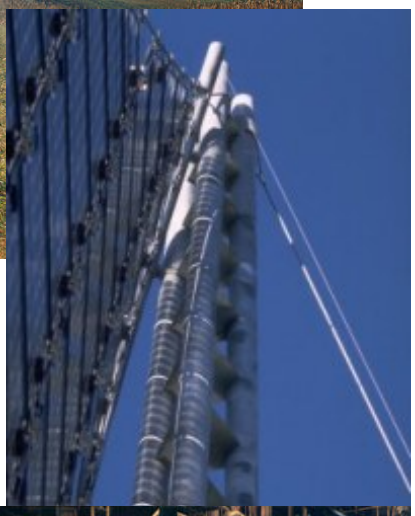

Clean Energy Funding for North Carolina

An Impact Analysis of State Energy Office Programs

Prepared for:

North Carolina Energy Policy Council
and the
State Energy Office,
North Carolina Department of Administration

Appalachian State University
Energy Center

Boone, North Carolina
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Table of Contents

1. Executive Summary

This report addresses the impacts of North Carolina State Energy Office (SEO) programs on energy savings, emissions reductions, and the state's economy. The goal is to better understand and quantify the complete set of impacts that SEO programs have on the state using a modeling tool that considers the various interactions between all sectors in the economy.

The North Carolina Energy-Economic Model (NCEEM) is employed to assess these programmatic impacts from fiscal years 2001-2003, for which there are detailed program spending records. Because only three fiscal years are considered, the impacts are a snapshot given that they do not reflect the complete activities of the SEO over its life. However, for these three years of programs, the model does project energy savings, emissions reductions, and economic impacts through the year 2010.

One of the key results of the analysis is that effects of SEO programs continue beyond the period of funding. By their nature, many SEO programs focus on market transformation, which means that rather than simply focus on immediate energy savings returns, the programs foster both the supply infrastructure and market education. As a result, efficiency and renewable energy gains continue beyond the years that SEO funds are expended. Another key result of the SEO funding, which is captured in the model, is the private investment in new technologies stimulated by these programs.

The NCEEM is an input-output economic model that takes into account the structure of the North Carolina economy by incorporating North Carolina-specific economic statistics from the Minnesota IMPLAN Group. Additional inputs to model are energy and economic forecasts developed for the SEO and NC Department of Commerce and individual program spending information from the SEO.

Total cumulative energy savings through 2010, including electricity and natural gas, are 12,997 billion BTUs (BBTUs) or 1,287 GWh. This ten-year total is roughly equivalent to a third of the annual output of a coal-fired power plant or enough energy for approximately 160,900 homes in one year. The majority of these savings are through energy efficiency improvements, which account for total cumulative reductions of 8,703 billion BTUs or 862 giga-Watt hours. After a rise in annual electricity savings during the years of program spending, total annual savings level out at 105 GWh through 2010. Renewables account for a total electric displacement of 209 GWh over the ten-year period, while cumulative natural gas savings are 1,965 BBTUs.

Based on these energy savings, the model projects emissions reductions for SO_2, NO_x, and CO_2. Total cumulative SO_2 reductions are 8,260 tons with annual reductions leveling off at 1,002 tons. Total cumulative NO_x reductions are 1,263 tons with annual reductions leveling off at 154 tons, which is equivalent to taking 16,600 cars off the road. The third pollutant considered is CO_2, which is not part of the NC Clean Smokestacks Act, but which is a major greenhouse gas. Through 2010, total cumulative CO_2 reductions are 1,629,621 tons, with annual reductions leveling off at 200,000 tons per year, which is equivalent to taking 32,900 cars off the road.

The economic impacts of SEO programs include increases in total wages, gross state product (GSP), and jobs. In all cases, impacts are in comparison to a

baseline case, which is based on projections previously developed for the SEO and the NC Department of Commerce. Over the ten-year period considered, annual wage impacts increase to $26.4 million by 2010, with total cumulative wage increases of $176 million over the ten-year period. That is, as a result of SEO programs an additional $26.4 million will be paid out in wages to workers in North Carolina in 2010. The annual wage impacts rise from $4.7 million in 2001 to $13.2 million in 2003 as an immediate result of program spending and additional investment stimulated by SEO programs. These annual wage impacts continue to rise through 2010 – beyond the period of program spending considered – as a result of the market transformation effects of many of the SEO programs.

Gross state product (GSP) is a comprehensive measure of the impact on the state's economy as a whole. Cumulative GSP increases by $191 million over this ten-year period, with total annual GSP impacts increasing to $24.3 million by 2010.

Finally, there is also an impact on job creation, with a total of 1,050 net jobs projected through 2010. New job creation is greatest during the years of program spending, with 474 created from 2001-2003; however, as with all other impacts, job creation continues through 2010, with 69 new jobs created in 2010.

While the analysis described here is focused on past spending through the SEO, the NCEEM is also being used to consider different spending scenarios in the future. The last disbursement of PVE funds will be in 2005, which will carry some programs through 2006. Therefore, new sources of funds for energy efficiency and renewable energy programs will have to be considered. In a separate report, the economic, energy, and emissions impacts of various public benefit fund (PBF) scenarios are analyzed in order to help guide policy makers as PBF funding decisions are made.

2. Introduction

State Energy Office and Study Background

The North Carolina State Energy Office (SEO) has been administering energy programs since 1973 and over this period has fostered both new initiatives and new organizations to carry out its mission to promote energy efficiency and renewable energy. Now operating under the N.C. Department of Administration, the Office is funded from Petroleum Violation Escrow funds and the U.S. Department of Energy. The SEO, which uses no state-appropriated funds, administers programs in four primary areas: energy efficiency and renewable energy, alternative fuels and alternative fuel vehicles, energy policy, and energy emergencies.

Through the years there has been an effort on a periodic basis to assess the energy savings impacts of SEO programs. These reports, the last of which is from 1998, provide a sense of the scope of the SEO's work and energy impacts.

This report presents the results of a new study of the impacts of the SEO's programs. The goal is to consider not only energy savings impacts but also emissions reductions and economic impacts, and this was performed as an outgrowth of the Energy Policy Council's July 2003 State Energy Plan. The Plan proposes a number of action items to help the state prepare for a future with limited Petroleum Violation Escrow funds (PVE), which are the current source of the majority of funding for the SEO's programs.

PVE funds are available to all states as a result of court settlements or judgments at the federal level against oil companies that overcharged customers during the 1970's and 1980's. The Energy Office does also receive U.S. Department of Energy (U.S. DOE) moneys in the form of special projects funds and formula funds, but the majority of support is through PVE. Furthermore, the SEO does not receive any state funds. According to the July 2004 SEO audit report, North Carolina had approximately $10 million of PVE funds in a trust account at the beginning of May 2004; however, final disbursements of these PVE funds will be in 2005, which will support some programs through 2006.

- *What have been the impacts of the State Energy Office? What will be the impacts of different funding scenarios as the state moves forward without PVE funding?*

With those funds expected to be depleted in 2005, the questions have been asked: What have been the impacts of the State Energy Office? What will be the impacts of different funding scenarios as the state moves forward without PVE funding?

This report addresses the first question, while the issue of future energy policy scenarios is taken up in a second report entitled Clean Energy Funding for North Carolina, An Impact Analysis of Future Energy Policy Scenarios. The second report specifically focuses on two primary policies considered in the 2003 State Energy Plan: the Public Benefits Fund (PBF) and the Renewable Portfolio Standard (RPS). The PBF is a mechanism to continue and expand funding levels for state energy programs through a collection on electricity and natural gas bills, and this approach is currently being used by fifteen states as the primary source of funding for energy programs, including efficiency, renewables, and low income programs. The RPS is a mechanism to guarantee the production of a minimum amount of renewable energy in the state and is currently used by sixteen states.

