Louisville Gas and Electric Company and Kentucky Utilities Company Electric Vehicle Charging Station Location Study

Case Nos. 2020-00349 and 2020-00350

June 17, 2022

PPL companies

Introduction and Executive Summary

The emergence of transportation electrification has been a once-in-a-century paradigm shift for the energy industry and for society at large, which will reduce carbon emissions. Indeed, electric vehicles (EV) are close to a tipping point, as adoption rates are growing exponentially, more electric vehicle offerings are being made available, technological advancements are being made regarding energy storage devices, and charging infrastructure is becoming more prevalent. Subsequently, there has been a significant shift in new vehicle advertisements as data from marketing analytics shows that EV ads made up 7.5% of auto advertising spend in the U.S. in 2021, more than triple the level of 2019[1].

Furthermore, the United States has begun investing billions of dollars for EV infrastructure, paving the road for an electrified transportation sector in the near future. Most recently the U.S. passed a bipartisan infrastructure bill that will provide $7.5 billion for EV charging, and alternative fuel, networks to be built across America[2]. This funding shows that the United States is poised to become a leader among transportation electrification efforts worldwide. The available funding poses a critical need for state regulators, utilities, EV charging providers, and EV manufacturers to collaborate and ensure that the funding is invested appropriately to maximize public benefit.

Recently, in 2021, the Kentucky Public Service Commission ruled[3] that Louisville Gas and Electric Company and Kentucky Utilities Company (LG&E and KU) shall proactively develop the following report to identify optimal locations for EV charging infrastructure vis-à-vis the LG&E and KU distribution and transmission systems. The report shall not be a study of the best commercial locations within LG&E and KU's service area for EV stations, taking into account factors like traffic patterns, amount of time parked or visibility. Conversely, this study shall be one that can only be completed by an incumbent utility, used to identify areas of the distribution and transmission system that, with minimal upgrade costs, can best support EV charging. This study shall determine the best EV charging locations from the perspective of efficient utility planning and should seek approximately 10-20 EV charging locations that represent the Companies' service territory's "low hanging fruit."

The following report will begin by highlighting the growth that the electric transportation sector has seen in recent years. Recent advances in EV charging technology will be covered highlighting the various "levels" of charging and how this will play a role in charging infrastructure deployment. Next, charging behavior will be discussed. The majority of charging behavior occur at the home and workplace, with only a small portion occurring at public locations, a trend that is expected to continue in the future. Next, typical site design for EV charging infrastructure will be discussed focusing on the various types of equipment that will need to be considered when deploying such infrastructure. In order to maximize public benefit and utilization of deployed EV infrastructure, the report will then discuss ideal characteristics of a charging host site or location. The report will discuss the appropriate process to follow whenever connecting new load to the electric system. This process is the same regardless of whether a third party, private customer, or LG&E and KU, itself is responsible for the load addition. Finally, the specific hosting capabilities that LG&E and KU offer for EV charging infrastructure will be addressed. LG&E and KU are poised to host EV charging infrastructure, with minimal electric system enhancement, at nearly any location that three-phase electric distribution infrastructure exists. This three-phase system commonly exists along the majority of interstates and highways, especially in commercial locations where EV drivers would be more prone to stop, including restaurants, shopping, and attractions.

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[1] https://www.bloomberg.com/green

[2] https://www.transportation.gov/briefing-room/president-biden-us-department-transportation-releases-toolkit-help-rural-communities

[3] Case Nos. 2020-00349 and 2020-00350

Overview of Electric Vehicles and Charging Infrastructure

Electric vehicles come in one of two major types, plug-in hybrid (PHEV) and battery electric (BEV). PHEVs were most prominent a few years ago, however BEVs have quickly overtaken PHEVs in recent years in terms of market share. The most striking difference between a BEV and a PHEV is that the former has a driving range limited by the energy storage capacity of its battery, while the latter is equipped with a liquid fuel tank and an internal combustion engine, therefore extending its driving range. This study will focus on BEVs as these vehicles have larger capacity batteries and are typically compatible with higher power charging infrastructure.

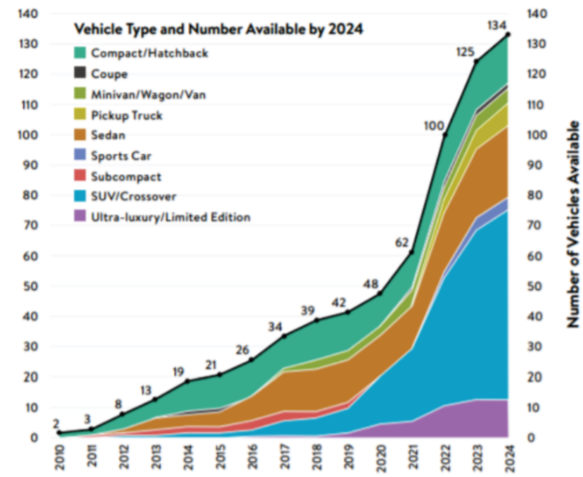

Figure 1 - Number of electric vehicle options by vehicle type and year.

When it comes to electric vehicles, customer choice is rapidly increasing. Figure 1 shows the number of electric vehicle offerings, divided by vehicle type, offered each year by the automotive industry. Note that future years are based on new vehicle announcements from various automotive manufacturers. By 2024, it is expected that there will be at least 134 electric vehicle offerings available to the public with approximately half of those being SUVs/Crossovers and pickup trucks. This is a crucial statistic as the majority of new vehicle sales today remain in the truck and SUV market.

The state of Kentucky has also seen significant growth in PHEV and BEV vehicles. Electric vehicles now represent over 2% of monthly new vehicle registrations in Kentucky. If these trends follow the national average, which they typically do, this percentage will continue to increase. Figure 2 shows the monthly market share, including the top 6 vehicles (as of December 2021) and any remaining PHEVs and BEVs.

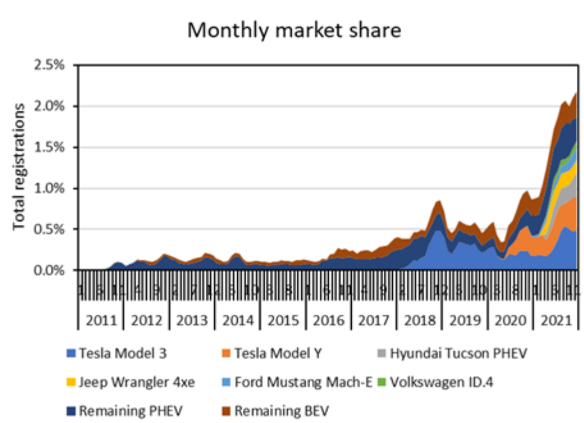

Figure 2 - Market share by EV make and model with top 6 separated from the remaining PHEV and BEVs.

