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Maryland Low Income Benefits:

Estimating the Benefits of Energy Efficiency Programs for Low-Income Customers in Maryland

Gabel Associates, Inc.
417 Denison Street
Highland Park, NJ 08904
732-296-0770
gabelassociates.com

gabel associates

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This report was prepared by Brendon Baatz – VP, Gabel Associates, and Isaac Gabel-Frank – VP, Gabel Associates, with assistance by Nicolas Freschi.

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EXECUTIVE SUMMARY

Low-income energy efficiency programs provide significant benefits to program participants and the utility system. These programs provide home weatherization services at no cost to customers under a specific poverty threshold, which is 200% of the federal poverty guidelines in Maryland. Program participants receive free home insulation and energy efficiency equipment, which reduces electric and natural gas bills through energy savings, as well as many other benefits including improved indoor air quality, enhanced home comfort, lower water bills, and reduced maintenance costs for equipment. The programs also include health and safety improvements to participating homes, which enhance safety and provide an array of health benefits. Program participants also experience a higher likelihood of paying utility bills, which reduces service disconnections, late payment fees, customer calls, collections, and other costs associated with nonpayment.

The programs also produce far reaching benefits to the utility system. As customer demand is reduced because of increased efficiency, Maryland would import less power, rely on fewer new power plants, and need less investment in costly transmission and distribution infrastructure needed to meet higher demand. Finally, energy and capacity prices are reduced because of lower demand. The utility system benefits accrue to all customers in Maryland because these costs are shared by everyone.

This report reviews the potential benefits associated with the expansion of low-income energy efficiency in Maryland. The review of benefits is intended to provide policymakers in Maryland with relevant data and information to determine the best approach moving forward with low-income energy efficiency programs in the State. Our review finds that a more aggressive low-income energy efficiency effort has the potential to produce significant benefits in Maryland.

This report analyzes the potential benefits of achieving a goal of 1% low-income energy efficiency savings in Maryland. We assume energy savings beginning in 2022, ramping to the 1% target over a five-year period. Given the magnitude of the goal, a five-year ramp assumption is appropriate because of the logistical challenges of growing a program to meet the goal. The five-year ramp is also consistent with the growth of the EmPOWER Maryland energy efficiency programs.

We estimate four specific categories of benefits: utility system, environmental, non-energy, and participant bill savings. Table 1 shows estimated utility system, environmental, and non-energy benefits. All values shown in table 1 are in present value terms, meaning the values over the multi-year period are expressed in 2021 dollars.

Table 1. Benefit results (NPV 2021$ millions)

Benefit Type	Present Value Benefit
Utility System Benefits	127.6
Environmental Benefits	145.5
Non-Energy Benefits	236.9
Total	**509.9**

As table 1 shows, the benefits are significant. We describe each benefit in greater detail below.

1. **Utility system benefits:** Energy efficiency programs provide significant benefits to the electric utility system. These benefits are achieved because energy efficiency programs displace traditional power generation and reduce the need for future infrastructure expansion in generation, distribution, and transmission. The displacement of traditional generation reduces system costs and saves all customers money through reduced bills in future years. Energy efficiency programs in Maryland also reduce the need for electricity imports. Maryland imports roughly 35% of its electricity needs from out of state, which may be avoided through local energy savings.[1]
2. **Environmental benefits:** Energy efficiency programs produce substantial environmental benefits through reduced air pollution at power plants. As demand for electricity is reduced because of energy efficiency programs, fossil-fueled power plants reduce output, which reduces air emissions associated with power generation. The primary power plant emissions displaced include carbon dioxide (CO_2), nitrogen oxide (NO_X), sulfur dioxide (SO_2), and particulate matter ($PM_{2.5}$). All these emissions produce harmful effects on human health and the natural environment. This analysis estimates the displaced CO_2, NO_X, SO_2, and $PM_{2.5}$ emissions and quantifies the value of the avoided health harms, also known as damages.
3. **Non-energy benefits:** Non-energy benefits, or non-energy impacts, represent the savings or value to participants (or society) stemming from energy efficiency programs that are not direct energy savings. Benefits are realized by program participants through improved comfort, enhanced air quality (and associated health benefits), health and safety improvements that occur through weatherization programs, reduced utility bills for other services (i.e. water), fewer moves, and reduced fires. Benefits are realized at the utility perspective through cost savings associated with reduced arrearages, fewer disconnection/reconnection because of bill savings, reduced low-income subsidy payments, and decreased bad debt write offs.

[1] United States Energy Information Administration. Maryland Electricity Profile 2019. eia.gov/electricity/state/maryland/.

An additional benefit of energy efficiency programs is the programs stimulate the economy, increasing the state gross domestic product (GDP) and creating jobs. Low-income energy efficiency programs create economic growth in several ways. First, spending on energy efficiency programs generates direct jobs through the implementation and delivery of programs, which also stimulate many sectors of the economy. Second, the customer bill savings produced by the programs drive significant economic growth because customers inject these dollars back into the local economy. The positive benefits associated with the increased local spending driven by bill savings provide "ripple" effects through the economy creating jobs in many other sectors and boosting the local economy.

We used IMPLAN, an industry standard input/output economic model, to estimate economic benefits. IMPLAN works by estimating the effects of a specific policy or event on the economy. The model allows policy makers to consider how a specific policy proposal will stimulate the economy and create jobs. Table 2 shows the results of the economic impact assessment. According to this analysis, the implementation of a 1% low-income energy savings target ramping over a five-year period would add $152.3 million to Maryland's economy and create 2,654 job-years.[2]

Table 2. Total net economic and job creation impacts (job-years, NPV 2021$ millions)

	Employment (job-yrs.)	Value Added ($million)
Direct	2,837	172.3
Indirect	1,035	89.5
Induced	-1,218	-109.4
Total	2,654	152.3

The programs also produce significant customer bill savings. Bill savings are the primary reason why customers invest in energy efficiency technologies and change behavior. The bill savings also drive economic growth as customers inject dollars back into the local economy. Table 3 shows the projected participant bill savings for supply and distribution costs. As the table shows, customers would save $165.2 million over the life of the energy savings.[3]

[2] A job year is equivalent to a job in any given industry over the period of one year.

