NYC DCAS
Citywide Administrative Services

Analysis of Electric Vehicle Battery Operations

Fleet Office of Real-Time Tracking (FORT)

The New York City Department of Citywide Administrative Services (DCAS) is one of the nation's largest electric vehicle (EV) adopters, with over 5,500 electric (BEV) and plug-in (PHEV) units in the City fleet and an additional 4,400 hybrids. DCAS also operates one of the nation's largest live tracking initiatives for vehicles, with 29,000 units part of the Fleet Office of Real-Time Tracking (FORT) located at the David N. Dinkins Municipal Building in Manhattan.

As a major adopter of alternative fuel vehicles, DCAS periodically issues reports on technical areas involving sustainable fleet technology. Among these, DCAS has reported on maintenance cost savings from EVs, the performance of hybrids in real applications, the role of electrification in fleet efficiency, and the viability of renewable diesel for trucking.

The operation of electric vehicle batteries in real-use applications is a critical issue as EV adoption expands across the City fleet through Local Law 140. Using FORT telematics data, DCAS has set out to better understand the performance of EVs against the Environmental Protection Agency's (EPA) fuel economy ratings, the impact of cold weather on EV batteries, the performance of batteries while idling, to what extent these batteries will degrade in performance over time, and the safety performance of EVs compared to other vehicles.

These initial findings are outlined below and being shared publicly. This report combines both clean and safe fleet transition in accordance with EO53 of 2020. In May 2025, DCAS and US DOT Volpe also launched an update to the Clean Fleet Transition Plan report consistent with Mayoral Executive Order 53 of 2020. DCAS will be further assessing electric vehicle operations in that report, and will update findings below in the future as additional data is obtained.

DCAS has examined EV battery operations across over 6.5 million miles of actual city-based usage.

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Summary findings

- **In Actual Use, BEVs Perform Well Against EPA Fuel Economy Ratings:** BEVs, on average, achieved 91 miles per gallon equivalent (MPGe) in actual operations, 14% lower than the average EPA ratings. BEVs achieve actual MPGe dramatically closer to their EPA ratings than any other fuel type.
- **Cold Weather Impacts Batteries up to 33%:** Cold weather has a clear and consistent impact on battery range and fuel efficiency for BEVs. The average impact is 33% across all EV models. This finding has important planning implications for winter and cold weather operations. Gas and diesel units that were analyzed did not show comparable cold weather impacts. Idling in cold weather also impacts batteries more than during warm weather.
- **Degradation of Batteries over Time was a Limited Concern:** Electric batteries showed a limited amount of degradation over time, from 0 to 4.8 miles equivalent of degradation per year.
- **Weather Impacts Battery Depletion During Idling:** While idling BEVs do not produce emissions as with gas or even hybrid vehicles, they do use energy. Idling is more energy intensive in cold weather.
- **Crash performance of EVs and Hybrids were Comparable:** The analysis did not find appreciable differences in crash impacts for EVs and hybrids. However, EVs do report much higher instances of harsh acceleration than hybrids. This is likely impacted by instant torque and the impacts of one-pedal driving.
- **Intelligent Speed Assistance (ISA) Improved Fuel Economy:** Chevrolet Bolts deployed with ISA achieved 6% improved fuel economy over Bolts without ISA. This finding shows that ISA has both safety and fuel economy benefits.

Report

The BEV fleet of the City of New York consists of over 2,500 vehicles[1]. The actual use-based energy economy of the light-duty BEV fleet in MPGe in 2024 was 85 MPGe. This was determined through analysis of telematics data through the FORT, which currently utilizes Geotab tracking units. The breakdown of the number of vehicles of each model year, their actual MPGe[2], and a comparison with their combined city/highway EPA rating[3] is shown in the following table.

	Year	Number of Vehicles	Distance (mi)	Energy Used (kWh)	Actual MPGe	EPA Rating (Combined)	Percent DIfference
Bolt							
	2017	41	202,119	72,330	94	119	-21%
	2018	22	79,477	25,823	104	119	-13%
	2019	33	162,069	49,013	111	119	-7%
	2020	25	113,676	32,218	119	118	0%
	2021	12	46,174	12,616	123	118	4%
	2022	431	2,424,550	862,936	95	120	-22%
	2023	180	864,982	279,911	104	120	-14%
Total	—	744	3,893,047	1,334,847	98	120	-18%
Bolt EUV							
	2023	21	51,138	17,986	96	115	-17%
Total	—	21	51,138	17,986	96	115	-17%

[1] This study covers a subset of around 1400 vehicles with Geotab Go9 device for most accurate reporting.

[2] Actual MPGe was calculated with the following:

$$\text{Actual MPGe} = \frac{\text{Total Distance (mi)}}{\text{Total Energy Used (kWh)}} \times 33.7$$

where the 33.7 is a conversion factor representing the amount of kWh that is equivalent to one gallon of gasoline.

[3] The EPA calculates combined fuel/energy economy by weighting the city value by 55% and highway value by 45%. This roughly corresponds to the proportion of city vs highway driving done by a sample of city vehicles studied, where over 40% of the time and over 55% of the distance spent driving was on highways.

