Economic Impacts of the NHSaves Programs

Submitted to the New Hampshire Evaluation, Measurement, and Verification (EM&V) Working Group

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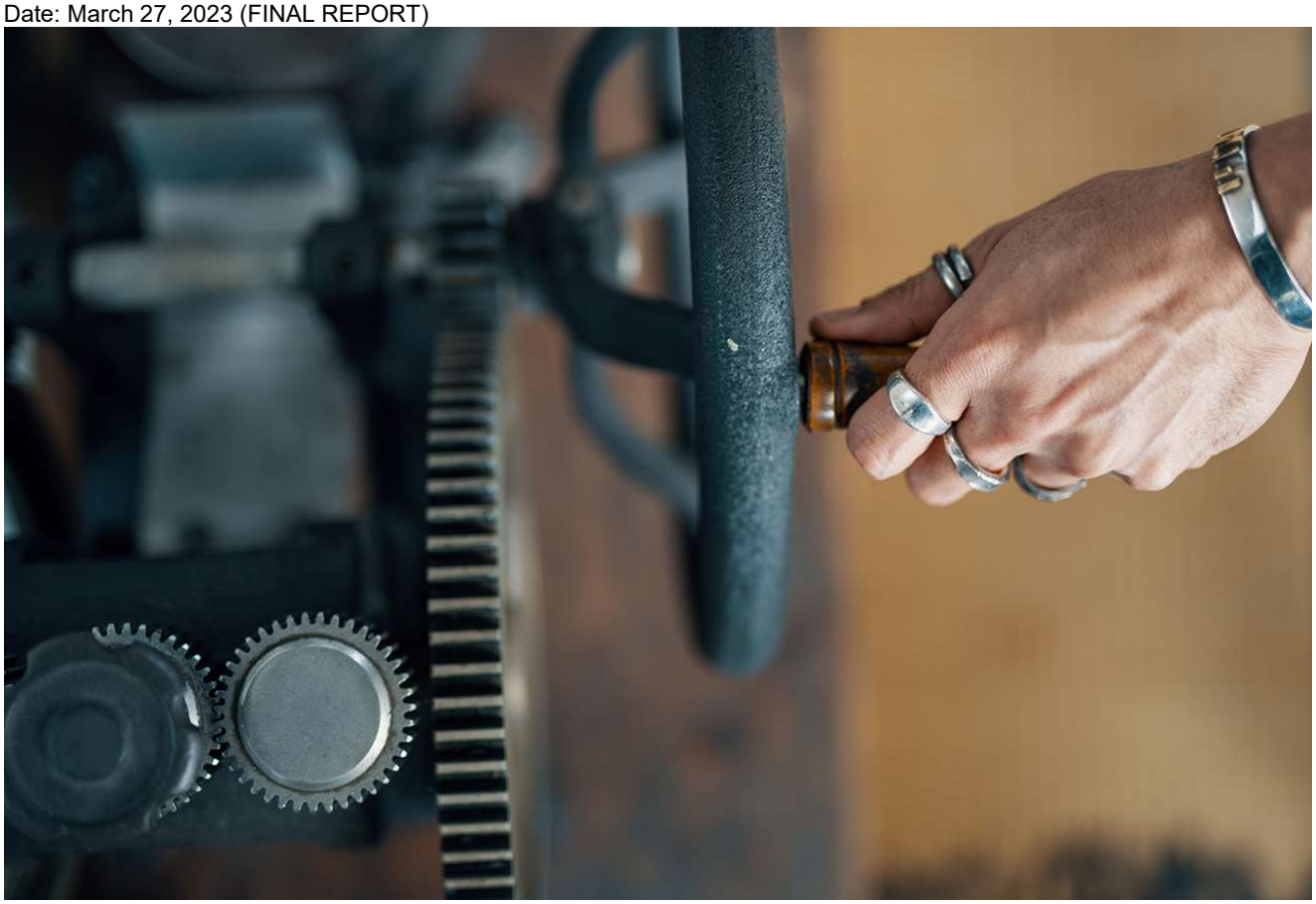

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1 EXECUTIVE SUMMARY

1.1 Background

New Hampshire statutes frequently mention the importance of economic benefits associated with energy policies and programs. For instance, the New Hampshire Revised Statutes on integrated least-cost resource planning state: "The following order of energy policy priorities shall guide the commission's evaluation: energy efficiency and other demand-side management resources; renewable energy sources; all other energy sources. *The Commission must consider potential environmental, economic, and health-related impacts of each option proposed by a utility to meet its customers' needs*."[1]

The New Hampshire Public Utilities Commission (the Commission) approved the 2022–2023 NHSaves Plan[2] (the Plan) in an order on April 29, 2022,[3] in which it found that the Plan has the potential to positively impact the New Hampshire economy "through achievement of energy savings and through the long-term multiplier effect of energy efficiency projects on the local economy." It also directed Eversource Energy, Liberty Utilities, the New Hampshire Electric Cooperative (NHEC), and Unitil (the NH Utilities) to "comprehensively study and report on the 2021 and 2022 Plan's long-term impact on the New Hampshire economy." The New Hampshire Evaluation, Measurement, and Verification Working Group (EM&V WG) engaged a team of independent evaluators from DNV and Louisiana State University (LSU) (the evaluation team) to conduct this study in response to these directives.[4] The evaluation team developed a workplan for this study in coordination with the members of the EM&V WG, and independently executed the research according to that workplan.

1.2 Methods

There are two general phases during which energy efficiency programs create economic impacts:[5]

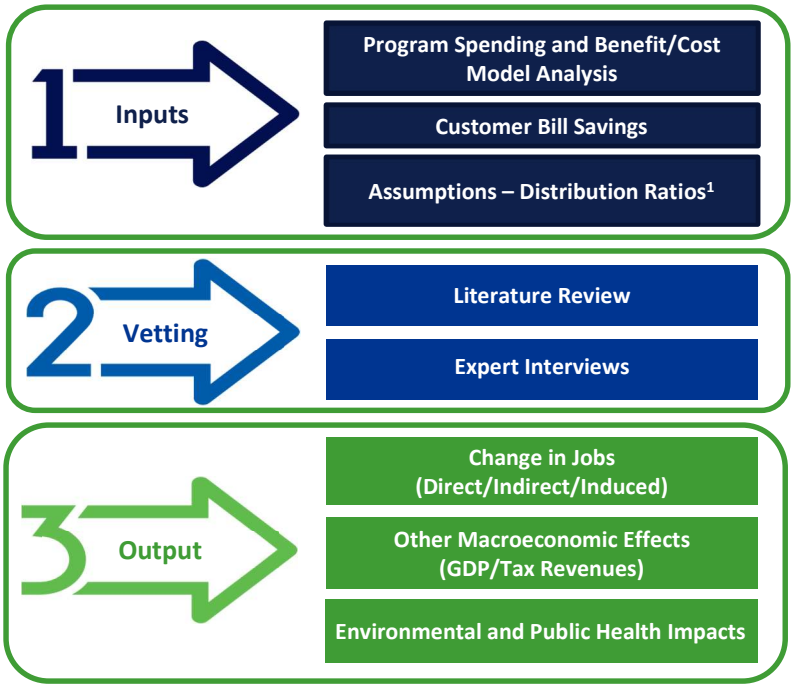
1. The implementation phase, during which economic impacts result from the production and installation of energy efficiency equipment, and
2. The savings phase, after energy efficiency measures are installed and result in energy bill savings that is re-allocated to other spending that creates economic impacts.

The evaluation team used an Input-Output (I/O) modeling approach to analyze the economic impacts from the implementation and savings phases of the 2021 and 2022 NHSaves programs. I/O models allow comprehensive analyses examining industry-wide effects of economic activities and major shifts across sectors,[6] based on economy-wide social accounting matrices that incorporate spending patterns within and across sectors. The evaluation team also estimated the economic value of the health benefits associated with the NHSaves programs, using EPA's Co-Benefit Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) and Avoided Emissions and Generation Tool (AVERT). Finally, the team interviewed officials at 10 organizations with expertise and knowledge of the NHSaves programs to provide context and insights on the economic impacts of the programs as modeled.

The evaluation team modeled economic impacts using a three-stage approach, summarized in Figure 1-1.

[1] NH Rev Stat § 378:39 (2021)
[2] https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/LETTERS-MEMOS-TARIFFS/20-092_2022-03-01_NH_UTILITIES_NHSAVES-PLAN.PDF.
[3] https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/ORDERS/20-092_2022-04-29_ORDER-26621.PDF
[4] The EM&V WG consists of: (1) representatives from the NH Utilities, (2) staff from the NH Department of Energy (3) independent evaluation consultants under contract to the NH Department of Energy, and (4) an EESE Board member appointed by the Board Chair. This research was conducted under a contract that was competitively procured by the EM&V WG in 2022.
[5] Synapse Energy Economics. New Hampshire Cost-Effectiveness Review, Application of the National Standard Practice Manual to New Hampshire, Oct. 2019.
[6] Miller, Ronald E, and Peter D Blair. 2009. *Input-Output Analysis: Foundations and Extensions*: Cambridge University Press.

Figure 1-1. Summary of approach for estimating economic impacts



[1]Distribution ratios reflect the proportions in which program spending is apportioned across different industries/economic sectors.

Key limitation: The economic analyses in this report reflect the overall economic output and employment effects of the NHSaves programs, and are not an accounting of the full costs and benefits of the NHSaves programs. The results presented in this report are complementary to the other gains from energy efficiency projects in New Hampshire as reflected in the Granite State Test (GST),[7] including utility system avoided costs, other fuel and water resource savings, and non-energy benefits such as participants' reduced operations and maintenance costs or improved comfort. Cost-effective energy efficiency programs, by definition, provide a lower-cost alternative to supply-side resources. Even programs with negligible local employment impacts, if cost-effective, have net benefits that ensure they return more to the state's ratepayers in terms of avoided system costs and other energy and non-energy benefits than they cost, regardless of their employment and other economic impacts.

1.3 Results

Table 1-1 summarizes the economic impacts modeled for this study, including their definitions and values. Except where noted, all economic impacts presented in this report reflect impacts on the New Hampshire economy specifically. All employment effects reflect full-time-equivalent (FTE) jobs.[8] Note that employment effects during the implementation phase represent jobs that are created for one program year (2021 or 2022), and so the number of jobs is equivalent to the number of job-years. Employment effects during the savings phase occur in proportion to customer bill savings, over the useful life of the measures installed by the programs. As such, savings phase employment effects represent an aggregate estimate of job years, which are spread out over the life of the program measures for each sector.

[7] The GST is the primary cost-effectiveness test for the NHSaves programs. The NH Utilities calculate the GST using Benefit-Cost models that are filed alongside program plans and reports. The GST was developed through a stakeholder process that culminated in a consensus recommendation to adopt the test, followed by Commission approval of the test. See https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/ORDERS/17-136_2019-12-30_ORDER_26322.PDF The New Hampshire legislature has also established it as the primary cost-effective test for New Hampshire's energy efficiency programs. See https://gencourt.state.nh.us/bill_status/legacy/bs2016/bill_status.aspx?lsr=717&sy=2022&sortoption=&txtsessionyear=2022&txtbillnumber=HB549

[8] FTEs measure total full-time, part-time, and temporary employees, based on the total number of hours worked divided by the number of hours in a full-time schedule.

Table 1-1. Summary of NHSaves' impacts on the New Hampshire economy[1]

Phase	Impact	Definitions	Values
Implementation (program years 2021-2022)	Employment[2]	*Direct effects* accruing to industries involved in production and installation activities	2021: 380.79 jobs (5.09 per $1M) 2022: 359.68 jobs (5.09 per $1M)
		Indirect effects on industries supplying inputs to the sectors benefiting directly	2021: 126.05 jobs (1.68 per $1M) 2022: 118.99 jobs (1.68 per $1M)
		Induced effects, which are second order effects due to increased consumer spending from the income gains made in sectors with direct and indirect effects	2021: 249.13 jobs (3.33 per $1M) 2022: 224.64 jobs (3.18 per $1M)
	New Hampshire gross domestic product (GDP)[2]	Value added reflects the total in-state economic activity generated by the NHSaves programs. It includes direct, indirect, and induced effects. Aggregated across all industries, this value represents the program's contribution to state GDP	Estimated value added associated with the programs was $97 million in 2021, and $87 million in 2022[3]
	Local and state tax revenues	Additional tax revenues generated by the economic activity associated with NHSaves program spending, modeled according to New Hampshire's tax regime	Total estimated tax revenue generation of approximately $3.8 million in 2021 and $3.2 million in 2022
Savings (year of implementation through the end of measures' useful life)	Customer bill savings effects[4]	Gains in employment associated with reduced utility bills, including (1) induced effects from additional disposable household income (e.g., spending on goods and services), and (2) direct, indirect, and induced effects from increased production in the C&I sector	About 1480 total additional job years resulting from long-term bill savings for low-income, residential, and C&I sectors over the lifetime of the program measures
	Public health benefits	Annual monetary value of avoided healthcare costs for New Hampshire citizens from emissions reductions resulting from the NHSaves programs in 2021[5]	Annual benefits range from $68,000 to over $153,000 at a 7% discount rate and from about $76,000 to over $172,000 at a 3% discount rate[6]
		Annual monetary value of avoided healthcare costs for citizens in the contiguous U.S. from emissions reductions resulting from the NHSaves programs in 2021[5]	Annual benefits range from $649,000 to almost $1.5 million at a 7% discount rate and from $727,000 to over $1.6 million at a 3% discount rate[6]

[1] All impacts represent incremental economic effects of each program year independently, relative a no-program counterfactual.
[2] Employment and state GDP effects shown in this table are based on a conservative modeling assumption for the local purchase percentage (LPP), which represents the share of program-rebated materials that are purchased from in-state manufacturers or wholesalers. The team also modeled employment effects with a more aggressive assumption for LPP, as presented in Section 4.1.
[3] These results are generally consistent with other estimates of the impacts of public programs on GDP, which typically find multiplicative effects whereby GDP grows by a factor of 1 or more times the amount of program spending.
[4] Bill savings impacts result from participant energy cost savings, System Benefit Charge costs, and long-term utility system avoided costs. For the NHSaves programs, the net impact of these factors are reductions in overall utility system costs and total customer bills.

[5] Due to limitations in modeling tools and underlying data, the team modeled one year of emissions reductions and associated health impacts from the 2021 programs. The results do not reflect the full emissions and health impacts of 2021 measures over their useful lives.
[6] The range of health impacts estimates reflect the use of different underlying epidemiological studies. The low estimates reflect mortality impacts of PM2.5 as evaluated by the American Cancer society, and the high values reflect results from the Harvard six-city mortality study.

1.3.1 Context for economic impacts

The economic and regulatory context in which the NHSaves programs operate should be considered alongside the quantified economic impacts presented above. In particular, the NHSaves programs experienced uncertainty and funding instability associated with Commission decisions affecting the 2021 and 2022 period modeled in this study.[9] It was not feasible to quantify the economic impacts of these dynamics as part of this study, but based on expert interviews, the uncertainty and funding instability dampened the programs' economic benefits. Interviewees cited the following impacts:

- **Workforce disruption.** Almost all interviewees cited workforce disruptions caused by the decisions. Several noted that the 2021–2023 plan had originally included significant increases in program funding and savings goals, and that despite some uncertainty around the plan due to COVID-19 and other factors, they took steps to prepare for expected funding increases by hiring or otherwise ramping up in advance of the 2021 program year. This ramp-up exacerbated the impact of the subsequent decisions, which in some cases included layoffs of contractors or other staff.
- **Customer impacts.** Most interviewees we spoke with also cited customer impacts caused by the decisions. For customers with projects in progress at the time of the decisions, many of the projects were put on hold, some of them indefinitely. For customers considering participating but without projects in progress, they often did not know if they would be able to participate because the NH Utilities could not tell customers what to expect in terms of funding. Some larger customers faced particular challenges financing projects, such as affordable housing projects that utilize multiple inter-related funding sources, for which predictable timing is important in planning and assembling financing. Similarly, large industrial participants require predictable timing in project funding in order to align with their annual capital planning cycles, and funding uncertainty negatively impacted their ability to install efficient equipment through NHSaves.

The scope of this review included accounting for the NHSaves programs' out-of-state expenditures. The evaluation team took several steps in our I/O modeling to account for inter-state flows of program funding, as described in sections 3.1 and 3.2. The team also interviewed experts for context and insights on the inter-state impacts of the programs, and several themes emerged:

- The vast majority of installation contractors are based in-state, particularly for weatherization projects. However, multiple interviewees noted that NH is a relatively small state with a large population close to the state's borders—particularly with Massachusetts and southern Maine—providing significant opportunities contractors in neighboring states to work in New Hampshire, and vice versa.
- Interviewees said the types of firms most often based out-of-state are specialized firms with expertise in complex custom projects and controls measures, and other equipment types where higher levels of program support and customer adoption in other states have led to growth in the workforce for those technologies (e.g., heat pumps).
- Interviewees said that a key reason NHSaves needs to utilize out-of-state contractors in some cases is that states face competition for workforce, and neighboring states have large, well-funded programs that over time have led to growth in the contractor workforce in those states.

An overarching issue raised in the interviews was that New Hampshire has significant out-of-state expenditures on supply-side resources, and that these expenditures should be considered alongside analyses of out-of-state expenditures on

[9] Specifically, in December 2020, the Commission ordered the 2021 programs to operate at 2020 funding levels rather than the higher levels proposed in the 2021-2023 plan, until the Commission could fully consider the plan. Then, in November 2021, the Commission issued an order denying the 2021-2023 plan and ordering a steady, significant reduction in program funding starting in 2022. Although the funding reductions were partially restored in 2022, the Commission's decision limited the flow of funding and initiation of new projects for much of 2022, impacting workforce and customer decisions. See DE 20-092, Order No. 26,440, December 29, 2020; and DE 20-092, Order No. 26,553, November 12, 2021.

energy efficiency resources. Despite being a net electricity exporter, New Hampshire relies heavily on imports of other sources of energy—particularly fossil fuels for heating and transportation. Specifically, according to EIA data from 2022, New Hampshire does not produce fossil fuels, and over $2 billion flowed out of the state for energy imports across all fuels and end uses.[10]

1.3.2 Comparison of results

I/O models have been deployed in different contexts to assess the employment effects of energy efficiency and other types of energy services programs. A comparison of results from recent studies that used I/O modeling to analyze the employment impacts of regional and state-specific energy programs shows that the employment effects of the NHSaves programs—ranging from about 10 to 14 jobs per $1 million in program investment—are similar to the employment effects found in state-level studies from other jurisdictions. In addition to these implementation period jobs, the team's estimates of employment effects from customer bill savings suggest that the total jobs resulting from the NHSaves programs is at the high end of the range for comparison programs.

1.4 Conclusions and considerations

The 2021 and 2022 NHSaves programs—both residential and commercial and industrial (C&I)—had significant positive economic impacts on New Hampshire's economy, including short-term and long-term employment effects, increased state GDP, state and local tax revenues, and monetized public health benefits. These impacts are complementary to other gains from energy efficiency projects in New Hampshire as reflected in the GST, including utility system avoided costs, other fuel and water resource savings, and non-energy benefits.

It is important to note that these quantified impacts are best estimates, which reflect underlying assumptions and limitations in modeling tools and data. The team documented these assumptions and limitations and presented ranges of conservative and aggressive estimates throughout the report for in-state impacts and other factors. Despite some amount of imprecision, which is inherent in economic modeling, the scale and scope of quantified impacts provides clear evidence of the economic benefits of the programs. In addition, as described in the National Standard Practice Manual,[11] jurisdictions "should account for all relevant, substantive impacts (as identified based on policy goals), even those that are difficult to quantify and monetize. Using best-available information, proxies, alternative thresholds, or qualitative considerations to approximate hard-to-monetize impacts is preferable to assuming those costs and benefits do not exist or have no value."

In addition to quantitative modeling, the team's interviews with officials from multiple organizations with expertise and knowledge of the NHSaves programs validate the importance of the programs in supporting and growing the local workforce and in providing New Hampshire businesses and residents with funding to support energy efficiency investments. The value of the programs can be seen in part by the disruptions to local workforce and customers that occurred when the programs' continuity became uncertain. The programs also provide a tool for workforce recruitment and retention that can help New Hampshire compete with surrounding states that offer similar state-wide energy efficiency programs.

There are several areas of analysis covered in this study that were limited due to schedule and scope constraints, summarized in the list below, which could be explored in greater depth. This could include primary New Hampshire data collected from customers and other market actors via surveys, interviews, or other methods to validate and expand on the team's modeling results, while considering tradeoffs between costs, rigor, and value of additional research.

[10] EIA data shows total energy expenditures of $4.6 billion, total consumption of 296 trillion Btu, and total in-state energy production of 149 trillion Btu. U.S. Energy Information Administration, New Hampshire State Energy Profile, updated Sept 2022. https://www.eia.gov/state/print.php?sid=NH.

[11] The NSPM is a publication of the National Efficiency Screening Project (NESP), which works to improve cost-effectiveness assessments of customer-funded electric and gas energy efficiency programs. The NSPM includes a set of fundamental principles for cost-effectiveness analysis, which have been applied in multiple jurisdictions nationwide. See NESP, *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources,* Spring 2017, available at https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf.

- Analysis of inter-state workforce effects of the NHSaves programs, to help quantify the qualitative insights from expert interviews on workforce competition and use of in- and out-of-state contractor workforce
- Updating health impacts analysis for future program years to reflect updated ISO-NE data on electricity generation mix and updated demographic data underlying epidemiological models
- Further analysis of long-term customer bill savings and discount rate sensitivity analyses, to provide additional insight in response to the Commission
- Analysis of secondary energy consumption related to economic activity spurred on by the NHSaves programs—also known as the "rebound effect"—to provide additional insight in response to the Commission.