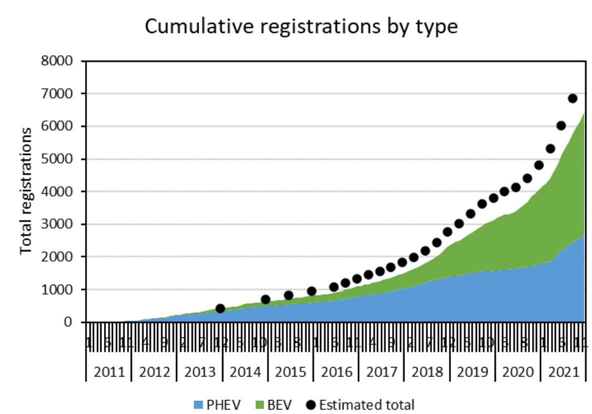

Figure 3 - Cumulative BEV and PHEV registrations in Kentucky.

BEVs now represent the majority of electric vehicles registered in the state of Kentucky. Figure 3 shows cumulative new vehicle registrations with the two wedges representing PHEVs and BEVs respectively. The black dots represent the total vehicles estimated to be in operation. This number is higher most likely due to a net influx of used vehicles in Kentucky. Furthermore, Figure 4 plots cumulative EV registrations at the zip code level across Kentucky. Not surprisingly, most EV registrations tend to accumulate around larger cities and population centers throughout the state. Conversely, another way to study EV registrations is by evaluating areas that are experiencing the most growth when compared to traditional internal combustion engine vehicle registrations. Figure 5 shows a map of Kentucky and represents the percentage of new electric vehicle registrations, when compared to total registrations, in each county in 2021. This Figure 5 represents the areas with the highest rates of EV registrations. The data represented in Figures 2-5 is current through December 2021 and is provided to LG&E and KU as members of the Electric Power Research Institute (EPRI).

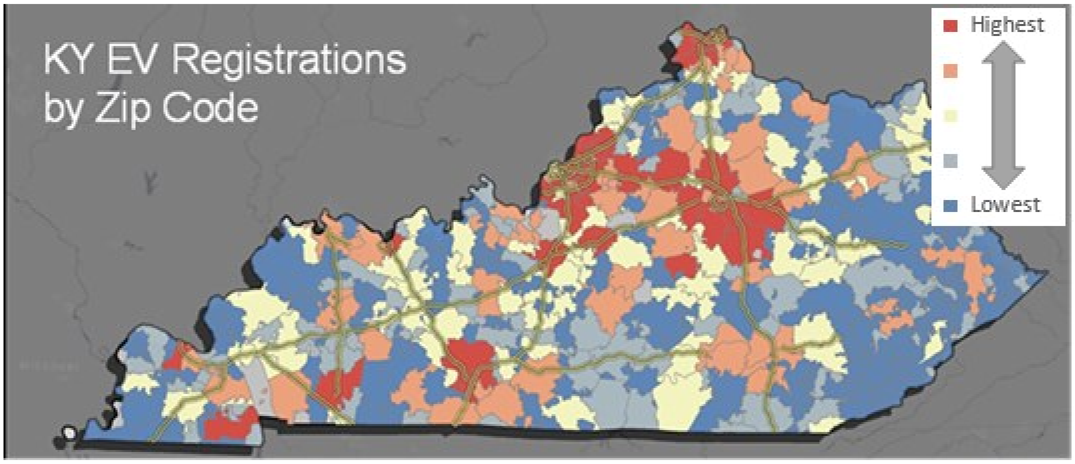

Figure 4 - Map of Kentucky representing cumulative EV registrations by zip code.

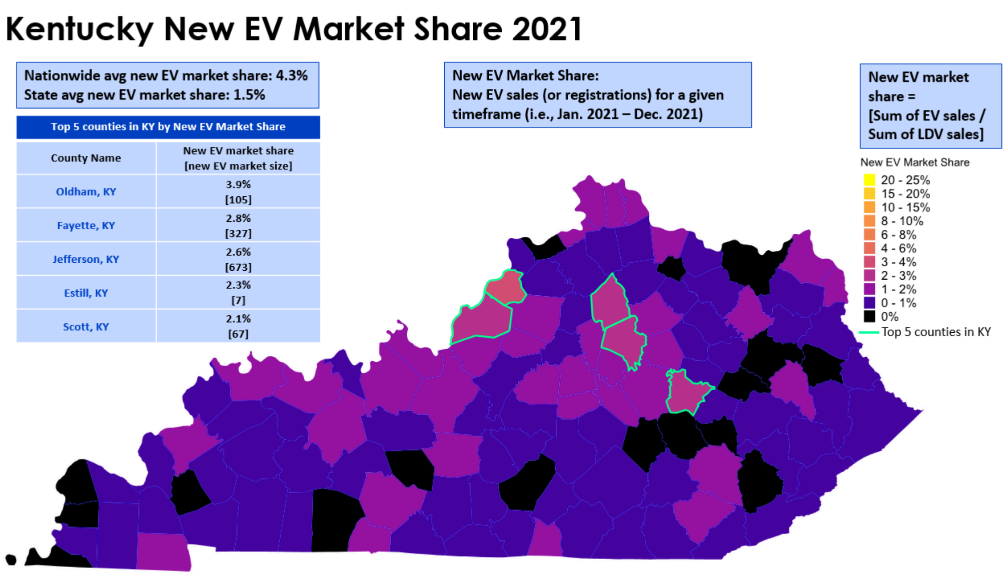

Figure 5 - Map of Kentucky counties showing the percentage of new vehicle registrations that are electric.

As EV options increase for consumers, the types and technology of EV chargers also continue to develop. EV chargers, sometimes referred to as electric vehicle supply equipment (EVSE), also are available in several sizes and capacities. The most common EV chargers are AC Level 1, AC Level 2, and DC Fast Chargers (or Level 3). Level 1 chargers are portable and can plug into a standard 120V wall receptacle and are most common in residential applications where 240V supply may not be available. Level 2 charging requires a dedicated 240V or 208V service, often hardwired into the charger. Level 2 chargers are most common in commercial and public charging locations, however, can be installed in residential applications as well. DC Fast chargers require 480V three-phase service which is typically only available at public and commercial charging sites. DC charging is much more convenient in these areas due to the faster charging speed. Figure 6 represents the various types of EV chargers and notes the most common applications for each.

