

Economic Impact Analysis of Rhode Island Energy's Annual Energy Efficiency Plan for 2023

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I. Executive Summary

The Brattle Group was asked by Rhode Island Energy (RIE) to assess the economic impacts of implementing RIE's Annual Energy Efficiency Plan for 2023, as part of Rhode Island Public Utilities Commission's Total Resource Cost Effectiveness Standard evaluation. In this report, we assess the economic impacts of 14 energy efficiency programs based on their impact on regional gross domestic product (GDP). We also provide program-specific economic multipliers that capture the regional economic benefits relative to the cost of each program.

To provide a comprehensive assessment of economy-wide impacts, we couple two modeling frameworks – benefit-cost (BC) and economic impact assessment. The results output by each framework are used as separate measures that quantify different aspects of the programs' contribution to economic growth. The BC analysis assesses the direct costs and benefits to RIE and its ratepayers for each program. Economic impact analysis measures how those direct impacts, along with subsequent ripple effects that take place in the rest of the economy, affect gross regional product in Rhode Island.

To assess economic impacts, we use BEYOND, Brattle's proprietary macroeconomic model of the US. BEYOND uses open-source government data to simulate interactions among key institutions in the US economy (industries, households and government), while preserving transparency in the model's input data. To provide reliable estimates of future economic impacts over the time horizon of RIE's programs, we calibrate GDP growth in Rhode Island to most recent projections based on government data. Accounting for the growing scale of the economy is important in capturing the magnitude of program impacts, particularly given the near three-decade time horizon over which RIE's energy efficiency benefits are experienced. Our analysis also provides GDP impacts in the rest of New England to demonstrate that increased economic activity driven by energy efficiency in Rhode Island creates growth in neighboring states through trade.

We find that economic impacts at the program level are all positive, indicating that all energy efficiency and demand response programs are expected to create GDP growth in Rhode Island's economy. Within Rhode Island, all programs with the exception of one gas program, create economic benefits that are greater than total program costs. When economic growth in the rest of New England is considered, economic benefits exceed total costs for all programs.

II. Introduction

The Brattle Group was asked by Rhode Island Energy (RIE) to assess the economic impacts of implementing RIE’s Annual Energy Efficiency Plan for 2023 (2023 Annual Plan), as part of Rhode Island Public Utilities Commission’s Total Resource Cost Effectiveness Standard evaluation. In this report, we assess the economic impacts of 14 energy efficiency (EE) and demand response (DR) programs based on their impact on regional gross domestic product (GDP). We also provide program-specific economic multipliers that capture the regional economic benefits relative to the cost of each program.

Brattle previously provided economic impact analyses of RIE’s EE and DR programs in 2019.¹ Our current analysis builds on Brattle’s 2019 analysis in three important ways. First, to assess economic impacts, we use BEYOND, Brattle’s proprietary macroeconomic model of the US. BEYOND uses open-source government data to simulate interactions among key institutions in the US economy (industries, households and government), while preserving transparency in the model’s input data. Second, to provide reliable estimates of future economic impacts over the time horizon of RIE’s programs, we calibrate GDP growth in Rhode Island to most recent projections based on government data. Accounting for the growing scale of the economy is important in capturing the magnitude of program impacts, particularly given the near three-decade time horizon over which RIE’s energy efficiency benefits are experienced. Third, our analysis expands the scope of impact assessment to estimate the GDP impacts in both Rhode Island and the rest of New England. We demonstrate that increased economic activity in Rhode Island created by RIE’s programs can result in growth in neighboring states through trade.

Section III provides an overview of the RIE’s EE and DR programs. Section IV provides details on the modeling methodology. In this section we provide an overview of the BEYOND model and how the model was calibrated to provide reliable results. We also describe how the EE and DR programs were modeled in BEYOND. Section V presents our model results and discusses the value of coupling benefit-cost with economic impact assessment in assessing the cost-effectiveness of energy efficiency programs. The appendix provides a detailed description of the BEYOND model.

¹ Berkman, Mark, Jürgen Weiss. “Review of RI Test and Proposed Methodology.” The Brattle Group (2019).

III. Rhode Island Energy's Annual Energy Efficiency Plan for 2023

RIE's 2023 Annual Plan, which covers the third year of the 2021-2023 Three-year Energy Efficiency Plan, was designed to help Rhode Island's economy achieve greater efficiency while contributing to the state's COVID-19 pandemic recovery. We evaluate fourteen EE and DR programs across three program types: residential, income eligible and commercial and industrial programs. The majority of these programs are offered as both electric and gas efficiency programs. Below we provide a summary of each program under review.²

A. Residential Energy Efficiency Programs

1. EnergyWise Single Family

The EnergyWise program is a direct-to-customer in-home program that educates residents on how their home can become more energy efficient. The program offers single-family customers (buildings with 1-4 dwelling units) home energy assessments, weatherization services, and information regarding their energy usage. The program addresses base load electric use and heating, cooling, and water heating energy loads in all residential buildings. Participants receive energy efficiency recommendations and technical assistance, as well as financial incentives to upgrade inefficient items such as heating and water heating systems, thermostats, and insulation.

