Performance Benchmark Assessment of FY2019 DC Sustainable Energy Utility Programs

FINAL

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SUBMITTED TO:
District of Columbia Department of Energy and Environment

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Glossary

Term	Definition
Gross electric savings (MWh)	The electric savings that the customer is expected to receive at the meter.
Modified gross electric savings (MWh)	The modified gross generator-level savings are calculated by increasing all gross meter-level electric savings to adjust for line losses and by further increasing savings from renewable energy projects to reflect spillover. Modified gross savings are used to assess progress towards the performance benchmarks.
Gross gas savings (Therms)	Gross gas savings includes both cross-fuel and like-fuel interactive effects. Interactive effects reflect the increase or decrease in energy usage due to the installation of an energy-efficiency measure. A common example is an LED bulb installed in conditioned space that produces less waste heat than an incandescent bulb. This reduces the energy consumption from cooling equipment (a like-fuel interactive effect) but increases consumption from gas-fired heating equipment (a cross-fuel interactive effect).
Modified gross gas savings (Therms)	The modified gross gas savings excludes cross-fuel interactive effects. Modified gross savings are used to assess progress towards the performance benchmarks.
Energy savings (MMBtu)	Cumulative energy savings reflecting both electricity savings and gas savings.
Peak demand savings	Demand savings that occur during the summer peak demand period of 2:00 PM and 6:00 PM from June through September.
First-year savings	Estimated energy savings achieved during the first year after the installation of energy-efficient equipment or other measure.
Lifetime savings	Estimated energy savings achieved over the course of the full lifetime of the installed energy-efficient equipment or other measure.
Tracked savings	Savings values reported by DCSEU from their program tracking database.
Evaluated or verified savings	Tracked savings values from DCSEU that have been verified by the evaluation team.
Realization rate	The realization rate equals the ratio of evaluated savings to tracked savings.
Impact evaluation	Component of the evaluation that verifies the tracked savings reported by DCSEU.
Free-ridership	The portion of program savings that would have occurred in the absence of the program.
Participant spillover	Participant spillover can manifest in participants who take actions beyond the tracked program savings and without financial assistance from the program.
Net-to-gross ratio	NTG ratio = 1 – Free-ridership % + Participant Spillover %
Avoided costs	System costs avoided due to reductions in energy and capacity requirements.
Average emissions rate	Average greenhouse gas emissions rate (CO_2 per MWh) among all electricity production.
Marginal emissions rate	Greenhouse gas emissions rate (CO_2 per MWh) for the marginal electric generation unit, which is the final unit committed to match supply and demand.

Key Highlights

This report presents the results of an independent assessment of the performance of the District of Columbia Sustainable Energy Utility (DCSEU) energy programs against established benchmarks for Fiscal Year 2019 (FY2019). In FY2019, the DCSEU achieved the minimum target for the first five benchmarks and achieved the maximum target for three of the five benchmarks with maximum targets (Table 1). However, after the third year of the contract, the DCSEU remains behind pace on the five-year external funds cumulative benchmark, assuming equal progress is intended each year.

Table 1: FY2019 Performance Benchmarks Summary

Benchmark Type	Benchmark		Minimum Target	Maximum Target
Annual Cumulative Target	1. Reduce Electricity Consumption		✓	✓
	2. Reduce Natural Gas Consumption		✓	✓
	3. Increase Renewable Energy Generating Capacity		✓	✓
Annual Target	4. Improve Energy Efficiency of Low-income Properties	a. Expenditures	✓	*n/a*
		b. Savings	✓	X
	5. Increase Green-collar Jobs		✓	X
Five-year Cumulative Target	6. Leverage External Funds		41%	21%

The cost of first-year energy savings for DCSEU programs has declined by about one-third since FY2017. In addition, the cost of first-year energy savings for the DCSEU in FY2019 is less than that of nearby PECO Energy and Philadelphia Gas Works (PGW). This indicates that the DCSEU is delivering programs at a cost that is substantially lower than neighboring utilities, though there may be other factors in these jurisdictions that affect both costs and savings. Lastly, cost-effectiveness testing found that the DCSEU portfolio was cost-effective as a whole.

Executive Summary

NMR Group, Inc., EcoMetric Consulting, Demand Side Analytics, BluePath Labs, and Setty – collectively referred to as *the NMR team* – were contracted by the District of Columbia Department of Energy and Environment (DOEE) to evaluate the energy-efficiency and renewable energy programs implemented by the District of Columbia Sustainable Energy Utility (DCSEU). This report presents the results of our independent assessment of the DCSEU's Fiscal Year 2019 (FY2019) programs, including performance against established benchmarks. The DCSEU FY2019 programs began on October 1, 2018 and ended on September 30, 2019.

Unlike the previous DCSEU contract, which involved a series of one-year renewals, the current DCSEU contract has a five-year base period, with an option to extend for an additional five years. The DCSEU officially began working under the current multiyear contract in April 2017. The DCSEU's performance against established benchmark targets is based on all results attained against performance benchmarks under Option Year 6 of Contract No. DDOE-2010-SEU-001 combined with results achieved under the current multiyear contract.

For more details on our evaluation methodology and findings for each of the DCSEU residential and commercial programs selected for evaluation in FY2019, please review the *Evaluation of DC Sustainable Energy Utility FY2019 Programs* report. In addition, Appendix A provides descriptions for each of the program tracks offered by the DCSEU in FY2019.

PERFORMANCE BENCHMARK AND TRACKING GOALS ASSESSMENT

The DCSEU contract specifies performance benchmarks related to energy savings, renewable energy generation capacity, expenditures, leveraging funds, and job creation that the DCSEU is responsible for achieving, as outlined in Table 2. Three of the benchmarks provide performance incentives associated with meeting or exceeding the minimum performance targets on an annual basis and a cumulative basis. The leveraging external funds benchmark provides an incentive at the end of the five-year contract period. Additionally, the low-income and green jobs benchmarks only provide incentives for meeting or exceeding the targets on an annual basis. Likewise, penalties will be assessed on an annual basis if the DCSEU fails to achieve the minimum targets for the low-income and green jobs benchmarks, while penalties for the electric, gas, renewable energy, and leveraging funds benchmarks will be assessed at the end of the five-year contract period if the DCSEU fails to achieve the cumulative minimum targets.

In FY2019, the DCSEU achieved the minimum target for each of the first five benchmarks (Table 2). In addition, the DCSEU achieved the maximum target for three of the five benchmarks with maximum targets. However, after the third year of the contract, the DCSEU remains behind pace on the five-year external funds cumulative benchmark for both the minimum (41%) and maximum targets (21%), which should be about 60% assuming equal 20% progress each year.

Table 2: FY2019 Performance Benchmarks Summary

Benchmark Type	Benchmark		Verified Results	Minimum Benchmark		Maximum Benchmark	
				Target	Achieved	Target	Achieved
Annual Cumulative Target	1. Reduce Electricity Consumption (MWh)		378,735	230,594	✓	288,242	✓
	2. Reduce Natural Gas Consumption (Therms)		6,805,789	4,092,310	✓	5,115,387	✓
	3. Increase Renewable Energy Generating Capacity (kW)		11,209	2,300	✓	3,000	✓
Annual Target	4. Improve Energy Efficiency of Low-income Properties	a. Expenditures	$4,037,174	$3,854,487	✓	*n/a*	*n/a*
		b. Savings (MMbtu)	37,868	23,278	✓	46,556	X
	5. Increase Green-collar Jobs		75.7	66	✓	88	X
Five-year Cumulative Target	6. Leverage External Funds		$1.03M	$2.5M	41%	$5.0M	21%

Figure 1 illustrates the percentage progress towards each of the first five benchmarks. The DCSEU exceeded the minimum targets for electricity savings, gas savings, renewable generation capacity, and low-income savings by a substantial degree – ranging from 163% for low-income savings to 487% for renewable energy capacity. While the DCSEU achieved the minimum targets for the low-income expenditure and the green jobs benchmarks, they did so to a lesser degree – with achievements of 105% and 115%, respectively.

In addition, the DCSEU exceeded the maximum target for each of the first three benchmarks – with achievements of 131% for electric savings, 133% for gas savings, and 374% for renewable energy capacity. However, the DCSEU fell short of the maximum target for both the low-income savings (81%) and green jobs (86%) benchmarks.

Figure 1: FY2019 Achievement of Annual Performance Benchmarks

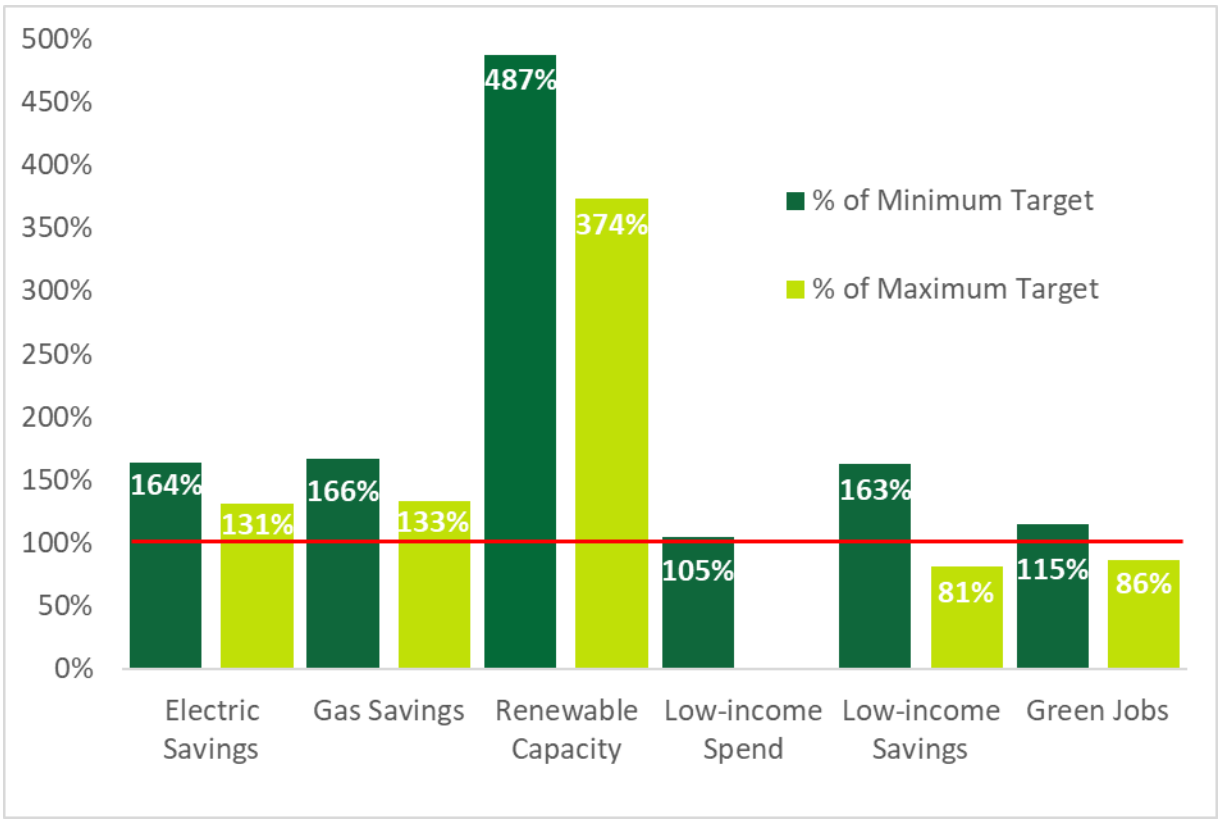


Figure 2 displays progress towards the five-year cumulative performance benchmarks. A red line shown at the 60% level illustrates the third-year goal, assuming constant linear progress.[1] The DCSEU is ahead of pace for both the minimum and maximum benchmarks for electric savings (82% and 66%) and gas savings (80% and 67%). At 258% and 224%, the DCSEU has already achieved both the minimum and maximum five-year targets for renewable capacity. As described earlier, the DCSEU is behind pace for both the minimum (41%) and maximum (21%) targets for leveraging external funds.

Figure 2: Progress towards Five-Year Cumulative Performance Benchmarks

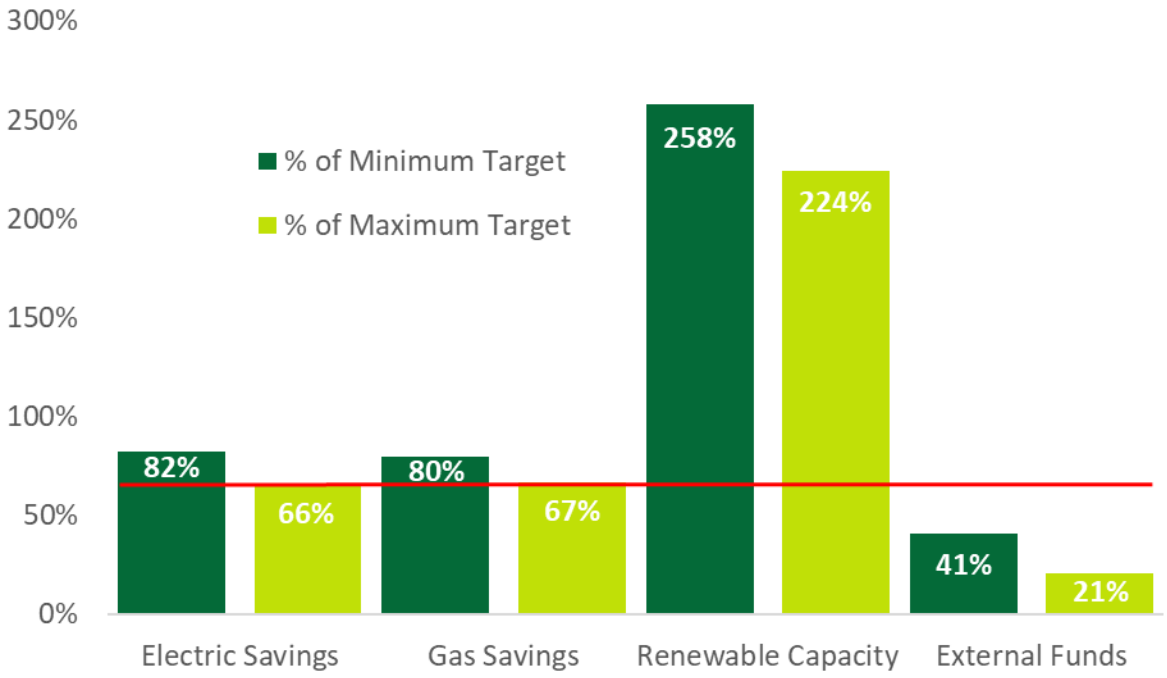


Table 3 displays the DCSEU's progress towards its two tracking goals. The DCSEU achieved 22.4 MW of summer peak demand savings, which represents nearly 1% of District peak demand usage in 2019. In addition, DCSEU completed 89 projects with large energy users in FY2019.

Table 3: FY2019 Progress Towards Tracking Goals

Tracking Goal	Evaluated Number
Reduce Growth in Peak Demand (MW)	22.4
Reduce Growth in Energy Demand of Largest Energy Users	89

Since FY2017, the DCSEU programs are estimated to have saved a combined 159,316 metric tons of annual CO2 emissions based on an average greenhouse gas emissions rate. The FY2019 avoided emissions of 63,450 metric tons represents about 0.8% of the estimated District-wide

[1] The electricity savings and gas savings benchmarks generally have larger incremental annual savings goals during the latter years of the five-year contract.

emissions of 7,552,734 metric tons in 2016. In addition, since FY2017, the DCSEU programs are projected to yield about 4,403,108 MWh in lifetime electricity savings and 60,969,012 therms in lifetime natural gas savings over the full life of the measures.