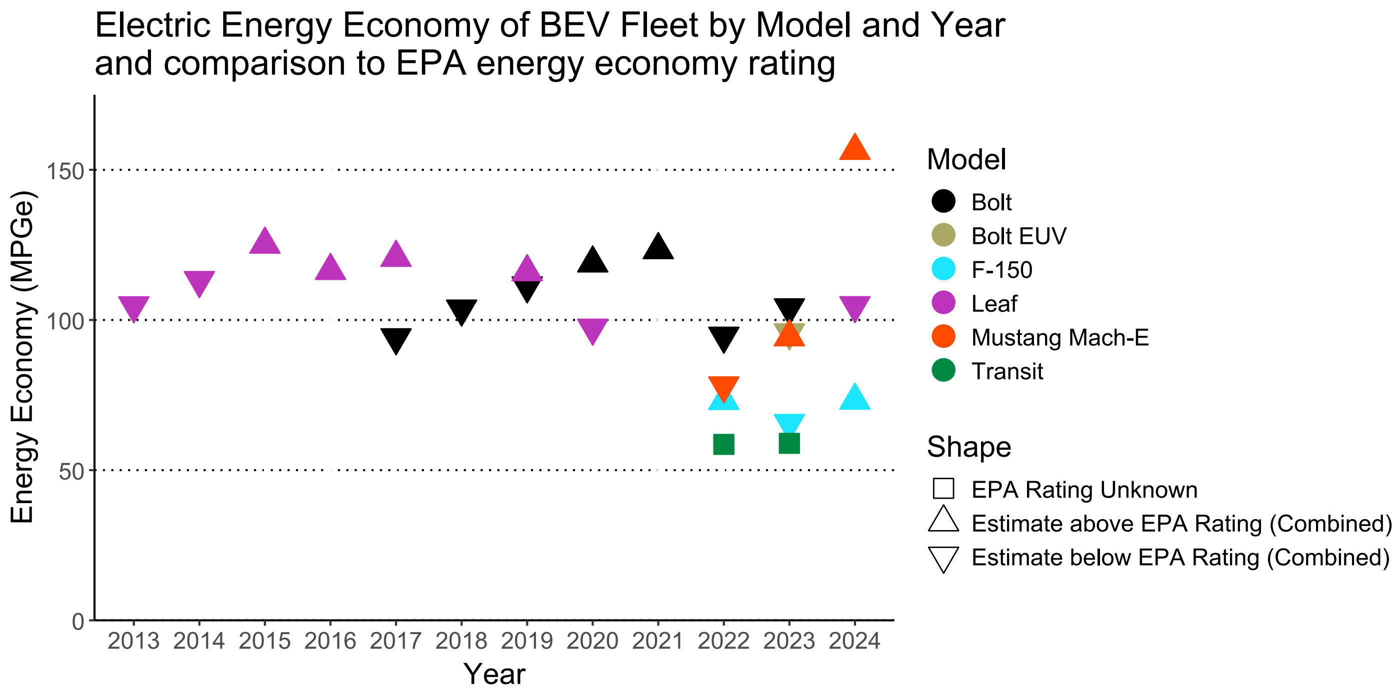
	Year	Number of Vehicles	Distance (mi)	Energy Used (kWh)	Actual MPGe	EPA Rating (Combined)	Percent DIfference
F-150							
	2022	1	2,908	1,341	73	68	7%
	2023	125	657,177	337,489	66	68	-4%
	2024	18	38,362	17,656	73	68	7%
Total	—	144	698,447	356,486	66	68	-3%
Leaf*							
	2013	2	3,458	1,112	105	115	-9%
	2014	1	2,466	734	113	114	-1%
	2015	10	22,534	6,067	125	114	9%
	2016	18	48,193	13,951	116	114	2%
	2017	4	16,344	4,561	121	112	7%
	2019	1	2,615	760	116	108	7%
	2020	6	22,077	7,642	97	108	-10%
	2024	17	36,672	11,786	105	111	-6%
Total	—	59	154,359	46,613	112	112	-1%
Mustang Mach-E							
	2022	56	488,298	210,595	78	93	-16%
	2023	67	409,402	146,280	94	93	1%
	2024	19	22,684	4,888	156	91	71%
Total	—	142	920,384	361,763	86	93	-8%
Grand Total	—	1,110	5,717,375	2,117,695	91	105	-14%

*There are no Leafs from 2018 or 2021-2023 in the NYC Fleet.

Transits are not classified as light duty, and the EPA does not have an official energy economy estimate for them. NYC Fleet Management operated over 200 of these fully electric vans in 2024 across nearly 900,000 miles.

	Year	Number of Vehicles	Distance (mi)	Energy Used (kWh)	Actual MPGe
Transit					
	2022	8	39,340	22,633	59
	2023	196	835,349	477,736	59
Total	—	204	874,689	500,370	59

The graph below shows the actual MPGe by model year, with the shape indicating whether the estimate is above or below the EPA rating. While at first glance, it appears that newer models are less energy efficient than older models, this is driven by the inclusion of three new vehicle types, vans (Transit), SUVs (Mustang Mach-E), and pickups (F-150), into the BEV fleet in more recent years. The latest Mustang Mach-E (2024) appears to have performed unusually well. These were in service since July 2024, so these vehicles were active only in the warmer half of the 2024 study period. The significance of this finding is explored further in the section on seasonality.



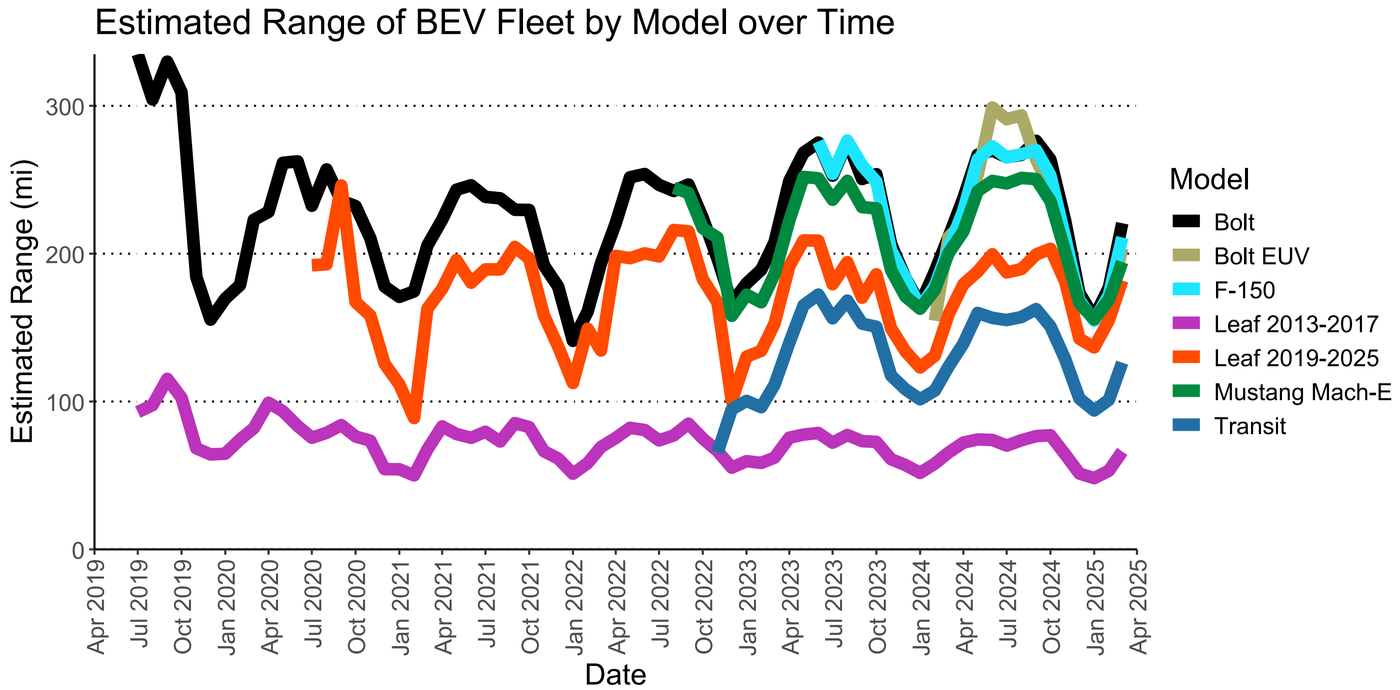
Seasonality in Energy Economy and Range

Battery performance is sensitive to temperature, as can be seen from the comparison of energy economy between June and December 2024 below.