2. EnergyWise Multi-Family

The EnergyWise Multi-Family program offers comprehensive energy services for market-rate multifamily customers (buildings with 5+ dwelling units), including energy assessments, incentives for heating and domestic hot water systems, cooling equipment, lighting, and appliances. All types of multifamily properties are eligible.

² A more detailed description of each program is provided in the following document: Letter from Rhode Island Energy to the Rhode Island Public Utilities Commission, "Re: Docket No. 22-33-EE -- The Narragansett Electric Company's d/b/a Rhode Island Energy's Annual Energy Efficiency Plan for 2023," September 30, 2022

3. Residential New Construction

The Residential New Construction (RNC) program promotes the construction of high-performing energy efficient single family, multifamily, and income eligible homes, as well as the education of builders, tradespeople, designers, and code officials.

4. Home Energy Reports

The Home Energy Reports (HER) program encourages energy efficiency behavior through personalized print and email reports and a seamlessly integrated website. Each of the communication channels displays energy consumption patterns and contains a normative comparison to similarly sized and similarly heated homes, as well as to an energy reduction goal for each customer.

5. Residential Consumer Products

The Residential Consumer Products program promotes the purchase of high efficiency household appliances, including kitchen appliances and electronics carrying the ENERGY STAR® label. This program trains retail sales staff about products. The program also offers refrigerator, freezer, and dehumidifier recycling.

6. Residential High-Efficiency Heating, Cooling, and Hot Water (ENERGY STAR® HVAC)

The ENERGY STAR® HVAC program promotes the installation of high efficiency central air conditioners and eligible heat pumps for electric customers and new energy efficient natural gas related equipment including boilers, furnaces, windows, water heating equipment, thermostats, boiler reset controls, and water saving devices. Incentives for energy efficient air source heat pumps for space and water heating equipment are available for customers with electric resistance heating and hot water. Incentives are also available for air source heat pumps used as accessory heating and cooling devices in homes with a primary heating system that is natural gas, oil, or propane.

7. Residential ConnectedSolutions (Active Demand Response)

The Residential ConnectedSolutions program is RIE's active demand response program that sends control signals to customer owned electric devices to reduce peak energy use and improve power quality on the grid. Consumers with eligible controllable equipment (e.g., Smart

thermostats, batteries, and pool pumps) can enroll to participate in ConnectedSolutions. All electric consumers are eligible to participate in ConnectedSolutions.

B. Income Eligible Energy Efficiency Programs

1. Income Eligible Single Family

Income Eligible Single Family Services are delivered by local Community Action Program agencies. Three levels of home energy assessments are offered: lighting and appliance, heating and weatherization, and comprehensive assessment. Customers who qualify for the Low-Income Home Energy Assistance Program (LIHEAP) are eligible to receive all services and equipment upgrades at no cost.

2. Income Eligible Multi-Family

Comprehensive energy services for income-eligible multifamily customers (buildings with 5+ dwelling units) include energy assessments, incentives for heating and domestic hot water systems, air source heat pumps, cooling equipment, lighting, and appliances. In most cases, there are no costs to the customer for these services as most income eligible upgrades are covered at 100%.

C. Commercial and Industrial Programs

1. Large Commercial and Industrial New Construction and Building Energy Code Support

This program encourages energy efficiency in new construction, major renovations, planned replacement of aging equipment, and replacement of failed equipment through financial incentives and technical assistance to developers, manufacturers, vendors, customers, and design professionals. Commercial and industrial customers with annual electric consumption greater than 1,000,000 kWh per year are eligible.

2. Large Commercial and Industrial Retrofit

This program incentivizes the replacement of existing equipment and systems with energy efficient alternatives when the customer might otherwise not plan on making efficiency investments. This may include energy efficient equipment such as lighting, motors, and heating,

ventilation and air conditioning (HVAC) systems, thermal envelope measures, and custom measures in existing buildings. All commercial, industrial, and institutional customers are eligible to participate.

3. Small Business Direct Install

This is a retrofit program that provides turn-key solutions to customers that consume less than 1,000,000 kWh per year. As part of the program, customers receive a free onsite energy assessment and a customized report detailing recommended energy efficient improvements. Rhode Island Energy then completes retrofit installations at the customer's convenience. The program serves small businesses of all types from restaurants to non-profits, to small offices. Rhode Island Energy pays up to 70% of installation and equipment costs, and customers can finance the remaining share of the project over as many as 60 months.

