Review of RI Test and Proposed Methodology

PREPARED FOR

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Executive Summary

National Grid asked the Brattle Group to review the current methodology for determining the economic benefits associated with the "Rhode Island Test."

We have some concerns with the current methodology, but believe there are relatively simple adjustments to how economic benefits are calculated that would allow an economic benefits calculation that is free of double counting and represents the potential impacts of National Grid's energy efficiency (including CHP) and demand response programs on the Rhode Island economy in an unbiased fashion.

Our major recommendations are to adjust the current methodology by a) including **net** (rather than gross) changes in spending; and b) to add consideration of the net impact of changes in disposable income as a result of the evaluated programs.

With respect to a), the current methodology in the Rhode Island Benefit Cost Test (RI Test) would focus on the economic impact of program spending on the Rhode Island economy. However, this approach only analyzes the "gross" impact of the evaluated programs and fails to take into consideration that a major component of energy efficiency (including CHP) and demand response programs is **avoided** (emphasis added) spending. A proper evaluation of the economic impacts of an evaluated program therefore needs to consider the impact of program spending net of avoided spending, hence focus on net incremental spending due to an evaluated program.

With respect to b), the current methodology omits calculating the impact of customer savings on the Rhode Island economy, ostensibly to avoid double counting of benefits. However, while customer savings are indeed already being captured by existing benefit-cost tests, such tests do not capture the "ripple effects" of changes in disposable income on the Rhode Island economy and thus potentially underestimate the economic benefits of the evaluated programs. As with a), it is important that the economic benefits be evaluated on a "net" basis so that only the portion of economic impacts not already captured by existing benefit-cost metrics are being counted.

We lay out a simple approach for implementing these improvements to the proposed economic impact methodology, which builds largely on National Grid's use of the REMI model, a widely respected macro-economic model that can be used to derive reasonable and unbiased estimates of the economic benefits of evaluated programs under the Rhode Island test.

I. Overview and Terminology

We were asked by National Grid to evaluate past approaches to estimating the economic impacts of energy efficiency programs and to propose a methodology for estimating such impacts for energy efficiency (EE) and demand response (DR) programs and Combined Heat and Power (CHP) projects for inclusion as required by the Rhode Island Benefit Cost Test (RI Test).[1] National Grid has also asked us to prepare an analysis of the economic development impacts of these programs. This includes the creation of a multiplier to assist in future updates to economic impact estimates.

While CHP is an eligible measure within National Grid's Large Commercial and Industrial Retrofit program, there are inherent differences between EE and CHP projects that result in a somewhat different allocation to macroeconomic sectors. Therefore, this report provides a specific methodology for the creation of a CHP multiplier.

This report includes two parts. Part 1 outlines the methodology we propose to estimate the economic impacts of National Grid's energy efficiency and demand response programs and CHP projects. The method we propose is designed to accurately measure these impacts while avoiding double counting with other elements of the test and to coordinate with other planning and evaluation efforts undertaken by National Grid. Part 2 presents the findings of the economic impact analysis completed in conjunction with National Grid.

Before describing our proposed method to implementing an approach to estimate the economic benefits as part of the RI Test while avoiding double counting issues, we first summarize some basic concepts related to the measurement of benefits and costs of energy efficiency (including CHP) and demand response programs.

First, it is important to make the distinction that while all of the benefits and costs within the RI Test are appropriate for inclusion in benefit/cost (B/C) metrics; several of these benefits are not easily monetized for inclusion in an economic impact assessment. For the purpose of this study, we refer to these as non-monetary benefits and do not include them in our economic impact assessment, even though some of them could have significant ultimate economic impacts. For example, the value of greenhouse gas (GHG) emissions reductions beyond RGGI requirements likely reflects "avoided costs" to society that would have real economic consequences in the long run. These avoided costs would then translate into higher disposable income at some point in the future. However, over the forecast horizon considered by the analysis, the quantification of the impacts of lowered GHG emissions on disposable income (and the reduction in spending, for example on climate change adaptation measures, is highly uncertain. For these reasons, we propose

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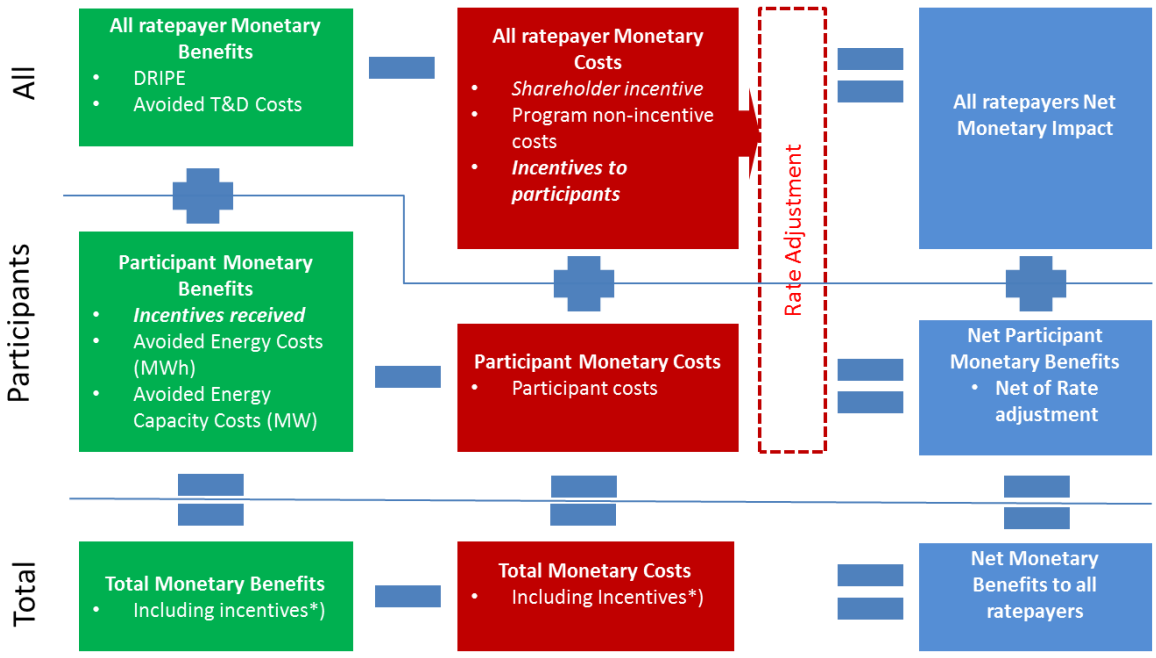
[1] The Rhode Island PUC established a Framework for Cost-Benefit Analysis Section 1.2(B) of the Least Cost Procurement Standard for the procurement of energy efficiency resources, approved by the Rhode Island PUC in Docket 4684.

not to attempt to estimate the economic impacts of certain benefits (and costs) in the economic benefits calculation for the RI Test. Such non-monetized benefits include avoided GHG emissions (beyond those monetized through the RGGI program), NOx emissions reductions, improved thermal comfort, noise reduction, property value increases, national security benefits, health benefits, reduced tenant complaints, improved safety, reduced safety related emergency calls and improved lighting quality.

Second, as illustrated in Figure 1, (monetary) benefits and costs accrue to two types of parties: participants and all ratepayers/customers. All customers (participants and non-participants) benefit from lower wholesale prices (Demand Reduction Induced Price Effects - DRIPE) and avoided Transmission and Distribution (T&D) costs, all of which, all else equal, lower customer retail rates, and all participants pay the program costs for energy efficiency (including CHP) and demand response programs, which National Grid recovers through adders to its retail rates. Program participants may in addition incur their own costs to participate, but also receive monetary benefits in the form of rebates and lower electricity consumption.[2]

Figure 1: Treatment of (participant and non-participant) net monetary customer savings



*) Incentives are a transfer from (non-participating) to participating ratepayers and don't affect net monetary benefits across all ratepayers

All National Grid program costs (including rebates) are recovered from all ratepayers through retail rate adders. As a consequence, program participants' net monetary benefits equal their private

[2] Some customers (residential) don't pay for capacity separately. However, since their electricity rate will include a component to include capacity, avoided capacity costs flow into lower electricity costs for those customers through lower electricity consumption.

monetary benefits (lower electricity bills, rebates) and benefits accruing to all ratepayers (lower electricity rates due to DRIPE plus lower distribution and transmission rates due to avoided T&D expenses) minus the impact of any increase electricity rates due to National Grid recovering its total program costs). "Non-participants" net benefits are equal to the change in their electricity bills due to the changes in electric rates, which could be positive or negative, depending on whether the factors putting downward pressure on rates (DRIPE, avoided T&D costs) are larger or smaller than the factors putting upward pressure on rates (National Grid recovering its program costs via rate adders). Importantly, and as shown in Figure 1 above as the final row, the total net benefit to all ratepayers is the sum of participant and non-participant (all) (monetary) benefits minus participant and utility (monetary) costs. These net monetary benefits to all ratepayers represent "net customer savings" that can have additional impacts on the Rhode Island economy to the extent they are spent in Rhode Island.

II. RI Test Methodology Review

A. RI Test Description

The Rhode Island Public Utilities Commission (RIPUC) revised its Total Resource Cost Effectiveness Standard to include both economic development and environmental benefits, and to align with the new Cost-Benefit Framework, renaming it the RI Test.[3] This test is to be applied to energy efficiency (including CHP) and demand response programs. National Grid presented its first RI Test results to the RIPUC.[4]

The revised cost-benefit test, the RI Test, incorporates non-embedded greenhouse gas reductions (reductions not already captured in baseline avoided costs) and economic development impacts. The focus here is on the latter impact.

The elements of the RI Test are as follows:

Benefits:

1. Electric Energy Benefits
2. Electric Generation Capacity Benefits
3. Electric Transmission Capacity and Distribution Capacity Benefits
4. Natural Gas Benefits
5. Fuel Benefits (including the value of delivered fuel savings from programs that influence delivered fuel consumption)
6. Water and Sewer Benefits

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[3] See for example, Danny Musher, RI Office of Energy Resources, "Overview of Rhode Island Cost-Effectiveness Practice, June 15, 2017.

[4] National Grid, Overview of RI Test, Rhode Island Public Utilities Commission, Technical Session RIPUC Docket 4684, September 13, 2017.

7. Non-Energy impacts
8. Price Effects
9. Non-embedded Greenhouse Gas Reduction Benefits
10. Economic Development Benefits
11. Non-embedded NOx Reduction Benefits
12. Value of Improved Reliability

Sum of 1 through 12 on a present value basis for the program lifetime

Costs:

1. Participant costs
2. Utility Cost
    - Participant incentives, Evaluation, Marketing, Sales/Technical Assistance, Evaluation, Company Shareholder Incentive

Sum of 1 through 3 on a present value basis for the first year of the program.

The test equation is stated as:

Benefit Cost Ratio (BCR) = the Present Value of Total Benefits/the Present Value of Total Costs

National Grid routinely estimates benefits 1-9 and 11-12 as well as all of the cost categories. The main purpose of this report is to propose and implement a methodology for benefit item 10 while avoiding potential double counting of the other benefits.

B. Concerns Regarding Economic Impact Evaluations under the RI Test

In this section, we review the current methodology for calculating economic impacts, and how National Grid incorporates those impacts in the RI Test.

1. Background

The Least Cost Procurement Standards that dictate the RI Test does not prescribe a definition of what constitutes the newly added economic impacts component or the appropriate method to measure this component.[5] However, a presentation by the RI Office of Energy Resources at the RIPUC in June 2017[6] suggested three contributing components to economic impacts of energy efficiency (including CHP) and demand response programs: 1) participant bill savings; 2) customer

[5] Least Cost Procurement Standards (Standards) approved at the Open Meeting on April 27, 2017 in Docket 4684

[6] Danny Musher, RI Office of Energy Resources, "Overview of Rhode Island Cost-Effectiveness Practice, June 15, 2017.

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costs; and 3) program/participant costs. The RIPUC presentation indicated that the first two elements are already accounted for in previously performed B/C tests, leaving the third element to be measured as the change in Gross Domestic Product (GDP) associated with program and participant spending. This change could be calculated by applying a GDP multiplier to dollars spent.[7]

National Grid had previously conducted a study, "Macroeconomic Impacts of Rhode Island Energy Efficiency Investments: REMI Analysis of National Grid's Energy Efficiency Programs", using REMI, a commercial macroeconomic model.[8] This study took into account 1) construction impacts from program and participant spending; 2) bill savings to customers resulting in increased customer spending on good and services; and 3) increased rates and participant investment costs, which will partially offset the impact of bill savings (i.e., potential economic impacts depend on customer spending of savings due to programs net of program and participant costs) resulting in economic multipliers per dollar of spending on energy efficiency and CHP measures.

In a September 2017 presentation to the RIPUC,[9] National Grid explained how it utilized the GDP multiplier resulting from the REMI analysis in the RI Test in a representation of the economic benefits of energy efficiency and CHP.[10] As indicated in this presentation and in Attachment 4 of its 2018 Annual Energy Efficiency Plan, the Company indicated that it was concerned that the benefit of bill savings to customers was already accounted for in benefit/cost screening since the value of all energy savings was already included as a monetary benefit. In addition, the impact of customer costs was also already included as a negative dollar benefit. Therefore, National Grid only used the resulting REMI multipliers associated with the construction impacts to avoid potential double counting.

2. Potential concerns with most recent approach

We have two concerns with the current approach to estimating economic impacts. The first relates to the treatment of items deemed already covered by existing B/C tests and their exclusion due to the potential for double counting. The second has to do with estimating the economic impact of program and customer spending. We discuss our potential concerns with each of these next.