It is worth noting the timing of this and the companion report. The data collection and modeling work behind these reports began in the early fall of 2003. This

effort therefore predates the audit work concluded in the summer of 2004 and is not intended to serve as a response to the audit report. However, both the audit report and these energy-economic analyses both should have an impact on the continued discussion of how to maintain the state's energy programs beyond the end of PVE funding. As the audit report indicates, there is limited PVE funding left, and this for the past fifteen years has been the primary source of funding for North Carolina's energy programs.

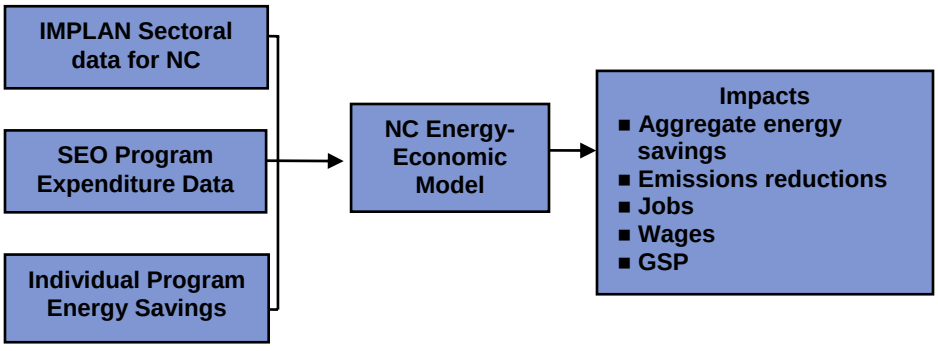
Modeling Tool and Approach

The impacts of both current SEO energy programs and projected PBF and RPS scenarios are evaluated using an economic modeling tool developed by nationally recognized economist Skip Laitner, who has conducted several similar studies on the national and state levels. The model, which is referred to as the North Carolina Energy-Economic Model (NCEEM), is an input-output economic model that takes into account the structure of the North Carolina economy. The basic logic of the model is presented in Figure 2-1.

As described in greater detail in Section 4, this model incorporates North Carolina-specific economic statistics from the Minnesota IMPLAN Group; energy and economic forecasts developed for the SEO and NC Department of Commerce; and individual program spending and energy savings information from the SEO. From these inputs the following impacts are calculated:

- Energy savings, both electricity and natural gas,
- Emissions reductions for SO_x, NO_x, and CO_2,
- Statewide wages and gross state product, and
- Net job creation.

Figure 2-1. North Carolina Energy-Economic Model



The model incorporates North Carolina industry-specific data with information about SEO program spending and energy savings data to generate impact figures.

It is the intention of the investigators that these outputs will be of value to the Energy Policy Council and the North Carolina legislature in the months and years ahead as decisions are made on how the state's energy programs should be continued.

Organization of this Report

The report is organized around two main sections: Section 3, SEO Programs Summary, and Section 4, Impact Analysis. Section 3 provides an overview of the programs funded by the SEO over the three fiscal years 2001, 2002, and 2003. These years were chosen because they are the most recent years for which there is complete spending information available on a program-by-program level. Energy savings statistics are also available for many of the programs operated in this period. Additional details of SEO's programs can be found in the July 2004 State Audit Report of the Energy Office and Energy Policy Council, which lists all current SEO programs.

Section 4 presents the results of the analysis. This section describes the NCEEM model and the state's energy funding sources before addressing the results in terms of energy savings, emissions reduction, and economic impacts.

3. Programs Summary

SEO Programs: Program Types

Programs of the North Carolina State Energy Office cover a wide variety of activities from agriculture to transportation to building and industrial efficiency. These programs can be categorized both by function, e.g., demonstration, research and development (R&D), etc., and by technical area of focus, e.g., agriculture, buildings, etc. Table 3-1 highlights the functional division of SEO program funding during FY 2001-03.

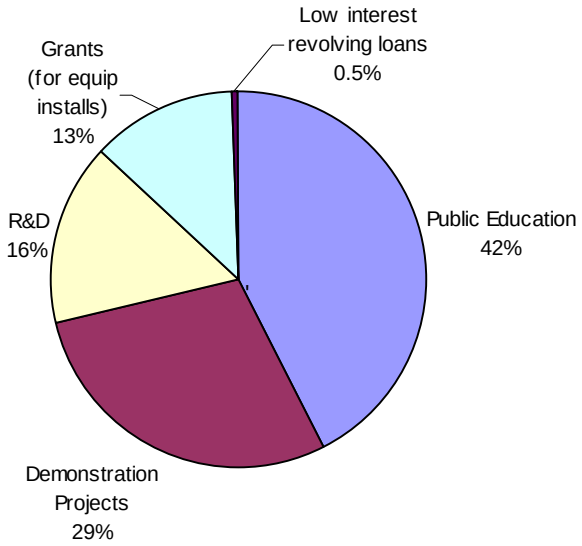
Table 3-1. SEO Spending by Program Type, FY 2001-03

Program Type	Funding FY 2001-03
Public Education	$4,682,445
Demonstration Projects	$3,165,661
R&D	$1,722,119
Grants (for equip installs)	$1,399,178
Low interest revolving loans	$49,954
TOTAL	**$11,019,357**

Source: SEO budget records

Figure 3-1 highlights the spending breakdown by percentages. Public education and demonstration projects represent the majority of program spending at 70% or $7,848,106. Low interest revolving loans are a small fraction because this is a new program just starting in FY 2003.

Figure 3-1. Breakdown of SEO program spending, FY 2001-03



SEO spending can be broadly grouped among the above five program types. Note that some programs such as those that are university-based may include activities that fall into multiple categories such as public education, R&D, and demonstration projects, in which cases the percentage spent in these programmatic areas is estimated.

SEO Programs: Technical Categories

Table 3-2 shows the SEO program spending breakdown by technical category. These figures can be slightly misleading because there are many programs which focus on more than one area, including some of the university supported programs, however, each SEO program is categorized in one of these areas.

Table 3-2. SEO Spending by Technical Program Area, FY 2001-03

Technical Program Area	Funding FY 2001-03
Administration*	$42,295
Agriculture	$329,000
Awareness and Education	$484,024
Buildings	$3,342,923
Business and Industry	$4,016,056
Renewable and Alternative Energy Sources	$2,053,981
Sustainable Communities and Emergency Response	$178,648
Transportation	$572,435
TOTAL	**$11,019,357**

Source: SEO budget records

* This total includes the Annual Report on Energy Savings (ARES) and does *not* include SEO overhead totals. For information on SEO administrative spending, see the 2004 NC Auditor's report.

The vast majority of funds were dispersed in the form of grants. Also, 74% or nearly three quarters of all projects are multi-year projects receiving funding at least two of the three years considered (FY 2001-03) or are known to continue beyond FY 2003. As discussed below in the impacts section, programs that are on going avoid the ramp-up period before program impacts are observed. That is, first-year energy savings impacts of programs are typically small relative to subsequent years because of the time it may take to roll out a new program. Although the majority of SEO programs are on going, it is conservatively assumed in the analysis that all programs begin in FY 2001, the first year of consideration.

➢ *Market transformation describes programs whose goals are to make long-term, sustained changes in energy use patterns by, for example, educating consumers, training practitioners, or cultivating new businesses.*

Programs can also be classified by whether or not they are focused on market transformation. Market transformation describes programs whose goals are to make long-term, sustained changes in energy-use patterns by, for example, educating consumers, training practitioners, or cultivating new businesses. Formally, market transformation is defined as a reduction in market barriers resulting from a market intervention (programs), as evidenced by a set of market effects that lasts after the intervention has been withdrawn or reduced.

This is contrasted with program spending on grants for equipment installation for example, where the goal is to realize near-term energy savings. While this latter example can have market transformation effects by stimulating a demand for things such as high efficiency HVAC equipment, these are not considered market transformation programs.

The majority of NC SEO energy programs are market transformation in nature. While no statistics are available to strictly define the percentage, Figure 3-1 provides some guidance: Public Education programs are classified as market transformation, as would be Demonstration and R&D programs. Using this simple proxy, it is estimated that approximately 85% of SEO programs can be classified as market transformation.