4. Commercial Connected Solutions (Active Demand Response)

The Commercial Connected Solutions or Active Demand Response program is focused on reducing peak electric demand and associated costs for large and small commercial customers. All customers, regardless of size can participate. The program is technology neutral and provides a customer incentive for verifiable shedding of load in response to a signal or communication from the Company.

5. Commercial and Industrial Multifamily

Comprehensive energy services for market-rate multifamily customers (buildings with 5+ dwelling units) include energy assessments and incentives for heating and domestic hot water systems and weatherization. Coordinated services are offered for all types of multifamily properties.

IV. Methodology

A. BEYOND-BCR Framework

We provide a comprehensive assessment of cost effectiveness by coupling two modeling frameworks – benefit-cost (BC) and economic impact assessment. The direct costs and benefits to RIE and its ratepayers for each program are assessed in the BC model. State GDP impacts

that stem from each program's direct costs and benefits are calculated in our economic impact assessment (macroeconomic) model.

To assess GDP impacts, we use Brattle's proprietary macroeconomic model, BEYOND. BEYOND is a dynamic computable general equilibrium (CGE) model of the US economy that simulates interactions between key institutions in the economy (industries, households and government) based on the circular flow of economic activity. BEYOND uses open-source government data as model inputs to characterize the US economy. The model represents 50 states plus Washington, D.C.; 11 aggregate economic sectors that account for 71 industries; and five representative households defined by income levels.

The representation of regional economic sectors in the model, which is based on national level input-output data published by the Bureau of Economic Analysis (BEA), account for all commodity supply and use activities in the economy. National level input-output data are regionalized using data inputs such as the Commodity Flow Survey (CFS) from the Census Bureau. Economic behavior of households is modeled by income group using Statistics of Income (SOI) data from the Internal Revenue Service (IRS). Lastly, the State Energy Data System (SEDS) published by the Energy Information Administration (EIA) is used to accurately represent supply and demand of energy resources by final demand and sectors.

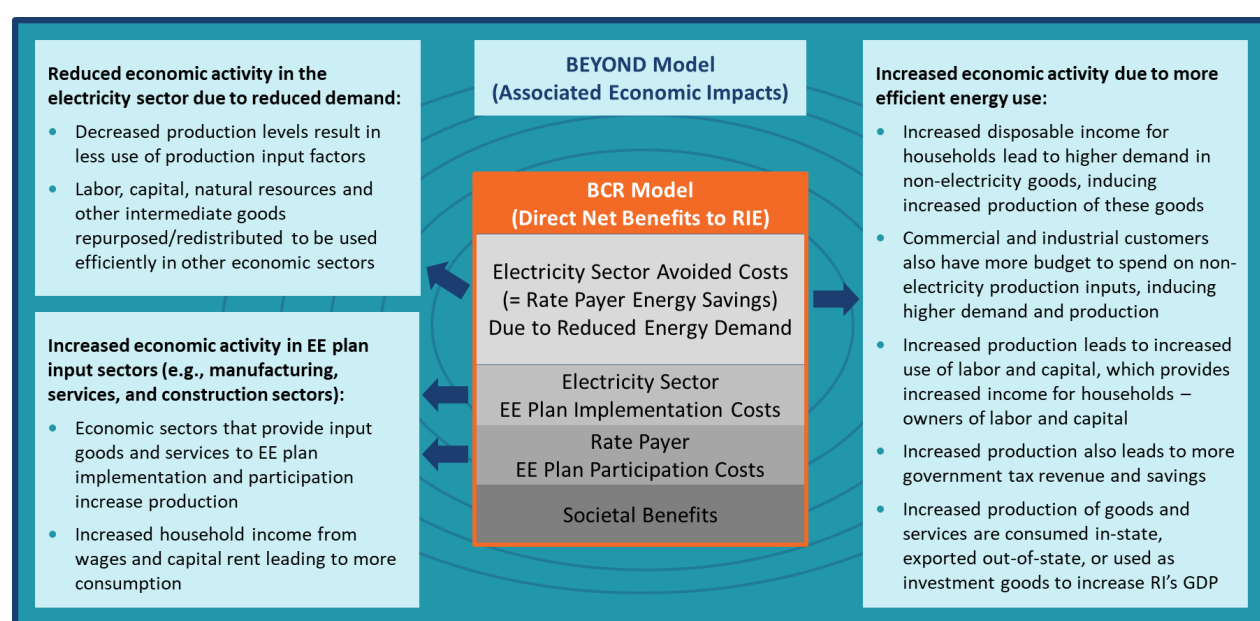
Standard BEYOND model outputs include gross domestic product, household consumption, labor income and wage rates, and sector specific output and prices. A more detailed description of the model is provided in the Appendix of this report.