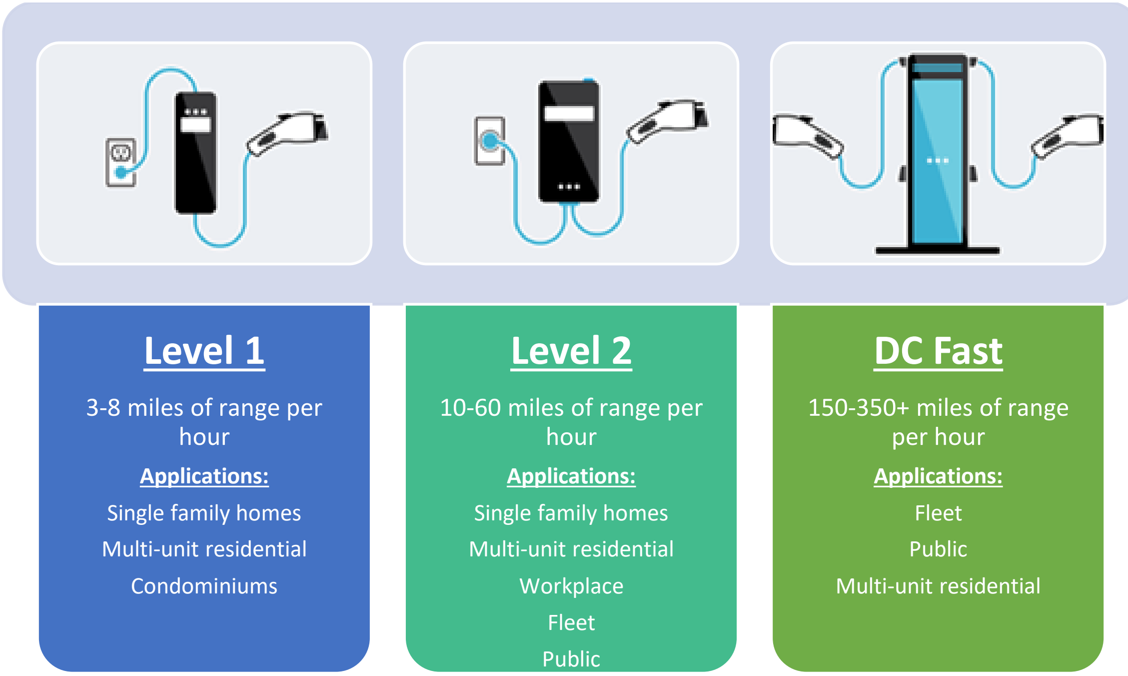

Figure 6 - EV charging levels.

EV Charging Behavior

According to McKinsey & Company, consumers with EVs tend to follow a charging hierarchy that starts at home[4]. This is due to the fact that most individual passenger cars remain parked for eight to twelve hours at night, and home charging can be easy and often cheaper than charging elsewhere. It is important to note that this charging activity occurs behind the residential meter and is billed at the same rate as other residential load. It is not separately metered unless the charging infrastructure is on a dedicated EV rate, therefore it is hard to monitor. Next in the hierarchy is workplace charging followed by publicly accessible charging. This depends heavily on whether companies offer charging for employees while at work. Typically, public charging is utilized primarily by long range travelers, however this may shift slightly as EVs become more prevalent and public charging infrastructure is expanded. Figure 7 represents two scenarios, one where public charging is more prevalent and the other where the majority of charging occurs at home. In both cases, the expected amount of public charging does increase between 2020 and 2030, therefore justifying the need for public charging infrastructure.

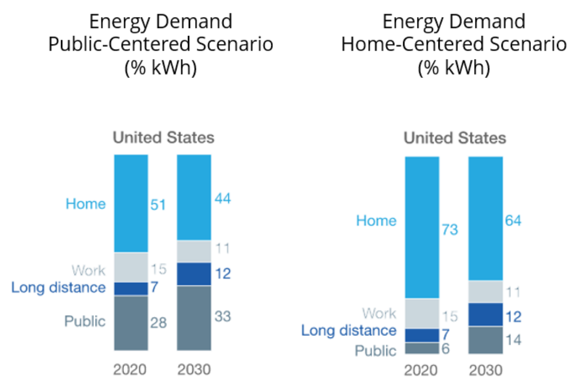

Figure 7 - Percentage of energy consumption, based on charging location.

[4] McKinsey & Company is a global management consulting firm committed to helping organizations accelerate sustainable and inclusive growth. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/charging-ahead-electric-vehicle-infrastructure-demand

As the technology for EV chargers continues to advance, the available power to charge also rises. State of the art DC fast chargers are now capable of up to 400 kW of charging power[5] per dispenser. Dedicated chargers for busses and trucks are even higher power, now approaching 1 MW or higher. This is a great benefit when trying to minimize time at the charging station, however this creates other potential issues for the utility operator. Utilities prefer smooth slow varying loads as they are easier to predict and are easier to support from a grid operations perspective. When large loads become variable, negative localized power effects are possible including, but not limited to flicker, harmonics, and voltage deviations, among others. Unless adequate measures are taken to prevent such effects, high power DC fast chargers with low utilization factors are subject to the same problems. The higher costs associated with building a more robust utility service for intermittent loads is typically recovered through demand costs. These demand costs are passed along to the customer when they charge their vehicle therefore resulting in a higher cost per mile for EV owners that is typically not desirable.

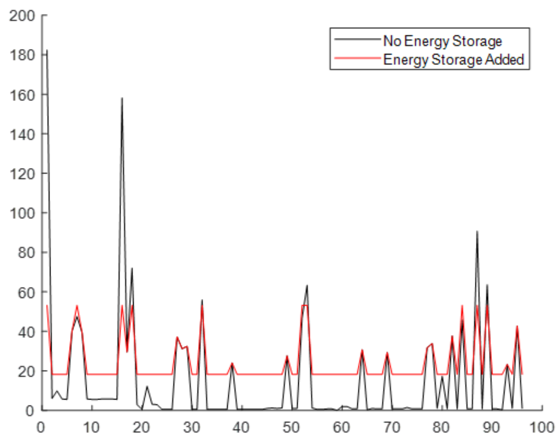

Figure 8 - Actual measured demand from a high-power DC fast charger in the LG&E and KU service area. A simulation was performed to model the effects of adding energy storage.

There are a few ways to minimize the effects of intermittent high power charging activity. One method is commonly referred to as "Smart Charging." In this option, managed charging activity for high penetrations of EVs can provide potential benefits to the electric system, the EV owner, or the charging provider. However, the motivation behind smart charging varies by stakeholder and application. For example, the utility may be interested in mitigating peak system demand or reducing renewable curtailment. Generally, smart charging allows EV charging to shift according to grid load, renewable generation and/or locational conditions; all while continuing to serve the charging needs of EV owners. Smart charging can do this by stopping, delaying, reducing, or increasing power levels of charging, which may be a deterrent for consumers with EVs if it negatively affects the charging experience. As depicted in Figure 8, the second method to minimize effects of intermittent high-power charging is to couple the charging location with energy storage. In essence, the battery storage charges at a relatively low constant power during periods when the EV charger is inactive. Then, when the power is needed for a charging session, the battery storage supplies ***most of*** the power to the vehicle therefore limiting the spike in demand on the electric grid. However, there are ***several*** drawbacks to this method. Despite falling costs, energy storage currently remains an expensive option, especially when lithium-ion technology is utilized. Energy storage also requires strategic planning as safety can also be a concern with some battery chemistries. This method requires adaptive controls since charging activity may vary over time.

Typical Charging Location Design

With continued advances in EV charging technology, the specific site designs for charging locations have evolved. Level 2 EV chargers, which were widely deployed in the past, and continue to be deployed today, are relatively simple to install since they operate on AC voltage, consume lower power, take up a small footprint, and can be easily metered or managed. DC fast charging infrastructure, on the other hand, requires more supporting infrastructure, operates at higher power levels, and requires three-phase electric service. These

[5] https://www.greencarreports.com/news/1125436_the-most-powerful-dc-charging-station-in-europe-for-cars-can-deliver-400-kw

characteristics along with the ever-changing technological landscape make it more difficult to design a DC fast charging location.