One result of this focus is that aggregate energy savings projections tend to be conservative as it is difficult to quantify the longer-term impacts of market transformation programs. Generally, one can expect energy savings to continue to accrue well beyond the end of spending, which is 2003 for the purposes of this study. As the results here show, energy savings are expected to level off and continue through 2010. This implies that energy savings through these program expenditures will only be realized for between seven and ten years and that new energy savings will be limited in the years beyond program spending. These are both conservative assumptions based on the SEO's focus on longer-term impacts.

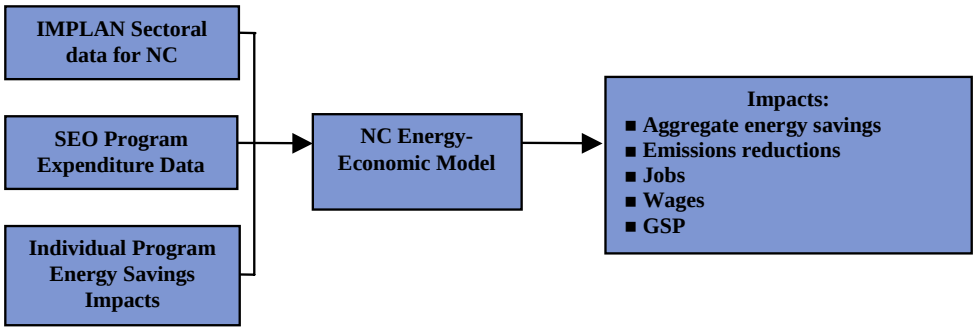
4. Impact Analysis

The North Carolina Energy-Economic Model (NCEEM)

Model Overview

The North Carolina Energy-Economic model (NCEEM) is a twenty-sector input-output model tailored to the North Carolina economy that relies on standard cross-sector (cross-industry) economic linkages updated by the Minnesota IMPLAN Group. The model then becomes a tool to evaluate the impacts of North Carolina State Energy Office programs by feeding in data on NC SEO expenditures and data on the energy savings resulting from individual programs. The NCEEM was developed by nationally recognized modeling economist Skip Laitner based on similar work for other southern states such as Mississippi and Texas. Figure 4-1 illustrates the model's basic structure.

Figure 4-1. North Carolina Energy-Economic Model



The NCEEM combines North Carolina-specific industry economic statistics, forecasts developed for the NC Dept of Commerce, and information on spending and energy savings from individual programs.

The model considers all the major sectors in the North Carolina economy. These twenty sectors include:

- Agriculture
- Households
- Government
- Electric and natural gas services
- Trade
- Financial services
- Extraction industries
- All major manufacturing industries
- Service sectors

The NCEEM is an input-output model and therefore relies on cross-sector relationships based on actual economic data to project changes in final demand for each of the twenty sectors considered. For an industry such as agriculture, for example, the model links the value of that sector's total production or output to the amount of input needed from all other relevant sectors, e.g., manufacturing,

government, etc., to produce that output. The linkage is two-sided: for an industry such as agriculture the model considers both what other industry inputs are needed to produce agricultural output and which industries in turn purchase goods from the agricultural industry. In this way, the model is able to reflect economy-wide impacts when, to continue the agricultural example, an SEO program helps the agricultural sector save energy.

The core economic data upon which the model is based is from the Minnesota IMPLAN Group. This company maintains national, state, and county level economic statistics that are widely used in economic modeling. Data for North Carolina is updated as of 2000.

- *The NCEEM is also used to analyze the economic and emissions impacts of proposed North Carolina energy programs.*

The NCEEM is also used to analyze the economic and emissions impacts of *proposed* North Carolina energy programs. As an action item from the 2003 State Energy Plan, the Energy Center at Appalachian State University is using the model to consider the economic, energy savings and jobs impacts of various public benefit fund (PBF) and renewable portfolio standard (RPS) scenarios in North Carolina. For this analysis, rather than incorporate historical expenditure data, the model incorporates various PBF and RPS scenario assumptions. The results from the scenario study are reported separately.

Baseline Case

The model highlights the impacts of SEO program spending relative to the baseline case with no assumed SEO spending. This baseline case incorporates both economic and energy assumptions drawn from the May 2003 report North Carolina Energy Outlook – Final Report prepared for the State Energy Office and the NC Department of Commerce by Global Insight. In this way, the baseline for this study is consistent with projections already used by the state.

Key results from the 2003 North Carolina Energy Outlook that are used as inputs to this study are included in Appendix 1.

Energy Savings

Energy savings from State Energy Office programs are calculated based on nationally published energy savings rates for various program types, e.g., grants, R&D, and public education. This approach to energy savings calculations provides a common basis of comparison with other states and corrects for inconsistencies in energy savings reporting from the various programs or where savings are not reported. Energy savings are broken down into electricity savings, natural gas savings, and generation displacement through the use of renewable energy sources.

Because this study is a snapshot of SEO spending in FY 2001-03, the model considers the program savings as if there were no programs in previous years or in subsequent years. Therefore energy savings values are artificially low given that the ongoing impacts of previous years' programs continue to benefit the state, just as the impacts of the three program years considered here continue well into the future. For purposes of this study, the year 2010 is taken as the end date, although it is reasonable to assume that most programs will have energy savings impacts well beyond 2010.

Table 4-1 presents the total annual results of the analysis for the three major categories of savings: electric energy savings through efficiency programs, natural gas energy savings through efficiency programs, and energy displacement through renewable energy programs. Total electricity savings and cumulative renewables are expressed as both giga-Watt hours (GWh) and billion BTUs (BBTU). Billion BTUs serves as a common unit for comparing electric and natural gas savings. For both electricity and natural gas savings, values are broken out among residential, commercial, and industrial sectors. Such a breakdown is not available or particularly helpful for the renewable energy totals.

Table 4-1. Total Annual Energy Savings from 2001-03 SEO Programs.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Cumula-tive Total
Total Annual Electricity Savings (GWh)												
Residential	0.0	3.6	13.4	23.2	24.6	24.8	24.8	24.8	24.8	24.8	24.8	**214**
Commercial	0.0	0.9	7.2	20.2	33.6	33.9	34.8	34.8	34.8	34.8	34.8	**270**
Industrial	0.0	1.7	19.6	41.9	44.1	44.5	45.4	45.4	45.4	45.4	45.4	**379**
Total (GWh)	0.0	6.1	40.2	85.3	102.2	103.2	105.0	105.0	105.0	105.0	105.0	**862**
Total (BBTU)	0.0	62.2	407.3	864.3	1035.0	1043.9	1060.8	1059.4	1058.0	1056.7	1055.3	**8,703**
Total Annual Renewables												
GWh	0.0	0.4	3.7	19.7	23.7	24.6	27.3	27.3	27.3	27.3	27.3	**209**
BBTU	-	4.3	37.4	199.4	240.1	248.4	275.9	275.5	275.2	274.8	274.5	**2,105**
Total Annual Natural Gas Savings (BBTU)												
Residential	0.0	3.8	30.6	52.9	55.9	56.4	56.5	56.5	56.5	56.5	56.5	**482**
Commercial	0.0	14.0	16.3	45.9	76.4	77.2	79.2	79.2	79.2	79.2	79.2	**626**
Industrial	0.0	0.0	44.5	95.3	100.3	101.2	103.2	103.2	103.2	103.2	103.2	**857**
Total	0.0	17.8	91.4	194.0	232.6	234.8	238.9	238.9	238.9	238.9	238.9	**1,965**
Total Primary Energy Savings/Generation (BBTU)	0	84	536	1,258	1,508	1,527	1,576	1,574	1,572	1,570	1,569	**12,773**

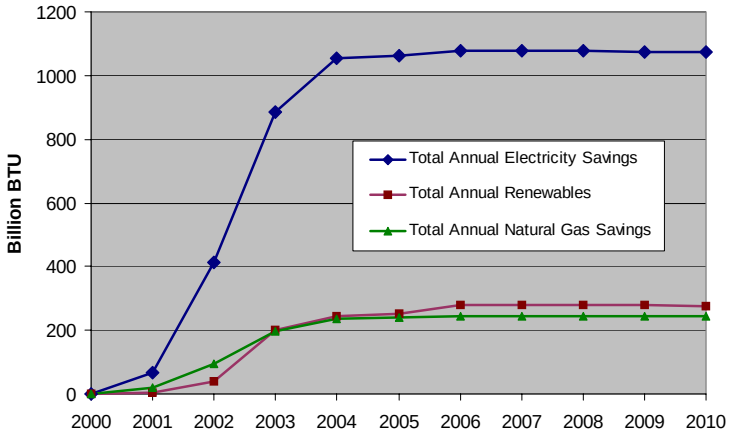
As the numbers show, cumulative energy savings impacts level off after 2004 as a result of FY 2003 being the last year of analysis. This is illustrated in the figures that follow.