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7 Ibid, page 6.

8 Ibid, page 17. See also National Grid Customer Department, Macroeconomic Impacts of Rhode Island Energy Efficiency Investments, REMI Analysis of National Grid's Energy Efficiency Programs, October 2014.

9 National Grid, Overview of Rhode Island Test, Rhode Island Public Utilities Commission, Technical Session, RIPUC Docket No. 4684, September 13, 2017

10 Ibid, page 16.

a. The current approach to avoid double counting understates the economic impact

National Grid correctly identifies ratepayer benefits and costs to be already reflected in the existing B/C test. Any estimate of the economic impact of energy efficiency (including CHP) and demand response programs, such as an estimate of GDP impacts of these programs, would also include these same benefits. However, current B/C tests only reflect the **direct** (emphasis added) savings to customers. They do not reflect some additional economic impacts, sometimes called indirect and induced impacts, resulting from net consumer savings from the evaluated programs. As highlighted in Figure 1 above, energy efficiency (including CHP) and demand response programs (if cost-effective) will likely lead to net monetary savings to all ratepayers in the aggregate. Some of these monetary savings will be spent on goods and services, and this additional spending can have an impact on the Rhode Island economy. Ignoring these indirect effects on the Rhode Island economy therefore likely understates the economic impact of the programs under consideration. Put differently, there is likely a multiplier affect associated with increased disposable income resulting from the programs and the currently proposed approach (and the one most recently applied by National Grid) ignores this multiplier effect. Our proposed approach, outlined below, therefore is to include this multiplier (and still avoids double counting).

b. Measurement of construction impacts must be on a net basis to correctly capture the incremental benefit of the programs

National Grid's current methodology to measure incremental economic impacts suggests analyzing the economic impact of program and (incremental) participant spending on the Rhode Island economy to develop a multiplier for this effect. This approach captures the economic impact of program related **gross spending** (emphasis added) by both National Grid and participants. However, as is clear from the benefit and cost categories under existing B/C tests, most of the benefits of these programs are **avoided spending** (emphasis added) on energy (electricity, gas), capacity (generation, transmission and distribution). By focusing on gross spending, the proposed methodology fails to take into the account the economic impacts on Rhode Island of reductions in spending under the programs that would have occurred in the absence of these programs. By doing so, the proposed methodology likely overestimates the economic impact of the programs, even though the exact size of the bias depends on the impact on Rhode Island of the program related spending versus the spending avoided by the programs. The relative impact of either depends on the sectors, in which both gross and avoided spending occur. As we describe below, we propose to develop estimates of **net spending** (emphasis added) due to the evaluated programs as the basis for developing multipliers.

III. Proposed Approach

A. Measuring Economic Impacts

There is no detailed discussion in the documents referenced above regarding how economic impacts should be quantified in the RI Test.[11] A review of economic impact analyses of energy efficiency programs including in particular a study conducted by the U.S. Environmental Protection Agency[12] indicates that a range of measures are often used to determine such programs' impacts on the local economy including:

- Jobs (defined variously as full-time equivalents (FTEs), job years, payroll, and labor income)
- Personal income
- Gross output
- Value added or Gross Domestic Product (GDP) (state product)
- Taxes and fees

The RIPUC presentations referenced above focused on GDP although reference is also made to employment and jobs. The same is true for National Grid's 2014 study. We conclude that State GDP is indeed the correct measure to be added to benefits in the RI Test for the reasons detailed below. GDP is defined as value added. Value added is defined as:

Value added = profits – depreciation cost + labor cost

Thus, GDP is sometimes referred to as industry contribution to the economy. Industry is broadly defined here to include economic activity by all sectors of the economy. In contrast the benefits (other than economic impacts) considered in the RI Test are all related to energy consumers. Avoided costs result in lower rates to consumers; investments in energy efficiency provide energy savings to consumers.

B. Measuring Net Impacts

As highlighted above, the impacts of the evaluated programs must be compared against a baseline. The baseline should reflect the projected economic activity absent the evaluated programs. The data to estimate net impacts are available because they are captured as part of the benefits and costs calculations under current B/C tests. For example, avoided costs reflect capacity and energy investments that would be made absent the efficiency programs. This investment will result in

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[11] These sources are listed in notes 3, 4, and 6 above.

[12] See for example U.S. Environmental Protection Agency, "Quantifying the Multiple Benefits of Energy Efficiency and Renewable Energy, A Guide to State and Local Governments, Part 2, Chapter 5, 2018 Edition

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construction and operations employment, higher sales, and more taxes. Thus, it is possible that on net, more jobs would be added under the baseline than with the efficiency program. Our work for Rhode Island on renewables impacts[13] found this to be the case in several years under certain scenarios because of differences in labor requirements and customer cash flow effects (higher upfront spending and lower disposable income, but more savings and higher disposable income in later years).

IV. Proposed Methodology

Based on these findings, our review of National Grid's 2014 REMI study with supporting data and discussions with National Grid staff, we believe that with modest refinements designed to avoid double counting and to properly estimate net impacts of programs the method National Grid used previously and which relied on REMI will provide a reliable basis for estimating the economic impact component of the RI Test.[14] The EPA study referred to above considers this method for estimating economic impacts a reasonable approach. REMI has been widely used for this purpose and offers several benefits including state level data and the ability to account for the influence of price as well as spending. REMI is a commercial economic market simulation model that National Grid licenses. REMI provides the means to estimate economic impacts attributable to energy efficiency programs measured in terms of value added, gross output, employment and taxes. The proposed methodology requires the careful determination of how much is spent, and on what, for each of the programs being evaluated. While both the levels, as well as the categories, of spending likely differ between the various energy efficiency programs as well as between energy efficiency measures on the one hand, and DR and CHP programs on the other hand, the methodology described below will be applicable across all programs, for which economic impacts are to be estimated.

Figure 2 below summarizes our proposed approach. It shows how the existing Benefit-Cost framework can be used to develop inputs for the economic impact assessment and how the results of the economic impact assessment can be adjusted to derive a measure of "net incremental economic impact", i.e. a measure of additional impacts of National Grid's energy efficiency (including CHP) and demand response programs in Rhode Island not already captured by its standard economic benefit cost methodology.

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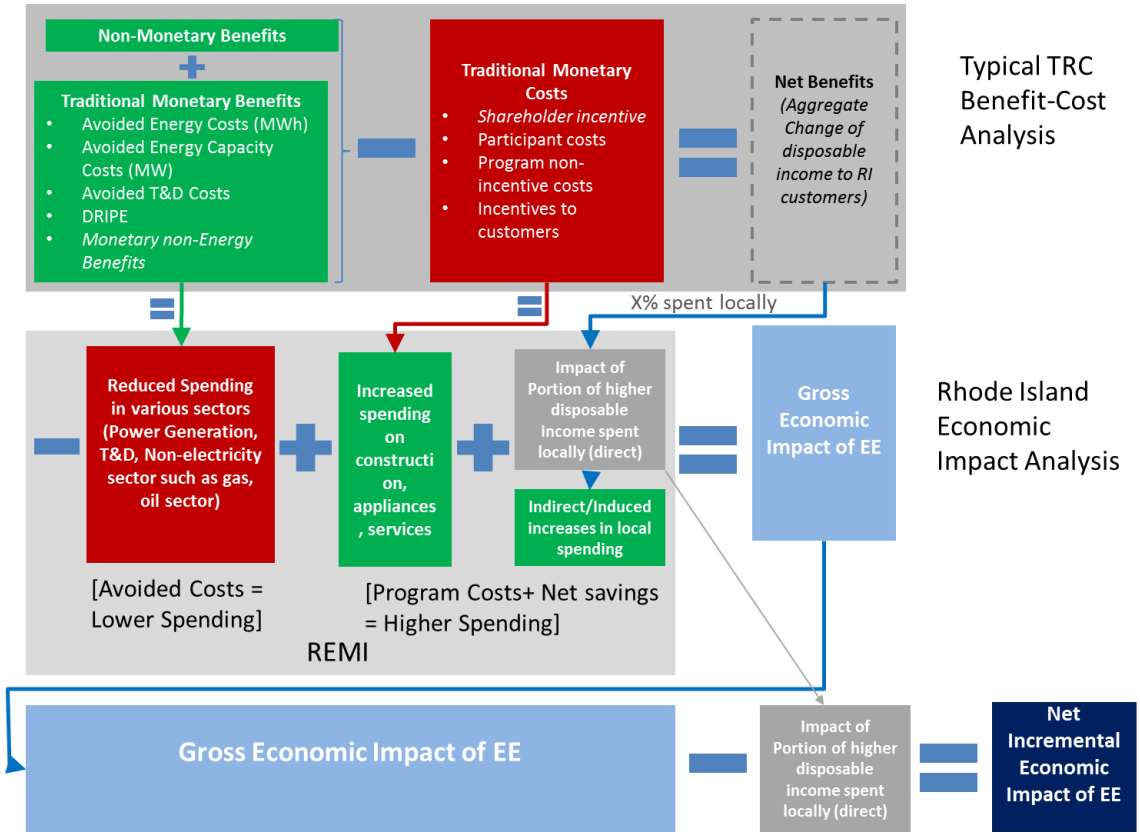
[13] Jurgen Weiss and Mark Berkman, "Renewable Energy Growth Program Analysis, Economic, Jobs, and Environmental Impacts for Program Years 2015 and 2016 and the Overall Program Years 2015 to 2019," Prepared for the Rhode Island Office of Energy Resources and Rhode Island Distributed Energy Board, by The Brattle Group, May 12, 2017.

[14] We have been in discussion with Courtney Lane and Al Morrissey of National Grid.

Figure 2: Schematic Overview of Proposed Economic Impact Methodology for RI Test



In its current benefit-cost methodology, National Grid calculates Net Benefits (and resulting B/C ratios) by estimating savings primarily in the form of avoided costs in the electric and natural gas sectors.[15] It also estimates program and participant costs. The difference between savings and costs is a measure of net benefits. With the exception of shareholder incentives, which increase disposable income to National Grid's shareholders, these net benefits are passed on to National Grid's Rhode Island customers and increase their disposable income.[16] Existing B/C calculations by National Grid already calculate this net monetized benefit as an aggregate (i.e. in dollars) per measure and program, even though the split of net benefits is likely different for program participants and non-participants.[17] However, this total net monetary benefit across all customers/ratepayers represents not only the monetary value of the overall efficiency gain

15 National Grid also estimates the benefits of avoided non-embedded greenhouse gas emissions and non-energy benefits. As described above they are not included in the economic benefit estimate.

16 It is conceivable that some National Grid shareholders also spend part of their increased disposable income in ways that impact the Rhode Island economy. We propose not to consider this potential effect.

17 More specifically, National Grid calculates direct benefits to program participants, DRIPE benefits that accrue to all customers (program participants and non-participants), and the rate increase required to pay for program costs and shareholder incentive, which is recovered from all customers. The net of the aggregated benefits and costs constitute increases to Rhode Island consumer disposable income.

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resulting from the evaluated programs; it also represents the change in disposable income to National Grid's Rhode Island customers/ratepayers.

Since the change in disposable income (the net monetary savings) may be spent on goods and services that have an impact on the Rhode Island economy, this measure is one of three important ingredients in an economic impact test (as described above) and, given that National Grid's current estimates exclude it from consideration, should be added. This can be done without double counting, as described further below.

The other two inputs are increases and decreases in direct spending. As Figure 2 illustrates, the direct benefits of evaluated programs, i.e. avoided monetary costs,[18] represent a **decrease** in spending relative to a world without these programs. All else equal, they would be expected to reduce economic activity including potentially in Rhode Island. These decreases in spending have not previously been reflected in National Grid's economic impact assessments or proposed to be included in the economic benefits calculation under the RI Test, but, to avoid overestimating the impacts from National Grid's programs should be reflected in a modified economic impact analysis. Program costs have previously been included and should continue to be included: They result in **increases** in spending relative to a "but-for world" without these programs.

Hence, any economic impact analysis using REMI performed for individual energy efficiency (including CHP) and demand response programs would consist in a) assigning the decreases (avoided monetary costs) in spending as well as the increases (program and customer costs) in spending to individual REMI sectors and to increase household and commercial spending proportionally to the three customer classes' net savings from each evaluated program.[19] With these inputs, REMI will estimate state GDP impacts.

However, these impacts will be "gross" in the sense that they include the direct impact on the Rhode Island economy of a portion of customers' financial savings from the programs. To illustrate this point, assume that the traditional B/C calculation determines a net increase in average customer disposable income of $200/year. If a customer is assumed to spend 75% of additional disposable income on goods and services in Rhode Island, the REMI model would assume a **direct** increase in economic activity of $150 (75% of $200). In addition, the $150 of extra spending in Rhode Island would have indirect and induced effects – additional spending on a restaurant visit would lead to higher income to restaurant employees, some of which would again be spent in Rhode Island. The REMI analysis estimates the direct, indirect and induced economic impact of

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[18] This includes all benefits that represent avoided spending that would have occurred absent the evaluated programs since these avoided costs would have resulted in economic activity absent the evaluate programs. They include lower spending on energy through lower prices (DRIPE) for energy and capacity, lower purchases of energy and capacity (MWh and MW savings), lower expenditure on T&D infrastructure, and potentially lower spending on natural gas and other fuels.

[19] The same methodology can be used to assess economic benefits at an aggregated or disaggregated level, *i.e.*, for a collection of measures, individual programs or across programs.