Depending on the technology chosen for the DC fast charging location, i.e., chargers with integral AC/DC conversion capabilities or modular systems with separate power conversion enclosures, the typical design contains many of the same components from an infrastructure perspective. Figure 9 shows a high-level diagram of a DC fast charging location. The site design depicted in this figure shows EV chargers with integral AC/DC power conversion electronics. However, keep in mind that some modular sites require AC/DC power conversion cabinets that are separate from the dispensers and located between the load center and the dispenser. In addition to the dispensers and power conversion cabinets, typical DC fast charging sites also have sizeable service transformers, and power distribution switchgear. Depending on the capacity of the charging location, the site may be connected and metered at primary voltage levels, i.e., 12,470 Volts, or it could be interconnected and metered at secondary voltages such as 480 Volts, as shown.

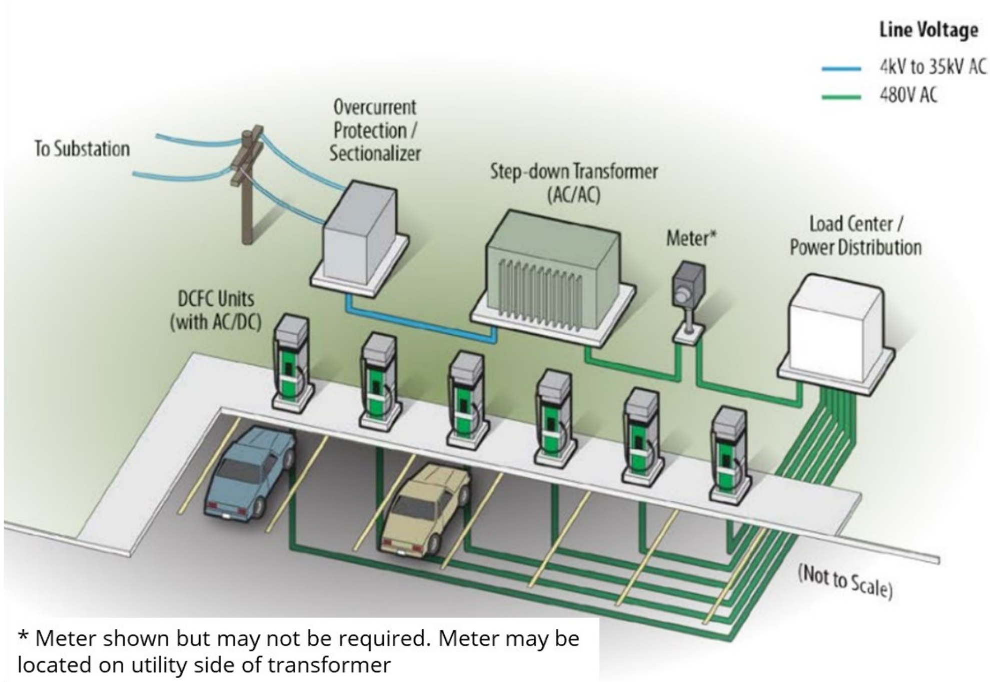

Figure 9 - Diagram of a typical DC fast charging location with multiple dispensers. Note that this design shows chargers with integral power conversion. AC/DC power cabinets may be required for modular designs.

When designing a DC fast charging location, there are many items to consider. One of those considerations is how to future-proof the site design to account for anticipated increases in electric vehicles in a given region. As a best practice, many third-party charging providers often design sites with expansion capability as demand for the infrastructure increases. Charging infrastructure expansion options can include increasing the number of dispenser ports and/or upgrading to higher power chargers. A few considerations for future-proofing a charging location include construction approaches, electrical equipment selection, utility services, and hardware choices. When designing and constructing the site, additional conduits may be installed, or conduits can be upsized to allow for the addition of dispensers or higher capacity chargers. This often requires additional concrete pads to be planned for, if not installed. When designing switchgear and other supporting equipment on site, ensure that spare breaker positions are considered to allow for expansion. Work with utilities when submitting load sheets to ensure that adequate capacity is available at the site if future expansion occurs. This includes the possibility of upgrading the service transformer, and capacity on the existing incoming primary circuit. Additionally, when designing the site, ensure that cybersecurity concerns are considered. For example, consider using hardwired communications instead of wireless where possible can help prevent potential intermittency issues with data.

Various charging providers typically utilize proprietary charging networks for data collection and monitoring. When picking EVSE manufacturers, ensuring that current networked chargers can flexibly communicate with alternate charging networks is essential. Companies might go out of business, or a charging provider may want to integrate other brands into their charger mix. One way to prevent re-purchasing chargers and increasing interoperability is ensuring they are Open Charge Point Protocol (OCPP)[6] certified. The certification allows for charger/network communication regardless of brand.

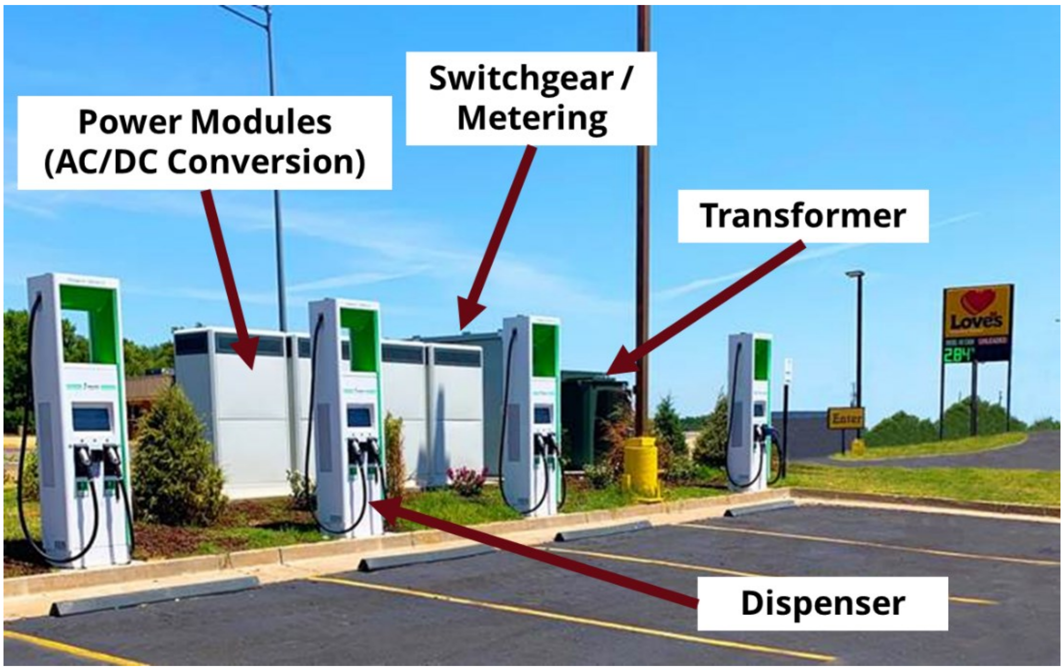

Figure 10 - Typical DC fast charger site from Electrify America. Some sites enclose the supporting equipment behind a fence and others do not.

