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Increasing Community Electric Vehicle Adoption with Public Electric Vehicle Charger Installations

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SUMMARY

As transportation electrification increases, it poses both decarbonization solutions and grid problems. To balance grid implications with environmental benefits, utility-owned public electric vehicle infrastructure can provide utilities with a controllable solution while actively supporting the increase in electric vehicle (EV) adoption. ComEd was awarded a grant from the DOE to increase the EV adoption for customers living in multi-unit dwellings (MUD). As part of the grant, ComEd is planning to deploy five electric vehicle supply equipment (EVSE) within the Bronzeville Community. This paper summarizes the location planning and permitting process to help provide utilities with considerations that should be made when installing a public EVSE (electric vehicle supply equipment). To track the public EVSE adoption, usage data and metrics are provided during the first 30-days after the EVSE was commissioned with the primary goal of increasing EV adoption in the community. The analysis methodology was automated to be able to easily provide reports to the Illinois Commerce Commission (ICC). With local grid operational data, the analysis can be extended to provide the impact of an EVSE and inform operators when to reduce charging rate based on historic charger usage and projected loading for an identified area.

KEYWORDS

Multi-unit dwelling, Electric Vehicles, public EVSE

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1. INTRODUCTION

As the transportation sector represents over a quarter of all energy consumption in the United States, beneficial electrification of transportation is one of the most effective ways to reduce carbon emissions and mitigate climate change [1-2]. Utilities play a critical role in accelerating the adoption of electric vehicles (EV) by preparing the grid for the impact of large-scale EV adoption. Uncertainties related to the timescale of adoption, timing of demand and exact locations where demand will occur must be addressed through a combination of empirical approaches and analytical models. Different segments of the transportation sector will require different approaches to reflect varying trajectories of technological development, policy deployment, mobility needs and economic drivers. The focus of this work is on a subsegment of the residential market: multi-unit dwellings (MUDs).

The DOE has noted that EV adoption by MUD residents has been slower compared to single family home residents [3]. Lack of access to conveniently accessible EVSE in or near MUD properties is thought to contribute to this trend. The DOE launched a multi-stakeholder project to develop MUD EVSE deployment strategies to promote MUD resident EV adoption [4]. When a utility owns public EVSEs and the customer base in that community is dependent on that charging infrastructure, the utility possesses a greater level of control over grid impact due to EV proliferation.

ComEd was selected to participate in the project to evaluate the grid considerations and impacts of MUD EVSE deployment. ComEd is a large utility serving over 4 million electric customers in Northern Illinois, including the City of Chicago. The company's transmission and distribution grid consists of 65,000 miles in primary distribution and 5,800 miles in transmission. ComEd's system includes 1,076 substations and 552,600 distribution transformers. ComEd is currently collecting data beyond the DOE's data collection period on the publicly installed EVSE.

This paper extends the efforts presented during the 2021 USNC Grid of the Future Symposium [5]. Now, a portion of public EVSE have been deployed. Data is used to inform charging scenarios for MUDs, model the potential grid impact of future deployment, and develop grid enhancements that will support EV adoption. This paper aims to provide lessons learned for utilities installing public EVSE and provide initial usage data findings from the first public EVSE installation with the goal of increasing EV adoption in a community.

2. EVSE INSTALLATION PROGRESS

Bronzeville, ComEd's first Community of the Future (CoF) was selected for the installation of five EVSE on public right of ways. Community of the Future is ComEd's flagship program which engages communities to display cutting edge innovative technologies, like microgrids, to enhance everyday lives. Public chargers are installed in the community where ComEd is installing a microgrid that is connected to two feeders and over 750 kW of solar generation. The Bronzeville Community Microgrid serves approximately 1,000 customers in Bronzeville. Last year (2021), two locations were proposed for the installation of EVSE: the first location was near a 99-unit MUD development (2 chargers with 4 total ports) and the second location nearby multiple MUDs with 120+ residential parking spaces (3 chargers with 6 total ports). During coordination over the past year, an additional location has been added to the deployment

in Bronzeville with a reallocation of charger installation between these 3 locations. The following is a summary of the activity at the 3 locations from 2021 to 2022.

