BHI Policy Study

# The Economic Impact of North Carolina's Renewable Energy and Energy Efficiency Portfolio Standard

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# Executive Summary

In 2007, North Carolina passed Senate Bill 3 (SB 3) that established a state Renewable and Energy Efficiency Portfolio Standard (REPS). The REPS mandates that a percentage of electricity generated be derived from *new* renewable resources. Renewable resources include energy from solar, wind, and biomass. Hydroelectric facilities under 10-megawatt (MW) also are included. However, municipal electric power companies are exempt from the 10 MW ceiling on hydropower.

Specifically, SB 3 requires that all of North Carolina's public electric utilities increase the percentage of electricity generated from new renewable energy sources. The REPS will be phased in over time. SB 3 mandates that the REPS account for 3 percent of state retail electricity sales by 2012, 6 percent by 2016, 10 percent by 2018 and 12.5 percent by 2021 and thereafter. Municipally-owned and electric membership utilities need only reach the 10 percent level.

The target consists of two separate requirements. The Renewable Portfolio Standard (RPS) requires utilities to generate the escalating percentages of their retail electricity through new renewable sources as outlined above. Utilities can also meet a portion of the RPS through the Energy Efficiency Portfolio Standard. Prior to 2021, utilities can meet 25 percent of the RPS requirement through energy efficiency (EE) programs, rising to 40 percent in 2021 and after.

SB 3 allows utility companies to meet part of, or the entire, renewable energy requirement by purchasing renewable energy certificates (RECs). RECs are tradable and designed to enable investment in renewable energy facilities outside North Carolina. Thus, certificates can be purchased from in state or out-of-state renewable energy facilities.

In the case of utilities purchasing out-of-state RECs, the electricity will not likely be consumed in North Carolina. Under this scenario, North Carolina electricity consumers would be subsidizing the development of renewable energy in other states through the cost recovery mechanisms of SB 3 outlined below, while still paying for electricity for use in North Carolina.

Utilities may levy fees on their customers to recover the incremental cost of renewable electricity sources and up to $1 million in alternative energy research expenditures. The fees escalate with the REPS requirements, but at modest levels.

SB 3 also phases out the current sales tax levied on energy sales to farmers, manufacturers and laundry service companies for electricity, piped natural gas and other fuels. By cutting these taxes, the state stands to lose revenue. According to the General Assembly's Legislative Fiscal Note, the state will lose approximately $20 million in FY09, $30 million in FY10, $45 million in FY11 and $44.7 million in FY12.[1]

Since renewable energy generally costs more than conventional energy, many have voiced concerns about higher electric rates. Moreover, since North Carolina has a limited ability to generate renewable energy, the state will start from a low power generation base. In addition, some renewable energy sources - wind and solar power in particular - require the installation of conventional backup generation capacity for those cloudy, windless days. The need for this backup further boosts the cost of renewable energy.

The Beacon Hill Institute at Suffolk University (BHI) — in conjunction with the John Locke Foundation — has set out to estimate the costs and benefits of SB 3 and its impact on the state's economy. To that end, BHI applied its STAMP® (State Tax Analysis Modeling Program) for North Carolina (NC-STAMP), which allowed us to estimate the economic effects of the state REPS mandate.[2]

BHI estimated the net cost of implementing the REPS under two separate scenarios. In the first, caps on the cost recovery fees paid by North Carolina's consumers and businesses are reached each year. The second estimates the cost to consumers and businesses were the cost recovery caps not in place. Table 1 displays our cost estimates for both scenarios.

**Table 1: Aggregate Net Costs of SB 3 with and without Cost Recovery CAPS (Current, $)**

| | 2008-2011 | 2012-2014 | 2015-2021 | Total |
|---|---|---|---|---|
| Under Cost Recovery Caps | $200.83 | $195.55 | $1,448.18 | $1,844.55 |
| Without Cost Recovery Caps | $1,759.77 | $1,870.77 | $831.97 | $4,462.51 |

In the aggregate, the state's electricity consumers will pay $1.845 billion in cost recovery fees between 2008 and 2021, which will be added directly to their utility bills. In contrast, if the cost recovery caps were not in place, the REPS would cost North Carolinians $4.463 billion.

[1] General Assembly of North Carolina, Session 2007, Legislative Fiscal Note. http://www.ncga.state.nc.us/Sessions/2007/FiscalNotes/Senate/PDF/SFN0003v4.pdf (accessed May 2008).
[2] Detailed information about the South Carolina -STAMP® model can be found in Appendix A.

Table 2 presents our estimates of the economic and fiscal effects of the state REPS in 2009 Net Present Value (NPV) dollars with the cost recovery fee caps in the top half of the table and the no-caps scenario in the bottom half.

With the caps in place, North Carolina will lose 3,592 jobs, investment will decrease by $43.20 million and real disposable income will fall by $56.80 million by 2021. As a result, the state economic output measured in real state Gross Domestic Product (GDP) will be $140.35 million lower than without the mandate. The lower economic output will cause state and local tax revenue collections to fall by $43.49 million including the losses caused by sales tax cuts outlined in SB 3.