2 INTRODUCTION

The New Hampshire Public Utilities Commission (the Commission) approved the 2022–2023 NHSaves Plan[12] (the Plan) in an order on April 29, 2022,[13] in which it found that the Plan has the potential to positively impact the New Hampshire economy "through achievement of energy savings and through the long-term multiplier effect of energy efficiency projects on the local economy." It also directed Eversource Energy, Liberty Utilities, the New Hampshire Electric Cooperative (NHEC), and Unitil (the NH Utilities) to "comprehensively study and report on the 2021 and 2022 Plan's long-term impact on the New Hampshire economy, quantifying the factors noted in the 2022–2023 Plan at Bates pages 6 and 7[14] by properly accounting for discounting that reflects ratepayers' time-preference, and by estimating the energy savings to reflect both the energy intensity and the spillover impacts also associated with future incremental economic activity prompted by the Plan." A subsequent order of clarification, issued June 21, 2022,[15] states that "the study and reporting requirement calls for sensitivity analysis using a range of discount rates to demonstrate: 1) the impact of time-preference on benefits and costs, and 2) to account for the impact of economic activity resulting from quantifiable cost savings that will result in future energy consumption." In a separate request issued on November 1, 2022, the Commission directed the NH Utilities to "use existing practices and the best data available to provide calculations that, after adjusting for free-ridership and out-of-state expenditures, provide estimates of the positive economic impacts of the Energy Efficiency Program on NH ratepayers." The Commission ordered this review of economic impacts to be submitted by March 31, 2023.

The DNV team with Dr. Anmol Soni of Louisiana State University (LSU) (the evaluation team), in coordination with the New Hampshire Evaluation, Measurement, and Verification Working Group (EM&V WG), designed this study to be responsive to the Commission's various requests to the greatest extent possible within the given timeframe, as shown in Table 2-1.

Table 2-1. Response to Commission reporting requirements

Commission Reporting Requirement	Source	Research Scope
Comprehensively study and report on the 2021 and 2022 Plan's long-term impact on the New Hampshire economy, quantifying the factors noted in the 2022–2023 Plan	4/29 order	Addressed, results in sections 4.1 and 0
Sensitivity analysis using a range of discount rates to demonstrate the impact of time-preference on benefits and costs, and to account for the impact of economic activity resulting from quantifiable cost savings that will result in future energy consumption.	6/21 clarification order	Partially addressed, results in Section 4.3.3
Use existing practices and the best data available to provide calculations that, after adjusting for free-ridership and out-of-state expenditures, provide estimates of the positive economic impacts of the Energy Efficiency Program on NH ratepayers.	11/1 data request	Addressed, results in sections 4.1, 0, and 4.3.2

[12] https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/LETTERS-MEMOS-TARIFFS/20-092_2022-03-01_NH_UTILITIES_NHSAVES-PLAN.PDF.
[13] https://www.puc.nh.gov/Regulatory/Docketbk/2020/20-092/ORDERS/20-092_2022-04-29_ORDER-26621.PDF
[14] The factors listed in the plan are (1) customer energy cost savings, (2) continued energy savings, (3) peak demand reduction savings, (4) a strong state economy, (5) a highly trained workforce, and (6) a cleaner environment.
[15] https://www.puc.nh.gov/Regulatory/Orders/2022orders/Documents/26-642.pdf

3 METHODOLOGY

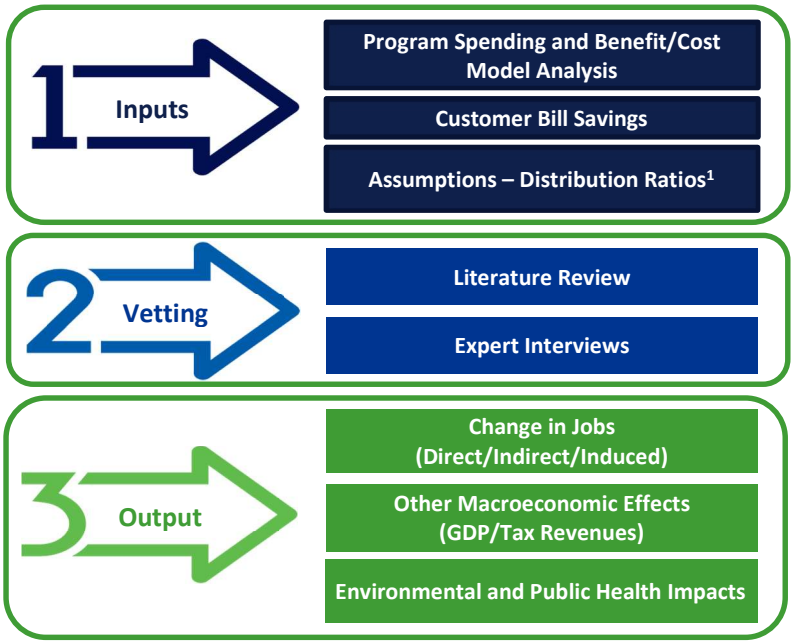
A large body of research has shown that investments in cost-effective energy efficiency have a positive impact on a state's economy. Economic impacts primarily result from direct, indirect, and induced workforce impacts; customer cost savings; public health benefits; and other macroeconomic effects such as increased gross domestic product (GDP) and tax revenues.

There are two general phases during which energy efficiency programs create economic impacts:[16]

1. The implementation phase, during which economic impacts result from the production and installation of energy efficiency equipment, and
2. The savings phase, after energy efficiency measures are installed and result in energy bill savings that is re-allocated to other spending that creates economic impacts.

The evaluation team used an Input-Output (I/O) modeling approach to analyze the economic impacts from the implementation and savings phases of the 2021 and 2022 NHSaves programs. I/O models allow comprehensive analyses examining industry-wide effects of economic activities and major shifts across sectors,[17] based on economy-wide social accounting matrices that incorporate spending patterns within and across sectors. The evaluation team modeled impacts on New Hampshire's economy using a three-stage approach, summarized in Figure 3-1 and detailed in the following sections.

Figure 3-1. Summary of approach for estimating economic impacts



[1]Distribution ratios reflect the proportions in which program spending is apportioned across different industries/economic sectors.

3.1 NHSaves program data analysis

The first step in developing inputs for the I/O modeling was to gather and analyze information from the NH Utilities on actual and planned program spending and customer bill impacts from the NHSaves programs. As agreed with the EM&V WG, given the timing of the study, the evaluation team based the analysis on 2021 actual spending from the 2021 B/C models used for annual reporting, and 2022 planned spending from the 2022-23 plan B/C models.[18] For customer bill impacts, the

[16] Synapse Energy Economics. New Hampshire Cost-Effectiveness Review, Application of the National Standard Practice Manual to New Hampshire, Oct. 2019.
[17] Miller, Ronald E, and Peter D Blair. 2009. *Input-Output Analysis: Foundations and Extensions*: Cambridge University Press.
[18] Actual 2022 spending for the full program year would not be available until the March 31 deadline for this study.

team used the bill and rate impacts as modeled and filed with the 2022-23 plan, reflecting bill impacts associated with the two years of NHSaves programs as planned. The team collected and analyzed B/C and bill impact models for the four electric and two gas operating companies: Eversource, Unitil, Liberty, and NHEC electric models; and Liberty and Unitil gas models.[19]

3.1.1 B/C model review

The primary source of data used to model the economic impacts from the implementation phase of the NHSaves programs was the NH Utilities' B/C models. The B/C models include six categories of program spending data, as follows:[20]

- **Internal administration**: internal utility costs associated with program design, development, regulatory support, and quality assurance. Costs include employee labor, benefits, expenses, materials, and supplies.
- **External administration**: external costs associated with program administration. This includes contractors and consultants used in support of program design, development, regulatory support, and quality assurance.
- **Customer rebates and services**: Costs associated with incentives that reduce the cost of equipment as well as costs for services to speed adoption. This includes direct rebate dollars paid to distinct participants, as well as indirect incentives for equipment discounts. It also includes services such as technical audits, employee and contractor labor to install measures, expenses, materials, and supplies.
- **Internal implementation services**: Tracking of internal utility costs associated with delivering programs to customers, including labor, benefits, expenses, materials, and supplies.
- **Marketing**: Costs for marketing, advertising, trade shows, toll-free numbers, and NHSaves website. Types of expenses include labor, benefits, consultants, contractors, expenses, materials, and supplies.
- **Evaluation**: Costs for EM&V activities including labor, benefits, expenses, materials, supplies, consultants, contractors, and tracking systems.

The evaluation team compiled spending data from each utility's B/C model and cleaned and analyzed the data to develop inputs for I/O modeling. The spending categories required different levels of analysis and different general assumptions regarding allocation of the funding to labor and materials, as well as to in-state and out-of-state recipients. These assumptions are shown in Table 3-1 and discussed in more detail below.

Table 3-1. NHSaves program spending categories and general assumptions

Spending category		Level of analysis	In-state/out-of-state assumption	Labor and materials assumption
Internal Administration		Program-level	All in-state staff	All labor and overhead[3]
External Administration		Program-level	In-state/out-of-state proportion derived from NH Utilities' filings[2]	All labor and overhead[3]
Customer Rebates & Services	**Rebates**	Measure-level with IMPLAN industry mapping	All in-state recipients	Labor[4] and materials proportion applied at sub-program level based on review of program documents and data, utility staff input, and PERI/IMT research[1]
	Services	Program-level	In-state/out-of-state proportion derived from NH Utilities' filings[2]	All labor and overhead[3]
Implementation Services		Program-level	All in-state staff	All labor and overhead[3]
Marketing		Program-level	In-state/out-of-state proportion derived from NH Utilities' filings[2]	All labor and overhead[3]

[19] The B/C model analysis includes all the NH Utilities, but the customer bill savings analysis includes only the three electric and two gas investor-owned utilities regulated by the Commission. The bill savings analysis does not include NHEC, which offers energy efficiency as part of the NHSaves plan, but is a customer-owned cooperative not regulated by the Commission in the same way as the investor-owned utilities.

[20] See NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Report 5 - Market Barriers

Spending category	Level of analysis	In-state/out-of-state assumption	Labor and materials assumption
Evaluation	Program-level	In-state/out-of-state proportion derived from NH Utilities' filings[2]	All labor and overhead[3]

[1] Political Economy Research Institute & Institute for Market Transformation. Analysis of Job Creation and Energy Cost Savings From Building Energy Rating and Disclosure Policy, March 2012.
[2] Analysis of NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Report 3.1, RR 1-006B. See section below for further details.
[3] Labor was modeled using the IMPLAN code for management of companies and enterprises, which includes both employee compensation and share of overhead costs.
[4] Refers to project installation labor.

As noted, the modeling exercise relied entirely on the program spending values reported in the NH Utilities' B/C models for 2021 and 2022. Overall funding declined by more than $4 million over the two years. The largest absolute change in funding was in the Energy Star Products program, which saw a 22% decline, and the greatest increase was in the residential engagement and C&I customer engagement programs (included in the All Others category in Table 3-2).

Table 3-2. Total program spending, 2021 actual and 2022 planned

Program	2021 (actual)	2022 (planned)	Change
Energy Star Homes (ES Homes)	$3,449,257	$3,979,650	$530,393
Home Performance with Energy Star (HPwES)	$11,263,490	$10,794,370	-$469,121
Energy Star Products (ES Products)	$9,735,295	$7,600,158	-$2,135,137
Home Energy Reports	$555,043	$483,512	-$71,530
Residential Active Demand Response	$159,209	$190,156	$30,947
Home Energy Assistance (HEA)	$14,464,427	$14,066,713	-$397,714
Large Business Energy Solutions (LBES)	$15,892,231	$14,558,651	-$1,333,580
Small Business Energy Solutions (SBES)	$16,471,108	$15,279,584	-$1,191,524
Municipal Energy Solutions (Muni)	$1,879,379	$1,943,528	$64,150
All others	$833,240	$1,561,498	$728,258
Total	**$74,702,678**	**$70,457,819**	**-$4,244,860**

Accounting for participant costs and free-ridership. Customer rebates represent the largest share of program spending by a wide margin and were of particular importance in the I/O modeling. In most cases, program spending on rebates is accompanied by participant contributions toward the cost of energy efficiency upgrades.[21] The B/C models include measure-level total resource cost (TRC) data, which reflects the total incremental cost of an energy efficiency measure relative to the baseline measure—including both the program's and the participant's share. Participant contributions are attributable to some extent to the programs, but the extent of attribution varies by program, measure type, and other factors. New Hampshire has not conducted extensive research on program attribution levels—i.e., free-ridership and spillover—but the NH Utilities' B/C models include free-ridership and spillover estimates for certain measure types and delivery pathways, such as midstream and lighting offerings, taken from neighboring jurisdictions. For this analysis, the evaluation team used these factors to estimate the share of customer contributions that could be attributed to the programs. For example, at the ends of the attribution spectrum, the team assumed programs with 0% free-ridership and spillover (i.e., 100% net-to-gross) can claim 100% of participants' share of project costs as attributable to the program. In contrast, programs with 100% free-ridership and 0% spillover (i.e., 0% net-to-gross) cannot claim any of the participants' share of project costs as attributable to the program. The evaluation team applied these free-ridership and spillover factors to estimate the portion of participant spending attributable to the programs, addressing the Commission's directive to adjust for free-ridership.

[21] The primary exception to this is the low-income Home Energy Assistance program, which does not require any customer co-pay.

Accounting for out-of-state expenditures. Several spending categories include program expenditures for external contractors and consultants that may reside outside of New Hampshire, including spending on customer rebates that is directly paid to contractors but is then passed through to New Hampshire-based customers.[22] To determine the proportion of contractor and consultant spending that flows to out-of-state recipients, the evaluation team reviewed and analyzed cost data from several recent NH Utilities filings.[23] Table 3-3 provides the data from these filings on the NH Utilities' 2021 spending on outside contractors and consultants, including the portion of this spending for rebates—which are required to flow to New Hampshire-based customers—as well as the non-rebate portion—which may or may not ultimately flow to New Hampshire-based recipients.

Table 3-3. NHSaves 2021 statewide contractor and consultant expenses

State/Country[1]	Total Contractor and Consultant Expenses	Rebate Portion (100% pass-through to NH customers)	Non-Rebate Portion
NH	**$29,668,388**	**$26,566,101**	**$3,102,286**
CA	$7,034,417	$5,738,082	$1,296,336
MA	$15,713,696	$14,619,373	$1,094,323
TX	$1,101,425	$740,242	$361,183
NY	$396,292	$53,318	$342,974
GA	$1,538,904	$1,239,306	$299,599
RI	$440,426	$165,199	$275,228
IL	$1,451,318	$1,227,080	$224,238
PA	$634,687	$440,885	$193,802
WI	$211,162	$32,300	$178,862
CO	$169,355	$0	$169,355
VA	$141,903	$52,492	$89,411
CT	$360,792	$272,795	$87,997
OH	$63,430	$0	$63,430
NJ	$51,610	$18,898	$32,712
MN	$89,265	$76,065	$13,200
VT	$254,676	$243,935	$10,741
ND	$5,533	$0	$5,533
FL	$105,768	$101,000	$4,768
AZ	$12,050	$9,550	$2,500
ME	$2,006,320	$2,004,220	$2,100
MD	$163,317	$163,317	$0
CANADA	$42,954	$0	$42,954
IRELAND	$9,507	$0	$9,507
INDIA	$1,344	$0	$1,344
Total	**$61,668,540**	**$53,764,159**	**$7,904,381**

[22] Customer rebates, by definition and program rules, are provided only to eligible customers of the NH Utilities who must reside in New Hampshire. Internal administration expenditures are also assumed to be for New Hampshire-based staff for purposes of our analysis.

[23] NHPUC Docket No. IR 22-042 11-01-2022 IR Requests, Attachment RR 1-006B; NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Report 3.1

[1]Based on business address used for payments.
Sources: NHPUC Docket No. IR 22-042 11-01-2022 IR Requests, Attachment RR 1-006B; NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Report 3.1

The team estimated the share of non-rebate spending flowing to out-of-state contractors and consultants using the values in Table 3-3. As the NH Utilities noted in their filings, the business address of a given contractor or consultant does not necessarily reflect the location of the individual(s) working with the programs. The NH Utilities' 2021 data does not track contractor and consultant expenses based on the location of the employees working with the programs, and a comprehensive review of these expenses was not within the scope of this study. However, multiple contractors that are shown in the NH Utilities' filings as being out-of-state businesses based on their corporate address employ New Hampshire-based staff who work for the programs. Based on this review, we modeled several scenarios assessing the sensitivity of the results to the share of contractor and consultant expenses flowing to out-of-state recipients. Table 3-4 shows the share of non-rebate contractor and consultant spending that flows to in- and out-of-state recipients under a range of assumptions about the extent to which non-rebate funding sent to out-of-state business addresses is passed back to New Hampshire-based employees of those businesses. The evaluation team ran a sensitivity analysis of the economic impacts using the middle two assumptions: 25% and 50% of spending on out-of-state business addresses being passed back to New Hampshire-based employees (see Section 4.3.2.)

Table 3-4. Non-rebate contractor and consultant expenses to out-of-state recipients

Assumed share of spending on out-of-state business addresses that is passed through to New Hampshire-based employees	Share of total non-rebate expenses flowing to in-state recipients	Share of total non-rebate expenses flowing to out-of-state recipients
0% passed through to New Hampshire-based employees	39.2%	60.8%
25% passed through to New Hampshire-based employees	54.4%	45.6%
50% passed through to New Hampshire-based employees	69.6%	30.4%
75% passed through to New Hampshire-based employees	84.8%	15.2%

Accounting for labor and materials. For customer rebate spending, the team estimated the share of program spending on the purchase of equipment or materials and the share for labor by installation contractors, technical/engineering vendors, and other project-specific (i.e., non-administrative) labor. Some programs, such as residential weatherization, involve labor-intensive activities installing relatively low-cost materials such as spray foam and weatherstripping, while other programs such as midstream or upstream lighting and appliances involve equipment markdowns or point-of-purchase rebates and do not include program spending for installation or other project-specific labor. The team developed estimates for the share of labor and materials spending based on a review of the programs, discussion with utility staff, and application of labor cost shares from research by the Political Economy Research Institute (PERI), a nationally recognized independent research unit at the University of Massachusetts Amherst.[24]

Table 3-5 below shows the labor and materials assumptions used in modeling.

Table 3-5. Assumptions for labor and material costs, by program

Program/Subprogram	Percent materials[1]	Percent labor[2]	Source
Energy Star Homes (ES Homes)	25%	75%	Estimated based on program review and discussion with utility staff
Home Performance with Energy Star (HPwES)			
HPwES Weatherization	20%	80%	PERI/IMT[3]

[24] Political Economy Research Institute & Institute for Market Transformation. Analysis of Job Creation and Energy Cost Savings From Building Energy Rating and Disclosure Policy, March 2012. PERI is a nationally recognized source of expertise on economic modeling of employment impacts and has been cited in regulatory filings by the NH Utilities and other energy efficiency program administrators throughout the country in estimating the employment impacts of their programs.

Program/Subprogram	Percent materials[1]	Percent labor[2]	Source
HPwES HVAC Systems	70%	30%	PERI/IMT[3]
HPwES 3rd Party Financing	0%	100%	Assumed for financing program
Energy Star Products (ES Products)			
ES Lighting	100%	0%	Estimated based on upstream program design and discussion with utility staff
ES Appliances	90%	10%	Estimated based on midstream program design and discussion with utility staff
ES HVAC Systems	90%	10%	Estimated based on midstream program design and discussion with utility staff
Home Energy Reports	5%	95%	Assumed due to home energy reports program design
Residential Active Demand Response	5%	95%	Estimated based on demand response program design and discussion with utility staff
Home Energy Assistance (HEA)			
HEA Weatherization	20%	80%	PERI/IMT[3]
HEA HVAC Systems	70%	30%	PERI/IMT[3]
Large Business Energy Solutions (LBES)			
LBES Retrofit	69%	31%	PERI/IMT,[3] weighted by spending by end use
LBES New Equipment & Construction	63%	37%	PERI/IMT,[3] weighted by spending by end use
LBES Midstream	90%	10%	Estimated based on midstream program design and discussion with utility staff
Small Business Energy Solutions (SBES)			
SBES Retrofit	66%	34%	PERI/IMT,[3] weighted by spending by end use
SBES New Equipment & Construction	69%	31%	PERI/IMT,[3] weighted by spending by end use
SBES Midstream	90%	10%	Estimated based on midstream program design and discussion with utility staff
SBES Direct Install	70%	30%	PERI/IMT,[3] weighted by spending by end use
Municipal Energy Solutions (Muni)			
Muni Retrofit	65%	35%	PERI/IMT,[3] weighted by spending by end use
Muni New Equipment & Construction	64%	36%	PERI/IMT,[3] weighted by spending by end use
Muni Direct Install	70%	30%	PERI/IMT,[3] weighted by spending by end use

[1] Estimated share of projects' incremental cost attributed to equipment/materials purchased.
[2] Estimated share of projects' incremental cost attributed to labor by installation contractors, technical/engineering vendors, or other project-specific implementation (i.e., non-overhead, non-administrative) labor.
[3] Political Economy Research Institute & Institute for Market Transformation. Analysis of Job Creation and Energy Cost Savings From Building Energy Rating and Disclosure Policy, March 2012.

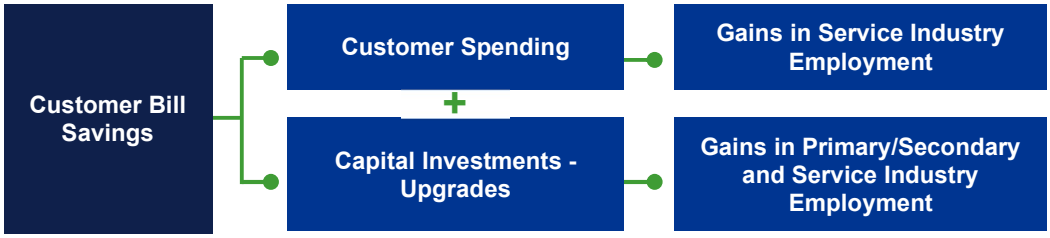
3.1.2 Bill impacts review

The team used the bill and rate impact model results filed by the NH Utilities for the 2022–2023 program years to model the economic impacts of customer bill savings due to the NHSaves programs.[25] The evaluation team incorporated these data in our model to quantify the economic impact during the NHSaves programs' savings phase, which occurs once energy efficiency measures are installed and begin to return savings through reduced energy bills. These bill impacts result from participant energy cost savings, system benefit charge costs, and long-term utility system avoided costs. For the NHSaves

[25] Both the B/C model analysis and bill savings analysis reflect the impacts from 2 program years. However, the bill savings reflects a more recent two-year period (2022-2023), because the NH Utilities estimate and file bill savings for the entire period of their filed plans, not for individual years. As such, the available bill savings values were for either the 2021-23 plan, or the 2022-23 plan update. We used the 2022-23 values for our analysis as they reflect a two, not three-year period, and were more recently updated, following the 2021 funding changes.

programs, the net impact of these factors are reductions in overall utility system costs and total customer bills.[26] The team's I/O modeling accounts for the impacts of bill savings on the economy as depicted in Figure 3-2.