Table 1: Sites and Proposed EVSE Installation

#	Location	# of EVSE	Total ports
1	99-unit MUD development	1	2
2	Location near multiple MUDs and 120 residential parking spots	3	6
3	Major road across the street from large MUD development	1	2

Location 1

In 2021, the ComEd project team discussed an initiative to install EV Chargers at a CoF Advisory Council member. After the project team and the external stakeholders agreed upon the location, ComEd developed a design to install 2 EV Chargers at Location 1. During the permit process with the City of Chicago, it was declared that one of the EV Chargers was going to impact City of Chicago's street expansion design/plan; therefore, it was removed from the original design and only one (1) EV charger to be install at this location.

The project team started the permit process and discussions with City of Chicago in October 2021. Permits were obtained in the first week of April 2022. Installation of the EVSE was completed on April 20th. On Wednesday, April 27th, New Business has completed service installation at location 1 by providing the meter in the field as well as connecting the service line for the EV Charger.

On Thursday, April 28th 2022 the project team has successfully commissioned the EV Charger location at location 1 in the Bronzeville. The chargers are currently free to use, to gauge the initial usage of the charger without a cost barrier to customers. The EVSE is a dual port pedestal charger from BTC Power (BTC EVP-2002-30-P-0001).

Location 2

Construction began on April 6, 2022, at location 2. During construction, the site was identified by the site owner and confirmed by the Alderman's office that the spot was considered as an "unofficial loading zone." Due to this, construction was halted and agreed to proceed on the opposite side of the street. As of June 2022, ComEd has reinitiated the permitting process for the site. Due to permitting taking up to 6 months and a permit was granted on the other side of the street, the team is requesting an expediated permitting process.

Location 3

Due to there being an additional charger from location 1, the team is currently working to identify a new location (location 3) for the charger to be installed. Thus far, community meetings have confirmed this will be an ideal location for an EVSE due to its proximity to the Illinois Tech campus as well as new MUD buildings.

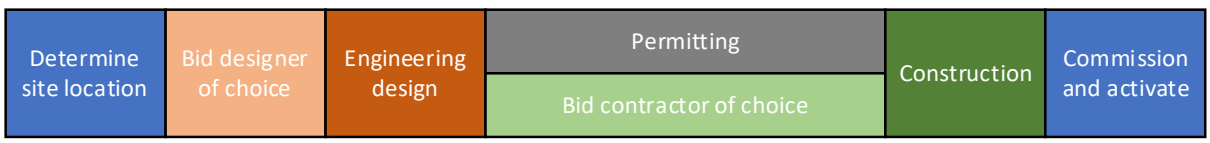

Figure 1: Generic public EVSE installation timeline

Some lessons learned from the initial EVSE installation include the need of engaging all parties of interest during the permitting process. Departments within municipalities may not have access to the same data as in the case of location 2. The original location acted as an unofficial

loading zone and construction had to be moved across the street with approval from the property owner. Since the permitting phase can last for up to 6 months depending on the location, it is in the EVSE installer's best interest to engage with permitters and all related parties before and throughout the permitting process. If changes need to be made based on permitter assessment, engineering designs can be modified and accurate bids from construction contractors can be provided.

3. EVSE DATA

ComEd is required to provide yearly reports to the Illinois Commerce Commission (ICC) on the usage of the public EVSE. Data is captured from the chargers on the EV Connect platform. When a car is plugged-in, high-level session data is recorded including a Driver ID (anonymized), connector ID, Connected Timestamp, Disconnect Timestamp, Charge Time (minutes), Connection Time (minutes), and Energy Provided (kWh) as well as pricing information. Connection Time tracks the amount of time a vehicle was plugged in, while Charge Time provides the amount of time which the vehicle was charging. Session data allows ComEd to track anonymously track usage of the charger. When a member of the Bronzeville community provides their email address, the price to charge is reduced for that user and data user data can be directly tracked. As of June 2022, there is no price to charge at the EVSE installed at location 1. Without a cost incentive, community members have not provided email addresses and usage data is anonymous.

