2021-2022 MOR-EV Cost-Effectiveness Report

October 1, 2023

Introduction

Originally launched in 2014, Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) is a program designed to reduce emissions and improve local air quality by influencing consumers to purchase or lease an electric vehicle (EV) rather than a traditional gasoline- or diesel-powered vehicle. Funded by the Executive Office of Energy and Environmental Affairs' Department of Energy Resources (DOER) and administered statewide by the Center for Sustainable Energy (CSE), MOR-EV provides a suite of EV rebates to residents and entities in the Commonwealth that purchase eligible electric vehicles.

The MOR-EV Program supports the Healey-Driscoll Administration's continued efforts to reduce greenhouse gas (GHG) emissions from the transportation sector as cost-effectively as possible. The Fiscal Year 2023 Section 95 Regional Greenhouse Gas Initiative Authorization included a provision for DOER to examine the cost-effectiveness of the MOR-EV Program in terms of GHG reductions by October 2023.

This report and associated analyses encompass data for calendar years 2021 and 2022[1] related to MOR-EV light-duty rebates (EVs with a gross vehicle weight rating of 8,500 pounds or less) that were issued to individuals, private corporations, and nonprofit entities for eligible electric vehicle purchases and leases.

Definitions

BEV	**Battery electric vehicle**. An electric vehicle that draws propulsion energy solely from an on-board electrical energy storage device during operation that is charged from an external source of electricity.
FCEV	**Fuel cell electric vehicle**. An electric vehicle that draws propulsion energy solely from an on-board energy storage device during operation, where energy stored as hydrogen is converted to electricity by a fuel cell, that is recharged from an external source of hydrogen.
PHEV	**Plug-in hybrid electric vehicle**. An electric vehicle with an on-board electrical energy storage device that can be recharged from an external source of electricity and that also has the capability to run on another fuel.

[1] See the MOR-EV Cost-Effectiveness Study published in April 2022 for an in-depth external analysis conducted for light duty rebates issued in calendar years 2014-2019. Calendar year 2020 was omitted from this report due to the anomalous nature of the data that can be attributed to the impacts of the COVID-19 pandemic.

PHEV+	Also referred to as an extended range electric vehicle or (EREV), which is a type of PHEV. The key difference is that a PHEV+ operates all electrically until the battery is depleted and will typically have a larger battery pack than a PHEV.
Purchase price	The price paid to purchase a new vehicle, which includes the price set by the manufacturer (MSRP) plus the costs associated with the trim level of the vehicle with all color options, wheel upgrades, drive train or battery upgrades, and other packages. For leased vehicles, this refers to the gross capitalized cost. Costs *not* included in the purchase price/gross capitalized cost calculation for the purposes of the MOR-EV program during this time period were destination or delivery charges, sales and use taxes, OEM or dealership rebates applied at the time of purchase or lease, additional maintenance or repair packages purchased from the dealership or showroom, documentation fees, registration fees, or add-ons which relate to the maintenance or operation of the vehicle, such as electric vehicle charging packages, floor mats, first aid kits, cargo nets, etc.
ZEV	Zero emission vehicle. Section 41 of chapter 179 of the Acts of 2022 defines a ZEV as a motor vehicle that produces no engine exhaust carbon emissions.

MOR-EV Program Overview 2021-2022

Program Requirements

The following eligibility criteria were in place for MOR-EV rebates in 2021-2022:

Applicant Eligibility

To be eligible to receive a MOR-EV rebate, a vehicle purchaser or lessee was required to be a private resident of Massachusetts or a corporation (including nonprofit organizations) located and licensed to do business in Massachusetts. In 2021, fleets were limited to a maximum of ten rebates per calendar year, but this cap was removed in 2022.

Vehicle Eligibility

MOR-EV rebates were available for the purchase or lease of BEVs, FCEVs, and PHEVs with an all-electric range of 25 miles or greater, throughout this time. To be eligible, the vehicle was required to be a new, on-road vehicle, and the specific model had to be certified by the California Air Resources Board (CARB). There was an ownership retention requirement for a minimum of 36 consecutive months immediately after the vehicle purchase or lease date; lease terms of at least 36 months were required as applicable. Additionally, the vehicle was required to be registered with the Registry of Motor Vehicles for a minimum of 36 consecutive months for use in Massachusetts. Throughout 2021, the vehicle purchase price cap was set by statute as $50,000 for any eligible vehicle type. Effective November 10, 2022, the purchase price cap increased to $55,000 for BEVs and FCEVs only.

Rebate Amount

In 2021, the MOR-EV Program offered a $2,500 rebate for eligible BEVs and FCEVs as well as a $1,500 rebate for eligible PHEVs with an all-electric range of at least 25 miles. Starting November 10, 2022, the rebate amount for BEVs and FCEVs increased to $3,500; there were no changes made to the PHEV rebate amount in 2022.

Rebate Spending

Combined total rebate spend during this time was $21,150,000 for 9,878 rebates. Table 1 shows the breakdown of the rebates by type and rebate spending totals associated with each vehicle type, as well as the breakdown of rebate spending.

Table 1: 2021-2022 MOR-EV Rebate Breakdown

Vehicle Type	Number of Rebates Issued	% of Number of Rebates Issued	Rebate Spending	% of Rebate Spending
BEV	5,735	58%	$14,941,500	71%
PHEV	4,013	41%	$6,013,500	28%
PHEV+	130	1%	$195,000	1%
TOTAL	***9,878***		***$21,150,000***	

Other 2021-2022 Trends

Of the 9,878 rebated EVs between 2021 and 2022, 93% were vehicle purchases and 7% were leases of at least 36 months per the program requirements. There were 39 unique EV model types from 15 different manufacturers[2] included among the MOR-EV rebates: 22 unique BEV models and 17 unique PHEV models.