COST-EFFECTIVENESS ASSESSMENT

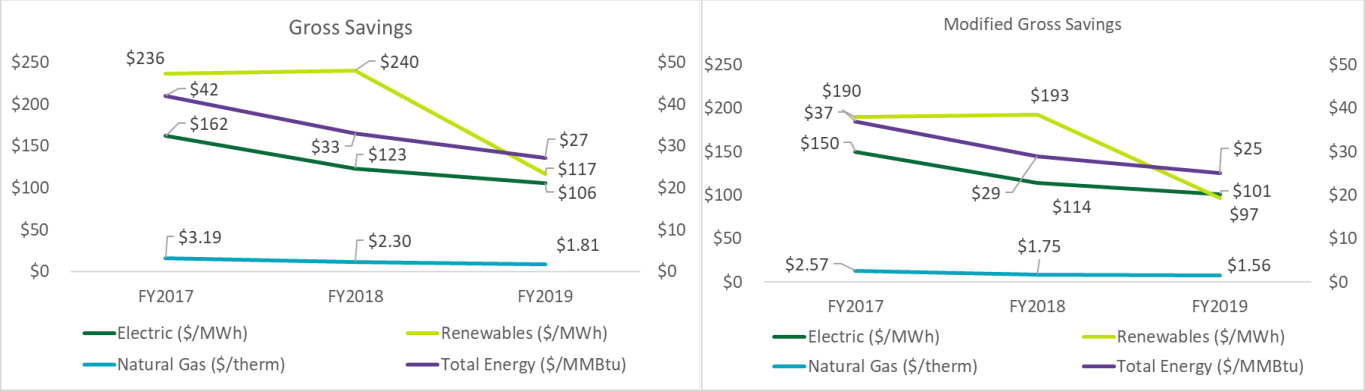
The NMR team calculated the costs of saved energy and conducted cost-effectiveness testing for the DCSEU's FY2019 programs.

Costs of Saved Energy

To inform future planning of budgets and savings goals, we calculated the DCSEU's cost of acquiring the verified energy savings. The cost of FY2019 gross and modified gross first-year electricity savings[2], excluding the DCSEU's renewables programs, was $106 per megawatt hour ($106/MWh) and $101/MWh, respectively (Figure 3). In addition, we calculated that the DCSEU's cost for gross and modified gross electricity savings from renewables programs was $117/MWh and $97/MWh, respectively. For natural gas savings, the DCSEU's cost of gross and modified gross savings[3] was $1.81/therm and $1.56/therm, respectively.

Since FY2017, DCSEU's overall cost of saved energy has declined by over one-third. Electricity savings from both energy efficiency programs and renewable energy programs as well as natural gas savings have exhibited a similar or larger reduction. However, while the cost of saved energy for low-income programs declined by over one-third from FY2017 to FY2018, it increased by about 16% in FY2019.

Figure 3: DCSEU Trends for Costs of First-Year Energy Savings



At $106/MWh, the DCSEU's cost for gross electricity savings in FY2019 is less than the cost for PECO Energy ($148/MWh) from June 2018 to May 2019. In addition, the DCSEU's FY2019 cost for gross gas savings ($1.81/therm) is less than one-half the cost for Philadelphia Gas Works (PGW) ($3.76/therm) from Sept. 2018 to Aug. 2019. While these comparisons are useful, it is

[2] Modified gross electricity savings exceed gross electricity savings due to adjustments for line losses and adjustments for spillover from renewable energy projects (see Section 1.1.1 for more detail).
[3] Modified gross natural gas savings exceed gross natural gas savings due to the exclusion of cross-fuel interactive effects (see Section 1.1.2 for more detail).

important to understand that these jurisdictions have different markets, savings goals, regulatory requirements, cost-effectiveness tests, program maturity, and delivery systems, which may affect both costs and savings.

Cost-effectiveness Testing

The NMR team conducted a benefit-cost analysis of the DCSEU's FY2019 offerings at the program and portfolio level using a Societal Cost Test (SCT). The SCT examines cost-effectiveness from the perspective of the utility, program participants, and non-participants. The NMR team primarily took model inputs from DCSEU tracking data, which were then adjusted using the results of the FY2019 evaluation. The mechanics of the DCSEU tracking database are well-organized to facilitate benefit cost modeling, and their application was well-documented. Therefore, the NMR team considered three scenarios for the FY2019 benefit-cost analysis:

- **Modified Replica**: This scenario replicated the DCSEU cost-effectiveness calculations to ensure that our model returned comparable results to the DCSEU model. Once we confirmed that our model produced similar results with the same data, we implemented some corrections to inputs and formulas.
- **Gross Verified Savings**: This scenario incorporates the realization rates as determined by the impact evaluation.
- **Net Verified Savings**: This scenario adjusted the tracked savings by both the realization rate and the net-to-gross ratio. Incremental measure costs are discounted by the applicable free-ridership rate.

Table 4 lists the DCSEU portfolio-level cost-effectiveness ratios under each scenario. The NMR team found that the DCSEU program portfolio, when taken as a whole, was cost-effective under each of the three scenarios. SCT benefit/cost ratios for FY2019 declined slightly in all three scenarios from FY2018. To interpret these results, from a SCT perspective, for every $1.00 spent, the District realized about $1.84 return on its investment in the Modified Replica Scenario, $1.81 return for the Gross Verified Scenario, and $1.71 in the Net Verified Scenario.

Since FY2017, the benefit/cost ratios have remained fairly stable, with the exception of the modified replica scenario which declined in FY2019 after DCSEU incorporated updated avoided cost assumptions.

Table 4: Portfolio-level Societal Cost Benefit/Cost Ratio

Scenario	FY2019	FY2018	FY2017
Modified Replica	1.84	2.34	2.25
Gross Verified Savings	1.81	1.87	1.89
Net Verified Savings	1.71	1.83	1.76

In Section 2.2.3, we offer recommendations to improve the accuracy of future cost-effectiveness testing.

CONCLUSIONS

Our assessment of DCSEU's progress towards its FY2019 benchmarks found that the DCSEU succeeded in meeting the minimum targets for the first five benchmarks. The DCSEU achieved both the minimum and maximum targets for the portfolio electricity savings, portfolio gas savings and renewable energy generating capacity benchmarks. In particular, the DCSEU has already exceeded the maximum target for the five-year renewable energy capacity benchmark. However, the DCSEU missed the maximum targets for both the green jobs benchmark and the low-income savings benchmark, neither of which have yet been achieved during the current contract. In addition, the DCSEU continues to fall behind pace on the five-year cumulative leveraged funds benchmark, assuming equal progress is intended each year. Because the full array of benchmarks reflects diverse and sometimes competing objectives, achieving the benchmarks requires constant monitoring on the part of the DCSEU.

DCSEU's cost of FY2019 energy savings declined for electric and gas energy-efficiency programs as well as renewable energy programs, indicating that DCSEU has improved the effectiveness of its operations. In addition, the cost of energy savings for the DCSEU continues to be substantially lower than that for neighboring utilities. However, the cost of saved energy for low-income programs increased in FY2019, which may warrant monitoring in the future.

The cost-effectiveness testing found that the DCSEU portfolio was cost-effective as a whole, similar to previous years.

For detailed recommendations regarding specific DCSEU programs, please see Appendix B.

Section 1 Assessment of Performance Benchmarks and Tracking Goals

In this section, we assess the District of Columbia Sustainable Energy Utility's (DCSEU's) Fiscal Year 2019 (FY2019) progress towards its performance benchmarks and tracking goals. We also provide information regarding lifetime energy savings and reductions in greenhouse gas (GHG) emissions.

1.1 Performance Benchmarks

In this section, we assess the DCSEU's FY2019 progress towards each of the following performance benchmarks:

- Reduce Electricity Consumption
- Reduce Natural Gas Consumption
- Increase Renewable Energy Generating Capacity
- Improve the Energy Efficiency of Low-income Properties
- Increase the Number of Green-collar Jobs
- Leverage External Funds

1.1.1 Reduce Electricity Consumption

The enumerated benchmark for reductions in electricity consumption states that DCSEU shall develop and implement energy-efficiency programs that directly lead to annual reductions of weather-normalized total electricity consumption, measured as a percentage of the total consumption of electricity in the District in 2014. The contract requires that DCSEU achieve a minimum of 230,594 MWh savings across the first three years, which represents 2.0% of 2014 weather-normalized consumption in the District. The maximum target equals 288,242 MWh savings, which represents 2.5% of 2014 weather-normalized consumption in the District.

The DCSEU tracks electric savings in two ways: gross meter-level savings and modified gross generator-level savings. The gross meter-level savings reflect the annual electric savings that the customer is expected to receive at the meter. The modified gross generator-level savings are calculated by increasing all gross meter-level electric savings by 4.609% to adjust for line losses and by further increasing savings from renewable energy projects by 15% to reflect spillover. Spillover reflects the assumption that renewable energy projects are likely to lead to additional savings beyond the savings from the incentivized projects. The formulas are displayed below.

*Modified gross electric savings for solar projects = Gross electric savings * 1.04609 * 1.15*

*Modified gross electric savings for non-solar projects = Gross electric savings * 1.04609*

Modified gross generator-level savings are used to assess progress towards this performance benchmark.

Table 5 displays the modified gross generator-level electric savings as tracked by DCSEU, our calculated portfolio-level realization rate, and the evaluated savings. The realization rate equals the ratio of evaluated savings to tracked savings (i.e., DCSEU savings recorded in their tracking database). The NMR team estimates that the actual portfolio electric savings equals 151,321 MWh for FY2019, which is 97% of the DCSEU reported tracked electric savings. Most of the reduction is from the Low-income Prescriptive Rebate program, where we found unreasonably high hours of use for lightbulbs installed inside housing units. The cumulative evaluated savings from FY2017 through FY2019 equals 378,735 MWh.

Table 5: Modified Gross Electric Savings Verification

Year	Tracked Modified Gross Savings (MWh)	Realization Rate	Evaluated Modified Gross Savings (MWh)
FY2019	155,799	97%	151,321
FY2018	135,898	99%	134,728
FY2017	93,958	99%	92,686
Total	**385,655**	**98%**	**378,735**

Our gross savings verification of the FY2019 programs found that DCSEU expended the appropriate amount of rigor on their savings calculations. In general, the documentation provided was sufficient, and the methods and assumptions were suitable. The NMR team believes the DCSEU calculated energy savings with a reasonable degree of accuracy.

Table 6 displays our assessment of the DCSEU's progress towards the electric savings benchmark. Our evaluation found that the DCSEU achieved 378,735 MWh in electric savings from FY2017 through FY2019, which represents 164% of the minimum cumulative benchmark and 131% of the maximum cumulative benchmark for the third year of the contract. The 378,735 MWh figure represents 82% of the minimum five-year cumulative benchmark and 66% of the maximum benchmark.

Table 6: Reduce Electricity Consumption Benchmark Performance

Modified Gross Annual Electric Savings (MWh)	Minimum Target (MWh)	Maximum Target (MWh)	Evaluated Savings (MWh)	Percent of Minimum Target	Percent of Maximum Target
Year Three Cumulative Target	230,594	288,242	378,735	164%	131%
Five-year Cumulative Progress	461,188	576,485	378,735	82%	66%

1.1.2 Reduce Natural Gas Consumption

The contract requires that DCSEU achieve a minimum of 4,092,310 therms of natural gas savings across the first three years, which represents 1.2% of 2014 weather-normalized consumption in the District. The maximum target equals 5,115,387 therms of natural gas reductions, which represents 1.5% of 2014 weather-normalized consumption in the District.

The DCSEU tracks natural gas savings in two ways: gross savings and modified gross savings. The gross savings reflect the estimated annual savings, including both cross-fuel and like-fuel interactive effects. Per the contract, DCSEU calculates modified gross savings by excluding

cross-fuel interactive effects. The modified gross savings are used to assess progress towards this performance benchmark.

Interactive effects reflect the increase or decrease in energy usage due to the installation of an energy-efficiency measure. A common example is energy-efficient lighting: an LED bulb installed in conditioned space produces less waste heat than an incandescent bulb, which then reduces the energy consumption from cooling equipment but increases consumption from heating equipment. In this case, the cooling savings is a like-fuel interactive effect (the lighting and cooling equipment both use electricity), while the heating penalty is likely a cross-fuel interactive effect (the lighting uses electricity, while the heating equipment likely uses gas).

The NMR team converted the gas savings, which the DCSEU tracks in MMBtu, to therms by multiplying by a factor of 10.

Table 7 displays the modified gross gas savings as tracked by the DCSEU, our calculated portfolio-level realization rate, and the evaluated savings. The realization rate equals the ratio of evaluated savings to tracked savings. The NMR team estimates that the actual portfolio gas savings equals 2,569,795 therms in FY2019, which is 95% of the DCSEU tracked gas savings of 2,718,547 therms.

Table 7: Modified Gross Gas Savings Verification

Year	Tracked Modified Gross Savings (Therms)	Realization Rate	Evaluated Modified Gross Savings (Therms)
FY2019	2,718,547	95%	2,569,795
FY2018	2,300,391	97%	2,237,961
FY2017	2,114,138	95%	1,998,033
Total	**7,133,076**	**95%**	**6,805,789**

The FY2019 realization rate is less than 100% primarily due to the evaluation of the Custom Retrofit and smart thermostat Seasonal Savings programs. For the Custom Retrofit program, one large project led to most of the savings reduction because updated analyses were not reflected in the tracking database. For the Seasonal Savings program, the deployment period was shorter than claimed which reduced the savings. However, overall, our evaluation found that the tracked gas savings were calculated with a reasonable degree of accuracy.

Table 8 displays our assessment of the DCSEU's progress towards the gas savings benchmark. Our evaluation found that the DCSEU achieved 6,805,789 therms in gas savings since FY2017, which represents 166% of the minimum cumulative benchmark and 133% of the maximum cumulative benchmark for the third year of the contract. The 6,805,789 therms figure represents 80% of the minimum five-year cumulative benchmark and 67% of the maximum benchmark.

Table 8: Reduce Gas Consumption Benchmark Performance

Modified Gross Annual Gas Savings	Minimum Target (Therms)	Maximum Target (Therms)	Evaluated Savings (Therms)	Percent of Minimum Target	Percent of Maximum Target
Year Three Cumulative Target	4,092,310	5,115,387	6,805,789	166%	133%
Five-year Cumulative Progress	8,525,645	10,230,774	6,805,789	80%	67%

In order to compare gas savings to electricity savings, we converted the gas savings from therms to MWh.[4] At the equivalent of 199,466 MWh, the cumulative FY2017-FY2019 evaluated gas savings represent about 53% of the comparable electricity savings.

1.1.3 Increase Renewable Energy Generation Capacity

The DCSEU is tasked with increasing the renewable energy generation capacity in the District, primarily through the installation of solar photovoltaic (PV) and solar thermal systems. The contract requires that the DCSEU provide incentives to fund the installation of a minimum of 2,300 kW of renewable energy generating capacity across the first three years. The maximum target is 3,000 kW.

According to the DCSEU tracking database, solar PV systems were installed at 84 sites during FY2019. These installations spanned five programs, as illustrated in Table 9.

Table 9: FY2019 Solar System Summary

Program Name	Track Number	Number of Sites	Tracked Solar Capacity (kW)	Verified Solar Capacity (kW)
Solar PV Market Rate	7101PVMR	15	6,660	6,660
Solar Photo Voltaic	7107PV	3	107	107
Low-income Solar Renewable Credit	7107SREC	62	197	197
Retrofit - Commercial Custom	7520CUST	1	10	10
Market Opportunity - Commercial Custom	7520MARO	3	155	155
Total		**84**	**7,129**	**7,129**

For these 84 sites, we summed the renewable energy capacity of solar PV or solar thermal systems using the *KWLoad* variable[5] included in the DCSEU tracking database. The NMR team verified that the generation capacity matched the DCSEU tracking data for the seven solar projects that we reviewed as part of the impact evaluation. Therefore, we estimate that the actual

[4] We converted therms to MWh by first dividing by 10 therms per MMBtu then dividing by 3.412 MMBtu per MWh.
[5] The *KWLoad* variable reflects the electric generation capacity of solar PV systems in Alternating Current kilowatts.

renewable energy generation capacity is 7,129 kW, which equals the DCSEU tracked capacity of 7,129 kW.