Figure 3-2. Summary of customer bill savings impacts on the New Hampshire economy



The NH Utilities estimated the bill and rate impacts of the 2022–2023 plan using the model developed by Synapse Energy Economics.[27] The evaluation team used the impacts as modeled by the NH Utilities and filed with the plan,[28] rather than separately re-modeling the impacts. Using this model, the NH Utilities estimated that over the life of the measures installed across all programs, the 2022–2023 programs will reduce the revenue requirements of the regulated electric utilities by -0.4% on average, or -$158.8M in total, and reduce the revenue requirements of the regulated gas utilities by -1.0% on average, or -$58.5M in total.[29] Table 3-6 shows the changes in revenue requirements by utility, as filed.

Table 3-6. Long-term revenue requirement changes due to 2022–2023 plan, by utility

Utility	Percent Change	Dollar Change (millions)
Eversource	-0.40%	($135.70)
Liberty Electric	-0.50%	($16.20)
Unitil Electric	-0.10%	($6.90)
Electric Total	**-0.40%**	**($158.80)**
Liberty Gas	-2.00%	($44.80)
Unitil Gas	-0.40%	($13.70)
Gas Total	**-1.00%**	**($58.50)**

Source: NHPUC Docket No. DE 20-092 March 1, 2022 Plan Filing (2022-2023) Attachment M

There are several limitations to the rate and bill impact analysis, as described by the NH Utilities in the 2022–2023 plan.[30] Most significantly for purposes of our analysis of the economic impacts of customer bill savings, the rate and bill model is limited to electric and natural gas system cost savings. The NHSaves programs result in significant customer bill savings

[26] As described in the *National Standard Practice Manual,* energy efficiency resources create both upward and downward pressures on rates, and the net impact on rates will be a result of a variety of factors. Energy efficiency creates upward pressure on rates "as a result of (a) the recovery of efficiency program administration and implementation costs; and (b) the recovery of lost revenues resulting from EE programs." It creates downward pressure on rates "as a result of avoided costs, including reduced generation capacity costs, reduced T&D costs including reduced line losses, reduced environmental compliance costs, reduced utility credit and collection costs, and reduced wholesale market prices from price suppression effects." Bill impacts result from these rate impacts, but vary between participants and non-participants, and depend on the level of savings achieved on a customer basis. See National Efficiency Screening Project (NESP), *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources, Appendix C*, Spring 2017.

[27] Synapse. New Hampshire Rate, Bill, and Participation Impact Analysis, A User's Guide to the RBP Models, Aug 2020. 20200805-Electric-ME-Report-Guide-To-RBP-Models.pdf (nh.gov)

[28] NHPUC Docket No. DE 20-092 March 1, 2022 Plan Filing (2022-2023) Attachment M

[29] A utility's revenue requirement is the total amount of money it must collect from customers to pay all costs including a reasonable return on investment, and it is approved by regulators as part of a rate case. As detailed in the model user's guide, "to synthesize the rate and bill impacts across the customer sectors, the models estimate the net change in the utility's revenue requirement due to the planned efficiency programs. The change in revenue is dispersed across each rate class differently, depending on the efficiency programs and the rate class structures. Each rate class will experience a different change in revenue and therefore rate impact." Synapse. New Hampshire Rate, Bill, and Participation Impact Analysis, A User's Guide to the RBP Models, Aug 2020. 20200805-Electric-ME-Report-Guide-To-RBP-Models.pdf (nh.gov)

[30] NHPUC Docket No. DE 20-092 March 1, 2022 Plan Filing (2022-2023) Attachment M

from reduced consumption of oil, propane, or other unregulated fuels, particularly among residential customers. These bill savings are not accounted for in the bill and rate impacts filed by the NH Utilities, nor are they accounted for in our analysis. In addition, the values filed by the NH Utilities reflect long-term revenue requirement changes that use the same discount rate assumptions as in the B/C model filed with the 2022–2023 plan (see Section 4.3.3.2). Re-analysis and modeling of the bill and rate impacts of the plan under different discount rate assumptions was not feasible within the timeframe of this study.

3.2 IMPLAN modeling

The core of the economic impact modeling was performed with IMPLAN, which is an industry-standard input-output model developed by the U.S. Forest Service in the 1970s to produce accurate estimates of forest resource economic impacts. IMPLAN allows users to generate three measures of employment changes.[31]

- **Direct employment effects**, which are benefits accruing to industry involved in production and installation activities.
- **Indirect employment effects**, which refer to the changes in industries supplying input to the sectors benefiting directly.
- **Induced employment effects**, which are the second-order effects due to increased consumer spending resulting from the income gains made in the sectors witnessing direct and indirect effects.

In addition to employment impacts, outputs of the IMPLAN model include local, state, and federal GDP impacts and tax impacts associated with the programs. The software accounts for New Hampshire's particular tax regime in the modeling—i.e., no sales tax and limited income tax (interest and dividends income only). The following sections describe the steps the evaluation team took to develop modeling inputs for IMPLAN.

3.2.1 Meta-analysis of energy efficiency I/O literature

The evaluation team began by conducting a search of recent literature on deploying I/O models to estimate the employment effects of energy efficiency programs. The objective of the literature review was to ensure our modeling approach was consistent with other recent research in the field, and we also leveraged the literature to identify certain modeling assumptions such as assumptions for the share of spending on labor and materials across programs.

I/O models have been deployed in different contexts to assess the employment effects of energy efficiency and other types of energy services programs. For example, in its analysis of energy efficiency programs in the state of Colorado—also referenced in prior NHSaves program plans—PERI concluded that every million dollars spent on energy-efficient measures, such as building retrofits, supports 6.2 direct jobs, 2.7 indirect jobs, and 3.3 induced jobs.[32] In a similar analysis in Pennsylvania, $1 million in building retrofits was associated with 6.6 new jobs.[33] Recent studies have also examined the impacts of large scale federal and state level programs on macroeconomic indicators such as GDP and employment. We focused our review on studies in the last five years that used I/O modeling to analyze the employment impacts of regional and state-specific energy programs. Section 4.4 provides a summarized comparison of the results of these studies, and APPENDIX A. LITERATURE REVIEW SOURCES provides the full list of studies the team reviewed and Section 4.4 presents a table with the detailed employment intensity numbers from these other studies.

3.2.2 Distribution ratios and industry code matching

Distribution ratios reflect the proportion in which program spending is apportioned across different industries/economic sectors. The evaluation team reviewed the measure-level program spending data from the B/C models, matching them to

[31] The team modeled employment impacts in terms of full-time-equivalent jobs per year. This is a comparable metric to job-years but allows more granular results that can be separately reported for each year of program impacts, rather than reporting a single job-years value representing multiple years of impacts. Also see Pollin, R., Chakraborty, S., Lala, C., Semieniuk, G. *Job Creation Estimates for Colorado Through Inflation Reduction Act Modeling State-Level Impacts of Climate, Energy, and Environmental Provisions,* at https://peri.umass.edu/economists/shouvik-chakraborty/item/download/1037_fd083b171774ebd2af03bd349aa60ee4

[32] See Pollin, R., Wicks-Lim, J., Chakraborty, S., & Hansen, T. (2019). A Green Growth Program for Colorado. *Amherst: Political Economy Research Institute Research Report, University of Massachusetts Amherst*. Study available at: https://www.peri.umass.edu/publication/item/1168-a-green-growth-program-for-colorado

[33] Pollin, R., Wicks-Lim, J., Chakraborty, S., & Semieniuk, G. (2021). Impacts of the Reimagine Appalachia & Clean Energy Transition Programs for Pennsylvania. *Amherst: Political Economy Research Institute Research Report, University of Massachusetts Amherst*.

industry-specific codes from IMPLAN, which are primarily built on a dataset of 546[34] economic sectors. These sector definitions are based on the North American Industry Classification System (NAICS) codes published by the US Office of Management and Budget.[35] This matching process was used to develop distribution ratios (also referred to as Bills of Goods[36,37,38]) across different industries, reflecting the flow of program dollars to sectors (e.g., construction) and sub-sectors (e.g., materials processing).

Given the level of detail in the NH Utilities' B/C model, the evaluation team was able to allocate measure-level rebate spending to the relevant industries with a high degree of accuracy, for each utility over the two-year period being studied. The ability to deploy information directly from the NH Utilities' B/C models provides this analysis a greater level of detail and depth than most prior I/O modeling-based analyses. Studies typically deploy top-down approaches that either rely on distributing total program spending across industrial sectors based on assumed distribution ratios[39,40] or more recently, with PERI's analysis in Maine[41] that uses target energy intensity numbers to estimate the overall clean energy potential and total required spending on clean energy projects.

To take advantage of the granular, measure-level program spending data, we modeled the effects of each sub-program individually, distributing each measure-level spending value into materials and labor costs (Table 3-1). IMPLAN allows users to model economic impacts in different ways.[42] One of these approaches is setting up each activity as a commodity event. Commodity events are not tied to specific industries and allow for flexibility when estimating the effects of output from different industries. As an example, electricity can be produced from different sources such as fossil fuels, renewable energy, or nuclear energy. Instead of modeling each source of electricity generation separately, by deploying the effect as a commodity event, the study modeled the overall effect of electricity. All material components and labor inputs were modeled as commodity events for the relevant commodity sectors summarized in APPENDIX B. IMPLAN METHODS.

For program rebate spending on materials (e.g., insulation, light bulbs, HVAC equipment, etc.), it is important to account for in- and out-of-state production and purchase of material inputs. To address this, the team modeled two different scenarios for IMPLAN's local purchase percentage (LPP) values. LPP indicates the share of each measure's total economic effect that will be retained within the region being examined (in this case, the state of New Hampshire).[43] Specifically, LPP ratios represent the extent to which the model assumes commodities are purchased from in-state manufacturers or wholesalers. In applying LPP values, users can supply their own estimates or use IMPLAN's internal values. The team modeled two scenarios for LPP—a conservative and an aggressive scenario:

- For the conservative scenario, the team allowed IMPLAN to determine this ratio using the regional purchase coefficient (RPC)[44] included within the software. The regional purchase coefficient values reflect the proportion of total demand in the state that is supplied by local producers. For example, if the RPC of a particular commodity is 50%, that would imply that half the total demand for the commodity is supplied locally. The RPCs included in the version of IMPLAN deployed in this study are estimated econometrically based on economy-wide trade flow data.

[34] https://support.implan.com/hc/en-us/articles/360058813353-546-Industries-Conversions-Bridges-Construction-2019-Data
[35] The only exception to the IMPLAN-NAICS links relevant for this study is the construction sector in IMPLAN which is based on the type of building structures from the Bureau of Economic Analysis' Benchmark Input-Output model. See https://support.implan.com/hc/en-us/articles/115009674668-Sectoring-Schemes and https://support.implan.com/hc/en-us/articles/115009505667-Special-Industry-Definitions
[36] Brown, M. A., Soni, A., & Li, Y. (2020). Estimating employment from energy-efficiency investments. *MethodsX, 7, 100955.*
[37] Brown, M. A., Li, Y., & Soni, A. (2020). Are all jobs created equal? Regional employment impacts of a US carbon tax. *Applied Energy, 262, 114354.*
[38] Baer, P., Brown, M. A., & Kim, G. (2015). The job generation impacts of expanding industrial cogeneration. *Ecological Economics, 110, 141-153.*
[39] Baer, P., Brown, M. A., & Kim, G. (2015). The job generation impacts of expanding industrial cogeneration. *Ecological Economics*, *110*, 141-153.
[40] Pollin, R., Garrett-Peltier, H., Heintz, J., & Hendricks, B. (2014). Green growth: A US program for controlling climate change and expanding job opportunities. *Center for American Progress*, 2.
[41] Pollin, R., Wicks-Lim, J., Chakraborty, S., & Semieniuk, G. (2020). A program for economic recovery and clean energy transition in Maine. *Amherst: Political Economy Research Institute Research Report, University of Massachusetts Amherst*.
[42] https://support.implan.com/hc/en-us/articles/360019638713-Explaining-Event-Types
[43] https://support.implan.com/hc/en-us/articles/115009499327-Local-Purchase-Percentage-LPP-
[44] https://support.implan.com/hc/en-us/articles/115009499527-Regional-Purchase-Coefficient

- To compute more aggressive in-state effects, the study also deployed a 100% LPP with the assumption that all commodities could be purchased from local manufacturers or wholesalers.

For project installation labor, the team redistributed the program spending on labor across the major construction sectors in IMPLAN. For residential programs these include construction, and repair and maintenance of new residential buildings (single and multi-family). For non-residential programs, we split the spending values between construction of new health care, manufacturing, power and communications, and educational and vocational structures and between new construction and maintenance/repair of non-residential structures.

The team also developed distribution ratios for the program-level costs of administration, internal implementation, services, marketing, and evaluation, in alignment with the NH Utilities' accounting definitions for those cost categories. Specifically, we attributed those costs to IMPLAN industry sectors representing management and consulting services. To allow for accurate within state impacts, we modeled these administrative costs as commodity outputs. Since the evaluation team, in consultation with utilities, had established that internal administration and implementation spending remains in-state (Table 3-1), the LPP values for these spending categories were set at 100%. For other administrative expenses (external administration, marketing, evaluation, and services), the study estimated two scenarios—first, where the passthrough to New Hampshire-based employees is 50% and, second, where the pass-through falls to 25%, as shown in Table 3-4. In all cases, the effects are modeled as commodity events allowing us to compute the indirect (material and supplies effects) and the induced effects of additional direct employment in the management and consulting services sectors, which include employee compensation, materials, supplies, and other overhead.

The full table of matched industry codes is provided in APPENDIX B. IMPLAN METHODS.

3.2.3 Modeling bill savings effects

As noted in Section 3.1.2, the team modeled bill savings effects using the bill and rate impact model results filed by the New Hampshire utilities. Since the programs witnessed uncertainties and funding instability in 2021, the team relied on the most up-to-date filings from March 1, 2022, reflecting the 2022-23 plan.[45] The reduction in revenue requirements for the regulated electric and gas utilities due to the 2022–2023 programs was estimated to be $217.3 million in total across all utilities, all customer sectors, and both years of the plan. The impact of customer bill savings varies across customer sectors, due to their different financial circumstances and organizational structures. To apportion these bill savings across the low-income, residential, and C&I sectors, the team apportioned the bill savings for each sector according to that sector's projected lifetime kWh and MMBtu savings for electricity and gas, respectively, from the 2022-23 plan, as shown in Table 3-7.

Table 3-7. NHSaves projected bill savings distributed across sectors

Sector	Share of 2022–2023 lifetime electric savings	Share of 2022–2023 lifetime gas savings	Reallocated electric bill savings	Reallocated gas bill savings	Total bill savings
Low-Income	2.5%	6.7%	$3,917,172	$3,947,093	**$7,864,265**
Residential	20.2%	33.8%	$32,150,545	$19,787,417	**$51,937,961**
Commercial & Industrial	77.3%	59.4%	$122,732,283	$34,765,490	**$157,497,773**
Total	**100%**	**100%**	**$158,800,000**	**$58,500,000**	**$217,300,000**

The bill savings values for each sector were used to compute the employment effects of lower energy spending across the three sectors. It should be noted that these effects will materialize over long periods of time. As noted in the 2022–2023 plan filings, many of these measures last for close to two decades—the average measure life was 12.2 years for 2022 planned electric measures, and 16.6 for planned gas measures—and the total job gains are distributed over the entire period.

[45] NHPUC Docket No. DE 20-092 March 1, 2022 Plan Filing (2022-2023) Attachment M

Residential sector bill savings

The residential sector bill savings impact analysis is based on reapportionment of residential savings across different income categories. IMPLAN's state-level descriptive data includes shares of households by annual income levels. Since the residential programs are available to all types of households, we assume that savings from reduced energy bills are distributed proportionally across the different income levels, as shown in Table 3-8.[46]

Table 3-8. New Hampshire household annual income distribution and bill savings allocation

Income category	Number of households	% of total	Bill savings by household income category
Households <$15k	3,792	7%	$3,455,758
Households $15-30k	58,625	10%	$5,343,840
Households $30-40k	41,089	7%	$3,745,338
Households $40-50k	39,077	7%	$3,562,006
Households $50-70k	78,551	14%	$7,160,102
Households $70-100k	99,079	17%	$9,031,328
Households $100-150k	107,835	19%	$9,829,410
Households $150-200k	52,352	9%	$4,772,035
Households >$200k	55,272	10%	$5,038,146
Total	**569,793**	**100%**	**$51,937,961.38**

Source: IMPLAN demographics data for New Hampshire

As noted earlier, IMPLAN allows for modeling energy bill savings as additional household income, which results in employment gains through induced spending by households. Since bill savings are modeled as gains in income, they only flow through the economy as induced effects and not direct or indirect effects on the economy. Since households do not engage in direct production activity, this "additional" income is then used in induced economic activity (e.g., restaurant services, recreation).

Low-income sector bill savings

The evaluation team modeled low-income customer bill savings based on the share of 2022-23 planned savings for the low-income Home Energy Assistance (HEA) program. HEA is an income-targeted program generally serving participants with household income that is at or below 60 percent of the state median income for their household size.[47] The average household size in New Hampshire is 2.46 persons.[48] For households with three persons, 60% of the state median income equates to $62,950, so we allocated the low-income bill savings for both electricity and gas proportionally among households with annual incomes of less than $70,000 (see Table 3-9). As with residential bill savings, since low-income

[46] This is a simplifying assumption made for purposes of this review. In reality, savings are likely distributed unevenly across income levels, with higher income households seeing greater levels of savings due to higher baseline energy consumption driven by factors such as larger home sizes and more energy-using equipment (e.g., central air conditioning). As a result, this analysis may overstate the impacts of low-income participant bill savings and understate the impacts of higher-income residential participant bill savings. Further analysis of household savings distribution was not possible within the scope and timeline of this study.

[47] Program eligibility requirements also allow for serving customers who are eligible for the New Hampshire Electric Assistance Program, or anyone residing in subsidized housing or municipal or nonprofit organizations serving those in need. See https://www.energy.nh.gov/consumers/help-energy-and-utility-bills/assistance-programs-eligibility for information on program eligibility.

[48] https://www.census.gov/quickfacts/NH

savings accrue directly to households, we modeled them as additional household income, which results in induced economic activity (e.g., services, recreation).

Table 3-9. New Hampshire low-income distribution and bill savings allocation

Income category	Share of households below $70,000 annual income	Program savings share (IMPLAN inputs)
Households <$15k	15%	$1,168,041
Households $15-30k	23%	$1,806,219
Households $30-40k	16%	$1,265,928
Households $40-50k	15%	$1,203,959
Households $50-70k	31%	$2,420,118
Total	**100%**	**$7,864,265**

Source: IMPLAN demographics data for New Hampshire

C&I sector bill savings

The team followed a somewhat different approach for modeling commercial and industrial sector bill savings. As noted above, IMPLAN provides information across 546 industry/commodity sectors, which we used to identify the share of different sectors across the state's economy. The team then apportioned the total C&I savings across different sectors in the same proportion as the share of these sectors in the state's output. We assume that all C&I sector savings are redirected towards additional industry activity, and model these impacts as industry output in the same proportion as the share of these sectors industries in the total output, shown in Table 3-10. IMPLAN defines total output as the monetary value of the total production in any sector. In other words, total output reflects the production for each industry in a given year plus the net inventory changes in the sector. We used output as the basis for reapportioning the total savings across all major sectors/industries since it provides a good picture of the total share of each sector in the state's economy.

Table 3-10. Share of industries in the New Hampshire output[1]

Description	Share of economic output
11 - Agriculture, Forestry, Fishing and Hunting	0.2%
21 - Mining, Quarrying, and Oil and Gas Extraction	0.2%
22 - Utilities	1.7%
23 - Construction	5.5%
31-33 - Manufacturing	15.3%
42 - Wholesale Trade	6.6%
44-45 - Retail Trade	6.1%
48-49 - Transportation and Warehousing	1.5%
51 - Information	3.9%
52 - Finance and Insurance	8.7%
53 - Real Estate and Rental and Leasing	11.7%
54 - Professional, Scientific, and Technical Services	8.3%
55 - Management of Companies and Enterprises	2.9%

Description	Share of economic output
56 - Administrative and Support and Waste Management and Remediation Services	3.5%
61 - Educational Services	1.1%
62 - Health Care and Social Assistance	7.8%
71 - Arts, Entertainment, and Recreation	1.1%
72 - Accommodation and Food Services	4.1%
81 - Other Services (except Public Administration)	2.9%
9A - Government Enterprises	0.8%
9B - Administrative Government	6.0%
Total	**100.0%**

[1]Output = total production + net inventory changes[49]

3.3 Expert interviews

To provide context for the I/O modeling results, the evaluation team interviewed individuals from ten organizations with expertise and knowledge of the NHSaves programs. These interviewees included two vendors and three large, multi-project participants in the NHSaves programs. The interviews covered topics including (1) NHSaves program impacts on workforce and customers, including impacts from recent regulatory decisions and changes in funding levels, (2) the flow of program funding to in-state and out-of-state recipients, (3) local workforce needs and opportunities, (4) how changes in energy bills impact other spending by customers. Table 3-11 provides a list of organizations interviewed for the study.