[3] In Maryland utilities can collect distribution revenue shortfalls in later periods through a surcharge on all customer bills. Therefore, it is expected that some of the participant distribution savings would be recollected.

Table 3. Participant bill savings (NPV 2021$ millions)

Sector	Bill savings
Distribution	67.2
Supply	98.0
Total	**165.2**

We also reviewed the potential costs to achieve the 1% energy savings target. Under the current Maryland low-income energy efficiency program, the cost per first year kWh is approximately $3.07. This cost is higher than the national average for low-income energy efficiency programs, but this is because the current program is focused on deeper energy savings and whole building retrofits. To consider the benefits under a lower potential cost, we also analyzed an alternate cost scenario 50% lower than the current Maryland cost. A lower cost is probable for three reasons. First, the low-income program implementer will likely achieve economies of scale as the program grows to meet the 1% target. Second, as the program matures, efficiencies are gained through experience. Third, additional sources of funds may materialize that reduce the cost to Maryland ratepayers to fund the program. These funds could include other utility programs, federal funds, and other state government programs. Table 4 shows the potential costs of the program under the two cost alternatives.

Table 4. Estimated cost to achieve 1% energy savings target ($million)

Year	Base Case	Alternate Case
2022	45.6	22.9
2023	61.6	30.9
2024	83.2	41.7
2025	112.3	56.3
2026	156.2	78.3

In the base case, the cost of $156.2 million in 2026 represents the high cost to achieve the 1% energy savings target. Even assuming the higher end of the cost range, the policy is still cost effective with $509.9 million in benefits and $377.5 million in total costs (present value over the five-year period). This equates to net benefits of $132.4 million and a benefit cost ratio of 1.35. At a lower cost, shown in table 4 as the alternate case, the program is cost effective with a 2.7 benefit cost ratio and net benefits exceeding $321 million. This analysis shows the program is cost effective under a range of potential costs, providing significant benefits to program participants and all residents across Maryland.

1 INTRODUCTION

This report estimates the benefits of expanding low-income energy efficiency efforts in Maryland. We examine the benefits of implementing a low-income energy savings goal of 1% to be achieved over a five-year period beginning in 2022. The intent is to provide policy makers in Maryland with estimates on the potential benefits of an expanded low-income energy efficiency program in Maryland. We estimate four specific categories of benefits: utility system, environmental, non-energy benefits, and participant bill savings. We also estimate the economic and job-creation impacts related with investment in low-income energy efficiency programs.

Gabel Associates is an energy, environmental and public utility consulting firm with its principal office in Highland Park, New Jersey. For over 27 years, the firm has provided highly focused and specialized energy consulting services and strategic insight to its clients. Gabel Associates has applied its expertise to drive success for hundreds of clients involved in virtually every sector of the energy industry. The firm has built its reputation on its extensive knowledge and rigorous analysis of energy markets. We have successfully assisted public and private sector clients implement energy projects and programs that reduce costs and enhance environmental quality. The firm possesses strong economic, financial, project development, technical, and regulatory knowledge.

Firm personnel also serve as expert witnesses on a wide range of issues at the Federal Energy Regulatory Commission and at State Commissions, including those related to energy and capacity markets, ratemaking and tariff design, energy efficiency, reactive rates, interconnection, renewable energy, electric vehicles, and mergers/acquisitions.

2 POLICY SCENARIO

This report examines the benefits of implementing a low-income energy savings goal of 1% to be achieved over a five-year period beginning in 2022. The analysis is based on a statewide low-income energy efficiency program delivered by the Maryland Department of Housing and Community Development (DHCD). DHCD has delivered the low-income program in Maryland since 2012. During this time, stakeholders have discussed the framework for a potential low-income program energy savings goal. Such a goal would require a specific level of savings on an annual basis specific to low-income customers. Maryland has a statewide energy savings target for residential and business customers, which was first established in 2008 and renewed in 2015. The target requires Maryland electric utilities to achieve annual energy savings equal to 2% of retail sales. While this program has been successful, it does not currently specify a certain level of energy savings for low-income customers.

This report examines the benefits of achieving an annual energy savings of 1% of low-income energy sales. The energy savings schedule includes an annual ramp up in energy savings to allow DHCD necessary time to grow the program delivery infrastructure to meet the savings target. This ramp rate is consistent with the approach outlined in the 2015 Maryland Public Service Commission order establishing the 2018-2023 statewide energy savings target.[4] Table 5 shows the annual energy savings under the savings goal. Please note, the table only shows the first-year energy savings for each program year, but savings are expected to continue for years after the completion of projects, meaning the cumulative energy savings total is higher than what is shown in table 5.

Table 5. Low-income first year savings

Year	First-year energy savings (MWh)
2022	14,866
2023	20,069
2024	27,094
2025	36,576
2026	50,868

The energy savings target was developed using Maryland specific energy consumption and household income data. According to a recent Maryland specific study, approximately 447,863 households in Maryland are considered low-income (income lower than 200% of

[4] Maryland Public Service Commission. 2015. Order No. 87082 in Case Nos. 9153-9157. 167.102.231.189/wp-content/uploads/Order-No.-87082-Case-Nos.-9153-9157-9362-EmPOWER-MD-Energy-Efficiency-Goal-Allocating-and-Cost-Effectiveness.pdf.

federal poverty level).[5] Based on the average household annual consumption of 11,845 kWh, the total low-income household consumption is approximately 5,086,794 MWh.[6,7] One percent of this total would be 50,868 MWh, which is the basis for the goal outlined in this report.