Table 10 displays the tracked and verified solar generation capacity for FY2017, FY2018, and FY2019. Overall, a total of 11,209 kW in solar generation capacity has been installed.

Table 10: Renewable Energy Capacity Verification

Year	Tracked Solar Capacity (kW)	Realization Rate	Verified Solar Capacity (kW)
FY2019	7,129	100%	7,129
FY2018	1,836	100%	1,836
FY2017	2,244	100%	2,244
Total	**11,209**	**100%**	**11,209**

Table 11 displays our assessment of the DCSEU's progress towards the renewable energy generating capacity benchmark. Our evaluation found that the DCSEU incentivized 11,209 kW of renewable generation capacity since FY2017, which represents 487% of the minimum cumulative benchmark and 374% of the maximum cumulative benchmark for the third year of the contract. The 11,209 kW figure represents 258% of the minimum five-year cumulative benchmark and 224% of the maximum benchmark.

Table 11: Renewable Energy Capacity Benchmark Performance

Electric Generation Capacity from Solar PV and Solar Thermal Sources	Minimum Target (kW)	Maximum Target (kW)	Evaluated Savings (kW)	Percent of Minimum Target	Percent of Maximum Target
Year Three Cumulative Target	2,300	3,000	11,209	487%	374%
Five-year Cumulative Progress	4,350	5,000	11,209	258%	224%

1.1.4 Improve the Energy-efficiency and Renewable Energy Generating Capacity at Low-income Properties

Per the DCSEU contract, the low-income benchmark includes two separate metrics that must be met on an annual basis:

- Spend 20% of the Sustainable Energy Trust Fund (SETF) funds on low-income housing, shelters, clinics, or other buildings serving low-income residents in the District.
- Achieve 46,556 MMBtu in electricity and natural gas savings from low-income programs.

In order to verify that tracked low-income program expenditures and savings were accrued to eligible low-income projects, we reviewed the 29 low-income multifamily projects that we sampled for the FY2019 evaluation to ensure that they met the low-income program requirements. For FY2019, *low-income households* are defined as those with annual incomes equal to or below 80% of the Area Median Income (AMI) or 60% of the State Median Income (SMI). Affordable, low-income housing in the District is defined as one of the following:

a) A single home where the owner or occupant meets the definition of *low-income household*;

b) A multifamily building where at least 66% of the households meet the definition of *low-income household;*

c) Buildings owned by non-profit organizations or the government that meet the definition of *low-income households*; or

d) Buildings where there are contracts or other legal instruments in place that assure that at least 66% of the housing units will be occupied by *low-income households*.[6]

In addition to low-income housing, the DCSEU contract allows low-income programs to target shelters, clinics, or other buildings serving low-income residents in the District. After reviewing supporting documentation and third-party sources, the NMR team was able to verify that all 29 sampled low-income multifamily projects met at least one of these low-income criteria. Table 12 displays these 29 sites and notes the verification category or categories they met to achieve low-income status.

Table 12: FY2019 Low-income Site Verification

Program Track	Site ID	Project ID	Site Name	Verified (Y/N)	Verification Criteria
Income Qualified Efficiency Fund (7610IQEF)	25415	16991	Lynn Property Management[7]	Y	Long-term subsidy agreement with DCHA to provide affordable housing (d); 100% low-income units (b)
	2457, 2872, 5833	17001	Capital Manor Cooperative[8,9]	Y	Listed on DCHA Affordable and Subsidized Housing Resource Guide and on HUD Affordable Housing Site as Low-income, Elderly, and Special Needs Housing; provided Declaration of Covenant – Affordable Housing (d)
	2457	17002	Capital Manor Cooperative[8,9]	Y	Listed on DCHA Affordable and Subsidized Housing Resource Guide and on HUD Affordable Housing Site as Low-income, Elderly, and Special Needs Housing; provided Declaration of Covenant – Affordable Housing (d)
	25251	16839	The Village at Chesapeake[9]	Y	Address listed on HUD Affordable Housing site as LIHTC; 174 of 174 (100%) low-income units (b)
	209	16833	Southern Homes & Gardens Corp[10]	Y	Listed on DCHA website as affordable housing site; 100% low-income units (b)
	10556	16826	Cascade Park Apartments	Y	At least 85 low-income units out of 117 occupied (73%); meets 66% threshold (b)

[6] "Low-income – Income Qualification FY17."
[7] http://lims.dccouncil.us/Download/40037/PR22-0833-Introduction.pdf
[8] http://www.dchousing.org/docs/housing_resources.pdf
[9] https://resources.hud.gov/#
[10] http://www.dchousing.org/doc.aspx?docid=148

Program Track	Site ID	Project ID	Site Name	Verified (Y/N)	Verification Criteria
	27870	16823	Webster Gardens, LP	Y	Provided DHCD Indenture of Restrictive Covenants for Low-income Housing Tax Credits (d)
	23846	17726	Douglas Knolls Apartments	Y	100% low-income and/or subsidized units (b)
	982	17288	Fort Stevens Hill Apartments[9]	Y	Listed on HUD Affordable Housing site as LIHTC (b)
Low-income Prescriptive Rebate (7613LIRX)	4763	17880	Marbury Plaza Garden Apartments	Y	For the entire Marbury Plaza complex, at least 96% of leased units listed as low-income units (b)
	29935	17728	Sheridan Station Phase III[9]	Y	Listed on HUD Affordable Housing site as LIHTC; 100% low-income units (b)
	8214	17566	Rolling Terrace Apartments	Y	39 of 53 low-income units (74%) (b); accepts subsidies
	26173	17536	Sheridan Station Apartments[9]	Y	Listed as LIHTC on HUD Affordable Housing Site; 112 of 112 (100%) leased apartments are low-income units (b)
	29290	17463	Hubbard Place[7,9]	Y	Listed as LIHTC on HUD Affordable Housing Site; listed on DC Affordable and Subsidized Housing Resource Guide; 100% of units are low-income or subsidized units (b)
	28595	16919	Faircliff Plaza West[7]	Y	Listed on DC Affordable and Subsidized Housing Resource Guide (b)
	980	16918	Faircliff Plaza East[7,9]	Y	Listed as LIHTC on HUD Affordable Housing Site; listed on DC Affordable and Subsidized Housing Resource Guide (b)
	12396	16892	New Horizon Apartments	Y	67 of 67 (100%) rented apartments are low-income units (b)
	146	18001	Orchard Park Apartments[7,9]	Y	Listed as LIHTC on HUD Affordable Housing Site; listed on DC Affordable and Subsidized Housing Resource Guide; 254 of 254 occupied units with low-income or subsidized rents (b)
	27913	17832	Marbury Plaza Tower 2	Y	For the entire Marbury Plaza complex, at least 96% of leased units listed as low-income units (b)
	4763	17375	Marbury Plaza Tower 1	Y	For the entire Marbury Plaza complex, at least 96% of leased units listed as low-income units (b)
Low-income Multifamily Comprehensive (7612LICP)	23900	18331	Woodland Terrace[11]	Y	Listed as Public Housing on DC website (c)
	26988	17464	Fort Lincoln[7,11]	Y	Listed as Public Housing on DC website; DCHA property serving seniors and disabled residents (c)

[11] https://www.dchousing.org/topic.aspx?topid=3

Program Track	Site ID	Project ID	Site Name	Verified (Y/N)	Verification Criteria
	30185	17153	The Parks at Walter Reed – Building 14 M	Y	Provided Affordable Housing Covenant (d)
	26987	16816	James Apartments[11]	Y	Listed as Public Housing on DC website; DCHA property serving seniors and disabled residents (c)
	857	16449	Benning Heights Apartments[7,9,12]	Y	Listed as subsidized housing on the HUD Affordable Housing Site; owned by not-for-profit, 100% affordable housing (c)
	23558	16367	So Others Might Eat[13,14]	Y	Project listed on DHCD website as having 36 affordable units; owned by non-profit and listed as low-income housing on DCHA site (c)
	686	17933	Sibley Plaza[11]	Y	Listed as Public Housing on DC website (c)
	2615	15824	Harvard Towers[11]	Y	Listed as Public Housing on DC website; listed on DCHA website; serves senior and disabled residents (c)
	15723	14729	Parkway Overlook[15,16,17]	Y	DCHA owned affordable housing (c)

Based on our review of the 29 sampled projects, we assume that all program costs and savings allocated to low-income programs were accrued by eligible low-income properties.

Next, we assessed progress towards the expenditure benchmark, followed by the savings benchmark.

1.1.4.1 Spend 20% of SETF funds at Low-income Housing, Shelters, Clinics, or Other Buildings

The DCSEU contract specifies that the calculation of the low-income spend percentage include portfolio-wide administrative and support costs in the denominator but not the numerator. Therefore, the NMR team applied the following equation:

$$\textit{Low-income spend \%} = \frac{\textit{Low-income program costs}}{\textit{Cumulative program costs + Portfolio administrative \& support costs}}$$

Table 13 displays our assessment of DCSEU's progress towards the low-income expenditure benchmark. Based on total FY2019 portfolio expenditures of $19,272,437, the contract requires

[12] https://dhcd.dc.gov/release/dhcd-commits-5-million-preserve-nearly-150-affordable-units-ward-7
[13] https://dhcd.dc.gov/release/hptf-financing-will-preserve-affordable-rental-units-wards-1-and-8
[14] https://dchousing.org/doc.aspx?docid=20160203132653060 37
[15] https://www.dchousing.org/doc.aspx?docid=2019042615324682111
[16] https://www.dchousing.org/doc.aspx?docid=2019042615324682111
[17] https://dhcd.dc.gov/release/district-agencies-announce-progress-transform-parkway-overlook-community

that DCSEU spend a minimum of $3,854,487 (20%) on low-income programs. There is no maximum target for low-income expenditures.

DCSEU reported spending $4,037,174 across nine low-income programs, which represents 105% of the target.

Table 13: FY2019 Low-income Expenditure Benchmark Performance

Measurement	Minimum Target	Evaluated Number	Percent of Minimum Target
Dollars spent on low-income properties	$3,854,487	$4,037,174	105%

1.1.4.2 Achieve 46,556 MMBtu in Electricity and Gas Savings from Low-income Programs

In Table 14, we list the tracked energy (electric plus gas) savings and evaluated savings for each of the eight low-income programs offered by the DCSEU in FY2019. Overall, the DCSEU tracking database reported 52,010 MMBtu in savings, and we verified 37,868 MMBtu.[18] Most of the savings adjustment is from the Low-income Prescriptive Rebate program, as described in Section 1.1.1.

Table 14: FY2019 Low-income Energy Savings by Program

Program	Track	Tracked Modified Gross Savings (MMBtu)	Evaluated Modified Gross Savings (MMBtu)
Solar Photo Voltaic	7107PV	675	689
Low-income Solar Renewable Credit	7107SREC	1,073	1,094
Implementation Contractor Direct Install	7610ICDI	1,466	1,466
Income Qualified Efficiency Fund	7610IQEF	7,611	7,658
Low-income Multifamily Comprehensive	7612LICP	14,329	14,464
Low-income Prescriptive Rebate	7613LIRX	23,528	9,170
Retail Lighting Food Bank	7717FBNK	1,220	1,220
Low-income Home Energy Conservation Kit	7717HEKT	2,109	2,109
Total		**52,010**	**37,868**

Table 15 displays our assessment of DCSEU's progress towards the low-income savings benchmark. The contract requires that the DCSEU achieve a minimum of 23,278 MMBtu savings from low-income programs. The maximum target equals 46,556 MMBtu.

Our evaluation found that DCSEU achieved 37,868 MMBtu in energy savings from low-income programs, which represents 163% of the minimum target and 81% of the maximum target. This represents a reduction from FY2018, when 96% of the maximum target was achieved. As

[18] The DCSEU tracking database reports natural gas savings in MMBtu and electricity savings in kWh. The NMR team converted kWh electricity savings to MMBtu by multiplying by a factor of 0.003412.

discussed in more detail in Section 2.1, the costs of saved energy for low-income programs is typically multiple times greater than for other types of programs.

Table 15: FY2019 Low-income Savings Benchmark Performance

Measurement	Minimum Target	Maximum Target	Evaluated Number	Percent of Minimum Target	Percent of Maximum Target
Modified gross electric savings plus modified gross gas savings from low-income programs (MMBtu)	23,278	46,556	37,868	163%	81%

1.1.5 Increase the Number of Green-collar Jobs

This benchmark requires that the DCSEU create green jobs in the District during each year of the contract. The contract requires that the DCSEU create a minimum of 66 full-time equivalent (FTE) jobs each year. The maximum annual target is 88 jobs.

In order to calculate the number of FTE jobs created, the contract specifies the following criteria:

- One FTE green job equals 1,950 hours worked by the DCSEU staff and subcontractors.
- One FTE green job equals $200,000 worth of DCSEU incentives provided to customers or manufacturers.
- Only direct jobs are to be considered. Indirect jobs and induced jobs are not counted.

In order to calculate the number of green jobs created by the DCSEU staff and subcontractors, DOEE provided a spreadsheet of payroll hours worked by the DCSEU staff and subcontractors during FY2019. The NMR team divided the total number of hours worked by 1,950 to yield the number of green jobs created by the DCSEU (Table 16).

In addition, the DCSEU provided a spreadsheet with the total incentive amount distributed in FY2019, which equaled $9,259,973. However, a portion of these incentives flowed through DCSEU subcontractors, whose created jobs were already counted under the payroll hours calculation. Therefore, we excluded a total of $3,050,332 in subcontractor incentives and used the remaining $6,209,641 as the basis for the calculation of jobs created due to incentives (Table 16).

Table 16: FY2019 Green Jobs Calculation

Category	Total Hours or Dollars (A)	Assumed Hours or Dollars per Job (B)	Number of Green Jobs Created (A / B)
DCSEU Staff Hours	63,415 hours	1,950 annual hours	32.5
DCSEU Subcontractor Hours	23,809 hours	1,950 annual hours	12.2
Incentive Dollars	$6,209,641	$200,000	31.0
Total Green Jobs Created			**75.7**

Table 17 displays our assessment of the DCSEU's progress towards the green jobs benchmark. We calculated that the DCSEU created 75.7 jobs, which represents 115% of the minimum target and 86% of the maximum target.

Table 17: FY2019 Green Jobs Benchmark Performance

Measurement	Minimum Target	Maximum Target	Evaluated Number	Percent of Minimum Target	Percent of Maximum Target
Number of FTE jobs created by the DCSEU	66	88	75.7	115%	86%

1.1.6 Leverage External Funds

The contract requires the DCSEU to secure outside funds, excluding SETF funds or other District government funds, to support the energy programs implemented by the DCSEU. The DCSEU is required to obtain a total of $5,000,000 of outside funds over the five-year period of the base contract. There is no annual target for this benchmark; there is only a cumulative five-year goal. Therefore, we tracked the DCSEU's annual progress towards the $5,000,000 five-year benchmark.

The DCSEU provided the NMR team with a spreadsheet listing details regarding the outside funds received during FY2019. The DCSEU reported obtaining a total of $317,131 in outside funds during FY2019, mostly from participating in the PJM forward capacity market and from Calvert Impact Capital (Table 18).

Table 18: FY2019 Leveraged Funds Calculation

Funding Source	Description	Amount
PJM Capacity Market	Forward Capacity Market Credits	$200,000
Individual	Energy Opportunity Fund	$100
Richard E. & Nancy P. Marriott Foundation	Workforce Development	$5,000
Major League Baseball	Energy Kits	$5,000
Lynch Development	Energy Opportunity Fund	$200
National Cooperative Bank	Workforce Development	$1,500
Calvert Impact Capital	Low-income Single-family Solar	$105,331
Total		**$317,131**

Including the reported outside funding of $439,111 from FY2017 and $268,881 from FY2018, we calculate that the DCSEU has secured a total of $1,025,123 since FY2017 (Table 19).