Figures 4-2 and 4-3 illustrate the total annual and the cumulative energy savings, respectively, from the data in Table 4-1. Figure 4-2 includes annual energy savings based on the three savings sources tracked: overall electricity savings from efficiency programs, new renewable energy sources, and new natural gas savings. (Natural gas savings in green are read on the right hand vertical axis.) Annual energy savings follow a predictable pattern of increasing over the three-year funding period and then leveling off beyond FY 2003.

Because this is a snapshot of three program years and no prior year funding is assumed, most program savings are given a time lag to represent the ramping-up of programs. This is reflected in Figure 4-2. Many of the SEO funded programs during Fiscal Years 2001 – 2003 were in fact funded prior to this three-year period considered, so the lag time assigned to the savings serves as a conservative assumption.

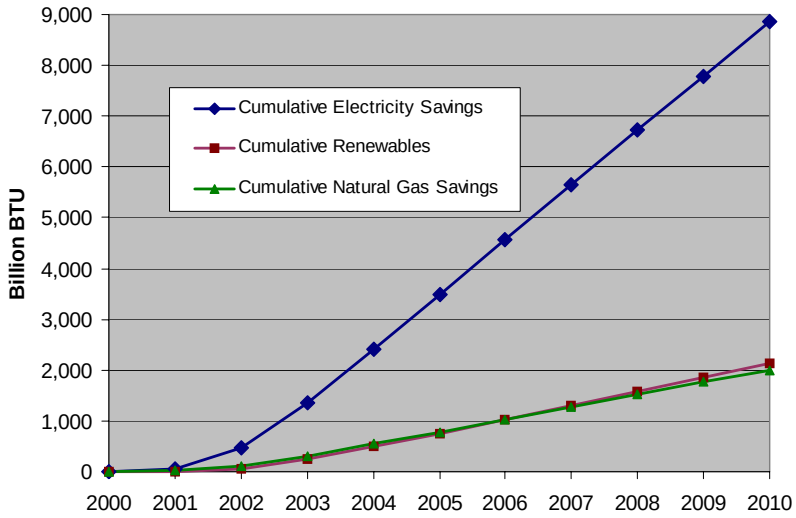
The continuing impacts of energy investments are shown out to the year 2010. This is explained by way of simple example: A three-year commercial facility HVAC improvement program might see limited new energy savings in year one, but then increasing impacts in years two and three as the program is fully implemented and reaches its intended audience. Once funding for such a program stops after year three, the rate of new installations of high efficiency HVAC systems may decline; however, the installed base of new HVAC systems from the years of program funding will continue to deliver energy savings through the life of the buildings.

Figure 4-2. Total annual electricity savings, natural gas savings, and renewable energy production



Annual electric savings (GWh), natural gas savings (BBTU), and new renewable energy production rise rapidly during the years of program spending and level off through 2010 as program impacts continue beyond the years of funding.

Figure 4-3. Cumulative Energy Savings



Total cumulative electricity savings reach 8,866 BBTU by the year 2010, while renewable energy and natural gas savings reach 2,129 and 2,002 BBTU, respectively. Total combined cumulative savings of 12,997 BBTU or 1,287 GWh, is roughly equivalent to a third of the annual output of a coal-fired power plant or enough energy for approximately 160,900 homes in one year.

Figures 4-2 and 4-3 also reflect conservative assumptions about the continuing energy savings impacts of SEO programs. As previously discussed, most SEO programs are targeted to market transformation, and not necessarily at near-term energy impacts. As a result, for many of these programs – such as energy training programs through the Industrial Extension Service – there will be continued *growth* of new equipment installations well beyond any end to program funding. Where, for example, energy savings in Figure 4-2 level off at approximately 1,100 BBTU per year beyond 2004, the reality is likely to show the annual savings to continue to grow over time. Again, this is a result of the SEO's focus on market transformation programs that have a longer-term and more sustained impact.

Emissions Impacts

The energy savings outlined in the previous section translate directly into reduced emissions of key pollutants. Here the impacts on sulfur dioxide (SO_2), nitrogen oxides (NO_x), and carbon dioxide (CO_2) are addressed.

Emissions reduction calculations are based on emissions factors expressed in tons per trillion BTU (tons/TBTU). These factors, which are based on the North Carolina installed generation base, take into account the relative contribution of coal, natural gas, petroleum, and nuclear to the state's total generation. These factors also take into account the scheduled emissions reductions agreed to as part of the 2002 Clean Smokestacks Bill. Appendix 3 lists the emissions factors for SO_2, NO_x, and CO_2. Table 4-2 shows the results of the analysis for the three pollutants.

Table 4-2. Total Annual and Cumulative Emissions Reductions (Tons)

Total Annual emissions	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Total Annual SO_2 Reductions	64	390	836	975	985	1,002	1,002	1,002	1,002	1,002
Total Annual NO_x Reductions	9	58	127	149	151	154	154	154	154	154
Total Annual CO_2 Reductions	10,385	69,331	159,874	192,224	194,731	200,615	200,615	200,615	200,615	200,615
Total Cumulative emissions										
Total Cumulative SO_2 Reductions	64	454	1,290	2,265	3,250	4,252	5,254	6,256	7,258	8,260
Total Cumulative NO_x Reductions	9	68	194	343	494	648	802	955	1,109	1,263
Total Cumulative CO_2 Reductions	10,385	79,716	239,589	431,814	626,544	827,160	1,027,775	1,228,391	1,429,006	1,629,621

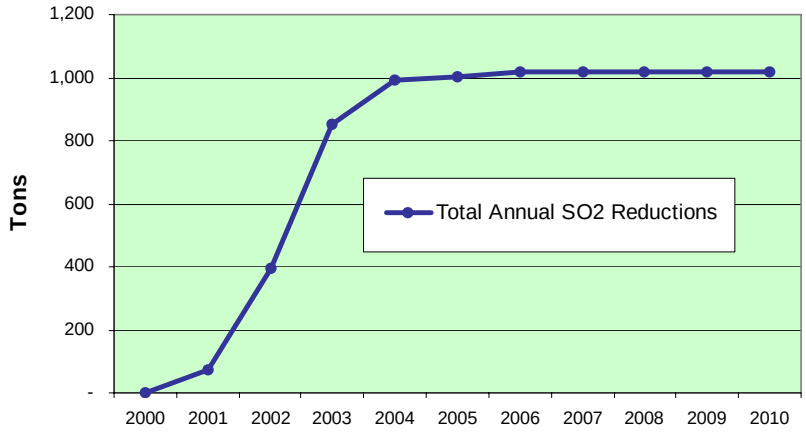
Sulfur Dioxide

Among North Carolina's electric generation sources, SO_2 emissions are exclusively produced from burning coal. SO_2 is the main cause of fine particles, haze and acid rain. Under the 2002 Clean Smokestacks Act these emissions are to be reduced from 1998 levels of 489,000 tons to 250,000 tons by 2009 (49%) and 130,000 tons by 2013 (74%).[1]

Figures 4-4 and 4-5 show the emissions reductions achieved as a result of SEO energy savings programs. Figure 4-4 shows total annual SO_2 reductions (top line) and the new, incremental reductions in SO_2 emissions each year. During and immediately following program years there are new savings, but beyond 2005, there are very small amounts of new savings such that total annual savings level out at 1,000 tons/year.