2.1 Data Sources and General Assumptions

The analysis relies on a common set of assumptions related to utility avoided costs, marginal emissions rates, measure lifetime, discount rate, energy and demand forecasts, and non-energy benefits. When available, the analysis relied on Maryland specific data. Specifically, the analysis utilized avoided cost estimates from the EmPOWER Maryland Avoided Cost Model for 2021-2023 Program Planning to estimate electric energy, electric capacity, renewable energy, transmission and distribution capacity, electric energy DRIPE, electric capacity DRIPE, loss factors, and natural gas costs. These avoided costs are developed collaboratively with the utilities, Public Service Commission staff, Office of People's Counsel staff, and other stakeholders in Maryland and approved by the Maryland Public Service Commission.

Energy savings estimates, including measure lifetimes, types of expected programs, demand savings, and natural gas savings were all sourced directly from DHCD's approved plans in Maryland for 2021-23.[8,9] Relying on actual planning values for these variables provides the most accurate estimate of possible benefit outcomes for Maryland. The planning values were developed based on prior evaluation studies and actual results from previous program years. A 5% nominal discount rate was used to estimate the present value of costs and benefits examined in this report, which is consistent with the societal discount rate perspective in Maryland. Additional data sources and assumptions are described throughout the report and shown in Appendix A.

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[5] Maryland Low-Income Market Characterization Report. 2018. Apprise Institute for Study and Evaluation. Prepared for the Maryland Office of People's Counsel. assets.ctfassets.net/ntcn17ss1ow9/4YFXt2RD3KNTx6ulRDxQYR/c445a91365b8211bc0d0e7cc374112e3/APPRISE_Maryland_Low-Income_Market_Characterization_Report_-_September_2018.pdf.

[6] Average annual household consumption is based on data from the Energy Information Administration Form 861 for 2018. eia.gov/electricity/data/eia861/.

[7] The total is based on 96% of households because 96% of statewide customers are serviced by EmPOWER Maryland utilities.

[8] Maryland Department of Housing and Community Development. 2020. "2021-2023 EmPOWER Maryland Program Limited Income Program Plan." August 31, 2020. 167.102.231.189/wp-content/uploads/Order-No.-87082-Case-Nos.-9153-9157-9362-EmPOWER-MD-Energy-Efficiency-Goal-Allocating-and-Cost-Effectiveness.pdf.

[9] Maryland Public Service Commission. 2020. Order No. 89679 in Case No. 9648. December 18, 2020. 167.102.231.189/wp-content/uploads/Order-No.-87082-Case-Nos.-9153-9157-9362-EmPOWER-MD-Energy-Efficiency-Goal-Allocating-and-Cost-Effectiveness.pdf.

3 BENEFITS

This report examines four specific areas of energy efficiency benefits of low-income efficiency programs. The four areas include: avoided utility system costs, avoided air emissions (and associated avoided damages), non-energy benefits, and participant bill savings. The economic and job creation impacts related to these benefits are summarized separately in Section 4.

3.1 Utility System Benefits

Energy efficiency programs provide significant benefits to the electric utility system. These benefits are achieved because energy efficiency displaces traditional power generation and reduces the need for future infrastructure expansion in generation, distribution, and transmission. The displacement of traditional generation reduces system costs and saves all customers money through reduced bills in future years. Energy efficiency programs in Maryland also reduce the need for electricity imports. Maryland imports roughly 35% of its electricity needs from out of state, which may be avoided through local energy savings.[10]

We estimated the value of five specific utility system benefits. These benefits include avoided electric energy costs, avoided electric capacity costs, avoided natural gas costs, energy and capacity price suppression (also known as demand reduction induced price effects or DRIPE), and avoided transmission and distribution capacity. Table 6 shows the estimated utility system benefits.

Table 6. Utility system benefits (NPV 2021$ millions)

Benefit	Present Value Benefit
Avoided Electric Energy Costs	69.1
Avoided Electric Capacity Costs	14.1
Avoided Natural Gas Costs	18.0
Electric Energy DRIPE	6.0
Electric Capacity DRIPE	2.9
Avoided T&D Costs	17.4
Total Benefits	**127.6**

As the table shows, investment in energy efficiency for low-income customers produces significant utility system benefits. The values shown for each benefit are the net present value of the benefit over the life of the energy savings. The analysis assumed energy savings are

[10] United States Energy Information Administration. Maryland Electricity Profile 2019. eia.gov/electricity/state/maryland/.

implemented over a five-year period, but the programs would still produce substantial energy savings beyond the final year of implementation because savings continue for several years after implementation. The most significant benefit is the avoided electric energy costs. We describe these benefits in greater detail below, including the methodological approach used to quantify the value of each benefit.

3.1.1 Avoided Electric Energy Costs

The avoided electric energy costs represent the wholesale electric market purchases that would be avoided because of the reductions in energy usage associated with low-income energy efficiency programs. These costs are generally composed of fuel and avoided variable operations and maintenance costs, but in the context of a retail choice state like Maryland, they represent the marginal cost of production for the incremental unit of electricity avoided through an energy efficiency program. This benefit also includes the value of avoided losses, which occur during the production and delivery of electricity to end use customers. Losses are a real benefit because as electricity is avoided, the associated losses are as well.

The avoided electric energy costs were forecasted using the EmPOWER Avoided Cost Model for 2021-2023 Program Planning. Values were provided for each electric utility company for summer and non-summer on- and off-peak periods between 2019 and 2036. The forecast was weighted by electric utility company based upon 2019 residential electricity consumption by utility, sourced from the Energy Information Administration (EIA) for 861.[11] Rates after 2036 were escalated based upon the compound annual growth rate for the final five years (2032-2036) of the EmPOWER Avoided Cost data. Losses were also sourced from the EMPOWER Avoided cost data and weighted in a similar manner as the energy forecast.

