EV Charging Infrastructure Pilot Projects

A straw proposal

For public distribution and discussion at the Third Technical Workshop; May 11, 2022; Case No: NEPR-MI-2021-0013

Contents

Objectives

There are two main components to this straw proposal:

1) An outline for segmenting and sequencing the deployment of EV charging infrastructure

2) Pilot projects for deploying EV charging infrastructure.

A "ladder approach" to market segmentation and sequencing

The higher the power level of an EV charger, the more expensive it is to develop and interconnect with the electric grid. Since LUMA is operating a system with limited visibility and information, including loading factors present on the system, the Energy Bureau proposes that EV infrastructure deployment start with the lowest-cost charging infrastructure that will be the easiest to implement, and then gradually work up to more challenging installations.

This "ladder approach" is perceived as providing LUMA time to assess the condition of the system, gather basic data on the capacity of its feeders and transformers, and begin to plan for the expansion that will be required by higher-power chargers, even as it begins to engage with its EV-owning customers and gains valuable operational expertise about the demand of EVs on its system.

The following use-cases were previously presented at the January 27 workshop. Under the "ladder approach," they would be developed more or less in the following sequence.

It is presumed that LUMA will update, at least annually, its estimate of expected EV charging loads on its system, as sketched out in the following worksheet. By entering a number of chargers per site and a number of sites for each of these use-cases, LUMA could use this worksheet to estimate the load it will need to anticipate for each use-case of EV charging. These calculations can then inform LUMA's capacity expansion planning for EV charging infrastructure.

Use-case	Power Level (kW)	# per site	# sites	Total load	Flex?
Residential L1	1			1 kW	
Residential L2	2.9 – 16.9			2.9 – 16.9 kW	
Workplace & public L2	7.7 – 16.9			< 1 MW	
Public DCFC depots	50 – 150			< 2 MW	
Transit bus barns	50 – 150			5 – 30+ MW	
Fleet vehicle yards	50 – 350			< 5 MW	

Interstate truck stops	150 – 1,700			20 – 40 MW	

Some core ideas about supporting each of these use-cases follows.

Residential L1

Level 1 (or L1) charging consists of nothing more than plugging an EV straight into a standard 120V outlet. This typically provides a maximum rate of charge of about 1.2 kW (120V @ 10A).

No charger needs to be installed, and no upgrades would be required to support this level of power demand at a typical house, as long as roughly 10A of capacity is available on the residential service panel. Typically, there should be no additional cost for LUMA or for a residential customer who wants to charge an EV at home this way.

An opportunity here would be to offer a time-of-use rate to steer charging toward the off-peak hours of the LUMA system, and to install an interval meter for the EV outlet only.

Residential L2

Residential charging in single-family homes is faster and more versatile with the use of a Level 2 (L2) charger. The power that an L2 charger delivers varies from manufacturer to manufacturer and model to model, with both 120V and 240V options available. Here is a fairly typical bracketing of power and current levels within a 240V L2 product line:

Amps	kW
12 – 16	2.8 – 3.8
20 – 32	4.8 – 7.7
40 – 80	9.6 – 19.2

If a customer's residential main panel does not have the spare capacity to support the amperage of the selected charger, then their panel will need to be upgraded.[1]

Workplace, MUD & public L2

Workplaces, multi-unit dwellings (MUDs), and low-cost public charging sites typically install multiple L2s per location. Workplaces will install L2 chargers in the company parking lots, because they will need to support employee vehicles that can charge slowly over the course of a work shift (typically, eight hours at a time). L2 chargers are appropriate for MUDs where they can be shared by multiple residents of the building. L2 chargers may also be found in public locations, like retail shopping centers, parks and other recreational areas, or any other publicly accessible site where a vehicle can be connected to a charger for hours at a time.

---

[1] There are some devices that can be used to support an EV charger under certain circumstances when the main panel has insufficient spare capacity. This article offers a helpful overview of such devices: Jeff St. John, "New tools and tech to prep your electrical panel for an all-electric home," Canary Media, February 22, 2022.

