ARTICLE 23

TWENTY-THIRD ARTICLE
Submitted by: Jesse M. Gray, TMM10, Heather Hamilton, TMM3

To see if the Town will adopt the following resolution:

RESOLUTION CALLING FOR THE ELECTRIFICATION OF THE TOWN'S MOTORIZED FLEET

Whereas, Brookline has a strong desire to assist the rest of the world in stopping climate change; and

Whereas, the Town must dramatically reduce its emissions via implementation of "strong and immediate" policies if it wishes to assist in keeping global warming below 1.5°C, per the December 2018 Intergovernmental Panel on Climate Change report; and

Whereas, fossil fuels for the Town's own motorized vehicles are a significant source of atmospheric carbon emissions, and all Town vehicles burn fossil fuels (although many sedans are hybrids); and

Whereas, a variety of all-electric vehicles (and sources of 100% clean electricity) are now available, with more becoming available every year;

NOW THEREFORE, BE IT RESOLVED that the Town Meeting calls upon the Town to fully electrify the Town's motorized vehicle fleet.

BE IT FURTHER RESOLVED THAT the Town Meeting calls upon the Town, as of July 1, 2019 or using funds allocated in the budget for FY2020 and fiscal years thereafter, to no longer acquire via purchase, lease, or otherwise, fossil fuel-consuming vehicles, including cars, trucks, buses, emergency vehicles, street sweepers, lawn mowers, snow blowers, skid-steers, or any other motorized portable equipment for which *a practical alternative* is already acquirable or can reasonably be expected to become acquirable within the needed time frame via purchase or lease. For purposes of this resolution, a *practical alternative* shall be defined as one or more non-motorized or electrified device(s) that singly or in combination can reasonably be expected to (1) meet the required needs with equivalent utility for the intended use (as determined by the department head requesting the vehicle) once an appropriate charger (or outlet) is installed, and (2) cost no more than 25% greater, in their initial purchase or total lease price, than an otherwise suitable fossil fuel-consuming vehicle, inclusive of obtainable federal, state, and vendor purchase or lease incentives but exclusive of one-time costs of installing infrastructure and equipment needed to provide electrical power for charging or operation. A fossil fuel-consuming vehicle, when electrified post-market (but prior to

use), shall be considered as a potential *practical alternative* with total purchase cost equal to the sum of the initial purchase cost and post-market electrification cost.

BE IT FURTHER RESOLVED THAT when a higher ranked *practical alternative* on the following list is obtainable, the Town Meeting calls upon the Town to choose that higher ranked item over lower ranked ones, in the following order:

1. Fully electric equipment (*e.g.*, Battery Electric Vehicles [BEVs])
2. Partially electric plug-in hybrid equipment (*e.g.*, Plug-in Hybrid EVs [PHEVs])
3. Partially electric non-plug-in hybrid equipment (*e.g.*, conventional hybrids).

BE IT FURTHER RESOLVED THAT the Town Meeting requests the Town to note the energy source(s) of vehicles and powered devices in budget requests (*e.g.*, fossil fuel, plug-in hybrid, non-plug-in hybrid, or fully electric).

BE IT FURTHER RESOLVED THAT although much of the Town's school bus and school van transport is currently provided by contract, such that vehicles are not owned or leased by the Town, the Town Meeting nevertheless encourages the Town and Schools to explore electrification of the contracted fleet and, as soon as is practical, to transition the contracted fleet to fully electric vehicles, by modifying or switching the contract and/or by acquiring some or all of the Town's own fleet via purchase or lease.

Or act on anything relative thereto.

PETITIONER'S ARTICLE DESCRIPTION

I. Overview

This resolution calls upon the Town to fully electrify the Town's vehicle fleet by imposition of a moratorium on the purchase of new fossil fuel-consuming vehicles, in instances where a practical and affordable electrified alternative is obtainable. The resolution is immediately relevant for many of the Town's passenger cars, such as inspector cars, which can now be fully electrified practically and affordably as defined by the resolution. Full electrification may not be immediately practical or affordable for many other vehicles including garbage trucks, patrol cars, and SUVs, for which fully *Electric Vehicle (EV)* alternatives may not yet be available, practical, or cost-competitive. However, it may already be practical and affordable to partially electrify many of these vehicles, for example with hybrid patrol cars, hybrid pickup trucks, and hybrid vans. In the case of the pickup trucks and vans, it may be practical and affordable to purchase a

conventionally fueled vehicle and retrofit or "upfit" that vehicle to electric or hybrid electric prior to use[1].