Table 19: Leveraged Funds Annual Summary

Year	Amount
FY2019	$317,131
FY2018	$268,881
FY2017	$439,111
Total	**$1,025,123**

The $1,025,123 figure represents 41% of the $2,500,000 minimum target and 21% of the $5,000,000 maximum target (Table 20). In order to be on track to meet the minimum requirement after the third year of the five-year contract, the percent progress should equal about 60%, assuming a linear progression towards the target. While the DCSEU may obtain greater funding during the final two years of the contract, they are currently well behind pace on achieving this benchmark.

Table 20: Cumulative Leveraged Funds Benchmark Performance

Measurement	Minimum Target	Maximum Target	Evaluated Number	Percent of Minimum Target	Percent of Maximum Target
Dollars received from external sources	$2,500,000	$5,000,000	$1,025,123	41%	21%

1.2 Tracking Goals and Other Metrics

In this section, we assess the DCSEU's FY2019 progress towards its two tracking goals:

- Reduce Growth in Peak Demand
- Reduce Growth in Energy Demand of Largest Energy Users

In addition, we present data on GHG reductions, net energy savings, and lifetime energy savings.

1.2.1 Reduce Growth in Peak Demand

While the DCSEU is not required to offer programs to exclusively reduce peak demand, demand savings result from the electric savings programs, and the DCSEU is required to report on demand savings. Because the peak demand savings goal is for tracking purposes only, it does not have a contractual performance target.

The DCSEU tracks peak demand savings in two ways: gross meter-level savings and modified gross generator-level savings. The contract requires that modified gross generator-level peak demand savings be used to assess progress towards this tracking goal.

The gross meter-level savings reflect the annual peak demand savings that the customer is expected to receive at the meter. The modified gross generator-level savings are calculated by increasing all gross meter-level peak demand savings by 7.707% to adjust for line losses and by further increasing savings from solar projects by 15% to reflect spillover. The formulas are displayed below.

*Modified gross peak demand savings for solar projects = Gross peak demand savings * 1.07707 * 1.15*

*Modified gross peak demand savings for non-solar projects = Gross peak demand savings * 1.07707*

The peak demand period occurs between 2:00 PM and 6:00 PM from June through September. In 2019, the peak load usage for DC was 2,306 MW.[19]

Table 21 displays the modified gross peak demand savings as tracked by the DCSEU, our calculated portfolio-level realization rate, and the evaluated modified gross peak demand savings. The realization rate equals the ratio of evaluated savings to tracked savings. The NMR team estimates that the actual portfolio peak demand savings equals 22.4 MW, which is 96% of the DCSEU tracked peak demand savings of 23.4 MW. The 22.4 MW figure represents 0.97% of the estimated peak load usage of 2,306 MW.

Table 21: Modified Gross Summer Peak Demand Savings Verification

Measurement	Tracked Savings (MW)	Realization Rate	Evaluated Savings (MW)
Modified gross electric demand savings during summer peak period	23.4	96%	22.4

The evaluated peak demand savings of 22.4 MW for FY2019 is similar to FY2018, which are both higher than FY2017 (Table 22). Because electric savings lead to demand savings, the larger electric savings in FY2018 and FY2019 yielded higher demand savings than in FY2017.

Table 22: Evaluated Modified Gross Summer Peak Demand Savings Trends

Measurement	FY2017	FY2018	FY2019
Evaluated modified gross electric demand savings during summer peak period (MW)	12.4	21.4	22.4

1.2.2 Reduce Growth in Energy Demand Of Largest Energy Users

While the DCSEU is not required to offer programs aimed exclusively at reducing the energy usage of large energy users, they are required to track projects with large users. Because the large user goal is for tracking purposes only, it does not have any contractual performance targets.

The DCSEU contract's definition of a large energy user is as follows:

> *Large energy users are defined as organizations, individuals, or government entities that own a building with more than 200,000 square feet of gross floor area or own a campus of buildings in a contiguous geographic area that share building systems or at least one common energy meter without separate metering or sub-metering, such that their energy use cannot be individually tracked. Gross floor area includes infrastructure that contain heated and unheated space that is connected to a qualifying building. Energy-efficiency*

[19] 2020 Consolidated Report. Potomac Electric Power Company. April 2020. Table 1.2-B.

or renewable energy measures must be installed in a qualified building or an infrastructure connected to a qualified building in order to qualify as a large energy user project.

The DCSEU provided a spreadsheet listing FY2019 large energy users, titled *Largest_Energy_Users*. Using the addresses listed in this spreadsheet or listed with the company ID in the tracking database, we evaluated the large energy user status of the project sites listed for these companies.

Some projects included multiple site listings. Additionally, some sites participated in multiple projects and project tracks. The number of unique site IDs participating in each track are listed in Table 23.

Table 23: FY2019 Large Energy User Sites

Program	Track	Number of Unique Sites
Solar PV Market Rate	7101PVMR	4
CI RX – Equipment Replacement	7511 CIRX	57
Market Transformation Value	7512MTV	6
Commercial Upstream	7513UPLT	155
Retrofit – Custom	7520CUST	56
Market Opportunities – Custom	7520MARO	26
New Construction – Custom	7520NEWC	14
Pay for Performance	7520P4PX	7
Low-income Multifamily Comprehensive	7612LICP	12
Low-income Prescriptive	7613LIRX	7
Residential Upstream	7725RSUP	1
Innovative Low-income	7913INLI	1
Total		**326**

To confirm that the company sites met the large user criteria from the contract, the NMR team reviewed the building size reported by the DCSEU for these companies' project sites when available. However, some sites were listed with a square footage of zero. To confirm building size for sites where the area was not provided, the NMR team consulted the DOEE Covered Building List for 2019,[20] which lists buildings over 50,000 gross square feet in the DC tax records. For locations not listed in the DOEE file, we sought external verification through institution websites, news articles, or government documents. Based on input from DCSEU, the NMR team evaluated users at the site level. There was sufficient data to confirm that 61 site IDs did not meet the 200,000 ft^2 threshold. In addition, there was insufficient data to verify another 34 site IDs. However, the NMR team was able to verify that 86 of 181 site IDs were large energy users. In addition, the NMR team did not count sites that only participated in the Commercial Upstream track as large energy users because there is no verification activity for these projects. An additional three Commercial Upstream companies brings the total number of verified large energy users to 89.

[20] https://doee.dc.gov/publication/download-covered-building-list-2019

The 89 completed projects with large energy users in FY2019 is less than prior years (Table 24).

Table 24: Evaluated Large Energy User Trends

Measurement	FY2017	FY2018	FY2019
Number of large energy users with completed projects	104	127	89

1.2.3 Greenhouse Gas Reductions

Table 25 displays the avoided CO2 equivalent emissions in annual metric tons since FY2017 based on the evaluated gross savings including line losses to reflect savings at the generator. The NMR team utilized a GHG emissions calculator spreadsheet from DOEE to calculate the avoided annual GHG emissions assuming 758 lbs. of CO2 per MWh, which we understand reflects an average emissions rate across the fleet of electric generators. Overall, we estimate the DCSEU's programs saved an estimated 159,316 metric tons of annual CO2 emissions since FY2017 using the average emission rates. The FY2019 avoided emissions of 63,450 metric tons represents about 0.8% of the estimated District-wide emissions of 7,552,734 metric tons from 2016.

We also calculated GHG reductions based on marginal emission rates because they more accurately reflect the impact of energy efficiency and renewable energy programs on displacing generation across the fleet. Energy efficiency and renewable energy programs "are not generally assumed to affect baseload power plants that run all the time, but rather marginal power plants that are brought online as necessary to meet demand."[21] We estimated an annual weighted average marginal emissions rate based on the savings accumulated during each of the four seasonal costing periods. This calculation yielded an annual marginal emissions rate of 1,376 to 1,415 lbs. of CO2 per MWh, which is almost double the average emissions rate. The FY2019 avoided emissions of 107,758 metric tons represents about 1.4% of the estimated District-wide emissions of 7,552,734 metric tons from 2016.

Table 25: Greenhouse Gas Emission Reductions

Year	Avoided CO2 Equivalent Emissions (Metric Tons)	
	Average Emission Rates	Marginal Emission Rates
FY2019	63,450	107,758
FY2018	55,478	92,963
FY2017	40,389	66,147
Total	**159,316**	**266,868**

[21] https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

1.2.4 Net Energy Savings

Table 26 displays the net energy savings for FY2019, which adjusts the gross savings for both free-ridership and participant spillover. Free-ridership reflects the portion of program savings that would have occurred in the absence of the program. Participant spillover manifests in participating customers who take actions that lead to additional savings beyond the tracked program savings and without financial assistance from the program.

Overall, the net modified savings represent 63% of the gross modified savings for electricity, 56% for gas, and 61% across both fuels.

Table 26: FY2019 Net Energy Savings

	Electric Savings (MWh)	Gas Savings (Therms)	Energy Savings (MMBtu)
Gross Modified Savings	151,321	2,569,795	773,286
Net Modified Savings	94,883	1,443,180	468,059
Net-to-Gross Ratio (Net / Gross)	63%	56%	61%

1.2.5 Lifetime Energy Savings

Table 27 displays the modified gross electric savings projected over the lifetime of the measures. Since FY2017, the DCSEU programs are projected to save about 4,403,108 MWh in lifetime electric savings. The NMR team calculated the lifetime savings for each measure by multiplying the first-year energy savings by its expected lifetime. Because certain measures are subject to increased efficiency standards in the future, the lifetime savings may be adjusted to reflect this situation.

Table 27: Lifetime Modified Gross Electric Savings

Year	Tracked Lifetime Modified Gross Savings (MWh)	Realization Rate	Evaluated Lifetime Modified Gross Savings (MWh)
FY2019	1,807,714	99%	1,784,211
FY2018	1,507,610	99%	1,496,844
FY2017	1,140,086	98%	1,121,053
Total	**4,455,410**	**99%**	**4,403,108**

Table 28 displays the lifetime modified gross gas savings. Overall, the FY2017 through FY2019 programs are projected to save about 60,969,012 therms in lifetime gas savings. The NMR team calculated lifetime savings for each measure by multiplying the first-year energy savings by its expected lifetime. Because certain measures are subject to increased efficiency standards in the future, the lifetime savings may be adjusted to reflect this situation.

Table 28: Lifetime Modified Gross Gas Savings Verification

Year	Tracked Lifetime Modified Gross Savings (Therms)	Realization Rate	Evaluated Lifetime Modified Gross Savings (Therms)
FY2019	24,817,702	96%	23,813,001
FY2018	18,562,650	102%	18,850,804
FY2017	20,298,108	90%	18,305,207
Total	**63,678,460**	**96%**	**60,969,012**

Section 2 Cost-effectiveness Assessment

In this section, we describe our evaluation efforts to assess the cost of saved energy and the cost-effectiveness of the DCSEU programs.

2.1 Cost of Saved Energy

To inform future planning of budgets and savings goals, we calculated the DCSEU's cost of first-year verified energy savings in FY2019. In order to calculate the cost of saved energy, the DCSEU provided the NMR team with program-specific incentive costs for electric and natural gas measures, as well as portfolio-wide administrative and support costs for FY2019. In order to calculate total electric and natural gas costs, we allocated the portfolio-wide administrative and support costs to each program and fuel type based on its program-specific incentive cost. We then summed the total costs by fuel type and program.

Because renewable energy projects typically cost more per unit of savings than energy-efficiency projects, we calculated costs separately for energy-efficiency projects and renewable energy projects. Therefore, we provide the costs for three categories of savings:

- Electric savings, excluding renewables programs
- Electric savings from renewables programs only
- Natural gas savings

As described in Section 1.1.1, modified gross electricity savings exceed gross electricity savings due to adjustments for line losses and adjustments for spillover from solar projects. In addition, as described in Section 1.1.2, modified gross gas savings exceed gross gas savings due to the exclusion of cross-fuel interactive effects. Therefore, the DCSEU's costs for modified gross energy savings are less than the costs for gross energy savings. We calculate costs for both types of savings because gross savings are more directly comparable to other jurisdictions while the performance benchmarks are based on modified gross savings.

We calculated that the DCSEU's cost for first-year gross and modified gross electricity savings excluding renewables programs was $106/MWh and $101/MWh, respectively (Figure 4 and Figure 5). In addition, we calculated that the DCSEU's cost for gross and modified gross electricity savings from renewables programs was $117/MWh and $97/MWh, respectively. For natural gas savings, we calculated that the DCSEU's cost of gross and modified gross savings was $1.81/therm and $1.56/therm, respectively.

Figure 4: DCSEU Trends for Costs of First-Year Gross Energy Savings

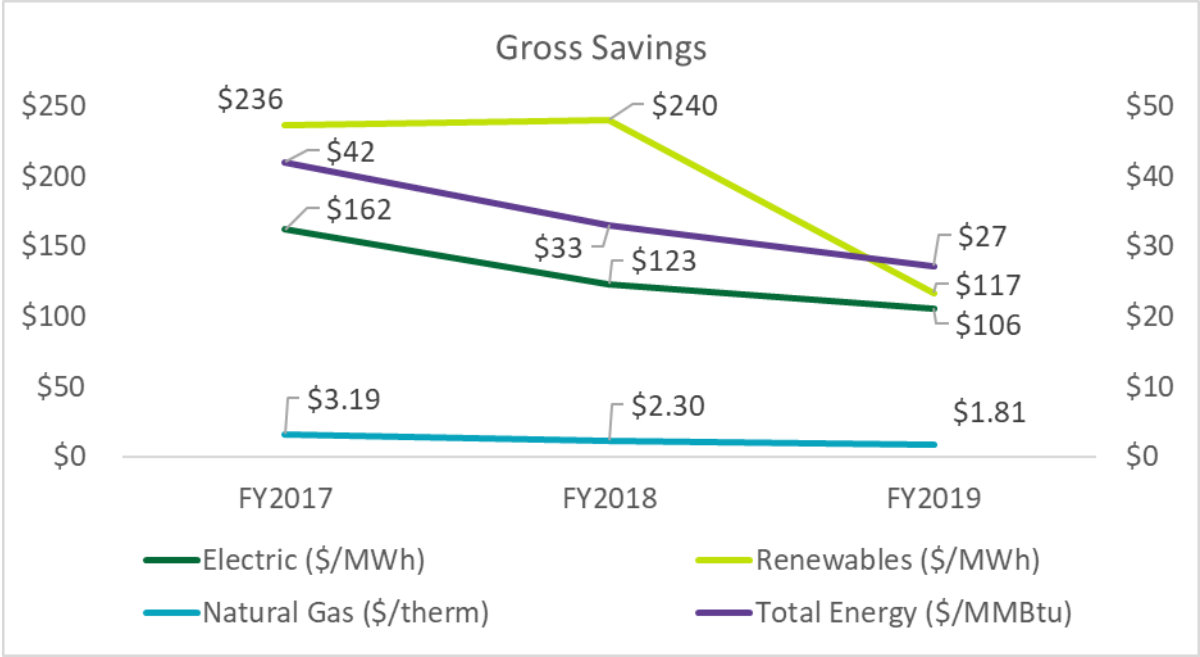
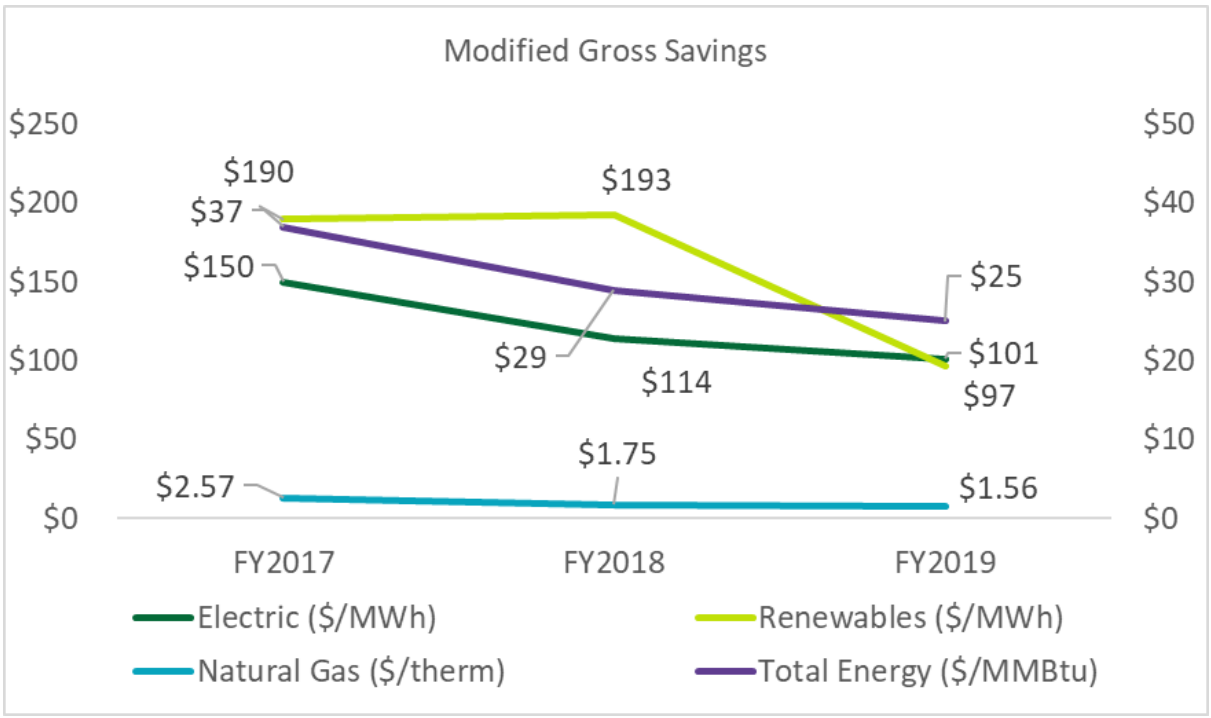


Figure 5: DCSEU Trends for Costs of First-Year Modified Gross Energy Savings



The DCSEU's cost of gross energy savings declined by 35% from $42/MMBtu in FY2017 to $27/MMBtu in FY2019 across the entire portfolio (Figure 4). Similarly, the cost of gross energy savings for electricity declined by 35%, for renewables declined by 51%, and for natural gas

declined by 43%. The substantial drop in the cost of renewable electricity savings is likely due to the large increase in installed capacity – from 1,836 kW during FY2018 to 7,129 kW during FY2019.