Within the session data, EVSE adoption is being tracked by recording the date of unique User IDs plugging into the charger. While the number of total users provides an understanding of overall charger usage, associating sessions with User IDs provides a greater a better indication of users that consistently use the charge. Looking at number of charging sessions by user is useful for seeing whether a user is active or just a one-time user. Associating user session data with different timescales can provide further information on who is an "active user." For our purposes, a user utilizing a charger 3 or more times in a 30-day period is considered an "active user." While information is still anonymized, "active users" can be assumed to be members of the Bronzeville community. Furthermore, charging sessions that occur overnight and associated with a User ID can be used to help confirm which "active users" are part of the community. Overnight intervals, however, should not be the only metric utilized for finding community adoption of the chargers.

During charging sessions, power delivered to the charger is tracked at a 15-minute interval, which provides more granular detail compared to 30-minute interval captured by our Automated Meter Infrastructure (AMI). Interval information is organized by session, providing the Power Start Timestamp, Power End Timestamp, Interval Average Power (kW), Interval Peak Power (kW), and Interval Energy Dispensed (kWh). If an interval starts outside a 15-minute window on a particular hour, that interval will start at that time, and end at the next 15-minute window. For example, a user starts at 10:08 rather than 10:00, the interval will only last 7-minutes, starting at 10:08 and ending at 10:15. When the vehicle has reached its desired state of charge and the charger stops providing power, the charge session ends, and the final interval timestamp is recorded. Beyond the charge event interval information, EV Connect provides the Vehicle Connect Time, Vehicle Disconnect Time, Average Power (kW), and Energy Per Charge Event (kWh).

Interval data can help determine the grid impact of a charger, when comparing it to surrounding load data. Assessing the impact determines what controls need to be in place for an EVSE.

Depending on the charger and EVSE management platform, the max power of an EVSE can be adjusted based on historic usage, time of day, and relating data.

4. EVSE USAGE

An analysis of the EVSE at location 1 is provided for the first 30 days of operation (5/10/2022 through 6/9/2022). After commissioning, ComEd made no effort to promote the EVSE within the community. Thus far, customer adoption has been governed by seeing the physical charger and finding the charger on the EV Connect app. Overall, the charger served 8 unique customers during the 30-day period and provided a total of 637.053 kWh to their vehicles.

