Accommodating Innovative Uses of Public Right of Way

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in cooperation with
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Commonwealth of Kentucky

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Research Report
KTC-24-32

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16. Abstract

State departments of transportation (DOTs) are embracing the use of clean energy and connectivity (CEC) applications along publicly owned right of way (ROW). Applications such as wind and solar power installations, broadband lines, small cell wireless equipment, electric vehicle charging stations, and technologies related to connected and automated vehicles (CAVs) hold considerable promise for conferring environmental benefits, energy savings, and generating much-needed revenue for DOTs. This report explores innovative uses of state-owned ROW that the Kentucky Transportation Cabinet (KYTC) could implement. Although Kentucky may not be currently situated for all clean energy applications, opportunities in solar do currently exist and more are likely in the future as technologies continue to evolve. KYTC does have experience with broadband installation in the public ROW as many broadband installations have been installed along state-owned roadways over the last 25 years. This area will remain a critical priority for connecting unserved and underserved communities to the internet. Although traffic signal installations are not preferred locations for small cell wireless equipment, existing utility poles, light poles, bridges, and sign trusses could all potentially be used. Engaging with CEC technologies and applications requires domain-specific expertise that KYTC currently lacks in-house. As such, private involvement will be necessary to build out these technologies on public ROW. As the Cabinet works to experiment with innovative uses of ROW, it is critical for the agency to perform its due diligence and execute careful planning to ensure all projects comply with state and federal laws.

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Executive Summary

This report discusses potential clean energy and connectivity (CEC) applications along Kentucky Transportation Cabinet (KYTC) right of way (ROW), including renewable energy, broadband, small cell wireless equipment, connected and automated vehicles (CAV), and electric vehicle (EV) charging stations. These applications hold considerable promise and could bring environmental benefits, energy savings, and possibly open much-needed revenue streams for KYTC. However, taking advantage of CEC applications will require due diligence and careful planning. While many of these CEC applications have existed for several years, emphasis on them has increased over the last few years. A Federal Highway Administration (FHWA) guidance memorandum (Pollack, 2021) clarifies how state departments of transportation (DOTs) can incorporate CEC uses along roadways:

- Accommodation as a utility under 23 CFR Part 645; or
- Approval as an alternative use of highway right of way under 23 CFR Part 710.

FHWA states the preferred method is to accommodate CEC applications as utilities. The primary reason for accommodating as a utility is the methods and requirements are covered under existing DOT utility accommodation policies.

If CEC applications are approved as alternative uses of the ROW, each project must be evaluated on its own merits, requiring a separate project that must follow a larger Federal-aid process. However, it is unclear whether CEC applications meet the definition of a utility under Kentucky law. To resolve this question, KYTC legal staff and the Public Service Commission should collaborate to clarify the statutory definition of a utility and whether each CEC application falls under that definition.

Developing renewable energy sources on state-owned ROW has the potential to offset energy costs for KYTC, but many challenges can hinder the ability of the Cabinet to take advantage of these applications.

Generating wind energy is highly dependent on wind speeds that can be very unpredictable, especially in an area with unfavorable wind speeds such as Kentucky. This, coupled with the large amount of land necessary to site wind turbine facilities, makes wind energy production an improbable use of KYTC-owned ROW. The state is better positioned to take advantage of solar energy but is still geographically disadvantaged compared to other areas of the U.S. Wind and solar also face regulatory challenges related to power purchase agreements (PPAs) and Kentucky statutes that limit the economic feasibility of selling electricity back to the electric grid.

Many Kentucky residents have no or inadequate access to broadband internet. Current efforts such as Kentucky Wired and grant programs administered by the Kentucky Office of Broadband development have made great strides to expand access. Many broadband installations to date have been along KYTC roadways. The Cabinet manages broadband installation requests under its current permitting process and through the utility coordination process for roadway projects, which is administered by the Division of Right of Way and Utilities. The MOBILE NOW Act has built on the framework in place by adding extra requirements that emphasize broadband installations on DOT projects. KYTC should continue with its efforts and identify new methods to include broadband installations along state-owned roadways.

Small cell wireless applications use low-powered radio access nodes or base stations to enhance cellular coverage and capacity, especially in populated areas. State and local governments face tremendous pressure to include small cell wireless equipment on existing infrastructure in the public ROW. Many agencies have significant amounts of

existing infrastructure on state-owned ROW that could be well suited for small cell wireless equipment. KYTC should permit small cell wireless in a manner that does not restrict the existing infrastructure's ability to serve its intended use. Discussions with the Division of Traffic Operations indicate that existing traffic signal infrastructure is not a suitable location for small cell wireless equipment. Possibilities that could be explored further include existing utility poles, light standards, bridges, and sign trusses.

More and more vehicles come equipped with CAV technologies. The roadside equipment required to make CAVs possible include communication lines, electric lines, small cell wireless equipment, sensors, cameras, and roadside units (RSU). KYTC has developed a strategic plan for CAVs and has an ongoing planning study to evaluate the potential for I-64 between Louisville and Lexington to serve as a CAV corridor.

Roadside infrastructure required for solar energy, wind energy, broadband, small cell wireless, and CAVs should follow all standards listed in KYTC's Utility Accommodation Policy (UAP), as found in the *Permits Guidance Manual*. Before installing new equipment, it is important to consider roadside safety elements such as clear zone.

Kentucky is currently building out the first phase of its EV charging network on designated Alternative Fuel Corridors (AFCs), which consists primarily of interstates and parkways. EV charging stations share many of the same installation guidelines mentioned above (e.g., following KYTC's UAP, clear zone requirements) but have the added feature of requiring human interaction at the charging site. As such, its improbable that EV charging stations will be situated directly on the ROW as standalone features. However, future opportunities may exist at ancillary facilities that are not located on Interstate right of way such as rest areas, truck parking areas, weigh stations, and park and ride lots.

Engaging with CEC technologies and applications requires domain-specific expertise that KYTC lacks in-house. As such, the Cabinet will need to rely on the private sector to build out these technologies on public ROW. Contracting methods that let private industry fund, design, build, maintain, and operate equipment are ideal for leveraging private industry skills, expertise, and funding.

When considering CEC applications discussed in this report, it is critical to keep in mind that federal law restricts commercial activity on interstates. 23 U.S.C. § 111 states that service stations or other commercial establishments for serving motor vehicle users cannot be constructed on the interstate system's ROW. The law also limits activity at interstate rest areas. Although some CEC applications have been accommodated as a utility, the law is still restrictive with respect to commercial activities, which will limit the amount of private involvement for CEC-related projects along interstates (e.g., building EV charging stations at rest stops).

Chapter 1 Introduction

The implementation of advanced Intelligent Transportation Systems (ITS), efficient technologies for renewable energies, and enhanced connection points for wireless transmissions have been a focal point for the Federal Highway Administration (FHWA) for the last several years. In 2021, FHWA released a guidance memorandum to state departments of transportation (DOTs) clarifying certain uses of the public right of way (ROW) that may be used to address climate change, increase equitable communications access, and grow energy reliability alternatives (Pollack, 2021). Potential uses identified include renewable energy generation, electrical transmission and distribution projects, broadband distribution, vegetation management, inductive charging travel lanes, alternative fueling facilities, and other appropriate uses. Collectively, these applications fall under the umbrella of clean energy and connectivity (CEC) and have the following benefits:

- Better leverage the full value and productivity of the existing ROW
- Reduce greenhouse gas and other pollutant emissions
- Promote energy security by diversifying energy generation and delivery methods
- Foster the creation of a local green job market that enhances the viability of the nation's renewable energy industry
- Create a potential revenue source for state DOTs to develop projects and negotiate agreements that include land lease or land license payments and power purchase agreements
- Reduce or eliminate ongoing maintenance expenses for state DOTs

These technologies can help generate renewable energy in Kentucky (solar and wind), enhance connection points for wireless transmissions (small cell wireless), and facilitate ITS solutions to support connected and automated vehicles (CAVs).

This research report develops a framework for the Kentucky Transportation Cabinet (KYTC) to strategically deploy clean energy structures and devices on public ROW and support accommodation standards to guide decision-making. It focuses on CEC uses along Kentucky highways, which include installations permitted through the KYTC Division of Maintenance or those included in a roadway construction project. Best practices for identifying corridor types, appropriate locations, and identification of physical standards are also included.

Chapter 2 Overview of Federal and State Utility Accommodation Policies

2.1 Clean Energy, Connectivity and State DOTs

The 2021 FHWA guidance memorandum describes how state DOTs can leverage public ROW for renewable energy generation, electrical transmission and distribution projects, broadband projects, vegetation management, inductive charging lanes, and alternative fueling facilities. Using land owned by state DOTs for renewable energy projects should reduce ongoing maintenance costs (e.g., less area to mow) while maximizing its value. For some states, it provides a new method of revenue generation by allowing DOTs to establish public-private partnerships to develop renewable energy projects using land-lease or land-license deals or power-purchase agreements. FHWA encourages more efficient and effective state use of ROW assets to achieve one or more of the following:

(1) Leverage the full value and productivity of existing ROW assets
(2) Reduce pollutant emissions
(3) Promote energy security though diversification
(3) Foster the creation of a local green or renewable energy job market
(4) Create a potential revenue source
(5) Reduce or eliminate ongoing ROW maintenance expenses (Van Dyke et al., 2021)

2.2 Federal Regulations to incorporate CECs to the ROW

For KYTC, one important aspect of the FHWA guidance memorandum pertains to how states accommodate these types of projects. Federal guidance provides two methods to address CECs: (1) as a utility accommodation pursuant to 23 CFR 645.205 or (2) as an alternative use of highway ROW. Addressing CECs as a utility accommodation in the transportation planning process is the preferred method for inclusion on state ROW when consistent with state law. Alternative use of highway ROW can be approved when such occupancy, use, or reservation is in the public interest and will not impair the highway or interfere with the free and safe flow of traffic (23 CFR 1.23(c)). If the CEC project under consideration is a utility under state policy, the project is treated as a utility accommodation and processed through the state DOT permitting and utility process.

Although the preferred method of incorporating CECs into the public ROW is as a utility accommodation, state DOTs may need to update their Utility Accommodation Policy (UAP).[1] The FHWA provided recommended language updates and advised completing the same process for broadband projects, which is also considered a part of the CEC application. The specific areas FHWA recommends for revision for state UAP policy include the following (Pollak, 2021):

(1) Acknowledging renewable energy generation as a utility facility when consistent with state law and establishing the proper form of written agreement or permit
(2) Discussing how utility accommodation can be better integrated into the transportation planning process at the state, regional, and corridor levels
(3) Addressing applicable terms and conditions, pursuant to 23 CFR 645 Subpart B

The second method to address CECs on the public ROW is by treating them as an alternative use of the ROW. As CECs are in the public interest, they must comply with property management regulations found at 23 CFR 1.23, 23 CFR Part 710, and 23 U.S.C 111. FHWA has some suggestions for this method as well:

[1] A UAP is required to be submitted to FHWA pursuant to 23 CFR 645.211 and 645.215.

Planning and design details about the project and provisions for maintenance access, terms of use, maps, plans, and sketches must be incorporated in ROW Use Agreements for a time-limited alternative use of a Federal-aid highway (per 23 CFR 710.405).

Non-transportation uses are subject to 23 U.S.C. 156 requirements to charge fair market value (FMV) for the lease or disposal of highway ROW if the property was acquired with Federal-aid highway funding. FHWA has already determined that CEC projects qualify for the full market value exception found in 23 U.S.C. 156(b)) and 23 CFR 710.403(e)).

To help states determine which process to follow for CEC applications, FHWA compiled Table 2.1. This chart compares the different requirements for when an installation on the ROW is accommodated as a utility vs when it is accommodated as an Alternative Use Permit.

Table 2.1 Utility Accommodation Process Compared to Alternative Use Permit Process for State DOTs to implement CECs in State ROW

	State definition allows for renewable energy to be considered as a utility facility *and* the project serves the public	**State law excludes renewable energy as a utility facility, project is not serving the public, or utility elects not to apply for a permit**
Applicable Federal Regulation	23 CFR part 645 **Utility Accommodation**	23 CFR part 710 **Alternative Use Permit Approvals**
Process	A State DOT's Utility Accommodation Policy (UAP) outlines the procedures, criteria, and standards it uses to evaluate and approve individual applications for utility facilities within the ROW. The FHWA Division Office reviews and approves new and revised UAPs for compliance with Federal requirements. The State DOT then enters a written arrangement setting forth the terms for a particular project. The State DOT can approve a utility project installation in accordance with the process outlined in the UAP without referral to FHWA. 23 CFR part 645	State DOTs may execute a ROW use agreement for a renewable energy project. This requires a determination by FHWA that such use is in the public interest; is consistent with the continued use, operations, maintenance, and safety of the facility; and such use does not impair the highway or interfere with the free and safe flow of traffic. (Except on Interstate highways, FHWA may assign its approval responsibilities to the State DOT. 23 CFR 710.405(a)). An application for a ROW use agreement approval must include planning and design details about the project, including provisions for maintenance access, terms of use, maps, plans, and sketches. 23 CFR 710.405.
FHWA Approvals Required for Renewable Energy Use of ROW	The FHWA must give programmatic approval of the UAP; project by project approval from FHWA is not required unless the proposed installation is not in accordance with 23 CFR part 645 or the UAP. 23 CFR 645.215.	FHWA approval is required for each use. 23 CFR 710.403(b) For non-Interstate projects, FHWA may assign approval authority to the State through their 23 U.S.C. 106(c) Stewardship and Oversight Agreement. 23 CFR 710.405(a).
FHWA Approvals Required for Access Control Changes on the Interstate	The State DOT must obtain written approval from FHWA prior to any temporary or permanent modification of access control on the Interstate System. (23 U.S.C. 111(a), 23 CFR 710.403(a). The approval applies to segments that have received Federal-aid funds.)	The State DOT must obtain written approval from FHWA prior to any temporary or permanent modification of access control on the Interstate System. (23 U.S.C. 111(a), 23 CFR 710.403(a). The approval applies to segments that have received Federal-aid funds.)
Approvals Required for Access Control	Approval is required prior to any temporary or permanent modification of access control on non-Interstate highways. 23 CFR	Approval is required prior to any temporary or permanent modification of access control on non-Interstate highways. (23 CFR

Changes on Non-Interstate Federal-aid Highways	620.202 and 620.203(a) and (h); see also 23 CFR 710.405 and 23 CFR 645.211. The approval applies to segments that have received Federal-aid funds. The approving authority for NHS highways is determined by the FHWA-State DOT Stewardship and Oversight Agreement. For non-NHS highways, the State DOT is the approving authority. See 710.403(a).	620.202 and 620.203(a) and (h); see also 23 CFR 710.405 and 23 CFR 645.211. The approval applies to segments that have received Federal-aid funds.) The approving authority for NHS highways is determined by the FHWA-State DOT Stewardship and Oversight Agreement. For non-NHS highways, the State DOT is the approving authority. (See 710.403(a).)
Does FHWA require the State DOT to charge a fee?	No. Fees charged for utility use, and the disposition of such fees by the State, are at a state's discretion. (This exception to 23 U.S.C. 156(c) is based on conference report language for section 126 of the Federal-Aid Highway Act of 1987 (Title I of the Surface Transportation and Uniform Relocation Assistance Act of 1987, Pub. L. 100-17 (Apr. 2, 1987)). With respect to 23 U.S.C. 156 provisions on income from right-of-way, added by the Act, the report stated, "[t]he charges and disposition of fees for utility use and occupancy of right-of-way will continue to be governed by 23 C.F.R. 645" (H.R. Conf. Rep. 100-27). The FHWA also has broad authority to establish utility accommodation criteria under 23 U.S.C. 109(l).) The FHWA does encourage States to use generated revenues for transportation purposes.	Yes, if Title 23 funds were used to acquire the ROW (subject to exceptions under 23 U.S.C. 156(b) and 23 CFR 710.403). Fair market rent is required for use of the ROW, unless there is an applicable exception or justification that the project is in the public interest based on social, environmental, and economic considerations, in which case an exception may be approved. The Federal share of the net income must be used for title 23-eligible purposes in accordance with 23 U.S.C. 156(c).
How does FHWA ensure the renewable energy project does not cause safety, aesthetic, or other problems?	The FHWA uses its stewardship and oversight program to make certain the State DOT meets these responsibilities. 23 CFR 645.215(b)	Through FHWA review and approval of the ROW use agreement. 23 CFR 710.405

2.3 Accommodation as Utility

For Kentucky to treat CECs applications as a utility and follow the process of implementing them in Kentucky's ROW as a utility accommodation, the CEC must meet the Federal definition of a utility as defined in 23 CFR 645.207:

> 23 CFR 645.207 defines "utility facility" as a privately, publicly, or cooperatively owned line, facility, or system for producing, transmitting, or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, storm water not connected with highway drainage, or any other similar commodity, including any fire or police signal system or street lighting system, which directly or indirectly serves the public. The term utility shall also mean the utility company inclusive of any substantially owned or controlled subsidiary. For the purposes of this part, the term includes those utility-type facilities which are owned or leased by a government agency for their own use, or otherwise dedicated solely to governmental use. The term utility includes those facilities used solely by the utility which are a part of its operating plant.

If a CEC application under consideration for installation on Kentucky's ROW meets the federal definition of a utility, the second step is to determine if it meets the Kentucky Revised Statutes (KRS) definition of a utility:

> KRS 278.010 (3) defines a "Utility" as any person[2] and, for purposes of paragraphs (a), (b), (c), (d), and (f) of this subsection, a city, who owns, controls, operates, or manages any facility used or to be used for or in connection with:
>
> (a) The generation, production, transmission, or distribution of electricity to or for the public, for compensation, for lights, heat, power, or other uses;
> (b) The production, manufacture, storage, distribution, sale, or furnishing of natural or manufactured gas, or a mixture of same, to or for the public, for compensation, for light, heat, power, or other uses;
> (c) The transporting or conveying of gas, crude oil, or other fluid substance by pipeline to or for the public, for compensation;
> (d) The diverting, developing, pumping, impounding, distributing, or furnishing of water to or for the public, for compensation;
> (e) The transmission or conveyance over wire, in air, or otherwise, of any message by telephone or telegraph for the public, for compensation; or
> (f) The collection, transmission, or treatment of sewage for the public, for compensation, if the facility is a subdivision collection, transmission, or treatment facility plant that is affixed to real property and is located in a county containing a city of the first class or is a sewage collection, transmission, or treatment facility that is affixed to real property, that is located in any other county, and that is not subject to regulation by a metropolitan sewer district or any sanitation district created pursuant to KRS Chapter 220.[3]

Although the statutory language may appear somewhat dated, a utility as defined by KRS 278.010 (3) is quite broad. For example, the statute includes within the definition of utility "…any person … who owns, controls, operates, or manages any facility used or to be used for or in connection with … the transmission over wire, in air, or otherwise of any message by telephone or telegraph." While KRS 278.010 (31) defines commercial mobile radio services and

[2] Person is a natural person, partnerships corporation and two (2) or more people having a joint or common interest per KRS 278.010 (2). Corporations includes private, quasi public, and public corporations, and all boards, agencies, and instrumentalities thereof, associations, joint-stock companies, and business trusts per KRS 278.010 (1).

[3] This statutory section specifically states a regional wastewater commission established pursuant to KRS 65.8905 is not a utility.

includes lines used in cellular telephone service, the statute does not define telephone. Yet, we commonly refer to cell phones as telephones. The Law Dictionary defines telephone as "any instrument or apparatus, which transmits sound beyond the limits of ordinary audibility." While Britannica defines a telephone as "an instrument designed for the simultaneous transmission and reception of the human voice" and the Merriam-Webster Dictionary defines a telephone as "a device by which sound (such as speech) is converted into electrical impulses and transmitted (as by wire or radio waves) to one or more specific receivers." Any of these definitions would fall within the scope of a utility as defined in KRS 278.010. For additional discussion, please see Chapter 5 of this report.

The same can be concluded for broadband services and small cell wireless applications, based on the definition of a telegraph. A telegraph is defined as "an apparatus, system, or process for transmitting messages or signals to a distant place, especially by means of an electric device consisting essentially of a sending instrument and a distant receiving instrument connected by a conducting wire or other communications channel" (Random House, 2024). That definition can encompass electronic notepads and/or computers or other devices. This interpretation of the statutory definition of utility is further bolstered by Kentucky statutes which encourage connecting unserved and underserved households and businesses to broadband and provide funding for such deployment efforts.

The generation, production, transmission, or distribution of electricity to or for the public, for compensation, for lights, heat, power, or other uses is not limited to fossil fuel sources of electricity. As in the case of broadband, the Kentucky legislature has expressed its desire to use renewable electric generation by enacting KRS 56.770 – 56.784 (Energy Efficiency for State Government Buildings) and other statutes.

2.4 KYTC Utility Accommodation Policy (*Permits Guidance Manual*)

KYTC's encroachment permit policy is directly applicable to how the agency can accommodate innovative uses of public ROW. The Cabinet must consider when a utility or other encroachment on state-maintained ROW is needed pursuant to the permitting process as outlined in KYTC's *Permits Guidance Manual*. This applies to utilities that are relocated as part of a highway project and for new accommodations. A brief overview of the KYTC *Permits Guidance Manual's* policy on accommodating utilities is given below. If the innovative use of ROW meets the Kentucky definition of a utility, the requirements described below would affect its placement within ROW.

The KYTC *Permits Guidance Manual* (Chapter 300) defines the policy of accommodating utilities within the ROW of the Kentucky State Highway System as such:

> "*any utility company, firm, individual, or governmental agency seeking to perform any type of work or activity other than routine maintenance on the right of way of a non-fully controlled access highway within the Kentucky State Highway System shall obtain a permit from the Department of Highways.*" (KYTC, 2021).

Separate requirements are set forth for utility facilities located on highways without full access control (e.g., access by permit) and highways with full access control (e.g., interstates, parkways, expressways). If a utility company is seeking a permit that includes attaching equipment to a utility pole owned by a different company, the applicant may be required to submit an attachment agreement or an acknowledgement from the utility pole owner before permit approval (KYTC, 2021).

On fully controlled access highways, the policy states:

"*utilities shall not be permitted to be installed longitudinally within the right of way of the Interstate or other fully controlled access highways, unless supported by an engineering study prepared by a registered professional engineer"* (KYTC, 2021).

The engineering study must show the following conditions can be met:

- No adverse effects to the safety, design, construction, operation, maintenance, or stability of the highway.
- The utility will not be constructed or serviced directly from the mainline highway or connecting ramps.
- The utility facility will not cause any stoppages to traffic during construction, operation, or maintenance of the facility.
- The utility facility will not interfere with or impair the present use or future expansion of the highway.
- The new longitudinal facility will not be permitted if a practical alternative location is available (i.e., alternative location not in the public's interest).