Table 3-11. Organizations interviewed on NHSaves' economic impacts

Interviewee Organization	Description
ACEEE	Non-profit organization promoting energy efficiency via technical and policy analyses, advisory services, and collaborative partnerships
BAE Systems	Large industrial customer with energy-intensive engineering and laboratory facilities in New Hampshire. *NHSaves participant*
GDS Associates, Inc.	Engineering and energy consulting firm. *NHSaves vendor*
Lake Region Community Developers	Community-based affordable housing development and services non-profit. *NHSaves participant*
NH Business and Economic Affairs	State agency created to enhance the economic vitality of New Hampshire and promote it as a destination for domestic and international visitors
NH Department of Environmental Services, Air Division	State agency created to protect and restore the environment and public health in New Hampshire through wise management of the state's environment
NH Community Development Finance Authority	Quasi-governmental agency providing technical assistance and financing to support community economic development initiatives
NH Department of Energy	State agency created to promote and coordinate energy policies and programs in the state
Resilient Buildings Group	Consulting firm providing energy efficient building management and construction services. *NHSaves vendor*

[49] https://support.implan.com/hc/en-us/articles/360035998833-Understanding-Output

University of New Hampshire Facilities Management	Department providing professional services for University renovation, repair, and new construction projects. *NHSaves participant*

3.4 Health impacts modeling

Energy efficiency programs can offer benefits to individuals, businesses, and society, including lower energy bills and improved grid reliability, as well as a range of public health impacts. These health impacts can include reductions in the frequency and/or severity of health problems caused by emissions and other outputs of fuel combustion and extraction required for supply-side resources. Such health impacts have been widely researched and include reductions in the number of premature deaths, incidences of respiratory and cardiovascular illnesses, and missed days of work and school. There are a range of economic benefits associated with these health impacts, including reduced medical costs, and increased economic productivity of the impacted population.

New Hampshire's energy-related statutes and Commission orders frequently mention public health, and New Hampshire stakeholders previously considered these impacts for purposes of cost-effectiveness testing of the NHSaves programs, although they ultimately decided against including public health impacts in the Granite State Test (GST). As noted above, the economic impacts modeled in this study are additional to program cost-effectiveness.[50]

The evaluation team estimated the economic value of the health benefits associated with the NHSaves programs using EPA's Co-Benefit Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) and Avoided Emissions and Generation Tool (AVERT).

- COBRA is an EPA software tool that produces estimates of public health and associated economic impacts due to changes in air pollution stemming from energy policies and programs. Researchers can model multiple scenarios by specifying increases or decreases in criteria pollutants, as well as discount rates options.[51] COBRA relies in part on epidemiological models for the statistical value of life and changes in adult mortality and non-fatal heart attacks.
- AVERT is an EPA software tool designed to estimate the impact of energy programs and policies on the emissions produced by the power sector. AVERT estimates annual marginal rates of avoided criteria pollutants such as particulate matter (PM2.5), nitrogen oxides (NOx), sulfur dioxide (SO_2), carbon dioxide (CO_2), volatile organic compounds (VOC), and ammonia (NH_3) from electric power plants at a county, state, or regional level.

The team used COBRA to model the economic value of the health benefits associated with emissions reductions caused by the NHSaves programs. For electric programs, the team used AVERT to estimate those emissions reductions, and for gas programs, the team used EPA emissions factors for residential and business end-user combustion to estimate criteria pollutants. See APPENDIX C. AVERT AND COBRA METHODS for more details on the sources and methods used for this analysis.

Limitations. COBRA and AVERT are useful for modeling the overall health impacts of changes in criteria pollutants, but both have limitations that should be considered in applying the results.

- AVERT provides a snapshot of regional electricity dispatch and does not consider changes in dispatch over time due to fuel prices, curtailments, transmission system changes, or other factors. Therefore, the use of AVERT for forward

[50] Cost-effectiveness testing is used to screen programs to determine which have benefits that exceed their costs, and therefore merit using ratepayer dollars to fund. Despite New Hampshire stakeholders' decision to exclude public health impacts from cost-effective testing under the GST, there is clear evidence that energy efficiency programs produce public health benefits that result in economic impacts for the state.

[51] COBRA uses a discount rate to express future economic values in present terms because not all health effects and associated economic values occur in the year of analysis. COBRA assumes changes in adult mortality and non-fatal heart attacks occur over a 20-year period. EPA recommends using both 3% and 7% discount rates. The 3% interest rate corresponds to the interest rate on government backed securities, whereas the 7% interest rate reflects the opportunity costs of capital.

looking scenarios is not recommended.[52] In addition, AVERT models generation dispatch impacts at the regional level, agnostic of the location of electricity reductions. In reality, dispatch decisions are location sensitive.

- COBRA also has limitations in the applicability of its results over time. Each COBRA run represents benefits from emissions reductions in a specific year, based on epidemiological models embedded in the software, which use demographic profiles and other information that reflects impacts for a specific point in time. To analyze multiple years of emissions impacts, the model should be separately run for each year and the results aggregated for each run.

The team modeled the annual emissions reductions and associated health impacts of the 2021 NHSaves programs. It is important to note that these modeling results are based on first year savings only, so they reflect only annual, one-year impacts, and not the full impacts of the savings from the 2021 measures over their useful lives. The limitations noted above should be considered if applying these results to programs' lifetime savings.

[52] For detail, see AVERT User Manual Version 2.3 (epa.gov)

4 RESULTS

4.1 Employment effects

The following section details the employment effects of the 2021 and 2022 NHSaves programs, during both their implementation phase (2021–2022) and savings phase (implementation through the end of measures' useful lives). Except where noted, all economic impacts presented in this report reflect impacts on the New Hampshire economy specifically. All employment effects reflect full-time-equivalent (FTE) jobs. [53] Note that employment effects during the implementation phase represent jobs that are created for one program year (2021 or 2022), and so the number of jobs is equivalent to the number of job-years. Employment effects during the savings phase occur in proportion to customer bill savings, over the useful life of the measures installed by the programs. As such, savings phase employment effects represent an aggregate estimate of job years, which are spread out over the life of the program measures for each sector.

For the implementation phase, as detailed in Section 3.1.1, the team used programs' free-ridership-adjusted total resource cost (TRC) data to estimate the direct, indirect and induced employment effects of program rebates for the 2021 (actual) and 2022 (planned) program years.[54] The team also estimated the effects of internal and external administrative spending on total employment under different scenarios. For the savings phase, the team used the bill and rate impact model results filed by the NH Utilities for the 2022–2023 program years to model the economic impacts of customer bill savings due to the NHSaves programs. Customer bill impacts result from participant energy cost savings, system benefit charge costs, and long-term utility system avoided costs. For the NHSaves programs, the net impact of these factors are reductions in overall utility system costs and customer bills. The following sub-sections describe the findings in greater detail.

4.1.1 Implementation phase

In the conservative LPP scenario,[55] the NHSaves programs generated approximately 756 jobs in 2021 and 703 jobs in 2022—approximately 10 jobs per $1 million in program spending, in both years, as shown in Table 4-1 and Table 4-2. It is important to note that in addition to employment generated from program rebates, the management and implementation of energy efficiency programs is also associated with many local jobs. As described earlier, the study modeled the effects of internal administrative expenses as well as external administration costs including services, marketing, and evaluation. In the conservative scenario, administration and services employment contributes over 40% of the total employment created in 2021. In the aggressive LPP scenario,[56] the share of jobs from program rebates increases, and the share of administration and services-based employment effects decreases to about a third and a quarter of the total jobs generated in 2021 and 2022, respectively.

At the program and sub-program level, there are a range of employment effects, which vary based on two factors.

1. The total number of jobs associated with a program is driven in part by the size of the program budget. For instance, in terms of total jobs, the four programs with the largest budgets—LBES, SBES, HEA, and HPwES—also created the largest number of jobs in both years.
2. The total number of jobs associated with a program is also driven by its employment intensity—that is, the number of jobs created for every $1 million in program spending. At over 14 jobs per million in program spending in 2021 and

[53] FTEs measure total full-time, part-time, and temporary employees, based on the total number of hours worked divided by the number of hours in a full-time schedule.
[54] In most cases, program spending on rebates is accompanied by participant contributions toward the cost of energy efficiency upgrades. The NH Utilities' B/C models include measure-level TRC data, which reflects the total incremental cost of an energy efficiency measure relative to the baseline measure—including both the program's and the participant's share. Participant contributions are attributable to some extent to the programs, but the extent of attribution varies by program, measure type, and other factors. Attribution levels are reflected in the NH Utilities' B/C models via free-ridership and spillover estimates for certain measure types and delivery pathways, such as midstream and lighting offerings, taken from neighboring jurisdictions. For purposes of our analysis, the evaluation team used these factors to estimate the share of customer contributions that could be attributed to the programs.
[55] Where LPP was set equal to RPC, as described in Section 3.2.2. LPP indicates the share of the economic effect of rebated measures that will be retained within the region being examined (in this case, the state of New Hampshire). Specifically, LPP ratios represent the extent to which the IMPLAN model assumes commodities are purchased from in-state manufacturers or wholesalers.
[56] Where LPP was set to 100%.

2022, ES Homes had the highest employment intensity, and HPwES also had high employment intensity at nearly 14 jobs per million in 2021. At the other end of the range, ES Products had the lowest employment intensity in both years, followed by the Home Energy Reports program. These differences are due to programs' different distribution ratios, which reflect the proportions in which program spending is apportioned across different industries/economic sectors. For example, ES Homes and HPwES require relatively more material and local project construction or installation contractors, whereas the Home Energy Reports program primarily involves spending on labor and overhead.

It is important to note that the employment effects of different programs do not reflect a comprehensive accounting of the costs and benefits of the programs. Cost-effective energy efficiency programs, by definition, provide a lower-cost alternative to supply-side resources. Even programs with negligible local employment impacts, if cost-effective, have net benefits that ensure they return more to the state's ratepayers in terms of avoided system costs and other energy and non-energy benefits than they cost. Table 4-1 and Table 4-2 show the employment estimates by sub-program for 2021 and 2022, including jobs from program rebates, administration and services-based jobs, and jobs per $1 million in program spending.

Table 4-1. New Hampshire implementation period FTE employment estimates, 2021 program year (actual)[1]

Program	Sub-program	Total Program Costs	Conservative LPP			Aggressive LPP		
			Rebate Employment	Administration and Services Employment	Jobs per million $ in program costs	Rebate Employment	Administration and Services Employment	Jobs per million $ in program costs
ES Homes		$3,449,257	34.81	13.75	14.08	35.18	13.75	14.18
HPwES	Weatherization	$11,263,490	94.20	62.33	13.99	100.04	62.33	14.67
	HVAC Systems		0.98			2.82		
	3rd Party Financing		0.01			0.01		
ES Products	Lighting	$9,735,295	1.58	36.52	4.78	8.86	36.52	10.39
	Appliances		4.53			23.05		
	HVAC Systems		3.94			32.69		
Home Energy Reports		$555,043	1.52	2.63	7.47	1.73	2.63	10.95
Residential Active Demand Response		$159,209	0.001	1.38	8.71	0.15	1.38	9.65
HEA	Weatherization	$14,464,427	65.45	51.67	9.77	87.23	51.67	12.04
	HVAC Systems		24.15			35.27		
LBES	Retrofit	$15,892,231	77.64	71.48	11.31	159.70	71.48	18.65
	New Equipment & Construction		28.92			55.20		
	Midstream		1.65			10.06		
SBES	Retrofit	$16,471,108	40.32	70.23	9.25	73.50	70.23	15.85
	New Equipment & Construction		20.77			27.35		
	Midstream		12.21			63.61		
	Direct Install		8.83			26.45		
Municipal	Retrofit	$1,879,379	7.04	8.32	10.58	16.06	8.32	18.99
	New Equipment & Construction		3.50			8.24		
	Direct Install		1.03			3.07		
Others[2]		$833,240	0.01	4.58	3.35	2.36	4.58	8.32
Total		**$74,702,678**	**433.07**	**322.90**	**10.12**	**774.35**	**322.90**	**14.69**

[1] All impacts represent incremental effects of each program year independently, relative a no-program counterfactual.
[2] Other programs include C&I active demand and education, residential education, and Energy Rewards RFP.

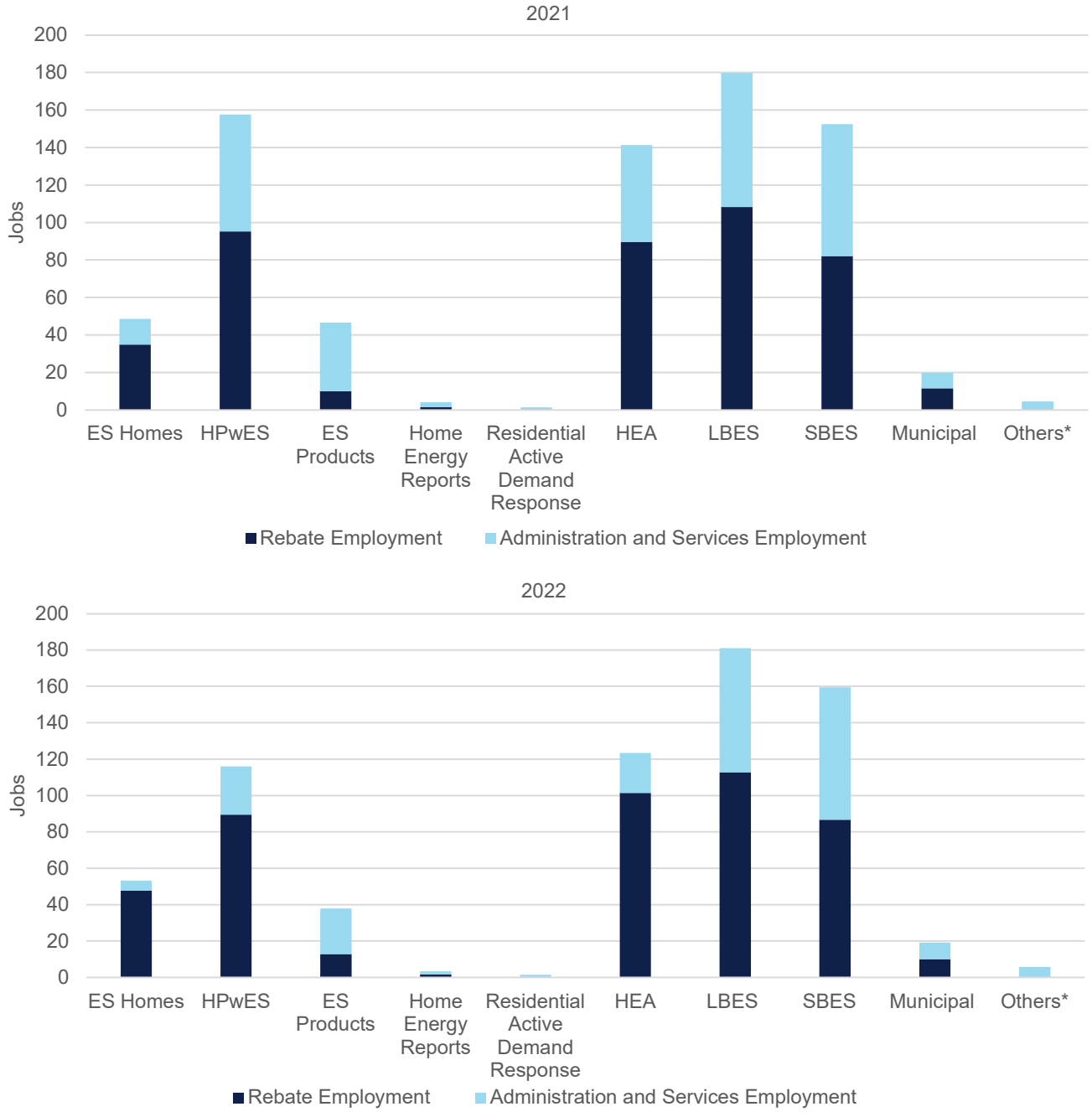
Table 4-2. New Hampshire implementation period FTE employment estimates, 2022 program year (plan)[1]

Program	Sub-program	Total Program Costs	With LPP (Conservative estimates)			Without LPP (Aggressive estimates)		
			Rebate Employment	Administration and Services Employment	Jobs per million $ in program costs	Rebate Employment	Administration and Services Employment	Jobs per million $ in program costs
ES Homes		$3,979,650	47.70	5.44	15.34	48.01	5.44	13.43
HPwES	Weatherization	$10,794,370	88.30	26.53	10.74	93.46	26.53	11.41
	HVAC Systems		1.09			3.11		
	3rd Party Financing		0.03			0.03		
ES Products	Lighting	$7,600,158	0.91	25.02	4.97	2.59	25.02	11.47
	Appliances		5.36			16.22		
	HVAC Systems		6.52			43.38		
Home Energy Reports		$483,512	1.60	1.81	7.04	3.63	1.81	11.24
Residential Active Demand Response		$190,156	0.00	1.47	7.73	0.00	1.47	7.73
HEA	Weatherization	$14,066,713	69.56	21.93	8.77	74.39	21.93	10.53
	HVAC Systems		31.84			51.85		
LBES	Retrofit	$14,558,651	82.66	68.22	12.44	159.17	68.22	19.70
	New Equipment & Construction		28.72			52.92		
	Midstream		1.44			6.05		
SBES	Retrofit	$15,279,584	47.47	72.83	10.44	86.11	72.83	17.69
	New Equipment & Construction		18.75			41.60		
	Midstream		9.33			35.81		
	Direct Install		11.15			33.93		
Municipal	Retrofit	$1,943,528	7.10	9.10	9.85	15.71	9.10	16.22
	New Equipment & Construction		2.94			6.72		
	Direct Install		0.00			0.00		
Others[2]		$1,561,498	0.00	5.70	5.45	0.00	5.70	5.45
Total		**$70,457,819**	**462.46**	**240.84**	**9.98**	**775.15**	**240.84**	**14.42**

[1] All impacts represent incremental effects of each program year independently, relative a no-program counterfactual
[2] Other programs include C&I active demand and education, residential education, and Energy Rewards RFP.

Figure 4-1 shows the total employment results from the 2021 and 2022 NHSaves programs, by program and type of program spending—customer rebate or administration and services spending. As shown, rebate spending is the driver of most employment for all programs, except for ES Products, which due to its midstream/upstream design, involves relatively less project installation labor and therefore lower local employment effects.

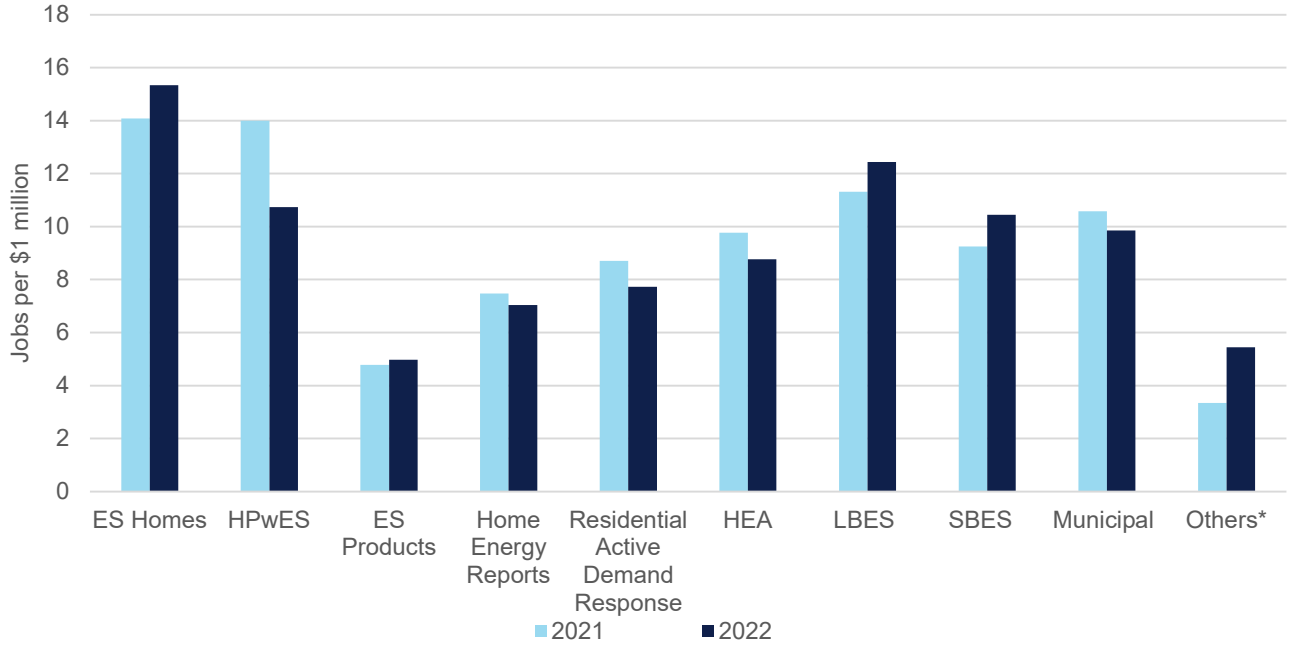
Figure 4-1. Total employment estimates for the 2021 and 2022 NHSaves programs, by program[1]



[1]Results shown for the conservative LPP scenario.

Figure 4-2 shows employment intensity—in terms of jobs per $1 million in program spending—for each NHSaves program in 2021 and 2022. As noted above, ES Homes had the highest employment intensity at over 14 jobs per million in 2021 and 2022, and HPwES also had high employment intensity at nearly 14 jobs per million in 2021.

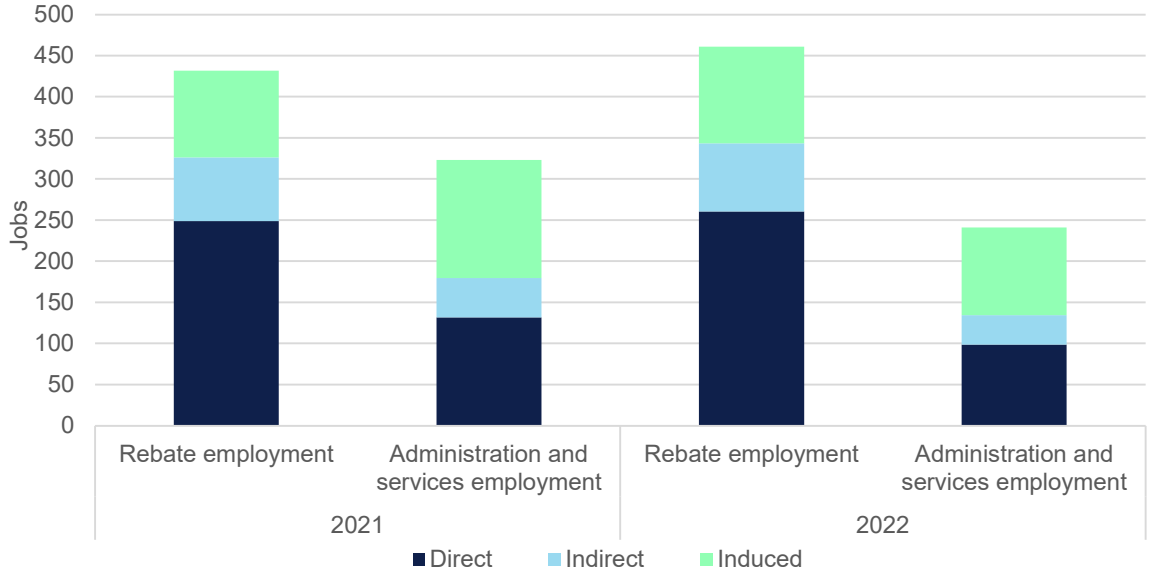
Figure 4-2. Employment intensity estimates for the 2021 and 2022 NHSaves programs, by program[1]



[1]Results shown for the conservative LPP scenario.