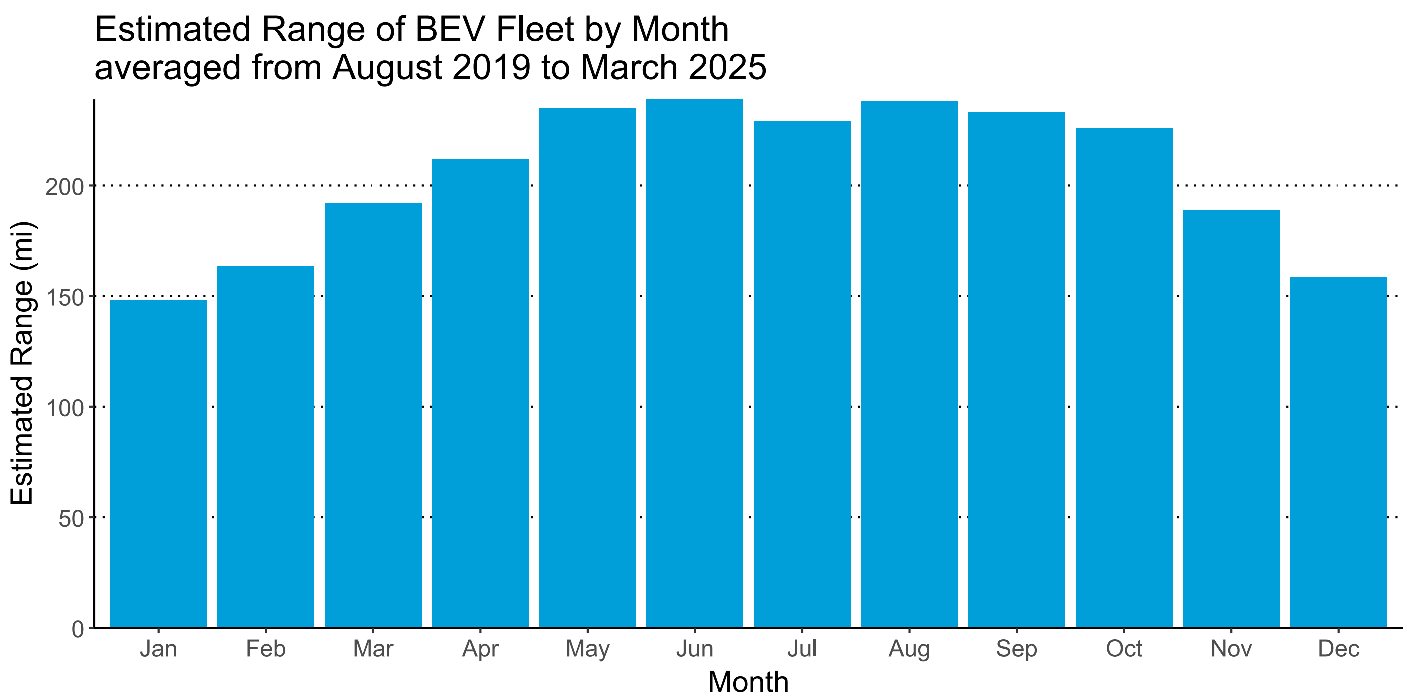
Year	Number of Vehicles in June 2024	Actual MPGe in June 2024	Number of Vehicles in December 2024	Actual MPGe in December 2024	Percent Reduction in December
Bolt					
2017	38	118	38	71	40%
2018	19	119	17	77	35%
2019	31	125	32	83	33%
2020	25	145	25	88	39%
2021	12	146	11	102	30%
2022	402	115	415	73	37%
2023	165	125	171	74	40%
Bolt EUV					
2023	10	115	20	69	40%
F-150					
2022	1	81	1	53	34%
2023	123	80	124	46	42%
Leaf*					
2013	2	129	2	81	37%
2014	1	130	1	91	29%
2015	9	129	9	102	20%
2016	18	122	18	94	22%
2017	4	119	4	84	29%
2019	1	150	1	66	55%
2020	6	112	5	72	35%
2024	7	112	16	84	24%
Mustang Mach-E					
2022	52	96	55	66	31%
2023	59	109	66	73	32%
Transit					
2022	8	75	8	38	49%
2023	175	70	189	43	38%

*There are no Leafs from 2018 or 2021-2023 in the NYC Fleet.

The range appears to be mostly determined by model and seasonality (lower range during the colder months). The Leafs dramatically improved in range from the first (through 2017) to the second generation (starting 2018), so they are shown separately below.

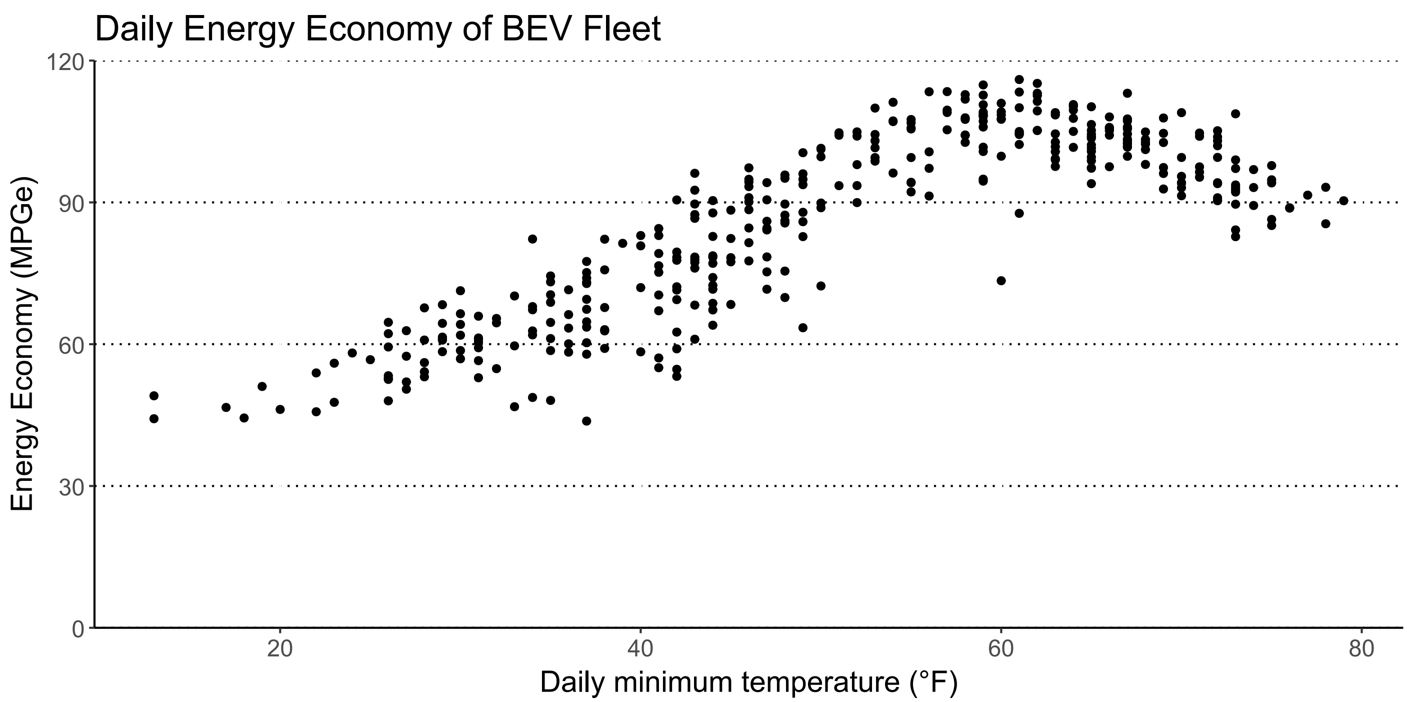


The figure below represents the seasonality in estimated range by averaging the range of all vehicles per month in each year. The average estimated range in the winter months (January, February, and December) is 157 mi, while the average in the summer months (June, July, and August) is 235 mi, a decrease of 33%. This pattern appears consistently across all models, as shown by the table of the percent difference between summer and winter months for each model.