The direct net benefits of each program for RIE and its ratepayers are assessed using RIE's Benefit-Cost Ratio (BCR) model. The BCR model's benefits include two types of benefits: avoided electricity sector costs due to reduced energy demand and associated environmental benefits. Avoided electricity sector costs are assumed to translate into bill savings for ratepayers. For costs, two types of costs associated with program implementation are calculated: program implementation costs incurred by RIE and program participation costs incurred by participants.

Economic impact analysis quantifies the ripple effects of these direct costs and benefits that go beyond RIE and its ratepayers (see Figure 1). Take for instance, the primary direct benefit of energy efficiency programs, reduced energy consumption. The macroeconomic model accounts for the bill savings associated with reduced energy consumption, but also subsequent economic transactions, including increased household consumption on non-energy goods due to

increased disposable income. Electric bill savings for companies also free up budget for non-electricity production inputs, contributing to higher production of goods and services in the economy. Costs incurred by RIE and program participants on the other hand, have the opposite effect. Added costs decrease available budget for final consumption and production inputs, reducing consumption in those goods and services. Those same costs however also increase economic activity in sectors of the economy that the costs are paid to. As such, the macroeconomic model assesses how the direct costs and benefits of RIE's programs impact gross regional product in Rhode Island.

FIGURE 1: COMPREHENSIVE IMPACT ASSESSMENT OF 2023 EE PLAN USING BEYOND-BCR



B. BEYOND Model Calibration

Economic benefits for most of RIE's programs are distributed over time. The BCR model shows that program benefits are experienced by participants over the next 27 years, from 2023 to 2049. Due to the long time horizon over which RIE's programs are evaluated, the projected growth of Rhode Island's economy during this period is an important factor to consider for accurate assessment of economic impacts. Assessing economic impacts of energy efficiency benefits using an outdated representation of the US economy will likely output unreliable results.

We hence calibrate the representation of the US economy in each model year (from 2023 to 2049 at annual time steps) using the EIA's projection of US real GDP growth. We also calibrate growth in GDP components (consumption, investment, government expenditure) and the size of the labor force.

Sector-specific production functions are also calibrated to incorporate realistic assumptions on how substitutable production inputs are. For instance, assumptions on the substitutability of gas, oil and electricity for household heating, or input factors such as labor, capital and natural resources for production, can make a material difference in economic impact assessment. We calibrate BEYOND's production functions to those of SAGE, a well-established CGE model of the US economy developed by the US Environmental Protection Agency.³

C. Modeling RIE's Energy Efficiency Plan

We model three key aspects of RIE's EE and DR programs. First is avoided costs. Avoided costs are determined in BEYOND based on each program's annual energy savings, relative to assumed energy consumption levels absent energy efficiency. To calculate annual energy savings for the average ratepayer, we calculated the annual reduction in energy consumption (electricity, gas, and oil and propane) for each measure within a program. The total reduction at the program level was obtained by summing the reduction amounts across all measures within a program. For programs that do not specify energy savings (e.g., active demand response programs), total utility avoided costs calculated by RIE's BCR model was used to represent avoided costs in the electricity sector. Utility avoided costs include avoided costs in both electric energy and capacity, as well as savings in non-electric resources such as natural gas, propane and water. Although we do not disclose annualized energy savings information by program in this report, total avoided costs by program, as calculated in RIE's BCR model, is presented in Table 1. Environmental benefits that are included as part of program benefits in the BCR model are excluded from program benefits modeled in BEYOND, since linkages between economic activities and environmental impacts are non-existent in conventional input-output accounts.

The second aspect is the implementation costs incurred by RIE. We assume that all of RIE's implementation costs are incurred in 2023, in the beginning of each program measure life. We also assume that all costs are allocated to the services sector, consisting of expenses relating to

³ <https://www.epa.gov/environmental-economics/sage-model-documentation-version-201>

program planning, marketing, research, tech assist and training, and sales. This assumption is consistent with the assumption made in RIE’s BC analysis. Although most implementation cost elements were program specific and hence were directly allocated to those programs, some cost elements were applied at the program type level (e.g., residential, income eligible, commercial and industrial) and not to specific programs. “Energy Efficiency Education” for instance, is associated with the residential sector but not with any specific program. We distributed these non-program-specific costs uniformly across programs within program types. General portfolio costs that were not tied to programs (or even program types) were also similarly distributed across relevant programs. The resulting implementation costs by program are presented in Table 2.

