and shelter.

American Tradition Institute and the Rio Grande Foundation commissioned the Beacon Hill Institute at Suffolk University (BHI) to estimate the costs of this House Bill and its impact on the state's economy. To that end, BHI applied its STAMP® (State Tax Analysis Modeling Program) to estimate the economic effects of the state RPS mandate.[8]

Estimates and Results

In light of the wide divergence in the costs and capacity factor estimates available for the different electricity generation technologies, we provide three estimates of the effects of New Mexico's RPS mandate using low, average and high cost estimates of both renewable and conventional generation technologies. Each estimate represents the change that will take place

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[7] See "How Less Became More: Wind, Power and Unintended Consequences in the Colorado Energy Market," Bentek Energy, LLC. (Evergreen Colorado: May, 2010).
[8] Detailed information about the STAMP® model can at http://www.beaconhill.org/STAMP_Web_Brochure/STAMP_HowSTAMPworks.html.

in the indicated variable against the assumption that the RPS mandate would not be implemented. The forthcoming Appendix contains details of our methodology. Table 1 displays our estimates of the cost and economic impact of the RPS mandate on the state.

Table 1: The Cost of the RPS Mandate on New Mexico (2010 $)

Costs Estimates	**Low**	**Average**	**High**
Total Net Cost in 2020 ($ m)	196	619	991
Total Net Cost 2011-2020 ($ m)	1,215	2,302	3,642
Electricity Price Increase in 2020 (cents per kWh)	0.61	1.92	3.07
Percentage Increase	6%	20%	32%
Economic Indicators			
Total Employment (jobs)	(906)	(2,859)	(4,573)
Gross Wage Rates ($ per Worker)	(224)	(707)	(1,130)
Investment ($ m)	(12)	(39)	(62)
Real Disposable Income ($ m)	(147)	(465)	(743)

The RPS would impose costs of $619 million in 2020, within a range of $196 million and $991 million. For the period of 2011 – 2020 the RPS mandate would cost $2.302 billion with a low estimate of $1.215 billion and a high of $3.642 billion. As a result, the RPS mandate would increase electricity prices by 1.92 cents per kilowatt hour (kWh) or by 20 percent, within a range of 0.61 cents per kWh, or by 6 percent and 3.07 cents per kWh, or by 32 percent.[9]

The STAMP model simulation indicates that, upon full implementation, the RPS law will harm New Mexico'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 New Mexico economy would shed 2,859 jobs, within a range of 906 and 4,573 jobs.

The decrease in labor demand — as seen in the job losses — will cause gross wages to fall. In 2020 the 20 percent mandate would reduce annual wages by $707 per worker, with the low cost case producing a $224 wage drop and the high cost case would reduce wages by $1,130 per worker.

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

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[9] Based on a price of 7.3 cents per kWh for 2015 from the U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2010, Table 8: Electricity Supply, Disposition, Prices, and Emissions, New Mexico http://www.eia.doe.gov/oiaf/aeo/aeoref_tab.html. Using compound growth rate from 1990 - 2008 projected retail sales of 16,903 (thousand MWhs) divided by retail sales of $1.227 billion.

goods and services. In 2020 annual real disposable income will fall by $465 million, and by $147 million and $743 million under the low and high cost scenarios respectively.

Furthermore, annual net investment in 2020 will fall by $39 million, within a range of $12 million and $62 million. The investment losses are tempered by the investments required in building renewable power plants and transmission lines and to reconfigure the electricity grid. However, this mandated investment is of dubious value since it supplants investment in affordable and efficient electricity production with investment in costly and inefficient electricity production.

Table 2 below shows how the RPS will affect the annual electricity bills of households and businesses in New Mexico. In 2020 the RPS will cost families an average of $160 per year, commercial businesses $1,393 per year, and industrial businesses $22,340 per year. Over the next 10 years, the average household ratepayer will pay $628 in higher electricity costs; the average commercial ratepayer will spend an extra $5,468 and the average industrial ratepayer an extra $87,671.