Figure 4-3 shows employment estimates for 2021 and 2022 by type of effect—direct, indirect, and induced—and type of program spending. As shown, customer rebates generated the largest share of jobs, primarily through direct employment effects—i.e., employment in industries involved in production and installation activities.

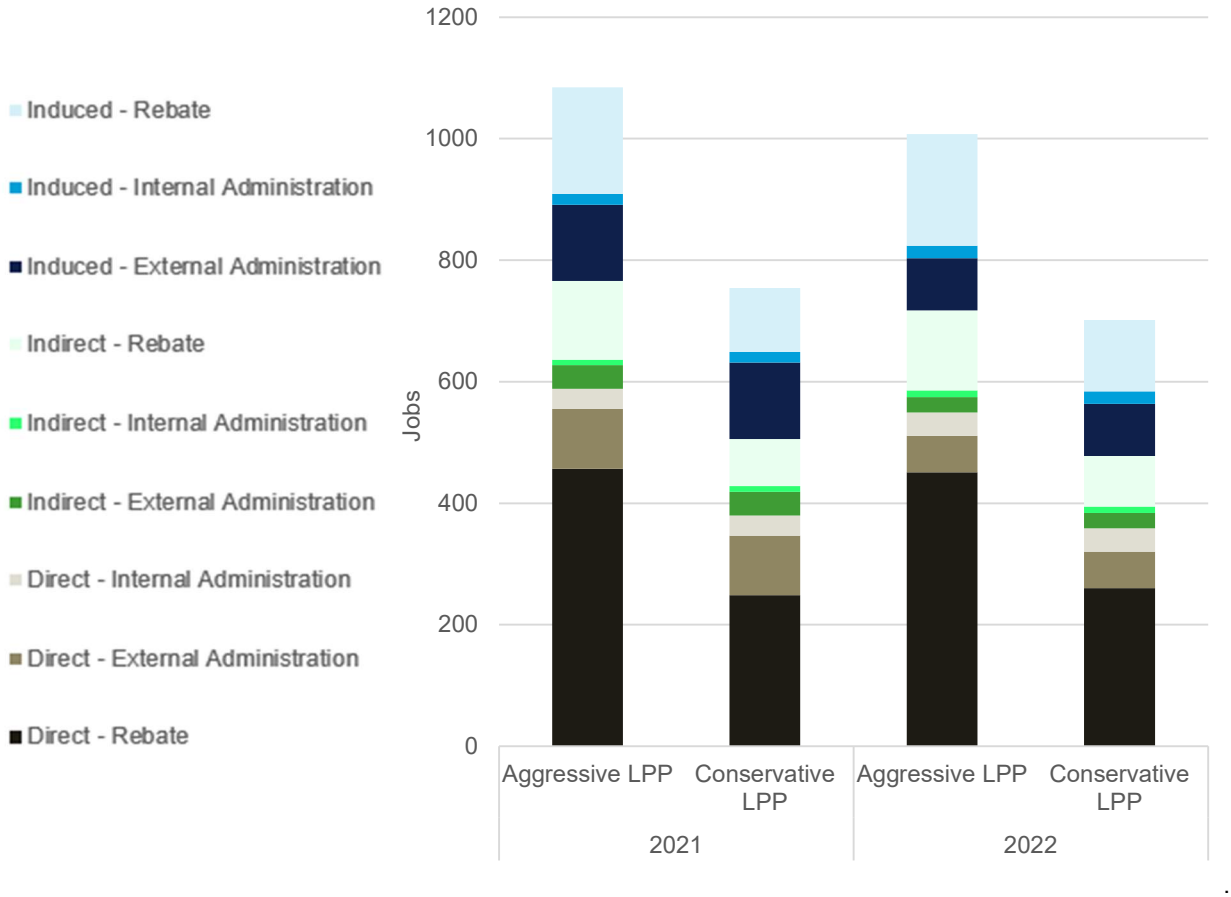
Figure 4-3. Employment estimates for the 2021 and 2022 NHSaves programs, by type of effect[1]



[1]Results shown for the conservative LPP scenario.

Figure 4-4 further breaks out employment, by type of effect, program spending, and LPP scenario (conservative or aggressive). As shown, the increase in jobs between the scenarios is due to increased rebate-generated employment, particularly for direct employment effects.

Figure 4-4. Employment estimates for 2021 and 2022 NHSaves programs, by scenario and type of effect



4.1.2 Savings phase

As shown in Section 3.2.3, the NH Utilities estimated that the 2022–2023 NHSaves programs will result in over $217 million in total customer bill savings over the useful life of the measures installed.[57] These bill savings result in increased customer (e.g., household) spending and industrial investment and outputs, which in turn create employment gains across sectors. The total NHSaves projected customer bill savings for the low-income, residential, and C&I sectors are estimated to result in about 1480 additional job years. (As noted above, savings phase employment effects represent an aggregate estimate of job years, which are spread out over the life of the program measures for each sector.)

The bill savings estimates the team modeled were limited to projected savings in electricity and natural gas bills. New Hampshire households also rely on delivered fuels such as oil and propane, and the NHSaves programs result in significant reductions in delivered fuel consumption, with associated bill savings.[58] Bill savings for those fuels were not included in the

[57] Both the B/C model analysis and bill savings analysis reflect the impacts from 2 program years. However, the bill savings reflects a more recent two-year period (2022-2023), because the NH Utilities estimate and file bill savings for the entire period of their filed plans, not for individual years. As such, the available bill savings values were for either the 2021-23 plan, or the 2022-23 plan update. We used the 2022-23 values for our analysis as they reflect a two, not three-year period, and were more recently updated, following the 2021 funding changes.

[58] According to the 2022-2023 NHSaves Plan, the programs will result in savings of 3.6 million MMBtu from delivered fuels such as oil and propane over the lifetime of the measures installed in 2022 and 2023—compared to projected savings of 5.4 million lifetime natural gas MMBtu.

analysis since the NH Utilities' bill and rate models do not include delivered fuel impacts. As such, the results of this analysis reflect a conservative estimate of the economic impacts of customer bill savings.

The overall increase in jobs for each sector closely mirrors the distribution of bill savings. Because the C&I sector sees both direct, indirect, and induced effects, it has the highest employment intensity at 7.3 job years per $1 million in bill savings. Among households, the low-income sector showed a slightly higher employment intensity (6.06 job years per $1 million) than the residential sector overall (5.45 jobs per $1 million). Table 4-3 shows the modeled bill savings employment effects for the 2022–2023 NHSaves programs.

Table 4-3. Bill savings employment effects, 2022–2023 programs

Sector	Employment (job years generated)				Total bill savings	Job years per million	Share of job years generated	Share of total bill savings
	Direct	Indirect	Induced	Total job years				
Low Income	N/A[1]	N/A[1]	47.67	47.67	$7,864,265	6.06	3.2%	3.6%
Residential	N/A[1]	N/A[1]	283.16	283.16	$51,937,961	5.45	19.1%	23.9%
C&I	697.89	176.37	275.41	1149.67	$157,497,773	7.30	77.7%	72.5%
Grand Total				**1480.49**	**$217,300,000**	**6.81**	**100%**	**100%**

[1]Because residential and low-income bill savings accrue to households which are not engaged in direct production and employment activities, these bill savings result in induced effects but not direct or indirect effects.

4.1.2.1 Residential sector bill savings

Long-term residential sector bill savings (approximately $52 million) were associated with a little over 283 additional job years over the life of the residential program measures. Household bill savings employment effects are modeled as induced effects (e.g., increased household spending on services), and the effects accrue to households in proportion to their share in the state. Households with annual incomes between $70,000-$100,000 contributed the largest number of total induced job years (52.50), in part because they are one of the largest household income brackets in the state, at 17% of all New Hampshire households (see Table 3-8). In terms of employment intensity (job years per $1 million in bill savings), households between $15,000 and $30,000 in annual income showed the highest intensity at 6.5 additional job years per $1 million, while households with over $200,000 in annual income showed the lowest intensity, at 3.37 per $1 million, as shown in Figure 4-5.

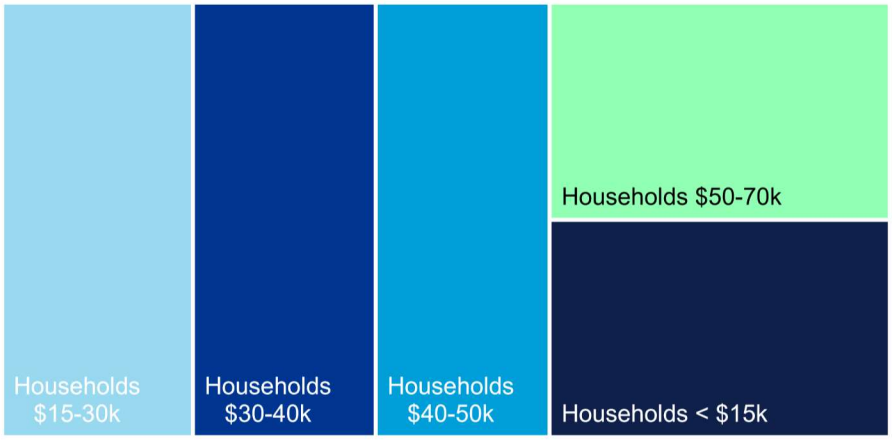
Figure 4-5. Projected employment effects of residential energy bill savings (job years per $1 million)[1]

[1] Residential bill savings were modeled as income gains for households. The figure reflects employment intensity, in job years per $1 million in residential customer bill savings, by annual household income bracket.

4.1.2.2 Low-income sector bill savings

Long-term low-income sector bill savings (approximately $8 million) were associated with a little over 47 additional job years over the life of these program measures. The largest number of total job years accrue to households with annual income between $50,000 and $70,000, again because they represent the largest share of low-income New Hampshire households (31% of low-income households, as shown in Table 3-8). As shown in Figure 4-6, employment intensity is relatively uniform across low-income household income brackets, with all brackets creating 5.8 and 6.5 job years per $1 million in bill savings.

Figure 4-6. Projected employment effects of low-income energy bill savings (job years per $1 million)[1]



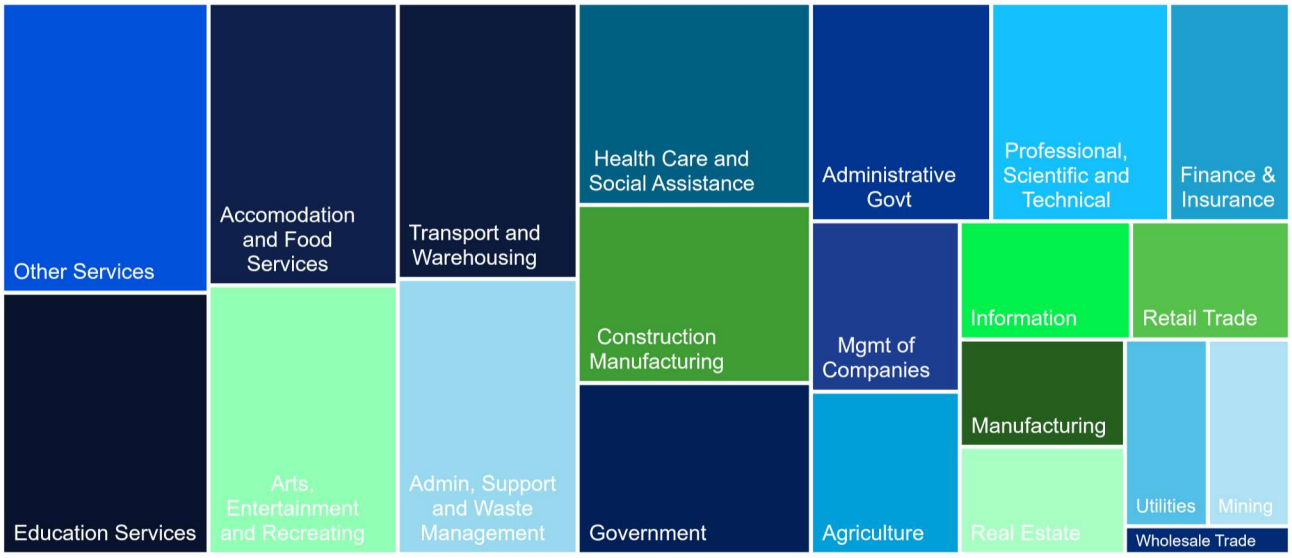
[1] Low-income bill savings were modeled as income gains for households. The figure reflects employment intensity, in job years per $1 million in low-income customer bill savings, by annual household income bracket.

4.1.2.3 C&I sector bill savings

Total C&I sector long-term bill savings of $158 million were associated with nearly 1,150 additional job years during the life of the program measures. Since the commercial and industrial sector savings were modeled as increases in industry production, the employment effects included direct (~698 job years), indirect (~176 job years) and induced (~275 job years) effects. Health care and social assistance sectors had the largest effects, with over 142 job years generated, followed by the

professional, scientific, and technical sector and the manufacturing sector at 124 and 104 job years, respectively. In terms of employment intensity, the other services sector had the highest intensity at 14.6 job years per $1 million in savings, followed by the education services sector at 13.17 job years per $1 million. The wholesale trade sector had the lowest intensity at 1.1 job years per $1 million. Figure 4-7 shows the distribution of employment effects across C&I sectors.

Figure 4-7. Projected employment effects of C&I energy bill savings, by sector (jobs per $1 million)[1]



Context and validation

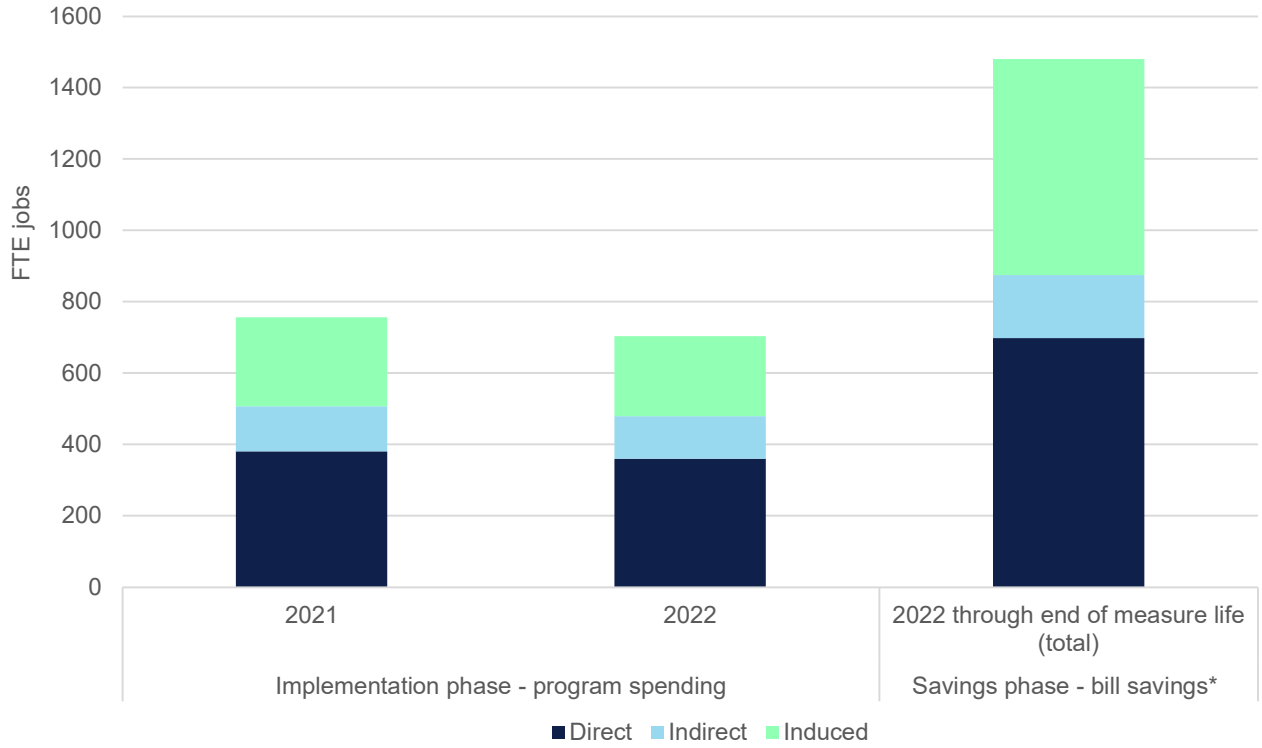
To validate our assumptions about estimating and allocating the economic effects of long-term energy bill savings, we reviewed literature and asked expert interviewees about the topic. Based on the interviews and literature, customer bill savings can get re-allocated in multiple ways, depending on the type of customer and their economic circumstances. Interviewee responses generally corroborate the assumptions and results of our IMPLAN modeling, and help illustrate the financial decisions New Hampshire households and businesses face. According to interviewees:

- Residential bill savings are typically allocated towards other household expenses but given the variability in energy prices and other costs, changing incomes, and changing patterns of home occupancy and working from home, savings from energy efficiency projects may be less noticeable to non-low-income homeowners.
- Low-income bill savings provide added resilience for residents who are resource constrained, and for whom relatively small changes in expenses can have disproportionate impact on daily activities and overall quality of life.
- Large business bill savings may be reallocated towards investment in more energy efficient equipment or toward companies' overall capital, maintenance, or operating budgets.
- Small business bill savings may be reallocated toward hiring or employee compensation, as well as investment in more energy efficient equipment or other budget items. Small business facing financial pressures may also use savings to reduce those pressures and avoid negative financial outcomes.

Across all sectors, interviewees told us that increased energy costs have shifted focus from proactively pursuing energy efficiency for environmental or other reasons toward reactively responding to increasing energy bills by looking for ways to reduce costs. This dynamic does not necessarily change how bill savings are allocated, but rather affects customers' motivations for seeking out and participating in energy savings programs.

Figure 4-8 provides a summary of the employment estimates for both phases (implementation and savings) analyzed in the study. The small decrease in program spending over the two years of the implementation period is reflected in the decline in program-related jobs. The aggregate bill savings would add another projected 1480 jobs over the savings phase, based on total customer bill savings over the useful life of the measures installed, per the NH Utilities' 2022-2023 plan filings.

Figure 4-8: Summary of Employment Estimates for NH Saves Programs and Bill Savings



*Savings phase employment effects represent total FTE job-years, estimated using the 2022 net present value of customer bill savings over the useful life of the energy efficiency measures installed through the NHSaves across two program years.

4.2 Other economic impacts

4.2.1 New Hampshire gross domestic product

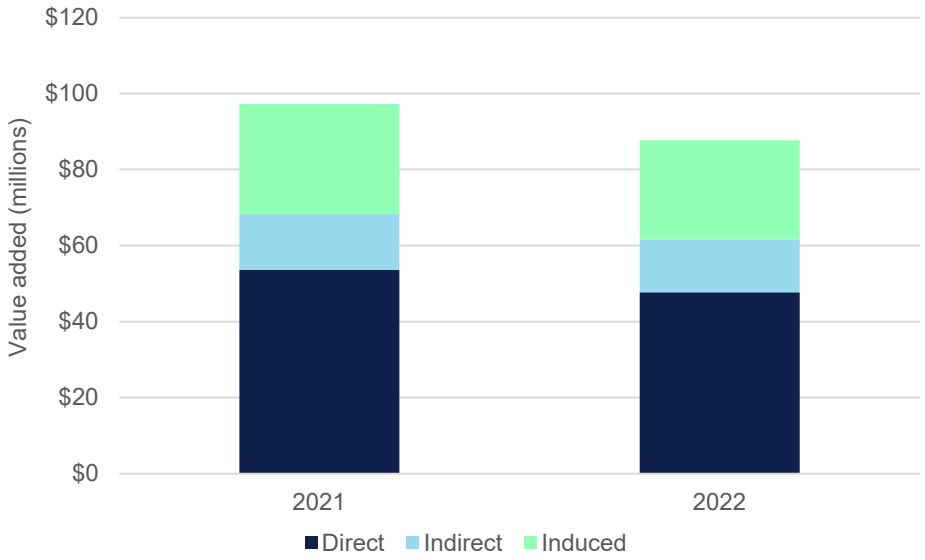
The total economic impact of NHSaves programs modeled in this study can be measured through the changes in value added estimates generated by IMPLAN. Value added reflects the programs' contribution to GDP[59] and is calculated as the total output net of intermediate inputs. As noted in the methodology section, we modeled each sub-program as a combination of output events which reflect direct effects accruing to a particular industry (e.g., spending flowing to HVAC manufacturers or wholesalers), which are then passed through different sectors in the form of indirect effects involving business-to-business transactions (e.g., spending on motors, wiring, etc. for HVAC equipment). Finally, the direct and indirect effects have associated induced effects in the form of increased consumer spending (e.g., restaurant meals, grocery purchases). The total value added reflects the cascading effects of all three levels of spending resulting from the programs.