Because they are typically installed outdoors, workplace & public L2 chargers usually require chargers that have weatherproofing, communications and other features not typically found in a residential installation. The power they deliver is typically in the 6.9 – 7.7 kW range for a 240V supply, but again a range of models offer different power output levels.

A small public charging site might feature two L2 chargers, whereas a MUD or workplace might feature dozens or hundreds of them in a single parking lot. These chargers will typically be connected to the grid through a custom subpanel sized to meet the present (or future) needs of the chargers located there.

The power requirements for installations of multiple L2 chargers typically scale linearly with the number of chargers. However, it's not unusual for there to be a few DCFC chargers located along with an installation of many L2 chargers. Assuming 240V supply, a sample calculation of the load requirements for this type of installation is shown below.

EVSE Amps	EVSE kW	Chargers per site	Total load kW
30	7.2	10	72
30	7.2	50	360

Public DCFC depots

Public DCFC depots are typically located in commercial retail locations, like shopping centers, and along freeways. These sites require high levels of traffic in order to generate enough revenue to operate profitably, so they are targeted at high-traffic locations.

Public DCFC chargers require much higher power levels, where 150 kW is the current industry standard. They also require robust weatherproofing and other safety features, and are much more expensive than L2 chargers. It is not unusual for a 150 kW DCFC to cost $100,000, with total installation costs potentially doubling that.

A typical new installation of a public high-speed charging site will have two, 150 kW chargers. Larger charging depots may have six or more chargers per site, pushing the load requirements of a single site into megawatt, not kilowatt, territory. Accordingly, DCFC sites are typically complex installations, sometimes requiring the installation of larger service drops or distribution transformers, as well as more complex and lengthy interconnection processes.

High powered DCFC chargers typically have 480V power supplies. The power requirements for public DCFC depots are much greater than for L2 sites, but again they generally scale linearly with the number of chargers. Assuming 480V power supply, here is a sample calculation.

EVSE Amps	EVSE kW	Chargers per site	Total load kW
312	150	2	300

312	150	6	900

Because monitoring these chargers is critical to their operation, all DCFC chargers are equipped with communications capabilities, and most of them come equipped to support multiple communications methods. The charging network operator will have their own back-end systems to monitor the chargers, execute transactions and process payments for charging sessions, and so on. Therefore, integrating their monitoring data with a utility system typically involves integration of the charging network operator's back-end system with the utility's back-end system.

To reinforce a point made in Mr. Nelder's presentation at the January 27 workshop, the entire use-case of high-speed charging is to get the fastest charge possible at the moment needed. Therefore, managing the load of DCFC chargers cannot be done by shifting the time of a charging session to when it's best for the grid or cheapest for the charger, as it can be for L2 chargers. The options for managing DCFC charging dynamically are therefore limited. One option is to co-locate redundant and expensive battery storage with the charger, and pull energy from the battery when grid power costs are high or supply is constrained; because of its additional cost, this strategy is rarely employed. Another is to reduce the rate of power delivered to the customer, but that makes for a poor customer experience. Therefore, beneficial integration of DCFC onto a power grid primarily concerns siting the charging station where large capacity supply is relatively inexpensive (like near a substation or another existing large capacity service, like a former industrial site), if possible, and then closely monitoring those loads, especially when the DCFC is on a commercial tariff with a demand charge.

Transit bus barns, fleet vehicle yards and semi-tractor truck stops

Transit bus barns, fleet vehicle yards and semi-tractor truck stops have large power requirements, which can be in the range of 5 MW or more. Accordingly, these installations have a very different set of equipment requirements and power supply needs. Oftentimes, they will require primary voltage and include a dedicated substation, along with other associated switchgear, in addition to the chargers themselves.

These installations are complex and expensive, and require long lead times to build, both for the customer and for the utility. Therefore, while it is unlikely that LUMA will need to actually provision supply for these types of installations in the next few years, **it is vitally important that LUMA begin outreach efforts now to potential fleet operators** who may want to electrify their fleets in the next five years or so, and begin the planning that will be required for a successful installation.