**Table 2: BHI Estimates for SB 3 (NPV, 2009 $)**

| Year | Employment (Jobs) | Investment ($millions) | Real Disposable Income ($ millions) | Real State GDP ($ millions) | State and local Revenues ($ millions) |
|---|---|---|---|---|---|
| With Caps | | | | | |
| 2010 | (1,046) | (22.94) | (8.23) | (90.21) | (35.12) |
| 2012 | (3,078) | (38.61) | (49.36) | (134.65) | (47.29) |
| 2014 | (3,275) | (37.24) | (44.09) | (116.07) | (42.22) |
| 2021 | (3,592) | (43.20) | (56.80) | (140.35) | (43.49) |
| Without Caps | | | | | |
| 2010 | (13,412) | (233.06) | (404.87) | (899.19) | (413.54) |
| 2012 | (13,845) | (165.17) | (291.59) | (599.72) | (245.71) |
| 2014 | (14,202) | (152.34) | (247.01) | (517.39) | (218.41) |
| 2021 | (15,373) | (182.61) | (271.15) | (606.65) | (246.57) |

Were the cost recovery caps not in place, the state economy would experience even greater economic losses. By 2021, the state would shed more than 15,373 jobs; and would lose $182.61 million in investment and $271.15 million in real disposable income. In terms of real state GDP, the economy would be $606.65 million smaller. The negative economic effects would spill over into state and local tax collections. We estimate a loss of $246.57 million in revenues in 2021.

# Introduction

The debate concerning the environmental and economic impacts of global climate change has intensified in recent years. Combined with fluctuations in fossil fuel prices, this interest has encouraged many state governments to respond with public policy initiatives designed to address climate-related issues and alternative energy sources. North Carolina has been no exception.

In 2007, North Carolina (NC) passed Senate Bill 3 (SB 3) that established a state Renewable and Energy Efficiency Portfolio Standard (REPS). The REPS mandates that a certain percentage of electricity generated be derived from new renewable sources. The REPS aims to diversify energy sources, encourage investment in renewable energy, and improve air quality. Although Congress has contemplated imposing a national REPS, only state or local governments have forged ahead in passing legislation they hope will quickly address climate change.

Specifically, SB 3 requires that all public electric utilities that provide electric services to customers in North Carolina increase the amount of their electricity generated from new renewable energy sources. The REPS requirement in SB 3 will be phased in over time. For example, electricity generated from new renewable energy sources must be equivalent to 3 percent of retail sales by 2012, 6 percent of sales by 2016, 10 percent of sales by 2018 and by 2021 and thereafter 12.5 percent of sales (10 percent for municipal owned and electric membership utilities). Renewable energy resources include solar, wind biomass and hydropower. However, the 2021 target of 12.5 percent consists of two separate requirements:

1. An RPS that will require utilities to generate 7.5 percent of their electricity through new renewable sources.
2. The remaining 5 percent will come from reduced electricity usage – due to energy efficiency measures.

The North Carolina Utilities Commission hired consultants from LaCapra Associates to review the potential costs and benefits of imposing an RPS in North Carolina. Key results from the study concluded that NC should have "sufficient renewable resources within the State to meet a

5% RPS requirement".[3] However, the report goes on to state that North Carolina could expect to experience difficulties, such as an increase in average retail electricity rates in attempting to meet a more aggressive RPS.

Utility companies have the opportunity to meet the requirement by generating electric power using renewable energy resources. The bill also allows utility companies to meet part of the renewable requirement by purchasing Renewable Energy Certificates (RECs). Certificates can be purchased from in-state or out-of-state renewable energy facilities. Therefore, the purchase of an out-of-state certificate acts as an investment in that out-of-state's renewable energy portfolio, and may never be sold within North Carolina.

Utilities may recover the incremental cost of renewable resources and up to $1 million annually in alternative energy research expenditures from customers. The cost per customer account is capped according to the following schedule in Table 3.

**Table 3: Utility Annual Cost Recovery Fee ($ per customer)**

| Sector | 2008 | 2012 | 2015 |
|---|---|---|---|
| Residential | $10 | $12 | $34 |
| Commercial | $50 | $150 | $150 |
| Industrial | $500 | $1,000 | $1,000 |

SB 3 also phases out the current sales tax paid by farmers and manufacturers for electricity, piped natural gas and other fuels. Specifically, Section 10 incrementally decreases the tax rate paid by farms and manufacturing industries until it is eliminated. These sales tax rates will reduce to 1.4 percent effective July 1, 2008, to 0.8 percent effective July 1, 2009 and to zero on July 1, 2010.

Section 10 also reduces the sales tax rate to 2.85 percent for sales of electricity to commercial laundry or pressing and dry cleaning establishments. Section 11 phases out the excise tax imposed on piped natural gas used by manufacturers and farmers, while Section 12 phases out the privilege tax paid on their purchases of manufactured fuel. Both taxes will be completely repealed by July 2010.