3.1.2 Avoided Electric Capacity Costs

One of the primary benefits of energy efficiency programs is avoiding or delaying the construction of or need for new power plants. Efficiency programs reduce demand across all hours of the year, reducing the need for generating capacity to meet increased demand over time. In a deregulated state like Maryland, the reduced capacity demand created by energy efficiency programs reduces the need for market capacity purchases. Electric utilities in Maryland are required to purchase generating capacity in the PJM capacity market to ensure customer power needs will always be met. The cost savings produced by avoiding capacity market purchases benefit all utility customers in Maryland.

The avoided electric capacity costs were forecasted using the EmPOWER Avoided Cost Model for 2021-2023 Program Planning. Values were provided for each electric utility between 2019

[11] United States Energy Information Administration. Form EIA-861M detailed data. 2019 Sales and revenue. eia.gov/electricity/data/eia861m/.

and 2036. The forecast was weighted by electric utility company based upon 2019 residential electricity consumption by utility, sourced from the EIA form 861.[12] Rates after 2036 were escalated based upon the compound annual growth rate for the final five years (2032-2036) of the EmPOWER Avoided Cost data. Losses were also sourced from the EMPOWER avoided cost data and weighted in a similar manner as the energy forecast but were based upon demand loss factors.

Values were adjusted to account for reserves by applying the PJM Forecast Pool Requirement. We also assumed a one-year delay before any capacity savings were included in the load forecast. This means that to the extent any energy efficiency capacity savings are offered into an earlier delivery year, or if they are incorporated into a load forecast sooner, the savings to Maryland customers in the capacity market will increase.

3.1.3 Avoided Natural Gas Costs

Avoided natural gas costs are similar to the benefits of avoided electric energy costs, in that they represent the wholesale natural gas market purchases that would be avoided as a result of the reductions in energy usage associated with low-income energy efficiency programs. These costs are generally composed of natural gas commodity costs, often based upon the Henry Hub index price, as well as interstate transportation costs, or basis, which represents the cost of transporting natural gas from the Henry Hub index (located in Louisiana) to the city gate where natural gas distribution companies take gas delivery.

The avoided natural gas costs were forecasted using the EmPOWER Avoided Cost Model for 2021-2023 Program Planning. Values were provided for each electric utility company between 2019 and 2036. The forecast was weighted by electric utility company based upon 2019 residential electricity consumption by utility, sourced from the EIA form 861.[13] Rates after 2036 were escalated based upon the compound annual growth rate for the final five years (2032-2036) of the EmPOWER Avoided Cost data.

3.1.4 Demand Reduction Induced Price Effects (Energy and Capacity)

The demand reduction induced price effects (DRIPE) price suppression impact (also known as merit order benefits) is a benefit that captures the reduction in wholesale electric energy and capacity prices to all customers, not just participants, as a result of energy efficiency. PJM wholesale markets are fundamentally supply and demand based – therefore, downward movement in the demand curve as a result of reduced consumption should result in less

[12] United States Energy Information Administration. Form EIA-861M detailed data. 2019 Sales and revenue. eia.gov/electricity/data/eia861m/.

[13] United States Energy Information Administration. Form EIA-861M detailed data. 2019 Sales and revenue. eia.gov/electricity/data/eia861m/.

expensive generation resources being dispatched for electricity. If either market "clears" at a lower price, the associated reductions in market prices flow through to all customers. A 2019 study of this benefit in Ohio found that the price suppression benefits to all customers in Ohio from the 2017 energy efficiency programs were estimated to be approximately $2 per month for a typical residential customer.[14] Other jurisdictions have also estimated similarly high DRIPE benefits.[15,16]

This report estimates the DRIPE benefit for wholesale energy and capacity price suppression effects. This benefit accrues to all customers in Maryland because costs are reduced for all customers. The electric energy and capacity DRIPE benefits were forecasted using the EmPOWER Avoided Cost Model for 2021-2023 Program Planning.

3.1.5 Avoided Transmission and Distribution Capacity

Energy efficiency programs produce small demand savings by each customer, but in aggregate can result in significant reductions to demand across the Maryland footprint. These demand savings can avoid or delay the need for future expansion of transmission and distribution capacity. Transmission and distribution systems are constructed to serve maximum or peak demand. As demand increases over time, the transmission and distribution infrastructure must be expanded to accommodate the increasing demand. The value of avoiding or delaying these costs can be substantial but are heavily specific to the time and location of increased demand. This benefit also reduces costs for all customers on the electric system, not just those who participate in energy efficiency programs.

The avoided transmission and distribution capacity costs were forecasted using the EmPOWER Avoided Cost Model for 2021-2023 Program Planning. Values were provided for each electric utility company between 2019 and 2036. The forecast was weighted by electric utility company based upon 2019 residential electricity consumption by utility, sourced from the EIA form 861.[17] Rates after 2036 were escalated based upon the compound annual growth rate for the final five years (2032-2036) of the EmPOWER Avoided Cost data.

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[14] Chernick, P. 2019. *Energy Efficiency Benefits to All Customers: Price Mitigating Effects for Ohio.* Resource Insight, Inc. June 12. resourceinsight.com/wp-content/uploads/2019/06/Energy-Efficiency-Benefits-to-All-Customers.pdf.

[15] Neme, C. and P. Chernick. 2015. *The Value of Demand Reduction Induced Price Effects.* Regulatory Assistance Project. March 19. raponline.org/wp-content/uploads/2016/05/efg-ri-dripewebinarslidedeck-2015-mar-18-revised.pdf.

[16] Synapse Energy Economics. 2018. *Avoided Energy Supply Components in New England: 2018 Report.* October 24. synapse-energy.com/sites/default/files/AESC-2018-17-080-Oct-ReRelease.pdf.