It is important to note that value added is one way to measure GDP, and it is intricately interlinked with the other impacts measured in this report, including employment. These different metrics reflect the same underlying economic activity, which is the effect of the NHSaves program spending. The NHSaves programs overall added just over $97 million to state GDP

[59] Value added serves as a measure of contribution to the GDP. It is calculated as the total output net of all intermediate input costs. For more please see: https://support.implan.com/hc/en-us/articles/360017144753-Understanding-Value-Added-VA-

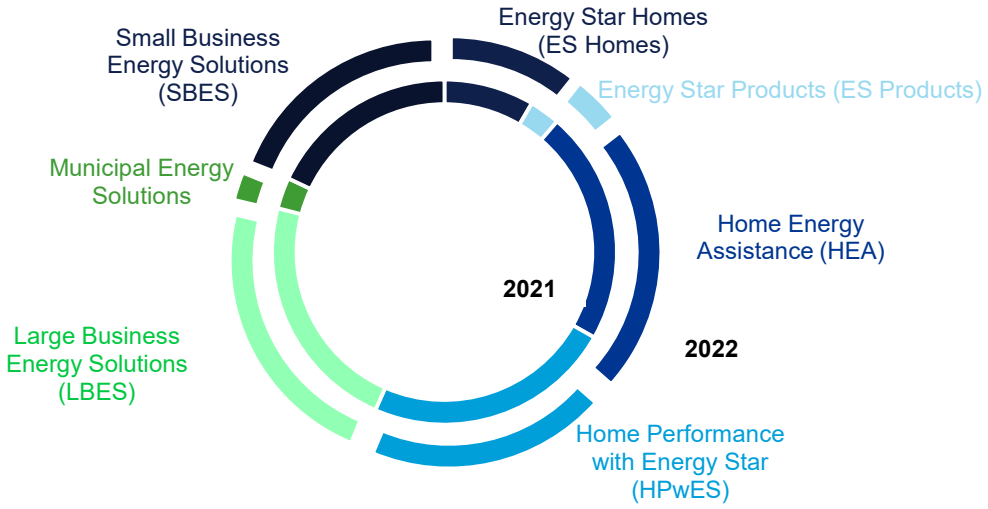
through their total direct, indirect, and induced effects in 2021, and over $87 million in 2022, as shown in Figure 4-9. These estimates reflect the conservative LPP scenario for the share of NHSaves-rebated equipment being purchased from in-state wholesalers and manufacturers. The value added amounts are 1.3 times the program spending in 2021 and 1.2 times the program spending in 2022. These results are generally consistent with impacts of other public programs on GDP, which typically have multiplicative effects whereby GDP grows by a factor of 1 or more times the amount of program spending.

Figure 4-9. NHSaves total value added as a contribution to New Hampshire GDP, 2021 and 2022



Since value added is a function of economic output across sectors, the total effect of each program is directly related to each program's budget, as well as the team's assumed material and labor cost distribution ratios for given programs. In both 2021 and 2022, the HPwES, HEA, and LBES programs had the largest contribution to the state's GDP, as shown in Figure 4-10.

Figure 4-10. NHSaves total value added as a contribution to New Hampshire GDP, 2021 and 2022, by program[1]



[1]2021 values are shown in the inner circle and 2022 values are in the outer circle.

4.2.2 State and local tax revenues

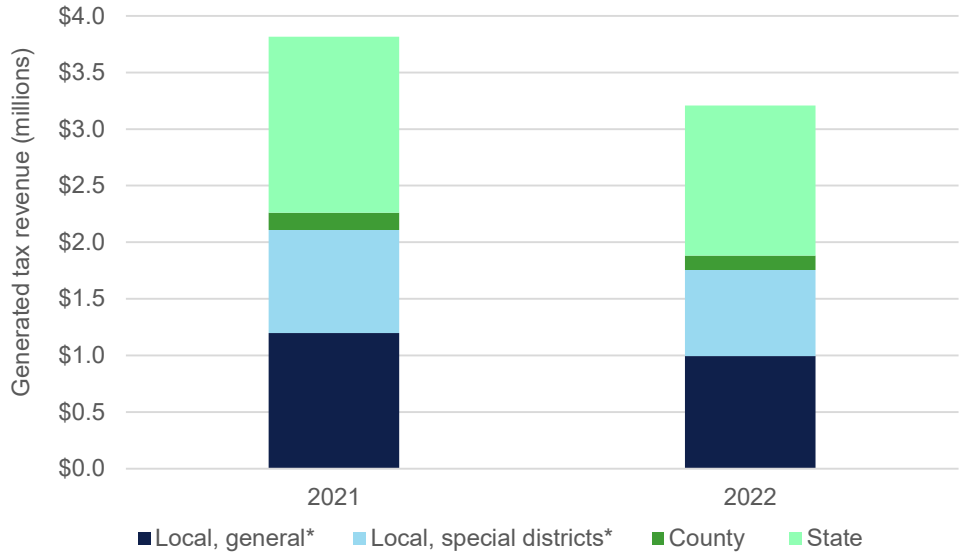
The team's I/O modeling also generated estimates of additional state and local tax revenues generated by the economic activity associated with NHSaves program spending, which are modeled according to New Hampshire's tax regime (e.g., no sales tax, limited income tax). Economic activity generated by the NHSaves programs and detailed in the above sections, such as increased industrial production, employee compensation, or business income, are in many cases taxable. The evaluation team focused on the state and local tax estimates generated for the sub-county, county, special districts, and state governments, and did not model federal tax revenues given the New Hampshire-specific scope of this study. It is important to note that the results for each level of government do not necessarily reflect the governments that levy the tax, but rather they reflect the governments to which the tax dollars ultimately flow.

The total estimated tax revenue generation for all NHSaves programs was about $3.8 million in 2021, and just over $3.2 million in 2022, as shown in Figure 4-11. These estimates reflect the conservative LPP scenario for the share of NHSaves-rebated equipment being purchased from in-state wholesalers and manufacturers. Of these total tax revenue amounts, rebate spending is responsible for approximately $900,000 in 2021 and just over $1 million in 2022, and administrative spending is responsible for the remainder. Administrative expense categories lead to a larger share of direct and indirect tax revenues than rebate spending for two reasons. First, administrative expenses are relatively more human capital-intensive than rebate spending because they reflect spending on managing and implementing programs, whereas rebate spending includes a larger portion of material spending. In addition, a larger share of administrative expenses are incurred in-state, relative to rebate spending. Since rebate spending includes material and out-of-state leakages, the tax revenue from rebates occurs through indirect and induced impacts.

Given New Hampshire's unique taxation structure, most of the tax gains arise from indirect and induced effects. This is because the largest transactions flowing from program funding are the direct purchases of materials (e.g., HVAC measures), and New Hampshire has no sales tax on those transactions, which would show up as direct effects. Primary categories of tax revenues include employer and employee contributions to social insurance taxes, and property taxes.[60] Some of the other tax categories modeled in the software such as taxes on production and imports are applicable but are tied to indirect effects transactions. Other tax categories, such as property taxes, apply to programs' induced effects. For example, property taxes reflected the largest share of tax revenues from the LBES program. Figure 4-12 shows the tax revenue generated by NHSaves at each level of government, by program.

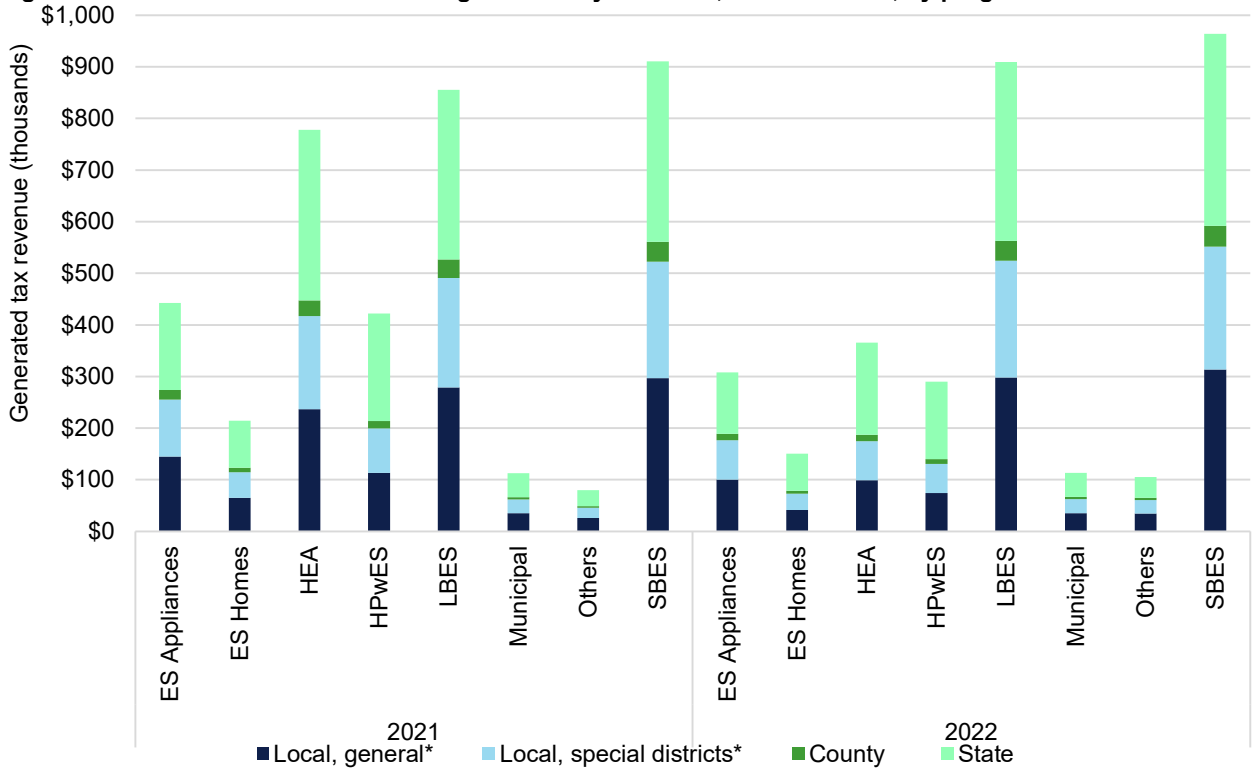
[60] Social insurance taxes include taxes for state government retirement programs, state unemployment taxes, workers' compensation, Medicaid, as well as other federal programs (not modelled in the results presented here), such as Federal Insurance Contributions Act, the Children's Health Insurance Program, Federal Insurance Contributions Act, Federal Unemployment Tax Act, Medicare, military medical, Old Age, Survivors and Disability Insurance, and others. Please see: https://support.implan.com/hc/en-us/articles/360041584233-Taxes-Where-s-the-Tax-

Figure 4-11. State and local tax revenue generated by NHSaves programs, 2021 and 2022



*Local reflects all sub-county level taxes, including general municipal taxes and special districts such as those related to water or transportation infrastructure or other public services.

Figure 4-12. State and local tax revenue generated by NHSaves, 2021 and 2022, by program



*Local reflects all sub-county level taxes, including general municipal taxes and special districts such as those related to water or transportation infrastructure or other public services.
**Other programs include C&I and residential active demand response, education, and behavior (Home Energy Report) programs.

4.2.3 Value of health benefits

The team modeled the estimated monetary value of avoided healthcare costs for New Hampshire citizens from emissions reductions resulting from the NHSaves programs in 2021, as shown in Table 4-4. COBRA outputs a low and high estimate, each at a 3% and 7% discount rate. The low and high estimates reflect the use of different underlying epidemiological studies, particularly on the mortality impacts of PM2.5.[61] The total value ranges from just over $68,000 to over $153,000 at a 7% discount rate and approximately $76,000 to just over $172,000 at a 3% discount rate.

Table 4-4. Estimated annual monetized NH benefits in 2021 (NH only)

Program[1]	Monetary Value (dollars, annual)			
	Low (3%)	High (3%)	Low (7%)	High (7%)
NHSaves Electric Programs	$40,867	$92,260	$36,458	$82,258
NHSaves Gas Residential Programs	$29,059	$65,622	$25,927	$58,510
NHSaves Gas Commercial Programs	$6,393	$14,433	$5,704	$12,868
Total	**$76,319**	**$172,315**	**$68,089**	**$153,636**

[1]Electric program benefits are based on reduced emissions from grid electricity, regardless of the type of end user. In contrast, gas program benefits result from end use combustion, which differs by the type of end user (residential or C&I).

Air pollution does not stop at state boundaries, so the evaluation team also analyzed the avoided healthcare costs for citizens in the entire contiguous United States resulting from emissions reductions attributable to the NHSaves programs. The majority of these benefits would be experienced by citizens of neighboring states; the effects of pollution decreases the farther away from the source one travels. These estimates are substantially greater than the NH-only estimates because many more people would be affected. The savings at a 7% discount rate range from just under $649,000 to almost $1.5 million. The savings at a 3% discount rate range from $727,000 to over $1.6 million.

Table 4-5. Estimated annual monetized NH benefits in 2021 (contiguous US)

Program[1]	Monetary Value (dollars, annual)			
	Low (3%)	High (3%)	Low (7%)	High (7%)
NHSaves Electric Programs	$613,199	$1,383,382	$547,166	$1,233,551
NHSaves Gas Residential Programs	$92,249	$208,245	$82,314	$185,693
NHSaves Gas Commercial Programs	$21,558	$48,669	$19,236	$43,399
Total	**$727,006**	**$1,640,296**	**$648,716**	**$1,462,643**

[1]Electric program benefits are based on reduced emissions from grid electricity, regardless of the type of end user. In contrast, gas program benefits result from reduced end use combustion, which differs by the type of end user (residential or C&I).

It is important to note that these modeling results reflect the impacts of one year of savings from the measures installed during the 2021 program year. As noted in the 2022–2023 plan filings, many of these measures last for close to two decades—the average measure life was 12.2 years for 2022 planned electric measures, and 16.6 for 2022 planned gas measures. The modeling results do not reflect the full impacts of the savings from those measures over their useful lives, which would be significantly larger than the values shown for 2021. However, due to the limitations in the AVERT and COBRA models described in Section 3.4, the team presents the one-year annual values only.

More detailed breakouts of the health benefits are provided in APPENDIX C. AVERT AND COBRA METHODS AND DETAILED RESULTS.

[61] The low estimates are based on the mortality impacts of PM2.5 evaluated by the American Cancer society, whereas the high values reflect the results from the Harvard six-city mortality study. Rather than using an average, the model presents results from both studies. See Fine particulate matter and mortality: a comparison of the six cities and American Cancer Society cohorts with a medicare cohort - PubMed (nih.gov).

4.3 Context and sources of uncertainty

4.3.1 Regulatory and funding uncertainty

The NHSaves programs experienced uncertainty and funding instability during the 2021 and 2022 period modeled in this study. The evaluation team did not quantify the associated economic impacts in the I/O modeling presented in this study, but based on expert interviews, the program uncertainty and instability in funding levels dampened the economic benefits of the programs. Specifically, in December 2020, the Commission ordered the 2021 programs to operate at 2020 funding levels rather than the higher levels proposed in the 2021–2023 plan, until the Commission could fully consider the plan.[62] Then, in November 2021, the Commission issued an order denying the 2021-2023 plan and ordering a steady, significant reduction in program funding starting in 2022.[63] Although the funding reductions were partially restored in 2022, the Commission's decision limited the flow of funding and initiation of new projects for much of 2022, impacting workforce and customer decisions.

The evaluation team interviewed officials at 10 organizations with expertise and knowledge of the NHSaves programs to provide context and insights on the impacts of these decisions. Several key themes emerged from these discussions:

- **Workforce disruption.** Almost all interviewees cited workforce disruptions caused by the decisions. Several noted that the 2021–2023 plan had originally included significant increases in program funding and savings goals, and that despite some uncertainty around the plan due to COVID-19 and other factors, they prepared for anticipated increases by hiring or otherwise ramping up in advance of the 2021 program year. This ramp up exacerbated the impact of the subsequent decisions, which, according to the interviewees, in some cases, led to unanticipated layoffs of contractor or other staff, most notably in the low-income programs. One interviewee noted that the disruptions were more acutely felt by vendors specializing in energy-efficient equipment—e.g., weatherization and LED lighting providers—and less acutely felt by HVAC or other vendors who provide equipment that customers need regardless of whether there is an energy efficient version available. The disruptions also created ongoing challenges in business planning and investment decisions. As one vendor we interviewed noted, contractors need advance knowledge of program funding levels and goals so they can deliver them consistently throughout the year, and uncertainty undermines trust between the trade ally workforce and the program administrators. Several interviewees also noted that firms are recovering from these disruptions but that it takes longer to recover than it did to lose workforce.
- **Customer impacts.** Most interviewees we spoke with cited customer impacts caused by the decisions as well. For customers with projects that were in progress at the time of the decisions, many of the projects were put on hold, some of them indefinitely, according to interviewees. Additionally, in the absence of consistent and reliable funding availability, the NH utilities could not recruit or enroll customers who would have otherwise considered participating in NHSaves programs. As one interviewee said, “It was almost impossible for the utilities to be out there promoting and selling programs, because they didn’t know what they were selling.” The impacts varied depending on the types of projects and customers as follows, according to interviewees.
    - **For small businesses pursuing projects with the promise of program funds**, they often may have had to stop projects such as lighting retrofits, possibly indefinitely. For HVAC or other project types, such customers may have gone ahead with standard efficiency models, rather than high efficiency models.
    - **Large customers can face project financing challenges** due to their multi-layered financing arrangements and capital planning processes. For instance, interviewees involved in developing affordable housing and community buildings for economic development projects said that they use a combination of NHSaves incentives along with

[62] DE 20-092, 2021-2023 NEW HAMPSHIRE STATEWIDE ENERGY EFFICIENCY PLAN, Order Approving Short-Term Extension of 2020 Energy Efficiency Programs and System Benefits Charge Rate, Order No. 26,440, December 29, 2020
[63] DE 20-092, 2021–2023 Triennial Energy Efficiency Plan Order on 2021–2023 Triennial Energy Efficiency Plan and Implementation of Energy Efficiency Programs, Order No. 26,553, November 12, 2021

grant funding, tax subsidies, loans, and other sources to fund projects. These funding sources are inter-related and predictable timing is very important in planning and assembling financing for these projects. For instance, one interviewee said they apply for competitive public funding for affordable housing, and promised funding from NHSaves improves their chances of getting selected. In other cases, grant or other sources require applicants to assess energy savings opportunities and/or identify matching funds for energy improvements, which NHSaves provides. If they think they have this funding and then it falls through, they can end up with a large hole in the budget that risks the overall project's success. One interviewee that develops such projects estimated that 23 (about half) of their ongoing projects, involving a total of over $1 million in incentives, were moderately or significantly impacted by the 2021 decision. A large industrial participant we interviewed said that they fund projects during their annual capital planning season, and having uncertainty or lack of program funding available during that period means they must forgo savings opportunities and lose out on rebates. They estimated that the recent decisions caused them to lose out on over $200,000 in rebates.

Since the period of these decisions, legislation was enacted providing greater stability and certainty regarding the continued funding of the NHSaves programs.[64] However, a subsequent Commission investigation into NHSaves planning, programming, and evaluation raised concerns among stakeholders and trade allies that they would see continued uncertainty and instability in levels of program activity.[65] In addition, the NH Utilities noted that program vendors are still hesitant to commit to program activities in some cases because, although the Utilities understand that the legislation provides more certainty going forward, the vendors do not necessarily believe that to be the case. Further attempts to estimate the economic impacts of the NHSaves programs will require careful analysis of how these ongoing regulatory activities influence workforce and customer expectations and decisions.

4.3.2 In-state and out-of-state impacts

In response to the Commission's directive to adjust for out-of-state expenditures in estimating the economic impacts of the NHSaves programs, the evaluation team reviewed and analyzed data on the NH Utilities' 2021 spending on outside contractors and consultants obtained from recent filings,[66] as described in Section 3.1.1. Using these data, the team estimated the share of non-rebate spending flowing to out-of-state contractors and consultants (rebate spending is assumed to flow solely to NH customers, per program requirements), based on their business address provided by the NH Utilities. However, as the NH Utilities noted in their filings, the business address of a given contractor or consultant does not necessarily reflect the location of the individual(s) working with the programs, and multiple contractors that receive significant program funding and are listed as being out-of-state businesses based on their corporate address employ New Hampshire-based staff who work for the programs.

To account for this in the I/O modeling, the evaluation team ran a sensitivity analysis of economic impacts using two assumptions for the share of program spending that flows from businesses with out-of-state corporate addresses back to New Hampshire-based employees of those businesses: 25% and 50%, as shown in Table 4-6. It is important to note that the far more influential factor for modeling the in- and out-of-state flows of program funding is the LPP.[67] As the results presented in Section 4.1.1 show, the modeled job intensity of the NHSaves programs with conservative LPP assumptions was about 10 jobs per $1 million in 2021 and 2022, but over 14 jobs per $1 million in both years under the more aggressive

[64] HOUSE BILL 549, Signed by Governor Sununu, Feb. 24, 2022
[65] IR 22-042, Investigation of Energy Efficiency Planning, Programming, and Evaluation ORDER OF NOTICE, Aug 10, 2022
[66] NHPUC Docket No. IR 22-042 11-01-2022 IR Requests, Attachment RR 1-006B; NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Report 3.1
[67] LPP indicates the share of the economic effect of rebated measures that will be retained within the region being examined (e.g., New Hampshire). As detailed in Section 3.2.2, LPP ratios represent the extent to which the IMPLAN model assumes commodities are purchased from in-state manufacturers or wholesalers.

LPP assumption. In contrast, the assumed percentage of pass-through to New Hampshire-based employees changes job intensity by less than 1 job per $1 million between the two scenarios modeled and presented in Table 4-6.

Table 4-6. Non-rebate contractor and consultant expenses to out-of-state recipients[1]

Assumed share of out-of-state spending passed through to New Hampshire-based employees	2021		2022	
	Total jobs generated	Jobs per $1 million in program costs	Total jobs generated	Jobs per $1 million in program costs
25% passed to New Hampshire-based employees	698.59	9.35	664.35	9.43
50% passed to New Hampshire-based employees	755.97	10.12	703.30	9.98

[1]Employment effects in this table are modeled with a conservative LPP (=RPC) assumption. See Section 3.2.2 for details.

4.3.2.1 Context and explanatory factors

In addition to the modeling results, the experts interviewed provided context and insights on the inter-state impacts of the programs. One overarching issue raised in the interviews was that New Hampshire has significant out-of-state expenditures on supply-side resources, and that these expenditures should be considered alongside any analysis of out-of-state expenditures on energy efficiency resources. Despite being a net electricity exporter, New Hampshire relies heavily on imports of other sources of energy—particularly fossil fuels for heating and transportation. Specifically, according to EIA data from 2022, New Hampshire does not produce fossil fuels, and over $2 billion flowed out of the state for energy imports across all fuels and end uses.[68] Further analysis of the in- and out-of-state economic impacts of energy supply expenditures would provide context for the results of our analysis but was not feasible within the timeframe of this study.