Utilities that cross (i.e., perpendicular to the roadway direction) fully controlled access highways can be permitted if certain conditions are met. The policy states:

"*The preferred method for new utility crossings on fully controlled access highways is underground. However, new overhead utility crossings may be allowed if the utility owner can show the proposed facility will meet the criteria outlined for existing overhead crossings in this policy; and the proposed facility, as installed is supported by an engineering study prepared by a registered professional engineer"* (KYTC, 2021).

This engineering study has similar requirements as those required for the longitudinal placement of utilities. Other requirements for new overhead crossings that must be met include minimum vertical clearance of the utility over the roadway and shoulders and the placement of poles, support structures, and ancillary equipment. Underground crossings are permitted if certain conditions are met, including minimum depth (under roadways, ramps, and ditch lines), pipe encasement needs, and construction methods. FHWA review and approval of permits is required for all requests involving an interstate (KYTC, 2021).

The policy for highways without full access control states:

"Utilities may be permitted longitudinally within, as well as across, the right of way limits, provided they do not interfere with the safe use of the roadway, median, and shoulder areas. Permitted utility installations shall not interfere with maintenance operations or aesthetics." (KYTC, 2021).

Requirements for overhead utility facilities placed within the ROW of non-fully controlled access highways include minimum vertical clearance over the roadway and placement of poles outside of the clear zone. For underground utilities, the policy states:

"*New or relocated utilities installed longitudinally shall not be installed under pavement, shoulders, or a roadside ditch. New or relocated utility facilities installed longitudinally shall be located behind the ditch and toe of slope as near to the edge of the right of way as practical."* (KYTC, 2021).

Certain minimum depth and encasement requirements for underground utilities placed on non-fully controlled access highways must also be met, which vary depending on the type of utility present.

Chapter 3 Clean Energy and Connectivity and the Public Right of Way

Clean Energy and Connectivity as defined in the 2021 FHWA guidance memorandum to state DOTs clarified specific uses of the public ROW that may be used to address climate change, increase equitable communications access, and grow energy reliability alternatives (Pollack, 2021). As discussed in Chapter 1, these potential uses identified include renewable energy generation, electrical transmission and distribution projects, broadband distribution, vegetation management, inductive charging travel lanes, alternative fueling facilities, and other appropriate uses.

Chapter 3 focuses on the following identified CECs to assist KYTC in response to the 2021 FHWA memorandum.

- Solar Power as a Renewable Energy Source
- Wind Power as a Renewable Energy Source
- Broadband
- Small Cell Wireless
- Connected and Automated Vehicles (CAVs)
- Electric Vehicles (EVs)

These technologies can help generate renewable energy in Kentucky (solar and wind), enhance connection points for wireless transmissions (small cell wireless), and facilitate ITS solutions to support connected and automated vehicles (CAVs).

3.1 Solar Power as a Renewable Energy Source

Solar power systems generally apply to three areas: (1) residential, (2) commercial and industrial, and (3) utility-scale. Residential solar systems connect to individual homes and are intended to offset energy requirements to power smaller buildings. Commercial and industrial systems are similar to residential systems, but on a larger scale. These systems generally utilize large, flat roof spaces, parking lot canopies, or open fields for solar systems that can be a source of revenue for companies. Utility-scale solar systems are often very large and sell electricity directly to utility companies or are owned by them. These systems can provide electricity to thousands of homes and businesses.

Three different scaled solutions for solar power system installations are available: (1) grid-tied, (2) off-grid, and (3) hybrid systems. A grid-tied solar system is connected to the power grid. With this type of system, owners can enjoy the benefits of solar backed up by the local electric utility company if solar energy production is too low to support the desired load. An off-grid solar system is not connected to the power grid and relies solely on solar energy production for electricity. Batteries are used to store excess solar energy for use at night or other times when solar energy production is low. A hybrid solar system is a combination of the previous two types. They are connected to the power grid and are also equipped with a battery storage system. Hybrid systems are the most flexible since electric power can be provided by the local utility through the power grid or by excess energy stored in the battery system when solar energy production is low.

Residential installations may be any of the three types. Commercial and industrial installations are usually grid-tied or hybrid systems since they likely always require electricity and cannot be off-grid. Utility-scale installations are always connected to the electric grid.

All three solutions are theoretically feasible within a highway ROW. Residential and commercial-scaled systems can assist or entirely offset energy requirements needed to power rest areas, maintenance barns, highway lighting, traffic signals, or larger government buildings. Although it is unlikely that sufficient land is owned by a transportation agency to accommodate a utility-scale installation, a utility scale installation could power DOT property and more. Regardless, the requirements of any solar power systems are similar.

Solar power installations are straightforward with few components and moving parts. The components of a system include:

- Solar photovoltaic (PV) cells that convert solar energy into electricity.
  - Several PV cells are grouped into modules, which then can be grouped further to make up a solar panel. The grouping of solar panels at a location is referred to as a solar array. See Figure 3.1.
- Inverters that convert direct current (DC) electricity created by the PV cells into alternating current (AC) electricity.
- Racking and mounting systems (fixed or sun tracking) that attach PV panels to a roof or the ground.
- Monitoring systems that track performance of the installation.
- Energy storage components (battery or grid connection for net metering).

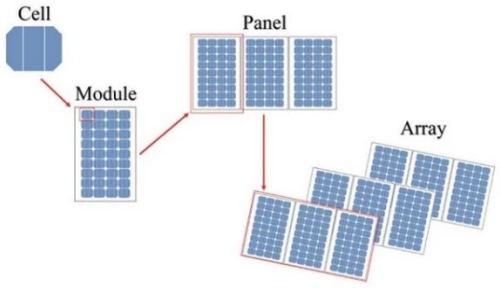

Figure 3.1 Solar Energy Generation Layout
(Source: EEPower)

DOT Solar Power Applications

Although many states have begun testing solar power generation on ROW, the states discussed below have brought online the most facilities and have used partnerships with utility companies to access the local electric grid.

Oregon: Oregon began solar power generation on ROW in 2008 under the Oregon Solar Highway Program. The first site (Figure 3.2), located at the I-5 and I-205 interchange south of Portland, is made up of 594 solar panels and generates approximately 104 kilowatts (kW) of electricity, which helps power interchange lighting (ODOT, n.d.). The situation of providing interchange lighting works backwards of traditional net metering. During the day, when lighting is turned off, the solar panels feed electricity into the grid and then at night when the lights are powered on, electricity from the grid is used. In 2011, ODOT began construction on a larger, 1.75 megawatt (MW) solar facility at a rest area on I-5 south of Wilsonville (ODOT, n.d.). Both facilities have remained in operation and utilized public-private partnerships for project planning, construction, and operation. The use of public-private partnerships allowed ODOT to take advantage of federal and state renewable energy tax credits and incentives.

ODOT created a guidebook that other state DOTs can use to develop solar facilities on ROWs. This guidebook, most recently revised in 2016, provides information and recommendations to state DOTs in the following areas (ODOT, 2016):

- Creating a statewide solar program that includes the ROW and other DOT-owned facilities
- An overview of gaining support, finding funding, navigating state specific regulatory environments, and FHWA policies
- The development of a solar project, including the creation of a project team and screening sites for feasibility
- Public involvement and communication strategies
- Business models, including public-private partnerships and funding mechanisms
- Contractor selection, project delivery, and implementation

Figure 3.2 ODOT Solar Facility at I-5 and I-205 Interchange
(Source: Google Earth)

Massachusetts: The Massachusetts Department of Transportation (MassDOT) has installed solar panels on administrative buildings and at interchanges in the state. The ground-mounted installations at interchanges are part of the MassDOT Solar Energy Program. This program intends to "*build ground-mounted solar PV generation facilities within state highway layouts throughout Massachusetts*" and "*reflects the agency's desire to reduce greenhouse gas emissions by promoting renewable energy generation* (MassDOT, 2024)."

MassDOT solar program works by using public-private partnerships to lease preapproved solar generation ROW locations. The state purchases power from the site developer at a predetermined rate for the length of the lease (MassDOT, 2024). MassDOT lists the following reasons why this financing and operating arrangement is beneficial:

- Zero upfront capital costs
- Full utilization of federal tax incentives through the private sector
- Positive cash flow from the difference between power purchased from the contractor and credits applied to utility accounts
- Lease revenue for the developer's use of state properties

To date, MassDOT has developed eight sites on ROW, which generate approximately 4.3 MW of electricity. It is estimated they save $600,000 annually in electricity costs. MassDOT had developed web-based dashboards for each of the locations part of the solar program that provide historical statistics for the site, such as electricity produced

by unit of time, information on the mass of CO_2 saved, and the equivalent number of homes heated for a year or miles driven. Figure 3.3 provides an example of this dashboard at one location.

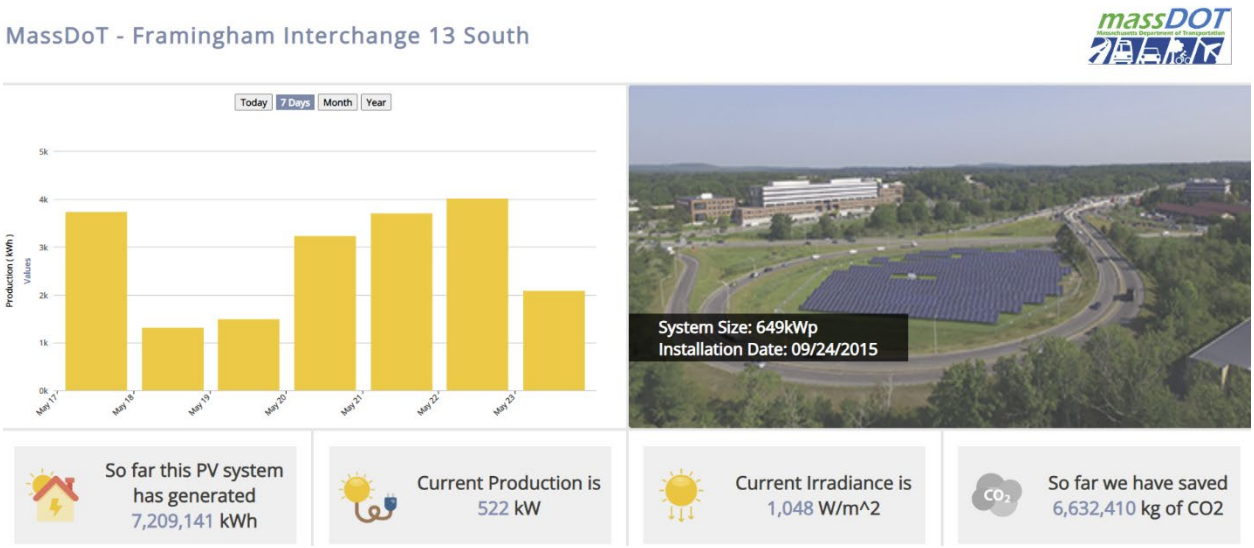

Figure 3.3 MassDOT Solar Site Dashboard
(Source: Google Earth)

Michigan: Michigan DOT has installed solar facilities at five Rest Area/Welcome Centers and at park and ride lots. Rest area/welcome center solar facilities were funded by a U.S. Department of Energy grant and consist of single ground-mounted arrays.

The park and ride lot solar facility (Figure 3.4) located near State Route 44 and I-96 in Grand Rapids consists of two rooftop carport installations that were constructed in 2012 (FHWA, 2015). These two rooftop solar arrays generate approximately 96 kW of electricity and are used to power lighting at the adjacent interchange (FHWA, 2019).

Figure 3.4 Park and Ride Rooftop Solar Facilities in Grand Rapids, Michigan
(Source: Google Earth)

Vermont**:** The Vermont Agency of Transportation (VTrans) has installed solar facilities at state garages, an airport, and at a welcome center (VTrans, 2016). At the welcome center, they used ground-mounted solar arrays.

VTrans has developed a five-step process (VTrans, 2016) for developing a solar project. A more detailed description is available in the *Vermont Solar Development Plan*.

- Step 1: Assemble the Project Team
  - Recognize core capabilities and competencies required for solar project success
  - Find internal and external team members who can provide subject-matter expertise as the project is developed.
- Step 2: Candidate site evaluation
  - Initially screen sites and reduce to fewer locations for a more in-depth review.
  - Solar suitability analysis, stakeholder identification, environmental considerations
- Step 3: Evaluate financial analysis and ownership models
  - Incentives available and financial analysis
  - Ownership models
- Step 4: Due diligence and project confirmation
  - A more in-depth review of each project component including project financing
  - Interconnection studies, public engagement, impacts analysis
- Step 5: Implementation
  - Final design and permitting
  - Site Construction
  - Operating the solar facility and maintaining it

Solar Radiation Levels

In the U.S., the southwest receives the most solar radiation per day because this region is closer to the equator and experiences fewer days with significant cloud cover. Although several factors are at play, one measure for the potential of solar power generation is solar irradiance, which is the power per unit area received from the sun. While Kentucky's potential to receive solar radiation is less than the southwest, it is similar to locations in Oregon, Massachusetts, Michigan, and Vermont, which have successfully developed solar projects (see Figure 3.5). Most of Kentucky receives between 4 and 4.5 kWh/m^2/day of solar radiation. Other factors such as surrounding topography and the presence of trees or buildings impact the amount of radiation received at a particular location.

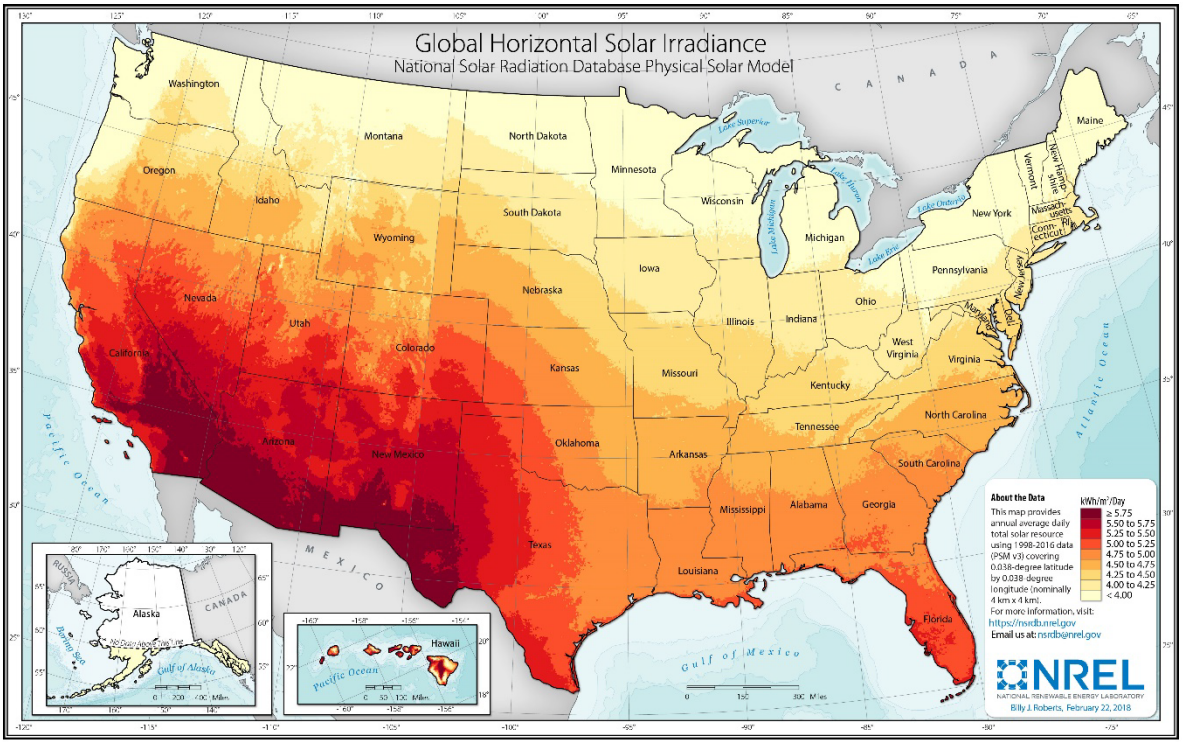

Figure 3.5 Annual Average Daily Solar Irradiance
(Source: National Renewable Energy Laboratory [Sengupta et al, 2018])

Physical Standards

When designing a renewable power generation project, the system should be sized for the anticipated load (Kraus et al, 2020). The electrical load (electricity demand) will depend on the facility needing power (e.g., interchange lighting, rest areas, weigh stations, park and ride lots) and devices expected to need electricity at the site (e.g., lighting, heating, and cooling, water pumps).

If allowable by state statute, connecting to the electric grid can provide greater system reliability and redundancy. By utilizing net metering, unused power can be sold back to the grid for greater project financial viability. Having resiliency built into the system on renewable energy projects is essential for project success and the safety of the traveling public.

Proximity to substations, three-phase power lines, higher voltage lines, and the ability for the grid to support the generated electricity is needed (VTrans, 2016). Most electric companies must perform an interconnection study to determine if the existing electric infrastructure needs upgrading to support new connections.

Orientation

Solar arrays should be oriented to be mostly southern facing to take advantage of the location of the sun as it moves throughout the day. Typically, at least six hours of direct sunlight per day is preferable.

Locational Standards

The solar array and its components, including any fencing, at a minimum should be located outside of the clear zone as described in the *AASHTO Roadside Design Guide* (RDG). Where placed adjacent to a horizontal curve, the curve adjustment factor should be applied to the clear zone. Some states, such as Michigan, have chosen to place solar

facilities at a distance greater than the clear zone distance in the RDG (Kraus et al, 2020). For interchanges, gore quadrants are preferred for locations at merge (entrance ramps) rather than locations within diverge (exit ramps) given the higher potential of errant vehicles ending up in the divergent areas of the roadside. Adding roadside barriers to make a site feasible for solar infrastructure is not recommended, as it would introduce a new obstacle to the roadside. Instead, other sites should be considered for solar installation if roadside proximity is a requirement for larger solar installations.

The location of site access points to solar sites on Kentucky's public ROW should be reviewed to minimize any safety concerns to the driving public or those maintaining the infrastructure. Location access points should follow *KYTC Permits Guidance Manual* entrance guidelines, including adequate intersection sight distance. If the access point involves ROW located on the Interstate system, an FHWA review is also required. The preferred order of site access points are listed below.

- Access off a local or state-maintained roadway
- Access off a freeway ramp
- Access off the mainline freeway

Site security is another safety consideration. The solar array should include security fencing and monitoring against tampering and trespassing. Other states have installed security cameras, warning signs, and motion-activated lighting.

Other safety considerations include placing solar panels at locations that would not shade the roadway pavement or pedestrian facilities, thus creating a situation where ice may melt slower. Although solar panels are designed to absorb light, glare should be considered when locating solar arrays (Kraus et al, 2020).

Topographical/Geographical Standards

When selecting a site for solar arrays, the location of vegetation and trees should be evaluated. These have the potential to block light, for at least part of a day, from the solar panels and can potentially damage solar facilities during inclement weather.

The surrounding topography should also be reviewed before choosing the location. Locations in valleys or with hillsides have the potential for reducing the duration of light each day. The slope of the land the solar array is located on affects project cost and ease of maintenance. Several sources recommended a maximum ground slope of 5%.

Available ROW is important in site selection in that enough space is needed to safely locate (e.g., outside of clear zones) a solar array designed for the anticipated load. Sites with at least two acres of available space are recommended as a minimum for locations at interchanges.

Highway Maintenance

KYTC will also need to consider general roadway maintenance when developing new ROW facilities, like solar, on the public ROW. Consideration for roadway maintenance activities in the *Field Operations Guide*, such as access for mowing, vegetation removal, snow and ice removal during major winter events and other regular maintenance activities could bring direct conflict with new installations. Other maintenance/construction related activities, such as the ROW being used as a construction laydown yard or storage site (for temporary barrier wall) for resurfacing or reconstruction projects, should be reviewed. Especially at interchanges, determine if the location serves as a stockpile for embankment material for use on future projects. Lastly, site selection will depend on if the area has already

been identified as a pollinator habitat-planting plot, as many of these occur along interstates, parkways, and at their interchanges.

Corridor and/or Suitable Location Guidance

The source (e.g., solar, wind) of renewable energy suitable for different transportation facilities can vary. The types of roadside facilities considered for renewable energy power generation include rest areas, truck parking areas, interchanges, weigh stations, park, and ride lots, and excess ROW.

The discussion below shows the most applicable solar type facility for each of these locations. In general, four types of solar generation facilities have been used on ROW — ground-mounted solar arrays, roof-mounted solar arrays, parking canopy solar arrays, and solar trees. Table 3.1 shows the type of solar facility that is most appropriate for use at each roadside facility.

Ground-mounted solar arrays

These are the simplest facility type. Numerous ground-mounted solar arrays have been constructed by state DOTs across the country, including at rest areas and within interchanges. Figure 3.6 shows a ground-mounted solar array at the I-94 rest area and truck parking in Michigan.

Figure 3.6 Ground-mounted: I-94 Rest Area and Truck Parking, Michigan
(Source: Google Earth)

Roof-mounted solar arrays

These are common for residential and commercial/industrial installations. With roof mounting, the size of the system is limited by the roof area available at the facility. The direction and slope of the roof are also factors. The roof of the building or structure should be checked to determine if it can handle the additional loading of the panels. The condition of the roof should also be considered before attaching solar panels (i.e., if the roof is at the end of its service life and will be replaced in the near future solar panels should not be installed until after roof replacement). Roof attachments should also meet local building codes. Figure 3.7 offers an example of a roof mounted solar array at the I-5 rest area in California.

Figure 3.7 Roof Mounted: I-5 Rest Area, California
(Source: Google Earth)

Parking Canopies

Parking canopies are similar to roof-mounted solar arrays but are located over parking spaces where large trucks are not expected. The placement of the canopy should not impede any Americans with Disability Act (ADA) requirements at the roadside facility, such as loading areas at handicap parking stalls.

Solar Trees

Solar trees are installed at locations with high visibility to give an aesthetic presentation. The amount of power generated by solar trees is less than the other types. Typically, these would be located at rest areas and can provide a renewable energy education opportunity. Solar trees can be connected to the grid but are usually used to power one location. Consideration for the shading potential of solar trees should be evaluated at pedestrian facilities. Figure 3.8 shows a solar tree at the I-85 rest area in Georgia.