Table 2: Effects of RPS on Electricity Ratepayers (2010 $)

	Low	Medium	High
Cost in 2020			
Residential Ratepayer ($)	51	160	256
Commercial Ratepayer ($)	442	1,393	2,229
Industrial Ratepayer ($)	7,080	22,340	35,736
Total over period (2011-2020)			
Residential Ratepayer ($)	334	628	994
Commercial Ratepayer ($)	2,910	5,468	8,647
Industrial Ratepayer ($)	46,661	87,671	138,654

Conclusion

Senate Bill 418, which mandates the details for New Mexico's RPS, states that

> "…the use of renewable energy by public utilities subject to commission oversight in accordance with the Renewable Energy Act can bring significant economic benefits to New Mexico;"[10]

Unfortunately the Senate is being disingenuous with this statement. While negligible economic benefits are possible as a result of SB 418, there will be large costs that state electricity ratepayers will see in the form of higher utility rates, lower employment, wages and investment.

If state lawmakers were interested in determining whether the policy will bring *net* benefits, they would require a detailed cost benefit analysis before they enacted the Renewable Portfolio Standard. Once this was completed they could debate the merits of higher utility costs in exchange for renewable energy. When creating and implementing a state level Renewable Portfolio Standard that inevitably forces state residents to pay premiums on their electricity, the costs are borne by state ratepayers, while the majority of benefits are reaped by those outside the state. Moreover, by limiting the scope of renewable energy to exclude large hydroelectric facilities, the bill becomes less of an energy policy and more of a targeted handout to specific industries.

Firms with high electricity usage will likely move their production, and emissions, out of New Mexico to locations with lower electricity prices. Therefore, the New Mexico policy will not reduce global emissions, but rather send jobs and capital investment outside the state. As a first step New Mexico policymakers should repeal the RPS before electricity costs spiral out of control. Absent repeal, the Public Regulation Commission should make liberal use of the "reasonable cost threshold" to mitigate the damage from the RPS.

[10] New Mexico Senate Bill 418. http://www.nmlegis.gov/Sessions/07%20Regular/final/SB0418.pdf.

Appendix

Electricity Generation Costs

As noted above, governments enact RPS policies because most sources of renewable electricity generation are less efficient and thus more costly than conventional sources of generation. The RPS policy forces utilities to buy electricity from renewable sources and thus guarantees a market for the renewable source. These higher costs get passed on to electricity consumers including residential, commercial and industrial customers.

The U.S. Department of Energy's Energy Information Administration (EIA) estimates the Levelized Energy Cost (LEC), or financial breakeven cost per MWh to produce new electricity in its *Annual Energy Outlook*.[11] The EIA provides LEC estimates for conventional and renewable electricity technologies (coal, nuclear geothermal, landfill gas, solar photovoltaic, wind and biomass) assuming the new sources enter service in 2016. The EIA also provides LEC estimates for conventional coal, combined cycle gas, advanced nuclear and onshore wind only, assuming the sources enter service in 2020 and 2035.

While the EIA does not provide LEC for hydroelectric, solar photovoltaic and biomass for 2020 and 2035, it does project overnight capital costs for 2015, 2025 and 2035. We can estimate the LEC for these technologies and years using the percent change in capital costs to inflate the 2016 LECs. In its *Annual Energy Outlook*, the EIA incorporates many assumptions about the future price of capital, materials, fossil fuels, maintenance and capacity factor into their forecast. Table 3 on Page 11 shows that the EIA projects that the LEC for all four electricity sources (coal, gas, nuclear and wind) fall significantly from 2016 to 2035. The fall in capital costs drives the drop in total system LEC over the period.

The EIA estimates that wind generation will benefit from lower transmission and maintenance costs. EIA forecasts that transmission costs for wind will drop from $8.4 per MWh in 2016 to $5.6 per MWh, or by 33 percent; between 2020 and 2035 and fixed operations and maintenance costs will drop from $11.4 per MWh to $8.9, or by 22 percent, over the same period. The drop in capital, maintenance and transmission costs combine to reduce wind power cost from $149.3 per MWh to $78.9 per MWh, or by an astounding 47.2 percent over the period. According to EIA, by 2035 wind would become the third least expensive behind biomass and natural gas.