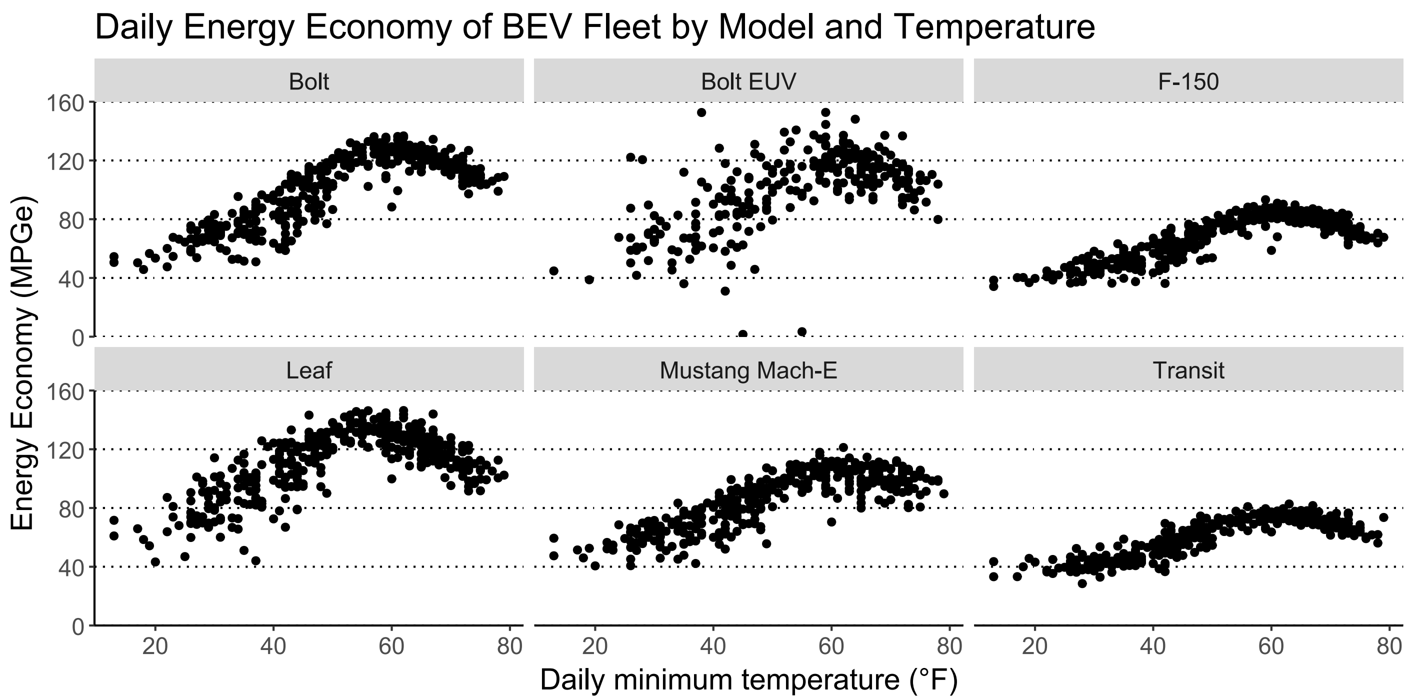


	Estimated Range in Winter (mi)	Estimated Range in Summer (mi)	% Decline in Winter
Bolt	174	265	34%
Bolt EUV	161	294	45%
F-150	169	268	36%
Leaf 2013-2017	56	76	26%
Leaf 2019-2025	138	194	28%
Mustang Mach-E	166	248	32%
Transit	102	160	36%
Total Fleet	157	235	33%

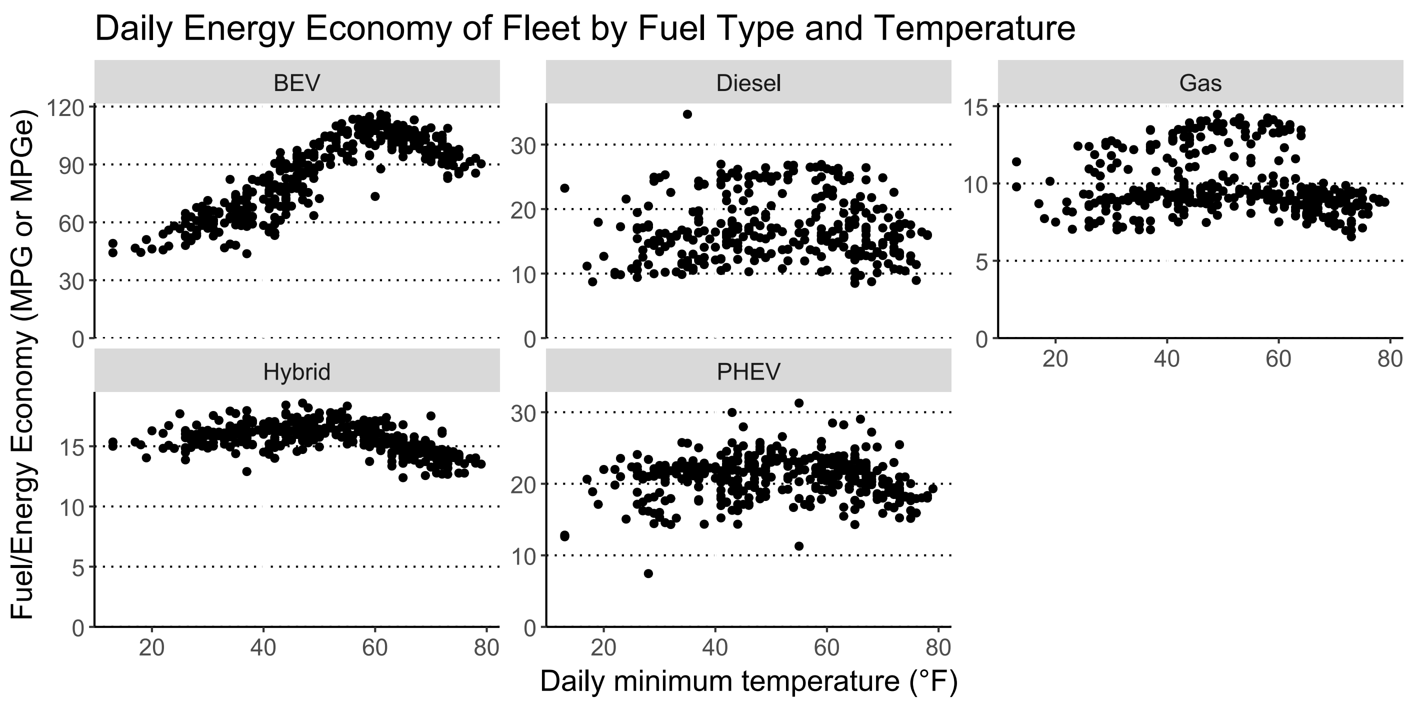
This suggests that environmental temperature is an important factor in determining the range of BEVs. There appears to be a clear relationship between the energy efficiency of vehicles and daily minimum temperature[4], with a peak efficiency at around a daily minimum of 60 degrees Fahrenheit. The different models show similar patterns, with Leafs showing a peak at a slightly lower temperature than other models.