In order to compare the cost of saved electricity to the cost of saved gas, we converted the gas savings from therms to an MWh equivalent.[22] The cost of gross gas savings is less than the cost of gross electricity savings, with the ratio ranging from 58% to 67% each year.

Table 29: DCSEU Comparison of Costs of First-year Gross Energy Savings

Fuel Savings Type	FY2019	FY2018	FY2017
Electric savings, excluding renewables programs	$106/MWh	$123/MWh	$162/MWh
Gas savings equivalent	$62/MWh	$78/MWh	$109/MWh
Ratio of Gas Cost to Electric Cost	58%	63%	67%

Due to the similar geographic location and climate, we compare the DCSEU's costs of first-year electricity savings to those from two nearby utilities: PECO Energy in Pennsylvania and Baltimore Gas & Electric (BG&E) in Maryland. In addition, we compare DCSEU's costs of first-year gas savings to the costs for Philadelphia Gas Works (PGW), which serves the city of Philadelphia. While these comparisons are useful, it is important to understand that these jurisdictions have different markets, savings goals, regulatory requirements, cost-effectiveness tests, program maturity, and delivery systems, which may affect both costs and savings.

PECO Energy serves the city of Philadelphia and surrounding counties, which are less urban than DC. PECO is subject to Pennsylvania's Act 129, which requires that energy-efficiency programs achieve nearly a 4% cumulative reduction in annual electricity use (or approximately 0.8% per year) over the five-year period of the Phase III programs that launched in 2016. In addition, at least 5.5% of savings must come from programs solely directed at low-income customers in multifamily housing and at least 3.5% from government, non-profit, and institutional organizations. Pennsylvania Act 129 requires the portfolio of programs offered by each electric distribution company to be cost-effective using a modified version of the Total Resource Cost (TRC) test. The TRC typically includes a more limited range of benefits than the Societal Cost Test (SCT) employed by DC.

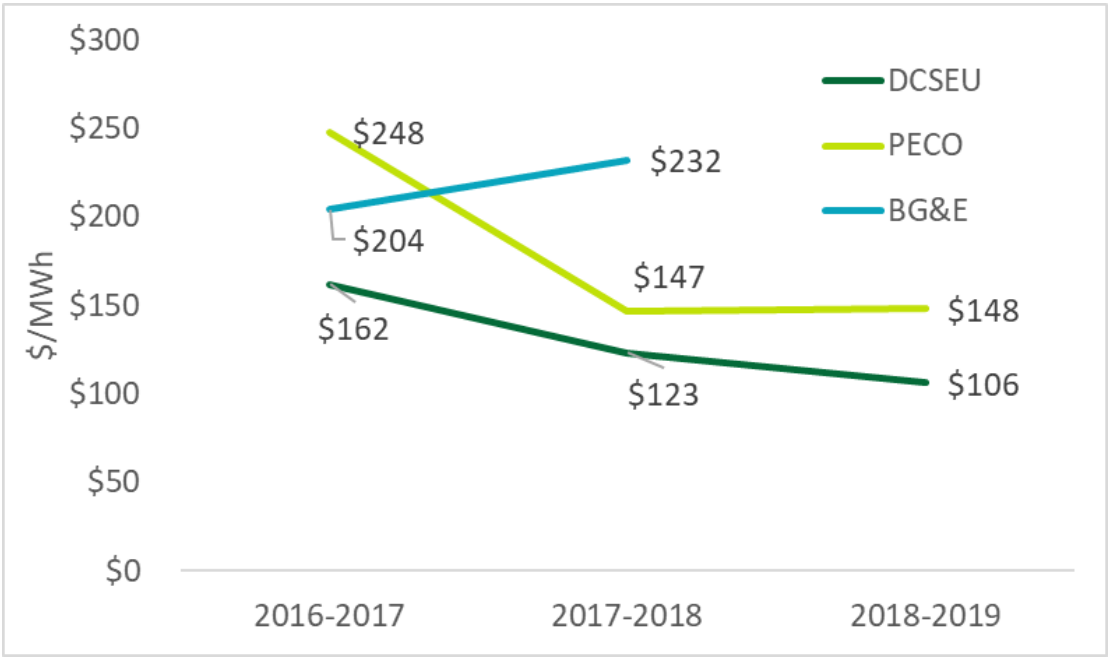
BG&E services the city of Baltimore, as well as surrounding counties, which are less urban than DC. Beginning with the 2016 program year, the Maryland EmPOWER programs are designed to achieve an annual incremental gross energy savings equivalent of 2.0% of the weather normalized gross retail sales baseline, with a ramp-up rate of 0.20% per year. The programs are screened on four factors: cost-effectiveness, impact on the rates of each ratepayer class, impact on jobs, and impact on the environment. Maryland requires that each utility's programs be cost-effective at both the residential and commercial sector-level using the TRC test.

[22] We converted therms to MWh by first dividing by 10 therms per MMBtu then dividing by 3.412 MMBtu per MWh.

In comparison, the DCSEU has multiple benchmarks, in particular low-income and green jobs, that may impact costs. In addition, the DCSEU budget and goals are a fraction of those for either PECO or BG&E, although substantially greater than for PGW.

At $106/MWh, the DCSEU's FY2019 cost for gross electricity savings is less than the cost for PECO at $148/MWh (Figure 6). DCSEU's cost of saved energy has been lower than both PECO and BG&E each year. Because PECO and BG&E only offer electric energy-efficiency programs, we only compare the costs to save electricity.

Figure 6: Comparison of Costs of First-Year Gross Electricity Savings



At $1.81/therm, the DCSEU's FY2019 cost for gross gas savings is less than one-half the cost for PGW ($3.76/therm) (Figure 7). A similar situation occurred in FY2018 and FY2017.

Figure 7: Comparison of Costs of First-Year Gross Gas Savings

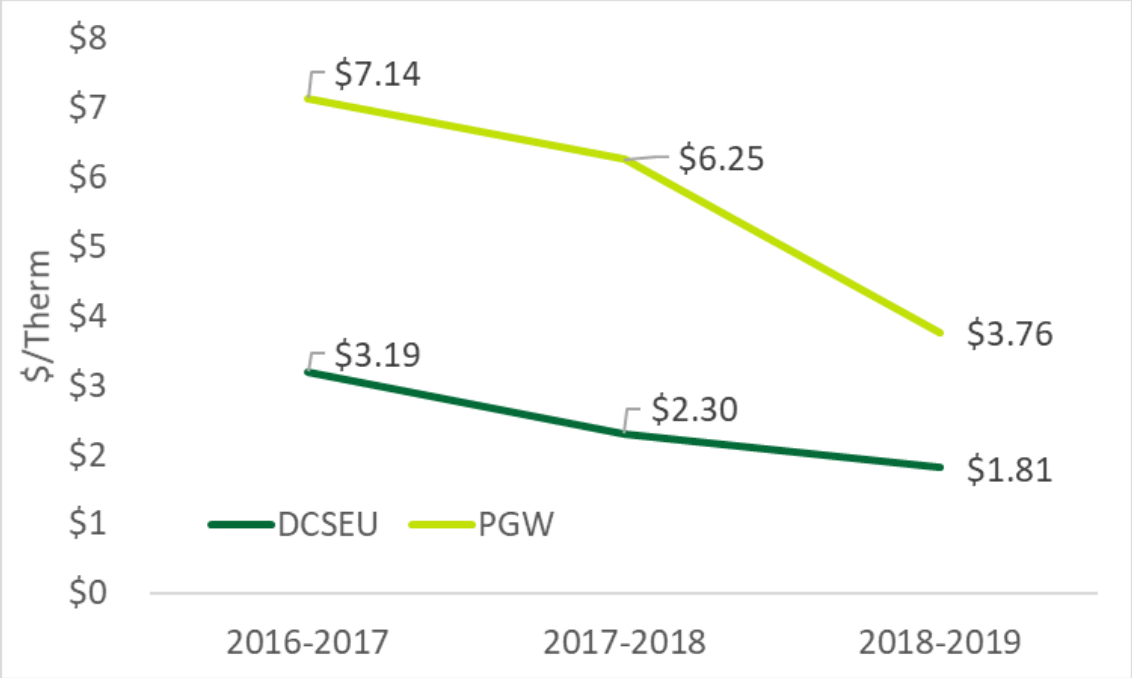
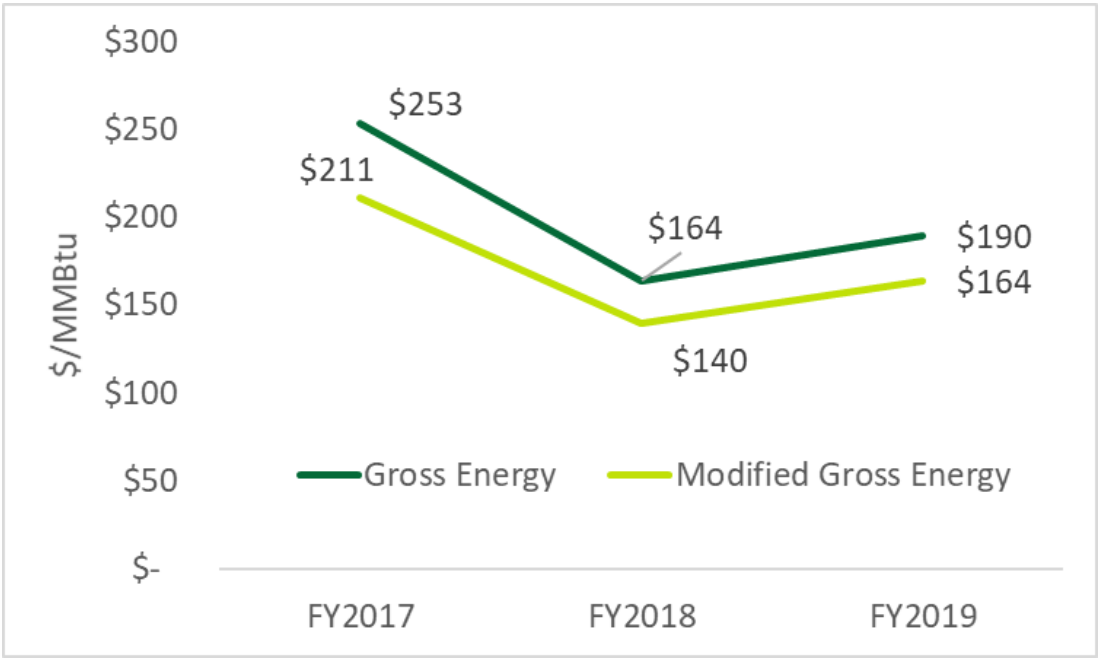


Figure 8 displays the costs of saved energy across all eight DCSEU low-income programs listed in Table 14. The costs of gross and modified gross energy savings declined by about 34% to 35% from FY2017 to FY2018 but then increased by about 16% in FY2019.

Figure 8: Costs of First-Year Gross Energy Savings for Low-Income Programs



Because low-income projects typically require greater levels of program investment, the costs of saved energy are higher than for other types of programs. We calculated the cost of saved electricity for DCSEU's low-income programs to be about five times greater than the cost of non-low-income programs. This is similar to the findings from a national study that estimated the cost of saved electricity for low-income programs as approximately four times greater than for other types of programs.[23]

2.2 Cost-Effectiveness Assessment

The NMR team modeled the cost-effectiveness of the DCSEU FY2019 program offerings at the portfolio level and for each of the programs that were active in FY2019. We did all of our modeling using a SCT perspective. The SCT is a variant of the Total Resource Cost (TRC) Test, which includes various externalities and a lower societal discount rate than the discount rate based on the utility weighted average cost of capital used in the TRC. The discount rate determines the net present value of future resource savings. Table 30 lists the cost and benefit elements included in the SCT Test.

[23] *The Cost of Saving Electricity Through Energy Efficiency Programs Funded by Utility Customers: 2009–2015.* Lawrence Berkeley National Laboratory. June 2018.

Table 30: Societal Cost Test – Costs and Benefits

SCT Costs	SCT Benefits
Incremental Measure Cost	Avoided Energy Costs (kWh, MMBtu)
Other Financial or Technical Support Costs	Avoided Generating Capacity Costs
Program Administration Costs	Avoided T&D Capacity Costs
NMR Evaluation, Measurement, & Verification Costs	Avoided Water Cost
DOEE Oversight Costs	Reduced Risk/Increased Reliability
	Reduced Operation and Maintenance (O&M) Cost
	Benefits from reducing environmental externalities, including air and water pollution, GHG emissions, and cooling water use.
	Non-energy Benefits (NEBs), including comfort, noise reduction, aesthetics, health and safety, ease of selling/leasing home or building, improved occupant productivity, reduced work absences due to illness, ability to stay in home/avoided moves, and macroeconomic benefits.

The primary data sources that the NMR team used for the cost-effectiveness assessment were as follows:

- Measure-level energy savings, effective useful life (EUL) assumptions, incremental measure cost values, incentive amounts, and projections of O&M savings from the DCSEU tracking database.
- Non-incentive expenditures for program administration and delivery, as provided by the DCSEU. This includes both costs that were allocated to specific tracks and common costs for support services that are assigned at the portfolio level.
- Avoided cost assumptions, as documented in a series of memos and workbooks that outline the latest values. These values are provided in Section 2.2.1.
- Realization rates and net-to-gross ratios, as determined by the FY2019 impact evaluation.

In addition to the detailed information contained in the DCSEU program tracking database, the DCSEU provided the NMR team with its own cost-effectiveness findings for FY2019. The DCSEU calculated a portfolio SCT ratio of 1.72 with $94.1 million of net benefits at the portfolio level for FY2019. As a first step in the analysis, the NMR team developed a parallel set of calculations using DCSEU inputs, assumptions, and formulas. This analysis returned a portfolio SCT ratio of 1.72 and $90.5 million in net benefits. After closely replicating the DC model, the NMR team made a few adjustments to address different assumptions. Section 2.2.2 provides additional details about the differences observed between models. The NMR team produced three additional cost-effectiveness scenarios using different inputs and assumptions. The additional scenarios are described below. The results are summarized in Table 31 and presented in detail in Section 2.2.2.