Figure 3.8 Solar Tree: I-85 Rest Area, Georgia
(Source: Google Earth)

Table 3.1 Roadway Facility Solar Types

Roadway Facility	Ground Mounted	Roof Mounted	Parking Canopy	Solar Tree
Rest Area[1]	X	X	X	X
Truck Parking[2]	X	X		
Weigh Station[3]	X	X		
Park and Ride Lot[4]	X	X	X	
Interchanges[5]	X			
Excess Right of Way	X			

[1]Electrical needs typically include outdoor lighting, building needs

[2]Electrical needs typically include outdoor lighting

[3]Electrical needs typically include outdoor lighting, building needs, security cameras, Weigh in Motion Equipment

[4]Electrical needs typically include outdoor lighting, EV charging

[5]Electrical needs are typically for interchange lighting

Future Transportation Improvements

When selecting a site for solar power generation in the ROW, a review of future transportation improvements is necessary to protect the renewable energy investment. ODOT recommends that site selection consider future transportation needs over a 20+ year horizon that would encompass the length of any solar project agreements (ODOT, 2016). Future needs should be accessed at the mainline roadway, interchange, and any crossing roadway near the proposed solar site.

In Kentucky, several transportation plans and documents can be consulted for the potential for future projects and transportation needs:

- KYTC Highway Plan
- Statewide Transportation Improvement Plan (STIP)
- Metropolitan Transportation Plans (MTP) and Transportation Improvement Plans (TIP) if within a Metropolitan Planning Organization (MPO) boundary.
- KYTC Long Range Statewide Transportation Plan
- Statewide Corridor Plan (Linking Kentucky)
- Available Planning Studies and Reports

Best Practices for Implementing Solar Power on State-Owned ROW

- Review how other states have leveraged solar power through public-private partnerships, state and federal tax energy credits, private lease agreements, and PPAs. Identify strategies KYTC can use to lower power consumption on highway projects.
- Physical Standards
  - Solar arrays should be southern facing and receive at least six hours of direct sunlight daily.
  - For large electric loads, solar stations should be connected to the electric grid for resiliency and safety for the traveling public. Unused power can be sold back to the grid to reduce costs if allowed by law.
- Locational Standards
  - Solar arrays must be located outside the clear zone.
  - Solar installation access points should be established pursuant to the *KYTC Permits Guidance Manual*. Minimize safety issues installations pose to the driving public and workers maintaining site infrastructure.

- Adopt roadside landscape management practices that will prevent vegetation from obstructing solar installations.
- Avoid siting installations where topographical constraints could reduce the amount of sunlight received by solar panels.

- Solar installations should not be located on parcels where transportation improvements will likely be needed within the next 20 years. A 20-year time horizon should cover the length of any agreement between KYTC and private sector partners.

3.2 Wind Power as a Renewable Energy Source

Wind can be a more efficient power source than solar. Wind turbines release less carbon dioxide, consume less energy, and produce more energy. One wind turbine can generate the same amount of electricity as about 48,704 solar panels (ElementalGreen, n.d.). However, that potential comes at a cost. Most wind production facilities in the U.S. are in rural areas as they require a large area of land, may serve as a source of noise pollution, and can be an eyesore to some residents. Like the varying periods and availability of sunlight for solar installations, wind speeds can vary greatly from hour to hour and season to season. For these reasons, wind turbines are not suitable for all states and regions in the U.S. as the technology currently exists. However, as renewable energy technology progresses, additional states and regions could add this to their renewable energy tool kit.

DOT Wind Power Applications

Wind power as a renewable energy source has not been as pervasive as solar power due to the land requirements, potential perceived negative effects and the unpredictability of wind speeds. As such, the implementation of wind-generated power on state ROW has not been tested to the extent solar generated has been. The majority of states using wind generated power are located in the central or western part of the country.

Montana: In 2008 the Montana Department of Transportation (MDOT, 2011) installed a 98 foot tall, three bladed free standing lattice tower 10 kW wind turbine at the I-90 Anaconda Rest Area. This was an experimental installation to determine the cost effectiveness of a wind turbine connected to the grid to supplement power at the rest area (MDOT, 2011). When in operation the turbine supplemented 20 percent of the annual rest area power needs. The wind turbine did experience mechanical issues and was not in continuous operation during the observation period.

Nebraska: A hybrid wind and solar power generation facility was installed at the intersection of 84th Street and Nebraska Parkway in Lincoln to power a traffic signal and intersection lighting. Connecting wind and solar renewable energy generators at the location was expected to provide more continuous power generation to the connected microgrid and the larger electric grid (Qiao et al, 2011).

Texas: The Texas Department of Transportation (TxDOT) installed wind turbines at two rest areas in 2003. The first on US 62 in Culberson County with a 10 kW turbine on an 80 foot tall tower. The second location on I-40 (Figure 3.9) in Gray County is a 50 kW turbine on an 80 foot tall tower. During the first two years of operation, a private company operated and maintained the turbines, providing training to TxDOT staff on system monitoring, problem evaluation, and minor repairs (FHWA, 2019). Power generated at both locations is used for rest area electricity.

Figure 3.9 I-40 Rest Area Wind Turbine in Texas
(Source: Google Earth)

U.S. Wind Speeds

Average annual wind speed is one measure used to gauge site suitability for wind power generation, as different regions of the U.S. experience different annual wind speeds. For example, the central plains region (northern Texas to North Dakota) and the area east to west between Iowa and Wyoming, experience the highest average annual wind speeds, typically between seven and nine meters per second (m/s). Whereas Kentucky experiences average annual wind speeds in the range of four to six m/s.

Figure 3.10 shows U.S. average annual wind speeds at 80 meters above the surface, which represents an elevation where commercial wind generation is present. Wind speeds vary throughout the day and by season. In Kentucky, on average wind speed generally is lower in the summer months and higher in the winter months (UK, 2024).

Wind power generation infrastructure is relatively new in Kentucky compared to other states. In 2024, Louisville Gas & Electric / Kentucky Utilities opened its first utility wind turbine in the state. This 165 foot tall wind turbine located in Mercer County is part of the company's research program and will be evaluated to determine the potential for wind to contribute to renewable energy production in Kentucky (LG&E/KU, 2024).

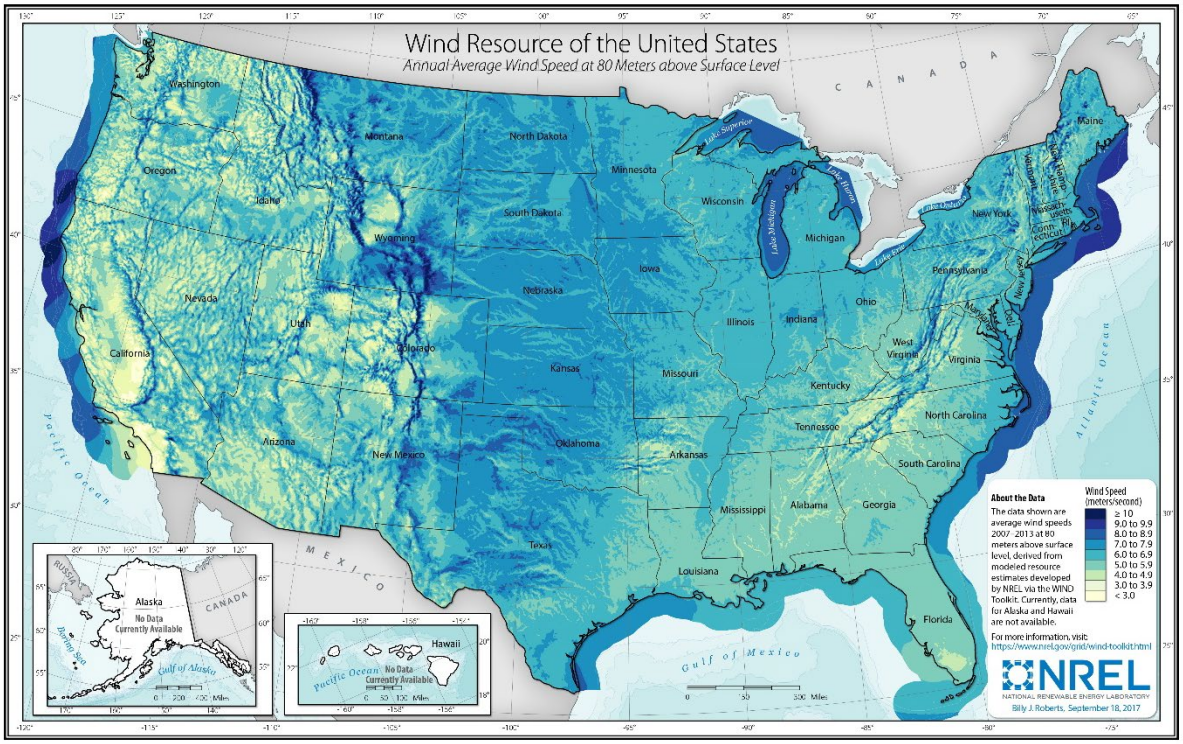

Figure 3.10 Annual Average Wind Speed at 80 Meters
(Source: National Renewable Energy Laboratory [Draxl et al, 2015])

Physical Standards

Currently, two types of wind energy turbines exist — horizontal-axis turbines and vertical-axis turbines (See Figure 3.11). Horizontal-axis turbines are presently used more frequently in the U.S. landscape, as they are more efficient than older vertical-axis turbines. Horizontal-axis turbines typically have three blades, similar to an airplane propeller, mounted on a tower whereas vertical-axis turbines have blades attached at the top and bottom of a vertical rotor (KiwiEnergy, 2018).

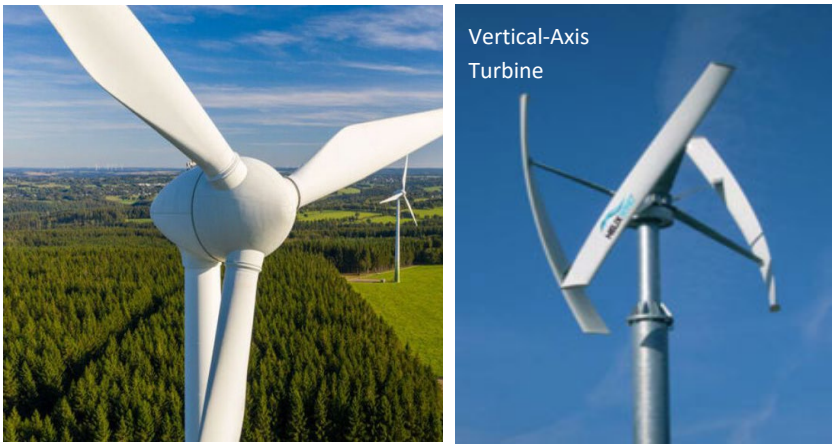

Figure 3.3.11: Wind Turbine Types
(Source: Wind Cycle and Windpower Engineering & Development)

Three types of wind energy installations are common — utility-scale, offshore, and distributed. Utility-scale turbines produce from 100 kilowatts (kW) to several megawatts (MW) of electricity that is supplied to the electric grid. Off-shore wind turbines are located in large bodies of water and are typically the largest turbines that can be constructed with current technology. Distributed wind turbines produce less than 100 kW and are typically used to power a home, farm, or small business that may not be on the electric grid or to offset power consumption at a facility that is connected to the grid (KiwiEnergy, 2018).

Wind power systems rely on few components and moving parts. The components of a system include:

- Tower – Supports the nacelle, hub, and blades at heights up to nearly 300 feet in the United States as of 2020.
- Nacelle – Housing on top of the tower that contains all the components necessary to convert wind energy into electricity.
- Hub – Attaches the blades to the nacelle and allows rotation.
- Blades – Typically three in an airfoil shape similar to the wings of an airplane.
- Inverter – Converts direct current (DC) electricity into alternating current (AC) electricity when needed.
- Energy storage components (battery or grid connection for net metering)

Orientation

Wind turbines are designed to move into the direction of the wind. Smaller turbines use a tail fin to move the blades into the wind and larger turbines have geared powertrains that physically move into the wind. Therefore, orientation for wind turbines is not as critical as is for solar facilities.

Locational Standards

Many of the factors to consider when selecting the location of wind power generation facilities are the same as those considered when selecting a location for solar power. However, there are a few aspects of wind power that are different.

Topographical/Geographical Standards

Generally, the higher above the ground a wind turbine is located the higher the wind speeds are expected to be. Favorable locations include relatively flat terrain, tops of smooth rounded hills, and mountain gaps that funnel and intensify the wind (EIA, 2023). Given the limited size of the ROW and roadside facilities, the large wind turbines used on utility-scale power generation are not expected to be placed on the ROW. Smaller wind turbines are more likely to be used. Since these smaller turbines are not as high off the ground, tree and vegetation obstructions should be avoided.

Best Practices for Implementing Wind Power in the ROW

- Good locations for wind turbines include higher elevations with flat terrain and mountain gaps that can funnel and intensify wind.
- Public meetings and educational forums should be held for community members impacted by potential wind turbine installations so they can provide feedback.
- As wind turbine technology advances, new applications for ROW installation may emerge.

3.3 Broadband

The Federal Communications Commission (FCC) defines broadband internet as having a minimum download speed of 25 megabits per second (Mbps) and 3 Mbps upload speed. It provides high-speed internet via multiple types of technologies including fiber optics, wireless, cable, DSL, and satellite. For the purposes of this report, broadband will focus on fiber optic installations, which can be either underground in conduit or above ground attached to pole lines.

Figure 3.12 shows the breakdown of internet speed ranges in Kentucky. Half the state has access to 1 gigabit per second (Gbps) upload/100 Mbps download internet speeds, but almost 14 percent of the state is unserved and does not have access to broadband internet speeds. A little over 3 percent of the state has a maximum speed of 25 Mbps upload/3 Mbps download internet speed, which represents an underserved area.

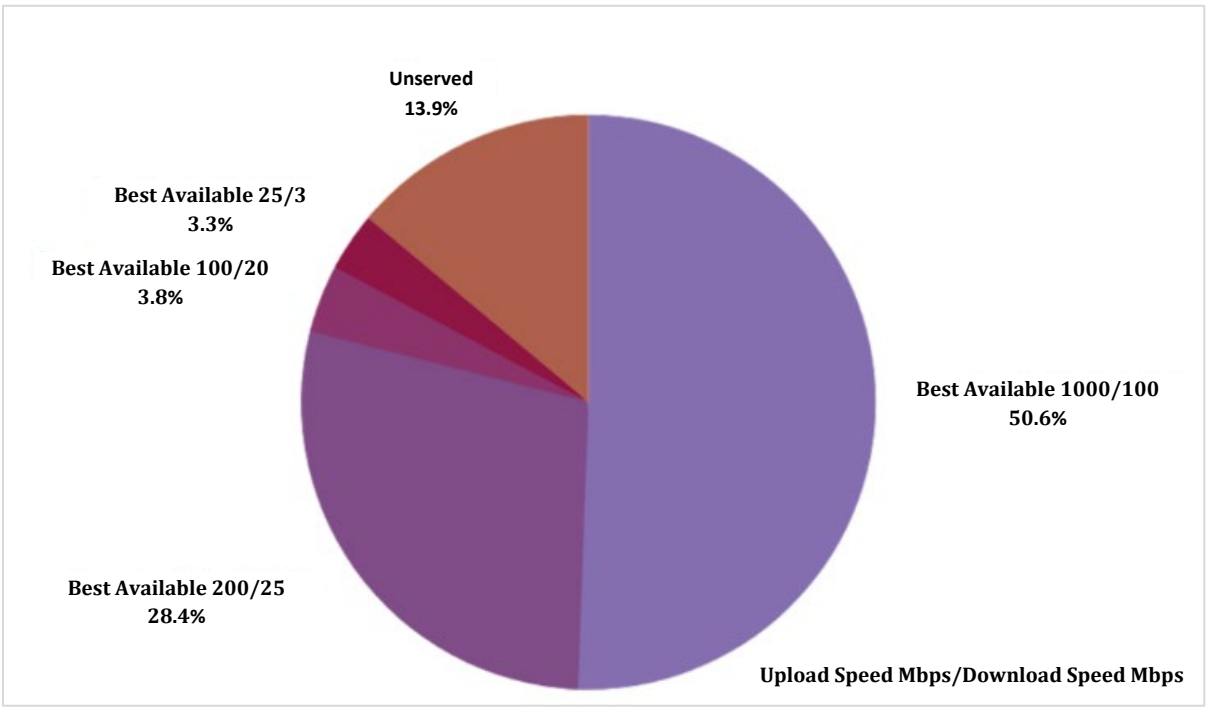

Figure 3.12 Percentage of Locations by Internet Speed
(Source: KY BEAD Five-Year Action Plan)

Providing internet by broadband can be broken down into three "mile" categories. The first mile can be looked at as the larger internet. This is the transmission of large amounts of data between servers and even across oceans and continents. The middle mile is the network connection between the larger internet and the final leg of connection. This middle mile can connect large office buildings, government organizations, industrial parks, and campuses. The last mile provides the final connection between internet service providers and homes and small businesses.

MOBILE NOW Act

The MOBILE NOW Act (MNA) and the FHWA Broadband Infrastructure Deployment Rule (23 CFR 645) require states to perform the following functions for broadband implementation:

- Identify a broadband coordinator who is responsible for facilitating broadband implementation on the ROW (MOBILE NOW Act, 2018). In Kentucky, this coordinator resides in the Office of Broadband Development.

- Establish a registration process for broadband companies that want to be included in the deployment program. Broadband providers in Kentucky can register through the Kentucky Office of Broadband Development website.[4]
- Set up an electronic notification to the registered companies on an annual basis of the state DOT's highway improvement program (e.g., Statewide Transportation Improvement Program) and other notifications as needed. The Kentucky Office of Broadband Development provides electronic notifications to the registered companies.
- Coordinate initiatives with other statewide telecommunication and broadband plans, state and local transportation plans, and land use plans. This includes strategies to minimize repeated excavations that involve broadband infrastructure installed on ROW.
- If providing broadband as part of a Federal-aid highway project, the state DOT shall ensure existing broadband entities are not disadvantaged.
- Does not establish or mandate that a state install or allow broadband in highway ROW and that the US Secretary is not authorized to withhold funds.

DOT Broadband Applications

Most states, including Kentucky, classify the installation of broadband infrastructure as a utility and allow its placement on ROW in the same way they grant permits for other telecommunication services. Below are examples from other states.

Wisconsin: The Wisconsin Department of Transportation updated its *Right of Way and Permits Manual* to comply with the FHWA's new rule on broadband infrastructure deployment on ROW that resulted from the MNA. The manual now complies with the Section 607 requirements of the MNA, including

> (1) a broadband utility coordinator has been identified, (2) a registration process has been put in place for broadband companies to receive highway project updates, (3) an electronic notification process has been started to notify the broadband companies annually of STIP updates and when necessary, and (4) the state is to coordinate its activities with other statewide telecommunication and broadband plans, state and local transportation plans, and land use plans (WDOT, 2022).

Arizona: State statute (AZ HB 2596 Laws 2021) and code (A.A.C. R17-3-602) requires the Arizona Department of Transportation (ADOT) to collect compensation from telecommunication companies if their facilities are placed longitudinally along highways (Burgess et al, 2024). These fees are applicable to new broadband construction parallel to the highway. Perpendicular crossings and the installation of fiber in existing conduit is exempt.

Fees can be monetary or in-kind. An in-kind compensation includes specific telecommunication facilities and services for use by the state. An annual occupancy rate is paid for the longitudinal placement and ranges from $0.25 per linear foot along an uncontrolled highway to $1.00 per linear foot placed on the Interstate system. The code has written in an annual 2 percent rate increase. There is an option for the utility to pay this fee annually or as a lump sum. The law dictates that fees received are to be used for the operations and maintenance of state conduit and/or for future broadband projects.

Utah: The Utah Department of Transportation (UDOT) also requires compensation for the placement of telecommunication facilities (e.g., cable, line, fiber, wire, conduit) on state ROW (Utah Code 72-7-108). Compensation can be in

[4] https://broadband.ky.gov/resources/Pages/Broadband-Coordination.aspx

the form of cash, in-kind, or a combination of the two. In-kind compensation can include giving the state access to the placed telecommunication lines. Fees can be paid as an annual installment or as a lump sum and are apportioned to the Transportation Fund.

UDOT allows broadband facilities longitudinally on Interstate ROW if the installation does not significantly compromise the safe, efficient, and convenient use of the Interstate System for the traveling public (Burgess et al, 2024). In addition to a permit, UDOT also requires an agreement be in place before allowing the placement of broadband facilities. This agreement is limited to a maximum term of 30 years.

Indiana: In 2018, the Indiana Department of Transportation established broadband permit guidelines and broadband corridors (IDOT, n.d.). The purpose of these corridors are to *"facilitate, implement, and maintain new avenues for rapid deployment of broadband throughout Indiana by focusing on removing any barrier that may prevent providers from deploying broadband or wireless facilities within the right of way."* Broadband corridors include all of the Interstate highways within the state, toll roads and bridges, and other select highways.

Non-recurring and recurring (annual or monthly) fees are assessed depending on the encroachment type. These can be assessed on longitudinal fiber optic, macro cell towers, and small cell wireless poles (for small cell wireless see Chapter 3.4). In addition to a permit for these installations a broadband agreement is also required.

Maryland: The Maryland Department of Transportation (MDOT) has three processes described in their *Utility Manual* that affect the placement of broadband facilities on ROW – Consolidation and Joint Use Trenches, Out of Service/Deactivated Lines, and Resource Sharing (MDOT, 2021).

- Consolidation and Joint Use Trenches involve grouping utilities in space in a way that reduces the amount of ROW needed to accommodate them. Given the greater needs placed on ROW, this is a method to accommodate multiple uses while maintaining the safety and functionality of the transportation facility.
- Utility companies are still responsible for out of service/deactivated utility lines, even if left in place. Any out-of-service/deactivated facility that contains hazardous materials or that is located aerially shall be removed at the utility's expense. If left in place the utility company is to provide information including the location, size and type of materials used. This helps MDOT know what is located in its ROW.
- Resource Sharing is the private industry installing telecommunications equipment on ROW in exchange for providing telecommunications services to state entities. The types of equipment that can be installed include fiber optic lines, wireless communication facilities, data sharing, and the collocation of equipment on existing infrastructure. Maryland law allows for resource sharing agreements (Ch 115 3A-307).

Current Kentucky Broadband Efforts

KentuckyWired

KentuckyWired is a middle mile network connecting government offices, universities, community colleges, state police posts, state parks, and other government institutions to the internet (KCNA, 2022). The middle mile provides a connection between the larger internet and the final leg of connection to customers. This state-run project is overseen by the Kentucky Communications Network Authority and has constructed over 3,300 miles of 288-strand high-speed fiber optic cable in all 120 Kentucky counties. Internet service providers and cellular service providers are allowed to connect to KentuckyWired fiber optic through leasing arrangements.