With regard to local workforce, interviewees said that the vast majority of installation contractors are based in-state, particularly for weatherization projects. However, multiple interviewees noted that NH is a relatively small state with a large population close to the state's borders, providing significant opportunities for neighboring states' contractors to work in NH, and vice versa. There were several recurring themes on the use of out-of-state contractor workforce by the programs, as follows:

- **Sources of out-of-state contractor workforce.** Program vendors and large customers we interviewed said that Massachusetts is the largest source of out-of-state workforce (and materials) for the NHSaves programs, and that it has a substantial and well-trained energy efficiency workforce that includes specialized firms not always available in-state. Other jurisdictions providing workforce for NHSaves mentioned by interviewees include Maine (particularly near the Seacoast area) and Canada, where contractors are drawn to NH because the exchange rate is highly favorable for working in the U.S. and getting paid in dollars.
- **Types of firms coming from out-of-state.** According to the experts interviewed, the types of firms that are most frequently New Hampshire-based include weatherization contractors, construction management firms, and general contractors. The types of firms most commonly based in other states are specialized firms with expertise in complex custom projects and controls measures. Interviewees also said that there is a relatively large population of in-state contractors for small business projects, but there are many regional firms providing commercial lighting, HVAC, and refrigeration as well. They also said larger industrial equipment often comes from out-of-state.
- **Drivers of out-of-state contractor workforce**. Interviewees said that a key reason for the need for out-of-state contractors is that states face competition for workforce, and neighboring states have larger, more well-funded programs that over time have led to growth in the contractor workforce in those states. They also said that there are certain equipment types where higher levels of program support and customer adoption have led to growth in the workforce for those technologies neighboring states. For instance, one interviewee said that NH has a large base of

[68] EIA data shows total energy expenditures of $4.6 billion, total consumption of 296 trillion Btu, and total in-state energy production of 149 trillion Btu. U.S. Energy Information Administration, New Hampshire State Energy Profile, updated Sept 2022. https://www.eia.gov/state/print.php?sid=NH.

HVAC contractors, but that contractors with expertise in heat pumps often come from neighboring states with more widespread heat pump adoption.

Interviewees mentioned several other issues related to the flow of workforce and program spending between states.

- **The NH workforce benefits from other states' programs**. One interviewee who is currently an NHSaves vendor had previously worked for the Mass Save programs while living in NH, during which time he completed numerous training courses and earned a BPI certification. This education and training were largely funded by the MA programs but provided a foundation for the interviewee's current work for NHSaves.
- **NHSaves can enhance local workforce recruitment**. One agency official we interviewed said that when recruiting businesses to move to New Hampshire, particularly from Canada, they are often concerned by the state's high energy costs. He said that programs such as NHSaves that can help businesses manage energy costs are a key part of the business recruitment "sales pitch."

4.3.3 Long-term impacts

As noted in the New Hampshire Cost Effectiveness Review,[69] I/O modeling is best suited for relatively short-term analysis. Longer term economic impacts (beyond 5 years) are highly uncertain due to a variety of factors, and I/O models as well as EPA's COBRA and AVERT models are based on current economic and energy structures. Large government programs can lead to potential shifts in industry structures which cannot be factored into current I/O matrices. Other structural changes could include, for example, pandemics such as COVID-19 leading to fundamental shifts in building usage affecting the impact of residential and commercial energy efficiency investments, as well as international economic disruptions and military conflicts affecting energy markets. Such changes are highly difficult to anticipate, predict, and model.

However, the evaluation team conducted several analyses that shed light on the Commission's directive to assess the impact of different discount rate assumptions, and to account for the economic activity and energy consumption resulting from future cost savings. These impacts occur specifically during the savings phase of the programs, after energy efficiency measures are installed and result in (1) energy use reductions and corresponding health benefits as discussed in Section 4.2.3, and (2) bill savings that is re-allocated to other spending, creating economic impacts as discussed in Section 4.1.2.

4.3.3.1 Rebound effects

The evaluation team's IMPLAN modeling accounted for the economic activity resulting from future cost savings, as part of the bill savings modeling task as detailed in Section 3.2.3. Specifically, the team's modeling of long-term bill savings treated residential savings as additional household income, which results in employment gains through induced economic activity (e.g., household spending on services, recreation). Modeling of C&I sector bill savings assumed those savings are redirected towards additional industry activity, resulting in additional economic output.

However, the modeling did not account for secondary energy consumption related to this additional economic activity—also known as the "rebound effect" or "'macroeconomic growth effect." As described by Gillingham et al (2015), "the basic premise is that an increase in the efficiency of energy-consuming durables may spur economic growth—and that economic growth requires additional energy consumption."[70] There are multiple theoretical pathways through which this effect occurs, but empirical estimates of its effect are limited and there are steep challenges in developing such estimates. A review of research on the topic described such challenges:[71]

> "For the last century, we have seen large increases in both energy use and the energy efficiency of many durable goods. But in order to claim a causal relationship between energy efficiency and energy use, it must be shown that energy

[69] https://www.puc.nh.gov/Regulatory/Docketbk/2017/17-136/LETTERS-MEMOS-TARIFFS/17-136_2019-10-31_STAFF_NH_COST_EFFECTIVENESS_REVIEW.PDF
[70] Gillingham, K, Rapson, D, and Wagner, G. (2015, September 25). The Rebound Effect and Energy Efficiency Policy, Review of Environmental Economics and Policy, Yale University and the National Bureau of Economic Research. Retrieved March 1, 2023, from https://resources.environment.yale.edu/gillingham/GillinghamRapsonWagner_Rebound.pdf
[71] Ibid

consumption has not increased due to some other factor. …In fact, it is extremely difficult, if not impossible, to separate the effect of energy efficiency improvements from exogenous economic growth and the simultaneous dramatic improvements in energy services."

Similarly, a PERI study of clean energy investments in Maine noted that although increased energy efficiency can result in rebound effects, these effects are likely to be modest in advanced economies where there is already high saturation in energy-using equipment. For example, the study notes that homeowners are not likely to clean dishes more frequently because they have more efficient dishwashers, and although consumers may heat and cool their homes and drive their cars somewhat more given higher levels of efficiency, these increases are modest in advanced economies.[72] In another example, research on the Massachusetts Home Energy Services weatherization program found little evidence of rebound, with about half of participants reporting no changes in cooling and heating setpoints following weatherization of their homes. Among those who did change setpoints, the vast majority reported doing so in a way that would reduce consumption (i.e., higher cooling and lower heating setpoints).[73] Attempting to quantify the rebound effect for the NHSaves programs would require more rigorous analysis that is beyond the scope of this review.

4.3.3.2 Discount rate assumptions

For the customer bill savings analysis, the team relied on the bill impacts values as filed by the utilities. As noted in Section 3.1.2, the values reflect long-term revenue requirement changes that use the same discount rate assumptions as in the B/C model filed with the 2022–2023 plan, shown in Table 4-7. Re-modeling the bill and rate impacts of the plan under different discount rate assumptions was not feasible within the timeframe of this study.

Table 4-7. Discount rate assumptions for customer bill savings analysis

Rate	Value	Source
Nominal Discount Rate	3.25%	Updated October 18, 2021. Based on the June 2021 Prime Rate in accordance with the Final Energy Efficiency Group Report, dated July 6, 1999 in DR 96-150
Inflation	2.03%	Updated October 18, 2021. Based on the inflation rate from Q1 2020 to Q1 2021, per the Federal Reserve Bank of St. Louis
Real Discount Rate	1.19%	Real Discount Rate = [(1 + Nominal Discount Rate)/(1 + Inflation Rate)] – 1

Source: NH Utilities' B/C and Bill and Rate Impacts models for 2022-2023 plan.

For health impacts analysis, we applied the 3% and 7% discount rates built into COBRA, which are reflected in the results as presented in Section 4.2.3. Further discount rate sensitivity analysis for health impacts was also not feasible within the timeframe of this study.

Implementation phase impacts, including employment and other economic impacts, are generally incurred in the same period as the program dollars were spent (2021 and 2022), and the team determined that discounting was not appropriate for these impacts. The team assumes dissipation of these impacts once those years' dollars are spent, an assumption that was validated by our interviews with experts, who widely cited direct workforce disruptions resulting from program funding reductions.

Although comprehensive sensitivity analyses of discount rate assumptions were not feasible within the timeframe of this study, the results suggest that modelled program impacts are less sensitive to discount rate assumptions than to other underlying assumptions. For instance, the value of the health impacts presented in Section 4.2.3 above decrease by about 11% when moving from a 3% discount rate to 7% discount rate. By comparison, the value of the health impacts presented above increases by about 125% between the "low" and "high" scenarios that reflect the two different underlying

[72] Pollin, R., Wicks, J., Chakraborty, S., & Semieniuk, G. (2020, August 27). PERI - A Program for Economic Recovery and Clean Energy Transition in Maine. Political Economy Research Institute. Retrieved February 14, 2023, from https://peri.umass.edu/component/k2/item/1339-a-program-for-economic-recovery-and-clean-energy-transition-in-maine

[73] Navigant. Massachusetts Home Energy Services Realization Rate Assessment (RES 39), Mar. 2020 https://ma-eeac.org/wp-content/uploads/MA-RES-39-HES-RR-Assessment-Executive-Summary_FINALwES_19MAR2020.pdf

epidemiological studies on the mortality impacts of PM2.5.[74] Similarly, the NH Utilities' filings[75] of B/C model results under different discount rate assumptions show that statewide, the programs' GST benefits decrease by about 12% when moving from the 1.41% real discount rate used in the plan to a 3% real discount rate, and they decrease by 15% when moving from a 3% to 5.5% real discount rate. Other sensitivity analyses presented in this report, such as employment effects under conservative and aggressive LPP scenarios, show larger changes in results due to differing assumptions.

4.4 Results comparison

I/O models have been deployed in different contexts to assess the employment effects of energy efficiency and other types of energy services programs. Studies have also examined the impacts of large scale federal and state level programs on macroeconomic indicators such as GDP and employment. For example, a 2020 study by PERI[76] estimates the effects of economic stimulus measures in the US economy and concludes that investments of about $600 billion per year over 10 years would create 4.6 million jobs per year in infrastructure and 4.5 million jobs in the clean energy sector. In addition, the study also concludes that public investments in these programs will stimulate private investments worth $300 billion which would result in another 4.5 million jobs. In a similar analysis in the state of Maine, the group concludes that an average annual investment of $2.2 billion in the state would create 15,000 jobs per year.[77]

Table 4-8 provides a comparison of results from recent studies that used I/O modeling to analyze the employment impacts of regional and state-specific energy programs. Differences in scope, jurisdiction, and the type of programs analyzed should be considered in comparing results.[78] For instance, most nationwide studies reflect a higher job intensity compared to region- or state-specific studies. Nationwide studies in the US have typically estimated job intensities in the range of 10 to 15 jobs per $1 million in program investment, as shown Table 4-8. In state-specific studies, these numbers range from about 6 to 12 jobs per million. The results of the team's analysis of the NHSaves programs—around 10 jobs per million in 2021 and 2022 in the conservative LPP scenario—are closer to the higher end of the range of results of state specific analyses. In the more aggressive LPP scenario, the numbers are higher at over 14 jobs per million in both years—closer to the estimates from nationwide studies.

[74] The low estimates are based on the mortality impacts of PM2.5 evaluated by the American Cancer society, whereas the high values reflect the results from the Harvard six-city mortality study. Rather than using an average, the model presents results from both studies. See Fine particulate matter and mortality: a comparison of the six cities and American Cancer Society cohorts with a medicare cohort - PubMed (nih.gov).

[75] NHPUC Docket No. IR 22-042 2021 Program Year Compliance Filing Order No. 26,621, Attachment RR 1-001C, December 16, 2022.

[76] Pollin, R., & Chakraborty, S. (2020). Job creation estimates through proposed economic stimulus measures. *Political Economy Research Institute (PERI)*. Available at https://peri.umass.edu/publication/item/1297-job-creation-estimates-through-proposed-economic-stimulus-measures

[77] Pollin, R., Wicks-Lim, J., Chakraborty, S., & Semieniuk, G. (2020). A program for economic recovery and clean energy transition in Maine. *Amherst: Political Economy Research Institute Research Report, University of Massachusetts Amherst*

[78] In addition, the evaluation team's analysis presented in this report reflects the most granular, measure-specific review of energy efficiency program economic impacts among the literature we reviewed. The analyses in comparison studies were largely conducted at the aggregate economy level. Most studies do not examine the effects of specific program measures in the way this analysis does.

Table 4-8. Comparison economic impact studies[79]

Title	Authors	Year	Publisher/ Journal	Jurisdiction	Approach	Industry	Jobs per $1 million	URL
Job Creation Estimates for Colorado Through Inflation Reduction Act	Pollin, R., Chakraborty, S., Lala, C., Semieniuk, G.	2022	PERI	Colorado	IMPLAN		9.2	Link
State-Level Employment Projections for Four Clean Energy Technologies	Truitt, S., Elsworth, J., Williams, J., Keyser, D., Moe, A., Sullivan, J. Wu, K.	2022	NREL	USA	IMPLAN		6.04	Link
Employment Impacts of Proposed U.S. Economic Stimulus Program: Job Creation, Job Quality, and Demographic Distribution Measure	Pollin, R., Chakraborty, S., Wicks-Lim, J.	2021	PERI	USA	IMPLAN	Building Retrofits	13.4	Link
						Industrial Efficiency	14.2	
A Program for Economic Recovery and Clean Energy Transition in California	Pollin, R., Wicks-Lim, J., Chakraborty, S., Kline, C., Semieniuk, G.	2021	PERI	California	IMPLAN	Building Retrofits	7.7	Link
						Industrial Efficiency	5.7	
						Grid Upgrades	5.1	
Impacts of the Reimagine Appalachia & Clean Energy Transition Program for Pennsylvania	Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G.	2021	PERI	Pennsylvania	IMPLAN	Building Retrofits	8.8	Link
						Industrial Efficiency	6.7	
						Grid Upgrades	6.9	
Impacts of the Reimagine Appalachia & Clean Energy Transition Program for West Virginia	Wicks-Lim, J., Robert, P., Chakraborty, S., Semieniuk, G.	2021	PERI	West Virginia	IMPLAN	Building Retrofits	7.7	Link
						Industrial Efficiency	3.6	
						Grid Upgrades	4.6	
Estimating employment from energy-efficiency investments	Brown, M., Soni, A., Li, Y.	2020	*MethodsX*	USA	IMPLAN	Residential	12.55	Link
						Commercial	12.64	
Energy Efficiency 2020	IEA	2020	IEA	USA	Publicly available data	Building Retrofits	14.8	Link
						Efficient New Buildings	15	
						Industry Efficiency	10	

[79] Natanael Pabon-Trinidad, an MPA student in the Department of Public Administration at Louisiana State University contributed in compiling this Table.

Title	Authors	Year	Publisher/ Journal	Jurisdiction	Approach	Industry	Jobs per $1 million	URL
A Program for Economic Recovery and Clean Energy Transition in Maine	Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G.	2020	PERI	Maine	IMPLAN	Building Retrofits	11.8	Link
						Industrial Efficiency	8.1	
						Grid Upgrades	6.9	
Impacts of the Reimagine Appalachia & Clean Energy Transition Program for Ohio	Pollin, R., Wicks-Lim, J., Chakraborty, S., Semieniuk, G.	2020	PERI	Ohio	IMPLAN	Building Retrofits	9.7	Link
						Industrial Efficiency	7.6	
						Grid Upgrades	7.4	
Maryland Benefits: Expanding the Results of EmPOWER Maryland through 2015	Baatz, B., Barrett, J.	2017	ACEEE	Maryland	Publicly available data		13.2	Link
Green versus Brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model	Garrett-Peltier, H.	2017	*Economic Modeling*	USA	I-O Models	Weatherization	8.21	Link
						Home Weatherization	7.41	
						Commercial Retrofits	7.26	
						Industrial Energy Efficiency	7.41	
						Smart Grid	6.76	
The job generation impacts of expanding industrial cogeneration	Baer, P., Brown, M., Kim, G.	2015	*Ecological Economics*	USA	IMPLAN	Industrial Cogen	14.48	Link
Verifying Energy Efficiency Job Creation: Current Practices and Recommendations	Bell, C., Barrett, J., McNerney, M.	2015	ACEEE	USA	IMPLAN		5 to 11	Link
Green Growth: A U.S. Program for Controlling Climate Change and Expanding Job Opportunities	Pollin, R., Garrett-Peltier, H., Heintz, J., Hendriks, B.	2014	Center for American Progress/PERI	USA	IMPLAN		14.6	Link
Analysis of Job Creation and Energy Cost Savings From Building Energy Rating and Disclosure Policy	Burr, A., Majersik, C., Stelberg, S.	2012	PERI/IMT	USA	IMPLAN	Multifamily Capital Upgrades (weighted)	13.41	Link
						Commercial Capital Upgrades (weighted)	12.94	

Title	Authors	Year	Publisher/ Journal	Jurisdiction	Approach	Industry	Jobs per $1 million	URL
Employment Estimates for Energy Efficiency Retrofits of Commercial Buildings	Garrett-Peltier, H.	2011	PERI	USA	IMPLAN		13.6	Link
The Economic Benefits of Investing in Clean Energy: How the economic stimulus program and new legislation can boost U.S. economic growth and employment	Pollin, R., Heintz, J., Garrett-Peltier, H.	2009	PERI/Center for American Progress	USA	IMPLAN	Building Retrofits	11.9	Link
						Smart Grid	8.9	

5 CONCLUSIONS AND CONSIDERATIONS FOR NEW HAMPSHIRE

Based on the analysis and results presented above, the 2021 and 2022 NHSaves programs had significant positive economic impacts on New Hampshire's economy, including short-term and long-term employment effects, increased state GDP, state and local tax revenues, and monetized public health benefits.

It is important to note that these quantified impacts are best estimates, which reflect underlying assumptions and limitations in modeling tools and data. The team documented these assumptions and limitations and presented ranges of estimates throughout the report that include conservative and aggressive assumptions for in-state impacts and other factors. Despite some amount of imprecision, which is inherent in economic modeling, the scale and scope of quantified impacts provides clear evidence of the economic benefits of the programs. In addition, as described in the National Standard Practice Manual,[80] jurisdictions "should account for all relevant, substantive impacts (as identified based on policy goals), even those that are difficult to quantify and monetize. Using best-available information, proxies, alternative thresholds, or qualitative considerations to approximate hard-to-monetize impacts is preferable to assuming those costs and benefits do not exist or have no value."

In addition to quantitative modeling, the team's interviews with officials from multiple organizations with expertise and knowledge of the NHSaves programs validate the importance of the programs in supporting and growing the local workforce and in providing New Hampshire businesses and residents with funding to support energy efficiency investments. The value of the programs can be seen in part by the disruptions to local workforce and customers that occurred when the programs' continuity became uncertain. The programs also provide a tool for workforce recruitment and retention that can help New Hampshire compete with surrounding states that offer similar state-wide energy efficiency programs.

5.1 Further research

There are several areas of analysis covered in this study that were limited due to schedule and scope constraints, summarized in the list below, which could be explored in greater depth. This could include primary New Hampshire data collected from customers and other market actors via surveys, interviews, or other methods to validate and expand on the team's modelling results, while considering tradeoffs between costs, rigor, and value of additional research.

- Analysis of inter-state workforce effects of the NHSaves programs, to help quantify the qualitative insights from expert interviews on workforce competition and use of in- and out-of-state contractor workforce
- Updating health impacts analysis for future program years to reflect updated ISO-NE data on electricity generation mix and updated demographic data underlying epidemiological models
- Further analysis of long-term customer bill savings and discount rate sensitivity analyses, to provide additional insight in response to the Commission
- Analysis of secondary energy consumption related to economic activity spurred on by the NHSaves programs—also known as the "rebound effect"—to provide additional insight in response to the Commission.

[80] The NSPM is a publication of the National Efficiency Screening Project (NESP), which works to improve cost-effectiveness assessments of customer-funded electric and gas energy efficiency programs. The NSPM includes a set of fundamental principles for cost-effectiveness analysis, which have been applied in multiple jurisdictions nationwide. See NESP, *National Standard Practice Manual for Assessing Cost-Effectiveness of Energy Efficiency Resources,* Spring 2017, available at https://nationalefficiencyscreening.org/wp-content/uploads/2017/05/NSPM_May-2017_final.pdf.

APPENDIX A. LITERATURE REVIEW SOURCES

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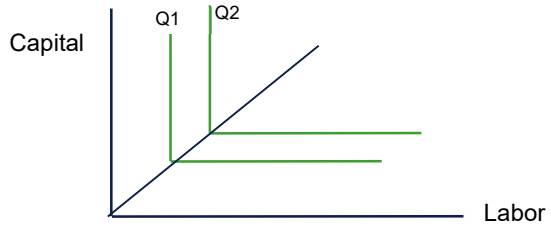
APPENDIX B. IMPLAN METHODS

Input-output (I-O) modeling provides a snapshot view of the economy and is often used to assess how changes in one sector impact the entire economy. I-O modelling has been deployed extensively to estimate the effects of environmental programs including the impacts on GDP, employment, and other economy-wide indicators.[81,82]

The I-O approach relies on exchange among different industries in an economy. The entire economy is represented using a matrix of inputs used to produce outputs known as the Leontief Inverse Matrix. The analysis begins with the n x n matrix A that represents the economy. Each element of the matrix A, aij = xij/xj, represents the inputs needed from industry i to produce one unit of output for industry j. In the symmetric Leontief Inverse Matrix ((I-A)-1), the rows represent the inputs to produce the outputs represented in columns. The coefficient matrix is then post-multiplied by a final demand vector that represents (ΔY)—the change in output for different industries owing to the increase in investments.

IMPLAN deploys a social accounting matrix (SAM) that represents the economy-wide transactions between and within industries, institutions, and households. The SAM is an extension of an I-O matrix as explained in the following paragraphs. The software is based on 546 industries and 536 commodities. Each industry/commodity is, in turn, represented by a Leontief production function (Q = Min(aK, bL))—i.e., the inputs are used in fixed proportions and the resulting isoquants (the relationship between inputs and outputs) are at right angles implying that different inputs are always deployed in fixed proportions to manufacture a commodity (Figure B-1).