[3]LaCapra Associates, *Analysis of a Renewable Portfolio Standard for the State of North Carolina* (December, 2006): ii, http://www.ncuc.commerce.state.nc.us/reps/NCRPSReport12-06.pdf, (accessed April 17, 2008).

The state stands to lose revenue by cutting these taxes. According to the Legislative Fiscal Note, the state and local governments will lose approximately $23.8 million in FY 08-09, $35.4 million in FY 09-10, $52.6 million in FY 10-11 and $51.7 million in FY 11-12.[4]

Many parties have voiced concerns that requiring a certain level of renewable energy generation would have too great an impact on electric rates, as renewable generation costs more than conventional generation. The LaCapra report conclusions support their concerns. The Beacon Hill Institute, in conjunction with the John Locke Foundation, estimated the costs and benefits of SB 3 and the economic impact of the legislation on the state economy.

**North Carolina-STAMP**

BHI has developed a Computable General Equilibrium (CGE) model for North Carolina. The purpose of the model, called NC-STAMP (North Carolina State Tax Analysis Modeling Program) is to identify the economic effects of a variety of state policy changes.

NC-STAMP is a five-year dynamic CGE model that has been programmed to simulate changes in taxes, prices (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 into account all the important markets and flows. It is an *equilibrium* model because it assumes that demand equals supply in every market (goods and services, labor and capital). This 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, with the help of a computer.[5]

[4] Legislative Fiscal Note.
[5] 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).

# BHI Estimates and Results

The RPS mandates that at least 7.5 percent of electricity generated must be derived from renewable sources. By mandating the use of renewable sources of electricity, the state is essentially compelling the sale and use of more expensive electricity at higher prices relative to conventional energy. As noted above, SB 3 allows North Carolina energy companies to pass on to customers the higher energy costs, subject to a cap. BHI used the NC-STAMP model to measure the changes to the North Carolina economy that will take place as a result of SB 3. Each estimate represents the change that will take place in the indicated variable against a "baseline" assumption about the value that variable would take in the indicated year.

We estimated two scenarios under SB 3. The first assumes that the utility companies comply with SB 3 up to the level of the caps outlined in Table 2. The second assumes there are no caps and that the utilities could pass on the entire cost increase onto their customers. The appendix provides detailed explanations of our methodology.

***SB 3 under the Cost Recovery Caps***

BHI assumes that North Carolina's electric utilities will incur costs that meet the cost recovery caps under the REPS. The caps will prevent retail electricity prices from rising above the specified range, and thus the average retail electricity price in North Carolina will increase up to the cap limit. The price increase will leave consumers with less money to allocate to other expenditures and businesses with less money to fund new investments, hiring and expansion.

Using data from the Energy Information Agency of the U.S. Department of Energy, we estimate that the utilities will be able to pass the increased costs to consumers by raising prices up to the proposed caps.[6] We projected the number of customers in North Carolina for each year from 2008 through 2021 using the average compound growth rate from 1990 to 2007 in each category.

[6] U.S. Department of Energy, Energy Information Agency, Electricity, Electric Annual Data Tables, Number of Retail Customers by State by Sector, 1990-2007, Internet, available at http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html,accessed April 15, 2009.

We then multiplied the appropriate fee for each year by the number of customers in the category. Table 4 contains the gross total fees from 2008 through 2021.

Over the entire period, residential consumers will incur cost recovery fees of $1.590 billion dollars - the vast majority of the fees. Commercial and industrial electricity customers will pay $255 million in cost recovery fees. In total, North Carolina's electricity consumers will pay $1.845 billion in cost recovery fees.

**Table 4: Sum of Cost Recovery Fees (millions of current $)**

| Sector | 2008-2011 | 2012-2014 | 2015-2021 | Total |
|---|---|---|---|---|
| Residential | $173.11 | $168.56 | $1,248.32 | $1,589.99 |
| Commercial | $27.28 | $26.56 | $196.71 | $250.55 |
| Industrial | $0.44 | $0 .43 | $3.15 | $4.01 |
| Total | $200.83 | $195.55 | $1,448.18 | $1,844.55 |

SB 3 also outlines a series of sales tax cuts for energy-intensive industries such as manufacturing, farming and laundry services. The tax cuts are an attempt to mitigate the effect that the higher energy prices will have on these industries. Prior to 2015, revenue reductions from the tax cuts, estimated in the Fiscal Notes, matches the recovery fees for the industrial and commercial sectors listed on the middle two rows in Table 4. However, starting in 2015 the recovery fees dwarf the tax cuts, providing inadequate relief to these industries thereafter.

Moreover, SB 3 does not offer residential and other commercial consumers any relief from higher electricity prices other than the caps. This omission could add over $1.5 billion to the electricity bills of North Carolina residents and up to $250 million for commercial electricity ratepayers that do not qualify for the tax cuts.

Table 5 displays our estimates of the economic impact of SB 3. The simulation indicates that SB 3 will harm the North Carolina economy. The state will shed 1,046 jobs in 2010, with losses increasing to 3,592 jobs by 2021. North Carolinians will face higher utility prices which will increase their cost of living, which will in turn put downward pressure on households' disposable income. This combination of higher energy prices and lower employment will reduce incomes in North Carolina. Real disposable income will fall by $8.23 million in 2010, reaching a loss of $56.80 million by 2021 in NPV 2009 dollars.