II. Climate rationale for vehicle electrification

Stopping climate change requires us to *simultaneously*:

(1) **Electrify Everything** (so that we no longer burn fossil fuels locally).
(2) **Clean up the electrical grid** (so all power is clean power).

This resolution addresses the electrification of transport, which accounts for about 25% of the Town's carbon emissions[2]. Electrification of transport is limited by the production and demand for EVs. These are limits set by market forces and human psychology, not a lack of technological prowess of EVs. Nearly 90% of EV owners -- those who know the technology best -- say they will never buy another gasoline car[3]. A consumer education campaign and a consumer movement hold the key to electrification of transport.

The Town of Brookline can spur this movement and directly reduce its own carbon emissions by electrifying its Town fleet of more than 300 vehicles. **An electric car purchased today and powered by the Town's existing municipal electrical power reduces total carbon emissions per mile driven by 60-70% compared to an efficient hybrid car[4]. As the grid itself gets cleaner by at least 2% per year through 2029 and 1% per year thereafter[5], and as Brookline potentially also buys even cleaner municipal power, that same electric car could eventually drive its first mile without any additional carbon emissions beyond those required for manufacturing.**

There is clear precedent among neighboring communities for fleet electrification. Newton has been taking advantage of the Mass EVIP program ($7,500 discount on each EV) to buy 25 EVs[6] and has plans to electrify its entire passenger car fleet of 42 vehicles. New Bedford has purchased more than 20 EVs[7][8], and other municipalities around the state have purchased 1-3 EVs each[9][10]. Three Mass communities, including Cambridge,

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[1] https://www.cars.com/articles/plug-in-pickup-3-things-we-learned-driving-an-electrified-ford-f-150-1420701103098/

[2] Source: Town of Brookline, Massachusetts Greenhouse Gas Inventory Overview, 2010. Includes not only municipal but also commercial and private vehicle emissions within the borders of the Town (excluding MBTA).

[3] https://insideevs.com/electric-car-owners-wont-return-to-gas/

[4] Based on comparison of Prius and Fusion non-plug-in hybrids to a Chevy Bolt EV, assuming local Eversource mix, using U.S. EPA "Beyond Tailpipe" Emissions and MPG values from EPA and Consumer Reports. https://www.fueleconomy.gov/feg/Find.do?action=bt2&year=2019&vehicleId=40520

[5] The 2% annual increase in the renewable portfolio standard (RPS) is state law. https://blog.greenenergyconsumers.org/blog/rps-res-in-plain-english

[6] https://newton.wickedlocal.com/news/20180305/newton-to-use-275k-in-grant-funding-to-buy-electric-cars-charging-station

[7] https://www.atlasevhub.com/wp-content/uploads/2017/06/Public-Sector-Fleet-EV-Procurement-Examples.pdf

[8] https://www.government-fleet.com/130156/city-leases-10-low-cost-electric-vehicles

[9] https://www.mass.gov/files/documents/2016/08/pz/ccc-ma-ev-policy.pdf

piloted electric buses[11]. A Town of Brookline fleet electrification policy that is ambitious, clear, and practical could also inspire residents and staff to buy their own EVs.

III. Budgetary impact

Budget overview. Transitioning the Town fleet to EVs should be roughly budget-neutral, with potentially higher costs in the near term and lower ones in the longer term. There may possibly be higher short-term costs in the first few years due to charger installation and higher purchase prices of (some) EVs. There may also be lower costs in the medium to long-term due to savings on maintenance (detailed explanation below). Whether the Town will save on fuel costs depends on a number of variables, including the model of vehicle being replaced, the Town gasoline price, and the cost of municipal power. Currently it costs slightly more to 'fuel' an electric car than a Toyota Prius hybrid but less to fuel a hybrid cargo van than a standard one. Since the Town has some flexibility in deciding when to replace fleet vehicles, it could slow the vehicle replacement rate with a goal of maintaining budget neutrality. Alternatively, it could choose instead to accelerate replacement to achieve economies of scale and maximize capture of state incentives.

Beginning the transition in FY2020 would be helpful for climate reasons but would present some financial challenges. We envision that there are a variety of ways the Town could handle these challenges, including combinations of (1) swapping less expensive EVs (e.g., Nissan Leafs) for previously proposed vehicles (and using the difference for charger/outlet installation), (2) delaying purchases and instead installing chargers, or (3) using funds that turn out not to be needed elsewhere.

This budgetary analysis focuses on a comparison of the current "inspector" cars (Prius and Fusion hybrids) with fully electric alternatives, as well as comparisons of conventional pickup trucks and vans with hybrid versions of the same.