To date the KentuckyWired fiber optic network is built out and installed. Where on state ROW an encroachment permit was obtained prior to broadband construction. With this infrastructure now installed, future maintenance

must adhere to permitting requirements in the KYTC *Permits Guidance Manual*. The project now focuses on migrating state offices, universities, and community colleges over to the network. In total, this will encompass 769 sites. The KentuckyWired network and partnerships are shown in Figure 3.13.

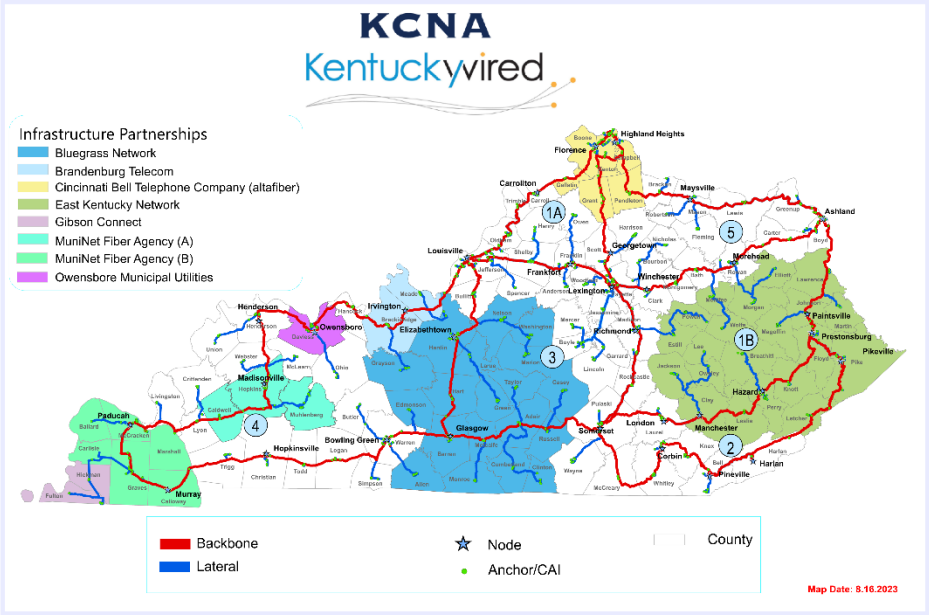

Figure 3.13 KentuckyWired Network

Kentucky Office of Broadband Development

From its website, "*the Kentucky Office of Broadband Development was established in 2022 as the central broadband planning and coordination entity to encourage, foster, develop, and improve broadband within the Commonwealth*." The office focuses on the last mile of broadband implementation, which is the last leg of connection between an internet service provider and homes or small businesses. By doing so, the Office looks to make broadband accessible to unserved and underserved communities and populations. It seeks to improve Kentucky's economic competitiveness, aid in job creation, and meet the broadband needs of Kentuckians. The Office also holds the Utility Broadband Coordinator required by the MNA.

It manages both state and federal funding sources including the state Broadband Deployment Fund ($300 million), the Better Internet Grant Program ($182 million), the Rural Infrastructure Improvement Fund ($20 million), and the Broadband, Equity, Access, and Deployment (BEAD) Program. Kentucky is set to receive close to $1.1 billion through the BEAD program. The Office of Broadband Development has developed a Five-Year Action Plan that lays out the state's priorities for expanding broadband in Kentucky. This plan is a piece of information needed as part of the BEAD program. This action plan was conducted in partnership with the Digital Equity Act (DEA) planning process. This planning process is overseen by the Office of System Equity which provides many resources including the Kentucky Broadband Map of Targeted Populations, which provides mapping and guidance on areas in Kentucky that are targeted for future broadband installations.

Corridor and/or Suitable Location Guidance

In Kentucky, Broadband installation on state ROW has been treated as a utility. Specifications on location, clearance, and depth as set forth in the KYTC *Permits Guidance Manual* and summarized in Chapter 2.4 of this report are used.

Consideration can be made for receiving compensation from telecommunication companies to place broadband infrastructure on state-maintained ROW. If KYTC wants to pursue compensation for the installation of broadband on state ROW, a thorough review of current state law should be conducted. Legislation would then need to be enacted that updates regulations to include compensation and valuation methods. Chapter 6 provides additional information on compensation from utility companies.

One opportunity for consideration is the utilization of abandoned utility conduit for the installation of new broadband fiber. Several states have been evaluating how to incorporate abandoned utility conduit for the installation of broadband. However, to implement this process the location of the abandoned facility, its condition, and the physical characteristics (i.e., conduit size and material) need to be known. This would require updated utility relocation and permitting guidance to make receiving this information from the utility companies mandatory when abandoning a facility.

The sale of surplus ROW for the purpose of locating broadband facilities is a possibility and could also be sold for the purposes of locating small cell wireless or future connected roadway infrastructure. The sale of surplus ROW is a one-time revenue generation source and also relieves KYTC of future maintenance obligations on the property.

Broadband Corridor Plan

KYTC should consider developing a broadband corridor plan that identifies possible routes for future inclusion of broadband facilities. The plan could be informed by many possible sources:

- Location of abandoned utility corridors and/or conduits
- Location of suitable access ROW
- Identification of corridors identified as likely candidates for CAV applications. Broadband will be needed in the CAV corridors to provide backhaul.
- Plans for future expansions of high speed internet as identified in BEAD program and the Kentucky Broadband Map of Targeted Populations

Best Practices for Broadband on Right of Way

- Continue to treat broadband as a utility and adhere to the Kentucky utility accommodation policy.
- Update utility accommodation policies to include MNA requirements.
- Develop a broadband corridor plan.
- Establish regulations that will allow KYTC to seek compensation from broadband companies, including in-kind compensation that would let the agency use some of the fiber line for transportation-related uses. This could potentially aid in CAV implementation. A best practice is to build into the regulations a description of how fees will be adjusted over time.
- Require utility companies to provide digital plans as part of permit submittals. These would be placed into a KYTC database that documents what utilities are present on the ROW. This is a best practice for all utilities.
- Require that utility companies — once facilities have been decommissioned or abandoned — provide material type, size, and location data to KYTC. This can aid in better locating utilities for future road construction.

3.4 Small Cell Wireless

Small cell wireless equipment is an integral component of the infrastructure that enables 5G communications. Small cell wireless requires little power and provides short-range wireless data transmission within small geographical areas and allows high data transfer rates for mobile devices. Mobile wireless data use has exploded in recent years. The statistics according to the *Cellular Telephone Industries Association (CTIA)* are astounding (CTIA, 2024):

1. 325 million Americans are covered by 5G networks. (CTIA, 2024)
2. 97 percent of Americans own a cellphone with 85 percent of Americans owning smartphones. (CTIA, 2024)
3. 523 million data-only devices were connected to mobile networks in 2022 compared to 336 million in 2013. The rate of growth is not declining. (CTIA, 2024)
4. The year-over-year growth in active 5G devices was 88 percent in 2022. (CTIA, 2024)
5. Wireless download speeds are more than 117 times faster than they were in 2010. (CTIA, 2024)
6. 94 million Americans have access to 5G home broadband. (CTIA, 2024)
7. Wireless data traffic use is more than 190 times what it was in 2010. (CTIA, 2024)

Figure 3.14 Small Cell Wireless in Louisville, Kentucky (Source: Google Earth)

We are all familiar with macrocell towers that can be up to 200 feet tall. Approximately 200,000 macrocell towers are currently spread across the U.S. landscape. As shown in Figure 3.14, small cell wireless facilities can blend into the landscape by using colors and materials that are similar to the surroundings. Approximately 450,000 outdoor small cell wireless nodes have been constructed across the country and they mostly go unseen (LightReading, 2023).

Figure 3.15 shows how small cell wireless fits within a cellular network. Small cell wireless facilities are generally constructed in densely populated urban areas where the demand on a macrocell tower has exceeded capacity. As the volume of data transmitted through mobile devices increases, the number of users that can use the macrocell tower decreases.

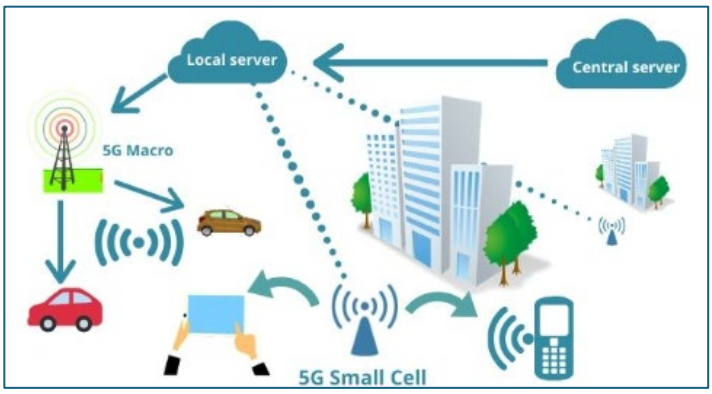

Figure 3.15 5G Network Architecture
(Hoffman, 2019)

Small cell wireless is used to densify coverage and alleviate that issue. Small cell wireless is usually connected to the network via fiber optic lines rather than through the air back to the macrocell tower. As a result, they add capacity to the overall system by accommodating users through the small cell wireless device and removing them from the macrocell tower. In densely populated areas, a network of small cells within the range of a macrocell tower may be used to densify cellular coverage and increase capacity. The range of a small cell wireless device can be up to approximately 1.5 miles while a macrocell tower range can be 25 miles. (CrownCastle, n.d.). Chapter 3.5 provides additional information on how small cell wireless will aid in the adoption of connected and automated vehicles (CAVs).

As data transfer continues to grow rapidly, the number of small cell wireless deployments is expected to grow rapidly. It should be expected that companies will want to construct small cells within the highway ROW if they have not already. In Lexington, some small cell wireless devices are already in use as shown in Figure 3.16. Given the smaller size of small cell wireless technology there is versatility in where these can be placed and there is potential for them to blend into the surroundings.

Figure 3.16 Small Cell Wireless on Light Pole in Lexington, Kentucky

Below are locations, both on and off ROW, where small cell wireless technology could possibly be installed in addition to new poles (Hossain et al, 2020).

- Streetlights
- Traffic signals
- Billboards
- Utility poles
- Bus shelters
- Water towers
- Sides or roofs of buildings

DOT Small Cell Wireless Applications

A review of other state policies and procedures for permitting small cell wireless facilities on ROW was conducted. Some states, such as Colorado (CDOT, 2021), Delaware (DDOT, n.d.), and Michigan (MDOT, 2019) have a specific permitting process or special small cell wireless terms and conditions the applicant must agree to. Other states treat small cell wireless facilities as any other type of utility and follow their utility permitting processes. Some states, such as Indiana (INDOT, 2019), have procedures for permitting macrocell tower sites on ROW, but no specifics for small cell wireless. Current practice in Kentucky has been to treat a request to place small cell wireless infrastructure on ROW as a permit.

Figure 3.17 Delaware DOT Small-Cell GIS Online Map
(Source: Delaware DOT)

Some states and municipalities have created online GIS mapping databases available to the public showing permitted small cell wireless locations in their jurisdiction (DDOT 2024, Tucson 2024, Boston 2024). Figure 3.17 is an example of small cell wireless GIS mapping from Delaware DOT (DDOT, 2024). Information provided typically includes the geographic location of the small cell wireless device, the utility owner, permit approval date, and the attachment method (e.g., new pole, to an existing pole).

Although more widespread at the municipal level, some states charge fees for utility companies to construct small cell wireless facilities in their ROW and can also charge an annual recurring fee. As an example, Michigan DOT requires a $200 permit fee to co-locate small cell wireless on an existing utility pole or Michigan DOT facility (MDOT, 2019). It has a $300 fee to install small cell wireless on a new pole or support structure (MDOT, 2019). Colorado DOT requires a non-recurring application fee (that can be paid electronically) of $500 to permit up to five small cell wireless facilities and $100 for each small cell wireless facility beyond five that are attached to existing poles (CDOT, 2021). They also charge a non-recurring fee of $1,000 for each new pole intended to support small cell wireless facilities (CDOT, 2021). Colorado DOT also requires a recurring annual fee of $270 per small cell wireless facility (CDOT, 2021). Delaware DOT requires the small cell wireless provider to pay $100 for each small cell wireless facility as part of the permit application (DDOT, n.d.). The applicant also agrees to reimburse the DOT for any construction inspection costs the agency incurs over the $100 base fee should that be exceeded (DDOT, n.d.).

KYTC Permits Questionnaire

To gauge the frequency of KYTC receiving requests to permit small cell wireless facilities on state-maintained ROW, a *Qualtrics* survey was emailed to Permits Supervisors in each of the 12 Highway Districts throughout the state. Below is a summary of the survey results:

- Six of the twelve Highway Districts (50%) have received an encroachment permit request to place small cell wireless facilities on ROW.
- Utility companies that have requested small cell wireless facilities on ROW include Verizon Wireless, Cellco Partnership dba Verizon Wireless, and SQF.
- Received permits were for both single locations and for multiple locations (i.e., several small cell wireless placements along a corridor). Of the multiple locations, these ranged from three small cell wireless devices up to several dozen.
- One district has permitted small cell wireless only on existing utility poles, two districts have only permitted them on new poles, two districts have permitted them on both new poles and existing poles, and the other district that has permitted them did not provide a response.
- During the process of obtaining a permit, two districts have received requests where the applicant has also received local permits or reviews.
- Two districts have denied permits for small cell wireless locations on ROW. One being a request to attach to traffic signal poles and the other being because the utility company has the option to secure a private easement outside of the ROW.
- Four districts included the electric feed to the small cell wireless device in the same permit while two districts approved the electric feed under a separate permit.
- General comments received were to investigate how to handle requests for small cell wireless poles within the clear zone and also in areas where the ROW is crowded with other utilities, thus, to have the facilities placed within private easement outside of the ROW.

Full survey results are in Appendix A.

Kentucky Cities with Small Cell Wireless Policies

With small cell wireless technology located in areas with the highest population density, cities, towns, and county governments were first to encounter permitting requests for small cell wireless in Kentucky. A review of the 20 most populous Kentucky cities yielded 12 that had established local ordinances or policies. A summary of these ordinances and policies can be found in Appendix B.

Each ordinance and policy varies in the amount of information needed and the level of review needed for the municipality to permit the small cell wireless facility. Below is a summary of the policies of the three most populated cities in Kentucky. Louisville Metro has updated its *Right of Way Guide and Utility Policy* to include the review of small cell wireless facilities. The policy encourages co-location with existing utility poles. The location of small cell wireless facilities on Louisville Metro infrastructure is possible but requires the asset to be replaced with one that can support both, such as light poles. Approval is granted via a two-step process. The first step is a review of the proposed locations, which includes public input and historical reviews. The applicant is required to coordinate any historical reviews with local historic districts. This environmental coordination includes consulting parties, the Louisville Metro Preservation Office and the Kentucky State Historic Preservation Office. The second step focuses on compliance with the requirements set forth in the *Right of Way and Utility Policy*.

Lexington-Fayette Urban County Government does not have specific small cell wireless approval procedures in place and treats these as a permit. Permit requirements are set forth in the Public Right of Way ordinance. Permits fall under three categories — annual general permit, installation permit, and surface cut permit. Fees are associated with these permits along with registrant and franchise fees utility companies must contribute to. The Department of Historic Preservation participates in the process of pole relocations and new installations.

The City of Bowling Green does not have specific small cell wireless approval procedures in place and treats these as a permit. Requirements are contained in a Work within Right of Way ordinance, which lays out permitting requirements and fees paid for permit processing. The utility company is to obtain a surety bond. Permit applications for new infrastructure must be in keeping with the character of a historic neighborhood.

Division of Traffic Operations Coordination

Coordination with the KYTC Division of Traffic Operations was conducted via email and focused on issues or concerns that may arise if small cell wireless equipment were attached to state maintained infrastructure (e.g., traffic signals, light poles, panel signs). Below is a summary of the concerns and issues that may arise if attaching equipment to the state-maintained infrastructure.

- Need to maintain structural integrity of traffic signal or light pole if small cell wireless is attached, especially if the pole is drilled into or the equipment is attached to it.
- Interference between the small cell wireless equipment and the traffic signal controller cabinet equipment and communication equipment.
- Need a separate power source and meter.
- Add language that KYTC should not be responsible if small cell wireless equipment is damaged, if the small cell wireless affects the operations of the traffic signal it needs to be removed immediately, and if the state infrastructure is improved in the future the small cell wireless is to be removed in a reasonable timeframe at no cost to KYTC.
- No colors or logos that would draw the driver's attention away from the road. Will it add to too much clutter for the driver to take in?
- Need to consider if small cell wireless could impact employee safety, such as interfering with pacemakers.
- Interference with existing overhead utilities.
- Interference with ADA accessibility where space is limited.
- Keep out of sight triangles so sight distance is not obstructed.
- Need compliance with the electrical code.
- Which utility company would be allowed to attach? Should it be first come first serve?

Corridor and/or Suitable Location Guidance

After reviewing the KYTC *Permits Guidance Manual*, small cell wireless guidance from various states and municipalities, and consulting with District Permits Supervisors and the Division of Traffic Operations, the following recommendations were developed for managing small cell wireless locations within the ROW, if a small cell meets the definition of a utility in Kentucky. The KYTC *Permits Guidance Manual* currently contains most of the information and guidance needed to permit small cell wireless, but a few additional requirements are recommended.

Attachment to KYTC Owned Infrastructure

Given the potential conflicts and issues that may arise, the placement of small cell wireless components on state-owned and -maintained infrastructure (e.g., traffic signals, light poles, overhead sign trusses, noise barrier walls, pedestrian overpasses) should not be the first option. Other locations, such as on existing utility poles, should be

considered first. Any proposed attachment to KYTC infrastructure should be reviewed by the appropriate Divisions and shown to not impact the attached infrastructure. Impacts considered include but are not limited to the structural capacity of the attaching structure to handle the new load, the attachment method, electrical interference, heat produced by the attached equipment, and visual disturbances to the traveling public. As will be seen in Chapter 3.5 the implementation of connected and automated vehicle technologies will also put pressure on attaching to traffic signal poles and other state-owned infrastructure near intersections.

Locational Requirements within Right of Way

Given the limited space available within the ROW, especially in urban areas where small cell wireless is more likely to be found, attachment to existing utility poles should be the first choice. This reduces the number of poles in the ROW, has less impact on roadside safety, and provides less visual clutter. Permission from the utility owner would need to be granted and provided to KYTC. The second choice is to place a new pole with small cell wireless that adheres to the requirements in the KYTC *Permits Guidance Manual* for new installations (e.g., behind the ditch or toe of the slope and outside of the clear zone as described in the AASHTO *Roadside Design Guide*). The utility company should provide reasons why they cannot attach to existing utility poles before new poles are permitted. The small cell wireless equipment should be placed as close to a property line as practical and placement in front of a residence should be discouraged. Attaching small cell wireless to KYTC infrastructure should be the last option.

Equipment and Installation

A small cell wireless installation consists of small radio equipment and antenna. In addition to this equipment, three things are required — electricity; backhaul, which is usually fiber optic cable for transmission to the core network; and a permitted space (CTIA, n.d.). Maintenance of traffic during the installation can follow the requirements of other utility work in the KYTC *Permits Guidance Manual* Chapter 200 for Work Zone Safety. If the electrical feed to the small cell equipment is to be placed and maintained by an electric company, and not the wireless provider, this should be covered under a separate permit. No equipment cabinets or other aboveground hardware should be permitted in the clear zone. These can typically be provided underground in junction boxes or attached to the pole itself.

Sight Distance and Visual Distractions

Constructed small cell wireless facilities should not restrict intersection sight distance or intersection sight triangles. Further guidance on intersection sight distance and sight triangles can be found in the AASHTO *A Policy on Geometric Design of Highways and Streets* (Chapter 9.5 on intersection sight distance). Small cell wireless equipment should blend into the background and use colors, textures, and materials similar to the surroundings it is located in and the pole to which it is attached (CDOT, 2019).

ADA Requirements

A small cell wireless facility should not impede ADA requirements set forth by the U. S. Access Board in the Public Right of Way Accessibility Guidelines (PROWAG) for pedestrian facilities within ROW. This includes cabinets and other attachments to the pole that may encroach into the pedestrian zone. The AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities, 2nd Edition* also provides guidance.

Local Approvals

If the small cell wireless facility within state-maintained ROW also falls within a municipality that has its own ordinances or small cell wireless policy, local approvals will typically be needed before KYTC permits the facility. Often these local requirements include aesthetics, historic district review, and equipment size/dimensions requirements.

Removal for Roadway Construction and Abandonment

Other states have provided certain requirements and conditions for when the small cell wireless components would need to be removed from the ROW. These include for roadway construction purposes, if a safety condition arises, or for the abandonment of the facility. Under the current Terms and Conditions of the KYTC Encroachment Permit Application (KYTC, 2020), language is present for the removal of the utility if written notice is given by KYTC for the following reasons:

- Clause 7: The encroachment may be ordered removed by the Department at any time, and for any reason at the permittees expense if 30 days written notice is given by KYTC.
- Clause 8: If KYTC determines that motor vehicle safety deficiencies develop because of the installation, the permittee shall pay to adjust, relocate, or other corrective measures deemed by KYTC if written notice is given. The notice should include a specified completion date.
- Clause 14: If the provisions of the permit are violated, KYTC may require the permittee to remove the encroachment and restore the ROW. If the permittee does not remove the encroachment KYTC can do so and recover the removal costs from the permittee.
- Clause 16: If KYTC determines it is necessary for the encroachment to be removed or relocated because of the reconstruction, relocation, or improvement of a highway KYTC can revoke the permit and order its removal.

The permit application terms and conditions do not contain a specific timeframe to remove the encroachment except in clause 8, which is at the discretion of KYTC, and there is not a specific clause for the removal of the small cell wireless facility due to its abandonment. The Cabinet could clarify some of this language.

GIS Mapping

Other states and municipalities have created small cell wireless GIS mapping layers to keep track of where small cell wireless devices are located on their ROW, which utility company owns them, and the type of installation (e.g., new pole, pole attachment). If KYTC pursues this, this information, including latitude and longitude for each small cell wireless location in the permit would be needed. The existing Kentucky Encroachment Permit Tracking[5] online map could be modified to create a small cell wireless category that contains this information.