**Table 5: BHI Estimates of Economic Impacts of SB 3 with Caps (NPV 2009 $)**

| | 2010 | 2012 | 2014 | 2021 |
|---|---|---|---|---|
| Total Employment (Jobs) | (1,046) | (3,078) | (3,275) | (3,592) |
| | | (38.61) | (37.24) | |
| Investment ($ millions) | (22.94) | | | (43.20) |
| Real Disposable Income ($millions) | (8.23) | (49.36) | (44.09) | (56.80) |
| | | (134.65) | (116.07) | |
| Real Gross Domestic Product ($millions) | (90.21) | | | (140.35) |
| | | (47.29) | (42.22) | |
| State and local Revenues ($ millions) | (35.12) | | | (43.49) |

The higher cost of energy will hurt firms' profit margins, causing them to reduce investment in North Carolina. We estimate that investment in North Carolina will drop by $22.94 million in 2010 and $43.20 million in 2021. The combination of lower investment, employment and incomes will shave $90.21 million off of real GDP in North Carolina by 2010 and $140.35 million by 2021.

State and local government revenues will suffer due to the negative economic impact of the SB 3 mandates. As a result, tax revenue will decrease by $35.12 million in 2010 and $43.49 million in 2021. State and local governments will face the same higher electricity prices as consumers and businesses, which will further strain their budgets.

***SB 3 without the Cost Recovery Caps***

One could argue that the recovery caps contained in SB 3 artificially hold the additional cost of renewable electricity down and that the true cost of meeting the REPS is significantly higher than the caps. The recent experience of Progress Energy provides a telling example. The company reviewed over 100 proposals to produce electricity from renewable sources in order to begin complying with the REPS. The cost estimates contained in the proposals were four times higher than company officials expected. Progress Energy CEO Bill Johnson told the *News and Observer,* "We actually doubt we can get 7.5 percent within the price cap. You'll get to the price caps in a couple of years."[7]

BHI estimated the cost of building new renewable electricity facilities in North Carolina to meet the requirement of SB 3. Table 6 contains the results. New renewable electricity facilities incur

[7] John Murawski, *The News & Observer,* "Energy Targets Out of Reach: Utility says clean electricity will cost far too much", Internet, available at http://www.newsobserver.com/business/story/1435874.html, accessed on April 15, 2009.

costs that include construction, or capital costs, fixed and variable costs for operations and maintenance and fuel costs, in the case of biomass and waste resource facilities. The cost of building new renewable facilities will be the largest cost to comply with the REPS, which we estimate to be $5.878 billion from 2009 to 2021. Operating and maintenance and fuels cost will add an additional $170.45 million to the price.

Balanced against the costs of the new renewable electricity generation facilities are savings from avoiding the construction of new conventional electricity generating facilities and the net costs of the EE programs. The avoided costs of new conventional facilities total $1.630 billion and the energy efficiency programs will save another $43.59 million, bringing the total costs of SB 3 to $4.463 billion through 2021. BHI simulated the impact these cost increases will have on the North Carolina economy. Table 7 displays the results in 2009 NPV dollars.

**Table 6: Utility Costs of SB 3 (millions of current $)**

| Cost Type | 2009-2012 | 2013-2016 | 2017-2021 | Total |
|---|---|---|---|---|
| Capital Costs | $2,007.74 | $2,171.92 | $1,699.17 | $5,878.84 |
| Fixed and Variable O&M* | 17.22 | 38.62 | 114.61 | 170.45 |
| Avoided Costs** | (271.31) | (349.28) | (1,009.78) | (1,630.36) |
| Energy Efficiency Measures | (6.11) | (9.51) | (27.97) | (43.59) |
| Total | 1,759.77 | 1,870.77 | 831.97 | 4,462.51 |

*Operations, maintenance and fuel for biomass and animal waste electric facilities.
**Includes capital, fixed and variable O&M and fuel of conventional sources of electricity.

The implementation of SB 3 without the cost caps would inflict greater damage to the North Carolina economy than under the caps. Employment would fall by 13,412 jobs in 2010, increasing to over 15,373 in 2021 as the electric bills of North Carolina's households and businesses skyrocket. Again, the combination of higher cost of living and higher unemployment would reduce real disposable income by $404.87 million in 2010 and $271.15 million in 2021. The electricity price increase would not only prevent businesses from hiring workers but also from making new investments.

**Table 7: BHI Estimates of Economic Impacts of SB 3 without Caps (NPV, 2009 $)**

| | 2010 | 2012 | 2014 | 2021 |
|---|---|---|---|---|
| Total Employment (Jobs) | (13,412) | (13,845) | (14,202) | (15,373) |
| Investment ($ millions) | (233.06) | (165.17) | (152.34) | (182.61) |
| Real Disposable Income ($millions) | (404.87) | (291.59) | (247.01) | (271.15) |
| Real Gross Domestic Product ($millions) | (899.19) | (599.72) | (517.39) | (606.65) |
| State and local Revenues ($ millions) | (413.54) | (245.71) | (218.41) | (246.57) |

Investment would fall by $233.06 in 2010 and $182.61 million in 2021. The negative effects of SB 3 would cause state GDP to drop by $899.19 million in 2010 and by $606.65 million in 2021.