The third aspect is the participation costs incurred by program participants. As with implementation costs, participation costs were also assumed to be incurred in 2023. Assumptions on how participation costs are allocated across economic sectors is consistent with those used in the 2019 Brattle analysis. Participant costs by program and cost allocation weights across sectors are respectively shown in Tables 3 and 4.

TABLE 1: TOTAL AVOIDED COSTS BY PROGRAM

	Electric	Gas	DR
Residential			
Residential New Construction	\$ 3,248,590	\$ 1,032,109	
ENERGY STAR® HVAC	\$16,958,161	\$ 6,930,735	
EnergyWise Single Family	\$15,488,815	\$ 8,119,955	
EnergyWise Multi Family	\$ 2,821,384	\$ 4,497,501	
Home Energy Reports	\$ 4,159,480	\$ 726,563	
Residential Consumer Products	\$ 5,512,401		
Residential ConnectedSolutions			\$ 3,144,955
<i>Residential Total</i>	<i>\$48,188,830</i>	<i>\$21,306,862</i>	<i>\$ 3,144,955</i>
Income Eligible			
Income Eligible Single Family	\$18,177,479	\$ 9,062,602	
Income Eligible Multi Family	\$ 3,571,360	\$ 8,595,972	
<i>Income Eligible Total</i>	<i>\$21,748,838</i>	<i>\$17,658,573</i>	
Commercial and Industrial			
Large Commercial New Construction	\$24,945,181	\$12,404,196	
Large Commercial and Industrial Retrof	\$50,429,565	\$ 9,203,431	
Small Business Direct Install	\$ 6,534,532	\$ 1,420,442	
Commercial ConnectedSolutions			\$12,784,513
Commercial and Industrial Multi Family		\$ 5,453,431	
<i>Commercial and Industrial Total</i>	<i>\$81,909,277</i>	<i>\$28,481,499</i>	<i>\$12,784,513</i>

TABLE 2: IMPLEMENTATION COSTS BY PROGRAM

	Electric	Gas	DR
Residential			
Residential New Construction	\$ 2,209,521	\$ 859,003	
ENERGY STAR® HVAC	\$ 5,958,346	\$ 3,824,363	
EnergyWise Single Family	\$16,202,831	\$10,110,619	
EnergyWise Multi Family	\$ 1,958,811	\$ 1,722,887	
Home Energy Reports	\$ 2,763,365	\$ 597,983	
Residential Consumer Products	\$ 3,106,633	\$ -	
Residential ConnectedSolutions			\$ 2,580,685
<i>Residential Total</i>	\$32,199,506	\$17,114,854	\$ 2,580,685
Income Eligible			
Income Eligible Single Family	\$12,376,356	\$ 5,633,962	
Income Eligible Multi Family	\$ 3,868,951	\$ 3,420,403	
<i>Income Eligible Total</i>	\$16,245,307	\$ 9,054,364	
Commercial and Industrial			
Large Commercial New Construction	\$ 9,365,096	\$ 3,051,398	
Large Commercial and Industrial Retrof	\$23,272,093	\$ 4,872,336	
Small Business Direct Install	\$ 8,648,087	\$ 922,575	
Commercial ConnectedSolutions			\$ 6,762,713
Commercial and Industrial Multi Family		\$ 1,123,992	
<i>Commercial and Industrial Total</i>	\$41,285,275	\$ 9,970,302	\$ 6,762,713

TABLE 3: PARTICIPATION COSTS BY PROGRAM

	Electric	Gas	DR
Residential			
Residential New Construction	\$ 634,571	\$ 301,051	
ENERGY STAR® HVAC	\$ 2,464,497	\$ 3,718,720	
EnergyWise Single Family	\$ 2,790,635	\$ 872,146	
EnergyWise Multi Family	\$ 89,897	\$ (150,143)	
Home Energy Reports	\$ -	\$ -	
Residential Consumer Products	\$ 683,261	\$ -	
Residential ConnectedSolutions			\$ -
<i>Residential Total</i>	\$ 6,662,861	\$ 4,741,775	\$ -
Income Eligible			
Income Eligible Single Family	\$ -	\$ -	
Income Eligible Multi Family	\$ -	\$ -	
<i>Income Eligible Total</i>	\$ -	\$ -	
Commercial and Industrial			
Large Commercial New Construction	\$ 648,465	\$ 60,465	
Large Commercial and Industrial Retrof	\$10,315,471	\$ 2,537,209	
Small Business Direct Install	\$ 1,596,033	\$ 166,338	
Commercial ConnectedSolutions			\$ -
Commercial and Industrial Multi Family		\$ 309,925	
<i>Commercial and Industrial Total</i>	\$12,559,969	\$ 3,073,937	\$ -