Typical DC fast charging locations have multiple dispensers. Electrify America installations, such as the one depicted in Figure 10, have 4, 6 or 8 dispensers with the option to expand in the future. Tesla, on the other hand, typically designs their sites with 8, 12 or 16 charger ports with minimal plans for expansion in the future. Some EV charging sites also combine DC fast charging technology with standard AC level 2 chargers to support older electric vehicles. The number of dispensers can greatly affect the capability to host charging since cutting edge dispensers are capable of up to 400 kW each. Taking this into account, DC fast charging stations can easily add multiple megawatts of load at the point of interconnection.

LG&E and KU is confident that these typical charging sites can be hosted nearly everywhere on the electric distribution system where three-phase primary distribution circuits exist. However, until specifics are known about each specific site, including location, anticipated load shape, and planned utilization, specific hosting capabilities are unknown. It is anticipated that DC fast charging sites would not become problematic from a hosting perspective until they become as common as fuel stations, with several locations within a small geographic region. Larger depot-style charging sites for sizeable fleets could also pose potential problems, however these sites typically proceed through the standard utility planning process which allows for adequate

[6] https://www.openchargealliance.org/certification/

infrastructure upgrades to be made well in advance. By following the application process for new load, which is outlined later in this document, proper steps can be taken to ensure that the electric distribution system can adequately host the new load addition.

Application Process for New Load

Any time that new electrical load is added to the LG&E and KU distribution system, such as EV charging infrastructure, the same process is followed regardless of whether the request originates from the customer or from an internal company request. This process begins with the project proponent or customer reaching out to a locator at the respective operations center within LG&E and KU. At that point, the customer will be requested to provide a load data sheet[7] (see Figure 11) that details the type, capacity, and load shape of electrical consumption that will be expected. This assists engineering planners and designers so that they can appropriately design the electrical service and ensure that the existing distribution system can handle the additional load.

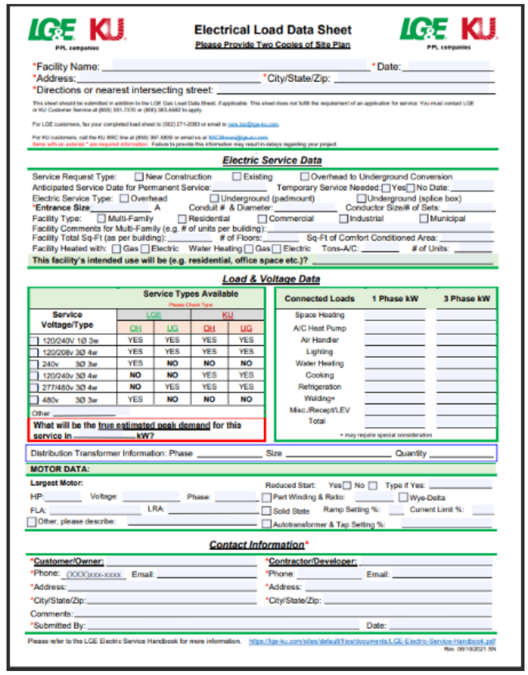

Figure 11 - An example Electrical Load Data Sheet.

Larger electrical load additions to the system may require infrastructure enhancements, such as replacement or upsizing of conductors, new circuit buildout, or even possibly the need to construct a new distribution substation. In this event, the project proceeds through the distribution planning process where it is prioritized, modeled, and planned for. However, this is fairly rare as it is typically only required when new businesses, factories, or industrial facilities are built. When related to EV charging, the planning process is only followed when large banks of chargers are installed for fleet vehicle electrification that add several megawatts of load in a specific location.

For the majority of new load additions, the electrical load data sheet shown in Figure 11 is passed directly to electrical designers at the operations center where they investigate all available options for service and associated costs. Those options are communicated to the customer and a decision is made on the appropriate design for the new service. At this point, Engineering Design will finalize plan and manage construction. Once construction is complete, the customer receives service and permission to operate. If infrastructure upgrades are required and costs are covered by the customer and not the utility, a contract may be initiated.

In some rare occasions, the load addition will be served directly from the LG&E and KU transmission system. In these instances, either the load is too large for the existing distribution system to handle, or the rate structures for retail transmission service are financially attractive to the customer. In these situations, the LG&E and KU load serving entity must request transmission service for the new delivery point on the LG&E and KU transmission system. The request is initiated via a submittal on the LG&E and KU Open Access Same-Time Information System (OASIS) along with information on the load, including location and characteristics. The request is evaluated by the Independent Transmission Organization (ITO) in accordance with LG&E and KU's Open Access Transmission Tariff (OATT). The ITO is responsible for granting new transmission service and performs a series of studies to determine the impact of the requested service on the LG&E and KU transmission system. The ITO may determine that the existing transmission system is capable of serving the new load or

[7] https://lge-ku.com/business/lge-builderdeveloper-relations

identify network upgrades needed to mitigate system constraints. There is not an established threshold to determine when a load is served from the LG&E and KU distribution system versus the LG&E and KU transmission system; rather it largely depends on the location of the load and the desires of the customer. In some rare instances, larger load increases at an existing distribution substation served from the transmission system may also require the LG&E and KU load serving entity to request transmission service for the increased load.

LG&E and KU Hosting Capabilities

To accurately determine the hosting capabilities for DC fast charging locations on the LG&E and KU system, more detailed information is required about the size, capacity and location of any planned or proposed EV charging infrastructure. Since this is somewhat of an unknown until the utilities are notified of a service request, LG&E and KU utilized the fact that a typical DC fast charging station have a minimum of 2-4 charging dispensers. Utilizing the highest power DC fast charging infrastructure available today, this would equate to a site consumption of 1-2 MW. Additionally, according to Tesla's website, Tesla now offers a V3 Supercharger which advertises much less charging time than prior versions of EV Chargers from Tesla. Tesla's specification indicates a single car charger results in 250kW load during charging time and the 1 MW charging cabinet would presumably charge 4 cars at the same time.

Utilizing a combination of modern 350 kW DC fast chargers and the data from Tesla, it was assumed that a typical DC fast charging location capable of charging 4 vehicles simultaneously would introduce a load of approximately 2 MW once additional auxiliary site loads were considered. For the sake of this study, it was also assumed that the charging sites would have an approximate power factor of 0.9.

The study commenced with an analysis of the transmission system to see where incremental load from EV charging activity could be added. Transmission Planners in the US typically build models of the transmission system for two years, five years and ten years into the future. The transmission system is stressed during summer peak load or the hottest day of the year and winter peak load or the coldest days of the year. This study utilized the 2031 models for both the winter and summer peak load conditions.

LG&E and KU builds summer and winter peak models based on two sets of forecasted winter and summer peak conditions. Distribution companies, including LG&E and KU, with load on the transmission system forecast future loads based on a 50% probability that actual loads will be higher than this forecast and a 50% probability that actual loads will be lower than this forecast. LG&E and KU also receives a load forecast based on a 10% probability that actual loads will be higher than this forecast and a 90% probability that actual loads will be lower than this forecast. The 90/10 load forecast probability would occur during more extreme weather than a normal summer or winter season.