[4] Daily minimum temperature from National Weather Service, NY-Central Park Area, https://www.weather.gov/wrh/Climate?wfo=okx



While temperature appears to have a strong effect on the energy economy of battery electric vehicles, this may be due to the effect on the battery itself or due to increasing usage of climate control during extremes of temperature. The peak near 60 degrees Fahrenheit could mean that batteries are most efficient near that temperature, or that drivers are utilizing more heating and cooling the hotter or colder the outdoor temperature gets from 60 degrees Fahrenheit. However, a similar analysis of the energy/fuel economy of other fuel types in 2024 seems to indicate that battery electric vehicles are uniquely sensitive to temperature. Diesel, gas, and plug-in hybrid vehicles show consistent energy economy regardless of temperature, and traditional hybrids appear to have a slight negative effect of high temperatures but no effect of low temperatures.



DCAS previously studied the fuel efficiency of hybrid vehicles compared to traditional internal combustion engine (ICE) vehicles and found hybrid vehicles outperformed ICE vehicles even more than predicted by EPA ratings for fuel economy[5]. The energy economy of battery electric vehicles is closer to their EPA rating than any other fuel type. All vehicles included in this section were light-duty vehicles with Geotab Go9 devices of model year 2013 and newer.

	Number of Vehicles	Distance (mi)	Fuel Used (gal or gal equivalent)	Actual MPG or MPGe	EPA Rating	Percent Difference
BEV	1,110	5,717,375	62,840	91	105	-14%
Diesel	5	35,050	2,074	17	22	-24%
Gas	495	2,640,616	267,820	10	21	-54%
Hybrid	650	4,875,917	313,984	16	32	-51%
PHEV	936	6,282,161	308,195	20	91*	-78%

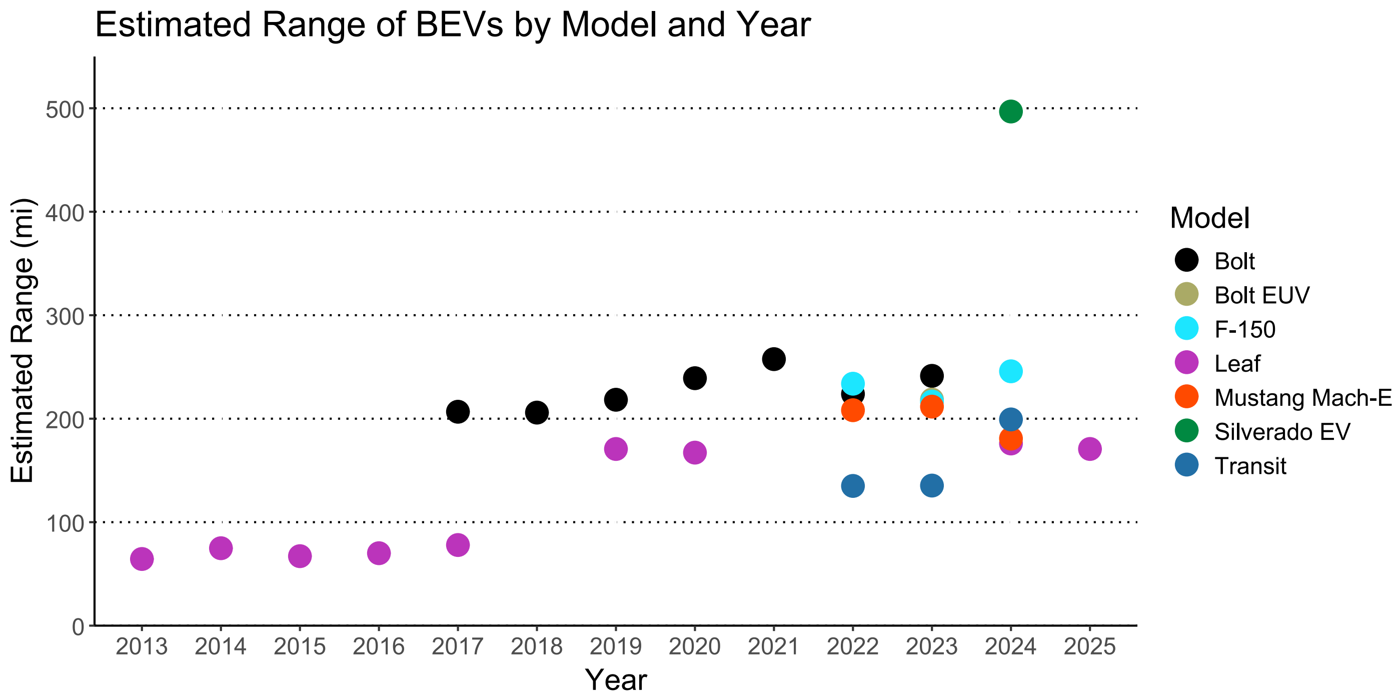
*This uses the EPA rating for combined gas and electric. Using only gas, the EPA rating for the PHEV vehicles would be 35 mpg, with a percent difference of -42%.

Range and Battery Degradation

As seen in Leafs from the first to the second generation, vehicles may improve in range by model year over time. There appears to be a general increase in range over time for the two models with more than three years of data (Leafs and Bolts), but the increase may happen in steps, such as for Leafs where the range changed from an average of less than 100 miles to over 150 miles between model years 2017 and 2019. Since there is no corresponding increase in energy efficiency, this increase is likely occurring due to an increase in the size of the battery.

Bolts showed a steady increase through 2021, which dropped in 2022 and 2023. This may be because there are relatively few Bolts of model years 2017-2021 (between 11 and 59 per year) compared to 2022 (419 Bolts) and 2023 (198 Bolts); these numbers may be skewed by vehicles that have an especially high range. The values for 2022 and 2023 are likely more representative of the range capability of these vehicles.

[5] https://www.nyc.gov/assets/dcas/downloads/pdf/fleet/NYC-Fleet-Newsletter-306-May-27-2020-Hybrids-Work-Even-Better-in-Reality-Than-in-Theory.pdf



As battery performance is sensitive to temperature, it is important to consider temperature when discussing battery degradation. The monthly mean temperature[6] was used to determine how both temperature and age of vehicle can affect the estimated range, while taking into consideration the nonindependence of estimates from the same vehicle over time.