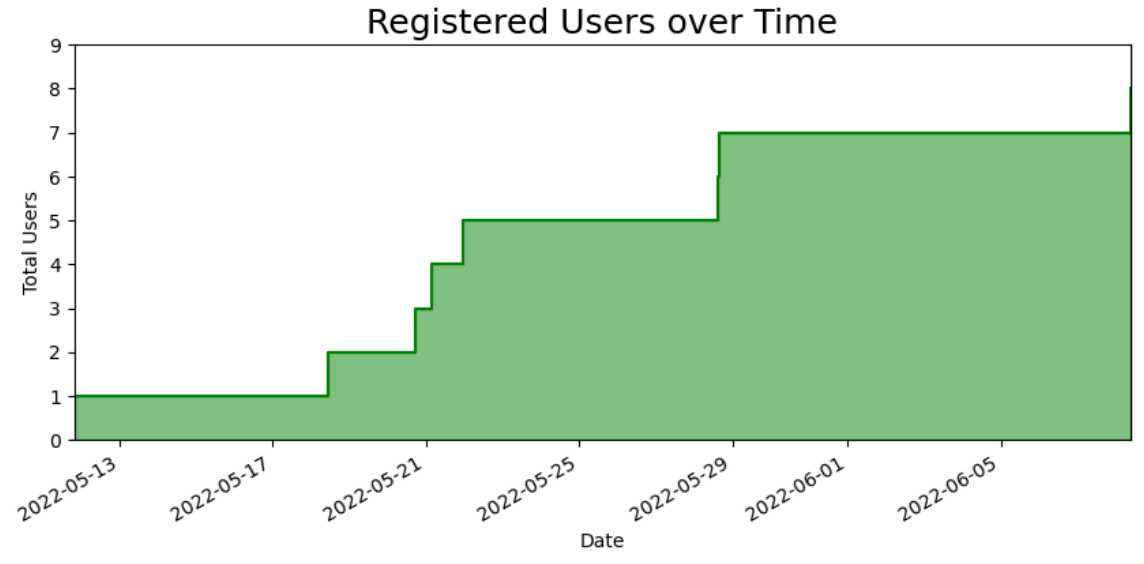

Figure 1: Total unique customers over time

About 2 weeks after being commissioned, users started to engage more with the EVSE. During the first 30 days. From Table 1, the earliest adopters of the charger have been the most active users.

Table 1: Customer charger usage overview

Customer ID	Date Joined	Sessions	Total Energy (kWh)
5315137d-8fcd-450c-aa5f-231aca2a026c	5/11/2022	9	229.387
a91108f6-0c39-4902-996e-7a637e1fbb99	5/18/2022	6	16.718
f8b5e69b-d2ce-45a9-802c-5070b5d716c6	5/20/2022	9	374.732
USCPIC001SY9CR	5/21/2022	1	13.671
9f223fbf-af7d-44d4-8091-b60047b493b8	5/21/2022	1	14.51
181c200f-5d9b-4c82-bb83-1bc7947ed61b	5/28/2022	1	2.081
a27ea732-cf6c-4fda-b332-b8317cf83f32	5/28/2022	1	8.094
1a5a6a19-97d4-4ef1-805a-0ea30f1ad9b4	6/8/2022	1	27.86

Overall, when a vehicle was plugged in, 90.3% of that time was spent charging the vehicle and the remaining 9.7% of the time the vehicle is sitting idle for the customer to unplug their vehicle. Despite there being no penalty for leaving their vehicles, customers have thus far been good stewards of the public charger. Additionally, while the charger has two ports available to customers, only 1 port has been utilized at a time over the first 30 days. In other words, 2 vehicles could be plugged into the charger, but all recorded sessions have only had 1 vehicle plugged into the charger. There are on average about 1 charging session per day with an average

charge duration of 372 minutes (6 hours, 12 minutes) and average connected duration of 412 minutes (6 hours, 52 minutes).