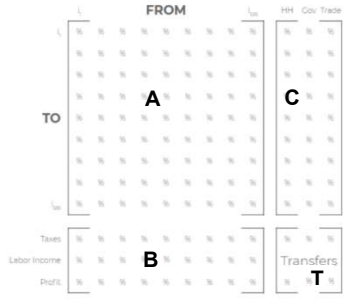
Figure B-1:Representation of a typical Leontief Isoquant Map



The underlying data for a region in each year represents the backward linkages within industries. These linkages include the intermediate inputs, employee compensation, proprietor income (i.e. profits) and taxes.[83] In Figure B-2, for example, block A represents the payments (for intermediate inputs) from each of the 536 industries (in the columns) to all the industries (in the rows). As an illustration, moving down each row in the first column, each cell represents the share of payments from industry 1 to industries 1 through 536. To account for the imports of each commodity from outside the region being examined, the model also weighs the transfers by the regional purchase coefficient of each industry. This is the Input-Output component of the overall SAM.

[81] Miller, R. E., & Blair, P. D. (2009). *Input-output analysis: foundations and extensions*. Cambridge University Press.
[82] Garrett-Peltier, H. (2017). Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. *Economic Modelling*, *61*, 439-447.
[83] https://support.implan.com/hc/en-us/articles/360035967274-Industry-Leontief-Production-Functions-in-IMPLAN

Figure B-2: Illustration of the underlying structure of the SAM in IMPLAN[84]



In addition to the input-output relation based on the production relations presented above, the social accounting matrix also includes information on the total value added (block B) measured through the tax on production and imports, labor income, and profits earned by proprietors. These values are based on the region-specific data contained in IMPLAN. The social accounting matrix also incorporates the flow of payments from household income, government spending and inter-regional trade flows through different forms of spending to each industry (block C). Finally, the SAM also accounts for the transfers from households, government, and inter-region trade in the form of taxes, labor income (that accrues to households and business), and profits to businesses (block T).

Computing Employment Effects in an I-O set-up

To generate the employment effects, the team starts with the economy-wide 1xn vector e of employment multipliers where each element e_i represents the employment needed to generate one unit of output for industry *i*. The post-multiplication product $(e(I-A)^{-1})$ provides the total employment effects of investments in the economy. The analysis generates three types of effects – direct, indirect, and induced, as described below.

- ***Direct effects*** represent the total impact on sectors that get affected by direct spending due to the creation of a new industry. In energy efficiency programs, the direct effects relate to production and installation activities.
- ***Indirect effects*** primarily include the materials and industry demand. These effects accrue to industries supplying inputs to the sectors benefiting directly.
- ***Induced effects*** reflect the second order effects realized in the form of increased spending on consumer goods and services by those earning higher incomes due to the direct and indirect effects.

Distribution ratios and industry code matching

To take advantage of the granular, measure-level program spending data in the NH Utilities' B/C models, we modeled the employment effects of each sub-program individually, distributing each measure-level spending value into materials and labor costs. All material components and labor inputs were modeled as commodity events for the relevant commodity sectors. Table B-1 below provides the list of IMPLAN industries matched against each energy efficiency measure in the NH Utilities' B/C model.

[84] Figure sourced from IMPLAN: https://support.implan.com/hc/en-us/articles/360035967274-Industry-Leontief-Production-Functions-in-IMPLAN

Table B-1. IMPLAN industry and B/C model measure matching

IMPLAN Industry Name	Measures
Air and gas compressor manufacturing	Air compressors, air nozzles, compressor storage, custom compressor measures
Air conditioning, refrigeration, and warm air heating equipment manufacturing	Air conditioning, chillers, furnaces, heat pumps, other HVAC, refrigeration measures, ice machines, circulator pumps, VRFs, VFDs
Air purification and ventilation equipment manufacturing	Dehumidifiers, air purifiers, demand control ventilation, fan motors
All other industrial machinery manufacturing	Large custom measures
All other electrical equipment and component manufacturing	Advanced power strips
Architectural, engineering, and related services	Comprehensive design, code compliance, Home Energy Raters
Automatic environmental control manufacturing	Boiler controls, RTU controls, energy management systems, lighting controls, hood controls, thermostats
C&I machinery and equipment repair and maintenance	Retro-commissioning
Community food, housing, and other relief services	Workforce development and training
Construction of new multifamily residential structures	EnergyStar Homes measures (multifamily)
Construction of new single-family residential structures	EnergyStar Homes measures (single family)
Electric lamp bulb and part manufacturing	LED lighting (lamps)
Environmental and other technical consulting services	Energy audits, quality assurance, technical assistance
Food product machinery manufacturing	Ovens, fryers, griddles, hot food holding cabinets, steam cookers
Heating equipment (except warm air furnaces) manufacturing	Boilers, circulator pumps, infrared heaters, condensing unit heaters
Household cooking appliance manufacturing	Residential dishwashers
Household laundry equipment manufacturing	Clothes washers, clothes dryers
Household refrigerator and home freezer manufacturing	Freezers, refrigerators, refrigerator recycling
Lighting fixture manufacturing	Lighting fixtures, custom lighting, performance lighting
Maintenance and repair construction of residential structures	Air sealing, duct sealing, contractor fees
Management of companies and enterprises	Administrative and vendor fees, rebate processing, 3rd party financing
Metal window and door manufacturing	Insulated doors
Mineral wool manufacturing	Envelope insulation, duct insulation
Motor and generator manufacturing	Custom motors, case motors, ECM motors
Newly constructed single-family residential structures	Residential code compliance
Other commercial service industry machinery manufacturing	Commercial water heaters, commercial dishwashers
Other major household appliance manufacturing	Residential water heaters
Other plastics product manufacturing	Window inserts
Plumbing fixture fitting and trim manufacturing	Showerheads
Polystyrene foam product manufacturing	Pipe insulation, pipe wrap
Pottery, ceramics, and plumbing fixture manufacturing	Faucet aerators
Pump and pumping equipment manufacturing	Pool pumps
Sheet metal work manufacturing	Heat recovery ventilators
Small electrical appliance manufacturing	Vending misers
Valve and fittings, other than plumbing, manufacturing	Steam traps, pre-rinse spray valves
Water, sewage and other systems	Wastewater treatment facility measures
Wood windows and door manufacturing	Window replacements

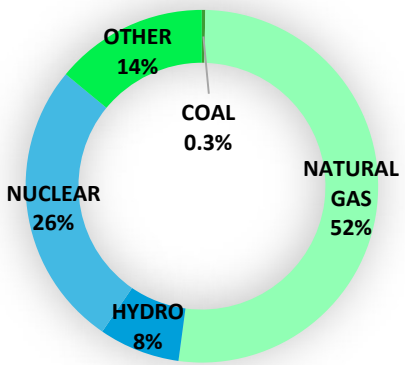
APPENDIX C. AVERT AND COBRA METHODS AND DETAILED RESULTS

Electric generation

The analysis of the NHSaves electric programs' emissions and health impacts is based on the programs' reductions in demand during peak hours.[85] According to Energy Information Administration data, nuclear energy is the main source of electricity generated in New Hampshire.[86] However, during peak hours, fossil fuel generators act as marginal power plants. Power plants operated on fossil fuels, especially coal, are one of the major sources of the criteria pollutants. The NHSaves programs result in savings during ISO New England peak hours, thereby reducing the need for these plants and in turn reducing criteria pollutants. The model also assumes that there are no imports or exports, hence the regions are self-sufficient when it comes to electricity.

In this study, we used AVERT along with COBRA to estimate the health benefits arising from the energy efficiency programs in the power sector. It should be noted that from 2001 to 2020, air emissions from the regional generators in New England have declined drastically. According to ISO New England, the decline can be attributed to decrease in generation from coal and oil powered generation and an increased penetration of renewable resources in the generation fleet. Low emitting gas resources now make up 52% of all electric generation in New England and 98% of the fossil-fueled generation (Figure C-1).

Figure C-1. ISO New England electric generation mix by fuel type, 2022



Source: ISO New England, 2022

End-use combustion

For analysis of the NHSaves gas programs, DNV estimated criteria pollutants using the emission factors provided by the EPA,[87] following the methodology laid in the COBRA user manual.[88] The EPA emission factors report units of pollution (lbs) per million cubic feet (MMcf) of natural gas. To use these emission factors, we converted the savings from MMBtu to MMcf, using the following steps:

- Converted MMBTU to therms by multiplying it by 10
- Converted therms to cubic feet by dividing by 0.01037, per the EIA (In 2020, the U.S. annual average heat content of natural gas delivered to consumers was about 1,037 Btu per cubic foot. Therefore, 100 cubic feet (Ccf) of natural gas equals 103,700 Btu, or 1.037 therms)

[85] See ISO-NE, https://www.iso-ne.com/about/key-stats/electricity-use/ and https://www.iso-ne.com/about/key-stats/air-emissions.
[86] See https://www.eia.gov/state/analysis.php?sid=NH
[87] See EPA document AP-42, Compilation of Air Emission Factors
[88] See https://www.epa.gov/sites/default/files/2021-03/documents/cobra-fact-sheet-natural-gas.pdf

- Converted cubic feet to MMcf by dividing by 1,000,000
- Multiplied the MMcf of fuel savings by the EPA emission factors for residential and C&I users defined in EPA AP-42
- Divided by 2,000 to convert pounds to tons.

We estimated benefits from residential and commercial gas programs separately given the difference in the emission factors and end uses for those sectors. For the residential sector in particular, end-use combustion fuels include propane, kerosene, wood pellets, and fuel oil. However, modeling end-use combustion for each fuel type was not feasible due to data and project timeline limitations. Therefore, the study assumed all end-use combustion used natural gas. Because combustion of other fuels (particularly oil, kerosene, and wood pellets) creates more criteria pollutants than combustion of natural gas, this assumption resulted in a conservative estimate of the health effects of the programs due to changes in end-use combustion.

Detailed health benefits results

The tables in this section show the detailed breakdown of the health benefits stemming from the 2021 energy savings attributable to the NHSaves program, both for New Hampshire only, as well as the contiguous United States, each at a 3% and 7% discount rate. The tables present both low and high estimates, reflecting the use of different underlying epidemiological studies, particularly on the mortality impacts of PM2.5.[89] The tables illustrate that most of the benefits are attributed to avoided mortality due to the decrease in PM2.5, and the remaining results from effects on morbidity. EPA uses the value of statistical life (VSL) to calculate estimates of mortality benefits.

New Hampshire only, electric

This section documents the detailed COBRA outputs for electric program savings when the pollution effects are limited to New Hampshire only.

Table C-1. Estimated annual monetized benefits from electric savings in 2021, New Hampshire, 3% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.004	0.008	$40,296	$91,160
Nonfatal Heart Attacks *	0	0.004	$64	$593
Infant Mortality	0	0	$127	$127
Hospital Admits, All Respiratory	0.001	0.001	$32	$32
Hospital Admits, Cardiovascular **	0.001	0.001	$46	$46
Acute Bronchitis	0.004	0.004	$2	$2
Upper Respiratory Symptoms	0.066	0.066	$3	$3
Lower Respiratory Symptoms	0.046	0.046	$1	$1
Emergency Room Visits, Asthma	0.002	0.002	$1	$1
Asthma Exacerbation	0.07	0.07	$5	$5
Minor Restricted Activity Days	2.388	2.388	$209	$209
Work Loss Days	0.399	0.399	$80	$80
Total Health Effects			**$40,867**	**$92,260**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks.

[89] The low estimates are based on the mortality impacts of PM2.5 evaluated by the American Cancer society, whereas the high values reflect the results from the Harvard six-city mortality study. Rather than using an average, the model presents results from both studies. See Fine particulate matter and mortality: a comparison of the six cities and American Cancer Society cohorts with a medicare cohort - PubMed (nih.gov).

Table C-2. Estimated annual monetized benefits from electric savings in 2021, New Hampshire, 7% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.004	0.008	$35,891	$81,195
Nonfatal Heart Attacks *	0	0.004	$60	$555
Infant Mortality	0	0	$127	$127
Hospital Admits, All Respiratory	0.001	0.001	$32	$32
Hospital Admits, Cardiovascular **	0.001	0.001	$46	$46
Acute Bronchitis	0.004	0.004	$2	$2
Upper Respiratory Symptoms	0.066	0.066	$3	$3
Lower Respiratory Symptoms	0.046	0.046	$1	$1
Emergency Room Visits, Asthma	0.002	0.002	$1	$1
Asthma Exacerbation	0.07	0.07	$5	$5
Minor Restricted Activity Days	2.388	2.388	$209	$209
Work Loss Days	0.399	0.399	$80	$80
Total Health Effects			**$36,458**	**$82,258**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

New Hampshire only, gas

This section documents the detailed COBRA outputs for gas program savings when the pollution effects are limited to New Hampshire only.

Table C-3. Estimated annual monetized benefits from residential gas savings in 2021, New Hampshire, 3% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.003	0.006	$28,624	$64,808
Nonfatal Heart Attacks *	0	0.003	$46	$425
Infant Mortality	0	0	$104	$104
Hospital Admits, All Respiratory	0.001	0.001	$23	$23
Hospital Admits, Cardiovascular **	0.001	0.001	$33	$33
Acute Bronchitis	0.003	0.003	$2	$2
Upper Respiratory Symptoms	0.052	0.052	$2	$2
Lower Respiratory Symptoms	0.037	0.037	$1	$1
Emergency Room Visits, Asthma	0.002	0.002	$1	$1
Asthma Exacerbation	0.055	0.055	$4	$4
Minor Restricted Activity Days	1.805	1.805	$158	$158
Work Loss Days	0.302	0.302	$61	$61
Total Health Effects			**$29,059**	**$65,622**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-4. Estimated annual monetized benefits from residential gas savings in 2021, New Hampshire, 7% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.003	0.006	$25,495	$57,724
Nonfatal Heart Attacks *	0	0.003	$43	$398
Infant Mortality	0	0	$104	$104
Hospital Admits, All Respiratory	0.001	0.001	$23	$23
Hospital Admits, Cardiovascular **	0.001	0.001	$33	$33
Acute Bronchitis	0.003	0.003	$2	$2
Upper Respiratory Symptoms	0.052	0.052	$2	$2
Lower Respiratory Symptoms	0.037	0.037	$1	$1
Emergency Room Visits, Asthma	0.002	0.002	$1	$1
Asthma Exacerbation	0.055	0.055	$4	$4
Minor Restricted Activity Days	1.805	1.805	$158	$158
Work Loss Days	0.302	0.302	$61	$61
Total Health Effects			**$25,927**	**$58,510**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-5. Estimated annual monetized benefits from C&I gas savings in 2021, New Hampshire, 3% discount rate

Health End Point	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.001	0.001	$6,300	$14,258
Nonfatal Heart Attacks *	0	0.001	$10	$92
Infant Mortality	0	0	$22	$22
Hospital Admits, All Respiratory	0	0	$5	$5
Hospital Admits, Cardiovascular **	0	0	$7	$7
Acute Bronchitis	0.001	0.001	$-	$-
Upper Respiratory Symptoms	0.011	0.011	$-	$-
Lower Respiratory Symptoms	0.008	0.008	$-	$-
Emergency Room Visits, Asthma	0	0	$-	$-
Asthma Exacerbation	0.012	0.012	$1	$1
Minor Restricted Activity Days	0.388	0.388	$34	$34
Work Loss Days	0.065	0.065	$13	$13
Total Health Effects			**$6,393**	**$14,433**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-6. Estimated annual monetized benefits from C&I gas savings in 2021, New Hampshire, 7% discount rate

Health End Point	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.001	0.001	$5,611	$12,699
Nonfatal Heart Attacks *	0	0.001	$9	$86
Infant Mortality	0	0	$22	$22
Hospital Admits, All Respiratory	0	0	$5	$5
Hospital Admits, Cardiovascular **	0	0	$7	$7
Acute Bronchitis	0.001	0.001	$-	$-
Upper Respiratory Symptoms	0.011	0.011	$-	$-
Lower Respiratory Symptoms	0.008	0.008	$-	$-
Emergency Room Visits, Asthma	0	0	$-	$-
Asthma Exacerbation	0.012	0.012	$1	$1
Minor Restricted Activity Days	0.388	0.388	$34	$34
Work Loss Days	0.065	0.065	$13	$13
Total Health Effects			**$5,704**	**$12,868**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Contiguous US, electric

This section documents the detailed COBRA outputs for electric program savings when the pollution effects are estimated for the entire contiguous United States.

Table C-7. Estimated annual monetized benefits from electric savings in 2021, contiguous US, 3% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.055	0.125	$603,516	$1,365,606
Nonfatal Heart Attacks *	0.006	0.057	$976	$9,070
Infant Mortality	0	0	$2,542	$2,542
Hospital Admits, All Respiratory	0.013	0.013	$495	$495
Hospital Admits, Cardiovascular **	0.013	0.013	$658	$658
Acute Bronchitis	0.065	0.065	$40	$40
Upper Respiratory Symptoms	1.184	1.184	$51	$51
Lower Respiratory Symptoms	0.832	0.832	$22	$22
Emergency Room Visits, Asthma	0.032	0.032	$18	$18
Asthma Exacerbation	1.248	1.248	$93	$93
Minor Restricted Activity Days	39.426	39.426	$3,456	$3,456
Work Loss Days	6.657	6.657	$1,333	$1,333
Total Health Effects			**$613,199**	**$1,383,382**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-8. Estimated annual monetized benefits from electric savings in 2021, contiguous US, 7% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.055	0.125	$537,542	$1,216,323
Nonfatal Heart Attacks *	0.006	0.057	$917	$8,521
Infant Mortality	0	0	$2,542	$2,542
Hospital Admits, All Respiratory	0.013	0.013	$495	$495
Hospital Admits, Cardiovascular **	0.013	0.013	$658	$658
Acute Bronchitis	0.065	0.065	$40	$40
Upper Respiratory Symptoms	1.184	1.184	$51	$51
Lower Respiratory Symptoms	0.832	0.832	$22	$22
Emergency Room Visits, Asthma	0.032	0.032	$18	$18
Asthma Exacerbation	1.248	1.248	$93	$93
Minor Restricted Activity Days	39.426	39.426	$3,456	$3,456
Work Loss Days	6.657	6.657	$1,333	$1,333
Total Health Effects			**$547,166**	**$1,233,551**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Contiguous US, gas

This section documents the detailed COBRA outputs for gas program savings when the pollution effects are estimated for the entire contiguous United States.

Table C-9. Estimated annual monetized benefits from residential gas savings in 2021, contiguous US, 3% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.008	0.019	$90,794	$205,483
Nonfatal Heart Attacks *	0.001	0.009	$158	$1,465
Infant Mortality	0	0	$364	$364
Hospital Admits, All Respiratory	0.002	0.002	$77	$77
Hospital Admits, Cardiovascular **	0.002	0.002	$101	$101
Acute Bronchitis	0.01	0.01	$6	$6
Upper Respiratory Symptoms	0.176	0.176	$8	$8
Lower Respiratory Symptoms	0.124	0.124	$3	$3
Emergency Room Visits, Asthma	0.005	0.005	$3	$3
Asthma Exacerbation	0.185	0.185	$14	$14
Minor Restricted Activity Days	5.94	5.94	$521	$521
Work Loss Days	1.002	1.002	$201	$201
Total Health Effects			**$92,249**	**$208,245**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-10. Estimated annual monetized benefits from residential gas savings in 2021, contiguous US, 7% discount rate

Health Endpoint	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.008	0.019	$80,869	$183,020
Nonfatal Heart Attacks *	0.001	0.009	$148	$1,376
Infant Mortality	0	0	$364	$364
Hospital Admits, All Respiratory	0.002	0.002	$77	$77
Hospital Admits, Cardiovascular **	0.002	0.002	$101	$101
Acute Bronchitis	0.01	0.01	$6	$6
Upper Respiratory Symptoms	0.176	0.176	$8	$8
Lower Respiratory Symptoms	0.124	0.124	$3	$3
Emergency Room Visits, Asthma	0.005	0.005	$3	$3
Asthma Exacerbation	0.185	0.185	$14	$14
Minor Restricted Activity Days	5.94	5.94	$521	$521
Work Loss Days	1.002	1.002	$201	$201
Total Health Effects			**$82,314**	**$185,693**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-11. Estimated annual monetized benefits from C&I gas savings in 2021, contiguous US, 3% discount rate

Health End Point	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.002	0.004	$21,222	$48,020
Nonfatal Heart Attacks *	0	0.002	$38	$351
Infant Mortality	0	0	$85	$85
Hospital Admits, All Respiratory	0	0	$18	$18
Hospital Admits, Cardiovascular **	0	0	$24	$24
Acute Bronchitis	0.002	0.002	$1	$1
Upper Respiratory Symptoms	0.04	0.04	$2	$2
Lower Respiratory Symptoms	0.028	0.028	$1	$1
Emergency Room Visits, Asthma	0.001	0.001	$1	$1
Asthma Exacerbation	0.042	0.042	$3	$3
Minor Restricted Activity Days	1.352	1.352	$119	$119
Work Loss Days	0.228	0.228	$46	$46
Total Health Effects			**$21,558**	**$48,669**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks

Table C-12. Estimated annual monetized benefits from C&I gas savings in 2021, contiguous US, 7% discount rate

Health End Point	Changes in Incidence (cases, annual)		Monetary Value (dollars, annual)	
	Low	High	Low	High
Mortality *	0.002	0.004	$18,902	$42,770
Nonfatal Heart Attacks *	0	0.002	$36	$330
Infant Mortality	0	0	$85	$85
Hospital Admits, All Respiratory	0	0	$18	$18
Hospital Admits, Cardiovascular **	0	0	$24	$24
Acute Bronchitis	0.002	0.002	$1	$1
Upper Respiratory Symptoms	0.04	0.04	$2	$2
Lower Respiratory Symptoms	0.028	0.028	$1	$1
Emergency Room Visits, Asthma	0.001	0.001	$1	$1
Asthma Exacerbation	0.042	0.042	$3	$3
Minor Restricted Activity Days	1.352	1.352	$119	$119
Work Loss Days	0.228	0.228	$46	$46
Total Health Effects			**$19,236**	**$43,399**

* The low and high values represent differences in the methods used to estimate some of the health impacts in COBRA. For example, high and low results for avoided premature mortality are based on two different epidemiological studies of the impacts of PM2.5 on mortality in the United States.
** Except heart attacks