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the programs. Yet clearly counting both the $200 in additional disposable income and the $150 in direct economic activity as savings would be double counting, and this is likely the reason why the economic impact of increased disposable income has not been included in past economic impact assessments. Therefore, to determine "net incremental" economic impacts therefore requires subtracting from the gross estimate the direct impact of the portion of increased disposable income being spent in Rhode Island (i.e., the gray box at the bottom of Figure 2 above or $150 in the example).[20] Only the resulting net incremental benefits estimated should be added as the economic impact benefit (#10 in the list above).

A Rhode Island Test benefit cost ratio including the economic impact component is then calculated as the ratio of total benefits divided by total costs.

V. Implementation

In this section we describe how the proposed methodology would be implemented. Since National Grid evaluates cost-effectiveness at the measure and program level, the above methodology needs to be translated into measuring economic impacts at the measure and/or program level as well.

A. Energy Efficiency

For each of the evaluated programs, National Grid estimates, on an annual basis, various categories of costs and benefits, which mirror the costs and benefits required by the RI Test and which were described above. Costs associated with customer incentives are captured at the measure level, but all other costs such as marketing, sales and technical assistance, and evaluation activities are measured at the program level. In addition, shareholder incentive costs are captured at the sector level, and regulatory costs at the portfolio level.

National Grid currently (as of 2018) calculates benefits and costs for 223 measure/program combinations in its energy efficiency programs. This likely makes developing (annual) economic impact estimates for each measure/program combination impractical, given the resulting need to run the REMI model 223 times to develop economic impact estimates. We also note that, since measures will be deployed at the same time and as a bundle, estimating the economic impact by individual measure may miss interaction effects when measures are deployed in combination.

For these two reasons, we propose that at least initially economic impacts should be estimated at the program level (except for CHP) and the resulting multipliers applied at the measure level when evaluating the cost-effectiveness of individual measures. While not providing the level of

[20] Existing B/C tests may calculate the net benefit including both monetary and non-monetary benefits. As discussed above, for the economic benefits evaluation only monetary savings should be included. Therefore, to adjust REMI results from gross to net, only the net **monetary** (emphasis added) customer savings calculated in existing B/C tests should be subtracted from the REMI economic benefit estimates to determine the incremental economic benefits due to the evaluated programs.

granularity, doing so would still inform potential shifts in the relative spending among programs to reflect potentially asymmetric economic impacts on Rhode Island.

To better inform program design through changes in measure mix, we propose, as an ongoing research activity, to periodically assess the economic impacts of "measure groups", i.e., measures that are broadly similar in both their benefit and cost pattern (similar ultimate measures and hence similar economic activity, similar ratio of program expense, similar impact on avoided cost categories).

B. Combined Heat and Power (CHP)

The Least Cost Procurement Standards and R.I.Gen.Laws §39-1-27.7(c) (6)(iii) direct National Grid to incorporate the economic development benefits of CHP in Rhode Island as part of its cost-effectiveness screening.

CHP projects impact the economy in similar ways to EE and DR programs. The costs estimated include both customer and incentive costs. Just like EE programs, CHP costs become "additional spending" in affected REMI sectors. Similarly, National Grid estimates electricity savings. It includes a negative savings estimate for gas, indicating that the avoided electricity costs (from purchases) come at the expense of having to purchase natural gas. Therefore, the (negative) natural gas "savings" should be treated as additional expenditures for the natural gas sector in REMI. If operation and maintenance (O&M) expenses are available for a project, they should be treated like other costs in REMI, i.e., as increases in spending in the affected sectors. As with EE, National Grid separately estimates energy and capacity benefits from CHP. The monetized savings represent reduced spending in the electricity sector in REMI. As with EE programs, National Grid already estimates annual and lifetime net monetary savings from any of the assumed CHP projects. Just with the Net Benefits for EE programs, these savings represent additional income and should be added to REMI as such (most likely accruing to the industrial sector) to estimate the gross incremental economic impact of CHP. To estimate the net incremental economic impact, the portion of net savings assumed to be spent in Rhode Island (the direct impact of increased consumer spending due to higher income) should be removed from the REMI estimated increase in state GDP.

While CHP projects have the same kind of economic impacts as EE and DR programs, there are some inherent differences that require a somewhat different treatment. For example, unlike EE and DR programs, CHP programs lead to net energy savings by increasing consumption of natural gas as a fuel for the CHP, but reducing the purchase of electricity in a way that leads to net savings to consumers (and society, since CHP increases the efficiency of the combined production of heat and power). We have reviewed the approach for estimating net savings from CHP and concluded that it properly incorporates this idiosyncrasy. Also, given that CHP projects involve different spending patterns (for example on a power plant) than EE and DR programs, it leads to a different allocation to macroeconomic sectors within REMI. Because the relative share of spending across CHP projects can vary substantially by project and CHP projects tend to be sizable, National Grid proposes to screen projects individually if they are greater than 3 MW. We believe that this is a

reasonable approach to balance insights that can be gained from a project-by-project analysis with the additional effort required to develop a project-level analysis.

CHP projects tend to have a large portion of total spending used to purchase cogeneration equipment that is produced outside of the region and has no local economic impact.

To account for the fact that CHP equipment is likely purchased outside Rhode Island, the previous National Grid macroeconomic study included 60% of the CHP project spending benefits as an increase in final demand in the construction industry within REMI. This is the portion of total CHP spending used to install cogeneration equipment at C&I facilities, based on an existing sampling of CHP data. The remaining 40% of spending is assumed to be used to purchase equipment from outside of the region, and was not included in the analysis.

We find that this assumption is reasonable for future determination of economic multipliers for CHP projects.

National Grid's previous CHP economic multiplier was based off the costs and benefits from a sampling of representative CHP projects. This multiplier was then used in cost-effectiveness screening for CHP projects. It is appropriate for National Grid to develop a CHP multiplier based off a sampling of CHP projects using the methodology outlined in this report for use in screening future CHP projects below 3 MW in size. However, larger CHP projects above 3 MW in size should use project-specific inputs to the REMI model.

C. Demand Response

Demand Response (DR) programs are a new offering in 2019 and therefore the Company did not develop an economic benefit multiplier in its previous REMI analysis. To develop net incremental economic benefit measures for demand response programs, the same basic principles apply as with EE programs. As with EE, DR programs involve program and customer costs as well as incentives. Benefits from DR programs consist primarily of a combination of reduced electricity (or gas) consumption (although the majority of benefits likely come from shifting of demand to lower cost periods rather than a reduction in demand) and the purchase of electricity/gas at lower prices (at least from the wholesale market perspective). Hence, the benefits from DR programs can be estimated as the combined effect of lower consumption at lower cost, again expressed in aggregate savings per year. These savings are partially offset by DR related costs, both program and customer costs (administration, marketing, but also potentially hardware such as smart thermostats, stand-by equipment, etc.). One potential difference with EE programs concerns the treatment of "incentives". With EE programs, incentives (rebates) are generally designed to compensate for the difference between what a consumer would otherwise spend on some piece of equipment (say a normal refrigerator) and its energy efficient equivalent. With DR, incentive payments may be compensating for such incremental costs (like a smart versus a non-smart thermostat), but more often they may simply represent a participation incentive to entice participation (and essentially compensate for inconvenience). In that case, incentive payments do not represent (net) program expenditures, since they represent only a transfer from all ratepayers to participating ratepayers

(via National Grid), with no incremental spending by DR program participants related to the incentives. As a consequence, DR incentive payments should not be included in the REMI model as additional spending. As with EE and CHP, any cost will have to be allocated to appropriate REMI sectors. The monetary savings (in the form of lower electricity purchase costs) represent reductions on spending for the electricity sector (as with EE and CHP). The net savings (total savings from DR programs minus National Grid and participant costs) still represent incremental disposable income, (some of) which is spent. Hence, with the potential exception of the treatment of "incentives", the economic test for DR programs is conceptually identical to the economic benefit tests for EE and CHP.[21]

D. Practical Process of Implementing Program Level Economic Impact Test

National Grid already collects all or almost all the information necessary to assess the economic impact at the program level for EE DR programs and CHP projects by estimating program benefits and costs including program costs at that level.

To estimate economic impacts for each program and CHP project therefore requires primarily an "allocation" of both monetary benefits and costs at the program or CHP project level to various REMI sectors. The estimation of economic benefits should exclude from consideration non-monetary benefits such as emissions related benefits not captured with current environmental markets such as RGGI and various non-energy benefits listed above).[22]

There are 3 categories of benefits and costs to be considered:

Estimated benefits = avoided costs: The benefits **to be included** in the economic impact test include:

- Electricity sector avoided costs
  - Energy [EE, CHP, minimally for DR]
  - Capacity [EE, CHP, DR]
  - Transmission and distribution [EE, CHP, DR]
  - Energy DRIPE [EE, CHP, DR]
  - Capacity DRIPE [EE, CHP, DR]

- Oil and gas fuel savings [EE]

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[21] There are of course differences in the macroeconomic sectors to which savings and costs need to be allocated and the distribution of increased and reduced spending across these sectors.

[22] This does not mean that such benefits will no longer be part of the B/C test. It only means that they are not included in the estimation of the economic impacts of the evaluated programs since only monetary savings will have the kinds of economic impacts that can be evaluated within REMI.

National Grid already calculates these benefits on an annual basis. Once an allocation to REMI sectors for each benefits category is made, assumed spending in those sectors would be assumed to be REDUCED by the amount of annual savings.

Estimated costs: The costs to be included consist of National Grid and customer costs. The sum of National Grid Program costs gets recovered from all customers via an EE charge. National Grid and customer costs include:

- National Grid Program Costs
  - Program Planning and Administration [EE, CHP, DR]
  - Marketing [EE, CHP, DR]
  - Sales and Technical Assistance and Training [EE, CHP, DR]
  - Evaluation and Market Research [EE, CHP, DR]
  - Regulatory Costs [EE, CHP, DR]
  - Rebates and Other Incentives [EE, CHP, likely not DR unless offsetting participant costs]
  - Shareholder Incentives [does not result in additional spending in REMI, but impacts customer/ratepayer net monetary savings]
- Participant Costs
  - Costs not covered by rebates [EE, CHP, DR]

Finally, the economic benefit analysis should consider the **net monetary savings** to National Grid's Rhode Island customers/ratepayers, i.e. the increase in disposable income attributable to the evaluated program(s). This net increase in disposable income equals all monetary benefits listed above, minus the sum of program and participant costs, also as listed above. Note that, as shown in Figure 1 above, rebates and incentives appear as both benefits and costs and thus cancel out at the aggregate level of all National Grid Rhode Island customers/ratepayers even though they do affect program participants and non-participants asymmetrically.

Each of these three categories of benefits and costs have to be allocated to various REMI sectors.

The allocation category captures how increased discretionary income from savings should be spent by consumers. For example, will households spend this money on new appliances, food, entertainment, recreation etc? These spending decisions will influence different sectors of the economy. To simplify this allocation, increased spending is generally spread proportionately on existing spending allocations built in to REMI. These allocations are based on typical household spending patterns[23].

The allocation of spending and savings by REMI sector must be done carefully, but since REMI is limited to 70 sectors, the allocation cannot be very precise. In addition, the specifics of spending, particularly on energy efficiency investments are difficult to determine. Consequently, most studies using REMI or other macroeconomic models choose to rely on only a modest number of

[23] Based on discussion with REMI economist and technician.

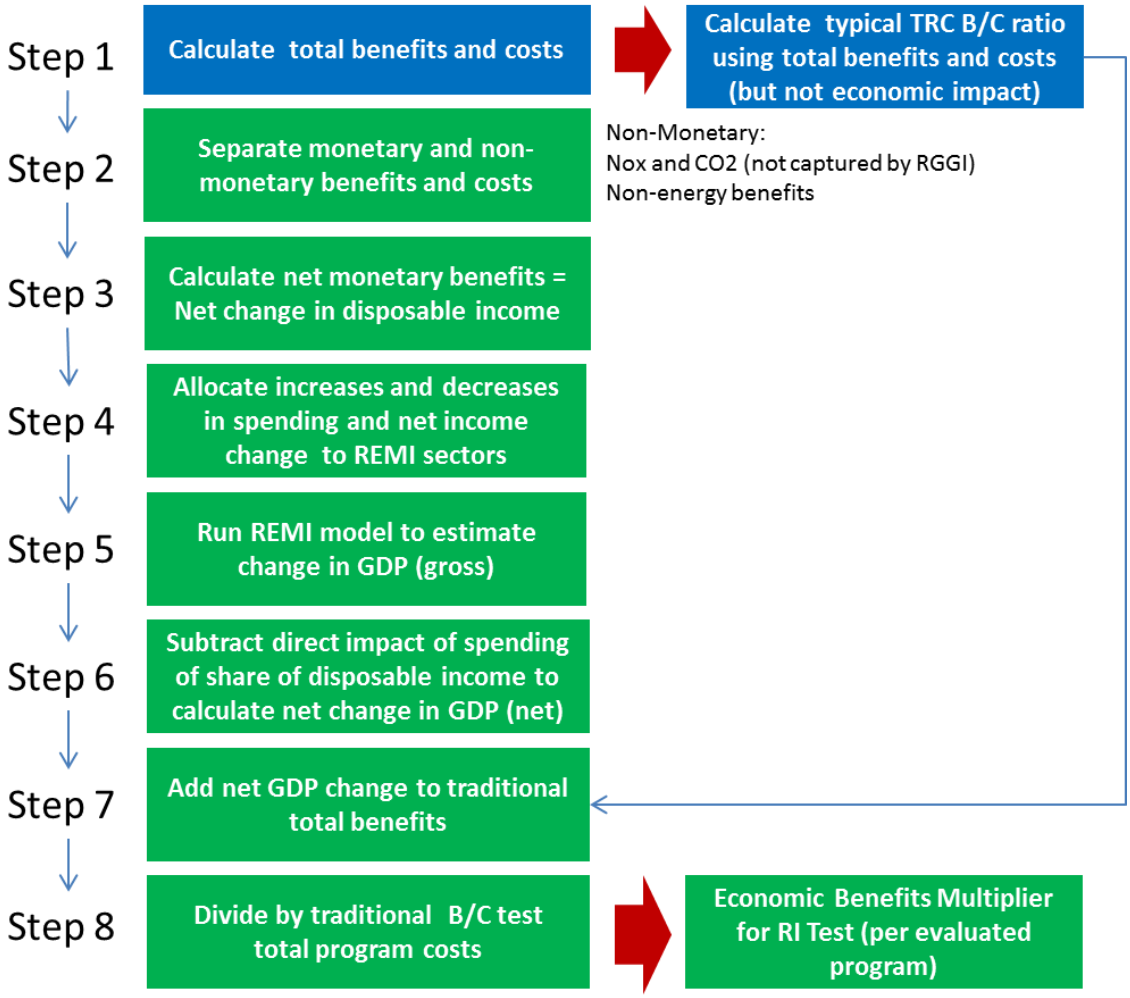
sectors. National Grid's previous sector allocation appears reasonable, but may be more specific than the data really allows. Limited spending to no more than 3 to 5 sectors including the construction, professional services sectors should be adequate. Consumer spending attributable savings is typically allocated to households assuming that spending in non-energy sectors goes up proportionately. Spending from savings by non-residential customers is generally treated in the same way. Less energy savings results in more spending on labor and capital.