All models showed a sensitivity to temperature, with F-150s showing the greatest sensitivity (a change in range of between 2.63 to 2.78 miles per degree Fahrenheit), while older Leafs showed the least sensitivity (0.49 to 0.58 miles per degree Fahrenheit). This does not necessarily mean that the battery performance of Leafs is not affected by temperature. As can be seen from the graphs of energy economy and daily minimum temperature, the relationship between battery performance and temperature only appears linear up to a peak of about 60 degrees Fahrenheit for most models. For Leafs, this peak appears to be at a slightly lower temperature of approximately 55 degrees Fahrenheit, which may explain why, in a linear approximation, the slope is shallower for Leafs than other models.

Degradation in range was seen in both generations of Leafs and the Mustang Mach-E, while Bolts, F-150s, and Transits showed no clear relationship as the estimate spanned both positive and negative values. Even the greatest estimates of degradation are less than 5 mi per year.

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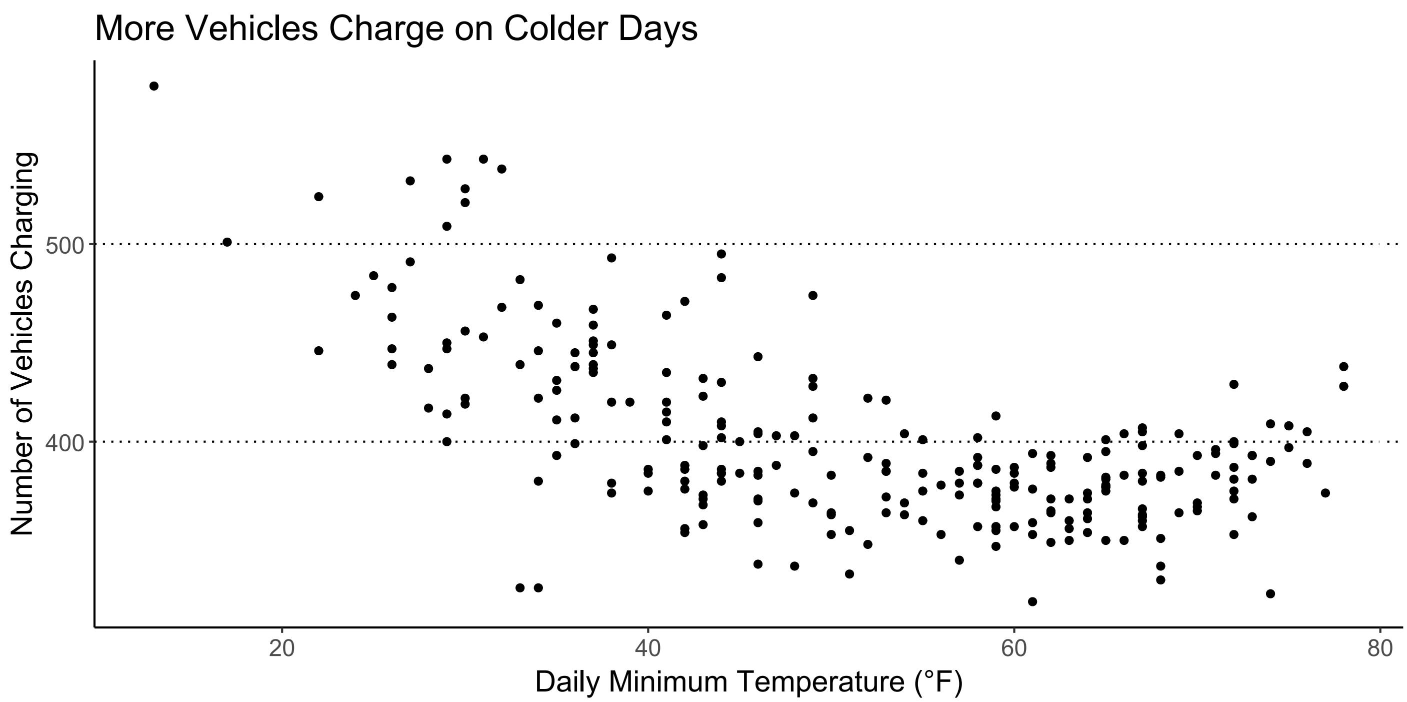
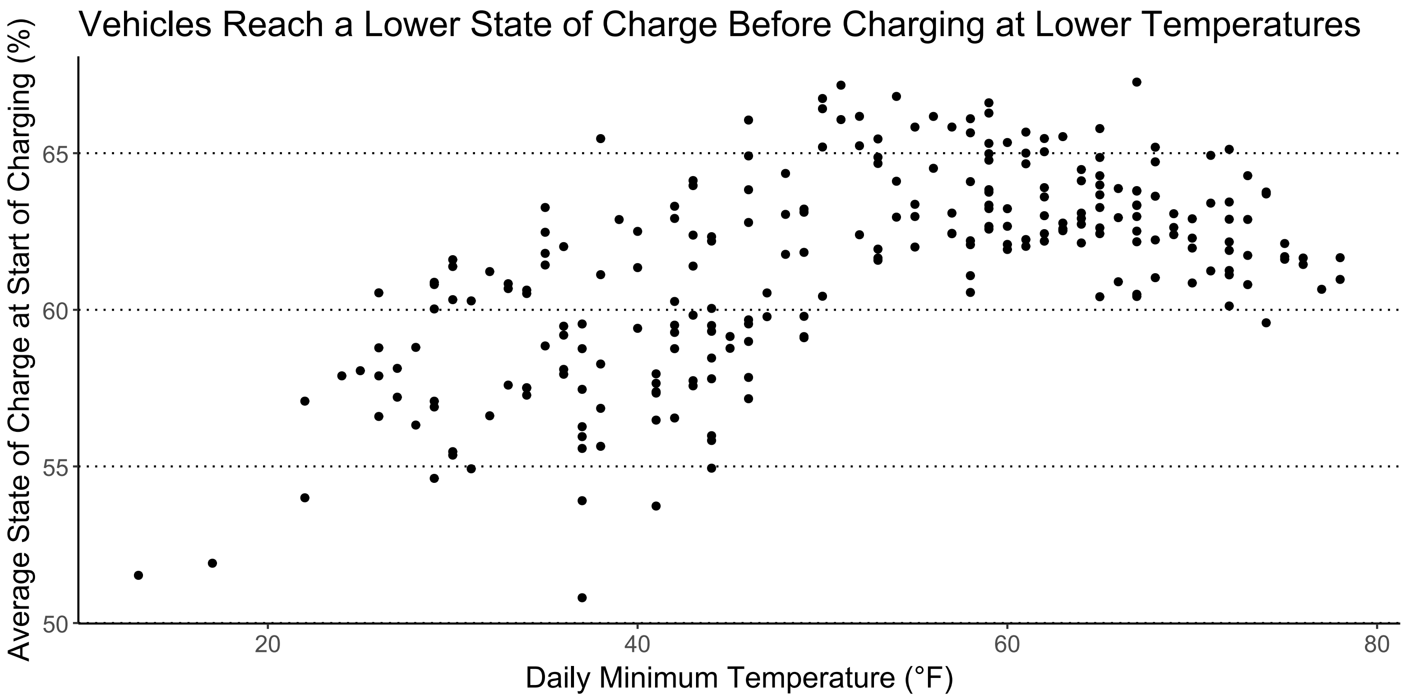
[6] Monthly mean temperature from National Weather Service, NY-Central Park Area, https://www.weather.gov/wrh/Climate?wfo=okx