Using the EIA change in overnight capital costs for solar and biomass produces reductions in LECs similar to wind from 2016 to 2035. The biomass LEC drops by 57.3 percent and solar by 47.3 percent over the period. These compare to much more modest cost reductions of 23.1 percent for coal, 9.9 percent for gas and 26.7 percent for nuclear over the same period. EIA does provide overnight capital costs for renewable technologies under a "high cost" scenario.

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[11] U.S. Department of Energy, Energy Information Agency, *2016 Levelized Cost of New Generation Resources from the Annual Energy Outlook 2010* (2008/$MWh), http://www.eia.doe.gov/oiaf/aeo/electricity_generation.html, (accessed September 20, 2010).

However, for each renewable technology the EIA "high cost" scenario projects capital costs to drop between 2015 and 2035.

Table 3: Levelized Cost of Electricity from Conventional and Renewable Sources (2008 $)

Plant Type	Capacity Factor	Levelized Capital Costs	Fixed O&M	Variable O&M (with fuel)	Transmission Investment	Total Levelized Cost
Advanced Coal - 2016	0.850	81.2	5.3	20.4	3.6	110.5
2020		77.1	5.3	19.6	3.6	105.6
2035		55.9	5.3	20.2	3.5	84.9
Gas - 2016	0.870	22.9	1.7	54.9	3.6	83.1
2020		21.4	1.6	53.7	3.6	80.3
2035		15.6	1.6	54	3.7	74.9
Nuclear -2016	0.900	94.9	11.7	9.4	3.0	119.0
2020		86.9	11.7	9.9	3.0	111.5
2035		60.9	11.7	11.6	3.0	87.2
Wind - 2016	0.344	130.5	10.4	0.0	8.4	149.3
2020		81.6	8.9	0.0	5.6	96.1
2035		64.4	8.9	0.0	5.6	78.9
Solar PV - 2016	0.217	376.8	6.4	0.0	13.0	396.1
2025						297.7
2035						208.6
Biomass -2016	0.830	73.3	9.1	24.9	3.8	111.1
2025						62.8
2035						47.5
Hydro -2016	0.514	103.7	3.5	7.1	5.7	119.9
2025						101.3
2035						83.4

Moreover the building of vast wind power plants will require large quantities of raw materials, particularly aluminum and other commodities. The rising demand for these commodities – from the construction of renewable energy plants and from fast growing emerging market economies – will certainly increase their prices and therefore costs for wind power plants. Aluminum prices have doubled over the past two years as the world economy emerges from the recession.[12] As a result capital and other costs are more likely to rise than fall over the next two decades.

Table 3 also displays capacity factors for each technology. The capacity factor measures the ratio of electrical energy produced by a generating unit over a period of time to the electrical energy that could have been produced at 100 percent operation during the same period. In

[12] See MetalPrices.com, "LME Aluminum Price Charts," http://www.metalprices.com/FreeSite/metals/al/al.asp#MoreCharts (accessed January 2011).

this case, the capacity factor measures the potential productivity of the generating technology. Solar, wind and hydroelectricity have the lowest capacity factors due to the intermittent nature of their power sources. EIA projects a 34.4 percent capacity factor for wind power, which, as we will see below, appears to be at the high end of any range of estimates.

Estimating a capacity factor for wind power is particularly challenging. Wind is not only intermittent but its variation is unpredictable, making it impossible to dispatch to the grid with any certainty. This unique feature of wind power argues for a capacity factor rating of close to zero. Nevertheless, wind capacity factors have been estimated to be between 20 percent and 40 percent.[13] The other variables that affect the capacity factor of wind are the quality and consistency of the wind and the size and technology of the wind turbines deployed. As the U.S. and other countries add more wind power over time, presumably the wind turbine technology will improve, but the new locations for wind power plants will likely have diminishing or less productive wind resources.

The EIA estimates of LEC and capacity factors paint a particularly rosy view of the future cost of renewable electricity generation, particularly wind. Other forecasters and the experience of current renewable energy projects portray a less sanguine outlook.