For rebated vehicles with pricing data (the MOR-EV application platform started consistently capturing this datapoint for all rebates in mid-2022), the purchase price[3] ranges and averages are listed by vehicle technology in Table 2 below.

Table 2: 2021-2022 Rebated Vehicle Purchase Price Trends

Technology Type	MOR-EV Rebate Year	Vehicle Purchase Price Range	Average Purchase Price	Percent Change in Average Price, 2021-2022
BEV	2021	$10,900-$50,000	$43,000	+6.1%
	2022	$25,230-$55,000	$45,625	
PHEV	2021	$10,900-$50,000	$36,560	+17.6%
	2022	$27,600-$50,000	$42,995	

Over 99% of MOR-EV light-duty rebates issued during this time were to individual residents of the Commonwealth; the remaining ~1% of rebates were issued to nonprofit and corporate fleets.

Emissions Reductions

For this analysis, greenhouse gas (GHG) reduction totals are calculated as the difference in annual emissions for a BEV, PHEV, or PHEV+ versus emissions from a typical internal combustion gasoline passenger car using

[2] Manufacturers included BMW, Chevrolet, Chrysler, Ford, Honda, Hyundai, Kia, MINI, Mitsubishi, Nissan, Polestar, Subaru, Tesla, Toyota, and Volkswagen. The top three in terms of rebated vehicle volume were Toyota, Hyundai, and Tesla.

[3] Purchase price herein refers to the final price paid by the applicant minus registration, taxes, and fees, which was the definition of purchase price for MOR-EV in 2021-2022; this is inclusive of gross capitalized cost for eligible vehicle leases.

the Alternative Fuel Life Cycle Environmental and Economic Transportation (AFLEET) Tool[4] 2020 under the following assumptions for Massachusetts:

- Vehicle type: Passenger car
- Annual vehicle mileage: 12,400 miles[5]
- AFLEET fuel economy assumptions outlined in Table 3 below.

Table 3: AFLEET Fuel Economy Assumptions

Light-Duty Fuel Type	Fuel Economy – Miles per Gallon Gasoline Equivalent (MPGe)
Gasoline	30.9
Gasoline Plug-in Hybrid Electric Vehicle (PHEV)	53.2
Gasoline Extended Range Electric Vehicle (PHEV+)	44.4
All-Electric Vehicle (BEV)	106.2

The AFLEET tool calculates well-to-wheels GHG emissions (all emissions related to fuel production, processing, distribution, and use) in short tons; results have been converted to metric tons in the tables below. Electric vehicle adoption associated with MOR-EV rebates led to an approximate net reduction in GHG emissions of over 27,000 metric tons in 2021 and 2022 combined, resulting in additional air pollutant reductions as outlined in Tables 4-6 below.

Table 4: Estimated Annual GHG Emissions (Metric Tons)

MOR-EV Rebates	*Gasoline Alternative GHG Emissions*	BEV GHG Emissions	PHEV / PHEV+ GHG Emissions	Net GHG Emission Reductions
2021	*22,957*	2,898	4,969	15,090
2022	*19,296*	2,381	4,308	12,607
TOTAL	*42,253*	5,279	9,277	27,697

Table 5: Estimated Annual Vehicle Operation Air Pollutants (Pounds) - 2021

2021	*Gasoline Alternative Air Pollutants*	BEV Air Pollutants	PHEV / PHEV+ Air Pollutants	Net Air Pollutant Reductions
CO	*183,257*	0	57,086	126,172
NOx	*2,589*	0	678	1,912
PM10	*5,282*	2,926	2,154	202
PM2.5	*1,027*	430	395	202
VOC	*23,257*	0	6,052	17,205
SOx	*243*	0	44	199

[4] In accordance with the desire to measure both the environmental and economic costs and benefits of alternative fuel and advanced vehicles, Argonne National Lab developed the Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool. The AFLEET Tool allows stakeholders to estimate petroleum use, greenhouse gas emissions, air pollutant emissions, and costs of ownership for light-duty vehicles and heavy-duty vehicles.

[5] AFLEET uses the following source for passenger car mileage: Oak Ridge National Lab (ORNL). Davis (2013) Transportation Energy Data Book 32 Table 4.1 http://cta.ornl.gov/data/tedb32/Edition32_Chapter05.pdf

Table 6: Estimated Annual Vehicle Operation Air Pollutants (Pounds) - 2022

2022	*Gasoline Alternative Air Pollutants*	BEV Air Pollutants	PHEV / PHEV+ Air Pollutants	Net Air Pollutant Reductions
CO	*154,029*	0	49,497	104,532
NOx	*2,176*	0	587	1,589
PM10	*4,440*	2,405	1,868	167
PM2.5	*863*	354	342	167
VOC	*19,548*	0	5,248	14,300
SOx	*204*	0	38	166

GHG Reduction Cost-Effectiveness for MOR-EV

Cost Analysis

This section analyzes the cost per ton of reducing GHG emissions by increasing electric vehicle adoption through MOR-EV rebates. Using emissions reduction estimates from AFLEET, and MOR-EV rebate spending data from CSE, this analysis provides a simple and replicable methodology that DOER can consistently apply in future program years. The analysis was performed retroactively to capture the resulting cost per ton reduced in 2018-2019 since the methodology is significantly different than the one employed by the consulting firm that conducted the previous MOR-EV cost-effectiveness study.[6] As outlined in Table 7, the costs per ton of the program remained relatively stable between 2018 and 2021-2022. The average cost per ton reduced for MOR-EV in 2021 and 2022 was $100.99.