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[10] https://www.mass.gov/how-to/apply-for-massevip-fleets-incentives and https://www.mass.gov/doc/massevip-fleets-completed-projects-list-july-2018/download

[11] https://www.mass.gov/files/documents/2018/04/30/Mass%20DOER%20EV%20school%20bus%20pilot%20final%20report_.pdf

Current purchase costs (from the Mass VEH98 and VEH102 purchasing price lists)

$25,000	Toyota Prius (seats 5)	Conventional (non-plug-in hybrid)
$26,000	Ford Fusion (seats 5)	Conventional (non-plug-in hybrid)
$18,000[12]	**Smart EQ ForTwo (seats 2)**	**EV -- 63 mi city range[13]**
$21,000[12]	**Nissan Leaf (seats 5)**	**EV -- 151 mi range[13]**
$27,000[12]	**Chevy Bolt EV (seats 5)**	**EV -- 238 mi range[13]**
$32,000	Ford F150/F250	Conventional (non-hybrid)
$37,000[14]	**Ford F150/F250[15] + post-market conversion[16]**	**Plug-in hybrid (XL Hybrids)**
$29,000	Ford Transit Van	Conventional (non-hybrid)
$31,000[14]	**Ford Transit Van + post-market conversion[16]**	**Non-plug-in hybrid (XL Hybrids)**

A Nissan Leaf costs about $4,000 less than a Prius. A Smart EQ ForTwo, which may be appropriate for some applications, costs $7,000 less than a Prius. For some (or most) passenger applications, the Town could choose a Chevy Bolt EV ($2,000 more than a Prius), as it has additional driving range before requiring charging. In addition, the Bolt has better battery thermal management than the Leaf (liquid vs air-cooled), and its battery may last longer, potentially making it a better investment.

Maintenance costs

EVs have very few moving parts. They can be driven for tens or hundreds of thousands of miles with nothing other than air filter replacements, fluid replacements, tire rotations, tire alignments, and tire replacements. These maintenance items are the only ones on the

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[12] Inclusive of Mass EVIP incentives of $7,500 ea, available for up to 25 cars. It is possible that leasing may be a better value, as the separate $7,500 federal tax credit can be readily passed through to the Town in a lease. ***It is also possible that the Town may also be able to find a dealer that would pass through the federal tax credit in a purchase, which would put the Chevy Bolt EV at $20,000 the Nissan Leaf at $14,000, and the Smart EQ ForTwo at $11,000.*** This latter strategy has been adopted by Seattle (https://www.atlasevhub.com/wp-content/uploads/2017/06/Public-Sector-Fleet-EV-Procurement-Examples.pdf) and Alameda County, CA (https://www.georgetownclimate.org/files/report/Capturing-the-Federal-EV-Tax-Credit-for-Public-Fleets%20-%20Case%20Study.pdf).

[13] EPA ranges are averaged across all seasons. **Winter range may be up to 50% lower on the coldest days.**

[14] Inclusive of 80% upfit cost paid for by Mass DOER: https://www.mass.gov/info-details/clean-vehicle-program-public-private-fleets.

[15] The F250 is not yet on VEH102.

[16] XL Hybrids (https://www.xlfleet.com/) is one provider of post-market electrification..

Chevrolet maintenance schedule for the first 150,000 miles for the Bolt EV[17]. EV brakes last longer because of powerful regenerative braking, which uses the motor to slow the vehicle and charge the battery. Electric motors require no maintenance, and at a cost of about $1,000, they are less expensive than a catalytic converter. One study put Nissan Leaf EV maintenance at 23-29% lower than a Corolla and 14% lower than a Prius (either non-plug-in or plug-in hybrid)[18], but the real savings may turn out to be much greater now that EVs have matured significantly in their technology. EV battery life is often the biggest concern about the long-term costs of owning an EV, but unlike cell phone batteries, car batteries have 5-10 year warranties and can function for hundreds of thousands of miles with no maintenance at all[19].

Fueling costs

Electricity is relatively stably priced, and the Town currently pays $0.18/kWh ($0.09 generation[20] + $0.09 supply/distribution[21]). In contrast, the Town's fuel contract varies more from year to year. This year it is $2.50 / gal and next year is $2.04 / gal[22].