[17] United States Energy Information Administration. Form EIA-861M detailed data. 2019 Sales and revenue. eia.gov/electricity/data/eia861m/.

3.2 Environmental Benefits

Energy efficiency programs produce substantial environmental benefits through reduced air pollution at power plants. As demand for electricity and natural gas is reduced through energy efficiency programs, fossil-fueled power plants reduce output, which reduces the air emissions associated with power generation. The primary power plant emissions displaced include carbon dioxide (CO_2), nitrogen oxide (NO_X), sulfur dioxide (SO_2), and particulate matter with a diameter of 2.5 micrometers and smaller ($PM_{2.5}$). All these emissions produce harmful effects on human health and the natural environment. This analysis estimates the displaced CO_2, $PM_{2.5}$, NO_X, and SO_2 emissions and quantifies the value of the avoided health harms, also known as damages.

3.2.1 Avoided Air Emissions

The volume of avoided air emissions from electric generation was estimated using marginal emissions rates sourced from the Emissions and Generation Resource Integrated Database (eGRID).[18] This data source relies on publicly available emissions data for nearly all electric power generation in the United States. The non-baseload tons per MWh estimate from the most recent eGRID data release (currently eGRID2018 released in March 2020) was used to estimate displaced CO_2, NO_X, and SO_2 emissions. In September 2020, the U.S. Environmental Protection Agency (EPA) released Draft eGRID2018 PM2.5 Data[19] which contains estimates of $PM_{2.5}$ emissions in Maryland. These rates were then de-escalated over time based upon emissions rates from the most recent EIA Annual Energy Outlook (currently 2020) for the PJM/East region. The de-escalation is intended to reflect the likely shift away from fossil-based generation towards less polluting generation sources. The volume of avoided air emissions from reduced household natural gas consumption was calculated based upon New Jersey Clean Energy Program Protocols to Measure Resource Savings FY2020.[20] Table 7 shows the estimated avoided air emissions for the life of the energy savings.

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[18] United States Environmental Protection Agency. Emissions and Generation Resource Integrated Database (eGRID). Released 1/28/2020, Revised 3/9/2020. epa.gov/energy/emissions-generation-resource-integrated-database-egrid.

[19] United States Environmental Protection Agency. Emissions and Generation Resource Integrated Database (eGRID) Related Materials. Released 7/20/20. epa.gov/egrid/egrid-related-materials.

[20] New Jersey Board of Public Utilities. New Jersey's Clean Energy Program Protocols to Measure Energy Savings FY2021 Addendum. Released 12/2/2020. Page 9. njcleanenergy.com/files/file/Library/FY21/FY21%20Savings%20Protocols.pdf.

Table 7. Avoided air emissions by pollutant (tons)

Pollutant	Avoided emissions (tons)
CO_2	1,406,591
SO_2	812
NO_X	917
$PM_{2.5}$	71

3.2.2 Avoided Emissions Damages

The social costs estimates are based on human and environmental health harms. Air pollution causes significant health harms resulting in lost workdays, hospital visits, asthma, respiratory disease, and increased morbidity for adults and children. Carbon dioxide emissions are a significant contributor to human induced climate change, which causes increased wildfires, droughts, hurricanes, and other costly weather events. Climate change is also contributing to rising sea levels, which presents significant costs to coastal communities. The negative social costs driven by power plant pollution is substantial and avoiding these costs is a critical benefit of energy efficiency programs.

The avoided damages for CO_2 were estimated using the "Social Cost of Carbon for Regulatory Impact Analysis - Under Executive Order 12866" produced by the Interagency Working Group on Social Cost of Greenhouse Gases, United States Government.[21] The avoided damages from SO_2, NO_X, and $PM_{2.5}$ were estimated using the February 2018 Technical Support Document Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 17 Sectors by the EPA Office of Air and Radiation Office of Air Quality Planning and Standards.[22] These sources quantify the social costs or damages to human health and the environment per unit of pollution. To estimate the potential benefit, the per unit damage value is multiplied by the avoided air emissions.

Table 8 shows the estimated avoided social costs by pollutant.

[21] Interagency Working Group on Social Cost of Greenhouse Gases, United States Government. 2016 Technical Support Document: -Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis -Under Executive Order 12866. August 2016. epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf.

[22] United States Environmental Protection Agency. 2018. Technical Support Document: Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 17 Sectors. epa.gov/sites/production/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf.

Table 8. Avoided emissions damages (NPV 2021$ millions)

Pollutant	Present Value Benefit
CO_2	62.8
SO_2	55.6
NO_X	9.1
$PM_{2.5}$	18.0
Total	**145.5**

3.3 Non-Energy Benefits

Non-energy benefits, or non-energy impacts, represent the savings or value to participants (or society) stemming from energy efficiency programs that are not direct energy savings and are traditionally not captured in cost-effectiveness testing. Non-energy benefits are often omitted from analyses because they can be viewed as less tangible and can be more difficult, although not impossible, to quantify. However, decades of research on non-energy benefits have resulted in qualitative and quantitative support for substantial benefits for investing in energy efficiency, in excess of the more regularly quantified energy-related savings.

Non-energy benefits are realized by program participants, utilities, and society as a whole. Benefits are realized by program participants through improved comfort, enhanced air quality (and associated health benefits), health and safety improvements that occur through weatherization programs, reduced utility bills for other services (i.e. water), fewer moves, and reduced fires. Benefits are realized at the utility perspective through cost savings associated with reduced arrearages, fewer disconnection/reconnection because of bill savings, reduced low-income subsidy payments, and bad debt write offs. Most of the utility benefits are cost savings driven by low-income customer's improved ability to pay utility bills.

States across the country take differing approaches to quantifying and including non-energy benefits in the evaluation of energy efficiency programs. Massachusetts and California are at the forefront of non-energy benefit research and have conducted numerous studies and evaluations to quantify their benefits. Other states rely on broader methods, utilizing a non-energy benefit adder in cost-effectiveness testing in lieu of quantifying specific non-energy benefits. This provides value by assuring that non-energy benefits are included in the analysis, but is obviously less ideal than determining the actual benefits within a specific location.