Specifically, we recommend the following methodology to provide both dollar impacts and economic multipliers for future use in the RI Test:

1. Allocate spending and savings by program to consumers (household and commercial sectors. This requires assignment to REMI sectors informed by prior research and other studies. National Grid's previous assignments in 2014 appear reasonable. Further research may be necessary to determining what shares of net savings are spent and invested for both households and commercial sectors.
2. Run REMI for each evaluated program with both increases and decreases of spending across sectors to estimate the gross GDP impact of each evaluated program.
3. Subtract the direct impact of the portion of net monetary savings assumed to be spent from the evaluated program to derive a net GDP impact for each evaluated program (in absolute $ terms).
4. To calculate a multiplier for each evaluated program, add the net economic impact to the total benefits measure under the existing B/C test and divide the resulting total by the total cost under the existing B/C test.
5. This approach can be used for all of National Grid's EE and DR programs together or for individual programs as well as for CHP projects. Even though measure level impacts within each program likely differ somewhat from program level impacts, the practicalities and cost of attempting to estimate measure level impacts make such an effort likely generally uneconomical (given that the additional precision likely requires assumptions for information only available at the program level). As a result, in general we propose to use the program level multipliers to evaluate measure level impacts.
6. In addition, we propose, as an ongoing R&T task, to calculate, independent of regular annual filings, economic impacts at a grouped measure level, for example for all lighting measures, to better understand any potential bias involved in applying program level multipliers at the measure level.
7. Update the full analysis and all individual EE program multipliers every 3-5 years unless the previous step indicates the need for an update. Also use the insights gained from the previous step to decide whether updates should be made more or less frequently. Implement the next update for the evaluation of the next 3-year plan, i.e., in 2020.

The steps in the recommended methodology are summarized in Figure 3. Note that the key differences in this approach from the current one are: 1)the reliance on net benefits and costs and 2) the inclusion of GDP contributions from spending related to changes in aggregate disposable income to both participant and non particpant ratepayers.

Figure 3: Summary of proposed Methodology



VI. Economy-wide Impacts

In this review, we have laid out a framework and methodology for reliably estimating the economic impact component of the RI Test that is free of double counting. This component consists of (1) the economic impact of program and participant spending, net of the negative economic impact of avoided energy and capacity demand induced by the programs; and (2) the indirect and induced economic impact of program costs and benefits. These impacts should be included in the RI Test because they are not otherwise captured by the cost-benefit analysis used to screen National Grid's energy efficiency programs.

However, net economy-wide impacts also include the direct economic impact of programs costs and benefits. The table below summarizes the economy-wide impacts of National Grid's energy efficiency programs, including these direct impacts.

These are net economic impacts for the State of Rhode Island, after the negative economic impact of all costs and decreased energy demand have been considered. National Grid's 2019 EEPP is projected to create 2,778 jobs years during the life of the programs. In addition, the EEPP is expected to raise Rhode Island GDP by $301 million, Rhode Island real personal income by $496 million and state tax revenue by $30 million. On an average annual basis, the EEPP is expected to support 198 jobs per year, $21 million in annual GDP, $35 million additional income to Rhode Island residents and $2.2 million in additional state tax revenues.

Table 1: 2019 EE Program Plan Net Economics Impacts - State of Rhode Island

Program Lifetime Impact (2019-2032)	Electric	Natural Gas	Total
Job Years	2,370	408	2,778
GDP (2018 $ million)	$256	$44	$301
Personal Income (2018 $ million)	$443	$54	$496
State Tax Revenue (2018 $ million)	$27	$3	$30
Average Annual Impact (2019-2032)	**Electric**	**Natural Gas**	**Total**
Jobs	169	29	198
GDP (2018 $ million)	$18.3	$3.2	$21
Personal Income (2018 $ million)	$31.6	$3.8	$35
State Tax Revenue (2018 $ million)	$1.9	$0.2	$2.2

Note: Includes Demand Response programs.

A. Comparison to Prior Studies

The table below compares the economic impact results for the current 2019 EE Program Plan Study with those of prior studies, specifically, the 2014 EE Program Plan Study prepared by National Grid, "Macroeconomic Impacts of Rhode Island Energy Efficiency Investments;" and the 2009 EE Program Plan Study prepared by Environment Northeast (ENE), "Energy Efficiency: Engine of Economic Growth." To assist in the comparison, "2019 EE Program Plan Benchmark" results are also included. This is a preliminary run on the 2019 EE Program Plan in which the methodology used is the same as in the 2009 and 2014 studies.

The table shows estimated net job years and GDP created per $ million in program spending; and net job years and GDP created per $ million in program and participant spending. Separate results are shown for the electric and gas EE programs. Demand Response and CHP is not included.

Table 2: Comparison of Results to 2009 ENE Study

Study	Job Years / $ Million			GDP / $		
	Electric	Gas	Total	Electric	Gas	Total
2019 EE Program Plan Study						
Program Spending / Budget	22.2	12.9	20.0	2.4	1.4	2.2
Program and Part Spending / Program Cost	18.1	9.6	16.0	2.0	1.0	1.7
2019 EE Program Plan Benchmark						
Program Spending / Budget	33.1	19.5	29.9	3.6	2.1	3.2
Program and Part Spending / Program Cost	27.0	14.5	23.8	2.9	1.6	2.6
2014 EE Program Plan Study						
Program Spending / Budget	45.1	23.0	39.7	4.2	1.9	3.6
Program and Part Spending / Program Cost	36.5	18.5	32.1	3.4	1.6	2.9
2009 ENE Study						
Program Spending / Budget	36.2	38.5	37.4	4.0	4.4	4.2
Program and Part Spending / Program Cost	27.0	25.5	26.3	3.0	2.9	3.0

Notes:
Job Year and GDP multipliers include impact of program and participant spending, lifetime program savings, and program and customer costs.
ENE Study multipliers are for the RI "Separate" case, that is, they do not include spillover effects from EE programs in other New England states.

In general, economic impact results per dollar of EE spending are less in the 2019 EEPP Benchmark and the final 2019 EEPP Study than in prior studies. There are several reasons for this including changes in in the mix of programs, the split between residential and commercial costs, cost benefit ratios and underlying changes in the Rhode Island economy and customer mix. The latter are reflected in updated REMI model data and updates to its supply and demand function model coefficients, which are estimated using the latest empirical data.

Changes in the mix of EE programs can impact economic development impacts because commercial and industrial EE programs tend to have larger economic impacts than residential. For example, energy cost savings to businesses tend to result in more local job creation than residential energy cost savings, according to REMI data. This is one explanation for the lower 2019 multipliers compared to the 2014 study. The 2019 EE Program Plan has a lower share of commercial and industrial programs than the 2014 EE Program Plan. For electric, commercial and industrial program spending accounts for 52% of the 2014 electric EEPP but only 46% of the 2019 electric EEPP. For gas, commercial and industrial program accounted for 37% of 2014 gas EEPP spending but only 32% of 2019 gas EEPP spending.

Another reason that the 2019 EE Program Plan Benchmark results are lower than prior studies is that both electric and gas benefit/cost ratios are lower than in the 2014 EEPP. Finally, the share to commercial and industrial customers in total load has decreased for both electric and gas. This implies that less of the ratepayer burden of the 2019 EEPP falls on C&I customers compared to the 2014 EEPP, implying less of a negative overall economic impact, which mitigates the downward revision from the 2014 study to the 2019 study.

Differences between the 2019 EE Program Plan Benchmark and the final 2019 EE Program Plan results are due to methodological changes designed to avoid double counting and improve accuracy. First, program and participant spending were allocated to sectors in REMI based on the breakdown found in the program spending budgets and discussions with the program managers. Program Planning and Administration (PP&A), Marketing, and Sales, Technical Training and Assistance (STAT) budgets were allocated to appropriate Professional Services industries in REMI. For Energy Wise, Residential and Commercial Pilots, Income Eligible Programs and Large Commercial Retrofit and Small Business Direct Install programs, Rebate and Incentives budgets were allocated to the construction industry in REMI. Rebates and Incentives for Residential Lighting, Home Energy Reports, HVAC, Residential Products, Residential New Construction (RNC) and Large Commercial New Construction were left out of the REMI analysis. For these programs, the money is used purely to provide rebates and incentives for customers to purchase more efficient versions of equipment they were already going to purchase. For example, rebates on efficient light bulbs, manufactured outside of Rhode Island, to replace worn out bulbs in the home. This has no significant impact on Rhode Island economic activity. Not including this spending in the construction spending reduced the 2019 economic multipliers compared to the prior studies.

Second, the 2019 EE Program Plan study includes the negative economic impacts of decreased energy demand resulting from the programs. This is responsible for most of the difference between the 2010 EE Program Plan Benchmark and the final plan studies which failed to include these impacts.

Finally, the REMI analysis was carried out on a program-by-program basis. This did not have the effect of raising or lowering the overall results significantly in one direction or the other but does allow more accurate program multipliers for use in planning future EEPPs.

B. Economic Multipliers

This section presents the economic multipliers derived from REMI outputs for each of the individual EE programs in contrast to the more aggregate values presented above. These multipliers are presented in Table 3. Like the aggregate values, they are derived from the REMI analysis. REMI is run accounting for the adjustments presented in Figure 2 and specified in the 7 steps outlined on page 16 above. Thus, the REMI results present the dollars of GDP generated for each dollar of program spending accounting for participant spending and netting any expected decreases in spending in various sectors resulting from reduced energy spending created by the programs. In other words, the multipliers are net of the necessary adjustments discussed above. As a result, multiplying program-specific spending by a program multiplier presents the incremental GDP impact of that program.

We worked closely with National Grid staff to make these program-specific adjustments including, for example, the offsetting losses of economic activity attributable to reduced transmission and distribution investments attributable to lower energy demand, along with the revenue losses

attributable to reduced demand, and the appropriate assumptions regarding consumer behavior related to energy savings.

As discussed above, we recommend that the full analysis and all individual EE program multipliers be updated every 3-5 years. We also suggest, as an ongoing R&T task, to calculate, independent of regular annual filings, economic impacts at a grouped measure level, for example for all lighting measures, to better understand any potential bias involved in applying program level multipliers at the measure level and to potentially update multipliers as a result of such analyses.

Table 3: Multipliers by Energy Efficiency Program Type

Program Type	GDP/$ Program Spending
Electric Program	
Residential	
Residential New Construction (RNC)	$1.40
HVAC	$1.42
EnergyWise	$0.93
EnergyWise Multifamily	$1.34
Residential Lighting	$1.59
Residential Products	$1.52
Home Energy Reports	$1.00
Single Family - Income Eligible Services	$0.86
Income Eligible Multifamily	$1.19
Commercial and Industrial	
Large Commercial New Construction	$3.11
Large Commercial Retrofit	$5.80
Small Business Direct Install	$1.97
Total Electric Portfolio	**$2.14**
Gas Program	
Residential	
ENERGY STAR® HVAC	$0.83
EnergyWise	$1.01
EnergyWise Multifamily	$1.63
Home Energy Reports	$1.06
Residential New Construction	$0.22
Single Family - Income Eligible Services	$0.99
Income Eligible Multifamily	$1.55
Commercial and Industrial	
Large Commercial New Construction	$1.42
Large Commercial Retrofit	$2.53
Small Business Direct Install	$1.75
Commercial & Industrial Multifamily	$1.89
Total Gas Portfolio	**$1.26**
Combined Heat and Power (CHP)	
Total CHP Project <3 MW	**$2.13**
Demand Response	
Residential Connected Solutions	$0.83
Commercial Connected Solutions	$2.19
Total Demand Response Portfolio	**$2.02**

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MADRID
ROME
SYDNEY

THE Brattle GROUP

Implementation of The Brattle Group Methodology

Documentation of REMI Inputs and Results

PREPARED BY

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Economics Team, Safety and Business Excellence
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April 16, 2019

Table of Contents

I. Introduction

This document provides a detailed summary of the steps National Grid took to implement the recommended methodology for estimating the economic impacts of Rhode Island's energy efficiency programs for use in cost-benefit assessments included in the "Review of RI Test and Proposed Methodology", prepared by the Brattle Group for National Grid, January 2019.