Best Practices for Small Cell Wireless on Right of Way

- Allow KYTC to seek compensation when small cell wireless equipment is installed on state-owned ROW. Over 50% of states charge fees for placing small cell wireless equipment on state-owned ROW.
- Build a geodatabase that catalogues the locations of small cell wireless equipment on Cabinet ROW. It should store data on the facility location, utility company, and other relevant information. The Kentucky Encroachment Permit Tracking online mapping system could be updated to include small cell wireless information.
- For safety and aesthetic reasons, small cell wireless equipment should blend into the surroundings and be inconspicuous. It should not block sight distance lines at intersections, nor should it be placed in locations that would impede pedestrian movements.
- If installation of small cell wireless equipment is allowed by permit on KYTC-owned infrastructure, in addition to what is agreed to in the permit application, criteria should be established for how and when the equipment is to be removed and a timeline established for removal. The permit application needs to include language that specifies a process for equipment removal or repair should state-owned infrastructure be damaged (e.g., by a vehicle crash).

[5] https://maps.kytc.ky.gov/EncroachmentPermitTracking/

- A hierarchy of installation methods/locations should be established focused on safety. For example, attaching small cell wireless equipment to an existing utility pole is preferred to constructing a new pole.
- Permitting coordination with local governments is needed at small cell wireless facilities located on state roadways that overlap municipal boundaries, especially when equipment will be placed in a historic district.

3.5 Connected and Automated Vehicles

Connected vehicles (CVs) are vehicles that can communicate electronically with other vehicles or transportation infrastructure. Automated vehicles are those that can operate — to some extent — without the input of a human driver. For this study, the focus of the discussion is the CV, since in large part, automated vehicle operations are the results of those connections.

CVs communicate with other vehicles and with infrastructure through Global Positioning Systems (GPS), broadband wireless, and cellular services. Ultimately, communications devices that enable CVs require the ability to connect with thousands of devices at any time. These devices that will enable the autonomous vehicle environment are and will continue to be installed in vehicles and become part of the infrastructure. Cellular phones will continue to be carried by pedestrians and bicyclists as well as by motorists. Figure 3.18 lists CV applications that USDOT has sponsored to date.

Figure 3.18 USDOT Sponsored CAV Applications
(Source: USDOT)

Over the years, the communications technology needed to transfer the vast amounts of data required for CV infrastructure has been debated. Vehicle manufacturers, equipment manufacturers, and even countries have been testing two communications technologies thought to be the future of CVs. Dedicated short-range communication (DSRC) protocol initially led the way, particularly in the U.S. Many vehicles built in the U.S. with communications technology are based on DSRC. Many ITS solutions that have been researched and implemented are based on DSRC. When the decisions were made to focus on DSRC in the U.S., the last generation of cellular technology, Fourth Generation (4G) and Long-Term Evolution (LTE), was still current and speeds, data capacity, and latency did not compare favorably to DSRC. Today, however, the Fifth Generation (5G) mobile network is much faster, has lower latency and higher capacity, with a greater range than DSRC. The communication range of DSRC is approximately 900 feet (Chowdhury et al., 2018) compared to the approximately 1.5 mile range of a 5G small cell wireless (CrownCastle, n.d.). As a result, it appears that cellular communications technology will be the solution that enables CV infrastructure in the future.

In December 2019, the Federal Communications Commission (FCC) initiated a Notice of Proposed Rulemaking to take a fresh look at the 5.9 GHz radio spectrum (5.850 – 5.925 GHz) for spectrum optimization (FCC, 2020a). The 5.9 GHz radio spectrum had originally been set aside by the FCC in 1999 for Intelligent Transportation Systems (ITS) and DSRC usage for safety-related transportation and vehicular communications (FCC 2020a). Since then, a large portion of this spectrum has not been put to use. This order is expected to become policy and should solidify cellular communications as the backbone that will enable the connected and automated vehicle system. Some agencies have already begun the process of retrofitting existing ITS equipment with cellular communications equipment. In April 2023 (FCC, 2023a) and again in August of 2023 (FCC, 2023b) the FCC provided waivers to state Departments of Transportation, municipalities, auto manufacturers, technology companies, and research institutions that had requested a waiver to use part of this spectrum for cellular vehicle to everything (C-V2X) testing.

CV technology is already here in some vehicles available. Adaptive cruise control and automated route planning based on real-time conditions using Google Maps[6] or Waze[7] are examples. As technology advances, the methods and extent of communications will change. CVs communicate in the following ways (Figure 3.19; Jaiswal & Shaikh, 2022):

- Vehicle-to-vehicle (V2V) — Vehicles wirelessly exchange information about their movement characteristics and location with other vehicles.
- Vehicle-to-infrastructure (V2I) — Vehicle-generated traffic data are captured and information from the infrastructure is sent to the vehicle to inform the driver of noteworthy conditions.
- Vehicle-to-pedestrian (V2P) — Pedestrian detection systems in vehicles (including transit), infrastructure, or both.
- Vehicle-to-network (V2N) — Vehicles can communicate with the internet using cellular networks.

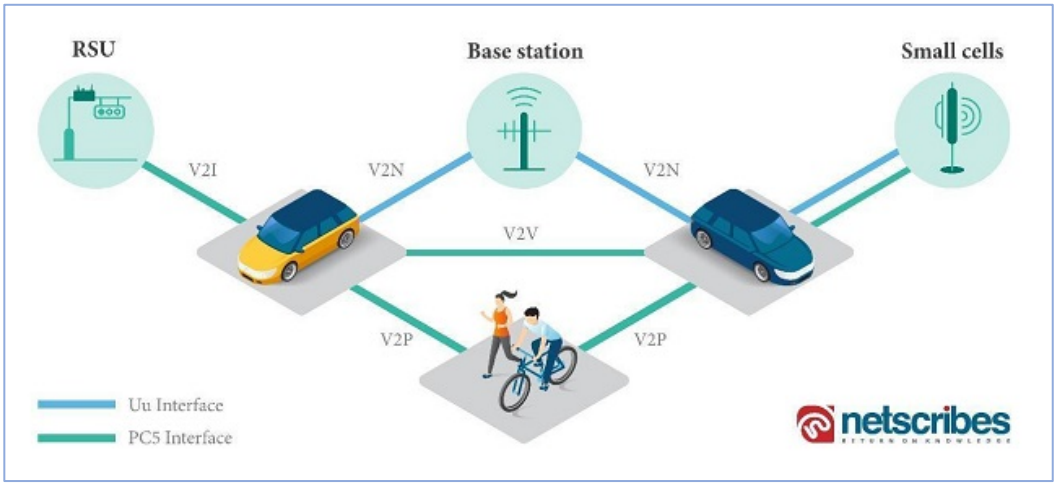

Figure 3.19 Connected Vehicle Environment
(Source: Jaiswal & Shaikh, 2022)

The term V2X (vehicle-to-everything) includes V2V, V2I, V2P, and V2N. C-V2X is V2X enabled by cellular communications. A V2X system typically consists of two elements:

[6] https://www.google.com/maps
[7] https://www.waze.com/live-map/

- On-board units (OBU): Wireless radios installed on vehicles and other moving travelers that integrate with other elements of the vehicle to obtain and share useful information about the actions of the vehicle. They also receive information about external conditions and provide that to the driver or vehicle system itself. (ITS America, 2023) Figure 3.20 shows aftermarket DSRC onboard units used in a CAV pilot project in New York City (Talus et al, n.d.).

Vendor 1: Danlaw V2X Aftermarket Safety Device

Vendor 2: Savari MobiWave V2X Aftermarket Safety Device

Figure 3.20 Aftermarket Onboard Units from New York City Pilot Project
(Source: USDOT [Talus et al, n.d.])

- Roadside units (RSU): Wireless radios installed along the side of the roadway, which communicate with vehicles by sending and receiving V2X messages. These fixed radios are typically mounted on roadside infrastructure and can integrate with technologies operated by infrastructure owners, such as traffic signal systems or sensors. RSUs can be connected directly to a wireless or wired communication network, such as fiber optic networks, for backhaul of information to and from traffic operation systems or data analytics platforms (ITS America, 2023). Figure 3.21 shows RSUs used in a CAV pilot project in Tampa (Vadakpat, n.d.).

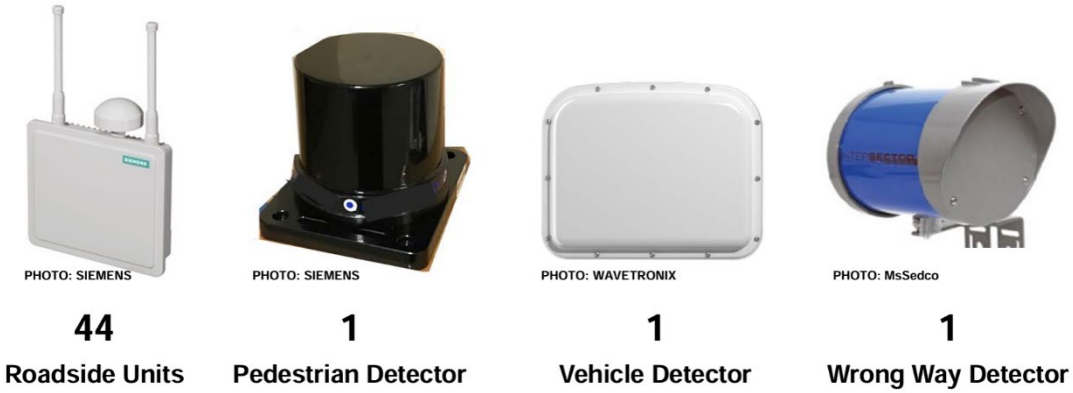

Figure 3.21 Roadside Units from Tampa Pilot Project
(Source: USDOT [Vadakpat, n.d.])

RSUs may need to be located on the ROW and are pertinent to this study as a result. Agencies will likely need to provide or be involved in the provision of RSUs by third parties.

Figure 3.22 (ITE 2022) depicts a typical V2X system's components and their interfaces. RSUs communicate with vehicles that have OBUs or Mobile Units (MU) and relay those messages as needed through backhaul systems to back offices, traffic signal controllers (TSCs), or traffic management systems (TMSs) that are part of the infrastructure. Communications through a secure credential management system (SCMS) may also utilize the internet to send messages to centralized data centers to coordinate large-scale traffic management. OBUs may also be able to communicate directly with these centralized data centers through cellular networks.

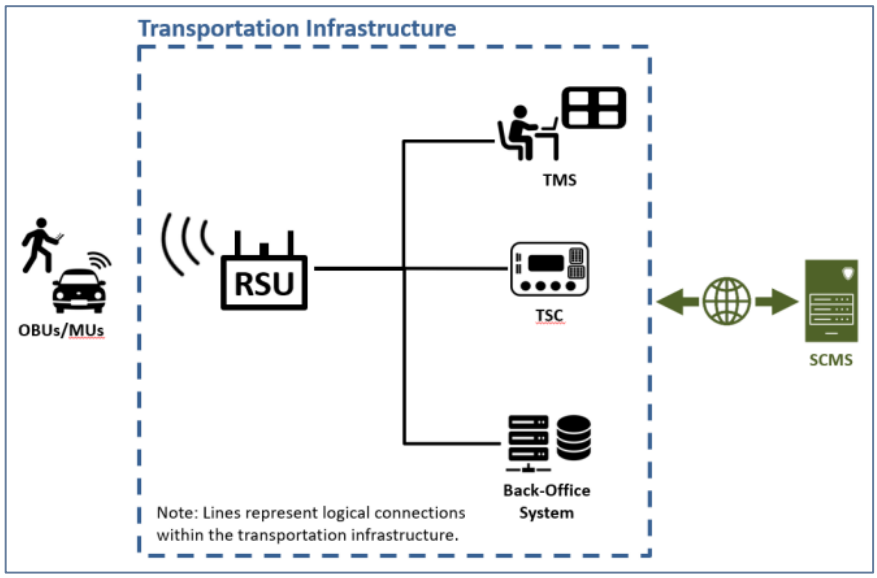

Figure 3.22 Interfaces of V2X System
(Source: ITE, 2022)

While continually evolving, a standard development report for roadside units has been developed and published by AASHTO, ITE, NEMA, and SAE International with support by USDOT (ITE, 2022).

From this description of what a V2X system consists of, implementation of CAVs is interwoven with the adoption of broadband (for backhaul communications) as presented in Chapter 3.3 and small cell wireless (5G) networks (as a communication median between vehicles, pedestrians, and infrastructure) as presented in Chapter 3.4.

Connected and Automated Vehicles in Kentucky

KYTC has developed a strategy for CAVs that describes how it intends to achieve CAV readiness and describes steps the agency should take to implement CAV technologies. It lists these potential benefits of CAV implementation (KYTC, n.d.):

- Safer roads
- Less congestion
- More reliable travel times
- Lower air pollution and greenhouse gas emissions
- Improved and equitable mobility for underserved populations, including older adults, people with disabilities, and people who do not drive.

Also of importance are the short-term goals of this strategy, which include (KYTC):

- Staying informed
- Interstate Regulatory Consistency
- Including Other Agencies and External Stakeholders
- AV Shuttle Pilot
- CAV Testing Grounds
- Locate Connected Corridors
- Work Zone Data
- Assisting in Legislation
- Educational Outreach
- Assisting Local Governments
- Planning and Collaboration

During the 2024 legislative session, a law was passed laying the first stone for AVs on Kentucky's roads. House Bill 7 (KY, 2024) establishes the regulatory framework for the operation of fully automated vehicles on public highways, defines when human drivers are needed, establishes AV requirements, the limits of insurance needed, registrations practices, and other AV-related items.

Kentucky has begun a study to analyze the I-64 corridor between Louisville and Lexington for CAV opportunities. This ongoing study will examine the suitability of dedicated CAV lanes, managed lanes, implementation strategies. It also looks at the identification of legal and regulatory requirements, NEPA requirements, and future maintenance considerations.

Corridor and/or Suitable Location Guidance

The location of equipment needed to sustain connected vehicle infrastructure on ROW depends on if DSRC or C-V2X technology is used.

Equipment: The equipment needed to construct, maintain, and operate a CAV system on ROW includes RSUs (either DSRC or C-V2X based), an electric source to power them, and fiber optic backhaul to traffic management centers, traffic signal controllers, cameras, sensors, and/or back-office systems.

Infrastructure Ownership: To date most CAV use in the US has been in the form of pilot projects testing the technology. Procurement methods that could be used to introduce this technology include the leasing of a section of roadway to a private company that would then construct, operate, and maintain it. A road user fee would typically be collected from users in this model. Another method could be where the state DOT owns the infrastructure on the ROW (e.g., RSU, fiber, attachment devices) and a contractor constructs, operates, and maintains the system. An example is the TRIMARC incident management system in Louisville.

Electrical: RSUs and other communication devices in CV infrastructure require electricity to operate. Urban areas have the potential to be more attractive to CAV applications because of the better abundance of electric distribution.

Environmental: A CAV project would have the same environmental review requirements as other KYTC projects. Pilot projects have estimated that vehicle emissions would be lessened by the implementation of CAV technology.

Land Area/Use**:** USDOT CAV pilot projects have been successfully implemented in urban (New York City, Tampa) and rural (Wyoming) areas. CAV applications shown in Figure 3.19 can be adapted for urban and rural environments, with overlap between the two. Fact sheets for each of these pilot projects have been added for more information on the applications used.[8,9,10]

Roadway modifications: Modifications to the roadway could be part of CAV applications. Potential modifications include separating lanes on freeways to serve as CV corridors. Depending on the CAV application, existing roadside equipment such as traffic signal controllers may need to be replaced or upgraded to be compatible with the CAV technology.

Clear zone: No new mounts or poles for RSUs or other items should be placed within the clear zone. Preference should be given to attaching RSUs to existing state-owned infrastructure, such as light poles, sound barrier walls, traffic signals, overhead sign trusses, and pedestrian overpasses. Non-destructive attachment methods would need to be investigated. If a new pole would need to be added to mount the RSU on, this should be outside of the clear zone.

CAV Corridor Plan

KYTC could supplement its Interstate 64 CAV planning study by developing a plan that identifies corridors suitable for CAV applications. This plan could address the following items:

- Geographic areas with the greatest demand (e.g., urban areas)
- Roadway segments with broadband availability and nearby sources of electricity to power CAV equipment
- Roadway segments with sufficient ROW to allow for the installation of CAV equipment

[8] https://www.its.dot.gov/factsheets/pdf/NYCCVPIiot_Factsheet.pdf
[9] https://www.its.dot.gov/factsheets/pdf/TampaCVPIlot_Factsheet.pdf
[10] https://www.its.dot.gov/factsheets/pdf/WyomingCVPilot_Factsheet.pdf

Best Practices for Connected and Automated Vehicles

- Establish guidelines for locating CAV-related physical infrastructure (e.g., RSUs, sensors) on state-owned ROW. Guidelines should account for safety and how equipment could affect roadway maintenance activities.
- CAV infrastructure placed within the ROW should be outside the clear zone or attached to an existing facility.
- Discouraging the placement of other equipment (e.g., small cell wireless) on state-maintained infrastructure reserves space for CAV implementation. An example is traffic signal poles at intersections.
- Without attaching directly to state-maintained infrastructure expand the impact of CAV technologies by looking for opportunities to take advantage of broadband and small cell wireless technology within state-owned ROW.

3.6 Electric Vehicle Charging Stations

Sales of electric vehicles (EVs) have experienced rapid growth, with sales exceeding 13 million worldwide in 2023. In the U.S., sales have accelerated since 2018 and topped 1.3 million in 2023.

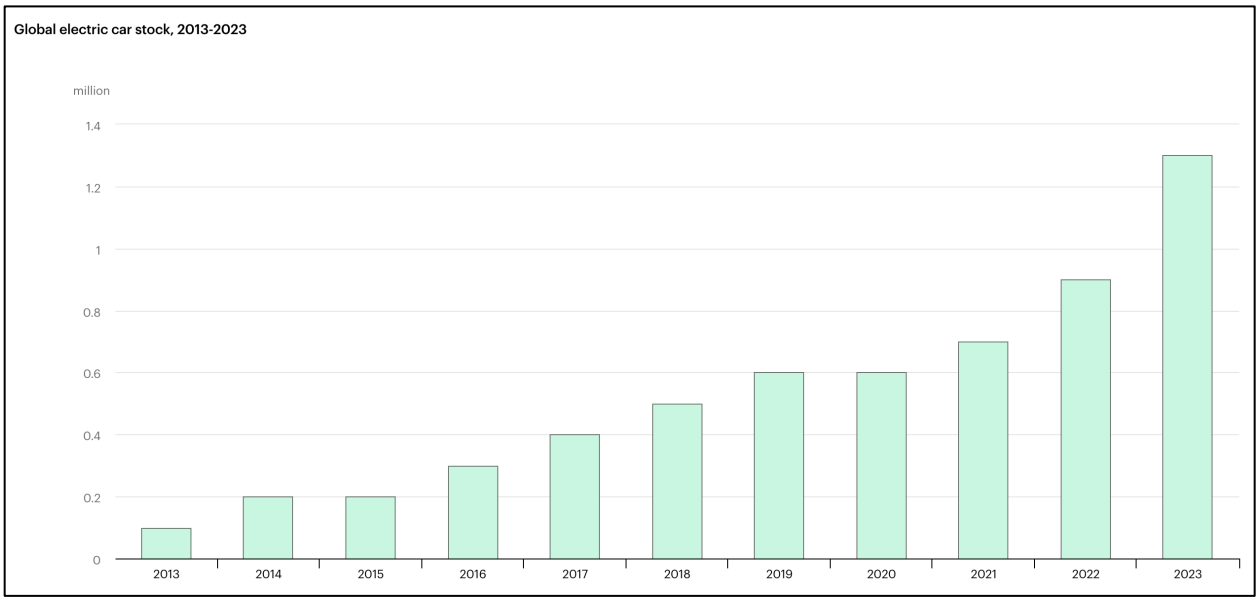

Figure 3.23 US Electric Car Sales (2013 – 2023)
(Source: IEA, 2024)

Keeping pace with anticipated growth requires substantial investments in EV charging infrastructure. The 2021 Bipartisan Infrastructure Law (BIL) initiated the process of providing federal funding to develop a nationwide network of charging stations. In February 2022, FHWA issued initial guidance under the National Electric Vehicle Infrastructure Formula Program (NEVI) to provide a framework for spending federal funds on charging stations across the U.S. The program was designed to initially focus on designated Alternative Fuel Corridors (AFC), mainly along interstates and parkways. When the AFCs are fully built out, funding may be used on any public road or in other publicly accessible locations.

EVs can be charged using electric vehicle service equipment (EVSE) operating at different charging speeds. EVSE charging stations are classified into three levels:

- Level 1
  - Plug into 120-volt AC outlet
  - Can charge a battery electric vehicle (BEV) to 80% in 45-50 hours
  - Standard outlet found in a home or office

- Level 2
  - Plug into 240 or 208-volt AC outlet
  - Can charge a BEV to 80% in 4-10 hours
  - Same as outlets used in a home to power large appliances such as a clothes dryer

- Level 3
  - Also referred to as Direct Current Fast Charging (DCFC) stations

- Specialized charger that converts AC to DC for faster charging
- Can charge a BEV to 80% in 20 minutes

The NEVI program requires all ESVE stations along AFCs be Level 3 DCFC stations until the AFC system is completely built out.

Current KYTC Efforts

Since issuing the initial request for proposals (RFP) to cover the design, construction, ownership, operation, and maintenance of DCFC stations along Kentucky's AFC network in October 2023, KYTC has announced three rounds of awards to private developers to build a total of 42 charging stations along the AFC corridor.

Corridor/ Location Guidance

Locating EV charging stations presents different challenges than other CEC uses because human interaction is required for their use. All other CEC uses previously mentioned (e.g., renewables, broadband, CAV equipment) occupy spaces along the roadway but do not require human interaction to function. In these cases, any equipment located along a roadway must be designed with roadside safety in mind to avoid creating a hazard for errant vehicles that leave the roadway. A charging station requires that people physically drive to a location and plug their cars into a charging port. Due to concerns over roadside safety, it is unlikely that EV charging stations will ever be built along the side of the roadway. This makes KYTC-owned facilities located off non-interstate roadways, such as rest areas, truck parking areas, weigh stations and park and rides, more logical locations for EV charging stations. Excess ROW parcels are also a possibility, but they would likely require the development of additional infrastructure to access them.

Restrictions on commercial activities, discussed in Chapter 5.3, further complicate the possible locations of EV charging stations. Private involvement is needed for these projects, and restrictions on commercial activities limit the ability to have private involvement on projects along interstates (see Chapter 4). However, as KYTC builds out the initial AFC network, the focus will turn to smaller routes. This will allow KYTC to consider using ancillary facilities that are not located along an interstate route for EV charging stations. Since smaller routes are not subject to the commercial activity restrictions that apply to Interstates, private involvement could be more easily utilized for these projects. To assist in the identification of future EV charging station locations, KYTC should follow the work being done by the Center for Regional and Rural Connected Communities under the project *A Data-Driven and Equitable Solution to Address Electric Vehicle Charging Needs in Rural and Underserved Communities* seeks to provide insights into EV demand estimation, optimal deployment of charging infrastructure, and effective EV routing in rural areas.