Specific to Maryland, there are two defining sources of non-energy benefits which can be readily quantified and incorporated into analysis of energy efficiency programs. The first is an

Order from the Maryland Public Service Commission recognizing and defining non-energy benefits in Maryland related to building shell comfort and reduced arrearages benefit.[23] These non-energy benefits, quantified in terms of dollars per customer per year, were included in the analysis. The second source is an expansive study conducted by Skumatz Economic Research Associates, Inc. (SERA) for The Natural Resources Defense Council, Inc. (NRDC) entitled Non-Energy Benefits / Non-Energy Impacts (NEBs/NEIs) and their Role & Values in Cost-Effectiveness Tests: State of Maryland.[24] This study provides estimated values for dozens of non-energy benefits across three perspectives: utility, societal, and participant. This study was also used to supplement the non-energy benefit values in the analysis in order to provide a fuller assessment of non-energy benefits stemming from low-income programs.

Table 9 shows the estimated monetized values for non-energy benefits.

Table 9. Non-energy benefits (NPV 2021$ millions)

NEB Source	Present Value Benefit
PSC Approved	100.2
SERA for MD	136.6
Total	**236.9**

3.4 Participant Bill Savings

Energy efficiency program savings produce significant electric bill savings for customers that modify behavior and invest in efficient technologies. Bill savings are the primary reason customers engage in energy efficiency programs and the largest driver of economic benefits.

Electric customers in Maryland pay distribution and energy supply charges on a monthly basis to electric distribution utilities. We estimated participant bill savings as a result of the distribution and supply bill savings. Maryland is a retail choice state meaning distribution companies do not own generation, and customers can choose an alternate supplier on the open market for energy supply.

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[23] Maryland Public Service Commission. 2015. Order No. 87082 in Case Nos. 9153-9157. 167.102.231.189/wp-content/uploads/Order-No.-87082-Case-Nos.-9153-9157-9362-EmPOWER-MD-Energy-Efficiency-Goal-Allocating-and-Cost-Effectiveness.pdf.

[24] Skumatz, Lisa A., Ph.D., 2014. "Non-Energy Benefits / Non-Energy Impacts (NEBs/NEIs) and Their Role & Values in Cost-Effectiveness Tests: State of Maryland", prepared for Natural Resources Defense Council (NRDC), Superior, CO, March. sahlln.energyefficiencyforall.org/sites/default/files/2014_%20NEBs%20report%20for%20Maryland.pdf.

To estimate supply and distribution bill savings for participating customers, we relied on publicly available tariff data for all five major electric distribution utility companies. Using this data, we estimated the total effective price per kWh for each utility's residential tariff rate class. We then weighted the effective rates by the total sales in 2019 to determine a weighted average effective rate for residential and commercial customers. These rates were used to estimate the direct participant bill savings.

The distribution rates included riders and other charges that may be recovered in later years if the electric utility was unable to recover all authorized revenues in the year in question. Electric utilities in Maryland are decoupled, meaning revenue shortfalls because of weather, economic conditions, or lost sales from energy efficiency will be recovered in future periods. If a revenue shortfall exists, a company collects the unrecovered revenues from all customers, meaning any lost bill savings are reallocated across a large number of customers. Therefore, it is unclear exactly what, if any, distribution bill savings would be recovered from program participants at a later date.

Residential supply rates were also based upon tariffs from each utility's residential rate class. These rates are procured by the utilities periodically and passed through to energy suppliers.

Both the supply and distribution bill savings are substantial when estimated over the life of the program. Table 10 shows the distribution bill savings, supply bill savings, and total participant bill savings. As noted above, we would expect a small portion of the distribution bill savings to be reallocated back to participants at a later time.

Table 10. Participant bill savings (NPV 2021$ millions)

Sector	Bill savings
Distribution	67.2
Supply	98.0
Total	**165.2**

4 ECONOMIC IMPACTS AND JOB CREATION

Energy efficiency programs can be a powerful tool for local economic development and job creation. While cost-effective energy efficiency programs provide many other benefits, including lower utility system costs, improved health outcomes, and lower bills for program participants, the job creation and local economic growth benefits are critical as states begin to recover from the COVID-19 pandemic.

Economic development benefits were estimated using IMPLAN, a widely used industry standard input/output model. IMPLAN estimates changes in the local economy based on spending and revenue changes to specific industries. IMPLAN is based on the interdependency between economic sectors, which allows estimations of impacts to the economy and ripple effects from changes in spending to specific sectors. The data in IMPLAN is sourced directly from the U.S. Bureau of Economic Analysis, Department of Agriculture, Bureau of Labor Statistics, and Census Bureau (among many other public sources).[25]

The economic impacts and job creation are categorized into direct, indirect, and induced impacts and jobs created. Direct impacts and jobs are those caused from the initial dollar spent or saved in the exact industry that dollar was spent or saved. Indirect impacts and jobs are those generated in the supply chain and support industries that are directly impacted by an expenditure. Induced jobs are those generated by the re-spending of received income resulting from direct and indirect job creation in the affected region. The indirect and induced jobs are created in many industries across the economy.

We modeled four distinct disruptions to the economy as a result of energy efficiency spending: (1) program expenditures; (2) participant bill savings; (3) ratepayer costs; and (4) lost revenue to generators. Program expenditures and participant bill savings represent positive impacts, while ratepayer costs and lost revenue to generators represent negative impacts. The summation of these four disruptions represents the net economic impact or jobs created as a result of energy efficiency spending in Maryland.

Economic impacts are categorized by the amount of value added to the state GDP. Job impacts are categorized by job-years created. A job-year is not a full-time permanent employee but refers to a full-time equivalent employee for one year.