The break-even gasoline cost for EVs to be less expensive to fuel than a Prius (non-plug-in) hybrid is about $3.50/gal (at $0.18/kWh). Currently, it is more expensive to fuel an EV than a Prius, but a Ford Fusion hybrid and a Chevy Bolt EV are relatively similar in fueling costs:

Annual fueling costs (assumes 6,000 miles/yr, $2.04/gal, $0.18/kWh):		
$236	Prius	$0.04/mile (52 mpg)
$292	Ford Fusion hybrid	$0.05/mile (42 mpg)
$302	**Bolt EV**	**$0.05/mile (0.28 kWh / mile)**
$324	**Nissan Leaf**	**$0.05/mile (0.30 kWh / mile)**
$335	**Smart EQ ForTwo EV**	**$0.06/mile (0.31 kWh / mile)**

Annual fueling costs (assumes 6,000 miles/yr, $2.04/gal, $0.18/kWh):		
$532	Ford Transit Van	$0.09/mile ($2.04/gal / 23 mpg[23])
$422	**Ford Transit Van hybrid (XL Hybrids)**	$0.07/mile ($2.04/gal / 29 mpg[24])

17 https://my.chevrolet.com/content/dam/gmownercenter/gmna/dynamic/manuals/2017/Chevrolet/BOLT%20EV/Maintenance%20Schedule.pdf
18 https://www.sciencedirect.com/science/article/pii/S030626191731526X?via%3Dihub
19 https://www.fleetcarma.com/exploring-electric-vehicle-battery-life-degradation-developments/
20 Source: Town staff.
21 Estimate based on information from Town staff.
22 Source: Town staff.
23 MPG source: EPA
24 Source: XL Hybrids, 25% improvement in MPG.

Although the transit van fuel savings are relatively modest, the savings would be more substantial for vehicles with lower fuel efficiencies, including medium- and heavy-duty trucks. In addition, if the Town were to harvest more of its own solar power, this might make it less expensive in the long-term to operate a fully electric vehicle, compared to a Prius, even at current gasoline prices.

Charger installation costs

In a fleet transition to electric, the Town will incur a one-time per parking spot cost for installing chargers. The Town has experience in charger installation, having installed chargers in public Town lots and having plans to install chargers on Beacon St. Currently, many passenger cars park in the upper Town Hall garage and in a lot adjacent to the Public Health building. Large vehicles park at 870 Hammond Pond. Several Fire passenger (non-operations) cars park on the street outside the central administrative offices. There is also a parking lot behind the main Fire/Police building used mostly for personal vehicles.

It is hard to estimate charger installation costs without a quote from an electrician for a specific project, but a reasonable range for Town Hall upper garage is $2,500 to $5,000 per electrified parking spot, inclusive of Mass EVIP incentives of $2,500 (per vehicle, for charger hardware only)[25]. Other charger installation projects, such as the lot adjacent to the Public Health building, may be more expensive due to the need to lay conduit underground. As a point of reference, the Town's three 2017 charger installation projects in Town public lots involved bringing conduit and power underground to the location, purchasing the charger units, installing the charger units, purchasing a 5 year communication plan per port, and purchasing a 5 year parts on-site labor warranty. The costs for these (externally funded) projects[26], which installed two charging spots each, were:

Fuller Street (Level 2 Wall Mount): $17,169.60 (existing power source)
($4,720 of which was infrastructure)
Centre Street (Level 2 Bollard Mount): $18,575.20 (existing power source)
($5,560 of which was infrastructure)
Kent/Webster (Level 2 Bollard Mount): $27,540.20 (power source upgraded as well)
($14,675 of which was infrastructure)

[25] This ballpark cost estimate is derived from a conversation with Ted Steverman, Town Electrical Inspector, who estimated that $2,500 to $5,000 for the electrical infrastructure was appropriate for Town Hall upper garage, and that the final cost would depend on the scale of the project (*i.e.*, how many spots electrified at once). Notably, conduit in that garage can be run on the ceiling or walls, so what is frequently the most expensive part of charger installation (digging and laying conduit under asphalt or concrete) is not needed in this location.

[26] Source: Town staff

The remaining non-infrastructure costs in each case were for the chargers, which were expensive for these lots because they were smart chargers that are enabled for public smart phone payment and access (with annual service fee). For the Town fleet, it may be ideal to buy $500-$1000 non-networked chargers, although they would not enable usage to be tracked as readily.

To enable EVs to be purchased and used while awaiting charger installation, vehicles could on a temporary basis (weeks to months) potentially be charged overnight in Town public lots, charged overnight at other Town-owned locations at which charger installation may be more expedient, fast-charged at existing publicly available fast chargers, or charged overnight from a conventional outlet.

IV. School bus and van electrification.

Separately from the proposed moratorium on certain internal combustion engine purchases, this resolution also calls for electrification of the school bus and van fleet, which is currently a contracted fleet, not owned or leased by the Town. This resolution does not advocate for any particular implementation timeline for the contracted fleet but instead merely encourages the Town and the Schools of Brookline to transition the existing contract fleet to an electric one as soon as is practical.