The EV charging study utilizing transmission models from the 2022 Transmission Expansion Plan used both the 90/10 and 50/50 summer and winter peaking models for the year 2031 but utilizing the option of adjusting generation when overloads are identified in the 90/10 more extreme load forecast conditions. The study assumed that all EV chargers are in service and charging at peak power at the same time during either a winter or summer peak load condition for the 2031 models to analyze the largest possible effect on peak load conditions.

The study ultimately found that the LG&E and KU transmission system can reliably host approximately 600 MW of EV charging load at peak without network upgrades, considering the summer and winter peaks. Therefore, more in-depth studies would be required once additional details are known about the planned deployment of EV charging.

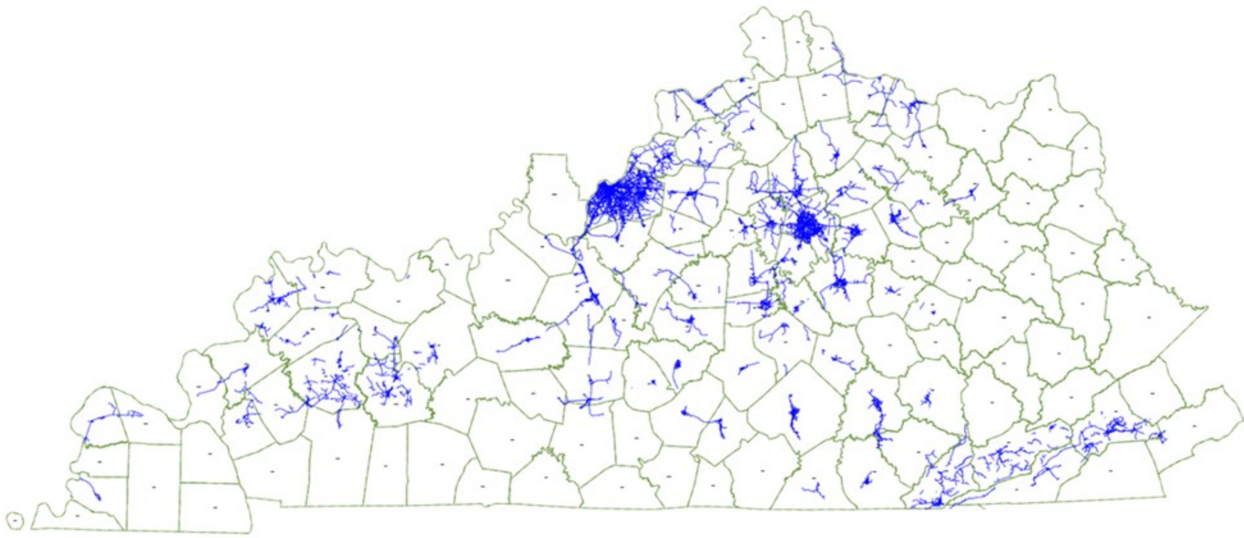

Figure 12 - Map of Kentucky showing the location of three phase electric distribution infrastructure. Note that three phase infrastructure typically exists in all city centers and along most major highways.

Taking the 600 MW of hosting capability into account, the electric distribution system was then examined to determine hosting capabilities. Since DC fast charging infrastructure requires 3-phase utility service, only areas where existing 3-phase infrastructure has been constructed were considered. Figure 12 shows the LG&E and KU three phase electric distribution infrastructure across Kentucky. Since the map in Figure 12 can be small and difficult to read, a zoomed in version of the Louisville / Jefferson County (Figure 13) and Lexington / Fayette County (Figure 14) areas are also provided to show additional detail. Electric distribution circuits are typically built in a radial fashion where the "backbone" of the circuit is typically 3-phase and utilizes larger capacity wires and cables. The "branches" of the distribution circuit typically consist of single-phase lines and are used to serve neighborhoods and communities. Due to this construction, adequate capacity characteristically exists on all 3-phase portions of the electric distribution system, with minor exceptions for areas where small wire was used due to lack of load, or new developments have limited the capacity of the circuit. An additional constraint to consider is the rating and loading of the substation transformer during peak load conditions.

Figure 13 - Map of the Louisville / Jefferson County area showing the location of 3-phase electric distribution infrastructure.

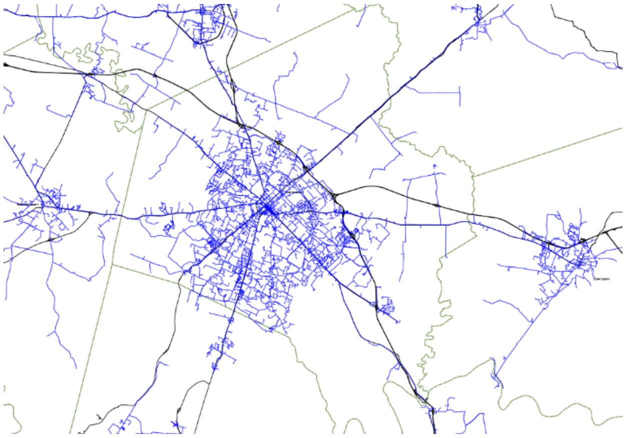

Figure 14 - Map of the Lexington / Fayette County area showing the location of 3-phase electric distribution infrastructure.