[1] *North Carolina Energy Outlook*, Global Insight, Inc. 2003.

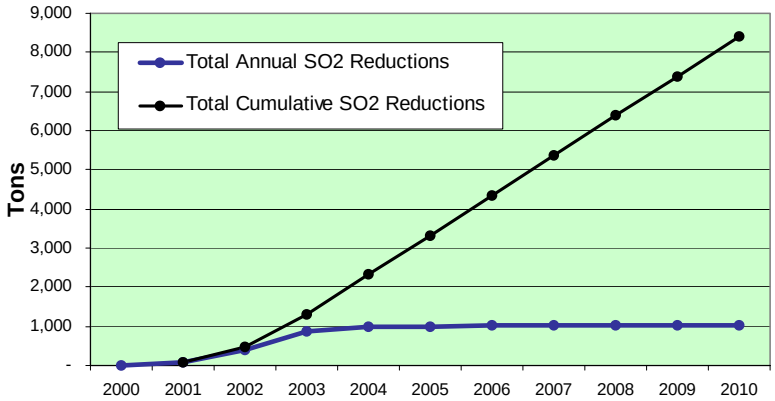
Figure 4-4. Annual SO_2 Emissions Reductions (Tons)



Total annual SO_2 emissions reductions. Emissions reductions increase during the years of new energy savings and level off at 1,000 tons per year through 2010 as annual energy savings level off.

Figure 4-5 presents the same basic data but illustrates the cumulative impact of these continuing annual emissions reductions. By the year 2010, it is projected that a total of 8,260 tons of SO_2 emissions will have been eliminated through the energy savings achieved via SEO programs in fiscal years 01-03.

Figure 4-5. Cumulative SO_2 Emissions Reductions (Tons)



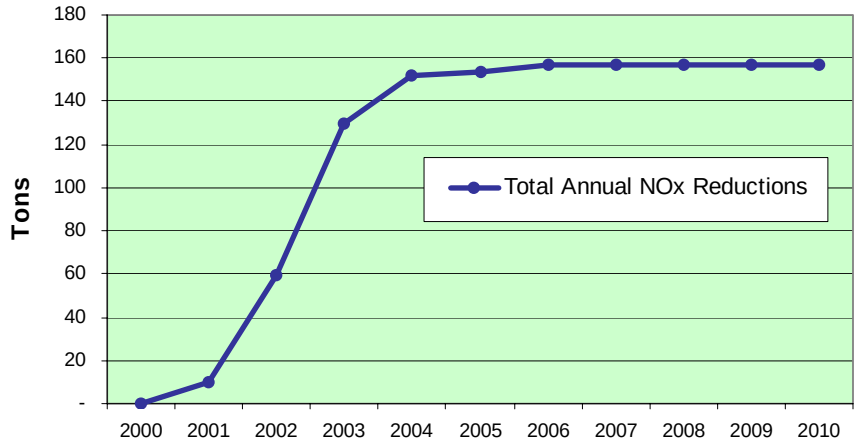
Cumulative SO_2 emissions reductions are represented by the top line, while the lower line, total annual emissions reductions, is repeated from Figure 4-4. The scale is different to account for the cumulative emissions reductions, which reach a total of over 8,000 tons by 2010.

Nitrogen Oxides

Like sulfur dioxide, nitrogen oxides (NO_x) are a primary target of the Clean Smokestacks Act. Nitrogen oxides can travel long distances, causing a variety of health and environmental problems in locations far from their emissions source. These problems include ozone and smog, which are created in the atmosphere from nitrogen oxides, hydrocarbons, and sunlight.[2] NO_x is the main cause of ozone and contributes to acid rain and haze. Under the Act, NO_x emissions are to be reduced from 245,000 tons in 1998 to 56,000 tons by 2009 (79%).

Figures 4-6 and 4-7 show the NO_x reductions achieved as a result of SEO energy savings programs. Figure 4-6 shows total annual NO_x reductions, which like SO_x emissions increase significantly during and immediately following program years but level off in years beyond 2005 as energy savings from SEO programs level off. Cumulative NO_x reductions rise to 1,287 tons by 2010.

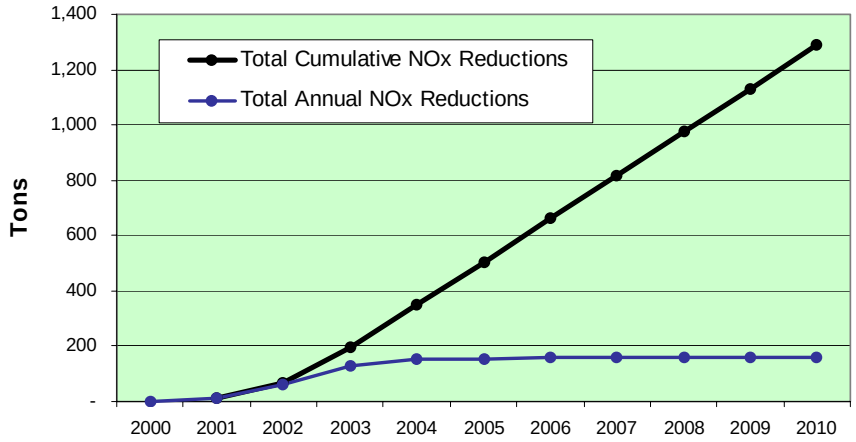
Figure 4-6. Annual NO_x Emissions Reductions (Tons)



Total annual NO_x emissions reductions. Emissions reductions increase during the years of new energy savings and level off at 154 tons per year through 2010 as annual energy savings level off. This is equivalent to taking 16,600 cars off the road.

[2] U.S. Environmental Protection Agency, www.epa.gov.

Figure 4-7. Cumulative NO_x Emissions Reductions (Tons)

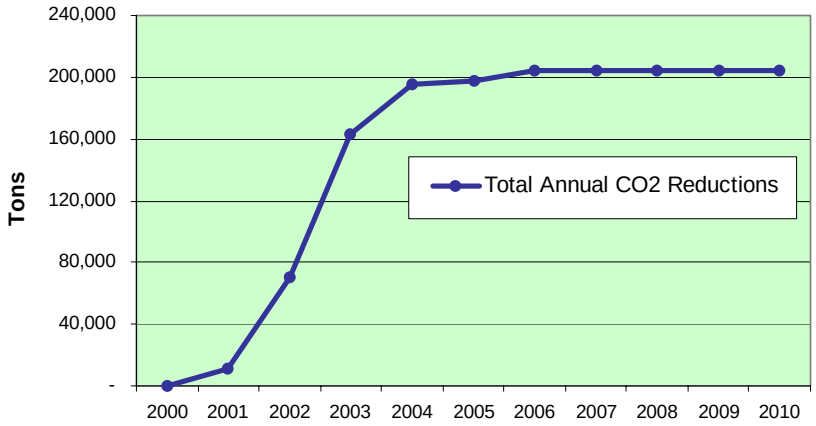


Cumulative NO_x emissions reductions are represented by the top line, while the lower line, total annual emissions reductions, is repeated from Figure 4-6. The scale is different to account for the cumulative emissions reductions, which reach a total of over 1,200 tons by 2010.