Best Practices for EV Charging Stations

- Look for opportunities to combine renewable energy production with EV charging.
- Investigate longer-term how Level 3 EV charging comes to rural communities and routes not on the AFC list.

3.7 Broader Implications for KYTC

Research on Clean Energy and Connectivity lead to two additional potential areas of further investigation. Although these ideas are not specific to any of the CECs being investigated, they are applicable to all utilities and other uses of the ROW. Fundamentally, as technology continues to advance, it is reasonable to expect that over time the demand for non-transportation related uses of the ROW will increase. To address the growing complexity of managing utilities and other activities (e.g., CEC uses, ITS equipment, multimodal and transit facilities, managed lanes and tolling equipment, pollinator habitat) on the ROW, KYTC could consider a policy on the usage of the ROW or update the current *Utility Accommodation Policy* to better account for this potential crowding. This should be safety focused,

but other needs to factor in and balance are roadway maintenance implications, drainage concerns, environmental impacts, and the effects to project timelines and budgets from the additional ROW usage.

Additionally, as the ROW becomes ever more crowded, it will be crucial to know the location of utilities and other installations that are located on the ROW. The creation of a GIS-integrated database with the ability to utilize point and line data would significantly improve KYTCs knowledge of what is within the ROW and has the ability to store pertinent information that is easily assessable to users. Integration of the Kentucky Utilities and Rail Tracking System (KURTS) and Kentucky Encroachment Permit Tracking (KEPT) programs would be needed, along with putting this into a GIS based format such as has been used for the Kentucky Encroachment Permit Tracking online map.

This implementation could include requiring digital plans, preferably as-built quality, from utility companies and other entities that have a permitted facility within the ROW. Long-term this may aid in the ability to better estimate road project costs and timelines. Examples of how other states and municipalities have kept track of small cell wireless installations can serve as an example of how to accomplish this.

Chapter 4 Private Involvement

Innovative uses of ROW (e.g., solar power, wind power, broadband, small cell wireless, electric vehicles, CAVs, EVs) require specialized expertise for planning, designing, constructing, operating, and maintaining the infrastructure. Typically, this knowledge lies outside the range of expertise of engineers and technicians at state DOTs, who traditionally have a background (e.g., civil engineering) focused on the design, construction, operation, and maintenance of roadway and highway facilities. These new technologies often require domain-specific knowledge of electrical systems, communication networks, and information technology systems. Where DOT employees have this knowledge, they are typically in high demand and have minimal bandwidth available to take on new types of projects. The funding mechanisms and contractual knowledge needed for these systems can also be outside of the traditional methods used by state DOTs (e.g., PPAs).

Below is a listing of potential private sector involvement by CEC category.

Solar and Wind

Renewable energy production on agency-owned ROW can benefit both the private sector and DOTs. The private sector can supply the expertise and upfront capital to build and operate the facility, while an agency could purchase electricity generated in an environmentally responsible manner at a predetermined rate, potentially reducing electricity costs over a specified period.

While some DOTs have experience installing and maintaining small solar facilities (e.g., solar powered lights or cameras), larger applications require expertise because there are more specialized equipment requirements, such as inverters that convert DC to AC power, large battery storage facilities, and connecting to the larger electric grid if net metering is included. Roadway designers and state DOTs typically lack expertise in the design of renewable energy facilities. Private sector consultants that specialize in renewable energy site design, the development of contracting documents/specifications, and the inspection of renewable energy facilities are needed as part of a project development team. These consultants can also provide expertise in drafting the language for public-private partnership agreements that is needed to utilize power purchase agreements and net metering. They can also offer advice on navigating the renewable energy regulatory landscape. When developing RFPs for renewable energy engineering services, special care should be taken to develop appropriate selection and scoring criteria through the Division of Professional Services that identify these areas of expertise.

Broadband

Broadband technology is typically owned and operated by private telecommunication companies, although these firms do seek grants and funds administered through other government entities. If installed on DOT-owned ROW, broadband can potentially benefit agencies by giving them access to fiber optic bandwidth by agreement. Other states have identified potential broadband corridors along their highways, most often on facilities with full access control, and have allowed the placement of broadband on ROW in exchange for use of the facility and/or payment. Adding broadband along these corridors can also potentially aid with implementation of CAV technologies, especially in rural areas where an existing broadband connection may not be easily accessible.

Small Cell Wireless

Like broadband, small cell wireless is constructed and operated by private telecommunication companies. With CAV technologies moving away from DSRC to C-V2X wireless communication, 5G and small cell wireless are becoming a critical part of CAV applications, whether it be from access to existing small cell wireless antennas or providing RSUs along roadways.

Connected and Automated Vehicles

CAV technologies are still in their infancy, so it is difficult to predict with certainty the level of private involvement that will occur when it is more broadly adopted. Because these technologies have a wide range of applications (USDOT has identified over 30), the particular application and its needs will determine the level of private sector involvement. For example, CV technologies on DOT-owned equipment (i.e., trucks, snowplows, other vehicles) that collect telemetry data are more likely to be installed and maintained by in-house staff. At the other end of the spectrum, with the adoption of CV corridors, such as CAV lanes along highways with full access control, the private sector is integral in developing, constructing, operating, and maintaining CAV technologies. Their expertise in telecommunications and other electronic devices will be needed. A funding model can be adopted that uses private sector funding for CAV projects in return for the ability to collect user fees over a specified time period.

One important aspect related to the adoption of CAV technologies is the connection to broadband and small cell wireless, which may not be visible on the front end but are needed to link to traffic management centers, back-office data centers, traffic signal cabinets, and for communication between different modes of transportation. The private sector's construction and operation of broadband and small cell wireless is important for the widespread implementation of CAV applications.

Electric Vehicles

For EV charging infrastructure, KYTC has decided that utilizing the private sector to provide charging stations along identified alternative fuel corridors is the most efficient choice. Using federal funding, private sector companies have been awarded contracts to construct fast charging stations at identified locations off of the highway ROW. These companies will own, operate, and maintain the charging stations on behalf of the state.

Chapter 5 Regulatory Considerations and/or Challenges

5.1 Public Service Commission (PSC)

The mission of the Kentucky Public Service Commission (PSC) is "to foster the provision of safe and reliable service at a reasonable price to customers of jurisdictional utilities while providing for the financial stability of those utilities by setting fair and just rates and supporting their operational competence by overseeing regulated activities" (PSC, n.d.). Utilities that fall under the jurisdiction of the PSC include investor-owned electric, natural gas, telephone, water and sewage utilities, customer-owned electric and telephone cooperatives, water districts and associations, and certain parts of gas pipelines (PSC, n.d.). Over 1,500 utility entities are under the PSC's jurisdiction.

Over the years, the level of involvement and oversight the PSC has brought to telephone and broadband regulation has changed. Since 2004 most state regulations for broadband have been removed. This puts broadband mostly under the Federal Communications Commission (FCC) rules and regulations. Small cell wireless oversight is not explicitly described in state regulations. The PSC has oversight on macro cell tower placement outside communities with local planning and zoning authority, but no specific oversight related to small cell wireless facilities.

Renewables

Electric utilities are under the PSC's jurisdiction. These include the renewable energies referenced in KRS § 278.465**:**

- Solar Energy
- Wind Energy
- Biomass or biogas energy, or
- Hydro energy
- These renewables are described for the purposes of being an eligible electric generating facility for net metering.

Pole Attachments

Although the PSC does not regulate cellular and broadband utilities, it meets regularly with electric and telecommunication companies to facilitate discussions on attachments to utility poles. Agreements for telecommunication companies to attach small cell wireless and 5G equipment onto existing utility poles owned by other utility companies is essential for the full implementation of this technology.

5.2 Federal Communications Commission

Broadband

The MNA requires states to perform the four following functions for broadband implementation:

- Identify a broadband coordinator who is responsible for facilitating broadband implementation on the ROW (MOBILE NOW Act, 2018). In Kentucky, this coordinator resides in the Office of Broadband Development.
- Establish a registration process for broadband companies that want to be included in the deployment program. Broadband providers in Kentucky can register through the Kentucky Office of Broadband Development website.[11]
- Set up an electronic notification to the registered companies on an annual basis of the state DOT's highway improvement program (e.g., Statewide Transportation Improvement Program).

[11] https://broadband.ky.gov/resources/Pages/Broadband-Coordination.aspx

- Coordinate initiatives with other statewide telecommunication and broadband plans, state and local transportation plans, and land use plans.

In Kentucky, broadband services are market based and not subject to state administrative regulation (KRS 278.5462**)**. No agency in the state shall impose any requirement upon a broadband service provider with respect to the availability of facilities or equipment used to provide broadband services or the rates, terms, or conditions for, or entry into the provision of broadband service.

Small Cell Wireless

The FCC is the main regulator of small cell wireless in the US. Since 2014 the FCC has taken measures to accelerate the implementation of small cell wireless. In October 2014 it released the report and order to accelerate broadband deployment by improving wireless facility siting policies and expanded the reach and reduced the cost of broadband deployment by improving policies regarding public ROW and wireless facility siting (FCC, 2014). This order sought to remove unnecessary reviews to reduce costs and time delays that result from cell facility siting and construction. Many of the reviews that were evaluated involved environmental and historic property coordination. This resulted in updated categorical exclusions for small cell wireless devices placed on existing towers, collocated on existing infrastructure, and for new poles with small cells. Requirements for state and local government review of small cell wireless siting were adopted. These include the implementation of a shot clock application review timeline.

In September 2018, the FCC provided a declaratory ruling for accelerating wireless broadband deployment by removing barriers to infrastructure investment. Recognizing that the transition to 5G was in the works, the FCC worked to remove regulatory barriers that inhibit the deployment of the infrastructure needed to support 5G (FCC, 2018). This ruling also recognized the importance of 5G in CV adoption. The shot clock timeline was further clarified and a failure to act defined. Although no automatic small cell wireless approval is granted by a failure to act (i.e., not approve a permit application within the specified timeframe), it does state the state or local entity could open themselves up to possible litigation if they fail to do so. Small cell wireless review shot clocks were set at 60 days for a small cell attached to an existing structure and 90 days for the review of small cell using a new structure (FCC, 2018).

In June 2020, the FCC issued a declaratory ruling focused on state and local government's obligations to approve wireless facility modification requests. This clarifies the meaning of rules implementing the Spectrum Act of 2012 for state and local governments to review ***modifications of existing structures*** (FCC, 2020b). The FCC ruling holds that "*states and local governments are to approve within 60 days any request for modification of an existing wireless tower or base station that does not substantially change the physical dimension of such tower or base station."* The 60 days begin when the applicant takes the first procedural step in the locality's application process by submitting written documentation that the proposed modification is an eligible facility request (FCC, 2020b). The definition of a substantial change was also further clarified.

5.3 Restrictions on Commercial Activity on Interstates

Highways that are part of the Interstate System have additional requirements relating to the use of and access to their ROW. These are contained in 23 U.S.C. § 111. Specifically, states are not to permit automotive service stations or other commercial establishments for serving motor vehicle users to be constructed on the ROW of the Interstate System. States are also not to change the boundary of the ROW on the Interstate System to accommodate the construction of or access to an automotive service station or other commercial establishment. States can, however, permit the use of airspace above or below the highway for such purposes as will not impair the full use and safety of the highway and will not require or permit vehicle access directly from the highway or interfere in any way with the free flow of traffic on the Interstate System.

23 U.S.C. § 111 lists the limited activities permitted at rest areas. Any revenue generated by commercial activities in rest areas must be used to cover the costs of acquiring, constructing, operating, and maintaining rest areas in the state.

FHWA stated in an April 2021 memorandum to Division Administrators and Directors that "*A Clean Energy and Connectivity (CEC) project in the Interstate or non-Interstate ROW that is being accommodated as a utility facility serving the public is not a prohibited commercial activity under 23 U.S.C. § 111 unless such project also qualifies as an automotive service station or other commercial establishment pursuant to 23 U.S.C. § 111.*"

5.4 Statutory Definitions of Utilities

The federal definition of a utility, which dates to the late 1980s, is as follows:

> *"Utility facility" – privately, publicly, or cooperatively owned line, facility, or system for producing, transmitting, or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, storm water not connected with highway drainage, or any other similar commodity, including any fire or police signal system or street lighting system, which directly or indirectly serves the public. The term utility shall also mean the utility company inclusive of any substantially owned or controlled subsidiary. For the purposes of this part, the term includes those utility-type facilities which are owned or leased by a government agency for its own use, or otherwise dedicated solely to governmental use. The term utility includes those facilities used solely by the utility which are a part of its operating plant (23 CRF 645.207, 2000).*

The Commonwealth of Kentucky defines a utility, which was last amended in 2011, as follows:

> *"Utility" means any **person** except a regional wastewater commission established pursuant to KRS 65.8905 and, for purposes of paragraphs (a), (b), (c), (d), and (f) of this subsection, a city, who owns, controls, operates, or manages any **facility** used or to be used for or in connection with* (KRS § 278.010, 2011):
>
> *(a) The generation, production, transmission, or distribution of electricity to or for the public, for compensation, for lights, heat, power, or other uses;*
> *(b) The production, manufacture, storage, distribution, sale, or furnishing of natural or manufactured gas, or a mixture of same, to or for the public, for compensation, for light, heat, power, or other uses;*
> *(c) The transporting or conveying of gas, crude oil, or other fluid substances by pipeline to or for the public, for compensation;*
> *(d) The diverting, developing, pumping, impounding, distributing, or furnishing of water to or for the public, for compensation.*
> *(e) The transmission or conveyance over wire, in air, or otherwise, of any message by telephone or telegraph for the public, for compensation; or*
> *(f) The collection, transmission, or treatment of sewage for the public, for compensation, if the facility is a subdivision collection, transmission, or treatment facility plant that is affixed to real property and is located in a county containing a city of the first class or is a sewage collection, transmission, or treatment facility that is affixed to real property, that is located in any other county, and that is not subject to regulation by a metropolitan sewer district or any sanitation district created pursuant to KRS Chapter 220;*

"Person" includes natural persons, partnerships, corporations, and two (2) or more persons having a joint or common interest.
"Facility" includes all property, means, and instrumentalities owned, operated, leased, licensed, used, furnished, or supplied for, by, or in connection with the business of any utility.

Both the federal and state definitions of a utility do not explicitly mention broadband, small cellular wireless networks, 5G, renewables, or EV charging. While arguments can be made that these uses fall under both definitions, the final decision needs to come from a joint opinion from the legal staff of KYTC and the PSC.

5.5 Legalities of Power Purchase Agreements in Kentucky

A Power Purchase Agreement (PPA) as defined by the US Department of Energy is "*an arrangement in which a third-party developer installs, owns, and operates an energy system on a customer's property, with the customer then purchasing the system's electric output for a predetermined period.*" PPAs are most commonly used for renewable energy systems. PPAs are an option for a government agency when (USDOE, n.d.):

- The agency wants to reduce energy costs, hedge against energy price volatility, or improve operational resiliency.
- The agency seeks a third-party to own, install, and maintain an energy system.
- The agency is unable to take direct advantage of renewable energy tax incentives.
- The agency is located in a state or jurisdiction where third-party ownership of generation equipment is permitted.

Several PPA contract models are available for use, including:

- **Self-Ownership** — The DOT self-funds and owns the renewable energy project, issuing contracts as needed for design, build, operations, and maintenance support.
- **Third Party PPA (P3)** — The DOT enters a contract with a private entity to design, build, finance, operate, and maintain (or any combination thereof) a renewable energy project with little to no upfront capital investment required by the DOT.
- **Renewable Lease / License Revenue (P3)** — The DOT leases unused land in the ROW to a private developer, who would develop a renewable energy project and make set land lease payments to the DOT.
- **Morris Model (P3)** — This is a hybrid PPA and a bond issuance model. A private developer would design, build, operate, and maintain (or any combination thereof) a project with the DOT and the Treasury Department would provide low-rate financing.
- **Utility Contract (Traditional PPA) —** The DOT would have a standard PPA contract with a local utility with set rates and terms.
- **Direct Access (Traditional PPA)** — The DOT would establish a PPA with an electricity service provider as opposed to a utility, potentially offering lower pricing. NOTE: This model cannot be used in Kentucky due to the regional assignments of companies to be the sole source provider of utility service.
- **Regional Renewables Choice (Traditional PPA)** – The DOT would establish a PPA with a choice of the supply stream but remain connected to the local utility. NOTE: This model cannot be used in Kentucky due to the regional assignments of companies to be the sole source provider of utility service.
- **Community Choice Aggregation (Traditional PPA)** — The DOT would establish a PPA in which power is procured from an alternative supplier, while transmission and distribution services are provided by the local utility. NOTE: This model cannot be used in Kentucky due to the regional assignments of companies to be the sole source provider of utility service.

In Kentucky electricity is fully regulated, meaning the PSC regulates prices and operations of electric utilities within the state. Regulated electricity markets are designed to protect consumers from price gouging and to ensure the stable and reliable provision of electricity, while allowing utilities to recover their costs and earn a reasonable return on investment. In this scenario electric utilities exclusively serve a geographic area of the state, and no other entity is allowed to sell electricity within that utility's area.

From the review of literature and Kentucky statutes, PPAs do not appear to be banned, but are rather limited in how they can be implemented. Given that regulated electric utilities cover specific territories in Kentucky, a customer cannot enter into a PPA with an independent electric generator. Independent electric generators cannot legally sell electricity directly to retail customers in a regulated utility's territory (KEEC 2018). In theory, a utility company could enter into a PPA on behalf of the customer (KEEC, 2018). Additional information on PPAs in Kentucky and recent case law can be found in the literature review section.

Another factor that makes renewable energy generation less attractive in Kentucky is the regulatory rates involving net metering. Net metering is a billing mechanism that allows consumers who generate their own electricity (typically from renewable sources like solar panels or windmills) to send excess electricity back into the grid and receive credit on their utility bills. In 2019, Kentucky passed Senate Bill 100, which significantly altered the state's net metering policy. Prior to this bill, net metering customers received credits at the retail rate for the excess electricity they generated and fed back into the grid. This bill shifted the compensation for excess generation from the retail rate to a rate determined by the Kentucky PSC. This new rate, often referred to as the *export rate*, is typically lower than the retail rate. This makes generating renewable energy financially unattractive because the consumer would pay more for electricity that they receive from the grid than the price that they get credited for selling electricity back to the grid. However, since Senate Bill 100's passage there have been several challenges to the export rate for individual utility companies. In the future, public pressure could require further statutory changes to make net metering a more attractive option for renewable energy generation.

5.6 Environmental

The level of environmental review for a CEC project depends on the funding source. The use of federal funds requires full National Environmental Policy Act (NEPA) compliance. Examples of full NEPA compliance are projects that are part of the Kentucky Electric Vehicle Charging Program and broadband projects part of the BEAD program (KOBD, 2023). Another example of NEPA compliance is the Michigan I-94 CAV corridor project that is working to create a dedicated CAV lane between Detroit and Ann Arbor. Included in the NEPA review is the potential impacts to communities the project may have and public and stakeholder input (MDOT, n.d.).

If state funds are used for a project certain environmental requirements are still required, such as obtaining a Kentucky Pollutant Discharge Elimination System (KPDES) permit for soil disturbances and Section 404 Corps of Engineers permits for stream impacts.

Although full NEPA compliance may not be required, private companies constructing utility facilities on ROW are still subject to certain environmental requirements such as Corps of Engineers permitting, which could fall under a nationwide permit for utility construction, and Water Quality Certification from the Kentucky Division of Water.

Regardless of funding source or the overseeing agency, utility infrastructure constructed under a KYTC encroachment permit requires the permittee to agree to the terms and conditions of the permit. Below, from the

encroachment permit application, are terms and conditions most pertinent to permittees' acknowledgment of compliance with federal and other agency requirements. (KYTC, 2020):

- Clause 2: Applicant shall meet requirements of the Clean Water Act; if the project will disturb one acre or more, the applicant shall obtain a KPDES KYR10 Permit from the Kentucky Division of Water. All disturbed areas shall meet the requirements of the Department of Highway's Standard Specifications, Sections 212 and 213, as amended.

- Clause 15: Permittee, its successors, and assigns shall use the encroachment premises in compliance with all requirements of federal law and regulation, including those imposed pursuant to Title VI of the Civil Right Act of 1964 (42 U.S.C. 2000d et seq.) and the related regulations of the USDOT in Title 49 C.F.R. Part 21, all as amended.

- Clause 19: This permit is not intended to, nor shall it, affect, alter, or alleviate any requirement imposed upon the permittee, its successors and assigns, by any other agency.

- Clause 22: The undersigned Utility acknowledges ownership and control of the facilities proposed to be installed, modified, or extended by the Applicant/Permittee and agrees to be bound by the requirements and terms of this application and all related documents making up the approved permit, by the Department's *Permits Guidance Manual*, and by all applicable regulations and statutes in effect on the date permit issuance. This information and application is certified correct to the best knowledge and belief of the undersigned Utility.

Chapter 6 Opportunities for Revenue Generation

6.1 Current Kentucky Revenue Generation from Utilities Located on the Right of Way

At the state level, KYTC accommodates utilities within highway ROW by issuing an encroachment permit. This encroachment permit follows the KYTC Utility Accommodation Policy as set forth in Chapter 300 of the *Permits Guidance Manual* and does not include the collection of revenue from utility companies or any entity seeking an encroachment permit. Kentucky is one of only five states that does not charge a fee for the permitting of utilities on ROW, even including fees for the administration and processing of these permits (Sturgill et al, 2023).

Examining the CAC uses from this report shows that KYTC has been issuing encroachment permits for broadband and small cell wireless installations. The electric vehicle program has opted to construct EV infrastructure outside of the ROW so this program does not fall under encroachment permit jurisdiction, although if new electric infrastructure is needed to reach the charging stations more than likely this will be placed on ROW and needs to be permitted. To date, renewable energy and CAV technologies have not been permitted on ROW in Kentucky.

Although not part of the KYTC, the KentuckyWired program is a state-run project (the Kentucky Communications Network Authority) that constructed over 3,300 miles of high-speed fiber optic cable in every Kentucky county. A large portion of this infrastructure is located on state ROW. Part of how this fiber optic cable is being funded is through the leasing of half the fiber strands to private companies. This can serve as an example of how government and private industry can use the same broadband facilities.