The Brattle Group recommended the following key changes to the previous methodology used in "Macroeconomic Impacts of Rhode Island Energy Efficiency Investments, REMI Analysis of National Grid's Energy Efficiency Programs," National Grid Customer Department, November 2014, which developed the prior economic impact benefit multipliers for use in the RI Test:

1. The allocation of spending, benefits, and costs to sectors in REMI based on the breakdowns found in each program spending budget and projected benefits instead of the use of total overall Plan values. This provides for a program specific economic impact that more accurately reflects how the implementation of each program impacts the RI economy.
2. Changing the allocation of energy efficiency program spending to sectors in the REMI model from using a generic study to using actual electric and gas program budget data that more accurately reflects where money gets spent in the economy.
3. The exclusion of rebates and incentives for Residential Lighting, Home Energy Reports, HVAC, Residential Products, Residential New Construction (RNC) and Large Commercial New Construction from the REMI analysis.
4. Accounting for the negative impacts that reduced energy consumption has on transmission, distribution, and generation spending in Rhode Island.
5. Avoiding double counting of ratepayer benefits and costs in the RI Test by only counting their indirect and induced economic impacts.

These changes provide for more accurate accounting of the net-incremental benefits of Rhode Island's energy efficiency programs beyond what is already claimed in the RI Test.

As recommended by the Brattle Group, the analysis detailed in this document continues to use the REMI regional economic model of Rhode Island to estimate these economic impacts.

A. Energy Efficiency Program Economic Impacts

The REMI analysis of Rhode Island's energy efficiency programs to determine the economic development component of the RI Test involved estimating the following economic impacts, on a program-by-program basis:

- Program and participant spending

- Customer benefits
- Reduced energy demand
- Program and participant costs
- Net economic development benefits to the State of Rhode Island
- Economic impact component of the RI Test

While the economic impact of program and participant spending and customer benefits is positive, the impact of reduced energy demand and program and participant costs is negative. The net economic impact to the State of Rhode Island is sum of these positive and negative impacts. This is the net economic development benefit of the energy efficiency programs to Rhode Island after all costs have been accounted for.

The economic development component of the RI Test is the sum of all energy efficiency program economic impacts not already included in the RI Test, namely:

- Positive economic impact of program and participant spending
- Negative economic impact of reduced energy demand
- Indirect and induced economic impact of program costs and benefits. While the direct economic impact of these costs and benefits are already included in the RI Test, their indirect and induced impacts are not.

These economic impacts are expressed in absolute terms and as multipliers on program spending, which are used to calculate the economic development component of the RI Test as described in the Brattle report. The document details the steps National Grid took to follow the Brattle Group methodology using inputs from National Grid's 2019 Energy Efficiency Program Plan (EEPP) to develop economic impact multipliers for use in the RI Test for future EEPPs.

Program and participant spending is used for planning, marketing, implementing and evaluating the EEPP programs; for purchasing materials and equipment; and installing the measures. This generates jobs, income and economic activity in construction and professional services, as well as related industries.

EEPP benefits are participant energy and other cost savings related to lower energy use and equipment operating costs; lower market energy and capacity prices that reduce energy costs for all Rhode Island customers; and improved electric reliability. All put more money in consumer's pockets and lower costs for Rhode Island businesses. Consumers typically spend a portion of their savings on local goods and services, which boosts Rhode Island economic activity. For businesses, lower costs increase regional competitiveness, allowing Rhode Island firms to sell more into competitive markets, leading to increased output and hiring.

Reduced energy consumption and spending due to the EEPP has negative economic impacts also. National Grid's revenue decoupling mechanism (RDM) maintains local electric and gas distribution industry revenue; but revenue falls for electric and gas commodity suppliers. The amount is equal to total customer bill savings, including savings due to market energy price

reductions from the EEPP. Moreover, reduced energy consumption lowers distribution and transmission infrastructure capacity spending needs. These savings equal reduced spending in the local gas and power line construction industry, which has negative economic impacts.

The economic impact of program and participant costs is negative. The programs are funded by an energy efficiency charge on all customer bills. This ratepayer impact and participant costs reduce local purchasing power and the competitiveness of local firms.

B. Direct, Indirect and Induced Impacts

Each of these EEPP economic impacts has three components, direct, indirect and induced. Direct economic impacts are tied directly to EEPP spending, benefits, reduced energy demand or costs. For example, the number of contractors hired to install efficiency measures in businesses and homes is a direct economic impact of EEPP program and participant spending. Customer cost savings are the direct economic impact of EEPP benefits. Ratepayer impacts and participant costs are the direct economic impact of EEPP costs.

Indirect economic impacts are felt in the local supply chain, for example, industries providing goods and services for the programs. Examples are increased demand for local materials such as wood, insulation and other construction materials, and tools and rental equipment to install measures.

Induced economic impacts are felt mainly in the local service sector, for example, increased retail activity and hiring. Induced economic impacts result from the spending of the direct and indirect EEPP workers; from customers spending a portion of their bill savings on local goods and services; from businesses expanding output because of lower energy costs; and from customers and firms reducing their spending on local goods and services because of energy efficiency charges and participant costs. The total or net economic impact of EEPP program and participant spending, customer benefits, reduced energy demand and program and participant costs is the sum of their direct, indirect and induced impacts.

C. REMI Model

National Grid used the REMI regional economic model of Rhode Island to estimate these economic impacts using inputs form the 2019 EEPP. REMI is a dynamic equilibrium economic model based on public data and peer-reviewed methodology. REMI has been used in the industry for 40 years to estimate the local economic impact of various programs, policies and investment proposals, including energy efficiency programs. REMI has over 150 US and international clients, including the Rhode Island Department of Revenue; other local, state and federal government planning agencies; non-profit research organizations; energy consultants; universities and utilities. REMI is owned by Regional Economic Models, Incorporated and leased to its clients. National Grid leases a 169-sector version of REMI's Rhode Island model.

The REMI model is a complete representation of the macroeconomic structure of the Rhode Island economy. By entering assumptions about the amount, timing and type of energy efficiency investment, customer benefit or cost, REMI predicts their economic impact in Rhode Island in terms of jobs, incomes, gross domestic product (GDP) and other economic variables. These impacts are measured as differences from a base case in which no EEPP investments are made and the case in which the 2019 EEPP investments are made.

The REMI model estimates total economic impacts, including their direct, indirect and induced components. REMI economic impacts are estimated using an input-output model that captures the industry structure of Rhode Island and measures how a change in demand in one industry of the economy changes demand in other industries related to it. The REMI model also includes residential demand functions and Cobb-Douglass production functions that estimate how households and businesses adjust to changes in energy and other costs.

The REMI model structure consists of five major sectors or blocks:

1. Output and Demand
2. Labor and Capital Demand
3. Population and Labor Supply
4. Compensation, Prices and Costs
5. Market Shares

Because REMI is a general equilibrium model, all blocks are interrelated. As EEPP-induced changes in energy demand and costs impact customers and participants, these sectors adjust until equilibrium is re-established in all markets.

The REMI model also includes regional purchase coefficients (RPCs) that measure the portion of Rhode Island demand for goods and services that is met by local firms versus suppliers from out of state. For example, the construction industry RPC is approximately 94%, meaning that 94% of the Rhode Island demand for construction services is met by local firms and 6% is met by out-of-state firms. The professional services RPC is 55%. If EEPP spending on professional services is input to REMI as increased final demand for professional services, then REMI uses this RPC to determine how much of the demand will be met locally. If it is known that all spending on professional services will be to local firms, this spending can be input to REMI as increased professional services "sales." When input as sales, REMI assumes 100% of the demand is met by local firms.

A complete description of the REMI model, methodology, data sources, studies and client lists is available at www.remi.com.

The remainder of this report documents how the Brattle recommendations were followed to develop REMI model inputs to develop economic benefit multipliers for use in the RI Test.

II. Economic Impact of Program and Participant Spending

Program spending inputs to the REMI model were taken from the electric and gas program budgets shown in Appendix Tables E-2 and G-2 of the EEPP. Participant spending inputs were taken from the "Customer Cost" tables in the same Appendix. EEPP program and participant spending totals $171.3 million for the 2019 EEPP, with $128.7 million for electric and $42.6 million for gas. This is a large amount of spending which is expected to significantly impact the Rhode Island economy.

A. Allocation of Spending to REMI Industries

For each program, the budget Tables E-2 and G-2 show the breakdown of spending into Program Planning and Administration (PPA); Marketing; Rebates and Other Customer Incentives; Sales, Technical Assistance and Training (STAT); and Evaluation, Measurement and Verification (EM&V). The budget tables also show spending on the shareholder incentive, finance costs and regulatory oversight.

Brattle met with National Grid energy efficiency personnel to review this data and assess its appropriateness as REMI inputs. Based on these discussions, it was agreed that the PPA, Marketing, STAT and EM&V budgets for all programs should be input into REMI as increased Rhode Island demand for professional services. These services include engineering, planning, advertising, public relations, marketing and other professional, scientific or technical services. The REMI model estimates the percent of the increased demand for these services that will be met by local firms and what the Rhode Island economic impact will be, including the direct, indirect and induced impacts of the spending.

It was also agreed that spending on rebates and customer incentives should be left out of the REMI analysis for Residential Lighting, Home Energy Reports, HVAC, Residential Products, Residential New Construction and Large Commercial New Construction. For these programs, the money is used purely to provide rebates and incentives for customers to purchase more energy efficient versions of equipment they were already going to purchase. For example, rebate spending on efficient electrical equipment, manufactured outside of Rhode Island, has no local economic impact.

For other programs, rebates and customer incentives are spent locally on installation and implementation of measures. This includes EnergyWise Programs, Residential and Commercial Pilot Programs, Community Based Initiatives, Income Eligible Programs, Large Commercial Retrofit and Small Business Direct Install. Rebate and incentive spending for these programs was entered in REMI as increased demand for construction services.

Shareholder incentives and finance costs were left out of the spending analysis as the vast majority of this money flows out of the Rhode Island economy and has no local economic impact (however,

this money is included in the economic analysis of program costs, described below). Spending on regulatory (OER and EERMC) was input into REMI as increased demand for professional services. Participant spending was allocated to REMI industries based on the allocation of program spending. Table 1 (electric) and Table 2 (gas) show the final allocation of EEPP program and participant spending to REMI industries. For electric programs, 49% of spending was allocated to the construction industry, 22% to professional services and 29% was excluded from the REMI analysis. For gas, 49% of spending was allocated to construction, 28% to professional services and 23% was excluded from the REMI analysis.

Table 1

Allocation of Electric Program and Participant Spending to REMI Industries ($2018 ths.)						
2019 Electric Program	Construction	Arc, Eng &Related Services	Adv, Pub &Related Services	Other Prof &Related Services	Excluded from REMI Analysis	Total
Residential New Construction (RNC)	$0.00	$166.85	$3.93	$477.58	$712.09	$1,360.44
HVAC	$0.00	$175.68	$168.39	$864.24	$3,021.52	$4,229.82
EnergyWise	$15,576.13	$644.60	$481.40	$1,617.26	$0.00	$18,319.39
EnergyWise Multifamily	$2,381.49	$166.20	$48.53	$798.65	$0.00	$3,394.87
Residential Lighting	$0.00	$598.79	$636.46	$787.65	$16,445.32	$18,468.22
Residential Products	$0.00	$143.09	$745.91	$931.59	$967.90	$2,788.49
Home Energy Reports	$0.00	$118.84	$10.92	$10.24	$2,501.20	$2,641.20
Energy Efficiency Education	$0.00	$0.00	$40.00	$0.00	$0.00	$40.00
Residential Pilots	$104.10	$43.37	$24.50	$50.75	$0.00	$222.72
Community Based Initiatives - Res	$59.06	$6.20	$56.25	$0.00	$0.00	$121.51
Comprehensive Marketing - Res	$0.00	$5.72	$550.82	$0.00	$0.00	$556.55
Single Family - Income Eligible	$9,184.84	$560.22	$129.12	$1,820.54	$0.00	$11,694.73
Income Eligible Multifamily	$2,682.28	$165.91	$9.46	$525.26	$0.00	$3,382.90
Large Commercial New Construction	$0.00	$447.23	$405.24	$1,407.26	$3,146.37	$5,406.09
Large Commercial Retrofit	$24,012.35	$2,388.11	$446.63	$6,073.91	$0.00	$32,921.01
Small Business Direct Install	$9,267.50	$946.65	$461.31	$594.03	$0.00	$11,269.49
Commercial Pilots	$87.50	$19.43	$30.00	$61.00	$0.00	$197.93
Community Based Initiatives - C&I	$19.69	$1.70	$18.75	$0.00	$0.00	$40.14
Regulatory	$0.00	$1,773.42	$0.00	$0.00	$0.00	$1,773.42
Finance Costs	$0.00	$0.00	$0.00	$0.00	$5,000.00	$5,000.00
Shareholder Incentive	$0.00	$0.00	$0.00	$0.00	$4,905.01	$4,905.01
Total Program and Participant Budget	**$63,374.95**	**$8,372.01**	**$4,267.60**	**$16,019.96**	**$36,699.40**	**$128,733.92**
Share of Electric Grand Total	**49%**	**7%**	**3%**	**12%**	**29%**	**100%**