The economic damage would reduce state and local government revenues by a total of $413.54 million in 2010 and $246.57 million in 2021. State and local governments would face even higher electricity prices than under the cost recovery caps.

# Conclusion

SB 3 was signed into law in 2007 to "promote the development of renewable energy and energy efficiency in the state through implementation of a renewable energy and energy efficiency portfolio standard."[8] However, many current forms of renewable energy — solar and wind in particular — are more costly and less reliable than conventional sources.

The renewable portfolio standard will raise electricity prices for consumers and businesses in North Carolina. At the same time, the energy efficiency portfolio standard contained in SB 3 will not achieve enough energy savings necessary to offset the higher prices. Meanwhile, the North Carolina business community will see a reduction in its competitive advantage over the 18 states that have not adopted similar legislation.[9] The result is that North Carolina will face slower growth in disposable income, employment and state GDP over the next 12 years.

[8] SB 3

[9] U.S. Department of Energy, Energy Efficiency and Renewable Energy, EERE State Activities and Partnerships, States with Renewable Portfolio Standards, Internet, available at http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm, accessed May 2009.

# Appendix A: Calculating the Net Costs of SB 3

***Calculation of Costs and Benefits of Energy Efficiency Programs***

SB 3 allows electric utility companies to satisfy a portion of the REPS mandate through implementing Energy Efficiency (EE) measures. Utilities may achieve 25 percent of their REPS requirement through EE before 2021 and 40 percent in 2021 and after.

The U.S. Environmental Protection Agency provides a methodology for calculating the social costs and benefits of energy efficiency programs.[10] The benefits of energy efficiency programs include avoided costs of providing additional electricity, which include generation, transmission and distribution. There are savings of natural resources such as natural gas, water and clean air. On the cost side the methodology includes program overhead and installation costs as well as incremental measured cost. Incremental measured cost attempts to adjust the cost of the energy efficiency device to only measure the amount of energy savings that is in excess of what the customer would otherwise have made in the absence of an incentive program.

The benefits of the energy efficiency programs must be adjusted to reflect only those gains that are directly attributed to the energy efficiency program. The adjustment attempts to account for free riders or those that would have made the energy efficiency investment in the absence of the program but benefit from the incentives of the program anyway. Other customers may purchase the equipment but fail to install it. Some equipment will fail and need to be replaced before its estimated useful lifetime. In addition, the adjustment accounts for the rebound effect which dilutes the results as some customers increase their electricity consumption in light of lower electric bills. There may also be a spillover effect as marketing programs induce people to adopt energy efficiency measures, but do not participate in the program. Table 8 displays the details of our calculations of the costs and benefits for the EE programs.

We first calculated the amount of electricity that utilities could save through EE programs to achieve the allowable EE portion of the REPS. For example, the first REPS mandate in 2012 is that 3 percent of electricity generated must be from renewable sources, of which 25 percent may

[10] U.S. Environmental Protection Agency, National Action Plan for Energy Efficiency Resources, Understanding Cost-Effectiveness of Energy Efficiency Programs: Best Practices, Technical Methods, and Emerging Issues for Policy-Makers, Internet, available at http://www.epa.gov/cleanenergy/energy-programs/napee/resources/guides.html; 2-2.

be achieved through EE programs, or 0.75 percent. We assumed that utilities will invest an equal amount of money in EE programs each year to achieve the goal. Therefore, utilities will invest enough to save 0.1875 percent of total 2008 electricity sales per year from 2009 and 2012 (0.75 percent / 4 years = 0.1875 percent). We utilized the LaCapra estimates of total electricity demand for each year and multiplied the figure by the incremental increase in the percentage of the REPS that can be satisfied through the EE programs. For example, in 2009 we multiplied 156,433,000 megawatts hours of electricity of demand by 0.1875 percent to get 293,312 megawatt hours of electricity saved. This calculation was repeated for each year REPS requirement increases and for 2021 which the EE portion of the REPS increases from 25 percent to 40 percent.

Next we calculated the costs of the energy efficiency programs for both the utility (administrative costs, incentives and a portion of installation costs) and the customer (including their portion of the equipment purchase and installation costs). The National Action Plan for Energy Efficiency, a joint project of the U.S. Department of Energy and the Environmental Protection Agency, provides estimates of the utility and customer costs of EE programs in a July 2006 report. The estimates range from 3 to 5 cents of levelized cost per kilowatt hour: 1 to 3 cents cost to the utility and 2 cent cost to the customer. We note that the LaCapra report estimates levelized costs of 2 cent per kilowatt hour for utilities, which is the midpoint of the estimates contained in the National Action Plan report. To calculate the utility and customer costs for each year, we multiplied the midpoint of 4 cents per kilowatt hour by the kilowatt hours saved by the programs. The result is a cost of $355.773 million displayed in the rightmost column in the bottom half of Table 8.