Carbon Dioxide

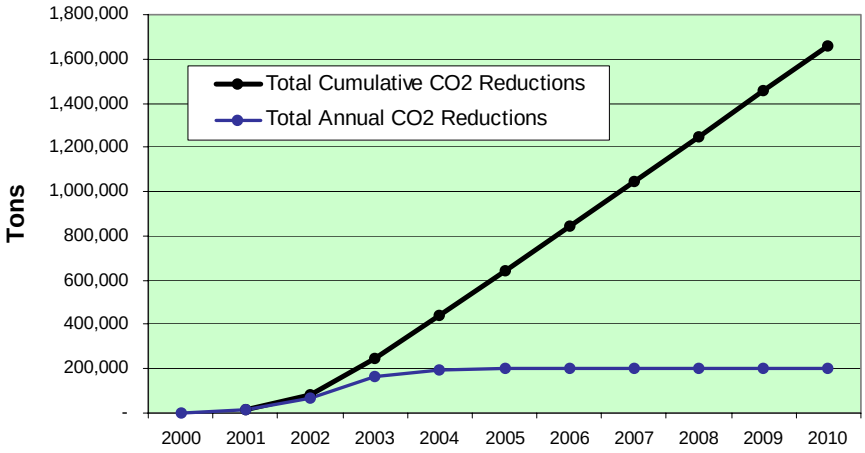
Carbon dioxide is a concern because of its contribution to the greenhouse effect. CO_2, however, is not restricted as part of the Clean Smokestacks Act. A detailed inventory of North Carolina's CO_2 sources and sinks has been performed by the Appalachian State University Department of Geography in coordination with the U.S. Environmental Protection Agency. Figures 4-8 and 4-9 show the CO_2 reductions achieved through SEO programs.

Figure 4-8. Annual CO_2 Emissions Reductions (Tons)



Total annual CO_2 reductions are dramatically greater than for SO_2 and NO_x, although the same pattern is observed with reductions increasing most significantly during the years of program spending and leveling off after 2005. Annual CO_2 reductions level off at 200,000 tons/year, which is the equivalent of taking 32,900 cars off the road.

Figure 4-9. Cumulative CO_2 Emissions Reductions (Tons)



The top line represents cumulative CO_2 emissions reductions, while the lower line, total annual emissions reductions, is repeated from Figure 4-8. The scale is different to account for the cumulative emissions reductions, which reach a total of over 1,658,000 tons 2010.

Economic Impacts

Beyond energy savings and emissions impacts, the primary goal of this analysis is to answer the questions:

- *What are the near- and longer-term economic impacts of these energy programs?*
- *Are we sacrificing jobs and growth for energy savings?*

The metrics used to address these questions are (1) net jobs growth, (2) state wages, and (3) gross state product (GSP). And, answers to these questions go well beyond consideration of simple bill savings as a result of greater energy efficiency or the use of renewables. Successful energy savings and renewable energy programs cause shifts in the state's economy, and it is the net effect of these shifts that is considered here. Restated, the question this analysis seeks to answer is:

- *Given the energy savings resulting from state and private investment in energy efficient and renewable energy technologies, what are the net impacts in North Carolina on jobs, wages and our overall GSP.*

➢ *Total bill savings of $61.3 million over a ten-year period based on three years of SEO program spending of $11.02 million represents a substantial return on investment.*

As discussed above, the NCEEM provides a tool to address these issues on a statewide basis. While the goal is not to simply consider the bill savings from the various programs, these bill savings do serve as one of the key inputs into the economic model. Table 4-2 shows these bill savings projected out to 2010. These figures draw directly from the energy savings data presented above. Electric and natural gas rates are applied to the energy savings to develop these dollar savings figures. Therefore, the pattern mirrors that of the energy savings: bill savings increase strongly during the years of program spending and the years immediately following, but for the years further out, savings level off.

Total bill savings of $61.3 million over a ten-year period based on three years of SEO program spending of $11.02 million represents a substantial return on investment. Note that all values in Table 4-3 are in 2000 dollars. Expressed in 2000 dollars, SEO program spending is $10.6 million. The years 2001-03 are shaded in the table to emphasize that these savings reflect program spending only in the fiscal years 2001-03.

Table 4-3. North Carolina's annual bill savings based on SEO-induced electricity and natural gas energy savings.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Savings (Millions 2000 Dollars)											
Electricity											
Residential	0.28	1.04	1.77	1.85	1.84	1.82	1.80	1.77	1.75	1.73	**15.7**
Commercial	0.06	0.44	1.23	2.01	2.01	2.04	2.01	1.99	1.96	1.94	**15.7**
Industrial	0.08	0.90	1.93	2.04	2.07	2.13	2.14	2.16	2.18	2.20	**17.8**
Natural Gas											
Residential	0.03	0.27	0.45	0.47	0.46	0.46	0.46	0.46	0.46	0.46	**4.0**
Commercial	0.10	0.11	0.30	0.49	0.48	0.49	0.49	0.49	0.49	0.49	**3.9**
Industrial	0.00	0.22	0.46	0.48	0.48	0.50	0.51	0.52	0.53	0.55	**4.3**
Total Consumer Savings	0.54	2.97	6.15	7.34	7.34	7.43	7.41	7.40	7.38	7.36	**61.3**

Impact of Federal Funding as a Source of Energy Funds

One important consideration in the analysis is the source of funds for the SEO programs. As outlined in the July 2004 SEO Audit Report, all of the funding for SEO staff and programs originates from the federal level through one of three sources: (1) petroleum violation escrow (PVE) funds, (2) Special programs, which North Carolina competes for, and (3) formulated funds that each state receives annually from the U.S. Department of Energy. The significance of this is that North Carolina sees a net influx of funds from an external source. That is, the analysis does not have to consider the cost of these programs if, for example, they had been funded through the State Treasury and thus taxation.

However, even this apparent benefit is not so clear when viewed in the larger context of how energy programs are funded nationally. Beyond the PVE and formulated funds that the state of North Carolina receives each year there are many opportunities for additional U.S. DOE and U.S. Department of Agriculture funding through competitive solicitations such as the annual Special Projects RFPs.

In recent years, as directed by the U.S. Congress, nearly all of these solicitations – whether for state energy offices or individual institutions – require substantial non-federal funding as cost share. Typically a 25% – 50% match is required, such that if a state or an institution proposes a $100,000 project to the U.S. DOE, at least $25,000 – $50,000 for that project must come from non-federal sources. Energy programs of the U.S. Department of Agriculture typically require a 3:1 match. The challenge for states such as North Carolina that do not have any state supported energy programs is to find adequate non-federal funds to provide this cost share. While some of the PVE funds allocated to North Carolina are designated as non-federal and thus can be used as cost share, this is a limited pool.

As a result, although North Carolina enjoys the apparent benefit of not having to fund for its energy programs through taxation or other mechanisms, the State Energy Office as well as individual institutions such as universities continue to miss opportunities to draw more substantial amounts of federal energy funding through competitive bid processes. States that have large, state-supported energy programs continue to dominate the large funding award opportunities through the availability of their non-federal energy cost share funds.

Therefore, North Carolina could greatly increase the amount of federal energy funds flowing to the state if the state were able to generate its own energy funding. [FILL IN]

Stimulated Private Energy Investment in North Carolina

While North Carolina has not been able to fully compete for additional federal funds, the State Energy Office has been able to leverage its own funding to attract substantial private (North Carolina) investment in energy programs. Data in Table 4-4 approximates the minimum contribution of private funding to energy efficiency and renewables based on SEO programs.