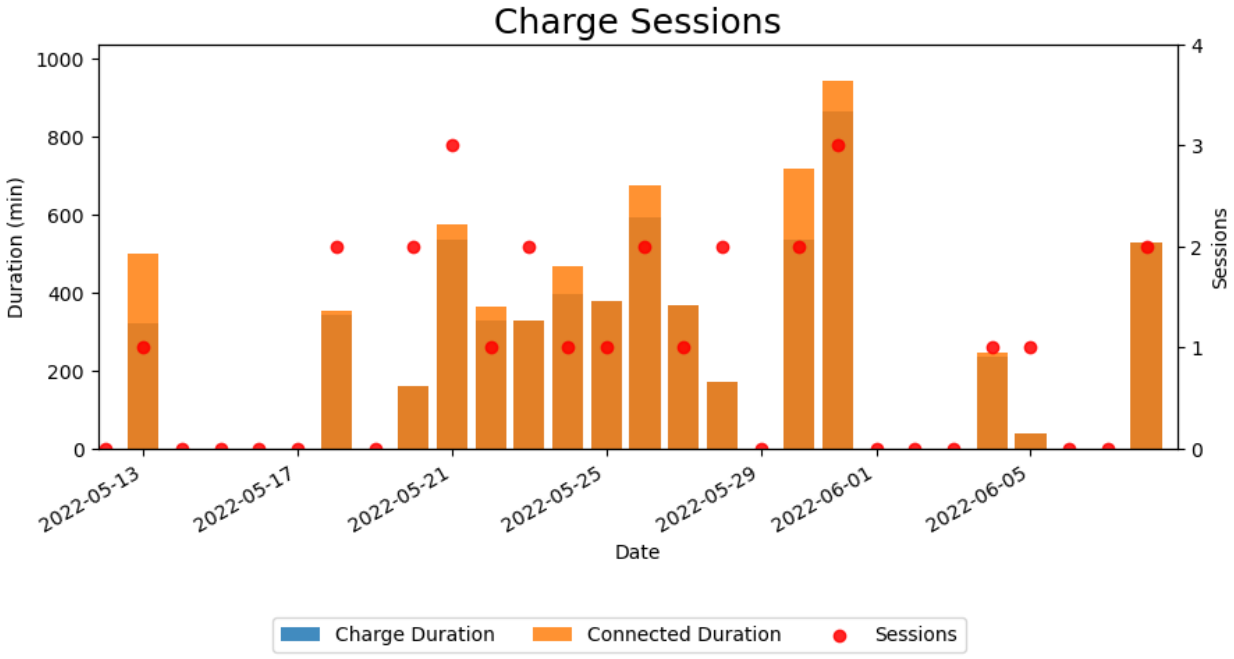

Figure 3: Charge sessions by day

Table 2: Daily duration details

Date with Charge Session	Sessions	Charge Duration (min)	Connected Duration (min)	Energy Provided (kWh)
5/11/2022	2	214.91325	214.91	24.066
5/13/2022	1	320.0006833	500.25	35.573
5/18/2022	2	342.3242167	351.57	36.878
5/20/2022	2	160.3433667	160.3433667	17.56
5/21/2022	3	535.9073333	576.11395	59.273
5/22/2022	1	329.9883833	364.73455	36.051
5/23/2022	2	327.2179167	327.2179167	36.572
5/24/2022	1	394.9909333	467.6399	40.883
5/25/2022	1	376.7926833	376.7926833	41.739
5/26/2022	2	593.6658167	673.2107167	64.953
5/27/2022	1	367.7177667	367.7177667	41.311
5/28/2022	2	169.7696833	169.7696833	10.175
5/30/2022	2	536.2026833	716.5183167	58.784
5/31/2022	3	865.16055	941.18315	93.667
6/4/2022	1	234.9902667	245.0260167	25.823
6/5/2022	1	39.15258333	39.15258333	4.245
6/8/2022	2	526.8269167	526.8269167	59.5

Interval data from the chargers is captured every 15 minutes while the vehicle is charging. The average power provided during charging sessions varied between 3.59 kW and 6.74 kW.