Table 2

Allocation of Gas Program and Participant Spending to REMI Industries ($2018 ths.)						
2019 Gas Program	Construction	Arc, Eng &Related Services	Adv, Pub &Related Services	Other Prof &Related Services	Excluded from REMI Analysis	Total
ENERGY STAR® HVAC	$0.00	$174.42	$294.42	$606.41	$4,234.51	$5,309.76
EnergyWise	$8,320.11	$326.87	$98.76	$1,935.51	$0.00	$10,681.25
EnergyWise Multifamily	$1,463.91	$86.02	$40.96	$428.63	$0.00	$2,019.52
Home Energy Reports	$0.00	$26.98	$0.86	$5.12	$414.95	$447.90
Residential New Construction	$0.00	$76.45	$6.19	$362.66	$987.50	$1,432.81
Comprehensive Marketing - Residential	$0.00	$0.50	$73.17	$0.00	$0.00	$73.68
Community Based Initiatives - Residenti	$19.69	$0.52	$18.75	$0.00	$0.00	$38.95
Single Family - Income Eligible Services	$3,778.00	$190.15	$14.87	$1,029.82	$0.00	$5,012.84
Income Eligible Multifamily	$2,474.50	$99.03	$10.30	$348.87	$0.00	$2,932.69
Large Commercial New Construction	$0.00	$396.31	$430.66	$1,653.10	$2,833.16	$5,313.23
Large Commercial Retrofit	$3,616.75	$551.81	$402.67	$1,220.01	$0.00	$5,791.25
Small Business Direct Install	$57.16	$11.40	$30.71	$43.01	$0.00	$142.28
Commercial & Industrial Multifamily	$816.92	$39.19	$17.68	$118.58	$0.00	$992.37
Commercial Pilots	$241.10	$40.58	$9.52	$89.93	$0.00	$381.13
Community Based Initiatives - C&I	$6.56	$0.20	$6.25	$0.00	$0.00	$13.01
Regulatory	$0.00	$539.69	$0.00	$0.00	$0.00	$539.69
Shareholder Incentive	$0.00	$0.00	$0.00	$0.00	$1,460.57	$1,460.57
Total Program and Participant Budget	**$20,795**	**$2,560**	**$1,456**	**$7,842**	**$9,931**	**$42,583**
Share of Gas Grand Total	**49%**	**6%**	**3%**	**18%**	**23%**	**100%**

B. REMI Results for Program and Participant Spending

Table 3 (electric) and Table 4 (gas) show REMI results for program and participant spending. Impacts are for the State of Rhode Island and include the direct, indirect and induced impacts of this spending. Electric spending is expected to create 873 annual jobs and $74.5 million in Rhode Island gross domestic product (GDP). Gas spending is expected to create 302 annual jobs and $25.8 million in GDP. This is before the economic impact of customer benefits, reduced energy demand and costs have been considered.

Tables 3 and 4 include annual job and GDP multipliers on program and participant spending (EEPP spending). On average, every $1.0 million in electric EEPP spending creates 6.8 annual jobs and $0.58 million in RI GDP. Every $1.0 million in gas EEPP spending creates 7.1 annual jobs and $0.61 million in GDP.

Note the larger multipliers for the EnergyWise, Residential and Commercial Pilots, Community Based Initiatives, Income Eligible, Large Commercial Retrofit and Small Business Direct Install programs. As discussed above, rebate and incentive spending was allocated to construction for these programs. Rebate and incentive spending for Residential Lighting, Home Energy Reports, HVAC, Residential Products, Residential New Construction and Large Commercial New Construction was left out of the REMI analysis. Thus, EEPP spending multipliers are lower for those programs.

Table 3 - Economic Impact of Program and Participant Spending

ELECTRIC	Pgm&Part Spending ($2018 ths.)	% of Total	Jobs	Jobs/$m Spending	GDP ($2018 ths.)	GDP/$ Program Spending
Res New Construction	$1,360	1.1%	5	3.4	$399	$0.29
HVAC	$4,230	3.3%	8	1.9	$690	$0.16
EnergyWise	$18,319	14.2%	185	10.1	$15,693	$0.86
EnergyWise MF	$3,395	2.6%	32	9.5	$2,751	$0.81
Residential Lighting	$18,468	14.3%	13	0.7	$1,165	$0.06
Residential Products	$2,788	2.2%	10	3.6	$935	$0.34
Home Energy Reports	$2,641	2.1%	1	0.4	$103	$0.04
EE Education	$40	0.0%	0	0.3	$1	$0.02
Residential Pilots	$223	0.2%	2	8.6	$166	$0.75
Community Based - Res	$122	0.1%	1	7.2	$81	$0.67
Comp Mkting - Res	$557	0.4%	2	3.5	$227	$0.41
SF Income Eligible	$11,695	9.1%	116	9.9	$9,818	$0.84
MF Income Eligible	$3,383	2.6%	34	10.0	$2,854	$0.84
Large Commercial NC	$5,406	4.2%	15	2.7	$1,301	$0.24
Large Comm Retrofit	$32,921	25.6%	320	9.7	$27,166	$0.83
Small Bus. Direct Install	$11,269	8.8%	113	10.0	$9,639	$0.86
Commercial Pilots	$198	0.2%	2	8.1	$141	$0.71
Community Based - C&I	$40	0.0%	0	7.2	$27	$0.67
Regulatory	$1,773	1.4%	16	8.9	$1,378	$0.78
Finance Costs	$5,000	3.9%	0	0.0	$0	$0.00
Shareholder Incentive	$4,905	3.8%	0	0.0	$0	$0.00
Total	**$128,734**	**100.0%**	**873**	**6.8**	**$74,534**	**$0.58**

Table 4 - Economic Impact of Program and Participant Spending

GAS	Pgm&Part Spending ($2018 ths.)	% of Total	Jobs	Jobs/$m Pgm&Part Spending	GDP Created ($2018 ths.)	GDP/$ Program Spending
ENERGY STAR® HVAC	$5,310	12.5%	7	1.2	$595	$0.11
EnergyWise	$10,681	25.1%	105	9.8	$8,906	$0.83
EnergyWise MF	$2,020	4.7%	19	9.6	$1,648	$0.82
Home Energy Reports	$448	1.1%	0	0.6	$24	$0.05
Res New Construction	$1,433	3.4%	3	2.2	$265	$0.19
Comp Mkting - Res	$74	0.2%	0.253	3.4	$30	$0.41
Community Based -Res	$39	0.1%	0	7.2	$26	$0.66
SF Income Eligible	$5,013	11.8%	49	9.8	$4,149	$0.83
MF Income Eligible	$2,933	6.9%	30	10.1	$2,515	$0.86
Large Commercial NC	$5,313	12.5%	16	3.0	$1,410	$0.27
Large Comm Retrofit	$5,791	13.6%	53	9.2	$4,548	$0.79
Small Bus Direct Install	$142	0.3%	1	7.7	$97	$0.68
C&I Multifamily	$992	2.3%	10	10.0	$843	$0.85
Commercial Pilots	$381	0.9%	4	9.4	$304	$0.80
Community Based - C&I	$13	0.0%	0	7.1	$9	$0.66
Regulatory	$540	1.3%	5	8.9	$419	$0.78
Shareholder Incentive	$1,461	3.4%	0	0.0	$0	$0.00
Total	**$42,583**	**100.0%**	**302**	**7.1**	**$25,789**	**$0.61**

C. Comparison to Prior Studies

Two prior economic impact studies of RI energy efficiency programs relied on a different allocation of program and participant spending to REMI industries. These studies are, "Macroeconomic Impacts of Rhode Island Energy Efficiency Investments, REMI Analysis of National Grid's Energy Efficiency Programs," National Grid Customer Department, November 2014; and "Energy Efficiency: Engine of Economic Growth, A Macroeconomic Modelling Assessment," Environment Northeast (ENE), October 2009. These studies relied on a generic allocation of energy efficiency program and participant spending based on separate ENE research. Table 5 (electric) and Table 6 (gas) below compare the spending allocation from the prior studies to the current allocation.

The prior allocation put approximately 30% of spending in various manufacturing industries (white boxes in Tables 5 and 6) that produce materials typically demanded for energy efficiency products and services. REMI estimates that this spending has a relatively small impact on Rhode Island economic activity because of low RPCs for these manufacturers. However, as described above, we have identified spending on products that we know are not produced in Rhode Island and so we excluded this spending from the REMI analysis altogether. Thus, while only 7.7% of electric EEPP spending was excluded from the REMI analysis under the prior allocation, 28.5% is now excluded. For gas, only 3.4% of EEPP spending was excluded under the prior allocation but

23.3% is excluded now. This lowers estimated economic impacts on of EEPP spending compared to prior studies. The prior allocation only excluded spending on shareholder incentives and finance costs.

Table 5 - Electric comparison of spending allocation to prior studies.

2009/2014 Study Allocation	2019	% of Total
Wood products	$672.208	0.5%
Glass product mfg	$1,085.517	0.8%
Paper products	$1,344.417	1.0%
Machinery mfg	$7,048.396	5.5%
Computer, electronic product mfg	$2,222.116	1.7%
Electrical equip and appliance mfg	$7,202.805	5.6%
Plastics, rubber prod mfg	$2,171.034	1.7%
Wholesale trade	$1,705.480	1.3%
Retail trade	$10,263.997	8.0%
Utilities	$5,713.485	4.4%
Construction	**$70,333.461**	**54.6%**
Prof. Services	**$9,121.510**	**7.1%**
Excluded from REMI Analysis	**$9,849.496**	**7.7%**
Total	**$128,733.923**	**100.0%**

2019 Study Allocation		
Construction	**$63,374.950**	**49.2%**
Arc., engineering and related services	**$8,372.010**	**6.5%**
Advertising, marketing, public relations	**$4,267.604**	**3.3%**
Other Professional and technical ervices	**$16,019.964**	**12.4%**
Excluded from the REMI Analysis	**$36,699.395**	**28.5%**
Total	**$128,733.923**	**100.0%**

Table 6 - Gas comparison of spending allocation to prior studies

2009/2014 Study Allocation	2019	% of Total
Wood products	$288.494	0.7%
Glass product mfg	$384.878	0.9%
Paper products	$558.988	1.3%
Machinery mfg	$2,131.858	5.0%
Computer, electronic product mfg	$674.683	1.6%
Electrical equip and appliance mfg	$2,063.131	4.8%
Plastics, rubber prod mfg	$769.756	1.8%
Wholesale trade	$542.953	1.3%
Retail trade	$4,320.353	10.1%
Utilities	$1,807.934	4.2%
Construction	**$25,019.830**	**58.8%**
Professional Services	**$2,568.516**	**6.0%**
Excluded from REMI Analysis	**$1,451.570**	**3.4%**
Total	**$42,582.945**	**100.0%**

2019 Study Allocation		
Construction	**$20,794.705**	**48.8%**
Arc., engineering and related services	**$2,560.119**	**6.0%**
Advertising, marketing, public relations	**$1,455.775**	**3.4%**
Other Professional and technical ervices	**$7,841.648**	**18.4%**
Excluded from REMI Analysis	**$9,930.698**	**23.3%**
Total	**$42,582.945**	**100.0%**

Also, spending on construction is significantly lower under the current allocation. The prior method allocated 54.6% of electric and 58.8% of gas EEPP spending to construction. The current allocation puts 49.2% of electric and 48.8% of gas spending in construction, based on the actual budget data. This also reduces estimated economic impacts compared to the prior studies because construction has high RPCs.

Finally, the prior method allocated only 7.1% of electric spending to the professional services whereas the current study allocates 22.2%. For gas, the prior study estimated only 6.0% of spending on professional services versus 27.8% under the current allocation. Current allocations for professional services are defined exactly by the electric and gas budgets.

The net effect of the new allocation is to reduce the estimated economic impact of EEPP program and participant spending. Under the prior allocation, each $1.0 million in EEPP spending was estimated to create 9.2 annual jobs and $0.64 million in GDP. Under the current allocation, every $1.0 million of spending creates only 6.8 annual jobs and $0.58 million in GDP. For gas, the reduction is from 9.3 annual jobs and $0.67 million in GDP per $1.0 million EEPP spending to 7.1 annual jobs and $0.61 million in GDP.

III. Economic Impact of Customer Benefits, Reduced Energy Demand and Costs

EEPP customer benefit inputs to the REMI model were taken from the electric and gas program benefits in the 2019 Rhode Island EEPP, specifically Appendix Tables E-6 and G-6. These tables show the different types of benefits for each electric and gas program. Table 7 below summarizes these benefits for all electric and gas programs. Total EEPP benefits are $400.6 million, with $335.6 million for electric and $65.0 million for gas. The value of emissions reductions is not included.

Table 7 - Summary of 2019 Benefits and Savings ($2018 ths.)

	Capacity					Energy					Non Electric				
Total Benefits	Summer Generation	Capacity DRIPE	Trans	Dist	Reli-ability	Winter Peak	Winter Off Peak	Summer Peak	Summer Off Peak	Electric DRIPE	Natural Gas	Gas DRIPE	Oil	Other Resource	Non Resource
Electric															
$335,581	$20,254	$37,580	$26,751	$23,260	$132	$38,472	$27,898	$20,503	$12,686	$81,620	-$2,833	$0	$12,907	-$150	$36,502
100%	6%	11%	8%	7%	0%	11%	8%	6%	4%	24%	-1%	0%	4%	0%	11%
Gas															
$64,976	$136	$1,107	$191	$166	$10	$20	$30	$25	$16	$43	$36,798	$921	$0	$502	$25,011
100%	0%	2%	0%	0%	0%	0%	0%	0%	0%	0%	57%	1%	0%	1%	38%
Total															
$400,557	$20,390	$38,686	$26,941	$23,426	$143	$38,492	$27,928	$20,528	$12,702	$81,662	$33,965	$921	$12,907	$352	$61,513
100%	5%	10%	7%	6%	0%	10%	7%	5%	3%	20%	8%	0%	3%	0%	15%

Notes: From 2019 EEPP Appendix, Tables E-6 and G-6. Excludes Emissions Benefits and some amenities. CHP and Demand Response Programs also excluded.