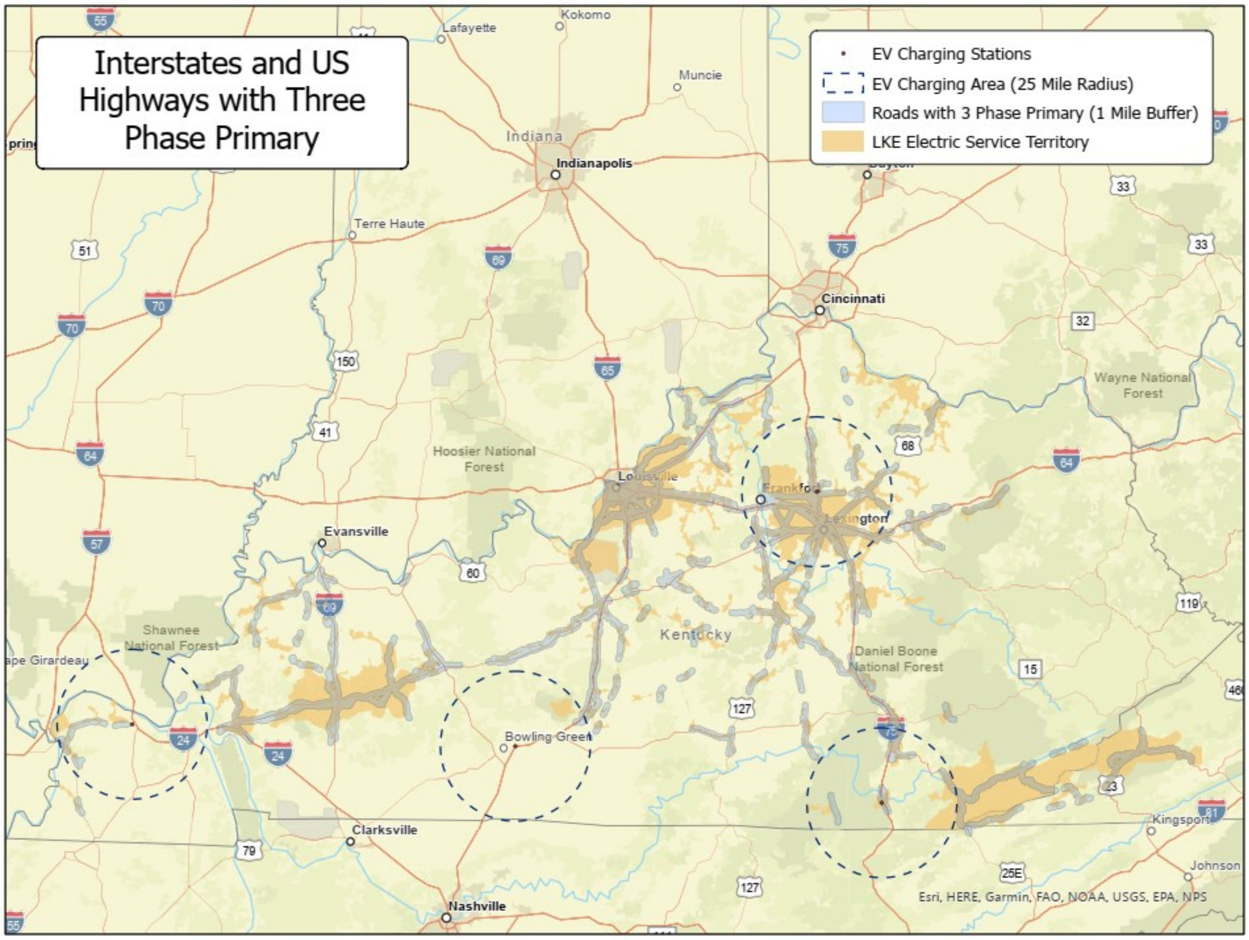

Figure 15 - Map showing LG&E and KU service areas, interstates and US highways with 3-phase electric distribution within 1 mile, and existing DC fast charging infrastructure.

As federal infrastructure funds are made available for DC fast charger deployment in Kentucky, additional constraints are placed on the site selection for charging locations that are seeking federal funding. Namely, the requirements for an EV charging location to be within 1 mile of a major interstate or highway, the availability of 3-phase utility service, and the location being no further than 50 miles from the next closest charging location. Keeping these constraints in mind, LG&E and KU also developed a map showing optimal locations for EV charging locations. The map shown in Figure 15 shows the LG&E and KU service area, major interstates, three-phase primary electric distribution that is within 1 mile of an interstate or US highway, and existing publicly accessible DC fast charging locations. Note that Tesla charging infrastructure was not plotted in this figure since it is proprietary to Tesla vehicles only. Based on this map, LG&E and KU feels well positioned to host EV charging in most major cities throughout Kentucky as well as along interstates in the western and central parts of the state.

Hosting Site Selection

LG&E and KU, along with PPL Corporation, committed to join the Electric Highway Coalition in September 2021. Through this partnership, the companies will collaborate with other coalition utilities to provide EV drivers access to efficient and fast electric vehicle charging stations that broaden the network charging infrastructure and create convenient options for long distance EV travel.

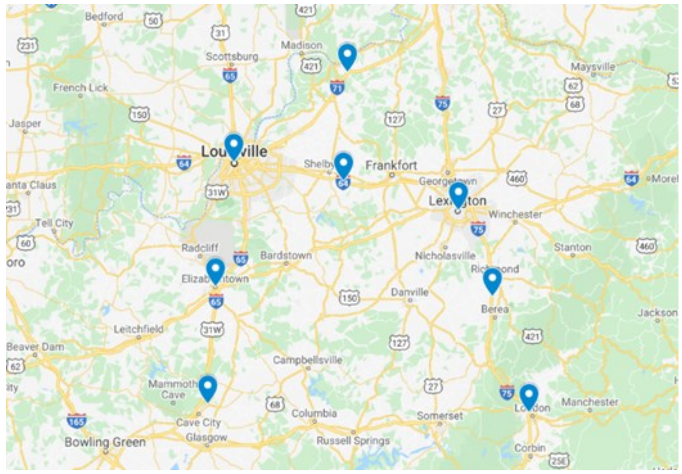

Figure 16 - LG&E and KU potential DC fast charging locations identified in initial studies.

LG&E and KU is developing a strategy for where to place DC fast chargers. The site locations will be updated if other charging stations are installed within the proximity of the proposed locations to ensure broad penetration in the company's service area. At no time is LG&E and KU seeking to compete with EV fast charging installation companies.

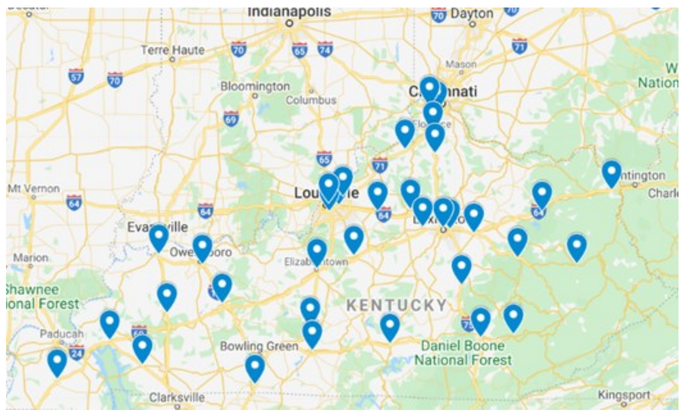

Figure 17 - DC fast charging locations identified by KY utility group (LG&E and KU, Duke, TVA, EKPC, Big Rivers).

The following criteria was considered to determine the Company's initial list of potential fast charging locations shown in Figure 16:

- Along major interstates and freeways in LG&E and KU service territory.
- Within 2 miles of an interstate or highway. Note that this has since been changed to 1 mile due to updated NEVI guidelines.
- Within 50 miles of other existing or planned fast charging stations.
- Location requiring minimal or no electric infrastructure upgrades.
- A minimum of 2 available parking spaces with the flexibility to expand the number of spaces and vehicles served in the future. Note that this has been updated to 4 vehicles due to updated NEVI guidelines.
- Near retail shopping, entertainment, food establishments, or other amenities useful to drivers.
- Free, public access during all days of the week and all hours of the day.
- Prominent, visible, well-lit location.

The Company, in collaboration with neighboring utility companies including Duke Energy, Tennessee Valley Authority (TVA), East Kentucky Power Cooperative (EKPC), and Big Rivers Electric Corporation, identified potential areas of interest for fast charging stations within the Commonwealth. Figure 17 shows the areas of interest from this group referred to as the Kentucky Utility Group.

Additionally, in May 2021, the University of Louisville shared their findings related to EV charging in a report titled, Charging Station Location Suitability: A Joint Urban Study and Industrial Engineering Approach. The locations identified within this report are shown in Figure 18.