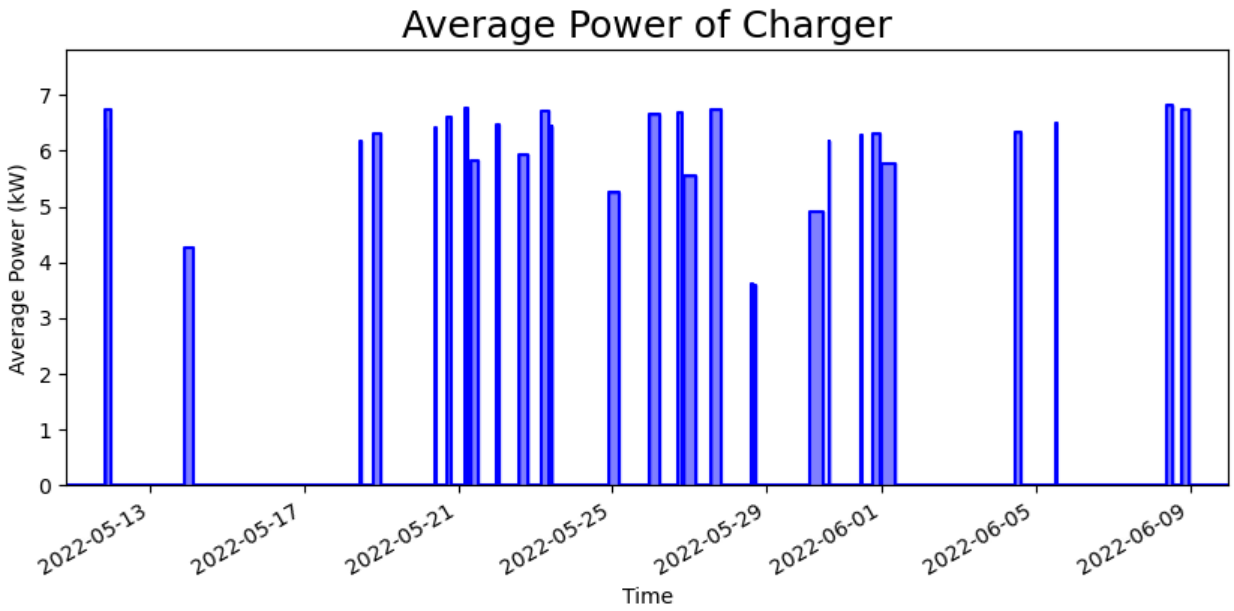

Figure 4: Charger power

From initial interval analysis, charging intervals primarily occur during nighttime and morning hours. This provides good indication that local residences are utilizing the charger overnight and that the charger should have low grid impact based on user behavior. If customers engagement increases during daytime hours and high impact is anticipated, the power can remotely be reduced during those hours.

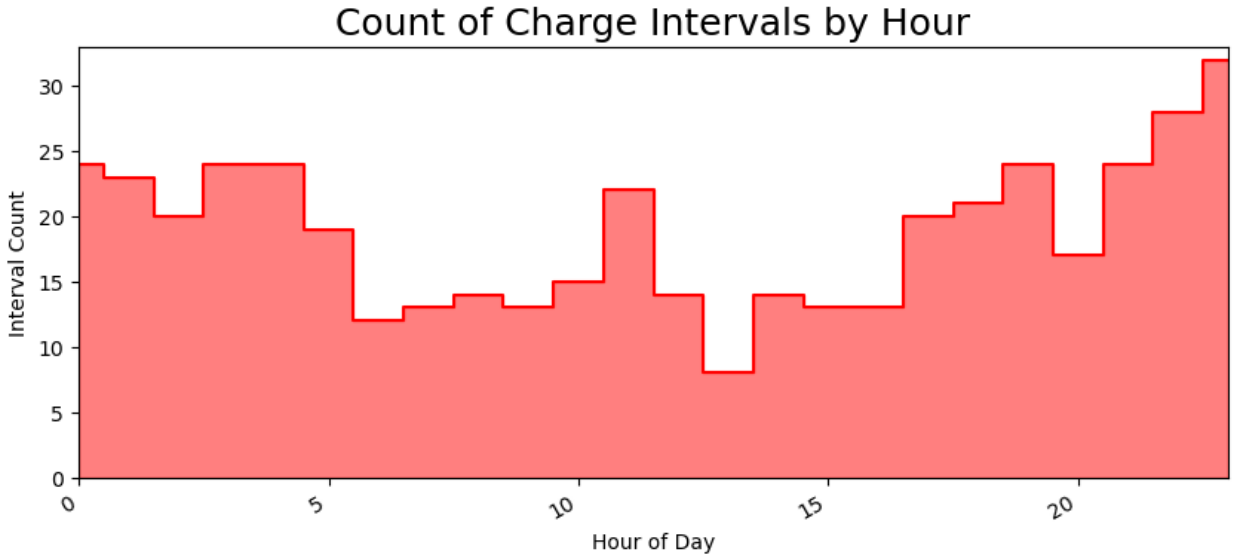

Figure 5: Interval count by hour of day

5. CONCLUSION

ComEd continues to make efforts toward installing public charging infrastructure in the Bronzeville community. To assist community members directly, there are plans to provide a lower cost to charge at the public EVSEs for EV owners in the community. While, the first charger was installed on a dedicated transformer – future studies will assess the impact of public EVSE infrastructure on the grid, look at EV adoption in Bronzeville after public chargers are installed compared to the rest of ComEd's territory, and modifying pricing to assess charger usage in different scenarios. Monitoring the impact of the utility-owned chargers over their lifetime will provide greater insight into the

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