Today wind and biomass are the largest renewable power sources and are the most likely to satisfy future RPS mandates. The most prominent issues that will affect the future availability and cost of renewable electricity resources are diminishing marginal returns and competition for scarce resources. These issues will affect wind and biomass in different ways as state RPS mandates ratchet up over the next decade.

Both wind and biomass resources face land use issues. Conventional energy plants can be built within a space of several acres, but a wind power plant with the same nameplate capacity (not actual capacity) would require many square miles of land. According to one study, wind power would require 7,579 miles of mountain ridgeline to satisfy current state RPS mandates and a 20 percent federal mandate by 2025.[14] Mountain ridgelines produce the most promising locations for electric wind production in the eastern and far western United States.

After taking into account capacity factors, a wind power plant would need a land mass of 20 by 25 kilometers to produce the same energy as a nuclear power plant that can be situated on 500 square meters.[15]

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[13] Renewable Energy Research Laboratory, University of Massachusetts at Amherst, "Wind Power, Capacity Factor and Intermittency: What Happens When the Wind Doesn't Blow?" Community Wind Power Fact Sheet #2a, http://www.ceere.org/rerl/about_wind/RERL_Fact_Sheet_2a_Capacity_Factor.pdf (accessed December, 2010).

[14] Tom Hewson and Dave Pressman, "Renewable Overload: Waxman-Markey RES Creates Land-use Dilemmas," *Public Utilities Fortnightly* 61 (August 1, 2009).

[15] "Evidence to the House of Lords Economic Affairs Committee Inquiry into 'The Economics of Renewable Energy'," Memorandum by Dr. Phillip Bratby, May 15, 2008.

The need for large areas of land for situating wind power plants will require the purchase of vast areas of land by private wind developers and/or allowing wind production on public lands. In either case land acquisition/rent or public permitting processes will likely increase costs as wind power plants are built. Offshore wind is vastly more expensive than onshore wind power and suffers from the same type of permitting process faced by onshore wind power plants, as seen in the 10-year permitting process for the planned Cape Wind project off the coast of Massachusetts.

The swift expansion of wind power will also suffer from diminishing marginal returns as new wind capacity will be located in areas with lower and less consistent wind speeds. As a result, fewer megawatt hours of power will be produced from newly built windmills. Moreover the new wind capacity will be developed in increasingly remote areas that will require larger investments in transmission and distribution, which will drive costs even higher.

The EIA estimates of the average capacity factor used for onshore wind power plants, at 34.4 percent, appears to be at the higher end of the estimates for current wind projects. This figure is inconsistent with estimates from other studies.[16] According to the EIA's own reporting from 137 current wind power plants in 2003, the average capacity factor was 26.9 percent.[17] In addition, a recent analysis of wind capacity factors around the world finds an actual average capacity factor of 21 percent.[18] Moreover, other estimates find capacity factors in the mid teens and as low as 13 percent.[19]

Biomass is a more promising renewable power source. Biomass combines low incremental costs relative to other renewable technologies and reliability. Biomass is not intermittent and therefore it is distributable with a capacity factor that is competitive with conventional energy sources. Moreover biomass plants can be located close to urban areas with high electricity demand. But biomass electricity suffers from land use issues even more so than wind.

The expansion of biomass power plants will require huge additional sources of fuel. Wood and wood waste comprise the largest source of biomass energy today. Other sources of biomass include food crops, grassy and woody plants, residues from agriculture or forestry, oil-rich algae, and the organic component of municipal and industrial wastes.[20] Biomass power plants will compete directly with other sectors (construction, paper, furniture) of the economy for wood and food products and arable land.

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[16] Nicolas Boccard, "Capacity Factors for Wind Power: Realized Values vs. Estimates," *Energy Policy* 37, no. 7 (July 2009): 2680.
[17] Cited by Tom Hewson, Energy Venture Analysis, "Testimony for East Haven Windfarm," January 1, 2005, http://www.windaction.org/documents/720 (accessed December 2010).
[18] Boccard.
[19] See "The Capacity Factor of Wind, Lightbucket," http://lightbucket.wordpress.com/2008/03/13/the-capacity-factor-of-wind-power/, (accessed December 22, 2010) and National Wind Watch, FAQ, http://www.wind-watch.org/faq-output.php (accessed December 2010).
[20] Biomass Energy Basics, National Renewable Energy Laboratory, Biomass Basics, http://www.nrel.gov/learning/re_biomass.html (accessed December, 2010).

