MEMORANDUM

TO: Belmont Municipal Light Board
Belmont Light

FROM: Roy J. Epstein

SUBJECT: Claflin Light EV Charger Analysis

DATE: May 13, 2020

Introduction

This memorandum summarizes my analysis of utilization of the ChargePoint EV chargers at the Claflin St. parking lot. Belmont Light provided detailed data on every charging session for 2019Q4, i.e., October 1, 2019 through December 31, 2019. The data fields examined included session start time/date, session duration, time spent charging (often less than session duration because car remains plugged in after charge is completed), kWH provided, user town of residence, and a unique, anonymous user ID. There are four charging stations at Claflin St.

I've incorporated comments on an earlier draft by the Light Board Advisory Committee and Belmont Light at the March 5, 2020 LBAC meeting. There was general agreement at the meeting on the following goals for public charging stations in Belmont:

- Establishment of a price that would both a) allow cost recovery, including electricity costs and capital and maintenance costs and b) encourage prompt freeing-up of a charging space when charging is complete;
- Elimination of the existing parking fee and 2-hour time limit on a charging space;
- Equity, including both provision of charging opportunities for renters and approximate parity with the cost of home charging;
- Encouragement of maximum utilization of the public charging facilities;
- Eventual transition to fast charging technology.

In terms of a specific price, the LBAC members and I recommend $1 per hour while connected to the charger.

As discussed below, it would be appropriate to adjust the rate for the chargers in various circumstances, such as cars left at the charger overnight. Because new sessions are unlikely after midnight or before 6 am, the fee should be waived during that period after charging is complete.

Discussion

The first question I examined is whether there are enough chargers at Claflin St. This led me to a second question of whether we should end the policy of free charging. Because Claflin St. is not the only charging station in Belmont (there are two at Woodland St) and new chargers are about to come online at Cushing Sq., the analysis then led me to consider the implications for an overall policy as more chargers are deployed around town.[1]

In brief, my conclusion is that there are currently enough charging stations at Claflin St. Introduction of a fee for use of the chargers will cover operating costs and contribute to covering capital costs. A fee will improve management of the problem of waiting time for a space, which arises to a limited extent. A fee will also facilitate deployment of more chargers around Belmont.

The following high-level observations on the data stand out to me:

i. The cost of power for the Claflin St. chargers currently is approximately $6,000 per year. This is based on electricity consumption of 14,602 kWH for the quarter and Belmont Light's 2019 all-in power cost of $0.102/kWH.

[1] My discussion is limited to public charging stations subject to direct control by Belmont Light and/or the Light Board. I do not consider private facilities such as those recently installed at the Star Market in Waverly Square.

ii. The median user had two charging sessions. For Q4 as a whole, there were 196 distinct users.

iii. The great majority of users come from Belmont, who account for 68% of the sessions and 76% of the kWH. The true share of Belmont users is probably higher.[2] The distribution of users includes Arlington (9% of the sessions), Georgetown (4% of the sessions), Malden (4% of the sessions), Waltham (4% of the sessions), and a widely dispersed fringe from the rest of Massachusetts and the country.

iv. Charging is disproportionately on weekends. Sundays, Saturdays, and Friday evenings account for more than 43% of total kWH.[3]

v. Congestion, i.e., the need to wait because all four stations are occupied, arises primarily on weekends, not during business hours. About 25% of the charging sessions commenced with an EV that occupied the last open station. Full utilization, with the risk of congestion, occurs most often on Sunday (40% of the cases), Saturday (12% of the cases), Friday evening (11% of the cases), and Wednesday evening (6% of the cases).

vi. The average duration of a session is nearly three hours. However, the actual charging time is less. The majority of users disconnect promptly but a significant fraction of them do not. This is revealed by a median "overstay" of about one minute but an average overstay of about forty minutes. About 10% of the sessions overstay by two hours or more.

[2] User origin is based on ChargePoint account records but users can move to Belmont without updating this information. The data include multiple sessions for users listed from San Diego, Baltimore, and other distant cities, which may indicate they are located in Belmont.

[3] Weekend charging is not a Q4 phenomenon. I have separate data for Claflin St. for a randomly selected week in June 2019 that show even more weekend charging.

vii. Effects on the Belmont Light daily kWH peak from Claflin St. appear to be modest. About 16% of the kWH consumption comes from sessions that start on weekdays between 2:30 pm and 6:30 pm. Given duration, these sessions draw power from 2:30 to about 9 pm.

A relatively small number of Belmont residents are the main users of the Claflin St. chargers. While at present there are about 300 EVs in Belmont, only 96 of them used the Claflin St. chargers at any time during the quarter. Moreover, the Belmont demand is highly skewed. Eighteen ChargePoint accounts consumed 75% of the kWH supplied to the Belmont users. These intensive users are not commuters or Belmont Center store customers. For example, the Belmont user with the highest demand, who accounted for over 11 percent of the total Belmont kWH, charged almost exclusively overnight. The Belmont user with the second highest demand (8% of total Belmont kWH) behaved similarly. It bears emphasizing that just two users accounted for nearly 20% of the Belmont demand at Claflin St.

The Belmont demand is primarily an alternative to home charging. This is evident from the fact that the median quarterly power consumption was 31 kWH for a Belmont user. A newer EV typically gets about 4 miles/kWH.[4] The median Belmont user therefore received the equivalent of about 125 miles, which annualized comes to 500 miles. Claflin St. clearly accounts for a tiny fraction of the median user's charging requirements and home charging is the most plausible alternative power source.