Table 7: Cost per Metric Ton of Emissions Reduced by MOR-EV Over Gasoline Vehicle Baseline, 2018-2019 and 2021-2022

Program Year	Vehicle Type	Number of Rebates Issued	Estimated Annual GHG Reduction over Gasoline Equivalent (metric tons)	Estimated Lifetime[7] GHG Reduction over Gasoline Equivalent (metric tons)	MOR-EV Program Rebate Costs ($)	Cost per Metric Ton of GHG Emissions Reduced Over Vehicle Lifetime ($/metric ton)
2018	BEV	4,438	10,167	306,501	$15,523,000	$110.99
	PHEV / PHEV+	2,716				
2019[8]	BEV	1,923	6,455	96,834	$2,884,500	$29.79
2021	BEV	3,148	15,090	226,363	$11,180,500	$98.54
	PHEV / PHEV+	2,219				
	BEV	2,587	12,607	189,094	$9,969,500	$103.44

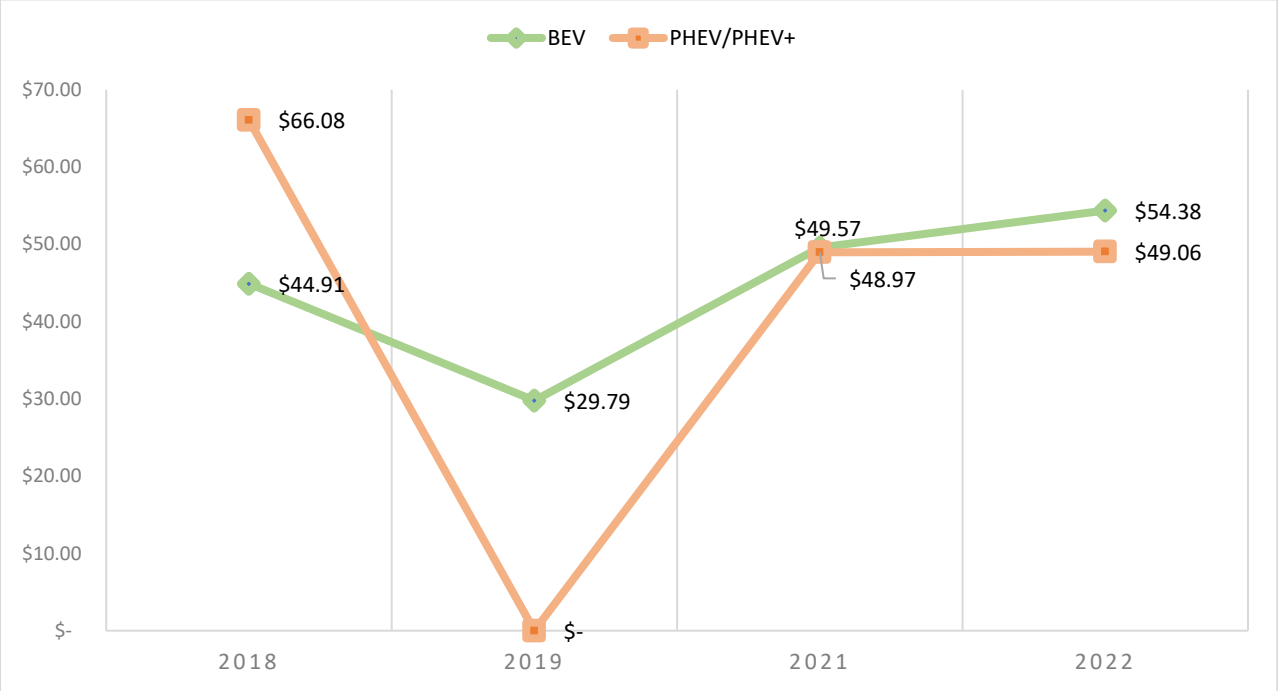
[6] The Synapse analysis used a complex methodology that relied on different assumptions than those utilized by AFLEET. This includes but was not limited to: GHG emissions estimates calculated using tailpipe emissions by specific vehicle model; inclusion of a social cost of gasoline; both 15-year vehicle lifetime and 7-year first owner impacts; and an extrapolated amount of program free ridership, which was removed from the original cost per ton analysis.

[7] Assumed lifetime of a new vehicle before final retirement is 15 years. Source: Davis, S.C. and R.G. Boundy. Transportation Energy Data Book: Edition 39. Table 3.15. Oak Ridge National Laboratory. April 2021. (Link).

[8] PHEV rebates were not included in the MOR-EV Program in 2019. BEV rebates were $1,500 per eligible vehicle in 2019 as compared to $2,500 or $3,500 in other years due to limited program funding.

2022[9]	PHEV	1,924				

Figure 1: Cost per Metric Ton of GHG Emissions Reduced Over Vehicle Lifetime by Vehicle Type



MOR-EV Emissions Reduction Costs Compared to Other Programs

In an effort to determine the cost-effectiveness of the MOR-EV Program in reducing GHG emissions, DOER reviewed the cost of GHG emissions reductions in a variety of programs across the U.S. as well as the avoided costs of carbon or social cost of carbon being employed by other public entities. Table 8 below provides a sampling of this data as a point of comparison.