TABLE 4: PARTICIPATION COST ALLOCATION

Cost Allocation	Electric	Gas
Wood Products	1%	1%
Nonmetallic mineral product manufacturing	1%	1%
Paper	1%	1%
Machinery manufacturing	6%	5%
Computer, electronic product manufacturing	2%	2%
Electrical equip, appliance manufacturing	6%	5%
Plastics, rubber prod manufacturing	2%	2%
Wholesale trade	1%	11%
Retail	9%	4%
Utilities	5%	1%
Construction	59%	61%
Professional services	8%	6%
Total	100%	100%

V. Results

We report the economic impacts of 14 energy efficiency programs based on their impact on GDP relative to a baseline GDP forecast of Rhode Island’s economy. This allows the model to measure the net change in GDP attributable to the programs under consideration. We note that the baseline scenario excludes the implementation of programs under review.

Our analysis also provides program GDP impacts in neighboring states within New England. Model results show that increased economic activity in Rhode Island creates growth in neighboring states through trade. In general, a portion of goods and services produced in Rhode Island is consumed by neighboring states as final consumption goods or as intermediate goods used in production. Increased production driven by increased energy efficiency in Rhode Island increases supply of Rhode Island exports (goods and services produced in Rhode Island) to the rest of New England, hence contributing to economic growth in the region. Goods and services produced in the rest of New England are similarly consumed in Rhode Island. Increased economic activity driven by energy efficiency in Rhode Island hence increases demand for goods and services produced in neighboring states, also contributing to economic growth in those states.

Table 5 summarizes economic impacts by program type and region (Rhode Island, the rest of New England, and all of New England). All results are in 2023 dollars and are rounded to the

nearest \$1000. We find that economic impacts, as measured by GDP, are positive for all program types at the state and regional level.

TABLE 5: ECONOMIC IMPACTS AS MEASURED BY GDP BY PROGRAM TYPE

All Programs	Economic Benefits (2023 Dollars)		
	RI	Rest of NE	NE Total
Electric Programs			
Residential Programs	\$ 48,465,000	\$ 13,633,000	\$ 62,098,000
Income Eligible Programs	\$ 27,293,000	\$ 7,107,000	\$ 34,401,000
Commercial & Industrial Programs	\$ 125,967,000	\$ 21,761,000	\$ 147,728,000
Electric Program Total	\$ 201,725,000	\$ 42,502,000	\$ 244,227,000
Gas Programs			
Residential Programs	\$ 22,873,000	\$ 3,896,000	\$ 26,769,000
Income Eligible Programs	\$ 15,707,000	\$ 2,788,000	\$ 18,495,000
Commercial & Industrial Programs	\$ 35,239,000	\$ 5,244,000	\$ 40,483,000
Gas Program Total	\$ 73,819,000	\$ 11,927,000	\$ 85,747,000
DR Programs			
Residential Programs	\$ 4,418,000	\$ 739,000	\$ 5,156,000
Commercial & Industrial Programs	\$ 16,949,000	\$ 3,032,000	\$ 19,981,000
DR Program Total	\$ 21,367,000	\$ 3,771,000	\$ 25,138,000
Grand Total	\$ 296,912,000	\$ 58,199,000	\$ 355,112,000

Tables 6 provides greater detail at the program level. We show that all economic impacts are positive for all programs. To capture the regional economic benefits relative to the cost of each program, we calculate program-specific economic impact multipliers. Economic impact multipliers are calculated as the total GDP impact over total program costs (the sum of participation and implementation costs). A multiplier value greater than unity indicates that economic benefits (GDP growth) exceed total program costs. Within Rhode Island, all programs, with the exception of the EnergyWise Single Family Gas Program, create economic benefits that are greater than total program costs. When economic growth in the rest of New England is considered, economic benefits exceed total costs for all programs.

We note that, in our 2019 analysis, the economic efficiency metric from the BC framework and the regional economic impact metric from the macroeconomic model were added together to provide one aggregate net benefits value. To use macroeconomic impacts as an additive term to the BC model's economic efficiency metric, the 2019 analysis adjusted the macroeconomic impact results to avoid double counting each programs' total net benefits.

In the current framework, the results output by the BC analysis and economic impact analysis are used as separate measures that quantify different aspects of the programs' contribution to economic growth. While the BCR model measures the direct net benefits to RIE and its ratepayers reflecting the economic efficiency of each program, BEYOND measures how those direct impacts, together with subsequent economic transactions that take place in the rest of the economy, affect gross regional product both within and outside of Rhode Island.