EE programs, like all investments, are subject to diminishing returns. In other words, the first dollar invested in EE programs should achieve a higher rate of energy saved than the last dollar invested in the programs. Therefore, the cost of EE programs should increase as more resources are allocated. Balanced against the principle of diminishing returns is the fact that our investments take place over time and technological progress should shift the costs of EE programs down, as better and more advanced equipment is available. Despite these offsetting principles, it is likely that our use of a flat cost of EE programs overstates their effectiveness, especially in later years.

Next we calculated the benefits of the EE programs in the form of saved electricity and clean air. We estimated the benefits from the electricity saved by multiplying our calculation of the megawatt hours saved under the programs by the Southeastern Electricity Reliability Council's projection of electricity price for the southeastern region.[11] For example, in 2009 the electricity price for the Council projects an electricity price of 7.7 cents per kilowatt hour, multiplied by 293,312,000 kilowatt hours (multiplied by 1,000 to convert megawatt hours to kilowatt hours) gives us a savings of $22,577,843. This step was repeated for each year through 2021.

Next, we calculated the benefits of reduced emissions of sulfur dioxide ($SO_2$) and nitrogen oxides ($NO_x$). We do not include carbon dioxide because the benefit of reducing carbon dioxide emissions at the state level is negligible because it has no measureable effect on the global emissions or concentrations. First, we computed the per megawatt hour of emissions by dividing the EIA estimate of emissions for each chemical by the North Carolina's electric power industry by the number of megawatts of power demanded.[12] We needed to price the value of the emissions. Permits to emit sulfur dioxide are traded under the existing cap and trade system that was established in the early 1990s to help curb acid rain in the northeast United States. The latest bids by utilities to emit one metric ton of sulfur dioxide was $69.74.[13] There is no such readily available price for nitrogen oxides. Instead, we use the figures produced in a study that establishes a methodology for the pricing emissions.[14] The study values nitrogen oxides at $1,034 per metric ton. Using these figures, we estimate the emissions benefits of the EE programs as $4.574 million over the entire period.

Then we adjusted the benefits to reflect the rebound effect, free riders, lower installation rates and early equipment failures. We used the estimate from the National Action Plan for Energy Efficiency that the benefits are reduced by 10 percent due to these factors.[15] Therefore our total benefits are reduced to $621.060 million.

To calculate the Net Present Value (NPV) of the costs and benefits, we followed the National Action Plan discount rate of 5 percent for the calculation net benefits to society. The NPV of the

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[11] EIA, 2009 Energy Outlook, An Updated Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act, Table 80. Electric Power Projections for EMM Region, Internet, available at http://www.eia.doe.gov/oiaf/aeo/supplement/stimulus/arra/excel/sup_elec.xls.

[12] EIA, State Energy Profiles, North Carolina, Internet, available at http://tonto.eia.doe.gov/state/state_energy_profiles.cfm?sid=NC.

[13] U.S. Environmental Protection Agency, Clean Air Markets, 2009 EPA Allowance Auction Results, Internet Available at http://www.epa.gov/airmarkt/trading/2009/09summary.html.

[14] Levy JI, Hammitt JK, Yanagisawa Y, Spengler JD. "Development of a New Damage Function Model for Power Plants: Methodology and Applications." *Environmental Science and Technology* 33: 4364-4372 (1999), for the valuation per metric ton of $NO_x$.

[15] [15] U.S. Environmental Protection Agency, National Action Plan for Energy Efficiency Resources, Model Energy Efficiency Program Impact Evaluation Guide, Internet, available at http://www.epa.gov/RDEE/documents/evaluation_guide.pdf, 5-6.

costs is $274.134 million and the NPV of the benefits is $419.475 million over the period. The difference between the benefits and cost is $174.341 million.

Our final step was to allocate the net benefits to the utilities and the electricity consumers. We utilized Duke Energy's "Save-a-Watt" program as a model, which allows the utility to charge a rider fee to all North Carolina's utility customers to reimburse the company for of the avoided costs of the EE programs.[16] This rider allows North Carolina's public utilities to earn a rate of return on the EE programs equal to that which utilities earn on electricity sales in terms of profit. Duke has agreed to charge only 75 percent of total costs. We use the 75 percent as a proxy to allocate net benefits of the EE programs to the utility and customers. Thus the utilities will realize $130.756 million, while utility customers' will enjoy net benefits of $43.586 million.