Table 7 breaks customer benefits down into "Capacity," "Energy" and "Non Electric." Grouped under Capacity are Summer Generation, Capacity DRIPE, Transmission, Distribution and Reliability. Summer generation and capacity DRIPE savings are market electric price reductions due to the EEPP. These make up 17% of total electric benefits. Transmission and Distribution savings are electric infrastructure costs avoided because of the EEPP. These make up 15% of total electric benefits. Reliability benefits consists of reduced outage costs to businesses due to improved electric reliability. These are small, less than 1%, of total electric benefits.

Grouped under Energy in Table 7 are Winter and Summer, Peak and Off Peak energy savings; and Electric DRIPE savings. The Winter and Summer energy savings are electric bill reductions due to reduced energy usage caused by the measures. These total 29% of total electric program benefits. Electric DRIPE are customer bill savings due to market electricity price reductions caused by lower electricity demand because of the EEPP. These make up 24% of total electric program benefits.

Gas program benefits include a small amount of these electricity cost savings. This is because gas program measures may lead to reduced electricity use as a spillover effect. Examples are lower summer air conditioning use because of improved insulation associated with a gas program; and lower auxiliary electricity requirements from more efficient furnaces.

Grouped under Non Electric benefits in Table 7 are Natural Gas, Gas DRIPE, Oil, Other Resource and Non Resource benefits. Natural Gas benefits are bill savings from reduced energy use, market price reductions and reduced gas infrastructure capacity costs. These make up 57% of total gas program benefits. Gas DRIPE, which consists of market commodity cost decreases due to reduced gas use, is small, only 1% of total gas program savings.

Oil consists of oil heating customer cost reductions, a spillover effect of the electric programs, for example, more insulation. Oil benefits are zero for the gas programs.

Other Resource benefits are general cost savings to participants due to the measures, for example, reduced operating and maintenance costs for new equipment. These benefits are slightly negative for the electric programs, i.e., some measures involve more equipment and operation costs.

Non-Resource benefits are primarily amenities associated with the measures, such as reduced noise. However, they make up 38% of total gas program benefits. Brattle reviewed EEPP amenities with National Grid and advised removing many of them from the REMI analysis.

A. Customer Benefit Inputs to REMI

In table 7, Summer Generation, Capacity DRIPE, Electric DRIPE and Gas DRIPE (green boxes); Transmission and Distribution (blue boxes); and Reliability (purple boxes) benefit all customers. These energy cost savings were entered in REMI, on a program-by-program basis, as energy cost decreases, with the split between residential and C&I based on their share in total load. Electricity savings were entered as a decrease in the price of electricity, gas savings as a decrease in the price of natural gas.

Winter and Summer Energy, Natural Gas, Oil, Other Resource and Non-Resource savings are all participant benefits. These were entered in REMI as residential or C&I energy cost savings, depending on the program. Electric energy savings were entered as a decrease in the price of electricity, natural gas savings as a decrease in the price of natural gas and oil savings as a decrease in the cost of heating oil.

Other Resource savings were entered as a general cost decrease to residential and C&I customers. Other Non-Resource benefits were entered in REMI as an amenity. This has no immediate economic impact but can lead to increased net migration to Rhode Island over time and ultimately more Rhode Island economic activity.

B. Reduced Energy Demand

REMI inputs for estimating the economic impact of reduced energy demand were taken from the same benefits tables described above, specifically Appendix Tables E-6 and G-6 of the EEPP.

EEPP customer benefits reduce both energy sector and construction activity. Reduced spending on energy due to lower usage and lower prices (the green and orange boxes in Table 7 above) is reduced revenue to the electric generation and natural gas supply industries -- the "commodity" suppliers. Rhode Island accounts for approximately 7% of New England electric generation, per 2017 data from the US Energy Information Administration (EIA). Therefore, 7% of these electric savings were input to REMI as reduced sales to Rhode Island electric generators. On the gas side, there are no suppliers in Rhode Island so no adjustment was made.

Transmission and distribution capacity savings (blue boxes in Table 7 above) are reduced spending in the electric power line construction industry. Typically, 75% of Rhode Island electric infrastructure spending is for construction/installation while 25% is for materials and equipment purchased outside of Rhode Island. Therefore, 75% of electric transmission and distribution benefits were entered in REMI as decreased demand for power line and structures construction.

The EEPP does not break out natural gas transmission and distribution capacity savings from the natural gas benefits. Any gas transmission capacity savings would occur outside of Rhode Island and was not considered for the REMI analysis. For gas distribution capacity savings, the analysis assumed that 16% of Natural Gas benefits were avoided gas distribution infrastructure capacity. This is the same percent that distribution makes up of electric energy, transmission and distribution benefits.

C. Energy Efficiency Program Costs

Energy efficiency program costs consist of participant costs plus energy efficiency charges on customer bills used to fund program spending. The energy efficiency charge on electric and gas bills is calculated as the total program budget, including shareholder incentives and finance costs, divided by total energy sales. This per unit energy efficiency charge was multiplied by total residential and C&I energy sales to determine the portion of the budget funded by residential and C&I customers.

For electric, the total program funding requirement was $105.1 million. The residential portion was $61.1 million and the C&I portion was $44.0 million. These amounts were entered in REMI as electric price increases for residential and commercial customers, respectively. REMI results, annual jobs and GDP impacts, were allocated to programs based on their share in total program cost.

For gas, the total program funding requirement was $31.6 million. The residential portion was $22.6 million and the C&I portion was $9.0 million. These amounts were entered in REMI as gas prices increases for residential and C&I customers, respectively. REMI results were then allocated to programs based on their share in total program cost.

Participant costs were taken from the Customer Cost tables of the EEPP Appendix. These total $23.7 million for electric and $11.0 million for gas. These costs were entered in REMI as general cost increases to businesses and households. Specifically, residential program participant costs were entered as a real income decrease wile C&I program costs were entered as a production cost increase. REMI then estimated the economic impact of participant costs on a program-by-program basis.

D. REMI Results for EEPP Benefits, Reduced Energy Demand and Costs

Table 8 (electric) and Table 9 (gas) below show the net economic impact of customer benefits, reduced energy demand and program and participant costs for each EEPP program. Impacts are for the State of Rhode Island and include the direct, indirect and induced impacts. These impacts are in addition to the program and participant spending impacts shown earlier in Tables 3 and 4.

Net electric program benefits are expected to create 1,487 job years and $136 million of GDP in Rhode Island (a "job year" is one job for a period of one year). Net gas program benefits are expected to create 106 job years and $15 million in Rhode Island GDP.

Net benefit impacts are negative for some programs, such as electric and gas EnergyWise programs. This is because the programs have relatively high costs compared to their benefits. However, when the economic impact of program and participant spending is added, these programs have a positive economic impact in Rhode Island.

Table 8 - Impact of Electric EEPP Benefits, Reduced Energy Consumption and Costs

ELECTRIC Program/Spending Category	Total Benefits ($2018 ths.)	% of Total	Job Years Created	Jobs/$m Pgm&Part Spending	GDP Created ($2018 ths.)	GDP/$ Program Spending
Residential New Construction (RNC)	$2,740	0.8%	7	2.6	$989	$0.36
HVAC	$8,663	2.6%	24	2.7	$3,992	$0.46
EnergyWise	$18,726	5.6%	-19	-1.0	-$250	-$0.01
EnergyWise Multifamily	$5,123	1.5%	10	1.9	$1,771	$0.35
Residential Lighting	$46,434	13.8%	182	3.9	$27,412	$0.59
Residential Products	$5,881	1.8%	18	3.0	$2,827	$0.48
Home Energy Reports	$5,962	1.8%	20	3.4	$3,100	$0.52
Energy Efficiency Education	$0	0.0%	0	0.0	-$27	$0.00
Residential Pilots	$0	0.0%	-2	0.0	-$149	$0.00
Community Based Initiatives - Residential	$0	0.0%	-1	0.0	-$81	$0.00
Comprehensive Marketing - Residential	$0	0.0%	-4	0.0	-$371	$0.00
Single Family - Income Eligible Services	$13,603	4.1%	-6	-0.4	$982	$0.07
Income Eligible Multifamily	$5,068	1.5%	8	1.6	$1,595	$0.31
Large Commercial New Construction	$26,145	7.8%	123	4.7	$16,625	$0.64
Large Commercial Retrofit	$177,062	52.8%	1,042	5.9	$109,441	$0.62
Small Business Direct Install	$20,174	6.0%	55	2.7	$9,104	$0.45
Commercial Pilots	$0	0.0%	-1	0.0	-$133	$0.00
Community Based Initiatives - C&I	$0	0.0%	0	0.0	-$27	$0.00
Regulatory	$0	0.0%	0	0.0	$0	$0.00
Finance Costs	$0	0.0%	0	0.0	$0	$0.00
Shareholder Incentive	$0	0.0%	0	0.0	$0	$0.00
Total Spending Budget and Customer Cost	**$335,581**	**100.0%**	**1,456**	**4.3**	**$176,801**	**$0.53**

Table 9 - Impact of Gas EEPP Benefits, Reduced Energy Consumption and Cost

GAS Program/Spending Category	Total Benefits ($2018 ths.)	% of Total	Job Years Created	Jobs/$m Pgm&Part Spending	GDP Created ($2018 ths.)	GDP/$ Program Spending
ENERGY STAR® HVAC	$5,850	9.0%	6	1.0	$1,671	$0.29
EnergyWise	$9,898	15.2%	-11	-1.1	$328	$0.03
EnergyWise Multifamily	$3,802	5.9%	8	2.2	$1,417	$0.37
Home Energy Reports	$880	1.4%	3	3.7	$548	$0.62
Residential New Construction	$902	1.4%	-2	-2.7	-$30	-$0.03
Comprehensive Marketing - Residential	$0	0.0%	-0.5	0.0	-$47	$0.00
Community Based Initiatives - Residential	$0	0.0%	0	0.0	-$25	$0.00
Single Family - Income Eligible Services	$10,392	16.0%	12	1.1	$1,425	$0.14
Income Eligible Multifamily	$7,685	11.8%	19	2.5	$2,653	$0.35
Large Commercial New Construction	$8,131	12.5%	15	1.8	$2,494	$0.31
Large Commercial Retrofit	$14,213	21.9%	50	3.5	$7,132	$0.50
Small Business Direct Install	$240	0.4%	1	4.3	$136	$0.57
Commercial & Industrial Multifamily	$2,983	4.6%	9	2.9	$1,094	$0.37
Commercial Pilots	$0	0.0%	-2	0.0	-$241	$0.00
Community Based Initiatives - C&I	$0	0.0%	0	0.0	-$8	$0.00
Regulatory	$0	0.0%	0	0.0	$0	$0.00
Shareholder Incentive	$0	0.0%	0	0.0	$0	$0.00
Total Spending Budget and Customer Cost	**$64,976**	**100.0%**	**106**	**1.6**	**$18,548**	**$0.29**

IV. Net Economic Development Impact to State of Rhode Island

The net economic development impact of the 2019 EEPP to the State of Rhode Island is the sum of program and participant spending, customer benefit, reduced energy demand, ratepayer cost and participant cost economic impacts. This is shown in Table 10 for the electric programs and in Table 11 for the gas programs. Note that these tables do not include the economic impact of demand response and combined heat and power programs. These programs are treated separately in Sections VI and VII below.

Electric EEPPs are expected to create 2,328 job years and $251 million in GDP over the 14-year life of the programs. Gas EEPPs are expected to create 408 jobs years and $44 million in GDP over their program life. This includes all economic costs and benefits.