Considering the broader economy-wide impacts can be important especially when program costs, which generally contribute to lowering net benefits in a BC framework, create considerable economic activity in other sectors of the economy employed in the process of implementing those programs. The regional distribution of economic impacts within and outside of Rhode Island provides another assessment, one that indicates where the benefits are created, which may be important especially when benefits, while positive, fall disproportionately outside of Rhode Island. Indeed the Office of Management and Budget's current proposed revisions to benefit cost analysis recognize the need to examine distributional impacts (by location and other demographics) when evaluating government programs and investments.

Separating the BC analysis and economic impact assessment avoids the issue of "double counting" of net benefits that was considered in our 2019 report. The main issue has to do with whether the economic impact analysis captures benefits incremental to those accounted for in elements of the BC analysis. For instance, because the economic impacts calculated by BEYOND considers *all* economic activity involved in the implementation of RIE's EE and DR programs, the resulting macroeconomic impacts entail BC elements captured by the BCR model's direct net benefits (e.g., program expenses, energy savings). Concerns have hence previously been raised regarding whether GDP-based economic impacts can be added directly to the net benefits calculated through BC analyses.⁴ Brattle's 2019 report provides a framework in which double counting of net benefits is mitigated when the two metrics are added together. We however avoid this issue altogether by separating the results of the BC and economic impact analysis.

⁴ Woolf, Tim, Ben Havumaki, Steve Letendre, Caitlin Odom, Jamie Hall. "Macroeconomic Impacts of the Rhode Island Community Remote Net Metering Program." Synapse Energy Economics (2021).

TABLE 6: ECONOMIC IMPACTS AND MULTIPLIERS BY PROGRAM

Electric Programs	BEYOND Economic Impacts			Program Costs			Economic Multipliers	
	RI	Rest of NE	NE Total	Participation	Implementation	Total	RI	NE Total
Residential Programs								
Residential New Construction	\$ 3,707,000	\$ 1,024,000	\$ 4,731,000	\$ 634,571	\$ 1,591,952	\$ 2,226,524	1.66	2.12
ENERGY STAR® HVAC	\$ 11,343,000	\$ 3,714,000	\$ 15,058,000	\$ 2,464,497	\$ 5,340,777	\$ 7,805,274	1.45	1.93
EnergyWise Single Family	\$ 21,536,000	\$ 5,335,000	\$ 26,871,000	\$ 2,790,635	\$ 15,585,262	\$ 18,375,897	1.17	1.46
EnergyWise Multi Family	\$ 2,823,000	\$ 734,000	\$ 3,557,000	\$ 89,897	\$ 1,341,243	\$ 1,431,139	1.97	2.49
Home Energy Reports	\$ 4,658,000	\$ 1,418,000	\$ 6,075,000	\$ -	\$ 2,145,796	\$ 2,145,796	2.17	2.83
Residential Consumer Products	\$ 5,584,000	\$ 1,654,000	\$ 7,238,000	\$ 683,261	\$ 2,489,065	\$ 3,172,326	1.76	2.28
Residential ConnectedSolutions	\$ 4,418,000	\$ 739,000	\$ 5,156,000	\$ -	\$ 1,963,117	\$ 1,963,117	2.25	2.63
Low Income Programs								
Income Eligible Single Family	\$ 19,762,000	\$ 5,064,000	\$ 24,826,000	\$ -	\$ 11,843,223	\$ 11,843,223	1.67	2.10
Income Eligible Multi Family	\$ 7,900,000	\$ 2,130,000	\$ 10,030,000	\$ -	\$ 3,335,818	\$ 3,335,818	2.37	3.01
Commercial & Industrial Programs								
Large Commercial New Construction	\$ 42,476,000	\$ 7,320,000	\$ 49,795,000	\$ 648,465	\$ 8,269,222	\$ 8,917,688	4.76	5.58
Large Commercial and Industrial Retrofit	\$ 66,860,000	\$ 11,514,000	\$ 78,373,000	\$ 10,315,471	\$ 22,176,219	\$ 32,491,690	2.06	2.41
Small Business Direct Install	\$ 17,987,000	\$ 3,137,000	\$ 21,124,000	\$ 1,596,033	\$ 7,552,214	\$ 9,148,246	1.97	2.31
Commercial ConnectedSolutions	\$ 16,949,000	\$ 3,032,000	\$ 19,981,000	\$ -	\$ 5,666,840	\$ 5,666,840	2.99	3.53