Furthermore, Louisville Metro Government (LMG) conducted an EV survey[8] with the purpose to determine what efforts LMG can implement to increase EV adoption in the metropolitan area. The 2018 report listed multiple locations of interest around Metro Louisville with the locations receiving the highest scores shown in Figure 19.

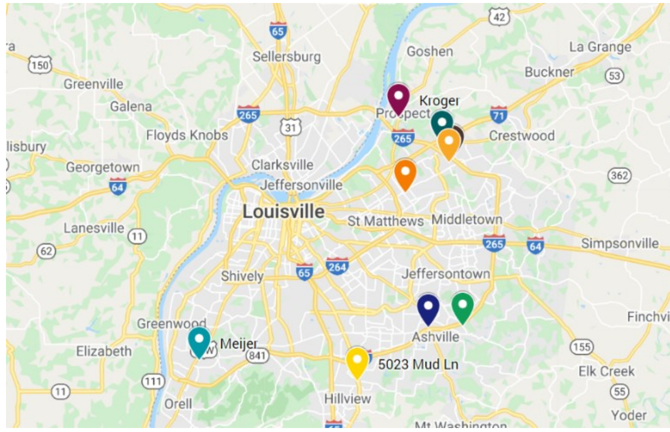

Figure 18 - Suggested charging locations from the University of Louisville study. Note that colors represent different stations

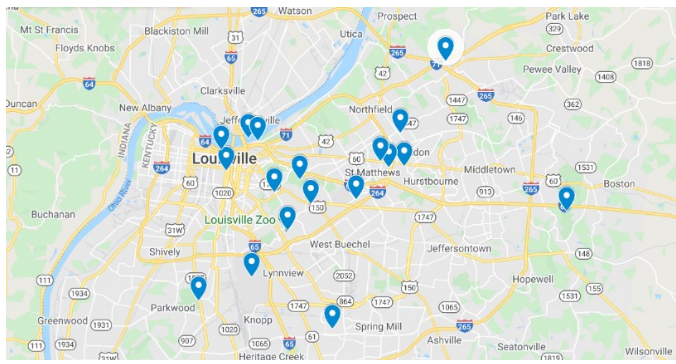

Figure 19 - Louisville Metro Government suggested charging locations.

The Company utilized the inputs from each source of the internal research, Kentucky Utility Group, University of Louisville, and Louisville Metro Government to identify the overlapping locations. These overlapping locations represent the sites with the highest level of interest for an EV fast charging station, thus the targeted locations for the Company. Refer to Figure 20 to view the locations in the Louisville area and Figure 21 for those in the KU service territory.

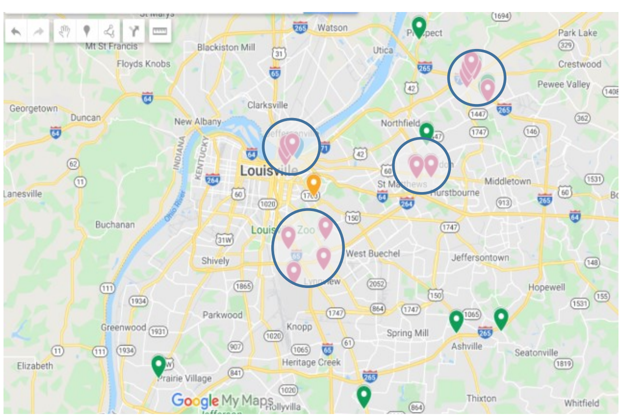

Figure 20 - Overlapping potential EV charging station locations in Louisville Metro as of October 2021. Note that colors represent various data sources.

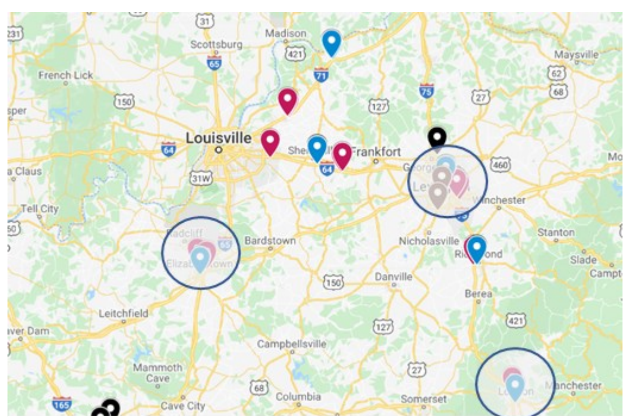

Figure 21 - Overlapping potential EV charging station locations in KU service area as of October 2021. Note that colors represent various data sources.

[8] https://louisvilleky.gov/air-pollution-control-district/document/finalevsurveyreport20190423pdf

These maps will be updated as information is learned of additional fast charging station installation to be located within any one of these identified areas.

An application for site hosts is being prepared for interested business customers to express their interest in providing parking spaces for the LG&E and KU-owned EV fast charging stations to be located within the areas of interest shown in Figures 20 and 21. A process similar to a standard Request for Proposals issued by LG&E and KU Supply Chain will be conducted which outlines a thorough list of criteria for the interested party to answer. Those answers will have a pre-determined weighting for an overall scoring system to be utilized.

Due to different parking space configurations that may be available, the site host application will include parking layouts and space requirements from which the applicant will select which meets their situation. Distribution Operations is assisting with the space requirements considering not only the EV dispenser and power cabinet, but also the transformer and clearances.

Conclusion

EV charging technology has continued to evolve allowing for faster and higher power charging. New vehicles offered today now support charging speeds at the top end of charging technology, upwards of 350 kW. As popularity for EVs grows, the need for infrastructure, both public and private, expands. Surveys from leading research firms have shown that the majority of EV charging occurs at the home or business with little charging activity occurring at public stations. However, as EV registrations grow into larger populations, it is expected that public charging will play a larger role in the electric transportation sector. Opportunity charging along interstates and highways will enable consumers with electric vehicles to travel longer distances. For convenience, these charging locations will require DC fast chargers.

LG&E and KU has performed studies on the electric transmission and distribution systems to determine where DC fast chargers can be optimally hosted. Assuming this infrastructure is evenly distributed across the LG&E and KU service area, the Companies are confident that they can host over 600 MW of charging load without requiring major transmission infrastructure enhancements. Some locations can host higher amounts of charging load; however, this varies from substation to substation and depends on local existing loads on the system. Since EV charging load is no different than any other new load on the electric system, the Companies would treat it the same as any other new load addition. The electric distribution system is typically radial in nature and the 3-phase backbones of those circuits are sized to handle new load and system re-configuration from switching activities. Therefore, DC fast chargers could be hosted nearly everywhere that existing 3-phase primary distribution infrastructure has been built. The Companies have 3-phase infrastructure throughout larger cities where existing commercial or entertainment industry exists and along most major interstates and highways.

Ultimately, until more details are known about a specific EV charging location, such as location, number of charging dispensers, estimated peak electric load, and load shape, it is difficult to pinpoint specific locations where EV charging can be hosted with 100% accuracy. However, based on the aforementioned qualities of the LG&E and KU electric transmission and distribution systems, the Companies are well positioned to host EV charging in most major cities throughout Kentucky as well as along interstates in the western and central parts of the state.