Table 8: Emissions Reduction Cost per Ton Comparison

Transportation Sector Programs	**Estimated Cost of GHG Reduced ($/Ton)**
MOR-EV Light-Duty Rebate Program, 2021-2022	$100.99
Federal CAFE Standards[10]	$50 – $321
Low Carbon Fuel Standards (e.g., California)[11]	$104 – $3,004
Other Clean Energy Efforts	**Estimated Cost of GHG Reduced ($/Ton)**
2024 Levelized Cost of Offshore Wind[12]	$140
Programs Employing Cost of Carbon	**Avoided/Social Cost of Carbon Value ($/Ton)**

[9] In 2022, the MOR-EV rebate amount for BEVs increased from $2,500 to $3,500 partway through the year.
[10] Gillingham, Kenneth and James H. Stock. The Cost of Reducing Greenhouse Gas Emissions. Journal of Economic Perspectives. Volume 32, Number 4—Fall 2018—Pages 53–72. (Link)
[11] Gillingham, Kenneth and James H. Stock. The Cost of Reducing Greenhouse Gas Emissions. Journal of Economic Perspectives. Volume 32, Number 4—Fall 2018—Pages 53–72. (Link)
[12] All-sectors regional marginal abatement cost curve findings from AESC 2021. (Link)

Mass Save Programs[13]	$128
U.S. EPA's Proposed Value[14]	$190
New Jersey Board of Public Utilities[15]	$42
NYSDEC[16]	$55.98 – $428.29

Relative Cost-Effectiveness

Based on this data, the cost of emissions reduction through the MOR-EV program in 2021 and 2022 was well within the range of values across other programs and furthermore falls into the lower range when compared with these other values.

Geographical Distribution of Rebates

The geographical distribution of MOR-EV rebates (i.e., vehicle registration information) in 2021 and 2022 at the county level can be found in Figure 2 below; Appendix A includes a municipality-level report out of this data. Appendix B includes a preliminary analysis of a subset of rebates to determine the relative proportion of MOR-EV rebated vehicles owned or leased by Environmental Justice populations as defined by the Executive Office of Energy and Environmental Affairs.[17] New MOR-EV rebate offerings being deployed in 2023, including funding for used EVs and an income-based rebate adder, are intended to bolster the accessibility of EVs to all residents of the state. As of spring 2023, DOER is also establishing a culturally competent outreach program to ensure that MOR-EV rebates are effectively communicated to all residents of the Commonwealth, particularly Environmental Justice populations, and allow for regular feedback on the design and implementation of the program. DOER will aim to work with a network of stakeholders and community-based organizations across the Commonwealth to develop and deliver culturally competent outreach and to engage more residents in the MOR-EV Program.

[13] Avoided cost of GHG emissions as approved by the Department of Public Utilities for the 2022-2024 Three-Year Energy Efficiency Plan. (Source)

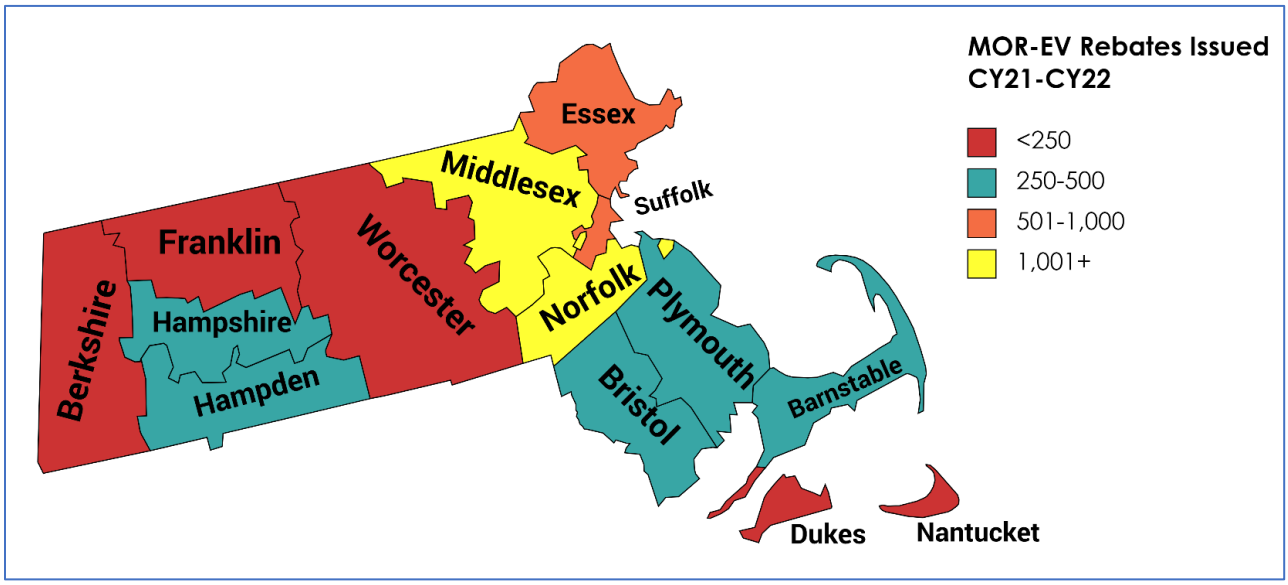
[14] The U.S. EPA has proposed raising the social cost of carbon to $190 in their "Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances" (Source)