It is important to underscore that these types of installations are absolutely inevitable. They may not feature on LUMA's system today or tomorrow, but they are definitely coming soon. Continuing to run diesel or gasoline powered fleets is simply not tenable, as the whole industry is moving toward electrification. And while there may be a few pilot projects that continue to experiment with hydrogen fuel cell vehicles or LNG/LPG/CNG vehicles as alternatives, it is extremely unlikely that they will ever be able to compete with straight BEVs for all vehicle weight classes and use-cases. There is no alternative for a utility but to begin planning now for how it will accommodate very large new loads for sites hosting vehicle fleets of all kinds.

Sequencing strategy

Since the complexity and cost of integration increases with each of the preceding use-cases, it is advised that LUMA plan to accommodate each use-case in the same order presented here, so that it can gather operational information and experience and build on it in a stepwise fashion as it 'climbs the ladder' and grapples with the additional complexity and cost of each new use-case.

However, it is worth emphasizing again that high-powered sites will be expensive to provision and may require a long time for LUMA to be able to integrate them. For example, beginning the planning for a transit bus barn for fully electric buses five years before the facility needs to be operational is not too early. So, while the actual construction of charging infrastructure could follow the 'ladder' as presented here, the planning effort for all use-cases should begin immediately.

Data collection and monitoring

The available methods to gather data from EV charging and monitor the load on the LUMA system varies by the type of installation. Whatever the methods, LUMA should ensure that it can start gathering valuable information about when customers are charging their EVs, how much load they are adding to the system, and approximately how much energy they consume in each charging session. Ultimately this data will inform LUMA's capacity expansion planning.

If LUMA chooses to collect data from chargers, then those chargers must be "smart" chargers equipped with two-way communications capability. Allowing "dumb" chargers to proliferate on the LUMA system without having the ability to collect and monitor the load data will lead to an expensive and difficult future challenge of trying to retrofit monitoring capability on legacy chargers. Even if the initial means are rudimentary, it's better to put monitoring in place from the beginning than to have nothing at all.

Data that should be collected includes:

1. Start and stop times of each charging session
2. Power levels during the charging session, collected on at least 15-minute intervals in order to capture the shape of the power curve during each session
3. Total kWh delivered per charging session
4. Time, duration, and nature of any equipment faults

There are three main ways to collect and monitor charging data, as follows.

Install a dedicated meter

A dedicated meter would only report data on EV charging, and not the whole house, because that's the only way that EV charging loads can be accurately measured and reported. This is also advised because it is difficult and a poor customer experience to try to use all household appliances off-peak and would raise customer concerns about increasing their non-EV electricity costs.

Where a dedicated meter is installed to monitor EV charging, it would be ideal for LUMA to bear the cost of installing this redundant meter as part of moving the customer to a TOU rate for the EV charging. Otherwise, the cost of the extra meter can be a deterrent to prospective EV buyers.

Get data from the chargers

Where Level 2 and DCFC chargers are deployed, it is possible for LUMA to get the data directly from the charger, but only if the charger is equipped with communications capability. This is often the distinction between a "smart" and a "dumb" charger. The accuracy of this data is typically adequate for it to be used for billing purposes, thus eliminating the expense of a dedicated interval meter.

There are multiple communications methods that EV chargers can support, such as wired Ethernet, Wifi, and cellular data. Details of the communications methods and their capabilities are beyond the scope of this document, but they can dictate the suitability for various kinds of applications.

Get data from the vehicles

A managed charging aggregator that uses the built-in telematics of vehicles, like WeaveGrid[2], can monitor charging directly from the vehicle and then integrate that data with the LUMA platform. This avoids the need for a "smart" charger equipped with a communications module, and works with all power levels of charging (L1, L2 and DCFC).

---

[2] References to vendors and products throughout this document, such as WeaveGrid, are offered as examples. They are not be interpreted as endorsements or recommendations.