Table 11 summarizes the total net increase to the state GDP and job creation for both program cost estimates (for more detail on the alternate cost estimate, please see Section 6). The table shows the net effects, meaning all four components of the analysis were aggregated to produce the results.

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[25] IMPLAN. Data Sources. implan.com/data-sources/.

Table 11. Total net economic and job creation impacts (job-years, NPV 2021$ millions)

	Base Case Cost		Alternate Case Cost	
	Employment (job-yrs.)	Value Added ($million)	Employment (job-yrs.)	Value Added ($million)
Direct	2,837	172.3	1,413	84.1
Indirect	1,035	89.5	513	43.8
Induced	-1,218	-109.4	-75	-21.6
Total	2,654	152.3	1,851	106.3

As table 11 shows, implementation of the savings target would produce significant economic benefits. Under the base cost scenario, which assumes a higher cost to deliver the program, $152.3 million and 2,654 job-years would be added to the Maryland economy. Under the lower cost case, $106.3 million and 1,851 job-years would be added to the economy. All economic benefits shown in table 11 would accrue over the life of the energy savings.

4.1 Impact of Program Expenditures

Program expenditures are the funds spent by program administrators to implement and deliver energy efficiency programs. These include the costs of energy efficiency measures, the costs of installing energy efficiency measures, and the costs of administering and overseeing energy efficiency programs. This spending includes program implementation staff, utility staff, trade allies, installers, evaluators, and others. These create jobs in many industries and sectors that span retail, construction, engineering, plumbing, and other services. The spending also employs people in manufacturing, construction, wholesale trade, professional building services, retail services, and other industries.

We estimated the economic impacts and job creation of energy efficiency program expenditures by using a program-by-program approach to break out materials and labor, mapping spending into specific industries within IMPLAN. The spending breakdown (i.e. customer incentives, program marketing, and other administrative costs) were derived from the historic spending structure of DHCD in prior program years.

4.2 Impact of Customer Bill Savings

Customer bill savings produced by the programs drive significant economic growth because customers inject these dollars back into the local economy. The positive benefits associated with the increased local spending driven by bill savings provide “ripple” effects through the economy creating jobs in many other sectors and boosting the local economy. Customer bill savings are partially offset by increases in customer bills related to the cost recovery of the avoided distribution costs. Because distribution costs are decoupled from energy usage in

Maryland, these costs are ultimately recollected from customers. Therefore, we only calculated impacts associated with retail supply costs.

We estimated the economic impacts and job creation of customer bill savings by mapping the increased disposable income to households by income level. For this analysis, we assumed all savings would accrue to customers with household income at or below $100,000 per year, with 60% of all savings accruing to customers with household income at or below $40,000 per year.

4.3 Impact of Ratepayer Costs

Ratepayers are often saddled with costs associated with implementing energy efficiency programs. These costs result in higher rates and bills associated with the cost recovery of energy efficiency programs. The reduction in disposable income has the inverse impact as customer bill savings, and results in less money being spent throughout the economy.

To capture the negative economic impacts of higher rates and bills from the cost recovery associated with the programs, we calculated a proxy revenue requirement assuming that 70% of program costs were amortized over five years at a utility weighted average cost of capital, while the balance of costs were expensed in the year they were spent. These costs were assumed to be borne by all ratepayers, not just those that qualify as low-income.

4.4 Impact of Generator Lost Revenues

The deregulated energy market in Maryland allows customers to choose their own energy supplier. It also means that energy suppliers, who are not regulated by the Commission, cannot collect lost revenues from customers. These lost revenues impact the energy suppliers as a corporate entity, but also their employees.

To capture the negative economic impacts of lost revenue to generators, we calculated the value of lost supply charges to customers based upon standard offer service rates in Maryland. However, it is important to note that Maryland imports a large portion of its energy from out of state, which means that a reduction of one MWh of consumption due to energy efficiency does not mean that a Maryland based company would reduce its sales by one MWh.

5 COST

We estimated the total cost of the proposed 1% energy savings target by reviewing historic costs in Maryland to deliver a similar program. A common metric to measure the cost of energy efficiency programs is to apply the "cost of saved energy" which is defined as the total cost to save one unit of energy, usually expressed in dollars per kilowatt-hour. Estimating the cost of saved energy allows for a simple estimate of achieving higher levels of energy savings.

The cost of saved energy, the total cost to deliver each unit of energy savings, was derived from the DHCD approved three-year plan for 2021-2023. The first-year cost per kWh of the approved plan is $2.39. However, the approved plan includes significant energy savings from energy savings kits. These kits produce very low-cost energy savings driven by lighting products that will most likely not be offered in the near future because of changes to the efficiency standards of light bulbs. Therefore, we removed the kits from the calculation, which increases the first-year cost of saved energy to $3.07 per kWh. We relied on this value for the base case in our cost analysis.

We also considered a lower cost alternative. A lower cost is probable for three reasons. First, the low-income program implementer will likely achieve economies of scale as the program grows to meet the 1% target. Second, as the program matures, efficiencies are gained through experience. Third, additional sources of funds may materialize that reduce the cost to Maryland ratepayers to fund the program. These funds could include other utility programs, federal funds, and other state government programs.

Our lower cost assumption is also supported by experience in other states. We reviewed the low-income program energy savings and costs for 55 other utilities nationally using data presented by the American Council for an Energy Efficient Economy.[26] The average cost of saved energy per first year kWh was $1.07, with a range between $0.09 to $4.68 per first year kWh. The range of costs can likely be explained by the variation among program types and quality of data reported. Low-income energy efficiency programs range from single low-cost programs that distribute lighting measures to comprehensive weatherization of single and multifamily homes. The current program in Maryland relies almost exclusively on comprehensive weatherization, so a higher cost is appropriate. Our lower cost assumption is roughly half of the current cost of saved energy for the approved DHCD program plan for 2021-2023.