[15] Uses avoided cost of GHGs in cost test for energy efficiency and demand reduction programs and IWG's 2016 cost of carbon values for year 2020. (Source)

[16] Uses IWG's 2016 cost of carbon values. (Source)

[17] https://www.mass.gov/info-details/environmental-justice-populations-in-massachusetts

Figure 2: MOR-EV Rebates by County



Implementation of the 2022 Climate Act

MOR-EV was one of the first programs of its kind in the United States and the performance of the program to date offers many lessons learned. As with any new initiative, there are successful aspects of the program as well as opportunities for improvement. Three particular program challenges identified through the previous cost-effectiveness report were 1) financial sustainability, 2) cost-effectiveness, and 3) equity. These issues are high priorities for the current and next phases of the program, and new program elements launched in 2023 will focus on advancing these three priorities.

To further support greater EV accessibility to residents of the Commonwealth, Section 41 of *An Act Driving Clean Energy and Offshore Wind*[18] *("2022 Climate Act")* provided for the expansion of MOR-EV rebate offerings to address some of the concerns highlighted in the April 2022 cost-effectiveness report (e.g., to further support EV accessibility to residents and address program equity) and created a trust for future funding.[19] The legislation requires changes in some areas and allows for changes in others. Figure 3 offers a brief overview of key required program changes that are pertinent to light-duty vehicles and the status of implementation.

Figure 3: Implementation of Section 41

New MOR-EV Program Requirements Under Section 41		Program Changes and Implementation Status
Phase Out of Rebates for Plug-in Hybrid Electric Vehicles (PHEVs)	▪ Section 41 defines Zero Emission Vehicle as *A motor vehicle that produces no engine exhaust carbon emissions,* which in effect removes PHEVs from program eligibility.	✓ PHEVs purchased or leased after June 30, 2023, are no longer eligible for MOR-EV rebates.

[18] Chapter 179 of the Acts of 2022.
[19] The Electric Vehicle Adoption Incentive Trust Fund was funded via St. 2022, c. 268 (signed into law on November 10, 2022).

Battery Electric and Fuel Cell Electric Vehicle Rebates (BEVs and FCEVs)	▪ $3,500-$5,000 rebate for eligible vehicles with a final purchase price of $55,000 or less for individuals, corporations, and nonprofits.	✓ As of November 10, 2022, MOR-EV offers a $3,500 rebate for BEVs and FCEVs with a sales price of $55,000 or less for individuals, corporations, and nonprofits.
Income-Qualified Rebate Adder (MOR-EV+)	▪ Applicants who meet income criteria set by DOER and purchase or lease a new or used BEV or FCEV will be eligible for an additional $1,500 rebate adder.	✓ As of August 8, 2023, DOER has launched access to a $1,500 rebate adder available for income-qualified individuals called MOR-EV+. ▪ MOR-EV+ eligibility is based on demonstration of eligibility for other income-based federal or state programs that separately verify income. ▪ The MOR-EV+ rebate adder can be obtained in addition to standard MOR-EV rebates for new or used BEVs and FCEVs.
Used Vehicle Rebates	▪ $3,500-$5,000 rebate for purchase or lease of a used qualifying ZEV.	✓ As of August 8, 2023, DOER has launched a $3,500 rebate offering for eligible used EVs or FCEVs; DOER determined that these rebates are designated for income-qualified individuals who purchase or lease eligible vehicles. Income-qualified eligibility is based on demonstration of eligibility for other income based federal or state programs (same as MOR-EV+) ***or*** by meeting certain income thresholds that align with the federal clean vehicle tax credit ($75,000 for single filers, $112,500 for head of household filers, and $150,000 for joint filers). ▪ Only vehicles with a purchase price or gross capitalized cost of $40,000 or less are eligible for a used vehicle rebate.
Internal Combustion Engine Vehicle (ICEV) Trade-in Rebates	▪ $4,500 total rebate for an ICEV trade-in at the time of purchase or lease of an eligible ZEV.	▪ Expected to be launched in late 2023, the total rebate is to be not less than $4,500 for the purchase or lease of a qualifying zero-emission vehicle if an individual is purchasing or leasing the vehicle and trading in a vehicle with market value that has an internal combustion engine.[20]

[20] The vehicle with an internal combustion engine must be at least 12 years old and have been continuously registered for the previous two years: (A) in the commonwealth; and (B) to the consumer or the consumer's immediate family.

Appendix A:
MOR-EV Light-Duty Total and Per Capita Rebates Issued by Municipality, 2021-2022

Appendix A			
Data listed here are for rebates issued in calendar years 2021 and 2022 Data only provided for municipalities where rebates were issued			
Municipality	**MOR-EV Light-Duty EV Rebates, 2021-2022**	**2022 Population Estimate***	**# of MOR-EV Rebates per 1,000 residents**
Abington	10	16,965	0.59
Acton	124	23,829	5.20
Acushnet	6	10,585	0.57
Adams	2	8,047	0.25
Agawam	31	28,393	1.09
Amesbury	24	17,179	1.40
Amherst	123	40,059	3.07
Andover	83	36,363	2.28
Arlington	189	45,522	4.15
Ashburnham	4	6,372	0.63
Ashby	5	3,163	1.58
Ashfield	6	1,688	3.55
Ashland	58	18,466	3.14
Athol	5	11,897	0.42
Attleboro	69	46,601	1.48
Auburn	14	16,762	0.84
Avon	1	4,735	0.21
Ayer	14	8,424	1.66
Barnstable	52	49,532	1.05
Barre	1	5,533	0.18
Becket	7	1,931	3.63
Bedford	46	14,161	3.25
Belchertown	30	15,316	1.96
Bellingham	22	17,407	1.26
Belmont	117	26,710	4.38
Berkley	5	6,797	0.74
Berlin	5	4,189	1.19
Bernardston	3	2,104	1.43
Beverly	49	42,235	1.16
Billerica	28	41,319	0.68
Blackstone	6	9,211	0.65
Blandford	3	1,210	2.48
Bolton	18	5,728	3.14
Boston	464	650,706	0.71