One study estimates that 66 million acres of land would be required to provide enough fuel to satisfy the current state RPS mandates and a 20 percent federal RPS in 2025.[21] When the clearing of new farm and forestlands are figured into the GHG production of biomass, it is likely that biomass increases GHG emissions.

The competition for farm and forestry resources would not only cause biomass fuel prices to skyrocket, but also cause the prices of domestically-produced food, lumber, furniture and other products to rise. The recent experience of ethanol and its role in surging corn prices can be casually linked to the recent food riots in Mexico and the struggle facing international aid organizations addressing hunger in places such as the Darfur region of Sudan. These two examples serve as reminders of the unintended consequences of government mandates for biofuels. The lesson is clear: biofuels compete with food production and other basic products and distort the market.

Calculation of the Net Cost of New Renewable Electricity

To calculate the cost of renewable energy under the RPS, BHI used data from the Energy Information Administration (EIA), a division of the U.S. Department of Energy, to determine the percent increase in utility costs that New Mexico residents and businesses would experience. This calculated percent change was then applied to calculated elasticities, as described in the STAMP modeling section.

We collected historical data on the retail electricity sales by sector from 1990 to 2008 and projected its growth through 2020 using its historical compound annual growth rate (3.6 percent).[22] To these totals, we applied the percentage of renewable sales prescribed by the New Mexico RPS. By 2020, renewable energy sources must account for 30 percent of total electricity sales in New Mexico.

Next we projected the growth in renewable sources that would have taken place absent the RPS. We used the EIA's projection of renewable energy sources by fuel for the Western Electricity Coordinating Council / Rocky Mountain Power Area and Arizona-New Mexico-Southern Nevada Power Area through 2020 as a proxy to grow renewable sources for New Mexico. We used the growth rate of these projections to estimate New Mexico's renewable generation through 2020 absent the RPS.[23]

We subtracted our baseline projection of renewable sales from the RPS-mandated quantity of sales for each year from 2011 to 2020 to obtain our estimate of the annual increase in renewable

[21] Hewson, 61.
[22] U.S. Department of Energy, Energy Information Agency, New Mexico Electricity Profile 2010, "Table 5: Electric Power Industry Generation by Primary Energy Source, 1990 Through 2008," http://www.eia.doe.gov/cneaf/electricity/st_profiles/new_mexico.html. (accessed January 25, 2011)
[23] U.S. Department of Energy, Energy Information Agency, *Annual Energy Outlook 2010*, "Table 99: Renewable Electricity Generation by Fuel," http://www.eia.doe.gov/oiaf/archive/aeo10/aeoref_tab.html (accessed December 2010).

sales induced by the RPS in megawatt hours (MWhs). The RPS mandate exceeds our projected renewable in all projected years (2011 to 2020). This figure also represents the maximum number of MWhs of electricity from conventional sources that are avoided, or not generated, through the RPS mandate. We will revisit this shortly. Table 4 below contains the results.

Table 4: Projected Electricity Sales, Renewable Sales and RPS Requirement

Year	Projected Electricity Sales MWhs (000s)	Projected Renewable MWhs (000s)	RPS Requirement MWhs (000s)	Difference MWhs (000s)
2011	24,234	1,812	2,423	611
2012	25,016	2,599	2,502	-98
2013	25,825	2,599	2,583	-17
2014	26,662	2,599	2,666	67
2015	27,528	2,599	4,129	1,530
2016	28,423	2,599	4,263	1,664
2017	29,349	2,599	4,402	1,803
2018	30,308	2,599	4,546	1,947
2019	31,299	2,599	4,695	2,096
2020	32,324	2,599	6,465	3,866
Total	**280,969**	**25,205**	**38,675**	**13,469**