Pilot Projects

The purpose of the following pilot projects is to establish foundations for LUMA's policies and procedures related to EV charging infrastructure, and prepare them to scale up as more EVs arrive on their system. As a premise, "pilot projects" are presumed to be demonstration-level implementation of products/services, the results of which will inform the subsequent roll-out of the modified products/services into the market. In other words, it is expected that "scalable projects" will be the core of each pilot.

Key metrics to test in pilot projects

LUMA should design the pilots to test the following metrics of vehicle-grid integration:

- Load data collection and integration
- Residential demand, cost tolerance and load management
- Public demand trends for L2 and DCFC
- Managed charging: How flexible are loads, how reliable are customer responses?
- Passive managed charging through rate design
- Active managed charging through aggregator controls of EV chargers
- Active managed charging through aggregator controls of EVs
- Interconnection process for L2 and DCFC: How long does it take and what does it cost?
- Fleet engagement: How long does it take to scope the requirements for a fleet charging facility, how long does it take to provision power supply, and what does it cost?

LUMA should also use the pilots to test its interconnection process, by tracking:

- how much time elapses between alerting customers to a pilot programs, and enrolling them in the program
- how much time elapses between a customer initiating an interconnection application and actually commencing charging under a program
- any errors, misunderstandings, or other impediments to completing an interconnection.

LUMA should also track the costs and benefits associated with implementing the programs, including:

- Staff time to promote the programs and enroll customers
- Interconnection application fees
- Dedicated meter installation costs
- Upgrade costs on the customer side of the meter (e.g., installing a larger main service panel, or make-ready on the customer side of the meter, or wiring dedicated outlets for chargers)
- Upgrade costs on the utility side of the meter (e.g., installing more or larger feeders, distribution transformers, and service drops)
- Data integration costs for using data from EV chargers or from vehicle telematics
- Avoided costs realized through customer participation in TOU rates

Project 1: Residential demand, cost tolerance, and integration

The purpose of a pilot program for residential EV charging would be to test the responsiveness of EV owners to price signals by offering a TOU rate with at least a three-fold difference[3] between on- and off-peak rates.

LUMA should require that participants in the pilot share data about their charging with LUMA. In order to enable this, LUMA could use any of the data collection methods described above, i.e., a) install, at its own cost, dedicated interval meters for L2 EV chargers; b) collect data directly from L2 chargers equipped with communications modules; c) use a third-party service that collects data directly from the EV's on-board telematics (can collect data for both L1 and L2 charging).

LUMA could then gather and analyze the data collected to understand how much load shifting the TOU rate is able to encourage, and how many of their customers take advantage of the TOU rate (vs. how many ignore it and just charge at will).

If LUMA is unable to enroll a sufficient number of customers in this L2-based pilot, it could offer an L1 flavor of the pilot as a backup strategy. But the revenues LUMA earns from L1 charging might not be sufficient enough to justify the costs of testing out various elements of the program, like data integration issues. Should that also prove to be the case, then a last-ditch pilot design could be for LUMA to simply offer to install a dedicated outlet equipped with rudimentary data reporting (perhaps as part of an AMI rollout) at no cost to the customer, in order to kick-start EV adoption until there are enough EVs on the system to justify further pilot projects and tests.

Project 2: Public demand trends for L2 and DCFC

The purpose of a pilot program for public EV charging would be twofold:

1. to test the preference of EV owners for slow (L2) and fast (DCFC) charging
2. to test the performance of LUMA in processing interconnection applications for public chargers

Ideally, LUMA would work with private sector EV charging networks who would own and operate the chargers, and provide data on their usage to LUMA. These chargers are more likely to be located in high-traffic areas where the charging network operators can obtain a relatively high utilization rate. If necessary to attract the participation of charging network operator partners, LUMA could offer to share the costs of installation by paying for the "make-ready" portion of the installation (either up to the customer meter, or up to the stub-out of the charger itself on the customer side of the meter).