Claflin St. is successful in serving Belmont Center employees and business owners. There is one user from Georgetown, who was the fifth largest consumer for the quarter. That individual charged exclusively on weekdays and the charging session typically started before 8 am, which indicates an association with a Belmont business. There are similar users from Arlington and elsewhere.

[4] https://www.fueleconomy.gov/feg/PowerSearch.do?action=noform&path=1&year1=2019&year2=2020&vtype=Electric).

As discussed, congestion is primarily a weekend issue. But even on weekends a station is available much of the time. I have also analyzed a scenario in which users free up their space promptly by reducing overstay time to zero. With this more efficient behavior, the median wait time due to congestion is markedly reduced.

The number of EVs in Belmont is certain to grow. But there is no compelling reason to provide ever increasing quantities of electricity for free. The vast majority of EV charging in Belmont takes place at home, where the user pays for the electricity. Free charging at Claflin St. is mainly a benefit to a small subset of current EV owners that is paid for by Belmont Light's other customers.

The major advantage to establishing a price to use Belmont Light's chargers is to allow the cost to be recovered from those who are using the service. The price also provides an incentive for users to disconnect promptly when done to make space for the next car.

The current ChargePoint chargers deliver about 6 kWH per hour per EV. Belmont Light's wholesale cost for the electricity equates to about $0.60 per hour. In addition, it is reasonable to charge something additional to allow at least partial recovery of the cost of installing and maintaining the charger. [5]

Appendix 1 shows all of the hourly charging fees (April 2020) in Massachusetts that to my knowledge are set by a municipal authority:

A user price of $1 per hour (which could be pro-rated to $0.25 per quarter-hour) is reasonable while charging. This would cover the cost of the electricity. Moreover, I estimate the $1 fee would contribute about $2,160 per year per machine to help cover operating and capital costs. [6] The revenue available to cover capital costs should increase over time with growing hours of utilization per charger.

[5] In addition to the cost of electricity, Belmont Light is also obligated to pay ChargePoint an annual fee for various services.

[6] The two charging machines at Claflin St. delivered total of about 2,700 hours of charging time in 2019Q4, which implies about 5,400 hours per machine per year (2,700 divided by

I do not see a good reason for a pricing policy that only begins when the session exceeds a certain length. Covering costs should be a core principle, whether the session is short or long.

An "overstay" fee also provides an incentive to move the car and not block access by others after charging is complete. A fee of $1 per hour (or pro-rated to $0.25 per quarter hour) would also be reasonable. However, unlike regular parking rates, the overstay fee should remain during weekends and evenings. One exception is overnight charging. Because new sessions are unlikely after midnight or before 6 am, the overstay fee could be waived during that period.

I recommend up a 5 minute grace period after charging is complete, after which the overstay fee should take effect. The overstay fee would be charged until the vehicle is disconnected from the charger.

There should be no additional parking fee for a charging space, provided that the vehicle is plugged in to the charger. The economic function of the parking fee is to ration scarce spaces and promote turnover of the space. That is already accomplished with the charging and overstay fees. Hopefully this policy would be compatible with a gate-controlled parking lot, as may be the case at Cushing Sq.

The Claflin St. chargers currently have signs announcing a 2-hour limit for a charging session and that regular parking rates apply. I recommend removal of these signs. Instead, the signs should explain the policy in this memorandum. A vehicle occupying a space and not plugged into the charger should be ticketed as a parking violator.

If effects from weekday overall demand peaks become a significant concern, we could consider a higher price for peak periods to reflect the cost of the power more accurately and to provide an incentive to charge at some other time. Belmont Light also has the

2, times 4). The additional fee of $0.40 per hour over the $0.60 power cost would generate about $2,160 annually ($0.40 times 5,400).

ability to shut off the charger remotely during a peak event. I understand that Seattle City Light, for example, already uses or will use TOU pricing for their public chargers.

I recommend setting the same price at all BL charging stations. There is no reason to create a price differential that would shift demand from one location to another when the underlying cost of service is the same.

It is desirable to make charging opportunities more widely available in town since landlords of residential rental properties may be slow to install appropriate circuitry for on-premises charging. Charging stations should also be available eventually at school and other municipal parking lots, which could also serve the surrounding neighborhood. Charging could also be an amenity at town playgrounds.

There may well be installation of dozens of new charging stations in the future, considering locations such as Belmont Center, Cushing Sq., Waverly Sq., the public schools, Beech St. Center, and playgrounds such as Grove St. and PQ. This could require hundreds of thousands of dollars in capital equipment, especially given upgrades as superfast chargers become the standard. The associated annual cost of electricity could also be in the hundreds of thousands dollars.

Setting the right price will facilitate expanding the number of charging stations, lead to efficient utilization, and ensure economic feasibility for Belmont Light. Belmont Light and the Light Board should introduce rational pricing policies for charging now to be prepared for the future.

Appendix 1

Hourly Fees Set by Municipal Authorities for EV Chargers in Massachusetts

(April 2020)

Town	**Fee**
Haverill	$1.80
Ayer	$1.65
Wakefield	$1.30
Reading	$1.30
Dighton	$1.30
Danvers	$1.25
Ipswich	$1.25
Concord	$1.20
Boxford	$1.20
Becket	$1.00
Littleton	$0.75
Dedham	$0.00
Westfield	$0.00
Braintree	$0.00
Average	$1.00
Median	$1.23