To estimate the cost of producing the additional extra renewable energy under an RPS against the baseline, we used estimates of the LEC, or financial breakeven cost per MWh to produce the electricity.[24] However as outlined in the "electricity generation cost" section above, the EIA numbers provide a rather optimistic picture of the cost and generating capacity of renewable electricity, particularly for wind power. A literature review provided alternative LEC estimates that were generally higher and capacity factors that were lower for renewable generation technologies than the EIA estimates.[25] We used these alternative figures to

[24] U.S. Department of Energy, Energy Information Agency, *2016 Levelized Cost of New Generation Resources from the Annual Energy Outlook 2010* (2008/$MWh), http://www.eia.doe.gov/oiaf/aeo/electricity_generation.html (accessed September 2010).

[25] For coal, gas and nuclear generation we used the production cost estimates from the International Energy Agencies, Energy Technology Analysis Programs, "Technology Brief E01: Cola Fired Power, E02: Gas Fired Power, E03: Nuclear Power and E05: Biomass for Heat and Power," (April 2010), http://www.etsap.org/E-techDS/ (accessed December 2010). To the production costs we added transmission costs from the EIA using the ratio of transmissions costs to total LEC costs. For wind power we used the IEA estimate for levelized capital costs and variable and fixed O & M costs. For transmission cost we used the estimated costs from several research studies that ranged from a low of $7.88 per kWh to a high of $146.77 per kWh, with an average of $60.32 per MWh. The sources are as follows:
Andrew Mills, Ryan Wiser, and Kevin Porter, "The Cost of Transmission for Wind Energy: A Review of Transmission Planning Studies," Ernest Orlando Lawrence Berkeley National Laboratory,

calculate our "high" LEC estimates and the EIA figures to calculate our "low" cost estimates and the average of the two to calculate our "average" cost estimates. Table 5 displays the LEC and capacity factors for each generation technology.

Table 5: LEC and Capacity Factors for Electricity Generation Technologies

	Capacity Factor (percent)	Total Production Cost (cents/MWh) 2010	2020	2025
Coal				
Low	74.0	67.41	64.82	63.53
Average	79.5	83.96	85.21	79.39
High	85.0	100.50	105.60	95.25
Gas				
Low	85.0	75.86	73.25	73.25
Average	86.0	79.48	76.77	75.42
High	87.0	83.10	80.30	77.60
Nuclear				
Low	90.0	76.94	59.20	49.33
Average	90.0	97.97	85.35	74.34
High	90.0	119.00	111.50	99.35
Biomass				
Low	68.0	111.10	86.99	62.88
Average	75.5	112.50	95.27	80.62
High	83.0	113.90	103.54	98.36
Wind				
Low	15.5	148.78	96.10	87.50
Average	26.9	201.22	188.54	175.85
High	34.4	287.67	269.54	251.40

We used the 2016 LEC for the years 2010 through 2018 to calculate the cost of the new renewable electricity and avoided conventional electricity, assuming that before 2016 LEC underestimates the actual costs for those years and for 2017 and 2018, the 2016 LEC slightly overestimates the actual costs. We assumed that the differences will, on balance, offset each other. For 2019 and 2020 we used the 2020 LEC. The assumption is that LEC will decline over time due to technological improvements over time.

We use the EIA's reference case scenario for all technologies. Since capital costs represent the large component of the cost structure for most technologies, we used the percentage change in the capital costs from 2015 to 2025 to adjust the 2016 LECs to 2025. For the technologies that the EIA does not forecast LECs in 2020, we used the average of the 2016 and 2025 LEC calculations, assuming a linear change over the period.

http://eetd.lbl.gov/EA/EMP (accessed December 2010); Competitive Renewable Energy Zones (CREZ) Transmission Optimization Study, The Electric Reliability Council of Texas, April 2, 2008 http://www.ercot.com/news/presentations/2006/ATTCH_A_CREZ_Analysis_Report.pdf (accessed December 2010); Sally Maki and Ryan Pletka, Black & Veatch, California's Transmission Future, August 25, 2010, http://www.renewableenergyworld.com/rea/news/article/2010/08/californias-transmission-future (accessed December 22, 2010).