6.2 Revenue Generation Opportunities from Other States

NCHRP Research Report 1053 (Sturgill et al, 2023) provides an overview of valuation and compensation approaches states use while accommodating utilities on ROW. This section will highlight the findings of NCHRP 1053, including information received from the survey that was sent to the states.

There are three main revenue generating categories for state DOTs — 1) Non-revenue generating (38% of states), 2) Revenue Neutral (22% of states), 3) Revenue Generating (40% of states). Revenue generating approaches consider ROW valuations and include leasing and rental alternatives. Revenue neutral approaches are cost-based and focus on the costs incurred by the DOT during the permitting and approval processes. These can include a valuation of the ROW. A non-revenue generating approach focuses only on the costs of the permitting process. Kentucky is a non-revenue generating state.

NCHRP Report 1053 describes in detail different accommodation mechanisms (easement, lease, franchise, license, permit, statutory authority). The most common accommodation mechanism is by license/permit (100%), followed by the leasing of ROW (52%). More than one accommodation mechanism could be present in a state. Kentucky accommodates by permit.

Compensation methods include – 1) cash (48%), 2) bartering (0%), 3) combined cash and bartering (38%), 4) none (14%). Kentucky does not seek compensation and therefore is in the *none* category. Compensation structures (one-time fee, annual fee, lease, revenue sharing, resource sharing, none) are how the states receive the compensation for utilities being on ROW. An annual fee (72%) and a one-time fee (66%) are the most common compensation structure with resource sharing (48%) third most common.

How states set the value of the fees they charge utility companies was also investigated. The most common method (88%) was capturing costs that DOTs incur during the permitting/approval process and using the value of adjacent land (32%) was the second most common method used.

The survey sent out to the states sought information on what utility types were charged fees for accommodations on ROW. Of states that charge fees for the placement of utilities on ROW, most charges are focused on either permits in general (36%) (i.e., administrative/permit processing) or on small cell wireless (52%). Figure 6.1 is a distribution of permitting fee charges by utility type in other states. Fees for cell towers (30%), and broadband/fiber optic (32%) facilities were also common. Less common was charging fees to more traditional utilities such as water, gas, and electric.

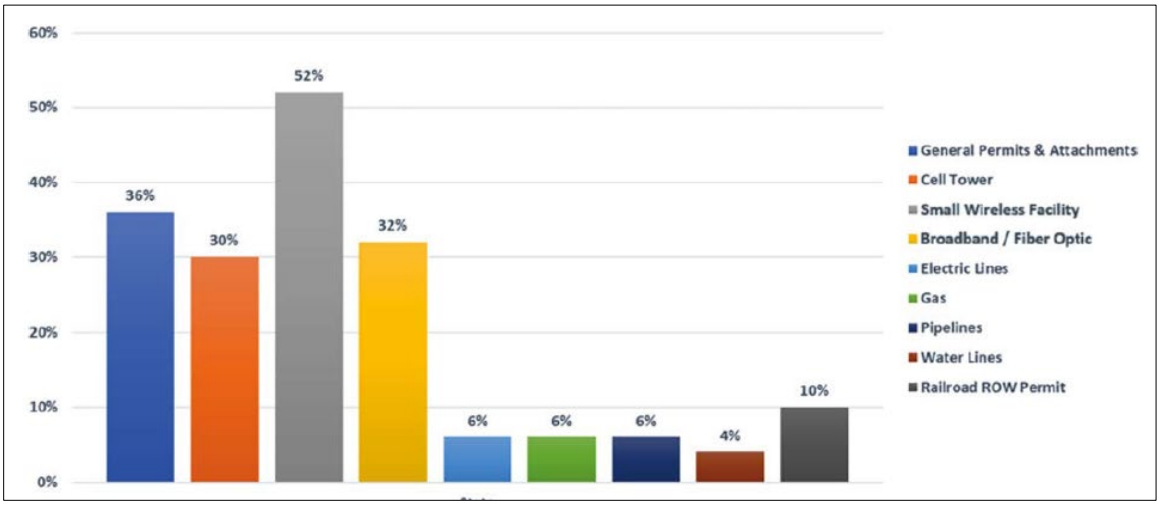

Figure 6.1 Distribution of Utility Types Charged by DOTs for Accommodation
(Source: NCHRP Report 1053)

Below is a summary of revenue generation from other states that have been pulled from this report for each CAC category.

Solar/Wind – Widespread solar and wind power generation on ROW has not yet been adopted. Of the states reviewed that have a solar program in place some form of a public-private partnership was used. Oregon, at both of their ROW solar generation facilities entered into public-private partnerships. Although not revenue generating, the generation of electricity on-site resulted in energy cost savings for the DOT. MassDOT also uses the public private-partnership model for solar projects. They lease the ROW locations to the site developer, thus generating revenue, and purchase electricity at the predetermined rate for the length of the lease. A review of literature has also resulted in similar type public-private partnerships and lease models in use.

Broadband – Of the different utility types, broadband is one of the more common utilities that states access fees from utility companies for their facilities being located in the ROW. NCHRP Report 1053 reports 32% of states charge for the placement of broadband/fiber optic on ROW. Both Utah and Arizona have updated state statute that allows for the state DOT to seek compensation from broadband companies placing facilities on ROW. This compensation can be in the form of cash (per linear foot in Arizona), be in-kind (i.e., allow the state to use some of the facility), or a combination of both. Cash payments can be in the form of an upfront lump sum or made in installments over the life of the agreement. One important item of note is that fees collected are to be put into the Transportation Fund (Utah) or for the operation and maintenance of state conduit or future broadband projects (Arizona). Indiana has

identified broadband corridors and accesses non-recurring and recurring fees depending on the encroachment type. Maryland allows for the resource sharing of broadband facilities placed on ROW. Broadband is allowed to be placed on ROW in exchange for the company providing telecommunication services to state entities.

Small Cell Wireless – Of the different utility types, small cell wireless is the most common utility installation that states assess fees from utility companies for being in the ROW. NCHRP Report 1053 reports 52% of states charge for the placement of small cell wireless on ROW. The Colorado DOT collects fees when permitting small cell wireless facilities on ROW. The non-recurring fee due at the time of permit submittal is $500 for up to five small cell wireless facilities with an additional $100 for each small cell wireless facility beyond five or $1,000 for a new pole that supports small cell wireless facilities. Recurring fees are also collected at the rate of $270 per small cell facility per year. Delaware DOT collects a fee of $100 per small cell wireless node/site and the wireless service provider is responsible for any DOT inspection expenses that may be over the fee. Michigan DOT collects fees as part of the process to permit small cell wireless facilities on ROW. The rate is $200 for each small cell wireless facility co-located on an existing utility pole or DOT facility and $300 for every small cell wireless facility located on a new pole or support structure.

Connected and Automated Vehicles – This technology is still in its infancy, so therefore no concrete revenue generation models are available. In most applications of this technology funding and ownership is still being evaluated. The I-94 CAV Corridor Project in Michigan is an early example of how funding could work. The state is working with a private company to install, operate, and maintain a connected vehicle lane in the identified corridor. In the future a user fee may be assessed via electronic tolling for the ability to utilize the connected vehicle lane. This fee would be put towards construction costs, operations, and maintenance of the connected vehicle facilities.

Electric Vehicles – With Kentucky electing to not place electric vehicle charging infrastructure on ROW, outside of identifying and selling excess ROW parcels no additional research was conducted into EV revenue generation opportunities on ROW.

6.3 Revenue Generation Opportunities in Kentucky

The issues of valuation and compensation approaches for utility accommodations are new to many states, not just Kentucky. While Kentucky is a non-revenue generating state, the nationwide trend is to become a revenue generating state. This has been done primarily with Broadband, but some states are doing this with EV charging stations and small cell wireless.

If a DOT wanted to begin the process of migrating to a revenue generation program, the consensus from Arizona and Utah, who developed broadband revenue generation programs, is to establish a legal framework which would allow for compensation and set out guidelines for establishing fees (Burgess et al, 2024). Part of the legal framework would include specifics as to where any revenue generated would go and how it could be used, such as into the Road Fund.

Specific to broadband, the possibility exists to identify broadband corridors, typically along Interstates and Parkways. Compensation from broadband companies could be in-kind compensation, which can be used at these locations to give KYTC access to broadband for use in future CAV corridors.

Although not specific to revenue generation, net metering laws as they currently stand do not make solar or wind as feasible on ROW in Kentucky, given the differences in costs to generate the electricity and the price that is given

to sell this back to the grid. This legislative environment would need to change to be more favorable to selling electricity generated on-site back to the grid.

If Kentucky intends to assess fees on small cell wireless installation placed on its ROW, the state could also explore adopting policy to allow the placement of macrocell towers, which is something Indiana has done. These fees typically include a one-time, up-front fee and recurring fees for tower facilities located on the ROW. Another option available to Kentucky is to levy an administrative/processing fee for encroachment permits in general. A thorough review of internal administrative and processing costs should be conducted to establish reasonable fees and guidelines. These guidelines should outline the conditions under which fees could be adjusted in the future and where the funds collected would go.

KYTC's ability to collect fees or charge utilities for using ROW is a complicated matter. While Kentucky's constitution and enabling legislation allows cities to charge franchise fees for utilities located in ROW, it is silent on whether the state has the authority to do likewise. Kentucky's utility structure also inhibits the direct sale of stored energy to any party other than an authorized utility company. This is a topic that should be considered for future research.

Chapter 7 Conclusion

Many CEC applications discussed in this report can provide environmental benefits, energy savings, and potentially open up new revenue streams to KYTC. But they carry several limitations.

Wind turbines are expensive, require significant amounts of land, and their effectiveness is highly dependent on wind speeds. Unless tower technology advances to the point where extremely tall towers can be built at lower costs, wind energy is probably not an efficient means of generating energy along Kentucky roadways.

The success of solar energy facilities hinges on the amounts of sunlight solar panels can be exposed to. Overall, it is a more viable option than wind energy. In areas where terrain does not block sunlight, solar panels can be used to generate small amounts of energy to offset energy costs. Areas that may provide opportunities for solar installations include rest areas, truck parking areas, weigh stations, park and ride lots, interchanges, and excess ROW.

The legality of PPAs in Kentucky and net metering regulations are hurdles that wind and solar energy projects will have to overcome. Current Kentucky regulations limit the potential economic benefits that can be accrued from these projects.

Kentucky has made significant effort to expand high-speed internet access into unserved and underserved areas. KYTC has been involved in these efforts because much of the installed fiber networks are along Cabinet roadways. Opportunities for future expansion of Kentucky's fiber network along KYTC roadways include abandoned utility corridors and excess ROW.

Small cell wireless applications are critical for expanding the cellular network. State and local governments face tremendous pressure to include small cell wireless equipment on existing infrastructure. While KYTC does not have many of these installations along the public ROW, requests to add them will likely increase over time. Furthermore, small cell wireless equipment will likely be a critical component of CAV infrastructure. KYTC needs to develop a more robust policy for integrating this technology into state-owned ROW without compromising the functionality and safety of roadways.

Kentucky is one of a few states that does not charge fees for permitting utilities on ROW. KTYC should explore opportunities to generate revenues through permitting fees, land leasing, and recurring occupancy fees. This would involve putting in place a legal framework to allow for compensation and setting out guidelines for establishing fees. In doing so, KYTC could raise revenue for more robust tracking systems, including GIS mapping of existing utilities and installations of CEC applications described in this report.

While researching the subject of this report, two areas that warrant investigation became evident. They are not specific to CEC applications and apply to all utilities and other uses of the ROW.

- With the evolution of technology, it is reasonable to expect that demand will continue to grow for conducting non-transportation related activities on ROW. To sort and bring order to the crowding of utilities and other activities (e.g., CEC uses, ITS equipment, multimodal and transit facilities, managed lanes, pollinator habitat) on the ROW, KYTC could consider a policy on ROW usage. This should be safety focused, but other needs to look at include roadway maintenance implications, drainage concerns, environmental impacts, and how the placement of items in the ROW will impact roadway project schedules and budgets.

- Given that ROW is expected to become more crowded, knowing the locations of utilities and other items will become more important. Integrating the Kentucky Utilities and Rail Tracking System (KURTS) and Kentucky Encroachment Permit Tracking (KEPT) program and providing GIS capabilities would greatly aid in cataloguing what is present on the ROW and keeping track of pertinent information. Part of the implementation could include requiring digital plans, preferably as-built quality, from utility companies and other entities that have a permitted facility within the ROW. Long-term this may help KYTC better estimate road project costs and timelines.

Being able to classify all CEC applications as a utility simplifies the process of administering these types of projects because KYTC has a programmatic agreement with FHWA for accommodating utilities. This agreement is contained in the agency's Utility Accommodation Policy (UAP), which is in the *Permits Guidance Manual*. Cabinet staff have experience with and knowledge of the guidelines contained in the UAP. However, to accommodate these uses as a utility requires, they fit the definition of a utility in Kentucky statutes. KYTC legal staff and personnel from the PSC should collaborate to clarify which CEC uses meet this definition of a utility.

7.1 Implementation Framework

The framework outlined below addresses how KYTC can manage installation and operation of CEC uses along Kentucky highways.

<u>All CEC Uses</u>

The most efficient method of implementing CEC uses is to treat them as a utility as described in 23 CFR Part 645. This lets KYTC rely on the current programmatic guidelines contained in its UAP. However, to utilize this method Cabinet legal staff needs to coordinate with legal staff at the PSC to clarify how Kentucky statutes define a utility. A joint legal opinion stating that each CEC use meets Kentucky's current statutory definition of a utility would be ideal and allow KYTC to incorporate these uses in accordance with guidelines found in the current UAP. If legal staff at the Cabinet and PSC determine any of these uses do not meet the definition of a utility, Kentucky statutes may need to be modified to include these uses within the definition.

KYTC needs to develop a GIS-based facility mapping process that addresses the collection, storage, and maintenance point and line data as well as pertinent metadata for CEC uses. This process could be used to map CEC uses and standard utility installations along Cabinet roadways. To facilitate identifying locations for some of these CEC uses, there should also be efforts made to locate and map abandoned utility corridors and excess right of way. As demand for placing utility and/or CEC infrastructure state-owned ROW grows, it will be critical for KYTC to maintain up-to-date geospatial data so it can coordinate competing uses and avoid conflicts.

KYTC should consider developing a policy on ROW usage that is safety focused while being attentive to roadway maintenance issues, drainage concerns, and how the placement of CEC uses would affect future highway project schedules and environmental concerns. This policy can be informed by other suggested studies in this document (e.g., the broadband corridor plan discussed in Chapter 3.3 and CAV corridor plan discussed in Chapter 3.5). The policy should also include provisions for removing CEC equipment from ROW when the equipment:

- Is no longer being used,
- Becomes a safety issue, or
- Is in conflict with a proposed highway project.

Because CEC applications discussed in this report all require expertise and knowledge in areas that are not typically familiar to KYTC employees, the Cabinet should focus its efforts on developing legally sound contracting methods that let private industry operate and maintain these systems.

Solar

The first major obstacle to implementing solar projects along Kentucky highways is to clarify whether they meet the definition of a utility as described above. Two other regulatory hurdles will limit the effectiveness of implementing solar and wind installations in Kentucky:

- Structure and legality of Power Purchase Agreements (PPA)
- Regulatory net metering rates

Kentucky's electric grid is fully regulated, meaning that the PSC regulates prices and operations of electric utilities statewide. Each electric utility exercises control over their designated geographic area, and no other entity can sell electricity within that utility's territory. Furthermore, net metering rates — which let utilities buy electricity from a generator (export rate) at a lower price than they sell electricity (retail rate) back to consumers — set in Kentucky statutes are not conducive to selling electricity back to the grid.

Ideally, KYTC would work with a private developer to design, build, operate and maintain these facilities. These functions could be partially funded by future profits the developer would make from them. Because of PSC regulations, however, a developer could not sell electricity not used by KYTC back to the public. As such, the only option is for the Cabinet to enter a PPA with an electric utility to supplement their electricity usage in the geographic area individual utilities control. Because KYTC lacks the expertise to maintain and operate facilities, this would be handled by the utility through the PPA, or the Cabinet could enter into a separate contract with a private entity. The export rate discussed above also places an economic restriction on this method because KYTC would sell surplus electricity back to the grid at a lower rate than it pays for electricity. Although batteries could be used to store excess electricity for use later in lieu of selling electricity back to the grid.

Areas where KYTC could pursue solar projects include rest areas, truck parking areas, interchanges, weigh stations, park and ride lots, and excess ROW. Solar projects should follow the Physical Standards, Locational Standards, Corridor and/or Suitable Location Guidance, and Best Practices for Implementing Solar Power in ROW, which are discussed in Chapter 3.1.

Broadband

As discussed in Chapter 3.3, broadband installations are covered by the current guidelines and practices for standard utility installations (e.g., phone, electric) and do not need special provisions to be accommodated on state-owned ROW. With passage of the Mobile Now Act (See Chapter 3.3) there will be continued motivation to install fiber optic cables on KYTC roadways. However, Kentucky has already made substantial progress in providing broadband to its citizens through KentuckyWired and work done by the Kentucky Office of Broadband Development. Spurred by these initiatives, future efforts related to broadband will likely focus on smaller roadways in rural areas. These areas could be identified in the broadband corridor plan discussed in Chapter 3.3.

Going forward, KYTC should consider ways to generate revenues from broadband installations. Options include:

- Constructing, maintaining, and owning broadband infrastructure and leasing it to private companies
- Leasing ROW to private companies that will install, operate, and maintain broadband infrastructure

- Charging fees for placement of broadband installations on the ROW

Broadband projects should follow the Corridor and/or Suitable Location Guidance and Best Practices for Broadband on Right of Way portions of Chapter 3.3.

Small Cell Wireless

Small cell wireless applications are critical for building out the 5G network that serves as the backbone of mobile networks across the U.S. As such, KYTC will continue to field requests to install small cell wireless infrastructure on its ROW. The Cabinet should look for ways to accommodate these applications. Most requests will likely arrive through the permitting process. While other possibilities exist, KYTC should focus its efforts on utility poles that have easy access to electricity and connections to fiber optic lines for backhaul. If KYTC infrastructure (e.g., roadway lighting, signs) is not reserved for CAV applications, they could be used as well.

The placement of small cell wireless installations needs to be coordinated with the Division of Traffic Operations and consider their concerns listed in Chapter 3.4. These projects should also follow the Corridor and/or Suitable Location Guidance and Best Practices for Small Cell Wireless on Right of Way portions of 3.4.

Connected and Automated Vehicles (CAV)

Fully connected corridors can only become a reality through the installation of many technologies — which come with high installation, operation, and maintenance costs. This report focused on technologies that may have to be placed alongside KTYC roadways:

- Electric lines
- Broadband fiber optic installations
- Roadside Units
- Small Cell Wireless applications
- Cameras and Sensors

If KYTC wants to pursue connected corridors, perhaps the most important decision the agency will have to make is who will own and operate equipment. Although small-scale projects have been funded through the federal government or private industry (e.g., Michigan's Interstate 94 CAV Corridor), depending entirely on external sources of funding is probably not viable. And private industry will be unwilling to fund projects at scale without the potential for revenue. Regardless of who owns equipment, individual roadside component required in a CAV project should follow the Cabinet's UAP guidelines. Because roadside CAV equipment has specialized maintenance requirements, KYTC will need to structure contracts so that private contractors perform maintenance.

Although KYTC is studying the potential for installing CAV lanes on the Interstate 64 corridor between Louisville and Lexington, the agency may want to identify other corridors that would be good candidates for CAV installations (see Chapter 3.5) Broadband fiber optic installations will be required along CAV corridors to provide connections to the primary network so that the massive amounts of data collected by the roadside equipment can be transferred to operations centers. Broadband installations should follow the KYTC UAP and Chapter 3.3 of this report.

KYTC already accommodates electric lines in the ROW though their existing UAP. Access to electricity will be needed for most of the devices installed along the roadway for a CAV project.

Electric Vehicle (EV) Charging Stations

KYTC is well on its way to implementing an EV charging station network in accordance with NEVI Formula Program Guidance issued by FHWA. The program is being managed by KYTC's Division of Planning and follows Kentucky's *Electric Vehicle Infrastructure Deployment Plan*. Kentucky's program is initially focusing on interstates and parkways. All EV charging stations built during this phase are located off KYTC-owned ROW, with private companies owning, operating, and maintaining the facilities. While this approach is proving effective, as the focus shifts to routes with less traffic the desire to use state-owned properties for charging stations may arise. These sites will likely be located on routes identified in the *Electric Vehicle Infrastructure Deployment Plan* and future updates to the plan. Charging stations projects should apply guidance listed in the Corridor/ Location Guidance and Best Practices for EV Charging Stations (Chapter 3.6).

For a summary of the implementation steps recommended in this report, see the CEC Implementation Matrix in Figure 7.1 below.