Table 10 - Net Rhode Island Impacts ELECTRIC

Program/Spending Category	Total Program Spending ($2018 ths.)	% of Total	Job Years Created	Jobs/$m Pgm&Part Spending	GDP Created ($2018 ths.)	GDP/$ Program Spending
Residential New Construction (RNC)	$859	0.8%	12	13.6	$1,388	$1.62
HVAC	$2,724	2.6%	31	11.5	$4,681	$1.72
EnergyWise	$15,778	15.0%	166	10.5	$15,444	$0.98
EnergyWise Multifamily	$3,065	2.9%	42	13.7	$4,523	$1.48
Residential Lighting	$14,968	14.2%	195	13.0	$28,577	$1.91
Residential Products	$2,124	2.0%	28	13.0	$3,762	$1.77
Home Energy Reports	$2,641	2.5%	21	8.1	$3,203	$1.21
Energy Efficiency Education	$40	0.0%	0	-6.6	-$26	-$0.64
Residential Pilots	$223	0.2%	0	1.7	$18	$0.08
Community Based Initiatives - Residential	$122	0.1%	0	0.4	$0	$0.00
Comprehensive Marketing - Residential	$557	0.5%	-2	-3.4	-$144	-$0.26
Single Family - Income Eligible Services	$11,695	11.1%	110	9.4	$10,800	$0.92
Income Eligible Multifamily	$3,383	3.2%	42	12.3	$4,449	$1.32
Large Commercial New Construction	$5,036	4.8%	137	27.3	$17,926	$3.56
Large Commercial Retrofit	$21,232	20.2%	1,362	64.2	$136,607	$6.43
Small Business Direct Install	$8,713	8.3%	168	19.3	$18,743	$2.15
Commercial Pilots	$198	0.2%	0	1.2	$8	$0.04
Community Based Initiatives - C&I	$40	0.0%	0	0.3	$0	-$0.01
Regulatory	$1,773	1.7%	16	8.9	$1,378	$0.78
Finance Costs	$5,000	4.8%	0	0.0	$0	$0.00
Shareholder Incentive	$4,905	4.7%	0	0.0	$0	$0.00
Total Spending Budget and Customer Cost	**$105,074**	**100.0%**	**2,328**	**22.2**	**$251,335**	**$2.39**

Table 11 - Net Rhode Island Impacts GAS

Program/Spending Category	Total Program Spending ($2018 ths.)	% of Total	Job Years Created	Jobs/$m Pgm&Part Spending	GDP Created ($2018 ths.)	GDP/$ Program Spending
ENERGY STAR® HVAC	$2,165	6.9%	13	5.8	$2,266	$1.05
EnergyWise	$8,466	26.8%	94	11.1	$9,235	$1.09
EnergyWise Multifamily	$1,678	5.3%	28	16.6	$3,065	$1.83
Home Energy Reports	$448	1.4%	4	7.8	$572	$1.28
Residential New Construction	$738	2.3%	1	0.9	$235	$0.32
Comprehensive Marketing - Residential	$74	0.2%	-0.2	-2.8	-$17	-$0.23
Community Based Initiatives - Residential	$39	0.1%	0	1.0	$1	$0.03
Single Family - Income Eligible Services	$5,013	15.9%	61	12.1	$5,575	$1.11
Income Eligible Multifamily	$2,933	9.3%	49	16.6	$5,168	$1.76
Large Commercial New Construction	$2,389	7.6%	30	12.7	$3,903	$1.63
Large Commercial Retrofit	$4,214	13.3%	103	24.4	$11,680	$2.77
Small Business Direct Install	$124	0.4%	2	17.2	$233	$1.87
Commercial & Industrial Multifamily	$918	2.9%	19	20.2	$1,938	$2.11
Commercial Pilots	$381	1.2%	1	3.2	$63	$0.17
Community Based Initiatives - C&I	$13	0.0%	0	1.0	$0	$0.03
Regulatory	$540	1.7%	5	8.9	$419	$0.78
Shareholder Incentive	$1,461	4.6%	0	0.0	$0	$0.00
Total Spending Budget and Customer Cost	**$31,593**	**100.0%**	**408**	**12.9**	**$44,337**	**$1.40**

V. Economic Development Component of the RI Test

The economic development component of the RI Test is calculated based on program and participant spending and reduced energy demand economic impacts; and the indirect and induced economic impacts of EEPP benefits and costs. This is shown in Table 12 for electric and Table 13 for gas below. The GDP multipliers are applied to proposed program spending to estimate that program's economic development benefit for the RI Test.

Table 12 - Economic Benefits for the Rhode Island Test, Electric

Program	Total Program Spending ($2018 ths.)	% of Total	Net Job Years	Jobs/$m Program Spending	GDP Created $2018 ths.	GDP/$ Program Spending
Residential New Construction (RNC)	$859	0.8%	10	11.8	$1,203	$1.40
HVAC	$2,724	2.6%	25	9.3	$3,875	$1.42
EnergyWise	$15,778	15.0%	159	10.1	$14,607	$0.93
EnergyWise Multifamily	$3,065	2.9%	39	12.7	$4,103	$1.34
Residential Lighting	$14,968	14.2%	160	10.7	$23,789	$1.59
Residential Products	$2,124	2.0%	24	11.2	$3,224	$1.52
Home Energy Reports	$2,641	2.5%	17	6.5	$2,647	$1.00
Energy Efficiency Education	$40	0.0%	0	-6.3	-$24	-$0.61
Residential Pilots	$223	0.2%	0	2.0	$25	$0.11
Community Based Initiatives - Residential	$122	0.1%	0	0.7	$4	$0.03
Comprehensive Marketing - Residential	$557	0.5%	-2	-3.1	-$127	-$0.23
Single Family - Income Eligible Services	$11,695	11.1%	104	8.9	$10,028	$0.86
Income Eligible Multifamily	$3,383	3.2%	39	11.4	$4,032	$1.19
Large Commercial New Construction	$5,036	4.8%	120	23.9	$15,671	$3.11
Large Commercial Retrofit	$21,232	20.2%	1,235	58.2	$123,053	$5.80
Small Business Direct Install	$8,713	8.3%	157	18.0	$17,171	$1.97
Commercial Pilots	$198	0.2%	0	1.5	$14	$0.07
Community Based Initiatives - C&I	$40	0.0%	0.0	0.6	$1	$0.03
Regulatory	$1,773	1.7%	16	8.9	$1,378	$0.78
Finance Costs	$5,000	4.8%	0.0	0.0	$0	$0.00
Shareholder Incentive	$4,905	4.7%	0.0	0.0	$0	$0.00
Total Program Spending Budget	**$105,074**	**100.0%**	**2,104**	**20.0**	**$224,673**	**$2.14**

Table 13 - Economic Benefits for the Rhode Island Test, Gas

Program	Total Program Spending ($2018 ths.)	% of Total	Net Jobs Created	Jobs/$m Program Spending	GDP Created $2018 ths.	GDP/$ Program Spending
ENERGY STAR® HVAC	$2,165	6.9%	9	4.2	$1,789	$0.83
EnergyWise	$8,466	26.8%	89	10.5	$8,515	$1.01
EnergyWise Multifamily	$1,678	5.3%	25	15.1	$2,735	$1.63
Home Energy Reports	$448	1.4%	3	6.3	$476	$1.06
Residential New Construction	$738	2.3%	0	0.2	$164	$0.22
Comprehensive Marketing - Residential	$74	0.2%	0	-2.5	-$15	-$0.20
Community Based Initiatives - Residential	$39	0.1%	0	1.2	$2	$0.06
Single Family - Income Eligible Services	$5,013	15.9%	55	10.9	$4,951	$0.99
Income Eligible Multifamily	$2,933	9.3%	44	14.9	$4,555	$1.55
Large Commercial New Construction	$2,389	7.6%	27	11.1	$3,397	$1.42
Large Commercial Retrofit	$4,214	13.3%	95	22.6	$10,674	$2.53
Small Business Direct Install	$124	0.4%	2	16.2	$218	$1.75
Commercial & Industrial Multifamily	$918	2.9%	17	18.4	$1,740	$1.89
Commercial Pilots	$381	1.2%	1	3.5	$74	$0.19
Community Based Initiatives - C&I	$13	0.0%	0	1.2	$1	$0.06
Regulatory	$540	1.7%	5	8.9	$419	$0.78
Shareholder Incentive	$1,461	4.6%	0.0	0.0	$0	$0.00
Total Program Budget	**$31,593**	**100.0%**	**371**	**11.7**	**$39,697**	**$1.26**

VI. Economic Impact of Demand Response Programs

Demand Response (DR) programs use rebates and incentives to pay customers to reduce electric use during periods of high demand. This spending does not increase or decrease economic activity and is excluded from the REMI analysis. Other DR program spending is used for planning and administration, marketing, sales and technical assistance, evaluation and market research. This is increased demand for professional services. There is no DR participant spending. The only cost to customers is the cost of reducing load. Besides rebates, DR participants realize some bill savings but the overwhelming majority of DR benefits are avoided transmission and distribution capacity requirements, lower summer capacity costs and lower market electricity prices that benefit all customers.

REMI input data for the DR program was taken from the electric budget, benefit and cost tables in the EEPP Appendix and entered in REMI as follows:

- DR program spending, excluding rebates and other customer incentives, were entered as increased demand for professional services.
- No participant spending.

- DR customer benefits input to REMI as decreased residential and C&I electricity cost.
- Reduced energy demand and DRIPE impacts due to DR entered in REMI as decreased sales to electric generation industry.
- Avoided transmission and distribution capacity entered in REMI as decreased construction demand.
- DR ratepayer costs entered in REMI as increased residential and C&I electric rates.

Table 14 summarizes estimated economic impacts for the DR program. "Net RI Impacts" are the Rhode Island State economic impacts after all CHP costs have been considered. They are the sum of program spending economic impacts, the negative economic impact of reduced energy demand, the positive impact of program benefits and the negative economic impact of program costs.

"Economic Impacts for the RI Test" are the sum of program spending impacts; reduced energy consumption impacts; and the indirect and induced economic impacts of program benefits and costs.

Table 14
DEMAND RESPONSE PROGRAM

2019 RI DR PGM SPENDING			Program Spending Impacts				Net Benefits Impact *					
Program	Total Program Spending ($2018 ths.)	% of Total	Jobs Created	Jobs/$m Program Spending	GDP Created ($2018 ths.)	GDP/$ Program Spending	Total Benefits ($2018 ths)	% of Total	Jobs Created	Jobs/$m Program Spending	GDP Created ($2018 ths.)	GDP/$ Program Spending
Residential	$283.1	12.3%	0.8	2.8	$68.452	$0.24	$918	5.2%	1.3	4.7	$186	$0.66
Commercial	$2,024.1	87.7%	1.4	0.7	$121.767	$0.06	$16,840	94.8%	38	19.0	$4,745	$2.34
Total	**$2,307.244**	**100.0%**	**2.2**	**1.0**	**$190.219**	**$0.08**	**$17,758**	**100.0%**	**40**	**17.2**	**$4,931**	**$2.14**

* Impact of benefits, costs and reduced energy consumption.

2019 RI DR PGM SPENDING			Net RI Impacts				ECONOMIC IMPACTS FOR RI TEST			
Program	Total Program Spending ($2018 ths.)	% of Total	Net Jobs Created	Jobs/$m Program Spending	Net GDP Created ($2018 ths.)	GDP/$ Program Spending	Net Jobs Created	Jobs/$m Program Spending	GDP Created $2018 ths.	GDP/$ Program Spending
Residential	$283.1	12.3%	2.1	7.5	$254.387	$0.90	2	6.9	$236	$0.83
Commercial	$2,024.1	87.7%	39.8	19.7	$4,866.721	$2.40	35	17.5	$4,426	$2.19
Total	**$2,307.244**	**100.0%**	**41.9**	**18.2**	**$5,121.108**	**$2.22**	**37**	**16.2**	**$4,662**	**$2.02**

VII. Economic Impact of Combined Heat and Power Programs (CHP)

CHP involves the installation of equipment to generate electricity from gas and capture waste heat for productive uses such as facility heating and cooling. CHP programs have similar economic impacts as energy efficiency programs. CHP program and participant spending includes the purchase and installation of the systems, providing jobs for local electrical contractors and other construction workers. CHP benefits are substantial, consisting of energy costs savings to participants and customers over a 20-year life time versus a 14-year life time for other energy

efficiency measures. These savings have positive impacts on the local economy. CHP reductions in utility electricity use have negative economic impacts. CHP program costs to ratepayers also have negative economic impacts, as do participant costs. The net economic impact to the state of Rhode Island is the sum of all these positive and negative economic impacts. The CHP component of the Rhode Island is the sum of economic impacts from program and participant spending; reduced energy demand; and the indirect and induced impact of CHP benefits and costs.

Table 15 summarizes the REMI analysis of CHP programs. The analysis is based on generic project data from previous National Grid CHP projects. This assumes a typical CHP project with a 20-year lifetime and 500,000 annual kWh capacity. Total project cost is $210,000 with $125,000 as program cost (incentive) and $85,500 as participant costs. Total customer and participant benefits are $611,228, yielding a benefit/cost ration of 2.9.

The REMI analysis assumes 60% of CHP program and participant spending is to construct and install the system and 40% is to purchase CHP components and equipment from outside of Rhode Island. Thus, 60% of spending was input to REMI as increased demand for construction services and 40% of the spending was excluded from the analysis.

Benefits were entered in REMI as decreased electricity costs to C&I customers. Avoided transmission and distribution spending was entered in REMI as decreased demand for power line construction services. As with the energy efficiency programs, 25% of this reduced demand was left out of the REMI analysis as this is the amount typically used for purchasing materials and equipment from outside of Rhode Island.

CHP program costs were allocated to residential and commercial customers based on their share in total kWh deliveries and entered as am electricity price increase. CHP participant costs were input to REMI as a production cost increase to C&I customers.

As the Brattle Group recommends, National Grid will utilize the below economic multipliers for screening CHP projects less than 3 MW in size. For larger projects the Company will input project-specific values in the REMI model using the same methodology described above.

Table 15
Typical Combined Heat Power Project -- Statewide Model

CHP Project Spending, Costs, Benefits,

Category	$2018	Job Yrs	Job Yrs/$m	RI GDP	RI GDP/$
Construction Spending	$210,500	1.4	6.4	$114,251	$0.54
Total Cost	$210,500	-1.2	-5.8	-$116,462	-$0.55
Total Benefits	$611,228	6.1	29.2	$648,776	$1.06
Avoided T&D Spend	$185,087	-1.3	-6.3	-$130,445	-$0.70
Avoided Capacity and Energy	$544,403	-0.3	-1.5	-$67,149	-$0.12
Total CHP Spending	$210,500	4.6	22.1	$448,971	**$2.13**

Based on these inputs, REMI estimates that CHP construction creates 6.4 job years and $0.54 million in GDP for every $1.0 million in program and participant spending. Ratepayer and participant cost economic impacts are negative while the impact of benefits is positive. The impact of avoided transmission, capacity and energy spending is negative.

For total costs and total benefits, Table 7 shows indirect and induced impacts only. Thus, summing all the impacts in Table 7 yield the CHP economic development component of the RI Test., $2.13 in GDP for every $1.0 million in CHP program spending.