Once we computed new LECs for the years 2020 and 2025 we applied these figures to the renewable energy estimates for the remainder of the period.

For conventional electricity we assumed that the technologies are avoided based on their costs, with the highest cost combustion turbine avoided first. For coal and gas, we assumed they are avoided based on their estimated proportion of total electric sales for each year. Although hydroelectric and nuclear are not the cheapest technology, we assume no hydroelectric or nuclear sources are displaced since most were built decades ago and offer relatively cheap and clean electricity today.

We also adjusted the avoided cost of conventional energy to account for the lower capacity factor of wind relative to conventional energy sources. We multiplied the cost of each conventional energy source by the difference between its capacity factor and the capacity factor for the renewable source and then by the ratio of the new generation of the renewable source to the total new generation of renewable under the RPS. With coal, for example, we multiplied the avoided amount generation of electricity from coal (3.05 million MWhs in 2020) by the LEC of coal ($85.21 per MWh) and then by the difference between the capacity factor of coal and the weighted average (using MWs as weights) capacity factor of wind (27 percent). This process is repeated for each conventional electricity resource.

These LECs are applied to the amount of electricity supplied from renewable sources under the RPS, because this figure represents the amount of conventional electricity generation capacity that presumably will not be needed under the RPS. The difference between the cost of the new renewable sources and the costs of the conventional electricity generation New Mexico represents the net cost of the RPS. Tables 6, 7 and 8 on the following pages display the results of our Average, Low and High Cost calculations respectively. In years 2012 and 2013, New Mexico is projected to have more renewable energy than required by law, so the cost in those years is zero.

We converted the aggregate cost of the RPS into a cost per-kWh by dividing the cost by the estimated total number of kWh sold for that year. For example, for 2020 under the average cost scenario in Table 6, we divided $619 million into 32,324 million kWhs for a cost of 1.92 cents per kWh.

Table 6: Average Cost Case of RPS Mandate from 2011 to 2020

Year	Gross Cost (2010 $000s)	Less Conventional (2010 $000s)	Total (2010 $000s)
2011	122,362	16,719	105,643
2012	0	0	0
2013	0	0	0
2014	13,446	1,841	11,606
2015	306,874	42,013	264,861
2016	333,811	45,701	288,111
2017	361,676	49,515	312,160
2018	390,501	53,462	337,039
2019	420,321	57,544	362,777
2020	726,175	106,743	619,432
Total	**2,675,166**	**373,538**	**2,301,628**

Table 7: Low Cost Case of RPS Mandate from 2011 to 2020

Year	Gross Cost (2010 $000s)	Less Conventional (2010 $000s)	Total (2010 $000s)
2011	90,652	26,562	64,090
2012	-	-	-
2013	-	-	-
2014	9,956	2,925	7,031
2015	227,211	66,761	160,451
2016	247,156	72,621	174,535
2017	267,787	78,683	189,104
2018	289,129	84,954	204,175
2019	311,208	91,441	219,768
2020	371,231	174,923	196,308
Total	**1,814,330**	**598,869**	**1,215,461**

Table 8: High Cost Case of RPS Mandate from 2011 to 2020

Year	Gross Cost (2010 $000s)	Less Conventional (2010 $000s)	Total (2010 $000s)
2011	174,632	10,645	163,987
2012	-	-	-
2013	-	-	-
2014	19,200	1,172	18,028
2015	438,192	26,753	411,439
2016	476,656	20,741	455,916
2017	516,444	22,472	493,972
2018	557,604	24,263	533,341
2019	600,186	26,116	574,070
2020	1,037,240	46,367	990,874
Total	**3,820,156**	**178,529**	**3,641,627**

Ratepayer Effects

To calculate the effect of the RPS on electricity ratepayers we used EIA data on the average monthly electricity consumption by type of customer: residential, commercial and industrial.[26] We multiplied the monthly figures by 12 to compute an annual figure. We inflated the 2008 figures for each year using the average annual increase in electricity sales over the entire period.[27] 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 7,584 kWhs of electricity in 2020 and we expect the high cost scenario to raise electricity costs by 1.92 cents per kWh in the same year in our average cost case. Therefore we expect residential ratepayers to pay an additional $160.12 in 2020.