Table 4-4. Private Investment in Energy Efficiency and Renewable Energy Stimulated by SEO Programs FY 2001-03 (million 2000 $)

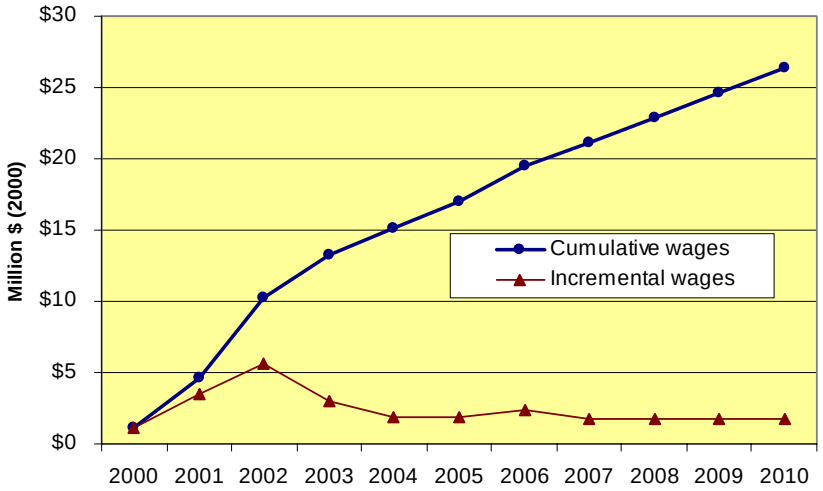
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Private Investment											
Residential	1.3	2.2	3.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	**6.9**
Commercial	0.2	0.8	1.2	0.0	0.1	0.2	0.0	0.0	0.0	0.0	**2.5**
Industrial	0.3	2.5	3.3	0.0	0.1	0.1	0.0	0.0	0.0	0.0	**6.3**
Utilities	0.3	1.0	2.8	0.3	0.5	1.7	0.0	0.0	0.0	0.0	**6.6**
Total Private Investment	2.0	6.4	10.7	0.4	0.7	2.0	0.0	0.0	0.0	0.0	**22.3**

The shaded years, 2001-03, highlight again that this analysis only considers the impacts of SEO programs in FY 2001-03. As was addressed in discussing energy savings projections, conservative assumptions have been used in energy saving projections beyond the end of FY 2003 spending. In the case of stimulated private investment in energy programs, the table makes evident that there are some lags in investment based on different program details. However, longer-term, continued private investment beyond 2006 is not considered. Based on the SEO's focus on market transformation programs, continued private investment in efficiency and renewables technologies can be expected beyond 2006, but such estimates become more difficult to make.

Impacts: Wages and Gross State Product

North Carolina wages and the Gross State Product have and will continue to be boosted by SEO's programs. By improving energy efficiency for most sectors, direct program economic impacts nearly the entire North Carolina economy. As a result of known spending patterns among sectors – discussed above and presented in Appendix 2 – program impacts reach every sector of the state's economy. The two most commonly used metrics for state economic impacts are wages (or income) and gross state product, which are illustrated in Figures 4-10 and 4-11, respectively.

Figure 4-10. Cumulative and incremental wage impacts as a result of SEO program expenditures (2000 dollars)

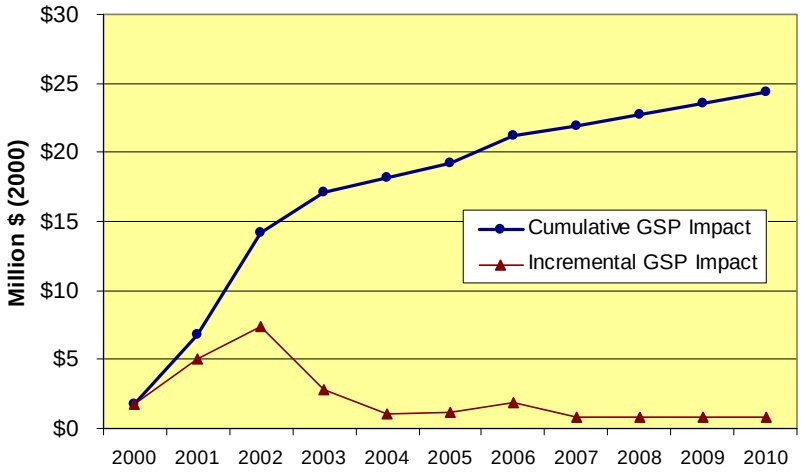


The most marked impact on state wages occurs during the period of program spending during FY 2001-03. Annual ("incremental") increases in wages decline beyond FY 03, but the cumulative wage impacts continue increase through 2010.

Wages refers to the total net gain in wage and salary compensation. Here it is the additional amount paid to labor as a result of SEO program spending. The model estimates that SEO spending from fiscal years 2001-03 will have a total cumulative impact on wages of $26.4 million, with an average annual increase in wages of $2.4 million. As with energy savings the largest increases in wages take place during the years of program spending, and the impacts continue in the out years as the economy's energy efficiency gains continue.

Figure 4-11 illustrates a similar pattern for gross state product, which typically will move in step with wages although these are independent measures. Here the cumulative impact to GSP over the ten-year horizon is $24.3 million. This can be compared against the total of $10.6 million (in 2000 dollars) spent by the SEO over the three program years. Again, although impacts are greatest in the years of program implementation, there continues to be a modest boost to GSP in years well beyond the end of program spending, with average annual increases in GSP of $2.21 million.

Figure 4-11. Cumulative and Incremental gross state product impacts as a result of SEO program expenditures (2000 dollars)



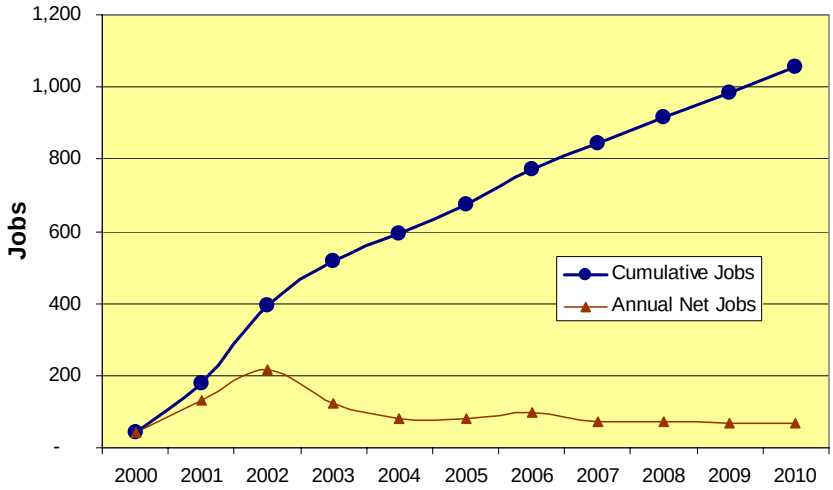
SEO program impacts on gross state product (GSP) shows a similar pattern as wage increases. Incremental GSP increases on an annual basis most rapidly during the period of program spending and then decreases through 2010. Cumulative GSP impacts continue to rise to approximately $25 million per year in 2010.

Impacts: Jobs

Perhaps the single most important metric of the impact and longer-term efficacy of SEO program spending is net job creation. The question is whether efficiency and renewable energy spending is in fact creating more jobs for North Carolinians rather than simply creating more job opportunities beyond North Carolina's borders.

As shown in Figure 4-12, total projected net job creation is 1,050 jobs over a ten-year period including the three initial years of program spending. The largest annual increases in job numbers are in the early years when program funds are being spent. While the rate of new job creation declines beyond the selected program years, there continues to be net job growth out to the end of the period of consideration.

Figure 4-12. SEO Program Annual and Cumulative Net Jobs Impacts



The annual in job creation takes place during FY 2003, with approximately 205 net jobs created. Net job increases continue through 2010, with a total cumulative increase in jobs of 1,050. Again, this job increase is the result of three years of SEO program funding.

5. Conclusions

The analysis in this report considers the energy and economic impacts of the North Carolina State Energy Office's spending during the three fiscal years 2001-03. Impacts are considered out to the year 2010 using the North Carolina Energy-Economic Model developed by Skip Laitner in cooperation with the Energy Center at Appalachian State University.

This study shows that despite the modest level of SEO program spending over the three fiscal years 2001-03, these programs have had measurable impacts on energy savings, emissions reductions, and the economy. Total program spending of $11.02 million supported programs as diverse as landfill waste to methane programs and teacher education programs. Funding was dispersed for administration, public education, demonstration projects, R&D, grants for equipment installation, and low interest revolving loans.