**Table 8: Calculations of Cost and Benefits of Energy Efficiency Programs ($)**

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|
| EE savings (MWh) | 293,312 | 293,312 | 298,768 | 304,313 | 413,393 | 420,653 | 427,883 |
| Costs | | | | | | | |
| Utility and Consumer ($) | 11,732,475 | 11,732,475 | 11,950,725 | 12,172,500 | 16,535,700 | 16,826,100 | 17,115,300 |
| Benefits | | | | | | | |
| Electricity Savings ($) | 22,577,843 | 22,062,870 | 22,704,552 | 22,857,884 | 30,808,777 | 31,518,346 | 31,901,012 |
| Emissions ($SO_2$, $NO_x$, $) | 148,288 | 151,047 | 153,850 | 156,748 | 212,667 | 216,323 | 219,932 |
| NPV benefits (2009 $) | 11,732,475 | 11,381,643 | 11,040,816 | 10,713,120 | 13,842,874 | 13,410,285 | 12,984,819 |
| NPV of Costs (2009,$) | 22,577,843 | 19,040,500 | 18,659,920 | 9,032,380 | 22,969,277 | 22,378,449 | 21,572,229 |
| Difference | 10,845,368 | 7,658,857 | 7,619,104 | (1,680,740) | 9,126,403 | 8,968,164 | 8,587,409 |
| Utility portion ($) | 8,134,026 | 5,744,143 | 5,714,328 | (1,260,555) | 6,844,802 | 6,726,123 | 6,440,557 |
| Consumer gain | 2,711,342 | 1,914,714 | 1,904,776 | (420,185) | 2,281,601 | 2,242,041 | 2,146,852 |
| | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **Total** |
| EE savings (MWh) | 580,030 | 590,950 | 601,333 | 1,529,750 | 1,556,633 | 1,583,983 | **8,894,312** |
| Cost | | | | | | | |
| Utility and Consumer ($) | 23,201,200 | 23,638,000 | 24,053,333 | 61,190,000 | 62,265,333 | 63,359,333 | **355,772,475** |
| Benefits | | | | | | | |
| Electricity Savings ($) | 43,705,052 | 45,286,606 | 46,523,406 | 118,483,714 | 122,030,650 | 125,032,423 | **685,493,136** |
| Emissions ($SO_2$, $NO_x$, $) | 298,764 | 304,013 | 309,356 | 786,980 | 800,807 | 814,879 | **4,573,654** |
| NPV benefits (2009 $) | 16,799,085 | 16,280,243 | 15,777,448 | 38,225,513 | 37,044,890 | 35,900,793 | **245,134,005** |
| NPV of Costs (2009,$) | 28,145,422 | 27,771,773 | 27,169,934 | 65,899,674 | 64,635,308 | 69,622,731 | **419,475,441** |
| Difference | 11,346,336 | 11,491,531 | 11,392,486 | 27,674,161 | 27,590,418 | 33,721,938 | **174,341,436** |
| Utility portion ($) | 8,509,752 | 8,618,648 | 8,544,365 | 20,755,621 | 20,692,814 | 25,291,454 | **130,756,077** |
| Consumer gain | 2,836,584 | 2,872,883 | 2,848,122 | 6,918,540 | 6,897,605 | 8,430,485 | **43,585,359** |

[16] Duke reaches Save-A-Watt settlement, Charlotte Business Journal, , Internet, available at http://www.bizjournals.com/triangle/stories/2009/06/08/daily74.html, June 12, 2009

### *Calculation of the Net Cost New Renewable Electricity*

To calculate the cost of new sources of renewable energy, BHI utilized data from the Energy Information Agency. We collected data of net generating capacity (in megawatt hours) and net summer capacity (in megawatts) from the North Carolina Electricity Profile for 2007.[17] These figures were grown through 2021.[18]

To these totals, we applied the percentage of new renewable generation proscribed by SB 3. For example, 3 percent of total electricity generation in North Carolina must be from new renewable sources by 2012. However, EE programs can account for 25 percent of the increase (or 0.75 percent), and thus 2.3 percent of the total electricity generation in North Carolina must be derived from new renewable sources. This process was repeated for 2015, 2018 and 2021. In 2021, EE can satisfy 40 percent of the REPS requirement of 12.5 percent, or 7.5 percent. Table 9 displays the results.

**Table 9: Total and Renewable Electricity Generation under REPS**

| | 2012 | 2016 | 2018 | 2021 |
|---|---|---|---|---|
| Total Electricity Generation (GWh) | 136,975 | 142,575 | 146,620 | 150,398 |
| Percent Renewable (less EE) | 2.25 | 4.5 | 7.5 | 7.5 |
| Renewable Generation (GWh) | 3,082 | 6,416 | 10,996 | 11,280 |
| Net summer Renewable Generation (MWh) | 646 | 1,345 | 2,305 | 2,364 |

Because our estimates of the new renewable energy requirements under the REPS are expressed in terms of total megawatt hours and net summer capacity in megawatts, we can calculated the net costs of building and operating the new renewable sources. These include the overnight capital costs (if a facility could be built overnight), variable and fixed operations and maintenance (O & M) costs, fuel costs and avoided cost (cost savings from not building a conventional facility).

[17] U.S. Department of Energy, Energy Information Agency, Electricity, State Electricity Profiles, North Carolina Electricity Profile, 2007 Addition, http://www.eia.doe.gov/cneaf/electricity/st_profiles/north_carolina.html,. April 15, 2009
[18] U.S. Department of Energy, Energy Information Agency, 2009 Annual Energy Outlook, Year-by-Year Updated Annual Energy Outlook 2009 Reference Case with American Recovery and Reinvestment Act, Table 80. Electric Power Projections for EMM Region, East Central Area Reliability Coordination Agreement, http://www.eia.doe.gov/oiaf/aeo/supplement/stimulus/regionalarra.html, (accessed April 20, 2009.)