In the text of the New Mexico RPS, a Reasonable Cost Threshold is explained as "above which a public utility shall not be required to add renewable energy to its electric energy supply

[26] U.S. Department of Energy, Energy Information Administration, "Average electricity consumption per residence in MT in 2008," (January 2010) http://www.eia.doe.gov/cneaf/electricity/esr/table5.html, The 2008 consumption figures were inflated to 2010 using the increase in electricity demand from the EIA of 0.89 percent compound annual growth rate.
[27] U.S. Department of Energy, Energy Information Agency, *Annual Energy Outlook 2010*, "Table 8: Electricity Supply, Disposition, Prices, and Emissions," http://www.eia.doe.gov/oiaf/aeo/aeoref_tab.html. (accessed December 22, 2010).

portfolio pursuant to the renewable portfolio standard."[28] The threshold is described as the least of two different methodologies. The first is that the cost threshold shall not exceed 3 percent of the electricity bill from 2015 on, while the second is a limit of $99,000 in 2012, growing at the rate of the Consumer Price Index. Neither of these thresholds is broken with our estimates in 2020.

Modeling the RPS using STAMP

We simulated these changes in the STAMP model as a percentage price increase on electricity to measure the dynamic effects on the state economy. The model provides estimates of the proposals' 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 RPS requires New Mexico households and firms to use more expensive "green" power than they otherwise would have under a baseline scenario, the cost of goods and services will increase under the RPS. 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 RPS. 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 STAMP (State Tax Analysis Modeling Program) 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.[29]

In order to estimate the economic effects of a national RPS 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)

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[28] Renewable Energy for Electric Utilities. New Mexico Law, Title 17, Chapter 9, Part 572. http://www.nmcpr.state.nm.us/NMAC/parts/title17/17.009.0572.htm

[29] 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).

economic structure (industrial, high-tech, service and agricultural) and electricity sector makeup.

First we computed the percentage change to electricity prices as a result of three different possible RPS policies. We used data from the EIA from the state electricity profiles, which contains historical data from 1990-2008 for retail sales by sector (residential, commercial, industrial, and transportation) in dollars and MWhs and average prices paid by each sector.[30] We inflated the sales data (dollars and MWhs) though 2020 using the historical growth rates for each sector for each year. We then calculated a price for each sector by dividing the dollar value of the retails sales by kWhs. Then we calculated a weighted average kWh price for all sectors using MWhs of electricity sales for each sector as weights. To calculate the percentage electricity price increase we divided our estimated price increase by the weighted average price for each year. For example, in 2020 for our high cost case we divided our average price of 10.246 cents per kWh by our estimated price increase of 5.966 cents per kWh for a price increase of 58.23 percent.

Table 9: Elasticities for the Economic Variables

Economic Variable	Elasticity
Employment	-0.022
Gross wage rates)	-0.063
Investment	-0.018
Disposable Income	-0.022

Using these 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 state's economy. We then averaged the percent changes together to determine what the average effect of the three utility increases. Table 9 displays these elasticities, which were then applied to the calculated percent change in electricity costs for the state of New Mexico discussed above.

We applied the elasticities to percentage increase in electricity price and then applied the result to New Mexico economic variables to determine the effect of the RPS. 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.[31] For example, under our high cost scenario we multiplied the electricity price increase (32 percent) by the employment elasticity (-.021535 percent) and the result by total employment estimated for 2020 (903,807) to get our employment estimate of 3,642.

[30] U.S. Department of Energy, Energy Information Agency, New Mexico Electricity Profile 2010, Table 8: Retail Sales, Revenue, and Average Retail Price by Sector, 1990 through 2008, http://www.eia.doe.gov/cneaf/electricity/st_profiles/new_mexico.html (accessed January 2011).
[31] See the following: Bureau of Economic Analysis, "National Economic Accounts," http://www.bea.gov/national/; Regional Economic Accounts, http://www.bea.gov/regional/index.htm. See also Bureau of Labor Statistics, "Current Employment Statistics ," http://www.bls.gov/ces/.

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