A representative sample of both L2 and DCFC chargers would be included in the pilot, to test driver preferences for slow or fast charging. Ideally, the pilot would have two types of sites:

---

[3] Research suggests that the differential between on- and off-peak rates should be at least 3x in order to attract substantial participation by EV drivers.

- Sites that are exclusively L2 or DCFC, so that the speed and cost of the interconnection process can be assessed separately for both types of chargers.
- Sites that have a mix of both L2 and DCFC chargers, in order to screen out locational preferences.

There should be several sites of each type participating in the pilot, preferably distributed around Puerto Rico such that LUMA can detect common patterns in diverse economic zones, or different zoning types.

The retail cost to drivers of using L2 chargers should be substantially less than for using a DCFC, because it costs far less to install and operate L2 chargers. There are no hard and fast rules here, but again a roughly 3x differential is probably in the right ballpark of what the retail prices offered by the charging networks would be in a competitive environment. (LUMA would have to take care that participants in this pilot do not distort the results by, e.g., offering L2 charging for free, or at a price too similar to the price of DCFC charging.)

As with Project 1, LUMA would track the costs and benefits of the program, and calculate driver preferences for slow and fast charging based on the collected usage data.

Project 3: Managed charging and data integration

As more EVs arrive on their system, LUMA will likely want to choose a single data collection and integration method to use as it scales up service to EVs, because maintaining the data integration for all three methods would be too complex and costly. The purpose of this pilot project would be to understand the costs and benefits of each of the three types of data collection described in "Data collection and monitoring" above, and to evaluate the practicality and cost of integrating the collected data into its own grid monitoring and billing systems.

Depending on its available program funding and its capacity to manage multiple data integration projects, LUMA should endeavor to explore all three kinds of data collection at some level, even if it's only at a demonstration scale, or as a paper exercise. There are many potential costs and limitations to each approach, as well as non-trivial research burdens, and LUMA should use the exercise to determine which approach it prefers.

The results of this pilot could then be used as the exclusive (or preferred) method of data integration for LUMA's EV programs in the future.

Project 4: Active vs. passive managed charging

The purpose of this pilot project would be to understand the efficacy and costs of active and passive managed charging approaches. This could be done as a subset of Project 1 by offering the program participants a choice between a "passive" TOU rate, or allowing active control by an aggregator controlling chargers (which could be a third party, or LUMA) or an aggregator controlling vehicles (such as WeaveGrid).

It may be necessary to offer carefully-designed incentives to attract a sufficient number of participants for all three types of managed charging strategies, but costs should be manageable if the pilots are sized for the minimum viable product under each strategy.

As with Project 3, the results of this pilot would ideally inform LUMA's subsequent efforts and steer future programs toward a single method of managing charging, because maintaining multiple strategies would likely prove costly and unworkable from a practical standpoint.

Project 5: Fleet support

The purpose of this pilot project would be to begin to understand the unique requirements associated with supporting a commercial vehicle fleet. For the initial project, the type of fleet is less important than its scale. LUMA should endeavor to work with a fleet operator who plans to need at least 5 MW of supply at a single location within the next ten years. For example:

- 85 transit buses charging at 60 kW rates
- 3 Class 8 semi-tractors charging at 1700 kW rates
- 35 Class 3-6 vehicles charging at 150 kW rates

This is likely to be a complex and challenging project that will take several years to realize, so it's important that any pilot project of this kind be fully funded for at least five years to ensure that it bears fruit.

In addition to the key metrics listed above, LUMA could use this pilot project to understand the unique requirements for supporting a large fleet facility, including:

- Lead time to provision power supply to the facility
- All upgrades required on the utility side of the meter, which could extend upstream to the substation or even beyond it
- Required process and paperwork to complete the interconnection from start to finish
- Staff effort required on both the LUMA and the customer side to complete the interconnection process
- How much expert guidance a customer needs from LUMA in order to scope the power requirements of its facility, as well as the potential for load-management and demand-charge mitigation strategies.