- ***Scenario #1 – Modified Replica:*** Replicates the DCSEU calculations with corrections to inputs and formulas. The first modification in Scenario #1 was formulaic and was also noted in the FY2017 and FY2018 evaluation reports. Some measures have interactive effects on other fuels. For example, installation of cooler LED lighting increases the consumption of fossil fuel heating systems because there is less waste heat in the space. The DCSEU treated this heating *penalty* as a cost for fossil fuels and a benefit for electricity and water. The NMR team standardized the accounting across resources and treated all interactive penalties (and associated externalities) as a negative benefit. This does not affect the Present Value of Net Benefits (PVNB) calculation, but does change the SCT ratios because dollars are moved from the denominator to the numerator. Measure life was also restricted to a maximum of 30 years for all measures. Whereas the DCSEU calculations did not apply line losses to energy benefits, the NMR team's modified replica model incorporates line loss factors into the calculation of energy and demand benefits. In addition, the modified replica model does not apply solar spillover to market rate solar projects. A final distinction is that the DCSEU model redefines the *present* for costs by inflating costs by half a year. The modified replica model assumes all costs occur in the present, in current dollars, and does not apply a cost adjustment.
- ***Scenario #2 – Gross Verified Savings****:* This scenario incorporates the realization rates as determined by the impact evaluation. Realization rates are applied to the first-year savings and future adjusted savings (in the case of measures with dual baselines) equally.
- ***Scenario #3*** – ***Net Verified Savings****:* This scenario adjusts the reported savings in the DCSEU system by both the realization rate and net-to-gross ratio. Regardless of program delivery mechanism (incentive vs. direct install), incremental measure costs are discounted by the applicable free-ridership rate. The net-to-gross ratios applied in Scenario #3 account for any spillover benefits in lieu of directly applying a spillover assumption, as was included in DCSEU's model but excluded from the presented scenarios.

Appendix A provides descriptions for each of the program tracks offered by the DCSEU in FY2019. The program groupings shown in Table 31 and subsequent tables are a function of the way DCSEU reports direct costs. DCSEU provided track-specific direct costs at the four-digit *job* level and some jobs include multiple tracks. For example, job number 7520 includes three Commercial Custom tracks: Retrofit (7520CUST), Market Opportunities (7520MARO), and New Construction (7520NEWC), as well as the Pay for Performance (7520P4PX) track.

Table 31: Societal Cost Test Ratios by Scenario

Program	DCSEU	Modified Replica Scenario #1	Gross Verified Savings Scenario #2	Net Verified Savings Scenario #3
Solar PV Market Rate	1.32	1.41	1.44	1.39
Solar Photo Voltaic/Low-income Solar Renewable Energy Credit	1.18	1.15	1.17	1.17
Refresh the District LI Single Family	0.00	0.00	0.00	0.00
Emergency Heating and Cooling Assistance	0.00	0.00	0.00	0.00
C&I RX - Equipment Replacement	3.47	3.78	4.05	3.96
Market Transformation Value	2.16	2.19	2.45	2.39
Commercial Upstream - Lighting	5.78	7.07	7.17	6.92
Retrofit/Market Opp/New Constr - Commercial Custom	1.65	1.72	1.65	1.59
Implementation Contractor DI/Income Qualified Efficiency Fund	1.16	1.21	1.21	1.21
Low-income MF Comprehensive	1.64	1.73	1.75	1.75
Low-income Prescriptive Rebate	5.58	6.79	3.98	3.98
Retail Efficient Appliances/Heating and Cooling/Lighting	2.80	3.40	3.38	3.02
Retail Lighting Food Bank/Home Energy Conservation Kit – Low-income	3.26	4.33	4.34	4.34
Residential Upstream	2.08	2.50	2.50	2.13
Innovation – Low-income	0.00	0.00	0.00	0.00
Innovation - Market Rate	0.00	0.00	0.00	0.00
Total Portfolio Level	**1.72**	**1.84**	**1.81**	**1.71**
Portfolio Level with EM&V and DOEE Oversight Costs	**N/A**	**1.80**	**1.77**	**1.65**

Incentives are neither a cost nor a benefit in the SCT Test. The incremental cost of the efficient measure is included in the SCT regardless of the proportion paid by the participant and program administrator. Program administration costs are treated as a cost in the SCT and include planning, IT, marketing, customer service, and all other non-incentive costs. Table 32 provides a breakdown of the FY2019 cost elements after moving increased fuel consumption to the benefits side of the ledger.

Table 32: FY2019 Cost Summary

Parameter	Cost Component	FY2019 Portfolio Total
A	Incentive Payments	$9,259,973
B	Participant Cost (Net of Incentives)	$110,980,371
C	Incremental Measure Cost (A + B)	$120,240,344
D	Track-specific Administrative Costs (Non-incentive)	$3,234,325
E	Portfolio Administrative Costs	$6,799,783
F	Total Program Administration Cost (D+E)	$10,034,108
G	**Total SCT Costs (C+F)**	**$130,274,452**
H	DOEE Oversight and NMR EM&V Costs	$2,425,976
I	**Total SCT Costs with Oversight and EM&V (C+F+H)**	**$132,700,428**

There are two different bins of administrative costs listed in Table 32. The track-specific administrative costs (Parameter D) are allocated to a specific program track, so they are included as a cost in the track-level SCT results, presented in Section 1. The portfolio-level results presented in this report include both the track-specific administrative costs and portfolio administrative costs (Parameter E). This is the same approach used by the DCSEU to calculate cost-effectiveness, and is commonly used by other states and utilities. The implication of this methodology is that each of the track-level results is slightly overstated because the SCT ratio does not reflect its share of costs allocated to the portfolio as a whole. If track-level cost-effectiveness results are important to DOEE, we could work with the DCSEU to develop an allocation method. Possible allocation approaches could include kWh contribution, MMBtu contribution, or spending (Parameters A + D). Parameter H includes costs of oversight from DOEE and the NMR team's EM&V costs. The total SCT costs with oversight are presented in Parameter I.

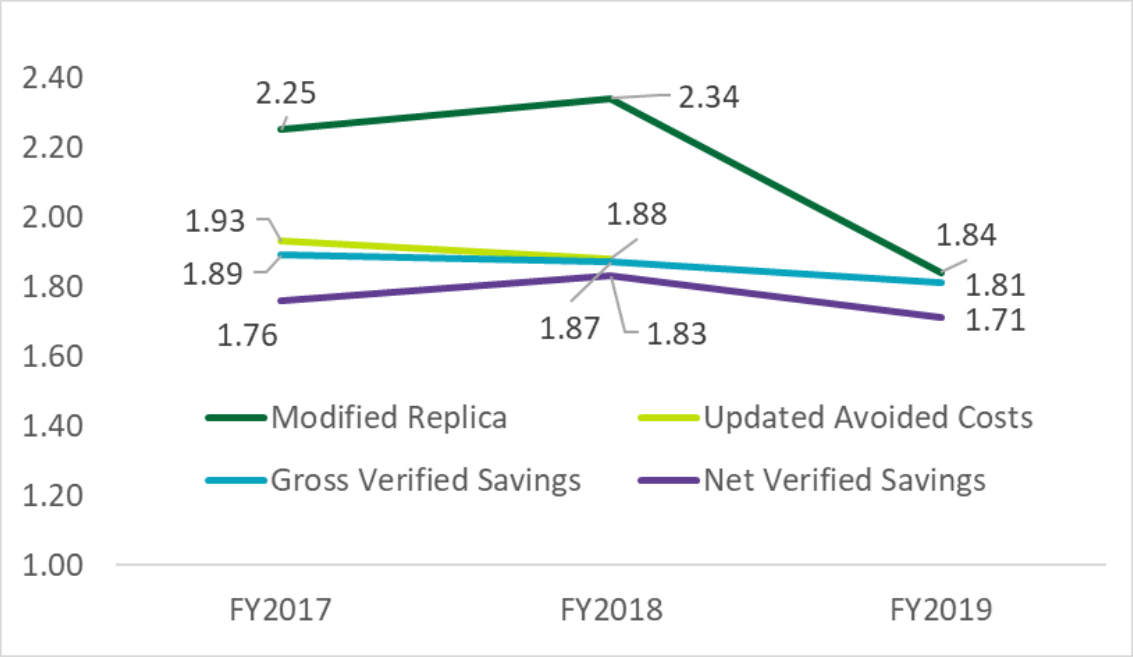
The DCSEU takes a strong position on the valuation of NEBs. In addition to a general 5% adder for the items listed in Table 30 and a 15% low-income solar adder, a $100 per short ton ($110.23 per metric ton) benefit is assigned to all avoided CO2 emissions. In our modified replica model, the NEBs (general 5% adder for select items and the 15% low-income solar adder plus $100 per short ton for CO2) account for 46% of all SCT benefits. For the remaining scenarios, NEBs represent approximately the same percent of all SCT benefits. Without NEBs, the portfolio is not cost-effective under the contract-defined SCT framework and 2019 model assumptions. However, the ratios are close to one, at 0.99, 0.97, and 0.93 for Scenarios #1, #2, and #3, respectively. Table 33 shows the estimated lifetime reduction in CO2 emissions attributable to FY2019 programs by scenario.

Table 33: Lifetime CO2 Emission Reductions – FY2019 Programs

Scenario	Lifetime Avoided CO2 Emissions (Metric Tons)
1 – Modified Replica	1,084,281
2 – Gross Verified Savings	1,076,832
3 – Net Verified Savings	644,770

Figure 9 displays the SCT results from FY2017 to FY2019. The modified replica results are lower in FY2019 than previous years because DCSEU applied our recommended updated avoided cost assumptions starting in FY2019. However, the gross verified savings and net verified savings results are similar each year.

Figure 9: DCSEU Societal Cost Test Ratio Trends



2.2.1 Avoided Costs

In FY2019, DCSEU modified their avoided cost assumptions to align with NMR's previously recommended cost assumptions. This update allows for a streamlined review process and simplifies the scenarios presented for cost-effectiveness. The DCSEU model, as well as the three presented scenarios, use the same avoided cost assumptions. Table 34 summarizes the values and sources applied by DCSEU in their cost-effectiveness testing.

Table 34: DCSEU FY2019 Avoided Cost Summary

Screening Assumption	Value	Source
Future Inflation Rate	1.420%	Based on past ten years of consumer price index data published by the U.S. Labor Department for the months of August
Water Avoided Cost	$2.999/CCF	Approved_fy_2018_operating_and_capital_budgets_final.pdf, 2017 Engineering Feasibility Report WATER.pdf
Real Discount Rate	5.082%	Ten-year treasury rate posted in the Wall Street Journal on the first business day of October 2018 (3.082%) plus 2% (as specified in the DCSEU contract no. DOEE-2016-C-0002).
Line Losses	1.046 (energy) 1.077 (demand)	PEPCO Zone Capacity and Transmission Peak Load Calculations for Year 2018.
Natural Gas Capacity Adder	5%	Per Section C.40.10.3 of contract DOEE-2016-C-0002.
Transmission Cost	$28.91/kW-year	PEPCO's 2018 filing of the FERC formula transmission rate update.

Screening Assumption	Value	Source
Distribution Cost	$67.21/kW-year	Distribution rate deduced from the 2017 DC Public Commission order re: Pepco distribution rate increase request.
Electric & Fuel Externalities	$100 per short ton (2,000 pounds) ($110.23 per metric ton)	Avoided Energy Supply Components in New England: 2018 Report and PJM's 2013-2017 CO2, SO2, and NOx Emissions Rate Report, published in March 2018.
Electric Energy Cost	Forecast by Year and Period	Hourly real-time locational marginal prices (LMPs) for PEPCO zone from January 2015 to May 2018 are used in conjunction with hourly load data for PEPCO zone for the same period to calculate load-weighted marginal price by energy period. This establishes the 2017 value. Price escalation over the remainder of the forecast horizon (2018-2050) is calculated by averaging growth projections from a series of EIA Annual Energy Outlook forecasts for the Mid-Atlantic region.
Generation Capacity	Forecast by Year	PJM Base Residual Auction clearing prices for PEPCO zone. Historic prices used for forecasting.
Natural Gas Cost	Forecast by Year and Sector	Projected prices for the industrial sector (Mid-Atlantic region) are adopted from the EIA Annual Energy Outlook 2018 supporting tables for energy price by sector and source.
Other Fuels Cost	Forecast by Year, Fuel, and Sector	Projected prices for the industrial sector (Mid-Atlantic region) (where possible, transportation sector used as a substitute for kerosene cost) are adopted from the EIA Annual Energy Outlook 2018 supporting tables for energy price by sector and source.
Risk Adder	5%	Specified in the DCSEU contract no. DOEE-2016-C-0002.
NEB Adder	5%	Specified in the DCSEU contract no. DOEE-2016-C-0002.
Low-income Adder for Solar Measures	15%	Modeled on regulatory order: State of Vermont Public Service Board "Order Re Cost-Effectiveness Screening Of Heating And Process-Fuel Efficiency Measures And Modifications To State Cost-effectiveness Screening Tool," 2/7/2012.

2.2.2 Cost-effectiveness Results

Table 35 presents the results of the NMR team's modified replica model. This scenario utilizes the reported gross savings values as stored in the program tracking system and the same array of avoided costs as DCSEU's calculations, but incorporates a set of modifications. Of the 16 program groups, 12 are cost-effective in this scenario. The portfolio is estimated to achieve $101 million of net benefits (benefits minus costs). The four programs that are not cost-effective have zero benefits. This is not unusual for new programs or programs that are designed to support the benefits of related programs. The four zero-benefit programs are the Refresh the District LI Single Family program, the Emergency Heating and Cooling Assistance program, and the two Innovation programs: Low-income and Market Rate. There are a few key differences between this analysis (SCT ratio = 1.84) and the DCSEU analysis (SCT ratio = 1.72):

- The NMR model treats increased fossil fuel usage as a negative benefit rather than a positive cost. It is more appropriate to compare net benefit figures because the DCSEU model differed from the NMR team model in its treatment of interactive effects between space conditioning and lighting, as discussed in the Scenario #1 description.
- There were some differing cost and benefit values between the DCSEU results summary and the NMR team's replica model using the detailed program tracking data. The NMR team treated all cost data in the program tracking system as nominal 2019 dollars. DCSEU's model inflates all measure costs by a half-year, effectively assuming that costs

occur in future dollars. In contrast, the NMR team's model follows the conventional accounting assumption that costs are incurred in the present and no temporal adjustment is made to costs. In addition, a few measures use a mix of 2016, 2017, 2018, and 2019 as the present value base year. We recommend that DCSEU define *present* consistently when calculating net *present* value for future fiscal years.

- The DCSEU model applies a blanket +15% spillover assumption to all market rate solar PV benefits. By design, the NMR team's replica model and gross verified models do not include spillover effects. Rather, any spillover effects are captured in the NTG factor applied in the net verified savings model. Applying both the spillover term and the NTG factor would functionally double count any spillover benefits.
- When site-specific hours of operation are utilized, DCSEU does not adjust the peak demand impacts stored in the program tracking data, but instead scales capacity benefits using the ratio of the site-specific operating hours to the TRM characterization. The replica model uses the kW impacts stored in the program tracking data to calculate capacity benefits. The extent to which the site-specific results differ from the TRM characterization is reflected in the NMR team's demand realization rate, which is incorporated into Scenario #2 and Scenario #3.