Aggregate impacts in North Carolina over the ten-year period 2001-2010 can be summarized:

- Electricity savings of 862 GWh
- Renewable energy generation of 209 GWh
- Natural gas savings of 1,965 billion BTU
- Combined electric and natural gas bill savings of $61.3 million
- Reduced SO_2 emissions of 8,260 tons
- Reduced NO_x emissions of 1,263 tons
- Reduced CO_2 emissions of 1,630,000 tons
- Induced private investment in energy of $22.3 million
- Increased state wages of $26.4 million
- Increased gross state product of $24.3 million
- Net job increase of 1,050

These results demonstrate the State Energy Office's contribution to the state's efficiency, environment, and economy. However, the greatest impacts are during the years of program spending (2001-2003 in this case), and should program spending be severely curtailed after 2005 as a result of lack of PVE funds, the benefits demonstrated here will level off and cease to show these program-year increases.

Should continuation of North Carolina's state energy programs be a priority for the state, the challenge will be finding new in-state sources of funds. As an action item of the June 2003 North Carolina State Energy Plan, the North Carolina Energy-Economic Model (NCEEM) is also used to project the efficiency, environmental, and economic impacts of various policy scenarios where a public benefit fund generates the resources to continue and expand efficiency and renewables spending in North Carolina. These results are documented in a separate report.

6. References

Ensuring a Sustainable Energy Future for North Carolina, State Energy Office, North Carolina Department of Administration, April 2002.

State of North Carolina Performance Audit of the State Energy Policy Council and State Energy Office. Office of the State Auditor. July 2004.

North Carolina Energy Outlook – Final Report, Prepared for the State Energy Office, NC Department of Administration, May 2003.

North Carolina State Energy Plan. State Energy Office of North Carolina, Department of Administration. June 2003.

7. Appendix 1. North Carolina Baseline Data

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Jobs (in thousands)	4085	4109.3	4133.7	4158.3	4183.1	4208	4269.9	4332.8	4396.5	4461.3	4527	4585.1	4643.9	4703.5	4763.9	4825	4884.7	4945.1	5006.3	5068.3	5131
Income (billion 1996 $)	202.0	207.7	213.5	219.5	225.7	232.0	241.4	251.2	261.4	272.0	283.0	294.6	306.7	319.3	332.4	346.0	357.8	369.9	382.5	395.5	409.0
GSP (billion 1996$)	260.0	268.1	276.4	285.0	293.9	303.0	315.4	328.2	341.6	355.5	370.0	385.3	401.2	417.8	435.0	453.0	471.6	491.0	511.1	532.1	554.0
Reference Case Electricity Sales (GWh)	119,752	120,779	120,864	124,397	128,034	131,777	134,736	137,762	140,855	144,018	147,252	150,087	152,976	155,922	158,923	161,983	164,790	167,645	170,550	173,505	176,511
Reference Case Natural Gas Sales (TBtu)	236.6	207.9	218.9	233.6	249.3	266.1	270.8	275.7	280.6	285.7	290.8	297.1	303.5	310.0	316.7	323.6	328.6	333.7	338.9	344.1	349.4
Total Primary Energy Consumption (TBtu)	2,569.8	2,507.6	2,562.6	2,640.2	2,720.1	2,802.5	2,859.4	2,917.5	2,976.7	3,037.1	3,098.7	3,152.5	3,207.2	3,262.8	3,319.4	3,376.9	3,429.0	3,481.9	3,535.5	3,590.1	3,645.4

Source: North Carolina Energy Outlook – Final Report, Prepared for the State Energy Office, NC Department of Administration, May 2003.

8. Appendix 2. North Carolina Sectoral Purchases Data

	Ag	Mine	Const	Hvy Const	Misc Mfg	Textiles	Pulp Papr	Furn	Chem	Pmtls	MtlDur	TCU	Elec	Gas	Trade	Fin ance	Svcs	Educa tion	Govt	HH
Agriculture	0.117	0.000	0.004	0.003	0.039	0.016	0.021	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.001	0.001	0.000	0.004
Mining	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000
Construction, Engineering Services	0.010	0.009	0.057	0.085	0.009	0.008	0.013	0.006	0.012	0.010	0.008	0.021	0.032	0.069	0.007	0.032	0.010	0.042	0.022	0.001
Heavy Construction	0.000	0.031	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Misc Manufacturing	0.050	0.004	0.076	0.087	0.183	0.027	0.034	0.044	0.020	0.021	0.061	0.048	0.003	0.005	0.036	0.005	0.041	0.032	0.003	0.088
Textiles and Apparel	0.003	0.000	0.003	0.002	0.003	0.203	0.004	0.019	0.003	0.001	0.005	0.001	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.015
Pulp and Paper	0.005	0.000	0.016	0.005	0.028	0.003	0.218	0.103	0.005	0.001	0.005	0.001	0.000	0.000	0.004	0.001	0.003	0.003	0.000	0.002
Furniture and Wood Products	0.002	0.000	0.034	0.009	0.003	0.001	0.004	0.057	0.000	0.003	0.004	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.004
Chemicals	0.035	0.011	0.015	0.040	0.025	0.056	0.041	0.015	0.113	0.018	0.009	0.023	0.008	0.003	0.004	0.001	0.011	0.004	0.005	0.020
Primary Metals	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.007	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Metal Durables	0.008	0.010	0.066	0.056	0.021	0.006	0.009	0.036	0.004	0.034	0.148	0.007	0.005	0.000	0.004	0.001	0.008	0.003	0.003	0.019
TCU	0.020	0.009	0.026	0.031	0.023	0.020	0.045	0.028	0.023	0.042	0.020	0.114	0.013	0.006	0.018	0.012	0.021	0.013	0.005	0.034
Electricity Services	0.005	0.006	0.001	0.001	0.005	0.008	0.012	0.005	0.005	0.017	0.004	0.002	0.000	0.001	0.005	0.002	0.003	0.002	0.002	0.017
Natural Gas Services	0.001	0.008	0.000	0.001	0.002	0.003	0.006	0.001	0.015	0.007	0.001	0.001	0.008	0.096	0.001	0.000	0.001	0.000	0.001	0.004
Wholesale and Retail Trade	0.046	0.011	0.095	0.053	0.056	0.061	0.069	0.085	0.038	0.089	0.069	0.018	0.003	0.007	0.021	0.003	0.015	0.010	0.001	0.175
Finance	0.030	0.043	0.018	0.017	0.016	0.016	0.013	0.015	0.011	0.013	0.013	0.020	0.010	0.013	0.028	0.104	0.037	0.047	0.004	0.146
Services	0.016	0.014	0.066	0.042	0.049	0.054	0.037	0.034	0.035	0.063	0.037	0.086	0.015	0.025	0.070	0.039	0.098	0.085	0.006	0.191
Education	0.000	0.000	0.001	0.000	0.001	0.001	0.002	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.019
Government	0.003	0.002	0.005	0.004	0.005	0.007	0.007	0.006	0.004	0.006	0.004	0.010	0.003	0.011	0.006	0.007	0.009	0.006	0.003	0.007
Households	0.088	0.326	0.235	0.261	0.189	0.247	0.193	0.296	0.203	0.184	0.222	0.292	0.180	0.068	0.419	0.158	0.467	0.616	0.745	0.002
TOTAL	**0.437**	**0.484**	**0.719**	**0.700**	**0.658**	**0.736**	**0.728**	**0.756**	**0.496**	**0.518**	**0.617**	**0.643**	**0.282**	**0.309**	**0.627**	**0.368**	**0.728**	**0.865**	**0.801**	**0.748**

Source: Minnesota IMPLAN Group, 2000 Data for North Carolina, Stillwater, Minnesota, 2003.

9. Appendix 3. Emissions Factors for SO_2, NO_x, and CO_2 Produced by Electric Generation

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
SO_2	1,921	1,757	1,594	1,433	1,262	1,107	886	764	461	364	356
NO_x	276	257	239	220	203	183	172	148	120	120	120
CO_2	282,582	285,360	288,137	290,908	293,706	296,463	299,383	302,059	304,672	307,225	309,718

All values in tons/trillion BTUs.