Bourne	14	20,667	0.68
Boxborough	24	5,412	4.43
Boxford	11	8,112	1.36
Boylston	8	4,924	1.62
Braintree	85	38,567	2.20
Brewster	9	10,444	0.86
Bridgewater	21	28,780	0.73
Brimfield	2	3,690	0.54
Brockton	28	104,826	0.27
Brookfield	2	3,432	0.58
Brookline	122	62,535	1.95
Buckland	3	1,810	1.66
Burlington	44	25,966	1.69
Cambridge	258	118,488	2.18
Canton	40	24,609	1.63
Carlisle	39	5,157	7.56
Carver	7	11,626	0.60
Charlemont	4	1,181	3.39
Charlton	16	13,360	1.20
Chatham	13	6,711	1.94
Chelmsford	79	35,906	2.20
Chelsea	16	38,637	0.41
Cheshire	4	3,215	1.24
Chester	2	1,220	1.64
Chesterfield	1	1,175	0.85
Chicopee	37	54,980	0.67
Chilmark	6	1,235	4.86
Clinton	17	15,484	1.10
Cohasset	15	8,346	1.80
Colrain	4	1,617	2.47
Concord	133	17,954	7.41
Conway	6	1,760	3.41
Cummington	5	818	6.11
Dalton	4	6,236	0.64
Danvers	25	27,781	0.90
Dartmouth	37	33,406	1.11
Dedham	39	24,997	1.56
Deerfield	16	5,162	3.10
Dennis	15	14,932	1.00
Devens	2	N/A	N/A
Dighton	8	8,168	0.98
Douglas	3	9,153	0.33
Dover	15	5,860	2.56
Dracut	25	32,060	0.78
Dudley	4	11,850	0.34
Dunstable	5	3,355	1.49

Duxbury	18	16,107	1.12
East Bridgewater	5	14,338	0.35
East Longmeadow	13	16,343	0.80
Eastham	11	5,822	1.89
Easthampton	51	16,045	3.18
Easton	31	25,240	1.23
Edgartown	6	5,266	1.14
Erving	2	1,667	1.20
Essex	6	3,668	1.64
Everett	21	49,350	0.43
Fairhaven	15	15,837	0.95
Fall River	22	93,682	0.23
Falmouth	39	33,104	1.18
Fitchburg	15	41,502	0.36
Foxboro	25	18,488	1.35
Framingham	127	70,963	1.79
Franklin	55	33,656	1.63
Freetown	3	9,236	0.32
Gardner	5	20,902	0.24
Georgetown	17	8,408	2.02
Gill	2	1,560	1.28
Gloucester	41	29,836	1.37
Grafton	45	19,815	2.27
Granby	7	6,055	1.16
Granville	1	1,528	0.65
Great Barrington	25	7,214	3.47
Greenfield	31	17,656	1.76
Groton	35	11,162	3.14
Groveland	2	6,721	0.30
Hadley	13	5,270	2.47
Halifax	6	7,698	0.78
Hamilton	13	7,526	1.73
Hampden	4	4,915	0.81
Hanover	14	14,758	0.95
Hanscom AFB	4	N/A	N/A
Hanson	3	10,587	0.28
Hardwick	2	2,658	0.75
Harvard	22	6,870	3.20
Harwich	17	13,647	1.25
Hatfield	8	3,314	2.41
Haverhill	33	67,153	0.49
Heath	3	721	4.16
Hingham	41	24,130	1.70
Hinsdale	2	1,900	1.05
Holbrook	5	11,285	0.44
Holden	24	19,880	1.21

Holland	3	2,573	1.17
Holliston	45	14,856	3.03
Holyoke	33	37,720	0.87
Hopedale	5	6,008	0.83
Hopkinton	53	19,249	2.75
Hubbardston	5	4,335	1.15
Hudson	36	19,744	1.82
Hull	19	10,142	1.87
Ipswich	29	13,848	2.09
Kingston	20	13,829	1.45
Lakeville	8	11,895	0.67
Lancaster	16	8,394	1.91
Lanesboro	7	3,016	2.32
Lawrence	13	87,954	0.15
Lee	6	5,707	1.05
Leicester	3	11,033	0.27
Lenox	8	5,064	1.58
Leominster	32	43,646	0.73
Leverett	13	1,860	6.99
Lexington	211	34,074	6.19
Lincoln	37	6,855	5.40
Littleton	45	10,139	4.44
Longmeadow	27	15,632	1.73
Lowell	53	113,608	0.47
Ludlow	19	20,871	0.91
Lunenburg	10	11,835	0.84
Lynn	34	100,891	0.34
Lynnfield	30	12,951	2.32
Malden	90	64,712	1.39
Manchester	9	5,354	1.68
Mansfield	38	23,816	1.60
Marblehead	35	20,233	1.73
Marion	11	5,291	2.08
Marlborough	50	40,971	1.22
Marshfield	23	25,713	0.89
Mashpee	15	15,468	0.97
Mattapoisett	23	6,589	3.49
Maynard	29	10,546	2.75
Medfield	30	13,072	2.29
Medford	138	65,399	2.11
Medway	22	13,393	1.64
Melrose	67	29,155	2.30
Mendon	9	6,286	1.43
Merrimac	10	6,699	1.49
Methuen	27	53,241	0.51
Middleboro	13	24,376	0.53