Table 12 shows the estimated cost by year for the base and alternate cost cases.

[26] American Council for an Energy Efficient Economy. State and Local Policy Database, Low-Income and Multifamily EE Programs. Accessed on January 20, 2021. database.aceee.org/city/low-income-multifamily.

Table 12. Total program cost by year (nominal$ millions)

Year	Base Case	Alternate Case
2022	45.6	22.9
2023	61.6	30.9
2024	83.2	41.7
2025	112.3	56.3
2026	156.2	78.3

6 BENEFIT SUMMARY AND CONCLUSIONS

The benefits of a more aggressive low-income energy savings goal are significant. The policy is cost effective with $509.9 million in benefits and $377.5 million in total costs (net present value over the five-year period). This equates to net benefits of $132.4 million and a benefit cost ratio of 1.35. Table 13 shows the net present value of benefits.

Table 13. Benefit of low-income savings target in Maryland (NPV 2021$ millions)

Benefit	Present Value Benefit
Avoided Electric Energy Costs	69.1
Avoided Electric Capacity Costs	14.1
Avoided Natural Gas Costs	18.0
Electric Energy DRIPE	6.0
Electric Capacity DRIPE	2.9
Avoided T&D Costs	17.4
Avoided CO_2 Emissions Damages	62.8
Avoided SO_2 Emissions Damages	55.6
Avoided NOx Emissions Damages	9.1
Avoided $PM_{2.5}$ Emissions Damages	18.0
Non-Energy Benefits	236.9
Total Benefits	**509.9**

The economic impact assessment also demonstrated the potential for benefits through increases to the Maryland GDP and creation of jobs. Table 14 shows the results of this analysis.

Table 14. Total net economic and job creation impacts (job-years, NPV 2021$ millions)

	Base Case Cost		Alternate Case Cost	
	Employment (job-yrs.)	Value Added ($million)	Employment (job-yrs.)	Value Added ($million)
Direct	2,837	172.3	1,413	84.1
Indirect	1,035	89.5	513	43.8
Induced	-1,218	-109.4	-75	-21.6
Total	2,654	152.3	1,851	106.3

Investment in energy efficiency for low-income customers provides demonstratable benefits to participants, all customers, and the State of Maryland. In addition, the focus on energy equity will have long lasting impacts and tangible benefits for economic, social, and political development in the post-pandemic world.

APPENDIX A

Table 15. Benefit cost analysis results under two potential cost scenarios

Benefits	Base Case Cost (NPV 2021$)	Alternate Cost Case (NPV 2021$)
Avoided Electric Energy Costs	69,132,121	69,132,121
Avoided Electric Capacity Costs	14,148,298	14,148,298
Avoided Natural Gas Costs	18,043,947	18,043,947
Electric Energy DRIPE	5,990,305	5,990,305
Electric Capacity DRIPE	2,864,096	2,864,096
Avoided T&D Costs	17,397,253	17,397,253
Avoided CO_2 Emissions Damages	62,761,507	62,761,507
Avoided SO_2 Emissions Damages	55,621,936	55,621,936
Avoided NOx Emissions Damages	9,117,296	9,117,296
Avoided $PM_{2.5}$ Emissions Damages	18,001,283	18,001,283
Non-Energy Benefits	236,850,627	236,850,627
Total Benefits	**509,928,669**	**509,928,669**
Costs		
Expenditures on EE	377,478,028	188,739,014
Total Costs	**377,478,028**	**188,739,014**
Net-Benefits		
Total	132,450,641	321,189,655
Cost-Benefit Ratio	**1.35**	**2.70**

Table 16. Energy savings, costs, and projects by year

	2022	2023	2024	2025	2026
First Year Electric Savings (MWh)	14,866	20,069	27,094	36,576	50,868
Lifetime Electric Savings (MWh)	210,605	284,316	383,827	518,166	720,630
First Year Electric Demand Savings (MW)	4	6	7	10	14
First Year Natural Gas Savings (therm)	392,947	530,479	716,146	966,797	1,344,556
Lifetime Natural Gas Savings (therm)	5,566,750	7,515,113	10,145,403	13,696,293	19,047,871
Total Program Costs (millions $)	45.6	61.6	83.2	112.3	156.2
Average Number of Projects	7,651	10,329	13,944	18,825	26,180

Table 17. Maryland PSC approved non-energy benefits. Benefit is applied per year per household.

Non-Energy Benefit	Value ($)
Building shell comfort	60.0
Reduced arrearages benefit	67.0
Total	**127.0**

Table 18. Additional non-energy benefits used in analysis. Benefit is applied per year per household.[27]

Benefit	Perspective	Value ($)
Bad debt write-offs	Utility	1.75
Reduced low-income subsidy	Utility	13.00
Disconnect/Reconnect	Utility	0.65
Notices	Utility	0.60
Customer calls and collections	Utility	0.90
Emergency/safety	Utility	3.25
Water/wastewater bill savings	Participant	15.00
Shutoffs/Reconnects	Participant	1.60
Bill-related calls to utility	Participant	2.00
Fewer moves	Participant	15.00
Maintenance	Participant	22.00
Lifetime extension of equipment	Participant	20.00
Equipment functionality	Participant	40.00
Health/fewer sick days work & school	Participant	9.00
Improved safety/reduced fires/insurance	Participant	7.50
	Total	**152.25**

[27] Skumatz, Lisa A., Ph.D., 2014. "Non-Energy Benefits / Non-Energy Impacts (NEBs/NEIs) and Their Role & Values in Cost-Effectiveness Tests: State of Maryland", prepared for Natural Resources Defense Council (NRDC), Superior, CO, March. sahlln.energyefficiencyforall.org/sites/default/files/2014_%20NEBs%20report%20for%20Maryland.pdf.