Gas Programs	BEYOND Economic Impacts			Program Costs			Economic Multipliers	
	RI	Rest of NE	NE Total	Participation	Implementation	Total	RI	NE Total
Residential Programs								
Residential New Construction	\$ 1,097,000	\$ 169,000	\$ 1,266,000	\$ 301,051	\$ 621,520	\$ 922,572	1.19	1.37
ENERGY STAR® HVAC	\$ 7,718,000	\$ 1,288,000	\$ 9,006,000	\$ 3,718,720	\$ 3,586,881	\$ 7,305,601	1.06	1.23
EnergyWise Single Family	\$ 9,391,000	\$ 1,493,000	\$ 10,884,000	\$ 872,146	\$ 9,873,136	\$ 10,745,282	0.87	1.01
EnergyWise Multi Family	\$ 3,769,000	\$ 714,000	\$ 4,483,000	\$ 150,143	\$ 1,485,405	\$ 1,635,548	2.30	2.74
Home Energy Reports	\$ 1,000,000	\$ 219,000	\$ 1,219,000	\$ -	\$ 360,501	\$ 360,501	2.77	3.38
Low Income Programs								
Income Eligible Single Family	\$ 8,301,000	\$ 1,420,000	\$ 9,721,000	\$ -	\$ 5,428,988	\$ 5,428,988	1.53	1.79
Income Eligible Multi Family	\$ 7,428,000	\$ 1,369,000	\$ 8,797,000	\$ -	\$ 3,215,429	\$ 3,215,429	2.31	2.74
Commercial & Industrial Programs								
Large Commercial New Construction	\$ 15,209,000	\$ 2,418,000	\$ 17,627,000	\$ 60,465	\$ 2,818,656	\$ 2,879,121	5.28	6.12
Large Commercial and Industrial Retrofit	\$ 13,797,000	\$ 1,818,000	\$ 15,615,000	\$ 2,537,209	\$ 4,639,594	\$ 7,176,803	1.92	2.18
Small Business Direct Install	\$ 2,141,000	\$ 289,000	\$ 2,430,000	\$ 166,338	\$ 689,833	\$ 856,171	2.50	2.84
Commercial and Industrial Multi Family	\$ 4,160,000	\$ 724,000	\$ 4,884,000	\$ 309,925	\$ 891,250	\$ 1,201,175	3.46	4.07

** Economic multipliers were calculated as calculated as the total GDP impact over total program costs (participation and implementation costs)*

Appendix A: BEYOND Model

The BEYOND model is a dynamic computable general equilibrium (CGE) model of the US economy. It simulates the interactions between all key institutions in the economy (industries, households and government) based on the circular flow of economic activity. Households purchase goods and services using the income they earn from providing labor and capital to businesses; businesses produce goods and services demanded by the economy and pay wages and capital rent to households using the revenue earned from production; the government collects taxes from households and businesses to pay for government expenditures and provide subsidies and other benefits to the economy. CGE models are based on a well-established economic literature and are generally accepted as reliable modeling tools to estimate economic impacts.⁵

BEYOND uses open-source government data as model inputs to characterize the US economy. The model represents 50 states plus Washington, D.C.; 11 aggregate economic sectors that account for 71 industries; and five representative households defined by income levels. The build-stream used to create BEYOND's input data is based on the build-stream developed by the Wisconsin National Data Consortium (WiNDC), a research group that facilitates the creation and documentation of open source multisectoral economic datasets for US states.⁶

The representation of regional economic sectors in the model, which is based on national level input-output data published by the Bureau of Economic Analysis (BEA), account for all commodity supply and use activities in the economy. National level input-output data are regionalized using data inputs such as the Commodity Flow Survey (CFS) from the Census Bureau. Economic behavior of households is modeled by income group using Statistics of Income (SOI) data from the Internal Revenue Service (IRS). Lastly, the State Energy Data System (SEDS) published by the Energy Information Administration (EIA) is used to accurately represent supply and demand of energy resources by final demand and sectors.

⁵ See e.g., Wing, Ian Sue. "Computable general equilibrium models and their use in economy-wide policy analysis." Technical Note, Joint Program on the Science and Policy of Global Change, MIT (2004).

⁶ Rutherford et al. <https://windc.wisc.edu/>

The dynamics of the model are determined by both exogenous and endogenous factors. Exogenous factors include reference scenario GDP growth, labor supply, and productivity growth. Savings and investment activities are determined endogenously.

An equilibrium is found by equating supply of goods to demand (market clearance condition for goods); supply of labor and capital to demand (market clearance condition for factors); household expenditures to income (income balance condition); and producer costs to revenue (zero-profit condition).

The economic sectors represented in BEYOND are as follows:

- Petroleum refineries
- Crude oil extraction
- Natural gas extraction
- Coal mining
- Electric power generation, transmission and distribution
- Transportation
- Construction
- Energy and emissions intensive sectors (embodied carbon greater than 0.5 kg/\$)
- Manufacturing sectors
- Services sectors
- Rest of economy

Key model outputs include:

- US gross domestic product
- Household consumption
- Labor income and wage rates
- Economy-wide fuel consumption
- Sectoral output and prices