Middleton	14	9,837	1.42
Milford	28	30,196	0.93
Millbury	10	13,936	0.72
Millis	9	8,836	1.02
Millville	6	3,147	1.91
Milton	53	28,364	1.87
Monson	9	8,090	1.11
Montague	16	8,463	1.89
Monterey	1	1,085	0.92
Nahant	9	3,289	2.74
Nantucket	20	14,421	1.39
Natick	131	36,272	3.61
Needham	163	32,114	5.08
New Bedford	27	100,682	0.27
New Braintree	1	990	1.01
New Marlborough	3	1,510	1.99
New Salem	2	1,008	1.98
Newbury	11	6,695	1.64
Newburyport	39	18,662	2.09
Newton	204	87,381	2.33
Norfolk	20	11,552	1.73
North Adams	12	12,777	0.94
North Andover	29	31,295	0.93
North Attleboro	35	30,930	1.13
North Brookfield	4	4,728	0.85
North Reading	28	15,549	1.80
North Troy	1	N/A	N/A
Northampton	82	29,327	2.80
Northborough	50	15,663	3.19
Northbridge	14	16,337	0.86
Northfield	9	2,872	3.13
Norton	11	19,108	0.58
Norwell	22	11,280	1.95
Norwood	51	31,317	1.63
Oak Bluffs	9	5,379	1.67
Oakham	1	1,866	0.54
Orange	6	7,558	0.79
Orleans	14	6,422	2.18
Otis	1	1,626	0.62
Oxford	7	13,287	0.53
Palmer	8	12,337	0.65
Paxton	4	5,024	0.80
Peabody	25	53,896	0.46
Pembroke	11	18,297	0.60
Pepperell	12	11,620	1.03
Petersham	3	1,183	2.54

Pittsfield	29	43,310	0.67
Plainfield	2	629	3.18
Plainville	9	9,865	0.91
Plymouth	86	64,269	1.34
Plympton	2	2,923	0.68
Princeton	7	3,504	2.00
Provincetown	6	3,723	1.61
Quincy	169	101,727	1.66
Randolph	22	34,530	0.64
Raynham	18	15,474	1.16
Reading	53	25,205	2.10
Rehoboth	12	13,023	0.92
Revere	33	58,528	0.56
Richmond	3	1,402	2.14
Rochester	14	5,816	2.41
Rockland	8	17,609	0.45
Rockport	16	6,925	2.31
Rowe	1	421	2.38
Rowley	8	6,283	1.27
Royalston	2	1,261	1.59
Russell	1	1,631	0.61
Rutland	12	9,298	1.29
Salem	47	44,722	1.05
Salisbury	5	9,189	0.54
Sandwich	22	20,611	1.07
Saugus	20	28,547	0.70
Savoy	1	646	1.55
Scituate	24	19,190	1.25
Seekonk	17	15,649	1.09
Sharon	78	18,408	4.24
Sheffield	8	3,329	2.40
Shelburne Falls	14	1,886	7.42
Sherborn	14	4,372	3.20
Shirley	9	6,782	1.33
Shrewsbury	105	39,805	2.64
Shutesbury	22	1,726	12.75
Somerset	15	18,192	0.82
Somerville	210	79,762	2.63
South Hadley	24	18,046	1.33
Southampton	3	6,207	0.48
Southborough	40	10,409	3.84
Southbridge	7	17,619	0.40
Southwick	5	9,190	0.54
Spencer	11	11,911	0.92
Springfield	39	154,064	0.25
Sterling	12	8,139	1.47

Stockbridge	5	1,998	2.50
Stoneham	45	22,705	1.98
Stoughton	28	28,969	0.97
Stow	35	7,042	4.97
Sturbridge	15	9,882	1.52
Sudbury	75	18,965	3.95
Sunderland	5	3,647	1.37
Sutton	8	9,379	0.85
Swampscott	22	15,280	1.44
Swansea	9	17,307	0.52
Taunton	33	59,922	0.55
Templeton	5	8,183	0.61
Tewksbury	27	30,833	0.88
Tisbury	14	4,886	2.87
Topsfield	6	6,504	0.92
Townsend	2	8,948	0.22
Truro	4	2,486	1.61
Tyngsboro	14	12,368	1.13
Tyringham	2	421	4.75
Upton	12	8,128	1.48
Uxbridge	17	14,386	1.18
Wakefield	43	27,069	1.59
Wales	2	1,807	1.11
Walpole	40	26,277	1.52
Waltham	107	64,065	1.67
Ware	13	10,385	1.25
Wareham	14	23,151	0.60
Warren	1	4,968	0.20
Warwick	2	780	2.56
Watertown	108	35,022	3.08
Wayland	67	13,664	4.90
Webster	4	17,601	0.23
Wellesley	78	30,524	2.56
Wellfleet	8	3,644	2.20
Wendell	2	921	2.17
Wenham	4	4,926	0.81
West Boylston	5	7,757	0.64
West Bridgewater	10	7,625	1.31
West Brookfield	4	3,817	1.05
West Newbury	12	4,562	2.63
West Springfield	18	28,501	0.63
West Stockbridge	5	1,329	3.76
West Tisbury	10	3,594	2.78
Westborough	49	21,506	2.28
Westfield	33	40,535	0.81
Westford	83	24,353	3.41