Table 35: Scenario #1 Modified Replica – SCT Results

Program	Sector	SCT Benefit ($1,000)	SCT Cost ($1,000)	SCT Net ($1,000)	SCT Ratio
Solar PV Market Rate	Solar	$34,426	$24,402	$10,023	1.41
Solar Photo Voltaic/Low-income Solar Renewable Energy Credit	Solar	$1,390	$1,212	$178	1.15
Refresh the District LI Single Family	Residential	$0	$14	($14)	0.00
Emergency Heating and Cooling Assistance	Residential	$0	$22	($22)	0.00
C&I RX - Equipment Replacement	Commercial	$29,408	$7,781	$21,627	3.78
Market Transformation Value	Commercial	$2,895	$1,320	$1,575	2.19
Commercial Upstream - Lighting	Commercial	$10,906	$1,542	$9,364	7.07
Retrofit/Market Opp/New Constr - Commercial Custom	Commercial	$116,368	$67,481	$48,888	1.72
Implementation Contractor DI/Income Qualified Efficiency Fund	Multifamily	$2,525	$2,092	$433	1.21
Low-income MF Comprehensive	Multifamily	$6,287	$3,626	$2,661	1.73
Low-income Prescriptive Rebate	Multifamily	$3,996	$589	$3,407	6.79
Retail Efficient Appliances/Heating and Cooling/Lighting	Efficient Products	$12,985	$3,815	$9,170	3.40
Retail Lighting Food Bank/Home Energy Conservation Kit – Low-income	Efficient Products	$654	$151	$503	4.33
Residential Upstream	Efficient Products	$43	$17	$26	2.50
Innovation - Low-income	Innovation	$0	$23	($23)	0.00
Innovation - Market Rate	Innovation	$0	$29	($29)	0.00
Total Portfolio Level	**Portfolio**	**$221,882**	**$120,914**	**$100,968**	**1.84**
Portfolio Level with EM&V and DOEE Oversight Costs	**Portfolio**	**$221,882**	**$123,340**	**$98,542**	**1.80**

Table 36 presents the results for Scenario #2. The electric energy, peak demand, and natural gas savings realization rates developed through the FY2019 impact evaluation were generally close to 100%, so the Scenario #2 SCT results were similar to Scenario #1 at the portfolio level. Twelve of the program groups are cost-effective in this scenario. The portfolio is estimated to achieve over $97 million of net benefits (benefits minus costs). The four programs that are not cost-effective have zero benefits.

Table 36: Scenario #2 Gross Verified Savings – SCT Results

Program	Sector	SCT Benefit ($1,000)	SCT Cost ($1,000)	SCT Net ($1,000)	SCT Ratio
Solar PV Market Rate	Solar	$35,205	$24,402	$10,803	1.44
Solar Photo Voltaic/Low-income Solar Renewable Energy Credit	Solar	$1,421	$1,212	$210	1.17
Refresh the District LI Single Family	Residential	$0	$14	($14)	0.00
Emergency Heating and Cooling Assistance	Residential	$0	$22	($22)	0.00
C&I RX - Equipment Replacement	Commercial	$31,487	$7,781	$23,706	4.05
Market Transformation Value	Commercial	$3,238	$1,320	$1,918	2.45
Commercial Upstream - Lighting	Commercial	$11,060	$1,542	$9,519	7.17
Retrofit/Market Opp/New Constr - Commercial Custom	Commercial	$111,129	$67,481	$43,648	1.65
Implementation Contractor DI/Income Qualified Efficiency Fund	Multifamily	$2,531	$2,092	$440	1.21
Low-income MF Comprehensive	Multifamily	$6,328	$3,626	$2,702	1.75
Low-income Prescriptive Rebate	Multifamily	$2,341	$589	$1,753	3.98
Retail Efficient Appliances/Heating and Cooling/Lighting	Efficient Products	$12,899	$3,815	$9,084	3.38
Retail Lighting Food Bank/Home Energy Conservation Kit – Low-income	Efficient Products	$655	$151	$504	4.34
Residential Upstream	Efficient Products	$43	$17	$26	2.50
Innovation - Low-income	Innovation	$0	$23	($23)	0.00
Innovation - Market Rate	Innovation	$0	$29	($29)	0.00
Total Portfolio Level	**Portfolio**	**$218,338**	**$120,914**	**$97,424**	**1.81**
Portfolio Level with EM&V and DOEE Oversight Costs	**Portfolio**	**$218,338**	**$123,340**	**$94,998**	**1.77**

Table 37 presents the results of Scenario #3. This scenario adjusts energy savings by incorporating both realization rates (from Scenario #2) and net-to-gross ratios. Twelve of the program groups are cost-effective in this scenario. Both the benefits and costs are reduced in this scenario because no savings (or benefits) are assigned to free riders and the incremental measure costs associated with free riders are not included as an SCT cost (because they would have purchased the efficient equipment absent the program). The Portfolio Level SCT ratio is lower in Scenario #3 (1.71) than Scenario #2 (1.81), and the net benefits are significantly lower ($53 million vs. $97 million).

Table 37: Scenario #3 Net Verified Savings – SCT Results

Program	Sector	SCT Benefit ($1,000)	SCT Cost ($1,000)	SCT Net ($1,000)	SCT Ratio
Solar PV Market Rate	Solar	$18,994	$13,688	$5,306	1.39
Solar Photo Voltaic/Low-income Solar Renewable Energy Credit	Solar	$1,421	$1,212	$210	1.17
Refresh the District LI Single Family	Residential	$0	$14	($14)	0.00
Emergency Heating and Cooling Assistance	Residential	$0	$22	($22)	0.00
C&I RX - Equipment Replacement	Commercial	$20,463	$5,172	$15,291	3.96
Market Transformation Value	Commercial	$2,400	$1,003	$1,398	2.39
Commercial Upstream - Lighting	Commercial	$6,751	$975	$5,775	6.92
Retrofit/Market Opp/New Constr -Commercial Custom	Commercial	$59,074	$37,096	$21,978	1.59
Implementation Contractor DI/Income Qualified Efficiency Fund	Multifamily	$2,531	$2,092	$440	1.21
Low-income MF Comprehensive	Multifamily	$6,328	$3,626	$2,702	1.75
Low-income Prescriptive Rebate	Multifamily	$2,341	$589	$1,753	3.98
Retail Efficient Appliances/Heating and Cooling/Lighting	Efficient Products	$6,646	$2,197	$4,449	3.02
Retail Lighting Food Bank/Home Energy Conservation Kit – Low-income	Efficient Products	$655	$151	$504	4.34
Residential Upstream	Efficient Products	$22	$10	$11	2.13
Innovation – Low-income	Innovation	$0	$23	($23)	0.00
Innovation - Market Rate	Innovation	$0	$29	($29)	0.00
Total Portfolio Level	**Portfolio**	**$127,626**	**$74,698**	**$52,929**	**1.71**
Portfolio Level with EM&V and DOEE Oversight Costs	**Portfolio**	**$127,626**	**$77,124**	**$50,503**	**1.65**

2.2.3 Cost-effectiveness Recommendations

The FY2019 cost-effectiveness analysis required the NMR team to thoroughly explore several of the energy, economic, and policy assumptions used by the DCSEU. Based on our review, we offer the following observations and recommendations:

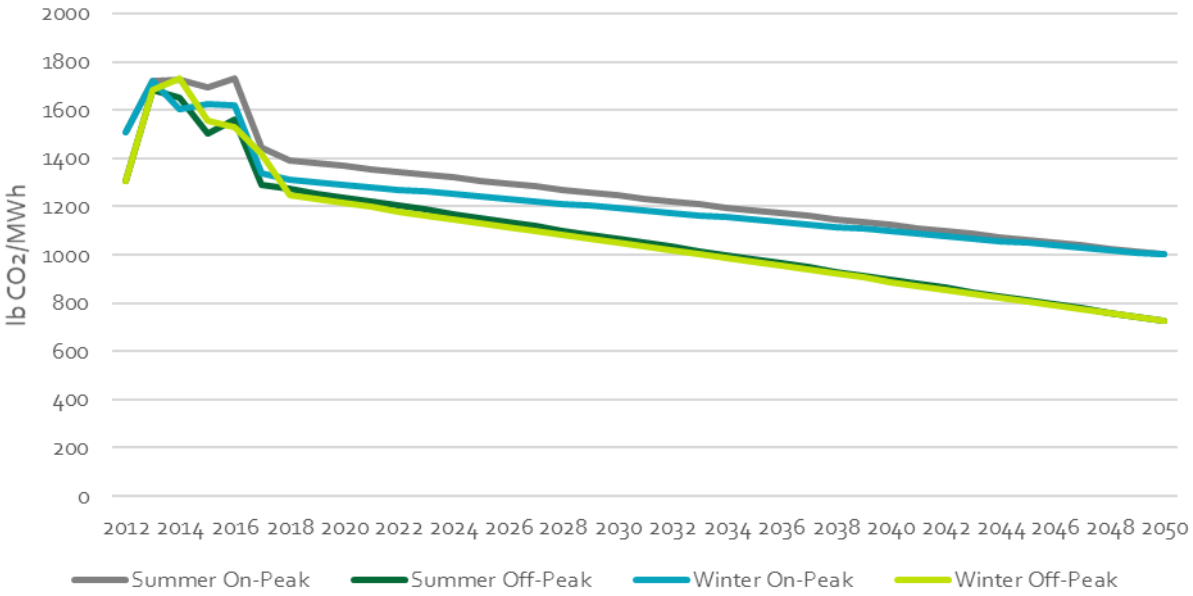
- Although the calculation of SCT benefits and costs occurs in external workbooks, the mechanics of the DCSEU tracking system are expertly organized to facilitate benefit cost modeling. The application was well-documented and the DCSEU staff was responsive to our inquiries. The tracking database details participation in all program measures and provides costs, benefits, energy use, and savings estimates.

- In FY2019, DCSEU updated their avoided cost assumptions based on FY2018 recommendations from the NMR team. The NMR team expected line loss factors to be embedded in the avoided cost values; however, they were not for FY2019. This caused the DCSEU analysis to omit line losses. This is the primary reason why the Modified Replica model yields a higher portfolio SCT ratio. For FY2020, line losses have been incorporated into the avoided costs, so there are no recommended adjustments for future modeling.
- It is inappropriate for DCSEU to include a 15% adder to solar projects in its SCT calculations – especially for market rate participants. Spillover benefits should only be reflected in the net verified SCT results and they should be based on evaluation findings, not a prescribed adder. This recommendation has already been implemented and starting in FY2020 the 15% spillover for solar has been eliminated.
- DCSEU applies a cost adjustment that assumes participant costs are incurred a half year in the future. Conventional accounting calculates costs as if they are incurred in the present. Investments in energy efficiency are fundamentally an upfront capital investment *today* for energy savings realized over many years. This adjustment to the timing of cost occurrence by DCSEU should be omitted.
- The handling of dual baselines was well executed in the DCSEU tracking system. The most important dual baseline measure is LED lighting. The DCSEU savings assumptions for FY2019 assume implementation of the 2020 Energy Independence and Security Act (EISA) Phase II backstop. Energy savings from screw-based LED bulbs were assigned full savings for two years and then a significantly reduced annual savings value for the remainder of their useful life.
    - Implementation and enforcement of the 2020 backstop provision at the federal level did not happen as planned on January 1, 2020.
    - Regardless of any action, or inaction, at the federal level, the residential lighting market is rapidly transforming to majority-LED sales.
    - For FY2020, we recommend the DCSEU weigh the available evidence and consult with the evaluation team and DOEE to decide how to handle the dual baseline assumption for residential lighting.
- The cost of residential LED lighting remains overstated in the DCSEU TRM and program tracking system. The assumed cost of LED bulbs was between $11 and $16 for FY2019. The retail cost of ENERGY STAR LED bulbs has dropped rapidly and is currently $3-$5 per bulb. Assuming a $1.50 cost for a halogen bulb means the incremental measure cost should be closer to $2-3/bulb.
    - The DCSEU tracking system has actual retail prices for all upstream bulbs, so it is unclear why the calculations rely on dated cost assumptions rather than actual values. If the actual retail prices can be leveraged for FY2020 cost-effectiveness, it will be important to carefully distinguish per-package prices from per-bulb prices.
    - Reducing the incremental cost assumptions would improve the cost-effectiveness of retail lighting measures to the extent DCSEU continues to support retail lighting.

- Reduced CO2 emissions and other NEBs represent a significant share of the SCT benefits from FY2019 programs.
  - The $100 per short ton ($110.23 per metric ton) assumption for avoided CO2 emissions should be reviewed to ensure it is consistent with the District's policy objectives and other regional research on the value of reduced carbon emissions. The NMR team produced a literature review of carbon prices and emission rates in 2019.[24] Findings indicate that there is considerable variation in estimates of the value of CO2 emissions, but the average of the sources reviewed is approximately $45 per short ton. This average is similar to the Obama administration's Social Cost of Carbon (SCC) central estimate which is used in New York, Illinois, Colorado, and Minnesota. It is worth noting that the Obama SCC estimate increases from $48 per ton in 2020 to $135 per ton in 2050 (in nominal $2050).
  - At $0 per short ton of CO2, but still including the 5% NEB and 15% low-income solar adders, Scenario #1 remains cost-effective with an SCT ratio of 1.05.[25] At $50 per short ton, while still including the NEB and low-income solar adders, the SCT ratio is 1.44 for Scenario #1. As shown in Table 35, the $100 per short ton assumption results in an SCT ratio of 1.84. While the CO2 assumption does not determine whether or not Scenario #1 is cost-effective at the portfolio level, it does have a significant impact on the magnitude of the ratio, and four programs shift from cost-effective to not cost-effective.
  - The value of CO2 emissions in the SCT is the product of the avoided cost of CO2 emissions and the assumed emissions rate. The emissions rate is the assumed tons of CO2 released by generating a MWh of electricity or combusting an MMBTU of natural gas. The electric emission rates in the FY2019 analysis are based on the marginal emission rates for the PJM system and held constant through 2050. The grid will likely become cleaner over the next 30 years, so the NMR team recommends the District consider a declining marginal emissions rate in future cost-effectiveness testing. The NMR team's 2019 memo on carbon pricing and emission rates suggests the DOEE consider an assumed 2050 marginal emissions rates of 1,000 pounds per MWh on-peak and 725 pounds per MWh off-peak based on assumed heat rate of 6,200 BTU/kWh for a combined cycle unit and 8,550 BTU/kWh for an advanced combustion turbine. A simple linear trend could be fit from the current marginal emissions rates to these 2050 destinations, which assume modern natural gas generation units on the margin. Figure 10 shows the recommendation visually. The four trend lines show the slope of the proposed improvement from current levels that range from 1,289 pounds per MWh (summer off-peak) to 1,442 pounds per MWh (summer on-peak).

[24] "Valuation of Avoided CO2 Emissions", December 13, 2019.
[25] Though, as described earlier, the benefit cost ratio falls below 1.00 when all NEBs are excluded.

Figure 10: Declining Marginal Emissions Rate Recommendation



- The 5% adder for NEBs (other than CO2 emissions) is a proxy value to recognize tangible benefits that are challenging to directly quantify. The NMR team will continue to collaborate with DCSEU and DOEE to assess the appropriate value for the overall NEBs adder, the feasibility of supplemental health or low-income NEB adders, and the possibility of incorporating NEB research into our future evaluation activities.

Appendix A Program Descriptions

This appendix provides a description for each of the program tracks offered by DCSEU in FY2019.

A.1 Commercial Sector

7520CUST - Retrofit – Commercial Custom

The Custom Retrofit program offers incentives to owners of large buildings to install energy-efficient equipment or make operational changes to their facility that result in energy savings. The program focuses on retrofit projects where the equipment is being replaced prior to the end of its life. Incentives are offered for a variety of equipment types, including lighting, chillers, boilers, heat pumps, steam systems, insulation, refrigeration, and various building or equipment controls. Through this program, the DCSEU offers technical assistance to help decision makers design, scope, and fund their projects. Rebates are paid on a traditional per-unit of energy saved basis.

7520MARO - Market Opportunities – Commercial Custom

The Market Opportunity Custom program focuses on retrofit projects where equipment is at the end of its life. It offers incentives to large building owners who update equipment to energy-efficient options or update operational controls to achieve energy savings. This track includes measures in lighting, HVAC, and various commercial/residential appliances. Key objectives of the incentive are to offset the costs of adding energy-efficient equipment beyond the current energy code; provide comprehensive technical services to help decision makers design, scope, and fund their projects; and share the economic benefits with the customer. Funding is available through a traditional rebate structure where participants are paid per unit of energy saved.