Figure 7.1 CEC Implementation Matrix

Implementation Step		CEC Applicability				
Category	**Description**	**Renewable Energy**	**Broadband**	**Small Cell Wireless**	**CAV**	**EV Charging**
Legal	Clarify if this use meets definition of a utility in Ky. statute.	✓	✓	✓	✓	✓
	Clarify the legalities of PPAs in Ky.	✓				
Legislation	If use does not meet Ky. definition of a utility, work with PSC to modify statute.	✓	✓	✓	✓	✓
	Pursue more favorable net metering legislation.	✓				
	Create legislation to allow revenue generation from utilities on right of way.		✓	✓		
Utility Accommo-dation Policy (UAP)	Modify UAP to include this CEC use.	✓	✓	✓	✓	✓
	Ensure UAP contains provisions for removal from right of way when a utility becomes inactive.	✓	✓	✓	✓	✓
Potential Revenue	Explore opportunities to generate revenues through permitting fees, land leasing, and recurring occupancy fees.	✓	✓	✓	✓	✓
	Update UAP if revenue generation is pursued.		✓	✓		
Contracting Methods	Use legally sound contracting methods that let private industry operate and maintain these systems.	✓	✓	✓	✓	✓
Coordinate with Traffic Operations	Coordinate with the Division of Traffic Operations on the usage of state-owned facilities for CEC uses.			✓	✓	
GIS Mapping	Develop a GIS location database with spatial information pertain-ing to each CEC facility.	✓	✓	✓	✓	✓
	Develop a GIS location database with spatial information that identifies abandoned utility corridors and excess right of way par-cels.	✓	✓			
Usage Policy	Develop a usage policy that prioritizes all uses of KYTC right of way.	✓	✓	✓	✓	✓
Develop Cor-ridor Plan	Develop a comprehensive corridor plan that identifies roadway corridors for effective and efficient implementation of CEC uses.		✓		✓	✓
Areas of Opportunity	Non-Interstate Rest Areas	✓				✓
	Interstate Rest Areas	✓				
	Truck Parking Areas	✓			✓	
	Weigh Stations	✓			✓	
	Park and Ride Lots	✓				
	Interchanges	✓			✓	
	Excess ROW	✓	✓	✓		
	Abandoned utility corridors		✓			
Guidance and Best Practices	See the following chapters of this report.	3.1	3.3	3.4	3.5	3.6

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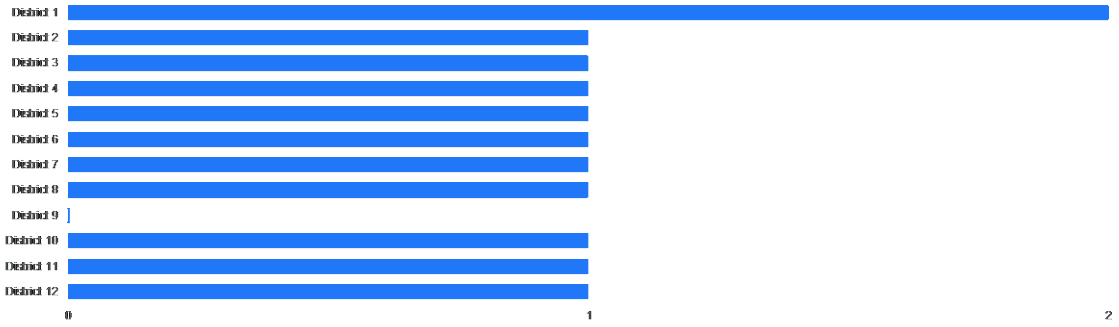
Appendix A Small Cell Wireless Permitting Survey Results

Small Cell Permitting Survey for District Permit Supervisors / Page 1

Responses: 12

What Highway District do you work in? 12



What Highway District do you work in? 12

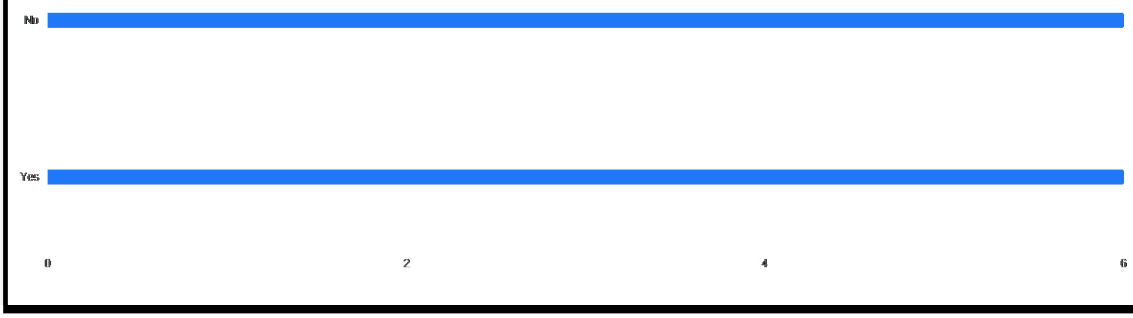
Q1 - What Highway District do you work in?	Percentage	Count
District 1	17%	2
District 2	8%	1
District 3	8%	1
District 4	8%	1
District 5	8%	1
District 6	8%	1
District 7	8%	1
District 8	8%	1
District 9	0%	0
District 10	8%	1
District 11	8%	1
District 12	8%	1

What Highway District do you work in? 12

What Highway District do you work in?	Average	Minimum	Maximum	Count
District 1	1.00	1.00	1.00	2

What Highway District do you work in?	Average	Minimum	Maximum	Count
District 2	2.00	2.00	2.00	1
District 3	3.00	3.00	3.00	1
District 4	4.00	4.00	4.00	1
District 5	5.00	5.00	5.00	1
District 6	6.00	6.00	6.00	1
District 7	7.00	7.00	7.00	1
District 8	8.00	8.00	8.00	1
District 9	-	-	-	0
District 10	10.00	10.00	10.00	1
District 11	11.00	11.00	11.00	1
District 12	12.00	12.00	12.00	1

Have you received an encroachment permit request from a utility company to install small cell wireless on KYTC right-of-way? 12



Have you received an encroachment permit request from a utility company to install small cell wireless on KYTC right-of-way? 12

Q2 - Have you received an encroachment permit request from a utility company to install small cell wireless on KYTC right-of-way?	Percentage	Count
No	50%	6
Yes	50%	6

Have you received an encroachment permit request from a utility company to install small cell wireless on KYTC right-of-way? 12

Have you received an encroachment permit request from a utility company to...	Average	Minimum	Maximum	Count
No	1.00	1.00	1.00	6
Yes	2.00	2.00	2.00	6

Cellco Partnership DBA Verizon Wireless

Yes

Verizon

SQF

Was the permit for a single location or did it include the placement of multiple small cell devices at multiple locations (example being several small cell devices spaced out along a corridor)? 5

Was the permit for a single location or did it include the placement of multiple small cell devices at multiple locations (example being several small cell devices spaced out along a corridor)? 5

Q3 - Was the permit for a single location or did it include the placement of multiple small cell devices at multiple locations (example being several small cell devices spaced out along a corridor)?	Percentage	Count
Single location	40%	2
Multiple locations	60%	3

Was the permit for a single location or did it include the placement of multiple small cell devices at multiple locations (example being several small cell devices spaced out along a corridor)? 5

Was the permit for a single location or did it include the placement of mul...	Average	Minimum	Maximum	Count
Single location	1.00	1.00	1.00	2
Multiple locations	2.00	2.00	2.00	3

10

dozens

3

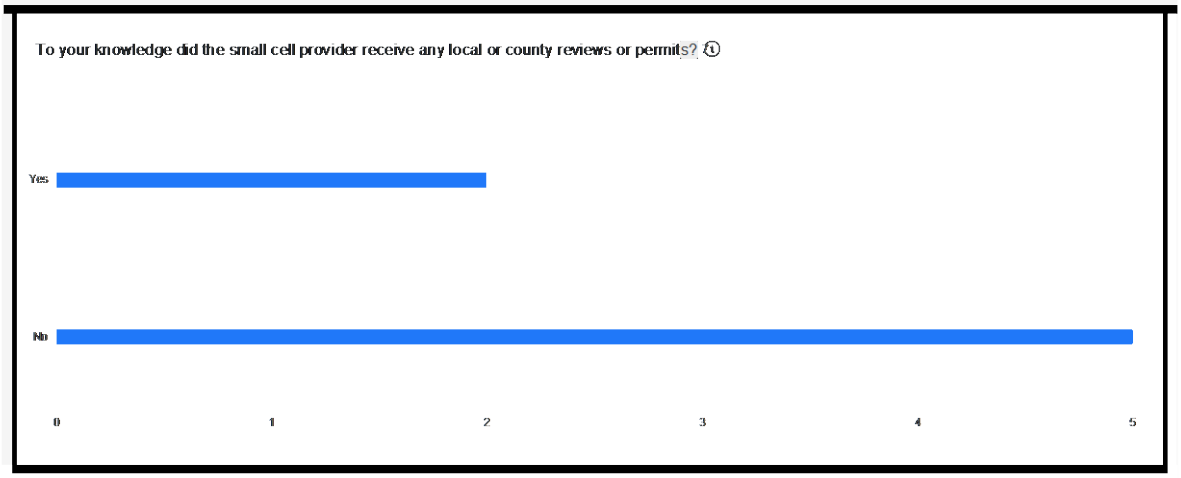
Which method of installation was included in the permit request? Mark all that apply. 7

Which method of installation was included in the permit request? Mark all that apply. 7

Q4 - Which method of installation was included in the permit request? Mark all that apply.	Percentage	Count
Small cell on new pole	57%	4
Small cell on an existing pole	43%	3
Small cell on an a KYTC owned device (light pole, traffic signal, sign support, other)	0%	0
Small cell on a locally owned device (light pole, other)	0%	0
Other	29%	2

We have rejected any permit asking for small cell on ROW because there is usually a private easement they can secure instead.

None


To your knowledge did the small cell provider receive any local or county reviews or permits?
Yes
No
0
1
2
3
4
5

To your knowledge did the small cell provider receive any local or county reviews or permits?

Q5 - To your knowledge did the small cell provider receive any local or county reviews or permits?	Percentage	Count
Yes	29%	2
No	71%	5

To your knowledge did the small cell provider receive any local or county reviews or permits?

To your knowledge did the small cell provider receive any local or county r...	Average	Minimum	Maximum	Count
Yes	1.00	1.00	1.00	2
No	2.00	2.00	2.00	5

Yes private easements were always secured.

Proposed to attach to Signal Poles.

No denials, we have required them to move their location for clear zone issues or to get off of KYTC owned structures.

No

no

No

No.

Was the electric feed to the small cell facility approved under a separate encroachment permit or was it included with the small cell permit? 6

Q7 - Was the electric feed to the small cell facility approved under a separate encroachment permit or was it included with the small cell permit?	Percentage	Count
Approved under a separate encroachment permit	33%	2
Included with the small cell permit	67%	4

Was the electric feed to the small cell facility approved under a separate encroachment permit or was it included with the small cell permit? 6

Was the electric feed to the small cell facility approved under a separate...	Average	Minimum	Maximum	Count
Approved under a separate encroachment permit	1.00	1.00	1.00	2
Included with the small cell permit	2.00	2.00	2.00	4

We are finding our ROW is usually always crowded with an underground utility and prefer private property easements anytime we can request them.

Include valid Detail, Break Away? Clear Zone?

Electric service was not included with the small cell permits, but looking through our records it appears the electric utility did not obtain permits to provide power to the small cell poles.

D7 has only had a few. All have been on existing poles at single locations.

Appendix B Small Cell Wireless Ordinances or Policy for Kentucky's 20 Largest Cities

Population Size Rank	City	Small Cell Wireless Policy or Ordinance?	Summary of Process	Historic District within the city?	Role of Historic District in Small Cell Wireless Policy/Ordinance Implementation	Any other interesting features about the policy/ordinance?
1	Louisville	Chapter 116: Communications Service	Telecommunications Provider (TP) assembles and distributes a preliminary packet of proposed locations. Louisville Metro Public Works (LMPW) reviews for compliance with PW's ROW Guide and Utility Policy. Review of proposed installation sites and construction is administered by LMPW. It is a two-step process. First, there is a review process for siting/policy compliance and review of public input based on policy and ordinance. Once that review is satisfied, the small cells move to the existing permitting process for construction. Property owners within 150 feet of each location are notified by mail and provided a 14-day review and comment period. TP meets with LMPW to review all comments and adjust proposal as needed. LMPW will grant permission if all criteria are met and public comments are considered, possibly with conditions. TP applies for ROW Encroachment Permit.	Yes	If in a historically sensitive area, a "106 Review" may be required. LMPW requires the applicant to coordinate any historical reviews with the local historical districts and the state then report the results back to LMPW. Information provided to Consulting Parties and Louisville Metro Preservation Officer for review and comment. Information provided to KY State Historic • Preservation Office (SHPO). TP must comply with any SHPO requirements.	Small cell review and installation has been made a part of the Metro utility policy. There isn't a separate stand-alone policy for review and installation. The policy highly encourages co-location on other poles, mostly LG&E/ATT poles. Co-location on Metro assets requires replacement of existing light pole with new asset, capable of supporting equipment and replacement lighting. The replacement pole is matching to Metro, or 'like for like'. A location data base is being organized now and as-built information is a requirement of their Franchise Agreement with Metro.

2	Lexington	Sec. 17C- LFUCG Public ROW Ordinance	Process overseen by Director of Engineering or their designee. Uses "registrants" and they must participate in joint planning, construction and advance notification of ROW work, including coordination and consolidation of surface work. Each utility registrant must have a representative to serve on the utility coordinating committee. It is a violation to miss 2 consecutive quarterly meetings or 3 meetings within the year. A reseller service provider or a lessee are not required to register the facilities it uses solely for the purpose of reselling, or facilities it utilizes as a lessee. Registrant must submit a master plan semi-annually. Applicants are required to bundle conduit where feasible and occupy as little space as possible. Permits are still required. There is an appeals process if registration request is denied.	Yes	Department of Historic Preservation reviews for location placement to determine if new pole placement is located in Historic District. If not in Historic District, then registrant is passed to engineering for pole relocations and new installs. If located in Historic District, Historic Preservation Staff explains the permitting process for new installations and construction in Historic District	One purpose of ordinance is to ensure government's costs for granting and regulating private access to ROW are borne by the party seeking access. ROW does not include airwaves above the ROW with regard to non-wire communications. Wireless facility means communications facility but does not include poles or cabling. There are aesthetic standards. Must comply with tree protection ordinance. LFUCG can dictate time, place, manner of installation. LFUCG has the right to request relocation or removal of the facility. A ROW maintenance fund was established for repair and resurfacing of streets. All registration fees, permit fees, and a portion of the franchise fee goes into the fund. There is a provision for what happens if LFUCG vacates the ROW.

						There is a special section for Town Branch Commons, which allows for leasing of facilities. There is a registration fee. Registrants must still have a valid franchise, lease or other contract, or easement which may require additional fees. Registration does not convey legal or equitable title. Registration is for 1 year. Registrations can be cancelled. Registrants must carry insurance, agree to indemnify, and hold harmless. Registration fees, Permit fees, and Franchise fees are paid annually. Performance bonds are required in surface cut work.
3	Bowling Green	CHAPTER XXI 21-4 Work Within ROW	Process overseen by City Engineer or their designee. Permit are required. There is a $75 permit fee and surety bonds are required.	Yes, 5 districts	Application for new infrastructure shall be in keeping with the character of historic neighborhoods.	Has a lot of provisions like those noted for Lexington. Purpose of the Ordinance is to ensure that the City's current and ongoing costs of granting and regulating private access and use of ROW are borne by the party seeking such access and causing such cost; and to

						provide for the payment of fair and reasonable fees to the City to ensure that this ordinance is properly administered and enforced. Must still comply with Franchise requirements. "Public Utility" or "Utility" shall mean a party that is defined in KRS Chapter 278 as a utility and is subject to the jurisdiction of the Kentucky Public Service Commission, the FCC or the Federal Energy Regulatory Commission, or (ii) is required to obtain a franchise from the City to use and occupy the right-of-way pursuant to Sections 163 and 164 of the KY Constitution.
4	Owensboro	Code of Ordinances Article I Appendix B.5. Telecommunications Franchise	Planning Commission (PC) oversees the required grant of franchise process. Application that complies with KRS 100.9865 can be used or information set forth in 20-8(b) of the regulation will be accepted. Application goes to PC staff. A decision must be made 60 days after a complete application and the fee is paid. Any appeal for denial is made to the PC. Waivers to the regulation are allowed, but there is a $500 fee for requesting a waiver.	Yes	If located in a downtown overlay district, Historic Preservation Board approval is required.	PC sets the application fee.

		Article V. 5.4 Encroachment Permits Article XX Cell Antenna Tower Regs § 20-9 Small cellular system and tower location and design standards.	There is at least one public hearing on the waiver. PC makes the decision to grant or deny the waiver. Encroachment permits are granted by the Zoning Administrator. A decision is made within 14 days of receiving a complete application. Non-tower small cell systems do not require staff review when locating on existing structures. Encouraged for use in residential areas. Requires reasonable efforts to locate new Small Cell Towers, based on the following hierarchy: 1) Interstate 2) Arterial 3) Collector 4) Local Requires reasonable efforts to locate new equipment based upon the following hierarchy of zones and land uses: 1) Co-locate on an existing structure whenever possible 2) Institutional 3) Industrial 4) Commercial 5) Public parks and 6) Agricultural New small cell systems are subject to Design Review and approval by PC staff. Preference is to be in areas with overhead utilities. Must accommodate a minimum of 2 service providers.			

			If facility is to be located within ROW within 100’ of a residential zone, this section applies.			
5	Covington and Kenton County	Article III, Section 3.0-3.6 Kenton County Regulation for Small Cell Towers	Covington: Design Review – PDS performs this review under the county-wide small cell regulations. City reviews on a limited basis. Legal Right to Occupy ROW – The legal authority to occupy the City’s right-of-way is obtained via the nonexclusive franchise award process. Ongoing ROW Management - Once a provider has the legal right to build its proposed design, the City’s right-of-way management ordinance ensures appropriate installation and ongoing maintenance. Kenton County: There is a pre-application meeting with the applicant, city staff, PDS staff, and KYTC, if applicable. An application is filed, and staff have 10 days to determine if it is complete. If it is not, it is returned to the applicant, who revises and resubmits. If it is complete the county has 60 days to review. If no action is taken in 60 days, it is deemed approved.	Yes	If in an historic district, Certificates of Appropriateness or Urban Design Review Board may be required. Efforts must be made to adhere to design control or fixture styles within the district.	

			During these 60 days, staff conduct an initial review, there can be meetings with city staff, if revisions are to be made, a revision checklist is sent to the applicant who makes the revisions and resubmits. There is a final review, a meeting with the city staff, and then the final action is taken. The final action is decided by the Kenton County Planning Commission, but the City must be in favor of the project. The applicant can request extensions to the timeframe outlined above.			
6	Georgetown	Ordinance No. 2021-01 Regulation of Small Wireless facilities and Small Cell Towers	Allows for a pre-application conference with Georgetown / Scott County Planning and Zoning as well as utility providers, owners of ROW, etc. Applicant must obtain a franchise with the City of Georgetown unless applicant already has one with the city or the state. PC and its staff process these applications. There is a limit of 10 new small cell towers, 10 non tower wireless facilities per application. Must provide location, certify all federal laws and KY Public Service Commission requirements have been met. A full	Yes, 5	Plans must adhere to any established design control measures or existing furnishing or fixture styles within the district. Where additional local design review processes exist, such as Certificates of Appropriateness or Urban Design Review Boards, such approvals may be required.	There is a $1,000 fee for each now small cell tower application and $500 fee for up to 5 non-tower wireless facilities, and $100 per non-tower facility after the first 5. There are location and design regulations as part of this ordinance.

			description of what is proposed to be installed, and other information. Applicant must be notified within 10 days if application meets submittal requirements. It is returned to make correction. PC must notify applicant within 90 calendar days for new small cell tower applications, and 60 calendar days for small cell wireless facilities of completeness of application.			
7	Richmond	Ordinance No. 22-08 Telecommunications Systems Franchising Ordinance of 2022	Applicants submit the application and application fee to the Board of Commissioners of the City of Richmond. There is a bidding process for the franchise license	Yes		Purposes of the Ordinance include, but is not limited to: (1) Permit and manage reasonable access to City ROW for telecommunications purposes on a competitively neutral basis. (2) Conserve the limited physical capacity of the ROW held in public trust by the City. (3) Ensure the City's current and ongoing costs of granting and regulating private access to and use of the ROW are fully paid by the Persons seeking such access and causing such costs.

						(4) Secure fair and reasonable compensation to the City and the residents of the City for permitting private use of the ROW; (5) There is a minimum annual franchise fee of $25,000 for the first year and it increases by $1,000 annually. The franchise is good for 10 years and is transferable. (6) There is a separate non-refundable $10,000 application fee payable to the city. (7) Any material alteration to the ROW must be done under the supervision of a licensed structural engineer paid for by the applicant.
8	Florence	Section 3197 Regulations for Cellular Telecommunication facilities No regulation found for small cell wireless facilities, only small cell poles.	Overseen by Planning and Zoning Commission using a Uniform Application	Yes		Has a map of cell towers: https://www.city-data.com/towers/cell-Florence-Kentucky.html
9	Nicholasville	None found		Yes		
10	Elizabethtown	None found		Yes		
11	Hopkinsville	None found		Yes		

12	Independence	Ordinance No. 2019-O-06 Confirming Sale and Awarding Franchise to MCI/Verizon for a 5 year Telecom-munica-tions Franchise Agree-ment … along, in, on, over, and un-der the public ROW				The Ordinance is the Actual Agree-ment of Sale Franchise fee is 1.3% of Gross Re-ceipts due quarterly. It can be increased to 5% per month.
13	Jeffersontown	None found				
14	Frankfort	Ordinance No. 6-2009 Series, Sec-tion 6.30	Located in the Zoning Ordinance Uses a Uniform Application (KRS 100.9856) which goes to the Frankfort/Franklin County Joint Planning Commission which has 60 days to approve or deny the application. It sets forth standards with which to evaluate the application.	Yes		
15	Henderson	Article XXIX Regu-lation of Cellular Antenna Towers Sec. 29.01-29.07 None found for small cell wireless		Yes, 5		
16	Paducah	Paducah Code of Ordinances Sec. 108-71 thru 86 Wireless Telecom-munications	There is an application requirement to con-struct the facilities with a list of information required. Applications must be signed and sealed by a P.E. The permitee must comply	Yes	Review and approval of permit when appropri-ate	Compensation for use of public ways is a permit requirement. This in-cludes a permit request fee, a gross revenue fee, and a permit renewal fee. Fees set by the Consumer Price

		Systems Permit and Access	with the rules and regs issued by the City Manager's office. After a permit is approved, the permittee must obtain written approval of, and all necessary permits from, all appropriate City/County agencies, including, but not limited to the Engineering Department, the Planning and Zoning Department, Department of Public Works, Department of Finance's Occupational Licenses, Street Department, and any other city department as may be appropriate.			Index. Fees are intended to be used solely to promote the health, safety, and welfare of the citizens and taxpayers of the community. City has the right to review the permitee's financial and billing statements.
17	Radcliff	None found				
18	Ashland	§ 157.285 Regulations	Applicant submits application, including a map which must include all land uses within 800' of the proposed facility, site plans with elevations to scale of the facility, and photos. New towers must include a site development plan with engineer signature and seal. Planning Commission (PC) staff or PC Board (after a public hearing) will review application. Applicant must be notified of any deficiencies within 10 days. Staff's final action must occur within 60 calendar days. If they don't it is deemed approved. Applicant notified by either the PC or the staff. If denied, must state basis for denial including specific code provisions on which the denial was based.	Yes	Regulation applies to all zoning districts.	Application fees: $\leq$ $500 for the first 5 facilities, $100 for each facility after 5. $\leq$ $1,000 for each new support pole $\leq$ $270 per year per facility in ROW which goes to the city for use of the ROW.

19	Erlanger	See Florence / Kenton County		Yes		
20	Winchester	Winchester, Kentucky Code of Ordinances Sec. 15-31 CODE OF ORDINANCES City of WINCHESTER, KENTUCKY Codified through Ordinance of 6-2022 of May 17, 2022. (Supp. No. 75)	Does not mention small cell wireless	Yes		