Westminster	11	8,330	1.32
Weston	43	11,661	3.69
Westport	13	16,413	0.79
Westwood	38	16,231	2.34
Weymouth	57	57,410	0.99
Whitman	6	15,259	0.39
Wilbraham	19	14,526	1.31
Williamsburg	16	2,469	6.48
Williamstown	28	7,663	3.65
Wilmington	31	22,904	1.35
Winchendon	5	10,385	0.48
Winchester	94	22,640	4.15
Windsor	2	818	2.44
Winthrop	22	18,510	1.19
Woburn	51	41,248	1.24
Worcester	114	205,319	0.56
Worthington	4	1,183	3.38
Wrentham	21	12,457	1.69
Yarmouth Port	18	25,244	0.71
*2022 Population Estimates Program, https://www.massachusetts-demographics.com/cities_by_population			

Appendix B: Environmental Justice Populations and MOR-EV Rebates, 2021-2022

Vehicles that received a MOR-EV rebate between 2021-2022 and are registered in a municipality that encompasses at least one EEA Environmental Justice (EJ) population are outlined below.

Registration Municipality and EJ Populations	Number of Rebates[21]	Total Rebate Funding	Percent of Rebate Funding
Municipality does not have any EJ populations	3,354	$7,188,000	34%
Municipality has at least 1 EJ population	6,516	$13,962,000	66%

Vehicle registration street address, which is necessary to determine the specific census block, was only available for 4,671 records (approximately 47% of MOR-EV rebates) between 2021-2022. Of the subset of MOR-EV rebate data available for this analysis, most MOR-EV rebate funds were applied to vehicles registered in census blocks that do not meet any of the EEA environmental justice criteria as follows.

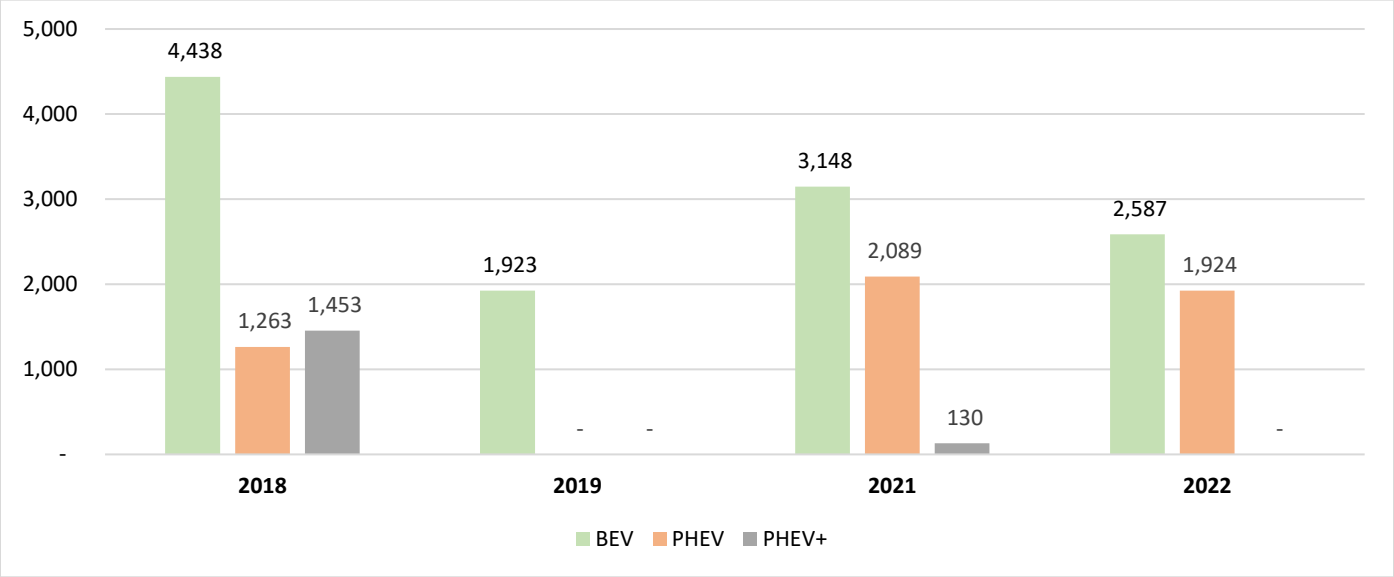
Registration Address (Census Block) and EJ Criteria	Number of Rebates	Total Amount of Rebate Funding	Percent of Rebate Funding
Not meeting any criteria	4,233	$8,981,000	91%
Meeting 1 EJ criteria	372	$754,000	7.6%
Meeting 2 EJ criteria	56	$112,000	1.1%
Meeting 3 EJ criteria	9	$18,500	0.2%
Data subset total	*4,671*	*$9,865,500*	

Going forward, full registration address data will be collected consistently for MOR-EV rebates to provide DOER the ability to continually review trends and identify opportunities for more directed engagement.

[21] Registration zip code was unavailable for 8 rebate records.

Appendix C: High-Level Rebate Data, 2018-2019 and 2021-2022

Number of MOR-EV Rebates Issued for New Light-Duty EVs



MOR-EV Rebate Spending for New Light-Duty EVs