We calculated the overnight costs using information from the "Assumptions to the Annual Energy Outlook, 2009."[19] The costs are displayed by technology (geothermal, landfill gas, photovoltaic, wind, and biomass) by year (2010, 2020 and 2030) and a high-cost and low-cost reference case. We used figures from the low cost reference case and 2010 and 2020 for each technology of renewable energy. We calculated an average overnight capital cost of renewable electricity generation using U.S. Net Summer capacity to weight each technology.[20] Table 10 contains the results.

As one can see from table 10, the EIA estimates for overnight costs of renewable energy show a decrease from 2010 to 2020. This is likely due to expected technological advances in the production of renewable energy. However, as noted with EE programs, renewable energy sources in North Carolina are subject to diminishing returns and increasing costs as more renewable energy resources are built in North Carolina. This may cause our estimates of the costs of renewable energy to be understated.

**Table 10: Costs of new Renewable Capacity (2007$/KWh)**

| | 2010 | | | 2020 | | |
|---|---|---|---|---|---|---|
| Source | Capital Costs | Fixed O&M | Variable O&M | Capital Costs | Fixed O&M | Variable O&M |
| Biomass | 3,636 | 64 | 7 | 3,116 | 55 | 6 |
| Hydroelectric | 2,801 | 14 | 2 | 2,058 | 10 | 1 |
| Wind | 2,791 | 30 | 0 | 2,544 | 28 | 0 |
| **Weighted Average** | **2,108** | **41** | **3** | **2,284** | **20** | **1** |
| Conventional (combustion Turbine) | 661 | 12.11 | 3.59* | 661 | 12.11 | 3.59* |

*Includes fuel costs of $0.02 per kilowatt.

We calculated a weighted average cost of renewable energy using the LaCapra estimates of the practical potential of new renewable resources in North Carolina.[21] The weighted average figures were applied to the new megawatts needed to satisfy the REPS requirement for the appropriate year (2012, 2015, 2018 and 2021). The fixed and variable costs were reduced for 2020 by the percentage reduction in capital costs between 2010 and 2020.

[19] U.S. Department of Energy, Energy Information Agency, "Assumption to the 2009 Annual Energy Outlook, Table 13.1: Overnight Capital Cost Characteristics for Renewable Energy Generating Technologies in three cases (2007/$kw):" 156, http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/renewable.pdf, accessed April 20, 2009)

[20] U.S. Department of Energy, Energy Information Agency, "Renewable and Alternative Fuels, Table 4: U.S. Electric Net Summer Capacity, 2003-2007," http://www.eia.doe.gov/cneaf/alternate/page/renew_energy_consump/table4.html, (accessed April 20, 2009.)

[21] LaCapra Associates, *Analysis of a Renewable Portfolio Standard for the State of North Carolina* (December, 2006): 61, http://www.ncuc.net/rps/rps.htm (accessed June 30, 2009).

Next we calculated the capital, fixed and O&M costs for conventional electricity generation using assumption tables form the EIA's Annual Energy Outlook 2009.[22] These costs were applied to the amount of electricity that would be generated by new renewable sources under the REPS, since this represents the amount of conventional electricity generation capacity that presumably will not need to be built under the REPS. We adjusted the avoided cost of conventional electricity downward to reflect the unreliability of solar and wind power. The difference between the cost of the new renewable and conventional electricity generation and the net cost of EE programs represents the net cost of the REPS. Table 6 in the body of the report contains a summary of the results.

***Modeling the REPS using STAMP***

Now that we have the net cost of the REPS, we can model their impact on the North Carolina economy using STAMP. We simulate the costs and benefits of the SB 3 as changes in tax policy, since the cost recovery fees and uncapped price increases act as a tax on electricity sales. Thus, we place increased state fees on the utility sector in the STAMP model by the net costs of the REPS we calculated above.

For the sales tax cuts outlined in SB 3, we entered them into the STAMP model using the data from the Legislative Fiscal Note. The percentage changes in the economic variables were applied to our baseline forecast of the variables from 2009 to 2021.

In order to estimate the impact of the REPS, we estimated the size of the utility sector within the STAMP model through 2021. We calculated the percentage increase represented by the net costs REPS for each year that the REPS increases, 2012, 2015, 2018 and 2021. We put these percentages into the STAMP model as an increase in state fees applied to the utility sector. The additional fee revenue stream was allocated back to the utility sector. The result is that utility customers would pay a higher price for utility services that would be refunded back to the industry. This method was used for both the capped cost recovery fees and the uncapped cost recovery fees.

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[22] U.S. Department of Energy, Energy Information Agency, "Assumption to the 2009 Annual Energy Outlook", Table 8.2: Cost and Performance Characteristics of New Central Electricity Generation Technologies, http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/electricity.pdf, (accessed April 20, 2009): . 88.

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



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