Three communities in Massachusetts participated in a Commonwealth-funded pilot with electric school buses and provided a detailed report on their experience[27], and all three communities, including Cambridge, are still operating them[28].

Currently, there is a significant premium for purchase of an electric bus, even with available incentives. Leasing programs are available that may render lease payments for an electric bus comparable to those for a diesel bus, after accounting for maintenance and potential fuel savings[29]. Also, in the future there may be incentives available through the VW settlement funds or other sources for bus purchases[30].

V. FAQ (Frequently Asked Questions)

Q: *What if the Town ends up not being able to capture federal or state incentives.*

The 25% price premium built into this resolution is intended to protect the financial interest of the Town. It will function as a safety mechanism that kicks in when the cost to purchase an EV begins to outweigh the potential maintenance savings. If an incentive turns out to be (or becomes) inaccessible, rendering the cost of suitable EVs greater than

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[27] https://www.mass.gov/files/documents/2018/04/30/Mass%20DOER%20EV%20school%20bus%20pilot%20final%20report_.pdf
[28] https://uspirg.org/reports/usp/paying-electric-buses
[29] https://www.proterra.com/financing/
[30] https://uspirg.org/reports/usp/paying-electric-buses

125% of that of a fossil fuel-consuming option, the Town would be able, even under the proposed policy, to purchase fossil fuel-consuming vehicles.

Q: *What if maintenance savings aren't be realized, and/or the cost of battery replacement makes maintenance savings a wash?*

There is risk with the status quo, as well as with electrification. The risk with the status quo is that the Town could miss out on much lower maintenance costs of EVs. This status quo risk may be a greater risk than the electrification risk.

Q: *Police vehicles operate 24/7 and follow Michigan State Police standards. Would this result in a need to increase the fleet and/or not be practical?*

This resolution would leave the decision of whether an EV is a *practical alternative* to the appropriate department head, in this case the Police Chief. If the Chief were to determine that obtainable BEVs, PHEVs, and non-plug-in hybrids were not practical, then under the proposed policy the department would be free to purchase non-EVs. If the Chief were to deem non-plug-in hybrids practical but BEVs/PHEVs not practical, the Town would be compelled, if operating under the suggested policy, to purchase the hybrids, assuming they added no more than 25% to the purchase price.

Q: Could this resolution, if adopted, result in fleet degradation due to constraints on the fleet purchasing budget?

A: The concern that this resolution could slow the replacement rate of vehicles in the fleet, thereby increasing maintenance costs, is a reasonable one.

One important thing to keep in mind about the 25% price premium is that it is not an average cost but rather an upper threshold. The average cost of purchased EVs relative to alternative non-EVs may be lower, the same, or 0-25% more expensive. The actual cost differential will to a large extent be a choice made by the Town administration (*e.g.,* a choice to buy Bolt EVs vs. Smart EQs). New Bedford and Newton have each acquired more than twenty Nissan Leafs, which are currently about $4,000 less expensive than Priuses.

Just as there are less expensive and more expensive EVs, there are also less expensive and more expensive charging solutions. The least expensive charging solution, in the near term, would be to add standard outlets to the upper parking garage under Town Hall. A new Nissan Leaf plus a standard outlet installation is likely to be less expensive than buying a new Prius.

While electrifying the fleet is a climate necessity, there is no perfect way to electrify the fleet. If it turns out that this particular electrification strategy ends up delaying vehicle purchases due to budget constraints, that is something that can be addressed in the future

by modifying the electrification strategy. Electrification could be slowed to save money, or it could be accelerated with additional funding.

Q: *The Prius experience has shown that savings estimated by the manufacturer does not translate to how the Town uses the fleet (city driving, stop and go).*

An empirical discussion of the Prius decision and outcomes should be grounded in firm data, which the petitioners do not possess. This explanation relies upon EPA estimates, which are one reasonable point of comparison. A 2019 Chevy Cruze is rated at 30 MPG (city), a 2019 Toyota Prius is rated at 48 MPG (city), and a 2019 Chevy Bolt EV is rated at 128 MPG equivalent (city). Using city-rated mileage, the use of EVs would save more on fuel costs than what this explanation projected in the above discussion of fuel costs using overall MPG.

Generally EVs perform very well in city driving, where they use regenerative braking to recapture kinetic energy. They also avoid wasted fuel due to idling, even when heating or cooling the cabin for prolonged periods of time.

SELECT BOARD'S RECOMMENDATION

ADVISORY COMMITTEE'S RECOMMENDATION

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