Model	Effect of Temperature (mi per °F)	Change in Range Over Time (mi per year)
Bolt	2.46 to 2.53	-1.2 to 0
F-150	2.63 to 2.78	-1.56 to 3.84
Leaf 2013-2017	0.49 to 0.58	-3.24 to -2.28
Leaf 2019-2025	1.54 to 1.87	-4.8 to -0.12
Mustang Mach-E	2.06 to 2.2	-4.2 to -0.6
Transit	1.5 to 1.58	-1.32 to 0.84

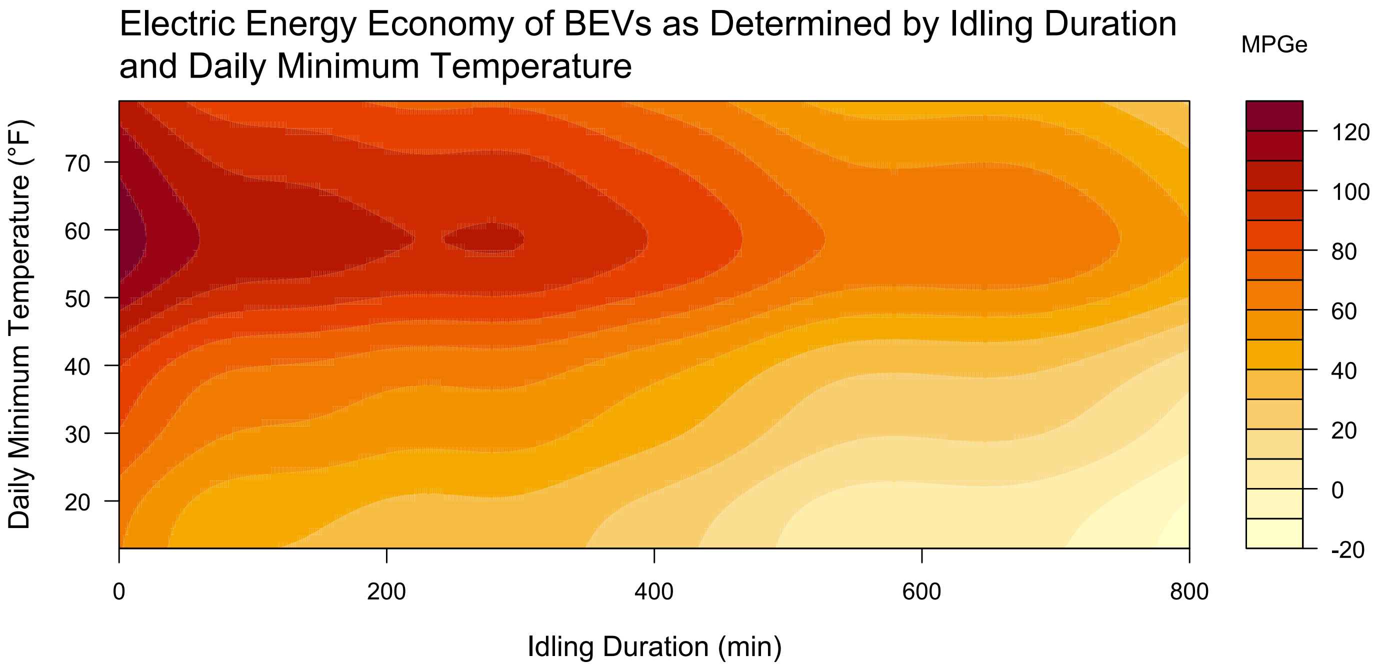
Vehicle range seems to decline with temperature and over time. Drivers may charge more frequently to compensate, and/or the batteries may reach lower states of charge on average at lower temperatures before the commencement of charging. The graphs below illustrate the same vehicle and temperature data from 2024, and the patterns appear to correspond to battery performance: more frequent charging starting at lower states of charge at lower temperatures with the least frequent charging and highest states of charge at the ideal temperature of around 60 degrees Fahrenheit.



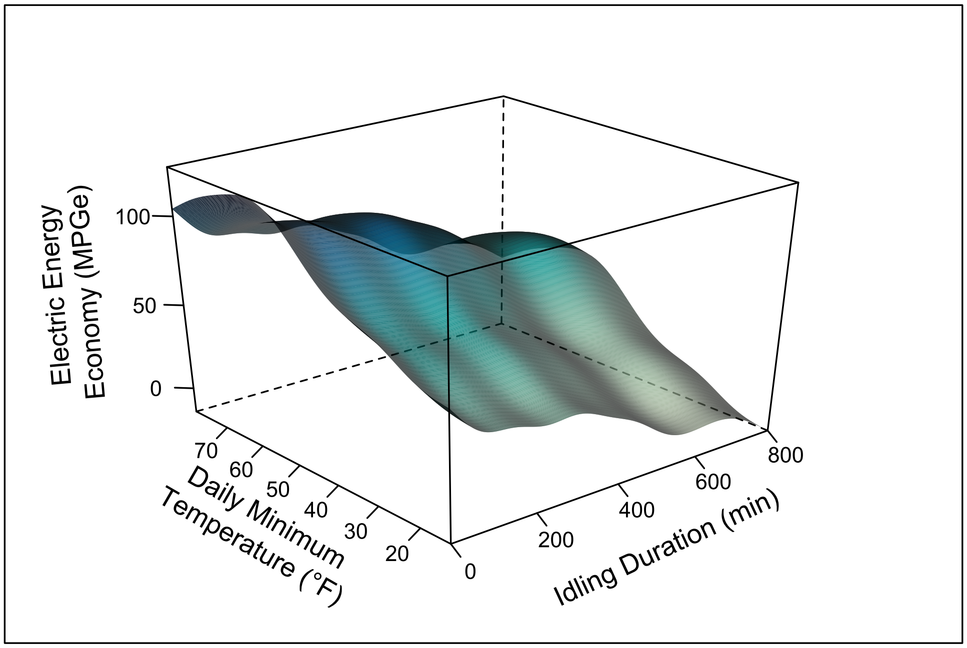


Battery Performance and Idling

Because battery performance is sensitive to temperature, the effect of idling may vary at different temperatures. The contour plot below describes the relationship between idling duration, temperature, and energy economy in battery electric vehicles in 2024. Not only did batteries perform best around 60 degrees Fahrenheit with little to no idling, but the performance was more robust to long periods of idling around that temperature. Once the temperature falls below 50 degrees Fahrenheit, idling quickly diminishes the energy economy of vehicles.