7520NEWC - New Construction – Commercial Custom

This program focuses on construction of new buildings or facilities that exceed energy code standards. The New Construction Track covers a large range of new construction measures, including lighting; HVAC; building controls; building envelope elements, such as insulation and windows; and plug loads, such as icemakers, refrigerators, and freezers. DCSEU provides technical assistance in the design stage to help decision makers design, scope, and fund their projects.

7520P4PX - Pay for Performance

The P4P program launched in FY2019 to incentivize complex, multi-measure energy-efficiency projects that are not covered under existing program tracks. It focuses on existing commercial and industrial buildings, which implement multiple measures simultaneously, or behavioral or operational changes where it is difficult to estimate savings. This may include re-/retro-commissioning, upgrades to the building controls, or fault detection. Incentives are paid based on pre- and post-metered energy usage data.

7511CIRX - C&I RX – Equipment Replacement

The BER initiative provides small- to medium-sized businesses located in DC with a comprehensive set of services and financial incentives to help them transition to more energy-efficient equipment. The initiative provides prescriptive incentives for lighting, refrigeration, HVAC, compressed air, and food service and vending equipment. Rebates require written pre-approval and are given for facility improvements that result in a permanent reduction in electrical and/or natural gas energy usage persisting for a minimum of five years.

7512MTV – Market Transformation Value

The Market Transformation Value program offers rebate incentives to large businesses and institutions for upgrades to energy-efficient equipment. This program provides per-unit rebates and includes measures for LED lighting, lighting controls, motors, and condensing gas boilers and furnaces.

7513UPLT – Commercial Upstream

The Commercial Upstream/Midstream Lighting Program provides customers with point-of-purchase rebates when they buy qualified lighting products from participating distributors. Through this program, customers can receive rebates for ENERGY STAR 2.0 certified LED directional, omnidirectional, and decorative bulbs, as well as Design Lights Consortium certified linear LED tubes. This program format enables closer and more efficient tracking of product purchases. Distributors provide sales information directly to DCSEU, enabling higher levels of quality control.

A.2 SOLAR SECTOR

7101PVMR – Solar PV Market Rate

The PV Market Rate program provides incentives to buildings that install solar panels to reduce their consumption from the electric grid. The program contributes to electricity and natural gas savings, installed renewable energy capacity, the formation of green jobs, and low-income spending and savings. It also helps meet the DCSEU performance benchmark and address the needs of the solar market by serving as a low or no cost technical assistance center for solar installations.

A.3 MULTIFAMILY SECTOR

7610ICDI - Implementation Contractor Direct Install

The Low-income Multifamily Implementation Contractor Direct Install (ICDI) initiative supports low-income multifamily communities in DC. DCSEU hires implementation contractors to install energy-efficient equipment in eligible buildings and covers 100% of the product and direct installation costs. The opportunity is offered to property owners, property managers, developers, architects, and engineers. The initiative is designed to serve a wide variety of energy-efficiency needs. Included measures allow for all spaces in multifamily buildings to be served, and may include the installation of heating and cooling systems, domestic hot water systems, lighting, refrigeration, and controls. While this track is aimed at low-income residences, multifamily resident

buildings that do not qualify as low-income can still have common space fixtures incentivized under this program.

7612LICP - Low-income Multifamily Comprehensive

The Low-income Multifamily Comprehensive program is designed to support low-income multifamily housing, specifically new construction or gut-rehab, in the installation of energy-efficient measures. The program allows DCSEU to provide technical expertise and funding. Each project is evaluated independently, and energy-efficient measures are selected to best meet the project's needs. Measures include domestic hot water systems, lighting, appliances, building controls, and thermal envelope measures.

7610IQEF - Income Qualified Efficiency Fund

The Income Qualified Efficiency Fund program is designed to serve low-income multifamily housing, shelters, and approved clinics. Funding and priority are competitively awarded to approved contractors for energy-efficiency projects that generate significant energy savings and pass the associated financial benefits on to low-income DC residents. Efficiency measures that maximize energy savings, reach a large number of low-to-moderate income residents, and/or assist residents who face a loss of heating or air conditioning due to inoperable equipment receive priority. Supported measures include domestic hot water systems, lighting, appliances, controls, and measures improving the thermal envelope.

7413LIER – Low-income Emergency Equipment Replacement

The Low-income Emergency Equipment Replacement initiative is designed to serve low-income homeowners that are referred to the DCSEU from the DC Department of Energy & Environment Low-income Home Energy Assistance Program (LIHEAP). Approved energy conservation measures for this track include furnaces, boilers, domestic hot water systems, appliances, and controls.

7613LIRX - Low-income Prescriptive Rebate

The Low-income Prescriptive Rebate program provides financial support for lighting installations in low-income multifamily housing and low-income shelters and clinics. Approved installations must be EnergyStar or Design Lights Consortium qualified. This initiative enables DCSEU to provide incentives and custom technical services for lighting improvements to low-income multifamily establishments.

7717HEKT - Home Energy Conservation Kit – Low-income

The Home Energy Conservation Kit – Low-income program sends home energy conservation kits to low-income District residents. These kits include an advanced power strip, a faucet aerator, and six LED bulbs. They offer low-income DC residents a free, easy way to implement energy saving measures.

A.4 EFFICIENT PRODUCTS SECTOR

7710APPL - Retail Efficient Appliances

The Retail Efficient Appliances program offers mail-in and online rebates for qualifying refrigerators, clothes washers, clothes dryers, heat pumps, air conditioners, boilers, furnaces, thermostats, and other products. Under this initiative, DCSEU partners with local retailers and contractors to promote these rebates, providing rebate forms in retail stores when possible.

7717FBNK - Retail Lighting Food Bank

The Food Bank Energy Efficient Lighting Distribution initiative provides LED lighting to low-income households in DC that receive goods from participating food banks. The DCSEU provides LEDs to these residents after verifying that their household is located in the District and conducting a short survey with the client to determine the appropriate number of bulbs needed.

7710LITE - Retail Lighting

The Retail Efficient Lighting program coordinates with lighting retailers and manufacturers to increase the availability of LEDs and offer them at lower prices for District residents and small businesses. This initiative works to educate customers on the benefit of LED lights and increase awareness as LEDs are less familiar to residents than CFLs or incandescent bulbs. Retailers and manufacturers are provided incentives on a per-bulb basis.

7710HTCL - Retail Heating and Cooling

The Retail Heating and Cooling program works with contractors in the District to install heating and cooling equipment in residential applications. Measures include advanced and programmable thermostats (not smart thermostats), central air conditioners, domestic hot water heaters, boilers, furnaces, and ductless and air-source heat pumps.

7710STAT - Retail Smart Thermostats

The Retail Smart Thermostats program offers incentives for the reduction of HVAC energy consumption through the installation of smart thermostats in houses in the District. DCSEU partners with Nest and local retailers to offer point-of-sale or conventional rebates for qualifying thermostats. Residents who install Nest thermostats can enroll in the Nest Thermostat Seasonal Savings program to garner additional energy savings.

7725RSUP – Residential Upstream

The Residential Upstream program is used to track residential, efficient lighting projects purchased through electrical distributors. Participating electrical distributors buy down the price of the lighting products and offer a point-of-sale rebate to their customers. After sale, they submit documentation to the DCSEU for reimbursement on the products.

A.5 INNOVATION

7913INLI - Innovation – Low-income

In order to support the development and deployment of new and innovative energy-efficiency and renewable energy initiatives, funds are allocated into one or more *innovation funds* to support pilot programs. This program works with and funds low-income customers to install innovative energy-efficient projects. DOEE must approve all incentivized measures under this track. Savings/spending counts towards the low-income savings/spending benchmark.

7915INMR - Innovation – Market Rate

In order to support the development and deployment of new and innovative energy-efficiency and renewable energy initiatives, funds are allocated into one or more *innovation funds* to support pilot programs. This program works with and funds market rate customers to install innovative energy-efficient projects. DOEE must review and approve all measures incentivized under this track.

Appendix B Detailed Program Recommendations

This section contains detailed program recommendations from the *Evaluation of DC Sustainable Energy Utility FY2019 Programs* report.

Our evaluation of the FY2019 programs found that DCSEU expended the appropriate amount of effort and rigor on their savings calculations. In general, the documentation provided was sufficient, and the methods and assumptions were suitable. The NMR team believes the DCSEU calculated energy savings with a reasonable degree of accuracy.

However, our evaluation yielded recommendations for most programs, as described below. While DCSEU prescriptive savings estimates were reasonable, in aggregate, for the FY2019 programs, the NMR team believes the DCSEU can continue to improve calculation methods and should prioritize improvements that offer the most cost-effective outcomes. The NMR team provides one recommendation that applies to most prescriptive programs.

- Apply project-specific efficiency levels and other inputs to improve the accuracy of tracked savings when feasible. DCSEU applied deemed values or ranges for efficiency levels, wattages, and other inputs to savings algorithms when site specific information was available. This issue was most prominent for commercial lighting, where the DCSEU used default assumptions when the actual wattage values, heating fuel type, and waste heat factors were available. For PV systems, DCSEU input default values for inverter efficiency and locations rather than available site-specific data. In addition, building-specific load shapes and hours of use should be utilized for new construction projects. In these cases, project-specific input values were available, which would improve the accuracy of tracked savings. DCSEU should examine how integrating site-specific information within the tracking system can be done efficiently when these data are already collected from customers.

For the Custom Retrofit, Market Opportunities, and PV Market Rate programs, we offer the following recommendation:

- Ensure that enough documentation is available to re-create savings calculations, and ensure that final versions of savings calculations are included in project documentation. For some projects, the data available was not sufficient to fully calculate savings. For example, savings parameters were missing from some custom projects, in particular for heat pumps. Similarly, for some custom projects, tracked savings did not match the calculated savings included in the documentation. In addition, data on system losses, DC to AC size ratio, and ground coverage ratio was not available for some PV systems.

For the Custom Retrofit and Market Opportunities programs, we offer the following additional recommendations:

- Request additional information from customers on the rationale behind control changes that result in significant energy savings. Confirm that the control changes will meet the

facility's operational requirements to reduce the likelihood of control strategies being reversed in the future, leading to reduced savings.

- Consider collecting more details during post inspections. The post inspection can be used to verify the installation of rebated equipment and to confirm operational information, such as equipment schedules or setpoints.
- Consider establishing guidelines for post inspection timing. For controls changes and other building commissioning measures, completing the post inspection several months after project completion may allow the DCSEU to identify situations where the customers anticipated actions were not fully implemented.

For the Custom Retrofit program, we offer the following additional recommendations:

- Consider labeling savings estimates as "pre-application" or "in-progress." Then create a separate "finalized" field to avoid situations where final project savings are not updated in the tracking database. In addition, for very large projects, require sign off on the final savings by the responsible analyst or engineer to avert situations where updated savings calculations are not fully communicated.
- Consider secondary calculations and more quality control checks for projects with high uncertainty to ensure that the claimed savings are well below the system's baseline consumption.
- Calculate demand savings independently of energy savings for projects that operate 8760 hours per year. Computing demand profiles requires additional inputs, which may not be easily derived from the energy savings.
- Consider reassessing whether incentive levels can increase for any measures with limited traction but high potential savings. Furthermore, DCSEU might wish to explore the impact of raising incentive caps.

For the Market Opportunities program, we offer the following additional recommendation:

- Consider establishing a pool of approved vendors to increase engagement among vendors to encourage them to prioritize the program in their sales discussions. Consider listing their contact information and highlighting their specialties on the program website. Also, consider monitoring their participation levels and then connect with less active vendors to identify barriers to participation.

For the CI RX Equipment Replacement program, we offer the following recommendations:

- Calculate a site-specific coincidence factor when site-specific lighting hours of use values are input to ensure that peak demand savings are not understated due to an incongruence in energy and demand load shapes. At a minimum, we recommend using a flag to assign a coincidence factor of 100% to any lighting that operates continuously.
- Change the TRM exterior summer coincidence factor to 0% as most exterior LEDs come standard with integral photocells. Additionally, customers who utilize timers most likely adjust them seasonally for safety and thus will avoid summer peak hours. However,

exceptions should be made for 8,760-hour lighting, where the summer coincidence factor would be 100%.

- Ensure that all projects in the CIRX program replace existing equipment and are not new construction, which require the baseline to consider the current building energy code.

For the Commercial Upstream Lighting program, we offer the following recommendations:

- Explore the impacts of discounting other measures, such as HVAC equipment and variable frequency drives.
- Ensure there is a strong system in place to track installation locations when engaging a new sector of distributors (i.e., HVAC).

For the P4P program, we offer the following recommendations:

- Annualize the energy and natural gas savings for each project. In addition, re-evaluate the annualized savings for any projects with less than one year of post-project usage.
- Ensure that the evaluation periods for FY2020 savings begin immediately after the verification period for FY2019 ended to ensure that the persistence of savings is properly accounted for as the program cycle continues.
- Collaborate with the evaluation team to develop a methodology to account for the effects of the COVID-19 pandemic when modeling the FY2020 program savings.
- Explore the impact of increasing incentive rates.
- To further improve program delivery, take steps to improve transparency.
    - Outline modeling approaches in program materials. Possibly hold a webinar with vendors to answer their questions.
    - Clarify program rules about installing other energy-efficiency measures during the participation period.
    - Ensure customers understand the estimated savings and incentives for their projects.
    - Create a strong feedback loop with customers about consumption during and after the performance period.

For the Solar PV Market Rate program, we offer the following recommendations:

- Work closely with participants and installation contractors to develop a common and flexible understanding of project timelines and financial constraints.
- Encourage contractors to assist customers with the DCSEU application process.
- Assess the length of time between system installation and rebate issuance to determine if there is an opportunity to accelerate rebate processing. If delays in rebate issuance are unavoidable, ensure regular communication with participants regarding the timeline.

For the Seasonal Savings program, we offer the following recommendations:

- Ensure that the claimed savings reflect the actual deployment period.

- Estimate separate winter seasonal savings for furnaces and air-source heat pumps, based on fuel type, baseline consumption, average equipment capacity, and savings percentage. In particular, apply the evaluated savings results of 2.55% savings for furnaces and 5.11% for air-source heat pumps.

For the Income Qualified Energy Efficiency Fund and Low-income Multifamily Comprehensive programs, we offer the following recommendation:

- Ensure that inputs used in savings calculations align with the actual installed equipment. Our evaluation found that, for some projects, the actual equipment installed differed from the quantity, efficiency level, and/or location provided in the project files, which all affect the accuracy of savings estimates.

For the Low-income Multifamily Comprehensive program, we offer the following recommendations:

- Calculate air sealing cooling and peak demand savings for projects heated with heat pumps where air sealing was performed.
- Confirm that the current federal baseline standards are used to accurately compute energy savings.
- Improve the transparency of application and modeling requirements and processes – this may include (1) using clearer descriptions of modeling approaches in materials and (2) conducting more direct outreach during participation to ensure that program processes are fully understood.
- Bolster technical support activities. In particular, increase communication around modeling, develop a repository of resources for participants and partners that details best practices and lists recommended vendors, and hold webinar trainings.
- Explore the impact of expanding measure offerings and increasing incentive levels. In addition, clearly identify and communicate the program-eligible measures to both partners and customers.

For the Low-income Prescriptive Rebate program, we offer the following recommendations:

- Employ prescriptive hours of use from recent metering studies instead of hours of use estimates provided by applicants. We recommend using the hours of use from the Pennsylvania TRM for in-unit installations and from the Mid-Atlantic TRM for common area installations.
- Confirm that lighting installation locations are recorded correctly so that the appropriate hours of use and waste heat factors are applied.
- Explore the impacts of supporting HVAC measures.
- Develop robust case studies with participant testimonials that demonstrate positive participant experiences and the realization of meaningful energy savings.
- Improve the transparency of the pre-approval process and eligibility criteria and ensure participants are aware of the online application option.

- Consider providing more support to property managers in completing the required paperwork.