Three-Dimensional Representation of Electric Energy Economy as a Function of Idling Duration and Daily Minimum Temperature



BEV and Safety

There may also be safety implications in the electrification of the fleet. Bolts in the New York City fleet were involved in roughly the same number of collisions as corresponding Priuses. Between May 1, 2024, and March 31, 2025, there were 60 reported collisions among 493 Bolts compared to 71 reported collisions among 493 Priuses. This sample contained only Bolts and Pwriuses that did not have ISA installed. During this time, the Bolts traveled about 2.95 million miles, while the Priuses traveled about 2.45 million miles. There was no significant difference between Bolts and Priuses for number of collisions per vehicle[7] or collisions per mile driven[8].

Of these collisions, Bolts were involved in five collisions with injury, while Priuses were involved in 12 collisions with injury. Priuses were involved in significantly more collisions with injury per mile driven[9].

[7] t = -0.89, df = 970.2, p-value = 0.37

[8] t = -0.40, df = 961.1, p-value = 0.69

[9] t = -2.14, df = 558.1, p-value = 0.033

The Safety Scorecard is a measure used to flag high- and medium-risk vehicles in the New York City fleet that incorporates several indicators of driving safety. The same sample of 493 Bolts and 493 Priuses was used to compare the Safety Scorecard between BEVs and hybrids. There is a small but significant difference in the Safety Scorecard between the two models. Bolts have a mean score of 92.7 while Priuses have a mean score of 96.1[10]. Bolts produced significantly more hard acceleration alerts per mile[11], but there was no significant difference in the number of harsh braking[12], harsh cornering[13], excessive speeding[14], or speeding[15] per mile. This difference could be related to the instant torque of BEVs, although hybrids like the Prius can also make use of this.

Below are the average numbers of alerts per individual vehicle and per mile between May 2024 and March 2025.

	Bolt Events per Vehicle	Prius Events per Vehicle	Bolt Events per Mile	Prius Events per Mile
Hard Acceleration	61	14	0.010	0.0028
Harsh Braking	33	17	0.0055	0.0035
Harsh Cornering	99	45	0.017	0.0091
Speeding	82	72	0.014	0.015
Excessive Speeding	0.12	0.075	0.000019	0.000015

In partnership with US DOT Volpe Center, and in conjunction with Executive Order 53 of 2020, DCAS will be further exploring the nexus between EVs and safety in the 2025 update to the Clean Fleet Transition Plan (CFTP).

Safety may also contribute to the efficiency of battery electric vehicles. Of the Bolts studied in 2024, 82 vehicles were equipped with ISA as of August 5, 2024. Compared to the 655 Bolts that never had ISA, these vehicles had a small but significant increase in energy economy in the period studied from August 6, 2024, to December 31, 2024. The ISA-equipped Bolts had an average energy economy of 116 MPGe, and non-ISA-equipped Bolts had an average energy economy of 109 MPGe, a fuel economy improvement of 6% with ISA installed. During the study period, the ISA-equipped Bolts traveled a combined distance of over 167,000 miles, which corresponds to a savings of approximately 3,100 kilowatt-hours over the course of approximately five months.

[10] $t = -8.88$, $df = 805.6$, p-value < 0.001

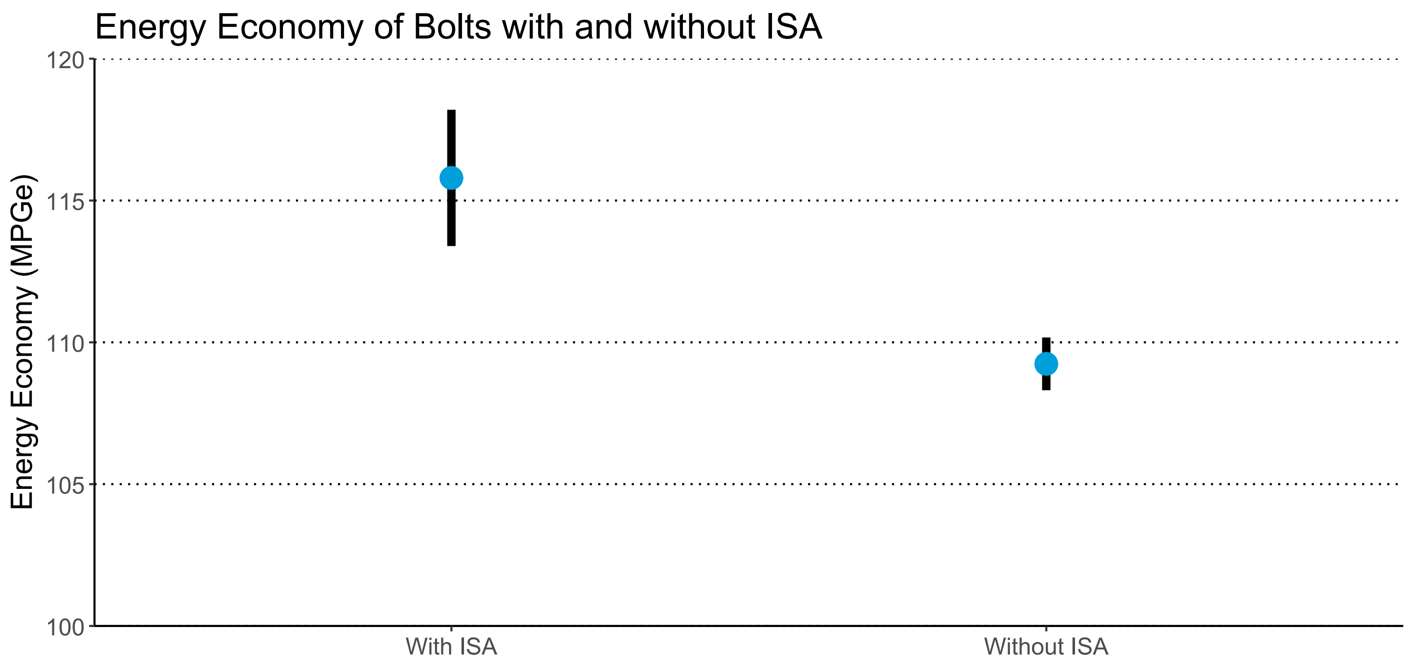
[11] $t = 2.92$, $df = 973.5$, p-value $= 0.0035$

[12] $t = 0.56$, $df = 923.6$, p-value $= .58$

[13] $t = .93$, $df = 788.7$, p-value $= .35$

[14] $t = 1.12$, $df = 921.7$, p-value $= .26$

[15] $t = -.92$, $df = 853.7$, p-value $= .36$



DCAS is leading the nation in ISA implementation and published a report with US DOT Volpe on the effectiveness of ISA in October 2024. DCAS will continue analysis to explore the nexus between safety and fuel efficiency with ISA.

This report was prepared by Tomomi Landsman, NYC DCAS Fleet Safety Analyst.
Louis A. Molina, DCAS Commissioner
Keith Kerman, DCAS Deputy Commissioner and NYC Chief Fleet Officer
Sherry Lee, Chief of Staff, Fleet Management & Budget
Alfredo Melian, Executive Director, Fleet Systems
Matthew Aronberg, Director of Fleet Office of Real-Time Tracking
Nathaniel Koszer, Fleet Safety Supervisor

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